2023 年中国天文学会年会论文摘要文集

大会报告摘要

山东大学天文学发展及活动星系光变研究介绍

胡绍明 山东大学

本报告第一部分对山东大学天文学发展的历史、目前的人员、研究方向、实验室、观测设备等情况做全面介绍，并对未来发展进行展望。第二部分将重点介绍活动星系核光变的观测研究工作，建立激波在喷流湍流中传播的物理模型结合观测数据对耀变体的光变特性进行了很好的解释，通过光谱能量分布、光变曲线分析研究光变爆发的物理机制。

the Origin of the Elements

Christopher A Tout　英国剑桥大学

Stars are the source of all elements heavier than and including carbon. To understand which stars yield which elements and when we must first understand the structure and evolution of stars. Much of this understanding grew over the course of the twentieth century led by increasingly better and systematic observation and subsequently by growing computational power. Elements up to the iron peak are created during fusion reactions that power the stars themselves and are dispersed when they die in spectacular supernovae. Even while a quantitative study of stellar evolution was beginning in the 1950s it was realized that heavier elements must be formed by neutron capture processes. It is only now in the twenty-first century that we begin to understand the details of how multiple nuclear burning shells and mixing during the late stages of the lives of some stars and the merging of binary neutron stars actually produces elements heavier than iron and distributes them through our Galaxy.

LHAASO 对迄今最亮伽马暴 GRB221009A 的观测及理论解释

王祥玉 南京大学

GRB221009A 是迄今最亮的伽马射线暴，其发生概率千年一遇。我国高海拔宇宙线观测站（LHAASO）由于其大视场和高灵敏度，探测到了 GRB221009A 的 TeV 辐射的完整演化过程，包括首次探测到了 TeV 余辉的起始上升阶段，揭示了余辉早期存在极快上升的特征等。LHAASO 的光变曲线中显示出明显的喷流拐折结构，是有史以来最早的喷流拐折，表明 GRB221009A 的喷流的张角极小。这意味着观测者碰巧看到了喷流的核心区域,从而解释了 GRB221009A 极高亮度的起因。LHAASO 还探测到了来自伽马暴的迄今最高能光子（约 18TeV），可能暗含新的物理现象。此研究工作被 Science 杂志接受发表。

基于大规模星系巡天的暗物质探测和星系-暗晕关联研究

杨小虎 上海交通大学

暗物质、暗能量分别占据宇宙约 26%、69%的总物质能量密度，它们不能被粒子物理标准模型所描述。天文学从占比不到 1%的发光物质（星系）出发，来测量暗物质的分布特性和暗能量的状态方程参数，以揭示它们的本质。实现上述终极目标的关键科学问题是：如何建立不可见暗物质和星系之间的精确定量关系？在本报告中，我们将围绕着从 90 年代的 LCRS、2000 年代的 2dFGRS、SDSS，到当前 DESI，再到未来的 CSST 等巡天，回顾和探讨宇宙大尺度结构研究领域如何从理论和观测两个方向实现对暗物质分布的探测以及对星系-暗晕定量关系的刻画。

利用暗物质粒子探测卫星研究宇宙线起源和传播

袁 强 中国科学院紫金山天文台

暗物质粒子探测卫星“悟空”号是我国发射的首个空间高能粒子探测器。除了通过观测高能电子和伽马间接探测暗物质，宇宙线研究也是其主要科学目标。经过七年在轨运行，“悟空”号积累了大量高能宇宙线观测数据，发现系列能谱结构，为理解宇宙线起源和传播等相关物理问题提供了重要数据。本报告将介绍“悟空”号卫星的运行状况和主要科学成果。

极早期宇宙的非微扰现象学与理论研究

蔡一夫 中国科学技术大学

在精确宇宙学的时代，多信使、高精度、小尺度的宇宙学观测在帮助我们在更加深刻的层面理解宇宙极早期的同时也给基于线性近似和微扰展开宇宙学扰

动理论带来了新的挑战。近年来，对原初引力波和原初黑洞的搜寻使得研究人员们对早期宇宙在小尺度上的非线性非微扰过程产生了浓厚的研究兴趣。此次报告综述汇报在宇宙学小尺度上关于原初黑洞产生以及引力波的研究进展。其中，我们重点介绍使用Mathieu方程的共振效应来研究小尺度功率谱放大以及诱导产生可观测的原初引力波的方法。此外，我们还尝试探讨了非高斯尾巴对原初黑洞形成的影响。我们发现 Mathieu 方程所具备的共振效应可以提供一种有效的方法来刻画原初宇宙中小尺度的非微扰动力学过程，从而能够更好地理解原初黑洞的形成以及相关的引力波产生机制。同时，非微扰的非高斯性在原初黑洞形成中可能会产生重要影响。

脉冲星 J0538+2817 和 J0659+1414 闪烁及偏振研究

姚菊枚 中国科学院新疆天文台

超新星遗迹壳层一直被怀疑能主导脉冲星散射。因此，对与超新星遗迹成协脉冲星的观测可以提供超新星遗迹壳层主导脉冲星散射的证据，同时也帮助我们去揭示超新星遗迹的性质。我们使用 FAST 对脉冲星 J0538+2817 和 J0659+1414 进行了闪烁和偏振观测。对脉冲星 J0538+2817，我们不仅找到了超新星遗迹主导脉冲星散射的证据，也首次找到了脉冲星三维度自转和速度共线的证据。对脉冲星 J0659+1414，我们发现其散射由两个致密电离区主导(麒麟斑壳层和本地泡壳层)，同时偏振分析显示脉冲星 J0659+1414 自转和速度的二维度夹角较大。

太阳系形成和早期演化

刘倍贝 浙江大学

研究表明，当太阳系的原行星盘存在时，巨行星通过轨道迁移进入周期呈整数比的共振状态。巨行星现今开阔的轨道预示其演化经历了动力学不稳定。我的工作通过一系列数值模拟，提出巨行星间的动力学不稳定很可能是由于气体盘由内向外耗散触发的，发生在太阳系诞生后约一千万内。

活动星系核反馈与星系演化

袁 峰 中国科学院上海天文台

近年来一个重要观测发现是黑洞与宿主星系之间的共同演化，而共同演化的物理机制很可能就是活动星系核反馈。研究星系演化的驱动机制被列为美国天文和天体物理规划的三个优先课题之一。在报告中，我将介绍国际上目前该领域的研究（尤其是数值模拟研究）进展，侧重于介绍我们课题组发展的专门用于研究活动星系核反馈以及星系演化的高分辨率 MACER 模型，以及基于该模型开展的一些数值模拟工作。

用微引力透镜搜寻“孤独”的暗天体

东苏勃 北京大学

将介绍利用微引力透镜法搜索孤立的恒星级黑洞和“流 浪行星”这两类暗天体的研究进展，并讨论使用光干涉阵 VLTIGRAVITY 和空间巡天望远镜 CSST 等先进设备开展暗天体探测的未来展望。

恒星初始质量函数

刘 超　中国科学院国家天文台

恒星初始质量函数 IMF 是现代天体物理的一个基本问题。从恒星形成与演化到星系的形成与演化，IMF 通常是理论模型的一个关键输入量，或者是从观测推算重要物理量的必要假设。虽然有研究者认为 IMF 应该随环境变化，但缺乏直接观测证据。经验的 IMF 一直被作为普适规律来使用。我们基于 LAMOST 和 Gaia 共同观测的 93000 颗晚型恒星（恒星质量范围 0.3－0.7Msun），在太阳附近 100－300pc 内开展了详细的恒星计数，首次揭示了在太阳附近，IMF 同星族金属丰度和年龄紧密相关。这些结果对理解银河系的化学演化，河外星系质量估计、乃至行星形成效率等问题都将产生重要影响。本报告将介绍这一最新的研究成果。未来，我们将借助 CSST 的空间观测，进一步约束 IMF 的形状随星族性质的变化。

GTC 望远镜高分辨率超稳定光谱仪中西合作

刘继峰 中国科学院国家天文台

10.4 米 GTC 望远镜是当今最大的单口径光学红外望远镜。当前我方正在为

GTC 研制一台具备世界一流高精度视向速度测量能力的高分辨率超稳定光谱仪，以此实物贡献成为 GTC 合作伙伴，获得相应份额的 GTC 观测时间及其所有科学仪器的使用权，惠及全国天文学者。

在光谱仪投入使用之前，我方可以优惠价格购买 GTC 保障性观测时间。近年来我国科研团队利用 GTC 望远镜观测数据不断产出重大成果，黑洞探测、富锂星等科学成果发表在《自然》上。

这项合作可填补我国缺少大口径光学望远镜的空白，促进多领域天文研究发展，为我国天文大科学装置（LAMOST、FAST、CSST、EP、SVOM 等）开展后随光学精测、多出亮点成果提供有力支持。

活动星系核的探索征程

薛永泉 中国科学技术大学

时值类星体发现六十周年之际，本报告将介绍类星体/活动星系核的研究简史、研究意义、重要成果（适当突出中国学者贡献）以及研究前景。

伽玛射线暴研究：过去，现在和未来

戴子高 中国科学技术大学

伽玛射线暴是在宇宙空间发生的伽玛射线闪耀事件，也是自然界中最剧烈的爆发现象，1973 年被宣布发现，然而至今仍是未解之谜。本报告将评述伽玛射线暴研究的进展，特别是与几例特别爆发事件（如 GW170817、GRB 211211A 和 GRB 221009A 等）相关的研究工作，最后将指出本课题存在的关键科学问题。

群星都是我们的世界：从最近三次天文诺奖看其发展

苟利军 中国科学院国家天文台

人们对于宇宙总是充满了兴趣，而宇宙当中的黑洞、引力波、系外生命等都是大众非常感兴趣的话题。在过去的这些年中，这些领域也取得了比较大的进展，相关的领域也获得了诺奖，所以本报告就具体介绍了这些获得诺奖的领域（分别于 2017 年，2019 年，和 2020 年），让大家对于天文学的最新进展也有一个了解。

射电天文分会场报告

射电星系动物园：公众科学与机器学习辅助的大尺度连续谱巡天

唐弘铭　清华大学天文系

随着下一代大尺度连续谱射电巡天项目（i.e. EMU, LoTSS, VLASS) 的有序推进，数千万计的射电星系/恒星形成星系将被发现，面向这些巡天项目的可靠射电天体搜寻工作流（source finding workflow）函待完善。目前，经典源查找算法（source finder; i.e. Selavy, PyBDSF) 虽对致密源和单射电辐射区（ single component source) 的射电天体有优越的处理能力，其搜寻多辐射区射电源（multi-component source)多及形态罕见源（source with unusual morphology) 的能力仍有待提高。本报告将简要介绍由 EMU 和 LoTSS 巡天发起的系列公众科学项目 - 射电星系动物园（Radio Galaxy Zoos），并解释公众科学和机器学习方法如何实现多福社区射电源和形态罕见源的证认/发现，并帮助巡天团队生成具有科学价值的射电天体目录。

无监督算法消除 21cm 前景减除中的波束效应

倪书磊　之江实验室

深度学习算法通常需要大量标记数据来实现更准确的预测和分类等研究。虽然天文学观测数据量非常大，但是由于大部分数据没有标签，导致实际可用于训练深度学习模型的标记数据通常是有限的。在中性氢前景减除的工作中，由于波束效应的影响，导致传统算法（比如 PCA、ICA 等）前景减除失败。

因此我们提出了一个需要一定先验知识的非监督算法--De-Conv U-Net 网络，该网络能够实现天文数据观测的退卷积功能。结合前景减除的传统算法，最终得到一个优于传统算法的结果。

利用射电干涉仪测量 21cm 全天频谱可行性的理论研究

张欣　中国科学院国家天文台

up to thousands of baselines. Using this algorithm, the monopole of both foreground and the 21 cm signal can be correctly recovered in a broad range of conditions. We find that a 3D baseline distribution can have much better performance than a 2D (planar) baseline distribution, particularly when there is a lack of shorter baselines. We simulate for ground-based 2D and 3D array configurations, and a cross-shaped space array located at the Sun-Earth L2 point that can form 3D baselines through orbital precession. In all simulations we obtain good recovered global spectrum, and successfully extract the 21 cm signal from it, with reasonable number of antennas and observation time.

VLBI 观测下的一个间歇性活动的年轻射电星系

曾艾玲　上海天文台

The classification of the radio source 0954+556 has been a debate in previous studies, as it exhibits properties of both a blazar and a young radio galaxy. It possesses some unique characteristics, such as being exceptionally bright in gamma rays, showing no variability in both the radio and gamma-ray bands, and featuring a significant bend in its jets from kiloparsec to parsec scales. We have collected our VLBA observations of this source from 1.7 to 43GHz over the past 20 years, as well as VLA observations from 1.7 to 22GHz, and some archival data. Spectral age analysis reveals it is an intermittent jet that undergone at least three episodes, with the intermittent activity causing the bent jet, i.e., an east-west orientation on kiloparsec scale and a north-south orientation on parsec scale. Polarization observations from VLBA and spectral index map indicate the recent outburst has produced a bow shock due to interaction with the interstellar medium. In addition, its flux increases from 22 to 86GHz, resulting in an explanation that it is in　a new phase of outburst.

Detecting Cosmic 21 cm Global Signal Using an Improved Polynomial Fitting Algorithm

刘天阳　中国科学院上海天文台

FAST reveals new evidence for M94 as a merger

周瑞蕾　中国科学院国家天文台

We report the first high-sensitivity HI observation toward the spiral galaxy M94 with the Five-hundred-meter Aperture Spherical radio Telescope (FAST). From these observations, we discovered that M94 has a very extended HI disk, twice larger than that observed by THINGS, which is accompanied by an HI filament and seven HVCs (high velocity clouds) at different distances. The projected distances of these clouds and filament are less than 50 kpc from the galactic center. We measured a total integrated flux (including all clouds/filament) of 127.3 (±1) Jy km s−1, corresponding to a H I mass of (6.51±0.06)×10^8M⊙ , which is 63.0% more than that observed by THINGS. By comparing numerical simulations with the HI maps and the optical morphology of M94, we suggest that M94 is likely a remnant of a major merger of two galaxies, and the HVCs and HI filament could be the tidal features originated from the first collision of the merger happened about 5 Gyr ago. Furthermore, we found a seemingly isolated HI cloud at a projection distance of 109 kpc without any optical counterpart detected. We discussed the possibilities of the origin of this cloud, such as dark dwarf galaxy and RELHIC (REionization-Limited HI Cloud). Our results demonstrate that high-sensitivity and wide-field HI imaging is important in revealing the diffuse cold gas structures and tidal debris which is crucial to understanding the dynamical evolution of galaxies.

A tale of two black hole images of M87

路如森　上海天文台

Due to its proximity and large black hole mass, the nearby radio galaxy M87 is a prime target for high-resolution imaging studies of AGN central engines. Event Horizon Telescope (EHT) observations of M87 at a wavelength of 1.3 mm have imaged the black hole shadow in M87, providing strong evidence for the presence of supermassive black holes. In this talk, we will report on the first VLBI images of M87 obtained with the Global Millimeter VLBI Array in conjunction with the phased ALMA and the Greenland Telescope at a wavelength of 3.5 mm. With these observations, we have independently obtained an image of the black hole shadow at a

wavelength different from that of the EHT. We show that the ring-like structure is dominated by the accretion flow around the black hole, and how it is connected to the jet on event horizon scales.

Evolution of magnetic field of the Quasar 1604+159 at pc scale

胡旭志 上海天文台

We report a study of the spectral index, linear polarization, and RM distributions at pc scale for the quasar 1604+159.

The source were observed at 5.0, 8.4, and 15.4 GHz in 2002, and 4.6, 5.1, 6.0, 7.8, 12.2, 15.2, and 43.9 GHz in 2020 .

Combining with the MOJAVE polarization results at 15 GHz from 2009 to 2013, we study the evolution of the magnetic field in the jet and the core.

Polarized emission detected in the jet of the two epochs we observed are centered in bright, compact jet features.

The EVPAs in the jet of have large separation of 50 deg. from the jet direction, different from the MOJAVE results in which the jet EVPAs orient basically along with the jet direction.

The spectral of the compact features detected along the jet ridge are flatter than the mean spectral index for the quasar population obtained by MOJAVE.

These results support existence of oblique shocks in the jet, obliquing the magnetic field orientation.

We find the EVPAs in the core at 15 GHz observed in 2020 has smooth change from normal to along to the jet direction.

We have constructed RM distribution for the two observations.

We find the rotation of EVPAs in the core observed in 2002 could be explained by a external screen, while the rotation observed in 2020 originate from internal.

The core |RM| increases with frequency follow a power law with index a = 2.9, suggesting a fast electron density fall-off in the medium with distance from the jet base.

双温广义相对论磁流体力学模拟下非热辐射对黑洞阴影的影响

张铭缘　上海交通大学

事件世界望远镜合作组在 230GHz 已经可以对黑洞最内部的结构成像。观测到的环状结构与热同步辐射理论结果吻合。但是，在低频波段，M87 在大尺度喷流结构上呈现出非热辐射的特征。在本研究中，我们利用双温广义相对论磁流体力学模拟，在不同黑洞自旋、电子加热机制和电子分布下探究非热辐射对黑洞阴影以及光谱的影响。通过比较不同模型下的黑洞阴影图像和光谱，我们发现当考虑 kappa 分布时，Rh=1 的 R-beta 模型在图像上以及光谱的高频波段与电子加热模型吻合。然而，二者的差别可以通过图像上的弥散结构来区分，尤其是在低频波段。而且，二者的差别在光谱的低频波段也有体现。相对于热分布来说，当考虑 kappa 分布时，喷流部分的辐射增强了，并且光谱的峰所在位置向低频迁移。

双活动星系核的 VLBI 观测研究

许万成　中国科学院新疆天文台

根据宇宙学理论和模拟，在星系并合的过程中，星系中心的超大质量黑洞也会发生并合。在并合的早期阶段会形成 kpc 尺度的双 AGN，进一步，将会形成 pc 尺度的超大质量双黑洞系统，最终实现双黑洞的并合。研究双 AGN 的辐射特征对于理解星系并合和演化的早期阶段具有重要意义。此前，Fu Hai 等人利用 SDSS 数据和 VLA 观测，证认了位于 SDSS Stripe 82 区域的四个双 AGN 样本（S005114, S220635, S223222, S230010）。我们利用 VLBA 望远镜对这 4 个双 AGN 的 8 个成分进行了高分辨率成像，研究其结构、流量、亮温度、辐射功率等射电辐射特征，并对其辐射机制做出推断。结果表明，我们探测到其中两个双 AGN 各有一个成分具有致密的核结构（S005114B 和 S230010A），其流量超过 VLA 观测下流量的一半，这意味着这两个成分都相当致密，因此我们认为其射电辐射的来源主要是黑洞吸积产生的弱喷流，并可能伴有恒星形成等其他辐射来源。其余的六个成分未探测到明显的核结构，它们的射电辐射较为延展，可能主要来自于恒星形成或气体外流/风。

According to cosmological theory and simulations, during the process of galaxy merging, the supermassive black hole at the center of the galaxy should also merge. In the early stage of merging, the kpc-scale dual AGN will be formed. Further, the pc-scale supermassive binary black hole system will be formed, and eventually the

merging of binary black hole will be realized. Studying the emission characteristics of dual AGNs is of great significance for understanding the early stage of galaxy merging and evolution. Previously, Fu Hai et al. used SDSS data and VLA observations to identify four dual AGN samples located in the SDSS Stripe 82 region (S005114, S220635, S223222, S230010). We used the VLBA telescope to conduct high-resolution imaging of the eight components of the four dual AGNs, and studied their radio emission characteristics such as structure, flux density, brightness temperature and emission power, and infer their radiation mechanism. The results showed that we detected two dual AGNs each with a compact nuclear structure (S005114B and S230010A), with a flux density exceeding half of the observed flux density under VLA. This means that these two components are quite compact, so we believe that the source of their radio emission is mainly the weak jet generated by black hole accretion, and may be accompanied by other radiation mechanisms such as star formation. The other six components have no obvious nuclear structure detected, and their radio emission is relatively extended, which may mainly come from star formation or gas outflow/wind.

中子星磁场与自转演化的研究

高志福　新疆天文台

快速射电暴领域的发现前景

李葫　中国科学院国家天文台

A Study on the Intrinsic Energy Distribution and Spectrum-Energy Relation of the Repeating Fast Radio Bursts

吕芬　上海科技馆

A Study on the Intrinsic Energy Distribution and Spectrum-Energy Relation of the Repeating Fast Radio Bursts.

A single-pulse study of newly discovered CRAFTS pulsar PSR J1239+0326

Rukiye Rejep 国家天文台

Pre-glitch Emission Variations in PSR J0742-2822

张颜荣 广州大学

Among all the known pulsars to have an association between the emission state change and the glitch, the emission state changes soon after the glitch or a couple of rotating periods prior to the glitch. A widely accepted interpretation is that glitches can induce the change of pulsar magnetosphere and hence emission. However, in this work, we have identified the pre-glitch emission state change at a confidence of 99.9992(3)% (4.5 sigma) for the first time by analyzing the archived observations of PSR J0742-2822 over the past 20 years. It is not expected within the framework of a sudden release of accumulated angular momentum/energy and sheds an entirely new light on the mechanisms responsible for both emission variations and glitches.

旋转射电暂现源的超宽带辐射特性研究

任欣慧 中国科学院新疆天文台

超宽带接收机在射电天文学中扮演着至关重要的角色，其高灵敏度和广阔的频率覆盖范围为研究旋转射电源（RRATs）提供了有力的工具。本文旨在探讨超宽带接收机在研究 RRATs 方面的应用，以深入了解这些神秘天体的辐射特性。

首先，我们介绍了 RRATs 作为一类新型射电暂现源的基本特征。RRATs 在绝大多数状态下处于射电宁静状态（McLaughlin et al. 2009），其辐射特点是射电波段偶发的单个爆发脉冲，每次爆发持续时间为 2~30ms，两个射电暴之间间隔 4min~3h，平均来说，每天可探测到的脉冲信号总计仅有 1 秒左右，其观测数据流中绝大部分是噪声。

随后，我们讨论了 Parkes 望远镜超宽带接收机在 RRATs 研究中的优势和应用。其广阔的频率范围使得超宽带接收机能够捕获到更多的脉冲特征，从而提供更全面的数据用于分析。高灵敏度使得超宽带接收机能够探测到较弱的射电信号，

进一步拓展了研究 RRATs 的能力。

在本研究中，我们将采用超宽带接收机对若干个已知的 RRATs 进行观测。通过分析观测数据，我们筛选出爆发脉冲，研究 RRATs 的脉冲轮廓，并且利用 pulsar_spectra 软件包进行光谱拟合以研究频谱特性，探讨其与其他射电暂现源的异同。

本研究对于揭示 RRATs 的性质和起源将具有重要意义。通过超宽带接收机的观测和分析，我们期望能够进一步认识 RRATs 在宇宙中的角色，为理解中子星的演化和强磁场环境中的物理过程提供新的启示。这将有助于推动射电天文学领域的发展，并为未来的天体物理学研究提供有益的参考。

FAST 球状星团脉冲星巡天项目 IV

连禹杰 北京师范大学天文系

6 年的时间内，500 米口径球面射电望远镜（FAST）球状星团脉冲星巡天项目已经完成对天区内 45 个星团的观测，观测深度从距离最近的 NGC6366（3.5 kpc）延展至 Palomar 4（108.7 kpc）。截至目前，FAST 在 12 个星团中发现了 44 颗新脉冲星，这些新发现使得 FAST 天区已知脉冲星数量增加超过两倍（由 31 增加到 75）。其中 M2、M10、M14、M92 首次报道有脉冲星发现，另外新发现的脉冲星中大部分（33 颗）为脉冲双星，其中包括轨道周期最短的脉冲双星 M71E、4 颗掩食双星（M13E、M92A、M14D 和 M14E）、3 颗毫秒脉冲双星位于已知有脉冲星的最远的球状星团 M53（M53B、D、E）。M53（NGC 5024）距离太阳系 17.9 kpc，我们在这里报道了一颗新毫秒脉冲双星 PSR J1312+1810E (M53E)的发现，并且基于 FAST 从 2019 年 11 月至 2022 年 4 月期间的 22 次观测，解出了 M53B-E 的新计时解。这些新发现和计时解得益于 FAST 的高灵敏度。我们发现 M53C 是这个遥远的 GC 中已知的唯一孤立的毫秒脉冲星，自旋周期为 12.53 ms，自旋周期导数为 5.26 × 10−20 s s^−1。我们的结果显示，M53B、D 和 E 的轨道周期分别为 47.7、5.8 和 2.4 天。伴星的质量分别为 0.25、0.27 和 0.18 太阳质量，很可能是白矮星；如果它们是延伸的天体，它们就不会使脉冲星发生掩食。我们在钱德拉（Chandra）的 X 射线背景图像中没有发现这些毫秒脉冲星在 0.3-8 keV 波段的 x 射线对应体。M53 中脉冲星的分布特征与银河系盘内的毫秒脉冲星群相似，正如从 M53 的低恒星密度所预期的那样。

The Statistical Polarization Properties of Coherent Curvature Radiation by Bunches: Application to Fast Radio Burst Repeaters

刘泽南　南京大学

FAST Galactic Plane Pulsar Snapshot survey: Progress

韩金林 国家天文台

我们在试验并获得结果的基础上，我们提出了“银道面脉冲星快照巡天”项目。2019 年秋向 FAST 科学委员会申请并获批为 FAST 重大优先项目。观测范围为 FAST 可观测天区内的+-10 度银道面，优先完成+-5 度范围。自 2020 年起，我们正式开始观测。新设计了 snapshot 观测模式，大大提高了望远镜时间的使用效率；通过优选观测时间和天区，大大提升了单位时间内脉冲星的发现效率；构建了完整高效的“端到端”脉冲星处理和智能识别软件体系，实现了周期信号和单脉冲信号的发现能力。经过三年多的努力，我们已经发现了 600 多颗脉冲星，包括 76 个 RRAT 和 145 个毫秒脉冲星。我们也发现了一批双星系统，包括 4 个双中子星系统和小质量的伴星系统如轨道周期为 53 分钟的双星。在脉冲星巡天观测的同时，我们同步记录了谱线数据。这使得我们在不额外耗费 FAST 时间的情况下，处理同步记录的数据获得了银河系中性氢和电离氢的高灵敏度三维图像。此外，通过测量 FAST 发现的新脉冲星和银道面上原先已知的暗弱脉冲星的偏振信号，我们探测了银河系 15kpc 范围内的大尺度磁场结构。FAST 的高灵敏度和高效观测模式的结合，使得我们在短短三年多时间内增加了银河系内关于脉冲星和星际介质认知。

Highly sensitive observations of spider pulsars with FAST

王双强 中国科学院新疆天文台

Black widows are millisecond pulsars ablating their companions. The material blown from the companion blocks the radio emission, resulting in radio eclipses. The properties of the eclipse medium are poorly understood. Here, we present direct evidence of the existence of magnetic fields in the eclipse medium of the black widow PSR J2051$-$0827 using observations made with the Five-hundred-meter Aperture Spherical radio Telescope (FAST). We detect a regular decrease in rotation measure (RM) in the egress of eclipse, changing from $60\,\rm rad\,m^{-2}$ to $-28.7\,\rm rad\,m^{-2}$. The RM gradually changes back to normal when the line-of-sight moves away from the eclipse. The estimated line-of-sight magnetic field strength in the eclipse medium is ~ 0.1\,G. The RM reversal could be caused by a change of the magnetic field strength along the line of sight due to binary orbital motion. The RM reversal phenomenon has also been observed in some repeating fast radio bursts (FRBs), and the study of spider pulsars may provide additional information about the origin of FRBs.

A multi-band study of pulsar glitches with Fermi-Lat and Parkes

刘鹏　厦门大学天文学系/中国科学院新疆天文台

Pulsar glitch is a rare and strange phenomenon, which means that the rotation frequency of a few pulsars suddenly increases in a short time. The phenomenon was first discovered in 1969, and nearly 700 glitch events have been detected in 209 pulsars so far. We combine the timing data of Fermi-LAT and Parkes 64-meter radio telescope for more than 13 years to study the glitch events of six young pulsar. We detected a total of 17 glitches in PSRs J1028-5819, J1048-5834, J1420-6048, J1709-4429, and J1718-3825, including two new glitch events.　A new small glitch is identified at MJD 56985(9) in PSR J1048-5834, which is currently the smallest one since it has been discovered, with a glitch size is $\Delta\nu \sim 1.9(4) \times 10^{-8}$ Hz. Meanwhile, in the radio band, we found that the shape of the integrated pulse profile of PSR J1048-5834 changed after two glitches. The pulse width at the 55% intensity level (W55) of the mean pulse profile exhibits two modes: wide and narrow modes, and the W55 of narrow mode shows a jump after glitch 7. Unfortunately, no evidence for a correlation between the spin-down rate evolution　and w55 has been found. Finally,

we also studied the pulse profile and flux density in the gamma-ray band, but found no variation.

Investigation of emission states of PSR J1722−3207

赵德　新疆天文台

We have conducted a detailed study of the single-pulse emission from the phase-stationary non-drift amplitude modulation observed in PSR J1722−3207 at 1369 MHz using the Parkes 64m radio telescope. Our findings reveal that this pulsar exhibits two distinct emission states: a periodic state of switching between a strong and weak region labeled as "I", and a consistently weak state in region "II". We have conducted an investigation into the polarization properties of both the strong and weak states. Considering the similarity with mode changes, we argue that PSR J1722−3207 demonstrates periodic mode-changing through amplitude modulation. Fluction spectral analysis indicates a very short modulation period of approximately 2.0 seconds or 20P1, where P1 represents the rotation period of the pulsar. Currently, explaining the phenomenon of periodic amplitude modulation of pulsars remains challenging with existing models.

Follow-up timing of 24 pulsars discovered in Commensal Radio Astronomy FAST Survey

吴庆东　中国科学院新疆天文台

The follow-up timing observations were carried out for 24 pulsars discovered with the Five-hundred-meter Aperture Spherical radio Telescope (FAST) in Commensal Radio Astronomy FAST Survey (CRAFTS). We report their phase-connected timing ephemeris, polarization pulse profiles and Faraday rotation measurements. With their spin periods spanning from 2.995 ms to 4.34 s, their period derivative were determined to spread between 7.996*10^(−21) s/s to 9.83*10^(−15) s/s, which imply that they have characteristic ages from 1.97*10^6 yr to 5.93*10^9 yr. Some of these new pulsars found by FAST are distant, dim, and low E-dot ones and are suitable for testing pulsar emission theories.

伴随脉冲星周期跃变的轮廓变化

刘杰　广州大学

Constraining the orbital inclination and companion properties of black widow pulsars detected by FAST

杜泽昕 华中师范大学

Black widows (BWs) are millisecond pulsars ablating their companion stars. The out-flowing material from the companion can block the radio emission of the pulsar, resulting in eclipses.

In this paper, we construct a model for the radio eclipse by calculating the geometry of the bow shock between the winds of the pulsar and companion, where the shock shapes the eclipsing medium but had not been described in detail in previous works. The model is further used to explain the variations of the flux density and dispersion measure (DM) of three BW pulsars (i.e., PSR B1957$+$20, J2055$+$3829, and J2051$-$0827) detected by the Five-hundred-meter Aperture Spherical radio Telescope (FAST).

Consequently, we constrained the parameters of the three BW systems such as the inclination angles and true anomalies of the observer as well as the mass-loss rates and wind velocity of the companion stars. With the help of these constraints, it is expected that magnetic fields of companion stars and even masses of pulsars could further be determined as some extra observation can be achieved in the future.

Numerical study of core formation along gas filaments in molecular clouds

李北成 上海天文台

Filamentary structures have been found at almost all size scales in the Galaxy. Massive filamentary dark clouds of a few parsecs to more than 10 parsec long are commonly found inside giant molecular clouds (GMCs) (e.g., Bergin & Tafalla 2007,

Andre et al. 2014). High resolution observations also reveal large number of thinner (~ 0.1 pc) and shorter filamentary substructures (≤ 1 pc) inside molecular clouds, even in the long and slender filamentary dark clouds (Hacar et al. 2013). Cores are found located along some of the filamentary substructures (e.g., Tafalla and Hacar 2015). Observationally, it is unclear on the formation of filamentary substructures and how exactly these substructures fragment into cores. Theoretical studies of the stability of filamentary structures (e.g., Nagasawa 1987, Inutsuka & Miyama 1992, Fiege & Pudritz 2000, Fischera & Martin 2012) show that fragmentation of isothermal cylindrical filament will happen at the wavelengths of the maximum instability growing mode. Separation of cores depends on whether the magnetic field is present and the field structures in terms of the ratio of toroidal/poloidal field components. However, the observed results do not match the predictions based on highly simplified models well. Some observed cores are even separated by about the FWHM of the filament, like the chain of pearls on a string (e.g., Men'shchikov et al. 2010, Arzoumanian et al. 2011, Tafalla and Hacar 2015). For molecular clouds crowded with filamentary substructures, frequent collisions among and merging of filaments also can induce fragmentation to the marginally stable filamentary substructures. Our high-resolution numerical simulation (Li et al. 2019) have shown that moderately strong magnetic field are critical in ensuring long term survival of long filamentary molecular clouds and the formation of filamentary substructures. In this presentation, I shall demonstrate the formation processes of the filamentary substructures, how these small structures come together to form a filamentary molecular cloud, and how cores would form along the substructures using our simulation.

银道面巡天 GLOSTAR 的进展与新发现

杨嫒媛　国家天文台

GLOSTAR 巡天是目前在 C 波段最灵敏的银道面巡天，利用了射电单天线（Effelsberg 100m）和干涉阵（VLA）望远镜，研究银河系内的恒星形成过程。该报告本报告将介绍 GLOSTAR 巡天的最新进展和新发现，尤其是 VLA 观测的结果。

Advances in Chemical Models for Prebiotic Molecules: Investigating Cyanamide and Its Isomers in the ISM

张霞　中国科学院新疆天文台

Prebiotic molecules are the building blocks of life, or the raw materials from which these building blocks formed, and are believed to have been delivered to Earth by comet-like objects. These molecules can develop within stars or planets and have played a critical role in the origin of life on Earth. Cyanamide (NH2CN) and its isomer carbodiimide (HNCNH) are significant prebiotic molecules found in the interstellar medium. They can undergo a series of chemical reactions to form adenine nucleobases, which are a crucial component of the genetic material RNA and DNA.

We outline a chemical reaction network for cyanamide and its isomers using theoretical chemical research and apply the three-phase NAUTILUS chemical code to simulate the formation and destruction of cyanamide and carbodiimide in various interstellar physical environments which include cold core, hot corino/core, and shock models. According to our findings, cyanamide and carbodiimide are mainly produced through free radical reactions on grain surfaces. Additionally, we suggest that surface chemistry contributes to the early evolutionary stages of these molecules, which are then released back into the gas phase and observed.

FAST 多波束塞曼效应测量分子云磁场

李晨睿　国家天文台

磁场在星际介质演化和恒星形成中发挥着重要作用。在分子云核尺度上，其与气体湍流，重力坍缩共同调控恒星形成。在现有理论中，分子云是否处于磁超临界是判断其是否能够坍缩成恒星的重要条件。而对磁场形态学与方向的研究则能够揭示更多分子云的演化与动力学过程。该研究使用 FAST 19 波束 r-band 接收机，基于 HINSA（氢原子窄线自吸收）谱线的塞曼效应，通过改进中心单波束测量磁场的方法（Qing et al. 2022），利用贝叶斯方法得到了暗云 B227 中几处 HINSA 吸收位置的磁场强度测量值（其中 3 个波束数据的结果高于 5sigma 误差）。通过进一步分析该区域，发现磁场强度与 13CO，HINSA 示踪的气体速度存在相关性。结合尘埃辐射计算出 H2 柱密度，经计算可得此区域处于磁超临界状态。磁超临界状态表明分子云已经完成了大部分磁通量耗散过程，此时重力（与湍流压力）占主导，我们推测，在弱磁场条件下，磁感线被湍流运动裹挟，方向相反

的汇聚气体流或质量流造成了磁场方向的反转。此研究给出了分子云核包层磁场强度更精确的数值，并预测该区域可能存在致密团块-原恒星核的形成。

TMC-1 复杂有机分子形成研究

卢杨　之江实验室

在 TMC-1 冷分子云中，已经观测到超过 150 种分子，包括含氧复杂有机分子（如 C2H5OH，CH3OCH3），长碳链分子（如 HCCCCCN，HCCCHCCC）以及多环芳香烃（PAHs，如 C10H7CN，C9H8）等。然而，现有的热扩散机制无法解释在低温环境（约 10K）下这些分子的合成。因此，本文引入宇宙线诱导的辐射化学非扩散机制和溅射非热解吸机制，通过多相天体化学模型研究了含氧复杂有机分子的形成过程。模拟结果与观测数据吻合良好，误差在两倍以内。同时，我们还对 89 个观测分子的丰度进行了比较，其中有 67 种分子的误差在一个量级内，约占总数的 75.3%。相较于其他的结果，我们的模拟结果与观测数据吻合度最高。这些研究使我们对冷分子云中复杂有机分子的形成机制有了更深入的理解。

磁流体代码 Athena++尘埃多流体模块的应用

黄平辉 加拿大维多利亚大学

Astronomy in Chile

Guido Garay　智利大学天文系

The Atacama desert in the north of Chile, with its pristine skies and low levels of humidity, offers the best conditions for astronomical observations in the world. During the late sixties, astronomical institutions of United States and Europe recognized these privileged conditions leading to the construction of three observatories hosting optical telescopes up to 4m in diameter: Cerro Tololo, La Silla and Las Campanas. At the turn of the century, a new generation of giant 8m class optical/infrared telescopes was constructed: the Very Large Telescope, the Magellan Telescopes and Gemini South. In 2012, the most powerful sub-millimeter telescope on Earth, ALMA, started operations. In the near future an astonishing generation of

mega-telescopes will start operations: The Vera Rubin Observatory, the Large European Telescope and the Giant Magellan Telescope. By the middle of this decade, Chile will host 70% of all the astronomical observation capacity in the world.

Also during the late sixties, the Chilean government established a policy granting foreign Astronomy Institutions status of International Organization, to install telescopes under duty-free importation rights. In return they asked guaranteed access to 10% of the observing time to Chilean astronomers. This has led to a remarkable development of astronomy in Chile during the last 60 years: (i) Chilean astronomers have been able to perform frontier research in several topics of astrophysics, (ii) The number of universities performing research in astrophysics increased from 2 to currently 23, spread across the country. Eleven of these offer Ph.D. and M.Sc. programs open to students from all over the world; (iii) the human resources devoted to astrophysics (researchers, postdocs and graduate students) has grown by a factor of 10.

Finally, a strong and fruitful research collaboration between Chinese and Chilean astronomers started 10 years ago with the installation in Santiago of the Chinese Academy of Science South America Center for Astronomy, which provides funds for Joint Research projects and Postdoctoral Fellowships.

从“冷核”到“热核”：ALMA ALMASOP 及 ATOMS 项目进展及展望

刘铁　中国科学院上海天文台

ALMASOP 项目利用 ALMA 观测了 72 个猎户座巨分子冷云核。ATOMS 项目利用 ALMA 观测了 146 个大质量恒星形成区。利用这两个项目数据，我们开展了一系列具有统计意义的工作，研究不同质量恒星形成过程。我将介绍这两个项目的研究进展及将来的研究计划。

从外向流驱动到外向流的反馈

李英杰 紫金山天文台

我们结合 FAST HI 与青海站 13.7 m 毫米波望远镜的分子谱线观测，在大质

量恒星形成研究中取得系列进展：1.首次在大质量恒星形成区探测到 HI 星风，发现 HI 星风有可能驱动分子外向流；2.首次发现星风中的 HI 丰度与 HI 窄线自吸收线(HINSA)丰度一致，暗示 HI 星风中原子氢更有可能继承于母分子云；3.大样本定量研究分子外向流的反馈。这一系列成果为研究星风/外向流中化学与演化及其对恒星形成与反馈的影响注入新的活力，展现了 FAST 与 13.7 m 望远镜协同观测研究的潜力。

From ashes to assemble: a dynamic view of massive protocluster formation and evolution

许峰玮 北京大学科维理天文与天体物理研究所

The ALMA Survey of Star Formation and Evolution in Massive Protoclusters with Blue Profiles (ASSEMBLE) aims to investigate the process of mass assembly and its connection to high-mass star formation theories in protoclusters in a dynamic view. We observed 11 massive (Mclump>1000 Msun), luminous (Lbol>10,000 Lsun), and blue-profile (infall signature) clumps by ALMA with a resolution of 2200-5500 au at 350 GHz (870 um) in continuum and line emission. 248 dense cores were identified, including 142 prestellar core candidates and 106 cores showing protostellar signatures. Compared to early-stage infrared dark clouds (IRDCs), the core mass and surface density within the ASSEMBLE clumps exhibited significant enhancement, suggesting concurrent core accretion during the evolution of the clumps. The maximum mass of prestellar cores was 2 times larger than that in IRDCs, indicating evolved protoclusters have the potential to harbor massive prestellar cores. The mass relation between clumps and their most massive core (MMCs) is observed in ASSEMBLE but not in ASHES, which is suggested to be regulated by continuous mass accretion. The mass correlation between core clusters and their MMCs has a steeper slope compared to that observed in stellar clusters, which can be due to the fragmentation of the MMC and stellar multiplicity. We observed a decrease in core separation and an increase in central concentration as protoclusters evolve, which can be explained by gravitational contraction. We confirm primordial mass segregation in the ASSEMBLE protoclusters, possibly resulting from gravitational concentration and/or gas accretion.

The Intensity of the Diffuse Galactic Emission Reflected by the Meteor Trail

赵飞宇 上海天文台

We calculate the reflection of the diffuse galactic emission by the meteor trails and investigate its potential relationship to the Meteor Radio Afterglow (MRA). The formula to calculate the reflection of diffuse galactic emission is derived from a simplified case, assuming that the signals are mirrored by the cylindrical over-dense ionization trail of meteors. The overall observed reflection is simulated through a ray tracing algorithm together with the diffuse galactic emission modeled by the GSM sky model. We demonstrate that the spectrum of the reflected signal is broadband and follows a power law with a negative spectral index of around -1.3. The intensity of the reflected signal varies with local sidereal time and the brightness of the meteor and can reach 2000 Jy. These results agree with some previous observations of MRAs. Therefore, we think the reflection of galactic emission by meteor trails can be a possible mechanism causing MRAs, which is worthy of further research.

SKA 多观测效应消除关键理论与技术

张利　贵州大学

VGOS 观测人造卫星的可行性分析

甘江英　中国科学院上海天文台

月球 VLBI 科学需求仿真

于佳　上海天文台

为确保空间 VLBI 任务的可行性，在项目启动前需要进行科学需求仿真。我国探月四期任务开展期间计划建设月球科研站，为确保任务的可行性，需要开展空间 VLBI 科学需求仿真。目前在空间 VLBI 仿真方面可以应用的工具还较为有限，我们采用自主开发的空地 VLBI 仿真工具包 OmniUV，可以完成各种空间和

地面台站的轨迹计算、uv 计算、可视度仿真以及图像与波束的重建等。我们采用缩小后的黑洞新月模型作为输入，通过加入月基、月轨以及日地 L2 点组成空地 VLBI 网络。仿真结果表明，月球台站的加入显著提高了基线长度，进而提高了观测灵敏度，使得该空间 VLBI 网络可以分辨地基 VLBI 网络无法获得的图像细节。

基于 GPU 集群的空间 VLBI 射电源条纹搜索关键技术的研究

段学铭　中国科学院上海天文台

我国探月四期工程将构建由中继星搭载的 4.1 米天线和地基射电望远镜组成的首个月轨空间 VLBI 实验系统。然而，由于空间 VLBI 射电源预报时延模型无法考虑轨道扰动和星载设备误差，较大的时延误差会影响 VLBI 数据处理的正常工作和后续探测器轨道测定精度。为提高模型准确性，我们将使用条纹搜索技术，对实际观测数据重新构造更精准的模型。鉴于条纹搜索的庞大计算量，我们采用 GPU 集群加速，充分利用其强大计算能力，提高了条纹搜索效率。通过这些努力，月轨空间 VLBI 实验系统的性能和准确性将大幅提高，为我国探月四期工程以及未来的空间探测任务奠定了坚实的基础。

电离层及望远镜 Beam 对宇宙黎明中性氢全天平均频谱的影响

王越　中山大学，物理与天文学院

The global 21 cm signal originating from cosmic hydrogen is regarded as one of the most promising tools to study the early Universe. Detecting this signal holds the potential to unveil crucial insights into the first stars, the nature of dark matter, and early structure formation. In our investigation, we delve into the combined impact of the ionosphere and antenna beam on this significant cosmic signal. Research has demonstrated that during calm nights in the ionosphere, the impact of the ionosphere on the global average spectrum is relatively smooth. While the additional microstructure and frequency-dependent changes of the beam may introduce contamination to the average spectrum, both effects can be effectively described and

accounted for through the application of log-polynomials.

基于 FPGA 的多通道高分辨率射电信号采集和处理系统的研究

张浩　三峡大学理学院

低频段射电观测是研究射电爆发、宇宙物质能量特性、脉冲星物理、恒星形成等科学问题的重要手段。针对低频射电望远镜信号采集对于采样率、带宽、多通道幅相一致性和工作稳定性的性能要求，本课题设计的射电信号采集和处理系统主要基于 ADS54J60 及 ZYNQ7000 SOC 等核心器件，实现了一种 4 通道高速数据采集和处理系统。系统主要由三部分硬件组成：高速数据采集卡、光通信接收卡、服务器，采用基于 SerDes 高速数据传输接口技术的 JESD204B、Aurora64B66B、PCIe Gen2.0 等通信方式实现高速数据传输；可实现 300MSPS@16bit 采样率的直接采样，最大 64MByte 时域波形数据的 DDR 实时存储，传输数据稳定无误；采用基于 FPGA+SFP+FPGA 的技术方案，不仅可用于采样点与数据中心距离较远的场景，同时可以通过 FPGA 的并行计算能力加速服务器数据处理流程。经功能验证和性能测试，高速数据采集卡在 10MHz 输入信号下无失真动态幅度范围 4mv~4000mv，可以覆盖输入频率范围 4.5MHz~150MHz，满量程信噪比 SNR 可达 32dB；在输入 10MHz@500mv 正弦信号下，4 通道幅度差小于 1mv，相位延时小于 3.3ns;高速数据采集卡与光通信接收卡间的数据链路总带宽可达 25Gbps；光通信接收卡与服务器之间的通信带宽可达 1.5GB/s；实验结果表明，该系统可满足大部分低频射电观测设备的采样需求。

天马望远镜运行

刘庆会　中国科学院上海天文台

本报告主要介绍天马望远镜及其运行情况。近几年来，天马望远镜成功完成嫦娥 3、4、5 号和天问一号 VLBI 测定轨任务，并在谱线、脉冲星和 VLBI 观测研究中取得重要成果。

风干扰下 10 米级亚毫米波望远镜的指向控制

汪峥　东南大学

10 米级亚毫米波望远镜大多安装于高海拔地区，其运行过程易受大风载干扰，而望远镜的柔性机械结构使得风干扰的影响更为显著。传统的指向控制方法（如比例控制）不能抑制风干扰对望远镜指向控制系统的影响，难以达到亚毫米波段天文观测所需的高指向精度（小于 3 角秒）。为降低风干扰对指向精度的影响，实现风干扰下的高精度指向控制，我们依托 10.4 米口径 LCT 亚毫米波望远镜（即计划于 2023 年从夏威夷搬迁到智利的 CSO 望远镜），提出了一种基于扰动观测器的指向控制方法。首先，基于 LCT 望远镜指向控制系统动力学模型，构造了扰动观测器，以估计其所受到的内外扰动(包括风干扰和柔性结构低频谐振)。在此基础上，提出了一种基于线性二次调节器的前馈控制与基于 H□ 的鲁棒反馈控制相结合的组合控制测策略来抑制扰动的影响。进一步地，建立了集成 LCT 望远镜机械结构模型、指向控制系统模型、重力及风干扰模型的综合仿真模型，设计了一种基于自抗扰控制理论的指向控制算法，并通过仿真验证了其抑制风干扰、保证高指向精度的有效性。

日照热对环焦天线性能影响研究

雷震　长安大学

装配后的 K/Ka 波段 12 米口径环焦反射面天线夏天在室外进行方向图测量时发现：天线两侧副瓣电平存在时变差值，夜晚很小，白天 11 点左右差值达到最大，阴天或有云飘过时较小，与太阳存在一定相关性。通过建立天线结构日照热力耦合模型，仿真了一天中天线的时变热变形以及其方向图变化，发现太阳照射引起的馈源支撑装置的温差导致了该装置的时变倾斜，最终引起了上述问题。本文报道的现象、建模方法及解决方案对同类型天线的设计具有指导意义。

射频片上系统电磁干扰评估与防护考虑

汪子悦　中国科学院新疆天文台

奇台射电望远镜（QTT）数据处理前端拟采用射频片上系统（RFSoC）开发，RFSoC 具有高集成、低功耗、功能强大等特点，安装于望远镜主焦点和格里高利焦点。然而，RFSoC 的电磁干扰问题突出，其电磁兼容性评估与分析为数据处理前端屏蔽防护提供重要数据支撑。本报告依托 HTG-ZRF8 RFSoC，在 3m 法

电波暗室内，采用近场探头对系统内部部件的辐射发射进行了测量，并提出一种面向部件级的电磁辐射量级的评估方法，采用此方法分析了芯片内部部件的辐射量级分布。此外，依据 GJB151B 标准，结合 QTT 电磁兼容控制要求，测量分析了 HTG-ZRF8 RFSoC 的辐射发射特性，并提出电磁防护设计要求，为进一步的屏蔽防护提供技术支撑。

Simulation of RFI cancellation using Subspace Projection Algorithm for PAF

仵鹏　中国科学院新疆天文台

射电天文源搜索：一种基于长短期记忆神经网络的方法

周俊海　西安电子科技大学

多层电磁屏蔽结构屏蔽效能影响因素研究

胡茂振　中国科学院新疆天文台

新疆奇台射电望远镜具有极高的系统灵敏度，其焦点附近电子设备的屏蔽需求接近 150dB，拟采用多层电磁屏蔽方案，故开展多层电磁屏蔽技术研究，为望远镜电磁兼容设计提供理论支撑。

本报告依据 Robinson 的等效电路模型和传输线理论，提出一种多层带孔矩形屏蔽腔体屏蔽效能的计算方法，理论计算和仿真的结果表明，多层屏蔽性能与层数存在线性关系，且层数越多，SE 越高，层间距越大，SE 越大，但增长速率逐渐减小。此外，采用该方法分析了多层腔体结构、孔缝尺寸、屏蔽层数、层间距、测量点位置等因素对屏蔽效能的影响，为多层屏蔽方案提供理论支撑。

张贴报告

含 AGN 矮星系的中性氢研究

陈泓颖　中国科学院国家天文台

Fast radio burst generated by coherent curvature radiation from compressed bunches for FRB 20190520B

崔翔翰　中国科学院国家天文台

The radiation mechanism of fast radio bursts (FRBs) has been extensively studied but still remains elusive. Coherent radiation and charged bunches are considered essential elements in the FRB mecha- nism. In this work, we develop an ideal model based on the framework of coherent curvature radiation and the magnetized neutron star like a magnetar, considering the kinetic energy loss of outflow par- ticles due to the inverse Compton scattering (ICS) caused by soft photons in the magnetosphere. By introducing the ICS deceleration mechanism of particles, the compression effect on the particle number density in a magnetic tube/family may be achieved, enabling the attainment of the necessary size for coherent radiation in the radial direction. This process facilitates the dynamic formation of bunches that can emit coherent curvature radiation along the curved magnetic field. We apply this model to FRB 20190520B, one of the most active repeating FRBs discovered and monitored by FAST, explaining its basic characteristics and frequency downward drifting. In particular, this model may also explain the position of bright spots in the dynamic spectral diagram.

基于压缩感知框架的射电天文图像复原方法

张讯　中国科学院上海天文台

两个新探测到的中微子源的 VLBI 形态以及 TXS0506+056 和 PKS1502+106 的中微子起源

曾艾玲　上海天文台

Steady accretion from global collapse to core feeding in massive hub-filament system SDC335

许峰玮 北京大学科维理天文与天体物理研究所

We present ALMA Band-3/7 observations towards "the Heart" of a massive hub-filament system (HFS) SDC335, to investigate its fragmentation and accretion. At a resolution of ~0.03 pc, 3 mm continuum emission resolves two massive dense cores MM1 and MM2, with 383 Msun (10--24% mass of "the Heart") and 74 Msun, respectively. With a resolution down to 0.01\,pc, 0.87 mm continuum emission shows MM1 further fragments into six condensations, and multi-transition lines of H2CS provide temperature estimation. The relation between separation and mass of condensations at a scale of 0.01 pc favors turbulent Jeans fragmentation where the turbulence seems to be scale-free rather than scale-dependent. We use the H13CO+ (1-0) emission line to resolve the complex gas motion inside "the Heart" in position-position-velocity space. We identify four major gas streams connected to large-scale filaments, inheriting the anti-clockwise spiral pattern. Along these streams, gas feed the central massive core MM1. Assuming an inclination angle of 45 deg and a H13CO+ abundance of 5(3)x10-11, the total mass infall rate is estimated to be 2.4(0.78)x10-3 Msun/yr, numerically consistent with the accretion rates derived from the clump-scale spherical infall model and the core-scale outflows. The consistency suggests a continuous, near steady-state, and efficient accretion from global collapse, therefore ensuring core feeding. Our comprehensive study of SDC335 showcases the detailed gas kinematics in a prototypical massive infalling clump and calls for further systematic and statistical studies in a large sample.

天马望远镜主动面系统分布式控制软件

张栋　中国科学院上海天文台

太阳、行星分会场报告

基于极端样本研究行星形成和演化

王雪凇 清华大学

罕见的系外行星样本能够帮助我们理解行星形成和演化过程中的一些极端或特殊情况，对于理解行星族群多样性，以及检验形成和演化的物理模型，都有非常重要的意义。系外行星凌星巡天望远镜 TESS 运行近五年以来，得益于其大视场巡天的独特优势，发现了许多具有特殊意义和价值的、较为罕见的系外行星和褐矮星系统。本报告将从超级地球和气态巨行星两个族群角度分别出发，展示一些近期通过 TESS 后随观测得到的特殊行星样本，以及它们能够提供给我们的关于行星形成和演化的信息。

磁流体代码 Athena++尘埃多流体模块的应用

黄平辉 维多利亚大学

近年来，ALMA 发现了大量存在精细结构的原行星盘，这些结构与原行星盘中的气体—尘埃动力学和行星形成密切相关。我们基于 Athena++磁流体动力学代码开发了一个多流体尘埃模块。该模块可以计算任意数量尘埃与气体之间的相互作用，并具有多个尘埃—气体相互作用数值求解器。此外，我们提出了尘埃扩散与气体相互作用的自洽处理方法，该方法加入了相应的动量修正，并确保了系统的伽利略不变性。新的扩散处理方法和尘埃—气体相互作用求解器与 Athena++的现有功能相兼容。我们给出了一系列数值测试，确保该代码达到预期的性能。该模块代码将在原行星盘的气体—尘埃动力学和行星形成研究中发挥重要作用。

3D Global Simulations of Accretion onto Gap-opening Plants

李亚平 中国科学院上海天文台

We perform a series of 3D simulations to study the accretion of giant planet

embedded in protoplanetary discs (PPDs) over gap-opening timescales. We find that the accretion mass flux mainly comes from the intermediate latitude above the disc midplane. The circumplanetary disc (CPD) for a super-thermal planet is rotation-supported up to $\sim$20-30\% of the planet Hill radius. While both mass inflow and outflow exists in the CPD midplane, the overall trend is an outflow that forms a meridional circulation with high-lattitude inflows.

We confirm the absence of accretion outburst from disc eccentricity excited by massive planets in our 3D simulations, contrary to the consensus of previous 2D simulations.

This suggests the necessity of 3D simulations of accretion even for super-Jupiters. The accretion rates of planets measured in steady-state can be decomposed into the ``geometric factor'' and the ``gap-opening factor''.

Through extensive parameter survey, we identify a power-law scaling for the geometric factor $\propto q_{\rm th}^{2/3}$ for super-thermal planets ($q_{\rm th}$ being the thermal mass ratio), which transforms to $\propto q_{\rm th}^{2}$ for less massive cases. Additionally, by adopting self-consistent prescription for the gap-opening factor, we conclude a comprehensive formula for the accretion rate. We have applied our simulations results to accreting protoplanet system PDS 70 and can satisfactorily explain the accretion rate and CPD size in observations.

The possible application in the accretion of stellar-mass black holes embedded in active galactic nuclei discs is briefly discussed.

An Alternative Formation Scenario for Uranium-rich Giants: Engulfing an Earth-like Planet

谢 典 中国科学院新疆天文台

基于 RV 观测数据的不同类型巨行星形成的新线索

苏湘宁 海南大学

Many studies have analyzed planetary occurrence rates and their dependence on

the host's properties to provide clues to planetformation, but few have focused on the mutual occurrence ratio of different kinds of planets. Such relations reveal whetherand how one type of planet evolves into another, e.g. from a cold Jupiter to a warm or even hot Jupiter, and demonstrate howstellar properties impact the evolution history of planetary systems. The formation processes of WJ and HJ may be dominated by orbital change mechanisms rather thanthe in-situ model. However, unlike WJ, which favors gentle disk migration, HJ favors a more violent mechanism that requiresfurther investigation.

原行星盘的长期演变及其对行星形成的影响

王欣明 西安电子科技大学

太阳系外行星和原行星盘的大量观测结果为我们理解行星的形成提供了极好的机遇。原行星盘作为婴儿行星的摇篮对行星的性质有着重要的影响。本报告中，我们将介绍一个新的一维原行星盘演变模型。这一模型中考虑了原行星盘的自身引力、分子云核的坍缩、磁转动不稳定性、引力不稳定性、原恒星辐射等物理过程。利用这一模型我们能够从分子云核坍缩形成原行星盘开始对盘的长期（百万年时间尺度）演变进行研究，如面密度的演变、温度的演变、盘中物质径向速度的演变以及角速度的演变等。结果表明，依据原行星盘自身引力在盘演变过程中所起的作用，可以将原行星盘划分为三种类型。我们将展示不同类型原行星盘演变的数值结果，并讨论对行星形成过程可能产生的影响。

星团中行星系统的动力学稳定性：碎屑盘

吴 开 西交利物浦大学

虽然碎屑盘很可能和行星同时形成，但已知的二者共存的系统很少。行星及行星系统周围的星团环境可能对碎屑盘的稳定性有重大影响。 我们研究了星团中碎屑盘的动力学演化，重点确定行星的存在和星团的密度对其演化的影响。我们结合 NBODY6++GPU 和 REBOUND 进行 N 体模拟，在 100Myr 的尺度上为 100 个类太阳恒星每个分配了 200 个测试粒子来模拟不同星团（N= 2000-64000; Rh = 0.78 pc）中的行星系统，两组模拟分别包含和不含位于 50au 的木星质量行星。 我们发现该行星会使测试粒子不稳定，并加速它们的演化。行星存在时，大多数行星附近和共振轨道上的粒子被驱逐，剩余粒子倾向于保持小轨道倾角和

处于顺行轨道。 对于从行星系统逃逸的粒子，速度低于星团逃逸速度而留在星团中的主要来自于冷区域或靠近行星的区域。一个有趣的发现是，存活碎屑盘的空间尺度、行星的影响范围这两个量和星团的恒星数量在对数-对数刻度上呈简单的线性关系。这能方便我们预测类似星团中的碎屑盘形态。

热木星影响下超短周期行星的形成

朱家骏 中国科学院紫金山天文台

系外行星研究领域的突破性进展时常伴随着特殊行星族群的发现。近年来，超短周期行星系统成为系外行星研究的一个新的前沿目标。超短周期行星是指轨道周期小于 1 天的行星，大部分理论认为这类行星经历了从短周期范围内迁到超短周期范围的过程，并用不同的模型解释迁移机制。本工作主要研究行星系统外侧存在热木星的情况下，超短周期行星的形成演化过程。经过早期的迁移过程后，行星系统的内侧类地行星与外侧热木星的轨道周期<10 天，并且处于共振状态。内侧行星在潮汐作用和行星摄动的共同影响下脱离共振，同时偏心率被持续激发，最高可以超过 0.5。随后内侧行星进入潮汐演化，轨道迅速内迁，最终形成超短周期行星。这个过程会受到行星间的质量关系和潮汐耗散函数等行星因素的影响，本工作研究了多组行星质量和潮汐耗散函数组合的演化情况，模拟结果表明具有更大质量的热木星，能使内侧行星轨道更接近主星，也有更大概率将内侧行星激发到 0.4-0.5 甚至更高的轨道偏心率，使其在潮汐作用下内迁到超短周期范围。

Classify and Explore the Diversity of Planetary Population and Interior Properties

蒋效铭 武汉大学

Classification is an essential method and has been developed widely in astronomy. However, planets still lack a universal classification framework, because the Solar System planet sample is too little for statistical analysis. Fortunately, exoplanets supply large samples to help build up synthetic planetary populations to support a classification framework. In this study, we use synthetic populations to study the diversity and evolution relations of planets. We detect six outstanding clusters in mass-radius space with the kernel density estimation (KDE) and extract

typical planets for each type. The first 4 types are gas-poor planets, and the last 2 are gas-rich. For an intermediate type, the light gas envelopes contribute to the observable radius but not the mass. Once the planet is massive enough (3.9 M_J) its size shrinks with increasing mass due to self-gravity. Based on the evolution tracks and the gas envelopes' properties, the environment is linked strongly to the gas properties and control which type can form at a specific location. The system with gas giants will be different from those without, including total planet mass and the number of planets in the system. Giant planets shape the whole system by orbital resonance. Each type of planet's period ratios are different, and gas giants have the most outstanding accumulation peak at 2:1 resonance. In the future, the patterns of observed planets' retrieved interior structures can help to confirm the suggested classification. However, the structure degeneracy induces high uncertainty, such that the framework will still profit from additional theoretical constraints.

快速旋转扁椭球行星内部的热对流动力学理论

孔大力 中国科学院上海天文台

类地行星液核和巨行星的整个内部往往都具有活跃的流体运动，对行星圈层结构的形成、热演化和内禀磁场的产生具有重要的意义。热对流是驱动和影响行星内部流体动力学过程的主要物理机制之一。学术界在研究行星内部的热不稳定性问题和热对流问题时一直忽略行星自转带来的扁率，这种近似虽然带来了分析方法上的简洁，但是会导致存在非物理的流动，也不适用木星、土星这样因为快速自转而显著变扁的行星。在这个报告中，我们建立了任意快速旋转扁椭球形行星内部的自引力平衡和热力学平衡参考态，以此为基础发展了旋转非球形热不稳定性的线性理论，系统性地获得了热对流的临界特性并进一步探索了瑞利数增大后动力学的非线性性质。我们还将汇报旋转热不稳定性问题中一类新的轴对称振荡模式，同时具备关于赤道面的南北对称性。这种旋转对称性及南北对称性的组合是旋转热对流研究领域最后一类动力学对称性，此前从未被发现。

寻找自下而上和自上而下行星形成机制的边界

冯发波 上海交通大学

行星可以通过自下而上的核吸积方式形成，也可以通过自上而下的盘引力不

稳定性形成。前一种机制比较适合形成短周期小质量的行星，而后一种机制可以形成长周期大质量的行星乃至褐矮星。然而，由于介于这两类行星之间的已知行星稀少，两种机制的界限尚不清楚。最近，我们团队通过结合视向速度和天体测量的方法探测到了 100 多颗质量在 5 到 120 个木星质量，周期大于 1000 天的冷巨行星和褐矮星样本，为区分这两种行星形成机制提供了重要样本。通过修正观测偏差，我们在类太阳恒星的雪线附近发现了大质量行星的聚集，并在雪线外围约 10 个天文单位发现褐矮星沙漠的消失。通过研究样本的偏心率与金属丰度，并采用无参、有参和星族合成的方式确认了大质量行星和褐矮星在雪线附近堆积是由核吸积和不稳定性共同导致的，而褐矮星沙漠在 10 个天文单位处的消失主要是因为引力不稳定性机制产生了大量褐矮星。该工作第一次从观测上找到了自下而上和自上而下行星形成机制的边界，对我们理解行星的形成过程具有重要意义。

系外行星大气的透射光谱研究

闫冬冬 中国科学院云南天文台

太阳系外行星大气逃逸对行星的组成、演化和可宜居性等方面都有重要的

影响，是目前国际天文学和天体物理领域的前沿和热点问题。透射光谱法是探测行星大气的有效方法。通过分析凌食过程中多个波段的透射光谱，人们已经在一些系外行星周围探测到了逃逸的氢氦大气。本报告将围绕氢氦透射光谱的模拟研究工作进行介绍。

东亚系外行星联测最近进展

滕环宇 东京工业大学

East Asian Planet Search Network (东亚系外行星联测; EAPS-Net) surveys late-G (including early-K) giant stars with precise radial velocities, aiming to search for planets around intermediate-mass stars in their evolved stages.

The EAPS-Net began 20 years ago, with 48 exoplanetary systems discovered by telescopes in east Asia. In this presentation, we report the latest discoveries from the EAPS-Net and statistical information from planet survey around evolved stars.

Constraining the Presence of Companion Planets in Hot Jupiter Planetary System Using TTV Observation from TESS

张子昕 中山大学

The presence of another planetary companion in a transiting exoplanet system can impact its transit light curve, leading to a sinusoidal transit timing variations (TTV). By utilizing both chi-square and RMS analysis, we can combine the TESS observation data with a N-body simulation to investigate the existence of additional planet in the system and put limit on its mass distribution. In this paper, we introduce Fitransit, an efficient and user-friendly tool for fitting transit light curves and calculate TTV with theoretical period, based on which we can give a limit on its potential companion's mass.

We used 124 hot Jupiter systems from the complete TESS data-set in the WASP program to demonstrate the use of Fitransit. Our findings indicate that, for most systems, the upper mass limit of a companion planet can be restricted to several Jupiter mass. This restriction becomes sticker near resonance orbits such as 1:2, 2:1, 3:1 and 4:1, down to several Earth masses. These findings align with previous studies suggesting that a lack of companion planets with resonance in hot Jupiter systems could potentially support the high eccentricity migration theory. Additionally, we observed that the choice between chi-square or RMS method does not significantly affect the upper limit on companion mass; however, chi-square analysis may result in weaker restrictions but is statistically more robust compared to RMS analysis in most cases.

The absence of resonant companion planets in the hot Jupiter systems is inconsistent with the conventional expectation from disk migration.

Long-term Transit Timing Variations of Hot Jupiters

汪文沁 中山大学

Many known hot Jupiters may experience tidal orbital decay, manifested as long-term transit timing variations (TTVs). We analyzed 7098 transits from the

Transiting Exoplanet Survey Satellite (TESS) for a sample of 362 hot Jupiters. The precise determination of mid-transit times allowed us to derive new accurate ephemerides for these systems. By combining our TESS timings with archival data, we applied linear and quadratic models to investigate potential variations in transit times. We identified 26 candidates that exhibit possible long-term TTVs, comprising 18 with decreasing periods and 8 with increasing periods. Except for WASP-12b, the presence of such variations in other systems remains inconclusive, warranting further observational efforts. In addition to orbital decay, alternative mechanisms such as apsidal precession, Rømer effect, and Applegate effect could also contribute to the observed period changes. Additionally, our leave-one-out cross-validation (LOOCV) test indicated that the period changes observed in certain candidates may be statistical artifacts resulting from individual data points.

Jupiter's equatorial quasi-quadrennial oscillation and jets forced by internal thermal forcing

连雨辰 中国科学院上海天文台

Observations have shown that there exists a four-six-year-period downward propagation of alternating westward/eastward jets in Jupiter's equatorial stratosphere down to 10 mbar (quasi-quadrennial oscillation, QQO). Meanwhile, an eastward equatorial jet occurs relatively constant deeper than 1 bar. Here, we simulate the QQO by injecting isotropic small-scale thermal disturbances to a three-dimensional general circulation model of Jupiter. It is found that the internal thermal disturbance is able to excite a wealth of waves that generate the equatorial QQO and multiple jet streams at middle and high latitudes of both hemispheres. The dominant wave mode in generating the QQO-like oscillation is that with a zonal wavenumber of 10. Inhomogeneous evolution of potential vorticity favors the emergence of the off-equatorial zonal jets. The off-equatorial jets migrate to the equator, strengthen the deep equatorial jets, and result in the prolonging of the QQO-like oscillations. We then superimpose a constant banded heating field over the perturbations, simulating the deep eastward equatorial jets successfully.

月球南极阿蒙森地区地质特征研究

张玉征 山东大学

一、介绍

阿蒙森(Amundsen)撞击坑是位于月球正面南极地区的一大型撞击坑，其中心位于 85.7°E，84.5°S，直径约 103.4km，其形成于晚酒海纪（3.92-3.85 Ga）[1]。由于阿蒙森撞击坑中的永久阴影区(PSR)面积较大，拥有众多的形貌类型，其附近存在光照相对充足的区域，拥有较多的平坦区域，可为着陆探测提供很多便利条件，所以阿蒙森撞击坑是未来月球探测重要候选着陆点之一，对于研究月球极区挥发物和区域地质演化方面具有很高的科学价值。本文综合利用 LOLA 高程及相关衍生数据，对阿蒙森撞击坑区域进行详细地形地质分析，绘制了该地区的大比例地质图，并联合 Diviner 温度数据、LOLA 光照条件和地球通信等数据对阿蒙森撞击坑区域月表物理性质进行全面分析，以服务于我国未来月球极区探测。

二、数据来源

本文所使用的数据来自由“月球勘测轨道飞行器” (Lunar Reconnaissance Orbiter, LRO)搭载的“月球轨道飞行器激光测高仪”(Lunar Orbiter Laser Altimeter, LOLA)所测量的月球表面高程图（DEM）以及搭载的“多通道太阳反射率和红外辐射计”（The Diviner Lunar Radar Experiment, Diviner）所绘制的月球表面温度图。原始数据可在美国 NASA 行星数据系统（PDS）的影像数据节点获得。在本研究中，我们使用的是南极极区 80°S 以上的 LOLA 高程数据和 Diviner 夏季最高温度数据，其中 LOLA 高程数据的空间分辨率为 20 米/像素，Diviner 温度数据的空间分辨率是 500 米/像素。

三、研究方法

使用 LOLA 高程数据，利用 ArcGIS 的表面分析功能，计算出其山体阴影图、地形坡度图、等高线图、粗糙度图等衍生数据，分析其地形特点，为未来月球南极极区着陆探测提供科学依据，并基于计算的山体阴影图对阿蒙森撞击坑区域进行地质填图，分析该区域的地质演化历史。使用 Diviner 夏季最高温度数据可以确定月球挥发物特别是水冰可能的存在的区域，以此分析出阿蒙森撞击坑区域潜在的科学研究价值。

四、结果

我们绘制出了基于 LOLA 高程数据得出的山体阴影图、地形坡度图、等高线图、粗糙度图等衍生图像，分析了阿蒙森撞击坑区域的地形特征，并找到了其地形平坦区域（坡度＜5°），同时我们还绘制出该区域的地质填图，分析出了其可能的地质演化历史，确定其潜在的地质研究的价值。我们还基于 Diviner 夏季

最高温度数据确定阿蒙森撞击坑区域满足水冰稳定存在温度条件的区域，并与该区域的 PSR 做对比，确定了该区域在研究月球挥发物和其他风化层性质方面具有的科学价值。

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火星天问一号着陆点物质成分：MarSCoDe 实测数据初步分析

刘长卿 山东大学

中国首次火星探测任务“天问一号”于 2021 年 5 月在火星 Utopia 平原着陆，着陆点位于火星北部荒原单元内（VBF）。VBF 是火星最大的沉积单元之一，形成于晚西方纪，覆盖了火星北半球大部分平原。已有研究表明，VBF 可能与火星古海洋沉积、南半球外流河道沉积或冰的挥发等地质过程有关，但其具体的地质成因仍是个未解之谜，尤其是火星是否曾存在古海洋一直是火星科学研究的热点问题。祝融号火星车的巡视探测为进一步约束 VBF 的成因和演化历史提供了新的探测数据。火星车携带了火星表面成分探测仪（MarSCoDe），该载荷由激光诱导击穿光谱仪（LIBS）、短波红外光谱仪（SWIR）和显微相机（MI）组成，可获得火星岩石/土壤的化学成分、矿物组成和显微形貌等信息。本研究采用 MarSCoDe 实测数据，结合实验室 LIBS 光谱学研究，初步实现了火星岩石/土壤的物质成分分析，发现着陆区岩石/土壤的化学蚀变程度较低，风化产物主要为无定型含水硅酸盐，表明着陆区曾存在较弱的水岩相互作用，推测火星北半球可能存在酸性冰冻海洋或冰川活动。

太阳抵近探测计划预研进展

林隽　云南天文台

为积极推进太阳抵近探测计划，项目组在有效载荷关键技术、卫星平台技术、最佳轨道研究、温控系统、防热材料、以及温差发电等方面开展了卓有成效的工

作，取得了显著进步。本报告将介绍项目组近期内在这些方向上取得的进展，包括针对太阳附近的特殊环境所需要采取的措施以及对这些措施的论证，另外还将介绍项目组下一步的工作计划。

关于 MUSER 和 IPS 望远镜研究进展

颜毅华 国家空间中心

毫米波太阳射电技术进展与仪器研制

严发宝 山东大学（威海）

稻城日冕基地建设进展

刘煜　西南交通大学

上海天文馆的自适应光学太阳望远镜

林清　上海科技馆

基于丽江 10cm 日冕仪的镜面尘埃杂散光研究

沙飞扬 云南天文台

Scattered light suppression is of great importance for coronagraph. The variable stray light, such as scatter of dust on objective lens, can create varying scattering background in coronal images, which is very detrimental to data analysis and hinders the scientific productivity of the instruments. In this study, the Lijiang 10cm coronagraph was utilized to analyze the quantitative relationship between the distribution of dust on the objective lens outer surface and the resulting scattering

background through measured data. Two models for the scattered background were obtained and the original data can be further corrected based on the models, confirming their accuracy. Straight calculations for dust scattering can be calculated by Scatter(r, Iθ(θ)) = (0.99 − 0.43r/R⊙) × 10−7Iθ(θ)/s + 0.17 − 0.1r/R⊙, which indicates that the scattering background at the image plane weakens with increasing height and enhances with increasing dust level on the objective lens. What's more, we also found that the dust near the center of the objective lens can contribute more significantly to the scattering background than those near the edges. For the first time, this study confirms numerically the significant impact of the dust on the objective lens for the stray light of the instrument system. It is crucial for the high-precision calibration of ground-based coronagraph data, enabling a more accurate analysis of coronal structure and the trend of coronal intensity attenuation. Moreover, it will support the provision of reliable observa- tional data for future routine measurements of the coronal magnetic field using coronagraphs.

太阳抵近探测器穿越 CME-耀斑电流片概率

陈雨豪 云南天文台

日冕物质抛射-耀斑电流片是太阳爆发时释放能量的核心结构。由于缺乏原位探测数据，我们对其精细结构与物理过程依然知之甚少。“抵近探测”计划旨在穿越大尺度电流片从而揭示其中复杂的磁重联物理过程。我们构建了简化的电流片几何模型并使用了观测数据。我们发现，太阳活动峰年一年内 PSP 预计穿越电流片的次数不足 2 次；通过选择更近、更大倾角的轨道，“抵近探测”飞行器可将该次数显著提升至 4 次以上。

A new method for monitoring scatter stray light of an inner-occulted coronagraph

刘大洋 山东大学(威海)

The scattered stray light of coronagraph is a type of stray light that is generated by the objective lens as its surface defects irradiated by sunlight. The defects mainly include dust, blemishes on the lens surface, microroughness of the lens surface, and

impurity and inhomogeneity of the glass. Unlike the other types of relatively-stable defects that occur after the objective lens is manufactured, the scattered stray light caused by dusts on the lens surface is difficult to quantify accurately due to the disorder and randomness of the dust accumulation. The contribution of this type of stray light to the overall stray light level is difficult to determine through any simulations or examinations. This can result in a continuous deterioration of the stray light level of a coronagraph and thus affect the observing capabilities of the instrument. To solve this issue, through analyzing the mechanism of scattered stray light and ghost image generated by the inner-occulting coronagraph, we propose a novel method to monitor the scattered stray light of dusts by utilizing different stray light correlation coefficients. In this method, we first simulate and measure the level of stray light from the ghost image of the objective lens, and then determine the flux ratio of scattered light and ghost image on the conjugate plane. Although the flux ratio varies with the accumulation of dusts on the lens surface, it keeps constant on the image plane. Therefore, the level of dust scattering light on the image plane can be obtained by using this ratio together with the level of ghost image stray light. We also validate the accuracy of this method in laboratory by applying objective lens with numerous surface cleanliness levels.

极紫外日冕单镜单栅计算成像系统设计方法研究

高金铭 浙江大学

日冕磁结构中的扭曲波列及其冕震学价值

李波　山东大学（威海）

基于活动区磁场参量和机器学习方法的耀斑预报研究

李婷　国家天文台

太阳耀斑是太阳系中最剧烈的爆发活动之一，是地球空间天气的重要驱动源。然而，目前，人们对于决定大耀斑发生的关键物理参量仍不清楚，因此对耀斑开展准确的预报十分困难。我们计算了 325 个活动区的 10 个磁场参量，发现光球总的磁自由能 E 和强梯度的极性反转线长度 L 这两个参量的结合可以较好地区分产生C级和M/X级的活动区（通过确定阈值，大约76%的活动区可以被区分）。我们还发现产生大耀斑的充分条件是E和L分别大于2.0*1023 erg/cm 和 35Mm。为了评估这些参量在预报方面的性能，我们采用神经网络（NN）和长短时记忆网络（LSTM）两个算法建立 24 小时的两分类预报模型。LSTM 算法比 NN 算法表现出更好的预报效果，利用最重要的 5 个物理参量，TSS 的评分达到 0.824±0.079, HSS 的评分达到 0.804±0.089。高的 TSS 和 HSS 评分表明利用活动区核心区的物理参量和 LSTM 算法可以对耀斑进行有效的预报。

太阳爆发中的高能粒子加速、传播和辐射

孔祥良 山东大学

在耀斑和日冕物质抛射等剧烈的太阳爆发过程中会加速产生大量的高能量粒子，其中电子能量可高达 MeV，质子能量高达 GeV。当这些高能粒子通过行星际空间传播到地球时，会对地球空间环境造成严重影响，称为太阳高能粒子事件。另外，高能粒子在太阳大气中传播、沉降到太阳表面的过程中，会通过不同的物理机制产生多波段电磁辐射，如高能电子通过韧致辐射和回旋同步辐射产生硬X射线和微波辐射，高能质子和离子可激发高达百 MeV 以上的伽马射线辐射。高能粒子的起源、加速和传播仍是太阳物理和空间天气领域的重要科学问题，本报告将介绍近期关于太阳爆发中的高能粒子加速、传播和辐射的一些数值模拟研究进展。

太阳爆发大尺度电流片的热力学湍流的三维 MHD 模拟

叶景　云南天文台

Turbulence plays a key role for forming the complex geometry of the large-scale current sheet (CS) and fast energy release in a solar eruption. In this paper, we present

the full 3D high-resolution simulations to reproduce the process of a moderate Coronal Mass Ejection (CME) and the thermodynamical evolution of the highly confined CS. Copious tube-like blobs are generated due to tearing instability giving rise to a higher reconnection rate and undergo the splitting, merging and kinking processes in a more complex way than 2D cases. A detailed thermodynamical analysis shows that the CS is mainly heated by the adiabatic and numerical viscous terms, and thermal conduction is the dominant factor that balances the energy inside the CS. Accordingly, the temperature of the CS reaches maximumly about 20 MK and the range of temperatures is relatively narrow. From the face-on view in the synthetic Atmospheric Imaging Assembly 131 $\mathring{A}$, the downflowing structures with similar morphology of supra-arcade downflows are mainly located between the post-flare loops and loop-top, of which spikes can extend higher above the loop-top by the moving blobs. The downward plasmoids can keep the twisted magnetic field lines until the annihilation at the flare loop-top indicating that \textbf{plasmoid} reconnection dominates in the lower CS, while the upward ones turn into the turbulent post-plasmoid structures before arriving at the bottom of the CME implying that turbulent reconnection dominates in the upper CS. The spatial distributions of the turbulent energy and anisotropy are addressed as well, which show a significant variation in the spectra with height.

暗条分裂及其部分爆发的观测研究

康凯锋 云南天文台

The partial eruption of a large-scale horse-shoe-like filament is investigated using datasets obtained from both ground-based and space-borne facilities. The filament became active after it was broken into two pieces, P1 and P2 seen in Hα, by magnetic reconnection between the magnetic field around it and that of a newly emerging active region nearby. P1 eventually erupted 13 hours after the breaking and escaped from the Sun, developing to a fast CME, and P2 stayed. But the mass in P1 falling down to P2 in the eruption suggests that the global magnetic fields over P1 and P2 were still connected to each other prior to the eruption. The reconnection process breaking the filament occurred outside the filament, and P1 and P2 were located almost at the same altitude, so the fashion of the filament partial eruption studied here differs from that of the “double-decker model” and that of

“Partially-expelled-flux-rope model”, indicating that we may not capture all facets of partial filament eruptions at present. Therefore, the event provides new observational constraints on the construction of the new models for partial eruptions. At the same time, by analysing the kinematics of the runaway part of the filament and calculating the decay index of the background magnetic fields, we confirm that the catastrophe (or torus instability) is the triggering mechanism of the partial eruption.

A narrow and a broad QFP wave trains excited simultaneously in a solar flare event

周新平 四川师范大学

The driven mechanisms of the narrow and broad quasi-period fast-propagating (QFP) wave trains are still widely disagreed. Using the Solar Dynamics Observatory/Atmospheric Imaging Assembly observation data, we present a narrow and a broad QFP wave trains excited one after another during the two flare phases on 2013 October 20. The co-occurrence of two types of wave trains provides an excellent opportunity to explore their triggering mechanisms and compare their different physical parameters. Measurements show that these two wave trains have different speeds, periods, energy flux, and relative intensity, although they originate from the

same flare source. Using the wavelet analysis, we find that narrow and broad wave trains have a consistent period with the flare and the filament’s untwisting motion, respectively. Based on these results, the narrow QFP wave train was most likely excited by the intermittent energy release in the accompanying flare. At the same

time, the energy release of the filament’s untwisting motion might be an essential driving mechanism for the broad QFP wave train.

太阳耀斑中三维磁重联的准周期性分析

张怡宁 国家天文台

太阳磁场数据的超分辨率重建

覃瑛　云南天文台

太阳磁场和太阳活动的研究已成为当今太阳物理和空间物理最热门的研究方向之一。空间观测与地基观测相比有着天然的优越性。图像超分辨率重建是指用信号处理和图像处理的方法,将已有的低分辨率图像转换成高分辨率图像的技术。本项目的核心研究内容和目标是利用深度学习强大的从样本数据中学习规律的能力，探索计算机视觉领域基于深度学习的超分辨率重建技术用于太阳磁场图像超分辨率重建的方法，实现和 SOHO/MDI 太阳磁场图像的可靠超分辨率重建，提高图像的分辨率以获取更多细节信息，同时矫正磁饱和现象，并消除数据之间的系统差。关键技术包括：数据 SOHO/MDI 预处理、网络构架搭建、超参数选择、训练方法优化、前期预训练模型到真实模型的升级等。我们对于 SOHO/MDI 磁场数据 4 倍超分重建的前期工作已经揭示了这种方法的可行性。本项目从研究的内容、采用的方法都具有显著的特点和创新性，且本项目属于高维度非线性回归的应用研究，具有更大的挑战。

太阳色球莫尔顿波罕见之谜

郑瑞生 山东大学(威海)

作为灾害性空间天气的主要源头，太阳爆发活动经常会扰动太阳大气而产生日冕波动，基于空间卫星可在极紫外（EUV）波段很好地观测，因而常被称为 EUV 波。日冕 EUV 波，与发生于地球之上的海啸形似，故也被称为“太阳海啸”。此类现象携带着爆发物理过程及其传播介质——太阳大气的物理信息，因而相关研究对揭示爆发活动机理、进一步发展冕震学和空间天气预报预警研究均具有重要价值。

目前，已经观测到上千例日冕 EUV 波事件。根据理论预期，EUV 波不仅可以向外冕传播，也会朝向太阳传播并可压缩色球，从而引发“色球海啸”，即一种名为“莫尔顿波”的现象。“莫尔顿波”是在 1960 年被美国太阳物理学家 Moreton 发现的。自发现以来，仅观测到数十个莫尔顿波事件，与大量存在的日冕 EUV 波现象在数量上形成鲜明“对比”。是什么原因造成如此巨大的数量差异？或者说莫尔顿波如此罕见的原因是什么？这是太阳物理学领域的一个未解之谜。

为了揭开色球莫尔顿波罕见之谜，查阅了 2010 年以来的所有日冕 EUV 波及相应的色球莫尔顿波事件，从中挑选出可被太阳动力学天文台（SDO）和日地关

系天文台（STEREO）双视角同时观测到的事例，寻找可能解决该谜题的“蛛丝马迹”。我们发现，对于伴有莫尔顿波的 EUV 波，在其波前底部均存在一段锐利且明亮的区域，而且在源自日冕与色球中间区域即所谓过渡区的 304 埃谱线上也存在类似波动响应；更令人惊讶的是，这类事件都是由倾斜爆发引起的。

Associate transition region activities with corona and solar wind

黄正化 山东大学(威海)

Solar transition region is normally defined in a temperature regime of 20 thousand to 1 million Kelvins and it bridges the chromosphere and the corona. The transition region is found to be very dynamic. Many activities, such as bright dots, UV bursts, loops and jets, are frequently found in this region. These activities are possible signatures of energy release and/or mass dumping in the transition region. The connection of transition region activities with the corona and solar wind is crucial for understanding the coronal heating processes. Many interesting phenomena have been reported with high-resolution spectral and imaging observations, such as concurrence of loops in transition region and corona, the link between transition region jets and coronal plumes and the driver to a coronal jet given by transition region jets. All these observations indicate that transition region activities might be crucial in coronal heating but not directly supply mass and/or energy to the corona. In this presentation, we will summarize our observations on the association between transition region activities and corona/solar wind.

天问一号 VLBI 差分测距信号应用于太阳风等离子体的研究

王志超　上海天文台

Reconstruction of global coronal and interplanetary magnetic field from models constrained by real observations

史广禄 紫金山天文台

Solar magnetic fields are closely related to various physical phenomena and particle transport, which can be reconstructed by theoretical models via photospheric magnetograms. We use Magnetohydrostatic (MHS) models to extrapolate coronal and interplanetary magnetic fields (IMFs) constrained by remote-sensing and in-situ observations. Three indicators are established to quantitatively evaluate the prediction quality of models in order to determine the optimal free parameters. Predictions of models have a good consistency with the remote-sensing and in-situ observations. Still, the magnetic field strength along the radial direction is underestimated near the Sun, called the "Open flux problem". While the "missing" magnetic flux decreases with the increase of the heliocentric distance. Even if the IMF at 1 AU is matched with measurements by artificially increasing the polar magnetic field, the IMFs located near the Sun are still underestimated. Results indicate that the interplanetary process is essential in missing the magnetic flux. Solving this problem could require improving the measurement accuracy of both the weak and polar magnetic fields, especially considering the dynamic behaviors of coupling particles and fields during complex interplanetary physical processes.

太阳爆发初期大尺度 QFP 波的形成机制的研究

胡佳亮 云南天文台

和移动磁元关联的两个紧邻黑子的衰退过程

彭洋　云南天文台

太阳黑子的衰退与移动磁元的关系对于理解太阳活动区的演化具有重要的

意义。在活动区 AR NOAA 13023 中的两个紧邻黑子，大量的移动磁元从黑子的外边界和两黑子之间的间隙中传播出来。基于磁场的倾角 γ，移动磁元被划分为横向 (0 度<γ<45 度) 和纵向 (45 度≤γ<90 度) 两种移动磁元。研究的主要结果如下:（1）两个黑子的平均衰退率分别为-2×10^20 和-1.4×10^20 Mx/day ；（2）全部移动磁元磁通量的产生率平均为黑子磁通量衰退率的 6.7 倍，其中，纵向移动磁元产生的磁通量大约是黑子损失磁通量的 1.5 倍；（3）纵向磁元产生的磁通量与黑子损失的磁通量变化趋势几乎一致；（4）在间隙处，纵向磁元产生的磁通量占总磁通量的 1/3。观测表明黑子的衰退过程与纵向移动磁元有很大的关系，部分纵向磁元的产生可能起源于黑子本影。

Wave propagation and transmission in a rotating polytropic spherical shell

续育茹 北京师范大学

Wave propagation can simultaneously transport momentum and energy, therefore it may have important effects on stellar or planetary interior structures and evolutions. It is quite common for a star or planet to have a multi-layer structure, and yet propagation and transmission of internal waves in these layers have not been fully explored. In this work, we study the wave propagation and transmission by solving the linearized equations of a compressible, self-gravitating, uniformly rotating polytropic spherical shell. We use a pseudo-spectral method which allow us to calculate the adiabatic and inviscid oscillation modes. The influence of Coriolis force is fully taken into account but the centrifugal force and rotation distortion is neglected for simplicity. We consider interior models with polytropic index n = 1.5 (convective), n = 2.5, 3, 4 (radiative), and n changing from 4 to 1.5 at radiation-convection boundary which is given to be 0.7R⊙ at present sun. We characterize the energy flux and kinetic energy of these waves and find that energy flux carried by high-frequency acoustic wave but kinetic energy carried by low-frequency gravity wave, inertial wave or mixed gravito-inertial wave. It is also shown that rotation can facilitate wave propagation and enhance wave transmission.

追寻中国古籍中的超级太阳极大期踪迹

王红睿 楚雄师范学院

中国古代典籍为研究太阳黑子活动提供了珍贵的裸眼观察资料。中国古代黑子记录语言一般较为简练，从中获取太阳黑子活动的量化描述的信息一般有非常大的难度。为了获取中国古籍中的超级太阳极大期线索，首先，笔者整理、分析了晋代、宋代和明代若干中国古籍中的太阳黑子活动记录；其次，初步分析了这些强烈太阳黑子记录的特点；最后，初步讨论了以这些中国古代太阳黑子记录来识别超级太阳极大期的问题。

Solar-cycle-related Variation of Differential Rotation of the Chromosphere

万苗　云南天文台

Solar-cycle-related variation of the solar chromospheric rotation is studied by analyzing the chromospheric rotation rate of 938 synoptic maps generated from the Ca II K line at the Mount Wilson Observatory during the period of 1915 August 10 to 1985 July 7. The results obtained are as follows: (1) The parameters A (the equatorial rotation rate) and B (the latitudinal gradient of rotation) in the standard form of differential rotation both show a decreasing trend in the considered time frame, although A has weak statistical significance. (2) There is a significant negative correlation between the level of solar activity and parameter B, indicating that there seems to be a correlation between field strength and chromospheric differential rotation. (3) During solar cycles 15, 16, 19, 20, and 21, the southern hemisphere rotates faster, whereas in cycles 17 and 18, the northern hemisphere rotates faster. (4) There exists a significant negative correlation between the N–S asymmetry of the chromospheric rotation rate and that of solar activity, indicating that differential rotation of the chromosphere seems to be strengthened by stronger magnetic activity in a certain hemisphere. Possible explanations for the above results are given.

太阳高能粒子双幂律能谱的产生机制

于飞瑜 山东大学（威海）

在很多大型太阳高能粒子（SEP）事件中，事件积分能谱经常呈现出双幂律

谱的特征。双幂律能谱是理解高能粒子加速和传播的一个重要特征，但其形成的物理机制仍不清楚。我们首先通过求解 Parker 输运方程，模拟了近太阳处 CME 驱动的激波穿过冕流磁场对粒子的加速作用。发现在整个模拟域和冕流-非冕流过渡区域中的积分能谱都可以用双幂律谱描述。我们认为双幂律谱可能是具有不同加速效率的来自不同源区的高能粒子发生能谱叠加而产生。我们还分析了在行星际空间传播过程中粒子能谱的变化来研究双幂律谱的产生机制。假设源区 SEP 的能谱是幂律谱×指数下降的形式，发现在行星际传播过程中来自不同源区的高能粒子能谱叠加可以产生双幂律谱分布。这进一步验证了我们提出的“多源区 SEP 混合产生双幂律谱”这一叠加图景，可作为 SEP 能谱中双幂律特征的一个很有前景的产生机制。

Fermi>100 MeV 伽马射线耀斑事件产生机制的研究

姜泽龙 山东大学

Fermi 卫星自发射以来已探测到 20 多个>100 MeV 伽马射线辐射时间超过耀斑脉冲相的事件，这类事件被称为持续性伽马射线耀斑事件。该辐射被认为是由>300 MeV 的高能质子与太阳大气撞击发生核反应所激发的。但>300 MeV 质子的来源仍存在争议，可能来源于耀斑，也可能来源于日冕物质抛射驱动的激波。其中，2014 年 9 月 1 日的伽马射线事件持续时间接近 2 个小时，这远远超过耀斑脉冲相的时间，并且伽马射线辐射中心距离耀斑活动区较远。一种可能的解释是日冕激波加速的一部分高能质子沉降到太阳表面激发该持续性伽马射线辐射。然而，对于持续伽马射线事件，质子沉降过程的详细的数值模拟仍然缺失。在本工作中，针对此事件，我们将质子输运的模型与数据驱动的日冕物质抛射磁流体力学模型相耦合，在日冕激波附近注入高能质子，模拟其在伽马射线峰值时刻附近的传输过程。发现撞击到太阳表面的>300 MeV 质子的空间分布与伽马射线的源区十分接近；模拟得到的撞击太阳表面质子能谱的谱指数和沉降比例也伽马射线观测数据基本一致。我们的模拟结果为被日冕激波加速的一部分>300 MeV 质子沿 CME 侧翼的磁力线朝向太阳传输、撞击太阳表面产生持续性伽马耀斑，另一部分高能质子沿激波前方的开放磁力线、传输到行星际空间产生太阳高能粒子事件的解释图景提供了有力的证据。

太阳黑子中色球三分钟振荡的光球起源

张鑫生 云南天文台

太阳黑子的大气中存在普遍的振荡现象。然而，目前尚不清楚这些振荡是由外部声学波(P 模)驱动还是内部磁对流产生的。为了获得有关太阳黑子本影波驱动源的线索，我们分析了由 IRIS SJI 2796 Å 图像记录的两个太阳黑子中的螺旋波模式。通过跟踪单个螺旋波模式的运动，我们在椭圆形太阳黑子内发现了基本慢体扭结模式的观测证据。我们还发现在本影内会同时存在两个单臂螺旋结构，它们既有同方向旋转的，也有反方向旋转的。我们认为产生这种现象是因为本影内存在不同的本影波驱动源或者激发了高阶磁流体力学波模式。此外，通过统计单臂螺旋结构的振荡中心在本影内的空间分布，我们发现色球层本影波在振荡功率较大的地方被反复触发，并且触发点的正下方对应着本影暗核区域和强磁场区域。这表明，在太阳黑子大气中观测到的慢磁声波是由外部 P 模驱动的。另一方面，我们发现半影亮纤维上方的振荡更加剧烈，这是半影区域振荡不均匀的体现。

A Revisit of Mass-metallicity Trends in Transiting Exoplanets

孙清辉 清华大学

Prediction of exoplanet detection with CSST astrometry

宣一帆 上海交通大学李政道研究所

Chinese Space Station Telescope (CSST), which will begin its scientific operations around 2025, is able to detect a number of exoplanets in nearby systems via relative astrometry in its all-sky optical survey. In this paper, we predict the number of gas giants and substellar companions detectable with CSST astrometry. We carry out an emulation by injecting a number of planets in a large representative sample of nearby stars from CSST-TRILEGAL Milky Way stellar mock catalogue, with the consideration of the geometric distortion correction of the charge-coupled divice (CCD). With reasonable assumptions of planet occurrence rates, the detection

limit and exoplanet yields are calculated. The main uncertainties come from the occurrence rate models and emulation accuracy due to undetermined CSST survey strategy. Our results show that CSST will be the dominant mission for astrometric detection of planets around nearby faint stars (M dwarfs) during its 10-year mission duration, extends the observational baseline of current space-based astrometric missions (e.g. Gaia Mission and Hubble Space Telescope / Fine Guidance Sensor), and synergistically provides a series of targets for direct imaging observation (e.g. James Webb Space Telescope).

超短周期行星的统计研究

涂培玮 南京大学

超短周期行星(Ultra-short-period planets, USPs)是指轨道周期小于一天的系外行星，是近年来系外行星研究领域中浮现出的一个特殊族群。前人提出 USP 行星的形成及演化可能与岩石行星、海王星、亚海王星或热木星有关，通过某些机制迁移到短周期轨道。联合 CKS，Gaia，LAMOST 和 NASA 系外行星档案馆等数据，我们整理了系外行星及其宿主恒星样本和相关参数。从中对 USP 行星宿主恒星的各项性质进行了统计分析，发现 USP 行星的形成及演化或许与岩石行星、亚海王星和海王星存在一定的相关性，但与热木星形成及演化的机制存在很大的不同。我们的研究，为进一步探索 USP 行星的起源以及与其他行星族群的关系提供了线索。

月球撞击坑中央峰成分及其对月壳分层结构的揭示

秦 宇 中国科学院上海天文台

中央峰是由于月球深部物质受到撞击作用上隆所致，不同大小的撞击坑中央峰的物质起源深度不同，对月球中央峰物质成分的研究可用于发现月壳成分在纵向上的分布规律。我们利用 Kaguya 探测器多光谱成像仪的数据，对月表 55 个撞击坑中央峰的铁钛含量进行了估算，并结合 GRAIL 给出的月壳结构模型，分析了铁钛含量在月壳内的纵向分布趋势。初步结果发现，铁钛含量随深度增加逐渐增加，且越接近月幔处含量越高。相关结果将进一步应用在月壳分层结构研究中。

韦布望远镜时代环行星盘中伽利略卫星的探测前景

孙锡磊 中山大学

随着詹姆斯韦布空间望远镜（JWST）的投入使用，新一代的观测结果信噪比更高，角分辨率更小。本文所模拟的内容将指出，在未来观测精度足够的情况下，能否观测到系外行星的卫星存在的信号。比起目前所能观测的原行星盘（Protoplanetary Disks, PPDs），环行星盘（Circumplanetary Disks, CPDs）的尺度小几个数量级，而卫星的存在只能改变环行星盘的部分结构，这在以前是很难探测的。本文先用流体动力学代码“Athena++”建立了环行星盘的模型，并参照木星的卫星系统，在盘内加入了四颗卫星，在盘外加入一颗恒星（恒星对盘会产生潮汐扭矩作用）。在此基础上不断调整参数，在环行星盘内部形成了类似于原行星盘中的间隙（gap）结构。而后，本文再使用辐射转移代码“radmc3d”对流体动力学模拟的结果推算其温度和光谱能量分布（Spectral Energy Distribution, SED），最终对比有无卫星对环行星盘的光谱能量分布产生了怎样的区别。

N-body simulation of atmospheric erosion from super-Earth cores

贺亚星 上海交通大学李政道研究所

From the distribution of exoplanets detected by the Kepler satellite, it has been observed that there is a scarcity of planets with radii between 1.5R_⊕ and 2R_⊕. This phenomenon is called as radius valley. We propose using impact erosion to explain the radius valley. Our model involves three super-Earths and many planetary embryos with varying numbers and eccentricities. We use REBOUND code to simulate the orbital evolution of the planets and the embryos. Embryos with high eccentricities can collide with super-Earths and erode their atmospheres. We use the collision results to calculate the remaining atmospheric mass of the super-Earths. We found embryos, with highly eccentric orbits, easily collide with super-Earths, leading to the evaporation of super-Earths atmospheres. On the contrary, embryos with lower eccentricities stay on relatively stable orbits and avoid collisions with the super-Earths, which retain their thick atmospheres. By amalgamating super-Earths resulting from low-eccentricity and high-eccentricity embryo systems, the radius valley can be effectively reproduced.

外侧冷木星对内侧超级地球轨道稳定性的影响

林灵鸿 浙江大学

激光驱动 Petschek-型磁重联的数值模拟研究

许杉杉 云南天文台

在实验室中用强激光照射用 U-型线圈连接的金属圆盘靶，溅射出的自由电子进入线圈，在两个平行放置的线圈中形成电流，在它的周围产生磁场，并在两个线圈之间形成反向磁场位型，驱动磁重联发生。通过磁流体动力学数值模拟，考察了该实验中发生的三维磁重联演化过程，首次在针对这类磁重联的数值模拟结果中发现了 Petschek-型磁重联特征，根据磁力线的形状特征的改变证认了耗散区与出流区的范围以及二者的分界线。并且，重联过程中产生的热等离子体，被很好地限制在电流片和 Petschek 慢模激波当中，没有发生热等离子体外溢的现象。通过对比分析已有的实验结果，确认数值模拟重现了实验结果。对实验结果给出了合理的解释。

Investigating Pre-eruptive Magnetic Properties at the Footprints of Erupting Magnetic Flux Ropes

王雯思 中国科学技术大学

It is well established that solar eruptions are powered by free magnetic energy stored in the current-carrying magnetic field in the corona. It has also been generally accepted that magnetic flux ropes (MFRs) are a critical component of many coronal mass ejections. What remains controversial is whether MFRs are present well before the eruption. Our aim is to identify progenitors of MFRs, and investigate pre-eruptive magnetic properties associated with these progenitors. Here we analyze 28 MFRs erupting within 45° from the disk center from 2010 to 2015. All MFRs' feet are well identified by conjugate coronal dimmings. We then calculate the magnetic properties

at the feet of the MFRs, prior to their eruptions, using Helioseismic and Magnetic Imager vector magnetograms. Our results show that only 8 erupting MFRs are associated with significant nonneutralized electric currents, 4 of which also exhibit pre-eruptive dimmings at the footprints. Twist and current distributions are asymmetric at the two feet of these MFRs. The presence of pre-eruption dimmings associated with nonneutralized currents suggests the preexisting MFRs. Furthermore, the evolution of conjugate dimmings and electric currents within the footprints can provide clues about the internal structure of MFRs and their formation mechanism.

Applications of ICME Composition

宋红强　山东大学(威海)

(0). In situ measurements of ICME composition, including the charge states and elemental abundances of heavy ions, open a new avenue to study CMEs.

(1). The charge states of a specific element reflect the electron temperature of CMEs near the Sun, and can be used to investigate their eruption process.

(2). The elemental abundances can be used to diagnose the origin of plasmas related to CMEs.

Formation of Double-power-law Spectra in Solar Energetic Particle Events

于飞瑜　山东大学(威海)

Double-power-law energy spectra have been observed in many large solar energetic particle (SEP) events. Itis an important feature for understanding the acceleration and propagation of high-energy particles, but its formation mechanism remains unclear. We first perform numerical modeling of particle acceleration near the Sun at a CME-driven shock propagating through a streamer magnetic field by solving the Parker transport equation. We find that the energy spectra integrated over the whole simulation domain and in the streamer-nonstreamer transition region can be described by a double power law. We suggest that the double-power-law distribution may emerge as a result of the superposition of energetic particles from different

source regions where the acceleration rates differ significantly. We also examine the double-power-law formation mechanism by analyzing the variation of particle energy spectra during propagation in the interplanetary space. Assuming that the SEP energy spectrum in the source region is a power-law with exponential rollover, we find that the superposition of energetic particles from different regions can produce a double power-law distribution during the interplanetary propagation. This further verifies that our proposed scenario of "mixing of SEPs from different source regions" can serve as a promising formation mechanism of the double-power-law feature in SEP energy spectra.

恒星与银河系分会场报告

Do all SNe Ia share the same explosion mechanism?

孟祥存 云南天文台

Type Ia supernova explosions in binary systems

柳正伟 云南天文台

Type Ia supernovae (SNe Ia) play a key role in the fields of astrophysics and cosmology. It is widely accepted that SNe Ia arise from thermonuclear explosions of white dwarfs (WDs) in binary systems. However, there is no consensus on the fundamental aspects of the nature of SN Ia progenitors and their actual explosion mechanism. This fundamentally flaws our understanding of these important astrophysical objects. In this review, we outline the diversity of SNe Ia and the proposed progenitor models and explosion mechanisms. In this talk, I will discuss the recent theoretical and observational progress in addressing the SN Ia progenitor and explosion mechanism in terms of the observables at various stages of the explosion, including rates and delay times, pre-explosion companion stars, ejecta-companion interaction, early excess emission, ejecta-CSM interaction, surviving companion stars, late-time spectra and photometry, polarization signals, and supernova remnant properties.

第一代超大质量恒星化学遗迹

邢千帆　国家天文台

理论预言第一代恒星质量可以达到太阳质量的数百倍，其中质量处于 140 到 260 倍太阳质量之间的第一代超大质量恒星演化形成对不稳定超新星，向周围抛射核合成产物并增丰早期的星际介质。然后数十年来，观测上始终未能发现证

明第一代超大质量恒星存在的证据。我们利用 LAMOST 光谱巡天数据发现了一颗钠和钴丰度极低的贫金属星，其钠比铁小于太阳比值的百分之一。这颗恒星的化学丰度还展现出极强的奇偶效应，比如极低的钠比镁和钴比镍。该恒星的化学丰度模式无法通过核坍缩超新星理论模型解释，却与 260 倍太阳质量的对不稳定超新星的理论计算结果高度一致，为第一代超大质量恒星的存在提供了清晰的化学证据。

The Effects of Rotation, Metallicity, and Magnetic Field on the Islands of Failed Supernovae

李　磊　新疆大学

失败超新星（FSN）是形成重恒星质量黑洞（MBH > ~30 Msun）的可能通道。然而，金属丰度、旋转和磁场对大质量恒星可爆性岛的影响尚不清楚。在这里，我们模拟了从零年龄主序 (ZAMS) 到塌缩前的质量范围在 6 到 55 Msun 之间的恒星结构和演化，考虑了不同的初始旋转速度、金属丰度和磁场。我们发现，快速旋转的恒星在中心碳点火时可以保持较低的 中心碳 质量分数，这使得从对流碳燃烧到辐射燃烧的转变发生在比不旋转恒星更低的 MZAMS 下。然而，快速自转不利于 FSN 的发生，但有利于长伽马射线暴（lGRB），因为它导致总是 CO 核心的比角动量大于核心崩溃时的最后稳定轨道。金属丰度的增加不会影响 FSN 发生的初始质量区间，但高金属丰度会抑制旋转混合，不利于产生 lGRB。即使对于快速旋转的恒星，磁场也可以限制质量损失率，从而在塌缩前产生更高的质量。磁场触发的磁制动可以降低高金属丰度模型的旋转速度，从而降低 CO 核心的比角动量，有利于 FSN 的发生。我们认为 LIGO 探测到的大质量黑洞可能起源于快速旋转的具有强磁场的大质量恒星，而不是那些金属丰度非常低的恒星。

Grids of Wolf-Rayet stars using MESA with the k-omega model

李　志　云南天文台

不同金属丰度对 WNL 型星形成与演化的影响

思霁娟 云南天文台

大质量恒星的形成和演化是天文学领域中备受研究关注的课题。这些恒星的演化进程主要受到恒星的星风和对流等不确定因素的影响，因此可能向很多不确定的方向演化。WNL 型星是一类特殊的大质量恒星，它们通常处于主序阶段或氦核燃烧阶段甚至跨越两个阶段，是大质量恒星经历了大部分富氢包层被星风剥离后的产物，表面显示 CNO 循环过程的中间产物强氮的发射线。这种类型的恒星的出现时间和演化过程主要受到物质损失和对流的影响。

最近的研究显示，恒星的星风物质损失与金属丰度之间存在显著的相关性，此外，金属丰度也通过影响不透明度进而影响恒星的热核反应率，从而影响 WNL 的氮含量。

为了研究 WNL 型星的形成和演化特征，我门使用恒星演化模型 MESA 程序来模拟这类恒星在不同金属丰度和初始质量下的演化过程，从而得到其在不同金属丰度下的形成和演化特征。由于大质量恒星演化较快，物质损失强，对 WNL 型星的研究不仅有助于了解大质量恒星形成与演化、宇宙金属丰度分布和高能物理过程，还为超新星爆发机制的理解提供了重要线索，并对理论模型的测试和改进起到关键作用。这些研究对于提高我们对宇宙的认识和了解有着重要意义。

双星并合形成沃尔夫拉叶星的研究

李卓文 新疆大学

Ia 型超新星遗迹的三维数值模拟研究

罗竞霄 云南天文台

Ia 型超新星是重要的天体物理研究对象，但其爆炸机制和前身星模型尚有争议。不同的前身星模型和爆炸机制对应着超新星遗迹的不同观测特征。在本报告中我将介绍我们如何利用 RAMSES 对超新星遗迹进行三维流体力学数值模拟，并分析不同前身星模型所下产生的超新星遗迹的观测特征。我们重点考虑单简并模型下超新星爆炸时伴星对抛射物结构的影响；我们实现了在共动膨胀参考系下

追踪 Ia 型超新星抛射物与周围介质交互并演化为超新星遗迹的过程；我们认为冲击伴星之后的抛射物结构特征可以影响年轻超新星遗迹的几何特征。

年轻类太阳恒星磁活动与行星宜居性研究

王汇娟 国家天文台

类太阳恒星是指质量与太阳接近的恒星，一般质量小于 3 倍太阳质量，这决定了它们具有晚型恒星光谱型（G、K 或 M 型），且恒星表面温度在 3500～6000 K 之间。年轻类太阳恒星是指位于主序前或零龄主序的类太阳恒星。光谱中存在明显的锂（6707.8 埃）吸收线可以被当作可信的年轻指示器。太阳附近的年轻类太阳恒星的研究是一个尚未完成的重要天文课题，这也将增进我们对银河系的结构和太阳的演化史的理解。尤其随着近年来国际上地外行星搜寻计划的兴起和对系外行星研究的深入，因年轻类太阳恒星是研究年轻行星的优质样本，且类太阳的特点也更有利于宜居类地行星的发现。恒星磁活动对行星宜居性有着重要影响。本报告将介绍年轻类太阳恒星磁活动与行星宜居性相关研究进展。

基于 LAMOST 中分辨率光谱巡天数据分析 F、G、K 型恒星的 H-alpha 色球活动分布

贺　晗 国家天文台

我们使用 LAMOST 的中分辨率光谱巡天（MRS）观测数据分析 F、G、K 型主序星和巨星样本的 H-alpha 色球活动性随恒星参数（有效温度 T_eff、表面重力 log g、金属丰度[Fe/H]）的整体分布情况。我们从 LAMOST DR8 中选取了 329,294 条 MRS 恒星光谱进行分析。我们为选取的光谱计算了表征 H-alpha 色球活动性的 I_halpha 指数，然后在 I_halpha 指数的基础上进一步计算出 R_halpha 指数。我们对 R_halpha 指数随不同恒星参数和主序星/巨星样本的分布进行了分析，同时还分析了 R_halpha 指数在 T_eff - log g 和 Teff - [Fe/H]参数空间的分布情况。分析结果显示：（1）对于主序星样本，R_halpha 指数随恒星有效温度的分布具有一个下凹形的下包络线，极小值在 6200 K 附近，一个上凸形的中包络线，极大值在 5600 K 附近，还具有一个上包络线，随 T_eff 的减小持续上升；（2）对于巨星样本，R_halpha 随恒星有效温度分布的中包络线和上包络线首先随 T_eff 的减小而上升，然后下降，在 4300K 附近降至低的活动水平，揭示了恒星在不同演化阶段所具有的不同活动特性；（3）无论对于主序星还是巨星样本，

R_halpha 随恒星金属丰度分布的上包络线对于[Fe/H]大于-1.0 的恒星都比较高，而对于金属丰度特别低的恒星，几乎没有表现出高的 R_halpha 指标。我们发布了一个恒星 H-alpha 活动指数的数据集，提供所分析 MRS 光谱的全部 I_halpha 指数和 R_halpha 指数数据。

基于 LAMOST-GALEX M stars 的恒星活动性研究

李　雪 国家天文台

M 型恒星在银河系中数量占了大约 70%，而且一般具有较强的恒星活动，尤其是在紫外波段。因此，人们对 M 星的恒星活动和宜居性有很浓厚的兴趣。我们利用 LAMOST DR9 的低分星表和 GALEX GR6+7 的数据，结合 Gaia eDR3 的距离参数，生成了一个包含有 6655 颗自转 M 恒星的星表，其中包括 582 颗具有旋转周期的恒星。这是目前可以用来研究紫外波段恒星活动性的最大数量的 M 星星表。我们计算了 NUV 波段和 FUV 波段的活动性指数，并首次给出了 NUV 波段的活动性-自转关系。Ha 和 Ca II H&K 的恒星活动指数与 NUV 波段的恒星活动指数呈线性正相关的关系。我们还通过光变曲线找到了 35 颗恒星的 43 次耀斑事件，并给出了每次耀斑事件的能量。耀斑的活动与 NUV 活动指数呈正相关，证实了耀斑可以用来表征恒星的活动性。在用我们样本计算了恒星宜居带和紫外宜居带之后，我们对在 M 矮星周围找到适合居住的行星持乐观态度。另外，即将发射的 CSST 具有大视场，在 NUV 波段也具有更深的探测极限，这将对我们研究紫外波段的恒星活动，更好的理解恒星的磁活动机制，以及宜居带的研究有很大的帮助。

银河系中心的恒星活动及其反馈过程

张孟飞 浙江大学

恒星活动的反馈过程对于星系演化的影响是至关重要的，然而其具体机制仍然不够清楚。银河系中心提供了一个详细研究这一过程的实验室，其曾经存在活跃的恒星活动，而如今却相对宁静很多，其中的关联值得深究。本次报告将会从小尺度(0.1 pc)到大尺度(1 kpc)介绍银心星风和超新星爆发的一系列流体模拟工作，以理解恒星活动自身及其与周围星际环境的相互作用。

LAMOST DR7 中发射线星的色球活动研究

丁玥丹 河北师范大学

恒星磁场是恒星活动的能量来源。根据发电机理论，磁场是由深对流区较差旋转或流湍流相互作用产生。磁场强度与恒星活动水平呈正相关。磁活动的强度可以通过各种代理来追踪，最好的是 Ca II H&K 发射线，其核心对磁场极其敏感。Wilson 对不同类型的恒星的色球活动进行了长期观测。为了量化活动水平沃恩等人引入了著名的 S 指数，Noyes 等人提出了 R'HK 值，它可以表征 Ca II H&K 线的过量色球发射。然而，对于暗淡的冷恒星，Ca II H&K 线不如热恒星的线显著，因此很难被探测到。色球活动的另一种表征是 Hα 发射。虽然这种发射可能由光电离主导，但随着温度的降低，碰撞激发的贡献将逐渐变得显著，因此 Hα 线可以作为色球活性的示踪剂。本工作利用 LAMOST DR7 发射线星探究主序恒星活动性。首先测量了 Hα 线等值宽度、S 指数随颜色的变化，并统计研究了主序带单双星的色球活动指数。

Variability of magnetic hot stars from the TESS observations

沈冬祥 新疆大学

Magnetic hot stars refer to the stars, which effective temperatures approximately in the range from 7,000 to 50,000 K, and with large-scale globally organized magnetic fields. These magnetic fields exhibit strengths ranging from tens of Gauss to tens of kilo-Gauss. They are key in understanding the effects caused by magnetic fields in the stellar evolution. However, there are only three magnetic hot stars studied via a combination of spectropolarimetric and asteroseismic modeling. Combined with T ransiting Exoplanet Survey Satellite (TESS) 1-56 sectors data sets, we provided a photometric variability and stochastic low frequency (SLF) variability study of 118 magnetic hot stars. new rotating variable stars are identified. Using the Bayesian Markov Chain Monte Carlo (MCMC) framework, we fitted the morphologies of SLF variability for magnetic hot stars. Our analysis reveals that the magnetic hot stars in our sample have $\gamma < 5.5$ with the vast majority having $1 \leq \gamma \leq 3$. The νchar is primarily in the ranges of 0 d < νchar < 6.3 d. The amplitude of SLF variability, logα0, shows a dominant distribution ranging from 0.8 to 3. No significant correlations are observed between the luminosity and fitting parameters, suggesting no clear

dependence of SLF variability on stellar mass for our sample of magnetic hot stars with masses between approximately 1.5M⊙< M < 20M⊙. We found a significant negative correlation between the Bp and vchar. This suppression effect of magnetic fields on vchar may be a result of their inhibition of macroturbulence.

Data Release of the AST3-2 Automatic Survey from Dome A, Antarctica

杨 栩 国家天文台

AST3-2 is the second of the three Antarctic Survey Telescopes, aimed at wide-field time-domain optical astronomy. It is located at Dome A, Antarctica, which is by many measures the best optical astronomy site on the Earth's surface. Here we present the data from the AST3-2 automatic survey in 2016 and the photometry results. The median 5σ limiting magnitude in i-band is 17.8 mag and the light-curve precision is 4 mmag for bright stars. The data release includes photometry for over 7 million stars, from which over 3500 variable stars were detected, with 70 of them newly discovered. We classify these new variables into different types by combining their light-curve features with stellar properties from surveys such as StarHorse.

Stellar physics from lithium in open clusters

孙清辉 清华大学

超级富锂前身星的演化：富锂巨星的形成通道

李雪峰 云南天文台

越来越多的观测数据表明，部分巨星表面含有异常高的锂(Li)，其占比约为1%。我们关注的是如何抑制巨星前身星的锂耗竭，而不是探求可行的额外的机制去锂富集。考虑到这一点，我们发现温盐混合能够实现这一目标。富锂巨星的形成取决于其前身星的锂丰度。如果其前身星的锂丰度丰度超过陨石值(3.3dex)，那么大多数巨星都将富含锂。这是不考虑额外的锂消耗的恒星锂丰度演化的一般模式。当引入旋转驱动混合时，只有部分恒星遵循这种模式。虽然细节尚不清楚，

但未来还应考量其他锂耗尽过程，这可能是解开 1%之谜的关键。

新星（Nova）-宇宙中锂元素的主要贡献者

高　君 新疆大学

7Li 被认为是最初在标准的大爆炸核合成(BBN)中合成的唯一轻元素。Coc 等(2014)计算出 BBN 中 7Li 的原始丰度为 2.66-2.73 dex。这个值是所谓的‘锂平台’值的三倍，这是从晕矮星上观察到的。这种数量差异被称为“锂问题”。作为宇宙化学演化中的一个重要元素， 7Li 从其原始值略微富集到其当前值:3.26 dex。当前对于宇宙中锂元素的来源主要由以下几种观点：BBN 原初核合成提供了约 20%左右的锂元素；宇宙射线裂变提供了约 16%；二星超新星爆发中微子过程可以产生一部分，但其过程难以观察且极不确定；渐近巨星的外壳层燃烧产生铍元素衰变成锂元素提供了约 1%的贡献。仍然有一半以上的锂元素的来源并没有一个确凿的定论，迫切需要我们寻找更多的提供途径。我们探究发现新星的爆发机制为锂元素的生产提供了一个良好的平台，但是当前所发现的新星观测源中所体现出的 7Be/1H 元素比并没有一个很好的模型可以匹配。因此构建一个可以匹配观测值的新星模型以及该模型条件下所产生的锂产量可以为宇宙中锂元素的储量提供多大的贡献，成为当前亟待解决的问题。

新星爆发是由一颗白矮星和主序星或者红巨星组成的密近双星系统中吸积到白矮星表面的富氢气体发生热核爆发的结果。热核爆发过程中产生的能量足以抛射掉大部分吸积的物质。新星抛射物中包含放射性 7Be, 22Na, 26Al。热核爆发过程中产生的 7Be 发生β 衰变形成 7Li。理论研究和观测证据都表明，新星是银河系锂元素增丰的贡献者之一。研究新星和分析新星在银河系尺度内对锂元素增丰的贡献具有非常重要的价值和意义。

在本文中，我们运用 MESA 程序计算了碳氧（CO）白矮星和氧氖镁（ONeMg）白矮星新星爆发抛射物中锂元素（7Li）的产量。把白矮星质量和吸积率作为输入参量，我们建立了由经典新星爆发模型组成的锂元素产量网格。为了研究银河系新星爆发的爆发率和新星对银河系锂元素增丰的总的贡献，我们根据锂元素产量网格数据，运用快速双星演化程序（BSE）对 106 个双星系统进行了大样本统计，并将统计结果跟观测结果和其它理论结果进行比较分析和讨论。

通过恒星演化程序 MESA 进行详细的恒星演化作为网格时，我们的工作模型中创新性的加入了元素扩散这一物理因素，使得锂产量在前人基础上提高了 5-7 倍，实现了新星爆发抛射过程中的锂富集。我们的研究结果表明，在相同的输入参量条件下，我们建立的模型所得到的结果和几个相关文献里所得到的结果一致。我们的几个新星爆发模型的 7Be/1H 元素比以及 7Li 丰度跟当前所观测到的元素相匹配。根据我们的网格和星族合成方法，我们估算了经典新星对银河系 7Li 增丰的贡献。我们估算出了新星爆发每年可以抛射的 7Li 产量，证实了银河

系约一半以上的 7Li 来源于新星，新星是宇宙中锂元素的主要贡献者。

矮星系和球状星团元素的天体物理研究

杨帅帅 河北科技大学

矮星系和球状星团作为宇宙中两个较为独特的群体，具有较低的金属丰度，其恒星表面化学组成的研究可为恒星演化提供了重要线索。

六分仪座矮星系和玉夫座矮星系作为银河系的伴星系，它的研究对星系早期的形成和银河系的形成来源至关重要。本报告对六分仪座的 22 颗贫金属恒星和玉夫座的 79 颗星的元素天体物理来源进行了研究。研究其恒星的轻元素、α 元素、铁族元素以及中子俘获元素。分析各过程在金属丰度下的变化趋势，并针对矮星系演化过程中对钱德拉塞卡极限下的 near-Ia 型、sub-Ia 型超新星的模型的适用情况进行了具体研究。后续对球状星团 47 Tuc 中的 13 颗星、NGC 3201 的 18 颗星进行多分量分解研究，通过对元素的计算拟合得到理想的结果，分析了两种金属丰度下各过程的贡献占比。

开普勒天区中行星宿主恒星的锂丰度研究

秦进晓 河北师范大学

行星宿主恒星(planet-hosting stars，简称宿主恒星)是至少有一颗已知行星在其轨道上的恒星，对宿主恒星及其行星的研究是天文学中一个重要的研究领域，可以帮助我们更好地了解恒星-行星系统的形成和演化。

国内外已经开展许多针对锂丰度和宿主恒星之间是否存在联系的研究，结合现阶段的研究结果共有两个观点，1.宿主恒星表现出普遍的更低的锂丰度，即锂衰竭更严重；2.宿主恒星与没有行星的单一恒星（简称单一恒星）锂衰竭程度基本一致，认为恒星的锂衰竭与有没有行星没有相关性。

鉴于现阶段对宿主恒星与单一恒星锂丰度之间差异产生的争议，因此本工作展开了对宿主恒星的锂丰度的研究。本工作使用两类恒星进行对比，一类是宿主恒星，一共挑选出 329 颗宿主恒星作为本工作研究的样本（简称宿主恒星样本），另一类是单一恒星，挑选出 189 颗单一恒星样本作为对比。此外我们还考虑非局部热动平衡效应对锂丰度的影响。该样本是已知的规模最大的基于高分辨率光谱对宿主恒星及单一恒星的锂丰度对比研究，且此研究通过相同的方法测量恒星锂丰度具有良好系统性。

我们发现，宿主恒星与单一恒星的锂丰度总体上分布基本一致，表明出恒星的锂衰竭与行星没有明确的相关性。将两个样本分为巨星和矮星进行分析，发现

无论是矮星还是巨星，宿主恒星的与单一恒星的锂衰竭表现出良好的一致性。其次，我们还对两个样本锂丰度与恒星参数的关系进行分析，发现恒星的锂丰度随有效温度的降低而降低；我们还发现锂丰度与银河系场星（-0.5 < [Fe/H] < +0.5）中的演化基本一致，且认为超太阳金属丰度范围（[Fe/H] > 0）内场星锂丰度的也可能存在一定下降趋势。最后，我们在样本中还发现了两颗富锂巨星。

r-过程增丰恒星的高分辨率光谱分析

解小瑾 国家天文台

基于 post-AGB 星研究中子俘获核合成

田　苗 河北师范大学

核合成情况时均采用元素丰度作为观测约束，我们也逐渐发现了元素丰度作为观测约束的局限性。因为相同的元素丰度实际上可以对应着同位素比例的不同组合，同位素能够为我们提供更加严格的观测约束。所以我们为了能够获得更加可靠的中子俘获核合成信息，需要从分析同位素展开研究。

post-AGB 星一般被认为是 i-过程可能发生的天体物理场所，r/s 星被认为是 i-过程形成的，我们选取了两颗具有 r/s 星特征的 post-AGB 星作为研究目标：IRAS 08143-4406、IRAS 14325-6428。首先，在欧洲南方天文台（ESO）数据库中下载了其完整的高分辨率、高信噪比的光谱，利用铁线对文献里两颗 post-AGB 星的大气参数进行了重新测定，在此基础上又测定了 IRAS 14325-6428 的 Ba 元素的同位素比例及其元素丰度。

Deep learning interpretable analysis for carbon star identification in Gaia DR3

叶　烁 河北师范大学

紫外内禀色指数的测定

杨栋梁 河北师范大学

Wide Binaries in the LAMOST-Gaia era

田海俊 杭州电子科技大学

Discovery of the first white dwarf + brown dwarf wide binary of the Galactic halo

张曾华 南京大学

We present the discovery of the first halo white dwarf + brown dwarf wide binary in Gaia DR3. It is a gravitationally bound system with a projected separation of 1375 au. The primary is a cool and old DC WD. The secondary is a metal-poor brown dwarfs with metallicity around [Fe/H] = -1.0. The system has a typical space velocities of Galactic halo members. The age of the system is older than 10 Gyr according to model fitting of the WD companion. With age constrain from the WD companion, the secondary companion becomes the first age benchmark brown dwarf of the of Galactic halo.

LAMOST 数据中周围存在共有包层残留物质的热亚矮星候选体

李江丹 云南天文台

Searching for Compact Object Candidates from LAMOST Time-Domain Survey of Four K2 Plates

戚森宇 厦门大学

激变变星多周期光变研究

李　昕 北京天文馆

基于 ZTF 和 Gaia DR3 搜寻银河系内的激变变星

林佳茂 中山大学

激变变星（CVs）是由一颗白矮星和一颗低质量主序星组成的致密双星系统（Warner et al. 1995）。在这类双星系统中，主序星会向白矮星转移质量。对于磁性较弱的双星，白矮星会形成吸积盘，而对于强磁性的双星，会形成吸积流，并放射出紫外线和 X 射线。

吸积过程中的不稳定性常导致爆发事件的发生。这种致密天体的引力信号可以被 LISA 和天琴等天文观测设备所探测到。确认激变变星的方法主要分为三种类型，包括观测矮新星爆发（Jan van et al. 2022）、在光度光变曲线中识别轨道，以及通过分析具有变星特征的光谱性质进行确认（Keith et al. 2023）。

我们将具有 X 射线源的数据与 Gaia DR3 进行匹配，获取准确的位置和光学信息。利用 ZTF 数据获取了时域观测数据，并通过 Lomb-Scargle 算法得到了光变曲线。最后，我们使用 CNN 对具有掩食光变特征的源进行识别。

短周期相接双星及其伴星天体的观测研究

张　斌 贵州师范大学

Discovery and analysis of a non-eclisping hot subdwarf + white dwarf binary

杨明宽 国家天文台

热亚矮星是一类处于演化晚期的特殊恒星，其中心为燃烧的氦核，表面被一层很薄的氢包层覆盖。我们对 LAMOST J171013.211 +532646.04 进行了分析，这是一个由一颗高温亮星和一颗低亮度致密星构成的双星系统。在 LAMOST 低分光谱中，没有发现发射线特征，光谱与热亚矮星模板匹配良好。光谱温度约为 25183 K，与 SED 拟合结果（约 25301 K）一致。此外，时域光谱揭示视向速度振幅为 226.25 ± 2.59 km/s，且轨道周期与来自 TESS、ZTF 等测光数据的结果一致（0.075835 ± 0.000003 天）。TESS 的光变曲线显示出椭变和 doppler beaming 情况，通过 WD 拟合得到可见星的质量为 0.492 ± 0.054 M⊙，不可见伴星的质量为 0.475 ± 0.052 M⊙。综合所有数据，推测该双星系统可能是由热亚矮星和白矮星构成的致密双星，预计约在 205 Myr 后合并。

J0419：一个长周期的极小质量白矮星前身星系统

张志翔 厦门大学

致密天体搜寻

赵欣林 国家天文台

黑洞作为恒星演化的最终阶段，其对恒星演化模型的检验起到了至关重要的作用。黑洞的不可见性导致发现单个孤立的黑洞是很困难的。因此，到目前为所确认的黑洞都是位于双星系统当中的。通过探测来自吸积盘的 X 射线来发现黑洞双星系统的方法已经被证实是可行的并被广泛应用。但是这种方法只能用于发现存在双星物质交换的那一类黑洞双星系统。最近几年，引力波探测、视向速度监视以及天测的方法已被用于探测处于没有相互作用的黑洞双星系统。通过交叉 GAIA DR3 和 LAMOST 的侧谱数据，我们发现了一颗处于质量间隙的黑洞候选体。

基于 CSST 多色测光识别主序双星及双星比例估计的预研究

李佳佳 云南天文台

The statistical properties of double main sequence (MS) binaries are very important for binary evolution and binary population synthesis. To obtain these properties, we need to identify these main sequence binaries. In this

paper, we have developed a method to differentiate single MS stars from double MS binaries from the Chinese Space Station Telescope (CSST) Survey with machine learning. This method is reliable and efficient to

identify binaries with mass ratios between 0.20 and 0.80, which is independent of the mass ratio distribution.

But the number of binaries identified with this method is not a good approximation to the number of binaries in the original sample.

Therefore, we have improved this point by using the

detection efficiencies of our method and an empirical mass ratio distribution and then can infer the binary fraction in the sample.

星团搜寻与参数确定

李忠木 大理大学

疏散星团外晕结构研究

钟 靖 上海天文台

疏散星团的结构与演化对双星演化的影响

庞晓莹 西交利物浦大学

Using membership of 85 open clusters from previous studies (Pang et al. 2021a,b, 2022b; Li et al. 2021) based on Gaia DR3 data, we identify binary candidates in the color-magnitude diagram, for systems with mass ratio $q > 0.4$. The binary fraction is

corrected for incompleteness at different distances due to the Gaia angular resolution limit. We find a decreasing binary fraction with increasing cluster age, with substantial scatter. For clusters with a total mass >200 M⊙, the binary fraction is independent of cluster mass. The binary fraction depends strongly on stellar density. Among four types of cluster environments, the lowest-density filamentary and fractal stellar groups have the highest mean binary fraction: 23.6% and 23.2%, respectively. The mean binary fraction in tidal-tail clusters is 20.8%, and is lowest in the densest halo-type clusters: 14.8%. We find clear evidence of early disruptions of binary stars in the cluster sample. The radial binary fraction depends strongly on the cluster-centric distance across all four types of environments, with the smallest binary fraction within the half-mass radius rh, and increasing towards a few rh. Only hints of mass segregation is found in the target clusters. The observed amount of mass segregation is not significant to generate a global effect inside the target clusters. We evaluate the bias of unresolved binary systems (assuming a primary mass of 1 M⊙) in 1D tangential velocity, which is 0.1–1 km s−1. Further studies are required to characterize the internal star cluster kinematics using Gaia proper motions.

Stellar rotation and extended main-sequence turn-off in galactic open cluster NGC 2423

卜玉田 中山大学

Most intermediate age open clusters exhibit extended main-sequence turn-offs (eMSTO). We investigated a galactic open cluster NGC 2423 with age of ~890Myr. The cluster clearly shows an eMSTO while the red clump of NGC 2423 is narrow. Furthermore, we measured the projected stellar rotational velocity (Vsini) of the cluster member stars and found out that the fast rotators are located in the red part of eMSTO in CMD while the slow rotators are located in the blue part. The Geneva/SYCILST model fits well with our result. Stellar rotation plays an important role in the causation of eMSTO.

星团 NGC1856 双主序结构的起源

王 莉 中山大学

The detection of split main sequences (MSs) associated with young clusters (<600 Myr) has caught lots of attention. A prevailing scenario is that a bimodality of stellar rotation distribution drives the MS bifurcation. Nevertheless, the origin of the stellar rotation dichotomy remains unclear. Hypotheses involving tidally-locked binaries or blue straggler stars (BSSs) are proposed to explain the observed split MSs. In this talk, we want to examine if the long-term dynamical evolution of star clusters can produce the observed split MSs, through high-performance N-body simulation. As a prototype example, the young massive cluster NGC 1856 exhibits an apparent MS bifurcation. Our simulation reports that at the age of NGC 1856, tidally-locked binaries are fully mixed with single stars. This is consistent with the observation that there is no significant spatial difference between blue MS and red MS stars. However, we find that only high mass-ratio binaries can evolve to the tidally-locked phase at the age of the NGC 1856. These tidally-locked binaries will populate a much redder sequence than the MS of single stars rather than a blue MS, which is inconsistent with the hypothesis. The number of tidally-locked binaries cannot account for the observation. Our simulation shows that BSSs produced by binary interactions do populate the blue periphery in the color-magnitude diagram, and their spatial distribution shows a similar pattern of single stars. However, the number of BSSs does not fit the observation.

球状星团和疏散星团的界限

黄若云 中山大学

Where do they come from? Identification of globular cluster escaped stars

徐 成 中山大学

Globular clusters (GCs), as old as our Galaxy, constantly lose stars to the field as they travel through different parts of the Milky Way (MW). Theses GC escaped stars

(or escapees) are the key to investigate contribution of GCs to MW halo. If a star has left the host GC a long time ago, chemical finger prints, e.g., N enrichment, may reveal its origin. In this work, we aim to establish dynamical connections between N-rich field stars recently identified by LAMOST and the existing MW GCs. By constructing the full action distribution, and combining with metallicity, we found 29 potential GC progenitors for 15 N-rich field stars. Particularly, some of them may be related to MW accretion events. On the other hand, if a star recently left its host GC via tidal evaporation, it still maintain the kinematic properties of the cluster. Here we identify extra-tidal candidates based on their spatial locations, proper motions, and their position on color-magnitude-diagrams. We successfully identified more than 1600 extra-tidal candidates in the vicinity of six GE-related GCs (i.e., NGC 1851, NGC 1904, NGC 6205, NGC 6341, NGC 6779, NGC 7089). The density map of the extra-tidal candidates is confirmed to be an efficient way to find extra-tidal structures. The possible two density peaks at opposite directions of the inner boundary is a good indicator for long stellar stream. Among 95 extra-tidal candidates with spectroscopic radial velocities and metallicity, 54 of them are confirmed to be GC escaped stars, as they share similar properties as host GCs. These extra-tidal candidates are ideal targets for follow-up spectroscopic observation, as it greatly improves the scientific outcome. Once statistically significant number of spectroscopic radial velocities and metallicities are available, the GC dynamical evolution (e.g., mass loss, rotation) can be carefully investigated.

银河系高速星研究进展

杜翠花 中国科学院大学

高速星是指在银河系中速度接近甚至超过银河系逃逸速度的恒星，如果寿命允许，它们最终很可能飞出银河系。早期光谱巡天发现的大部分是早型高速星，Gaia 巡天数据发布后又发现了大量的晚型高速星。早型与晚型超高速星是否有不同的动力学起源？恒星运动的轨道信息为研究高速星的运动学性质提供了极为重要的帮助，可以通过轨道回溯等综合分析方法来判断高速星的起源。了解高速星的起源可以帮助了解银河系中心黑洞曾经都发生过什么？还有助于研究银河系暗物质晕的性质和分布等。本次会议将介绍一下高速星的最新研究进展。

星震学探测恒星快速物质损失

吴　涛 云南天文台

星震学是目前为止为数不多能够直接探测恒星内部物质结构状态的研究手段和方法之一，它是通过振波（机械波）在恒星内部的传播将恒星内部结构状态的变化携带出恒星表面、变成可观测的光变或者视向速度的变化。通过星震学，我们可以精确确定恒星的基本机构参数、解析恒星内部静态结构。结合恒星结构演化理论模型，便能对恒星演化中的物理过程进行有效限制，如对流超射、扩散、旋转等等。在本报告中，我们将通过星震学分析恒星在在发生快速物质损失或吸积的时候，恒星内部结构状态的变化以及他咋星震学上的表现。以此限制恒星在演化过程该过程发生的时间以及速率等物理信息。

基于自监督的 LAMOST 光谱检索

袁　磊 山东大学

对于天文光谱的探索与分析是天文学中一个重要的研究方向。通过对同一类或者相近似的光谱进行研究，可以根据其共有的相似性质使我们对这一系列天体有更加深入的了解，而无论是通过目测检测的方法还是利用深度学习或机器学习方法，获得所需要的数据是较为困难的，其中的训练样本的查找及标注都需要花费极高的代价。本研究提出了一种基于自监督的通用的光谱相似检索的方法，不需要特殊标注的样本，极大的降低了获取数据的代价，并且我们并将此工具进行了可视化，基于此方法开发了便于人员使用的工具网页，可以随机挑选一条任意光谱的任意区域，使用该方法在 LAMOST DR8 中查询与该目标光谱所选区域相似的一系列光谱。

The Long-Period Supplement of Brown Dwarf Desert

陈章亮 中山大学

Brown dwarfs (BD) with the mass of 40−60 Jupiter mass that orbit around solar-type main sequence (MS) stars are rare in observation, which forms the so-called brown dwarf desert. Most of previous works focus on the distribution of

brown dwarfs around main sequence stars. These systems are partly discovered using radial velocity technique, where we only have m sin i measured. Only a few of these brown dwarfs have precise mass measurement using transit method technique or astrometry method. Here we propose to use the data of known eclipsing white dwarf - brown dwarf (WD-BD) binaries to study the brown dwarf desert. We use the binary evolution code COMPAS to infer the properties of their progenitors, which are MS-BD binaries. We find this new sample of MS-BD binaries is an excellent complement to the directly observed MS-BD sample used in studying the brown dwarf desert. We find tentative evidence that the brown dwarf desert extends to a period of several hundred days. By providing a larger sample of brown dwarfs with precise mass measurements around main sequence stars using binary evolution calculation, our study opens a new avenue of studying the brown dwarf desert

LAMOST 大质量恒星的样本和参数研究

霍振燕 河北师范大学

The measurements of masses and ages of massive stars play an important role in understanding the formation and evolution of their host galaxies. In this work, we present the measurements of masses and ages of 2,946 OB-type stars, including 37 O-type stars and 2909 B-type stars, based on their stellar parameters (effective temperature, surface gravity, and metallicity) and PARSEC isochrones. Our results show that the median mass of the 2,946 OB stars is 5.5\,M$_{\sun}$ with a median mass relative error of 10.7{\%} and the median age is 50.8\,Myr with a median age relative error of 27{\%}. A good agreement between our results estimated by using our method and those derived by using the orbital motions of binary stars from the literature is found for some B-type stars. In addition, we also fit the mass-luminosity relation of OB-type stars by using our derived mass and the luminosity from $Gaia$ DR3.

LAMOST DR7 低分辨率光谱库中经典 Ae 星的研究

张　倩　河北师范大学

经典 Ae 星作为经典 Be 星的晚型类似物，具有和经典 Be 星相同的性质和光

谱特征，是理解早型发射线星星周盘形成机制和过程的关键。由于随着温度下降，经典 Ae 星的 Hα 发射线强度特征比经典 Be 星弱，所以给证认经典 Ae 星带来了很大的困难。我们首先利用大空域多目标光纤光谱望远镜(LAMOST)巡天从 A 星目录中检索到带有 Hα 发射线的 A 型星光谱，目视检查之后筛选出有少量红外超的恒星，利用 MK class 光谱模板匹配的方法证认了 709 颗经典 Ae 星。我们发现经典 Ae 星的发射线强度与温度有关，呈稳定下降趋势。在红外波段的发射线强度随着颜色变红强度逐渐增强。

Infrared Emission Spectra of R Coronae Borealis Stars

蔺俊茹 河北师范大学

The R Coronae Borealis (RCB) stars are a small group of carbon-rich, hydrogen-deficient super-giants. While several RCB stars exhibit well defined PAH emission bands at 3.3, 6.2, 7.7, 8.6, and 11.3 um, the vast majority shows broad, unidentified emission complexes at ~ 6--10 um and ~ 11.5--15 ụm. These visible spectral profiles are beneficial for probing into the nature of the dust condensed in RCB stars.

以特殊调制天琴 RR 型星为线索探讨布拉什克效应现象及机制

李临甲 云南天文台

天琴 RR 型星是一类处于水平分支演化阶段的短周期脉动变星。它们的脉动模式主要为径向模式，光变变幅达到 0.2 – 1.0 星等。在其观测领域，有着一个十分著名的现象，也即是布拉什克效应（Blazhko effect）。这一效应表现为脉动变星的脉动频率及振幅存在周期从几天到几百天的调制。这与无线电技术中的调频和调幅信号有些类似。布拉什克调制在天琴 RR 型星中十分普遍，有一半以上的目标存在该效应，但其背后的机制还没有公论。近些年多个地面巡天项目的开展为变星领域积累了海量的大天区数据，而空间项目则提供了高精度不间断的测光数据。以此为基础，研究人员针对天琴 RR 型星的布拉什克效应展开了统计研究及深入细节分析。在本报告中，我们首先对相关研究背景及成果进行简单介绍

和评价；然后以自身研究出发，介绍两颗特殊的调制天琴 RR 型星，分别为存在调制突变的 c 型天琴 RR 型星 BE Dor 和存在最弱调制的 ab 型天琴 RR 型星 V838 Cyg；并结合其它研究结果展开讨论，介绍我们所发现的恒星大气物理参数（宏观湍流速度和金属丰度）与调制的相关关系，以及相应定性的机制解释；最后我们结合自身的研究对该方向的未来发展进行展望。

双星快速物质交换过程研究及在相关天体中的应用

葛宏伟 云南天文台

恒星物理是天体物理的基石，双星演化在天体物理研究中至关重要。双星演化形成各类重要天体，比如 Ia 型超新星、引力波源等等。双星演化中存在两个一直未解决的基本问题：物质交换的稳定性判据和公共包层演化。我们在本报告中介绍恒星和双星演化的重要性，如何构建恒星快速（绝热）物质损失模型，主要研究结果和其在相关天体如激变双星，X 射线双星、双白矮星和短周期热亚矮星双星中的应用。

双白矮星星族及其引力波辐射

李振威 云南天文台

双白矮星由两颗白矮星组成，在银河系内大量存在。许多特殊的天体或天文现象都与双白矮星密切相关，例如 Ia 型超新星、低频波段(mHz)引力波辐射 等。对这类双星的研究面，有助于加深我们对双星物质转移、恒星演化理论等课题的理解。本次报告将从以下几个方面介绍双白矮星星族的研究进展：（1）双白矮星的形成及演化；（2）含有极小质量白矮星的双白矮星星族的形成及性质；（3）物质转移稳定性判据对双白矮星星族的影响。在此基础上介绍银河系内双白矮星产生的引力波辐射信号。

高银纬尘埃云的识别与研究

孙明旭 河北师范大学

根据普朗克 857GHz 的尘埃发射数据，我们获得了高银纬区域的尘埃云目录。使用层次聚类方法，我们识别了 217 个高银纬尘埃云。此外，利用 Sun 等人给出

的 400 多万和 100 万颗恒星的光学和紫外色余数据，我们计算了 167 个高纬度尘埃云的距离，以及 137 个尘埃云紫外色余。基于这个目录，我们对局地泡、银河系尘埃盘标高进行了的研究。同时，我们发现高银纬、低消光的尘埃云可能有着更大比例的小尺寸尘埃颗粒。

高银纬区域银河系卷云的认证与多波段性质研究

赵韵宁 国家天文台

随着近些年深度光学成像的发展，越来越多的银河系卷云等低面亮度结构被逐渐探测到。银河系卷云在光学和红外波段表现出明显相关性，但其相关性斜率在不同天区之间弥散较大。我们的工作将在大范围天区认证银河系卷云，统计分析其相关性斜率的变化，讨论斜率弥散较大的原因，探讨尘埃性质。

我们的工作基于 DESI 和 IRAS 数据，选取了 6187 平方度的大面积天区进行测光。我们利用卷云光学和红外波段强相关性，挑选认证银河系卷云，构建了一个高银纬银河系卷云的大样本星表，其中包括 2248 个区域，覆盖了约 562 平方度的天区。

我们对卷云样本计算了光学红外相关性斜率，发现其在不同光学波段的测光结果符合弥漫银河星光模型，即卷云照明源是银河系内弥漫的星光。同时，我们讨论了卷云相关性斜率弥散较大的问题，发现大样本数据同样支持斜率存在较大弥散，而卷云在银河系的分布、外界辐射场导致的颜色、温度变化都不足以解释如此大的斜率弥散，尘埃本身性质是导致斜率弥散的主要原因。卷云尘埃本身性质的变化是局域的，没有明显的大尺度梯度变化。

近邻原恒星团红外能谱指数的统计分析

刘明超 云南天文台

红外能谱指数是示踪初期恒星体演化阶段的重要工具。根据理论模型，红外能谱指数可以分辨出初期星的包层塌缩阶段，盘吸积阶段以及残留盘阶段。对多个原恒星团中的恒星进行红外能谱指数的统计分析可以更精确的分析初期星的演化过程。这对于探索恒星的早期演化具有重要意义。而且，多个星团红外能谱指数的统计研究还可以帮助我们分析星团之间不同的演化状态。

星际介质中湍流与物质分布研究

吕　鑫　国家天文台

红外暗云被认为是大质量恒星形成最早阶段的场所，可以有效避免恒星形成反馈对物质分布带来的影响，是研究超声速湍流与物质分布关联理想的研究对象。我们使用 JCMT-SCUBA2 量热器首次获得了近邻红外暗云（<2 kpc）的目前最高灵敏度的单天线尘埃辐射图像。通过对 9 个红外暗云中的 43 个区域做了柱密度概率密度函数（column density probability distribution function，N-PDF）分析，我们获得了表征弥散区域密度涨落的对数正态部分柱密度方差。我们用银河画卷巡天的 13CO J=1-0 数据测量了所选区域中表征湍流强度的三维马赫数。同时，我们通过施密特律估算出每个区域期望的恒星形成率。结合柱密度方差与三维马赫数关系的理论模型与模拟结果，我们分析了所选区域中超声速湍流的驱动模式。柱密度方差与期望的恒星形成率显示出明显的正相关关系。这一结果表明，超声速湍流通过影响弥散物质的分布，进而影响镶嵌在弥散物质中的致密气体结构。

基于三维辐射转移的云核参数拟合工具 COREFIT

邢宇辰 国家天文台

为了更加精准地获取恒星形成云核的各项参数，我们开发了基于三维球对称模型、考虑辐射转移的 COREFIT 工具，考虑了辐射传输。COREFIT 的主要目标是拟合不同波长的尘埃发射数据从而获取云核密度、温度轮廓以及谱指数等信息。我们将介绍 COREFIT 的工作流程及拟合效果。

Luminosity Outburst of a High-mass Young Stellar Object Triggered by the Surrounding Radiation Field

刘君婷 广州大学

We present observations of the 6.7 GHz methanol and 4.8 GHz formaldehyde masers toward the high-mass young stellar object G24.33+0.14 (hereafter G24). Our observations were conducted from 2019 to 2021 using the Shanghai Tianma 65 m Radio Telescope and the Very Large Array in response to the luminosity outburst event traced by these two species masers in 2019. Our results indicate that the

provenance of the maser flares is unlikely to be ascribed to the protostar of G24 itself. Through analyzing NEOWISE infrared monitoring data, we identified two light curves of G24 with long-term (3083 days, ~8.5 yr) and short-term (424 days) periods. Intriguingly, 11 periodic variable sources located in the same bubble as G24 exhibiting periods comparable to the short-term period of G24 were also detected. The analysis of the spectral energy distributions of these periodic variables revealed a possible correlation between their temperature fluctuations and the surrounding radiation field that possibly emanates from the driving source of the bubble. This source could be an individual supergiant protostar of a few hundred solar masses with periodic pulsation potentially accounting for the observed short-term period in the G24 region.

尘埃尺寸沿原行星盘 DS Tau 上的分布研究

李大发 紫金山天文台

目前，我们尚不清楚原行星盘中的尘埃颗粒是如何克服快速的径向漂移，并从微米大小的颗粒生长到行星的。因此，寻找尘埃颗粒积聚和生长的证据变得尤为重要。为了研究原行星盘 DS Tau 中尘埃尺寸的径向分布，我们采用了自洽的辐射转移模型，并拟合了阿塔卡马大型毫米波/亚毫米波阵列 (ALMA)的多波段观测结果。通过这种方法，我们得到了从内盘的厘米级尺寸尘埃到外盘约 30 微米的颗粒的分布结果，这种由内而外的减少趋势与尘埃演化理论相一致。根据最佳拟合模型，我们发现质量约为 2 个木星质量的尘埃在间隙 (Gap) 内已经耗尽。考虑到气体与尘埃的质量比，这些损失的尘埃质量足以形成流体动力学模拟推断的质量为 3.5 个木星质量的行星。此外，我们的建模结果还表明，尘埃尺寸在间隙和环 (Ring) 之间的区域出现了跃变，变化大小取决于辐射转移模拟中采用的尘埃模型。未来的研究需要采用更高角分辨率的观测设备进行多波段观测，以更好地约束子结构附近的尘埃尺寸及其变化。通过进一步的观测和分析，我们可以更深入地了解原行星盘中尘埃的演化过程，为我们理解行星形成和行星系统的演化提供更多的线索。

麒麟座星环与反银心星流的化学特性研究

乔　一　中山大学

基于 LAMOST 巡天数据的银河系星流研究

石维彬 山东大学（威海）

我们基于 LAMOST 与 SDSS 的巡天数据获得的光谱数据，对 TriAnd、ACS 与 MRi 等结构进行运动学和金属丰度的探索与研究。通过 FoF 算法筛选设置限度获得三个结构的成员星。我们得到了 128 颗 TriAnd 的成员星，而它与银盘和晕的金属丰度的对比显示出它很可能源自于银河系厚盘。TriAnd 的运动轨迹也表明它在逐渐远离太阳。我们得到了 132 颗 MRi 的成员星和 32 颗 ACS 的成员星。在空间中的成员星分布表明 MRi 与 ACS 相互毗邻的结构，两个结构的轨道很接近。在速度与金属丰度的研究显示 MRi 与 ACS 的差异并不显著。我们推断二者可能有一个相同的起源。在反银心区域的探索中，我们发现了人马座星流的一部分，这部分星流属于人马座星流的导臂。当人马座星流经过 MRi 所处区域时，由于受到了外部的影响，星流内的部分成员星的运动方向发生了改变，形成了一个突起的子结构。

另外，基于 LAMOST K 巨星我们从轨道参数信息和化学演化上验证了人马座矮星系星流附近的两个区域（VOD 和 HAC）可能存在共同的起源，它们可能来自银河系与周边矮星系的同一个吸积合并事件，并且 VOD 的部分成员星的起源可能还与大小麦哲伦云有关联。

基于 LAMOST、SDSS 和 Gaia 巡天的 RR Lyrae 对银晕的研究

刘高潮 三峡大学

天琴座 RR 变星是一类贫金属短周期脉动变星，由于其良好的周光关系、较大的光变振幅及非常年老的特点使其成为探测银晕的良好探针。本报告将介绍我们研究团队基于 RR 变星开展的系列工作，包括利用光谱观测测量它的金属丰度，质心视向速度，距离等物理参数以及基于该样本探究银晕的化学、运动学性质；银晕的子结构等。我们还采用测光的方法来测量它的金属丰度及距离；结合光谱和测光数据，我们还探讨了天琴座 RR 变星的 Oosterhoff 双分性问题。

An asymmetric Galactic stellar disk traced by OB-type stars from LAMOST DR7

刘晓鹏 河北师范大学

Star formation history of nearby galaxies: a machine learning approach

杨玉姣 国家天文台

Resolved color-magnitude diagrams (CMDs) have proven to be a valuable tool for investigating the detailed star formation histories (SFHs) of nearby galaxies, as they encode the properties of individual stars. To address the challenges brought by big data, we have improved the synthetic CMD method by applying machine learning techniques. Our approach involved training the machine learning network using synthetic data generated from the state-of-art theoretical models and subsequently validating its performance with observed data from the Hubble Space Telescope. The predicted SFHs obtained through this method exhibit good agreement with those reported in the literature. The integration of machine learning not only enhances the accuracy and efficiency of the synthetic CMD method but also provide the possibility of studying the spatial variance of SFHs, especially in the context of large galaxies.

Measuring the Milky Way Vertical Potential with the Phase Snail in a Model Independent Way

郭　锐 上海交通大学

The vertical phase-space spiral (snail) is a direct sign of dis-equilibrium of Milky Way’s disc. Nevertheless,the wrapping of the phase snail contains information of the vertical potential. We propose a novel method tomeasure the vertical potential utilizing the intersections between the snail and z/Vz axes, for which we know themaximum vertical heights (Zmax) or the maximum vertical velocities (Vz,max).

Using a refined linear interpola-tion method, we directly obtain (Z , 1V2) for these snail intersections to constrain the vertical potential max 2 z,maxprofile empirically. Our method is model independent since no assumptions about the snail shape or the vertical potential have been made. Although the snail binned by the guiding center radius (Rg) is more prominent, it traces a vertical potential shallower than that of the snail binned by the same Galactocentric radius (R). We apply an empirical method to correct this difference. We measure the snail intersections in several Rg bins within 7.5 < Rg < 11.0 kpc for Gaia DR3, and apply the interpolation method to deduce the potential values at several vertical heights. The potential at the snail intersections, as well as the following mass modeling are consistent with the popular Milky Way potentials in the literature. For the Rg-binned phase snail in the Solar neighborhood, the mass modeling indicates a local dark matter density of ρdm = 0.0150 ± 0.0031 M ⊙ pc−3 , con- sistent with previous works. Our method could be applied to larger radial ranges in future works, to provide independent and stronger constraints on the Milky Way's potential.

"Hypervelocity Stars Track Back to the Galactic Center in Gaia DR3"

廖吉伟 中国科学院大学

基于欧洲空间局 Gaia 卫星发布的第三期数据，我们识别出两颗可能来自银河系中心的超高速星。根据起源于银心内超高速星的速度特征，我们挑选了相对银心径向速度大于 500km/s 的样本星。考虑到 Gaia 数据误差导致的轨道不确定性，我们筛选样本星里轨道只穿过银盘一次概率大于 80%作为起源于银心的候选星。最终，两颗超高速星的后向积分轨迹经过银心距 1kpc 内范围，表明潜在的银心起源。我们进一步研究这两颗星，发现其中一颗星轨道方向与围绕银心大质量黑洞 Sgr A*运动的年轻恒星盘一致，另一颗星是 A 型星与目前明确起源于银心的超高速星类型一致。这些表明它们可能来自银河系中心。我们也讨论这两颗星的喷射机制。除非它们受到大麦哲伦云引力势较大扰动，否则不太可能是 Hill 机制。

Based on the proper motions and radial velocities from Gaia Data Release 3, we identify two hypervelocity stars (HVSs) that may originate from the Galactic center (GC). We select the candidates by first filtering for all Gaia stars with Galactocentric

radial velocities >500 km s−1. We also require the candidates cross the Galactic midplane only once at 80% confidence, as determined by backwards orbit integration in several models of the Galactic potential, given the uncertainties in the Gaia measurables. The final two HVS candidates are the only such stars in our sample whose backwards-integrated trajectories pass within 1 kpc of the GC, suggesting a potential GC origin. We discuss possible ejection scenarios for these HVSs, in particular, by finding that ejection via the Hills mechanism is unlikely unless the HVS trajectories were significantly altered by local or large-scale perturbations to the assumed Galactic potential, e.g., the Large Magellanic Cloud. Interestingly, one of the HVSs ejects in a direction that is curiously aligned with the clockwise stellar disk around Sgr A*, suggesting a possible connection. We also discuss that the two stars may be ejected by other mechanisms.

利用碳星研究银河系的旋转曲线

高亚伟 河北师范大学

旋转曲线表示距离银心不同距离处的旋转速度，其可以用来探测银河系的结构和质量分布，给银河系质量模型以观测约束，进而探究银河系内暗物质的存在。我们准备利用碳星作为标准烛光去确定其光度距离，进而来研究银河系的旋转曲线和质量分布。

近邻矮星系在角动量和轨道上反常分布

李鹤凡 国家天文台

基于 Gaia EDR3，我们计算了 46 个近邻矮星系的自行及其误差。结合其他研究，我们提升了部分矮星系的自行精度，并将样本增加到 47 个。使用贝叶斯方法，可以得到矮星系三维位置与速度，进而计算角动量。36%到 57%的矮星系角动量指向 VPOS 结构，这种集中的指向与宇宙学预期的各项同性相悖。使用质量范围从 2.8*10^11 M_Sun 到 15*10^11 M_Sun 银河系引力势模型，我们分析了矮星系的轨道。与开普勒定律相反，它们更多地集中于其轨道近心点附近。选择效应难以完全解释这一现象，这表明有大量矮星系没有被发现，或者它们不是银河系的卫星星系。

银河系外晕中的壳结构

叶大塽 中国科学院大学

基于 Gaia DR3 中的 RR Lyrae 星表，我们用改进的幂律截断模型和两种方法拟合数据，发现有两个截断半径与 Gaia-Sausage-Enceladus(GSE)的两个远心点堆积的位置一致。此外，还存在一个由人马座流导致的截断。结合拟合得到的所有截断半径，我们分析金属丰度[Fe/H]随球半径 r 以及在柱坐标 R-|z|下的变化规律。在 36-96kpc，三轴椭球中的 z 与 x 轴比要比内晕中的小很多。而在 66-96kpc,三轴椭球的主轴方向完全不同于内晕中由 Hercules-Aquila Cloud (HAC)和 Virgo Overdensity(VOD)所主导的方向。我们认为这些现象是由一些位于低纬度处的高密度结构造成的。最后，我们使用 HDBSCAN 聚类算法探索到了分布于 50kpc 以外且相对背景晕较富金属的壳结构，并且认为它可能是 GSE 在外晕中的远心点堆积，这与最近的数值模拟结果一致。

几何曲率与天体附近粒子圆轨道

乔琛凯 重庆理工大学

张贴报告

Two Stellar-mass Black Hole Candidates from LAMOST Time-domain Survey

安黔渝 厦门大学

Graphene, Fullerenes and Nanotubes in the Space

陈秀慧 湖南文理学院

We present a series work about carbon dust in the space, which includes the theoretical calculation of IR emission of graphene, C24, and the possible detection of

infrared emission of planar C24, and also Fullerenes C60 close to the HII region candidate IRAS 17450–2759 toward Sgr B2. An absorption spectrum of carbon nanotube (CNT) in the space is also presented here. The IR emission spectrum of graphene from theoretical calculation showed unusual IR emission features at ~ 6.6, 9.8 and 20 μm. We have placed an upper limit of ~ 5 ppm of C/H on the abundance of graphene in the diffuse ISM. Subsequently, we have searched for characteristic IR emission features of C24 toward the high-mass star formation region (HMSFR) Sgr B2, and detected possible IR emission from C24 at ~ 6.637, 9.853 and 20.050 μm for the frst time in HMSFR. Those three IR emission features are also accompanied by the characteristic IR emission of possible C60. We also calculated the absorption spectrum of (5, 0) CNT, the smallest CNT, using the discrete dipole approximation, which exhibits four spectral features, peaking at ~ 0.3, 0.5, 0.9, and 2.9 μm.

Eclipsing Binaries in Gaia DR3

任方舟 中国科学院大学

Eclipsing binary systems (EBS) exhibit optical variability because of geometric properties rather than intrinsic physical variations. Their light curves vary from various parameters of the systems. As variables, EBS have several advantages such as high abundance, wide distribution, a broad range of stellar types and states, and a large number of special components, etc. They serve as a valuable complement to previous studies of stars and the Milky Way. Although the number of observed EBS is rapidly increasing, especially after the million EBS determined by Gaia DR3, large-scale studies based on such systems are still scarce.

In this research, I undertake a series of specific investigations on EBS, including studies on the structure of the Milky Way, statistical analysis of stellar activity, and the selection of unique stellar types. Additionally, I am dedicated to laying the groundwork for future time-domain astronomy, particularly in the context of multi-band, high-frequency observation modes for EBS research.

探究低质量 AGB 星碳-13 中子源特征的一种新方法

张凤华 沧州师范学院

数值模拟疏散星团动力学基本面演化的 CSST 观测

吴 开 西交利物浦大学

不少星团动力学模拟都假设星团初始处于位力平衡状态。虽然球状星团大多都处于位力平衡（Djorgovski 1995），但 SDSS DR14 的数据显示，银河系内年老的（大于 100Myr）疏散星团都处于过位力状态（Pang et al. 2018），即处于由 K 波段光度 Lks、半光度半径 rh、一维速度弥散 sigma1d 张成的三维相空间中位力平衡面的上方。动力学模拟的位力平衡的初始条件是否合理？我们用 NBODY6++GPU 和 PeTar 模拟了初始位力平衡的各种大小的星团（粒子数从 1k 到 1000k），并使用 GalevNB 模拟哈勃、Gaia 和 CSST 对其的观测的星等和光谱，得到在相空间中的演化路径。通过检验这些初始位力平衡的星团是否会经过实际观测数据点，来判断疏散星团初始形成时的位力状态。而另一方面，未来的 CSST 任务会进一步观测星团。我们将模拟转化成的 CSST 的可观测量：星等、颜色，特别是建立起颜色梯度和速度弥散的联系，以此预测 CSST 测光数据研究星团动力学状态的方法。

Sub-kiloparsec scaling relations between soft X-ray luminosity, dense gas and star formation rate in four nearby star-forming galaxies

张春意 厦门大学

The Most Distant and High Extinguished Open Clusters found in Our Milky Way

何治宏 西华师范大学物理与天文学院

Despite having data for over 10^9 stars from Gaia, only less than 10^4 star clusters and candidates have been discovered. Particularly, distant star clusters are

rarely identified, due to the challenges posed by heavy extinction and great distance. However, Gaia data has continued to improve, enabling even fainter cluster members to be distinguished from field stars. In this work, we will introduce a star cluster search method based on the DBSCAN algorithm; we have made improvements to make it better suited for identifying clusters on dimmer and more distant stars. After removing member stars of known Gaia-based clusters, we have identified 2086 objects with |b| < 10 deg, of which 1488 are highly reliable open star clusters, along with 569 candidates, 28 globular cluster candidates and 1 irregular galaxy IC 10 at low Galactic latitudes. We found that the proper motion of IC 10 is similar yet slightly different from the water maser observations, which is an important result for the comparison with Gaia and VLBA. Besides, when compared with the star clusters appearing in Gaia DR2/EDR3, we have found nearly three times as many new objects above a distance of 5 kpc, including hundreds of them above Av > 5 mag. And it has enabled us to detect a higher number of old clusters, over a billion years old, that are difficult to detect due to observational limitations. Our findings significantly expand the remote cluster sample and enhance our understanding of the limits of Gaia DR3 data in stellar aggregates research. The full position/CMD/isochrone figure set for 2085 clusters can be seen in China-VO: https://nadc.china-vo.org/res/r101258/.

仪器、时频分会场报告

8 米级成长型通用光学望远镜 EAST 项目

吴学兵 北京大学

本报告将介绍北京大学牵头提出的 6-8 米成长型通用光学望远镜 EAST 项目。采用成熟的拼接镜面技术，拟在 2028 年第一期建成 6 米口径，2030 年全部建成后口径达 8 米，将成为亚洲境内最大通用型光学望远镜，为我国天文学家提供能最大程度满足多样化观测需求的世界一流光学波段观测利器。

eXTP 卫星上的偏振测量 X 射线聚焦望远镜阵列

姜维春 中国科学院高能物理所

偏振测量 X 射线聚焦望远镜阵列（Polarimetry Focusing Array，简称 PFA）采用 Wolter I 型 X 射线聚焦镜和气体像素探测器（GPD），对 2-8 keV 的 X 射线同时具有成像、偏振、时变和能谱测量能力。PFA 是增强型 X 射线时变与偏振探测（enhanced X-ray Timing and Polarimetry，简称 eXTP）空间天文台的四种载荷之一，其有效面积可达 300cm^2@3keV，偏振灵敏度（MDP@2-8keV）优于 3%（10^6 s, 1mCrab），角分辨率 30″@2keV(HPD)，能量分辨率优于 1.8keV@6keV，时间分辨优于 10μ s。本报告将全面介绍 PFA 的载荷配置、科学观测能力和研制进展情况。

LOT 近地层自适应光学模拟和环状图像闪烁传感器测量大气光学湍流阈线方法的研究

裴冲 中国科学院南京天光所

12 米光学红外望远镜(LOT)是我国拟建设的一台通用大型望远镜，能够满足我国天文前沿科学研究的迫切需求。该望远镜将结合近地层自适应光学技术（GLAO），在 14 角分的视场内有效改善台址视宁度的影响，提高观测效率和科学性能。本报告介绍了 LOT 望远镜 GLAO 系统模拟和新一代环状图像闪烁传感器（RINGSS）测量大气光学湍流阈线的研究。系统分析了应用于中国大型光学

红外望远镜的近地层自适应光学技术的校正能力，分析了拼接镜面共相误差、系统装调误差、非共光路像差、大口径自适应变形镜等对校正能力的影响。研究了 RINGSS 的测量原理、数值模拟和数据处理方法，搭建实验系统，并开展了 RINGSS 和差分图像运动湍流测量仪 DIMM 的对比实验，获得视宁度、等晕角、大气相干时间和湍流强度廓线等重要的天文台址参数。

大视场望远镜光学设计关键指标与技术综述

董云芬 中国科学院南京天文仪器有限公司

LCT 望远镜及相关亚毫米探测仪器升级进展

杜伟杰 上海师范大学

LCT 项目为上海师范大学、加州理工学院、智利康塞普西翁大学三家联合发起的一项望远镜国际合作项目，目标将原位于夏威夷 Mauna Kea 山上的 CSO 亚毫米波望远镜搬迁到智利 Atacama 高原，恢复其观测功能，并完成接收设备的升级换代。在过去三年中由于受到不可抗因素影响进展一度缓慢，今年我们加快了搬迁进度，望远镜有望于 2023 年底前完成全部搬迁工作，将于 2024 年进行调试和试观测。本报告将详细介绍 LCT 望远镜的具体情况及其后端亚毫米探测仪器的升级进展。

南极天目望远镜样机研制及测试

周丹　中国科学院上海天文台

上海天文台提出 “南极天目望远镜计划”，拟建造百台小望远镜阵，利用南极上百天的连续极夜，获得 1 万平方度天区、每年上百天不间断的时域观测。望远镜具备自主控温系统和远程运控系统，结合漂移扫描技术，开展凝视观测。望远镜无需驱动、无需拆装、整体运输、落地安家，能够有效避免由于长途运输、反复拆卸安装和望远镜自身转动造成的器件故障和结霜结雾等。2022 年底，上海天文台研制南极天目样机运至南极中山站；2023 年 3 月-6 月对样机进行性能测试，并在极夜期间开展了连续观测。

MCI 滤光片研制及科学应用

郑立新 中国科学院上海天文台

中国空间站巡天望远镜 CSST 配有多个天文终端其中多通道成像仪 MCI 是终端之一，该终端中的滤光片是与科学目标应用应用息息相关，本报告主要介绍滤光片研制进展及其科学应用。

POLAR-2 能谱探测器伽马暴触发及定位软件算法研究

吴佩莲 成都理工大学

POLAR-2 是我国“天宫二号”上搭载的 POLAR 实验的后续实验项目，是增强型的伽马暴偏振探测仪器，主要用于伽马暴瞬时辐射的高精度偏振测量，计划于 2025 年前后发射安装在中国空间站开展空间高能天文实验。为了给偏振测量提供必要的输入，需要对伽马暴进行定位并进行能谱测量。POLAR-2 中的宽能段能谱探测器 BSD 载荷的主要功能是实现 10 keV-2 MeV 范围内伽马暴的能谱测量与定位。本报告主要介绍探测伽马暴所采用的信噪比触发和编码孔径成像算法，以及基于 FPGA 和 DSP 的数据传输和计算的触发及定位软件测试系统的设计。该系统可以在没有探测器输入的情况下，通过以太网传输测试数据，验证 BSD 触发定位算法的可行性和性能。同时，本报告还介绍了采用该系统以及模拟产生的伽马暴观测数据所开展的伽马暴触发和定位算法的测试验证工作。测试结果表明，该系统满足载荷设计需求，可以快速地在地面进行验证和优化触发定位算法。

基于混合编程技术的高对比度成像波前检测及校正在轨算法设计

陈嬰瑜 中国科学院南京天光所

空间超高对比度成像技术是开展类木甚至类地行星直接成像探测的必要条件，成像对比度需要达到 10-8 以下。上述目标的实现需要凭借空间高对比度成像波前检测和校正方法，对光学波像差提供精确的控制。传统的基于纯 CPU 设计的算法成熟稳定，可以实现高性能的波前处理，但受限于航天用 CPU 的性能，

空间波前检测算法需要采用 FPGA 作为波前检测计算的主要单元。本文利用 FPGA 和 CPU 混合架构实现波前校正算法，可以实现对像差的校正，在闭环校正中实现高对比度成像暗区的锁定，以及试验 FPGA 计算精度和对比度衰减情况之间的关系。该架构还适用于地基自适应光学系统，可以实现准确高速的波前检测及校正，在地基 ExAO、GLAO、MCAO 中也有较大的应用前景。

系外行星成像星冕仪模块波前相机焦面组件的热设计

文成成 中国科学院南京天光所

波前相机焦面组件是波前探测相机的关键成像器件，是系外行星成像星冕仪模块的关键载荷。为保证成像质量，减小暗电流和热噪声，需要对焦面 CCD 和其他大功耗电子器件进行有效散热，以保证焦面组件的工作性能与可靠性。基于有限的空间和散热资源，本文采取柔性石墨烯导热索加槽道热管的散热方案，对其散热路径进行了详细的热设计和热分析。利用热分析软件建立有限元模型并进行热仿真计算，结果表明：稳态时，CCD 芯片工作温度范围为--12.8~-10.9℃，满足控温指标，其余组件工作温度也均在设计要求内，表明热设计方案合理可行，满足任务需求

基于多色相差法的条纹跟踪技术研究

陈欣扬 中国科学院上海天文台

天文光干涉阵观测具有高分辨力的特点。大气湍流、仪器温度漂移及振动引起光程差快速随机变化，会造成条纹测量信号无法保持长时间稳定，大大降低了观测灵敏度。条纹跟踪技术用于检测并补偿因大气湍流扰动给长基线光干涉阵造成的子望远镜之间的光程差起伏与跳动。目前条纹跟踪技术探测灵敏度有限，不能满足对于活动星系核/类星体宽线区多样本的观测需求。多色相差法通过从多孔径干涉的光学传递函数中提取相位和解缠相位差获得光程差。该方法可一次采样获得所有基线的光程差，光束传递过程中的能量损耗极少。本文研究将多色相差法与集成光子芯片结合，通过单片芯片同时实现斐索型多路光束干涉和多色分光的功能。首先开展算法仿真，选择最优通道中心波长及带宽参数；其次设计非冗余线性阵列排布方案，研究多孔径的相位信号高精度提取方法；最后验证了运用多色相差法实时补偿子孔径光程差的有效性。

盱眙百米级光干涉阵关键系统测试进展

魏炜　中国科学院南京天光所

长基线光干涉技术已成为当前以及未来实现高分辨率天文观测的重要手段之一，国际上已有 VLTI、CHARA 以及 MROI 等百米级大型长基线光干涉阵列，而国内尚无可用的长基线光干涉天文观测设备。南京天光所在国家自然科学基金重大仪器及科技部重点研发计划的支持下，正于紫金山天文台盱眙观测站建设我国百米级长基线光干涉阵列，本报告将对该阵列终端相关系统的测试进展做汇报。

四孔径干涉望远镜样机研制

张聪聪 中国科学院上海天文台

正在研制一台四个 10cm 子孔径组成的干涉成像望远镜，通过斐索型光干涉技术实现瞬时直接成像，获得相当于一台 28cm 望远镜的等效分辨率。采用闭环倾斜和条纹跟踪技术，实现实时共相。

盱眙百米级光干涉阵列电控系统研制进展

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报告介绍了望远镜控制系统的硬件部分，包括控制器、电机、编码器和传感器等关键组件。这些硬件组件是实现望远镜运动和观测功能的基础。

望远镜控制系统的核心是电机。电机通过转动望远镜的各个轴，实现望远镜的定位、跟踪和观测目标的功能。一般常用的是力矩电机，较高的扭矩，适用于快速定位和跟踪目标；但是容易发热，影响观测。报告课题使用的是直驱电机，相比前者，它拥有高精度、高效率、高相应速度、可靠和静音等优点。

编码器是用于测量电机转动位置和速度的装置。它可以将电机转动的角度或位置转化为数字信号，提供给控制系统进行反馈和校准。编码器的精度和分辨率决定了望远镜的定位精度和跟踪能力。

传感器在望远镜控制系统中起到重要的作用。例如，光学传感器可以检测望远镜的姿态和方向，帮助控制系统实现自动定位和跟踪目标。温度传感器可以监测望远镜的温度变化，保证望远镜在不同环境下的稳定性和精度。

除了以上关键组件，望远镜控制系统还包括电源供应、接口电路、通信模块等辅助硬件。电源供应为系统提供稳定的电力支持，接口电路用于连接各个硬件组件，通信模块实现与计算机或其他设备的数据交互。

综上所述，望远镜控制系统的硬件部分包括电机、编码器、传感器等关键组件，它们共同协作，实现望远镜的运动和观测功能。这些硬件的选择和设计对于望远镜的性能和精度具有重要影响。

肖特零度®微晶玻璃及新型加工技术助力天文探索

蒋建伟 德国肖特集团

地基望远镜风屏结构设计

任志敏 中国科学院南京天光所

风载和湍流带来的望远镜振动和折射率突变会抵消开放式圆顶提供的优良圆顶视宁度条件，风屏结构可以在保证优良视宁度条件的前提下降低环境风的不利影响。为了研究风屏结构对望远镜周围环境风速分布、湍动能(Turbulence kinetic energy, TKE)分布、镜面风载和圆顶视宁度的作用结果，本文建立了望远镜、开放式圆顶和塔架的几何模型，然后利用 Fluent 进行了仿真实验，分析了在环境风速为 10m/s 的条件下，在不同的风屏杆件排布方向、风屏透过率和风屏杆件尺寸时，望远镜主观测方向及后方的风速和 TKE 的数值与分布情况以及望远镜封窗表面的风压分布和开放式轻质圆顶的视宁度，并与风洞实验结果进行对比。结果表明，在距离风屏 10m 处，杆件纵向排布的风屏减风高度较杆件横向排布的风屏大约 45%；风屏透过率为 50%时，可以同时满足减风速和湍动能的要求；望远镜的最大高度与风屏的距离应该满足一定的关系；风屏杆件的长度和宽度不会影响风屏结构的减风效果，但较大的风屏长度会增大后方的湍动能值；风屏的透过率越大，望远镜表面的风压就越大；风屏透过率为 50%时，圆顶视宁度达到最大值。结论表明，理想的风屏结构应该满足 1.纵向杆件；2.透过率 25%~50%；3.较小长度和较大高度的杆件。

多望远镜联合观测的时间同步系统研制

赵志雄 中国科学院国家授时中心

GPS 时间比对长期稳定度分析

高 喆 中国科学院国家授时中心

GPS 共视时间传递（GPS CV）和 GPS 精密单点定位（GPS PPP）时间比对技术被国际上主要时间实验室广泛用于参与协调世界时（UTC）的计算，链路长期运行的稳定性是当前影响高精度时间比对的主要因素。为了确保时间传递的长期稳定性，必须对链路进行校准，可是在许多情况下由于受限于费用和合适的校准设备，不能频繁校准。代替重复校准，可以通过两个链路之间的比较（所谓的双差）获得关于这些链路长期稳定性的一些信息。本文利用国际权度局（BIPM）的 GPS 移动校准站对中国科学院国家授时中心的比对链路校准后两年的数据，基于同源 GPS 接收机开展零基线共钟比对分析，其次以中国科学院国家授时中心（NTSC）和德国物理技术研究院（PTB）所保持的国家标准时间作为比对对象，建立长基线 GPS CV 和 PPP 比对实验，以研究比对链路的长期稳定性。结果表明：基于 NTSC 的 GPS 时间比对链路长期稳定性为 1.88ns，可以满足国际时间比对需求。

基于小波多尺度变换的 TWSTFT 和 GNSS PPP 链路融合算法

王 翔 中国科学院国家授时中心

提出一种 TWSTFT 和 GNSS PPP 远程时间传递链路的多分辨率数据融合方法，利用多尺度分析的思想，将 Kalman 滤波理论的基于模型的动态系统分析方法与小波分析理论的基于统计特性的多尺度信号变换方法相结合，建立起目标状态观测信息的多尺度数据融合估计算法。首先基于小波变换的分时分频多分辨率特点，把原始数据进行小波变换，接着分别在各尺度上进行 Kalman 滤波估计，最后通过小波变换的 Mallat 快速重构算法，得到融合后的结果。使用中国科学院国家授时中心(National Time Service Center, NTSC)和德国联邦物理技术研究所

(Physikalisch-Technische Bundesanstalt, PTB)之间的时间传递结果进行处理分析，结果表明融合算法能够整体改善链路的稳定度，尤其是短期稳定度获得了显著提升，并且能够处理链路异常中断、PPP 链路“天跳”的情况，提高链路的可靠性和鲁棒性。此算法广泛适用于不同采样率的时间传递链路的数据融合估计。

联邦 Kalman 滤波在多模 GNSS 时间比对融合中的应用

王威雄 中国科学院国家授时中心

为充分发挥多模 GNSS 星座的优势，我们提出了一种利用联邦 Kalman 滤波的多模 GNSS 时间比对融合方法。首先，在长基线和短基线上分别获得单系统共视结果。然后，以 TAIPPP 链路为参考，获得单系统共视解与 TAIPPP 之间的偏差。将单系统解都与 TAIPPP 链路对齐后，利用联邦 Kalman 滤波器将单系统解融合为一个全局解，并将其与标准差加权解、TAIPPP 和单 Galileo 解进行比较。结果表明，联邦 Kalman 融合解与其他时间比对方法的结果一致，并且其频率稳定度在平均时间小于 10000s 时最高。在 NTSC-PTB 和 NTSC-ORB 长基线上，联邦 Kalman 融合解与 TAIPPP 差的标准差相较于单 Galileo 共视链路的标准差增益因子分别为 3.57 和 2.57。在 TP-PTB 和 ORB-PTB 的短基线上，增益因子分别为 1.43 和 2.35。最后，分析了联邦 Kalman 滤波算法的鲁棒性，当子系统发生故障时，联邦 Kalman 滤波算法可以快速检测和隔离故障，保证了全局融合解的准确性。

基于国产光抽运小铯钟的驾驭算法研究

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基于国产光抽运小铯钟的特性研究驾驭算法，算法要求建立国产光抽运小铯钟与参考时间尺度的钟差状态模型和测量模型。驾驭的目的是控制光抽运小铯钟的信号，使其时间和频率值接近参考时间尺度。钟差状态模型中包括标量输入信号，它被馈送到致动器，例如相位微调仪，相位微调仪是一种通过增加频率阶跃连续校正时钟信号相位的设备。可用的输出信号或测量值是自由运行的光抽运小铯钟和参考时间尺度之间的相位偏差，或驾驭后的光抽运小铯钟和参考时间尺度之间的相位差。主要研究线性二次高斯控制方法用于国产光抽运小铯钟的驾驭，比较不同驾驭参数的选取对驾驭结果的影响，以及选取不同驾驭间隔的驾驭效果。

极紫外非球面光学成像系统面形检测与装调技术

卞殷旭 浙江大学

VIPA 光谱仪多模输入色散特性研究

朱小明 中国科学院南京天光所

在天文领域，一般采用多模输入的光纤光谱仪进行观测。望远镜口径越大，对传统光栅光谱仪的尺寸要求也越高。在这项工作中，我们从理论和实验两方面研究了多模光纤输入的虚拟成像相控阵（VIPA）光谱仪的色散特性。我们设计并搭建了一台工作波段 750-770nm 的光纤输入 VIPA 光谱仪。利用激光器频率梳（重复频率为 808 MHz）对光谱进行定标后，我们发现芯径分别为 10、25、50 和 105 μ m 的多模光纤输入时的光谱分辨率与单模光纤输入时相当，分辨率均在 76.2 万到 89.7 万，且传输效率相当。这表明，与传统阶梯光栅光谱仪相比，VIPA 光谱仪光谱分辨率受输入光纤纤芯直径的影响要小得多。研究还发现，VIPA 光谱仪的衍射包络线依赖于光源的相干性，而点扩散函数的半高全宽与探测器上的空间位置成反比。由于 VIPA 光谱仪在主色散方向上没有成像过程，因此光谱分辨率对输入狭缝的宽度/光纤芯径不敏感。这使得 VIPA 光谱仪有望作为超大型望远镜上的终端光谱观测仪器，实现超高光谱分辨率（R～30 万）。

基于光波导芯片的微型光谱仪研制

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光谱学是天文观测最重要的手段之一，可以用于研究的领域覆盖从宇宙学到系外行星研究。使用传统的衍射光栅设计的光谱仪体积、重量和造价至少和望远镜口径的 2 次方成正比。这就决定了使用传统的方式为未来 30 米的望远镜研制光谱仪不光造价极其昂贵，而且由于体积巨大又给仪器的热和机械的稳定性带来巨大挑战。这就必然决定了在未来光学和红外光谱仪技术上需要新的原始创新。近些年光子学在天文光谱学的应用显示出在将大型望远镜的光谱仪微型化方面的潜力极大。上海天文台已联合西湖大学和光电技术研究所开展了基于光子学技术的 WSL 光谱仪的研制工作，此项工作由上海天文台牵头，由上海天文台的科学团队提出科学需求，技术团队实现光谱仪的实验室安装、调试和检测工作；西湖大学集成光学实验室以其完备的聚合物光波导芯片设计和制备能力，为光谱仪的

研制提供测试芯片；光电技术研究所带有自适应光学的丽江 1.8m 望远镜为项目开展提供了 on-sky 观测望远镜。目前已在上海天文台完成了芯片性能的实验室测试，在测试过程中将芯片的应用需求反馈回西湖大学以便对芯片进行反复优化，以满足天文光谱仪使用的芯片要求。上海天文台和西湖大学已开展太阳光谱测试的联合实验，得到了中色散和低色散芯片的太阳光谱。其次，针对 1.8m 望远镜的库焦参数，设计了望远镜与微型光谱仪的耦合系统，正逐步完成微型光谱仪的机械设计和加工，计划在 2023 年底实现 on-sky 对天观测，从而获得基于 WSL 波导芯片的光谱观测数据。

光学天文观测环境控制研究

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光学天文观测环境是影响望远镜观测精度与效率的重要因素之一。由于受到天文台站建筑布局和圆顶内部湍流的影响，望远镜附近的观测环境发生改变，无法与选址时的观测环境媲美。为了充分发挥优秀的台址条件，提高望远镜观测精度，对如何在已选址后的台站建设、圆顶设计和观测运行过程中，实现观测环境控制提出了迫切需求。本次报告将从观测台站整体布局规划、圆顶内部环境控制两方面介绍相关研究工作，包括地表特征、建筑布局对观测环境的影响、圆顶外形和圆顶自然通风孔设计等。

基于深度学习的大视场巡天望远镜计算机辅助装调

张一鸣 中国科学院南京天光所

大视场巡天望远镜可获取大规模高质量、高灵敏度与高时频的星像观测数据，是现代天文望远镜的重要发展方向之一。基于对望远镜像质控制、镜筒设计等综合因素的考虑，现代大视场巡天望远镜一般均采用快焦比主镜设计，导致副镜针对失调具有很高的灵敏度，因此副镜装调方法需要先通过多个边缘视场波前传感器进行波前检测，然后对副镜失调量进行实时解算并校正副镜。

为了降低装调系统的硬件复杂度、提高装调的效率，本文提出了一种新型无波前传感器的实时高精度装调方法，其通过深度学习技术将焦面星像形变与失调量建立起映射关系，进而由神经网络模型直接计算出望远镜的失调量参数。研究工作具体如下：

1、建立了一种基于 ZEMAX 与 MATLAB 的动态链接库模拟方法，通过仿真获取望远镜各失调状态下的焦面点扩散函数，继而对其进行几何特征提取及拟合处理得到泽尼克系数，并以此与失调量建立用于深度学习装调的数据集。

2、搭建了一种基于 Mephisto 的深度学习装调模型，通过分析神经网络深度与模型精度及失调自由度之间的关系，确定网络的结构并进行超参数优化。结果表明在无噪声的情况下，该模型能精确计算望远镜各失调量，得到像质良好的点扩散函数图像，但存在由失调自由度非线性关系引起的计算退化问题。

3、针对望远镜不同失调自由度之间存在的非线性病态问题，本文提出了基于分步式神经网络模型的失调解算方法，通过两步式神经网络的结构调整与超参数优化，实现了大范围失调情况下的失调量高精度解算。

4、为了降低大气湍流对 Mephisto 深度学习装调模型的影响，通过鲁棒缩放方法对数据集进行预处理，用于抵御数据集中异常值的影响。结果表明本文提出的方法在受大气湍流的影响下依然具有鲁棒性，对失调量能进行精确计算并获得良好的像质，1000 组测试数据集中有 99%以上满足 RMS 光斑半径低于 18um。

微流星撞击的地面模拟实验

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由于龙虾眼光学 X 射线聚焦望远镜的结构特点，光学组件为单层，且微孔玻璃镜片极薄，其后直接为探测器（和探测器之间无其他组件遮挡），这使得这类望远镜升空后将直接暴露在微流星/空间碎片环境中，比以往的空间望远镜更容易在微流星撞击事件后产生功能性损伤(严重的可导致整个探测器失效)。因此，对于通量最高的 1-50μ m 直径微粒撞击望远镜模型的地面实验，将有助于了解和模拟在轨的损伤和机制。

针对 EP 卫星 WXT 载荷在空间环境中可能遇到的高速微流星撞击情况，通过等离子体驱动微小碎片加速器对微粒进行加速，撞击在包含 MPO 镜片及 CMOS 探测器的 WXT 简化模型上。由获得的撞击信号计算微粒速度，对镜片及探测器样品表面进行电镜观察，获得典型的撞击形态，统计撞击坑与微粒数量的大致对应关系，以研究撞击产生的损伤及可能的撞击过程和机制，从而估计 WXT（及其他使用 MPO 镜片的空间 X 射线望远镜）在轨的损伤情况。

人工智能与公众科学结合促进天文新发现

贾鹏　太原理工大学

光子灯笼技术及其天文应用

韩子健 中国科学院南京天光所

天文观测仪器的蓬勃发展推动了对小体积、低成本、高效率的新一代仪器的研究工作。近年来，集成光学元件的发展为天文技术与方法带来了新机遇，天文光子学应运而生，可为天文观测提供低成本、集成化的新一代高性能天文光学仪器。本报告将介绍光子灯笼及其天文应用。光子灯笼是一种低插入损耗、高模式选择性的新型全光纤线性光学器件，以综合单模光纤系统与多模光纤系统的优势，并实现模式转换与模式控制，可用于天文红外光谱滤波、光纤扰模、波前传感等方面。报告就光子灯笼器件的概况、工艺制备、天文领域前沿应用、挑战与前景等方面进行介绍。

红外天文滤光片的发射率测量研究

赵志军 河南师范大学

红外滤光片被广泛用于各类红外天文终端仪器中，发射率是决定其红外热辐射水平的重要参数。滤光片一般靠近探测器的位置，对仪器灵敏度有很大影响。滤光片发射率不仅直接决定仪器背景辐射大小，而且决定了仪器热背景控制所需制冷温度。因此，有必要测量滤光片发射率。但是滤光片属于透明材料且辐射信号弱（发射率低），要准确获知其发射率很困难，本文针对滤光片信号弱的问题，提出采用多元定标法获取滤光片发射率，测量灵敏度优于 0.04。

大口径天文光学镜面折衍混合补偿检测研究

黄亚　中国科学院南京天光所

随着现代天文光学系统的发展，天文镜面口径越来越大，面形也越来越复杂，这给天文镜面的加工和检测带来了极大的挑战，传统的光学干涉检测方法很难满足其检测需求。基于计算全息可以产生任意形状波前的特性，本报告研究基于计算全息的大口径天文光学镜面折衍混合补偿干涉检测技术，对大口径长焦距天文

望远镜主镜的离轴子镜实现折衍混合缩焦检测，减少干涉检测光路长度，降低对实验室场地和环境的要求;同时,对改正镜组中的大口径快焦比高次非球面透镜，借助辅助透镜，实现高次非球面的折衍混合补偿干涉检测。

下一代帕洛马天文台光谱仪的研制进展

季杭馨 中国科学院南京天光所

NGPS 作为一台宽波段、高通量和智能化的新一代光谱仪，将安装在美国帕洛马天文台 5 米海尔望远镜的卡焦焦点，替换有 40 多年历史的双通道光谱仪（DBSP）。NGPS 整体为四通道设计，单次曝光可实现 310nm-1040nm 的宽波段覆盖;光谱分辨率可实现 1800-6000;包含大气和望远镜的的仪器峰值效率优于 45%，达到国际先进水平。光谱仪焦面前留有自适应光学系统接口，配置连续可调像切分器，将成为中大型望远镜上先进的现代天文光谱仪。该光谱仪由北京大学、中国科学院国家天文台、南京天文光学技术研究所与美国加州理工学院联合研制，计划 2023 年 9 月完初光。

CSST 上积分视场光谱仪的分辨率模拟

龙琳　西华师范大学

中国空间站望远镜(CSST)是我国载人航天工程空间应用系统重大科学项目，口径 2 米。它具有大视场(~1.1 平方度)、高像质、多波段(从近紫外到近红外)等突出特点，是我国天文学走向国际前沿的重要机遇。其配备的光学设施积分视场光谱仪（IFS）将充分利用空间观测不受大气视宁度限制，因而可以进行地面望远镜无法企及的高空间分辨观测的特点，在 0.35-1.0 微米实现 0.2 角秒分辨率的成像光谱观测，这对星系的形成和演化、大尺度结构和宇宙学、暗物质和暗能量等的研究具有重要价值。同时， IFS 实现的高分辨率光谱观测填补了望远镜在分辨率上的参数空白，可以更好地去探索一些国际天文学前沿科学目标，为“未知的未知”科学发现提供技术上的支撑。

天文阶梯光栅拼接技术研究

韩建　中国科学院南京天光所

2023 年南极冰穹 A 大气视宁度测量结果

马斌　中山大学

基于全天相机 KLCAM 的超大视场图像天体位置全局定标研究

杨栩　中国科学院国家天文台

南极内陆高原的最高点 Dome A 由于独特的地理条件优势，非常适合展开天文观测，且我们已初步证明 Dome A 具有地面最佳的天文观测条件。其中，我们利用自主研发的全天相机南极昆仑云量极光监测仪（KLCAM），采用目视分类的半定量方法研究得到 Dome A 拥有 83%的晴夜时间。然而，该方法仅为半定量的方法，为了定量地对云量和极光进行统计研究，一个最合适的办法即为对全天相机图像展开测光分析，由此可获得云量和极光的定量统计。而展开测光的第一步即是对其中的天体位置进行定标。由于全天相机等图像超大视场的特性，其投影关系通常为非线性，天文图像处理中通常采用的如 SCAMP、Astrometry.net 等软件则无法对该种图像进行全局处理，仅能通过划分区块进行处理。而我们则利用全天相机 KLCAM 的图像，展开极大视场图像天体位置的全局定标研究，再对全天的天体展开测光。通过测光，我们不仅可以对云量极光展开定量分析，还可以研究云量极光的实时空间分布，协助望远镜的实时调度，并能对亮星展开时域天文研究。我们以第谷卫星星表作为参考，对单幅图像迭代解算出图像的天顶偏差与畸变项，并以此计算全局天体位置。通过我们的计算，在图像 x, y 两个方向天体定标的标准差均可以小于 1 个 pixel。

月球轨道 VLBI 地面验证系统

上官伟华　中国科学院上海天文台

China is planning to launch a relay satellite in the coming years with a payload for the Earth–Moon verylong-baseline interferometer observation research and scientific applications, known as the lunar orbit very-long-baseline interferometry

(VLBI) experiment (LOVEX) system. This system will perform the LOVEXs for in the world, and will improve the accuracy of planetary spacecraft orbit determination and the scientific observation capabilities of astrophysics and astrometry. Prior to launch, key technologies of the system must be verified, so we have established a LOVEX ground validation system with similar performance to the LOVEX system. The LOVEX ground validation system consists of a 4.5-m ring-focus antenna, Xband receiver, frequency converter and digital backend, hydrogen maser, and monitoring and control software. Using this system, we have successfully conducted VLBI differential observation experiments with the Shanghai 65 m radio telescope and Beijing 50 m radio telescope. The experimental results show that, after calibration with NRAO150, the standard deviations (STDs) of delay error of Tianwen-1 are within 0.5 ns, consistent with the theoretical timing accuracy, verifying the feasibility of the LOVEX time-delay calibration.

基于双星波前闪烁技术高空间分辨率测量近地层大气湍流廓线的研究

傅莹　中国科学院南京天光所

中国地基大型光学红外望远镜的近地层自适应光学系统设计都需要天文台址的低层大气湍流廓线的长期高空间分辨测量数据，为此南京天文光学技术研究所团队开展了 LOLAS(Low Layer SCIDAR)仪器的研制工作。报告将介绍该仪器的测量原理、模拟及观测实验结果，分析了目标星光谱及曝光时间等因素对 LOLAS 测量结果的影响，开展了 LOLAS 与 LuSci(Lunar Scintillometer)的观测对比实验，实验结果呈现很好的一致性。

基于机器学习的全天相机夜间云图自动分类

钟鑫　中国科学院南京天光所

云量覆盖直接影响望远镜的观测质量，实时掌握天空的云量分布将显著提升望远镜的观测质量和观测效率。但是目前对地基天文望远镜台址云量统计主要采用人工观察的方法，精度易受到观测员观测经验等主观因素的影响，而且工作量巨大，难以实时处理。本文提出一种机器学习方法对新疆慕士塔格观测站 2018

年夜间云图进行自动分类与统计，以期达到自动统计台址云量信息并为地基望远镜调度工作提供参考目的。把整个云图分成 37 个子区域，分别提取各子区域的天光背景、光照条件、星密度、云量大小等 19 个特征作为模型的输入，利用 XGBoost 算法实现对云量的分类。所提方法的处理结果表明所提模型对夜间云图的平均识别准确率可达 96.92%，全年可观测时间与人工观察统计方法相比的误差为 3%。所提方法为望远镜的实时调度提供了参考。

时域巡天望远镜视场像质新评价方法

陈超　中国科学院南京天光所

时域天文是天文研究中最热门的领域之一，大视场光学望远镜是时域天文研究的重要工具，对于大视场望远镜光学系统来说，成像的星点对称性越好、整个视场内成像均匀性越好对于天体定位、天体测光等方面的研究越有积极的作用。不同的望远镜光学结构具有不同的像点形状和分布特性，例如应用广泛的 R-C 系统其成像特点为中心视场像斑形状对称性极佳，边缘视场像斑形状劣化严重，然而使用传统的评价方法，例如光迹图 RMS 半径或者 80%能量半径等，很难描述出这种差异，更不能对不同光学系统作出有效的区分。针对于此，我们提出了一中基于光线追迹的新模型——RSVA（Raytracing&Spot-Vectorindex&Angle），使各光学系统在传统方法无法有效描述和区分的像斑形状以及均匀性分布的情况下能实现约 3－5 倍的对比差异，部分关键指标甚至能相差一个数量级。RSVA，是一种从新的视角观察光学系统的评价方法，特别适合于描述大视场光学系统像斑形状分布，它也是进一步研究光学系统与测光精度、定位精度等方向的光学系统评价基础。

基于等厚干涉的拼接镜面边缘传感器研究

张茜　中国科学院南京天光所

共焦及共相检测是大口径拼接镜面望远镜的关键技术之一。传统的拼接镜面边缘传感器多采用电学测量原理，例如电容式、电感式、电涡流式，可以达到很高的测量精度。但由于电子学元器件本身的特性，此类电学传感器对环境变化较为敏感，存在难以消除的温漂、时漂现象。针对此类问题，本团队开发了一种基于光学等厚干涉的边缘传感器，通过图像处理方法从干涉图中反解出每个拼接子镜的平移和倾斜误差（piston，tilt and tip)，从原理上避免了电子元件的温漂问题。

同时，该传感器针对镜面进行直接测量，没有中间误差；并且简化了拼接镜面的共相过程，无需在观测前进行单独定标，集共相定标与维持功能于一体。目前，已对该方案进行了仿真及实验研究，实验结果显示，共焦精度优于 0.02"rms，共相精度优于 15nm，能够满足大口径拼接镜面望远镜的实际需求。

大靶面科研级 CCD/CMOS 相机及其在天文观测中的最新应用

王帅　特励达普林斯顿仪器

Teledyne lnc.在全球成像市场占据主导地位。Teledyne Princeton Instruments（TPI）,Teledyne e2v（Te2v）,Teledyne Imaging Sensors（TIS）都是 Teledyne Digital Imaging US Inc.的业务部门，公司设计和制造高性能 CCD、sCMOS、ICCD、EMCCD、emICCD、InGaAs 和 HgTeGd 传感器和相机；光谱仪；以及用于科学研究、工业成像和 OEM 光学解决方案。40 多年来，我们一直在参与世界各地最激动人心的科学发现。使用我们的相机科学家能够观察到皮秒级的反应，并观察到宇宙伊始发出的微弱信号。借此机会我将详细介绍革命性的 COSMOS 相机以及它对未来巡天的意义，这是有史以来第一台大画幅、背照式、启用全局快门的 sCMOS 相机。此外，我还将介绍我们在天文学领域最新的令人兴奋的应用，希望我们的产品能够帮助更多的从事前沿天文研究的中国科学家。

张贴报告

天马望远镜主动面系统分布式控制软件

张栋　中国科学院上海天文台

望远镜主镜补偿法检测中鬼像的辅助作用

季波　中国科学院南京天文光学技术研究所

现阶段国内越来越多的科研机构投入到米级口径望远镜的研制中，这些望远镜一般采用单块口径 2 米左右的非球面主镜。由于体积、重量以及光学参数的限制，许多大口径非球面主镜的加工检测只能采用补偿法，而补偿检测所用的补偿

器常常无法避免鬼像的存在。通常我们认为鬼像是没有用处的，然而在同轴光路中鬼像又有其特殊的存在意义。本文从补偿检测的特性分析鬼像和系统光轴之间的关系，研究其在检测装调中的辅助作用，并将其运用于 1.6 米望远镜主镜的检测调试过程中，研究结果表明借助鬼像的状态判断和科学的装调手段，我们可以快速精确地实现光轴的校正，这对于大口径镜面的加工检测有十分重要的科学指导意义。

中山大学红外望远镜进展

马斌　中山大学

天力、天测分会场报告

地月空间的相对论时空基准

谢　懿　紫金山天文台

地月空间是人类太空活动的下一个重要场所：既是和平利用太空、共同开发的重要资源，也是大国博弈的“必争之地”。随着地月空间各种航天任务的开展，定位、导航和授时（PNT）也随之成为日益增长的紧迫需求，为此各国正在筹划相应的基础设施（如导航星座）建设。本报告将从广义相对论原理出发，首先阐明原时和坐标时的概念，接着从科学上对地月空间 PNT 所涉及的多个相对论时空基准做系统地介绍，然后以成熟的近地卫星导航系统为参照从工程上深入比较地月空间 PNT 与前者之间的差异，最后就地月空间 PNT 的相对论时空基准给出小结和建议。

银心黑洞相对论基本天文学

邓雪梅　紫金山天文台

作为广义相对论的重要预言之一，黑洞的存在已为引力波探测和事件视界望远镜直接证实。目前，欧洲南方天文台甚大望远镜重力干涉仪已实现了对绕银河系中心黑洞旋转的 S2 恒星几十微角秒的高精度天体测量，未来有望发现距离银心黑洞更近的天体，这将为强场下广义相对论基本原理和黑洞特性的检验带来了新机遇。本报告将从相对论基本天文学的角度，针对未来可能开展的黑洞“无毛”定理、等效原理以及非经典黑洞的检验和探索等方面给出建议和展望。

带电辛普森—维瑟时空的光线偏折

张　景　南京大学

本报告研究了带电辛普森-维瑟时空弱场和强场极限下的光线偏折以及由此产生的观测量。假设银心黑洞和 M87 中心黑洞分别为中心天体，评估了这些观测量的可探测性。此外，本报告还将比较该时空与其他潮汐或带电时空观测量的差别。结果发现，通过测量处于宁静态银心黑洞附近光线偏折时的流量差，或许可区分这些时空。上述工作已刊载于 EPJC（82, 471, 2022）上。

爱因斯坦—洛夫洛克极致密天体时空的光线强偏折

高原兴　南京大学

爱因斯坦—洛夫洛克极致密天体是一类黑洞替代天体。本文研究了光线在该天体近邻区域内发生的强偏折现象。光线的强偏折导致爱因斯坦—洛夫洛克极致密天体周围产生了一系列相对论像。根据对 M87*和人马 A*的直接成像以及人马 A*周围恒星的流量变化，本文探讨了这些相对论像的可观测性。本文发现，根据直接成像无法区分爱因斯坦—洛夫洛克极致密天体和黑洞，但在不远的将来有望根据流量变化区分这两种天体。上述工作已在 EPJC（2022，82，162）上发表。

中等质量黑洞的天体测量搜寻

卢　旭　南京大学

作为黑洞质谱中缺失的一环，中等质量黑洞可解释超大质量黑洞的形成机制，但至今尚无明确探测案例。对于球状星团中潜在中等质量黑洞，本工作旨在探测其对背景光源的光线偏折效应，开展中等质量黑洞搜寻工作。根据已有基于 Gaia 数据的球状星团数据和 CSST 观测编排信息，本工作确定了有望被观测的候选球状星团。对这些球状星团内的中等质量黑洞，本工作预报了其对背景光源光线偏折的天体测量信号和相应事件率，分析了干扰因素，评估了中等质量黑洞的天体测量搜寻前景。

霍恩德斯基有毛黑洞近旁类时粒子进动和周期轨道

林厚羽　紫金山天文台

Proper Motion Measurement from GPS1 to CSST

田海俊　杭州电子科技大学

月球天平动的变化分析

魏二虎　武汉大学

本文首先利用 VLBI 单点定位模型解算得到“嫦娥三号”着陆器的坐标和物理天平动参数，与 DE421 星历的插值结果相比，VLBI 数据对天平动参数Ω、i 和μ 的改进值分别为-0.6924"、0.0096"和-0.0097"。基于改进后的月球物理天平动参数求解着陆器坐标和速度，结果显示，相比于补偿前着陆器位置误差均有不同程度的下降，在 X、Y 和 Z 方向的定位精度分别提高了 24.204 m、0.405 m、1.996 m，着陆器速度误差的估计精度分别提高了 0.0106m/s、0.0135m/s 和 0.0072m/s。

利用小波去噪方法对噪声比较明显的天平动参数项进行去噪处理，通过小波分析的方法，确定了月球天平动在去除长周期项后共有 10 项不同的周期项，利用快速傅里叶变换(FFT)对不同的时间序列进行频谱分析，得到相对应的周期项。参考月球天平动、月球潮汐影响和月球内部结构等相关文章，本文确定了 18.6 年、1 年、230 天、29 天和 11 天五项周期项来源，发现月球天平动周期项除了受到太阳和地球的引力影响外，还与月震具有一定关系，以及部分项中欧拉角大小出现规律性变化，提出了周期项对月球内部液态核的可能性证明。最后分别尝试利用 ARIMA 模型预报和正弦函数拟合预报方法利用 20 好数据建立月球天平动直接预报和分频预报模型，采用 21 日数据进行预报检验。

LAMOST 导星系统及其发展

曹子皇　国家天文台

Gaia 星表在银盘区域的视差检验

丁　页　　上海天文台

Gaia DR3 给出了近 15 亿个源的三角视差。对 DR3 的类星体数据的检查显示，它们的视差是有偏移的，与预期的零附近的分布有系统的偏移，偏移了几十微角秒。我们试图映射 DR3 在银盘正负 10° 区域内的视差偏移的主要依赖关系，这可以提供修正这个区域 DR3 视差的方法。对于暗弱的光源，类星体提供了估计视差偏移最直接的方法。为了将其扩展到更亮的光源和更广泛的颜色范围，我

们使用基于物理双星的差分方法。

Gaia 类星体的证认及分类

武琦琦　　上海天文台

作为天球参考架的基准源，类星体的位置稳定性和天空密度一直是影响参考架可靠性的重要因素。基于 Gaia DR3 的高精度天体测量数据，我们筛选了一批新的类星体候选体，其整体纯度高于 90%，且有约 30 万颗源为新认证的候选体源。同时我们从参考架稳定性的角度出发，对 SDSS 中光谱认证的类星体进行了筛选，发现部分异常类星体（类星体双星，透镜类星体，显著喷流类星体等）在相同观测条件下有较差的位置精度，或存在明显自行或视差，因此不适合作为参考架的基准源。我们首次提出了一系列标准对此类类星体进行筛选，并初步得到数百颗异常类星体的候选体，并对这些候选体进行了光学认证。

长春人卫站光电探测技术研究进展

康　喆　长春人卫站

长春站空间目标光谱研究进展

邓诗宇　长春人卫站

随着科学技术的蓬勃发展，光谱测量与识别技术已经深入到许多领域，针对深空目标（恒星、星系、类星体等）和近空目标（碎片、火箭箭体、人造载荷等）的光谱测量和目标识别是可行的，并取得一系列成果。随着我国载人航天活动的开展，对空间环境态势感知成为当前空间环境监测的重要任务。因此，开展与空间目标监测相关技术的研究具有十分重要的应用价值和现实意义。本文面向国家重大发展需求，开展空间目标光谱测量技术与识别方法应用研究，有助于实现对空间目标的测量和识别，提高我国空间环境态势感知能力。

本文针对空间目标详细阐述了光谱获取技术方案，给出了空间目标表面材料反演与分析方法，得出至少 2 种及以上空间目标单一材料，置信度达到 80%以上；对空间目标光谱数据进行了分类，分类精度达到 75%以上。该方案是一套完整的基于地基望远镜对空间目标测量的实施方案，也可以为基于天基望远镜空间目标

测量提供技术参考。

本文主要包括以下三部分，第一简述了 3 种光谱仪的基本光学原理以及搭载至望远镜末端的光路状态，按照设计方案开展了光谱终端的改造与调试，并获取了空间目标光谱数据；第二进行了高光谱图像转化成一维光谱数据的事后处理、光谱数据处理；第三完成了空间目标光谱数据匹配反演以及数据分析。

CSST 巡天观测中的星链光污染评估

鹿　瑶　紫金山天文台

星链卫星升级换代呈现出尺寸越来越大、亮度越来越高的趋势，由于轨道更高，星链进入 CSST 视场不可避免，量化评估星链卫星光污染对 CSST 巡天观测造成的影响，是望远镜科学运行需求与观测策略研究的重要议题。本报告基于星链卫星 BRDF 光度模型，结合卫星轨道、姿态等全要素信息，探讨不同情况下 CSST 巡天观测中星链条纹的形态、展宽、移动方向、条纹长度等信息，给出有效光度、像元污染比例、闪光发生概率等参数，量化 CSST 巡天图像受星链卫星的污染程度，辅助优化巡天观测策略，助力 CSST 发挥最大科学价值。

系外行星干涉成像仿真模拟与误差分析

周睿思　南京大学

目前国内外对系外行星探测的手段多采用间接成像的方法，如：凌日法、视向速度法、微引力透镜法等。这探测手段大都是通过探测恒星信号的变化等来 推断行星的位置，运行轨道等。对于需要获得星体表面大气等信息的科学研究领域，如探测宜居星球等，间接探测已经不能满足需求了。在直接成像的过程中，主要的技术挑战是行星和恒星巨大的亮度对比度和两者之间的小角距。 而望远镜阵列干涉成像，正是一种有效地直接成像手段。它通过调整望远镜阵列地基线长度，基线方向、阵列形状使探测到微弱的行星的光信号成为可能。本课题将从对比不同数目 3、4、5 望远镜组阵，对具有高亮度对比度的光源成像效果，研究干涉图像的特征，分析干涉图像与干涉基线、望远镜参数之间的关系，实现望远镜阵列的干涉成像仿真，发现 4 个望远镜的构型是性能比较优秀的。在此基础上，分析 4 个望远镜的成像效果受各种误差的影响，如平台稳定性、恒星活动性等。

面对面归心测量系统

王志康　上海天文台

持续的、高精度的本地连接矢量监测是构建和维持高精度综合参考架的关键元素之一，针对 VLBI/SLR 望远镜参考点的归心测量是测定本地连接矢量的关键步骤之一。为解决归心测量工作中靶标随望远镜转动，而难以实现观测者与靶标点的“面对面”观测而引入系统差的问题。本报告基于旋转云台，设计了一套可无人值守全自动高精度归心测量系统，实现了固定棱镜以及自驱动棱镜的两种模式的自动高精度归心监测，极大程度地提高了观测效率，减轻了外业测量的工作量。

基于多种观测资料的单谱线分光双星轨道拟合研究

王晓丽　齐鲁师范学院

双星系统完整轨道及子星质量的确定对建立和维护高密度、高精度实用星表参考架及研究恒星物理、星团乃至银河系结构等也等具有重要意义。单谱线分光双星的子星物理性质迥异，受限于观测条件，大量这类双星系统的轨道参数和物理参数都未知。单谱线分光双星联合多维度、大历元跨度观测数据，可以得到一批星等差较大双星系统的高精度轨道解及物理参量(质量、光度、半径等)星表。研究结果可以进一步的用来对双星进行统计研究。单谱线分光双星两颗子星在同一年龄上可以更好的验证和约束恒星演化模型。单谱线分光双星的伴星很可能是致密、小质量等暗弱天体，精确地确定其质量对探测致密天体及小质量星具有特殊意义。同时可为结合后续 Gaia 释放的时序数据及我国 2m 空间站的高精度时序位置数据研究单谱线分光双星奠定了基础。

基于自由模式超导探测器的空间碎片激光测距

张海涛　云南天文台

空间碎片激光测距(DLR)是一种测量失效卫星、火箭体或地球轨道上其他空间目标距离的技术。DLR 成功率低的原因之一是目标的轨道预报准确性差。利用超导纳米线单光子探测器（SNSPD）在可自动恢复的自由模式下工作，目标轨道预测的准确性对 DLR 成功概率的影响会大大降低。通过这种方式，成功探测到 249 个空间碎片，并获得了 532 次数据。其中，探测到的最小的目标是空间

碎片 902，其轨道高度约为 1000 公里，雷达散射截面（RCS）为 0.0446 平方米。探测到最远的目标是空间碎片 12445，其轨道为大椭圆轨道，RCS 为 18.2505 平方米，其中测量的最远距离为 6260.805 公里。

单一短弧 SLR 确定慢自旋多 CCRs 失效航天器的旋转状态

宋　晨　紫金山天文台

多反射器失效航天器的卫星激光测距(SLR)回波信号中包含对应不同安装位置的角反射器(CCRs)的多距离资料。不同 CCRs 之间的相对距离及其变化取决于目标的旋转状态。然而，在很短的观测时间内，很多失效目标的旋转相对较慢。在这情况下，由于信息量有限，估计有效的旋转状态存在困难。本文中，以一个慢转速失效航天器 CZ-2C R/B (NORAD ID 31114)为例，开发一种通过单一短弧激光测距估计旋转状态的新方法。参考矢量法被用于新的姿态表示中。推导了相对距离，及其一阶导数和旋转状态的简化表达式。通过网格搜索和微分修正结合的状态估计方法，高效准确地估计了降维后的参数。此外，得到了 CZ-2C R/B 最大惯性主轴的一致方向，为后续研究提供了有效的信息。

空间目标的光度曲线仿真研究

赵晓芬　上海天文台

空间目标的形状、尺寸、姿态、表面材料、反射率和角速度等特征对目标跟踪、识别和碰撞预警具有重要意义。空间目标的光度与这些特征密切相关，利用地基光学望远镜获取的光度曲线，是反演目标物理特征信息的主要手段。理论光度模型的建立是利用光度曲线进行空间目标特征反演的基础。利用不同双向反射分布函数（BRDF）仿真地球同步轨道目标的光度曲线，并与望远镜观测得到的光度曲线进行比较。结果显示，基于 Phong 模型仿真的光度曲线与实测光度曲线的变化趋势一致，误差较小，并基于该模型仿真了多颗 GEO 卫星的光度曲线，均与实测曲线符合较好，为下一步光度曲线反演提供了参考依据。

基于欧拉网格的解体碎片云演化与碰撞分析

舒　鹏　　云南天文台

随着空间目标的数量快速膨胀，发生爆炸或碰撞解体事件的风险也急剧增加。解体形成的碎片云在空间不断演化，对其他航天器的安全运行造成了极大的威胁。传统上，多将碎片云视为独立个体的集合，对个体进行推演以获取整体演化特性。但是解体碎片的数量规模较大，且运动状态与物理特征具有不确定性，传统的离散性方法存在计算效率低、结果鲁棒性差的问题。

针对解体碎片云分布范围广、变形尺度大的特点，利用流体力学欧拉网格方法对解体碎片云的整体分布进行建模，将离散的碎片粒子群体运动抽象为连续的概率密度函数在动力系统中的迁移。求解轨道边值问题获得欧拉网格中的解体碎片特征速度，利用状态转移矩阵对特征速度对应的概率密度进行变换，计算出欧拉网格中解体碎片云的位置速度分布。

针对解体碎片云对航天器的持续撞击问题，以反问题视角构建解体碎片云撞击分析模型，推导航天器遭遇的解体碎片通量、撞击速度等指标，对航天器穿越解体碎片云的撞击风险进行分析。

提出的方法无需对解体碎片的全局分布进行简化近似，可获取任意演化时长、任意空间范围的准确密度分布，其结果比离散性仿真方法高效鲁棒。

深度学习在小行星目标检测中的应用

王翔君　山东大学（威海）

行星星光偏折及其对高精度天体测量的影响

李英杰　紫金山天文台

我们通过理论计算发现 SKA 高精度天体测量必须考虑更多太阳系天体引发的星光偏折效应，这是 SKA（亚）微角秒高精度天体测量建模的重要一步。只有精确掌握天体的星光偏折效应，建立(亚)微角秒天体测量的理论模型，才能实现 SKA 高精度天体测量及相关科学目标。为此，我们以木星为例，首次用 VLBI 成图的方法精确测量了行星引力场引发的星光偏折，测得关键后牛顿参数$\gamma = 0.984 \pm 0.037$. 这是精确测量行星与大卫星引发的光线偏折、检验广义相对论的开端，也是 SKA/FASTA 高精度天体测量的先导研究。

Analytical representation for numerical intergration ephemerides with limited time-span

奚小瑾　国家授时中心

火卫二动力学模型数值模拟

黄　凯　云南天文台

火星是太阳系除了地球以外唯一拥有自然卫星的类地行星，研究火卫系统有助于人类更为深入的了解类地行星系统的形成演化。本研究充分考虑了火卫二与火星的二体运动模型、火星重力场、太阳系主要天体的三体摄动、广义相对论效应、火星固体潮、火卫二天平动等影响火卫二运动的因素，建立了火卫二动力学模型，并使用 12 阶 Adams-Bashforth-Moulton 积分器对动力学模型积分计算得到火卫二轨道。同时，利用现行火卫数值历表 MARS097 中的数据对积分获得的火卫二轨道进行精密定轨，结果显示精密定轨后的轨道与数值历表的差别小于 10 米，数值实验结果表明建立的火卫二动力学模型稳定可靠。

利用有限谱方法计算火星自由核章动

张　冕　上海天文台

类地行星的自由核章动与其深内部结构密切相关，尤其是液核的状态。美国航空航天局的 InSight 号火星登陆器，利用其无线电信标，首次得到了其自由核章动的数据。本工作利用两种方法计算了 13 个火星内部结构模型的自由核章动。第一种方法为角动量法，第二种为有限谱方法。比较了前人计算的结果和 InSight 的观测结果，并进行了讨论。

椭圆型限制性三体问题中的一些近圆共振周期轨道及其稳定性

徐兴波　　淮阴工学院

“火星人”比地球人面临更多的潜在危险天体

周宇凡　南京大学

潜在危险天体（PHAs）是一类特殊的近地小行星（NEOs），它们存在与地球近距离交会甚至撞击的可能性，且尺寸较大容易造成巨大破坏。相应的概念也可以延拓到火星。对 PHAs 的研究将加深人类对于行星演化历史的理解。由于人类身处地球，对地球 PHAs 的观测自然比火星 PHAs 容易得多。不过目前多国的火星探测计划正在或将要开展，火基探测器观测火星 PHAs 也将成为可能。如果火星 PHAs 远多于地球 PHAs，那么这样的观测便具有巨大潜力与价值。因此我们对两者的数量进行了估计。

Spin-Orbit Coupling Dynamics in a Planar Synchronous Binary Asteroid

李伯胜　南京大学

The 1:1 spin-orbit resonance that the rotation period of a celestial body approximately synchronizes with its orbital period is widely observed in not only planet-satellite systems but also binary asteroid systems. The main goal of the current study was to investigate the mechanism which determines the stability boundary of the 1:1 spin-orbit resonance in a binary asteroid under the coupled influence of the secondary's rotation and orbital motion. Due to strong spin-orbit coupling, assuming the mutual orbit as an invariant ellipse (as usually done in planet-satellite systems) is not suitable for the binary asteroid systems that have a secondary of considerable mass and size, or have a close distance between the two bodies. The difference between our study and previous ones is twofold. The complete spin-orbit coupling model is considered, and explicit high order analytical solution is constructed. We found that the stable synchronous state requires a small eccentricity of the mutual orbit but permits a large libration angle of the secondary. The anti-correlation of the eccentricity and the libration angle is confirmed. The sable region for a very elongated secondary is small, which explains the lack of such secondaries in observations. In addition, the findings of this research provide insights into chaos and the resonances of basic frequencies, which may play an important role in the evolution of a binary

asteroid.

Understanding the Planetary formation and evolution in Clusters

刘慧根　南京大学

In this talk, I will briefly introduce the motivation of study planets in cluster environments (I.e. the UPiC projects) and the history of detecting planets in clusters. Then I will introduce several previous works about disk evolution in clusters, the planet occurrence rate correlated to the dynamical history of host stars. Finally I will show our most recent work to constrain a preliminary formation timescale of giant planets in clusters, based on the largest sample of planets and candidates in clusters and association.

热木星的年龄分布和时间演化

陈迪昌　南京大学

The unexpected discovery of hot Jupiters challenged the classical theory of planet formation inspired by our solar system. Until now, the origin and evolution of hot Jupiters are still uncertain. Determining their age distribution and temporal evolution can provide more clues into the mechanism of their formation and subsequent evolution. Using a sample of giant planets around Sun-like stars collected from the kinematic catalogs of the Planets Across Space and Time (PAST) project, we find that hot Jupiters are preferentially hosted by relatively younger stars in the Galactic thin disk. We subsequently find that the frequency of hot Jupiters declines with age. In contrast, the frequency of warm/cold Jupiters shows no significant dependence on age. Such a trend is expected from the tidal evolution of hot Jupiters' orbits, and our result offers supporting evidence using a large sample. We also perform a joint analysis on the planet frequencies in the stellar age-metallicity plane. The result suggests that the frequencies of hot Jupiters and warm/cold Jupiters, after removing the age dependence are both positivelycorrelated with stellar metallicities. Moreover, we show that the above correlations can explain the bulk of

the discrepancy in hot Jupiter frequencies inferred from the transit and radial velocity (RV) surveys, given that RV targets tend to be more metal-rich and younger than transits.

Stability analysis of double-averaged restricted elliptic three-body problem

盛凯程　山东大学

We are dealing with the averaged model used to study the secular effects in the motion of a body of the negligible mass in the context of a spatial restricted elliptic three-body problem. It admits a two-parameter family of equilibria (stationary solutions) corresponding to the motion of the third body in the plane of primaries' motion, so that the apse line of the orbit of this body is aligned with the apse lines of the primaries' orbits. The aim of our investigation is to analyze the stability of these equilibria. We show that they are stable in the linear approximation. The Arnold--Moser stability theorem provides sufficient conditions under which this means stability in a nonlinear sense too. These conditions are violated for parameters of the problem that belong to a set formed by a finite number of analytic curves in the parameters' plane.

Discovery of Unexpected Mutual Inclination in a Two-Giant System

汪宪钰　印第安纳大学

以轨道偏心率-周期关系限制小质量行星形成的初始条件

辛科霆　南京大学

近年来，许多小型太阳系外行星（如超级地球和亚海王星）被陆续发现并证

认，该类行星已经成为目前发现数量最多的一类系外行星。然而，相比于气态巨行星，这类质量更小的系

外行星的形成与演化的过程还未被完全理解。本报告基于小质量行星的后期形成演化模型（大碰撞模型）进行了数值 N 体模拟，并对比了模拟和观测行星的轨道偏心率-周期关系。通过对比发现，角动量赤字（AMD）转移理论可以在理论模型与观测结果之间建立联系，且由 AMD 理论所预言的行星轨道偏心率-周期关系在太阳系内亦有所提现。以 AMD 转移理论为基础，通过轨道偏心率-周期关系，我们得以进一步对小质量行星形成的初始条件做出限制。

Evidence of Hot Giant Exoplanets Formation Timescales in Open Cluster

戴远哲　国家天文台

Planets in young star clusters could shed light on planet formation and evolution since star clusters can provide accurate age estimation. However, the number of transiting planets detected in clusters was only ~30, too small for statistical analysis. Thanks to the unprecedented high-precision astrometric data provided by Gaia DR2 and Gaia DR3, many new Open Clusters(OCs) and comoving groups have been identified. The UPiC project aims to find observational evidence and interpret how planet form and evolve in cluster environments. In this work, we cross-match the stellar catalogs of new OCs and comoving groups with confirmed planets and candidates. We carefully remove false positives and obtain the biggest catalog of planets in star clusters up to now, which consists of 73 confirmed planets and 84 planet candidates. After age validation, we obtain the radius--age diagram of these planets/candidates. We find an increment of the fraction of Hot Jupiters(HJs) around 100 Myr and attribute the increment to the flyby-induced high-e migration in star clusters. An additional small bump of the fraction of HJs after 1 Gyr is detected, which indicates the formation timescale of HJ around field stars is much larger than that in star clusters. Thus, stellar environments play important roles in the formation of HJs. The hot-Neptune desert occurs around 100 Myr in our sample. A combination of photoevaporation and high-e migration may sculpt the hot-Neptune desert in clusters.

高能分会场报告

VLT MUSE observations of ultraluminous X-ray sources

冯骅　清华大学

Most ultraluminous X-ray sources (ULXs) may be powered by supercritical accretion onto stellar mass compact objects, in which case, massive winds will be powered and produce shock-ionized nebulae when interacting with the interstellar medium. Here I will report VLT MUSE observations of three ULXs, trying address questions regarding the physical nature of the bubble nebulae and the evolutionary history of ULXs.

船帆座脉冲星风云 X 射线偏振趋近同步辐射理论极限

谢斐　广西大学

脉冲星风云是由快速旋转的脉冲星驱动的星风冲击外部物质产生的高能天体。近日，国际合作研制的成像型 X 射线偏振望远镜 IXPE 对船帆座脉冲星风云（Vela PWN）进行了长达 20 天的观测，以极高精度测量了 Vela 脉冲星风云的 X 射线偏振度。其局部偏振度高达 63%，趋近于电子同步辐射理论的极限值，是人类至今观测到的 X 射线偏振度最高的天体。IXPE 的观测在揭示其磁场位形的同时，对其粒子加速机制提出严格的限制。

脉冲星自转减慢和高速中子星

彭秋和　南京大学

Pulsars after 55-year discovery： Potential significant targets of FAST and other telescopes

张承民 国家天文台

Insight-HXMT Detections of Hard X-Ray Tails in Scorpius X-1

丁国强 中国科学院新疆天文台

Using the observations of the high-energy detector of the Hard X-ray Modulation Telescope (Insight-HXMT) for Scorpius X-1 from 2017 to 2020, we search for hard X-ray tails in the X-ray spectra in ∼30–200 keV. The hard X-ray tails are found throughout the Z-track on the hardness–intensity diagram, and the detected hard X-ray tails become hard and weak from the horizontal branch (HB), through the normal branch (NB), to the flaring branch (FB). Comparing the hard X-ray spectra of Insight-HXMT between Cyg X-1 and Sco X-1, it is concluded that the hard X-ray spectrum of Cyg X-1 shows a high-energy cutoff, implying a hot corona in it, but the high-energy cutoff is not seen in the hard X-ray spectrum of Sco X-1. From fitting the broadband spectrum of Sco X-1 in ∼2–200 keV, it is proposed that the hard X-ray tails in the HB and NB can be explained by the overall Comptonization COMPTB model, suggesting that the hard X-ray tails could have resulted from the Comptonization of the photons from the neutron star (NS) surface by the thermal electrons in the region between the NS and the disk and the energetic electrons in the freefall toward the NS in the converging flow onto the NS. However, this model cannot be responsible for the hard X-ray tails in the FB. Further study on the FB hard X-ray tails is needed. Reference：Ding, et al. 2023, ApJ, 950, 69.

Confronting strange stars with compact-star observations and new physics

杨书华　华中师范大学

Strange stars ought to exist in the universe according to the strange quark matter hypothesis, which states that matter made of roughly equal numbers of up, down, and strange quarks could be the true ground state of baryonic matter rather than ordinary atomic nuclei. Theoretical models of strange quark matter, such as the standard MIT bag model, the density-dependent quark mass model, or the quasi-particle model, however, appear to be unable to reproduce some of the properties (masses, radii and tidal deformabilities) of recently observed compact stars. This is different if alternative gravity theory (e.g., non-Newtonian gravity) or dark matter (e.g., mirror dark matter) are considered, which resolve these issues. The possible existence of strange stars could thus provide a clue to new physics.

On the moment of inertia of PSR J0737-3039A from LIGO/Virgo and NICER

缪志强　厦门大学

Recent multi-messenger observations, such as GW170817 from LIGO/Virgo and the mass and radius measurements of X-ray pulsars from NICER, have significantly enhanced our understanding of the equation of state. Taking advantage of these available data, we delve into the investigation of the moment of inertia of PSR J0737-3039A, assuming it to be either a hybrid star (a neutron star with a quark core) or a quark star. Our findings suggest that if PSR J0737-3039A is a hybrid star, its moment of inertia is approximately 1.30 × 10^45 g cm2, while for a quark star, it presents a larger value of around 1.55 × 10^45 g cm2. This indicates the potential of distinguishing between hybrid star and quark star through measurements of PSR J0737-3039A moment of inertia.

Searching for single-frame rapid X-ray transients detected with Chandra

张一加　清华大学

We present a new method to identify rapid X-ray transients observed with Chandra. They manifest themselves as three or more photons in a single CCD frame within a point-spread-function region. In the Chandra archive, 11 such events are discovered. Among them, two are spatially coincident with extended objects in the Milky Way, one with the Small Magellanic Cloud, and another one with M31; the rest have no or a dim optical counterpart, and are not clustered on the Galactic plane. Possible physical origins of the rapid transients include short gamma-ray bursts, short-lived hypermassive neutron stars produced by merger of neutron stars, accreting compact objects in the quiescent state, magnetars, and stellar flares. We also identified another single-frame event on a faint X-ray source, which is likely an active galactic nucleus (AGN) in the cluster of galaxies Abell 3128. The flare duration and peak luminosity suggest that it contains an intermediate-mass black hole.

慧眼对 4U 1636-53 中热核 X 射线暴的观测

颜哲　中国科学院云南天文台

为了研究吸积中子星低质量X射线双星中热核X射线暴的光变曲线轮廓形成机制和其对吸积环境的影响，我们从光变曲线和能谱两方面对 HXMT 在 4U 1636-53 中观测到的 45 个暴进行分析。我们发现其中 30 个暴具有相似的光变曲线轮廓，并且大部分处于硬态。大多数暴的 2-10 keV 光变曲线轮廓不是单一 E 指数衰减，而是双 E 指数衰减，第一个 E 指数成分持续约 6 秒。我们采用标准方法和“fa”方法来拟合暴期间能谱。两种方法得到的黑体温度分布之间没有明显差异。多数“fa”值超过 1，这表明持续辐射增强。我们还发现的两个光球扩展暴都处于软态，它们峰值流量附近的“fa”值超过 10。在非光球扩展暴中观测到最大“fa”值与持续辐射流量之间存在反相关关系，而且我们测定了增强的持续辐射的上限。

Bubble in the Whale:　Identifying the Optical Counterparts and Extended Nebula for the Ultraluminous X-ray Sources in NGC 4631

郭静　厦门大学

脉冲星伽马射线晕和宇宙线传播

毕效军 高能所

脉冲星加速的高能正负电子在脉冲星周围介质中传播时会和 CMB 发生逆康普顿散射从而形成一个围绕脉冲星的伽马射线晕，通过对伽马射线晕空间分布的观测可以测量带电粒子在脉冲星周围介质中的扩散过程。随着最近几年对脉冲星伽马射线晕的观测发现脉冲星周围的介质属性和银河系的星际介质的平均属性有非常大的差别。因而这一结果引起了极大关注和研究兴趣。此外，该观测结果对于银河系宇宙线的传播过程也有直接影响，从而影响了相关的理论预期。报告中我将介绍这一研究的现状以及 LHAASO 在这一观测上所取得的重要进展。

银河系弥散甚高能伽马射线起源的研究

柳若愚　南京大学

我国的大科学装置高海拔宇宙线观测站(LHAASO)最近公布了其对银河系弥散甚高能伽马射线辐射的测量结果，其流量超出了传统所认为的宇宙线强子与星际介质相互作用起源模型所预期的流量 2-3 倍。我们结合了 IceCube 对银河系中微子的最新测量结果，发现 LHAASO 测量到的弥散伽马射线辐射中包含一个轻子起源的成份。我们进一步通过理论计算证明，银河系中的脉冲星晕可以解释弥散伽马射线辐射中该轻子成份，并弥补观测与宇宙线-星际介质作用模型预测的差距。我们的结果表明脉冲星晕对于甚高能伽马射线天文学的重要性，因为其构成了对于其它甚高能伽马射线源探测的背景辐射，影响到对其它源的测量结果。LHAASO 未来的观测有助于我们更好的理解这个背景。我们也期待未来多波段、多信使天文学的发展能带来对银河系弥散伽马射线辐射起源更清晰的认识。

LHAASO 对 Geminga 脉冲星晕的观测进展

张鸿飞　上海交通大学

脉冲星通常被认为是高速旋转的中子星，具有强磁场，并向星际空间释放大量正负电子，被认为是轻子宇宙线的主要来源之一。这些正负电子在星际空间中

扩散，并通过逆康普顿散射的方式产生高能伽马射线，形成一类尺度很大的天体，称为脉冲星晕。研究脉冲星晕的形态有助于了解银河系内粒子的扩散过程。Geminga 是离地球最近、形态最清晰的脉冲星晕，利用它，我们可以更加细致地研究星际空间的扩散过程，包括扩散系数的空间依赖以及随能量的变化等。

高海拔宇宙线观测站 LHAASO（Large High Altitude Air Shower Observatory）位于中国四川省稻城县，海拔 4410 米的海子山上。它专门用于观测高能伽马射线和宇宙线引发的大气簇射。本报告将介绍利用这一高海拔宇宙线观测站 LHAASO 对 Geminga 脉冲星晕的观测进展。

伽马射线脉冲星晕研究进展

方堃　中国科学院高能物理研究所

伽马射线脉冲星晕是一类分布于脉冲星周围的扩展源，由从脉冲星（脉冲星风云，PWN）逃逸的高能电子通过逆康普顿散射产生。脉冲星晕的发现清楚地表明了银河系局部存在宇宙线扩散速度抑制的现象，脉冲星晕也成为了研究宇宙线小尺度传播的重要工具。这类源从 2017 年发现至今已经引起了相当多的讨论。本报告围绕近年来脉冲星晕的相关研究进行介绍，包括已经观测到的脉冲星晕、脉冲星晕可能的产生机制、脉冲星晕对于宇宙线传播研究的意义、脉冲星晕对研究 PWN 电子逃逸过程的意义。此外，脉冲星晕的研究也对回答宇宙线正电子超出、TeV 弥散伽马射线超出等前沿问题具有重要的价值。

Improved bounds on the bosonic dark matter with pulsars in the Milky Way

梁迪聪　北京大学

Neutron stars (NSs) can be used to constrain dark matter (DM) since a NS can transform into a black hole (BH) if it captures sufficient DM particles and exceeds the Chandrasekhar limit. We extend earlier work and for the first time take into account the Galactic motion of individual NSs, which changes the amount of the captured DM by as large as one to two orders of magnitude. We systematically apply the analysis to 414 NSs in the Milky Way, and constrain the DM particle mass and its interaction with nucleon simultaneously. We find that the most stringent bound is placed by a few NSs and the bound becomes stronger after considering the Galactic motion. The

survival of observed NSs already excludes a cross section σnX≳10^−45 cm^2 for DM particles with mass from 100MeV to 10^3 GeV. Especially for a mass around 10GeV, the constraint on the cross section is as stringent as σnX≲10^−49 cm^2

奇异星与快速射电暴

黄永锋　　南京大学

重子物质的真正基态有可能是奇异夸克物质，而不是通常认为的中子物质。因此，人们看到的脉冲星有可能是奇异夸克星，而并不是通常所认为的中子星。但是，如何从观测上区分奇异夸克星和中子星，从而对重子物质的基态这一基本物理问题给出检验，却一直是非常困难的课题。近几年中，我们提出可以通过观测脉冲星的密近行星来搜寻奇异夸克天体。在本报告中，我们还将进一步探讨奇异夸克星产生快速射电暴的可能性。

快速射电暴的起源和宇宙学应用

王发印　　南京大学

Narrowly-Banded Bursts of FRB 20201124A as Probes for Radiation Physics of Repeating Fast Radio Bursts

吕芬　上海科技馆

The radiation physics of fast radio bursts (FRBs) is an open question. Combining observations in broad frequency coverage, we show that repeating FRB 20201124A only outbursts in a narrow range (0.4-2 GHz). Using a large and uniform sample obtained by the FAST telescope, we study its intrinsic spectral property and energy function via Monte Carlo simulations. About 95\% spectral peak frequencies ($\nu_p^{ obs}$) of the bursts are within the FAST bandpass with a typical burst bandwidth (FWHM) of 0.16 GHz, thus representing a robust coverage of their intrinsic energy. Our simulation analysis shows that the energy function can be

modeled as $\Phi(E)\propto E^{-0.60}e^{-E/E_c}$, where $E_c=9.49 \times 10^{37}$ erg. The derived intrinsic ν_p distribution is a normal function centered around 1.16 GHz with 0.22 GHz standard deviation. Such a narrow range of ν_p is distinct from those of FRB 20121102A and FRB 20190520B, which produces narrow-banded bursts, but over a broad frequency range. It is plausible that FRB 20201124A occurs in a fine-tuned plasma for making maser radiations at $\sim 1.16\pm 0.22$ GHz, while FRB 20121102A and FRB 20190520B could involve clumpy plasma conditions for making masers at several specific frequencies in a broad range. The energy function depends on the observations for these specific frequencies.

Possible 168-day Periodicity for the Active Repeater FRB 20201124A

陈浩严　　厦门大学

Periodic activity is one of the most intriguing yet least comprehended phenomenon occurring in some of the repeating fast radio bursts (FRBs). Currently, two active repeating FRBs, 20121102A and 20180916B, have confirmed periodicities of ~160 days and ~16 days, respectively. The origin of these periodicities remains a controversy. In this talk, we put endeavor to search for and analyze the periodicity of FRB 20201124A, an active repeating FRB source first reported by CHIME/FRB. By using all published bursts of FRB 20201124A by the end of March 2022, we find a possible period of ~168 days and infer an activity phase of 60% for FRB 20201124A.

快速射电暴以及磁星耀发产生的多波段余辉研究

魏煜佳　　紫金山天文台

磁星被认为是磁星巨耀发和快速射电暴的前身星。我们仔细研究了由发生在星风云并被重子喷射物包围的爆发产生的余辉发射。基于 Murase, Kashiyama 和 M\'esz\'aros 提出的星风气泡模型，我们分别对这种余辉发射的光谱和光变曲线进行了数值以及解析的计算。另外，我们也对参数空间进行了搜寻以得到射电信号的可探测性，并且发现对于 \sim 10^45 erg 的爆发，VLA 或者下一代射电

望远镜可以探测到对应的余辉发射。来自 MGF 以及 FRB 的多波段余辉发射的探测对定位以及揭示其前身星非常重要，因此我们也估计了可探测到的余辉事件数。

估算不同成分对快速射电暴色散和散射的贡献

莫俭锋　中山大学物理与天文学院

我们基于 TNG 宇宙学模拟项目和 CHIME 观测项目的数据，估算了宿主和河外前景的气体晕与星系对快速射电暴色散和散射的贡献，并结合现有银河系和星系际介质贡献的模型，估计了快速射电暴源临近局域环境的贡献；通过蒙特卡罗模拟，尝试对快速射电暴的能量参数和局域环境的参数进行限制。

伽玛暴瞬时辐射的偏振研究

兰迷香　　吉林大学

伽玛暴是宇宙中剧烈的爆发现象，其辐射机制、喷流组分和喷流中的磁场位型尚不清楚。偏振敏感地依赖于上述性质，可以作为有效的探针。本报告将介绍目前伽玛暴瞬时辐射的偏振观测对喷流的辐射机制、组分及其中的磁场位型的限制，并给出伽玛暴瞬时辐射的偏振相关的预言。

前兆和主暴脉冲宽度与能量之间幂律关系的比较研究

邓惠英　云南师范大学

在伽玛射线暴中，其前兆和主暴之间的同一起源还是没有统一的结论，对 GRB 物理起源的理论解释存在差异。我们尝试从伽玛暴的前兆和主暴的脉冲宽度与能量关系来研究前兆和主暴是否同一起源。在本文中，我们系统地搜寻了 Swift/BAT 和 Fermi/GBM 观测的光变曲线数据，发现了 13 个具有时间结构良好的前兆的长暴。我们用 Norris 函数拟合每一个不同能道的前兆光变曲线后发现：不仅前兆宽度和能量之间存在幂律关系，上升宽度和下降宽度的比率与能量之间也存在幂律关系；通过比较前兆和主暴脉冲的这一关系后发现，前兆的幂律指数的分布以及幂律指数之间的关系和主暴大致相同。此外，我们还发现，前兆宽度分布以及在上升宽度和下降宽度的比率上限不超过 1，并且呈不对称性，也与主

暴一致。这些说明前兆与主暴有不可区分性，表明前兆和主爆发可能具有相同的物理起源。

GRB 内部脉冲和耀发的整体演化行为研究

朱丹　云南师范大学

研究表明 X 射线耀发与伽玛暴瞬时辐射脉冲具有相似的性质，两者可能来自相同起源。本文尝试将伽玛暴之间存在的演化关系拓展到伽玛暴内部。通过搜寻 12 个同时具有多脉冲和多耀发的伽玛暴，我们第一次系统的研究了 GRB 内部多脉冲和多耀发的演化行为（包括宽度，峰值时间，上升时间，衰减时间，能谱延迟），发现这些相关性在 GRB 内部也存在，尽管不同的 GRB 演化斜率不同。此外，我们还发现对于单个 GRB 内部，脉冲和耀发 w，r/d 对能量的依赖性与瞬时辐射脉冲类似，并且两个幂律指数的均值分别为-0.42 和 0.07。脉冲和耀发的正延迟占比分别为 83%和 92%，耀发的延迟值比脉冲大。以上研究结果表明“暴内”脉冲和耀发的整体演化行为与“暴间”相似，耀发是脉冲的低能扩展，这为两者来自同一起源提供了进一步的证据。

致密星并合产生磁星所驱动的 X 射线源

俞云伟　华中师范大学

伽马暴的起源和发生机制

Binbin Zhang　南京大学

在多信使天文学时代，丰富的观测数据不断挑战着我们对传统伽马射线暴的起源、能量来源和辐射机制等方面的认知。在本报告中，我们将综合分析这类现象，并从多个角度探讨伽马射线暴的起源和发生机制，并探讨未来观测可能给我们带来的新理解。

MeV Gamma Rays from Neutron Star Mergers

王夕露　中国科学院高能物理研究所

Neutron star mergers (NSMs) are the first verified sites of rapid neutron capture (r-process) nucleosynthesis, and could emit gamma rays from the radioactive isotopes synthesized in the neutron-rich ejecta. These MeV gamma rays may provide a unique and direct probe of the NSM environment as well as insight into the nature of the r process, just as observed gammas from the 56Ni radioactive decay chain provide a window into supernova nucleosynthesis. Here we include the photons from fission processes for the first time in estimates of the MeV gamma-ray signal expected from an NSM event. We consider NSM ejecta compositions with a range of neutron richness and find a dramatic difference in the predicted signal depending on whether or not fissioning nuclei are produced. The difference is most striking at photon energies above ~3.5 MeV and at a relatively late time, several days after the merger event, when the ejecta is optically thin. We estimate that a nearby NSM could be detectable by a next generation MeV gamma-ray detector, up to ~10000 days after the merger, if fissioning nuclei are robustly produced in the event.

激波模型下的中心引擎供能千新星辐射

艾舜轲　武汉大学

双中子星并合的过程中，富含中子的并合抛射物内的核反应过程会驱动光学波段附近的千新星辐射。如果并合产物是一颗长时标存活的中子星（磁星），它就会向抛射物内注入额外的能量，驱动更亮的中心引擎供能的千新星。这一现象很早就被提出。但是，该过程的具体供能方式和供能效率还没有定论。 我们近年来针对这一问题做了一系列的研究。我们认为中子星的星风是磁场主导的等离子体，星风与抛射物碰撞就会产生磁化的正反激波对。通常人们假设正反激波下游的压强是相互平衡的，但这一假设不能满足能量守恒定律，这个漏洞在我们研究的问题中尤为明显。所以，首先我们打破压强平衡假设，提出了新的磁化相对论性激波的动力学模型，解决了能量不守恒的问题。然后，我们将新的模型应用到中子星星风和抛射物相互作用的具体物理问题中。我们发现，星风中产生的反向激波快速向中子星表面传播，并在星风未被彻底加速的半径处消失。抛射物内产生的正向激波缓慢传播，加热并加速抛射物。激波内部的能量大部分以动能和磁能的方式存在，只有小部分（占比 < 0.3）能量以内能的形式存在。当抛射物的质量为 0.001 倍太阳质量时，最多大约有占比 0.6 的星风能量会被注入到抛射

物中，在晚期这个比例低至 0.04。星风能量直接转化为内能的比例约为 0.006-0.3。在正向激波穿出抛射物后，不再有内能注入。接下来，我们计算了多组参数下星风和抛射物的相互作用过程，以及中心引擎供能千新星的多波段光变曲线，发现虽然供能效率没有前人假设的那么高，但其峰值光度依然可以比仅核反应供能的千新星高大约两个量级。另外，如果中心引擎自身的光度足够大，我们还有机会在 X 射线波段观测到正向激波穿出抛射物的特征辐射。

中心能源作用下并合事件的各种辐射成分研究

吴光磊　华中师范大学

一颗快速旋转且高度磁化的中子星（磁星）可能诞生于双致密星并合等过程。这一理论设想在近二十余年的伽马射线暴研究中常被提及且已受到诸多观测尤其是余辉观测的支持，新生的磁星与并合事件产生的抛射物之间互相作用产生的辐射也备受关注。一方面，磁星会将部分转动动能通过磁偶极辐射释放，作为额外的能源注入到抛射物中，使得抛射物相比纯放射性元素主导的情形下具有更明亮的热辐射；另一方面，相对论性的磁星星风与抛射物的碰撞会产生一个在重子抛射物中向外运动的激波（正向激波），以及一个在中子星风内部向内运动的反向激波（一般称为脉冲星风的终止激波）。在一定的条件下，正向激波会从抛射物中穿出，贮存在波后的热量将辐射出来，形成类似于超新星爆发时反弹激波穿出抛射物外层的激波突破信号。而反向激波区域则类似于在在超新星遗迹中的脉冲星风星云（PWN），此区域中由光子湮灭事件产生的正负电子对在磁场的作用下产生非热辐射，这些辐射在早期会被抛射物吸收；在晚期会从抛射物中穿出，从而产生非热辐射的信号。我们的研究讨论了这些过程的细节，包括与观测结果的比较以及正向激波在各向异性的抛射物中突破的过程的讨论。

GRB 221009A: revealing a hidden afterglow during the prompt emission phase with Fermi-GBM observations

张海明　南京大学

Constraining the jet composition of GRB 221009A with the prompt TeV emission limit

戴粹远　南京大学天文与空间科学学院

Recent LHAASO observations of the prompt emission phase of the brightest-of-all-time GRB 221009A imposes a stringent limit on the flux ratio between the TeV and MeV emissions, FTeV/FMeV ≤ 2×10−5. Within the framework of internal shocks, we study the internal γγ absorption in GRB 221009A by generating a set of synthetic bursts in a simulation that reproduces the observed feature of GRB 221009A. We find that the γγ absorption does not lead to an exponential cutoff, but rather a power-law spectrum, consistent with previous works. We further find that the attenuation due to γγ absorption alone cannot explain the flux limit ratio of GRB 221009A, suggesting a low ratio of synchrotron self- Compton (SSC) to synchrotron emission outputs. This requires that the magnetic field energy density is much larger than the synchrotron photon energy density so that the SSC flux is greatly suppressed. This indicates that the jet composition of GRB 221009A is likely Poynting-flux-dominated.

Study of the Radio-to-TeV Afterglow of GRB 221009A

任佳　南京大学

GRB 221009A 是最近发现的极明亮伽马射线暴，LHAASO 探测到它的极早期 TeV 余辉，展示了甚高能余辉从上升到衰减的完整演化过程。一系列的多波段后随观测揭示出 GRB 221009A 的余辉从甚高能到射电波段的辐射过程。我们利用自行开发的伽玛暴余辉拟合软件，细致分析拟合了完整的多波段余辉光变和能谱，得到了较好的拟合结果。我们发现 GRB 221009A 的前身星环境比较特殊，随着到前身星距离的增加，暴周介质经历了均匀向星风环境的转变，这要求前身星在爆发前夕经历了特殊的物质抛射过程。同时，前身星驱动的是狭窄的结构化喷流，由均匀的喷流核以及随角度幂率衰减的包围茧构成。我们认为，如此狭窄的茧，是由喷流突破出前身星过程中激波化的喷流物质构成，这与一系列数值模拟所建议的结果一致。在上述图像下，我们发现 LHAASO 所探测到的甚高能余

辉光变及能谱都可以在同步辐射+同步自康普顿散射的图像下很好的解释。我们的结果支持了标准余辉模型，表明几十年来伽玛暴余辉领域理论发展的成功，但同时也揭示了一些亟待考虑的后续研究方向。

Study on VHE Afterglow Radiation of GRBs

Lu-Lu, Zhang GuangXi University

伽玛暴的甚高能余辉辐射对于研究伽玛暴喷流性质和暴周介质环境具有非常重要的意义。自 2019 年来该领域观测研究取得突破。我们第一个工作针对伽玛暴 GRB 190829A 这个特殊事例进行研究。这是一个近邻与超新星成协的伽玛暴，其射电、光学、X 射线余辉观测数据非常丰富，高能粒子探测 H.E.S.S.国际合作组以简报形式报道了该暴的甚高能伽玛射线余辉观测发现，使其成为非常有研究价值的伽玛暴事例。国际上此前已有多个不同的研究组报道和解释其多波段观测数据，但均没有能自洽解释其观测数据的模型。我们与南京大学合作，系统研究这个暴多波段余辉观测数据，揭示其暴周环境、喷流结构特性，提出一个自洽的模型解释了该暴多波段观测数据，预言其甚高能余辉辐射，随后与 H.E.S.S 正式在 Sciecne 发表的结果高度吻合。我们的结果表明，类似 GRB 190829A 的这类近邻低光度源，其高能辐射由同步自康普顿过程主导。2020 年国际甚高能伽玛射线望远镜 MAGIC 观测简报报道了 GRBs 201015A 和 201216C 的 100 GeV 以上能区的伽玛射线余辉。我们研究了这两个暴的辐射特征，发现 GRB 201216C 是一个极亮、能谱硬、辐射各项同性能极至今探测到最高红移（约 1.1）的甚高能伽玛暴，与 2022 年探测到的至今最猛烈的伽玛暴 GRB 221009A 非常接近，而 GRB 201015A 是一个爆发总能偏低和能谱偏软的伽玛暴。他基于标准的伽玛暴余辉模型拟合了射电、光学和 X 射线的多波段余辉光变曲线，给出了高能余辉辐射的谱能分布，发现两个暴的高能辐射均可电子同步自康普顿（SSC）过程揭示。基于这两个极端事例与至今观测到甚高能余辉伽玛暴的比较研究，我们发现这些暴不具有显著的共性特征，但均在 3σ 置信度水平内同样遵循 $L_{\gamma,iso} - E_{p,z} - \Gamma_0$ 三参量关系。

Jetted Tidal disruption events: black hole spin, jet components and circumneuclear medium

雷卫华　华中科技大学

A star will be destroyed by tidal forces when it passes close enough by a supermassive black hole (SMBH). These events known as TDEs are expected to produce luminous flare emission in the UV to X-ray band. The observations of Sw J1644+57, in particular, suggest that at least some TDEs can launch an on-axis relativistic jet. A common speculation is that these rare events are related to rapidly spinning BHs, and the jet is powered by the Blandford-Znajek mechanism. Until now, four on-axis jetted TDEs were detected, i.e., Sw J1644+57, Sw J2058+05, Sw J1112.2-8238 and recently AT2022cmc. The rich obervation data (e.g., X-ray QPOs, radio data etc.) enable us to explore the properties of BH, jet and circumneuclear medium (CNM).In this talk, I will present our constraints on BH spin, jet components and CNM profile.

A model for X-ray quasi-periodic eruption sources

申荣锋　中山大学

X-ray quasi-periodic eruptions (QPEs) are sources that show high-amplitude (i.e., ×10∼100) and recurrent X-ray bursts, each burst lasting for sub- to a few hours and separated by longer and stable low-flux levels. We study four well-observed QPEs, and show that they could be explained by the periodic mass transfer from a white dwarf (WD), or from a main sequence star in one source) that orbits a massive black hole (BH). The WD momentarily fills its Roche lobe at each pericentre passage. Some of the overflow is stripped, and then accreted by the central BH, producing an X-ray burst. We find that the orbital eccentricities of the donors are all on the high end, i.e., > 0.9. The mass ratio between the black hole and the WD is typically ∼105 which categorizes them as extreme-mass-ratio inspirals.

An extensive study of blazar broad emission lines

肖胡兵　上海师范大学

In this talk, our aim is to introduce the connection between the two types ofemission by investigating the correlation between the blazar emission-line intensity property, which embodies thenature of an accretion disk, and the γ-ray flux property,

which is representative of jet emission. We compiled asample of 656 blazars with available emission-line equivalent widths (EWs), the GeV γ-ray flux, and the spectralenergy distribution (SED) information from the literature. In this work, we found 55 previous blazar candidates ofuncertain types (BCUs) that are now identified as flat-spectrum radio quasars (FSRQs), and found 52 “changing-look” blazars based on their EWs, 45 of which are newly confirmed. These changing-look blazars have a larger accretion ratio than BL Lacertae (BL Lac) objects. In addition, we suggest that the lower synchrotron peak blazars (LSPs) could be the source of changing-look blazars because 90.7% of the changing-look blazars in this work are confirmed as LSPs. An anti-correlation between EW and continuum intensity, the so-called global “Baldwin effect” (BEff), has been confirmed. We suggest that the steeper global BEff observed for the blazar than for radio-quiet active galactic nuclei (RQ-AGNs) is caused by the inverse Compton scattering of broad-emission- line photons. This interpretation is further supported by the positive correlation between theemission-line EW and intrinsic inverse Compton luminosity.

星盘碰撞模型驱动的 X 射线 QPE 爆发光变研究

张福鹏　广州大学

X 射线准周期爆发（QPE）是一种近年发现的类星体 X 射线强烈和快速爆发的一种新高能现象。然而其内在驱动机制是目前一个尚未解决的重要问题，并且由于观测上发现与潮汐撕裂恒星现象有关联而受到国际学界的广泛关注。在这个研究中，我们提出 QPE 现象由星盘碰撞而进行驱动的物理解释，并且将其应用于 QPE 源 GSN069 的观测分析上。在这个模型中，我们使用了全相对论的数值模拟，使用马尔科夫链蒙特卡罗拟合得到了致密天体绕转中心大质量黑洞的具体轨道参数。我们发现在 GSN069 中，伴星在一个低椭率（e~0.05），半长轴约为 360 个引力半径的轨道环绕中心黑洞(质量为～30 万个太阳质量)运动。我们的星盘碰撞模型中的轨道椭率和相对论进动可以较好地解释 QPE 现象中的一长一短的的时间间隔形式。我们发现 GSN069 中的 QPEs 现象可能是由一个红巨星被部分潮汐瓦解后遗留下的核与吸积盘准周期性碰撞产生。我们发现对于类似 GSN069 这样的星系，若 X 射线观测上 QPEs 的时间测量误差可以低于 100s，则黑洞的自旋可以通过利用 QPEs 约束出来。我们的结果表明 QPEs 可以作为一个探针测量中心黑洞的自旋以及检验黑洞无毛定理。

Inter-band time lags of strongly inhomogeneous quasar accretion disks

任国伟　　厦门大学

Inconsistent conclusions on quasar accretion-disk sizes are obtained by continuum reverberation-mapping observations and microlensing measurements. On the one hand, recent continuum reverberation-mapping observations suggest that quasar inter-band time lags are roughly consistent with the X-ray light-travel-time delays in the Shakura & Sunyaev disk (SSD). On the other hand, quasar microlensing measurements favor larger-than-expected half-light SSD radii. One possible model to explain the larger-than-expected half-light SSD radii is the inhomogeneous disk model proposed by Dexter & Agol (2011). In this work, we calculate the X-ray light-travel-time delays of the inhomogeneous disk model in the framework of the lamppost X-ray reprocessing. We find that the resulting inter-band time lags are almost identical to those of the SSD. Hence, the inhomogeneous disk model has can address the inconsistency between the continuum reverberation mapping and microlensing observations in quasars but produce shorter-than-observed inter-band time lags in Seyfert 1 galaxies. Hence, inhomogeneous temperature fluctuations in accretion disks are not the only physical process that controls disk size

类星体 6dFGS gJ0225-0601 的中心引擎和尘埃环面尺寸

李丹阳　厦门大学

我们使用 LCOGT 的密集时域观测，对类星体展开连续谱反响映射监测，测量其中心引擎尺寸，检验黑洞吸积理论。这里，我们报告一个源 6dFGS gJ022550.0-060145 的 u, g, r 和 i 连续谱的反响映射观测结果。我们发现，观测得到的中心引擎尺寸结果比经典黑洞吸积盘理论预言值大 2.6（误差 1.5）。利用来自 ZTF、PanSTARRs、CSS 和 ATLAS 的光学数据以及 WISE 红外(IR)的光变曲线，我们测量了该源 WISE W1 和 W2 波段与 V 波段之间的时间延迟。W1 和 W2 具有相似的时间延迟(相对于 V 波段，分别为 1252 天（误差 286 天）和 1554 天（161 天）)，这意味着 6dFGS gJ022550.0-060145 的尘埃环面是致密的。W1 的时间延迟与尘埃环的尺寸-光度关系一致(在 3-sigma 置信区间内);W2 波段时延略高于此关系。通过红外和光学光变幅值的比较，发现 W1 和 W2 发射区的尘埃覆盖因子分别为 0.7 和 0.6。未来，结合该源的 SDSS-V Black Hole Mapper 宽线区反响映射观测，我们将有望同时获得对该源的中心引擎、宽线区和尘埃环尺寸。

来自遥远耀变体的甚高能伽玛射线的传播

董丽娟　云南师范大学

我们重新统计了红移与甚高能伽玛射线观测光子谱指数之间的相关性，我们结果表明，宇宙对甚高能伽玛射线变得比预期的更加透明。我们引入河外星系背景光吸收和光子与类轴子粒子振荡现象来解释这种情况。我们集中分析了 70 颗红移 z<1 的耀变体。假设这种相关性仅仅是甚高能光子与河外星系背景光的光子-光子吸收的结果，然而发现预测与观测之间存在偏差，特别是在红移 0.2 <z<1 时。于是我们讨论了光子与类轴子振荡对耀变体的甚高能伽玛射线观测谱的影响。最后发现：（1）甚高能伽玛射线观测光子谱指数在红移 0.03<z<0.2 范围内呈非线性增加，我们认为这种现象是河外星系背景光吸收的结果。（2）甚高能伽玛射线观测光子谱指数在红移 0.03<z<0.2 范围内呈非线性增加，我们认为这种现象是河外星系背景光吸收的结果。光子与类轴子粒子振荡导致甚高能伽玛射线观测光子谱指数与红移 0.2<z<1 相互独立。我们认为河外星系背景光吸收和光子-类轴子粒子振荡都可以影响来自遥远耀变体的甚高能伽玛射线的传播。

活动星系核吸积盘中的致密星吸积与爆发

陈恳　南京大学

致密星可以在活动星系核 (AGN) 吸积盘中存在和演化，并且在中心超大质量黑洞周围引发一系列多信使事件。为了更好地理解在 AGN 盘中致密星的性质，我们研究了致密星的具体吸积过程。我们发现 AGN 盘中致密星的超爱丁顿吸积过程会产生近似各向同性的盘风外流，在致密星周围打开低密度空腔并且显著降低其平均吸积率；从而外流反馈会显著影响在 AGN 盘内的致密星的演化性质，主要体现为改变其质量增长率并且降低其对 AGN 盘气体的消耗。并且我们研究了发生在 AGN 盘中的双致密星并合事件的电磁对应体，包括了双中子星/黑洞中子星并合驱动的相互作用千新星事件，以及双黑洞并合后通过吸积驱动喷流而产生的电磁信号。

变脸耀变体 OQ 334 的费米视角

任珊珊　云南师范大学

关于变化的外观（CL）活动星系核（AGN）仍然存在一些未被发现的特征。因此，在部分 AGN 中观察到的 CL 现象的触发机制已经留下了悬而未决的问题。为了帮助解决这个问题，我们在费米-LAT 视角中追踪了 CL AGN OQ334 的光变曲线和光谱能量分布（SED）。关于等值宽度（EW）变异性的偏差，我们将 MJD 54628-58677 时期 OQ 334 的 Fermi-LAT 光曲线细分为七个不同的时期，包括平谱射电类星体（FSRQ）状态、过渡态和 BL Lac 天体状态。在这些不同时期获得了 Fermi-LAT SED 和多波段 SED。可以看出：1）源将静止状态转换为具有 EW 可变性的活动状态；2）多波段 SED 表现出显著的外部康普顿特征，即使 Fermi-LAT SED 在七种不同状态下同时显示出 FSRQ 和 BL Lac 物体的特征。在轻子模型中考虑来自同步辐射和外部环境的软光子场，我们分别模拟了这些不同时期的多波段 SED。模型结果表明：1）7 个不同时期外光子场的能量密度存在振荡演化过程；2）BL Lac 物体态中外部光子场的能量密度小于 FSRQ 状态。这些结果预计 CL blazar 是耀变体序列中的一个特殊阶段。由于外部光子场的能量密度与吸积速率成正比，我们认为可以从费米-LAT 的观点获得平流主导吸积流（ADAF）盘和标准盘（SSD）作为 CL AGN 中主导模式转变的证据。

Seyfert 星系多样的 X 射线 RMS 谱研究

胡静维　中国科学院国家天文台

活动星系核具有很强的 X 射线辐射，利用 X 射线波段数据对活动星系核的时变进行研究，可以揭示中心黑洞以及吸积盘内区的物理特性。我们采用 XMM-Newton 数据，对 78 个 Seyfert 星系共计 426 次观测进行了 X 射线短时标光变（1-100 ks）的系统性研究。我们对样本中所有源的时间平均谱和归一化均方根（rms）谱进行处理分析，发现它们表现出十分丰富的多样性特征。根据谱形的不同，我们将 rms 谱分为 5 个不同的子样本，将时间平均谱分为 4 个不同的子样本。rms 谱中最常见的形状是向下凹的拱形，并且 rms 在大约 1 keV 处达到峰值。我们发现不同的源可以表现出相似的时间平均谱和 rms 谱。但是时间平均谱和 rms 谱的子样本之间没有一一对应的相互映射，相似的时间平均谱可以伴随有不同的 rms 谱，反之亦然。这可能是由于不同的物理机制可以产生相似的 rms 谱。对于每个时间平均谱子样本，我们分别研究了在低频和高频两种情况下首选的 rms 谱谱形。我们还从统计上比较了不同子样本的相关性质，比如黑洞质量与爱丁顿比。此外，我们还研究了铁 Kalpha 线能段范围内的 rms，发现比起那些具有窄的或相对对称轮廓的源，那些具有宽的且延展红翼轮廓的源往往表现出更强的光变特征。我们的结果显示，为了了解 AGN 中 X 射线辐射的产生机制，将

能谱和时变联合在一起分析讨论是十分有必要的。本工作所有 rms 谱均已公开在个人网站 。

黑洞吸积态转变的探测研究

尹红星　山东大学（威海）

黑洞附近的吸积流结构及其演化仍有许多未解之谜。如，几何薄、光学厚的吸积盘是否在某些状态下截断，冕的形态或结构究竟是怎样的，等等。暂现黑洞 X 射线双星爆发过程中时变特征（如准周期震荡 QPO）和能谱特征随能谱态的演化，以及某些活动星系核的耀发或“变脸”过程中的时变特征和能谱（或 SED）特征的演化等，为研究黑洞附近吸积流结构及其演化提供了契机。我们对黑洞 X 射线双星 GX 339-4 在 RXTE 时代的四次成功爆发进行了时变和能谱分析，重点关注了爆发上升阶段从低硬态向硬中间态转变时的时变特征和能谱特征的转变，发现 C 型 QPO 在该转变前后有突变，且伴随能谱特征的转变。我们详细分析了黑洞 X 射线双星 4U 1630-47 在 1998 年爆发期间出现的毫赫兹准规则调制现象（QRM），虽然未能确切理解该现象的本质，但 QRM 的出现可能与低频 QPO 类型的转变或能谱态从硬中间态向软中间态的转变有关。星系级黑洞与恒星际黑洞的吸积系统在吸积环境和辐射表现等方面虽有诸多差异，但它们的吸积流结构应该是相似的，进行对比研究或许能够提供互补的证据。我们对某些活动星系核的耀发活动进行了关注。其中，平谱射电类星体 4C+21.35 在 2014 年被 Swift 观测到了一次独特的耀发。我们对该次耀发进行了 SED 分析，认为它可能起源于温冕的活动。

Binary black hole merger and accretion in AGN disks

李亚平　中国科学院上海天文台

Magnetized　Accretion Disks with Outflows for Changeing-look AGNs

吴文标　　厦门大学

Changing-look active galactic nuclei (CL-AGNs) challenges the standard accretion theory owing to its rapid variability. Recent numerical simulations have shown that, for the sub-Eddington accretion case, the disk is magnetic pressure-dominated, thermally stable, and geometrically thicker than the standard disk. In addition, outflows were found in the simulations.

Observationally, high blueshifted velocities absorption lines indicate that outflows exist in AGNs. In this work, based on the simulation results, we investigate the magnetic pressure-dominated disk, and find that the accretion timescale is significantly shorter than that of the standard thin disk.

However, such a timescale is still longer than that of the CL-AGNs.Moreover, if the role of outflows is taken into account, then the accretion timescale can be even shortened. By the detailed comparison of the theoretical accretion timescale with

the observations, we propose that the magnetic pressure-dominated disk incorporating outflows can be responsible for the rapid variability of CL-AGNs.

The CNM profile of jetted TDE AT2022cmc

周畅　华中科技大学

When a star passes too close to a supermassive black hole, it will produce a multi-band emission phenomenon, which is called tidal disruption events(TDEs). In a very few TDEs, the existence of relativistic jet was detected. It provides a rare and unique tool to investigate quiescent supermassive black hole at high redshift and the circumneuclear environment. Recently, an optical discovered TDE AT2022cmc (z~1.193) at a high distance providing rich multi-band data. According to its multi-band emission, it was regarded as a TDE with a relativistic jet. In this work, we firstly employ the Closure Relation method on AT2022cmc, and then perform multi-band fit to the radio and optical data with our forward shock code. We find the CNM density profile of AT2022cmc is consist with a Bondi-like profile like Swift J1644+57. We also find that the X-ray emission of AT2022cmc can be detected by Einstein Probe.

相互作用超新星光变曲线研究

刘良端　华中师范大学

超新星是大质量恒星生命周期的终点。在其整个生命周期中，大质量恒星会通过星风损失大部分质量，这些物质会逐渐散布到星际介质中，形成致密的星周物质。当超新星爆发发生时，大量物质会迅速抛射到星际空间，与星周物质相互作用产生两个激波：一个是向前传播于星周介质中的正向激波，另一个是向后传播于抛射物中的反向激波。这些激波不断扫掠周围星周物质，逐渐减速，并将超新星抛射物的动能转化为可观测的各种辐射。由于星周物质结构可能来源于多样化的质量损失过程，如晚期恒星爆发、双星相互作用和恒星风，因此产生的暂时现象可以呈现出多种不同的光变曲线形态。本次报告将系统介绍相互作用超新星可能的观测特征。

Tidally-induced Magnetar Super Flare at the Eve of Coalescence with Its Compact Companion

张镇　中国科学院高能物理研究所

In the late inspiral phase of a double neutron star (NS) or NS–black hole system in which one NS is a magnetar, the tidal force on the magnetar arisen from its companion will increase dramatically as the binary approaches. The tidal-induced deformation may surpass the maximum that the magnetar's crust can sustain just seconds or subseconds before the coalescence. A catastrophic global crust destruction may thus occur, and the magnetic energy stored in the magnetar's interior will have the opportunity to be released, which would be observed as a superflare with energy 100s of times larger than giant flares of magnetars. Such a mechanism can naturally explain the recently observed precursor of GRB 211211A, including its quasiperiodic oscillation. We predict that in the coming gravitational wave O4/O5 period, there could be a fraction of detected double NS mergers associated with such super flares. If observed, copious information on the structure and magnetic field in an NS interior can be obtained, which is hard to study elsewhere.

A Model for Type-IIP Supernovae with Medium Recombination Approximation

蒋宏轩　　上海交大李政道研究所

Sgr A∗ exhibits flares at various wavelengths, but their origin remains unclear. Magnetic flux ropes emerging from the black hole are one of the possible candidates for explaining the observed flares. Based on 3D two-temperature GRMHD simulations of magnetized accretion flows with multi-loop magnetic loops, we calculate the non-thermal emissions from the magnetic flux ropes using a kappa non-thermal electron distribution function (eDF). In kappa eDF, we use a variable kappa sub-grid model based on turbulent and magnetic reconnection acceleration scenarios. In a variable kappa model based on the turbulent acceleration scenario, we can reproduce the observation of near-infrared flares and broadband spectral energy distribution (SED) from the non-thermal emission from the magnetic flux ropes. In the flux variability, we also found an 11-minute time lag between the near-infrared and submillimeter flares. The spatial separation of the flaring regions at different frequencies is responsible for the time delay.

Polarization Signature of Companion-Fed Supernovae Arising from BH-NS/BH Progenitor Systems

文旭东　　北京师范大学

The formation of black hole-neutron star (BH-NS) or BH-BH systems may be accompanied withspecial supernova (SN) signals, due to the accretion feedback from the companion BH. The additionalheating, which is mainly attributed to the Blandford-Payne mechanism, would disrupt the isotropicnature of the luminosity distribution on the surface of the SN ejecta, leading to the appearance ofpolarization. Here we develop a three dimensional (3D) Monte Carlo polarization simulation code

(MCPSC) to conduct simulations for these special SNe. We find that the maximum polarizationlevel of approximately ∼ 2% occurs at the peak time of SN emission in the “close-binary” scenario,while in the “faraway-binary” case, maximum polarization (i.e. ∼ 0.7%) is observed at a considerablylater time than the peak of the

SN. The magnitude of polarization is dependent on the degree ofunevenness in the luminosity distribution and the angle between the line of sight and the equatorialdirection. When considering the geometric distortion of supernova ejecta at the same time, themagnitude of polarization may either increase (for a oblate ellipsoidal shape) or decrease (for a prolateellipsoidal shape). The polarization signatures represent a promising auxiliary instrument to facilitatethe identification of the companion-fed SNe. Moreover, by comparing the event rate of these specialSNe with the event rate density of LIGO-Virgo detected BH–NS/BH systems could further help todistinguish the BH–NS/BH formation channel

模拟低阈双中子星并合引力波探测限制哈勃常数

杜云飞　中国科学院高能物理研究所

有电磁对应体观测的双中子星并合引力波事件可以用亮汽笛方法来测量哈勃常数，这有望解决一直困扰我们的哈勃疑难。在本研究中我们用 GW-Universe Toolbox 和 aLIGO-design 背景模型来模拟低阈值双中子星并合引力波的亮汽笛源表。并同时考虑了可能的电磁对应体污染和引力波和电磁对应体之间的误匹配。哈勃常数由一种贝叶斯方法给出。模拟得到的结论有：1.信噪比阈值越低（Pastro>0.1）,对哈勃常数的限制越好，但这种变化不明显。增加后随电磁对应体的探测能力，能让低阈值源表对哈勃常数限制的改善更明显。2.其他更高阶的宇宙学常数不能通过低阈值的源表给出限制。我们也讨论了加入引力波探测器网络的模拟，和对后随电磁对应体探测效率这些未来我们可以改善的地方。

Anisotropic neutrinos and gravitational waves from black hole neutrino-dominated accretion flows in fallback core-collapse supernovae

韦云锋　　厦门大学

Fallback in core-collapse supernovae (CCSNe) plays an important role in determining the properties of the central compactremnants, which might produce a black hole (BH) hyperaccretion system in the centre of a massive CCSN. When the accretionrate is extremely high and neutrino cooling is dominant, the hyperaccretion

should be in the phase of the neutrino-dominatedaccretion flows (NDAFs), and thus a large number of anisotropic MeV neutrinos will be launched from the disc along withthe strong gravitational waves (GWs). In this paper, we perform a series of one-dimensional CCSN simulations with the initialexplosion energy in the range of 2−8 B (1 B = 10^51 erg) to investigate the fallback processes. By considering the evolutionof the central BH mass and spin in the fallback accretion, we present the effects of the initial explosion energies, masses, andmetallicities of the massive progenitor stars on the spectra of anisotropic MeV neutrinos and the waveform of GWs from NDAFs.These neutrino or GW signals might be detected by operational or future detectors, and the multimessenger joint detectionscould constrain the properties of CCSNe and progenitor stars.

Gravitational Waves Radiated from Binary System in Dynamical Chern-Simons Gravity

李钊　中国科学技术大学天文学系

Dynamical Chern-Simons (DCS) gravity is one kind of parity-violating theory, which induces the amplitude birefringence effect during the gravitational waves (GWs) propagating in the expanding universe. Another important probe to test this gravity is the binary black hole system and its gravitational radiation, which requires the accuracy template describing the inspiral phase of the binary coalescences process. Compared with another scalar-tensor gravity, we find that DCS modification is at least the 2PN-order correction to General Relativity, and does not produce extra polarization modes. In this talk, I will introduce my recent work, in which the gravitational waveforms are given in the post-Newtonian framework, including the long-timescale orbital evolution and the ready-to-use frequency-domain waveform. Future third-generation ground and space-based GW detectors will hopefully detect the higher PN waveform. Our results can be used for GW signal extraction, detector ability prediction, and gravitational test in future work.

利用大质量双黑洞引力波探测和 AGN 巡天澄清“final-parsec problem”

朱良贵　　北京大学

A dedicated gravitational wave burst search method for space-borne detectors

吴征　中山大学

The millihertz gravitational wave band is a rich source of signals for space gravitational wave detectors. These signals include not only the expected bursts from binary star mergers but also unmodeled and unexpected ones. In this paper, we propose a generic search method to distinguish these signals from instrumental noise in the simulated data of the TianQin gravitational wave detector. Our method targets gravitational-wave bursts with durations from a few seconds to 10,000 seconds and frequencies from 0.1mHz to 1 Hz, without assuming any prior information about their direction, polarization, or morphology. We use time-frequency analysis to obtain the energy distribution of the data and identify signal candidates by clustering. We then exploit the different responses of signal and noise transients in signal-insensitive channels to construct suitable detection statistics based on the energy values of different channels. We find that our method can detect burst signals with signal-to-noise ratios above 20 with 97.4 % detection efficiency at a false alarm rate of one per year. However, this result depends on the mean interval between noise transients.

中法天文卫星（SVOM）/GRM 研究进展

郑世界　中国科学院高能物理研究所

中法天文卫星（Space multi-band Variable Object Monitor，简称 SVOM）是由中国国家航天局和法国国家空间研究中心联合研制的一颗空间高能探测卫星，计划 2024 年发射。SVOM 卫星是继美国 SWIFT 任务之后一个重要的伽玛暴多波段探测项目，目标包括开展伽玛暴、宇宙学和多信使天体物理学研究。其中伽马射线监测器（GRM）是 SVOM 卫星上的中方科学载荷之一，负责对硬 X 射线和软伽玛射线进行能谱观测，并对伽玛暴进行实时触发。本报告主要汇报 GRM

仪器中心的研究进展情况，包括标定与本底分析、科学数据产品、科学探测能力分析等。

EP 卫星探路者 LEIA 的 X 射线监测介绍

程华清　　中国科学院国家天文台

自去年 7 月 27 日发射以来，爱因斯坦探针卫星（EP）探路者 LEIA（龙虾眼天文成像仪）在轨运行已超过一年时间。在这一年中，LEIA 已完成 MPO 和 CMOS 探测器技术的在轨性能验证和宽视场聚焦 X 射线望远镜的在轨标定方案研究，获得并公开了国际上首批宇宙大视场 X 射线聚焦成像天图。自 2022 年 11 月以来，LEIA 已经开始为软 X 射线的巡天检测提供观测数据，并获得了一些有趣的结果。本报告将对 LEIA 的 X 射线监测进行介绍。

天格计划最新进展

王晨宇　清华大学天文系

天格计划利用多个微纳卫星装载伽马射线探测器，对伽马射线暴等瞬变源进行监测，力争达到全天全时覆盖。目前，已经发射了 8 个天格载荷，有 6 个正在在轨工作，天区的实时覆盖率最高超过 80%，在持续探测伽马射线暴等高能事件，并已发表了若干科学结果。天格计划完全由学生主导，负责项目的硬件建设、测试标定、在轨运行和科学分析。我将代表天格学生团队介绍天格的基本情况和目前运行状态。

核天体物理谱线巡天计划 MASS

朱佳欢　　清华大学

The MeV Astrophysical Spectroscopic Surveyor (MASS) is a future mission concept for a large area Compton telescope based on 3D position-sensitive cadmium zinc telluride (CZT) detectors optimized for emission line detection. The CZT detector works at room temperature with a spectral resolution of 0.6% at 0.662 MeV, enabling us to construct a Compton telescope with a geometric area of 4096 cm^2 in the frame of a small satellite, to measure astrophysical nuclear emission lines and

address a variety of related astrophysical questions. In the next year, we will fly a CubeSat to have a direct test of the technique in space and observe the brightest emission lines in the sky.

张贴报告

Interacting Kilonovae: Long-lasting Electromagnetic Counterparts to Binary Mergers in the Accretion Disks of Active Galactic Nuclei

任佳　南京大学

We investigate the dynamics and electromagnetic (EM) signatures of neutron star–neutron star (NS–NS) or neutronstar–black hole (NS–BH) merger ejecta that occur in the accretion disk of an active galactic nucleus (AGN). Wefind that the interaction between ejecta and disk gas leads to important effects on the dynamics and radiation. Weshow five stages of the ejecta dynamics: gravitational slowing down, coasting, Sedov–Taylor deceleration in thedisk, reacceleration after the breakout from the disk surface, and momentum-conserved snowplow phase.

Meanwhile, the radiation from the ejecta is so bright that its typical peak luminosity reaches a few times10^43–10^44 erg s^−1. Since most of the radiation energy has converted from the kinetic energy of merger ejecta, wecall such an explosive phenomenon an interacting kilonova (IKN). It should be emphasized that IKNe are verypromising, bright EM counterparts to NS–NS/BH–NS merger events in AGN disks. The bright peak luminosityand long rising time (i.e., 10 to 20 days in UV bands, 30 to 50 days in optical bands, and 100 days to hundreds ofdays in IR bands) allow most survey telescopes to have ample time to detect an IKN. However, the peak

brightness, peak time, and evolution pattern of the light curve of an IKN are similar to a superluminous supernovain a galactic nucleus and a tidal disruption event making it difficult to distinguish between them. But it alsosuggests that IKNe might have been present in recorded AGN transients.

天文警报汇-多波段多信使的汇集与发布平台

郑世界　中国科学院高能物理研究所

近年来，引力波、快速射电暴、宇宙线等领域取得重大突破，标志着“多信使、多波段”天文学时代正式到来。其中，伽马暴和磁星爆发等暂现源的联合探测、联合分析发挥了重要作用，取得了一系列重大发现。为了抓住引力波暴、快速射电暴、磁星爆发等这些在宇宙中随机发生的天体现象，及时开展多信使、多波段的后随观测和联合观测，必须尽快获取、准确分析这些爆发事件的关键信息（如触发时间、空间位置、爆发强度、爆发类型等）。但这些信息通常会在不同的平台上以各种类型形式进行报告，给研究人员带来了一定的不便。由高能物理研究所粒子天体中心和国家高能物理科学数据中心联合研制了天文警报汇平台，目的是汇集来自各种公开平台的所有天文爆发事件，如伽马射线暴、软伽马射线中继器、快速射电暴、引力波和高能中微子等。我们将这些来自不同平台的 "信息 "收集起来，归类为天文爆发事件（对一个事件的观测可能会产生一个或多个 "信息"）。我们还提供信息发布功能，以及对所有和最新事件、信息的统计资料，展示"热门事件"。我们希望这个网站能为研究人员提供有用的信息，促进对天文爆发的研究。

船帆座脉冲星风云 X 射线偏振趋近同步辐射理论极限

Kuan Liu　广西大学

脉冲星风云是由快速旋转的脉冲星驱动的星风冲击外部物质产生的高能天体。近日，国际合作研制的成像型 X 射线偏振望远镜 IXPE 对船帆座脉冲星风云（Vela PWN）进行了长达 20 天的观测，以极高精度测量了 Vela 脉冲星风云的 X 射线偏振度。其局部偏振度高达 63%，趋近于电子同步辐射理论的极限值，是人类至今观测到的 X 射线偏振度最高的天体。IXPE 的观测在揭示其磁场位形的同时，对其粒子加速机制提出严格的限制。

r-Process Radioisotopes from Near-Earth Supernovae and Kilonovae

王夕露　中国科学院高能物理研究所

The astrophysical sites where r-process elements are synthesized remain mysterious: it is clear that neutron-star-mergers (kilonovae, KNe) contribute, and

some classes of core-collapse supernovae (SNe) are also possible sources of at least the lighter r-process species. The discovery of 60Fe on the Earth and Moon implies that one or more astrophysical explosions have occurred near the Earth within the last few Million years (Myr), probably SNe. Intriguingly, 244Pu has recently been discovered in deep-sea deposits spanning the past 10 Myr, a period that includes two 60Fe pulses from nearby supernovae. 244Pu is among the heaviest r-process products, and we consider whether it was created in the supernovae, which is disfavored by nucleosynthesis simulations, or in an earlier kilonova event that seeded 244Pu in the nearby interstellar medium that was subsequently swept up by the supernova debris. We discuss how these possibilities can be probed by measuring 244Pu and other r-process radioisotopes such as 129I and 182Hf, both in lunar regolith samples returned to Earth by missions such as Chang'e and Artemis, and in deep-sea deposits.

DAMPE 伽马射线数据简介

段凯凯　中国科学院紫金山天文台

通过费米卫星数据限制磁化参数

李安　北京师范大学

The High-Energy Detection Data Integration Analysis Tool and the Application in Gamma-Ray Burst Study

王鋆　中国科学院紫金山天文台

利用 GRB 221009A 的伽马射线观测推断星系间磁场强度

夏子晴　中国科学院紫金山天文台

TBD

董爱军　　贵州师范大学

星系、宇宙学分会场报告

Gravitational-Wave Cosmology with DECi-hertz Interferometer Gravitational-wave Observatory

曹硕　北京师范大学

It has been a half-decade since the first direct detection of gravitational waves, which signifies the coming of the era of the gravitational-wave astronomy and gravitational-wave cosmology. DECi-hertz Interferometer Gravitational-wave Observatory (DECIGO) is a future Japanese space gravitational-wave antenna, sensitive to frequency range between target frequencies of LISA and ground-based detectors. In this talk, I will give a brief introduction of the status report of DECIGO, focusing on its extensive applications in cosmology, fundamental physics and astrophysics.

Constrain Primordial non-Gaussianity with 21-cm Power Spectrum and Bispectrum from the Epoch of Reionization

赵思逸　　清华大学

Measuring primordial non-Gaussianity (PNG) with next generation surveys will help distinguish different inflation models. We investigate the detectability of the local template PNG, fNL, by measuring the 21-cm power spectrum and bispectrum from the Epoch of Reionization (EoR). For the first time, we model the bispectrum in redshift space during EoR and forecast the constraint of PNG using Fisher formalism. We find that 21-cm bispectrum can improve the constraint from power spectrum. A cosmic-variance-limited experiment can constrain fNL with error about 0.1, combining the power spectrum and bispectrum measurements at four redshift bins.

哈勃常数的晚期特殊行为

胡建萍　　南京大学

近期，类星体引力透镜的哈勃常数（H0）测量结果表明 H0 可能随红移呈下降趋势，置信度约为 1.7σ 。受此启发，研究人员基于 LCDM 模型从已有的观测数据分析中也发现了类似的行为。我们利用高斯过程方法对 H(z)观测数据进行模型无关分析，发现了 H0 的晚期跃迁行为，即 H0 从宇宙早期演化到晚期由较低值跃迁为较高值。这一发现可以有效地缓解哈勃危机，缓解程度~70%，此结果与类星体引力透镜的测量结果在 1σ 置信水平上相一致。此外，我们还利用其它观测数据和方法发现了类似的 H0 演化行为。种种迹象表明哈勃危机可能源于超越标准模型的晚期新物理。

dark energy on different scales and its detection in the Milky Way

张镇　高能物理研究所

The origin and nature of dark energy is one of the most significant challenges in modern science. This research aims to investigate dark energy on astrophysical scales and provide a cosmology-independent method to measure its equation-of-state parameter w. To accomplish this, we introduce the concept of a perfect fluid in any static, curved spacetime, and express the energy-momentum tensor of the perfect fluid in a general isotropic form, namely Weinberg's isotropic form. This enables us to define an equation-of-state parameter in a physical and global manner. Within this theoretical framework, we demonstrate that the energy-momentum tensor of dark energy on different scales can take the general isotropic form. Furthermore, we explore the SdSw spacetime and establish its connection with dark energy in cosmology through the equation-of-state parameter w. In the SdSw spacetime, a repulsive dark force can be induced by dark energy locally. We then apply the concept of the dark force to realistic astrophysical systems using the Poisson equation. Finally, we find that an anomaly in the Milky Way rotation curve can be quantitatively interpreted by the dark force. By fitting the galactic curve, we are able to obtain the value of the equation-of-state parameter of dark energy, independently of specific dark energy models.

Detection of pairwise kSZ effect with DESI galaxy clusters and Planck in Fourier space

黎绍宏　中山大学

We report a 4.5σ detection of the kinetic Sunyaev–Zel'dovich (kSZ) effect in Fourier space, by combining the DESI galaxy clusters and the Planck data. The galaxy cluster catalog is constructed from the DESI Legacy Imaging Surveys DR9, and the summary statistic we adopt is the density-weighted pairwise kSZ power spectrum. For measuring the power spectrum, we apply the Aperture photometry (AP) filter to locations of those galaxy clusters on the CMB sky and extract the cossponding kSZ signals. Then we cross correlate the cluster density field and the kSZ signal (essentially the cluster momentum field) and output the pairwise kSZ power spectrum. By fitting the measurement with a robust non-linear theoretical model, we identify the average optical depth of cluster sample to be (3.3\pm0.6)\times10^{-5}, with a median mass 6.1\times10^{13}M_{\odot}/h of the sample . We also vary the richness, mass cut of the catalog, the size of the AP filter to see how the optical depth evolves with them.

原初黑洞的宇宙丰度

杨玉鹏　曲阜师范大学

原初黑洞一直是物理学和天文学研究的问题之一。特别是 LIGO 和 Virgo 对黑洞合并引力波的观测使得对原初黑洞的研究引起了更为广泛的兴趣。研究原初黑洞的方式有很多，除了引力波之外，对其相关辐射的研究也是非常重要的。我们主要研究了原初黑洞吸积重子物质产生的辐射对宇宙介质演化的影响，通过 CMB 与 21cm 等相关的观测对原初黑洞的宇宙丰度给出了限制。此外，原初黑洞形成之后会吸积暗物质粒子形成一种致密暗物质小晕。我们研究了暗物质粒子在小晕中湮灭产生的伽马射线、中微子等对相关观测的贡献，并用相关的观测对原初黑洞的宇宙丰度给出限制。同时，我们也研究了被暗物质小晕包裹的原初黑洞对重子物质的吸积产生的辐射对宇宙黎明时期和黑暗时期 21cm 的影响，并用相关的观测（含预期观测）对原初黑洞的宇宙丰度给出限制。

Testing the spatial geometry of the universe with TianQin: the prospect of using supermassive black hole binaries

潘宇　重庆邮电大学

The determination of the spatial geometry of the universe plays an important role in modern cosmology. Any deviation fromthe cosmic curvature ΩK = 0 would have a profound impact on the primordial inflation paradigm and fundamental physics. In this paper, we carry out a systematic study of the prospect of measuring cosmic curvature with the inspiral signal of super?massive black hole binaries (SMBHBs) that could be detected with TianQin.The study is based on a cosmological-model-independent method that extended the application of gravitational wave (GW)standard sirens in cosmology. By comparing the distances from future simulated GW events and current cosmic-chronometer (CC)Hubble data, we evaluate if TianQin would produce robust constraints on the cosmic curvature parameter Ωk. More specifically, weconsider 1-yr to 10-yr observations of supermassive black hole binaries with total masses ranging from 10^3M? to 10^7M? .Our results show that in the future, with the synergy of 10-yr high-quality observations, we can tightly constrain the curvatureparameter at the level of 1σ Ω_k = 0.037 ± 0.043. Moreover, our findings indicate that the total mass of SMBHB does influencethe estimation of cosmic curvature, implied by the analysis performed on different subsamples of gravitational wave data. Therefore, TianQin is expected to provide a powerful and competitive probe of the spatial geometry of the universe,

compared to future spaced-based detectors such as DECIGO.

实验室精密实验检验宇宙暗能量模型

何建华　南京大学

暗能量是一种假设存在于宇宙中的神秘能量形式，被认为是导致宇宙膨胀加速的主要原因。在过去二十年中，天文宇宙学观测一直是研究暗能量的主要手段。然而，近年来地面实验室的实验精度不断提升，逐渐超越了天文宇宙学观测，为暗能量的检验提供了更加有效的方法。最近我们进行了一项关于暗能量的研究工

作，利用悬浮镇子系统进行了精密检验，特别关注了变色龙模型。我们的实验结果结合了之前的实验数据，最终覆盖了变色龙模型作为暗能量的全部参数空间。基于这些结果，我们能够确定性地排除了该变色龙模型作为暗能量的可能性。

Strongly Lensed Transient Sources

廖凯　武汉大学

在过去的几十年里，引力透镜基于两个主要观测源：恒星和星系（活动星系核）取得了巨大进展。这部分归功于这些光源恒定发光使得观测和监测相对容易。正在运行和即将运行的各类电磁波和引力波大型设备/巡天，使得时域天文学时代持续探测到强透镜瞬变源事件，例如，各类型的超新星，带有余辉的伽马射线暴波段、快速射电暴甚至引力波。透镜瞬变源在研究宇宙学方面有自身独特的优势，同时放大效应有助于理解高红移瞬变源分布。在这次报告中，我总结了搜索不同类型的透镜瞬变信号的方法，探测的最新结果及其在基础物理学、天体物理学和宇宙学中的应用。与此同时，我给出评述意见以及这一新领域的前景，可能有助于有兴趣进入该领域的听众。

Simulation-guided Galaxy Evolution Inference: A Case Study with Strong Lensing Galaxies

舒轶平　紫金山天文台

Testing General Relativity via Strongly Lensed FRB

江新月　云南大学中国西南天文研究所

This study aims to investigate the strong gravitational lensing effects of the f(T) gravity in astrophysics. We have focused on studying the theoretical expressions for the lensing effects in this gravity theory and have considered the lensing effects of f(T) gravity in a plasma environment. By simulating lensed Fast Radio Bursts (FRBs), we analyze the differences between the lensing effects in the ideal vacuum environment predicted by General Relativity and the lensing effects of f(T) gravity in a plasma

environment, including deflection angles, time delays, and magnifications. The results indicate that with the lensing effects predicted by General Relativity as a reference in a plasma environment, f(T) gravity can produce imaging at the same positions but with significant differences in magnifications and time delays. Therefore, when there are significant discrepancies between observational results and theoretical expectations, these differences can serve as clues for modifying the gravity theory and provide constraints on the parameter in f(T) gravity. This study provides theoretical guidance for further utilizing gravitational lensing effects to validate and constrain the f(T) gravity.

星系尺度强透镜的宇宙学应用及模型优化

陈云　国家天文台

星系尺度强引力透镜是一类强有力的宇宙学探针，但目前在该探针的宇宙学应用过程中还存在一些待解决的难题。针对联合使用早型星系的强透镜和动力学观测数据进行宇宙学参数估计时明显有偏这一问题，我们在 Chen et al. (2019)中首次成功找出该方法中导致估计偏差的两大主要因素；在此之前，文献中的同类研究也发现了估计偏差的存在，但都没有直接找出背后的原因。在样本选择时，为了满足球对称质量模型这一假设，Chen et al. (2019)中的判据包含了两个主要条件，即透镜星系必须是 E/S0 型早型星系，以及透镜星系不能有明显的子结构或邻近的伴星系；基于以上判据构建出了包含 161 个透镜系统的新样本。我们还将该样本用于透镜统计学进行宇宙学参数估计（Li & Chen 2023)，结果显示该方法对物质密度参数的约束明显优于对暗能量状态方程的约束。 Chen et al. (2019）中使用的新模型和新样本得到了很好地推广应用，包括被应用于在星系尺度上检验广义相对论，测量宇宙空间曲率，以及检验光速不变性等等. 我们的研究结果表明透镜模型优化和样本选择方法优化，二者都是提高强透镜宇宙学应用准确度和精确度的重要因素。后续的相关研究也是从这两方面同时着手进行深入探讨，以便为有效使用将来 CSST 等项目所提供的大样本做好准备。

Strong gravitational Lensing in the Era of Big Data

李楠　国家天文台

Gravitational lensing has become one of the most powerful tools available for

investigating the "dark side" of the Universe. Cosmological strong gravitational lensing, in particular, probes the properties of the dense cores of dark matter halos and offers the opportunity to study the distant Universe at flux levels and spatial resolutions otherwise unavailable. Moreover, with the capabilities of next-generation telescopes, astrophysics and cosmology are stepping into the big data era, i.e., tens of billions of objects will be observed. Hence, it requires automated approaches for identifying and modeling strong lenses in such enormous datasets. In this presentation, I will first indroduce a pipeline for the automated analysis of strong gravitational lenses by adopting machine learning algorithms, then present its performance on simulated data created by a lensing simulation program named PICS. The pipeline is being applied to DESI Legacy Imaging Surveys for testing its reliability on real observations, and will be included in the data processing pipeline for CSST.

盱眙百米级光干涉阵列光学系统研制进展

孙越　南京天光所

光干涉以其高分辨率的性能优势，在恒星的形成及演化、密近双星相互作用、系外行星探测等重要天文问题的研究上具有广泛的应用前景，开展光干涉技术研究对我国天文学的发展具有突出的前瞻性和战略性意义。南京天文光学技术研究所正在紫金山天文台盱眙观测站开展百米级光干涉阵列的建设工作，建设完成后，该装置将能够在 J、H 波段进行观测，天体测量精度预期可以达到 10 微角秒量级。本文将对该干涉阵列的光学系统研制进展进行介绍。

基于差分延迟干涉微角秒天体测量装置进展

徐腾　南京天光所

南京天文光学技术研究所目前正在紫金山天文台盱眙观测站建设基于 3 台 600 毫米口径望远镜、最长 100 米基线的天文光干涉阵，实现基于差分延迟干涉的微角秒天体测量，本报告将对该装置的研制进展进行介绍。

宇宙演化数值模拟的设计和优化

于浩然　厦门大学

宇宙网络结构蕴含丰富的宇宙学信息，计算机数值模拟是唯一能够精确描述其动力学演化的理论方法。CUBE 是面向大规模并行计算的宇宙演化模拟程序，具有高精度、高效率、低内存等特点。我将概述宇宙演化模拟方法，并展示利用 CUBE 运行的面向中国空间站望远镜的宇宙学模拟结果。

How Does the Angular Momentum of Dark Matter Halos Determine Galaxies' Properties?

杜敏　厦门大学

In our series of studies using the IllustrisTNG simulations, we have investigated the structures of galaxies and gained valuable insights into their formation and evolution. By accurately defining structures based on the kinematics of stellar particles, we have found that both bulge and disk structures form naturally, while stellar halos are formed through mergers. Thus, the properties of bulge and disk are primarily influenced by their host dark matter halos.

Our recent research reveals that the local js–Ms relation, also known as the Fall relation, emerges in disk galaxies at z<1. The index of 0.55 in the js–Ms relation arises from the indices of the jdm–Mdm relation (angular momentum and mass of dark matter) and the stellar-to-halo mass relation. Notably, we observe a significant deviation from the predicted jdm ∝Mdm^2/3 relation based on the tidal torque theory. This indicates that angular momentum is approximately conserved during the assembly of disk-like structures and plays a crucial role in determining disk growth and galaxy size.

Magpie 宇宙学模拟揭示暗弱微弱星系的相空间分布

赵旭　国家天文台

几十年来的观测表明银河系、M31 的卫星星系存在于一个非常薄的盘面上，并且有相似的轨道角动量方向，而在宇宙学模拟中，这种情况出现的概率小于 1%，这个矛盾被称为卫星星系盘问题(Plane of Satellite Problem)，它是标准宇宙学模型在小尺度上面临的四个问题之一。我们的 Magpie 宇宙学模拟采用最新的

技术，结合了流体数值模拟和半解析模型，能解析出最小 100 太阳质量的卫星星系，卫星星系数目达到 80-100。更高的分辨率让我们能够分析暗弱的卫星星系的相空间分布，并且探究它们是否与最大质量的卫星星系规律保持一致。除此之外，我们还能追踪卫星星系的合并历史，了解卫星星系盘的形成原因。我们的研究也能为观测暗弱卫星星系可能的分布给出一定的预测。研究表明，卫星星系盘问题在暗弱卫星星系中仍然存在，并且与 lmc 的 group infall 有关。

Uncovering Correlations between Galaxy Parameters and Dynamical Structures through Unsupervised Learning of IllustrisTNG Simulation Data

马硕　厦门大学

We attempt to apply unsupervised learning methods to the correlation research of galaxy parameters and their kinematic structures. We used principal component analysis (PCA) to normalize and downscale the parameters of disk galaxies from IllustrisTNG, preserving 90% of the information. We analyze the correlation between the downscaled parameters and the mass or mass fraction of the galaxy structure (including dynamically decomposed disks, bulges, and stellar halos and morphologically decomposed bulges) by the Maximum Inter-Information (MIC) method. It is found that there is a coupling between mass (including black holes, stellar and dark matter halos), centrality, and quenching, and that there is a correlation with mass in logarithmic space for each component, and not so much with the mass fraction. There is a correlation between the component mass fraction relations, especially for disk structures, and the coupling of the merger history and rotationality. Furthermore, by limiting the mass fraction of the stellar halo and reducing the impact of the merger effect, it is concluded that (1) for naturally evolving galaxies, the merger history and the galaxy mass together determine the mass share of the dynamical bulge, followed by the angular momentum of the host dark matter halo; (2) the morphology-based bulge component is almost exclusively dominated by the merger history; (3) the influence of the disk component has a similar effect as the bulge are similar; (4) the correlation between star formation history and black hole

and galaxy structure is weak.

The diverse gas-phase metallicity gradients in high-redshift galaxies from FIRE2 simulations.

孙训达　　中国科学院大学

We analyze the high-redshift galaxy spatially resolved chemical profiles using the cosmological zoom-in hydrodynamic simulations created as part of the the Feedback in Realistic Environments-2 project. We find that the radial gradient of gas-phase metallicity is usually negative after the thin disk formation during galaxy evolution. However, in the early evolutionary phase, galaxies can show strongly inverted (i.e. positive) radial gradients at high redshifts. We find a causal link between high specific star formation rate (sSFR) and the manifestation of inverted gradients. This is likely induced by metal-enriched gas outflows generated by strong galactic winds which push high metallicity gas outward, leading to the occurrence of inverted gradients. The occurrence rate of inverted gradients in FIRE-2 simulations is around 10 percent, consistent with current observations in high-redshift galaxies. Our work presents an important benchmark comparison between state-of-the-art numerical simulations and observations on the chemo-structural evolution of high-z galaxies.

What Can Bulge Do to Star Formation Rate in Paired Galaxies

何川　国家天文台

Galaxy interaction can induce star formation enhancement, however, such enhancement is conditional, which can be affected by many factors such as separation distance, mass ratio, environment, interaction phase, and orbital parameters. It is still controversial on what are the necessary and sufficient physical conditions for strong star formation enhancement to happen in paired galaxies. The FIR observations (by Spitzer and Herschel) on a sample of Ks-band-selected close major-merger pair (KPAIR) show that only SFGs in spiral-spiral pairs have significantly enhanced sSFR, but not those in spiral-elliptical pairs. Simulations of interacting galaxies have shown

that a massive bulge can stabilize the disk and suppress the SFR during and after close encounters. We (He+2022) study the B/T of SFGs in a subsample of KPAIR, H-KPAIR. We found significantly lower B/T for SFGs in S+S pairs than their S+E counterparts, especially, a larger fraction of disky galaxy (B/T<0.1) is found in S+S subsample. We found a negative dependence of the interaction-induced sSFR enhancement on the bulge-to-total ratio (B/T), and this can be a reason for the sSFR_enh difference between S+S and S+E cases. Significant sSFR_enh is found for paired SFGs with low B/T. These results are consistent with the prediction of theoretical simulations. However, disky SFGs (B/T $\leqslant$ 0.1) have very diversified sSFR_enh. Furthermore, for disky galaxies, significant sSFR_enh is still absent in S+E cases. It appears that the pseudobulges (pseudobulge galaxies are regarded as B/T=0) act differently from the classical bulge. The pseudobulges can either associate with nuclear/circum-nuclear starbursts or with SFR-quenched bar/ring structure. We found S+E are more likely to locate in relatively higher local density regions. The differences in environment preference between S+S and S+E pairs also lead to different collision scenarios and cause different SF performances (He+23 in prep.).

Constraints on the Cosmic Star Formation History via a new modeling of the SFG radio luminosity function

王文杰　湖南师范大学

Understanding the formation and evolution of galaxies through the cosmic time is a major quest of modern cosmology. One of the most fundamental processes driving the evolution of galaxies is star formation. Star formation rate density (SFRD) is thus a critical parameter for galaxies. In the past decades, a lot of research based on multiwavelength aspects has been devoted to an accurate measurement of the cosmic evolution of SFRD. Remarkable progress has been made on this, and the SFRD is now well understood up to z ~ 3, when the universe was no more than 3 Gyr old. Moreover, deep radio surveys reaching sub-mJy detection limits have emerged as a powerful tool to investigate the cosmic evolution of star-forming galaxies (SFGs). In this work we make use of the VLA-COSMOS 3 GHz data to measure the radio luminosity functions (LFs) of SFGs. We use models which consider a combination of density and luminosity evolutions to fit the LFs directly to the radio data using a full

maximum likelihood analysis. We have fully considered the effect of completeness corrections of sample. In order to obtain better constraints on LFs, we also added the local LF as well as the source counts of SFGs on the faint end. The parameters of fitting are determined through the Bayesian Markov Chain Monte Carlo (MCMC) approach. In addition, to provide an alternative nonparametric LF estimate for SFGs, we applied the kernel density estimation (KDE) method described by our previous work. Based on these LFs, we are able to place better constraints on the evolution of the cosmic SFRD.

The Formation and Evolution of Compact Stellar Systems in the IllustriousTNG Simulation

边缘　厦门大学

Compact stellar systems (CSSs), characterized by $8<\log M<10$ and $R_e<0.6$kpc, include super massive star clusters (SSCs), ultra-compact dwarfs (UCDs), and compact ellipticals (cEs), have been explained by various formation scenarios. They are mostly found in galaxy groups or clusters, but observations have also shown their existence in isolated environments. Therefore, the evolutionary process of CSSs is the result of the combined action of internal and external factors, which has always been a topic of debate in the process of galaxy evolution.

In this case, comparing the formation and evolution of CSSs in different environments can help extract the causal relationships between observational phenomena and physical processes more accurately. The IllustrisTNG simulation provides us with such an opportunity.　Based on its most accurate version, TNG50-1, which takes into account both the number of samples and simulation accuracy. We quantified and compared the changes in galaxy structure and chemical element enrichment in CSSs by selecting appropriate simulation parameters and tracing their evolutionary history.

Our results demonstrate a bimodal distribution of metallicity among CSSs in TNG50-1. In contrast to previous understanding that CSSs generally form through the tidal stripping of surrounding massive galaxies in high-density environments. 52% of CSSs in TNG50-1 belong to a population with comparatively low metallicity, with 80% of them forming in isolated or field environments without massive galactic

companions. The remaining CSSs are found in the sparser regions of groups/clusters. On the other hand, the populations with high metallicity, characterized by a different stellar age composition, predominantly reside in galaxy groups and cluster environments. In this scenario, the environment plays a crucial role in shaping the metallicity levels of CSSs. It stimulates stellar formation and imposes constraints that amplify the metallicity of newly generated stars.

A logically consistent perspective allows for the understanding of these two distinct formation channels (tidal stripping + environmental regulation and born-to-be), i.e., The effects of tidal stripping and environmental constraints become evident only when satellite galaxies are in close proximity to high-gradient gravitational field environments, which can lead to the formation of high metallicity CSSs, and there exists an excess of high-density CSSs-bearing subhalos close to massive ones within each massive halo.

中国的类星体巡天

吴学兵　　北京大学

Formation of a magnetically arrested disk around a black hole

吴学兵　武汉大学

X-ray Point Sources Inside Galaxy Halos: A Comparison of Virgo and the field Galaxies

胡祯崧　　南京大学

The stellar halo is a large spherical component of a galaxy. Due to its extended shape and low density, the halo can be reshaped by interactions between the host galaxy and its environment. For example, galaxy halos in galaxy clusters differ from

those in the field due to interactions with the intracluster medium or the neighboring galaxies. X-ray binaries are a useful tracer for stellar components, revealing the structure of galaxy halos. In this report, we compare the distribution of X-ray point sources in the halos of Virgo and the field galaxies. We find an excess of sources in the halos of Virgo galaxies, with an enhanced excess on the leading side compared to the other side, an effect not observed in the field galaxies. We suggest that this excess can be linked to enhanced star formation by ram pressure stripping in the cluster environment.

An Escaping Outflow in a Galaxy with an Intermediate-mass Black Hole

郑致远　南京大学

While in massive galaxies active galactic nuclei (AGN) feedback plays an important role, the role of AGN feedback is still under debate in dwarf galaxies. With well spatially resolved data obtained from the Multi-Unit Spectroscopic Explorer (MUSE), we identify a spatially extended (∼ 3 kpc) and fast (V_80 ∼ 471 km s−1) AGN-driven outflow in a dwarf galaxy: SDSS J022849.51- 090153.8 with M_∗ ∼ 10^9.6 M⊙ that host an intermediate-mass black hole of M_BH ∼ 105 M⊙ and L_AGN/L_Edd ∼ 0.15. Through the measurement of the rotation curve, we estimate the escape velocity of the halo and the ratio of the outflow velocity to the halo escape velocity to be 1.09±0.04, indicating that the outflow is capable of escaping not only the galaxy disk but the halo. The outflow size of our AGN is found to be larger than AGN in massive galaxies at the given AGN [O III] luminosity, while the

size of the photo-ionized narrow-line region is comparable. These results suggest the important role of AGN feedback through outflows in dwarf galaxies when their central intermediate-mass black holes accrete at high-Eddington ratios.

费米耀变体的喷流机制

张丽霞　广州大学

在观测上，耀变体呈现出极端的观测特征。为了解释这些极端观测特征，人们提出了“活动星系核的统一模型”。但是对其物理过程的研究仍然存在许多尚未解决的问题，比如喷流的形成机制，喷流的粒子加速机制，喷流的准直机制，高能辐射的主导机制及其耗散区域位置等等。其中，喷流的形成机制主要由

Blandford - Znajek（BZ）机制和 Blandford - Payne（BP）机制解释。然而在耀变体喷流形成机制的研究上，面临着样本不足以判定喷流形成的主导机制，宽发射线资料尚未被充分挖掘等问题，本报告基于扩展的宽发射线费米耀变体大样本，从费米耀变体中心能源机制物理参量之间的关系探讨其喷流形成的主导机制、喷流与吸积的联系，利用多波段辐射限定喷流物理参量并研究其高能辐射机制。通过研究费米耀变体中喷流形成机制和高能辐射机制，以更好地理解河外高能辐射源的起源。

Probing the Interplay between Active Galactic Nuclei Strength Activity and Star Formation

Huynh Anh N. Le 中国科学技术大学

In this talk, we present the study of the interplay between nuclei strength activity and star formation (SF) in their host galaxies in Active Galactic Nuclei (AGNs). This interplay also called AGN feedback plays a significant role in understanding the growth of supermassive black holes (SMBHs) and their host galaxies. People try to find answers to the following questions: how is the correlation and connection between AGN strength activity and SF in their host galaxies? How does AGN strength activity influence the interstellar medium in their host galaxies and trigger SF? Does the energy output from nucleus activity suppress or compress the gas component from the host galaxies, leading to quenching or enhancing SF? However, many diverse results have been obtained. Therefore, we have carefully controlled some main factors that may cause the contradicting results e.g., the challenge of star formation rate estimation, the inaccuracy of AGN strength measurements, and the sample selection effect. Using the latest and multiwavelength spectroscopic data (both integrated and high spatially resolved spectra), we constructed a large sample of AGNs for probing AGN physical properties, including the kinematic properties of ionized and molecular gas outflows, AGN feedback, the coevolution between AGN strength activity and SF. In this talk, we present some preliminary results of our studies e.g., the discrepancies of different SFR tracers and the well correlation between AGN strength (Eddington ratio luminosity) with SFRs.

The High Energy Mechanism for Active Galactic Nuclei: from Gamma-ray to Neutrino Emission

裴致远　广州大学

In this talk, I will review our recent progress and important findings on the high energy mechanism for active galactic nuclei (AGN). I will also talk about the relativistic jet property and beaming effect within gamma-ray, TeV and neutrino emission for AGNs detected by the Fermi-Large Area Telescope (Fermi-LAT). Principally, we come to the results and conclusions as follows:

(1) We present an effective method by means of the beaming effect to estimate four crucial parameters, including the upper limit of central black hole mass M, the Doppler factor δ, the location of γ-ray-emitting region Rγ, and the propagation angle with respect to the axis of the accretion disk , for more than 800 gamma-ray blazars. We put forward an updated demarcation between BL Lacertae objects (BL Lacs) and flat-spectrum radio quasars (FSRQs) based on the relation between broad-line region luminosity and disk luminosity both measured in Eddington units, i.e., Ldisk/LEdd = 4.68X10-3, indicating that there are some differences between BL Lacs and FSRQs on the accretion power in the disk;

(2) By adopting a two-component model of emission within jets, we successfully separated the emission of radio, X-ray, GeV and TeV into beamed and unbeamed contributions for the largest sample of Fermi blazars up to now. Our results suggest that the emission is mainly from the core/beamed component in gamma-ray blazars;

(3) The location of gamma-ray-emitting region in blazars has been an open issue for several decades and is still being debated. We use a large sample of gamma-ray-loud FSRQs with available spectral energy distributions and employ a so-called “seed photon factor approach” to locate the γ-ray production region. We principally ascertain that the GeV emission originated far beyond the broad-line region (BLR) and close to the molecular dusty torus (DT)—farther out at parsec scales from the central black hole, which supports a far-site scenario for γ-ray blazars. We probe the idea that inverse Compton scattering of infrared seed photons is happening in the Thomson regime. We also suggest that our method can also indicate the location of neutrino emission, in consideration of the neutrinos and γ-rays being cospatially produced within the same region. We compute the predicted neutrino energy for the overall sample and find εν for two frameworks of far-site scenario and

near-site scenario are comparable with >>1 PeV, satisfying our general expectation that blazars are optimal production factories for PeV–EeV energy neutrinos in the extra- galactic γ-ray sky;

(4) We use a parabolic equation to fit the Inverse Compton (IC) spectral component of 3743 blazars from the 4FGL-DR3 catalog and estimate IC peak frequencies. Our analyses draw the main conclusion that the Bayesian classification shows two components with a dividing boundary of log (vIC) =22.9 Hz, thus the large sample of blazars can be divided into low IC peak frequency (LCP) blazars and high IC peak frequency (HCP) blazars. We also find the beaming effect is stronger for the source with a lower IC peak frequency. The tight correlation between IC peak frequency and γ-ray photon spectral index is also obtained. Therefore, we can estimate the IC peak frequency by available γ-ray photon index via this relation.

利用光学偏振特征限制 CTA 102 长时标与短时标的光变机制

马晨丽　　山东大学（威海）

耀变体是一类特殊的活动星系核，其喷流方向大致指向观测者，往往具有显著的多波段光变以及较高的偏振度。引起光变的原因大致分为两种：其一是几何因素，视向角的变化导致多普勒因子的变化从而引起光变，螺旋喷流模型是这种机制下的典型模型；其二是内禀因素，喷流内部电子谱发生变化从而引起光变，例如激波模型所描述的沿喷流传播的激波导致辐射电子的加速与准直。但在特定的目标中，这两种机制引起的光变的特征非常相似，依然缺少强有力的依据来认证其占主导的光变机制。由于耀变体的偏振携带了源内部物理过程的大量信息，因此对源的偏振特征进行观测与分析可以帮助我们进一步的限制其光变机制。源在光学波段的偏振较大且易于观测，我们将从源光学波段的偏振特征出发研究其对应的光变机制。

CTA 102 是一个典型的耀变体源，红移为 1.032，是一个低峰频的平谱射电类星体。CTA 102 在 2016-2017 年间经历了一次多波段的耀发，不同的文献对此次耀发时的光变机制有不同的见解：Raiteri 认为光变主要由视角的变化引起，是由几何因素主导的一次耀发；而 Casadio 根据 VLBI 图像认证此次耀发是由一个视超光速的结构与一个静止结构的碰撞触发的。此次报告我们将从长时标和短时标两方面来分析 CTA 102 的光变机制问题。

首先在长时标上，我们采用二分量模型，将观测到的总流量分为无偏振的背景成分与高偏振的喷流成分，分别给出了在螺旋喷流模型和激波模型下的偏振度与流量的关系。这两种模型在流量-偏振度平面上给出了相似的趋势，在低流量时偏振度上升较快，而在高流量时偏振度接近饱和。区别在于，在螺旋喷流情况下，流量很高时偏振度有一个向下弯曲的趋势，而激波模型的偏振度则是基本保持不变。通过选取适当的参数，我们发现这两种模型都可以很好的拟合观测到的偏振度与流量的关系，仅仅考虑偏振度时可能无法对 CTA 102 的长时标光变机制给出区分。

其次在短时标上，我们选取了 5 个采样相对密集的耀发时段进行了分析。由于其偏振度给出的信息有限，并且偏振角具有 nπ 不确定性，因此我们选择研究其归一化斯托克斯参数 q 和 u 的变化。我们发现 CTA 102 不同的耀发表现在 q-u 平面上可以归结为两种不同的运动趋势，一种是顺时针或逆时针旋转的趋势，另一种是沿直线振荡的趋势。通过分析表明，q-u 面的旋转趋势可能与螺旋喷流有关，通过选择适当的参数，可以定性的再现观测到的旋转趋势。而振荡的趋势则可能是激波的结果，我们从 Hughes 给出的激波模型出发，选择激波的压缩系数为变量，得到了激波模型在 q-u 面上的振荡趋势。由于这两种趋势在观测中均有出现，因此 CTA 102 不同耀发所对应的短时标光变机制可能不同。

在长时标上，偏振度与流量大致是正相关的，但同时我们也在短时标上发现了偏振度与流量的反相关趋势，这可能意味着多辐射区的存在。然而，由于观测数据采样的限制，我们无法得到进一步的结论，期待将来会有采样更好精度更高的观测，以便对目标进行更细致的分析。

向类星体的黑洞模型挑战

彭秋和　南京大学

Mapping the Circumgalactic Medium and Intergalactic Medium through Lya Emission

郭昱程　　CRAL - Observatoire de Lyon, France

Based on the extremely deep MUSE observation on the Hubble Ultra Deep Field, we map the emission from the intergalactic medium and the circumgalactic medium at

the physical scale of hundreds of kpc. For Lya emitters at 3<z<4, we observe an average blueshift of the Lya line from the galaxy center to approximately 60 kpc. This provides evidence for the presence of large-scale gas inflows. We map the extended Lya emission out to approximately 270 kpc, approaching the scale of the intergalactic medium. We try to reproduce the observed flux and kinematics of the Lya haloes through our simulations to gain further insights.

X-Ray Constraints on the Hot Gas Content of Member Galaxies in Virgo

侯美存　　北京大学

The X-ray-emitting hot gas is one of the primary components of the X-ray emission in normal galaxies and is crucial for understanding the evolution of the galactic ecosystem. The Virgo Cluster is the nearest and a rich galaxy cluster at its early evolutionary stage, which offers a great opportunity to study the hot gas content of its member galaxies and the cluster environmental effects. In this talk I will introduce a systematic study of the diffuse hot gas around early-type galaxies (ETGs) and late-type galaxies (LTGs) residing in the Virgo cluster, based on Chandra observations, to test the X-ray scaling relations and understand the roles of cluster environmental effects and galactic evolution in regulating the hot gas content of galaxies.

The power spectrum of extended [C II] halos around high redshift galaxies

张萌　国家天文台

ALMA observations have detected extended (~10 kpc) [C II] halos around high-redshift (z > 5) star-forming galaxies. If such extended structures are common, they may have an impact on the line intensity mapping (LIM) signal. We compute the LIM power spectrum including both the central galaxy and the [C II] halo, and study the detectability of such signal in an ALMA LIM survey. We model the central galaxy and the [C II] halo brightness with a Sersic+exponential profile. The model has two

freeparameters: the effective radius ratio f_Re, and the central surface brightness ratio, f_sigma, between the two components. [C II] haloscan significantly boost the LIM power spectrum signal. For example, for relatively compact [C II] halos (f_sigma = 0.4, f_Re = 2.0), the signal is boosted by ~20 times; for more extended and diffuse halos (f_sigma = 0.1, f_Re = 6.0), the signal is boosted by ~100 times. For the ALMA ASPECS survey (resolution theta_beam = 1.13", survey area Omega_survey = 2.9 arcmin^2) the [C II] power spectrum is detectable only if the deL14d [C II] - SFR relation holds. However, with an optimized survey (theta_beam = 0.232", Omega_survey = 2.0 deg^2), the power spectrum is detectable for almost all the [C II] - SFR relations considered in this paper. Such a survey can constrain f_sigma (f_Re) with a relative uncertainty of 60% (20%). A successful LIM experiment will provide unique constraints on the nature,origin, and frequency of extended [C II] halos, and the [C II] - SFR relation at early times.

星系的电离气体速度场形态

冯帅　河北师范大学

近年来兴起的积分视场光谱观测技术可以对星系不同位置同时进行光谱观测，通过分析测量这些空间分辨的光谱数据，我们可以得到一系列物理参数的二维空间分布，其中就包含电离气体视向速度的二维分布，即速度场。速度场所呈现出来的形态蕴含了大量与气体运动有关的信息，而这些信息是无法通过传统的测光观测得到的。

基于 MaNGA 的积分视场光谱观测巡天，我们对近邻宇宙中超过 5000 个星系进行了电离气体速度场形态的测量。通过分析速度场中非对称的形态特征，我们对星系中非旋转的运动开展了系统性的普查。一方面，我们研究了以并合星系为代表的特殊星系中的非旋转运动，并提出速度场的非对称特征可以用来表征星系间的相互作用等物理过程。另一方面，我们还研究了普通星系中的非旋转运动，发现星系自身的引力势和气体的吸积/外流是导致非旋转运动的主要原因，并找到了气体吸积和外流在速度场形态中的差异。

星系中原子分子转化对金属丰度和电离态的依赖性

余捻坤　国家天文台

星系中的原子分子转化是重子循环中的重要环节，因此对星系的形成与演化发挥着重要作用。我们收集文献中邻近星系的分子和原子气体的观测，并结合FAST 的最新观测数据建立了统计样本。结合空间分辨的 MaNGA 数据，我们进一步研究分子和原子气体比例对于星系的金属丰度和电离状态的依赖性。电离状态越高则金属丰度越高，高金属丰度有利于气体冷却从而促进气体的转化和进一步塌缩。该研究通过研究重子循环中原子气体转化为分子气体过程中的依赖性，进一步了解星系形成与演化中的重要物理过程。

The Volumetric Extended-Schmidt Law: A Unity Slope

杜凯伊　　南京大学

We investigate the extended-Schmidt (ES) law in volume densities (ρ _{SFR} ∝ (ρ _{gas}ρ ^{0.5}_{star})^{α ^{VES}}) for spatially-resolved regions in spiral, dwarf, and ultra-diffuse galaxies (UDGs), and compare to the volumetric Kennicutt-Schmidt (KS) law (ρ _{SFR} ∝ ρ ^{α ^{VKS}}_{gas}). We first characterize these star formation laws in individual galaxies using a sample of 11 spirals, finding median slopes α ^{VES}=0.98 and α ^{VKS}=1.42, with a galaxy-to-galaxy rms fluctuation that is substantially smaller for the volumetric ES law (0.18 vs 0.41). By combining all regions in spirals with those in additional 13 dwarfs and one UDG into one single dataset, it is found that the rms scatter of the volumetric ES law at given x-axis is 0.25 dex, also smaller than that of the volumetric KS law (0.34 dex). At the extremely low gas density regime as offered by the UDG, the volumetric KS law breaks down but the volumetric ES law still holds. On the other hand, as compared to the surface density ES law, the volumetric ES law instead has a slightly larger rms scatter, consistent with the scenario that the ES law has an intrinsic slope of α VES≡1 but the additional observational error of the scale height increases the uncertainty of the volume density. The unity slope of the ES law implies that the star formation efficiency (=ρ_{SFR}/ρ_{gas}) is regulated by the quantity that is related to the ρ^{0.5}_{star}.

The morphology and structure analysis of star-forming galaxies in CLJ1001

徐璨　南京大学

Structural properties of cluster galaxies during their peak formation epoch, z~ 2-4 provide key information on whether and how environment affects galaxy formation and evolution. Based on deep HST/WFC3 imaging towards the z=2.51 cluster, J1001, we explore environmental effects on the structure, color gradients, and stellar populations of a statistical sample of cluster SFGs. We find that the cluster SFGs are on average smaller than their field counterparts. This difference is most pronounced at the high-mass end with nearly all of them lying below the mass-size relation of field galaxies. The high-mass cluster SFGs are also generally old with a steep negative color gradient, indicating an early formation time likely associated with strong dissipative collapse. For low-mass cluster SFGs, we unveil a population of compact galaxies with steep positive color gradients that are not seen in the field. This suggests that the low-mass compact cluster SFGs may have already experienced strong environmental effects, e.g., tidal/ram pressure stripping, in this young cluster. These results provide evidence on the environmental effects at work in the earliest formed clusters with different roles in the formation of low and high-mass galaxies.

Testing photoionization modeling in a spatially-resolved LINER M81 using CAHA IFU observations

李宗男　国家天文台

星系的形成和演化是天文学中的重要前沿领域，其中心超大质量黑洞对周围环境的影响仍然缺少定量的研究。星系中普遍存在的低电离核发射线区（LINER）的起源与超大质量黑洞的关系仍然备受争议。该研究旨在利用光致电离模型 CLOUDY 对距离最近的低光度活动星系核（LLAGN）M81 中心的 LINER 辐射进行空间分辨的定量描述。该研究详细考虑了 LLAGN 和星族的相对贡献，包括谱能量分布，星族的空间分布，星际介质的性质等。研究发现，即使考虑了活动星系核和星族的贡献，模型仍然不能解释用西班牙 CAHA 3.5 米望远镜的积分视

场光谱仪（IFU）观测得到的 1 kpc 以内发射线强度的径向分布。特别地，模型存在高能光子在外围区域不足的问题。这一发现表明传统的 LINER 模型不能很好地解释 M81 核区 1 kpc 以内的电离机制，还需要其他机制，比如激波，或者 AGN 活动等的共同作用。

MULTIWAVELENGTH BULGE AND DISK MORPHOLOGY OF THE GALAXY M81 (NGC 3031)

毛业伟　广州大学

A panchromatic investigation of morphology for the early-type spiral galaxy M81 is presented in this talk. We perform bulge–disk decomposition in M81 images at a total of 20 wavebands from far-UV to near-IR (NIR) obtained with GALEX, Swift, SDSS, WIYN, 2MASS, WISE, and Spitzer. Morphological parameters such as Sérsic index, effective radius, position angle, and axis ratio for the bulge and the disk are thus derived at all of the wavebands, which enables quantifying the morphological K-correction for M81 and makes it possible to reproduce images for the bulge and the disk in the galaxy at any waveband. The morphology as a function of wavelength appears as a variable-slope trend of the Sérsic index and the effective radius, in which the variations are steep at UV–optical and shallow at optical–NIR bands; the position angle and the axis ratio keep invariable at least at optical–NIR bands. It is worth noting that the Sérsic index for the bulge reaches ∼4–5 at optical and NIR bands, but drops to ∼1 at UV bands. This difference brings forward a caveat that a classical bulge is likely misidentified for a pseudo-bulge or no bulge at high redshifts where galaxies are observed through rest-frame UV channels with optical telescopes. The next work of this series is planned to study spatially resolved spectral energy distributions for the bulge and the disk, respectively, and thereby explore stellar population properties and star formation/quenching history for the galaxy composed of the subsystems.

红移 3 莱曼连续谱星系的物理性质研究

朱帅儒　上海天文台

宇宙再电离宇宙再电离是宇宙演化过程中最后一次重要的气态相变。在这个

阶段，宇宙里的大量中性氢被早期天体释放的莱曼连续光子电离。据现有观测结果，大多数电离光子都是由恒星形成的星系产生的。为了深入理解宇宙再电离的具体历程，我们需要更深入地研究莱曼连续谱星系的物理特性。在此研究中，我们整合了在 GOODS-South 天区报告的，红移值为 3 的莱曼连续谱星系的观测数据，并采用统一的分析方法来推测其物理特性。我们主要关注这些星系在紫外光谱的特性和恒星形成的情况，并发现样本星系在这些方面存在显著差异。这种差异可能揭示了莱曼光子逃逸的两种可能机制。

The Structure and Morphology of High-Redshift Galaxies Revealed by JWST

孙文　北京大学

We present an analysis of the morphological and structural properties of high-redshift galaxies using the JWST NIRCam observations. We perform two-dimensional, simultaneous, multi-band model fitting to investigate the overall morphological properties of the galaxies in their rest-frame optical wavelengths to quantify the global properties of the galaxies, as well as subcomponents such as bulges and disks. We study the error budget of the emanated structural parameters using realistic mock images, taking into account systematic uncertainties due to the choice of fitting method, the point-spread function, and cosmological dimming and resolution effects. We present detailed structural parameters of the bulges and disks at high redshift. We study the Kormendy relation, the evolution of the B/T ratio, and the distribution of Sersic indices to investigate the origin of classical and pseudo bulges. We study the scaling relation between central surface brightness and scale length to ascertain the nature of the first-generation disks, and to see whether they resemble the population of thin or thick disks in the local universe.

A UDG with negative metallicity gradient

倪俊保　南京大学

Ultra-Diffuse Galaxies(UDGs) are mysterious objects in the sky which challenging our understanding on galaxy formation and evolution. In this work, we

have space-resolved optical observation of a local isolated HI-selected UDG named AGC242019 with Multi-Unit Spectroscopic Explorer(MUSE) on board the Very Large Telescope(VLT). We measure its gas-phase metallicity gradient with different emission lines ratio calibrator. And we derive a negative result like other local spirals, i.e., -0.080 and -0.056 dex Re^{-1}. This implies an inside-out formation scenario of this UDG. Using photometric data from DESI Legacy Survey(g, r, z band) and GALEX(FUV/NUV), we fit its Star Formation History(SFH) with a spectral energy distribution(SED) fitting code. We find out that there are young stellar population(<3 Gyr) in AGC242019 especially in its outskirt. This result exclude the "failed spiral" formation scenario of this UDG. Based on an advanced gas regulator model, we show a low outflow rate in AGC242019, which means the stellar feedback scenario of HI-riched UDG cannot explain the formation of our UDG.

Probing the nature of the low star formation efficiency in massive dusty galaxies in SDSS Stripe 82

李洋　上海交通大学

This work characterizes the dust-related properties in ~ 100 massive dusty quiescent galaxies observed by Herschel SPIRE far-infrared survey in the SDSS Stripe 82 region. We estimate their physical properties by fitting the FUV-to-FIR spectrum energy distribution. By comparing to the dust-poor quiescent galaxy population, we find that the dusty quiescent galaxies have similar morphological concentration, bulge dominance, and central stellar age as their dust-poor counterparts. To investigate the origin of this counterintuitive population, we stack the color profiles of the massive dusty/dust-poor quiescent galaxies. We find that dusty quiescent galaxies have bluer g-i color at a radius between R50 and R90, rather than the dust-poor quiescent objects. In a radius smaller than R50, the two populations have similar color profiles. The subsample of dusty quiescent galaxies in a crowded environment has a color gradient as red as the dust-poor galaxies. No strong Balmer absorptions are found in the optical spectrum of both populations. The results indicate that dusty quiescent galaxies have similar past evolution as their dust-poor counterparts, and their quenching is not due to a quick consumption of gas by starbursts. But the dusty objects still have star formation in their outer disks, although

the surface densities are low. They may acquire cold ISM if they are in a low-density environment, and reserve it in a larger radius. Minor mergers could be the possible reason for the externally obtained interstellar medium.

FAST reveals new evidence for M94 as a merger

周瑞蕾　　国家天文台

We report the first high-sensitivity HI observation toward the spiral galaxy M94 with the Five-hundred-meter Aperture Spherical radio Telescope (FAST). From these observations, we discovered that M94 has a very extended HI disk, twice larger than that observed by THINGS, which is accompanied by an HI filament and seven HVCs (high velocity clouds) at different distances. The projected distances of these clouds and filament are less than 50 kpc from the galactic center. We measured a total integrated flux (including all clouds/filament) of 127.3 (±1) Jy km s−1, corresponding to a H I mass of (6.51±0.06)×10^8M⊙ , which is 63.0% more than that observed by THINGS. By comparing numerical simulations with the HI maps and the optical morphology of M94, we suggest that M94 is likely a remnant of a major merger of two galaxies, and the HVCs and HI filament could be the tidal features originated from the first collision of the merger happened about 5 Gyr ago. Furthermore, we found a seemingly isolated HI cloud at a projection distance of 109 kpc without any optical counterpart detected. We discussed the possibilities of the origin of this cloud, such as dark dwarf galaxy and RELHIC (REionization-Limited HI Cloud). Our results demonstrate that high-sensitivity and wide-field HI imaging is important in revealing the diffuse cold gas structures and tidal debris which is crucial to understanding the dynamical evolution of galaxies.

Discovery of Five Green Pea Galaxies with Double-peaked Narrow [OIII] Lines

林如秋　上海天文台

Although double-peaked narrow emission-line galaxies have been studied extensively in the past years, only a few are reported with the Green pea galaxies (GPs). We found five GPs with double-peaked narrow [OIII] emission lines, referred

to as DPGPs, selected from the largest collection of Green Pea galaxy spectra taken by LAMOST and SDSS. With multi-band photometry and optical spectral diagnostics, we have reliably confirmed the AGN activity in this sample. Based on the emission line profiles and optical morphology, the physical origin of the double-peaked profiles in these galaxies is more likely attributed to dual AGN mergers rather than outflows or accretion disks. This expecial sample is potentially revealing the co-evolutionary characteristics of a special class of high-mass galaxies and supermassive black holes.

DESI 巡天的极端贫金属星系

邹虎　国家天文台

HI content of massive red spiral galaxies observed by FAST

王岚　国家天文台

Black Hole Mass Estimation for DESI Quasars at 0.2<z<0.8

潘志伟　北京大学

Determining the mass of supermassive black holes in active galactic nuclei (AGN) is crucial for understanding black hole growth and quasar evolution. The conventional reverberation mapping method is time-consuming, motivating the development of the single-epoch method. Recent reverberation mapping campaigns have revealed increased departure from the traditional R-L relation. Additionally, studies have indicated that the accretion state, traced by the strength of FeII emissions, can influence the R-L relation. In this talk I will show how we leverage the

capabilities of the Dark Energy Spectroscopic Instrument (DESI) to conduct a comprehensive analysis. Our study employs a well-designed quasar sample within the redshift range of $0.2 < z < 0.8$ from DESI to systematically investigate and compare different single-epoch black hole mass tracers. By deriving the iron-corrected R-L relations, we significantly improve the accuracy of Hβ- and MgII-based supermassive black hole mass estimations, accounting for the accretion state. Moreover, we outline our future goal of extending these findings to higher redshifts.

Two-point correlation functions of metals in dwarfs: small clustering scales

李鑫　南京大学

Metals are produced by stellar nucleosynthesis and redistributed by galactic activities including inflow and outflows. The widely adopted metallicity gradient misses the key fractal structure of interstellar medium in galaxies. Recently, the more advanced method -- spatially two-point correlation functions—has been used to describe the 2-D distribution of metals in spiral galaxies. Here, we extend this methodology to dwarf galaxies in the Dwarf Galaxy Integral Survey (DGIS) that contains a representative sample of 65 dwarfs in the Local Volume observed with MUSE/VLT and WiFes/ANU-2.3m. As compared to spiral galaxies, metals of dwarfs are clustered on much smaller spatial scales and are homogenous over larger scales. By comparing the correlation length to SFR and stellar mass, we found that star formation, instead of stellar mass, plays the key role in regulating metal distribution in dwarfs, in contrast to the expectation from the tight correlation between metals and stellar masses of integrated galaxies.

the mass-metallicity relation in lensed field galaxies at cosmic noon with NIRISS----GLASS-JWST-ERS

何显龙　　武汉大学

Using the JWST near-infrared wide-field slitless spectroscopy obtained by the GLASS-JWST early release science program, we present a measurement of the

mass-metallicity relation (MZR) at cosmic noon.

A secure sample of 50 galaxies in the Abell 2744 lensed field with several emission lines is identified across two wide redshift ranges $z=1.8\sim2.3$ and $2.6\sim3.4$ in the stellar mass range of $\log{M_*/M_\odot}\in [7.3, 10.0]$.

We extend the measurements of the MZR to this dwarf mass regime, thanks to the exquisite sensitivity and resolving power of JWST, supplemented by the gravitational lensing magnification effect from the foreground Abell 2744 cluster.

The observed slope of MZR is $\beta\sim0.3$, consistent with the expected field galaxies, other than ~0.15 for overdense environments.

In addition, we compare two methods to measure line fluxes using 2D forward modeling and line profile fitting to 1D extracted spectra.

The line flux modeled by 2D is systematically $\sim30\%$ higher than by 1D, with a large scatter.

The systematic offset between these two methods presents, for the first time, an important guideline for future work deriving line fluxes from high-redshift galaxies with wide-field slitless spectroscopy, such as Euclid, Roman, and the Chinese Space Station Telescope.

Strange Quasar Candidates with Abnormal Astrometric Characteristics from Gaia EDR3 and SDSS (SQUAB-II): Optical Identifications

吉祥　上海天文台

There are some strange quasars with multiple Gaia detections or observed with abnormal astrometric characteristics, such as with large proper motions or significant astrometric noises. Those strange quasars could be potential candidates of quasar-star pairs, dual quasars (DQs),

or lensed quasars (LQs). Searching for both DQs and LQs is of great importance in many fields of astrophysics. Here in this work, we select 143 SDSS spectroscopically confirmed quasars that have multiple Gaia EDR3 detections within 1 arcsec of the SDSS quasar’s position. We

apply several optical identification methods to classify this sample. We firstly exclude 65 quasar-star pairs via their stellar features including their parallaxes and

proper motions, stellar features in the SDSS spectra, or via the colour-colour diagram. Based on the spectral-fitting results, we find 2 DQ candidates, one of which presents a double-peaked [O III] emission line feature and the other shows a broad Hβ velocity offset (∼ 870 km s−1) relative to the [O III] λ5007 line. Via the colour difference method, we further find 56 LQ candidates with similar colours in their multiple images. We also cross-match 143 objects with the HST archive and find 19 targets with archival HST images. Our classification results of those 19 targets are mainly consistent with previous works.

The conditional colour – magnitude distribution: II examining the galaxy colour – magnitude – halo mass relation inferred from galaxy group catalogues

许浩杰　上海天文台

Capturing the complex galaxy luminosity – colour – halo mass relation is essential to understand how galaxies form and evolve in dark matter haloes. In the previous work, we proposed the conditional colour magnitude distribution (CCMD) model to describe such relation, where free parameters are tuned by fitting clustering and number densities in fine luminosity–colour bins of galaxies from the Sloan SDSS DR7 Main Galaxy Samples. In this work, we present a comprehensive examination on the CCMD by comparing the colour-dependent occupation statistics from CCMD and from group catalogues. By applying the identical group finders to both CCMD mocks and SDSS, CCMD groups should contain the same group-finding and mass assignment errors as SDSS groups. We find great agreements in those statistics, regardless of group finders, suggesting that the CCMD well represent the reality in terms of galaxy colour and luminosity.

Lyman Continuum Galaxies at z~3.1 and Their Properties

刘语晨　北京大学

High-redshift star-forming galaxies are the dominant contributors to the LyC photons required in the epoch of reionization. Currently, the directly detected LyC galaxies are rare, and their specific contributions and properties remain clear. We present a study of Lyman continuum (LyC) emission in a sample of ~150 Lyα emitters (LAEs) at z~3.1 in the Subaru-XMM Deep Survey field. We obtain deep UV images using a custom intermediate-band filter Uj that covers a wavelength range of 3330~3650 angstrom and detect 7 individual LyC candidates in the Uj band. Their escape fractions of LyC photons are roughly between 40\% and 80\%. This supports a previous finding that a small fraction of galaxies may have very high escape fractions. By stacking their Uj band images, the escape fraction upper limit of the remaining LAEs that are not detected in the Uj is constrained as 16%. These results are consistent with the results in the literature. Compared with the non-LyC LAEs, the LyC LAEs tend to have higher Lyα luminosities, Lyα EWs, and SFRs, but their UV continuum slopes are similar to those of other galaxies. Finally, we found one AGN close to the LyC galaxies that may have helped their LyC photons to escape.

DECaLS 中的富 HI 低表面亮度星系候选体及其性质和起源研究

杜林　国家天文台

在 ALFALFA 巡天河外巡天数据与光学数据交叉过程中，有一小部分 HI 源未能在 SDSS 中匹配到光学对应体。近年来，这些缺乏光学对应体的 HI 源先后被证认为潮汐碎片、超致密高速云、富气超弥散星系等，然而仍有~1% 性质不明。本报告将介绍针对这 1%无光学对应体的源，我们在 DECaLS 巡天图像中搜寻到的 8 个具有极低表面亮度的光学对应体，其中 5 个是首次发现的。

通过多波段数据分析，我们发现这些源在颜色、面亮度、形态、恒星质量及气体恒星质量比等参数上均显示不出寻常的物理特性，且偏离了α .100 样本的 HI 和光学特性之间的比例关系，重子塔利-费舍尔关系和星系主序。进一步根据它们的物理特性和环境，我们推测它们中的其中一部分可能是在相互作用过程中产生的潮汐起源的星系，而另一部分则可能经历了相对的演化历史，在最近才开始温和的恒星形成。下一步，我们将利用更高精度的 HI 数据对这些源进行基于动力学的更深入的研究。

通过对这些源现有的多波段数据的分析，我们的工作为理解无光学对应体的

HI 源提供了观测依据，为这些“几乎黑暗”的目标源的性质和演化过程提供了新的线索。随着我国 500 米口径球面射电望远镜 (FAST)的投入使用、未来巡天空间望远镜 (CSST)的发射，以及国际上 JWST、LSST、ROMAN 等设施的逐步运行和开展，未来将有更多质量更好的数据来支持对这类暗弱天体的进行更加可靠和完备的研究。

CatNorth: An Improved Gaia DR3 Quasar Candidate Catalog with Pan-STARRS1 and CatWISE

傅煜铭　　Leiden Observatory

A complete and pure sample of quasars with accurate redshifts is crucial for quasar studies and cosmology. In this talk, we present CatNorth, an improved Gaia DR3 quasar candidate catalog with 1.5 million sources in the 3π sky built with data from Gaia, Pan-STARRS, and CatWISE2020. To construct training/validation datasets for classifying stars, galaxies, and quasars, we carefully built two different master stellar samples in addition to the labeled samples of galaxies and quasars. An ensemble classification model is obtained by averaging the two XGBoost classifiers trained with different master stellar samples. We provide photometric redshifts for all candidates with an ensemble machine learning regression model. For a subset of 89100 candidates, accurate spectroscopic redshifts are estimated with the Convolutional Neural Network (CNN) from the Gaia BP/RP spectra. The CatNorth catalog has a high purity of >90% while maintaining high completeness, which is an ideal sample for understanding the quasar population and its statistical properties.

Measuring the UV luminosity function at z < 2 with the UVCANDELS data

孙磊　中国科学院大学

UVCANDELS is a HST Cycle-26 Treasury Program awarded 164 orbits of primary ultraviolet (UV) F275W imaging and coordinated parallel optical F435W imaging in four CANDELS fields: GOODS-N, GOODS-S, EGS, and COSMOS, covering a total area of ~430 arcmin^2. This is ~2.5 times larger than the area

covered by previous UV data combined, reaching a depth of 27 ABmag. We present a robust analysis of the rest-frame UV luminosity function (LF) of galaxies at $z < 2$, relying on our UV-optimized aperture photometry method yielding a factor of 1.5x increase in the signal-to-noise ratios in our F275W imaging. Using well tested photometric redshift measurements and signal-to-noise ratio cut, we identify more then $15,000$ galaxies in total at $0.6 < z < 2.2$. We run an image-based simulation to estimate the completeness correction using a newly published package. Restricting our analysis to galaxies with above 30% completeness, we compute the rest-frame UV LFs and find the best-fit faint-end slopes at three redshift ranges, $0.6 < z < 1$,$1 < z < 1.4$, and $1.4 < z < 2.2$, respectively. we find that the faint-end slope is getting steeper with redshift.

Accurate Measurement of Galaxies in the Crowded Field

马超　北京大学

Galaxy clusters serve as critical cosmic laboratories to probe a myriad of science topics relevant to galaxy research. However, such dense environments, especially for the cluster core regions, are exceptionally hostile to an accurate measurement of the constitute and background galaxies, primarily because of the severe crowding and overlapping between the sources, as well as the presence of intra-cluster light (ICL). In order to mitigate these effects, we develop a new method to remove the light contamination from bright cluster galaxies (bCGs) and ICL, and apply this method to the F160W image of cluster MACSJ0416.1-2403. Based on galaxy fitting pipeline GALAPAGOS2, we then perform a detailed analysis of the resulting processed image, obtaining a primary catalog with robust photometric and structural parameters. we furthermore demonstrate that our subtraction procedure has superior performance over other existing methodologies in the literature, therefore enabling more complete galaxy sample close to the detection limit, and more realistic uncertainties. The unique pipeline we developed in this study will be applied to the remaining filters of the same cluster, as well as other clusters.

利用 MeerKAT MIGHTEE 射电巡天数据研究暗弱射电源的宇宙学演化

袁尊理　湖南师范大学

平方公里阵（SKA）是当今天射电文学界最引人瞩目的大科学装置，MeerKAT 是 SKA 的探路者设备，而 MIGHTEE 巡天是利用 MeerKAT 开展的一个深度射电巡天项目，本报告我将介绍我们基于该巡天数据开展的以下研究：（1）恒星形成星系中的射电-红外相关关系；（2）暗弱射电源的宇宙学演化。

DarkAI: I. Mapping the large-scale density field of dark matter based on U-Net neural network

王梓同　西安电子科技大学

本研究发展基于 UNet 神经网络的暗物质密度场重构模型，实现对速度场和潮汐场的无偏重构。首先，本工作利用 COLA、Jiutian 和 ELUCID 三种数值模拟数据，对重构密度场进行了一系列评估测试，结果发现，基于快速数值模拟 COLA 训练的模型适用于标准 N 体模拟样本，能够有效消除红移畸变效应，实现大尺度暗物质密度场的高精度还原，重构场与真实场的交叉功率谱在 k = 0.1 和 0.3hMpc-1 处仅有 3%到 15%衰减，并验证重构效果受不同宇宙学影响较小。其次，本研究探讨速度场和密度场重构效果，基于 UNet 重构密度场可以更好还原非线性区域的速度场，与真实场的相关系数为 1.01，均方根误差为 57.0km/s，相比基于线性偏袒因子的传统模型，分别提升了 12.2%相关度和减小 27.1%的弥散度，从而实现高精度的无偏还原。综上所述，UNet 重构模型可以基于快速数值模拟样本进行有效训练，这种方法可以兼顾重构效果和训练成本两种因素，提升深度学习方法在大规模星系巡天数据中的适用性。

This is a research about develop a UNet-style convolution neural network to reconstruct the cosmic density field from the redshift-space distribution of dark matter halos. The reconstruction starts with dark matter halos, which is motivated by the fact that galaxy groups can be used to represent the dark halo population and can be well-defined with halo mass from large redshift surveys of galaxies. By using the 3-dimensional mass-weighted density field of the halo as the input map, the neural network is trained based on the COLA simulation, which is an approximation of the

N-body simulation in size of 500h-1Mpc box with 5123 particles. The resulting UNet network model is evaluated using an ensemble of training-sample-like test samples, demonstrating that it allows for a recovery of the real-space dark matter density fields with only small reduction of the cross-correlation power spectrum at 3% and 15% levels at k = 0.1 and 0.3hMpc-1, respectively. The models are further verified using Jiutian simulation, which is a typical N-body simulation with 61443 particles in a 1000h-1Mpc-size box, and the ELUCID N-body simulation, which has a different cosmology of WMAP5. As a result, the dark matter density field can be recovered consistently at the accuracy level, and the reconstruction is unaffected by the different cosmologies between the training sample (Planck2018) and the test sample (WMAP5). It is also evident that the deep learning method outperforms the traditional method based on linear theory, and is helpful in accurately recovering the velocity field and tidal field of dark matter. Finally, it was found that the UNet-based model can reliably reproduce the cosmic density field and generalizes to the high-resolution N-body simulation after being trained with low-resolution COLA simulations. This shortens the computation time for producing training data and enhances the deep learning method's applicability to enormous amounts of data from a large galaxy survey.

Morphological Classification of 259,323 Main Galaxy Sample in DESI Legacy Survey BASS + MzLS using Deep Learning and Domain Adaptation

叶人豪　上海天文台

The morphological classification and measurement of galaxies is a critical part of the research on galaxy formation and evolution. We present a catalog of detailed morphology classification in the DESI Legacy Survey BASS+MzLS region of 259,323 main galaxy samples, which has never been done before. We trained a Bayesian convolution neural network on Galaxy Zoo DECaLS data and adapt it to the BASS+MzLS region using source-free unsupervised domain adaptation. Our model can predict the posterior of each question-answer pair in the GZD-5 decision tree that is related to morphology. Our performance is better than previous work and demonstrates the effectiveness of domain adaptation through the overlapping region between DECaLS and BASS+MzLS.

利用深度学习方法从测光图像中搜寻特殊天体

苏浩　山东大学

近年来，为了应对日益增长的海量数据与数据复杂性，机器学习算法，尤其是深度学习算法越来越多地应用于天文领域。目标检测是计算机视觉的重要分支之一，它赋予机器“看”的智能，能定位和辨识图像中的目标。基于深度学习的目标检测在 2014 年被提出之后，目标检测的效果和效率都获得了极大的提高，目前已广泛应用于自动驾驶、机器人视觉、视频监控等领域。我们根据天文数据和目标的特性，研究建立基于深度学习的目标检测模型，尝试使用目标检测的方法从测光图像中搜寻低表面亮度星系、侧向低表面亮度星系、超弥散星系、L 矮星等特殊天体。我们可以在不依赖于测光参数的前提下，完成从测光图像中大批量地、自动地搜寻这些特殊天体的任务，这是一种端到端的过程，能够有效的节省人力物力资源。

利用机器学习方法对 KiDS 巡天数据分类

封海成　云南天文台

进入 21 世纪以后，宽视场多波段图像巡天迎来了快速发展时期，这些巡天项目提供了几百万到几亿个天体的观测图像，为天文学研究提供了重要的研究素材。未来 10 年，随着 CSST 等下一代巡天望远镜的投入使用，我们将进一步获得数十亿个高质量图像数据。数据的暴涨必将在星系宇宙学和河内天文学等领域产生一些列重要研究成果，但也对天体目标的分类（如恒星、星系、类星体等）和性质测量（如，红移、星族等）提出挑战。近几年，机器学习因速度快、准确率高等优点被广泛应用到大数据处理中，并被多次证实在天文中具有卓越的表现。一般而言，不同类型的天体由于辐射机制的不同而产生不同的能谱分布，同时由于其内部物理性质的不同，在图像上会呈现出不同的空间形态。为此，我们搭建了一个能够同时学习能谱和图像信息的网络，从而实现快速、准确地对天体分类和测量参数的能力。本报告将重点介绍该方法在天文图像巡天项目中的应用以及在 KiDS DR5 巡天数据中的表现。

张贴报告

An Investigation of the Star Formation Rate of Galaxies at 0.4 < z < 0.5 with FADO

于耀淞　University Of Sheffield

The star formation rate (SFR) is an important astrophysical tracer for understanding galaxy formation and evolution, determining the relationship between interstellar medium properties and stellar formation, and inferring the evolution of cosmic stellar formation history and energy density. The mainstream approach to studying the stellar content in galaxies is based on pure stellar population synthesis models, without subtracting the contamination caused by nebular gas radiation-induced star formation rates. However, recent studies indicate that the contamination from nebular radiation cannot be ignored in galaxies with more active stellar formation activities and high redshift galaxies. Nevertheless, there are very few relevant studies, especially on high redshift galaxies. In this paper, we tentatively studied the SFR of stellar formation galaxies with z < 0.5 using the spectral fitting code FADO, which can calculate the contribution of nebular radiation to emission lines related to SFR in the spectrum, dynamically and self-consistently treating ionized gas. We compared the SFR obtained from FADO with that obtained from the pure stellar model-based code qsofitmore, which fits the same sample of galaxy spectra, and calculated the SFR using the luminosity of Hα λ6563 Comparing the results from qsofitmore and FADO, we found that the SFR obtained from FADO is an order of magnitude smaller than that from qsofitmore, with 96% of the data supporting this view. This suggests that the effect of nebular radiation on SFR cannot be ignored in at least 0.4 < z < 0.5 stellar formation galaxies, consistent with recent speculation. We predict that the impact of nebulae may be more significant in SFG at higher redshift (e.g., up to z～2) by combining optical and near-infrared spectral data, further supporting our conclusion.

基于空间望远镜无缝光谱的类星体搜寻

庞宇萱　北京大学

A Spectroscopic Insight into Metallicity Distributions in the Nearby Spiral Galaxy NGC 2403

吴啟明　广州大学

In this paper, we present a spectroscopic study of H ii regions in the Nearby Spiral Galaxy NGC 2403,aimed at obtaining metallicity distributions in multiple aspects. Through observation with the 2.16 m telescope of the National Astronomical Observatory of China as well as collection from literature, we compile a sample containing 159 H ii regions in the galaxy. By combining photoionization model, the N2O2 spectral index is ascertained to be the most reliable indicator among all common diagnostics and hence adopted to estimate the oxygen abundance in our work. Three kinds of metallicity distributions, including one-dimensional, two-dimensional, and azimuthal, are derived. A radial gradient is apparent but the slope is not constant. The radial trend appears with bends or discontinuities, which is not ascribed to systematic errors in the N2O2 diagnostic, as demonstrated in the work. Possible reasons for the variable-slope gradient, such as systematic errors in the diagnostics, kinematic truncation in the galaxy, bias in the traditional definition of the galactic center, and impact of gas inflow, are discussed in the end.

星系及其超新星和黑洞及类星体的形成和演化

钟萃相　江西师范大学

星系的形成和演化是天体物理学中最活跃的研究领域之一，因此许多人研究了这一领域。但由于他们没有完全理解从卫星到行星再到恒星的演化规律，他们的理论非常脆弱。一些早期的假说认为一个星系是由一片巨大气体云坍塌而成的，而较近的假说则认为星系是由较小的团块物质合并而成的，这些都是难以置信的。因此，作者对卫星、行星和恒星的形成和演化进行了系统的研究，建立了一套关于星系形成与演进的科学理论，从而揭示了星系的层次结构及其中的超新星、中子星、黑洞和类星体的形成和演化规律。

DESI Legacy Imaging Surveys: Does environment affect size growth of galaxies at z < 0.5?

陈招斌　南京师范大学

从 XMM-LSS 巡天场中用机器学习选取大样本类星体研究盘-冕关联

黄健　南京大学

我们使用了机器学习的方法，从 XMM-LSS 巡天场中测光选取了一个包含约 1000 个类星体的大样本，并研究了它们的盘-冕关联。

我们得到的相关关系斜率与前人得到的基本一致，且没有发现斜率随光度存在明显的演化。

TBD

刘雨　清华大学

GALMOSS：基于 GPU 加速的星系面亮度拟合

陈宓　上海天文台

一种 Gauss-Bonnet 引力理论下平宇宙 暴涨磁成因方程的研究

陈次星　中国科学技术大学

为了研究大统一理论下宇宙暴涨，本文研究了一种 Gauss-Bonnet 引力理论下的平宇宙暴涨基本方程和引力特性。具体方案是：我们先采用大统一物质场的拉氏量(见正文)，再根据一种较为复杂 Gauss-Bonnet 一般理论得到作用量，将两者结合得到总的拉氏量，对于相应的变量做变分，可以得到运动方程。利用规范玻色子的场方程可得到一些结论，即宇宙暴涨的引力特性。得到的方程可以对更

为具体的 Gauss-Bonnet 模型进行进一步的计算。

AGN 软 X 射线超的倾角依赖性

唐泽源　　广州大学

Collisions of young disc galaxies in the early universe

郭贝贝　中国科学技术大学

In the local universe, disk galaxies are generally well evolved and Toomre stable. Their collisions with satellite galaxies naturally produce ring structures, which have been observed and extensively studied. By contrast, at high redshifts, disk galaxies are still developing and clumpy. These young galaxies interact with each other more frequently. However, the products of their collisions remain elusive. Here, we systematically study the minor collisions between a clumpy galaxy and a satellite on orbits with different initial conditions, and find a new structure that is different from the local collisional ring galaxies. The clumpiness of the target galaxy is fine-tuned by the values of Toomre parameter, Q. Interestingly, a thick and knotty ring structure is formed without any sign of a central nucleus in the target galaxy. Our results provide a promising explanation of the empty ring galaxy recently observed in R5519 at redshift z = 2.19. Moreover, we show that the clumpy state of the collided galaxy exists for a much longer timescale compared to isolated self-evolved clumpy galaxies that have been widely investigated.

Studying X-ray spectra of large-scale jets of FR II radio galaxies: application of shear particle acceleration

何家春　广西大学

TBD

舒富文　南昌大学

使用未分辨中性氢探测星系中暗物质含量

雷雨　中国科学院上海天文台

Weak Lensing Reconstruction by Counting Galaxies with the DECaLS DR9

覃健　上海交通大学

Cosmic radio background from primordial black holes at cosmic dawn

张志鹤　国家天文台

Correlation analysis of barred and unbarred galaxies

卢帅　厦门大学

About two-thirds of disk galaxies in the local universe are observed to have bars, whereas dynamical studies predict that all disk galaxies should possess bars. To investigate this inconsistency, we conducted an analysis of massive disk galaxies

using the TNG100 simulation, which is a cosmological hydrodynamical realization of the IllustrisTNG suite. We examined the evolution of bar characteristics in these galaxies by employing techniques such as ellipse fitting and Fourier decomposition.

Our findings indicate that barred galaxies, short-barred galaxies, and unbarred galaxies exhibit nearly identical fractions of barred galaxies and similar bar strengths at z=1. However, as disk galaxies evolve from z=1 to 0, bars tend to appear more frequently in galaxies with stronger rotations. Moreover, for lower-mass galaxies (log M=10.6-10.85), bars tend to form in disk galaxies with higher mass concentration. Conversely, for higher-mass galaxies (log M=10.85-11.1), bars commonly appear in disk galaxies that have undergone fewer galaxy mergers. Additionally, we applied statistical methods like sparse principal component analysis (SPCA) and normalized mutual information feature selector (NMIFS) to analyze the length of bars in barred galaxies. Our analysis reveals that, within a limited stellar mass range, the primary factor influencing the length of bars in barred galaxies is the cumulative impact of galaxy mergers. Furthermore, the bar length exhibits correlations with the bulge component, specific star formation rate (sSFR), and mass concentration of the galaxies. This research suggests that the presence of bars in galaxies is determined by the combined effects of the galactic environment and internal baryonic physics.

Cosmic Evolution of the Fe II/Mg II Line Ratio in Quasar Broad-Line Regions

姜丹阳　　北京大学

The line flux ratio of Fe II/Mg II in quasar broad-line regions serves as a first-order proxy for the relative abundance of Fe to alpha-elements, and thus known as a cosmic clock. We present a study of the Fe II/Mg II emission line ratios in the broad-line regions of 27 luminous quasars at z=5.8-6.6, exploiting high-quality near-infrared spectra taken primarily by the XQR-30 program of VLT/XSHOOTER. We perform a robust spectral analysis of these quasars at high bolometric luminosities and find that the mean Fe II/Mg II flux ratio of 8.03 with a wide scatter of 3.92. We perform the same spectral analysis for two other samples at intermediate redshift (z=3.5-4.5) and low redshift (z=1.0-2.1) from the literature, which cover a similar bolometric luminosity range to the XQR-30 sample. We find that there is no

significant redshift evolution in the Fe II/Mg II ratio over the wide redshift range of z=1.0 to 6.6, which supports a rapid iron enrichment in the vicinity of the galactic nuclei.

21 厘米和 CO 谱线强度映射间的反对称关联函数作为再电离新探针——解析表达式和可观测性

刘肇宁　清华大学

面向海量数据分析与处理的天文科学平台

李长华　　国家天文台

哈勃常数可能存在的演化

贾轩　东　南京大学

目前哈勃常数 H0 的差异是宇宙学中最关键的问题之一，因为它可能表明存在未知的系统误差或新的物理学。哈勃常数 H0 是由局部距离阶梯和宇宙微波背景得出的。在这里，我们提出了一种新的非参数方法来估计哈勃常数作为红移的函数。我们通过对角化协方差矩阵建立了哈勃常数演化的独立估计。从 Ia 型超新星和观测到的哈勃参数以及重子声波震荡数据来看，哈勃常数呈现下降的趋势。

Forecast constraints on neutrino mass from CSST galaxy clusters

陈明静　　中国科学技术大学

宇宙学原初曲率扰动的概率分布函数

皮石　中科院理论物理所

Reporting a low-z Hot DOG's IRASF10026

刘帅　中国科学院大学天文与空间科学学院

Hot dust-obscured galaxies(Hot DOGs) are a special propulation of galaxies found by WISE at high redshift(z>2). Their luminosities are esxtremely high, up to 10^14 solar luminosity, and AGNs in these galaxies are surrounded by dust and gas. Their high luminosities are considered to come from the powerful accretion of supermassive black holes with little contribution from star formation. The fitted SED shows that the IR emission of Hot DOGs mainly originated from the ambient dust heated by the AGN feedback rather than star formation. Due to the selection effect of WISE W12dropouts, most known Hot DOGs mainly concentrate on high redshift. Recently we successfully identified a Hot DOG IRASF10026 in redshift z=1.12. We will report its properties as a Hot DOG in this paper.

河外星暴环境下的大质量恒星形成研究

邓方园　中国科学院大学天文与空间科学学院

恒星形成定律描述了形成恒星的气体性质与恒星形成速率间的相关关系。大量观测表明，从巨分子云团块尺度到星系尺度，从类银河系的恒星形成环境到极端恒星形成环境，致密气体质量与用红外光度来示踪的恒星形成速率之间存在一个保持良好的线性相关关系，该关系被称为致密气体版本的恒星形成定律。根据以上观测现象，我们在早先工作中提出了大质量恒星形成的“基本单元”模型——基于致密气体测量的大质量恒星形成中存在一种基本单元，该单元的物理性质在所有环境下都是相似的。也即，尽管恒星形成过程中致密气体总量受外部环境影响，但单个致密团块（基本单元）的性质仍能保持稳定。我们希望通过对比不同环境下致密团块的性质来验证基本单元模型。目前，银河系内已有相对成熟的致密团块研究，所以我们选择在近邻矮星系 NGC6822 的星暴环境中研究致密团块性质并与河内结果对比。初步结果显示，NGC6822 星暴环境下的致密气体团

块性质与河内的致密团块性质相似。

Unraveling the Geometric and Kinematic Traits of the Galactic Disk through Open Clusters

何治宏　　西华师范大学物理与天文学院

Recently, I use Gaia-based open clusters to study the geometry and motion of the Galactic disk. The findings suggest that the inclination angle of the Galactic disk increases gradually from the inner to the outer disk, with a shift in orientation at the Galactocentric radius of approximately 6 ± 1 kpc. In addition, this study brings forth the revelation that the mid-plane of the Milky Way may not possess a stationary or fixed position. A plausible explanation is that the inclined orbits of celestial bodies within our Galaxy exhibit a coherent pattern of elliptical shapes, deviating from perfect circularity. However, more observations are needed to confirm this. An analysis of the vertical motion along the Galactocentric radius reveals that the disk has warped with precession, and that the line-of-nodes shifts at different radii, aligning with the results from the classical Cepheids. Although there is uncertainty for precession/peculiar motion in Solar orbit, after considering the uncertainty, the study derives a median value of 6.8 km/s/kpc in the Galaxy. This value for the derived precession in the outer disk is lower than those in the literature due to the systematic motion in Solar orbit ($\theta = 0.6$ deg). The study also finds that the inclinational variation of the disk is significant and can cause systematic motion, with the variation rate decreasing along the Galactic radius with a slope of -8.9 μ as/yr/kpc. Moreover, the derived inclinational variation rate in Solar orbit is 59.1±11.2(sample)±7.7(VZ⊙) μ as/yr, which makes it observable for high precision astrometry.

Total and dark mass in galaxy centers with Machine Learning

吴思睿　中山大学

The galaxy total mass inside the effective radius is a proxy of the galaxy dark matter content and stellar population properties, e.g. the star formation efficiency. As

such, it encodes important information on the dark matter and galaxy evolution models. Total "central" masses can be inferred via galaxy dynamics or with gravitational lensing, but these methods have practical limitations related to their modelling assumptions (e.g. orbital distribution) and their typical analysis samples (rarity), respectively. We propose a novel approach, based on machine learning to make predictions on the total and dark matter content of galaxies using simple observables from imaging and spectroscopy surveys. We use catalogs of multi-band photometry, sizes, stellar mass, kinematics and dark matter measurements of simulated galaxies from TNG-100, a state-of-art cosmological (hydrodynamic) simulation, to train a Mass Estimate machine Learning Algorithm (MELA) based on Random Forrest. We separate the simulated sample in passive early-type galaxies (ETGs), both "normal" and "dwarf", and active late-type galaxies (LTGs) and show that the mass estimator can accurately predict the galaxy dark masses inside the effective radius in all samples. We finally test the mass estimator against the central mass estimates of a series of low redshift datasets ($z<0.1$) including SPIDER, DynPop and SAMI dwarf galaxies with standard dynamical methods based on Jeans equations. We find that MELA can correctly predict the total dynamical mass of the real samples of ETGs, LTGs and dwarf galaxies. Machine learning can learn from idealised simulated sample from hydro-simulations how to predict the dark and total mass content of galaxies, provided that the real galaxy sample show similar scaling relations among the ``observables" used as features. For all the reference dataset considered, \mla\ can predict the masses within 0.15 dex, with a limited fraction of outliers and almost no bias. This is independent of the sophistication of the kinematical data collected (fiber vs. 3D spectroscopy) and the dynamical analysis adopted (radial vs. axisymmetric Jeans equations, virial theorem). This make \mla\ a powerful alternative to make predictions of the mass of galaxies for enormous datasets for which ``standard" stage-IV survey data products are available (e.g. aperture photometry, stellar masses, fiber spectroscopy, size, etc.). We finally discuss how to generalise these results to account for the variance of cosmological parameters and baryon physics using a larger variety of simulations and the further option to reverse engineering this approach and use model-free dark matter measurements (e.g. via strong lensing), plus visual observables, to predict the cosmology and the galaxy formation model.

Environmental Effects as a Key Factor of Shaping Star－forming S0 galaxies

陈培彬　厦门大学

Impact of gravitational lensing on black hole mass function inference with third-generation gravitational wave detectors

何显龙　武汉大学

The recent rapid growth of the black hole (BH) catalogue from gravitational waves (GWs) has allowed us to study the substructure of black hole mass function (BHMF) beyond the simplest power-law distribution. However, the BH masses inferred from binary BH merger events, may be systematically 'brightened' or 'dimmed' by the gravitational lensing effect. In this work, we investigate the impact of gravitational lensing on the BHMF inference considering the detection of the third-generation GW detector - the Einstein Telescope (ET). We focus on high redshift, z = 10 in order to obtain the upper limits of this effect. We use Monte Carlo (MC) method to simulate the data adopting three original BHMFs under Un-Lensed and Lensed scenarios, then recover the parameters of BHMFs from the mock data, and compare the difference of results, respectively. We found that all the parameters are well recovered within one standard deviation(std., 1σ), and all three BHMF models are reconstructed within a 68 percent credible interval, suggesting that lensing would not change the main structure drastically, even at very high redshifts and with high precision of ET. And the modest influence beyond 50M⊙, depends on the modeling of the high mass tail or substructure of BHMF. We conclude that the impact of lensing on BHMF inference with ET can be safely ignored in the foreseeable future. Careful handling of lensing effects is required only when focusing on an accurate estimation of the high mass end of BHMF at high redshifts.

XMM-Newton Observations of Two Archival X-ray Weak Type 1 Quasars: Obscuration Induced X-ray Weakness and Variability

张子键　北京大学

We report XMM-Newton observations of two examples of an unclassified type of X-ray weak quasars from the Pu et al. 2020 survey of X-ray weak quasars in the Chandra archive, SDSS J083116.62+321329.6 at z=1.797 and SDSS J142339.87+042041.1 at z=1.702. They do not belong to the known populations of X-ray weak quasars that show broad absorption lines, weak ultraviolet (UV) broad emission lines, or red optical/UV continua. Instead, they display typical quasar UV spectra and spectral energy distributions. In the XMM-Newton observations, both quasars show nominal levels of X-ray emission with typical quasar X-ray spectral shapes (power-law photon indices of $1.99^{+0.27}_{-0.23}$ and $1.86^{+0.15}_{-0.14}$), displaying strong X-ray variability compared to the archival Chandra data (variability factors of $4.0^{+1.6}_{-1.4}$ and $9.0^{+7.4}_{-3.8}$ in terms of the 2 keV flux density). Simultaneous optical (rest-frame UV) spectra indicate no strong variability compared to the archival spectra. Long-term optical/UV and infrared light curves do not show any substantial variability either. We consider that the X-ray weakness observed in the Chandra data is due to X-ray obscuration from a small-scale dust-free absorber, likely related to accretion-disk winds. Such X-ray weak/absorbed states are probably rare in typical quasars, and thus both targets recovered to X-ray nominal-strength states in the XMM-Newton observations.

Black Hole Mass Estimation for DESI Quasars at $0.2<z<0.8$

潘志伟　北京大学

Determining the mass of supermassive black holes in active galactic nuclei (AGN) is crucial for understanding black hole growth and quasar evolution. The conventional reverberation mapping method is time-consuming, motivating the development of the single-epoch method. Recent reverberation mapping campaigns have revealed increased departure from the traditional R-L relation. Additionally, studies have indicated that the accretion state, traced by the strength of FeII emissions, can influence the R-L relation. In this talk I will show how we leverage the capabilities of the Dark Energy Spectroscopic Instrument (DESI) to conduct a comprehensive analysis. Our study employs a well-designed quasar sample within the

redshift range of $0.2 < z < 0.8$ from DESI to systematically investigate and compare different single-epoch black hole mass tracers. By deriving the iron-corrected R-L relations, we significantly improve the accuracy of Hβ- and MgII-based supermassive black hole mass estimations, accounting for the accretion state. Moreover, we outline our future goal of extending these findings to higher redshifts.

ISM density measurements from NIRSpec Spectroscopy

李思佳　厦门大学

天文学史、教育与科普分会场报告

中国毫米波天文发展 50 年回顾

杨戟　紫金山天文台

上世纪 60 年代星际分子的发现开创了分子天文新领域，也催生了毫米波天文观测。1973 年全国 8 年天文规划，将毫米天文选定为中国天文发展的一个新方向。紫金山天文台开始组织队伍牵头开展全国范围的毫米波选址，制订 15 米毫米波望远镜建设方案，组织开展毫米波天文课题研究。不久后，北京大学、北京师范大学等科研单位也开始筹建队伍，从事毫米波天科学研究。1982 年开始在青海建设毫米波望远镜。1996 年 13.7 米望远镜通过验收，投入天文观测。1998 年以后，望远镜不断更新，结合研发新的探测终端，发展新的观测方法，陆续开展了分子云及恒星形成区、IRAS 和 MSX 远红外源的 CO 发射、致密核及气体内落、分子外流、星际脉泽、SNR、河外星系、恒星包层等不同课题的研究。2010 年完成首台多波束接收机系统研制和安装，用于银河画卷巡天等科学观测。九十年代以来，我国也尝试开拓亚毫米波天文观测。过去 50 年间，在天文观测研究、技术研发、设备建设以及人才培养等方面，毫米波天文学科始终坚持国际合作之路。2002 年之后我国陆续与 SMA、ALMA、JCMT、APEX、EHT、LCT 等国际毫米波亚毫米波设备开展了科学与技术研发的共享与合作，也成为若干国际设备的建设和运行伙伴。天文研究课题拓展到了包括高红移星系、宇宙学以及黑洞致密天体等前沿领域。经过 50 年的发展，我国毫米波亚毫米波天文的人才队伍不断壮大，已成为天文学科的骨干力量之一。本报告将简要综述 50 年来中国毫米波天文发展的过程。

佘山天文台的百年历史研究

赵建海　上海天文台

开阳北极 6000 年—《北斗经》里北斗星象年代的天文学考察

易宏　北京独立学者，中国宗教学会理事

任何星象都有其时空属性。《北斗经》等《道藏》所收多种道经记载北斗第六星开阳又名北极（星），当系古人以开阳为北极星之记述。该名之成，当在其名位相符即北极接近开阳之时。多途互证，线索可靠。天象仿真可以确定，其时在约 6000 年前。这是迄今所知有文可考的人类最早的北极和北极星认定记录，与之关联的拜斗礼仪和《北斗经》雏形很可能也相伴而生。这一发现，是对此前未见确认华夏传世文献记载 5000 年前事传统认识的超越。天北极的确认，是华夏天球坐标原点的确定，是中国传统星象体系和以天道信仰为核心的华夏天道文明初成的重要标志。这是道教先驱对中华文明和人类文明的重要贡献。开阳实为被忘年的远古北极星，相关发现和考察，对道教研究乃至中华科学与文明探源，华夏文化寻根，不忘文明初心，讲好中国故事，都具有重大意义。

万历四十六年：解读中国古黑子记录峰值年背后的故事

王红睿　楚雄师范学院

万历四十六年(1618 年)曾被认为是第一个望远镜观测太阳周的极小值，甚至被某些学者认为是扩展孟德尔极小值的开始点。然而，2021 年 C14 数据(Usoskin et al., Astron. Astrophys. 649, A141, 2021)表明 1620 才是第一个望远镜太阳周极小值，万历四十六年太阳活动可能并不像之前 GSN 黑子数描述的那样微弱。令人遗憾的是，欧洲同行仅给出 1618 年太阳活动的 1 个年数据以及 1 个重构的年均太阳黑子数（从原 GSN 数值 15.0 提升到 23.6），缺少太阳黑子第一手的观测证据。

笔者从超过八百种的明朝史书中，搜索、找到并分析了 23 条万历四十六年目视黑子记录的古籍原文，我们找到了更多的万历四十六年黑子活动细节，发现了万历四十六年五月朔的双极、对目视观察者呈现为圆形的大黑子群。

万历四十六年 23 条历史记录达到了古代目视黑子记录的历史峰值，对重建 1618 年黑子数提供了珍贵的第一手资料。

Avoiding the Great Filter: A Simulation of Important Factors for Human Survival

冯福洋　北京师范大学

Humanity’s path to avoiding extinction is a daunting and inevitable challenge which proves difficult to solve, partially due to the lack of data and evidence surrounding the concept. We aim to address this confusion by addressing the most dangerous threats to humanity, in hopes of providing a direction to approach this problem. Using a probabilistic mode, we observed the effects of nuclear war, which is the harmful disaster in terms of its extent of destruction on the length of human survival. We consider the starting point of the predicted average number of survival years as the present calendar year. Nuclear war, when sampling from an artificial normal distribution, results in an average human survival time of 60 years into the future starting from the present, before a civilization-ending disaster.

中国天文学预印本平台介绍——构建一个公平公开、迅捷便利的普惠型学术交流

李 文　中国科学院国家天文台

中国天文学预印本平台（ChinaXiv-Astro），由中国科学院国家天文台与中国科学院文献情报中心共建，支持全球天文领域预印本交流。2023 年 8 月，中国天文学预印本平台正式发布。

中国天文学预印本平台是天文领域学术交流的重要平台，目前，《Research in Astronomy and Astrophysics》《天文学报》《天文学进展》《天文研究与技术》期刊允许作者在论文投稿前将论文手稿发布在预印本平台上。在平台中作者可在个人中心输入文章的 arxiv id，一键提交已发表在 arXiv 的论文。

报告解答四个问题：什么是预印本平台？我们为什么要建设中国天文学预印本平台？中国天文学预印本平台是什么样的？怎么使用中国天文学预印本平台？

兴隆基地科教融合工作介绍

张君波　国家天文台

地方工科院校天文通识课程教学与实践探索

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天文进入中小学校园——建立天文课程体系

史静思　　北京天文连线教育科技有限公司

经过几年的发展，天文连线逐渐形成一套面向中小学生的全年龄多需求的解决方案。

1.课程方面:已经形成一套从小学到中学的天文校本课程，涉及到多学科的交叉。课程内容与中小学必修的若干知识点相关联。部分课程配套相应的学具、硬件、软件，丰富课堂使用效果。课程形式包括线上、双师课堂、线下三种。

2.活动方面:开发原创天文研学活动，包括光学及射电两大类。

3.中学生科研类:从国内竞赛到国际学术会议，从小学到高中，都有成果展现。

报告将介绍以上工作进展及经验分享。

天文望远镜科普的新思路:天文望远镜-由近到远看世界

刘晓海　南通斯密特森光电科技有限公司

利用望远镜观星是传统的天文科普形式，通常是架好望远镜，观众只需排队观看即可。因望远镜少，每人只能观测很短的时间，加之观测时处在黑暗之中，观众难以看清望远镜，更加不可能了解望远镜的结构和工作原理，导致观后很难再有兴趣使用望远镜探索星空。

我们发起的“天文望远镜-近看世界”的科普课程，将望远镜融入近处生活，使用望远镜来创造生活中的乐趣，由近及远，熟练使用望远镜后，对于天文观测也就水到渠成。

改变过去的做法, 重点训练人使用望远镜的操作技能，深入潜出，让学员成

为真正的入门者，这如同教人【开车】，不是训练【乘车】。

学员通过动手组装望远镜、认识望远镜内部构造，在课程结束后都具备独立操作望远镜观看目标和手机拍照的技能。白天可看太阳及大自然万物，夜间看星空，不但用眼睛看，还会用手机记录所见精彩影像，让人深刻感知用望远镜近看世界的奇妙乐趣，以此启发学员对未知领域的好奇心和探索精神，播下科学求知的种子。

这套科普教程在实践中化繁为简，易于操作。教学实践显示本课程的学员，特别是中小学生反响十分热烈，收获巨大，同时提升了天文科普的重要性。

北京天文馆星空观测基地及暗夜保护工作实践

李鉴　北京天文馆

国际天文学联合会天文教育办公室工作概况及中国合作情况简介

崔洁　北京天文馆

上海天文馆数字化赋能科普教育的探索

施韡　上海天文馆

中国科学院国家天文台科普工作介绍

陆烨　国家天文台

上海天文博物馆展陈升级改造汇报暨新时代背景下天文科普教育实践与思考

左文文　上海天文台

知识重构型小学天文课程建设

刘兆行　北京师范大学

本文以“双减”后国家对科学教育的大力推动为背景，针对中小学科学教育中天文教师、天文教材与课程缺乏的现状，研发一套适合小学使用的天文教材与课程。该课程以提升学生科学素养为目标，通过课堂讨论、探索实践、总结归纳等多种方式，引导学生以科学思维去发现并解决问题，同时培养学生动手实验、课堂表达等多方面能力。课程中以学生自主探究为主体，大大减少了对开课教师的要求，有利于大范围推动天文教育的开展。

文中首先介绍了针对我国小学天文课程开展现状的调研情况，发现“我国目前义务教育阶段还缺乏一套体系完整的权威天文课程教材”。

第二部分介绍了小学天文教材与课程设计的总体纲要，同时展示了挑选出来的知识点草拟目录，重点讲述了在知识重构型理念下进行的活页式天文教材开发模式，附带有已经完成的 16 课时活页式教材内容。

第三部分重点介绍了已经完成的整章节活页式教材开发样例、活页式教材分模块化设计思路、典型教具设计展示、教师用书样例等成果；并将其应用于小学课堂中，实际开展了相应的天文教学，在实践中总结经验、发现问题，反馈于教材与课程的研发之中。

最后论述了本研究对天文教育的重大意义，展示了已经完成的成果，“初步具备了完成小学一学期每周一节（16 课时）天文课程教学任务的能力。”同时对天文教育领域的未来发展提出了几点展望。

“同一星空下”——新课标视角下的面向弱势儿童的公益天文教育实践

隋元　上海诺美学校

本研究聚焦于弱势儿童的科学素养教育问题，以天文兴趣课程为载体，开展了一系列针对性的天文教育实践。

目前已开展的工作以在上海的相对弱势儿童群体——流动儿童（农民工子女）作为服务对象切入，主要涉及到两个方面：即基于新课标与上海流动儿童特点的天文兴趣课程开发与面向上海流动儿童群体的公益天文教育实践。

首先，结合上海流动儿童的认知特点以及义务教育新课标，基于笔者现有的已开发中学天文学拓展课程资料，针对性地开发了对应课程，并结合 Python 编程编写了观察日志自动生成程序。

其次，本研究以上海太阳花社区儿童服务中心为平台，开展了具体面向上海流动儿童群体的公益天文教育实践，并在疫情冲击下对线上课程进行了进一步的深入探索与实践，并对相应教育成效进行了定性分析。

在上述工作基础上，本研究正在以和公益组织（上海真爱梦想基金会）合作的形式开发面向全国基层学校的天文兴趣课程课程包与师资培训项目，新学期计划在笔者将前往支教的乡村学校进行初步实践尝试以优化相应课程和师训设置，以更好地践行“同一星空下”的基于平等的教育理想。

上海天文馆在场馆内开展科普表演的探索

陈若颖　　上海天文馆

科学表演是表演人员通过语言和肢体运动，并借助场景、材料、仪器等“道具”，向观众或与观众一起进行传播科学的演示或表演教育活动，目前已经成为当前国际上流行的一种全新而独特的科学教育方式。为提升展示教育能力，丰富展厅活动，从依托展项开展的小型表演秀，到需要多种道具以及大量人员的大型科普剧，上海天文馆在场馆内进行了多次科学表演的探索，并逐步摸索出一套依托自身场馆的科学表演模式。

上海天文馆陨石藏品及实验室介绍

单星美　上海天文馆

陨石在天文馆展示项目中是特别值得关注的种类，上海天文馆建设团队秉承建设国际顶级天文馆的理念，在建设过程中就以最高的收藏标准开展了陨石的征集工作。天降陨石是我们唯一可以触摸太空的实物，也是其他科普场馆中难得一见的珍贵展品，上海天文馆在建设期间征集到来自全球各地共计七十多块精品陨

石，其中不乏品相精良的目击陨石和稀有品种。不仅如此，我们还建设了陨石实验室，配备了分析陨石的大型仪器，包括电子探针和扫描电镜等，希望借助本次会议向大家介绍上海天文馆的陨石藏品及实验室。

“蜗壳天文”科普公众号和科普团队初步建设

李钊　中国科学技术大学

为深入贯彻落实中共中央办公厅、国务院办公厅于 2022 年印发的《关于新时代进一步加强科学技术普及工作的意见》，向社会大众普及科学技术知识、弘扬科学精神、传播科学思想、倡导科学方法，中国科学技术大学天文学系自 2022 年秋季学期开始，在唐仲英基金会、大视场巡天望远镜（WFST）的支持资助下和范璐璐教授的指导下，由学生主导，有序开展天文科普公众号——“蜗壳天文”——的运营建设工作，并同步开展线下天文科普活动。“蜗壳天文”旨在依托中国科大天文学系强大的科研实力，动员本系本科生和研究生投身天文科普教育，建成国内高水平天文科普平台。截止到目前为止，本号用户已经达到 3726 人，推送天文专业知识科普、天象预告、天文大事件等各类文章 93 篇，科普团队举办天文台开放、中秋节赏月和巢湖野外观测等各类线下活动十余次，累计参与者两千余人。本次报告我将介绍“蜗壳天文”在 2022-2023 年的运营情况、蜗壳天文编辑小组和科普团队的建设情况以及未来一年的发展规划。