THE MAGNETIC FIELD AWAKENS

A new era for star formation

1st - 4th December 2020

BOOK OF ABSTRACTS

SESSIONS

Session I: Multi-scale and multi-technique analysis of the magnetic fields

1. Katia Ferrière

Observations of interstellar magnetic fields.
I will present a quick summary of the current state of knowledge of interstellar magnetic fields in the Milky Way, starting from the large Galactic scales and moving down to the intermediate scales of molecular clouds. I will review what the main observational methods (synchrotron emission, Faraday rotation, dust polarization, Zeeman splitting...) have recently taught us about the properties (strength, direction, and general configuration) of interstellar magnetic fields.

2. Andrea Bracco

The multiphase and magnetized neutral hydrogen seen by LOFAR.
Faraday tomography of LOFAR data below 200 MHz allows us to study the structure of the multi-scale magneto-ionic interstellar medium (ISM). An unexpected association of LOFAR synchrotron polarization with tracers of the magnetized-neutral ISM, such as atomic hydrogen (HI), has been previously suggested. In my talk I will present the first statistical analysis that quantifies the correlation between LOFAR data and HI observations at 21cm from the Effelsberg-Bonn HI Survey. In particular, we performed a morphological-correlation study between LOFAR polarization at intermediate Galactic latitude and the emission of the HI gas decomposed for the first time in its cold, luke-warm, and warm phases. Our results reveal a tight, but complex, relationship between LOFAR data and the multiphase HI gas that challenges the present understanding of the diffuse ISM.

3. Gemma Busquet

Magnetic fields in the infrared Dark Cloud G14.225-0.506 from cloud to core scale.
Magnetic fields are predicted to play an important role in the formation of filamentary structures and their fragmentation process to form stars and star clusters. The infrared dark cloud G14.225-0.506 (hereafter G14.2) displays a remarkable complex of parallel dense molecular filaments projected on the plane of the sky, constituting two hub-filament systems. Hubs are associated

with a rich population of protostars and young stellar objects and they present a different level of fragmentation when observed at high angular resolution. I will present a comprehensive study of the magnetic field in G14.2 obtained from multi-wavelength and multi-scale observations obtained with different facilities (optical, near-infrared, the CSO and ALMA), which allow us to assess the relevance of magnetic fields in regulating the collapse from large to small scales.

4. *Archana Soam*

Magnetic field structure in the infrared dark cloud G34.43+0.24.
I will present the B-fields mapped in IRDC G34.43+0.24 using 850 micron polarized dust emission observed with JCMT/POL-2. We examine the magnetic field geometries and strengths in the northern, central, and southern regions of the filament. The overall field geometry is ordered and aligned closely perpendicular to the filament's main axis, particularly in regions containing the central clumps MM1 and MM2, whereas MM3 in the north has field orientations aligned with its major axis. The overall field orientations are uniform at large (POL-2 at 14" and SHARP at 10") to small scales (TADPOL at 2.5" and SMA at 1.5") in the MM1 and MM2 regions. We obtained a plane-of-sky B-field strength of 470+/-190 micG, 100+/-40 micG, and 60+/-34 micG in the central, northern, and southern regions of G34, respectively, using DCF relation. The estimated value of field strength, combined with column density and velocity dispersion values available in the literature, suggests G34 to be marginally critical.

5. *Aris Tritsis*

Halo's Magnetic field as Evident from stRiated Interstellar Clouds (HOMERIC)
From the propagation of cosmic rays and the removal of CMB foregrounds to the formation of molecular clouds and star formation, the Galactic magnetic field (GMF) plays a paramount role. However, much like the journey of Ulysses in Homer's epic poem, our path towards determining the GMF has been a real Odyssey. HOMERIC (HalO's Magnetic field as Evident from stRiated Interstellar Clouds) aims to solve this problem by performing systematic, bona-fide tomographic measurement of the strength and orientation of the plane-of-sky component of the GMF. To this end, HOMERIC makes use of a novel method that utilises the imprint of hydromagnetic waves on interstellar clouds to trace back the strength of the magnetic field.

Session II: Magnetic fields: galactic and molecular cloud scales

1. *Martin Houde*

Characterising magnetic fields through polarisation measurements.
The fact that the role and importance of magnetic fields in different astrophysical processes (e.g., star formation) remain unclear is largely due to the many difficulties of probing magnetic fields in the ISM. While the Zeeman effect still provides the only direct way of measuring the strength of (generally the line-of-sight component of) magnetic fields, its weakness in the interstellar medium limits the types of environments and number of regions where detections can successfully be obtained. In this presentation I will therefore focus on recent improvements brought to existing measurement techniques (e.g., polarization from dust and spectral lines) as well as the developments of new methods to help elucidate the role of magnetic fields in different regions of the ISM.

2. *Kate Pattle*

The JCMT BISTRO Survey: the evolution of magnetic fields in filamentary structures.
In this talk I will discuss recent results from the James Clerk Maxwell Telescope (JCMT) BISTRO (B-Fields in Star-Forming Region Observations) Survey, which has been using the POL-2 polarimeter to map magnetic fields in dense structures of nearby star-forming regions. Particularly, I will discuss the insights which these observations give into the transition to magnetically subcritical gas dynamics which takes place in dense filamentary structures within molecular clouds. I will present recent BISTRO Survey observations of several nearby molecular clouds including Ophiuchus, Perseus and Orion, discussing commonalities between these regions and the search for a characteristic size or density scale at which magnetic fields lose their dynamic importance in the evolution of a dense filament to gravitational instability.

3. *Yue Hu*

Three-dimensional Galactic Magnetism Modeling with Velocity Gradients.
Probing magnetic fields in ISM is often challenging. Fortunately, recent studies show that the analysis of velocity gradients (the Velocity Gradient Technique;

VGT) can be used to trace the magnetic field morphology. It employs the anisotropic nature of magnetohydrodynamic turbulent motions. Our studies show that VGT is applicable for both transparent diffuse gas and dense molecular gas. With the assistance of the Galactic rotation curve, I will show how to obtain the 3D map of the galactic disk plane-of-the-sky magnetic field distribution. By using multiple molecular emission lines, which trace the gas over various volume density ranges, I will show the possibility of constructing 3D magnetic fields tomography in the molecular cloud. Additionally, identifying the transition region where the gravity takes over the magnetic field and turbulence remains elusive. I will show the self-gravity can induce the change of velocity gradients and how to identify self-gravitating regions.

4. *Philipp Girichidis*

The dynamical impact and orientation of magnetic fields in the interstellar medium.
Magnetic fields are ubiquitously observed in the interstellar medium (ISM) with dynamically relevant energy densities. Using 3D-MHD simulations of the supernova-driven ISM we investigate the dynamical impact of magnetic fields on the formation of molecular gas out of the atomic gas, GMCs and filaments. We show how magnetic fields delay the formation of H2 and help preventing the gas from forming stars too efficiently. The simulation covers a box of 500 pc and resolves scales down to sub-parsec, which allows to investigate the magnetic field strength and orientation from scales of the galactic disk down to the densest and self-gravitating parts of the molecular clouds. We also correlate the orientation of the magnetic field with respect to gas structures and gas velocities with the density and the degree of importance of contracting gravitational forces. We also illustrate why the orientation of the field is well identified in 3D simulations but might be hard to observe.

5. *Daniel Seifried*

What can we learn from synthetic polarisation observations? Insights into the dynamics and dust properties of molecular clouds.
I present results of fully self-consistent synthetic dust polarisation maps of simulated molecular clouds (MCs) created with POLARIS (Seifried et al., 2019+2020). By incorporating noise, we assess the reliability of polarisation observations from Planck and BlastPol. I also show that polarisation observations of MCs mainly probe their dense parts up to AV > 1 (~1000 cm^-3). Furthermore, I combine the results with analytical considerations to

shed light on the dynamical importance of magnetic fields, which reaches an orientation perpendicular to (column) density structures only for clouds with a mass-to-flux ratio below the critical value. Moreover, I show that projection effects strongly affect the observed orientation of magnetic fields, which can explain the observed variety in actual observations. Finally, if time left, I present ongoing research on what we can learn from polarisation degree spectra about the underlying dust properties (Balduin, Seifried et al., in prep.).

6. *Lars Bonne*

Formation of the Musca filament: Evidence for asymmetries in the accretion flow due to bending of the magnetic field.
To better understand the formation of star forming filaments, we analysed CO observations from the APEX telescope towards the Musca filament. In the APEX maps we find evidence for continuous mass accretion onto the filament and possible heating related to the presence of accretion shocks. To understand the origin of these local dynamics, we studied the kinematics of the Chamaeleon-Musca complex with NANTEN2 CO and GASS HI data. Our analysis supports the view that star formation in Chamaeleon-Musca originates from a low-velocity (5-10 km/s), 50 pc scale HI cloud-cloud collision. In this collision, bending of the magnetic field, as described in Inoue et al. 2018, would be responsible for the observed local accretion in Musca, implying an important role for the magnetic field in the emergence of dense star forming gas in the ISM.

7. *James Beattie*

A multi-shock model for the density variance of anisotropic, highly-magnetised, supersonic turbulence in the ISM.
Shocks form the basis of our understanding for the density and velocity statistics of supersonic turbulent flows, such as those found in the interstellar medium (ISM). The variance of the density field, sigma^2_{rho/rho_0}, is of particular interest for molecular clouds (MCs). However, previous variance models assume isotropy. This assumption does not hold when a strong, sub-Alfvénic mean magnetic field, B_0, is present in the cloud. We develop an anisotropic model for sigma_{rho/rho_0}^2, using contributions from hydrodynamical and fast magnetosonic shocks that propagate orthogonal to each other. To validate our model, we calculate sigma_{rho/rho_0}^2 from 12 high-resolution, 3D, supersonic, sub-Alfvénic MHD turbulence simulations and find excellent agreement with our theory. We discuss how the different shock

types may explain the observed density transition in bimodally orientated structures observed of the ISM and implications for SF theory in the presence of a sub-Alfvénic B_0.

8. Devaraj Rangaswamy

Magnetic fields and star formation around Hii regions: The S235 complex.

We present magnetic field properties towards the S235 complex using near-infrared H-band polarimetric observations, obtained with the Mimir and POLICAN instruments. The plane-of-sky (POS) magnetic field orientations inferred from starlight polarization angles reveal a curved morphology tracing the spherical shell of the H ii region. We identified 11 dense clumps using 1.1 mm dust emission, with masses between 30 – 550 M . The POS magnetic field strengths were estimated to be between 30 – 120 µG, with a mean of ~65 µG. The mass-to-flux ratios for the clumps are found to be sub-critical with turbulent Alfvén Mach numbers less than 1, indicating a strongly magnetized region. The clumps show scaling of magnetic field strength vs density with a power-law index of 0.52 ± 0.06, similar to ambipolar diffusion models. Our results indicate the S235 complex is a region where stellar feedback triggers new stars and the magnetic fields regulate the rate of new star formation.

9. Paulo Cortes

The magnetic field in Orion KL as seen by ALMA mosaicking.

We present the first linear-polarization mosaicked observations performed by the Atacama Large Millimeter/submillimeter Array (ALMA). We mapped the Orion-KLeinmann-Low (Orion-KL) nebula using super-sampled mosaics at 3.1 and 1.3 mm as part of the ALMA Extension and Optimization of Capabilities (EOC) program. We derive the magnetic field morphology in the plane of the sky by assuming that dust grains are aligned with respect to the ambient magnetic field. At the center of the nebula, we find a quasi-radial magnetic field pattern that is aligned with the explosive CO outflow up to a radius of approximately 12 00 (~ 5000 au), beyond which the pattern smoothly transitions into a quasi-hourglass shape resembling the morphology seen in larger-scale observations by the James-Clerk-Maxwell Telescope (JCMT). We estimate an average magnetic field strength hBi = 9.4 mG and a total magnetic energy of 2 × 10 45 ergs, which is three orders of magnitude less than the energy in the explosive outflow.

10. Dana Alina

Large-scale magnetic field in the Monoceros OB-1 East.
In the star formation process turbulence, gravity and magnetic fields take over one another at different scales and evolutionary stages. We analyzed the large-scale magnetic field and its interplay with the gas dynamics in the Monoceros OB-1 East molecular cloud. We combined spectroscopic data from the TRAO 14-m telescope and Planck polarimetric data to trace dynamically active regions using the gradients technique. We identified that the magnetic field properties of the Northern and Southern parts of the cloud are different. In the Northern filaments, the magnetic field seems to be dominated by turbulence and gravity. It is frozen into the filaments and is dragged during their evolution. In the Southern part, the magnetic field seems dynamically influence the morphology, guiding an accretion or being dragged by the mater falling into the main cloud. Our study shows that the magnetic field is tightly connected to the large-scale structure of the cloud.

Session III: Magnetic field in pre/protostellar cores

1. Maud Galametz

The magnetic fields in pre- and protostellar cores.
The magnetic field is known to be a key actor in the formation of stars. From a theoretical point of view, its presence in star-forming cores has been shown to dramatically alter the dynamics of the gas participating in the building of stars during the accretion phase. With the advent of ground-based (single-dish and interferometric) polarization capacities, more and more constraints have been gathered to better quantify its role oservationally, from the hosting protostellar core scales down to the innermost regions of the protostellar envelopes. I'll review some of the progresses made in our understanding of the effects of the B-fields on various physical processes such as the regulation of the accretion of matter, the core fragmentation or disk formation.

2. Siyao Xu

Magnetic field amplification during gravitational collapse.
Turbulence can be driven by gravitational collapse, which can further amplify the magnetic fields in a dense core and affect the star formation. To examine the dynamo behavior during gravitational collapse, we extend the theory of the nonlinear turbulent dynamo to include the effect of gravitational compression.

The relative importance between dynamo and compression varies during contraction, with the transition from dynamo- to compression-dominated amplification of magnetic fields with the increase of density. In the nonlinear stage of magnetic field amplification with the scale-by-scale energy equipartition between turbulence and magnetic fields, reconnection diffusion of magnetic fields in ideal magnetohydrodynamic turbulence becomes important. The resulting magnetic field structure and the scaling of magnetic field strength with density are radically different from the expectations of flux freezing.

3. *Eswaraiah Chakali*

The JCMT BISTRO survey: unveiling the magnetic fields in star-forming cores of B213.

We have conducted deep and sensitive dust polarization observations at 850 micron with JCMT/SCUBA2-POL2 as a part of BISTRO survey towards B213/Taurus. We probe magnetic fields (B-fields) in envelopes of two protostellar cores (K04166 and K04169), and in one prestellar core (Miz-8b). Detailed B-field morphology in K04166 is found to be well correlated with the geometries of larger scale B-field, filament, core, protostellar outflows, and core rotation axis. This strong morphological correspondence is in accordance with the strong B-field driven star formation in K04166. Similarly, B-fields in the envelope of K04169 are also ordered but make a 90 deg transition with respect to large scale B-fields and aligned parallel to the major axes of core and filament. Interestingly, outflows, core rotation axis, and B-fields are misaligned in K04169, probably due to material flows both along and perpendicular to the core. In contrast, B-field morphology in Miz-8b is rather complex due to the dominance of turbulence. Observed differences in core scale B-fields and their relative importance could be due to the differences in the gas kinematics at the locations of the cores.

4. *Hamza Ajeddig*

SOFIA HAWC+ polarisation observation of the starless B211 region of the filamentary cloud L1495.

Recent dust polarization observations of molecular clouds have shown the importance of magnetic fields in the dynamics of filaments and star formation. According to Planck polarization data, magnetic field lines have a very regular, organized morphology on large scales (>0.4 pc), roughly perpendicular to the dense filaments forming stars. Little is known on the smaller scales ~0.1 pc or less at which stars form in filaments, however. We present results of recent polarization observations of the B211 filament with SOFIA HAWC+ at 214 µm. The high resolution of HAWC+ (28.1”) shows an irregular morphology of the magnetic field in several sub-regions of the filament. Additional C18O(1-0) line observations with the IRAM 30m telescope confirm the existence of multiple velocity components velocity in B211 as reported by Hacar et al. Using the Davis-Chandrasekhar-Fermi method, we estimate the plane-of-sky magnetic field strength, which is found to range from 11 µG to 53 µG.

5. *Valentin Le Gouellec*

What causes the polarized dust emission seen by ALMA toward the interior of Class 0 protostellar envelopes ?

With the aim of characterizing the role played by magnetic fields in the formation of young protostars, several recent studies have revealed unprecedented features toward high angular resolution ALMA dust polarization observations of Class 0 protostellar cores. Especially, the dust polarization has been found to be enhanced along the irradiated cavity walls of bipolar outflows, but also in region most likely linked with the infalling envelope, in the form of filamentary structure being potential magnetized accretion streamer. These observations allow us to investigate the physical processes involved in the Radiative Alignment Torques (RATs) acting on dust grains from the core to disk scales. Synthetic observations of non-ideal magneto-hydrodynamic simulations of protostellar cores implementing RATs, show that the ALMA values of grain alignment efficiency are significantly higher than the ones obtained with the standard RAT alignment of paramagnetic grains.

Session IV: Magnetic field in accretion disks

1. *Geoffroy Lesur*

Magnetised protoplanetary disks.

In this short review, I will present the evidence of magnetic fields in protoplanetary discs, ranging from direct meteoritical measures to observations. I will then discuss how these constrains fit into the current theoretical framework of wind-driven discs and point out several observations which could test these models.

2. Chat Hull

Non-detection of spectral-line polarization in the TW Hya protoplanetary disk.

We report observations of polarized line and continuum emission from the disk of TW Hya using ALMA. We detect linear polarization in the dust continuum emission that is consistent with previous, lower-frequency observations. We target three emission lines, 12CO(3-2), 13CO(3-2), and CS(7-6), to search for linear polarization due to the Goldreich-Kylafis effect; however, we detect no significant linear polarization in the spectral-line emission. Employing a correction for the projected velocity of the disk and azimuthally averaging the line data, we are able to place 3-sigma limits on the polarization fraction of 12CO at <1% over the whole disk (210 au; 3.5"), and <0.3% in the inner 60 au (1"). 13CO and CS show no detectable polarization across the whole disk above the 3% level. These upper limits are consistent with current models of molecular line polarization arising from a disk oriented close face-on.

3. Patrick Hennebelle

What determines the formation of planet-forming disks?

I will present recent results on the formation of planet-forming disks during the collapse of a dense core. Both the dependency in the physical and numerical parameters is explored. It is argued that the magnetic field, play a key role and if strong enough the disks tend to be magnetically self-regulated. The sink particles on the other hand are playing an important role by setting an inner boundary which directly influences the disk masses.

4. Carla Arce-Tord

Insight on the magnetic field action in a massive proto-cluster.

To better understand the impact of the magnetic field at the proto-stellar stages, we used ALMA at 1.3 mm in full polarization mode to map the polarized emission from dust grains at a physical scale of ~2700 au, toward a large sample of massive dense cores in the W43-MM1 high-mass star-forming region. I will present results on the correlations between the magnetic field orientation and that of the cores and outflows in a sample of protostellar dense cores. We find that the orientation of the cores is not random with respect to the magnetic field, showing that it is well coupled with the dense material. Also, we find that the outflows could be oriented 50-70° or randomly oriented with respect to the magnetic field, similar to current results in low-mass star-forming regions. This suggests that, in some cases, the magnetic field is strong enough to control the angular momentum distribution from the core scale down to the inner part of the circumstellar disks where outflows are triggered.

5. *Wouter Vlemmings / Boy Lankhaar*

CN Zeeman splitting limits in the disk around TW Hya.

6. *Josep Miquel Girart*

Does dust polarization trace magnetic fields in protoplanetary disks?
It is well established that significant grain growth and settling occurs in relatively short time scales in protoplanetary or planet-forming disks. These pose the doubt on whether dust polarization can be used to trace magnetic fields in these environments. Here I will briefly present the different mechanisms that may produce dust polarized emission. I will also present some ALMA results of polarized dusty disks. Spoiler: yes, there is some hope that dust polarization may be used to study the role of magnetic field in the disk dynamics and evolution.

Session V: Magnetic field in jets and outflows

1. *Sylvie Cabrit*

Magnetic fields in protostellar outflows.

2. *Qizhou Zhang*

Magnetic fields in dense cores associated with protostellar clusters.
How molecular clouds condense and fragment to form a cluster of stellar objects remains an unsolved problem in astrophysics. Using the SMA, we carried out a legacy program to obtain dust polarization at a wavelength of 0.89mm for a sample of protocluster forming molecular clumps. This unprecedentedly large sample observed by a submm interferometer before the ALMA era enabled the first statistically significant study of the ensemble behavior of magnetic fields in protostellar cluster formation. We found compelling evidence of strong magnetic field influence on the gas dynamics during the formation of cores in a protocluster. This sample has been followed up with ALMA in dust polarization at a higher angular resolution to probe

magnetic fields within dense cores. I will present the findings from the SMA legacy survey as well as preliminary results from ALMA that probe the role of magnetic fields in protoclusters from the pc scale down to the scale of several thousand au.

3. *Raphaël Mignon-Risse*

High-mass turbulent core collapse with non-ideal magnetohydrodynamics (ambipolar diffusion) and hybrid radiative transfer.

Massive stars (> 8 Msun) are luminous and often in multiple systems. Nonetheless, neither their multiplicity, their accretion mechanism, nor their outflow origin is clear. Indeed, their birth environment is both magnetic and turbulent, and their interplay will affect both their multiplicity, disk formation, and outflow launching. I will present four radiation-MHD 3D simulations aiming at identifying the origin of their outflows, the accretion mechanism and eventually the formation of companions. I will first show that ~100-200AU magnetically-regulated disks form and lead to binary system formation when turbulence dominates over magnetic fields. The magnetic tower flow is the dominating outflow mechanism, over radiative acceleration, up to ~20Msun. I will compare some of the outflows properties to observational constraints. Eventually, I will address the question of the relative disk-outflow-magnetic fields orientation.

4. *Benoît Tabone*

Secular evolution of disks driven by MHD disk-winds and viscosity : constraints from the observed disk masses and accretion rates.

Disks around nascent stars are the birthplace of planets, and the mass reservoir between the infalling envelope and the growing star. MHD winds launched from the disk surface have recently been invoked to drive accretion, questioning the paradigm of viscous accretion. If so, MHD disk-winds would impact planet formation, and limit core-to-star efficiency. Recently, ALMA has brought clues of the presence of MHD disk-winds by the observation of few bright outflows. In this contribution, we present observational constraints on MHD disk-winds from the new vantage point of disk evolution. The viscous model of Shakura-Sunyaev is extended to include MHD disk-winds. ALMA and VLT surveys of star-forming regions are then analyzed in this new framework. We show that the decline of disk mass and its correlation with accretion rate are compatible with wind driven accretion with a disk magnetization of b~few1e3. This model constitutes a first step to include MHD disk-winds in planet formation models.

5. *Chin-Fei Lee*

Polarized SiO observations toward HH211.

Session VI: Magnetosphere and interaction with the inner disk

1. *Jean-François Donati*

Magnetic fields of PMS stars and and star-disc magnetospheric interactions.
Magnetic fields are known to play a key role in the early life of stars and their planets, as they form from collapsing dense pre-stellar cores that progressively flatten into large-scale accretion discs and eventually settle as young suns orbited by planetary systems. Pre-main-sequence (PMS) phases, in which central protostars feed from surrounding planet-forming accretion discs, are especially crucial for understanding how worlds like our Solar System are born. In this talk I will review the latest results on magnetic fields of PMS stars and their inner accretion discs from spectroscopic and spectropolarimetric surveys, focussing mostly on low-mass classical T Tauri stars (cTTSs) that are still surrounded by and accrete from their inner accretion discs through magnetospheric accretion / ejection processes.

2. *George Pantolmos*

Stellar wind torques in T Tauri stars: how to prevent spin-up?
Classical T Tauri stars (CTTs) magnetically interact with their surrounding disks, a process that controls their rotational evolution. Observations reveal that CTTs maintain a constant rotation with time, indicative of angular-momentum-loss processes that prevent their stellar spin rates to increase due to both accretion and contraction. Therefore, various types of outflows (e.g., magnetized stellar winds, magnetospheric ejections, disk winds) have been proposed to explain this phenomenon. I will present numerical simulations that quantify the magnetic braking (due to stellar winds) in accreting stars. We find that stellar winds originated from CTTs brake the stellar rotation more efficiently than outflows from diskless stars. However, we predict that these winds should eject

at >10% of the mass-accretion rate in order to counteract the stellar spin-up due to accretion.

3. Pauline McGinnis

The magnetic obliquity of accreting T Tauri stars.
The geometry of the magnetospheric accretion flow in a T Tauri star strongly depends on its magnetic obliquity (the angle between the rotational and magnetic axes). We derive magnetic obliquities for 11 accreting T Tauri stars by monitoring radial velocity (Vrad) variations of the HeI5876 line along the stars' rotational cycles. HeI is produced in the accretion shock, close to the magnetic pole. When the magnetic and rotational axes are misaligned, Vrad is modulated by stellar rotation with an amplitude related to the star's vsini and hotspot's latitude. We find an average obliquity of 11.4+-5.4 degrees. These stars' magnetic axes thus seem nearly but not exactly aligned with the rotational axes. From their positions on the HR diagram, most stars in our sample should be fully convective. We find tentative evidence that the magnetic obliquity may vary according to the stellar interior and that there may be a considerable difference between fully convective and partly radiative stars.

4. Aurora Sicilia-Aguilar

"Reading between the lines": Probing magnetospheric accretion, winds, and the innermost disk with emission line tomography
What happens in the innermost disk at the time of planet formation? While direct mapping cannot access these regions, emission (and absorption) lines in young stars trace their winds, accretion-related structures, spots, and innermost disk. In the optical, a large number of species with various excitation potentials can provide information on the temperature, density, and velocity of hot and tiny structures. Using time-resolved spectroscopy covering several rotational and disk orbital periods, we can obtain a very detailed view of the structure and variability of accretion columns and spots and information on the presence and launching points of stellar/disk winds in young stars. In outbursting sources, the temperature variation allows us to spectroscopically access an even larger region of the disk and surroundings. I will present the results on several young stars with different properties, discussing what we can learn from "reading between the (spectral) lines ».

5. Jerome Bouvier

A multi-faceted approach of magnetospheric accretion in young stars.