7th China-Chile Bilateral Conference for Astronomy

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The University of Hong Kong

Book of Abstracts

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Author: Jay Siegel[1]

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Author: Jiasheng Huang[1]

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Rise of the Giants: Witnessing the Birth of Supermassive Black Holes at Cosmic Dawn

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Supermassive black holes are ubiquitous in the nearby Universe. Their lifecycle appears to be closely connected to the evolution of galaxies. How and when did these mysterious objects form? What was the first generation of black hole seeds? How did they grow quickly enough to power the most distant quasars? And how precisely do black holes co-evolve with galaxies? I will summarize the demographics of central black holes in the local Universe and recent discoveries made with the James Webb Space Telescope that offer surprising, new insights into the earliest phases of black hole and galaxy formation during the first billion years of cosmic history. I will outline what we know and the much else that still remains uncertain.

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Measurements of Black Hole Masses using Spectral Energy Distribution of quasars at z~6

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In this talk, I will present a study using the accretion disk fitting method to measure black hole masses in quasars at z˜6. The quasar sample includes 42 quasars at a redshift range of 5.8 < z < 6.5 selected from the XQR-30, which is an ESO large program to obtain deep X-shooter spectra of quasars at z˜6. We derived the supermassive black hole mass using the slim and thin disk models adopted from XSPEC, as well as MCMC Bayesian Inference to fit the quasar broad band photometry. Compared to the black hole mass derived using CIV, the back hole mass derived from the SED fits better and agrees with that derived using MgII. This provides a unique opportunity to estimate the black hole mass in a large sample of quasars without decent near-IR spectra in the future large-scale quasar survey, such as the Rubin Observatory, LSST survey.

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Quasar surveys in China and Quasar Candidate Selections for the Southern Sky

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I will present our progress of quasar surveys in China, including LAMOST quasar survey, luminous high-redshift quasar survey and Galactic Plane background quasar survey. These surveys discovered more than 30k quasars at z=0-5, 100 quasars at z>5 and 1500 quasars behind the Galactic Plane respectively, and provided valuable database for studying changing-look quasars, supermassive black hole growth and astrometry reference frame. I will also introduce a catalog of 920k quasar candidate (CatSouth) selected in the Southern Hemisphere using data from SkyMapper, CatWISE and Visible and Infrared Survey Telescope for Astronomy (VISTA), which may be helpful to future spectroscopic quasar surveys in Chile.

Contributed talks / **19**

Extreme X-ray weakness and variability in super-Eddington accreting AGNs

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A prominent feature of Active Galactic Nuclei (AGNs) is their significant X-ray emission. However, we have systematically discovered a class of AGNs characterized by extreme X-ray weakness (more than 10 times weaker) and extreme X-ray variability transitioning from a weak state to a normal state. These AGNs do not exhibit corresponding significant variations in optical-infrared continuum or emission lines, while generally possessing super-Eddington accretion rates. In this presentation, I will introduce the results of X-ray and multi-wavelength observational studies on this class of AGNs,

as well as the corresponding accretion disk wind-induced obscuration model. These results will also help to understand phenomena such as rapid X-ray flares in narrow-line Seyfert 1 galaxies, the JWST "little red dots," and extreme X-ray weakness in intermediate-mass accreting black holes.

Contributed talks / 38

CO(7-6) and [C I](2-1) survey in z>6 quasars

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High-redshift (z
$gtrsim 6$) quasars are signposts of the earliest supermassive black holes and intense star formation, offering key laboratories for black hole–galaxy evolution at cosmic dawn. While far-infrared studies revealed large dust reservoirs and strong [C II] emission, the physical condition and molecular gas content of their interstellar medium (ISM) remain uncertain.
We present sensitive ALMA Band 3 observations of the redshifted CO(7–6) and \C I emission lines and the underlying dust continuum in a sample of 18 quasars at $z \sim 6$. We detect CO(7–6) in 15/18, \C I in 6/18, and continuum in 13/18 sources. Line luminosities and continuum fluxes are used to estimate molecular gas masses from CO, \[C I], and dust, and to investigate ISM excitation through line ratios with photodissociation region (PDR) and X-ray dominated region (XDR) modeling. Gas masses derived from different tracers are consistent within a factor of a few, and a hierarchical Bayesian cross-calibration of all four tracers yields per-source M_{H_2} and global conversion factors. The observed line ratios reveal a wide range of ISM excitation conditions, displaying signatures of compact, intense star formation and/or enhanced dust opacity (with a possible AGN continuum contribution). PDR models indicate high gas densities ($n > 10^{4}\tilde{}\mathrm{cm}^{-3}$) and strong radiation fields ($G_0 \sim 10^3$–10^4), while the deviations from these predictions suggest that a composite PDR+XDR scenario provides a more complete description of the ISM in these luminous quasars. These results demonstrate the power of multi-line diagnostics in revealing the excitation and structure of the cold ISM in early quasar host galaxies, and highlight the need for joint analysis of CO, [C I], [C II], and dust emission to fully characterize star formation and AGN-driven heating at cosmic dawn.

Contributed talks / 77

Evidence of Gas Depletion in Quasars with Moderate Radio Emission

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The energy released by active galactic nuclei (AGNs) is considered to have a profound impact on the cold gas properties of their host galaxies, potentially heating or removing the gas and further suppressing star formation. To understand the feedback from AGN radio activity, we investigate its impacts on the cold gas reservoirs in AGNs with different radio activity levels. We construct a quasar sample with a mean $z \sim 1.5$ and a mean $L_{\mathrm{bol}} \sim 10^{45.8}$ erg s^{-1}, all with Herschel detections to enable estimates of the total gas mass through the galactic dust continuum emission. The sample is then cross-matched with radio catalogs and divided into radio loud (RL) quasars, radio-detected radio quiet (RQ) quasars and radio-undetected quasars based on their radio loudness. Through spectral

energy distribution (SED) fitting, we find the radio-detected RQ quasars exhibit evidence of gas deficiency with host galaxies possessing ~ 0.3 dex lower dust and gas masses compared to the other two groups, despite being matched in $M_{\rm BH}$, $L_{\rm bol}$, M_* and SFR. Furthermore, evidence from optical spectra shows that both the fraction and velocity of outflows are higher in the radio-detected RQ group, suggesting a connection between the ionized gas outflows and the moderate radio activity. These results suggest that the AGN feedback could be more efficient in AGNs with weak/moderate radio emission than in those without radio detection or those with strong radio emission. Further high-resolution observations are needed to understand the interaction between the interstellar medium and the weak/moderate AGN radio activity.

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The Dynamic, Multi-Phase Nature of Early Galaxies: Insights from ALMA and JWST

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In this talk, I will present Chile-based efforts, carried out in close international collaboration, to understand how, where, and when galaxies evolve across cosmic time. By combining observations from ALMA and JWST/NIRCam+NIRSpec, we are investigating the multi-phase interstellar medium (ISM) in galaxies on kiloparsec scales during the first billion years of the Universe. These studies reveal a remarkable diversity of kinematic behaviors—from rotationally supported disks to complex, merger-driven motions—challenging simplified models of early disk formation. We also find widespread [CII]-traced cold gas outflows, extended gas and dust morphologies, and evidence of obscured star formation well beyond the UV-bright regions. Together, these results highlight the dynamic, multi-phase nature of early galaxy evolution and showcase how Chile's growing role as a global center for observational astronomy enables transformative research on galaxy assembly in the early Universe.

Contributed talks / 90

Strong Line Metallicity Calibrations for high-z Galaxies from Local Analogs.

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Strong nebular emission lines in the optical are routinely used to study the ISM of galaxies. In fact, thanks to the JWST, such measurements are now possible for galaxies at very high redshifts (z>7), well into the epoch of reionization (EoR). Often, the physical properties derived from these lines rely on local calibrations that are not necessarily accurate for the extreme populations that the JWST has been uncovering in the distant Universe. In this work, we present a study of a sample of local galaxies with strong-line ratios (e.g., OIII/Hb, NII/Ha) similar to those of z≥2 galaxies for which we have acquired very deep optical spectra using the Magellan/MagE spectrograph. The data reveal weak lines (e.g., [OIII]4364, [OII]7319+7330 [SIII]6312, [NII]5755) that are difficult to observe directly on distant galaxies, even with the JWST, and that allow us to make accurate estimates of the electron temperature and density of the ISM of these galaxies. These quantities are crucial to make the best estimates of the metallicities for these local analogs of high-z galaxies and may provide the best calibrations to estimate ISM metallicities in galaxies in the EoR. In addition to the rest-frame optical spectra, our data set also includes NIR spectra obtained with the Magellan/FIRE spectrograph.

NIR emission lines are inaccessible in EoR galaxies even for the JWST. These lines will help us better characterize the nature of the ionizing source in these galaxies as well as help us determine the shape of the extinction curve (using Hydrogen lines from the Paschen and Balmer series). This project is part of a China-Chile fund awarded in 2020 that has sparked a fruitful collaboration that remains strong and that has exploited some of the powerful telescopes available in Chile, contributing to the theses of both Chilean and Chinese students. .

Contributed talks / 110

Statistical insights into star formation and cold gas in protoclusters at cosmic noon

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The study of distant galaxy groups and clusters at the peak epoch of star formation has been limited by the lack of a statistically significant, homogeneously selected, and spectroscopically confirmed sample, with most wok focusing on individual case studies. We carried out a large NOEMA program, the Noema formIng Cluster survEy (NICE), to spectroscopically confirm the nature of 65 (proto)cluster candidates at z ˜2-4. 70% of the candidates host at least two galaxies with CO lines at concordant redshifts. These targets are selected as overdensities of massive galaxies at z > 2 with large total infrared luminosities. We systematically examine the star formation and cold gas properties of the protocluster members and find that SFRtot/Mhalo steeply increases with redshift, up to two dex higher than the field at z > 2. This rise is driven not by an excess of starbursts but by a concentration of massive, gas-rich galaxies (M⊠>10ˆ10 M⊠) in the cluster cores. JWST observations of the NICE prototype protocluster, CL J1001 reveal a top-heavey stellar mass function that suports this picture. The star-forming member galaxies exhibit higher μgas and τgas than their field counterparts. Recent JWST/NIRCam imaging further shows that the member galaxies are more compact than their field counterparts, consistent with ongoing compaction processes in these gas-rich environments. Together, these results suggest that dense environments can sustain star formation through substantial gas reservoirs, promoting early mass assembly and the eventual formation of massive ellipticals in cluster centers. Further investigation of the underlying physical processes will benefit from observations with state of the art facilities, such as VLT/MUSE to trace cold gas filaments and Gemini/FLAMINGOS-2 for membership identification, etc.

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Gravitationally Lensed View of DSFG-1 in PLCK G165.7+49.0: Strong Dust Emission and Spatially Resolved Stellar Population Analysis with JWST and SMA

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We present a detailed stellar population and dust-continuum analysis of the strongly lensed dusty star-forming galaxy (DSFG) PLCK G165.7+49.0 DSFG-1 (the "Emerald") at z = 2.236, based on JWST

NIRCam imaging and Submillimeter Array (SMA) millimeter observations. The system is multiply imaged into two components: image 1a, with a moderate magnification of $\mu \approx 3.8$, and image 1bc, with an extreme magnification of $\mu \approx 34.1$. SMA observations reveal exceptionally strong dust-continuum emission in image 1bc, indicative of intense dust-obscured star formation.
We perform both global SED fitting for images 1a and 1bc and spatially resolved SED fitting using Voronoi binning. We further reconstruct the source-plane morphology and conduct source-plane SED modeling to infer the intrinsic dust attenuation, stellar populations, and star formation properties. These analyses reveal the internal structure of dust and stars within the Emerald and demonstrate how strong gravitational lensing enables sub-kiloparsec studies of DSFGs at cosmic noon.

Contributed talks / 47

Galaxy Assembly from Reionization to Present-day Revealed by JWST

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Recent JWST observations have shed light on galaxy assembly and evolution from cosmic reionization to cosmic noon. In this talk, I will review some recent work in our group. First, we focus on [OIII]-bright galaxies at z˜7. By spatially resolved studies of hundreds of these 'Little Green Dots' , we find these galaxies exhibit compact, centrally concentrated star formation, rising star formation histories, and an outside-in growth scenario. They also show high ionizing photon production efficiencies and significant escape fractions, making them key contributors to cosmic reionization. Second, we analyze more than 40,000 galaxies across $0 < z < 4$ and find a transition in galaxy assembly. At $z > 2.5$, galaxies cannot grow in size via only in-situ star formation, suggesting a shift from outside-in to inside-out growth. This transition highlights the interplay between star formation, gas accretion, and feedback processes. Third, we explore the correlation between gas-phase metallicity and galaxy size at $1 < z < 7$. We find that gravitational potential significantly influences metal enrichment, suggesting that the baryon cycle is regulated by galaxy gravitational potential even in the early universe. Collectively, these studies provide a comprehensive view of galaxy assembly from reionization to cosmic noon, highlighting JWST observations in unraveling the complex interactions between galaxies and their CGM.

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A 13-Gyr view of galaxy growth and baryon cycle with JWST 3D Spectroscopy

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Using state-of-the-art reduction methods, we analyze the new JWST data acquired by the NIRISS/NIRCam wide-field slitless spectroscopy (WFSS) and NIRSpec in the multi-object slit-stepping spectroscopy mode. These complementary spectroscopic data sets obtained from multiple instruments open up key window on unbiased investigation of star formation, feedback, and ISM properties in and beyond the cosmic noon epoch. We bring forth the first spatially resolved analysis of high-redshift galaxies with JWST WFSS and measure the first gas-phase metallicity radial gradient with sub-kpc resolution at $z \geq 3$. We extend such analysis to galaxies in the epoch of reionization, finding a swift mode transition of galaxy mass assembly and chemical enrichment in the early Universe. We invent

a novel methodology of conducting 3D spectroscopy of galaxies by stepping the NIRSpec slits across their surfaces, obtaining resolved chemical and dynamical properties for a sample of 26 galaxies at z˜1. We find clear evidence for strong rotational support in galaxies showing negative metallicity gradients, consistent with the predictions by the FIRE-2 cosmological zoom-in hydrodynamic simulations.

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New Development of the Concept of a 2-Meter Class Space UV Mission

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In this talk, I will introduce the ongoing concept development of a 2-meter class space ultraviolet (UV) mission designed to achieve high-sensitivity, spectroscopic, and pointing observation capabilities extending into the far-ultraviolet (FUV, 90–200 nm) regime. The mission aims to address key astrophysical questions concerning the ionized interstellar and intergalactic medium, the physics of hot stellar atmospheres, and the ultraviolet radiation fields that influence planetary environments. The forthcoming China Space Station Telescope (CSST), scheduled for launch in 2027, will leave behind a wealth of engineering resources —including silicon carbide mirror blanks, AIV (Assembly, Integration, and Verification) facilities, and mission operation experience —that can serve as valuable legacies for future space astronomy missions. Building upon these resources, the combination of advanced UV mirror coating techniques and recent progress in back-illuminated CMOS detector technology in China offers a promising pathway toward realizing a dedicated and cost-effective space UV mission. Such an effort could provide the astronomical community with powerful new capabilities for exploring the far-ultraviolet universe.

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An Inroduction to the China Space Station Survey Telescope (CSST)

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The Chinese Space Station Survey Telescope (CSST) is an upcoming Stage-IV sky survey telescope, distinguished by its large field of view (FoV), high image quality, and multi-band observation capabilities. It can simultaneously conduct precise measurements of the Universe by performing multi-color photometric imaging and slitless spectroscopic surveys. The CSST is equipped with five scientific instruments, i.e. Multi-band Imaging and Slitless Spectroscopy Survey Camera (SC), Multi-Channel Imager (MCI), Integral Field Spectrograph (IFS), Cool Planet Imaging Coronagraph (CPI-C), and THz Spectrometer (TS). In this talk, on behalf of the CSST collaboration, I'll give a brief introduction to the CSST.

The introduction paper of the CSST is presented here at https://ui.adsabs.harvard.edu/abs/2025arXiv250704618C/abstract

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The Leighton Chajnantor Project (LCT): an update

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The Leighton Chajnantor Telescope (LCT) project is poised to open new opportunities for large astronomical surveys and advanced technology development at submillimetre wavelengths. The project will relocate the world's most accurate 10-m-class submm telescope—the Leighton Telescope of the former Caltech Submillimeter Observatory (CSO)—from Maunakea to a superior observing site on Cerro Toco within the Parque Astronómico Atacama in northern Chile.

LCT will enable a new submm window into the time-domain sky, support high-risk, high-return survey science with next-generation instrumentation, and carry out sustaining science across multiple areas of broad astrophysical interest. The project is a three-way partnership between the California Institute of Technology (Caltech), the Universidad de Concepción (UdeC), and Shanghai Normal University (ShNU). Through this collaboration, LCT will drive scientific and technological development across all partner communities and strengthen the capacity of these countries to participate in the design, operation, and management of major international observatories.

As a university-driven initiative, LCT places strong emphasis on training students and early-career researchers through direct involvement in forefront instrumentation and observational programs. In this presentation, we report on the current status of the project, including technical, logistical, and organizational progress, as we stand on the verge of transporting the telescope from Hawaii to Chile and approaching the formal launch of LCT's scientific and technical activities.

Contributed talks / 120

Development of Chinese ground-based solar coronagraph

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The report comprehensively presents our recent advancements in ground-based solar coronagraph research, particularly the achievements in western solar site selection and the development of medium-small aperture coronagraphs. We are also planning to construct larger-aperture coronagraphs and develop advanced terminal observation systems to study the fine structure and dynamic characteristics of the solar corona atmosphere, aiming to address some of the most recognized astrophysical challenges in coronal physics. Furthermore, we anticipate the establishment of a global ground-based coronagraph network for collaborative observations.

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Embodied Intelligence and Autonomous Operation of the Sun Yat-sen University 80 cm Infrared Telescope

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The Sun Yat-sen University (SYSU) 80 cm infrared telescope was commissioned in October 2024 at the Lenghu Observatory on the Tibetan Plateau, China. The telescope is equipped with J and K band cameras and is designed for time-domain observations in the near-infrared. Its primary scientific goals include follow-up observations of high-energy transients, such as gamma-ray bursts (GRBs) and supernovae, long-term monitoring of active galactic nuclei (AGNs), and variability studies of stellar objects like RR Lyrae stars and brown dwarfs. The project aims to achieve fully autonomous, embodied-intelligence-based operation of the telescope. In collaboration with the National Astronomical Observatories of China (NAOC), we integrated the TAOS control system to enable automatic scheduling and observation execution. Given that rapid transient follow-up is one of our core scientific objectives, we joined the telescope to the Einstein Probe (EP) and the Space-based multi-band astronomical Variable Objects Monitor (SVOM) "space-ground integrated alert network", enabling the real-time reception of transient alerts and the real-time feedback of telescope operational and observational status. Upon receiving transient alerts, the system autonomously evaluates the observing conditions, plans the observation, executes the task, and reports the results. Environmental perception plays a key role in this process: a weather station and an all-sky camera have been installed to provide real-time meteorological and sky condition data for the scheduler's decision-making. The system is further capable of dynamic scheduling to respond to target-of-opportunity (ToO) events that interrupt regular observation plans. Moreover, the telescope will perform real-time data reduction in the future, including photometric extraction and light-curve generation, and will feed these results back to the scheduler for adaptive decision-making. The synergy between the software architecture and hardware infrastructure forms the foundation for achieving a next-generation, fully autonomous, and intelligent infrared telescope.

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The space missions of the LSR

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TBD

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Radiation Pattern Analysis and Optimization for Leighton Chajnantor Telescope

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Leighton Chajnator Telescope (LCT, i.e., the former Caltech Submillimeter Observatory telescope) will be reassembled in Chile in 2026. Reassembly of its 10.4m segmented primary reflector is of great

importance because it determines the surface accuracy and hence the performances of the antenna' s radiation pattern, which has significant influence on the angular resolution of the telescope. In order to ensure the angular resolution of 8 arcsec, the performances of the radiation pattern of LCT' s antenna needs to be analyzed accurately and optimized carefully by tuning the actuators installed on the backup structure, under the deformation of the primary reflector caused by segmented panel misalignment and gravitational load. In this research, a numerical method for calculating the radiation pattern of LCT's antenna quickly is proposed based on optical path difference calculation, Zernike polynomial fitting and aperture integration, which achieves high computational accuracy and efficiency at the same time. Furthermore, a superposition principle is proposed for analyzing the radiation pattern performances when multiple actuations work together, based on which the method of optimizing the regulation of actuators is developed for improving these performances. Numerical experiments are conducted to verify the feasibility and efficiency of the proposed methods, which will be helpful to ensure good radiation pattern performances of LCT during is reassembly.

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Research on sub aperture accuracy design and manufacturing method of reflector panel for large aperture submillimeter wave telescope

Authors: Zhengxiang Shen[1]; Zhe Yuan[1]; Nuoxian Jia[1]; Peng Chen[1]; Saiya Wang[2]; Runfu Peng[2]; Yong Bi[3]; Chenggang Shu[2]; Zhanshan Wang[1]

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The reflector panel of large aperture submillimeter wave telescopes usually adopts the sub aperture splicing method, and its surface accuracy depends on the production accuracy of splicing a single sub aperture panel and the splicing accuracy of multiple sub apertures. This paper takes the main reflector of Xue-shan-mu-chang 15-meter Submillimeter Telescope (XSMT) as the research object, and uses a combination of simulation and experiment to conduct preliminary research on the design and manufacturing methods of the sub aperture of the reflector panel. Firstly, based on the Strehl ratio evaluation index, a quantitative analysis was conducted on the impact of Piston, Tip Tilt, Decenter, and manufacturing errors on the imaging performance of the system. An error sensitivity model was established, and the tolerance for each sub aperture stitching was given. We compared and studied the evolution law of the accuracy of the main reflector surface under different panel sizes, obtained optimized sub aperture segmentation sizes, and provided sub aperture segmentation strategies. Finally, a lightweight "aluminum honeycomb sandwich aluminum skin" composite structure reflective panel manufacturing method was proposed, which achieved high-precision surface shape through CNC milling, vacuum hot pressing, and multi wheel grinding and polishing process. A preliminary manufacturing process flow from blank forming to precision polishing was constructed. The thermal stability of the structure was verified through high-low temperature cycling tests on the samples, providing a feasible technical approach for the panel manufacturing of the XSMT.

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HIF: a new ground-based high-contrast imager for exoplanets detection research

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Detection and characterization of exoplanets is at the forefront of astronomical research, and over 6000 exoplanets have been detected and confirmed up to now. Most successful high-contrast instruments are available on highly competitive 8˜10-meter class telescope (e.g., GPI@Gemini, SPHERE@VLT, IRCS@Subaru, NIRC2@Keck).

In this presentation, a new ground-based instrumentation HIF (High-contrast Imager for detecting exoplanets orbiting Faint stars) recently developed by NIAOT (Nanjing Institute of Astronomical Optics & Technology, CAS) under the supported from National Natural Science Foundation of China (NSFC) will be introduced. The HIF is optimized to be used on 4-meter class telescopes and designed to image exoplanets with a contrast better than 10ˆ(-5) in the near-infrared wavelengths, and its limiting magnitude of 13. Laboratory testing results and preliminary observations by HIF on a domestic telescope will be presented.

In summary, the HIF is expected to open precise exoplanet imaging to middle-sized telescopes allowing them to join in the chase especially for dim objects in exoplanet studies. Additionally, high-contrast imaging technique and associated experience with exoplanet instrumentation development could be potentially employed for China's exoplanet research program in the future.

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Cosmic Ray Detection and Rejection for CSST

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As a space telescope, the China Space Station Survey Telescope (CSST) will face significant challenges from cosmic ray (CR) contamination. These CRs will severely degrade image quality and further influence scientific analysis. Due to the CSST's sky survey strategy, traditional multi-frame stacking methods become invalid. The limited revisits prompted us to develop an effective single-image CR processing method for CSST. We retrained the DeepCR model based on CSST simulated images and achieved $97.90 \pm 0.18\%$ recall and 98.67 ± 0.05\% precision on CR detection. Moreover, this talk puts forward an innovative morphology-sensitive inpainting method, which focuses more on areas with scientific sources. We trained a UNet++ model especially on contaminated stellar/galactic areas, alongside adaptive median filtering for background regions. This method achieves effective for CRs with different intensities and different distances from centers of scientific targets. By this approach, the photometric errors of CR-corrected targets could be restricted to the level comparable to those of uncontaminated sources. Also, it increases the detection rate by 13.6\% compared to CR masking. This method will provide a robust CR mitigation for next-generation space telescopes.

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Laboratory tests for the CSST SC CCD detectors

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The Chinese Space Station Survey Telescope (CSST) is China's first 2-meter-aperture space telescope. Over a period of ten years, the Survey Camera (SC) on CSST will perform 17500 deg^2 wide-field and 400 deg^2 deep-field multi-band imaging and slit-less spectroscopic surveys, covering a wavelength range of 255-1000nm. The SC focal plane array consists of 31 charge-coupled devices (CCD) of five types, each with 9232×9216 10μm square size pixels. In this presentation, we introduce the laboratory test suites and summarize the test results of the CSST SC CCD detectors. We measure the basic detector parameters including gains, linearities, dark currents, readout noises, charge transfer efficiencies, pixel-response non-uniformities (PRNU), cross-talks and quantum efficiencies. These parameters satisfy the scientific requirements of the CSST Survey Camera. We also investigate and model several detector effects that should be considered in observation, including the bright-fatter effect, the wavelength dependency of PRNU, the charge diffusion effect and the residual image. These test results can be applied to image simulations and further investigations in data processing.

Invited talk(s) / 89

Feeding and Finding Close-Separation Dual AGN: Insights from Multiwavelength SEDs and ALMA Observations

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Dual AGN at kiloparsec separations mark the phase of most rapid supermassive black hole growth, but systematic discovery is hindered by extreme obscuration ($N_H > 10^{24}$ cm^{-2}). I present a new method that combines ALMA millimeter continuum observations with hard X-ray data to identify these systems.

The mm/X-ray luminosity correlation traces SMBH accretion from the innermost regions and, critically, is unaffected by obscuration. We validate this approach with known dual AGN, which follow the same correlation as single systems despite having two active nuclei.
Applying this to Swift-BAT AGN in mergers, our multi-wavelength study shows that the morphological stage (not separation) drives 2-5× enhancements in black hole growth activity during late-stage mergers. ALMA CO observations reveal similar nuclear gas content in single versus dual AGN, suggesting that variability determines the occurrence of dual AGN. Our ongoing ALMA continuum survey, exploiting the mm/X-ray method, has revealed new dual AGN candidates at separations of 100 pc to 1 kpc—among the closest known and crucial for understanding merger-driven SMBH growth.

Contributed talks / 76

The Hyperluminous, Dust-obscured Quasar W2246-0526: ALMA High-Resolution [CII] Imaging

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Hot dust-obscured galaxies (Hot DOGs) are a rare class of hyper-luminous, dust-obscured quasars with accretion rates approaching or exceeding the Eddington limit. They are likely in a critical phase of galaxy evolution, where intense AGN-driven outflows exert feedback effects on their host galaxies and subsequently suppress star formation. W2246-0526 at z = 4.6, the brightest known Hot DOG

and one of the most luminous objects known in the Universe, serves as an ideal laboratory to study AGN feedback. Previous observations with ALMA have revealed a wealth of interesting properties of this unique target, including that it is in the process of accreting three of its neighboring galaxies and it has a highly turbulent ISM. In this seminar I will be presenting a study based on high spatial resolution observations (˜500pc) of the [CII] emission line. The [CII] dynamics is a dispersion dominated system combined with large nuclear outflows. On one hand, by removing the contribution of the outflows, we show that the nuclear velocity dispersion implies the presence of an SMBH with a mass of log (Mbh/M⊠) = 9.80±0.01, and we find that the size of black hole sphere of influence is as large as ˜ 2.3 kpc. This constitutes the first time a dynamic SMBH mass is measured by resolving the SoI at z > 2, and highlights that ALMA high-resolution [CII] observations of obscured luminous quasars hold great promise to increase the number of dynamical SMBH mass measurements in very distant galaxies. This is critical for testing indirect single-epoch broad-line mass estimators that underpin AGN-galaxy co-evolution models. On the other hand, our observations reveal spatially resolved, asymmetric nuclear outflows in [CII] with relatively low velocities (400 km/s < Vout <800 km/s) suggesting interaction with a very dense ISM. Despite their low velocities, our analysis shows that W2246-0526 has some of the most powerful outflows known to date. Combining our findings with the previous wealth of knowledge on this target, we conclude that the AGN in W2246-0526 is likely injecting large amounts of energy into its host's ISM, heating it up and, powering galaxy-scale turbulence that may ultimately inhibit star-formation.

Contributed talks / 107

Re-evaluating the Mass–Metallicity Relation with Self-Consistent Photoionization Models

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The galaxy mass–metallicity relation is essential for chemical evolution studies, yet its dependence on star formation rate (the so-called fundamental metallicity relation) remains contentious due to different metallicity calibrations. We present a photoionization model–based metallicity calibration that yields self-consistent metallicity and ionization parameter estimates for MaNGA galaxies from multiple optical line ratios. The calibration achieves close agreement with direct-method abundances, with a median offset of only 0.09 dex. Applying this calibration, we find no statistically significant dependence of metallicity on star formation rate, either for spatially-resolved regions or integrated galaxies, at nearly all stellar masses. On the other hand, the total stellar mass of a galaxy has a much stronger influence on the spatially-resolved mass-metallicity relation. As a result, apparent trends between metallicity and SFR are consistent with being induced by the star-formation main sequence rather than reflecting a fundamental three-parameter relation.

Contributed talks / 35

Strong spectral features from asymptotic giant branch stars in distant quiescent galaxies

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Dating the ages and weighting the stellar populations in galaxies are essential steps when studying galaxy formation through cosmic times. Evolutionary population synthesis models with different input physics are used for this purpose. Moreover, the contribution from the thermally pulsing asymptotic giant branch (TP-AGB) stellar phase, which peaks for intermediate-age 0.6–2 Gyr systems, has been debated for decades. Here we report the detection of strong cool-star signatures in the rest-frame near-infrared spectra of three young (˜1 Gyr), massive (˜10ˆ10 M⊠) quiescent galaxies at large look-back time, z = 1–2, using JWST/NIRSpec. The coexistence of oxygen- and carbon-type absorption features, spectral edges and features from rare species, such as vanadium and possibly zirconium, reveal a strong contribution from TP-AGB stars. Population synthesis models with a significant TP-AGB contribution reproduce the observations better than those with a weak TP-AGB, which are commonly used. These findings call for revisions of published stellar population fitting results, as they point to populations with lower masses and younger ages and have further implications for cosmic dust production and chemical enrichment. New generations of improved models are needed,informed by these and future observations.

Contributed talks / 54

Photometric redshift estimation and its characterization

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Accuracy photometric redshift (photo-z) estimation is crucial in imaging surveys. We present the photo-z estimation by the normalizing flow, a powerful deep learning method that can approximate complex probability distribution. We demonstrate that the method is able to give reliable photo-z estimation across a number of datasets. Besides accurate photo-z estimation, the characterization of the true redshift (true-z) distribution of a photo-z sample is also critical for unbiased cosmological parameter inference. By combining an improved self-calibration algorithm with the clustering-z method, we show that we can increase the true-z estimation accuracy, and extend the clustering-based method to higher redshift.

Contributed talks / 57

Simulating gas and dark matter with a new radiation hydrodynamics method

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Before and during cosmic reionization, the universe is filled with small gaseous structures, e.g. minihalos (with halo mass between 10ˆ4 and 10ˆ8 solar mass). These structures can influence the 21cm signal and slow down the ionization fronts during cosmic reionization.

To investigate their influence, we perform high resolution cosmological simulations using our newly-developed moment-based radiation hydrodynamics method in the SWIFT astrophysical code. We found these small-scale structures can boost recombination rates significantly during the first 100 Myrs after the passage of an ionization front. They can also boost the required number of photons to ionize the universe by a factor of two, compared to the uniform medium.

We are currently extending our study to include the effect of background density using the separate universe simulation technique. Furthermore, we explore the effects of additional physics, e.g.

different inflation and dark matter models, on these small gaseous structures. These will provide us valuable probes of cosmology and astrophysics by combining these theoretical prediction and 21cm/reionization observations.

Invited talk(s) / 52

Numerical study of AGN feedback

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In this talk, I will review our series of works on AGN feedback in a galactic scale based on the MACER framework. The key features of the MACER model are that: 1) it focuses on the galactic scale; 2) the inner boundary of the simulation domain is smaller than the Bondi radius thus we can reliably determine the mass accretion rate of the black hole; and 3) the state-of-the-art accretion physics is adopted in the model, including the exact description of radiation, wind, and jet in both the quasar and radio modes. We will discuss the galaxy quenching mechanism, the correlation between BH accretion rate and SFR, the X-ray surface birghtness profile, the (cold)gas fraction issue, and the cooling flow problem in galaxy cluster.

Invited talk(s) / 59

Probing the nature and evolution of JWST's little red dots

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JWST has uncovered a new population of compact objects that show a unique V-shaped SED in the UV and optical wavelength range. These so-called Little Red Dots (LRDs) often exhibit broad Balmer emission lines, indicative of the presence of AGNs. They generally lack detection of X-ray, radio, and mid-IR radiation, which is fundamentally different from typical AGNs. My team recently made significant progress with the latest JWST data. Specifically, we discovered a sample narrow-line only LRDs, a sample of LRDs with strong X-ray and radio emission, and LRDs with long-period variability, etc. These findings provide a deep insight into the nature and evolutionary path of LRDs. For example, the discovery of the LRDs with strong X-ray and radio emission suggests that at least some of LRDs will evolve into luminous AGNs at later times. I will review these findings and their implications for us to better understand LRDs.

Invited talk(s) / 46

Multiphase gas in regulating galaxy and black hole growth

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The growth of galaxies and their central supermassive black holes (SMBHs) is regulated by multiphase gas in the circumnuclear and star-forming regions, as well as in the circumgalactic environment. These gas phases range from cold molecular clouds to warm ionized gas and hot diffuse halos, transporting metals, dust, and angular momentum that influence both star formation and black hole accretion.

In this talk, I will present recent results on how multiphase gas regulates this growth cycle with multiwavelength observations, focusing on three parts:

1. Metal enrichment and dust content in the circumgalactic medium (CGM) revealed by JWST and ALMA.
   I will discuss how the distribution of metals and dust traces feedback, inflow, and outflow processes, and how these shape the long-term chemical evolution of galaxies.
2. Statistical results between CGM properties and host galaxy conditions.
   Using large quasar samples from DESI and high-quality spectroscopy from VLT and the galaxy detected by JWST, I will show how the ionization state and metallicity of the CGM connect with star formation history in the host galaxy from the reionization era to the present.
3. Dense and ionized nuclear gas in regulating black hole growth.
   I will present our recent results on how the density, ionization state, and geometry of circumnuclear gas influence accretion and the co-evolution of the SMBH and its host galaxy.

Together, these results highlight the central role of multiphase gas in linking baryon cycling, star formation, and black hole growth across cosmic time.

Contributed talks / 21

Rethinking Galaxy Evolution: A Multidisciplinary Perspective via a Simple Growth Model (and polls from 2 international conferences)

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Our current knowledge of galaxy formation and evolution relies on the comprehensive analysis of data which are analyzed using SED fitting techniques. The insights from these observations have been used for the development of sophisticated cosmological hydrodynamic simulations. Currently at the forefront of exploring galaxy evolution our community uses extensively data from JWST and cosmological hydrodynamic simulations like IllustrisTNG. In this talk I will share the results of opinion polls conducted at the 2021 European Astronomical Society meeting and the 2025 International Astronomical Union meeting, These two polls illustrate the significant challenges both observers and theorists/simulators are currently facing. In sight of many apparent limitations, the particularly disturbing poll results and the uncertainties our community currently face I propose a simple approach relying on growth models tested here on Planet earth. The Gamma growth pattern (which combines a power law growth and an exponential decline), a widely used parameterization across diverse scientific fields (ranging from biology to economics) and scales (from bacterial colonies to the spread of infectious diseases), serves to depict/study growth across many disciplines. In this presentation, I put forth the idea that this same Gamma growth pattern can be broadly applied to describe the cosmic star formation rate density, the mass accretion histories of dark matter halos, and the evolution of the Galaxy Stellar Mass Function (GSMF). The simplicity, minimal parameters, lack of resolution effects, multidisciplinary approach and the ability to link the smallest and largest scales of star formation provided by our methodology, offers a surprising perspective on the Physics of galaxies that I am looking forward to share in the 7th China-Chile Bilateral Conference for Astronomy.

Invited talk(s) / 140

The joint astronomical research between China and Chile.

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Invited talk(s) / 127

Space debris monitoring and situational awareness

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TBD

Contributed talks / 122

The Tianlin mission: a 6.6m UV-VIS-NIR space telescope for the search of biosignatures

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The ongoing and upcoming space-based planet survey missions, such as TESS, PLATO, and ET, are expected to discover thousands of small- to medium-sized planets via the transit method, including over 100 potentially habitable rocky planets. To further study these terrestrial planets, especially those with lower temperatures and wider orbits, the exoplanetary science community has proposed various follow-up missions. However, none of these missions will possess the capability to comprehensively characterize the atmospheres of Earth-like planets in habitable zones or detect potential biosignatures. China is funding a concept study for Tianlin, a 6+ meter class UV to NIR space telescope, projected to begin operations around 2035+ with a mission lifespan exceeding 10 years. Tianlin's primary goal will be the characterization of rocky planets in the habitable zones of nearby stars, with a focus on identifying possible biosignatures. Additionally, this mission aims to significantly enhance our understanding of exoplanet populations, nearby galaxies, and the early universe. In this talk, we will present an overview of the Tianlin mission concept and outline the baseline requirements for the telescope and instruments, informed by our preliminary simulations. We invite international collaborations from across hardware, software, and scientific research to contribute to this groundbreaking endeavor.

Contributed talks / 33

An introduction to the 2.5m Wide Field Survey Telescope: data system and recent progress

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The Wide Field Survey Telescope (WFST) is a dedicated photometric surveying facility being built jointly by University of Science and Technology of China (USTC) and the Purple Mountain Observatory (PMO). It is equipped with a 2.5-meter diameter primary mirror, an active optics system, and a mosaic CCD camera with 0.73 gigapixels on the primary focal plane for high-quality image capture over a 6.5-square-degree field of view. WFST has been installed near the summit of Saishiteng Mountain in the western China. WFST has presented its first light on September 17th, 2023, and the telescope is the stage of normal survey. In this talk, I will introduce the data system of WFST including the data infrastructure and the real-time data reduction pipeline. I will also introduce several tools which we are developing, including real/bogus classification, early light curve classification and the solar system searching.

Contributed talks / 137

Direct Imaging of the Cosmic Web using the Condor Array Telescope, and hydrodynamic simulation predictions

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The filamentary pattern in which the Universe's matter concentrates, the cosmic web, is predicted by the ΛCDM cosmological model and contains the majority of the universe's matter. Detailed mapping of this interconnected structure of gaseous filaments, galaxies, quasars, dark matter, and voids, is central to a comprehensive understanding of the origin and evolution of our Universe. Deep, wide-field imaging has been carried out using the Condor Array Telescope in New Mexico and the data will soon be significantly improved using a new Condor Array in Chile, with first light in 2026. I will describe theoretical calculations based on hydrodynamical simulations to predict the cosmic web Lyman-alpha emission properties for comparison with real data and compare detection predictions with real data.

Invited talk(s) / 82

FAST Observations toward M31 and Nearby Dwarf Galaxies

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Neutral hydrogen (HI) serves as an effective tracer of galactic internal dynamics, gas accretion, and feedback activity. Deep integrations of the nearby spiral galaxy M31 with the FAST telescope, when combined with interferometric data, reveal clear correlations between stellar feedback and both the kinematics and spatial distribution of atomic gas and the surrounding interstellar medium. For low-mass galaxies exhibiting either active galactic nuclei activity or vigorous star formation, high-sensitivity single-dish observations, supplemented by interferometric mapping, allow quantitative tests of the efficiency and physical mechanisms governing gas depletion and replenishment.

This presentation will highlight case studies of HI mapping in M31 and nearby dwarf galaxies, based on deep FAST integrations combined with interferometric data from the VLA and GMRT. In addition, I will emphasize the critical role of multi-wavelength diagnostics and continuum measurements in complementing HI spectral-line observations and interpreting the baryon cycle in these systems.

Contributed talks / 34

Searching for Spider-Like Pulsars from TESS Ellipsoidal Lightcurves with X-ray counterparts

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We present a search for new spider pulsar candidates through multi-wavelength cross-matching, including γ-ray, X-ray, and optical data. A search for sinusoidal-like optical modulations in TESS data of 183 eROSITA X-ray sources coincident with unassociated \textit{Fermi}-LAT γ-ray sources led to the identification of four promising spider pulsar candidates. We found optical variability periods ranging from 5 to 13 hours. All candidates display smooth sinusoidal-like phase light curves, similar to what can be expected from ellipsoidal variation; one show double-peaked profiles indicative of harmonics. The absence of sharp minima, which are often found in black widow systems due to irradiation, suggests these sources are more likely redback-type binaries. One source is included in a machine-learning catalog of unassociated γ-ray sources, with relatively high pulsar probabilities. We also identify potential Gaia counterparts for several sources and estimate their distances and luminosities where parallax measurements are available. Future observations, including further spectroscopic and multi-wavelength studies, are needed to fully characterize these systems.

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The Dominant Contribution of Pulsar Wind Nebulae to the Galactic Cosmic Ray Proton Spectrum and Prospects with SWGO

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This report articulates a two-fold investigation. First, it establishes Pulsar Wind Nebulae (PWNe) as a pivotal source class for the acceleration of Galactic cosmic rays (CRs), concentrating on the origin and propagation of CR protons. The analysis delineates the proton acceleration mechanism at the PWN termination shock and their ensuing escape into the interstellar medium. A key finding is that the time-evolving spin-down power of the central pulsar critically imprints the escaping CR spectrum, generating a high-energy cutoff that diminishes with the source's age. A population synthesis study, which convolves the Galactic distribution and properties of known PWNe, reveals that their aggregate emission can predominantly define the observed CR proton spectrum between approximately 100 TeV and 1 PeV. Second, the report introduces the simulation work and science preparatory activities for the Southern Wide-field Gamma-ray Observatory (SWGO) at TDLI. This forthcoming international gamma-ray observatory, a collaborative project involving China and Chile, holds substantial promise for groundbreaking studies of particle acceleration in PWNe.

Contributed talks / 113

Observing radio transients with Phased ALMA

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Radio transients, such as pulsars and fast radio bursts (FRBs), are primarily detected at centimetre (cm) radio wavelengths, where higher luminosities are found. However, could we study them at millimetre (mm) waves? For pulsars, this window remains poorly studied, but it represents a stepping stone to connecting the cm-radio emission with infrared/optical wavelengths and to discerning where the transition from coherent to incoherent emission occurs. For FRBs, detections have been made up to 8 GHz. Thus, studying radio-emitting neutron stars at millimetre wavelengths offers a direct link to FRBs and may indicate whether they can be detected above the classic cm- window.
In this presentation, we will explore new capabilities at ALMA that enable the observation of radio transients from 35 up to 300 GHz. The Phased ALMA Mode (PAM) was introduced in Cycle 8 (2021) to enable observations of weak radio sources (< 50 mJy), but only recently, in Cycle 11 (2024), it became available with its low-frequency instrument, Band 1 (35–50 GHz), with full polarisation. Importantly, when ALMA's 12-m antennas are coherently combined, they reach an equivalent sensitivity to an 80+ metre dish, enabling high-time resolution at mm-wavelengths with unparalleled sensitivity. We will present the results from the ongoing PAM campaigns, with a focus on our pilot study of the Galactic Centre magnetar, PSR J1745−2900. For this source, we detected a sample of highly polarised pulses at 86 GHz and used them to study the stability of the PAM system for transient searches, as well as the potential to detect bursts from repeating FRBs.
Due to its complex and scattered medium, the vicinity of Sgr A* holds the potential to serve as a laboratory for testing the behaviour of magnetars in extreme, magneto-turbulent environments and linking with FRBs.

Contributed talks / 40

Pulsar Science at the Xinjiang Astronomical Observatory: Progress and Prospects

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Over the years, the Xinjiang Astronomical Observatory of the Chinese Academy of Sciences (XAO) has established itself as one of the leading institutions in pulsar research in China. Through sustained efforts in pulsar observation and analysis, the XAO has developed substantial expertise and generated a series of findings with significant academic impact. In this presentation, we will provide a comprehensive overview of the pulsar research team at XAO, outlining its composition, core research areas, and tracing the evolution of its work. Representative achievements from recent years will be highlighted, along with insights into current progress and future prospects.

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Antarctic Infrared Binocular Telescope: Observations in the 1.4 μm water-vapor-absorption band

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Spectra of ultracool stars exhibit strong absorption features by water-vapor in their atmospheres. Normally, ground-based observations in 1.4 μm are limited by strong absorption of telluric water-vapor. However, Dome A, Antarctica has exceptionally dry conditions that offer a unique opportunity for observations in this band. We designed a new filter covering 1.34–1.48 μm, namely W', and installed it on the Antarctic Infrared Binocular Telescope (AIRBT) at Dome A in 2025. AIRBT comprises two identical 15 cm optical tube assemblies and two InGaAs cameras equipped with J and W' filters, respectively. The scientific goal with W' band is to search for and study cool stars by detecting their water-vapor-absorption features.
We first selected 3 nights from observations in 2025 as an Early Data Release (EDR), which covers ˜20 square degrees in the Galactic plane. The $J - W'$ vs $J - H$ color-color diagram distinguishes ultracool candidates with water-vapor-absorption features from reddened early-type stars. Furthermore, later-type stars tend to exhibit stronger water-vapor-absorptions. Some sources show larger $\Delta W'$ than ΔJ across the three nights, which we attribute to variations of their absorption depth. We conclude that it will be efficient to search for ultracool stars and estimate their spectral subtypes using W' band imaging at Dome A.
This talk will present the instrument design, observational strategy, and preliminary results of observations with W' band.

Invited talk(s) / 16

The Highly Filamentary Central Molecular Zone Revealed by ACES

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The Central Molecular Zone (CMZ) of the Milky Way primarily controls the gas flow from the disc of the Galaxy towards the central nucleus. The CMZ is well-documented to have extreme gas properties that clearly distinguish it from the rest of the Galaxy. While this region has been the subject of intense research, the CMZ-wide properties of the molecular gas at high angular resolution are relatively unexplored. Using Band 3 data from the ALMA ACES (ALMA CMZ Exploration Survey) program, we reveal the highly filamentary nature of CMZ molecular gas at unprecedented resolution (˜0.1 pc) seen in the HNCO 4(0,4)–3(0,3) line, while these features are seen in other molecular tracers as well. Visual inspection of these data suggest that there are two morphological classes of elongated structures, which we identify as: i) large-scale (> 5 pc) filamentary structures (LFs) potentially connected to the CMZ orbital streams; ii) a ubiquitous population of small-scale < 0.5 pc filamentary structures (SFs). Here, we present the morphological and kinematic properties of these structures, their association with magnetic fields, and their degree of chemical complexity.

Invited talk(s) / 48

The ALMA-ATOMS/QUARKS survey: what we have learned about the formation and evolution of high-mass proto-clusters

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To statistically investigate the star formation process in the Galaxy, we initiated the ALMA-ATOMS/QUARKS survey programme at ALMA, which observed about 140 high-mass proto-clusters at band 3 and band 6 under an angular resolution of ˜0.3-2 arcsec. The main science goals of the ALMA-ATOMS/QUARKS survey project are: (i) to deepen the understandings of the dense gas star formation law by studying the spatial distributions of various dense gas tracers in a large sample of Galactic clumps and evaluating how much of molecular gas is participating in star formation; (ii) to investigate how stellar feedback from formed OB (proto)stars influences the surrounding gas distributions and the next generation of star formation in their natal clumps; (iii) to resolve filaments and to study their roles in protocluster formation. I will talk about the current status of this survey and future plans.

Contributed talks / 105

Supernova Rate in local universe

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Supernovae are related to many frontiers of astrophysics, i.e., from probes of extreme physics to discovery of accelerating unvierse. Their distribution and birth rates can help constrain progenitor models and stellar evolution theory. Thanks to the wide-field transient surveys conducted over the past decade, the discovery of nearby supernovae tends to be relatively complete. We compiled a nearby SN sample, including 211 SNe discovered at distances < 40 Mpc over the years from 2016 to 2023, and derived fractions of different types and subtypes, rates and their dependence on environments. The new sample gives a fraction of 30.4% and 69.6% for type Ia and core-collapse SNe, respectively, and the fraction of SNe Ia increased by about 26% relative to previous estimates. In particular, the SN Ia rate shows a prominent increase from redshift z˜0.1 to z<0.01, revealing a unique double peak distribution in Sc- and E/S0-type galaxies. Such a distinct distribution suggests the presence of a "prompt" channel and the other one with a delayed time up to 12.6+/-0.4 Gyr, and the latter channel with a fraction of at least one third comes likely from merging explosion of double white dwarfs.

Contributed talks / 68

What determines star formation in the Galaxy

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Star formation is a complex, multi-variate process, with competing physical mechanisms (e.g., gravity, turbulence, magnetic field) being entangled. What determines the rate and efficiency of star formation remains a fundamental question in the field of star formation. We Utilize the probability distribution function of gas column density (N-PDF) to separate turbulence-dominated gas and gravitationally bound gas, finding a remarkably tight linear correlation between the gravitationally bound gas mass and the star formation rate (SFR), valid more than 4-5 orders of magnitude of star forming clouds in the Milky Way, include regions in the Galactic Central Molecular Zone (CMZ) . This result demonstrates that gravitationally bound gas is the star forming gas that people have long been looking for, and it is the key to determine star formation in the Galaxy. Once gravitationally bound, gas exhibits a consistent star formation efficiency to be converted into stars. This new correlation can well explain some classic puzzles like the existence of Av=8 threshold for star formation, and why the CMZ has very low star formation efficiency. It also provides a new perspective to the theoretic and simulation work of star formation.

Contributed talks / 50

Tracing the magnetic field in star formation regions

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Star formation is a complex process shaped by the interplay of gravity, magnetic fields, turbulence, etc. Recent polarization observations find that the magnetic field's significance across various stages of star formation, yet its precise role remains elusive. Here, we present studies of diverse star-forming regions to explore how magnetic field behavior varies across different environments.

Invited talk(s) / 44

Astronomy + poetry + inclusion: The potential of transdisciplinarity and inclusion as a path for scientific communication.

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This project has been the natural evolution of our outreach work at the "Instituto de Estudios Astrofísicos"of Diego Portales University (UDP), which since 2016 has focused mainly on 2 lines: Astronomical Art and Inclusive Astronomy.
Working together with poets, we have managed to merge both lines in transdisciplinary experiences

where the public is the one who communicates astronomy in a creative way, with inclusion as motivation.

We have been surprised to find expressions of scientific knowledge coming from the public so clear and meaningful that we, as astronomers, had not achieved before. We believe that the diversity of our audience (different ages, studies, experiences, people with or without disabilities) is responsible for these achievements, since their life experiences are reflected in their writings.

In this talk we will recount the evolution of this initiative, which started in 2022 with online astronomical observations of deep field objects taken in real time and described by poets and the audience. Then, along with the recognized Chilean poet Alejandra del Río, we carried out Poetic Creation Workshops around astronomical objects, where the public learned astronomy, poetry, and wrote their own poems. Finally we create the transdisciplinary General Formation course: "Astronomy and literature: a creative proposal"at UDP, that scales the workshop experience to an entire two weekly sessions course for undergraduates (2024- present), and the inclusive astronomy book project "Astronomía al Alcance", a spin off idea from the workshops that includes poetry and paper tactile models.

In these experiences the fundamental principles of inclusion, such as participation, equity, and identity, expand to a wide diversity of backgrounds and visions, putting the public in a position where everyone can contribute, and differences are valued. This highlights the importance and potential of transdisciplinarity and inclusion as a path for scientific communication.

Invited talk(s) / 74

Astronomy at Universidad de Chile

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In this talk I will introduce the astronomy department at U. Chile, from their historical context to the current main areas of research as well as important tasks relevant to the national astronomical community and the Chilean population at large.

Contributed talks / 109

From Harbour to Orbit: Hong Kong's SpaceTech Ecosystem

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Hong Kong is rapidly positioning itself within the global Space economy, supported by a new wave of entrepreneurial actors and recent regulatory developments enabling space-related innovation. Entrepreneurial ecosystem research shows that high-growth entrepreneurship depends on the configuration of culture, networks, finance, policy, and human capital rather than isolated firms or instruments (Isenberg, 2010; Spigel, 2017; Malecki, 2018; Spigel & Harrison, 2018). Recent work has extended this lens to diverse geographical and sectoral contexts, including emerging economies and specialised technology domains, yet the intersection of entrepreneurial ecosystems with highly regulated frontier sectors such as SpaceTech remains underexplored and largely treated at a national level only. Building on prior ecosystem mapping in emerging Asian contexts (Borsano, 2022),

this study examines how a SpaceTech innovation ecosystem is emerging in Hong Kong, using the Orion Astropreneur Space Academy (OASA) and the city's broader Space community as an anchor case.

Recent policy signals —including Chief Executive John Lee's 2025 Policy Address commitment to streamline vetting procedures for Low Earth Orbit (LEO) satellite licensing and to expand low-altitude and aerospace technology infrastructure —provide a shifting institutional environment that may unlock new pathways for upstream and downstream space ventures.

Using a qualitative methodology, the research draws on semi-structured interviews with ecosystem stakeholders, including founders, policy actors, OASA executives, industry practitioners, and Hong Kong–based legal and regulatory experts specialising in satellite governance and aviation/low-altitude legislation. The study analyzes how entrepreneurial initiatives, talent development programmes, and evolving regulatory frameworks interact to shape early-stage ecosystem formation. Findings will offer actionable insights for policymakers, astronomy partners, and cross-border science–innovation platforms seeking to integrate entrepreneurial ecosystems into space and satellite development agendas.

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Contributed talks / 86

Revealing Dark Matter under the Lens

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Unveiling the true nature of Dark Matter (DM), which manifests itself only through gravity, is one of the principal quests in physics. Leading candidates for DM are weakly interacting massive particles (WIMPs) or ultralight bosons (axions), at opposite extremes in mass scales, that have been postulated by competing theories to solve deficiencies in the Standard Model of particle physics. Whereas DM WIMPs behave like discrete particles (ρDM), quantum interference between DM axions is manifested as waves (ψDM). Here, we show (Amruth et al. Nature Astronomy, 2023) that gravitational lensing leaves signatures in multiply-lensed images of background galaxies that reveal whether the foreground lensing galaxy inhabits a ρDM or ψDM halo. Whereas ρDM lens models leave well documented anomalies between the predicted and observed brightnesses and positions of multiply-lensed images, we show for the first time that ψDM lens models are remarkably able to correctly predict the level of observed anomalies. More challengingly, when subjected to a battery of tests for reproducing very high angular resolution observations of quadruply-lensed triplet images in the system HS 0810+2554, ψDM is able to reproduce all aspects of this system whereas ρDM often fails. The ability of ψDM to resolve lensing anomalies even in demanding cases like HS 0810+2554, together with its success in reproducing other astrophysical observations, tilts the balance towards new physics invoking axions.

Contributed talks / 102

How to Fit All Emission Lines Simultaneously with Photoionisation Models

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Optical strong-line ratio diagnostics are standard tools for diagnosing the physical conditions of ionised gas in star-forming galaxies. However, traditional 2D BPT diagrams are not optimal for visualising inconsistency between data and model in multi-D line ratio space due to poor projection angles. Ji & Yan 2020 showed that using reprojections of 3D line ratio space will help visualise the inconsistency. They found a photoionisation model that can simultaneously fit [NII]/Halpha, [SII]/Halpha, and [OIII]/Hbeta ratios. However, this model and all other models in the literature significantly over-predicts the relative strength of [SIII] 9530A line by a factor of 3, and also has a small systematics in predicting the [OII] 3727 doublet strength. Significant modifications on the input assumptions of the photoionization model is required to simultaneously fit 5 line ratios composed by these 7 emission lines. We explored the model assumption space by changing the abundance pattern between O, N, and S and shifting the correspondence between stellar ionising SED and the gas metallicity. With these different assumptions, grids of photoionisation models are generated using Cloudy spanning a range of ionisation parameters and metallicities, which are compared with the data in three sets of 3D line ratio space. We found a best-fitting model that can reduce the discrepancy in [SIII/[SII] by a factor of two while maintaining the good agreement in [NII]/Ha, [SII]/Ha, and [OIII]/Hb. Such a model that can fit more line ratios simultaneously is crucial for refining strong-line calibrations of metallicity and ionisation parameters.

Invited talk(s) / 104

New insights into the life cycle of galactic ecosystems

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In this talk, I will present some of the latest observational results for understanding the life cycle of galactic ecosystems, including both nearby and high-redshift galaxies. I will first present new results on galaxy demographics in the early universe made possible by recent JWST studies, and then discuss more generally what we have learned in recent years about the fundamental physics governing the growth and quenching of galaxies over cosmic time, with a focus on the central role of supermassive black holes in shaping the formation and evolution of massive galaxies.

Invited talk(s) / 79

Mapping CGMs in the Nearby Universe

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Mapping the circumgalactic medium (CGM) in emission is one of the important scientific goals for astronomers to either use the modern ground-based telescopes or the future space missions.CGMs

are multi-phases, key to understand the galaxy ecosystem and its accretion and feedback.In this talk, I will introduce a few scientific projects in our group for the efforts in the warm and hot diffuse emission in nearby universe with high spectral resolution data from UV and X-ray.In addition, I will highlight the prospects in CGM fields based on the existing and future facilities (such as SMILE, CSST, HUBS, CAFÉ etc.) in China.

Contributed talks / 61

Introducing the VariableTNG Simulation: Impact of Baryon Physics on Galaxy Formation

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Cosmological hydrodynamical simulations are one of the most important methods to understand galaxy formation and evolution. Current hydro-simulations are able to produce many observables in the galaxy surveys. However, detailed comparisons between simulations and observations indicate apparent discrepancies. This raises the question whether the discrepancy is caused by the wrong physical mechanisms or inaccurate subgrid model parameters. Therefore, we propose the VariableTNG project by varying the model parameters of IllustrisTNG. Running with the resolution similar to that of TNG-100, we are able to use VariableTNG simulations to investigate the effect of different physical mechanisms. We have applied this set of simulations to study the morphological evolution of galaxies and the origins of the little red dots. We find that the morphology of galaxies is closely related to the star-formation density threshold and strength of AGN feedback. We also produce realistic little red dots SEDs in the VariableTNG simulations to check their density distribution as well as the stellar-black hold mass relations.

Contributed talks / 51

Isolated dark-matter-deficient dwarf galaxies

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In the standard cosmology, dark matter drives the structure formation of galaxies and constructs potential wells within which galaxies may form. The baryon fraction in dark halos can reach the Universal value (15.7%) in massive clusters and decreases rapidly as the mass of the system decreases. The formation of dwarf galaxies is sensitive both to baryonic processes and the properties of dark matter, owing to the shallow potential wells in which they form. In dwarf galaxies, in the Local Group, dark matter dominates the mass content even within their optical-light half-radii (re $\approx$ 1 kpc). However, recently it has been argued that not all dwarf galaxies are dominated by dark matter. We found 19 Dark-Matter-deficient Dwarf Galaxies (DMDGs) that could consist mainly of baryons up to radii well beyond re, at which point they are expected to be dominated by dark matter. An explanation of such dwarf galaxies from hydrodynamical simulations shows that interactions of galaxies at high-density regions could be responsible for the formation of baryon-dominated tidal dwarf galaxies, and environmental stripping could play a role in forming the DMDGs around galaxy clusters. Indeed, it is more challenging to explain the existence of DMDGs (14/19) in the fields where their formation and evolution are free from the environment. Such kind of system challenges the current galaxy formation theory and could also provide new clues for the nature of dark matter (e.g., warm dark matter, fuzzy dark matter, SIDM, or MOND). Based on VLA observations, we have

dynamically confirmed, for the first time, an isolated dark-matter–deficient dwarf galaxy. Further observations are required to establish a statistically significant sample and to unveil the formation mechanisms of these intriguing dwarf galaxies.

Contributed talks / 62

Cold gas cycle in nearby galaxies

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The gas cycle, comprising both inflow and outflow, is critical to galaxy evolution. Within this cycle, cold gas supplies raw material for star formation and black hole growth via inflow, and dominates the mass and energy of outflow. To investigate the role of cold gas cycle in galaxy evolution, we firstly collected a sample of gas-star misaligned galaxies from the MaNGA survey, which are believed to accrete gas from the environment. The interaction between pre-existing and accreted gas can consume angular momentum and trigger gas inflow. Applying the curve-of-growth method to quantify the HI profiles, we found that the cold HI gas in these misaligned galaxies is more centrally concentrated than their aligned controls. We also observed enhanced star formation in the center of star-forming misaligned galaxies. In a complementary study, we investigated the star formation driven cold molecular outflow in NGC 253 using the ALMA observation. We constrained the dense gas fraction with HCN/CO(1-0) ratio and the shock strength with SiO(2-1)/13CO(1-0) ratio. The elevated dense gas fraction and shock strength at the base of outflow streamers suggest that the star formation inside the giant molecular clouds can generate the shocks and further drive the molecular outflow.

Invited talk(s) / 123

Deep Spectroscopy of Planetary Nebulae in the Milky Way and M31 Using Large Telescopes

Author: Xuan Fang[1]

Co-authors: Zhijun Tu [1]; Jorge Garcia-Rojas [2]; Haomiao Huang [1]; Letizia Stanghellini [3]; Martin Guerrero [4]; Quentin Parker [5]; Robert Williams [6]; Jifeng Liu [1]; Ting-Hui Lee [7]

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Planetary nebulae (PNe) are probes of late-stage stellar evolution, and also key tracers of the stellar population, chemistry and kinematics of host galaxies; they are the only emission-line ISM that exist in almost every part of a galaxy, from bulge and disk to the outer halo. I will report new results from our deep spectroscopy of PNe in the Milky Way and Andromeda (M31) using the 10.4m GTC and 8.2m VLT, and briefly review on the observations of PNe with other large telescopes. In addition, I will introduce a new-generation Python-based emission-line identification code PyEMILI,

which we developed for deep, high-dispersion spectroscopy in the era of data-intensive astronomy today.

Contributed talks / 138

The HASH planetary nebulae database and recent science results

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The Hong Kong / AAO / Strasbourg H-alpha Planetary Nebulae research platform and catalogue "HASH" has become the gold standard community resource when working on Galactic and Magellanic Cloud PNe with more than 1200 registered users 60+ countries. I will present the current state of play and recent research highlights from our HKU based HASH team and the legacy and future of HASH as its contents are ported to the CDS in Strasbourg.

Contributed talks / 42

Searching for Planetary Nebulae in Open Clusters

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Only 5 Planetary Nebulae (PNe) among the previously known Galactic Open Cluster (OC) population of ~ 1,100 are known to date. They are extremely valuable because their properties can be directly linked to their progenitor stars, something that cannot be done for PNe in the general field. Since the first data release of the GAIA astrometric satellite, ≈7,200 new OC candidates have been identified. This offers fresh motivation to search them for potential PNe. On a statistical basis alone, given those OC-PN pairs we have already found, we might expect a further 30 OC-PN pairs to be present. We have searched all the latest large OC catalogues for new OC/PN associations and recovered 2 promising new candidates.

Contributed talks / 88

The Rise and Fall of HuBi 1

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HuBi 1 is a born-again PNe that underwent a very late thermal pulse (VLTP). The previous research suggests it experienced a rapid brightness decline over five decades, mostly attributable to dust obscuration formed through VLTP. Furthermore, VLTP-born-again objects experience a brightening phase due to the expansion of the star driven by the He-shell flash before the formation of the dust. In this study, we present the most comprehensive multi-wavelegth lightcurve of HuBi 1, which reveals a brightening process for the first time. Through this, we reconstructed the evolutionary history of HuBi 1. Moreover, we have analyzed its SED in the infrared band to investigate its dust properties.

Contributed talks / 18

Chemical Abundances and Globular Clusters of Milky Way dwarf Galaxies

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The satellite galaxies around our Milky Way (MW) are excellent laboratories for studying stellar evolution and galaxy evolution under different environments, even testing various cosmological models. Recently, we derived up to 13 chemical abundances in several MW satellite galaxies (e.g., Fnx, Scl) using high-resolution APOGEE spectra. Particularly, [Si/Fe] vs. [Fe/H] graph shows patterns related to galaxy stellar mass, indicating its crucial role in galaxy evolution. With our measured abundances, we found that Scl has a bottom-light IMF, which may have a significant impact on the inferred stellar mass of dwarf galaxies. On the other hand, we found that in-situ globular clusters (GCs) have higher primordial [Al/Fe] ratios compared to accreted GCs at [Fe/H]>-1.5. This chemical-driven GC classification is promising for future Galactic archaeology.

Contributed talks / 17

Dynamical Evolutions in Globular Clusters and Dwarf Galaxies

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We present a new two-fluid conduction scheme to simulate the evolution of an isolated, self-gravitating, equilibrium cluster of stars and collisionless dark matter on secular (gravothermal) timescales. We integrate the equations in Lagrangian coordinates via a second-order, semi-implicit algorithm, which is unconditionally stable when the mass of the lighter species is much less than that of the heavier species. The method can be straightforwardly generalized to handle a multispecies system with a population of stars or components beyond collisionless dark matter and stars. We apply the method to simulate the dynamical evolution of stellar-dark matter systems, exploring the consequences of mass segregation and gravothermal core collapse, and assessing those effects for observed globular clusters and dwarf galaxies in the Local Volume.

Invited talk(s) / 116

The Halo Outskirts With Variable Stars (HOWVAST) survey: detecting Milky Way mass tracers beyond 100 kpc.

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According to our currently favored cosmological framework, the Lambda- Cold Dark Matter model, galaxies like the Milky Way were built through the accretion and merger of smaller systems. In this scenario, the extended halo of the Milky Way must retain information about this process. Key to unveiling this information is our ability to trace the outermost regions of the halo by detecting and studying the properties of bound objects. One of the most relevant family of such objects is the low-mass, old-population, RR Lyrae (RRL) pulsational variables, ubiquitous in the halo and for which precise distances can be obtained. In this context, I report our search for faint RR Lyrae stars using Dark Energy Camera (DECam) data over ˜400 sq. deg., as part of the Halo Outskirts With Variable Stars (HOWVAST) survey, where we detect more than ~500 RR Lyrae candidates ranging in heliocentric distances from 7 to 270 kpc. 27 of these stars are located beyond 100 kpc from the Galactic center, increasing our current sample of distant mass tracers, critical to improve current Milky Way mass determinations which suffer from at least 50% uncertainty. HOWVAST represents our effort to carry out frontier Galactic science done with RRLs, and should only be surpassed once the Vera C. Rubin Observatory Legacy Survey of Space and Time (LSST) begins scientific operations, which is expected for early 2026.

Contributed talks / 71

Statistical Studies of Exoplanets with LAMOST and Future Prospects with ESST

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The year 2025 marks a milestone in exoplanet research, commemorating three decades since the groundbreaking discovery of 51 Peg b—the first planet found orbiting a Sun-like star. This seminal achievement, which earned the 2019 Nobel Prize in Physics, inaugurated an entirely new field of astronomy. Over the past thirty years, the field has evolved from initial, sporadic discoveries to the confirmation of over 6,000 exoplanets, heralding a new era of large-scale statistical studies.

In this endeavor, China's Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST), one of the world's most powerful spectroscopic survey telescopes, plays an increasingly vital role. This talk will review the past, present, and future of exoplanet statistical research from a historical perspective, with a particular emphasis on the pivotal contributions of LAMOST. The talk will conclude with an outlook on the potential of the future China-Chile collaborative ESST telescope to further propel this exciting field forward.

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Atmospheric Studies of Exoplanets via China-Chile Collaboration

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We will report on our recent progress in the atmospheric characterizations of exoplanets, using ground-based telescopes, including the 4.1m SOAR telescope, VLT, and CFHT. We have studied 5 hot Jupiters (WASP69b, 121b, 77Ab, 85Ab and MASCARA-4b) with low-resolution transmission spectroscopy and/or high-resolution Doppler spectroscopy. We demonstrate that a 4m class ground-based telescope can impose essential constraints on the chemical compositions and temperature profiles of exoplanet atmospheres and the study of their temporal variabilities. More observing proposals have been submitted and approved to better explore the capability and reliability of the ground-based telescopes/instruments. With high-resolution Doppler spectroscopy, we have successfully re-discovered heavy metals in MASCARA-4b, and revealed new species including Rb and Sm. We report tentative detections of, for example, Li and Ha in the atmospheres of WASP77Ab and 85Ab. This is a great joint effort via China-Chile collaboration.

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Unlocking JWST/NIRISS Spectra with Cross-Correlation: Detection of CO & H_2O in WASP-18b and a Better Constraint of C/O Ratio

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Spectroscopic observations of ultra-hot Jupiters (UHJs) are a primary means of understanding their origins and the formation mechanisms of their atmospheric structures. The James Webb Space Telescope (JWST), with its broad spectral coverage and high-precision instrumentation from near- to mid-infrared wavelengths, provides an ideal opportunity to probe the chemistry and physics in these extreme atmospheres using techniques such as transmission and emission spectroscopy. The JWST Early Release Science (ERS) program observations with NIRISS-SOSS provided excellent constraints for the dayside atmosphere of the UHJ WASP-18b (Coulombe et al. 2023). However, a clear carbon monoxide (CO) signal was not detected, which limited the constraints on the C/O ratio.

In this work, we apply cross-correlation techniques to the WASP-18b NIRISS SOSS dataset, successfully extracting reliable signals of CO at 4.41σ significance and H_2O at 3.39σ, where CO was unseen in previous analyses. Building on these unambiguous detections, our subsequent retrieval analysis significantly improves the constraints on atmospheric abundances, leading to a better-constrain on the C/O ratio for WASP-18b.

Our work demonstrates that the cross-correlation technique can effectively extract molecular signals from medium-resolution JWST data, enhancing the detection sensitivity for molecular species and showing the great potential of applying this method to JWST's medium-resolution spectra. By revisiting JWST archival data with this method, we can achieve a more comprehensive survey of planetary atmospheric chemistry, thereby placing precise constraints on key parameters such as planetary metallicity and C/O ratio. This work will not only maximize the scientific return of the JWST mission but also establish a new methodological foundation for theories on planetary population diversity and formation mechanisms.

Contributed talks / 66

Cometary Water Delivery: N-body Simulations of Non-Gravitational Forces in Early Earth Hydration

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We present N-body simulations of the Solar System incorporating non-gravitational forces (NGFs) generated by volatile sublimation in comets, using the REBOUND code. Our study focuses on quantifying how these jet forces influence comet dynamics and their role in delivering water to early Earth. By tracking close approaches within Earth's Hill sphere, we evaluate how NGFs modified the impact flux of water-rich comets throughout Solar System history. These simulations provide critical constraints on whether outgassing effects significantly enhanced aqueous delivery to primordial Earth compared to purely gravitational models, shedding light on the cometary origin of terrestrial oceans

Contributed talks / 119

Infrared absorption of 23 meteorites from the Atacama Desert

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Dust particles are the dominant source of opacity at infrared and (sub)millimeter wavelengths. While accurate dust opacities are crucial for modeling protoplanetary disks properties, their estimation is highly uncertain in this regime: dust opacities values used in models are mostly extrapolations in wavelength and grain sizes. To tackle this problem we have established the UDP Cosmic Dust Laboratory, the first one of its kind in Chile. We have started operations working on infrared measurements of meteorites from the Atacama Desert, planning to extend our opacity measurements to the submillimeter regime.
Meteorites are the best analogs of the type of dust expected in protoplanetary disks, and the most accessible samples from the Earth to study in the laboratory. The semiarid to hyper arid climates of deserts allows preservation and accumulation of meteorites. Being the driest desert in the world, the Atacama Desert shows an exceptional meteorite concentration per km2 that has remained hyper-arid for several Myr and has preserved meteorites for a long time with a very low erosion rate and slow chemical weathering.

In this study, I will present measurements of dust opacities of 23 meteorites, 3 carbonaceous and 20 ordinary chondrites from the Atacama Desert. We correlated their mid-infrared spectra with chemical composition and grain size distribution. Measuring dust opacities in the laboratory, we calculate the mass absorption coefficient (MAC), that can be used in radiative transfer modeling to be compared to astronomical data of protoplanetary disks.

Contributed talks / 26

Storage ring studies of carbon cluster thermal electronic radiation

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Highly excited molecules and clusters can emit visible and infrared radiation from thermally excited electronic states. This radiation, known as recurrent fluorescence, is particularly intense for carbon clusters and carbon-based molecules due to their high stabilities which allows them to store large amounts of excitation energy and thereby have the possibility to promote electrons to optically active excited states.
Photon emission time constants range from the typical infrared timescales of milliseconds down to a few tens of microseconds, depending critically on the electronic structure of the system. The thermal photon emission channel provides an efficient, but very system-dependent cooling of the molecules/clusters and can as an important stabilizing factors in the collision-poor interstellar medium.
Recurrent fluorescence radiation has been studied at several electrostatic storage rings. In these devices the radiative cooling is measured in parallel with unimolecular decays or thermal electron detachment from anions. I will present measurements from such devices on radiation from fullerenes, from pure carbon cluster ions for sizes below the fullerene size limit of $N \approx 30$, and for carbon-based molecules of astrophysical interest.

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Searching for the Exoplanet Source of Carbon Fullerenes

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The lack of natural sources of carbon fullerenes on Earth and within the solar system is one of the puzzles of astrochemistry, astrophysics and planetary science. Recently, Sittler et al. [1] have hypothesized that the ionospheric formation of these exotic species in the Titan atmosphere can occur from simple molecules such as methane. This can change our understanding of the carbon cycle throughout the universe and shed light on complicated astrochemistry reactions beyond the known fullerenes factories, such as dying stars and planetary nebulae [2]. We believe that, with a large number of exoplanets already discovered and cataloged, it is possible to search for the fingerprints of this allotrope of carbon within their atmospheres. Our observation strategy will first search for exoplanets with thick methane atmospheres. Within these candidates, we search for the UV/VIS absorption of fullerenes. Cataldo et al.[3] have recorded and measured the UV/VIS spectra of C60 fullerene in a solvent under laboratory conditions. In the visible wavelength range, the features at

404 (Strong), 440 (weak), and 670 nm (weak), together with five sub-features at 500, 530, 570, 600, and 628 nm, were also reported [3]. By absorbing a vacuum UV photon (7.80eV), neutral fullerene is ionised to C60+ [4]. This cation shows a strong absorption band at 823.1 nm [3]. The other member of the fullerene family, C70 and its cations C70+ also exhibit absorption bands within UV/VIS wavelength range. Their relatively strong absorption bands are (466.9 & 544.9 nm) and (445.5 & 641.8 nm) for C70 and C70+ species, respectively [3]. Considering these data, we are proposing the spectroscopic observation of these exotic species and perhaps other members of the fullerene family in the atmosphere of the targeted exoplanet systems. Our proposal benefits from reliable theoretical calculations of UV/VIS spectra when experimental data is not available. The theoretically calculated value of one of the weak allowed transitions of C60 (Figure 1) at the VIS wavelength range of 604.28 nm (corresponding experimental value at 600 nm) by applying EDF2/6-31G* quantum chemical model is presented in
Figure 2. The theoretical approach enables us to identify spectral signatures (weak/strong) of other fullerenes from the Roman spectrometer in the absence of experimental data.

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Planetary Sciences Research at U Chile

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The exoplanet group at Universidad de Chile conducts a broad range of research on exoplanets and planetary atmospheres. This work is made possible through the efforts of several students and collaborations with focus in the analysis of ground-base observations using state-of-the-art techniques and instrumentation. In this talk, I will summarize both published and ongoing projects, which include: Photometric time series of extrasolar planets; high-precision spectroscopy of Solar System objects, used as templates for precise atmophseric modeling; exoatmospheric characterization of both transiting and directly imaged exoplanets.

Contributed talks / 23

Are AU Mic b and c on mutually inclined orbits?

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Young planets offer a unique window into the early stages of planetary evolution. Insights into their orbital architectures are powerful to trace their formation environment and constrain the timescales of various dynamical processes. AU Mic is one of the nearest pre-main sequence stars (~20 Myr), hosting 2 Neptune-sized planets and a debris disk. Previous studies have shown that the rotation of the central star, the debris disk, and the inner planet b are all aligned, suggesting that the system has not undergone violent evolution. Here we report new Rossiter–McLaughlin (RM) measurements for both AU Mic b and c using Magellan Planet Finder Spectrograph (PFS), which happened to transit back-to-back on August 25 and 26, 2024. We confirm the aligned orbit of AU Mic b, but an unexpected stellar signal during ingress and the large TTV of AU Mic c prevent us from obtaining a precise constraint on its obliquity. We employed multiple sets of methods to correct for stellar jitter, and most methods favor a solution of a high obliquity for planet c. A recent independent measurement by ESPRESSO also reported a loose constraint that favored a similar solution. If the misalignment is confirmed, AU Mic will be the first known case of a misaligned young planet as well as a rare example of a highly mutually inclined system. This finding could indicate a complex formation process beyond traditional pictures or the presence of rapid dynamical processes during the early stages of planetary systems.

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Diverse Emission Patterns from Precessing Super-Eddington Disks Formed in Tidal Disruption Events

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A tidal disruption event (TDE) occurs when a star passes within the tidal radius of a supermassive black hole (SMBH). In TDEs it is expected that the orbital angular momentum of the disrupted star is generally misaligned with the SMBH spin axis, which should result in a misaligned super-Eddington disk precessing around the SMBH spin axis due to the Lense-Thirring effect. In this paper, we investigate the distinct observational signatures produced from such TDE disks, by performing radiative transfer calculations upon previous super-Eddington disk simulations. We demonstrate that the precession of the disk and wind drive time-dependent obscuration and reprocessing of X-ray radiation. Depending on the orientation of the viewing angle of the observer and the tilt angle of the disk, four main types of variability are induced:

1) The smooth-TDEs: The emissions from these TDEs show no fluctuations;

2) The dimmer: The main emission type (X-ray or optical) stays the same, with small to moderate modulations of brightness;

3) The blinker: X-ray and optical emissions take turns to dominate in one cycle of precession, with dramatic changes in the X-ray fluxes.

4) The siren: X-ray and optical emissions take over each other twice per cycle, possibly with two different peak X-ray fluxes within one cycle.

In all three scenarios, we observe an inverse correlation between X-ray and optical emissions.

Our model provides a unified physical framework for interpreting TDE multi-wavelength variability through disk precession dynamics and gives an alternative interpretation to the interesting case of J045650.3-203750 which was suggested to be a repeated partial TDE previously.

Contributed talks / 91

A new method of measuring magnetic field strength in the highly structured protostellar envelopes

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Magnetic fields are believed to play a crucial role in star formation and have been detected across all evolutionary stages. Their strengths have been measured in both the early, pre-stellar core stage and the later, well-formed protostellar and disk stages. However, during the intermediate stage—when the envelope is rapidly infalling and assembling the star–disk system—no robust method exists to measure the magnetic field strength. We propose a new technique to infer the field strength using kinematic and gravitational information during this intermediate phase, and validate it using non-ideal magnetohydrodynamic (MHD) simulations performed with Athena++. In simulations of the collapse of a non-turbulent protostellar core, we recover the classical pseudodisk: a flattened, rapidly infalling structure formed on the equatorial plane. When turbulence is included, the pseudodisk becomes warped into individual "sheets," forming a highly perturbed three-dimensional structure that we term "gravo-magneto sheetlets", reflecting their coupled gravitational and magnetic origins. These sheetlets dominate the envelope evolution, channeling most of the mass, magnetic flux, and angular momentum toward the disk. We find that the dominant forces acting on the sheetlets are gravity, gas inertia, and magnetic tension. Because the magnetic contribution can be inferred from the balance of the first two—both of which are observable—our method provides a new way to estimate the magnetic field force in protostellar envelopes. Given that magnetic tension depends only on the field's strength and geometry, incorporating independent constraints on field morphology (e.g., from dust polarization) enables an indirect measurement of the magnetic field strength during this critical, rapidly evolving, stage of star formation.

Invited talk(s) / 144

The ALeRCE broker: a community broker for the Vera C. Rubin Observatory

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A new time domain ecosystem is developing thanks to a new generation of large aperture and large field of view telescopes, notably the Vera C. Rubin Observatory. Among the tools required are fast machine learning aided discovery and classification algorithms, interoperable tools to allow for an effective communication with the community and follow-up telescopes, and new models and tools to extract the most physical knowledge from these observations. In this talk I will review the challenges and progress of building the Automatic Learning for the Rapid Classification of Events (ALeRCE) astronomical alert broker. ALeRCE (http://alerce.science/) is a broker that annotates, classifies and provides access to a living database of variable astronomical objects since 2019. ALeRCE is focused around three scientific cases: transients, variable stars and active galactic nuclei, and has become the 3rd group to report most transient candidates to the Transient Name Server. I will also discuss some of the results based on the real-time ingestion and classification of the Zwicky Transient Facility (ZTF) alert stream and the preparations for the incoming alert stream from the Vera C. Rubin Observatory.

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The evolution of Fast X-ray Transients

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Extragalactic Fast X-ray Transients (FXTs), manifesting as a few minutes to hours X-ray flashes, have likely been observed since the 1970s, but only a few dozen examples have been isolated as non-Galactic objects thanks to archival Chandra, XMM-Newton, and Swift data over the past two decades. The launch of Einstein Probe in 2024, which can rapidly detect and localize FXTs in its 3600 deg2 FOV Wide-field X-ray Telescope (WXT-EP), has allowed a detection rate of ~3 FXTs per week, far exceeding expectations, which has permitted the detection of 50+ optical
and NIR counterparts from a total sample of 150+ publicly announced FXTs. Intriguingly, many EP transients have been identified as collapsars (core-collapse supernova with jetted engines). A small minority have additionally been liked to binary neutron star mergers or tidal disruption events, while a substantial fraction remain unclassified. I will summarize ongoing efforts by our collaboration to understand the diverse channels that produce fast X-ray transients.

Contributed talks / **24**

Study Einstein Probe Transients with VLT/FORS2

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We conducted a series of VLT/FORS2 spectroscopic observations targeting a sample of fast X-ray transients and optical counterparts discovered by the Einstein Probe during 2024A. The observed events include supernova-like transients, GRB–associated events, and other rapidly evolving extragalactic sources. These observations provide key redshift measurements and early-time spectral features that help to constrain their physical origins. Combined with multi-wavelength data from space and ground-based facilities, the results highlight the importance of prompt optical spectroscopy in revealing the nature and diversity of fast extragalactic transients detected by the Einstein Probe.

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CO and Dust Formation in Supernovae

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The origins of cosmic dust remain a mystery, with supernovae (SNe) identified as significant contributors to dust production. Molecule formation following SNe explosions plays a crucial role in this process, as it efficiently cools the ejecta to a temperature suitable for dust condensation. To date, carbon monoxide (CO) molecules have been observed in only a few core-collapse SNe. In this talk, I will talk about CO and dust formation in core-collapse and Type Ia SNe. The paper related to this talk: https://www.nature.com/articles/s41550-024-02197-9

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Einstein Probe Discovery of a New Type X-ray Transient and its Mysterious Link to Supernovae

Author: Hui Sun[1]

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Massive stars end their lives as core-collapse supernovae, among which some extremes are broad-lined type Ic supernovae from Wolf–Rayet stars associated with long-duration gamma-ray bursts (LGRBs) with powerful relativistic jets. Their less-extreme brethren make unsuccessful jets that are choked inside the stars, appearing as X-ray flashes or low-luminosity GRBs. However, there exists a population of extragalactic fast X-ray transients with timescales ranging from seconds to thousands of seconds, whose origins remain obscure. Here we report the discovery of the bright X-ray transient EP240414a detected by the Einstein Probe, which is associated with the type Ic supernova SN 2024gsa at a redshift of 0.401. The X-ray emission evolution is characterized by a very soft energy spectrum peaking at <1.3 keV, which makes it different from known LGRBs, X-ray flashes or low-luminosity GRBs. Follow-up observations at optical and radio bands revealed the existence of a weak relativistic jet that interacts with an extended shell surrounding the progenitor star. Located on the outskirts of a massive galaxy, this event reveals a population of explosions of Wolf–Rayet stars characterized by a less powerful engine that drives a successful but weak jet, possibly owing to a progenitor star with a smaller core angular momentum than in traditional LGRB progenitors.

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Dark energy studies with massive galaxy surveys

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Large-scale structure has become a precision laboratory for testing gravity and dark energy. I will present recent results from our multi-tracer analyses of SDSS-IV/eBOSS luminous red and emission-line galaxies, using both configuration- and Fourier-space approaches. A key element is a "chained" multipole estimator that suppresses angular systematics, enabling robust use of auto- and cross-correlations to sharpen BAO/RSD constraints. I will then discuss a model-agnostic reconstruction of the dark-energy equation of state that combines DESI BAO, Type-Ia supernovae, and a CMB distance prior. The data suggest a coherent, mild departure from a cosmological constant—with an apparent crossing of the w=−1 boundary—while remaining consistent with current systematics tests. I'll close with prospects from ESST.

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Dark energy in vector-tensor theories of gravity

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Vector-tensor theories of gravity have received renewed attention in recent years as a compelling candidate to explain cosmic acceleration in a dynamical way, while also addressing the shortcomings of the more familiar scalar-tensor class of models. After a review of these developments, I will present a novel theory characterized by its simplicity and phenomenological features: it predicts exactly luminal gravitational waves and consistent cosmological histories exhibiting late-time acceleration without a cosmological constant. The model is successful in fitting data at a comparable level with LambdaCDM, while also being capable to alleviate the Hubble tension.

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Dwarf Galaxy Integral-field Survey (DGIS): Survey Overview and Insights into Their Ecosystem

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Low-mass galaxies are the building blocks of massive galaxies in the framework of hierarchical structure formation. To enable a detailed study of their galactic ecosystems by spatially resolving different galactic components, we conducted the Dwarf Galaxy Integral-field Survey (DGIS) using VLT/MUSE and ANU-2.3m/WiFeS. The sample comprises 63 dwarf galaxies at a spatial resolution of 10-100 pc. The overall scientific goals include studying baryonic cycles in dwarf galaxies, searching for off-nuclear (intermediate)-massive black holes, and quantifying the inner density profiles of dark matter. In this presentation, I will provide a brief overview of the DGIS survey and summarize several recent results, focusing on star formation activities and metallicity enrichment from individual galaxies to the full sample. These works demonstrate the survey's potential to advance our understanding of dwarf galaxy properties.

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Conference summery and Closing ceremony

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How similar and how different are type Ia supernovae 1991bg-like and 2002es-like

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Cosmological distances and the accelerated expansion of the Universe are explored trough measurements of Type Ia Supernovae. These objects are subclassified according to their intrinsic properties. Most of them follows the Phillips relation between the brigtness at maximum light and the width of the light curve. However, there are some objects that do not follow this relation, and such a scnenario could be dramatic for cosmology if the number of this objects increases. These supernovae correspond to the subluminous 1991bg-like and 2002es-like type Ia events. Here, we analize a sample of these objects using photometric and spectroscopic observations in order to investigate wheter they belong to the same population or not. Or if we need to classify separately.

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When Stars Collapse in Silence: Magnetar-Black Hole Variability Under the Veil of Dark Matter

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Magnetars, a rare class of neutron stars, possess ultra-strong magnetic fields and exhibit sporadic high-energy emissions. Their interactions with black holes remain among the most extreme and least understood processes in astrophysics. This study explores the dynamic behavior of magnetar - black hole systems, with particular focus on the role of dark matter either as a surrounding medium or as a contributing factor in the formation of black holes. The research investigates two primary hypotheses: (1) black holes may reside within dense dark matter halos, and (2) black holes could originate from or partially consist of dark matter.
By focusing on magnetar-black hole mergers, the study analyzes key phenomena such as sudden spin variations, magnetic field collapse, burst-like energy emissions, and altered gravitational waveforms, particularly under dark matter influence. These scenarios are examined through a hybrid approach combining real astrophysical observations with simulation-driven modeling. Datasets from the McGill Magnetar Catalog, ATNF Pulsar Catalogue, HEASARC, Event Horizon Telescope (EHT), and Gravitational Wave Transient Catalog (GWTC) form the observational backbone.
Simulations are conducted to replicate merger dynamics and gravitational interactions, while additional modeling investigates magnetospheric collapse and accretion behavior. Tools such as Universe Sandbox, along with MATLAB and Python-based libraries (e.g., Astropy, NumPy, Matplotlib), support both physical modeling and data visualization. The methodology also allows for the incorporation of other simulation environments if needed, depending on future complexities.
This study highlights the potential role of dark matter in modifying compact object interactions. By integrating theory, data, and simulation, it presents a novel perspective on how hidden cosmic ingredients may shape some of the universe's most violent and energetic events, potentially altering our understanding of black holes, magnetars, and the invisible scaffolding of the cosmos.
Keywords: Dark matter interactions, Magnetar–black hole merger, Compact object astrophysics, Gravitational wave signatures, Simulation-based modeling.

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Shaping the Cosmos: Mergers, Black Hole Dynamics, and the Transformation of Spiral Galaxies

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Galaxy mergers play a pivotal role in shaping the structure and evolution of galaxies. This study investigates how spiral galaxies morphologically transform following merger events. The focus lies on linking initial merger conditions mass ratios, angular momentum, gas content, and collision geometry to the resulting galaxy types.

Observational data from SDSS and HST, along with simulations like IllustrisTNG, EAGLE, GADGET, and RAMSES, will be used to analyze post-merger structural changes. Universe Sandbox aids in visualizing merger dynamics.

Environmental factors like local galaxy density and cluster membership will also be examined. The study further explores the interaction and merger of central black holes, tracking mass, spin, accretion, and gravitational wave signals key targets for missions like LISA.

Morphological evolution will be quantified using Python-based tools (AstroPy, NumPy, Pandas, Matplotlib) and indices like Gini-M20 and CAS. The research aims to enhance our understanding of galaxy transformation and dark matter redistribution within cosmic structures.
Keywords: Galaxy Mergers, Spiral Galaxies, Galaxy Morphology, Astrophysical Simulations, Cosmic Structure, Dark Matter Dynamics, Supermassive Black Hole Mergers.

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Evolution of the Galaxy Main Sequence and Its Scatter in KiDS DR5

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This study presents an observational analysis of the galaxy main sequence (MS) and its intrinsic scatter, based on data from the Kilo-Degree Survey Data Release 5 (KiDS DR5). The photometric redshifts of galaxies are determined using 2 different versions of GaZNet. Stellar masses and star-formation rates were determined using two SED fitting codes (CIGALE and LePhare), each paired with different stellar population models (SSPs, BC03 and M05). We characterize the MS—its slope, normalization, bending and dispersion—across the redshift range $0 < z < 2$ for both the full galaxy population and a sample selected specifically for MS galaxies, while we study how the relationship changes among different assumptions of SSP, SED fitting code and redshift determination. Furthermore, we observe that the intrinsic scatter in log(sSFR) at specific mass range grows at low redshift ($z \approx 0.1$) and is typically smaller at high redshifts. a trend that may indicate increasing burstiness in star formation toward later epochs. We perform a comparison of our results with state-of-the-art cosmological simulations. We find that the simulations are able to predict broadly the observations, however, usually they are limited to probe high mass objects due to box-size effects. The comparison of the observed scatter with the simulated reveals models like EAGLE and TNG100, typically similar scatter for the MS, something that suggests that numerical methods can broadly capture the diversity of SFHs of star forming galaxies.

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Growth from KiDS: Stellar mass assembly of galaxies since z=3 in light of Kilo-Degree Survey

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We present a comprehensive analysis of the galaxy stellar mass function (SMF) using the Kilo-Degree Survey Data Release 5
(KiDS DR5), covering an effective area of 997.816 deg2 after quality cuts. Our study leverages deep multi-band photometry (nine
bands from u to Ks) combined with state-of-the-art machine learning photometric redshift estimation (GaZNet-z) and several SED
fitting approaches to measure the SMF across the redshift range 0.001 < z < 3.0. We construct a pure galaxy sample through
a rigorous source classification using cross-matching with Gaia DR3 for star removal and the MILLIQUAs catalog for QSO
exclusion. To account for systematic effects, we apply aperture corrections. We estimate stellar mass completeness limits using
passive galaxy selection criteria and flux-to-mass scaling relations. Our SMF measurements are in good agreement with previous
studies at low redshifts (z < 1.25). However, out results have systematically lower values at intermediate redshifts (1.25 <
z < 2.0), likely reflecting observational limitations in the KiDS near-infrared bands. At higher redshifts good consistency with
the literature is recovered at the high-mass end. We observe a weak evolution for the high-mass end of the SMF across different
redshifts. Comparison with semi-analytical models reveals a good agreement with GAEA16-zDEP and Elucid-L-Galaxies models,
while hydrodynamical simulations perform well at z < 1, with EAGLE providing an excellent match across the full redshift range.
The large survey area of KiDS provides excellent statistics for constraining the high-mass end of the SMF, demonstrating the
power of wide-area photometric surveys for understanding galaxy stellar mass assembly over cosmic history

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Dust attenuation laws at kpc scales in nearby galaxies

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Dust attenuation modifies the spectra of galaxies over a wide range of wavelength. Integral field spectroscopy surveys of nearby galaxies such as MaNGA, NUV imaging from Swift/UVOT and NIR imaging from 2MASS combine to provide measurements of dust attenuation curves at ~3 arcsec resolution, corresponding to ~kpc scales in nearby galaxies. I will present these measurements for a sample of ~500 galaxies and discuss the correlations between stellar and gas attenuation, the correlations of stellar/gas dust attenuation with a variety of regional/global properties, the physical origin of the UV bump at 2175 angstrom in the attenuation curve. These measurements reveal significant variation of dust attenuation from galaxy to galaxy and from region to region within a galaxy, in terms of both dust opacity and attenuation curve slopes, which is driven by the physical properties of local regions such as stellar age and ionization parameter, at scales of kpc or smaller.

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A comprehensive analysis of the galaxy star formation rate function (SFRF) based on the Kilo-Degree Survey Data Release 5 (KiDS

DR5)

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We present a comprehensive analysis of the galaxy star formation rate function (SFRF) based on the Kilo-Degree Survey Data Release 5 (KiDS DR5). We exploit deep nine-band photometry (from u to Ks) in combination with the state-of-the-art machine learning–based photometric redshift estimates (GaZNet-z) and several SED fitting approaches to measure the SFRs up to redshift z = 3.0. Our SFRF measurements show initially good overall agreement with previous infrared-based studies and discrepancies with the predictions of cosmological simulations and Semi-analytic models. However, after correcting for the Eddington bias by iteratively subtracting the mean SFR shift induced by measurement uncertainties from each galaxy's SFRs we find that the resulting intrinsic SFRFs are consistent with previous determinations from UV/Ha SFR indicators and predictions from semi-analytic models/cosmological simulations. In a companion analysis, we characterize the MS —its slope, normalization, bending and dispersion—across the redshift range 0 < z < 2 for both the full galaxy population and a sample selected specifically for MS galaxies. For both the SFRF and SFR-M*relation we investigate the impact of changes among different assumptions of SSP, SED fitting code and redshift determination. We demonstrate that changing the assumptions of the SED fitting process can affect the derived SFRFs and SFR-M* relation, confirming previous studies who noted as well limitations in deriving properties of galaxies using the SED fitting techinque.

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Identifying Compton-thick AGNs in the COSMOS

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Compton-thick active galactic nuclei (CT-AGNs), defined by column density $\mathrm{N_H}$ $geqslant 1.5 \times 10^{24}\ \mathrm{cm}^{-2}$, are so heavily absorbed that their X-ray emission is often feeble, even undetectable by X-ray instruments. Nevertheless, their radiation is expected to be a substantial contributor to the cosmic X-ray background (CXB), predicting that CT-AGNs should comprise at least $\sim$30% of the total AGN population. In the Cosmological Evolution Survey (COSMOS), the identified CT-AGN fraction falls far below theoretical expectations, indicating that a substantial population of CT-AGNs is hidden due to their low photon counts or their flux below the current flux limits of X-ray instruments. To find out these hidden CT-AGNs, we carried out a two-step search: (1) we hunted for CT-AGNs among sources with < 30 net photons, and (2) we examined MIR-selected AGNs that remain undetected in X-rays. Ultimately, we successfully identified 150 CT-AGNs. Although we have already identified a significant number of CT-AGNs, a considerable population of CT-AGNs was still missed by our selection. Therefore, we estimated and discussed the number of missed CT-AGNs in our sample and proposed a practical strategy to search for them. Finally, comparing host-galaxy properties between CT-AGNs and non-CT-AGNs, we did not find strong evidence for a correlation between intense star formation and CT-AGNs.

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Navigating Stellar Evolution: Unraveling the Time Dependence of the Habitable Zone

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In this work, we studied the evolution of the habitable zone depending on the evolution of the host star. We notice it drastically changes in the phases of the life of the star. One important factor of the distance of the habitable zone is the albedo of the planet. This albedo is different depending on the wavelength and surface. We compared the snow and metal-rich albedos and their effect on reflecting the UV radiation. To improve our model, it was compared with realistic white dwarf spectra, obtaining similar results. Finally, it was compared the difference in using simulations such as SSE and MESA.

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Black hole - Galaxy correlations in GIZMO-SIMBA and TNG-Cluster

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We present a comparative analysis of black hole–galaxy scaling relations in two state-of-the-art cluster simulations: THE THREE HUNDRED project's GIZMO-SIMBA run and the TNG-Cluster simulation. Both simulations employ modern sub-grid models for galaxy formation and AGN feedback but differ in their accretion and jet prescriptions, providing ideal frameworks to study black-hole–galaxy co-evolution in dense environments.
Across redshifts $0 \le z \le 5$, we test a series of correlations including M_{BH}–M_{500}, M_{BH}–$M_{\star}$, M_{BH}–$\sigma_{\star}$, M_{BH}–f_{gas}, M_{BH}–sSFR, BHAR–SFR, and BHAR–$M_{\star}$. Both simulations broadly reproduce observed trends, but with distinct evolutionary behaviors: GIZMO-SIMBA shows nearly no redshift evolution in M_{BH}–M_{500} relations, while TNG-Cluster exhibits a mild evolution at high z that converges after $z \approx 1$. In the M_{BH}–$M_{\star}$ and M_{BH}–$\sigma_{\star}$ relations, SIMBA predicts nearly time-invariant correlations, whereas TNG-Cluster indicates stronger evolution among star-forming systems. Both simulations predict an anti-correlation between M_{BH} and gas fraction, suggesting strong AGN feedback expels gas from massive galaxies. We also test M_{BH}–$M_{gas/H2/HI}/M_{\star}$ in GIZMO-SIMBA. It shows a negative correlation and aligns with observational datapoints. GIZMO-SIMBA also well reproduces nearly linear relationships in M_{BH}–sSFR, BHAR–SFR, and BHAR–$M_{\star}$ correlations.
Our comparison highlights that despite both simulations matching present-day scaling relations, they achieve this through different evolutionary paths—illustrating how feedback implementations shape black-hole growth histories and baryon cycling in cluster environments.

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Simulated surface reconstruction with MCMC and Machine Learning

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Context. Starspots are the result of local magnetic fields on the surface of stars like the sunspots.

This implies stars show spots to a varying amount, large spots can produce a pronounced variability in light curves and this can give us a window to investigate the surface dynamics of stars.

Aims. The goal is to analyze light curves of spotted stars taken by recent surveys like TESS to reconstruct the star's surface.

Methods. We develop a Python code to reconstruct the surface of stars with spots using simulated and observational light curves.

We start from a spherical model incorporating limb-darkening and differential rotation, where the spots are represented by Gaussian masks. To explore the parameters methods such as Markov chain Monte Carlo and machine learning approaches are considered to fit the model.

Conclusions. We expect after tests show a reliable reconstruction of model input parameters used for the simulation. Furthermore, the code has proved to be applicable and scalable, opening the possibility to be used for real data from missions such as TESS

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Wandering Massive Black Holes in Nearby Dwarf Galaxies

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The seeds of supermassive black holes (SMBHs) emerge in the early Universe, yet their population properties remain poorly understood. If low-mass seeds were abundant, they should have left multiple wandering relics in present-day dwarf galaxies as a consequence of inefficient dynamical friction. However, searching for these off-center accreting massive black holes in local dwarf galaxies is extremely hard due to their low luminosity and heavy contamination from surrounding star-forming regions. We conduct the dwarf integral field survey (DGIS) to obtain high-quality spectral data of nearby dwarf galaxies using VLT/MUSE. We identified several wandering massive black hole (MBH) candidates in the sample, and even multiple off-center MBHs in single dwarf galaxies. These unique systems are consistent with the scenario of abundant low-mass seeds of supermassive black holes, and will facilitate our current understanding of the origin of SMBHs.

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High-Mass X-Ray Binaries I. Galactic Population and Progenitors of Binary Compact Object Mergers

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High-mass X-ray binaries (HMXBs) represent a crucial evolutionary phase connecting massive stellar binaries to the formation of double compact objects (DCOs), yet their contribution to the population of gravitational-wave (GW) sources remains uncertain. In this work, we investigate the HMXB

population expected in Milky Way–type galaxies and quantify their role as progenitors of merging compact binaries. We combine a suite of binary population synthesis models generated with SEVN—including updated prescriptions for Be-type systems and a modified neutron star mass distribution—with a sample of 66 Milky Way analogs selected from the high-resolution cosmological simulation TNG50.

We explore 54 combinations of binary-evolution parameters across 13 metallicities and identify the models that best reproduce the observed Galactic HMXB population by comparing simulated distributions of compact-object masses, orbital periods, eccentricities, and X-ray luminosities with current observational catalogs. Using the stellar mass, age, and metallicity of each TNG50 stellar particle, we populate galaxies with synthetic HMXBs and recover spatial and luminosity distributions consistent with expectations for young stellar populations. Our results show good agreement with observational constraints, while demonstrating that only a small fraction of HMXBs evolve into merging DCOs within a Hubble time. Their formation efficiencies depend sensitively on metallicity, favoring the production of BH–BH and NS–NS systems in low-metallicity environments. By mapping the period–eccentricity space of systems that successfully form merging DCOs, we identify the regions of parameter space that most efficiently produce GW sources and compare them with known Galactic HMXBs.
This work represents the first step of a broader project. Building on this framework, we aim to extend our analysis to the full population of quiescent and star-forming galaxies in TNG50, enabling a comprehensive study of how HMXBs and their descendant compact binaries evolve across cosmic time.

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Projection Is All You Need: Interpreting Polarization Measurements in the Orion Clouds with Sub-Alfvénic MHD Simulations

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The importance of the different mechanisms (such as gravity, magnetic fields, and turbulence) involved in star formation is a long-debated problem. To assess the relative strength of these mechanisms in astronomical observations, it is necessary to develop a quantitative framework for comparing observations with predictions from theoretical models or numerical simulations. Motivated by the intriguing magnetic field morphology in the Orion integral-shaped filament (ISF) (J. Wu et al. 2024), we aim to develop a statistical framework that quantifies the "similarity" between an observed dataset and a numerical simulation, while explicitly accounting for projection-angle effects. This is achieved by using some summary statistics that attempt to capture the morphology of 2D magnetic fields, and we compared the summary statistics from polarization measurements in Orion ISF by J. Wu et al. 2024 with summary statistics derived from projections of 3D sub-Alfvénic MHD simulations. Using maximum likelihood estimate (MLE) and hypothesis testing, we were able to estimate the most probable projection angle for magnetic fields in Orion ISF, and showed that the observations can provide evidence against certain projection angles given our sub-sub-Alfvénic setup. We also showed that using simply the diversity in observed core polarimetry morphologies does not provide sufficient evidence to reject our sub-Alfvénic cloud simulation model for most projection angles.

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Tracking cosmic mysteries: Discovering the unknown AGNs

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The universe is filled with mysterious events that provide vital insights into the fundamental processes of astrophysical systems. Identifying anomalies within normal populations remains a significant challenge, as astronomers must detect and characterize them in real-time.
In this talk, we will explore how the ALeRCE broker is transforming the way we track and discover cosmic anomalies, particularly within active galactic nuclei (AGN). By processing vast amounts of observational data, ALeRCE delivers rapid alerts on variable events, enabling astronomers to capture some of the most exciting and rare cosmic occurrences in their earliest stages. We will examine AGN-related transient phenomena, emphasizing its contribution to the broader effort of mapping the dynamic, ever-changing universe. Through recent examples, we will highlight how ALeRCE facilitates rapid multiwavelength follow-up observations and promotes collaboration between telescopes, allowing for more detailed studies of these enigmatic events.

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Address the tension of over-concentrated subhalos in strong lensing by a blue tilted primordial power spectrum

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Some over-concentrated subhalos are detected in strong lensing studies, challenging the standard cosmology model. Instead of modifying the Lambda Cold Dark Matter model, we explore the possibility of a small scale enhanced primordial power spectrum, the blue-tilted model, to achieve the ultra high concentration for dark matter subhalos. With our high resolution cosmological n-body simulations, we have validated the current semi-analytical models for concentration-mass relationship under such a blue tilted primordial power spectrum. Compared to the standard cosmology model whose predicted concentration-mass relationship has a large deviation from those strong lensing detection, we have shown blue tilted could decrease the tension effectively.

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Multi-epoch Cross-instrument Transmission Spectroscopic Study of the hot Jupiter WASP-69b

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The characterization of exoplanet atmospheres is essential for understanding planetary formation and evolution. Transit spectroscopy, a primary technique, probes atmospheric absorption features at the planetary terminator. We obtained in total 3 transit events of the hot Jupiter WASP-69 b using the 4-meter Southern Astrophysical Research (SOAR) Telescope and the 6-meter Magellan Telescope via China-Chile collaboration. Among the 3 transits, one was caught by SOAR and Magellan simultaneously. This study aims to study the temporal variation of the planetary atmosphere and instrumental differences by comparing the transmission spectra obtained at different epochs, and with different telescope/instruments (but at the same observatory). Besides, we attempt to refine the data processing method by introducing a 2D Gaussian Process (GP) during light curve analysis to model wavelength-dependent noise correlations, which aims to minimize the impact of potential wavelength-dependent systematics on atmospheric signal detection. Furthermore, we perform a preliminary retrieval analysis on the optical transmission spectrum of WASP-69 b, which resulted in the detection of Na and K. Future work will involve refining the theoretical model and adding archival HST and JWST data for a more comprehensive analysis.

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Detectablity of Water Vapor on Terrestrial Exoplanets around GK stars with Tianlin

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China has proposed a space telescope with aperture size of 6.6 meters named Tianlin, which is dedicated for the characterization of rocky planets in the habitable zones (HZ) around nearby GK stars. It will be equipped with a low to high resolution spectrograph and a high contrast coronagraph that should allow the delivery of high quality spectrum of exoplanets. We conduct a preliminary simulation of transmission and reflected spectra for Earth-like planets around G, K type stars and perform retrieval analysis of the detectablity of H2O, a key bio-indicating molecule. Our results show that Tianlin has the ability to constrain H2O abundances in the atmosphere of Earth-like planets in most cases.

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Clusters in the Clouds: an 8D+ view by VISCACHA

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Star clusters are powerful tools for studying stellar evolution when analyzed individually. Certain combinations of global parameters of star clusters in the Milky Way have led to a bimodal classification: old, massive globular clusters and young, low-mass open clusters. The star clusters found in the Magellanic Clouds exhibit a range of global parameters and internal structures that complement those observed in the Milky Way, making them particularly valuable laboratories for astrophysical research. The proximity of the Clouds enables detailed photometric and spectroscopic observations of their star clusters, as demonstrated by numerous recent surveys. Furthermore, the star cluster system serves as a tracer of the three-dimensional structure and kinematics of the Small Magellanic Cloud (SMC), Large Magellanic Cloud (LMC), and the Magellanic Bridge, providing a map of chemical abundances and other cluster parameters as a function of age. In this talk, I will provide a brief overview of the star clusters in the Magellanic Clouds, highlight several recent significant studies

—particularly those from the VISCACHA survey—and present some ideas for future research directions.

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A dark matter halo with a large-size core in dwarf galaxy UGCA320

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We present the rotation curve of dark matter in a nearby dwarf galaxy, UGCA320, with a stellar mass of $10^{8.39}\,M_{\odot}$. Using both the low-, medium- and high-resolution MeerKAT HI data cubes combined with MUSE Hα data, we derive the rotation curve of UGCA320 through the tilted-ring model. To ensure the consistency between the rotation curves derived from the HI and Hα data in the overlapping region, we find that the velocity dispersion of Hα is about 1 times that of HI. We fit the dark matter rotation curve using both the Navarro-Frenk-White (NFW) model and the pseudo-isothermal (ISO) model, which represent a cuspy and a cored dark matter halo, respectively. The ISO model gives a significantly better fit to the observed rotation curve than NFW model after accounting for the uncertainties. Besides, the inner density slope derived from the generalized NFW (gNFW) fit is -0.364, quantitatively favoring a cored profile. The best-fit ISO model yields a large core radius of about 8.94 kpc. The presence of such a cored dark matter halo challenges the standard cosmological model, and instead favors self-interacting dark matter (SIDM) scenario, in which dark matter particles experience strong interactions.

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Identification of an Actively Accreting Wandering Massive Black Hole in Dwarf Galaxy UGC 695

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Identifying massive black holes in dwarf galaxies, especially wandering (off-nuclear) ones, provides critical constraints on the formation and growth of black hole seeds. Accretion signatures can be used to identify black holes. Using IFU observations, we detected a wandering actively accreting massive black hole in dwarf galaxy UGC695 at z =0.0022. The source exhibits a strong narrow He II λ4686 emission line, indicative of the source's intense ionizing power. We further exclude other high-ionization sources as the dominant ionizing contributors, including ultraluminous X-ray sources (ULXs), X-ray binaries, Wolf–Rayet stars, supernova remnants (SNRs), and planetary nebulae (PNe).

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Lighting up Dark Matter with the Dragon

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Starting in 2018, observations of galaxy clusters through the world's best telescopes have revealed unusual phenomena: short-lived fluctuations in brightness, and sometimes position, localized to compact regions within gravitationally lensed images (the bending of light due to mass, predicted by Einstein's theory of general relativity). Sometimes, these **transient** events also manifest as the complete appearance or disappearance of lensed images. Despite the increasing number of observed transients, their origin still remains a topic of debate.

Amongst several hypotheses, a leading contender is that the individual stars in the background galaxies are being gravitationally lensed by intervening stars in the foreground galaxy cluster, thus being sufficiently magnified (or demagnified) in brightness to be detected in observations. Here, I will show how the recent JWST observations of more than 40 transient events within a single gravitationally lensed arc, known as the Dragon Arc, can be used to probe the nature of Dark Matter (DM) - a mystery withstanding nearly a century and is considered one of the most pressing problems in modern physics. These observations show a preferred spatial clustering inside rather than outside the cluster critical curve (a region where the light magnification reaches the highest values).

We find that the pervasive density modulations predicted by ultra-light DM particles such as Axions can create such an effect, while ultra-massive DM particles predict the opposite effect. This finding follows on the wake of our previous work, featured on the front cover of ***Nature Astronomy*** (Amruth et al. 2023), where we demonstrated that the two-decade long flux anomaly problem in galaxy lensing can also be resolved if DM is composed of ultra-light particles, providing independent support and pointing the path towards new physics.

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Exploring the Transition Disk T Cha with ALMA Multiwavelength Observations

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Transition disks provide an ideal laboratory for studying disk evolution, as their diverse morphologies allow for the analysis of the physical mechanisms at play and offer insights into the process of

planet formation. We investigate the transition disk T Cha using high-resolution, multiwavelength observations to characterize the dust properties and explore the origin of the carved gap. We find that while the outer disk is detected at all observed wavelengths, the inner ring remains unresolved and is undetected in most of them. Additionally, the gas traced by three CO isotopologues does not reveal the same substructure as the dust, and a curious anticorrelation between the gas and dust emission peaks is observed. We discuss the possible formation of a protoplanet as the origin of the gap and as a likely cause of a pressure trap where particles accumulate and grow, as suggested by the spectral index profiles.

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The Progress of the Qitai Radio Telescope Project

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The QiTai radio Telescope (QTT) is a fully steerable, Gregorian-type telescope with an aperture diameter of 110 meters. It is located in Qitai County, Xinjiang Uygur Autonomous Region, China. Construction of the QTT began in 2022 and is scheduled for completion in 2028. The observing frequency range of the QTT spans from 150 MHz to 115 GHz. The QTT features an active main surface, with actuators used to correct reflector deformation. For its early scientific goals, the QTT will be equipped with ultra-wideband receivers and phase array feeds (PAF). Electromagnetic compatibility and radio frequency interference control techniques are integrated throughout the system design.

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Astronomical Culture for Older Adults: Recovering the Memory of the Lickanantay People through Art

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The project "Astronomical Culture for Older Adults: Recovering the Memory of the Lickanantay People through Art", funded by the ESO Government of Chile Joint Committee (2024), aimed to bridge modern astronomy and the ancestral worldview of the Atacameño people, promoting the recovery of indigenous astronomical knowledge among older adults in Antofagasta. Through 17 workshops held in 15 institutions including neighborhood councils, health centers, and senior clubs the initiative reached 300 participants, 96.4% of whom were older adults.
Each session combined an interactive talk exploring the deep astronomical connection of the Lickanantay culture with a creative activity using the decoupage technique, where participants decorated wooden boxes with astronomical and cultural motifs, transforming knowledge into a tangible memory.
The project fostered intergenerational dialogue and cultural appreciation of the northern Chilean sky, while highlighting the value of indigenous science. Despite challenges such as administrative delays, lack of printed materials, and high demand, participant feedback was highly positive. The outcomes encourage expanding the initiative to rural areas and other regions with strong astronomical heritage, and adapting it to younger audiences through new artistic methods.

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AGC242019: a cupsy dark matter halo with a negative metallicity gradient

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The origin of ultra diffuse galaxies (UDGs) remain poorly understood. We carry out deep MUSE observations of one of the brightest UDG in the HI –AGC 242019. With various strong emission line metallicity calibrators, we found that this galaxy shows a negative metallicity gradient: $-0.08{\pm}0.02\,\mathrm{kpc}^{-1}/{-0.30}{\pm}0.07\,\mathrm{R_e^{-1}}$ for $\mathrm{N2S2H}\alpha$ metallicity calibrator and $-0.028{\pm}0.006\mathrm{kpc}^{-1}/{-0.11}{\pm}0.02\mathrm{R_e^{-1}}$ for O3N2, with average metallicities of 7.6 ± 0.2 and 8.4 ± 0.1, respectively. We also study its dynamics via $\mathrm{H}\alpha$ velocity map together with HI data measured before. The rotation curve prefer a cuspy profile rather than a core profile. All this result suggests that AGC 242019 may not be the result of dwarf galaxy that experiences very strong feedback.

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Pair Counting without Binning - A New Approach to Correlation Functions in Clustering Statistics

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We presents a novel perspective on correlation functions in the clustering analysis of the large-scale structure of the universe. We begin with the recognition that pair counting in bins of radial separation is equivalent to evaluating counts-in-cells (CIC), which can be modelled using a filtered density field with a binning-window function. This insight leads to an in situ expression for the two-point correlation function (2PCF). Essentially, the core idea underlying our method is to introduce a window function to define the binning scheme, enabling pair-counting without binning. This approach develops an idea of generalised 2PCF, which extends beyond conventional discrete pair counting by accommodating non-sharp-edged window functions. In the context of multiresolution analysis, we can implement a fast algorithm to estimate the generalised 2PCF. To extend this framework to N-point correlation functions (NPCF) using current optimal edge-corrected estimators, we developed a binning scheme that is independent of the specific parameterisation of polyhedral configurations. In particular, we demonstrate a fast algorithm for the three-point correlation function (3PCF), where triplet counting is accomplished by assigning either a spherical tophat or a Gaussian filter to each vertex of triangles. Additionally, we derive analytical expressions for the 3PCF using a multipole expansion in Legendre polynomials, accounting for filtered field (binning) corrections. Our method provides an exact solution for quantifying binning effects in practical measurements and offers a high-speed algorithm, enabling high-order clustering analysis in extremely large datasets from ongoing and upcoming surveys such as Euclid, LSST, and DESI.

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Exploring the Nature of Changing-look AGNs

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“Changing-look”active galactic nuclei (CL-AGNs), as AGNs with temporary appearance or disappearance of their broad emission lines, show a spectral type transition within a timescale of years to decades. The nature of this rare phenomenon remains an open question. A batch of CL-AGNs have been identified by our pioneer study in this field. Based on multi-epoch spectroscopy and multi-wavelength studies of CL-AGNs, this presentation will focus on: (1) the evolutionary role of CL-AGNs in the context of the coevolution of the SMBHs and the host galaxies where they reside in; (2) a new scenario of the origin of CL-AGNs stemming from their evolutionary role.

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Search and Characterize Earth-like Planets with CHORUS

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CHORUS (Canary Hybrid Optical high-Resolution Ultra-stable Spectrograph) is a next-generation extreme precision radial velocity instrument for the 10-meter Gran Telescopio Canarias, designed to reach 10 cm/s precision. CHORUS features a dual-arm design with a UV arm (310–420 nm, R˜25,000) and a visual arm (420–780 nm, R˜120,000). China will join the GTC consortium with CHORUS as the in-kind contribution. The expected science programs include PRV surveys of nearby stars, follow-up of transit discoveries, characterization of exoplanet atmospheres, finding stars with primordial composition, and galactic archaeology. I will introduce the ongoing precursor science programs focusing on refining target selection and mitigating stellar activity to improve detection sensitivity, and we invite the community to join these efforts in preparation for the science operation starting in 2028.

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CIDER/LAGER the search for z˜7 galaxies

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We have conducted two large imaging surveys using a custom made narrow band filters to select galaxies a z˜7.The Lyman alpha galaxies at the epoch of reionization (LAGER, z˜6.9) and the Charting ionization during the epoch of reionization (CIDER, z˜7.3) are producing dozens of galaxies. I will present the main results from these surveys.