CMF2IMF

The Origin of the Stellar Initial Mass Function

8–12 June 2026
ESO Garching

Scientific Organising Committee

Morten Andersen (ESO, Garching, co-chair)
Thomas Stanke (MPE, Garching, co-chair)
María Teresa Beltrán (INAF, Arcetri)
Andreas Burkert (LMU, Munich.)
Caroline Gieser (MPIA, Heidelberg)
Adam Ginsburg (University of Florida)
Patrick Hennebelle (CEA, Saclay)
Katharina Immer (ESO, Garching)
Tereza Jeřábková (Masaryk University)
Fabien Louvet (CNRS, Grenoble)
Sergio Molinari (IAPS-INAF)
Frédérique Motte (CNRS, Grenoble)
Koraljka Mužić (IA, University of Lisbon)
Aina Palau (IRYA, National Autonomous University of Mexico)
Jaime Pineda (MPE, Garching)
Thushara Pillai (Massachusetts Institute of Technology)
Hans Zinnecker (Universidad Autónoma de Chile)

Local Organising Committee

Morten Andersen (ESO, Garching)
Denisa Tako (ESO, Garching)
Katharina Immer (ESO, Garching)

Confirmed Invited Speakers

Héctor Arce (Yale University, USA)
Hervé Bouy (University of Bordeaux, France)
Helen Kirk (Herzberg Astronomy and Astrophysic Research Center, Canada)
Rolf Kuiper (University of Duisburg-Essen, Germany)
Estelle Moraux (University of Grenoble Alpes, France)
Thomas Nony (Osservatorio Astrofisico di Arcetri, Italy)
Stella Offner (University of Texas, USA)
Rowan Smith (University of St. Andrews, UK)

https://www.eso.org/sci/meetings/2026/CMF2IMF.html
CMF2IMF@eso.org

Background image: RGB: DSS2; Orange: Herschel/Planck gas column density (André et al. 2010, A&A 518, L102; Ladjelate et al. 2020, A&A 638, A73)

Contents

Programme

** Remote speaker*

Monday, 8 June – Mass Reservoir		
12:15–13:00	*Registration*	
13:00–13:15	Introductory / organisational remarks	SOC Chairs
13:15–13:45	*Overview of the stellar IMF and its variations*	*Estelle Moraux*
13:45–14:15	*How do stars get their mass? An observational history of the CMF*	*Thomas Nony*
14:15–14:45	*Following the Evolution from Cores to Stars: Theory and Simulations*	*Stella Offner*
14:45–15:15	Coffee break	
15:15–15:33	The assembly of star clusters: high resolution observations of the dense gas kinematics in protoclusters	Amelia Stutz
15:33–15:51	Kinematical characterization of the early stages of star formation: The G353 protocluster	Rodrigo H. Álvarez-Gutiérrez
15:51–16:09	Make or break for massive star formation: are monolithic high-mass pre-stellar cores real?	Ashley Barnes
16:09–16:27	Challenges in probing turbulent and magnetic support in cores: the W43-MM1 protocluster case study	Maxime Valeille-Manet
16:27–16:45	Do magnetic fields support the formation of high-mass cores?	Katerina Klos
16:45–17:03	Vibes: Virial-Based Extraction of cores in numerical Simulations	Simon Chevalier
17:03–17:21	A Framework for Modeling Evolution of the Core Mass Function	Theo Richardson
17:21–19:30	Beer & Brezn reception	

Tuesday, 9 June – Mass Reservoir		
09:00–09:30	*How to get from a core to a star/multiple system*	*Hector Arce*
09:30–09:48	A hierarchical, mass-dependent fragmentation model for shaping the IMF and stellar multiplicity	Isabelle Joncour
09:48–10:06	The contribution of core-fragmentation on protostellar multiplicity	Rajika Kuruwita*
10:06–11:06	Poster session 1 / coffee break	

11:06–11:24	The Formation and Fragmentation of Molecular Clouds	Ramisa Rahman
11:24–11:42	Core subfragmentation and mass growth in the W43-MM1 massive protocluster	Romeo Veyry
11:42–12:00	Multi-scale Kinematics of High-Mass Star-Forming Environments: An Accretion Streamer in the G328 Clump	Javiera Salinas
12:00–13:15	Lunch break	
13:15–13:45	*The Formation and Fragmentation of Molecular Clouds*	*Rowan Smith*
13:45–14:03	Linking (synthetic) CMFs to (sink) IMFs in massive clumps with the Rosetta Stone project	Alice Nucara
14:03–14:21	LANCET: capture the evolution of dense gas and core mass function in a 10-pc long filament	Fengwei Xu
14:21–14:51	Coffee break	
14:51–15:09	DAWN: Stellar mass distribution synthesis in feedback-driven cluster formation simulations	Yann Bernard
15:09–15:27	Prestellar CMF and Core Growth Revealed in ASHES High-mass Clumps	Kaho Morii
15:27–17:27	ALMA surveys	

Wednesday, 10 June – Fragmentation		
09:00–09:30	*The Core Mass Function in Nearby Molecular Clouds*	*Helen Kirk*
09:30–09:48	A comparison between pre-stellar and proto-stellar populations in Perseus	Milena Benedettini
09:48–10:06	The role of molecular filaments and prestellar cores in the origin of the IMF	Philippe André
10:06–11:06	Poster session 2 / coffee break	
11:06–11:24	The influence of magnetic fields in Cloud-Cloud Collisions	Theotokis Georgatos*
11:24–11:42	From a mass invariant in the compressible gravoturbulent ISM to the characteristic mass of the cores	Pierre Dumond
11:42–12:00	The Peak of the Stellar IMF from Supersonic Turbulence	Paolo Padoan
12:00–12:05	Group photo	
12:05–13:20	Lunch break	
13:20–13:38	Zoom-in numerical simulations for star formation	Georges Abboudeh
13:38–13:56	Evolution of the clump mass spectrum in simulations of evolving molecular clouds	Daniela Ezqueda Morales

13:56–14:14	Inversely synthesizing the core mass function of high-mass star-forming regions from the canonical initial mass function	Jianwen Zhou*
14:14–14:32	Investigating the nature of disappearing cores in source AG286.0716-1.82	Chiara Mininni
14:32–15:32	Coffee break	
15:32–15:50	NASCENT-stars: A Multi-wavelength Characterization of fragmentation in the Massive Dense Core CygX-N53	Devismita Panda
15:50–16:08	Core fragmentation in the W51 high-mass star-forming region	Taehwa Yoo
16:08–16:26	The fragmentation properties of massive star-forming regions in 30Dor-10 at 2000 AU resolution	Alessio Traficante
16:26–16:44	The Zero-Age Massive Stellar Population of W49A from VLA Observations	Roberto Galván-Madrid
16:44–17:00	Expanding Capabilities in Submillimeter Astronomy: The ALMA wideband sensitivity upgrade and the Atacama Large Aperture Submillimeter Telescope	Katharina Immer
19:00	Workshop dinner at Gasthof Neuwirt, Münchener Str. 10, Garching	

Thursday, 11 June – Environment and Feedback		
09:00–09:30	*The Bottom of the Initial Mass Function*	*Hervé Bouy*
09:30–09:48	Extreme IMF	Raffaella Schneider
09:48–10:06	The Initial Mass Function and Early Dynamical Evolution of Star Clusters in the Gaia DR3 Era	Priya Shah*
10:06–10:24	Substellar population of the young massive cluster RCW 36 in Vela	Afonso do Brito do Vale
10:24–11:06	Coffee break	
11:06–11:24	The low-mass IMF in the extreme environment of Trumpler 14	Tamara Rom
11:24–11:42	Probing Substellar Formation in a Feedback-Dominated Environment with Euclid	Styliani Tsilia
11:42–12:00	Unveiling the Low-Mass Stellar Population in the h and χ Persei Double Cluster	Indrajit Maity
12:00–12:18	Probing Environmental Influences on the Initial Mass Function: Solar neighborhood to Outer Milky Way	Jessy Jose
12:18–13:30	Lunch break	
13:30–13:48	Feedback-Regulated Fragmentation and the CMF–IMF Connection in Ruprecht 32	Harmeen Kaur

13:48–14:06	Impact of massive stars' radiative feedback on core star formation	Paolo Suin
14:06–14:24	The Role of Thermal Feedback and Non-LTE Chemistry in Shaping the Mass Reservoir of G14.225-0.506	Alexia Anguera Gonzalez
14:24–14:42	Connecting Filamentary Accretion to Feedback at 100 AU Scales in W33 Main	Lennart Böhm
14:42–15:30	Coffee break	
15:30–15:48	Study of free-free contamination in the sample of cores in the 15 ALMA-IMF protoclusters	Mélanie Armante
15:48–16:06	SESHAT: A Python Tool for Finding YSOs in JWST Data	Breanna Crompvoets
16:06–16:24	The Effect of External Photoevaporation on the Disk Lifetime in M17	Sam Millstone
16:24–16:52	What can the ELT tell us about the IMF?	Fabian Haberhauer

Friday, 12 June – Galaxy session / extreme environments		
09:00–09:30	*Shaping the Upper End of the IMF: From Core Mass Functions to the Most Massive Stars (Review)*	*Rolf Kuiper*
09:30–09:48	Multiscale accretion in dense cloud cores and the delayed formation of massive stars	Enrique Vázquez-Semadeni
09:48–10:06	The Initial Mass Function as the Equilibrium State of a Variational Process	Eda Gjergo
10:06–10:24	From Core Fragmentation to Galaxy-wide IMFs	Hosein Haghi
10:24–10:42	Linking the low- and high-mass ends of the initial mass function in star-forming galaxies	Diego Salvador
10:42–11:12	Coffee break	
11:12–11:32	From Inflow to Outflow: Rapid Evolution of Massive Embedded Clusters in NGC 253	Ashley Lieber
11:32–11:52	The present day mass function of Omega Centauri	Maximilian Häberle
11:52–12:12	The impact of a variable initial stellar mass function in the interpretation of high-z galaxy data	Fabio Fontanot
12:12–12:30	Concluding remarks	SOC Chairs
12:30–13:30	Lunch break	

Index of abstracts

Index of posters

Abstracts of talks

Overview of the stellar IMF and its variations

Estelle Moraux

How do stars get their mass? An observational history of the CMF

Thomas Nony

Measuring the mass distribution of cores (CMF) is a key step in understanding the origin of the IMF and in constraining star formation models. Over the last three decades, technical progresses in far-infrared and submillimeter observatories have transformed our view of the CMF. The first millimeter continuum surveys that probed the scale of dense cores revealed CMFs with a slope similar to the canonical Salpeter value (-1.35), leading to the hypothesis that cores are the direct mass reservoirs of stars. Since 2010, numerous Herschel studies have mapped nearby (<500 pc) clouds in the Gould Belt and also found CMF slopes close to Salpeter's. The arrival of ALMA marked a milestone, as it enabled observations at scales of a few thousand au in distant (>kpc), more massive clouds. Studies in the W43 region have shown, for the first time, CMFs that are significantly top-heavy. More recently, large programs such as ALMA-IMF, ALMAGAL, and ASHES have compared high-mass clouds and clumps at various evolutionary stages. Their first results paint a more complex picture, in which the slope of the CMF varies as the cloud evolves and under the influence of bursts, in line with dynamical models of star formation.

Following the Evolution from Cores to Stars: Theory and Simulations

Stella Offner

I will review different models for the origin of the stellar initial mass function (IMF) with a particular focus on examining ideas about the relationship between dense cores and the stars they form. I will present results from star cluster simulations, which track the evolution of cores and accreting gas, and discuss how the relationship between dense cores and stars may depend on stellar mass.

Finally, I will discuss how stellar multiplicity impacts the determination of the IMF.

The assembly of star clusters: high resolution observations of the dense gas kinematics in protoclusters

Amelia Stutz

Recent and upcoming ALMA-IMF results using N2H+ (1-0) high resolution (4 kau) observations in relatively massive and compact Milky Way protoclusters capture the dense gas kinematics, constraining cluster formation timescales and processes, as well as inflow onto dense star forming cores. I will focus on kinematic analysis in three protoclusters: G351, G353, and G012. Despite their apparent simplicity, the analysis reveals highly dynamic protoclusters and dense core feeding, potential filament rotation, and suggests that processes driving evolution in the gas ultimately control SFRs and SFEs. Initial work connecting ALMA-IMF protoclusters to their larger scale environment indicates that external gas feeding may extend the short (0.3 Myr) kinematically inferred lifetimes of the cluster assembly phase.

Kinematical characterization of the early stages of star formation: The G353 protocluster

Rodrigo H. Álvarez-Gutiérrez

While star clusters have been well characterized over the past few decades, there are many unknowns regarding their early stages. In this context, we use ALMA-IMF observations to characterize the dense gas kinematics of the nearby (2kpc) and massive (2500 Msun) G353 protocluster. These data allow us to study the early stages of massive star formation, from cores (0.02pc) to protocluster scales (1.5 pc). From N2H+ (1-0) data we find that G353 is a hub-filament system hosting three filaments. From DCN (3-2) we see that the core velocities are similar to the gas velocities traced by N2H+, suggesting that cores are kinematically coupled with the dense gas in which they form. At small scales we find N2H+ V-shaped velocity gradients (VGs), mostly along filaments, and particularly clumped at the hub. We interpret these VGs as signatures of converging gas flows. We estimate the mass associated with these VGs and their timescales, calculating mass accretion rates between (0.35–8.77)x10^4 Msun/yr. We propose that these VGs create overdensities of material, leading to the formation and feeding of cores, and the creation of multiple generations of stars.

Make or break for massive star formation: are monolithic high-mass pre-stellar cores real?

Ashley Barnes

The origin of the stellar initial mass function (IMF) is closely linked to how molecular clouds fragment into dense cores and how those cores evolve toward star formation. A key open question is whether high-mass stars form from massive, monolithic pre-stellar cores or instead assemble through fragmentation and competitive accretion. Identifying genuine massive pre-stellar cores is therefore essential for testing IMF formation pathways. I will present new ultra-high-resolution ALMA Band 6 observations of the candidate massive pre-stellar core C2c1a in the infrared dark cloud G028.37+00.07. These data reach spatial scales of $\sim$100 AU and show that the primary core remains a single, centrally concentrated continuum peak with no detectable sub-fragmentation. Despite extreme inferred densities (>10^8 cm^{-3}), the core is remarkably line-poor and shows no evidence for outflow or shock activity. Combining high-resolution brightness temperature constraints with larger-scale flux measurements implies a total mass of $\sim$10–30 solar masses concentrated within a few hundred AU. These results establish C2c1a as a strong candidate for a massive pre-stellar core and provide a rare benchmark for testing how the upper end of the core mass function maps onto the stellar IMF.

Challenges in probing turbulent and magnetic support in cores: the W43-MM1 protocluster case study

Maxime Valeille-Manet

Using ALMA 12m molecular line and dust-polarization observations of the massive protocluster W43-MM1, we estimated kinetic support in 45 dense cores (masses 1–115 Msun), with magnetic field estimates for 21 cores. Within a simple virial analysis, $\sim$70% of cores (kinetic alone) and $\sim$85% (kinetic+magnetic) appear supported against gravity – unexpected for protostellar cores. We show that contributions from organized motions (infall, convergent flows, rotation) and omission of surface terms can significantly broaden linewidths and lead to overestimation of non-thermal support. This highlights that any simplified virial framework can introduce biases when assessing physical support mechanisms within cores.

Do magnetic fields support the formation of high-mass cores?

Katerina Klos

Massive star formation long has been a topic of debate, centering around two opposing modes:

slow, quasi-static formation or dynamic, accretion-driven growth. We present results from SPMHD simulations (PHANTOM), modelling the early phases of star formation with the addition of magnetic fields. We simulate six clumps, four magnetised (mass-to-flux ratios 3,5,10,100) and two hydrodynamical clouds. Using an in-house potential-based clump-finding algorithm, we identify and track core evolution. Regardless of magnetisation, cores begin as low-mass 'seeds' and grow via mergers and accretion, becoming bound near the thermal Jeans mass. Magnetised clouds concentrate initial core formation in their central regions, whereas non-magnetised core formation is more distributed. Core-core interactions contribute significant material to overall core growth. These results suggest that, even with magnetic fields, quasi-static conditions required by the Turbulent Core model for massive star formation are not feasible.

Vibes: Virial-Based Extraction of cores in numerical Simulations

Simon Chevalier

The origin of the stellar initial mass function (IMF) and its relationship with the core mass function (CMF) remain among the major open questions in star formation. The definition of a core remains unclear, yet the way they are extracted critically shapes the resulting CMF. I developed vibes, a numerical tool that extracts bounded cores in numerical simulations based on a direct application of the virial theorem. This tool works both on Eulerian and Lagrangian simulations. It has been tested on RAMSES and STARFORGE outputs. Beyond the vibes method itself, I will discuss the temporal consistency of the extracted structures, following their evolution across successive snapshots and examining their accretion onto sink particles. I will also address the virial balance of the structures and the effects of projection by comparing the 3D vibes structures with 2D objects extracted by common source extraction tools on projected maps.

A Framework for Modeling Evolution of the Core Mass Function

Theo Richardson

I present a newly developed method for simulating protoclusters able to directly link theory with observations. This method connects an IMF and star formation history (SFH) with models of evolving young stellar objects to create protocluster models with continuous, self-consistent evolutionary histories and associated SEDs for all members. I use these to examine how the IMF, SFH, and accretion history are expected to manifest in observations, with a focus on the long wavelengths commonly used to measure the CMF. I discuss the extent to which these concepts may be inferred through measurement, thereby mapping out the theory space available to a CMF-IMF connection.

How to get from a core to a star/multiple system

Hector Arce

It is a common piece of astrophysical lore that transitioning from the Core Mass Function (CMF) to the Initial Mass Function (IMF) is a straightforward process dictated solely by core-to-star efficiency. However, this simplistic view overlooks the diverse physical mechanisms occurring within and around a core that govern the formation of one or more stars. In this talk, I will provide an overview of recent observational and theoretical results investigating these processes and their impact on the stellar mass-assembly phase. Specifically, I will discuss core and disk fragmentation, magnetic fields, outflow feedback, and large-scale infall streamers. Observations and numerical simulations demonstrate that fragmentation is prevalent across a wide range of scales and that the dynamical evolution of multiple systems continues throughout the protostellar stage. The IMF is therefore not a direct, scaled version of the CMF, but rather the byproduct of a complex interplay between a range of processes that take place in the core throughout the protostellar phase.

A hierarchical, mass-dependent fragmentation model for shaping the IMF and stellar multiplicity

Isabelle Joncour

Our work explores how hierarchical fragmentation of gas cores influences both the shape of the core mass function (CMF) across spatial scales and the multiplicity of young stellar objects. We adopt a hierarchical, scale-free fragmentation model grounded in physical principles within a gravoturbulent framework and apply it to the W43-MM2 and MM3 dense molecular clouds, which exhibit a top-heavy CMF. We show that successive levels of fragmentation progressively shift the core mass distribution toward lower masses and affect the slope of the high-mass part of the CMF. Our results suggest that a mass-independent fragmentation cascade cannot fully reproduce the observed stellar multiplicity, and that a universal IMF can only emerge if the hierarchical fragmentation is based on a specific mass-dependent process. We propose that fragmentation operates in two distinct regimes: gas feeding that controls the IMF slope, and fragmentation that sets the low-mass turnover.

The contribution of core-fragmentation on protostellar multiplicity

Rajika Kuruwita

When the bimodal distribution in the separation of protostellar binaries was first observed 10 years ago, the simple explanation for the peaks at 3000au and 75au was whether the binary formed via core- vs disc-fragmentation respectively. However, simulations of binary stars formed via core-fragmentation often show that the systems experience significant inspiral. In this work I used simulations of star cluster formation in a $4pc^3$ box to study the formation and evolution of binaries formed on core-fragmentation scales (100s–1000s au). I found that most systems that form often inspiral to their final separation, and we are able to reproduce the observed bimodal distributions. We conclude that core-fragmentation and inspiraling is a likely formation pathway for binaries down to a separation of around 20au.

The Formation and Fragmentation of Molecular Clouds

Ramisa Rahman

In this talk I will discuss how clouds are formed and how this affects the fragmentation within them. We will focus on the generation of turbulence and magnetic fields, and how this influences the stability of the network of filaments that form within clouds. Clumps and cores will form within this network, and their position within the cloud will influence whether they evolve as isolated objects or whether continued accretion will play a role. Given the short timescales over which these systems evolve it is hard in a single observation to link core properties to the resultant IMF. We will finish by exploring how synthetic observations of fragmenting molecular clouds can give insights to this process.

Core subfragmentation and mass growth in the W43-MM1 massive protocluster

Romeo Veyry

For a long time, the IMF was considered to originate from the CMF, but this idea is now debated. We study two key processes that influence the CMF: subfragmentation and core mass growth. Using a hierarchical model, we characterized the fragmentation cascade of W43-MM1 over two decades. Based on low fractality, high mass transfer, and unbalanced mass partition, we predict that the resulting IMF will remain top-heavy. Meanwhile, the ALMA-IMF consortium studies gas inflow and accretion rates toward cores using N2H+(1–0) and DCN(3–2). We constrain the mass evolution of 25 cores in W43-MM1 and aim to determine the evolution of the CMF. By combining constraints on subfragmentation and mass growth, we move toward a predictive, time-dependent framework linking cloud properties to the IMF.

Multi-scale Kinematics of High-Mass Star-Forming Envi-

ronments: An Accretion Streamer in the G328 Clump

Javiera Salinas

Accretion processes in massive star formation are inherently multi-scale: gas streams can feed clumps, massive cores, and protostellar systems. We present a kinematic study of an elongated structure in the high-mass star-forming clump G328.2551-0.53 that hosts a massive young protostellar object (15–20 $M_{\odot}$). Using multiple methanol transitions, we trace gas kinematics through position-velocity diagrams from 10,000 AU down to disk scales. We identify a coherent accretion streamer feeding the massive envelope ($\sim$100 $M_{\odot}$) of the central protostar. We model the streamer to characterize its gas mass, mass accretion rate, infall radius, and infall timescale. This structure provides direct observational evidence of ongoing mass transport from filamentary structures to the forming system.

The Formation and Fragmentation of Molecular Clouds

Rowan Smith

In this talk I will discuss how clouds are formed and how this affects the fragmentation within them. We will focus on the generation of turbulence and magnetic fields, and how this influences the stability of the network of filaments that form within clouds. Clumps and cores will form within this network, and their position within the cloud will influence whether they evolve as isolated objects or whether continued accretion will play a role. Given the short timescales over which these systems evolve it is hard in a single observation to link core properties to the resultant IMF. We will finish by exploring how synthetic observations of fragmenting molecular clouds can give insights to this process.

Linking (synthetic) CMFs to (sink) IMFs in massive clumps with the Rosetta Stone project

Alice Nucara

To quantify how clump initial conditions regulate fragmentation and how the resulting Core Mass Function (CMF) connects to the Initial Mass Function (IMF), we developed the Rosetta Stone project: an end-to-end (simulations observations) framework based on systematic production of realistic synthetic observations. We compared ALMA 1.3 mm continuum emission from SQUALO and ALMAGAL surveys with 24 RAMSES RMHD simulations of high-mass clump fragmentation. Relying on $\sim$2000 synthetic maps, we build synthetic CMFs and follow their evolution across spatial scales and evolutionary stages. Fragmentation is confirmed to be multi-scale and hierarchical: multiplicity increases from $\sim$7000 AU to $\sim$1000 AU and down to sink scales ($\sim$40 AU). This establishes a quantitative framework to link synthetic CMFs to sink IMFs as a function of clump initial conditions.

LANCET: capture the evolution of dense gas and core mass function in a 10-pc long filament

Fengwei Xu

The G316.8 filament provides an excellent controlled case: a 14-pc, nearly linear structure comprising three contiguous subregions spanning a clear evolutionary sequence from infrared dark cloud (Young) to HII region (Evolved). The LANCET project observes the entire filament with ALMA at 1.3 mm, with 0.3” resolution. We combine ALMA, Herschel, and APEX data to produce high-resolution temperature and column-density images. We characterize regional differences via (i) core mass function, (ii) N-PDF fitting, and (iii) Delta-variance. Across G316.8, dense cores, N-PDFs, and Delta-variance spectra consistently point to a coherent evolutionary trend in which gas is funneled into dense sub-parsec components and then converted to stars.

DAWN: Stellar mass distribution synthesis in feedback-driven cluster formation simulations

Yann Bernard

Although stars are central to our understanding of the universe, the origin of their mass distribution remains debated. Stellar feedback processes in star-forming regions, such as protostellar jets, winds and photoionisation, were originally perceived as star formation regulators by expelling infalling gas. Recent studies show that these processes can also alter the properties of nearby regions undergoing collapse. They can significantly modify the stellar mass distribution produced in dense starburst regions. In this presentation, I will present results extracted from DAWN star formation and cluster assembly simulations. I will describe the innovative methods used to create the DAWN model, which allow forming individual stars from a molecular cloud collapse and evolve them up to 10 Myr, including photoionisation feedback. I will then describe the mass distributions obtained with different parameterisations. Finally, I will emphasise the impact of HII regions on the gas density PDF and link it to the measured IMF.

Prestellar CMF and Core Growth Revealed in ASHES High-mass Clumps

Kaho Morii

CMF is a critical link in understanding the origin of the IMF. Using data from the ALMA Survey of 70 µm Dark High-mass Clumps in Early Stages (ASHES), we study the CMF in the earliest stages of high-mass star formation. From a large sample of 461 prestellar core candidates, we find that the CMF of gravitationally bound prestellar cores exhibits a power-law slope indistinguishable from the Salpeter IMF slope. However, the total CMF (including protostellar cores) is shallower, with protostellar cores reaching significantly higher masses. We demonstrate that this evolution can be explained by substantial external gas infall, more consistent with tidal-lobe accretion than Bondi–Hoyle–Lyttleton accretion. This challenges the assumption that the IMF is a simple scaling of the CMF; core-to-star efficiency is a mass-dependent process.

The Core Mass Function in Nearby Molecular Clouds

Helen Kirk

The dense core mass function, its relationship with the initial stellar mass function, and its variation across environments have been major areas of research for several decades. Large-area surveys covering many nearby molecular clouds, including the Herschel and JCMT Gould Belt Surveys, have been transformative in giving us a better understanding of the dense core mass function. Here, I review recent results on the role of filaments in setting the dense core mass function and whether the core mass function is universal or instead varies with environment.

A comparison between pre-stellar and proto-stellar populations in Perseus

Milena Benedettini

We present a catalog of protostars and Young Stellar Objects (YSOs) in the Perseus star forming region, extracted from six far-infrared continuum maps produced by Herschel PACS and SPIRE at 70–500 microns. Herschel instruments are particularly sensitive to protostars in the youngest evolutionary stages, namely Class 0 and I, still embedded in a robust dusty envelope. To ensure full characterization, we performed simultaneous source detection and flux measurement in the six Herschel maps plus data from Spitzer (24 micron), Scuba (450/850 micron) and Bolocam (1100 micron). The resulting SEDs were analyzed using radiative transfer models. We will present the physical properties of the Perseus YSO population and explore its correlation with the pre-stellar cores population identified in the same field.

The role of molecular filaments and prestellar cores in the origin of the IMF

Philippe André

I will discuss new insights into the origin of the stellar IMF based on a systematic census of dense cores and molecular filaments in nearby clouds with Herschel, supplemented by higher-resolution observations with APEX/ArTéMiS, ALMA, NOEMA, and JWST. I will first give an overview of the results obtained on the core mass function (CMF) as part of the Herschel Gould Belt survey (HGBS), paying special attention to distinguishing between the mass functions of self-gravitating prestellar cores, unbound starless cores, and protostellar cores. In all nearby HGBS regions, the observed prestellar CMF exhibits a peak below $\sim$1 Msun and a tail consistent with a Salpeter-like slope at higher core masses. I will critically examine the robustness of the prestellar CMF peak and its possible variation from region to region. Overall, our results point to the key role of the quasi-universal filamentary structure pervading molecular clouds. They suggest that the dense cores making up the peak of the prestellar CMF result from gravitational fragmentation of molecular filaments near the critical mass per unit length.

The influence of magnetic fields in Cloud-Cloud Collisions

Theotokis Georgatos

Cloud–cloud collisions are often discussed in the context of highly supersonic flows, yet low-supersonic collisions may play a more important role in shaping star-forming structures. Here, we explore how magnetic fields aligned with the collision direction influence the filamentary morphology and star formation that develops in such low-velocity collisions. We find that collisions produce two characteristic filamentary patterns: a hub–filament system and a spider's-web morphology. Magnetic fields slow the fragmentation of the shocked layer, broaden filaments, and shift the boundary between these regimes to higher velocities, thereby increasing the likelihood of forming hub-filament systems. I will show how these contrasting patterns emerge in simulations and explain how magnetic regulation reshapes when and where stars form, with direct consequences for the range of stellar masses.

From a mass invariant in the compressible gravoturbulent ISM to the characteristic mass of the cores

Pierre Dumond

Supersonic compressible turbulence is ubiquitous in star-forming regions. In 1951, Chandrasekhar derived a mass time-invariant under the assumption of statistical homogeneity of the turbulent field. Using high-resolution numerical simulations of compressible turbulence, we demonstrate that this invariant is preserved in media subject to decaying turbulence or self-gravity. We then present several applications of this invariant that provide new insights into the statistical properties of compressible turbulent flows and the formation of structures in the interstellar medium. From a star formation perspective, we show that the invariant can be used to predict the characteristic mass of prestellar cores and to explain its apparent universality across Milky Way-like star-forming environments. We also discuss how variations in this characteristic mass naturally arise in more extreme star-forming conditions, such as high-mass star-forming regions and high-redshift galaxies.

The Peak of the Stellar IMF from Supersonic Turbulence

Paolo Padoan

We study the origin of the stellar IMF using a new suite of non-ideal isothermal MHD simulations that include ambipolar drift and span a broad range of turbulent Mach numbers and virial parameters, representing the largest set of IMF simulations to date. The simulations are performed with the task-based asynchronous code DISPATCH in 4 pc boxes with continuous solenoidal driving, achieving resolutions down to 3 AU. We show that the IMF peak mass decreases with increasing Mach number, in qualitative agreement with turbulent fragmentation models, and we quantify this dependence. We also show convergence tests proving that the stellar IMF peak converges to realistic mass values without the need to invoke feedback processes.

Zoom-in numerical simulations for star formation

Georges Abboudeh

Star formation plays an important role in shaping its environment and drives the evolution of planets, the interstellar medium, galaxies, and the Universe as a whole. We investigate this process using numerical simulations that follow star-forming structures across a wide range of spatial scales. To avoid imposing artificial initial conditions, we first simulate a kiloparsec portion of a galaxy using the adaptive-mesh refinement code RAMSES. From this large-scale simulation, we identify and extract multiple star-forming regions that form as a result of the physics and initial conditions from the galactic environment. These regions are then re-simulated at higher resolution through a zoom-in technique, reaching spatial scales down to 200 AU. Within these zoomed simulations, we identify dense cores and analyze their statistical properties, including mass growth, the core mass function, turbulence, and fragmentation. By studying a large sample of regions with self-generated initial conditions, we capture the diversity of star-formation environments and quantify how core properties vary from one region to another. Finally, we compare our numerical results with observational data to assess how well the simulations reproduce observed core populations.

Evolution of the clump mass spectrum in simulations of

evolving molecular clouds

Daniela Ezqueda Morales

We investigate the temporal evolution of the clump mass function (CMF) using numerical simulations of molecular cloud formation and evolution. This study is motivated by recent observational results suggesting that the CMF is not static, but evolves with time. We define clumps using the Yt task density thresholds. Based on this definition, we analyze the mass distribution of clumps at time steps in the simulation. Our results show evidence of CMF evolution, characterized by an increase over time. However, due to the limited resolution of the simulations, a well-defined power law in the CMF is not reproduced. Despite this limitation results suggest that clear signatures of structural evolution in the CMF, consistent with recent observational findings.

Inversely synthesizing the core mass function of high-mass star-forming regions from the canonical initial mass function

Jianwen Zhou

Many studies have revealed that the core mass function (CMF) in high-mass star-forming regions is top-heavy. In this work, we start from the canonical initial mass function (IMF) to inversely synthesize the observed CMFs of high-mass star formation regions, taking into account variations in multiplicity and mass conversion efficiency from core to star ($\epsilon_{\rm core}$). To match the observed CMFs, cores of different masses should have varying $\epsilon_{\rm core}$, with $\epsilon_{\rm core}$ increasing as the core mass decreases. However, the multiplicity fraction does not affect the synthesized CMFs. To accurately fit the high-mass end of the CMF, it is essential to determine whether the CMF shows a slope transition from the low-mass end to the high-mass one. If the CMF truly undergoes a slope transition but observational biases obscure it, leading to a combined fit with a shallower slope, this could artificially create a top-heavy CMF.

A study of the core mass function at clump level in the ALMAGAL survey

Stefania Pezzuto

The Core Mass Function describes the mass spectrum of forming stars and evolves into the IMF. However, the CMF is usually derived over large samples of cores belonging to different parental clouds and evolutionary stages. Recently, a tool to compute power-law parameters for small samples has been derived. By assuming a power law to characterize the CMF, a study of the clump-by-clump CMF has been started inside the ALMAGAL consortium. In this talk I present the first results, showing how α, the exponent of the power-law distribution, changes from clump to clump.

Investigating the nature of disappearing cores in source AG286.0716-1.82

Chiara Mininni

Different surveys have observed cores at different scales, from 7000 au to 1000 au. The ALMAGAL survey observed more than 1000 clumps with ALMA and combined data to obtain images at full resolution (∼1000 au) and intermediate resolution (∼5000 au). Comparison of cores extracted at the two resolutions reveals that a non-negligible fraction of cores seen at ∼5000 au have no counterpart at ∼1000 au – ”disappearing” cores. We investigated the nature of these disappearing cores with a pilot study on source AG286.0716-1.8229, where 4 disappearing cores are present, observing deuterated species typically tracing prestellar cores to determine if these disappearing cores might be early evolutionary stages with a flat inner part of the radial profile.

NASCENT-stars: A Multi-wavelength Characterization of fragmentation in the Massive Dense Core CygX-N53

Devismita Panda

We present continuum and spectral analysis of the CygX-N53 massive dense core using NOEMA observations at 1mm and 3mm. Our continuum analysis resolved 38 and 24 compact fragments at 1mm and 3mm, respectively, at ∼0.8” (1200 au) resolution – more than three times previous detections. SED analysis identifies Class 0, I, and II objects. The two most massive fragments lack infrared counterparts and radio emission, confirming they are at the earliest stage. Spatial clustering analysis suggests that the N53 core fragments into two clusters. The youngest and most massive millimeter sources exhibit rich spectral line emission, providing insights into their physical and chemical conditions.

Core fragmentation in the W51 high-mass star-forming region

Taehwa Yoo

We study core fragmentation in the W51-E and W51-IRS2 protoclusters using ALMA Bands 3 and 6.

We characterize compact sources found in long-baseline images as pre/protostellar objects (PPOs). Observed trends: (i) massive cores host more PPOs, (ii) bright PPOs are preferentially formed in massive cores, (iii) equipartition of flux is uncommon. Thermal Jeans masses of parent cores are insufficient to explain fragment masses, especially at high masses. Unfragmented cores are larger, less massive, and less dense. Although massive cores undergo greater fragmentation – which could steepen the IMF relative to the CMF – this effect may be mitigated because the most massive fragment typically retains a substantial fraction of the core mass.

The Zero-Age Massive Stellar Population of W49A from VLA Observations

Roberto Galván-Madrid

We present a new approach to infer the masses of the youngest population of OB-type stars in protoclusters, i.e., those that are still deeply embedded, through the radio continuum emission of the ultra- and hypercompact HII regions that they photoionize. With our new method, we have inferred the hydrogen-ionizing photon rates and corresponding stellar masses for about 100 HII regions in W49A, one of the most active star formation regions in the Galaxy. We infer a young-stellar mass function with a slope that is robustly steeper than the Salpeter slope under different assumptions. We tentatively conclude that the origin of this unexpected result could be a shorter lifetime of the ultra-compact HII regions ionized by more massive stars, implying that these ”missing” very massive stars should be detectable in deep near- and mid-infrared surveys with JWST.

Expanding Capabilities in Submillimeter Astronomy: The ALMA wideband sensitivity upgrade and the Atacama Large Aperture Submillimeter Telescope

Katharina Immer

This presentation will provide an overview of the ongoing development of the Wideband Sensitivity Upgrade (WSU) for the Atacama Large Millimeter/submillimeter Array and recent progress toward the proposed AtLAST facility. For ALMA, I will discuss the goals and status of the WSU effort, which aims to significantly enhance observational efficiency and scientific capability through expanded instantaneous bandwidth and improved receiver performance. The presentation will highlight key technical developments and the anticipated scientific impact of increased continuum sensitivity and spectral survey speed. In addition, I will present the concept and current development status of AtLAST, a proposed large-aperture submillimeter telescope designed to enable transformative wide-field observations of the cold Universe. I will discuss the scientific motivation, technical challenges, and opportunities associated with the development of this next-generation facility. Together, these topics provide a perspective on both near-term advancements for ALMA and long-term opportunities in submillimeter astronomy.

The Bottom of the Initial Mass Function

Hervé Bouy

The low-mass end of the initial mass function links the physics of fragmentation, accretion, dynamical evolution, and planet-like object formation. Yet, despite decades of work, the census of brown dwarfs and free-floating planetary-mass objects remains incomplete, heterogeneous, and often limited by contamination and uncertain membership. In this talk, I will review past and recent observational progress in measuring the IMF across different environments, from nearby star-forming regions and open clusters to more distant and massive clusters. I will focus on what these populations reveal about the shape of the IMF below the hydrogen-burning limit, its possible environmental dependence, and its evolution with age through dynamical processing and evaporation. I will also discuss how the newest generation of wide and deep surveys is changing the field, including JWST and Euclid.

Extreme IMF

Raffaella Schneider

The Initial Mass Function and Early Dynamical Evolution of Star Clusters in the Gaia DR3 Era

Priya Shah

This study employs unsupervised and supervised machine learning techniques to accurately identify members of a large sample of open clusters using Gaia DR3 data, enabling a homogeneous analysis of their IMF and mass segregation. We construct clean color-magnitude diagrams to derive stellar masses via isochrone fitting and calculate the IMF slope for the low-mass stellar population across clusters of varying ages and environments. By analyzing the radial distribution of stars as a function of mass, we quantify the degree of mass segregation. Our results demonstrate that ML methods significantly improve the reliability of bulk cluster property measurements and reveal variations in the IMF slope among clusters of different parameters and galactocentric distances.

Substellar population of the young massive cluster RCW 36 in Vela

Afonso do Brito do Vale

The exact shape of the initial mass function (IMF) down to the brown dwarf regime remains a fundamental yet contentious topic. RCW 36 is an embedded, young, massive cluster in the Vela Molecular Ridge ($\sim$1 kpc), with a stellar surface density comparable to the Orion Nebula Cluster. Using deep HAWK-I/VLT near-infrared observations with ground-layer adaptive optics, complemented by 2MASS, SOFI/NTT, and Gaia DR3 kinematics, we obtained the deepest census of the stellar and substellar populations in RCW 36 yet. Nebular emission was removed using the deep-learning algorithm DeNeb, improving source extraction and increasing completeness down to 0.03 Msun. Membership weights were assigned through statistical comparisons of color–magnitude diagrams, and individual masses were estimated from model isochrones. We determine the IMF (dN/dM $\propto M^{-}$) down to $\sim$0.03 Msun, described by a broken power law with a slope shallower than Salpeter in the high-mass regime and a flat slope of 0.46±0.14 between 0.03–0.20 Msun. The star–BD ratio of 2–5 is consistent with other young Galactic clusters. We also detect signs of possible primordial mass segregation.

The low-mass IMF in the extreme environment of Trumpler 14

Tamara Rom

The universality of the initial mass function (IMF) remains uncertain, particularly in young massive star clusters where high stellar densities, strong UV fields, and frequent dynamical interactions may influence the formation and survival of low-mass and substellar objects. Using deep near-infrared observations obtained with GeMS/GSAOI on Gemini South, we probe the low-mass IMF of Trumpler 14 down to 0.01 $M_{\odot}$. Our results indicate a deficit of brown dwarfs at the lowest masses (<0.03 $M_{\odot}$), suggesting that extreme environments may suppress the production of substellar objects. Similar trends are emerging in other young massive clusters, hinting at a broader environmental effect. These results motivate a more systematic, comparative view of the low-mass IMF in extreme star-forming environments.

Probing Substellar Formation in a Feedback-Dominated Environment with Euclid

Styliani Tsilia

Using Euclid Early Release Observations, we investigate the very low-mass population of the young

(∼1-7 Myr), nearby (∼400 pc) regions around the Horsehead Nebula, focusing on high-reddening areas at the interface with Orion B. By combining Euclid near-infrared photometry and spectroscopy with ancillary data, we extend ultracool dwarf searches into regions of strong and spatially variable extinction. We present the final results, including the first spectroscopically confirmed ultracool dwarfs discovered in this embedded environment. These observations provide additional constraints on substellar formation under feedback-dominated conditions and highlight the role of local cloud structure in shaping the lowest-mass products of star formation.

Unveiling the Low-Mass Stellar Population in the h and χ Persei Double Cluster

Indrajit Maity

The IMF in dynamically complex environments remains poorly understood. The h and χ Persei double cluster provides a unique laboratory to examine how gravitational interactions between clusters influence stellar populations. At 14 Myr, this system spans diverse evolutionary stages from massive supergiants to substellar objects. This work undertakes a comprehensive membership analysis and IMF study using deep multi-band near-infrared and optical photometry from CFHT and astrometry from Gaia DR3. Membership was determined via color-magnitude diagrams, reaching beyond the brown dwarf limit down to ∼0.03 $M_{\odot}$. We derived independent mass functions for each cluster by fitting log-normal distributions, providing the deepest systematic characterization of the substellar population in this double cluster system.

Probing Environmental Influences on the Initial Mass Function: Solar neighborhood to Outer Milky Way

Jessy Jose

The IMF is a fundamental outcome of star formation. Its form is thought to depend on environmental factors such as metallicity, radiation field and stellar feedback. Most evidence for IMF variations comes from indirect evidence based on integrated properties of external galaxies. The outer Milky Way, characterized by low metallicity, reduced gas density, and a weaker radiation environment, provides an ideal laboratory for investigations down to the brown dwarf regime. We present a systematic and homogeneous study of the low-mass IMF in two dozen young clusters spanning contrasting Galactic environments, using deep, high-resolution near-infrared imaging. Our analysis probes the IMF down to substellar masses. The cluster sample spans a wide range of metallicity, Galactocentric distance, gas and stellar density, and UV field, enabling a comparative assessment of the role of the environment. This work provides critical constraints on environmental regulation of star formation.

Feedback-Regulated Fragmentation and the CMF–IMF Connection in Ruprecht 32

Harmeen Kaur

We present a multi-wavelength analysis of the young cluster region Ruprecht 32 aimed at investigating how feedback modifies fragmentation and shapes the emerging core population. Using Herschel-derived column density maps, we identify cores embedded within filamentary structures with masses ranging from 0.2 to 10 M . The inferred Jeans length is consistent with thermal fragmentation under varying local densities and external pressure. Mid-infrared ratio maps from Spitzer reveal enhanced emission tracing a photo-dissociation region (PDR) associated with a reflection nebula, indicating ongoing UV irradiation. ALMA CS emission confirms dense gas coincident with the embedded cluster. The spatial correlation between PDR structures, dense cores, and YSOs suggests that radiative feedback is dynamically influencing fragmentation and mass assembly. Ruprecht 32 provides an observational testbed for evaluating how environmental regulation impacts the core mass distribution and its mapping onto the stellar IMF.

Impact of massive stars' radiative feedback on core star formation

Paolo Suin

The extent to which star formation (SF) depends on local environmental properties is a highly debated topic. Of the potential regulators, external ionising radiation from nearby massive stars is one of the most challenging to quantify observationally. When massive stars form, the expansion of HII regions causes a sudden, dramatic change in local conditions that can potentially alter the fragmentation cascade from clumps to cores and stars. I will present a combined analysis of existing infrared and sub-millimetre observations of clumps and cores across various radiative feedback regimes, complemented by a dedicated suite of high-resolution MHD simulations. This approach scrutinises the temporal evolution of core properties under varying physical conditions, including magnetic field and feedback strength. I will present the regimes in which compression increases the fraction of gas locked into bound cores and enhances local SF, and those in which erosion dominates and quenches SF.

The Role of Thermal Feedback and Non-LTE Chemistry in Shaping the Mass Reservoir of G14.225–0.506

Alexia Anguera Gonzalez

The transition from the CMF to the IMF is regulated by fragmentation, feedback, and how the dense mass reservoir is observationally traced. The massive hub–filament system G14.225–0.506 provides an ideal laboratory, as its two main hubs exhibit different fragmentation despite similar large-scale conditions. We present SMA 1.3 mm continuum and molecular line observations at 4000 AU resolution. Using XCLASS to model more than 30 molecular species, we derive strong internal temperature gradients and find that key tracers such as CH OH and H CO exhibit significant deviations from LTE. These results demonstrate that non-LTE treatments are essential in early high-mass star-forming cores, as LTE assumptions can misestimate temperatures and line intensities, leading to biased core mass estimates. Active molecular outflows, traced by SiO, SO, and CO, reveal how internal feedback redistributes dense gas within the hubs.

Connecting Filamentary Accretion to Feedback at ∼100 AU Scales in W33 Main

Lennart Böhm

Massive stars form in environments where accretion flows and stellar feedback coexist, yet the efficiency of gas transfer remains poorly constrained. I present a multi-scale, multi-phase study of W33 M, which hosts multiple filaments converging toward young compact HII regions. New high-resolution ALMA observations reaching ∼100 AU scales are combined with archival ALMA, VLA+GBT, and VLT/KMOS data tracing dense molecular gas and tracers of stellar feedback. Coherent gas inflows are traced from the surrounding filaments into the hub and toward embedded sources. The spectral cubes are analyzed using pixel-based XCLASS spectral modeling, yielding spatially resolved temperatures, column densities, and kinematics. These results constrain the efficiency of accretion in the presence of feedback and provide observational constraints on mass growth and loss during massive star formation.

Study of free-free contamination in the sample of cores in the 15 ALMA-IMF protoclusters

Mélanie Armante

Taking advantage of ALMA-IMF data, we present an automatic method to estimate the flux of identified cores, removing contamination by free-free emission. We found ∼30% of the global core sample impacted by free-free emission, with an increasing number of significantly contaminated cores with evolutionary stage. Not properly taking this contamination into account could lead to misclassification or overestimation of masses, affecting the CMF slope. We give examples of the impact of this correction for evolved regions such as G012.80 or G333.60, for which the impact on the CMF high-mass end is significant. Finally, we show peculiar sources that may represent the first stage of the creation of ultra-compact HII regions.

SESHAT: A Python Tool for Finding YSOs in JWST Data

Breanna Crompvoets

We present SESHAT, the Stellar Evolutionary Stage Heuristic Assessment Tool, for the identification of YSOs from JWST photometry. This Python tool takes as input a catalog of JWST photometry and outputs which sources are YSOs, brown dwarfs, white dwarfs, galaxies, and field stars, with $>$85% recall when tested against pre-classified Spitzer data. The tool is built on an XGBoost framework, trained at runtime using the saturating and limiting fluxes and filters of the input dataset. It can categorize 100,000 sources in 8 filters in $<$5 minutes. With robust catalogs, we can explore the mass distribution of YSO populations in any cloud imaged with JWST and how it varies with environment.

The Effect of External Photoevaporation on the Disk Lifetime in M17

Sam Millstone

How and to what degree the environment impacts the lifetime of circumstellar disks, and ultimately final stellar mass, is a major open question. We utilize VLT/HAWK-I JHK photometry to find an inner disk fraction of 28±2% in the $\sim$1 Myr-old M17 star-forming region. To untangle physical and observational effects, we perform a mass- and extinction-limited comparison with other regions of similar age. Our results provide compelling evidence that increasing external UV flux reduces disk lifetime, even when accounting for observational effects. Within M17, we observe a positive correlation between disk fraction and UV, likely an artifact of the region's highly variable extinction. Our work demonstrates the necessity of including external photoevaporation when modeling the final mass of forming stars.

What can the ELT tell us about the IMF? (extended, includes ELT instrumentation)

Fabian Haberhauer

The ELT and its various instruments will open a completely new era of IMF studies. For the first time, we will be able to investigate the IMF not just "in our galactic backyard", but at significantly greater distances, offering a much greater variety of environments. Additionally, it will allow us to revisit well-known areas of star formation in much greater detail, enhancing our understanding especially of the low-mass end of the IMF. In this talk, I will present results of the latest observation simulations using the ScopeSim simulator engine to accurately predict what the ELT instruments MICADO, METIS and MOSAIC will be able to deliver in terms of IMF studies and related observations in the star and planet formation field. This should foster a discussion on how the precious observation time at the ELT can be used most efficiently for those science cases, maximizing scientific output

while minimizing the risk of failed observations.

Shaping the Upper End of the IMF: From Core Mass Functions to the Most Massive Stars (Review)

Rolf Kuiper

What determines the masses of the most massive stars, and is there a fundamental upper limit? This review talk addresses these questions by tracing the origin of the high-mass end of the initial mass function (IMF) from its observational signatures down to the physical processes that shape it. We begin with an observational account of the high-mass end of the core mass function (CMF), drawing on recent large-scale surveys of dense molecular cores, and discuss what current data tell us about possible variations across different environments. We then turn to a theoretical perspective and examine the physical mechanisms that govern and constrain stellar masses in the high-mass regime — including the competing roles of accretion, radiative and mechanical feedback, and the broader cloud environment. Together, these perspectives highlight the remarkable progress that has been made recently, as well as the fundamental questions that remain unanswered.

Multiscale accretion in dense cloud cores and the delayed formation of massive stars

Enrique Vázquez-Semadeni

Numerical simulations show that core mass increases in time, and that the most massive stars tend to appear later than lower mass stars. We describe an idealized model incorporating accretion onto cores and stars, with core mass growth regulated by a ”gravitational choking” mechanism of purely gravitational origin. This causes some of the mass accreted onto cores to stagnate there rather than being transferred to stars. We estimate the mass of the most massive allowed star before its photoionizing radiation overcomes the accretion flow. This model provides a proof of concept for the simultaneous growth of gas reservoir and stellar mass, the delay in massive star formation, the need for massive, dense cores, and the observed correlation between the most massive star and cluster mass.

The Initial Mass Function as the Equilibrium State of a Variational Process: why the IMF cannot be sampled

stochastically

Eda Gjergo

The stellar IMF is often treated as a stochastic probability distribution, yet such an interpretation implies Poisson noise inconsistent with growing observational evidence. In this work, we show that the stellar mass distribution implied by optimal sampling emerges from applying the Maximum Entropy principle to the fragmentation of star-forming clumps, whose structure is set by density-dependent cooling in the optically thin regime. By applying calculus of variations to minimize the entropy functional, we recover the power-law form of the IMF, and we show that any distribution deviating from it violates the Maximum Entropy principle. This work provides a first-principles foundation for the deterministic nature of star formation. Thus, the IMF is the distribution resulting from a maximally unbiased system.

From Core Fragmentation to Galaxy-wide IMFs: Environmental Variations and Their Dynamical Signatures

Hosein Haghi

If the IMF depends on gas density and metallicity, its imprint should extend from embedded clusters to entire galaxies. Within the Integrated Galactic IMF (IGIMF) framework, we developed the SPS-VarIMF code to compute galaxy spectra, colours, mass-to-light ratios, and remnant populations for time-varying galaxy-wide IMFs. We show that IMF variability leaves measurable signatures in ultraviolet–optical colours and can alter stellar mass-to-light ratios by up to an order of magnitude. On cluster scales, a top-heavy IMF enhances black-hole production and can drive systems into a dark star cluster phase via Spitzer instability, potentially explaining ambiguous faint satellites such as Ursa Major III/UNIONS 1.

Linking the low- and high-mass ends of the initial mass function in star-forming galaxies

Diego Salvador

I will present the first results from the Hector Galaxy Survey, providing simultaneous constraints on both the low- and high-mass ends of the IMF for 214 star-forming galaxies at $z{\sim}0.01$. By combining low-end IMF-sensitive stellar absorption features with high-end nebular emission diagnostics, we uncover substantial diversity in IMF shapes across the sample. Both IMF slopes correlate strongly with global galaxy properties, with more massive, metal-rich, and actively star-forming galaxies tending to be both more bottom- and top-heavy. These galaxy-scale constraints can be used to inform models of core evolution, accretion, and feedback, and provide empirical boundary conditions for theories linking the CMF to the IMF.

From Inflow to Outflow: Rapid Evolution of Massive Embedded Clusters in NGC 253

Ashley Lieber

At a distance of 3.5 Mpc, NGC 253 is the nearest example of a nuclear starburst. A majority of the star formation activity is concentrated in deeply embedded, massive (M>10^4) star clusters. With ALMA, sub-cluster scale resolution ($\sim$0.5 pc) is now possible. In this work, we leverage ALMA observations to analyze the evolution of the gas reservoir of these clusters during their young, embedded phases. By analyzing dense-gas tracers, we isolate signatures of gas outflow and inflow on cluster scales and compile them into a unified framework for early evolution of massive star clusters. We show that these clusters can rapidly evolve from a stage with active gas inflow to one where individual SSCs fully disrupt their natal gas and carve out coherent, multiphase structures on tens of parsec scales.

The present day mass function of Omega Centauri

Maximilian Häberle

Omega Centauri is the most massive globular cluster of the Milky Way and likely the core of an accreted dwarf galaxy. Due to its dynamically young age, its present day mass function allows us to study the initial mass function in an extreme environment. In the last years, various JWST programs have targeted Omega Centauri at different radii, revealing its lowest mass stars. In my contribution I will present preliminary results on the present day mass function of the different stellar populations in Omega Centauri probed at different radii.

The impact of a variable initial stellar mass function in the interpretation of high-z galaxy data

Fabio Fontanot

Recent results from JWST report space densities for bright and massive galaxies at z>7 that far exceed the expectation of theoretical models. In this work we present predictions from a realization of the GAEA model, which implements a prescription for a variable stellar IMF inspired by high-resolution numerical simulations that account for the role of cosmic rays as regulators of the star formation rate in giant molecular clouds. Our results show that a model implementing such a variable IMF reproduces several properties of the z>6 galaxy population, including their UV luminosity functions up to z$\sim$13 and the galaxy stellar mass function, but only when stellar masses are reconstructed assuming a universal IMF. Our findings highlight the need to consider the possibility for a different IMF shape in the error budget associated with stellar mass estimates.

Abstracts of posters

Star Formation and the IMF Beyond the Optical Disk of NGC 2090

Jyoti Yadav

Understanding how stars form in the faint outskirts of galaxies is key to uncovering the processes that shape galactic disks. We present a far-ultraviolet (FUV) study of star-forming complexes in the nearby spiral galaxy NGC 2090 using observations from the Ultraviolet Imaging Telescope (UVIT). Remarkably, NGC 2090 shows ongoing star formation out to ∼30 kpc, far beyond the optical stellar disk. We identify and characterize star-forming complexes both inside and beyond the optical radius, measuring their sizes and star formation rates. Outer-disk complexes are smaller and have a narrower range of star formation surface densities than inner-disk regions. We find that specific star formation rate increases with radius, supporting inside-out disk growth. Importantly, Hα to FUV ratios in the outer disk indicate the formation of massive stars, showing that the upper end of the IMF is not truncated even in these low-density, metal-poor outskirts highlighting that the outer disk can host active, high-mass star formation.

Evolution of the clump mass spectrum in simulations of evolving molecular clouds

Daniela Ezqueda Morales

We investigate the temporal evolution of the clump mass function (CMF) using numerical simulations of molecular cloud formation and evolution. This study is motivated by recent observational results suggesting that the CMF is not static, but evolves with time. We define clumps using the Yt task density thresholds. Based on this definition, we analyze the mass distribution of clumps at time steps in the simulation. Our results show evidence of CMF evolution, characterized by an increase over time. However, due to the limited resolution of the simulations, a well-defined power law in the CMF is not reproduced. Despite this limitation results suggest that clear signatures of structural evolution in the CMF, consistent with recent observational findings.

Investigating Star Formation in Cygnus OB2: Embedded Clusters and YSOs

Mariane Souza-Gomes

The study of star-forming regions provides insights that help elucidate open questions regarding the birth and evolution of young stellar objects, from the collapse of molecular clouds to the dissolution of open stellar clusters. In this context, the characterization of embedded systems within these regions yields essential elements for understanding the local star formation history, as well as the physical processes involved.
In view of this, the aim of this work is to study the Cygnus-X complex, a star-forming region that exhibits a complex gaseous structure surrounding the Cygnus OB2 association, where dozens of young stellar systems are currently forming. Due to its Galactic location, the local spiral arm is observed tangentially, overlapping several star-forming sites between approximately 0.5–3.0 kpc within the local spiral arm, while also probing the stellar population in the Perseus spiral arm ($\sim$4.5 kpc) and the outer spiral arm ($\sim$8.5 kpc). This particular configuration poses a challenge for investigating the connection between the complexes in this region.
In order to elucidate the spatial structure of Cygnus-X and to provide a better understanding of the evolution of young stellar systems, a deep near-infrared survey (WIRCam – CFHT) was employed, covering approximately 1 square degree in the northern part of the complex and sampling stellar objects with masses between 0.1 and 50 $M_\odot$.
Initially, young stellar groups within the Cygnus OB2 association were identified and characterized. The information obtained, when integrated with studies of other regions within the complex, will be fundamental for reconstructing the local star formation history.

The very low mass IMF in Orion OB1 - isolated planetary mass objects in excess?

Monika Petr-Gotzens

We developed probability based selection criteria to identify substellar objects from multi-band photometry. By applying our method to wide-field near-infrared photometry data in the Orion OB1 association, between 112 and 174 candidate isolated planetary mass objects are discovered, along with as many as 650 new brown dwarfs. Objects with masses potentially as low as 1.7 Jupiter masses were found.

Stellar Population Synthesis with a Physically Varying Galaxy-wide IMF

Akram Hasani Zonoozi

Interpreting galaxy luminosities relies on assumptions about the galaxy-wide initial mass function (gwIMF), which is typically treated as invariant in stellar population synthesis (SPS) models. However, if stars form in clusters with environment-dependent IMFs, the integrated galactic IMF (IGIMF) naturally varies with star formation rate and metallicity. We present SPS-VarIMF, a new SPS framework that self-consistently models galaxy spectra, colours, luminosities, and remnant populations under a physically varying gwIMF. We compare predictions from the IGIMF and a canonical invariant IMF for different star formation histories. For late-type galaxies, ultraviolet and optical colours provide a diagnostic of the underlying gwIMF. In contrast, early-type galaxies show nearly identical colours under different IMF assumptions, but their stellar mass-to-light ratios can differ by up to an order of magnitude. Our models also imply that present-day massive ellipticals were significantly brighter during their formation epoch. These results highlight that IMF variability can strongly affect the interpretation of galaxy light and stellar masses, and should be considered in SPS modelling and galaxy evolution studies.

The formation of brown dwarfs: lessons from proto-brown dwarf studies in nearby clouds

Nuria Huélamo & Aina Palau

In a recent review paper (Palau+2024), we have studied the pre- and proto-brown dwarf (proto-BD) population in different nearby clouds down to the planetary boundary. Among our findings, we confirm that massive proto-BDs seem to follow the same trends as protostars in different star forming regions. On the other hand, we report an underproduction of low-mass proto-BD candidates in Ophiuchus compared to Lupus or Taurus star forming regions, suggesting a possible influence of the cloud temperature in their formation due to the presence of hot stars. In this poster, we discuss the possibility that the low-mass end of the IMF, where low-mass BDs and planetary-mass objects reside, is subtly shaped by stellar feedback. Our overall results suggest that Jeans fragmentation seem the main mechanism to form objects down to 10 M_{Jup}, below which other mechanisms might be at work.

Characterizing the Interstellar Medium at the Galactic Center: The Role of Magnetic and Stellar Feedback

Farideh Mazoochi

The Galactic Center (GC) provides an important laboratory for examining the intricate interstellar medium and star formation processes within a galactic nucleus at high spatial resolution. In the circumnuclear disk (CND) surrounding Sgr A*, we analyze MeerKAT 1.3 GHz continuum data alongside ALMA H40α observations from ACES, using a resolution of 0.2 pc. By separating thermal and nonthermal components, we estimate a thermal fraction of about 13%. The derived equipartition magnetic fields show a clear correlation with JCMT CO (J = 3→2) data, suggesting a pressure equilibrium among magnetic fields, cosmic rays, and molecular gas in this region. Although ionized gas and magnetic fields remain present, the molecular gas density declines within $R \lesssim 2$ pc, likely as a consequence of feedback from Sgr A*. We find that nonthermal pressure, driven by turbulence, balances the magnetic and cosmic-ray pressures and exceeds the thermal pressure by roughly two orders of magnitude. The environment is characterized by a low thermal-to-magnetic energy ratio and supersonic plasma conditions, with an Alfvén Mach number of approximately 4. Additionally, a subcritical mass-to-magnetic flux ratio indicates that magnetic fields play a key role in preventing gravitational collapse within the CND. At larger distances from Sgr A*, we extend our study to the ionized gas in Sgr B1, a prominent H II region in the GC, to explore gas kinematics and the impact of stellar feedback and magnetic field on extended structures in this region.

THE IMF CHALLENGE - 25 QUESTIONS

Hans Zinnecker

I list 25 basic questions (15 from observations, 10 from theory) related to the stellar IMF, as a reference to a general discussion on the origin of the IMF and its possible variation with changes in the star formation environment.

Feedback in NGC3603: Warm but Quiet!

Thomas Stanke

Feedback from the massive star population of freshly formed massive young clusters is expected to have a significant impact on the physical properties of the gas surrounding the clusters. They may disrupt the clouds, inject turbulence, heat the gas, and trigger or suppress further star formation. Turbulence and dense gas temperature may both contribute to determining the mass spectrum of cores forming in the cloud, hence the origin of the stellar initial mass function. We present molecular line maps of the dense gas around the NGC 3603 young massive cluster to assess its impact in heating and inducing turbulence in the surrounding gas. We find that the NGC3603 cluster significantly heats the dense gas on scales of a few parsec, but suppresses turbulence in its immediate environment.

Detection of Infall Motions in Compact Sources at 5000 AU in the ALMAGAL Sample

Leonardo Berti

The formation of high-mass stars remains a complex and not fully understood process, differing significantly from that of low-mass stars. Understanding their early evolutionary stages is crucial for uncovering the mechanisms governing their formation and their impact on galactic evolution. In this poster we present a study of the infall dynamics of dense cores (1000-3000 AU) associated with high-mass star formation. The dataset is drawn from ALMAGAL (Molinari et al. 2025 e Sanchez-Monge et al. 2025), an ALMA large program designed to investigate all stages of massive star formation across the Galaxy. The ALMAGAL survey offers the opportunity to study this process with an unmatched combination of a uniform spatial resolution (1000 AU) and sample size (1013 Clumps observed), allowing for a comprehensive analysis of the physical and kinematic properties of cores. In this study, we use a 5000 AU core catalogue built using the same specifications of the 1000 AU catalogue presented in Coletta et al. 2025. This approach enables a connection to previous studies on clump scales ($\sim$1 pc, Traficante et al. 2018), providing a multi-scale perspective on accretion dynamics. To identify infall candidates, we analysed the H2CO line, selecting sources exhibiting distinctive asymmetric profiles indicative of infall motion (Fuller+2005). The robustness of this selection is ensured by additional checks on optically thin lines (DCN, HCCCN, CH3CN and CH3OCHO) to exclude potential spurious sources. This approach results in more than 100 candidates, the largest sample of infall candidates identified at core-envelope scales ($\sim$5000 AU), providing a statistically significant basis for estimating accretion rates. This catalogue of more than 100 infall candidates gives us a solid sample to estimate infall velocities and mass accretion rates at 5000 AU scales. With such a large sample, we will be able to directly compare what we see at core scales with what has been found in previous studies on larger scales (clumps $\sim$1pc), building a more complete picture across different spatial scales. In this way, we can connect the small-scale infall properties with the larger-scale dynamics of the parent clumps, building a more complete picture of accretion and of the early evolutionary stages of massive star formation.