The role of accretion and ejection variability in the evolution of young stars and their disks

Workshop at ESO Headquarters
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ESO
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Talk Abstracts and Poster List

List of Speakers

Talk Abstracts

Greg Herczeg

13:45-14:15, Monday 19th May

Invited review talk: Accretion bursts large and small

Laura Venuti

14:15-14:45, Monday 19th May

Invited review talk: Accretion variability and star-disk dynamics in young, low-mass stars

Silvia Alencar

14:45-15:00, Monday 19th May

Back to V2129 Oph: variability in timescales from days to a decade of a classical T Tauri star

V2129 Oph is a well known and often studied K5 classical T Tauri star, that presents a moderate mass accretion rate and a 6.5-day rotational period. It has an octupole+dipole surface magnetic field that was shown to vary over a few years timescale. More than a decade ago, the variability of its hydrogen emission lines was successfully reproduced with radiative transfer models based on the results of magnetospheric accretion from MHD simulations of the star-disk interaction. We came back to V2129 Oph to analyse high-resolution spectropolarimetric and photometric archive data that cover 13 years of observations, from 2005 to 2018, to investigate the variability of the accretion process and its connection with a variable stellar magnetic field. We explored variability timescales that go from days to years to a decade to determine the characteristic timescale of the accretion and outflows processes, of the longitudinal magnetic filed intensity, and the star-disk interaction, and investigate how each process affect each other.

Victor Almendros-Abad

15:00-15:15, Monday 19th May

Tracing disk evolution: The evolution of the mass accretion rate in brown dwarfs and stars

Understanding the physical processes driving the evolution of protoplanetary disks is crucial for unraveling how planets form. A key test of these processes is the relationship between stellar mass (Mstar) and mass accretion rate (Macc) studied across a broad range of stellar masses and ages. We have recently measured the Macc of 32 new brown dwarfs (BDs) and low-mass stars in the Ophiuchus, Cha-I, and Upper Scorpius star-forming regions using X-Shooter/VLT spectra. Combining these measurements with literature data, we found evidence that the Mstar--Macc relationship steepens with time during the early stages of disk evolution (1–3 Myr). At the later stages (5–10 Myr), the trend is less certain because of the limited data available at very low masses (<0.1 Msun). However, the results suggest that the steepening trend observed at the early stages may be consistent with the picture emerging at older ages. These findings indicate that very low-mass stars and BDs may undergo a faster decline of their accretion rates compared to higher-mass stars. Furthermore, we find that BDs consistently exhibit larger Mdisk/Macc ratios than stars across all regions studied (Ophiuchus, Lupus, Cha-I). These results provide important insights into disk evolution that suggest mass-dependent differences in accretion and disk dispersal timescales. In this talk, I will present these results, discuss their implications for our understanding of disk evolution, and highlight the exciting future prospects.

Connor Robinson

15:55-16:15, Monday 19th May

Inivted talk: Determining the impact of accretion on early stellar rotation rates

Initial stellar rotation rates impact planetary evolution by limiting where close-in planets can form and migrate. Young stars rotate slower than one would expect from simple arguments of conservation of angular momentum, likely due to complex interactions between the star, disk, and winds. However, the largest source of stellar torque is currently unclear. Measurements of the co-rotation and magnetospheric truncation radii are needed to infer the torque from accretion. The first is best measured via monitoring campaigns, while the latter is typically inferred via observationally expensive techniques only applicable to a handful of nearby stars. We demonstrate a new approach of applying results from magnetospheric accretion simulations to multi-color light curves to infer truncation and co-rotation radii for many young stars. We used this technique to a sample of stars observed with the LCO network as a proof of concept at visible wavelengths. Encouraged by these results, we applied our method to design a science objective for EVE - the Early eVolution Explorer, a proposed NASA Small Explorer (SMEX) Mission that would obtain month--long simultaneous ultraviolet and optical/NIR light curves for many young stars to learn how they shape the early evolution of planets and their atmospheres. The temporal and color information from EVE will provide a new view of accretion and rotation for young stars that is impossible from current observatories.

Hala Alqubelat

16:15-16:30, Monday 19th May

Spectral Disentangling of the Accreting Binary DQ Tau

DQ Tau is a highly eccentric (e = 0.568), equal-mass binary that exhibits sharp accretion events at periastron passage. The short-period nature of the system (16 days) enables orbital motion to clear a central region around the binary, leading to the formation of up to three accretion disks. The circumbinary accretion streams are strongly influenced by the system's orbital parameters. Using UVES and X-Shooter, we have applied the broadening function (BF) technique to calculate radial velocities (RVs) across multiple epochs over a year. The BF analysis confirms the presence of two RV signatures corresponding to the equal-mass components, as previously reported in the literature. Over multiple epochs, we observe variations in the BF peaks of both components, including changes in height (flux ratio), which depend on their orbital positions. Additionally, these variations provide insights into the veiling effect on both components. We plan to present the results of BF bisector analysis across different epochs and the dependence of RV measurements on wavelength ranges as activity indicators. Furthermore, for the first time, we will demonstrate the results of the spectral disentangling procedure applied to DQ Tau. This allows us to extract individual components' spectrum and estimate the accretion rates at each epoch. I will shortly describe how using the knowledge from this system, we can further explore the possible binarity of other variable accretors such as transition disks.

Marc Audard

16:30-16:45, Monday 19th May

Identifying time-variable young stars in the Milky Way with Big Data

Gaia is a fantastic surveying machine to study the Milky Way thanks to its astrometric, photometric, and spectroscopic capabilities. The Gaia 3rd data release includes close to 10.5 million variable sources (9.5M stars and 1M AGN/quasars). Among the 17 tables for 35 types and sub--types of variable stars in DR3, close to 80'000 young stars are classified as young stellar objects (YSO). I propose to give a summary of our Gaia variability analysis and showcase the power of Gaia in detecting and characterising variable sources, with the focus on the all-sky catalogue of variable YSO; I will indicate new developments anticipated for DR4, in particular for the characterisation of YSO. I will also describe the outcomes of the H2020 project NEMESIS, which employed artificial intelligence methods to interpret the largest, panchromatic Big data collection of young stellar objects. We have compiled data, including variability and binarity, for close to 28 thousands young stars in the Orion Star Forming Complex, based on scientific publications and archival data covering of 3 decades of observations. In addition, a homogeneous all-sky catalogue of 3 million candidate young stars was compiled using data from ground and space missions and deep learning methods, which can serve as input for upcoming surveys of young stars, including variability. Finally we have employed various machine learning supervised and unsupervised techniques to classify the young stars, using different techniques.

Elisabeth Banks

16:45-17:00, Monday 19th May

Large Amplitude 3-5 micron Variability of Dusty YSOs in < 500 pc Distant Star-forming Clouds

Time domain observations with IR space telescopes have demonstrated that many dusty young stellar objects (YSOs) show variability in the 3-5 micron spectral regime. The YSOs include deeply embedded protostars in their primary accretion phase, which cannot be detected at shorter wavelengths, and pre-main sequence stars with disks where the mid-IR traces emission from the inner disk. Building on work in the Orion molecular clouds, we expand our analysis of dusty YSOs to include other nearby star-forming regions. Using archival 3.6 and 4.5 micron observations from the Spitzer cold and warm missions over a 15 year period (2004-2019) in combination with 3.5 and 4.5 micron WISE and NEOWISE data over a 14 year period (2010-2024), we extract 20 years' worth of light curves for all dusty YSOs observed by multi-epoch observations with Spitzer and WISE in star-forming clouds within 500 parsecs. These are the Orion A and B, Ophiuchus, Perseus, Chameleon, Corona Australis, and Aquila clouds. We focus on YSOs whose light curves show large amplitude variability; i.e., those which display a change of at least one magnitude in either of the filters. Such variations can indicate significant changes in the accretion rate. After presenting the sample of such YSOs and a preliminary analysis of their properties, we provide an initial assessment of the incidence of large amplitude variability and its importance for the mass assembly of stars.

Jeffrey Bary

17:00-17:15, Monday 19th May

Disentangling the Signatures of Cool Starspots from Near-Infrared Accretion Diagnostics

Accurate estimates of accretion activity and its variability in pre-main sequence (PMS) stars rely on our ability to constrain both the fundamental parameters of the central stars and the activity level of the stellar surface. Optical-Near Infrared (NIR) spectra of these systems are a complex synthesis of multiple emission components associated with the stellar photospheres and chromospheres, stellar and disk winds, and circumstellar disks. Therefore, quantifying the spectral contributions from any of these processes requires us to disentangle the multicomponent emission. Here we present results from spectral modeling of accreting and non-accreting PMS stars. We find the spectra to be best fit by two-temperature spotted star models with spot filling factors ranging between 0.4 and 0.9 with median spot temperatures 1000 K cooler than the photosphere. Such results have significant impacts on measurements of effective temperatures, which in turn alter the masses, ages, and inferred mass accretion rates. The inclusion of spots in NIR spectral models of accreting stars obviates the need for any additional components of warm continuum emission in the IYJ region. For several accreting sources, we quantify the variability of the excess accretion continuum over an entire stellar rotation, finding evidence for significant variations in the veiling correlated with the stellar rotation in the most heavily spotted, accreting systems.

Dominika Itrich

09:00-09:15, Tuesday 20th May

Investigation of the accretion variability in the early stages of YSO evolution

Accretion of the matter onto young stellar objects (YSOs) is one of the most important characteristics of these objects. This not only determines the evolution of the future star, but also its disk and forming there planets. While pre-main sequence stars have relatively well characterised accretion activity, protostars still lacks deep understanding, mostly due to their embedded nature hindering observational investigations. Here, we present preliminary results of the near-IR spectroscopic survey of Class I, flat-spectrum, and Class II YSOs in the Taurus star-forming region carried out as part of the "Alien Earths" NASA ICAR programme. We employ LBT/LUCI and MMT/MMIRS H+K band observations to infer the properties of central objects and derive their accretion luminosities and mass accretion rates based on the Brg emission line. We show for the first time the multi-epoch accretion measurements of the famous HL Tau from the moderate-resolution LUCI spectra. We investigate the change in line profiles of the Brackett series lines, estimated from them the accretion rates, and compare these to the change in emission of H2 and [FeII] lines, tracers of outflows and jets. We conclude reporting the status of the program and showing other interesting cases from our study.

Michael Cecil

09:15-09:30, Tuesday 20th May

Evolution of the inner protoplanetary disk undergoing episodic accretion

The inner regions of protoplanetary disks are prone to various instabilities that can significantly impact the thermal and dynamical structure of planet-forming regions. 2D axisymmetric simulations of the inner disk provide essential insights into its vertical structure and evolution influenced by recurring instabilities. Our radiation hydrodynamic models combine vertical and radial radiation transport and the resolution of the inner dust rim with the transition from an inner, highly turbulent disk to the weakly viscous dead zone. The time-dependent evolution reveals periodically occurring instability by activating the magnetorotational instability (MRI) in the dead zone, resulting in episodic accretion outbursts. I will discuss the onset and evolution of the instability, the effects of outbursts on the density- and pressure structure of the inner disk, the importance of opacity considerations, and the peculiarities and modulation of the accretion rate due to MRI activation. Our models show the formation of pressure maxima at distances of up to 1 AU from the central T Tauri star, indicating locations of favourable conditions for planetesimal formation. On the other hand, stable pressure maxima present during quiescent phases at the inner edge of the dead zone are destroyed by the instability. These models illuminate vital aspects of the inner disk evolution during and after accretion events and can incentivise further theoretical and observational investigations.

Andrea Banzatti

09:30-10:00, Tuesday 20th May

Invited review talk: The role of accretion variability on the chemical evolution of inner disks

Lavinia Delfini

10:00-10:15, Tuesday 20th May

All-sky view of YSO accretion in the Solar Neighbourhood with Gaia DR3 XP spectra

The XP spectra published in the Gaia Data Release 3 offer a novel tool for the study of accretion in the Galaxy. We present the first all-sky homogeneous analysis of YSO accretion properties in the Solar neighbourhood. This analysis was performed by characterising the H-alpha emission line of YSOs within 500 pc as traced by the XP spectra. The result of this analysis is a catalogue with estimations of accretion luminosities and mass accretion rates, together with stellar parameters, for almost 150 thousand YSO-like H-alpha emitters all-sky. This new catalogue significantly increases the number of YSOs with accretion rate estimations in the local neighbourhood, allowing us to study accretion timescales and the spatial and physical properties of YSO accretion from a large, all-sky, and homogeneous sample for the first time. We will show some example uses of this new all-sky homogeneous catalogue: 1) Selecting YSO populations still uncharacterized; 2) Re-evaluating the correlations between accretion properties and stellar parameters; 3) Characterising the exponential decay of accretion with time in the Sco-Cen complex, and calculating the accretion timescale. This catalogue also permits studies of long-term accretion variability when compared to previous surveys. Additionally, the techniques and results presented here anticipate Gaia DR4, where all the XP spectra from individual Gaia epochs will be published, permitting short-term accretion variability studies.

Aurora Sicilia-Aguilar

10:15-10:35, Tuesday 20th May

Inivted talk: "Using time to map space": How variability unveils small scales in young stars and their disks

The star-disk connection is key for the formation of stars and planets, but its few-stellar-radii to sub-au scales makes it hard to image. "Using time to map space" is the only feasible method to study statistically significant numbers of sources in all stellar masses. I discuss what can be achieved by time-resolved spectroscopy and photometry, and the tools we have developed to optimise this analysis. STAR-MELT focuses on time-resolved spectra. "Reading between the (spectral) lines" of young stars unveils the location of the post-shock regions and footprints of accretion. We find stable (often, for years) and unstable accretion, non-axisymmetric infall and winds, and differences in the accretion structures and the star-disk connection that may be behind outbursts. The North-PHASE Legacy Survey is tracking 6 clusters in 6 bands, via time-resolved photometry for thousands of stars with masses down to 0.3 Msun, distributed over an area over 50 times the size of the full Moon. Observations will continue until 2028, but the results so far show that stable accretion structures are more common than expected, and unveil the complex and interactive history of star-forming regions behind young proper motion outliers missed by Gaia. The capabilities of time-resolved data increase as we gather more observations, its power expanding from the inner disk outwards in time, as long as we develop the tools to compile, combine, and analyse such complex and varied datasets.

Vardan Elbakyan

11:15-11:30, Tuesday 20th May

Episodic Accretion in High-Mass Stars: Mechanisms and Observational Implications

High-mass young stellar objects (HMYSOs) exhibit episodic accretion bursts that significantly influence their evolution and feedback on their surroundings. Recent advancements in numerical simulations and observations have uncovered diverse mechanisms driving these bursts, ranging from thermal instabilities (TI) and magnetorotational instabilities (MRI) to gravitational fragmentation and planet disruption events. In this talk, I will present a synthesis of results from 1D and 3D simulations, highlighting the role of TI in shaping long-duration bursts and the critical contribution of planet disruption in explaining short, intense bursts observed in HMYSOs. I will discuss how accretion bursts impact circumstellar disc dynamics, stellar evolution, and feedback processes, including episodic outflows and ionizing radiation. Furthermore, I will address the limitations of current models in reproducing the full spectrum of observed bursts and outline future directions, including multi-dimensional modeling and improved observational constraints, to bridge the gap between theory and observations. This exploration provides new insights into the episodic nature of accretion across stellar masses, with implications for star formation and the evolution of protoplanetary environments.

Aaron Empey

11:30-11:45, Tuesday 20th May

Investigating YSO Dippers with XShooter

The dipper subclass of YSOs are characterised by frequent dips in their light curves. Predicted to account for around 30% of classical t-tauri stars their unique behaviour ranges in the timescale but also level of periodicity exhibited and dip strengths. Certain targets exhibit irregular patterns on short time scales (a few days) with dips accounting for up to 50% of the photospheric flux.

Although the origin of their variability is a matter of debate, the driving mechanism is likely related to short term changes in the local dust extinction. Characterisation of the dust grains and their evolution provides interesting insights into the complex inner region of protoplanetary discs. We present the first multi-epoch survey of 16 irregular dippers from Upper Scorpius, observed with XShooter. Analysis of the variability of the continua, photospheric lines, and Gaia photometry confirm the observed dips are not due to changes in accretion nor stellar spots, but from dust sourced from the inner disc region. Comparison with dust opacity models suggest substructures composed of processed grains, with maximum sizes up to tens of microns, and that the effects of scattering by grains can be significant. The attributed dust size distributions show varying properties amongst dips of certain targets, suggesting multiple or changing substructures. Within this context the origin of this dust and the possible lifting mechanisms, including disc winds, warps and accretion columns, are explored.

Ruhee Kahar

11:45-12:00, Tuesday 20th May

What Time Can Tell Us About Space: A Study of Variability in Young Stellar Objects

Time resolved data are a powerful tool to investigate spatial scales well beyond the range of direct imaging. I study time variability of accretion-related lines and photometry (from the North PHASE Legacy Survey) for young intermediate-mass stars. North-PHASE investigates stellar variability on timescales from days to years for thousands of young stars. We also use Gaia to study the star formation history of the North-PHASE region. HAeBe and massive T Tauri stars have well-known protoplanetary discs, and evidence of extinction by circumstellar material. Emission and absorption lines (including metallic ones) display broad and narrow components, like what is found in lower-mass stars. Line velocity and relative intensity distinguish between different processes. The high-resolution time-resolved spectra assist us in distinguishing rotational modulation from accretion variations. North-PHASE covers NGC 2264 with broad- and narrow- band photometric filters. We use variability indices to detect different types of variable stars. With Gaia we explore the subcluster structure and using the variability of the sources we complete the results by finding YSO with anomalous proper motions, missed by Gaia. The study unveils a diverse variable star population, revealing the true kinematics of the entire population.

Cristiano Longarini

13:30-13:45, Tuesday 20th May

Measuring secular accretion rate variability through alpha viscosity

In the classical theory of protoplanetary disc evolution, the efficiency of angular momentum transport, encapsulated in the alpha parameter, is directly related to the accretion rate. Leveraging the data from the exoALMA large program, we model rotation curves to get the disc parameters that, combined with the measured accretion rates, provide an estimate of the alpha viscosity. We observe that alpha spans several order of magnitudes, with no discernible correlation to key disc parameters. A possible way to interpret this scatter is secular accretion rate variability, occurring on timescales longer than human observational windows but shorter than viscous timescales. In this talk I will present this interpretation, and show that the expected variability is in line with the well known accretion rate - disc mass correlation

Foteini Lykou

13:45-14:00, Tuesday 20th May

Dissecting the eruptive star variable Z CMa with mid-infrared interferometry

Young stellar objects showcase various flavours of spectroscopic and photometric variability, with the most common instigator being changes in mass accretion. Such changes are thought to affect their parent protoplanetary disks, in particular their structure, chemistry, and capability to form planets. The variabilities are not always periodic and can thus be unpredictable. Considering that most stars are born in binaries, orbital motion may add even more complexity in how the individual stars evolve and how their parent disks change. One such complex system, is the eruptive binary system Z CMa that is composed of an intermediate-mass Herbig Ae star and a low-mass Fuor-type companion, both of which are variable with photometric records of the system spanning nearly one century. In this talk, I will present the first-ever spatially resolved images of the two individual disks of Z CMa in the mid-infrared (MIR) with the new interferometric imaging instrument MATISSE/VLTI. By happenstance the MATISSE observations were obtained both during quiescence and during Z CMa's serendipitous great outburst of 2023. I will show differences and/or similarities of the MIR emitting regions of the two disks during that timeframe, both in the dust continuum as well as in gaseous signatures, and showcase how MIR interferometry can provide significant inputs on the chemistry and structure of the disks, that can later be used as signposts for theoretical works.

Lara Piscarreta

14:00-14:15, Tuesday 20th May

Unveiling the impact of accretion in pre-main sequence population studies: the case of Orion

Observations suggest that the protoplanetary disk frequency around pre-main sequence (PMS) stars in nearby star-forming regions declines rapidly with cluster age, indicating characteristic disk lifetimes of a few Myrs. This timescale sets an upper limit on planet formation and implies efficient disk dispersal and rapid planet growth. However, some members of the Orion Nebula, exhibiting infrared excess and strong Halpha emission (probing accretion), appear anomalously old (10 Myr) in the color-magnitude diagram (CMD). We performed a detailed spectroscopic analysis using ESO/X-Shooter and derived stellar properties (Teff, Av, L), accretion parameters (Lacc, mass accretion rate), and age indicators (lithium equivalent-width) for PMS stars spanning isochronal ages from 1 to >10 Myr. Once extinction and accretion effects are properly taken into account, their positions on the HR diagram is consistent with a young population (1-5Myr). This is supported by strong lithium absorption and typical Lacc/Lstar ratios expected for young, accreting stars. Preliminary results indicate that the location of PMS stars on an optical CMD is strongly influenced by veiling and accretion properties, with the seemingly old stars showing systematically higher accretion luminosities. Our findings highlight the impact of accretion on the photometric properties of PMS stars, stressing its importance when interpreting optical CMDs.

Caeley Pittman

14:15-14:30, Tuesday 20th May

Magnetospheric accretion variability in the ULLYSES sample

Accretion signatures are strongest in the UV, but previous work has been limited to small sample sizes due to the faintness of TTS. The HST ULLYSES program produced the largest and most consistently-processed UV dataset to date. Combined with contemporaneous observations and stellar parameter measurements from ODYSSEUS, PENELLOPE, and TESS, we have characterized the accretion region sizes, inclinations, accretion rates, hotspot structure, and accretion stability regimes for 71 CTTS. I will present the following: 1) Accretion shock models detect signatures of rotational modulation of accretion rates and hotspot surface coverage, showing that the high--energy radiation received at a given point in the disk varies with stellar rotation. 2) Multi-epoch accretion flow modeling of H-alpha profiles shows that individual CTTS traverse the boundaries between propeller, stable, and unstable accretion regimes over time. We will discuss correlations with outflow signatures. 3) TESS light curve analysis indicates that CTTS in the propeller regime are more likely to show stochastic rather than periodic variability, and they are more likely to be dippers than symmetric variables or bursters. These results demonstrate that the variability associated with accretion is tied to stellar rotation, changes in the magnetosphere-inner disk connection, and the relationship between the corotation and magnetospheric truncation radii. Additional studies are necessary to further disentangle these effects.

Kim Pouilly

14:30-14:45, Tuesday 20th May

A multi-kiloGauss field driving the accretion in EX Lupi: The EXors bursts mystery finally solved ?

In this work we will present the first ever magnetic field analysis of EX Lupi, the prototypical EX-or-type star. These objects are classical T Tauri stars, supposedly accreting from the disk through magnetospheric accretion. The strong magnetic field of the star truncates the disc at a few stellar radii and force the disc's material to leave its plan to freefall onto the star following the magnetic field lines. The particularity of EXors is that they show bursts and outbursts events ascribed to episodic accretion. These events produce luminosity increase of 1-5 magnitude in the optical frame lasting for a few months to a few years and can occur repeatedly. The aim of this study is to investigate the connection between accretion, eruptive events, and the magnetic field of EXors. To do so, we analyse a unique dataset of ESPaDOnS and SPIRou high-resolution spectropolarimetric spectra, to study the accretion process along the stellar rotation cycle, together with its large- and small-scale magnetic field configuration. This work is the first joint analysis of the magnetic field and accretion process for an EXor-type star. The impact of the magnetic field in the episodic accretion of EX Lupi will be discussed in this contribution.

Gabriella Zsidi

14:45-15:05, Tuesday 20th May

Inivted talk: High- and low-mass star formation through the eyes of time-series photometry and spectroscopy

Long-term, high-quality time-series observations have revolutionized our understanding of star formation, uncovering its complex and dynamic nature. Over a decade of infrared monitoring from the VVV/X survey has significantly contributed to disentangling the complex variability of YSOs. By identifying nearly 200 massive YSOs within the VVV/X dataset, leveraging previous results from the RMS survey, we found that a substantial fraction of massive YSOs show significant variability on long timescales (years). These variations suggest that interactions with the disk strongly influence the system luminosity despite the high luminosity of the central star. In addition to these long-term datasets, high-cadence photometric and spectroscopic monitoring observations provide complementary insights into how the early stages of stellar evolution are shaped by the interaction between the central star and its circumstellar environment. Drawing on observations from cutting-edge facilities such as TESS, Kepler, or the VLT, I will also present detailed insights into the accretion processes of individual low-mass YSOs and discuss their photometric and spectroscopic variability, shedding light on the dynamic processes shaping star and planet formation.

Koshvendra Singh

15:45-16:00, Tuesday 20th May

Modeling the Accretion Hotspot: Understanding the Accretion Morphology of Low-Mass Young Stars.

Low-mass young stars undergo magnetospheric accretion where disk matter follows stellar magnetic field lines and freely falls on the star creating a shock-heated region with 10000K temperature, called a hotspot. This hotspot can be regarded as a 2-dimensional (2D) slice of a 3D accretion structure at the stellar surface. It carries imprints of the accretion morphology and variable accretion dynamics (Espaillat et al. 2021, Singh et al.2024). However, the thermal and spatial structure of the hotspot is not well understood. In this talk, I will present our recent work on an empirical modeling of the thermal-spatial structure of the hotspot. We modeled the thermal profile along the two angular spherical coordinates by empirical symmetric functions, motivated by the results of sophisticated 3D MHD simulations from Kulkarni and Romanova 2013. The model produces observables as time lag among lightcurves, indicating the temperature distribution in hotspots, peak-to-peak lightcurve amplitudes, reflecting temperature ranges in it, as well as mass-accretion rate. We fit our model onto the observations of the dynamically and morphologically evolving hotspot of a young star named EX Lupi, during its outburst in March 2022 (Singh et al.2025, in prep.). The model fitting on the observation enhances our understanding of accretion-outflow balance at the inner disk and how accretion morphology transforms with accretion-variability.

Alana Sousa

16:00-16:15, Tuesday 20th May

Accretion Dynamics of Young Stars: Insights from NIR Line Analysis of Class I and Class II Targets

Accreting T Tauri stars exhibit spectroscopic variability across a wide range of timescales, ranging from seconds to decades, which can be attributed to di erent physical phenomena related to the accretion and ejection processes. The observed variability provides valuable insights into the underlying processes occurring within the circumstellar environment. Our study focuses on young stars observed with SPIRou/CFHT: 15 Class II stars from the SLS consortium and 15 Class I stars from the PROMETHEE project. We will present our analysis of the variability patterns of the HeI (10830Ang), Pa , and Br lines in this sample of accreting young stars and highlight the di erences in accretion and ejection properties between the Class I and Class II objects. The analysis involves characterizing the average profile shapes and their variance over timescales ranging from days to months. We perform a periodogram analysis on the velocity channels of the line profile and investigate potential correlations between accretion and ejection phenomena. Special attention is given to the potential evolution of accretion and/or ejection processes, with the Class II sample also explored on longer timescales of a few years. Our results are discussed within the framework of magnetospheric accretion theories for both object classes.

Leonardo Testi

16:15-16:30, Tuesday 20th May

The transition from accretion to protestar dominated luminosity in Class I YSOs

Measuring accretion in the initial phases of YSO evolution is critical to understand the subsequent evolution of the young star, the assembly and properties of the disk, and the first steps of planet formation. As part of the ECOGAL project, we have been comparing observations of accretion luminosity in Class I YSOs in Taurus and Ophichus with high-resolution numerical simulations of star formation. We derive the source accretion luminosities from the analysis of Brgamma, Pfgamma, Bralpha hydrogen recombination lines, using a calibration based on class II YSOs. We find that the data are broadly consistent with the prediction from our numerical simulations, with the overall YSO luminosity dominated by the accretion luminosity (and its variability) for most of the main accretion phase, the protostar intrinsic luminosity starts to dominate the overall luminosity output from the inner star/disk system towards the end of the class I phase. Our results support the conclusion that the disk temperature structure in the protostellar stage is determined by the accretion luminosity.

Verena Wolf

09:00-09:15, Wednesday 21st May

Time-dependent radiative transfer modeling of outbursts of massive YSOs

For massive YSOs (MYSOs, with M* > 8 Msun) only a handful of accretion outbursts have been observed so far. MYSOs are deeply embedded throughout their entire formation epoch. Therefore, those events are only visible in the infrared (IR). The bulk of their luminosity stems from reprocessed protostellar emission, radiated away as thermal dust continuum. Time-dependent radiative transfer (TDRT) allows us to simulate the propagation of the heatwave caused by the burst within the dusty environment of the MYSO. Its imprint in the emergent SED depends on the dust, the geometry, and the burst history. We compare TDRT models with IR observations for obtaining more reliable estimates of the burst energy. This will help to distinguish between different burst triggering mechanisms. The results for two MYSOs with different viewing geometry will be discussed. TDRT also allows one to study other processes in the circumstellar environment, e.g. the excitation of masers.

Geoffroy Lesur

09:15-09:45, Wednesday 21st May

Invited review talk: Gone with the Wind: The migration of Giant Planets in Windy Disks

Catherine Dougados

09:45-10:15, Wednesday 21st May

Invited review talk: The accretion-outflow connexion

Aisling Murphy

10:15-10:35, Wednesday 21st May

Inivted talk: Knot so fast! Investigating jet variability with integral field spectroscopy

High-resolution studies of young stellar jets at optical-NIR and sub-mm wavelengths have revealed the presence of small-scale structures within the jet close to the driving protostar. These include knots and fast shocks related to variability in the outflow mass and velocity, and smal-l-scale wiggling of the jet trajectory which may point to a massive companion within the inner disk. I will present results from optical-NIR observations of these small-scale structures using VLT/MUSE, and discuss what the variability of the jet may be able to tell us about its connection both to the young star and the inner circumstellar disk.

Antonio Armeni

11:15-11:30, Wednesday 21st May

Structure of the accretion flow and jet of RU Lup from spectroscopic monitoring

Classical T Tauri stars accrete material from a circumstellar disk through magnetic fields. However, the physics regulating the processes in the inner (0.1 AU) disk is still not well understood. With its long observational history and its rich emission line spectrum, RU Lup is a prime example to study this environment. Optical spectroscopic observations with CHIRON and ESPRESSO were obtained simultaneously with the two epochs of the ULLYSES monitoring of RU Lup. In this talk, I will discuss the main results obtained by analyzing this collection of data. The rich emission line spectrum of RU Lup allowed us to study the accretion hot spot and the circumstellar environment of the star. We detected a periodic modulation in the narrow component of the He I 5876 emission line with a period that is compatible with the stellar rotation period, indicating the presence of a compact region on the stellar surface that we identified as the footprint of the magnetic field. Using the time variability of the broad component of selected emission lines, we showed that the accretion flow is temperature-stratified and non-axisymmetric. In addition, we identified a structure of three discrete absorption components (DACs) in the blue wings of the Ca II H & K and Na I D lines. A comparison with the profiles of the forbidden emission lines suggests that these absorption components are formed in a series of knots in the jet. These DACs might trace the ionization structure of the outflow.

Naman Bajaj

11:30-11:45, Wednesday 21st May

The Wind-Jet-Accretion Connection: Insights from Spatially Resolved Jets and Winds with JWST

We may be on the brink of a paradigm shift in understanding how protoplanetary disks accrete, with MHD disk winds emerging as the primary mechanism for angular momentum removal. To investigate this, we present JWST NIRSpec spectro-imaging of jets and winds from one Class I and three Class II edge-on disks. These observations resolve bipolar jets in over 30 shock-excited forbidden lines, accompanied by H winds in all sources. We find that the narrow [Fe II] jets are consistently nested within wider, hollow H wind cones, a hallmark of MHD disk winds in Class II systems with dissipated envelopes. For these highly inclined disks, accretion rates estimated from near-IR hydrogen recombination lines are underestimated by over two orders of magnitude due to extinction. Instead, we find accretion rates calculated as 10 times jet mass loss rates to be consistent with similar stars in the Taurus star-forming region. We derive the key jet properties, including pre-shock density, shock velocity, ionization fraction, pixel-by-pixel electron density, and extinction maps to probe the jet launch and excitation mechanisms. Finally, we compare wind mass loss rates from H lines with contemporaneously derived accretion rates to test the disk-wind-driven accretion paradigm. This work highlights JWST's transformative ability to resolve protostellar outflows and offers critical insights into the interplay of accretion and ejection in young stellar systems.

Shridharan Baskaran

11:45-12:00, Wednesday 21st May

A New Look at Protoplanetary Disk Accretion: Mid-Infrared HI line analysis with JWST/MIRI

The balance between accretion and ejection in protoplanetary disks critically regulates disk dispersal and, in the end, mass available for planet formation. Traditional optical and near-infrared (NIR) hydrogen lines have been used to estimate accretion in young stellar objects (YSOs), but their use can be hindered by high extinction and contamination from winds and jets, to an extent. We present a comprehensive analysis of over 80 JWST/MIRI archival spectra of Class II disks, focusing on mid-infrared (MIR) hydrogen emission lines (Nup = 6–14). Leveraging MIRI's exceptional sensitivity and broad wavelength coverage (5–28 μm), we identify specific MIR HI lines that serve as reliable accretion indicators. We address molecular contamination affecting these lines and provide methods to mitigate it. Our study introduces new empirical relations to convert MIR HI line luminosity into accretion luminosity, facilitating accurate accretion rate estimates directly from JWST/MIRI spectra—especially for highly embedded sources. Furthermore, we demonstrate how MIR HI lines, analyzed with Kwan & Fischer (2011) models, offer improved insights into the physical conditions of accretion columns. By connecting mass accretion and ejection rates using fine-structure lines such as [NeII], [FeII], and [ArII] lines from MIRI, this work can advance our understanding of disk evolution in Class II YSOs, providing a more complete framework for planet formation.

Seok-Jun Chang

12:00-12:15, Wednesday 21st May

First detection and modeling spatially extended Ly in T-Tauri star TW Hya

UV radiation plays a crucial role in investigating the chemical composition of the protoplanetary disk since this UV radiation photodissociates molecules and pumps molecules. Hydrogen Lyman-(Ly) is one of the prominent UV emission lines in T-Tauri stars, with its resonance nature imprinting the physical properties of atomic hydrogen on Ly observables. However, uncertainties arise due to the presence of dusty protoplanetary disks and optically thick accretion flows, questioning whether Ly radiation from the central star reaches the disk & wind and influences their chemical composition. In this talk, I present spatially resolved Ly emission across a protoplanetary disk in face-on T-Tauri star TW Hya, observed with HST-STIS. The observation reveals spatial extension over ~50 AU, with a Ly spectrum showing a doublet-peaked profile and an enhanced red peak. To comprehensively interpret spatially extended Ly, a 3D Monte-Carlo radiative transfer simulation named 'RT-scat' is utilized. Modeling Ly through this code allows constraints on the physical properties of the neutral hydrogen in the wind and disk. Understanding the role of Ly emission in T-Tauri stars is pivotal for decoding the complex interactions between UV radiation and gas, which can significantly impact the chemistry in the protoplanetary disk. Our observation and modeling of Ly in TW Hya show the necessity of spatially resolved Ly observation of a broad range of targets.

Joel Sanchez

13:30-13:45, Wednesday 21st May

The time-variable inner disk structure of YSOs revealed by GRAVITY-VLTI

The inner few astronomical units of protoplanetary disks are a crucible of star and planet formation, where accretion, ejection, and the evolution of disk structure are intimately linked. In this talk, we will present high-angular resolution (0.1 - 5 au) near-infrared interferometric observations of three Herbig AeBe stars obtained with GRAVITY at the Very Large Telescope Interferometer (VLTI): HD163296, HD98922, and R CrA. These observations enable us to uniquely probe at sub-AU scales the K-band continuum and the BrG line-forming region to investigate the dynamics of the inner disk regions. Our results favors the presence of month-scale time-variable azimuthal asymmetries at the inner dusty rim, which provide crucial insights into the physical processes governing disk evolution. Such asymmetries may arise from various mechanisms, including local scale-heightvariations, asymmetric dust distribution, or vortex formation. We will also showcase results of how multiplicity plays a crucial role in the evolution of the disks by potentially splitting the inner disk from the outer one, affecting the launching mechanisms of jets and outflows. Finally, we will discuss the importance of expanding the current survey and the key role of the new capabilities of GRAVITY+ for those studies.

Karine Perraut

13:45-14:00, Wednesday 21st May

Towards daily monitoring of accretion-ejection processes at sub-au scale in T Tauris

On a scale of a few stellar radii, the innermost regions of T Tauri stars hold the keys to the magnetospheric accretion process and associated outflows. As brilliantly demonstrated by VLTI/GRAVITY, such scales are probed by near-infrared spectro-interferometry (Bouvier+2020, GRAVITY Coll. 2023, 2024). With GRAVITY we spatially resolved the Hydrogen I Br_gamma emitting region in a few T Tauri stars. When directly comparing these measurements to radiative transfer models including magnetospheric accretion and a disk wind, these sizes are in full agreement with the magnetospheric accretion scenario for low accretors, while strong accretors must generally account for the presence of a resolved disk wind component at/beyond the corotation radius to explain the interferometric data. For these strong accretors, we gain insight into these processes by combining near-infrared interferometry with complementary observing techniques over a wide wavelength range, notably with optical spectro-polarimetry to measure the intensity and topology of the surface magnetic field and study the star-disk interaction region. We obtain recent results on the strong accretors S CrA N and RU Lup. They provide a first glance at the exciting perspective brought by VLTI/GRAVITY+ that will allow daily monitoring of a large sample of T Tauris, opening the way to the characterization of the structure and dynamics of accretion/ejection processes in their innermost regions to an unprecedented degree.

Guillaume Bourdarot

14:00-14:15, Wednesday 21st May

Variable and embedded: a new avenue for accretion studies at sub-astronomical scales with GRAVITY+

Direct observation of the inner disks of young stars at (sub-)astronomical scales provide key insights on the variability and accretion mechanisms in these objects. VLTI/GRAVITY now allows statistical studies at these spatial scales in Herbig and classical T-Tauri stars. A big step forward is the implementation of novel instrument techniques, in particular with GRAVITY+, bringing order of magnitude improvements in terms of sensitivity and accuracy compared to existing observations. In this talk, we will present the first observations of two iconic systems for accretion studies: DQ Tau and HL Tau. DQ Tau is known to display a periodic accretion flare activity which coincides with the periastron of its inner binary. In 2024, DQ Tau was monitored over an entire accretion flare through a dedicated program with VLTI/GRAVITY, which allow to temporally and spatially resolve the dynamic of the flare with a ~day sampling. New astrometry measurements provide the most accurate determination of the orbit, dynamical mass, and inclination of the binary with the exquisite <100µas accuracy of GRAVITY. In the second part, using GRAVITY+, we present the first observations of the inner disk of HL Tau at sub-astronomical scales and resolved observations of the magnetospheric accretion region. We will present the implications of the latter in terms of accretion, and the comparison with large-scale disk structures as seen by ALMA.

Francesca Bacciotti

14:15-14:35, Wednesday 21st May

Inivted talk: Layered molecular outflows and their link with structured protoplanetary disks: the case of HL Tau.

Layered molecular CO winds arranged in a series of nested coaxial shells have been detected with ALMA in an increasing number of young systems. At the same time, we are faced with the interpretation of the spectacular ring/gap substructure detected in protoplanetary disks. The question arises whether there is a possible dynamical relationship between the structures observed in the two cases. In this context, HL Tau, the iconic young star first discovered to possess a disk with a ring-like substructure, presents itself as the ideal example for conducting such an exploration. Thanks to observations made as part of the ALMA-DOT project, we found that the molecular CO outflow shows nested and rotating shells with decreasing velocity toward the outermost layers, compatible with an interpretation in terms of extended magnetized disk wind. In this scenario, the three outermost shells have launch radii between 50 and 90 au from the star, at positions coincident with rings of higher gas density in the disk. We also derived a wind magnetic lever arm of about 4-5, which is higher than that commonly adopted for magnetically driven winds from these regions. In this talk I will discuss the implications of the results collected in the HL Tau case and other similar sources for our understanding of the physical properties of the outer disk, which are crucial for establishing the initial conditions for planet formation.

Matt Kalscheur

14:35-14:50, Wednesday 21st May

Observations of H2 in T Tauri Star Disk Winds

We present the results of a recent investigation of the kinematic properties of fluorescent H2 emission lines in the FUV spectra of 36 T Tauri stars observed primarily via Hubble Space Telescope's ULLYSES program. We fit co-added line profiles from four fluorescent progressions ([v',J'] = [1,4], [1,7], [0,2], and [3,16]) with one or two Gaussian components, as is done for [O I] wind studies. Of the high S/N line profiles (S/N ≥ 12 per resolution element at the peak of the profile), over half are best fit with a combination of a broad and narrow Gaussian component. For profiles of the [1,4] and [1,7] progressions, we find a systematic blue-shift of a few km s-1 between the broad and narrow centroid velocities and stellar radial velocities. For the [0,2] progression, we find centroid velocities consistently blueshifted with respect to stellar radial velocities on the order of -5 km s-1 for the single and narrow components, and -10 km s-1 for the broad components. The observed blue-shifts suggest that the molecular gas traces an outflow from a disk wind in some sources, and not solely disk gas in Keplerian rotation. To investigate potential timescale variability, we further compare how the line profiles change in 11 T Tauri sources with HST-COS FUV spectra recorded in similar observing modes months or years apart.

Giancarlo Mattia

14:50-15:05, Wednesday 21st May

Non-ideal processes in astrophysical jets

We performed non-ideal Magnetohydrodynamic simulations, in order to investigate how the mean--field dynamo and the magnetic diffusivity affect the disk and jet properties. At first we investigated a disk dynamo that follows analytical solutions of the mean-field dynamo theory, essentially based mainly on the Coriolis number. We thereby confirmed the anisotropy of the dynamo tensor acting in accretion disks, allowing both the resistivity and mean-field dynamo to be related to the disk turbulence. Then, we studied the feedback of the generated magnetic field on the mean-field dynamo. We found that a stronger quenching of the dynamo leads to a saturation of the magnetic field at a lower disk magnetization. Finally, we present a more consistent feedback model which encompasses a quenching of the magnetic diffusivity. We find strong intermittent periods of flaring and knot ejection for low Coriolis numbers. In particular, flux ropes are built up and advected towards the inner disk, thereby cutting off the inner disk wind, leading to magnetic field reversals, reconnection, and the emergence of intermittent flares.

Noah Otten

15:45-16:00, Wednesday 21st May

Variability in the Low Velocity Component in the Optical FELs of DG Tau

Here I present the kinematic and spectro-astrometric analysis of the different velocity components observed in the [O I] 6300 and [S II] 6731 forbidden emission lines (FELs) in three epochs of spectra from the classical T Tauri star DG Tau spanning ≈ 20 years in time. DG Tau is a well known source that has a variable jet/High Velocity Component (HVC) that has been significantly decreasing in radial velocity over the ≈ 20 years that our data spans. While the Low Velocity Component (LVC) also shows some variability over this same period of time, our study reveals that it behaves differently to the HVC which hint at key information about the origin of the LVC. In this talk, I will discuss the significance of the results for DG Tau and how this approach could be applied to other sources to test what variability can reveal about the origin of the LVC.

Aparna Unni

16:00-16:15, Wednesday 21st May

Variability of the HH 46/47 jet axis

The jets driven by young stars are observed to be variable with this manifesting as changes in the frequency and velocity at which knots are ejected and in the position of the jet axis. Many jets are known to show periodic variations in their jet axis or wiggling and this variability could be caused by a close unresolved companion. Such companions have also been flagged as a possible explanation for accretion bursts. In this presentation I will focus on the wiggling of the jet from the class I young star HH 46/47. It has a complicated morphology and shows significant bending or wiggling which could be caused by a close companion. The goal of the study is to map both lobes of the jet axis as close as possible to the driving source and to use models to assess if the presence of a companion best explains the morphology. JWST/MIRI observations taken as part of PROJECT-J revealed both lobes of the outflow to within 90 au of the driving source for the first time and are analysed here. As well as modelling to fit the wiggling of the jets, spectro-astrometry is also investigated as means for revealing a close companion.

Hans Zinnecker

16:15-16:30, Wednesday 21st May

The text book jet HH212 - what can we learn from it? (tentative) (with co-author Mark McCaughrean)

HH212 is one of the first molecular hydrogen jets discovered (Zinnecker et al. 1998). To this date it is still the most beautiful H2 jet in the sky, with bipolar symmetry of knots and bowshocks. The knots and bows testify to a time variable accretion and ejection process the details of which (time-scale, velocities, etc) still need tobe understood in a theoretical protostellar framework. We will discuss the history of the discovery of HH212 and the most recent submm (ALMA) and near-infrared (JWST) data.

Rebeca Garcia Lopez

09:00-09:15, Thursday 22nd May

Invited review talk: Connection to outer disk scales

Luca Cacciapuoti

09:30-09:45, Thursday 22nd May

What goes around comes around: a streamer infalling onto an outbursting class I YSO in Orion A.

Star and planet formation occur in dynamic environments, where the accretion history can differ significantly from the traditionally assumed symmetric collapse. Young stellar objects can experience episodic and anisotropic accretion as they move through the interstellar medium. Channel-like infall events, known as "streamers," can replenish the inner disk with material, which is eventually accreted onto the young star, contributing significantly to its final mass and triggering ejection events. The Class I YSO M512, located in the chaotic Orion A environment, is the first source for which multi-wavelength ALMA observations have been obtained to characterize both its dust and gas content. The thermal dust emission reveals an ISM footprint, supporting the scenario that the inner system will be fed with pristine material that could potentially double its current mass. The molecular line emission from gases such as CO, HCO, DCO, and N D+ traces the same arc-like structure, providing constraints on its physical properties and infall kinematics. Furthermore, M512 has been observed to exhibit outbursts, during which its brightness has doubled on timescales of months, occurring three times over a 7-year period. This young stellar object serves as a unique testbed for the issues addressed in RAVEYSO, as it exhibits episodic infall, the inward transfer of significant amounts of mass, and abrupt ejection events—traced from optical to submillimeter wavelengths in both gas and dust.

Rik Claes

09:45-10:00, Thursday 22nd May

The influence of variability and disk substructures on observational population studies.

The rate at which mater is accreted onto young stars provides critical constraints on the physics at play in their surrounding planet forming disks. In particular, the relationship between disk mass and mass accretion rate, provides a way to test disk models. In this presentation I will detail my work on measuring mass accretion rates of classical T Tauri stars to better understand the physics active in their disks. I will first present improvements made to the only direct method of measuring mass accretion rates. This method consists of self consistently measuring the accretion excess present in the spectra of Classical T Tauri stars. These improvements necessitated an extended grid of class III templates that has been made available to the community. The physics responsible for the creation of the observed varied disk substructures may also affect the accretion process. Therefore, I will also discuss the relationship between relative mass accretion rate and the disk substructures observed with high angular resolution techniques. Finally, I will discuss the influence of accretion variability on our efforts to use the mass accretion rate as a constraint on disk evolution. In doing so I will focus on XX Cha, a target that has been found to display a particularly large accretion variability.

Elena Díaz-Márquez

10:00-10:15, Thursday 22nd May

The VLA Orion A Large Survey: exploring the variability

The early stages of star and planet formation involve a balance between accretion and ejection of material during the gravitational collapse. This balance and the consequent protostellar evolution are crucial in determining the final properties of stars and their planetary systems. Orion A is the nearest star-forming complex containing a broad range of environments populated by protostars and Young Stellar Objects with different masses and evolutionary stages, representing a testbed for star formation theories. The VLA Orion A Large Survey (VOLS) is an international effort to image the Orion A complex in the C (~6 cm) and Ku (~2 cm) radio continuum bands, as well as in a selected number of spectral lines. VOLS represents the first radio survey to cover a large area of Orion A at subarcsecond resolution. In this work, we present the results obtained at 6 cm during 26 epochs of observations. We will present the physical properties of the stellar population in Orion A, including the variability of the radio continuum and CH3OH maser emission in the Orion Nebula Cluster.

Daniele Fasano

10:15-10:30, Thursday 22nd May

The Dance of the Planets: Investigation of PDS 70 c CPD motion

PDS 70 hosts two directly imaged protoplanets, PDS 70 b and c, in its dust depleted cavity, offering a unique window on planet formation processes. The detection of H emission spatially colocated with the planet suggests that there are circumplanetary discs still accreting material onto the planets. Leveraging on observations of PDS 70 spanning multiple years it is then possible to provide constraints on the orbital properties of these circumplanetary discs. In this talk I will present new ALMA observations of dust emission from PDS70 in bands 6 and 7. We perform uv modelling of the dust distribution to remove the outer disc and enhance the SNR inside the cavity. We re-detect and confirm the presence of a circumplanetary disc around PDS 70 c, constrain it's orbital properties and study the variability of the inner disc and the circumplanetary disc across multiple epochs.

Aleksandra Kuznetsova

11:15-11:30, Thursday 22nd May

Variable mass accretion across scale: the dynamical connection

External infall from the star-forming environment onto the disk, delivered by the envelope during the earliest embedded phases and recently observed at later phases as filamentary inflows dubbed 'streamers', dynamically perturbs the disk. These dynamical perturbations incite instabilities, drive differential transport of gas and solids through the disk, and mediate substructure formation. Our recent results from numerical studies of infall driven disk dynamics show that disk accretion can be efficiently enhanced by stochastic infall events from large-scale star-forming environments. I will discuss recent results from these studies, how they can inform disk evolution models, and their future prospects for placing constraints on variable mass assembly.

Ignacio Mendigutia

11:30-11:45, Thursday 22nd May

Linking Disks and Planets with Stellar Interiors in Intermediate and Massive Young Stars

Stellar interiors play a key role in determining the early evolution of young stars. In particular, convective sub-photospheric regions disappear during the pre-main sequence phase of stars with masses roughly between 1.5 and 4 Msun. In turn, the lack of convection affects the mixing of stellar material, the strength of the magnetic field and, consequently, the way that disk material is accreted. In this talk I will summarize our recent findings on the metallicity and accretion properties of intermediate-mass Herbig stars and their relationship with disk structures, the potential presence of giant planets, and the size of their innermost orbits. I will conclude by presenting our ongoing efforts to understand and infer disk-to-star accretion rates of more massive young stars with fully radiative envelopes.

James Miley

11:45-12:00, Thursday 22nd May

Millimetre flares in Class II protoplanetary discs: binarity? starspots? or accretion?

Continuum emission from protoplanetary discs at millimetre wavelengths is typically assumed to trace the cold, quiescent midplane of the disc where planet formation occurs. However, an increasing number of systems show extreme variability at millimetre wavelengths, including very strong, short-term mm flares. Such dramatic flux increases cannot be explained by temperature or density changes in the disc midplane. During the AGEPro large program, we serendipitously observed one such mm flare, constructing a light curve that captured significant variability over a week. This raises critical questions: What physical mechanisms drive these events, and how might they affect the reliability of mm flux measurements and subsequently inferred disc properties such as dust mass? In this talk, I will present our new detection of a strong mm flare in an AGEPro target, alongside a compilation of similar cases from the literature. I will discuss proposed mechanisms for this variability, including undetected binarity, magnetic reconnection on active stellar surfaces, or free-free emission from powerful accretion bursts. These findings suggest an intriguing link between physics in the innermost regions of star-disc systems and observational tracers traditionally associated with the outer disc. Finally, I will explore what these unexpected results can teach us about the physics that dictates the interaction of young stars with their accretion discs.

Claudia Toci

12:00-12:15, Thursday 22nd May

How to find needles in a stack (of protoplanetary discs): comparison between models and observations

Protoplanetary discs are the birthplace of planets and the site in which they accrete and evolve. It is then fundamental to characterize their evolution to fully understand the emerging exoplanetary population. Thanks to new facilities such as ALMA and SPHERE, we now have astonishing images of protoplanetary discs, showing a large number of gaps and ring-like structures, often connected to the presence of one or more planets embedded in the parental disc. Frontier research is to study the interaction between the disc and the planets that are forming inside, using observational result in synergy with current theoretical models and numerical simulations. The main goal is to understand which are the mechanisms responsible for the substructures as well as predicting new observables to confirm or reject the presence of candidate protoplanets. In this talk, I will describe results from the modelling of single, bright sources (e.g., HD169142, PDS70, HD100546), and will underline the information we can obtain by comparing multi-wavelengths, time evolving observations with results from the hydrodynamical models. In particular, I will focus on how simulations can help constrain the mass and position of the candidate proto-planets that may be responsible for the ALMA and SPHERE observational results, as well as how they can support future observational strategies.

Yinhao Wu

12:15-12:30, Thursday 22nd May

Exploring Winds in Protoplanetary Disks from the Perspective of Substructures

Recent observations suggest that protoplanetary disks are not as turbulent as previously predicted by theoretical models. To explain angular momentum transfer and accretion processes in non-viscous disks, astronomers have turned their attention to the MHD disk wind mechanism. In this talk, I will introduce our 2D multi-fluid hydrodynamic simulations with a simplified prescription of MHD disk winds, that study the formation of substructures in disks when angular momentum transfer dominated by MHD disk winds, as opposed to traditional viscosity-dominated disks. By identifying different observational signatures of these substructures, we may be able to directly determine the presence of MHD disk winds in disks through ALMA imaging. Additionally, I will discuss how this method has been applied in my latest research to explain the asymmetric structures and high accretion rates observed in the well-known DM Tau system.

Luigi Zallio

12:30-12:45, Thursday 22nd May

Measuring gas-disk sizes to infer the accretion scenario of proto-planetary disks

The field of planet formation is undergoing rapid development, mostly thanks to the transformational capabilities of ALMA. The proto-planetary disk gas radius (Rgas) is one of the fundamental properties needed for constraining disk evolution all the way to planet formation: the viscous evolutionary paradigm predicts that disks enlarge as a function of time, while the MHD wind--driven one states that they shrink due to angular momentum loss. Until now, it was impossible to test these predictions on a statistically significant scale, but with the advent of the DECO Large Program (P.I. Ilse Cleeves), which observed 80 “common” discs in 4 regions with different ages, we now have enough data to constrain this key prediction. In interferometry, images are highly processed data products, and this introduces systematic biases which are difficult to quantify. I will present a new strategy to extract gas-disk radii which retrieves the disk size directly in the visibilities, the native quantity measured by the interferometer. The analysis, implemented in the code CSALT (Andrews et al., in prep.), is based on a parametric model of the disc structure and emission; this approach allows a robust statistical inference of the model parameters. In this talk, I will present preliminary results obtained for a subset of proto-planetary discs with this new analysis technique using 12CO, 13CO, C18O tracers coming from the Large Program DECO, and I will outline the developments that I obtained.

Posters

Christian Andreas **Investigation of periodic maser outbursts in young stars with SOFIA**

Francesco Andreetto **Accretion in Class I planet-forming disks: Infrared Spectroscopy using CRIRES+**

Suman Bhattacharyya **Tracing the Rhythms of Circumstellar Disks: Variability and Duty Cycles in Classical Be Stars**

Youcef Bouarour **The First High Resolution Interferometric Survey in K-band of High Mass YSOs**

Jérôme Bouvier **Stable accretion and episodic outflows in the young transition disk system GM Aurigae.**

Raul O. Chametla **Turbulent stress within dead zones and magnetic field dragging induced by Rossby vortices**

Joao Victor Correa-Rodrigues **Mapping accretion process in the Canis Major star forming region**

Hariharan Dhinamani Saravana Muthu **Accretion-driven Eruptive Variables in Nearby Star-Forming Regions with the VVV survey.**

Cuc Dinh **Characterizing the 3 micron Absorption Band Observed toward FUor Objects**

Nela Dvořáková **The role of mergers induced by the birth cluster dynamics**

Leticia V. Ferrero **Infrared Jets and Submillimeter Observations: Unveiling the Nature of HH 138 and HH 137**

Kevin France **Measuring Morphology and Kinematics of Molecular Disk Winds with the Habitable Worlds Observatory**

Birgit Fuhrmeister **Veiling and extinction variations during the dipper cycle of V505Ori**

Lucía Fullana-García **Deriving mass accretion rates of Massive Young Stars with X-Shooter spectroscopy**

Eric Gaidos **Does An Inner-Outer Disk Connection Explains Disk Diversification?**

Arpan Ghosh **Simultaneous NIR and Radio Monitoring of YSOs to Probe the Connection Between Accretion and Ejection.**

Katia Gkimisi **A tool for exploring the effects of external photoevaporation in Trumpler 14**

Mae Higgins **Investigating Far-Infrared Variability in Protostars: A Herschel PACS Study of the OMC-2/3 Region**

Christopher Johns-Krull **Accretion and Wind Variability of DH Tau it Planetary Mass Companion**

Simran Kaur **Episodic Protostellar Outflow: Proper Motion Study in Serpens South**

Daniela Korcakova **Re-accretion of ejected matter after the merger process**

Rajika Kuruwita **Were all low-mass fast rotators born in a binary?**

Aaron Labdon **Characterising the new EXor SPICY 9758**

Rachel Lee **Modeling Protostellar Accretion Variability in Stellar Mass Assembly using Monte Carlo Simulations**

Mathis Letessier **An interferometric mid-infrared study of the “dipper” star RY Lup with VLTI/MATISSE**

Philip Lucas **Going high and low: two very unusual YSOs**

Giancarlo Mattia **Non-ideal processes in astrophysical jets**

Karina Mauco **A New Look at Disk Winds and External Photoevaporation in the Sigma-Orionis Cluster**

Julie Moquin **Using Principal Component Analysis to Study Spectroscopic Variability of Accreting Young Stars**

Alicia Moranchel Basurto **Circumstellar disks around FS~CMa stars: Exploring multipolar magnetic configurations**

Ernesto Giulio Mustienes Rando **Young stellar objects: clusters, variability and evolution during the planet-forming era in Perseus**

Erick Nagel **Evaporation in the magnetosphere stream affecting the distribution of observed dippers**

Toni Panzera **Bridging the Star-Planet Gap: Accretion Properties of the Young Brown Dwarf J0844**

Padmakar Parihar **Exploring disk accretion process in the DF Tau**

Paola Pinilla **The ALMA Survey of Gas Evolution of PROtoplanetary Disks (AGE-PRO)**

Christian Schneider **X-rays from accreting stars**

Thomas Stanke **Not all internal working surfaces are due to jet/accretion variability: the case of HH43 revisited**

Yasmmin Tamburus **The habitability of exoplanets based on the interaction of magnetized protostellar winds**

Mauricio Tapia **Mol12A (IRAS 05373+2349): The most massive and deeply embedded Herbig Be star**

Haruka Washinoue **Effect of X-ray emission from stellar flares on disk ionization**