Rogue Worlds Strike Back, Episode 2

Report of Contributions

Contribution ID: **5** Type: **Contributed talk**

Do rogue worlds host small orbiting companions?

Monday, December 15, 2025 4:20 PM (20 minutes)

Planets are known to ubiquitous around low-mass stars (M $gtrsim 80\ M_J$), and in our solar system, moons far outnumber the gas giant planets (M $lesssim 1\ M_J$) they orbit. But do rogue worlds, with masses in between our solar system planets and the lowest-mass stars, host orbiting bodies of their own? I will describe our team's work to observationally probe the population of small companions (which we call "exosatellites") around free-floating planetary mass objects. Our strategy is to search for transits of these small bodies in infrared light curves of free-floating planets. So far, we have used Spitzer data to place constraints on the occurrence rate of terrestrial and sub-Neptune-sized exosatellites around substellar worlds, and have demonstrated exquisite sensitivity to Io analogs with JWST light curves of planetary-mass objects. I will present a first look at a data from a new JWST program to perform simultaneous photometric monitoring of 50 substellar objects to study variability and look for transits. And finally, we will discuss the promise for the Roman space telescope to dramatically expand the search for exosatellites to hundreds of rogue worlds and measure on the prevalence of small companions around planetary mass objects.

Primary authors: VANDERBURG, Andrew (Harvard University); LIMBACH, Mary Anne (University of Michigan); SOARES-FURTADO, Melinda (University of Wisconsin-Madison)

Presenter: VANDERBURG, Andrew (Harvard University)

Session Classification: Moons of FFPs

Track Classification: In-person

Contribution ID: **6** Type: **Contributed talk**

Deep JWST Spectroscopic Survey of Free-Floating PMOs and Discovery of An Accretion Burst

Tuesday, December 16, 2025 11:10 AM (20 minutes)

We have conducted an extremely deep spectroscopic survey of the NGC 1333 young star cluster using NIRISS on the JWST to identify and characterize the lowest-mass free-floating objects in its midst. Our observations cover 19 known brown dwarfs, for most of which we confirm previously assigned spectral types. We discover six new candidates with L-dwarf spectral types that are plausible planetary-mass members of NGC1333, with estimated masses between 5-15 times that of Jupiter. One, at ~5 Jupiter masses, shows clear infrared excess emission and is a good candidate to be the lowest-mass object known to have a disk. We do not find any objects later than mid-L spectral type. The paucity of Jupiter-mass objects, despite the survey's unprecedented sensitivity, suggests that our observations reach the lowest-mass objects that formed like stars in this cluster. Our findings put the fraction of FFPMOs in NGC1333 at ~10% of the number of cluster members. We also search for wide binaries in our images and report a young brown dwarf with a planetary-mass companion. Separately, we report new findings on eight FFPMOs from near- and mid-infrared spectroscopy using NIRSpec and MIRI on JWST (see Damian et al contribution). In recent, multi-epoch observations of one of these objects with the XSHOOTER on the VLT, we have found dramatic changes in disk accretion-related emission lines, likely indicative of an accretion outburst –the first time such an event is seen in a planetary-mass object. We will discuss the implications of our findings for star and planet formation.

Primary author: JAYAWARDHANA, Ray (Johns Hopkins University)

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Presenter: JAYAWARDHANA, Ray (Johns Hopkins University)

Session Classification: Spectra / Atmospheres

Track Classification: In-person

Contribution ID: **7** Type: **Contributed talk**

On connection of FFPs with very young rapidly evolving binaries

Tuesday, December 16, 2025 9:40 AM (20 minutes)

Abstract: Metallicity correlations and other observed statistics indicate that disc fragmentation due to Gravitational Instability (GI) is the likely origin of massive companions to stars, such as giant planets orbiting M-dwarf stars, Brown Dwarf (BD) companions to FGK stars, and binary stars with separations smaller than about 100 au. In paper I of this series, we showed that disc fragmentation in young rapidly evolving binary systems inevitably ejects an abundant population of massive Jupiter-mass free-floating planets (FFPs). In this model, a massive disc around an initially single protostar fragments on a number of clumps, and the secondary star is an oligarch fragment that grows particularly massive. As the system rearranges itself from a singe to a binary star configuration, a dramatic "pincer movement" by the binary ejects planets through dynamical interactions with the stars. Here we propose that the same scenario applies to an even more abundant population of smaller FFPs discovered by the microlensing surveys. Although disc fragmentation is usually believed to form only massive objects, three different pathways [1,2,3] for forming small core-dominated planets exist. We present results from three complementary simulation approaches (3D SPH, 2D FARGO-ADSG, and N-body REBOUND), all of which indicate planet ejection efficiency greater than 50%. We discuss observational implications of this scenario. FFP observations may be the most convincing evidence yet that disc fragmentation forms not only giant planets, BD, and stellar companions, but also low mass (M« 1 Jupiter mass) planets, and that planets are made well before the binary matures. Future FFP observations may be decisive in constraining the physics of GI planet and binary formation scenarios.

[1]: Gibbons,P. +14, https://ui.adsabs.harvard.edu/abs/2014MNRAS.442..361G/abstract
Longarini, C. +23, https://ui.adsabs.harvard.edu/abs/2023MNRAS.522.6217L/abstract
[2] Boley, A +10, https://ui.adsabs.harvard.edu/abs/2010Icar..207..509B/abstract
Nayakshin, S 2017, https://ui.adsabs.harvard.edu/abs/2017PASA...34....2N/abstract
[3] Deng, H. +21, https://ui.adsabs.harvard.edu/abs/2021NatAs...5..440D/abstract
Kubli, N. +23, https://ui.adsabs.harvard.edu/abs/2023MNRAS.525.2731K/abstract

- List of collaborators: Aleksandra Calovic, Luyao Zhang, Hans Lee, Clement Baruteau, Sarah Casewell, Nuria Miret-Roig, Farzana Meru, Lucio Mayer.

Primary author: NAYAKSHIN, Sergei (University of Leicester)

Co-authors: Ms CALOVIC, Aleksandra (University of Leicester); Ms ZHANG, Luyao (University of Leicester); Mr LEE, Hans (University of Leicester)

Presenter: NAYAKSHIN, Sergei (University of Leicester)

Session Classification: Modeling

Track Classification: In-person

Contribution ID: **8** Type: **Contributed talk**

Investigating the exoplanet HD88986 b by using TESS & CHEOPS space telescope data.

Wednesday, December 17, 2025 11:20 AM (20 minutes)

The discovery of transiting planets with orbital periods exceeding 40 days has been exceptionally rare among the 5000+ planets identified to date. This dearth of findings poses a significant challenge to studying planetary demographics, formation, and evolution. In this study, we report detecting and characterizing HD88986 b, a potentially transiting sub-Neptune with the longest orbital period of any known transiting small planet. Our analysis drew on a combination of two sectors of TESS data and a 7-day observation from CHEOPS. Additionally, TLS was utilized for the analysis of HD88986 data. Our findings indicate that HD88986 b, exhibiting two likely single transits on sector 21 and sector 48, both consistent with the predicted transit time from the RV model, is a likely transit candidate. The wide orbit of HD88986 b suggests that the planet did not experience significant mass loss due to XUV radiation from its host star, likely retaining its original composition and offering insights into its formation. Furthermore, the cold nature of HD88986 b, owing to its extended orbital period, presents exciting prospects for future studies on the characterization of its cold atmosphere composition.

Primary author: ALMASIAN, Danial (Shahid Beheshti University of Tehran)

Presenter: ALMASIAN, Danial (Shahid Beheshti University of Tehran)

Session Classification: Mish Mash

Track Classification: In-person

Contribution ID: **10** Type: **Contributed talk**

Past, present & future of rogue planet direct detection with Euclid

Tuesday, December 16, 2025 2:00 PM (20 minutes)

Starting with the Euclid Early Observations program and continuing with the Quick data release 1 and moving into the Data Release 1, our Independent Legacy Science team is focusing on the study of ultracool dwarfs in nearby star-forming regions, young open clusters and the field. Our first results showcase the power of Euclid to detect rogue planets directly via high spatial resolution imaging, deep optical and near infrared photometry and slitless low-resolution near-infrared spectroscopy. In this presentation the results obtained so far from the analysis of Euclid data will be summarized, the status of ongoing work will be shown and the future plans will be discussed with special attention to the direct detection and characterization of rogue worlds, comparisons with state-of-the-art models, ground-based follow-up observations and estimates of the binary fraction and the substellar Initial Mass Function down to planetary masses.

Primary authors: MARTÍN GUERRERO DE ESCALANTE, EduardoLorenzo (Universidad La Laguna); THE EUCLID INDEPENDENT LEGACY SCIENCE TEAM

Presenter: MARTÍN GUERRERO DE ESCALANTE, EduardoLorenzo (Universidad La Laguna)

Session Classification: Euclid

Track Classification: In-person

Contribution ID: **11** Type: **Contributed talk**

Free-floating planets with DREAMS, K-ROAM and ET using gravitational microlensing

Monday, December 15, 2025 12:20 PM (20 minutes)

The mass function of free-floating planets (FFPs) could key insights into the planet formation and dynamics. Microlensing provides a powerful technique to probe this population, especially at the low-mass end. We will describe preliminary search results of FFPs using the existing KMTNet survey data (KMTNet Rogue Objects Astrophysical Monitoring, K-ROAM), and the ongoing DECam Rogue Earths And Mars Survey (DREAMS) using ∼70 nights on the Blanco telescope in Chile.

We will also discuss future prospects to determine the FFP mass function using the Earth Two satellite mission (currently scheduled for launch in October 2028).

Primary author: MAO, Shude

Co-authors: Dr YANG, Hongjing (Westlake University); Ms QIAN, Qiyue (Tsinghua University); Dr ZANG, Weicheng (Westlake University); Ms TANG, Yucheng (Westlake University); Ms LI, Zhixing (Tsinghua University)

Presenter: MAO, Shude

Session Classification: Microlensing

Track Classification: In-person

Contribution ID: **12** Type: **Contributed talk**

Free-floating planets in star clusters: a dynamical overlook

Wednesday, December 17, 2025 11:40 AM (20 minutes)

The Galaxy has an extremely large number of free-floating planets (ffps), either being bound in star clusters or orbiting freely around the Galaxy. The presence of these objects is common in all large scale objects, whatever we consider brown dwarfs as ffp or not. In my work, I will explain how these objects, with different abundances, remain gravitationally bound or are ejected from star clusters. In order to do so, I used Nbody6++GPU, an N-body direct code which is used for large N systems, such a star clusters.
In this talk, we will also take a look at the capture rate, and the possible formation of planetary systems in these clusters.

Primary author: FLAMMINI DOTTI, Francesco Maria (New York University Abu Dhabi)

Presenter: FLAMMINI DOTTI, Francesco Maria (New York University Abu Dhabi)

Session Classification: Mish Mash

Track Classification: In-person

Contribution ID: **14** Type: **Contributed talk**

A potential of the microlensing exoplanet observation including free-floating planets by JASMINE telescope collaborating with Roman

Tuesday, December 16, 2025 5:20 PM (20 minutes)

JASMINE is an infrared space-based telescope mission being planned in Japan. The telescope is expected to orbit around the Earth and to observe microlensing events in parallax with other space-based telescopes located away from the Earth, such as *Roman*. As of now, the proposed *JASMINE*'s target regime can support one of the *Roman*'s observation fields close to the Galactic center, and its cadence and exposure time for the microlensing event observation are subject to change. Here, we test and propose a reasonable combination of the cadence and exposure time, particularly with the aim of exoplanet detection. We find two reasonable combinations: 15-minute cadence for 100-second exposure, and 25-minute cadence for 30-second exposure. These settings of the cadence and exposure time are expected to detect $\sim$ 120 bound exoplanets and a few thousand free-floating planets during the simultaneous operation with *Roman* and *JASMINE*. Because the observation close to the Galactic center is difficult due to a strong extinction, *JASMINE*'s follow-up is worth accepting. It will support an increase in the number of examples for the study of exoplanet demographics.

Primary author: BAN, Makiko (Independent Astronomer)

Presenter: BAN, Makiko (Independent Astronomer)

Session Classification: Microlensing

Track Classification: In-person

Contribution ID: **15** Type: **Contributed talk**

The Fate of Circumplanetary Disks in Dynamically Ejected Planetary-Mass Objects

Wednesday, December 17, 2025 10:00 AM (20 minutes)

The James Webb Space Telescope (JWST) has revealed that free-floating planetary-mass objects (FFPMOs) often host substantial dusty disks. A key unanswered question is whether these objects formed in isolation or were dynamically ejected from planetary systems. We test the ejection hypothesis with 3D hydrodynamical simulations of a giant planet, hosting a circumplanetary disk (CPD), ejected via a stellar flyby. We find that the ejection process severely truncates the disk, leaving a remnant that is significantly smaller and less massive than disks around isolated objects. These results provide the first quantitative predictions for disks around ejected planets, creating a critical theoretical framework for interpreting the origin of FFPMOs with JWST.

Primary author: SMALLWOOD, Jeremy (University of Oklahoma)

Presenter: SMALLWOOD, Jeremy (University of Oklahoma)

Session Classification: Disks

Track Classification: In-person

Contribution ID: **16** Type: **Contributed talk**

Discs around planetary-mass objects: new insights from JWST

Wednesday, December 17, 2025 9:00 AM (20 minutes)

Circumstellar discs, a natural byproduct of the formation of low-mass stars and substellar objects, are crucial in setting the conditions and timescale for planet formation. These discs have been observed around free-floating planetary-mass objects (FFPMOs) at young ages. We present the near- and mid-infrared spectra of eight young FFPMOs with masses of 5–10 MJup, obtained using the NIRSpec and MIRI instruments on the James Webb Space Telescope. The photospheric spectra of our targets show a clear diversity at similar temperatures, especially in the 3-5 μm range, unaccounted for by existing atmospheric models. We find silicate absorption feature in the photosphere of one of our targets, the first such detection in very young FFPMOs, indicating silicate clouds in their cool atmospheres. Additionally, six objects show mid-infrared excess emission above the photosphere, as well as silicate emission features, demonstrating the presence of discs. The shape and strength of the latter features constitute strong evidence of grain growth and crystallisation, akin to that observed in discs around higher-mass brown dwarfs and stars. We also detect emission lines from hydrocarbon molecules in the disks of several targets and a multi-epoch study of one of them shows an ongoing accretion burst (see Jayawardhana et al. contribution). The presence and characteristics of discs point to the potential for the formation of rocky companions around FFPMOs.

Primary author: DAMIAN, Belinda (University of St Andrews)

Co-authors: SCHOLZ, Aleks (University of St. Andrews); JAYAWARDHANA, Ray (Johns Hopkins University); ALMENDROS-ABAD, Victor (INAF - Osservatorio Astronomico di Palermo); FLAGG, Laura (JHU); MUZIC, Koraljka (Instituto de Astrofísica e Ciências do Espaço, Lisbon); NATTA, Antonella (Dublin Institute for Advanced Studies); PINILLA, Paola (University College London); TESTI, Leonardo (Universit'a di Bologna)

Presenter: DAMIAN, Belinda (University of St Andrews)

Session Classification: Disks

Track Classification: In-person

Contribution ID: **17** Type: **Contributed talk**

How low can you go? Probing disc locking efficiency for low-mass PMO's

Wednesday, December 17, 2025 9:20 AM (20 minutes)

A key step in the formation of planetary-mass objects (PMO's, objects <20 M_J) is the disc locking phase, where the object's rotation is regulated by magnetic coupling with its ionized circumplanetary disc. By dumping excess angular momentum into the disc and allowing further accretion, disc locking is responsible for setting both the rotation and mass distribution of PMO's. Due to decreasing radiation output and disc mass, a transition to faster spins is expected at lower PMO masses as disc locking becomes less effective.
Despite healthy samples of PMO spins down to 10 M_J, this transition has yet to be found. This narrows it down to the observational gap between 1-10 M_J. Here we present four new spin measurements of rogue PMOs <10 M_J from high-resolution (R˜45,000) Gemini/IGRINS spectra, bringing the total from 2 to 6. We combine this population with bound planets <10 M_J and compare their low-mass spin distribution to the more massive PMO population, presenting our preliminary findings.

Primary author: SUN, Ethen (University of Toronto)

Presenter: SUN, Ethen (University of Toronto)

Session Classification: Disks

Track Classification: In-person

Contribution ID: **18** Type: **Contributed talk**

A Pathway to Galactic Rogue Worlds: Planetary Ejection by Type II Supernovae

Monday, December 15, 2025 3:30 PM (20 minutes)

The role of massive stellar death in the production of free-floating planets remains poorly explored. We model type II supernovae as a rogue planet formation channel through 2.5 million simulations of planetary and stellar companions exposed to homologous mass loss with typical SN II ejecta velocities of 1000–10,000 km/s. Nearly all companions are destabilized, yielding rogue planets with velocities of 1–275 km/s (peak ≈18 km/s), largely independent of mass. Survival for pulsar planets requires eccentric primordial orbits combined with a near-apocenter timing of the explosion. Type II supernovae thus can represent an efficient, previously underappreciated pathway for rogue planet formation.

Primary author: Dr REGÁLY, Zsolt (HUN-REN Konkoly Observatory)

Co-authors: Dr VINKÓ, József (HUN-REN Konkoly Observatory, University of Szeged); FRÖHLICH, Viktória (HUN-REN Konkoly Observatory, Eötvös Loránd University)

Presenter: FRÖHLICH, Viktória (HUN-REN Konkoly Observatory, Eötvös Loránd University)

Session Classification: Modeling

Track Classification: In-person

Contribution ID: **19** Type: **Contributed talk**

Life in the Dark: Tidal Heating and Urability on Moons of Rogue Planets

Monday, December 15, 2025 4:40 PM (20 minutes)

Rogue planets may retain moons after ejection from their host systems. The eccentric orbits of such moons can enable tidal heating sufficient for subsurface oceans to persist even without stellar irradiation. We test this through several thousand N-body simulations of planet–moon systems expelled by type II supernovae. All moons of rogue planets remain bound, with semi-major axes changing by <0.2% and eccentricities excited modestly ($lesssim 10^{-3}$ in single moon systems, $\simeq 2\times10^{-2}$ in resonant pairs). In 12–15% of cases, tidal heating reaches 0.1–10 times that estimated on Europa or Enceladus, suggesting a possibility to sustain subsurface oceans over gigayears. Such moons thus emerge as stable, tidally active, and potentially urable environments that allow for the emergence of life even in the absence of starlight.

Primary author: FRÖHLICH, Viktória (HUN-REN Konkoly Observatory, Eötvös Loránd University)

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Presenter: FRÖHLICH, Viktória (HUN-REN Konkoly Observatory, Eötvös Loránd University)

Session Classification: Moons of FFPs

Track Classification: In-person

Contribution ID: **20** Type: **Contributed talk**

A Near-Infrared Spectral Library of Very Young Brown Dwarfs and Planetary-Mass Objects in the Orion Nebula Cluster

Tuesday, December 16, 2025 11:50 AM (20 minutes)

Age-benchmark brown dwarfs' and planetary-mass objects' spectroscopy is key to characterize substellar evolution. In this paper we present the JHK medium resolution (R∼3000) spectra of 25 7-76 $\mathrm{M_{Jup}}$ (spectral types L3.0-M6.0) brown dwarfs and planetary-mass objects in the Orion Nebula Cluster obtained with MOSFIRE installed at the W. M. Keck\,I telescope. We obtained the spectral types of the targets in our sample using template brown dwarf and planetary-mass objects' spectra. We confirmed their extreme youth (<5 Myr) and membership to the cluster using spectral indices, and the diversity of their spectra even for targets with similar spectral types. Six of our targets presented Pa-β and Bra-γ emission lines, suggesting the existence of accreting protoplanetary disks to objects with masses as low as 7 $\mathrm{M_{Jup}}$. After analyzing the emission lines of those objects, and measuring their accretion rates, we compared them to those of stars, brown dwarfs and planetary-mass objects, confirming that planetary-mass young objects deplete their disks quickly at young ages. Finally, we illustrate the spectral evolution of a 7-10 $\mathrm{M_{Jup}}$ planetary-mass object through its life from 1-3 Myr to 200 Myr old using one of our la

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Presenter: MANJAVACAS, Elena (STScI)

Session Classification: Spectra / Atmospheres

Track Classification: In-person

Contribution ID: **21** Type: **Contributed talk**

Free-floating planets ejected from massive self-gravitating discs

Tuesday, December 16, 2025 10:00 AM (20 minutes)

Over the past 25 years, observations have uncovered a large population of free-floating planets (FFPs), whose origins remain debated. Massive FFPs (several Jupiter masses or more) may form via gravitational collapse of molecular clouds, similar to stars. Lower-mass FFPs likely originate in planetary systems and are later ejected through dynamical interactions. We show that disc fragmentation in very young stellar binaries may be an abundant source of Jupiter-like FFPs (JFFPs). In our model, disc fragmentation at tens to 100 au from the primary star produces gas giants, while fragmentation further out forms a more massive object that will eventually evolve into the secondary star. We present 3D simulations of massive, self-gravitating discs with embedded Jupiter-mass planets and a secondary seed (5–50 M_J); chaotic migration leads to frequent planet–secondary interactions, imparting velocity kicks via to the planets that can result in planet ejections. The ejection fraction increases steeply with the secondary-to-primary mass ratio, q, reaching ˜ 2/3 for q_s ≥ 0.05. Compared to Core Accretion JFFPs, disc fragmentation JFFPs: (i) form earlier, and may be more abundant in young clusters, and (ii) are ejected at much lower velocities.

Primary author: CALOVIC, Aleksandra (University of Leicester)

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Presenter: CALOVIC, Aleksandra (University of Leicester)

Session Classification: Modeling

Track Classification: In-person

Contribution ID: **22** Type: **Contributed talk**

Modeling Rogue and Wide Orbit Planets with Roman Space Telescope Data

Tuesday, December 16, 2025 4:40 PM (20 minutes)

The identification and modeling of rogue or wide orbit planets has been a challenging task for gravitational microlensing surveys, in part because of difficulties due to systematic errors and false positive detections. Roman will not have the same systematic errors and false positive signals as ground-based microlensing surveys, but the small number of magnified images and large expected rate of false positive signals make this a challenge. The modeling of wide orbit planetary microlensing events with weak host star microlensing signals has also been challenging for ground-based microlensing surveys. I describe the planets for the Roman Galactic Exoplanet Survey team to identify rogue and wide orbit planetary microlensing events, reject false positive events, and model these microlensing light curves.

Primary author: BENNETT, David (University of Maryland and NASA Goddard Space Flight Center)

Presenter: BENNETT, David (University of Maryland and NASA Goddard Space Flight Center)

Session Classification: Microlensing

Track Classification: In-person

Contribution ID: **23** Type: **Contributed talk**

Precursor and Follow-up High Resolution Imaging of a Microlensing FFP Candidate

Monday, December 15, 2025 11:40 AM (20 minutes)

I will present an analysis of the microlensing event OGLE-2023-BLG-0524, the location of which was serendipitously captured in 1997 with the Hubble Space Telescope (HST). Our team conducted recent follow-up imaging with HST in 2025, thus we achieve a record-breaking baseline length of 28 years between the high-resolution epochs. The very short duration of this microlensing event (t_E = 0.346 ± 0.008 days) indicates an FFP as the explanation. We have not detected any potential host star to the lens with the HST data, which further supports the true FFP scenario. Finally, our estimate of the angular Einstein radius value θ_E = 4.78±0.23 μas, suggests a super-Earth in the Galactic disk or a sub-Saturn-mass planet in the Galactic bulge.

Primary author: Dr TERRY, Sean (University of Maryland)

Presenter: Dr TERRY, Sean (University of Maryland)

Session Classification: Microlensing

Track Classification: In-person

Contribution ID: **24** Type: **Contributed talk**

Rogue worlds in the era of Roman

Tuesday, December 16, 2025 5:00 PM (20 minutes)

Launching in less than a year, the Nancy Grace Roman Space Telescope is poised to detect hundreds to thousands of free-floating planets at masses ranging from that of Mars to beyond Jupiter. Reconstructing the mass distribution of these worlds would provide key insight into their origins and dynamical history, and as such, is a prime target for the Roman mission. However, due to the inherent degeneracies of microlensing observables, reconstructing the mass of individual FFPs is challenging. In this talk, I will outline the prospects for an alternative scheme to reconstruct this mass function and provide updates on Roman's plan for a near-live-time FFP alert pipeline.

Primary author: DEROCCO, William (University of Maryland, College Park)

Presenter: DEROCCO, William (University of Maryland, College Park)

Session Classification: Microlensing

Track Classification: In-person

Contribution ID: **25** Type: **Contributed talk**

Can large protoplanetary discs produce rogue worlds?

Monday, December 15, 2025 10:00 AM (20 minutes)

The origins of massive planets seen by direct imaging are uncertain, but these worlds far from their host stars are likely the most vulnerable to ejection in stellar encounters. We have just completed the Planet-Earth Building-Blocks Legacy e-MERLIN Survey (PEBBLeS), which gives the first view of the distribution of small rocks (planetary seeds) in the midplane of massive discs of young stars. We find asymmetries in some large discs that could be the birth-sites of such distant massive planets. Repeating these radio images over time can show whether any of the proto-worlds are being ejected.

Primary author: Prof. GREAVES, Jane (Cardiff University)

Presenter: Prof. GREAVES, Jane (Cardiff University)

Session Classification: Direct Imaging

Track Classification: In-person

Contribution ID: **26** Type: **Contributed talk**

Probing Substellar-Mass Objects with Updated ATMO Atmospheric Models

Tuesday, December 16, 2025 12:10 PM (20 minutes)

We present a new generation of ATMO2020 atmosphere models which is appropriate for application to studies low mass stars, brown dwarfs and rogue planetary-mass objects. The models compute temperature–pressure profiles and emergent spectra for atmospheres in both radiative–convective equilibrium and non-equilibrium chemistry, covering effective temperatures and surface gravities within the ranges 200 ≤ Teff ≤ 3000 K and 2.5 ≤ logg ≤ 5.5. We extend the metallicity grid from -1.0 to +0.5 and incorporate additional opacities, including MgO and SiO. Thereby, these models broaden the diversity of available model atmospheres, particularly at sub-solar metallicities.

We compare synthetic spectra from these models to 178 spectroscopically confirmed ultracool dwarfs (M7–T7) from Domínguez-Tagle et al. (2025), and demonstrate that ATMO robustly constrains effective temperatures, surface gravities, and atmospheric compositions. These models provide a critical physical bridge between observed spectra and the underlying dynamical and chemical processes shaping ultracool dwarfs objects, enhancing our understanding of these objects.

Primary author: SEDIGHI, Nafise (Instituto de Astrofísica de Canarias)

Presenter: SEDIGHI, Nafise (Instituto de Astrofísica de Canarias)

Session Classification: Spectra / Atmospheres

Track Classification: In-person

Contribution ID: **27** Type: **Contributed talk**

JWST/NIRSpec Observations of Free-Floating Planetary Mass Objects in NGC 2024

Tuesday, December 16, 2025 11:30 AM (20 minutes)

A successful theory of star formation should predict the number of objects as a function of their mass produced through star-forming events. Previous studies in star-forming regions and the solar neighborhood have identified a mass function increasing from the hydrogen-burning limit down to about 10 MJ. Theory predicts a limit to the fragmentation process, providing a natural turnover in the mass function down to the opacity limit of turbulent fragmentation, thought to be near 1–10 MJ. In De Furio et al. (2025), we characterized the initial mass function in a young (< 1 Myr) embedded star-forming region, NGC 2024, down to sub-Jupiter masses using photometry from the Near Infrared Camera on the James Webb Space Telescope (JWST). We find a mass function increasing from about 60 MJ to roughly 12 MJ, consistent with previous studies, followed by a decrease down to 0.5 MJ, the first evidence for a decrease in the mass function in a stellar population to date. In GO-5409 (PI: De Furio), we obtained NIRSpec/MSA prism spectroscopy of dozens of candidate substellar members down to ˜ 3 MJ in order to confirm membership and better estimate their masses. In this talk, we present the results of our spectroscopic observations and our constraints on the mass function on Jupiter mass scales.

Primary author: DE FURIO, Matthew (University of Texas at Austin)

Presenter: DE FURIO, Matthew (University of Texas at Austin)

Session Classification: Spectra / Atmospheres

Track Classification: In-person

Contribution ID: **28** Type: **Contributed talk**

Implications of planet formation for the origin, mass, and number of free-floating planets

Monday, December 15, 2025 3:10 PM (20 minutes)

The discovery of free-floating planets (FFPs) firmly confirms the fact that during the formation of a planetary system, fully-formed and still-forming planets are scattered out of the system. As planet formation is an inefficient process, meaning that the large majority of the material in a protoplanetary disk is scattered out and does not contribute to the growth of planetary bodies, question remains on the extent to which different modes of planet formation (e.g., gas-giant formation vs the formation of rocky planets) and different formation environments (e.g., single stars or binaries) contribute to the origin, mass, and population of FFPs. In this talk, I will present an analysis of the efficiency of planet formation in different systems and use the results to determine the degree of plausibility for different settings and environments to be potential sources of FFPs, and contribute to the masses and sizes of these objects.

Primary author: HAGHIGHIPOUR, Nader (PSI/IfA-Hawaii)

Presenter: HAGHIGHIPOUR, Nader (PSI/IfA-Hawaii)

Session Classification: Modeling

Track Classification: In-person

Contribution ID: **29** Type: **Contributed talk**

Rogue planets with Euclid: Messier 78 and Lynds 1641

Tuesday, December 16, 2025 2:20 PM (20 minutes)

Primarily designed to explore the dark universe, the Euclid space telescope also opens exciting new opportunities for substellar science. Its Early Release Observations and Quick Data Release include several young star-forming regions in Orion. In this talk, I will present results from Messier 78 (M78) and Lynds 1641 (LDN1641). The M78 data are representative of the Euclid Wide Survey, which will map one-third of the sky down to J(AB)=24.5, while the LDN1641 observations reach two magnitudes deeper, offering a preview of the Euclid Deep Fields at the end of the mission. Both regions are strongly affected by extinction, so we combined Euclid's Y, J, and H photometry with ground-based K-band and Spitzer/IRAC data to build high-resolution extinction maps and isolate the most likely young members. Their masses cover the ultracool dwarf regime and extend down to planetary-mass objects, demonstrating Euclid's unique ability to detect free-floating planets in Orion. Finally, I will show how Euclid spectroscopy, together with ESO's KMOS follow-up, confirms the substellar nature of these candidates.

Primary author: ŽERJAL, Maruša (Institute of Astrophysics of the Canary Islands)

Co-authors: MARTÍN GUERRERO DE ESCALANTE, EduardoLorenzo (Universidad La Laguna); Prof. BOUY, Hervé (Université de Bordeaux, LAB); TSILIA, Styliani

Presenter: ŽERJAL, Maruša (Institute of Astrophysics of the Canary Islands)

Session Classification: Euclid

Track Classification: In-person

Contribution ID: **30** Type: **Contributed talk**

Searching for rogue planets around the Horsehead nebula

Tuesday, December 16, 2025 2:40 PM (20 minutes)

Euclid's capabilities to study ultracool dwarfs (UCDs), including brown dwarfs and free-floating planetary-mass objects, have already been demonstrated by its Early Release Observations. UCD candidates have been uncovered down to ˜4 MJup in the σ Orionis cluster, a young (˜3 Myr) and nearby (˜400 pc) star-forming region. The first search in this field was focused on low-reddening areas, while the adjacent high-reddening regime —shaped by the Orion B molecular cloud edge, including the Horsehead Nebula and NGC2023—remains largely unexplored in Euclid data.
In this work we extend substellar searches into these complex dusty environments by combining Euclid photometry with complementary infrared datasets. Using refined color–magnitude criteria, we identify new UCD candidates down to the planetary-mass regime in these regions of strong and variable extinction. Preliminary results reveal clustering in the spatial distribution of this embedded population, contrary to UCDs in the low-reddening region. These findings suggest ongoing substellar formation and highlight a potentially distinct formation mode in the dusty outskirts of σ Orionis, influenced by ionization fronts, feedback mechanisms and interactions with the surrounding molecular cloud. Characterizing this population will provide input for understanding how local environment might shape the very low-mass end of the initial mass function.

Primary authors: TSILIA, Styliani; ŽERJAL, Maruša (Institute of Astrophysics of the Canary Islands); MARTÍN GUERRERO DE ESCALANTE, EduardoLorenzo (Universidad La Laguna); Prof. BOUY, Hervé (Université de Bordeaux, LAB); DOMINGUEZ-TAGLE, Carlos (Instituto de Astrofísica de Canarias (IAC))

Presenter: TSILIA, Styliani

Session Classification: Euclid

Track Classification: In-person

Contribution ID: **31** Type: **Contributed talk**

Novel Approach to Microlensing Free-Floating Planets: Optical Interferometry

Tuesday, December 16, 2025 5:40 PM (20 minutes)

One of the key questions about microlensing free-floating planet (FFP) events is whether the lenses are bona fide unbound or bound to a star that is not microlensing because of chance alignment. One avenue to verify boundness is to image the FFP events with high angular resolution in order to directly detect the putative host star. The highest resolution is obtained with interferometry. I will discuss the recent technical developments in interferometric instruments and present a proposal for interferometric observations of FFPs that was recently accepted.

Primary author: POLESKI, Radoslaw (Astronomical Observatory, University of Warsaw)

Presenter: POLESKI, Radoslaw (Astronomical Observatory, University of Warsaw)

Session Classification: Microlensing

Track Classification: In-person

Contribution ID: **33** Type: **Contributed talk**

Peering into the accretion on planetary-mass objects with UVES at VLT.

Wednesday, December 17, 2025 9:40 AM (20 minutes)

Emission lines tracing active accretion have been detected in the youngest directly imaged exoplanets (e.g., PDS 70 b and c) and their free-floating counterparts. The profiles of these lines can provide valuable insights into the physics and kinematics of gas accretion, a process believed to determine the final spin of planetary-mass objects, their early physical evolution (hot- vs. cold-start scenarios), and the formation of exomoons.

I will present the first results from the ENTROPY campaign, which uses UVES at the VLT to obtain time-series observations of emission line profiles in young planetary-mass objects and wide-orbit companions. These observations aim to establish the first inventory of emission line profiles in planetary-mass objects and to identify the accretion mechanisms at play. I will focus on two objects whose line properties are characteristic of magnetospheric accretion.

Primary author: BONNEFOY, Mickael (Institut de Planétologie et d'Astrophysique de Grenoble)

Presenter: BONNEFOY, Mickael (Institut de Planétologie et d'Astrophysique de Grenoble)

Session Classification: Disks

Track Classification: In-person

Contribution ID: **34** Type: **Invited talk**

A Galactic Exoplanet Census with the Roman Space Telescope (Invited)

Tuesday, December 16, 2025 4:10 PM (30 minutes)

NASA's Nancy Grace Roman Space Telescope —launching in late 2026 —will open up unprecedented discovery space in the infrared universe. Combining Hubble-like sensitivity and resolution with a field of view 100 times larger and a sky-mapping speed 1,000 times faster, Roman will conduct panoramic, high-resolution surveys that will transform our understanding of dark energy, exoplanetary systems, galactic structure, the solar system, and star formation —all while producing an enormous data set that will be analyzed for decades to come. One of Roman's Core Community Surveys is the Roman Galactic Bulge Time Domain Survey (RGBTDS), an ambitious program that will monitor 1.7 square degrees toward the crowded Galactic center with unprecedented precision and cadence. Over 440 days across six observing seasons, Roman will repeatedly image the same stars every 12 minutes, enabling the detection of planetary systems by using microlensing to reveal thousands of cold planets and elusive free-floating worlds, and transits to discover tens of thousands of hot and warm planets, including Earth-sized and larger worlds orbiting their stars. Together, these observations will deliver the first comprehensive galactic census of exoplanets — spanning all major stellar populations and probing planets with radii or masses above ˜2× Earth's at all separations, from hot Jupiters to icy wanderers beyond the snow line. I will highlight Roman's revolutionary capabilities, preview its expected scientific yield, and describe the efforts of the Roman Galactic Exoplanet Survey Project Infrastructure Team (RGES-PIT), which is developing the framework, tools, and strategies to maximize the scientific return from the RGBTDS.

Primary author: GAUDI, Scott (The Ohio State University)

Presenter: GAUDI, Scott (The Ohio State University)

Session Classification: Microlensing

Track Classification: In-person

Contribution ID: **35** Type: **Contributed talk**

DIPSY: A New Disc Instability Population Synthesis

Tuesday, December 16, 2025 9:20 AM (20 minutes)

Disc instability (DI) remains the leading formation pathway for some of the observed giant planets. In particular, this model can more naturally explain giant planets at large separation, giant planets around M stars, and very young giant planets. However, there are still many open questions regarding this formation mechanism, and the expected population of planets is currently unknown. We developed a comprehensive model for the formation of a star-and-disc system through the collapse of a molecular cloud core and its evolution until disc dispersal and beyond. The model includes the potential fragmentation of the disc as well as the subsequent evolution of any fragments. We apply the model to perform a population synthesis in the DI paradigm (DIPSY). We will present the results of the baseline population and discuss the emerging population of companions around different types of stars. We find that, while fragmentation (the formation of bound clumps of gas in the disc, a necessary condition for planet formation in the DI model) may only happen in a minority of systems, it often leads to the formation of at least one companion when it does. The inferred population of companions spans a large range of masses, from the planetary to the stellar regime. Interestingly, DI also appears to produce a population of ejected objects.

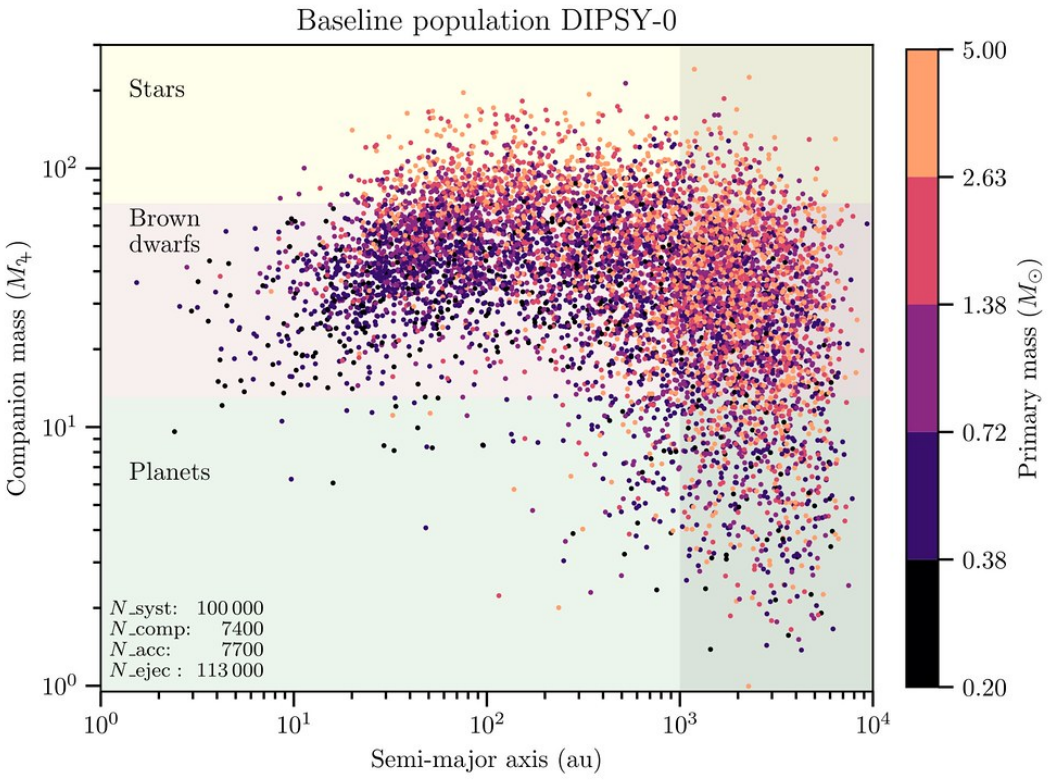

Figure 1: The figure

shows the result of the baseline calculation: the mass-distance diagram for 100'000 systems after 100 Myr. The final host star mass is given as colour code. The results of the population synthesis will provide hints both for the theoretical study of planet formation (e.g. hydrodynamic simula-

tions) and future observational surveys of companions. DIPSY contributes to our understanding of planet formation irrespective of the formation model.

Primary author: SCHIB, Oliver (University of Bern)

Co-authors: EMSENHUBER, Alexandre (University of Bern); MORDASINI, Christoph (University of Bern); HELLED, Ravit (University of Zurich)

Presenter: SCHIB, Oliver (University of Bern)

Session Classification: Modeling

Track Classification: In-person

Contribution ID: **36** Type: **Contributed talk**

Properties of Free-floating Planets Ejected through Planet–Planet Scattering

Monday, December 15, 2025 2:30 PM (20 minutes)

Multiple studies show that planet–planet scattering plays a key role in the dynamical evolution of planetary systems. It can also contribute to the census of free-floating planets. In this work, we run an ensemble of N-body simulations and record the properties of ejected planets. Our simulations sample a wide range of orbital and physical parameters. We find that 40%–80% of planets are ejected, depending on the initial number in the system. Most ejections occur over $\sim 10^8$–10^9 yr. The mean excess velocity of ejected planets lies in the range 2–6 km s^{-1} relative to the host star, and strongly depends on the semimajor axis of the innermost planet. Regardless of initial location, all planets are equally likely to be ejected. Bound and ejected planets show distinct mass distributions, with bound planets being more massive. Increasing planetary radii reduces the ejection fraction due to higher collision rates. The properties of ejected planets do not strongly depend on initial spacing, though ejection timescales increase with separation. The ejection fraction is also largely insensitive to the distance from the host star used to define unbound status. Comparing our results with observed free-floating planet populations, we conclude that fewer than five Jovian-mass planets need to form per star to match observations—consistent with current constraints from both observations and planet formation models.

Primary authors: Prof. PERETS, Hagai (Technion-Israel Institute of Technology); BHASKAR, Hareesh Gautham (Indiana University, Bloomington)

Presenter: Prof. PERETS, Hagai (Technion-Israel Institute of Technology)

Session Classification: Modeling

Track Classification: In-person

Contribution ID: **37** Type: **Poster**

Dynamical origin of Theia, the last giant impactor on Earth

Cosmochemical studies have proposed that Earth accreted roughly 5%–10% of its mass from carbonaceous (CC) material, with a large fraction delivered late via its final impactor, Theia (the Moon-forming impactor). Here, we evaluate this idea using dynamical simulations of terrestrial planet formation, starting from a standard setup with a population of planetary embryos and planetesimals laid out in a ring centred between Venus and Earth's orbits, and also including a population of CC planetesimals and planetary embryos scattered inward by Jupiter. We find that this scenario can match a large number of constraints, including (i) the terrestrial planets' masses and orbits; (ii) the CC mass fraction of Earth; (iii) the much lower CC mass fraction of Mars, as long as Mars only accreted CC planetesimals (but no CC embryos); (iv) the timing of the last giant (Moon-forming) impact; and (v) a late accretion phase dominated by non-carbonaceous (NC) bodies. For this scenario to work, the total mass in scattered CC objects must have been ~ 0.2–0.3 $M_{\oplus}$, with an embryo-to-planetesimal mass ratio of at least 8, and CC embryos in the ~ 0.01–0.05 $M_{\oplus}$ mass range. In that case, our simulations show there are roughly 50-50 odds of Earth's last giant impactor (Theia) having been a carbonaceous object —either a pure CC embryo or an NC embryo that previously accreted a CC embryo. Our simulations thus provide dynamical validation of cosmochemical studies.

Primary author: BRANCO, Duarte (Instituto de Astrofísica e Ciências do Espaço)

Co-authors: Prof. MACHADO, Pedro (Faculdade de Ciências da Universiade de Lisboa); RAYMOND, Sean (Laboratoire d'Astrophysique de Bordeaux)

Presenter: BRANCO, Duarte (Instituto de Astrofísica e Ciências do Espaço)

Session Classification: Mish Mash

Track Classification: Poster

Contribution ID: **38** Type: **Contributed talk**

Dynamical origin of wide-orbit planets

Monday, December 15, 2025 2:50 PM (20 minutes)

There is strong evidence from the broad eccentricity distribution of giant exoplanets that dynamical instabilities are ubiquitous. During the ejection of a planet, it may spend time on a wide enough orbit to be subject to external torques, from both passing stars (in particular, for early instabilities while the Sun was in its birth cluster) and the Galactic tidal field (for later dynamical instabilities). These external torques can trap a fraction of planets that would otherwise have been ejected as free-floating planets. The orbits of trapped planets depend on the strength of external torques – during the stellar cluster phase, planets can be trapped with semimajor axes of a few hundred au, on orbits similar to the proposed Planet 9. At later times, the Galactic tide can strand planets in the Oort cloud. I will discuss the dynamics of trapping planets on wide orbits, as well as the occurrence rate from simulations and how it compares with that of free-floating planets.

Primary author: RAYMOND, Sean (Laboratoire d'Astrophysique de Bordeaux)

Presenter: RAYMOND, Sean (Laboratoire d'Astrophysique de Bordeaux)

Session Classification: Modeling

Track Classification: In-person

Contribution ID: **41** Type: **Contributed talk**

Searching for Transiting Exomoons around Free-Floating Planetary Mass Objects

Monday, December 15, 2025 5:00 PM (20 minutes)

While we expect moons outside of our Solar System to be common based on our own Solar System's moon population and the predictions of satellite formation models, there have been no confirmed exomoon detections to date. JWST is collecting time-series observations of many free floating planets (FFPs) to study their weather, but these light curves are also the ideal datasets to search for exomoons that transit the FFP during observations. As a case study, we search for companions around WISE 0855 (T=250–285K, M=6.5±3.5M_{Jup}, d=2.3 pc), and demonstrate the overall sensitivity required to detect exomoons with JWST. We analyze 11 hours of time-series spectra from NIRSpec, and while we do not find statistical evidence of an exomoon transit in this dataset, injection and recovery tests of artificial transits for depths ranging between 0.1-1% allow us to explore the exomoon parameter space where we could successfully detect transits. For transit depths ≥0.5%, our detection rate is 96%, which, for WISE 0855, corresponds to a moon with a companion-to-host mass ratio similar to that of Titan and Saturn. Given our sensitivity, transit probabilities, and our observational duration, we determine a ~91% probability of detecting a Titan mass analog exomoon after 18 similar observations if every observed system hosts a Titan mass analog exomoon in a Galilean-like system. This suggests that JWST observations of dozens of FFPs could yield meaningful constraints on the occurrence rate of exomoons.

Primary author: WILSON, Mikayla (University of California Santa Cruz)

Presenter: WILSON, Mikayla (University of California Santa Cruz)

Session Classification: Moons of FFPs

Track Classification: In-person

Contribution ID: **42** Type: **Contributed talk**

The formation of free-floating planets: lessons from proto-brown dwarf studies in nearby clouds

Monday, December 15, 2025 10:20 AM (20 minutes)

In a recent review paper, we have studied the pre- and proto-brown dwarf (proto-BD) population in different nearby clouds down to the planetary boundary (Palau+2024). 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, suggesting a possible influence of the cloud temperature in their formation due to the presence of hot stars. Hence, in this presentation I will discuss the possibility that the planetary-mass regime of the IMF, where rogue planets reside, is subtly shaped by stellar feedback. Our overall results suggests that Jeans fragmentation seem the main mechanism to form objects down to 10 M_{Jup}, below which other mechanisms might be at work.

Primary author: HUÉLAMO, Nuria (Centro de Astrobiología (CSIC-INTA))

Presenter: HUÉLAMO, Nuria (Centro de Astrobiología (CSIC-INTA))

Session Classification: Direct Imaging

Track Classification: In-person

Contribution ID: **43** Type: **Contributed talk**

The Euclid-Roman joint survey to reveal the population of Rogue Worlds in the Milky Way

Tuesday, December 16, 2025 3:00 PM (20 minutes)

Because it does not require the flux measurement of the lens, the microlensing technic is sensitive to a wide rage of dark range, from stellar mass black hole to the free-floating regime. Starting in 2027, it is expected that the Roman mission will detect thousands of free-floating planets. This will allow a first estimate of the population of these objects in the Milky Way. However, several challenges exist. First, the mass and distance of these objects will be difficult to estimate with Roman only. I will present first how the joint survey of Euclid and Roman will allow the detection of the microlensing parallax, that will directly constraint their masses. Similarly, I will also show how this joint survey will eliminate a large range of false positive. Finally, I will discuss how the Euclid Galactic Bulge Survey achieved in 2025 could help to eliminate bounds planets at large orbits.

Primary author: BACHELET, Etienne (Université Marie et Louis Pasteur, CNRS, Institut UTINAM UMR 6213)

Co-author: BEAULIEU, Jean-Philippe (IAP)

Presenter: BACHELET, Etienne (Université Marie et Louis Pasteur, CNRS, Institut UTINAM UMR 6213)

Session Classification: Euclid

Track Classification: In-person

Contribution ID: **44** Type: **Contributed talk**

Rogue vs. Wide-Orbit Planets with Euclid

Tuesday, December 16, 2025 3:20 PM (20 minutes)

The Euclid Galactic Bulge Survey (EGBS), conducted in late March 2025, will play a crucial role in maximizing the number of precise mass and distance measurements for Roman microlensing events. These observations can also be used to constrain the physical parameters of any microlensing event occurring within the survey fields.

An open question remains: can these data help us distinguish between free-floating planet (FFP) candidates and wide-orbit planets?

In this work, I will present an analysis of historical FFP candidates captured within the EGBS fields. I will also discuss methods to use these observations to search for possible host stars in wide orbits, technical solutions to outstanding challenges related to the analysis of these data and, thereby improving our understanding of the true nature of these candidates.

Primary author: REKTSINI, Efstathia Natalia (IAP, CNRS)

Co-authors: BACHELET, Etienne (Université Marie et Louis Pasteur, CNRS, Institut UTINAM UMR 6213); BEAULIEU, Jean-Philippe (IAP)

Presenter: REKTSINI, Efstathia Natalia (IAP, CNRS)

Session Classification: Euclid

Track Classification: In-person

Contribution ID: **45** Type: **Contributed talk**

Free-floating and wide orbit planets from breaking the chains of cold Neptunes

Tuesday, December 16, 2025 10:20 AM (20 minutes)

Multiplanet systems are expected to form in resonance chains as a consequence of disk-driven migration. We investigate the dynamical evolution of cold Neptune systems initially assembled in resonance chains that later interact with planetesimals leftover from planet formation. We find that planetesimal masses comprising only 1–2% of the total planetary mass are sufficient not only to break the resonance chains but also to trigger a global dynamical instability, producing a mixture of planetary collisions, tidal disruptions/captures, and ejections. Unlike systems with Jovian-mass planets, which have frequently been studied in the past, our simulations show that Neptunes are remarkably efficient at inducing tidal disruptions and/or captures (˜0.7 per system), a rate comparable to that of ejections. After more than a billion years in a substantial fraction of systems, configurations containing wide-orbit Neptunes (average separation ⊠ 30–50 au) are retained, largely assisted by the dynamics of the disrupted planets. Such planets may represent an important contribution to the observed population of inferred free-floating planets.

Primary author: LORUSSO, Ryan (Indiana University, Bloomington)

Co-authors: BHASKAR, Hareesh Gautham (Indiana University, Bloomington); Prof. PETROVICH, Cristobal (Indiana University, Bloomington)

Presenter: LORUSSO, Ryan (Indiana University, Bloomington)

Session Classification: Modeling

Track Classification: In-person

Contribution ID: **46** Type: **Invited talk**

Direct imaging of free-floating planets (Invited)

Monday, December 15, 2025 9:30 AM (30 minutes)

Direct imaging has revolutionized our view of the substellar population, revealing a growing population of free-floating planets. I will review the first discoveries, the current observational picture, and the prospects opened by upcoming instruments. I will describe the strategies used to identify free-floating planets, combining deep imaging, proper motions, and spectroscopy. Finally, I will discuss observational diagnostics that can shed light on their origin and emphasize the importance of characterizing their environment to constrain their formation process.

Primary author: MIRET ROIG, Núria (University of Bordeaux)

Presenter: MIRET ROIG, Núria (University of Bordeaux)

Session Classification: Direct Imaging

Track Classification: In-person

Contribution ID: **47** Type: **Contributed talk**

Catch and release: Ejection and recapture of planetesimals and planets and their role in planet formation

The traditional view of planet formation often treats planetary systems as isolated environments. However, dynamical processes are highly stochastic, and the "release" of material—from planetesimals to fully-formed planets—is a common, if not dominant, outcome. Planet-planet scattering, for instance, is a chaotic "release" mechanism that can eject 40-80% of a system's planets, populating the galaxy with a vast reservoir of free-floating planets (FFPs), or "rogue worlds". This ejected population, however, is not merely lost. We explore the "catch" part of this cycle, demonstrating how rogue objects can be recaptured and play a fundamental role in the formation and evolution of new and existing planetary systems. First, we show that stars within dispersing clusters can efficiently "catch" FFPs, leading to the dynamical recapture of planets into stable, wide orbits, potentially explaining the origins of observed wide-orbit planets (and binaries). Second, the "catch" mechanism is even more profound in young systems. Protoplanetary disks, through gas-assisted capture, are exceptionally effective at trapping interstellar planetesimals. This process "seeds" nascent disks with km-sized planetesimals, suggesting planet formation is a galactically-linked process. This mechanism may also trigger an "epidemic" cascade: the "catch" of an external object can lead to "seeding" of planet formation in other systems and the ejection of many more planetesimals from those systems, which can then be captured and seed planet formation and so forth. This same gas-capture framework also provides the most efficient known channel for catalyzed lithopanspermia. Finally, this cycle extends to stellar graves. Dynamical exchange in evolved binaries represents a direct "catch and release" scenario, where a planet is "released" from one star only to be "caught" by its companion. The material captured in such events, or through mass transfer, can then form disks around white dwarfs, providing stable environments for the formation of "second-generation" planets.

Primary author: PERETS, Hagai (Technion-Israel Institute of Technology)

Presenter: PERETS, Hagai (Technion-Israel Institute of Technology)

Session Classification: Modeling

Track Classification: Poster

Contribution ID: **49** Type: **Invited talk**

TBD

Monday, December 15, 2025 2:00 PM (30 minutes)

Primary author: RICE, Malena

Presenter: RICE, Malena

Session Classification: Modeling

Track Classification: In-person

Contribution ID: **50** Type: **Invited talk**

TBD (Invited)

Tuesday, December 16, 2025 8:50 AM (30 minutes)

Primary author: MURRAY-CLAY, Ruth

Presenter: MURRAY-CLAY, Ruth

Session Classification: Modeling

Track Classification: In-person

Contribution ID: **51** Type: **Invited talk**

TBD (Invited)

Wednesday, December 17, 2025 10:50 AM (30 minutes)

Presenter: MORO MARTIN, Amaya

Session Classification: Mish Mash

Track Classification: In-person

Contribution ID: **52** Type: **Invited talk**

Free-Floating planet Mass Function by microlensing (Invited)

Monday, December 15, 2025 11:10 AM (30 minutes)

We review the detection and mass-function measurements of free-floating planets (FFPs) or very wide-orbit planets using the microlensing technique. The microlensing surveys have identified several events with extremely short Einstein radius crossing times, t_E<0.5 days, and very small angular Einstein radii of theta_E <10μas. Such events are likely produced by low-mass lenses, potentially down to planetary masses.
MOA collaboration measure the mass function of FFP or very wide orbit planets down to an Earth mass, from the MOA-II microlensing survey in 2006-2014. Six events are likely to be due to planets with Einstein radius crossing times, t_E<0.5days, and the shortest has t_E = 0.057days and an angular Einstein radius of theta_E= 0.90 uas. For the first time, we evaluated the detection efficiency as a function of both t_E and theta_E with image level simulations. These short events are well modeled by a power-law mass function with a power-law index of 0.96ˆ{+0.47}_{-0.27} for M/M_sun < 0.02. This result suggests that the FFPs were likely ejected from bound planetary systems whose initial mass function may have followed a similar power-law index of approximately 0.9. This model predicts that the Roman Space Telescope will detect about 1000 FFPs, with masses extending down to that of Mars. The PRIME telescope has begun a near-infrared microlensing survey toward the Galactic center to measure the masses of FFPs via space-based microlensing parallax in collaboration with Roman.

Primary author: SUMI, Takahiro (Osaka University)

Presenter: SUMI, Takahiro (Osaka University)

Session Classification: Microlensing

Track Classification: In-person

Contribution ID: **53** Type: **Contributed talk**

Formation of free-floating planets via planet-planet ejection

Wednesday, December 17, 2025 12:00 PM (20 minutes)

Microlensing observations suggest that the mass distribution of free-floating planets (FFPs) follows a declining power-law with increasing mass. The origin of such distribution is unclear. Using apopulation synthesis framework, we investigate the formation channel and properties of FFPs, andcompare the predicted mass function with observations. Assuming FFPs originate from planet-planetscattering and ejection in single star systems, we model their mass function using a Monte Carlo basedplanet population synthesis model combined with N-body simulations. We adopt a realistic stellarinitial mass function, which naturally results in a large fraction of planetary systems orbiting low-massstars. The predicted FFP mass function is broadly consistent with observation: it follows the observed power-law at higher masses (10-10000 $M_{\oplus}$), while at lower masses (0.1-10 $M_{\oplus}$) it flattens, remaining marginally consistent with the lower bound of the observational uncertainties. Low-mass, close-in planets tend to remain bound, while Neptune-like planets at wide orbits dominate the ejected population due to their large Hill radii and shallow gravitational binding. We also compare the mass distribution of bound planets with microlensing observations and find reasonably good agreement with both surveys. Our model predicts roughly 1.20 ejected planets per star in the mass range of 0.33 <m/M⊕ <6660, with a total FFP mass of roughly 17.98 M⊕ per star. Upcoming surveys will be crucial in testing these predictions and constraining the true nature of FFP populations.

Primary author: Dr GUO, Kangrou (Tsung-Dao Lee Institute, Shanghai Jiao Tong University)

Presenter: Dr GUO, Kangrou (Tsung-Dao Lee Institute, Shanghai Jiao Tong University)

Session Classification: Mish Mash

Track Classification: In-person

Contribution ID: **54** Type: **Contributed talk**

Rogue Planet Host Search: A Keck AO Imaging Survey of Microlensing FFP Candidates

Monday, December 15, 2025 12:00 PM (20 minutes)

Free-floating planet (FFP) candidates detected via microlensing could also be bound planets on wide orbits (>5–10 au). High resolution imaging may break this degeneracy via direct detection of the putative host stars. We are conducting a multi-year Keck AO imaging survey of a large number of microlensing FFP candidates detected over the past two decades. I present preliminary results on phase 1 of our survey consisting of six events. Notably, we report on the detection of candidate hosts for the terrestrial FFP candidate MOA-9y-5919L at projected separations of ˜1000 au. By comparison, no candidate hosts were detected within ˜100 au for all six events.

Primary author: ZHANG, Keming (Massachusetts Institute of Technology)

Presenter: ZHANG, Keming (Massachusetts Institute of Technology)

Session Classification: Microlensing

Track Classification: In-person