Program

Please note: talks are scheduled for 10+5' or 20+10'.

Sunday, March 3

20:00	*Dinner*	

Monday, March 4

12:30	*Lunch*	
14:00	L. Testi	Introduction

Session I: Accretion & Ejection

Chair: D. Galli

14:30	C. Manara	Measuring mass accretion rates to better understand how protoplanetary disks evolve
15:00	G. Rosotti	Disc evolution processes: a phenomenological view
15:30	E. Rigliaco	Low velocity winds: what we know and what they are telling us on the disk dispersal
16:00	*Coffee break*	
16:30	B. Ercolano	The role of disc photoevaporation on disc dispersal and the formation and evolution of planets
17:00	M. Koutoulaki	The dimming events of RW Aur A
17:15	R. Fedriani	Massive protostellar jets as a tool of ejection and accretion processes in HMYSOs
17:30	N. Calvet & L. Hillenbrand	Discussion: accretion
19:30	*Dinner*	

Tuesday, March 5

Chair: R. Alexander

09:15	A. Banzatti	Unveiling the secrets of inner disk winds from a detailed kinematic survey of [OI] optical lines
09:45	M. Flock	Gone with the wind: News from magnetic driven wind models of protoplanetary disks
10:15	R. Garcia Lopez	The innermost structure of protoplanetary disks
10:45	*Coffee break*	
11:15	C. Dougados & F. Bacciotti	Discussion: ejection

Session II: Disk demographics, substructures & dust evolution

12:00	I. Pascucci	The demographics of planet-forming disks
12:30	M. Tazzari	Measuring protoplanetary discs' sizes with ALMA
13:00	*Lunch*	

Chair: R. van Boekel

14:30	T. Birnstiel	From Disks to Rings – Dust Evolution in the ALMA Era
15:00	M. Villenave	Measuring vertical settling and radial drift of dust grains: an ALMA survey of young edge-on disks
15:15	A. Kataoka	Measuring the grain size and finding the magnetic fields by ALMA polarization
15:45	J. Huang	An Introduction to the Disk Substructures at High Angular Resolution Project
16:00	*Coffee break*	
16:30	L. Pérez	Results of the Disk Substructure at High Angular Resolution Project
17:00	F. Long	An ALMA survey of disk structures in Taurus
17:15	F. Ménard & J. Williams	Discussion: disk demographics & grain growth
19:30	*Dinner*	

Wednesday, March 6

Chair: G. Lodato

09:00	C. Dominik	Scattered light imaging and the structure of disks
09:30	A. Garufi	Evolution of protoplanetary disks from their taxonomy in scattered light

09:45	J. Bae	Planet-driven spiral waves in protoplanetary disks
10:15	P. Cazzoletti	Where do the spirals come from? A multi-wavelength high-resolution study of HD 135344B
15:30	*Coffee break*	
11:00	Z. Zhu	Accreting Circumplanetary Region and its Observational Signatures
11:30	S. Facchini	The interplay between inner and outer disk in misaligned systems
12:00	F. Meru	The role of gravitational instabilities on disc evolution and star & planet formation
12:30	L. Hartmann & A. Isella	Discussion: substructures
13:15	*Lunch*	

Free afternoon

Optional: Visit of Varenna

20:00	*Dinner*	

Thursday, March 7

Session III: Thermo-chemical processes

Chair: P. Caselli

09:30	A. Miotello	ALMA disk surveys: what does CO tell us about?
10:00	C. Pinte	Kinematic detection of embedded protoplanets in circumstellar discs
10:30	R. Teague	Unveiling the dynamics of planet formation
11:00	*Coffee break*	
11:30	C. Walsh	Probing the composition of the planet-building reservoir in protoplanetary disks: what we have learned from comets and ALMA
12:00	T. Bergin & E. van Dishoeck	Discussion: chemistry
12:45	*Lunch*	

Session IV: Planet formation in low-mass objects

Chair: J. Alcala

14:30	G. Herczeg	Accretion and winds of young brown dwarfs

15:00	A. Scholz	Watching brown dwarfs go round and round: Rotation and variability from stars to planets
15:30	L. Ricci	Properties of disks around young brown dwarfs and very low mass stars
16:00	*Coffee break*	
16:30	E. Sanchis Melchor	Results on an ALMA survey of disks around Brown Dwarfs
16:45	P. Pinilla	First steps of planet formation around very low mass stars
17:15	C. Clarke & J. Bouvier	Discussion: brown dwarf disks
19:30	*Dinner*	

Friday, March 8

Session V: From disks to planets

Chair: R. Waters

09:00	S. Mohanty	Close-in Super-Earths: In Situ Formation and Evolution in MRI-active Disks
09:30	A. Morbidelli	Formation and migration of super-Earths
10:00	M. Keppler	Discovery of a planetary mass companion in the gap of the transition disk PDS 70
10:15	D. Wilner	New Views of Debris Disks with ALMA
10:45	*Coffee break*	
11:15	M. Samland	The SPHERE View of 51 Eridani b
11:30	C.P. Dullemond & C. Mordasini	Discussion: from disks to planets
12:15	T. Ray	Conclusions
12:30	*Lunch & Farewell*	

Abstracts

Measuring mass accretion rates to better understand how protoplanetary disks evolve

Monday
14:30

Carlo Manara

European Southern Observatory

The evolution of protoplanetary disks is regulated by the interplay of various physical processes related to the interaction between the star and the disk, such as accretion of material onto the star and emission of material through winds. These processes are best studied spectroscopically. Instruments like the VLT/X-Shooter spectrograph allow us to observe simultaneously the signatures of the accretion process, such as the UV-excess and the emission lines, together with lines tracing winds and outflows. At the same time, such spectra allow us to robustly derive the physical parameters of the central objects, such as their temperature and their mass. When this information is combined with observations of disks at sub-mm wavelengths with ALMA it is then possible to quantitatively constrain disk evolution mechanisms. I will report on the dependence of the mass accretion rate with stellar mass and disk mass for the complete samples of low-mass objects in the Lupus, Chamaeleon, and Upper Scorpius regions. This set of data is key to critically test the current theories of disk evolution.

Disc evolution processes: a phenomenological view

Monday
15:00

Giovanni Rosotti

Leiden Observatory

After decades of research, explaining why discs accrete is still an open problem. Thanks to the ALMA revolution, as well as complementary surveys at visible wavelength of the disc-hosting stars, it is now possible to place phenomenological constraints on the mechanisms driving accretion and disc evolution in general. These constraints come from the evolution of the disc-star system macroscopic quantities, such as disc mass, radii and accretion rate. In the talk, I will detail these constraints, focussing in particular on two specific cases. The first is the relation between accretion rates and disc masses across different environments, such as single stars, binary systems and discs subject to intense ultra-violet field. The second is the evolution of disc radii, which can tell us whether viscous spreading, a smoking gun signature of viscosity, really happens. In practice, the analysis of disc radii is hampered by the fact that the most accessible observational tracer, dust continuum, is also subject to radial drift. I will show how the existing data supports the idea that, even if the transport of angular momentum is viscous, proto-planetary discs are not highly viscous: the alpha parameter cannot be bigger than 0.001.

The role of disc photoevaporation on disc dispersal and the formation and evolution of planets

Monday
16:30

Barbara Ercolano

Ludwig-Maximilians-University Munich

The formation and evolution of planets is intimately related to the physical conditions, the evolution and the dispersal of their natal planet forming disc. In this review I will briefly summarise the basics behind photoevaporation models of disc dispersal, emphasising some of their expected influence on planet formation and migration. I will also focus on the predictive aspects of these models and how well they compare with current observations.

The dimming events of RW Aur A

Monday
17:00

Maria Koutoulaki

Dublin Institute for Advanced Studies

The study of the inner gaseous disc of YSOs is crucial to understand the physical processes ruling disc evolution and its connection with planet formation. In this talk, I will present our results on the inner disc properties of the CTTS RW AurA. The RW Aur system has captured the attention of astronomers for its dimming events. By using X-SHOOTER spectra obtained when the star was in a bright and in a dim state, we compare the NIR CO emission in order to shed light on this mystery. In general, the NIR CO emission traces a warm (T=2000-5000K) and dense (NCO>1e12cm-2) gas as expected in the innermost region of discs. Both states need a cool (T=2600K) and dense (NCO=7e20cm-2) gas to reproduce the observations, with the emitting region located just inside the dust sublimation radius. By comparing the SED (from 300 to 1000 nm) and the CO emission of both states, we find that the dimming can be due to absorption by a layer of large grains with optical depth slowly declining from 2.8 to 1.6. The accretion rate remains constant (Macc~2e-8 Mo/yr) if one assumes that the same layer of dust also occults the accretion line emitting region. This excludes accretion bursts as the main cause of RW AurA brightness variability.

Massive protostellar jets as a tool of ejection and accretion processes in HMYSOs

Monday 17:15

Ruben Fedriani

Dublin Institute for Advanced Studies

In contrast with low-mass young stellar objects (YSOs), very little is known about the formation of high-mass YSOs (HMYSOs). Latest results indicate that HMYSOs might be born in a similar way as low-mass YSOs, i.e., through disc accretion and jet ejection. HMYSOs are deeply embedded in their parent cloud and are at kpc distance, often hindering direct imaging of their accretion discs and immediate surroundings. Protostellar jets, then, become essential to understand the physical properties of the accretion processes and, ultimately, of the central source. High-resolution near-IR instruments allow us to study HMYSO jets from parsec scales down to au scales. In this talk, I will present ESO/VLT and HST imaging and spectroscopic results on HMYSOs that shows the jet structure close to the central engine. The kinematic and dynamic properties are compared with low-mass jets, suggesting that jets from HMYSOs are scaled-up versions of their low-mass counterparts, and their properties scale with mass. Finally, I will confront the NIR and the radio jet to show that the radio regime is tracing just a small portion of the ejection and the majority is traced by the NIR regime.

Unveiling the secrets of inner disk winds from a detailed kinematic survey of [OI] optical lines

Tuesday 9:15

Andrea Banzatti

University of Arizona

I will present a new analysis of optical [OI] lines that trace winds and jets in TTauri stars, based on a survey of 65 spectra observed at the high spectral resolution of 7 km/s. This work, published in 2019, builds on recent analyses of similar datasets and focuses on the kinematic behavior of multiple low-velocity components (LVC), and on their connections to the high-velocity component tracing jets (HVC) as well as to stellar accretion and disk dispersal. This analysis revealed several correlations previously unknown, linking the wind kinematics to accretion onto the star and to the jet velocity and strength, and providing new important clues on the geometry and structure of inner disks winds. I will discuss the potential and challenges that these data and results contribute to the study of MHD winds and inner disk dispersal today.

Gone with the wind: news from magnetic driven wind models of protoplanetary disks

Tuesday 9:45

Mario Flock

Max Planck Institute for Astronomy

Each newly detected extrasolar planet raises the question about its origin. The process of planet formation is intrinsically tied to the young protoplanetary disk evolution. The understanding of the detailed gas and dust dynamics and their thermal evolution is essential to understand the disk evolution and finally the formation of planets. In this talk I will review the latest findings on the gas dynamics in protoplanetary disks. I will discuss the importance of magneto- and hydrodynamical instabilities and present recent results on magnetic driven wind models. New observational constraints help us in the understanding of the disk dynamics and their impact on the disk evolution.

Measuring protoplanetary discs' sizes with ALMA

Tuesday 12:30

Marco Tazzari

University of Cambridge

Together with the mass, the size of a protoplanetary disc is a fundamental property that informs us on the disc physical structure and its evolutionary state. Measurements of discs sizes can thus offer us important insights on the physical mechanism driving the disc evolution. In the last few years ALMA has been used to spatially resolved hundreds of discs at moderate resolution and sensitivity in many star forming regions. In this talk I will present an updated overview of the currently available disc size measurements and on the emerging empirical correlations. Secondly, I will discuss the implications of these measurements on our understanding of how dust evolves in discs. Finally, I will discuss the power of different techniques in inferring disc sizes from ALMA data and their observational biases.

From Disks to Rings – Dust Evolution in the ALMA Era

Tuesday 14:30

Til Birnstiel

Ludwig-Maximilians-University Munich

The fact that growing particles are becoming ever more mobile has been known since the 70s and it has since then sparked the imagination of theorists to explain various aspects of the protosolar nebula and other planet forming disks. It is thought to lead to enrichment of the inner disk in water and other volatiles, it leads to size differences between the gas and dust disks, affect the appearance of disks through its opacity effects, it brings dynamics to disk chemistry by sequestration of CO and water, and last but not least, might kick-start planet formation via the streaming instability and speeds up planet growth via pebble accretion. Until recently these were just ideas, but now ALMA has revolutionized this field, allowing us to observe these effects in great detail and even causing observers to use the term ”Stokes number”. In this talk, I will present the basics of dust growth, transport, and trapping. I will describe some of the observable effects of solid evolution and show what we have learned from ALMA and which new puzzles it has revealed.

Measuring vertical settling and radial drift of dust grains: an ALMA survey of young edge-on disks

Tuesday 15:00

Marion Villenave

European Southern Observatory

Disks observed edge-on are of particular interest as they provide a unique point of view to determine their vertical and radial dimensions. We present new ALMA continuum band 7 and band 4 (respectively 0.9 and 2.1 mm) observations of 8 edge-on protoplanetary disks located in the Taurus star-forming region. The comparison of the millimeter continuum images with HST near-infrared images enables us to compare the spatial distribution of the micron-sized dust grains with larger millimeter dust grains. While the scattered light images reveal a double nebulae structure separated by a dark line, the millimeter images show a flat brightness distribution for most of the disks. We find that the radial and vertical extents of all disks are larger at near-infrared wavelengths than at millimeter wavelengths. We also show that emission at band 7 extends further out than the one at longer, a likely consequence of radial drift. Finally, we bring constraints on the vertical thickness of disks for those revolved in the vertical direction at millimeter wavelengths.

Measuring the grain size and finding the magnetic fields by ALMA polarization

Tuesday 15:15

Akimasa Kataoka

National Astronomical Observatory of Japan

Constraining the grain size in protoplanetary disks is a key to understanding the first stage of planet formation. The grain size has been estimated by measuring the spectral index at millimeter wavelengths, while it has huge uncertainties. We propose an alternative way to constrain the grain size using millimeter-wave polarization. We show that thermal dust emission is scattered off of other dust grains, which produces millimeter-wave polarization with a fraction of $\sim$2.5%. By performing multi-wave polarization observations, we can constrain the grain size because the polarization is the most efficient when the grain size is comparable to the wavelengths. We also report two ALMA polarization observations of protoplanetary disks of HD142527 and HL Tau. We detect the polarized emissions in both cases. In the case of HD 142527, we confirm that the self-scattering is working in the north part while we see magnetic-field direction in the south part. In the case of HL Tau, the polarization pattern at 3.1 mm is completely different from that at 1.3 mm. We interpret that the strong wavelength dependence is due to the self-scattering. By modeling the polarized emission, we constrain the grain size to be 70 micron.

An Introduction to the Disk Substructures at High Angular Resolution Project

Tuesday
15:45

Jane Huang

Harvard-Smithsonian Center for Astrophysics

We present an introduction to the Disk Substructures at High Angular Resolution Project, the first high angular resolution ALMA survey of protoplanetary disks. 20 protoplanetary disk systems were observed at 1.25 mm at a spatial resolution of 5 au. Substructures are found throughout the sample, most commonly in the form of rings and annular gaps. Annular substructures can occur at virtually any radius where millimeter continuum emission is detected. The absence of an obvious correspondence between the substructure locations and the estimated temperature profiles suggests that they do not occur preferentially near molecular snowlines. Three of these disks also exhibit large-scale m=2 spiral patterns. Unlike the millimeter continuum counterparts of many of the disks with spiral arms detected in scattered light, these three sources do not feature high-contrast crescent-like asymmetries or large (R>20 au) emission cavities. This difference may point to multiple spiral formation mechanisms operating in disks.

Results of the Disk Substructure at High Angular Resolution Project

Tuesday
16:30

Laura Pérez

University of Chile

The process of disk evolution and planet formation will leave an imprint on the distribution of solid particles at different locations in a protoplanetary disk, resulting in a variety of substructure over large and small scales. The focus of the ”Disk Substructures at High Angular Resolution Project” (DSHARP) is to characterize the underlying substructure in a sample of 20 nearby classical disks, from dust continuum images at 1.3 mm with a few AU spatial resolution. In this talk I will discuss DSHARP results focused on specific targets, including those disks around multiple systems.

An ALMA Disk Structure Survey in Taurus

Tuesday
17:00

Feng Long

Beijing University

The remarkable disk substructures revealed from recent high-spatial resolution observations have transformed our view of disks. While their origin is still hotly debated, they already offer much-needed new constraints on planet formation models. We have performed a high resolution (0.1 arcsec, 15 au) ALMA observation at 1.3 mm for an unbiased sample of 32 disks in Taurus, and detect dust substructures in more than 1/3 of them. These substructures are preferentially detected in larger disks but we find no trend with either stellar mass or disk brightness. Axisymmetric rings and gaps are the most common type of substructures. We rule out ice lines as the universal mechanism for their formation based on the inferred gap and ring properties. If disk gaps are carved by planets, low-mass (Neptunes) planets are preferred. Interestingly enough most other disks in our sample are compact (radii less than 40 au) and do not show substructures at our current resolution limits. Some of these disks may be tidally truncated by companions. Others may have different initial conditions or evolution and different planet formation pathways.

Scattered light imaging and the structure of disks

Wednesday
9:00

Carsten Dominik

University of Amsterdam

While early examples of scattered light imaging of protoplanetary disks, in particular with HST have been available since the turn of the century, the field has been coming into its own with the use of polarimetric differencing as a key technique to discover structures in disks, using ground-based 8m-class telescopes with high order adaptive optics. Scattered light imaging is complementary to ALMA observations by probing not so much the surface density of dust or gas, but the illumination and geometry of the disk as well as the efficiency of vertical mixing. I will show that some of those structures probe local disk properties, while others are related to shadowing by regions much closer to the star, and how this can be used to derive the structure and properties of these disks.

Evolution of protoplanetary disks from their taxonomy in scattered light

Wednesday 9:30

Antonio Garufi

Osservatorio Astrofisico di Arcetri

Images in scattered light are now available for nearly 100 protoplanetary disks. The variety of brightness, extension, and morphology from this census motivates a taxonomical study to constrain their evolution. I show how the presence of disk substructures like spirals, rings, cavities, and shadows is related to the stellar age, disk mass, and morphology of the inner disk rim. A general picture seems to emerge, with yet unseen (sub-)giant planets leaving their (observed) imprint on both the inner disk near the star and the outer disk cavity.

Planet-driven spiral waves in protoplanetary disks

Wednesday 9:45

Jaehan Bae

Carnegie Institution of Washington

Thanks to increasingly powerful observing facilities and techniques we now routinely observe substructures in protoplanetary disks, including spiral waves. In this talk, I will introduce recent improvements in planet-disk interaction theories, focusing on the formation of spiral waves and its implications. In particular, I will discuss the importance of observationally constraining disk temperature structure and using more realistic thermal models in numerical simulations.

Where do the spirals come from? Multi-wavelength, high-resolution study of HD 135344B

Wednesday 10:15

Paolo Cazzoletti

Max Planck Institute for extraterrestrial Physics

Recent observations of protoplanetary disks in both optical/near-infrared scattered light and (sub-)mm continuum emission have revealed complex structures such as spirals, rings and vortices in micron- sized and mm-sized respectively. Planets are often invoked as an explanation, but the number of planets and their location are degenerate, and the same system can often be explained by more than one scenario. Moreover, most of the time simulations are only able to reproduce the structures observed in one wavelength at the time, missing the information provided by differently sized dust grains. In fact, no clear connection between the structures observed in scattered light and mm has so far been found. HD135344B is a bright transition disk showing perfectly symmetrical spiral arms at near-IR and asymmetric structures at mm-wavelengths at the same time, and an ideal candidate to look for this missing connection. We present new 0.06 resolution ALMA Cycle 4 and 5 observations of this object in Band 3 (3 mm) and Band 4 (2 mm). A combination of these optically thin observations with our previous data at shorter wavelengths

allows to study the spectral index and the dust properties inside the asymmetry through a multi-wavelength analysis, and thus to determine whether or not dust is being trapped inside a massive vortex. Ultimately, we will be able to test whether the asymmetric structure is massive enough to launch the spiral arms observed at near-IR and if a single, massive inner planet is sufficient to explain micron and mm wavelength observations simultaneously.

Accreting Circumplanetary Region and its Observational Signatures

Wednesday 11:00

Zhaohuan Zhu

University of Nevada, Las Vegas

Using disk features revealed by high-resolution protoplanetary disk observations (e.g. DSHARP) we can probe potential young planet population and make connections with exoplanet demographics. However, to confirm that these disk features are indeed related to young planets, we need to directly detect the forming planets. In this talk, I will briefly discuss physical processes occurring around the forming planets, both in the embedded phase and in circumplanetary disk phase, and the potential observational signatures due to the planets accretion process.

The interplay between inner and outer disk in misaligned systems

Wednesday 11:30

Stefano Facchini

European Southern Observatory

High angular resolution observations can access the inner few astronomical units of planet forming disks. In particular, scattered light images can probe the 3D geometry of the very inner regions, which affects the illumination pattern onto the outer disk. Complementary information is provided by ALMA, which can determine the gas kinematics of similarly small-scale regions. One unexpected result from these observations is that the inner regions of a subsample of protoplanetary disks are misaligned with respect to the outer disk, in particular in disks hosting large cavities at (sub-)mm wavelengths. In this talk I will show recent and new observations aimed at characterising this peculiar phenomenon, discussing the possible physical origins, ranging from misaligned low-mass companions to tilted magnetic fields.

The role of gravitational instabilities on disc evolution and star & planet formation

Wednesday
12:00

Farzana Meru

University of Warwick

In this talk I will review our current understanding of young massive turbulent discs that are the natural outcomes of the star formation process. Though protoplanetary discs only remain in this so-called self-gravitating phase for a brief period of time, a number of interesting processes occur which govern the evolution of the disc. I will discuss the properties of these discs and will talk about how we model them. I will also discuss the conditions under which such discs fragment as well as the subsequent evolution following fragmentation. I will also cover our current understanding of the dust dynamics in these discs and finally, I will put the theory work into context with observations.

ALMA disk surveys: what does CO tell us about?

Thursday
9:30

Anna Miotello

European Southern Observatory

Thanks to the advent of the Atacama Large Millimeter/submillimeter Array (ALMA), large surveys of protoplanetary disks in different star forming regions have been carried out to study the gas and dust components simultaneously. Carbon monoxide (CO) and its less abundant isotopologues have been observed to trace the bulk of the gas, while the dust was traced by the (sub-)mm continuum. A result that is common to these surveys is that CO emission from disks is fainter than expected. As a consequence, the overall CO-based gas-masses are very low, often lower than one Jupiter mass and global gas/dust mass ratios are much lower than the expected interstellar-medium value of 100. This may be interpreted as lack of gas due to fast disk dispersal, or as lack of volatile carbon that leads to faint CO lines. After summarizing the results from different ALMA disk surveys and their implications, I will present alternative observational strategies which may help us to disentangle between the das dispersal scenario and the chemical evolution hypothesis.

Unveiling the dynamics of planet formation

Thursday
10:30

Richard Teague

Univeristy of Michigan

With the unparalleled sensitivity afforded by ALMA, we now have exquisite observations of planet-forming disks at a spatial and spectral resolution which offer us a glimpse of the dynamics of the planet formation process. I will present recently developed methods for extracting extremely precise kinematical information from line profiles, achieving a precision on the order of 10m/s. Such precise velocities allow us to directly trace the underlying gas pressure profile, shedding new light on grain trapping mechanisms and probe density perturbations even for optically thick lines. In addition, I will present recent observations where we are able to see kinematical signatures most likely driven by an embedded planet, such as spiral shocks and vertical motions, demonstrating the true power of kinematic probes of planet formation.

Probing the composition of the planet-building reservoir in protoplanetary disks: what we have learned from comets and ALMA

Thursday
11:30

Catherine Walsh

University of Leeds

ALMA has shone light on the diversity in molecular composition and emission morphology of nearby planet-forming disks. These data highlight that gas and ice chemistry ongoing during the epoch of planet formation, not only determines the composition of planet-building material, but also emphasizes many different physical effects. The unprecedented sensitivity of ALMA has allowed the first detection of so-called 'complex organic molecules', or COMs, defined in astrochemistry as molecules with greater than five atoms. The detection and analysis of COM emission from planet-forming disks is vital for understanding the chemical archaeological record of our Solar System contained within comets. I will give an overview of current understanding of protoplanetary disk chemistry in light of recent data from ALMA. I will discuss how chemistry affects the dust-ice-gas balance and influences the composition of forming comets, the building blocks planets.

Accretion and winds of young brown dwarfs

Thursday 14:30

Gregory Herczeg

Beijing University

The first surveys for disks around brown dwarfs were motivated by the question of how brown dwarfs form. While they now appear as the low-mass tail of the IMF, the properties of the accretion disks provide us with a probe of how disk properties and star-disk interactions change with stellar mass. In this talk, I will discuss accretion and outflows from brown dwarfs and compare those results to what we know of solar-mass T Tauri stars.

Watching brown dwarfs go round and round: rotation and variability from stars to planets

Thursday 15:00

Aleks Scholz

Univeristy of St Andrews

Variability is a characteristic feature of young stars and brown dwarfs, and provides valuable information about the structure, evolution, and fundamental properties of these objects. On one hand, eclipses by circum-sub-stellar material are commonly seen in all sorts of young very low mass objects, and at this point they constitute the only way to learn about the sub-AU structure and the dynamics of their inner disks. On the other hand, the photometric modulation caused by spots allows us to measure reliable rotation periods. It turns out that brown dwarf rotation is controlled by their disks, just as in stars. Interestingly, the initial rotation periods of brown dwarfs appear to encode information about their formation process. Finally, the hunt for accretion bursts in young stars and, in the future, young brown dwarfs continues.

Results on an ALMA survey of disks around Brown Dwarfs

Thursday 16:30

Enrique Sanchis Melchor

European Southern Observatory

I present the results of an ALMA survey of protoplanetary disks around BDs in the Lupus region. In combination with previous observations in ALMA band 7, our sample includes the full list of known BD with IR-excess in Lupus. We performed an homogeneous study to infer physical properties like total dust mass, and characteristic size from fitting empirical models to the observed visibilities. I compare these results to the complete sample of disks around TTauri stars in the same region. In addition, I briefly discuss their ability to form planetary systems like Proxima and Trappist-1.

First steps of planet formation around very low mass stars

Thursday 16:45

Paola Pinilla
University of Arizona

The very first steps of planet formation in disks around very low mass (VLM) stars are still not understood since the physical conditions are extremely unfavorable. In particular, the dust radial drift velocities are higher in disks around VLM stars than around T-Tauri stars, depleting the disk in grains before they can grow. However, there is observational evidence of grain growth in disks around VLM stars and Brown Dwarfs, and therefore somehow the radial drift of the particles must reduced or completely suppressed in these disks. For stopping the radial drift and trapping dust particles, the most common explanation is embedded massive planets in the disk forming pressure bumps. However, for disks around VLM stars, at least a Saturn mass planet is required to open a gap in the gas surface density and to trap millimeter-sized particles, which is challenging because Saturn mass planets are far above the present-day planet forming capabilities of these disks. In this talk, I will present our observational and theoretical efforts to understand the first steps of planet formation in the extreme environments of disks around VLM stars.

Close-in Super-Earths: In Situ Formation and Evolution in MRI-active Disks

Friday 9:00

Subu Mohanty
Imperial College

One of the most surprising results from Kepler is the abundance of Earth to super-Earth sized planets orbiting very close to their central stars: a species of planet not found in our solar system. Various lines of evidence moreover now indicate that a significant fraction of these formed in situ, in the innermost regions of gas-rich disks. I shall first discuss the underlying structure of such disks, derived by combining an alpha-disk model with a self-consistent alpha-viscosity driven by the MRI. I shall show that this leads naturally to both a pressure maximum in the inner disk (invoked previously as a site for in situ planet formation) and to a gas-poor innermost disk (necessary to stop super-Earths from growing into gas giants). I shall then discuss dust dynamics (growth / fragmentation, radial drift, streaming instability) in such disks, to show that dust strongly accumulates in the inner disk, another necessary condition for planet formation there. However, there are also significant barriers to planet formation here, such as the Roche limit, which have been neglected before. I shall qualitatively discuss how the back-reaction of the dust on both the MRI and on the gas dynamics might alleviate these problems (quantitative calculations are underway). Finally, I shall put these investigations together to sketch an overall model of how in situ planet formation might occur in the inner disk, including the effects of photoevaporation on the planetary atmosphere. Time permitting, I shall end with a brief digression into the habitability of such close-in planets around M dwarfs in the face of stellar XUV-driven photoevaporation.

Formation and migration of super-Earths

Friday
9:30

Alessandro Morbidelli
Observatoire de la Côte d'Azur

We model super-Earth formation as a combination of pebble-accretion, planet migration and mutual collisions of proto-planets. Our super-Earth systems migrate to the inner edge of the protoplanetary disk, where they form a resonant chain of planets. However, after the disappearance of the gas from the disk, most systems become unstable. The dynamical instability destroys the original resonant chain. Several planets merge in mutual collisions. The occurrence of these collisions may explain the existence of massive super-Earth without any significant atmosphere. We find that the observed orbital distribution of super-Earths, characterized by the period-ratio distribution between adjacent planets, can be very well reproduced if ∼90% of the systems of super-Earths become unstable after gas dissipation. The so-called Kepler dichotomy, namely the detection of a single super-Earth in 70% of the cases and multiple super-Earth systems in the remaining 30% of the cases, can also be explained by the inclination excitation acquired by multi-planet super-Earth systems during their instability. In our models most super-Earth are expected to have an icy composition. This contrasts with recent claims that most super-Earths are rocky. We discuss this apparent conundrum. Finally, we find that the difference between super-Earths and terrestrial-like planets is just a matter of available flux of pebbles. In mass starving systems, the proto-planets do not grow enough to migrate significantly in the disk, and later collide after gas dissipation, forming a few terrestrial mass planets via giant impacts, like in our Solar System.

Discovery of a planetary mass companion in the gap of the transition disk PDS 70

Friday
10:00

Miriam Keppler
Max Planck Institute for Astronomy

Only few detections of planet candidates in disks exist, and most of them are still debated. Using the VLT/SPHERE instrument and complementary datasets covering multiple epochs and various near-infrared wavelengths, we recently discovered a companion to the ∼5 Myr young T Tauri star PDS 70 within the gap of its transitional disk. Comparison of the NIR photometry to evolutionary models implies that the companion is in the planetary mass regime (5-9 MJup), consistent with the mass range inferred from atmospheric modeling (∼2-17 MJup). In this talk, we present high-resolution ALMA observations of PDS 70 in the dust continuum and 12CO. We find a highly structured circumstellar disk in both dust and gas. Whereas the outer dust ring peaks at ∼0.65 arcsec, the CO integrated intensity shows evidence of a gap at ∼0.2 arcsec. We analyse the gas kinematics and find evidence of a deviation from Keplerian rotation inside ∼0.8 arcsec. Comparison to hydrodynamical simulations suggests that a ∼10 MJup planet may not be sufficient to explain the gap width and an additional low-mass companion may be needed to account for the observed disk morphology.

New Views of Debris Disks with ALMA

Friday 10:15

David Wilner

Harvard-Smithsonian Center for Astrophysics

The dust detected around many main-sequence stars is attributed to the ongoing collisional erosion of planetesimals. Since the dust-producing planetesimals persist only in stable regions, their locations and physical properties inform about planetary system structure and evolution. Millimeter wavelengths provide a unique window on these "debris" disks, as the large grains that dominate the emission share dynamics with the planetesimals, unlike small grains seen in the optical that are rapidly redistributed by stellar radiation and winds. Moreover, the surprising detections of millimeter line emission from trace gas in debris disks opens a new path to investigate planetesimal composition. In this talk, I will present recent results on nearby debris disks that take advantage of the capabilities now available with ALMA (and other radio interferometers), including planet-disk interactions, collisional models, and molecular line reconnaissance.

The SPHERE View of 51 Eridani b

Friday 11:15

Matthias Samland

Max Planck Institute for Astronomy

Spectra of the young (20 Myr), nearby (30 pc) and relatively cool (750 K) directly imaged planet 51 Eridani b have been obtained with SPHERE and have allowed modeling of this planet in great detail (Samland et al. 2017), including clouds and non-solar metallicity. The latter have often been neglected in exoplanetary studies, but will be important in the future to constrain formation scenarios of directly imaged planets. In this talk we present new results, including high-quality spectra and results from the orbital analysis of 51 Eridani b using SPHERE data.
