2026 NRAO Postdoc Symposium Abstracts

Session 1

Data Processing in the ngVLA era

Hendrik Mueller

The next generation of radio interferometers will produce data at unprecedented sensitivity, but also unprecedented data rates. During the last two years, I have focused on the imaging and deconvolution steps. We have identified the gridding step as the performance bottleneck and proposed different approaches to accelerate existing frameworks. Accelerations for the imaging and deconvolution steps could mainly flow from three distinct ideas: By accelerating the implementation itself (e.g. GPU computing), by developing new algorithms which provide a faster convergence speed in terms of major loop iterations (e.g. CG-CLEAN), and by algorithms that allow to go deeper within every minor loop and consequently reduce the number of necessary gridding/regridding operations (e.g. Autocorr-CLEAN, AI accelerated MS-CLEAN). All these developments have shown significant improvements over their more traditional algorithmic counterparts when studied in isolation. However, these approaches are not independent from each other. For example, changes to the minor loop influence the convergence speed of the major loop and vice versa. In this talk, I will reflect on our latest developments and tests to bring all these developments together into a single pipeline and study the interdependency of different recent approaches.

ngVLA Atmospheric Calibration

Kyle Massingill

I present on the development of calibration strategies for the next generation Very Large Array (ngVLA). Temporally variable water vapor in the troposphere layer of the atmosphere will introduce delay error to observations made with ngVLA. Calibration of this delay error is essential for the ngVLA to meet its science requirements. I present on progress to recover existing water vapor radiometer instruments at the VLA. I also give updates on our approach to using atmospheric modeling to write algorithms to translate WVR observations to relative delay. I'll discuss how data from global meteorological models and surface weather data can be used to improve retrieval. We are also using historical weather data to better understand the observing conditions at the proposed ngVLA long sites.

Metamorphic HEMT Low Noise Amplifier for Millimeter-Wave Radio Astronomy

Priyanka Mondal

Cryogenically cooled low noise amplifiers are an integral part of radio astronomical front end systems. Gallium Arsenide metamorphic high-electron-mobility transistor is under investigation based on the commercially available 70 nm technology from MACOM. One potential application is the ngVLA Band 6 post amplifier.

Session 2

Linking Radio Spectral Properties to Lyman Continuum Escape in Metal-poor Galaxies

Omkar Bait

The sources responsible for cosmic reionization are widely thought to be low-mass, metal-poor star-forming galaxies capable of efficiently producing and leaking ionizing radiation. Recently, a large sample of Lyman continuum (LyC) emitting galaxies has been identified at low redshift, providing a unique opportunity to study the physical mechanisms enabling LyC escape in detail. I will present the first systematic radio continuum study of LyC-emitting galaxies, based on multi-band (1–8 GHz) VLA observations. We find that their radio spectral energy distributions show a wide diversity, including spectral steepening and signatures of free–free absorption. Most notably, we uncover empirical correlations between the radio spectral index and LyC escape fraction, ionization conditions, metallicity, and star-formation rate surface density, suggesting a close link between radio emission physics and LyC leakage. These galaxies also exhibit significant deviations from the canonical radio–SFR relation observed in normal star-forming systems. Extending this work, I will present recent results on extremely metal-poor, compact starbursts that display highly unusual radio SEDs, offering new insights into star formation, feedback, and cosmic-ray transport in low-metallicity environments. Our results highlight radio emission as a powerful and complementary probe of supernova feedback, cosmic rays, and magnetic fields in regulating LyC escape. This work provides critical guidance for interpreting upcoming observations of metal-poor galaxies at high redshift with ngVLA and the SKA.

Star Formation Scaling Relations in the Local Group from the Local Group L-Band Survey (LGLBS)

Cosima Eibenstiener

I will present the VLA Local Group L-Band Survey (LGLBS) and one of the first science results. We use new 120pc resolution HI data from combined VLA C + D and GBT observations, together with archival UV, optical, infrared, and CO mapping data, to test star-formation scaling relations in six local group galaxies: M31, M33, IC 10, IC 1613, NGC 6822, and WLM. Radial profiles show that while the HI surface density declines only mildly with radius (extending out to ~2-5 optical radii for the dwarfs), both stellar-mass and star-formation-rate surface densities decrease sharply, producing an outwardly falling star-formation efficiency (SFE). Classical relations are recovered: $\Sigma_{\rm SFR}$ correlates weakly with $\Sigma_{\rm HI}$, nearly linearly with $\Sigma_{\rm H_2}$ where CO is detected, and shows intermediate behavior with total gas. On ~100 pc scales, SFE increases with Σ_* and the molecular-to-atomic gas ratio ($R_{\rm mol}$) rises with the ISM dynamical equilibrium pressure PDE, extending pressure–phase balance trends into the HI-dominated, low-metallicity regime. Across all galaxies, the resolved $\Sigma_{\rm SFR}$ - $P_{\rm DE}$ relation is present but exhibits larger scatter in dwarfs, consistent with stochastic star formation and non-local heating. Feedback yields ($Y_{\rm fb} = P_{\rm DE} / \Sigma_{\rm SFR}$) cluster around $\sim 10^3$ km s^{-1} in HI-dominated regions, slightly below those in molecular-rich spirals, implying environment-dependent coupling between stellar feedback and ISM pressure. This work allows us to place the six Local Group galaxies in the general context of the galaxy population in the present-day universe.

Radio Probes of Our Galaxy's Elusive Pevatron Particle Accelerators

Kathryn Plant

Several features of the cosmic ray particle spectrum suggest that sources within our Galaxy supply the observed particle flux well beyond PeV energies, and hence beyond the energies achieved by ordinary supernova remnants. Radio observations have key roles in the multiwavelength and multimessenger puzzle of identifying our Galaxy's Pevatron particle accelerators. In this talk, I will present a cosmic ray detector for the OVRO-LWA that detects 100—1000 PeV cosmic rays via the brief (∼5ns) bursts of radio emission produced by their collision with our atmosphere. I will also present my plans as a new Jansky fellow to use radio imaging to assess Pevatron candidates identified by their ultrahigh energy gamma ray emission. Since the trajectories of charged cosmic rays do not point to their sources, identifying these sources will require a combination of approaches, including imaging the associated neutral messengers as well as radio-derived estimates of the mass spectrum of the cosmic ray particles themselves.

Revisiting 18cm OH excitation through far-IR calibration

Michael Busch

Hydroxyl (OH) is one of the most promising tracers of the diffuse molecular interstellar medium, which has been shown to be largely "CO-dark". 18cm observations of the OH ground state have always been plagued by the non-LTE nature of the excitation and the ambiguity of the excitation temperature of the main lines (1667 and 1665 MHz), which are the strongest lines and usually used for column density estimation. We use observations of the SOFIA telescope of the FIR OH lines at 158 um in absorption in conjunction with new 18cm OH VLA observations to constrain the excitation temperatures of the ground state lines in a novel way. By determining the column density a prior and comparing with the observed optical depths at 18cm, we are able to solve directly for the ground state excitation temperatures. We find good agreement with previous studies (e.g. Hafner et al. 2023) that the main line excitation temperatures lie between, $3K < Tex < 10K$, with frequent anomalous behavior in the satellite lines.

Complex Aromatic Chemistry Detected at the Dawn of Star and Planet Formation

Samantha Scibelli

Millimeter and centimeter radio telescopes are the premier facilities with which we probe the molecular gas and dust content of the interstellar medium (ISM). Within the past decade, the combination of rotational line observations and laboratory spectroscopy has revealed an unambiguous prevalence of a growing number of 'complex' aromatic molecules. Synergistically, with the advent of near-infrared facilities like JWST the content of the even larger rings, i.e., polycyclic aromatic hydrocarbons (PAHs), is actively being studied in a diverse range of environments, from local molecular clouds to distant galaxies. In this talk, I will discuss the exciting new discovery of one of the building blocks of this PAH chemistry, benzonitrile (c-C6H5CN), toward the dust peak of the low-mass prestellar core L1544. These observations were conducted as part of the GBT L1544 Unbiased Complex Organics SurvEy (GLUCOSE) using the 100m Green Bank Telescope. While previously observed in dark clouds, this represents the first detection of benzonitrile in an actively collapsing prestellar core. The resolved kinematics of our narrow lines ($dV < 0.1$ km/s) provide evidence to suggest this molecule is also accreting onto the central 'pseudo-disk' of L1544. This discovery highlights that high spectral resolution instruments like the GBT are necessary to make these discoveries, and that the PAH chemistry abundant in ISM could very likely be incorporated directly into the later stages of star and planet formation.

Chemo-dynamical modeling of high-mass protostellar environments: linking chemistry and molecular emission

Melisse Bonfand

Star-forming regions are among the richest chemical environments in the universe, where atoms and simple molecules evolve into complex organic species under a wide range of physical processes. Observations reveal a large diversity of chemical compositions among star-forming regions, but the origin of this diversity remains unclear. This is particularly true for high-mass star-forming regions, whose complex structures and rapid evolution make them much less well understood than their low-mass counterparts.

In this talk, I will present results from a new modeling framework designed to investigate the physical and chemical evolution of high-mass protostellar environments. The model follows the collapse of a uniform molecular cloud onto a central massive protostar through an accretion disk, using a two-dimensional hydrodynamical approach coupled with a chemical kinetic code. The resulting chemical abundances are post-processed with a radiative transfer code to generate synthetic molecular emission maps and spectra. By directly comparing these predictions with observations, we assess how the evolutionary stage and source structure—particularly disk formation and inclination—affect the emission and spatial distribution of complex organic molecules.

Session 3

The Spectroscopy of the ODISEA Project: New Constraints on Accretion and Disk Evolution at Young Ages

Dary Ruiz

In this talk, I'll present the latest results from the ODISEA spectroscopy study. I'll show our new spectral type classifications and accretion rate measurements for the Ophiuchus YSO sample, and how these help build a consistent picture of the stellar properties. I'll then connect these results with the disk properties from millimeter observations, focusing on how accretion relates to disk mass and size. Finally, I'll compare these objects with ∼1 Myr-old populations to place them in an evolutionary context, and discuss what this tells us about early disk evolution and star–disk interaction.

Laboratory Experiments on Interstellar Ice: Tracing the Evolution of Planetary Volatiles

Alexia Simon

Stars and planets form within cold molecular clouds where gas and microscopic dust grains provide the environment for rich chemical evolution. On the surfaces of these grains, simple molecules such as H_2O, CO, CO_2, and CH_4 condense into icy mantles that act as chemical reactors, enabling reactions that cannot occur efficiently in the gas phase. The chemistry occurring within these ices shapes the molecular inventory inherited by protoplanetary disks, comets, and ultimately planets.

Laboratory astrochemistry provides a bridge between astronomical observations and chemical models by recreating interstellar ice chemistry under controlled conditions. In the laboratory, ice analogs are formed under ultra–high vacuum and exposed to radiation or thermal processing to investigate how molecules form, react, and desorb from grain surfaces. These experiments allow us to quantify key processes such as volatile entrapment, isotopic exchange, and radiation-driven chemistry that influence how molecules evolve throughout star and planet formation.

In this talk, I will present recent laboratory studies exploring how the physical structure and chemical composition of interstellar ice analogs affect the evolution of volatile molecules and isotopic signatures. These experiments help trace the chemical pathways that connect molecular clouds to planetary systems and provide new insights into the origins of planetary volatiles.

Azimuthal Dust Polarization from Aerodynamically Aligned Grains as Evidence for the Streaming Instability in Protoplanetary Disks

Zhe-Yu Daniel Lin

(Sub)millimeter dust polarization in protoplanetary disks suggest the presence of large (∼100 micron) grains that are aligned along their long axis following the azimuthal direction of the disk, i.e., large, azimuthally aligned, effectively prolate grains. The novel Badminton Birdie-like Aerodynamic Alignment allows large grains to be aligned to its long axis following the direction of gas flow experienced by the dust, defined as the A-field. From state-of-the-art 3D streaming instability simulations, I will demonstrate that the A-field is predominantly in the azimuthal direction in regions of high dust-to-gas ratio. Through polarized radiation transfer, I will show that polarization angle indeed follows the disk azimuthal direction. Therefore, dust polarization from birdie-like aligned grains offers evidence of ongoing streaming instability in protoplanetary disks.

High resolution spectroscopy of accreting planets analogs: first results of the ENTROPY program

Demars Dorian

Giant planets forming in protoplanetary disks have their evolutionary pathways determined by their accretion phase. Yet, their study remains limited by the current sample of embedded accreting planets: PDS 70 b and c, and the new challenger WISPIT 2b. However, wide-orbit planets may serve as proxies for embedded ones: although slightly more massive, they are not limited to the use of AO instruments, which often comes at the cost of spectral resolution.

Accretion mechanisms are studied through emission lines (Halpha, Paschen Beta, ...) forming at or near the accretion shock. They have been discovered on a couple dozen wide-orbit Planetary-Mass Companions (PMCs). However, studies often use medium-resolution spectrographs (e.g., MUSE R 3000), insufficient to resolve the line profiles and probe the gas dynamics. Recent studies have shown that echelle spectrographs (R 50 000) may in fact be used to study bright optical lines, offering a unique opportunity to constrain accretion models and accretion dynamics.

We present the results of a monitoring campaign of the Balmer emission lines (Halpha, Hbeta, ...) of Delorme 1 (AB)b, at $R\sim50{,}000$ with VLT/UVES. The lines are clearly resolved with variable line profiles and fluxes, on days to year timescales. We detect a UV excess, direct tracer of the accretion shock. We find that its Balmer lines are the combination of two components, only one of which is correlated with the UV excess. We discuss implications in the context of magnetospheric accretion and shock-induced emission. Finally, we present the early results of the ENTROPY program (ExoplaNeT accRetion mOnitoring sPectroscopic surveY), consisting of a systematic variability study of Balmer emission lines on 8 PMCs with VLT/UVES. We find different line behaviors depending on the target, where line profile variability observed at timescales of 20 minutes up to a year.

MHO 1+2, a peculiar protobinary system

Beatrice Kulterer

MHO 1+2 is a Class II protobinary located in the Taurus star-forming region. Formed from the same cloud, this system offers us the opportunity to study whether the chemical composition of protoplanetary disks is set by nature or nurture, as two disks born in the same cloud presumably share an initial molecular budget. I will present data from a wideband survey from the Submillimeter Array that reveals a clear chemical differentiation between the two components, which demonstrates that the chemistry in binaries is driven by nurture. In addition, I will discuss data from the Atacama Large Millimeter/submillimeter Array that reveals multiple large-scale structures that could be responsible for the chemical differentiation between the two protoplanetary disks.

Session 4

Isolation of Black-Widow Pulsar J1705−1903

Alex Saffer

Black widow pulsar systems are special binary systems where millisecond pulsars are in a tight orbit with a low mass companion. Gas is often stripped away from the companion leading to various effects with the pulsar signals, such as timing delays. In addition to this, the influence of tidal forces disrupts the orbit itself leading to changes of the model used in the dynamics of the system. PSR J1705−1903 is a millisecond pulsar with an extremely clean pulsar profile that has been used in pulsar timing experiments in both the NANOGrav and MPTA collaborations. However, as a consequence of the complicated dynamic behavior of the system, the requirements for proper timing and modeling of this system require more parameters as the timing baseline is extended. As a consequence, the practicality for including these systems in PTA's is left in doubt. In this talk, I will discuss a way in which these systems might be salvageable for future PTA analyses. The isolation technique involves modeling and removing the timing effects of the binary parameters from the residuals of the pulse, thus effectively "subtracting out" the companion from the system. The goal of this technique is to retain the precision needed for PTA experiments without the complicated modeling and systematics of a binary system.

Prospects of Cyclic Deconvolution in Millisecond Pulsars

Jacob Turner

Cyclic spectroscopy has the potential to revolutionize how pulsar astronomers study the interstellar medium and detect gravitational waves. These benefits are achieved by using the so-called cyclic spectrum to deconvolve the intrinsic pulsar pulse from the impulse response of the interstellar medium, known as the pulse broadening function. Quantifying a given pulsar's likelihood of achieving successful deconvolution can be accomplished via the cyclic figure of merit, which considers source S/N, features intrinsic to a given pulse, and the time-of-arrival delay caused by pulsar emission scattering off of free electrons in the interstellar medium. In this talk, we determine the cyclic figure of merit for 312 pulsars across 15 different telescope and observing frequency combinations in an attempt to quantify which sources and instruments are most suitable for this technique. We then expand this process to a simulated galactic pulsar population and quantify which telescopes may be the best for cyclic spectroscopy once a greater fraction of these sources are discovered.