SFB 1601 Student Seminars – Summer 2025

Date & Time: *30th January, 2026 (Friday), 14:00 - 17:15+*
Venue: Kosma room, Main Physics building, University of Cologne [map]
Social event: *from 17:15*

14:00 - 14:05	Welcome + Introduction	
14:10 - 14:40	The first high frequency Rotation Measure grid along the galactic plane with GLOSTAR	Anahat Cheema (MPIfR)
14:45 - 15:15	The role of massive stars in the cluster expansion phase	Furkan Dincer (Jülich)
Coffee break		
15:30 - 16:00	Large-scale physical and molecular conditions in Cygnus-X clumps	Ivalu Christensen (MPIfR)
16:05 – 16:35	"AG274.0659-1.1488: Probing Shocks in the Vicinity of an AmaSing Hot Core in the Outer Galaxy with ALMA and ATCA"	Eleonore Dann (Ph1)
16:40 - 17:10	Open discussion about the Student Council & its activities + Feedback	
17:15 —	Snacks and Social Event	

Coffee and drinks will be provided during the seminar. You can bring your own cup of coffee.

Abstracts on the next pages.

List of Abstracts

The first high frequency Rotation Measure grid along the galactic plane with GLOSTAR

speaker: Anahat Cheema (MPIfR)

Abstract: The ubiquitous magnetic fields present in the Universe are the key factors influencing the dynamics of the interstellar gas, from the large galactic scales to the small scales towards the sites of star formation. Studying these rather elusive fields is paramount in gaining insight into the structure of galaxies, especially the Milky Way. We aim to investigate the magnetic fields in the highly turbulent plane of our Galaxy. To do so, we use data from the GLObal view on STAR formation (GLOSTAR) survey. The survey observes the first quadrant of the Galactic plane using the Karl G. Jansky Very Large Array and the Effelsberg 100 m telescope, providing an angular resolution down to 1.5" and a sensitivity of ∼ 60-150 μJy beam^−1, within the 4-8 GHz C-frequency band. We construct the very first C-band rotation

measure (RM) grid of the Galactic plane by studying the Faraday effect experienced by the background extragalactic sources. Compared to other contemporary surveys at L and S bands such as MMGPS, POSSUM, and VLASS, our higher frequency coverage attributes to significantly reduced wavelength-dependent depolarization effects from the foreground Galactic turbulence, enabling us to probe through dense and turbulent regions inaccessible by other surveys. This is furthermore complemented with the small channel width in wavelength squared at C-band making it well suited for identifying polarized sources with extreme RMs of upto ∼3 × 10^5 rad m^−2, which would suffer from bandwidth depolarization in lower-frequency surveys.

Within the pilot region of the survey (28°< l < 36°and |b| < 1°), we detected 74 polarized sources, out of which 69 are identified in polarization for the first time. With our current conservative detection threshold, this corresponds to a preliminary RM grid with a source density of approximately 5 RMs per square degree which is ∼ 5 times denser than the current state-of-the-art RM grid on the Galactic plane. After extending the method to encompass the entire GLOSTAR footprint, we will be able to construct a much denser RM grid of the Galactic plane.

The role of massive stars in the cluster expansion phase.

Speaker: Furkan Dincer (Jülich)

Absract: Star clusters and associations are the nurseries for most stars. Especially during the first 10 Myr, these stellar groupings undergo significant changes. Many stars become unbound and some are ejected due to close encounters. The size of the clusters increases considerably. If the clusters have a sufficient number of stars, they are likely to contain massive stars, which may have a significant impact on the other cluster members due to being gravitational foci and their strong irradiation. Individual clusters can show an overabundance or scarcity of massive stars given their total membership. We investigate how much the cluster expansion process itself depends on whether a cluster is rich or poor in massive stars. We setup hundreds of realizations of clusters, drawing the individual stellar masses randomly from the initial mass function and simulate the cluster expansion process after gas expulsion for each of these clusters. Afterwards we compare the expansion history of clusters rich in massive star to those lacking them.

Large-scale physical and molecular conditions in Cygnus-X clumps

Speaker: Ivalu Christensen (MPIfR)

Abstract: The physical state of the interstellar medium (ISM) is essential for understanding the intricate processes involved in massive star formation within galaxies. The nearby (□ ∼ 1.5 kpc) molecular cloud, Cygnus-X, harbors multiples sites of high-mass star-formation, allowing us to probe the various stages as stars form and how the chemistry evolve.

Within the Cygnus Allscale Survey of Chemistry and Dynamical Environments (CASCADE), we aim to explore the large-scale distribution of deuterated molecules in Cygnus-X. A plethora of star-forming clumps are observed with the CASCADE survey, where clumps are believed to evolve from quiescent infrared-dark clouds to high-mass protostellar objects to hot molecular cores to ultra-compact HII regions.

The most active and dense region within Cygnus-X is the DR21 filament, harboring the prominent HII region DR21 Main with the most intense outflow of the Milky Way. The degree of deuteration, □, can significantly enhance over the elemental D/H-ratio (10^−5) depending on physical parameters such as temperature, density, and ionization fraction.

Deuterated molecules and their molecular D/H-ratios are important diagnostic tools to study the physical conditions of star-forming regions.

This thesis focuses on probing the deuterated fractions of Cygnus-X, investigating 67 clumps. Utilizing CASCADE observation of the ubiquitous H2CO complemented with higher *J*-transitions with the APEX telescope, we determine the physical conditions of 67 clumps in Cygnus-X. The methodology of determining the H2 volume density is efficient in probing the bulk of the gas within 0.2 pc of the clumps. With the physical conditions constrained, we model the chemical evolution of these clumps utilizing the plethora of molecules covered with CASCADE, including the 6 deuterated fractions: □(C2D), □(NH2D), □(N2D+), □(DCN), □(DNC), and □(DCO+). We find that the latter two deuterated fractions decrease and increase, respectively, as the clumps evolve and become hotter.

"AG274.0659-1.1488: Probing Shocks in the Vicinity of an AmaSing Hot Core in the Outer Galaxy with ALMA and ATCA"

Speaker: Eleonore Dann

Abstract: The outer Galaxy is a unique laboratory to study star formation in low metallicity environments down to resolutions of hundreds of AU. Due to the lower metallicity the gas cooling is expected to be less efficient, the gas-to-dust ratio increases towards the outer Galaxy and the H2 surface density decreases, for instance. These changes with Galactocentric distance are expected to affect star formation. The recent ALMA large program ALMAGAL (PIs: S. Molinari, P. Schilke, C. Battersby, P. Ho) observed ~1000 high-mass star-forming regions across the Galactic disk with ~100 sources in the outer Galaxy. One of the outer Galaxy ALMAGAL sources, AG274.0659-1.1488, stands out by its number of cores # 20 (Coletta et al. 2025) and chemical richness, containing at least one hot core. We studied the morphology of outflow tracers such as SiO, 13CO and H2CO observed with ALMAGAL in AG274.0659-1.1488. Furthermore, we conducted high-resolution radio continuum and 22 GHz water maser observations with ATCA to probe for feedback. We modelled the positions of the water masers using 2D Gaussians to trace velocity structures. Some positions of the water masers overlap well with the directions of the outflows. Others reveal complex structures. We find four distinct outflows in the star-forming cluster AG274.0659-1.1488 and additional candidates.