2–6 November 2026

BRIDGING HORIZONS:

Harnessing ESO's current facilities for the dawn of exoplanet population studies

European Southern Observatory
GARCHING, Germany

BridgingHorizons@eso.org

Observatoire de la Côte d'Azur
NICE, France

Lund University
LUND, Sweden

European Southern Observatory
SANTIAGO, Chile

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Pre-registration opens: 30 January 2026
Abstract submission: 15 March – 1 May 2026
Programme release: 1 August 2026



The diverse population of exoplanets.
Credit: Jay Simons



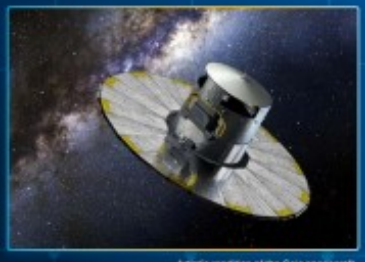
Artist impression of exoplanet Gaia-6b.
Credit: ESA/Gaia/DPAC/M. Marcussen



SPHERE image of the newborn planet PDS 70b.
Credit: ESO/A. Müller et al.



A possible companion in the disc of the star V960 Mon.
Credit: ESO/A. Dasgupta/ALMA (ESO/NAOJ/NRAO)/Weber et al.



Artist's rendition of the Gaia spacecraft.
Credit: ESA



Artist's rendition of the PLATO spacecraft.
Credit: ESA



Artist's rendition of ESA's Ariel exoplanet satellite.
Credit: Airbus



Data centre at ESO HQ in Garching.
Credit: ESO

https://www.eso.org/sci/meetings/2026/BridgingHorizons.html

Contents

Programme iv

Index of abstracts xiv

Index of posters xvii

Abstracts of talks 1

Abstracts of posters 27

Programme

The talks form one **joint session** shared live by all nodes; each is listed with its start time in **Garching** / **Nice** (CET) and in **Vitacura** (CLST, 4 h earlier), and the speaker's node. Before and after the joint session, each node has its own **local programme** (times are local). Invited talks are shaded; **discussions and sessions**, **social events**. Click a talk title to jump to its abstract.

Monday, 2 November 2026

Day 1

LOCAL PROGRAMME – BEFORE THE JOINT SESSION

Garching	Nice	Vitacura
Welcome session starts at 13:00	**11:00** **Registration and arrival** Allow 15 min to walk to the library on site. Please arrive before 11:50 to walk together to the cantine.	*Welcome session starts at 09:00*
	12:00 Lunch at the cantine (1 h)	

JOINT SESSION – ALL NODES

Garching Nice	Vitacura	TALK	SPEAKER
13:00	09:00	*Welcome*	
13:15	09:15	**ESO Facilities I: Past and Present**	**Robert de Rosa** invited VITACURA
13:35	09:35	**ESO Facilities II: Future**	**Louise Nielsen** invited GARCHING
14:00	10:00	Synergy of ESO's Extreme Precise Radial Velocity facilities with photometric space missions for exoplanet population studies	François Bouchy GARCHING
14:15	10:15	RV-Astrometry Synergy in the Detection of Warm Giants	Joanne Rojas Molina VITACURA
14:30	10:30	Optical polarimetry reveals auroral magnetism in planetary-like atmospheres	Paulo Miles-Páez GARCHING
14:45	10:45	Results and take-aways from the WIde Separation Planets In Time (WISPIT) survey	Richelle van Capelleveen GARCHING
15:05	11:05	Coffee break (30 min)	
15:35	11:35	**Astroinformatics hands-on**	**Amelia Bayo** invited GARCHING
15:55	11:55	**A dip in the past: revisiting direct imaging archives with novel algorithms**	**Vito Squicciarini** invited GARCHING
16:20	12:20	Direct Imaging of Protoplanet Candidates in Protoplanetary Disks Using VLT/ERIS NIX L-band Observation	Swastik Chowbay NICE
16:35	12:35	Accelerating atmospheric characterisation with Optimal Estimation	Paulina Palma-Bifani GARCHING
16:50	12:50	Adapting the YOSO Gaussian Motion Filter for Direct Exoplanet Imaging	Nitya Pandey VITACURA
17:05	13:05	A new Bayesian framework for exoplanet occurrence rates	João Faria GARCHING
17:20	13:20	Exploring Giant Planets Around Low-Mass Stars with NIRPS	Yolanda Frensch NICE

LOCAL PROGRAMME – AFTER THE JOINT SESSION

Garching	Nice	Vitacura
from 17:50 **Welcome cocktail**	**17:50** *End of day*	**13:50** Lunch break (1.5 h) **15:00** **Poster-talk session and hands-on: HCI tools** Including coffee break. **from 17:30** **Welcome event**

Tuesday, 3 November 2026

Day 2

LOCAL PROGRAMME – BEFORE THE JOINT SESSION

Garching		Nice		Vitacura
09:30	Morning coffee	**09:30**	Coffee and croissants for breakfast	*Joint session starts at 09:00*
10:30	**Discussion: "If our field's observation and travel budget were cut in half over the next decade, what would we keep, and what would we do differently?"** The ecological and financial constraints on our science, and how we keep doing good work within them. Chair: Remo Burn	**10:30**	**Discussion: "If our field's observation and travel budget were cut in half over the next decade, what would we keep, and what would we do differently?"** The ecological and financial constraints on our science, and how we keep doing good work within them. Chair: Remo Burn	
12:00	Lunch break (1 h)	**12:00**	Lunch at the cantine (1 h)	

JOINT SESSION – ALL NODES

Garching Nice	Vitacura	TALK	SPEAKER
13:00	09:00	**Dynamical evolution of planetary systems**	**Antoine Petit** invited NICE
13:25	09:25	**Planet formation**	**Julia Venturini** invited ONLINE
13:50	09:50	Two populations of exocomets in Beta Pictoris: matching theory to observations	Klaudia Jaworska ONLINE
14:05	10:05	Exocomets as deliverers of water in the young PDS 70 system	Alexandra Stockwell Murphy GARCHING
14:20	10:20	Close in super-Earth formation using GPU-Accelerated N-Body simulations with pebble accretion	Sebastían Roberto Ramírez Vargas VITACURA
14:35	10:35	Super-Earth formation in systems with cold giants	Claudia Danti VITACURA
14:50	10:50	The exceptional planetary system orbiting TOI-201: An eccentric brown dwarf in a 8-yr orbit coplanar to a warm Jupiter and a hot super Earth	Matias Jones VITACURA
15:05	11:05	Coffee break (30 min)	
15:35	11:35	ESPRESSO reveals that warm Jupiters are dynamically colder than hot Jupiters	Juan Ignacio Espinoza-Retamal VITACURA
15:50	11:50	High-Eccentricity Migration of Close-in Neptune-Mass Planets	Cristobal Petrovich VITACURA
16:05	12:05	**Ariel**	**Sudeshna Boro Saikia** invited GARCHING
16:25	12:25	**The ESA PLATO mission**	**Alexis Brandeker** invited GARCHING

Garching Nice	Vitacura	TALK	SPEAKER
16:50	12:50	An ensemble view of stars with proper motion anomaly in the first PLATO field	Silvano Desidera **GARCHING**
17:05	13:05	Exploring PLATO's detectability of small planets via injection-recovery simulations	Jeanne Davoult **GARCHING**
17:20	13:20	Comparing planetary populations: controlling for biases in host star properties by matching distributions	Scarlett Royle **VITACURA**

LOCAL PROGRAMME – AFTER THE JOINT SESSION

Garching	Nice	Vitacura
17:40 *End of day*	**17:40** *End of day*	**13:40** Lunch break (1.5 h) *Free afternoon*

Wednesday, 4 November 2026

Day 3

LOCAL PROGRAMME – BEFORE THE JOINT SESSION

Garching	Nice	Vitacura
Free morning	*Free morning*	*Joint session starts at 09:00*
11:30 Lunch break (1.5 h), coffee afterwards, Conference Picture	**12:00** Lunch at the cantine (1 h)	

JOINT SESSION – ALL NODES

Garching Nice	Vitacura	TALK	SPEAKER
13:00	09:00	**Future ground-based instrumentation**	**Desgrange, Célia** invited VITACURA
13:20	09:20	**Gaia Astrometry and the Future of Long-period Giant Exoplanet Research**	**Alexander Venner** invited GARCHING
13:45	09:45	Combining Gaia DR4 and GRAVITY+ to search for exoplanets in resolved binary systems	Daniela González VITACURA
14:00	10:00	Gaia Astrometric Substellar Companions: DR3 RV Follow-Up and DR4/DR5 Forecasts for Mutual Inclinations	Kamil Kalinowski GARCHING
14:15	10:15	Unlocking Gaia DR4 exoplanetary populations: combining predictive simulations and ground-based follow-up	Matteo Pinamonti ONLINE
14:30	10:30	Bridging exoplanet demographics across generations: Predicting the population reach of ELT/PCS	Jens Kammerer GARCHING
14:45	10:45	Detection limits for satellites of directly imaged substellar companions with high resolution spectroscopy: from VLT to ELT	Ilaria Giovannini GARCHING
15:05	11:05	Coffee break (30 min)	
15:35	11:35	Exosatellite Detected Around a Companion Brown Dwarf	Kevin Hoy VITACURA
15:50	11:50	ENTROPY: studying accretion signatures in the large separation companion YSES 1b	Sebastian Jorquera GARCHING
16:05	12:05	Bridging high-angular resolution for exoplanet studies: from current VLTI to the proposed VLTI/SHARPS instrument	Stefan Kraus ONLINE
16:20	12:20	**Modeling the interiors of super-Earths and sub-Neptunes**	**Marie-Luise Steinmeyer** invited GARCHING
16:40	12:40	**Overview of climate models, strengths and limitations**	**Guillaume Chaverot** invited NICE
17:05	13:05	ESPRESSO characterizes the small transiting exoplanet population with extreme precision radial velocities	Melissa Hobson NICE
17:20	13:20	How Earth-like is "Earth-like"? Distinguishing different climate scenarios of TRAPPIST-1 e with ELT and JWST	Linn Boldt-Christmas ONLINE

LOCAL PROGRAMME – AFTER THE JOINT SESSION

Garching	Nice	Vitacura
17:40 *End of day* **Voluntary, self-paid dinner at Garchinger Augustiner**	**ca. 17:45** **Apéro at the Telescope (Grand Coupole)** Transport to Nice Riquier train station provided afterwards.	**13:35** Lunch break (1.5 h) **15:05** **Discussion: Studying exoplanets on a population level in the era of Ariel, PLATO, JWST, VLT, ELT, etc.** Including a 20-min coffee break. **ca. 17:30/18:00** *End of day*

Thursday, 5 November 2026

Day 4

LOCAL PROGRAMME – BEFORE THE JOINT SESSION

Garching		Nice		Vitacura
09:30	Morning coffee	**09:30**	Coffee and croissants for breakfast	*Joint session starts at 09:00*
10:30	**Discussion: Studying exoplanets on a population level in the era of Ariel, PLATO, JWST, VLT, ELT, etc.** Chair: Bibiana Prinoth	**10:30**	**Discussion: Studying exoplanets on a population level in the era of Ariel, PLATO, JWST, VLT, ELT, etc.** Chair: Julia Seidel	
12:00	Lunch break (1 h)	**12:00**	Lunch at the cantine (1 h)	

JOINT SESSION – ALL NODES

Garching Nice	Vitacura	TALK	SPEAKER
13:00	09:00	**Study of exoplanet populations and their correlations with a multi-technique approach**	**Aldo Bonomo** invited NICE
13:30	09:30	Planet populations around cool stars with TESS	Harshitha Mysore Parashivamurthy VITACURA
13:45	09:45	Bridging discovery spaces: a unified framework for exoplanetary demographics	Domenico Barbato NICE
14:00	10:00	**Rocky planet detections**	**Hannah Osborne** invited VITACURA
14:20	10:20	**Rocky planet atmospheres**	**Giulia Roccetti** invited NICE
14:45	10:45	An empirical determination of the Cosmic Shoreline	Pedro Pablo Meni Gallardo NICE
15:05	11:05	Coffee break (30 min)	
15:35	11:35	Weighing the mass of LHS 3844 b	Alejandro Hacker VITACURA
15:50	11:50	In the Company of Two: NIRPS Hunts Planets in Binary Systems	Lina Messamah GARCHING
16:05	12:05	**Giant planets**	**Keren Duer-Milner** invited ONLINE
16:30	12:30	**Venus**	**Aurélien Stolzenbach** invited NICE
16:55	12:55	**Mars**	**François Forget** invited NICE
17:20	13:20	**Icy moons**	**Nozair Khawaja** invited ONLINE

LOCAL PROGRAMME – AFTER THE JOINT SESSION

Garching	Nice	Vitacura
17:45 **Beer & Brezn**	**17:45** *End of day*	**13:45** Lunch break (1.5 h) **Discussion: Exoplanets within Expanding Horizons** Including a 20-min coffee break. **Wine & Cheese**

Friday, 6 November 2026

Day 5

LOCAL PROGRAMME – BEFORE THE JOINT SESSION

Garching		Nice		Vitacura
09:30	Morning coffee	**09:30**	Coffee and croissants for breakfast	*Joint session starts at 09:00*
10:30	**Discussion: Exoplanets within Expanding Horizons** Chair: tbd	**10:30**	**Discussion: Exoplanets within Expanding Horizons** Chair: Melissa Hobson	
12:00	Lunch break (1 h)	**12:00**	Lunch at the cantine (1 h)	

JOINT SESSION – ALL NODES

Garching Nice	Vitacura	TALK	SPEAKER
13:00	09:00	**Neptunes**	**Vivien Parmentier** invited NICE
13:20	09:20	**Sub-Neptunes**	**Eva-Maria Ahrer** invited GARCHING
13:45	09:45	Three years of atmospheric characterization with The Near Infra-Red Planet Searcher (NIRPS)	Romain Allart GARCHING
14:00	10:00	**The population of cold Jupiters with direct imaging**	**Clémence Fontanive** invited GARCHING
14:20	10:20	**Hot and ultra-hot Jupiters**	**Adrien Simonnin** invited NICE
14:45	10:45	Atmospheric Composition and the Vertical Wind Profile of Ultra-Hot Jupiters with CRIRES+	Hossein Rahmati ONLINE
15:05	11:05	Coffee break (30 min)	
15:35	11:35	Vertical wind shears hints at magnetically damped circulation in an Ultra-Hot Jupiter	Valentin De Lia NICE
15:50	11:50	The diversity of winds in hot Jupiters	Ragnar Van den Broeck NICE
16:05	12:05	Preparing the ground for 3D retrievals for high-resolution spectroscopy phase-curves and eclipse mapping	Vatsal Panwar GARCHING
16:20	12:20	First brown dwarf mid-infrared spectrum with VLTI/MATISSE: HD984B	Jules Scigliuto NICE
16:35	12:35	Accreting gas giants: faint accretors waiting to be revealed, and resolved hydrogen lines with RISTRETTO, METIS, and UVES	Gabriel-Dominique Marleau GARCHING
16:50	12:50	*Workshop summary / thank you and farewell*	
17:00	13:00	**End of conference**	

Index of abstracts

Ahrer, Eva-Maria . . Sub-Neptunes

Allart, Romain . . Three years of atmospheric characterization with The Near Infra-Red Planet Searcher (NIRPS)

Barbato, Domenico . . Bridging discovery spaces: a unified framework for exoplanetary demographics

Bayo, Amelia . . Astroinformatics hands-on

Boldt-Christmas, Linn . . How Earth-like is "Earth-like"? Distinguishing different climate scenarios of TRAPPIST-1 e with ELT and JWST

Bonomo, Aldo . . Study of exoplanet populations and their correlations with a multi-technique approach

Boro Saikia, Sudeshna . . Ariel

Bouchy, François . . Synergy of ESO's Extreme Precise Radial Velocity facilities with photometric space missions for exoplanet population studies

Brandeker, Alexis . . The ESA PLATO mission

Chaverot, Guillaume . . Overview of climate models, strengths and limitations

Chowbay, Swastik . . Direct Imaging of Protoplanet Candidates in Protoplanetary Disks Using VLT/ERIS NIX L-band Observation

Danti, Claudia . . Super-Earth formation in systems with cold giants

Davoult, Jeanne . . Exploring PLATO's detectability of small planets via injection-recovery simulations

De Lia, Valentin . . Vertical wind shears hints at magnetically damped circulation in an Ultra-Hot Jupiter

de Rosa, Robert . . ESO Facilities I: Past and Present

Desgrange, Célia . . Future ground-based instrumentation

Desidera, Silvano . . An ensemble view of stars with proper motion anomaly in the first PLATO field

Duer-Milner, Keren . . Giant planets

Espinoza-Retamal, Juan Ignacio . . ESPRESSO reveals that warm Jupiters are dynamically colder than hot Jupiters

Faria, João . . A new Bayesian framework for exoplanet occurrence rates

Fontanive, Clémence . . The population of cold Jupiters with direct imaging

Forget, François . . Mars

Frensch, Yolanda . . Exploring Giant Planets Around Low-Mass Stars with NIRPS

Giovannini, Ilaria . . Detection limits for satellites of directly imaged substellar companions with high resolution spectroscopy: from VLT to ELT

González, Daniela . . Combining Gaia DR4 and GRAVITY+ to search for exoplanets in resolved binary systems

Hacker, Alejandro	Weighing the mass of LHS 3844 b
Hobson, Melissa	ESPRESSO characterizes the small transiting exoplanet population with extreme precision radial velocities
Hoy, Kevin	Exosatellite Detected Around a Companion Brown Dwarf
Jaworska, Klaudia	Two populations of exocomets in Beta Pictoris: matching theory to observations
Jones, Matias	The exceptional planetary system orbiting TOI-201: An eccentric brown dwarf in a 8-yr orbit coplanar to a warm Jupiter and a hot super Earth
Jorquera, Sebastian	ENTROPY: studying accretion signatures in the large separation companion YSES 1b
Kalinowski, Kamil	Gaia Astrometric Substellar Companions: DR3 RV Follow-Up and DR4/DR5 Forecasts for Mutual Inclinations
Kammerer, Jens	Bridging exoplanet demographics across generations: Predicting the population reach of ELT/PCS
Khawaja, Nozair	Icy moons
Kraus, Stefan	Bridging high-angular resolution for exoplanet studies: from current VLTI to the proposed VLTI/SHARPS instrument
Marleau, Gabriel-Dominique	Accreting gas giants: faint accretors waiting to be revealed, and resolved hydrogen lines with RISTRETTO, METIS, and UVES
Meni Gallardo, Pedro Pablo	An empirical determination of the Cosmic Shoreline
Messamah, Lina	In the Company of Two: NIRPS Hunts Planets in Binary Systems
Miles-Páez, Paulo	Optical polarimetry reveals auroral magnetism in planetary-like atmospheres
Nielsen, Louise	ESO Facilities II: Future
Osborne, Hannah	Rocky planet detections
Palma-Bifani, Paulina	Accelerating atmospheric characterisation with Optimal Estimation
Pandey, Nitya	Adapting the YOSO Gaussian Motion Filter for Direct Exoplanet Imaging
Panwar, Vatsal	Preparing the ground for 3D retrievals for high-resolution spectroscopy phase-curves and eclipse mapping
Parashivamurthy, Harshitha Mysore	Planet populations around cool stars with TESS
Parmentier, Vivien	Neptunes
Petit, Antoine	Dynamical evolution of planetary systems
Petrovich, Cristobal	High-Eccentricity Migration of Close-in Neptune-Mass Planets
Pinamonti, Matteo	Unlocking Gaia DR4 exoplanetary populations: combining predictive simulations and ground-based follow-up
Rahmati, Hossein	Atmospheric Composition and the Vertical Wind Profile of Ultra-Hot Jupiters with CRIRES+
Ramírez Vargas, Sebastían Roberto	Close in super-Earth formation using GPU-Accelerated N-Body simulations with pebble accretion

Roccetti, Giulia . . Rocky planet atmospheres

Rojas Molina, Joanne . . RV-Astrometry Synergy in the Detection of Warm Giants

Royle, Scarlett . . Comparing planetary populations: controlling for biases in host star properties by matching distributions

Scigliuto, Jules . . First brown dwarf mid-infrared spectrum with VLTI/MATISSE: HD984B

Simonnin, Adrien . . Hot and ultra-hot Jupiters

Squicciarini, Vito . . A dip in the past: revisiting direct imaging archives with novel algorithms

Steinmeyer, Marie-Luise . . Modeling the interiors of super-Earths and sub-Neptunes

Stockwell Murphy, Alexandra . . Exocomets as deliverers of water in the young PDS 70 system

Stolzenbach, Aurélien . . Venus

van Capelleveen, Richelle . . Results and take-aways from the WIde Separation Planets In Time (WISPIT) survey

Van den Broeck, Ragnar . . The diversity of winds in hot Jupiters

Venner, Alexander . . Gaia Astrometry and the Future of Long-period Giant Exoplanet Research

Venturini, Julia . . Planet formation

Index of posters

Ambalapatta Kannancheri, Bhavya . . Is the hot neptune desert really empty? A comparison of Tess vs Kepler

Bernardi, Andrea . . SaNDi-SHoP: Searching for Satellites'N'Disks with a Star-Hopping Program

Corley, Suber . . Mapping Exoplanets Across the Milky Way: A Representative Transit Census of the Galactic Disk with Rubin

Flaulhabe, Thiago . . Optical and Near-Infrared Analysis of NGC 2539: an open cluster hosting lithium-enriched giant stars

Heidari, Neda . . A Survey of Warm Jupiters: Orbital Architectures and Eccentricities

Janson, Markus . . Synergy of the ELT with an external occulter for characterising exoplanetary Earths and Solar System analogs

Montoya Calderón, Erick Franco . . Unveiling the kinematics and 3D geometry of eruptive young stellar objects: the case study of the FU Orionis system

Novais, Aline . . Sublimating exocomets in the PDS 70 system

Parashivamurthy, Harshitha M . . Planet populations around cool stars with TESS

Ramírez Reyes, Ricardo Leonardo . . A VLT/MUSE Framework for Detecting H_α Accretion Signatures in Wide-Orbit Planetary-Mass Companions

Rickmers Blamey, Ian . . Deepermoments: deep learning for moment maps

Royle, Scarlett E . . The effect of stellar position-velocity clustering on exoplanet properties and demographics

Sarkar, Soumyadeep C. . . SEARCHING FOR ACCRETION SIGNATURES IN YOUNG PLANET-FORMING SYSTEMS

Abstracts of talks

Sub-Neptunes

Ahrer, Eva-Maria
Invited

Three years of atmospheric characterization with The Near Infra-Red Planet Searcher (NIRPS)

Allart, Romain

NIRPS is a fiber-fed high-resolution spectrograph assisted by adaptive optics installed at LaSilla. Operated simultaneously with HARPS, NIRPS covers the Y, J, and H bands. I will describe the objectives of its consortium, which has been allocated 725 GTO nights over 5 years. A third of this time is dedicated to in-depth spectral characterizations, providing detailed, high-fidelity, high-signal-to-noise transmission and emission spectra in preparation for the ELT, as well as large, comprehensive atmospheric surveys to observe over 70 exoplanets, ranging from Jupiters to terrestrial planets. I will highlight key results we have obtained since the start of operations, including detections of escaping atmospheres and constraints on atmospheric compositions. I will then present a preliminary statistical analysis of atmospheric escape from the exoplanets we have observed. These results will demonstrate NIRPS's potential to deliver high-fidelity atmospheric spectra to statistically constrain exoplanet formation and evolution. Looking ahead, I will discuss how extending NIRPS into the K band will unlock a new realm of atmospheric science, enhancing and securing long-term follow-up of exoplanet atmospheres. Finally, NIRPS lays the groundwork for ELT spectrographs such as ANDES, and I will showcase how the lessons learned from NIRPS can be applied to the ELT instruments.

Bridging discovery spaces: a unified framework for exoplanetary demographics

Barbato, Domenico

The near future of exoplanet science will be shaped by large-scale population studies missions whose scientific return will rely on strong synergies with ground-based facilities and archival datasets. Robust

comparative exoplanetology therefore requires a coherent assessment of the complementary discovery spaces probed by different detection techniques. Current occurrence rate estimates often rely on heterogeneous completeness assessments of individual instruments, surveys, or methods. This limits our ability to derive homogeneous planetary demographics and to compare observations consistently with formation and evolution models. In this talk I present an in-development methodology that jointly characterises detection completeness across radial velocity, transit, proper motion anomaly, and direct imaging observations within a self-consistent statistical framework, applying the method to a few selected scientific cases of interest to show preliminary results. This approach combines archival and new observations to synergically quantify sensitivity to planetary architectures and explore implications for planet formation, migration, and dynamical evolution.

Astroinformatics hands-on

Bayo, Amelia
Invited

A large part of the fundamental knowledge that we can infer for exoplanets is tightly linked to the knowledge of the stellar host(s). This knowledge can be shaped in very different conceptual and practical formats: from large spectroscopic databases, to multi-wavelength compilations, products of advanced (or not) analysis pipelines and methodologies, etc. This talk was planned as a hands-on example of how to discover data in different categories, access them and combine them coherently. However, the same data-centers and projects that are enabling this discoverability and accessibility for astronomers are suffering from constant web scrapping overloads and attacks... therefore the "tutorial", unfortunately, won't be what we had envisioned.

How Earth-like is "Earth-like"? Distinguishing different climate scenarios of TRAPPIST-1 e with ELT and JWST

Boldt-Christmas, Linn

Transmission spectroscopy enables the study of gas giant exoplanet atmospheres using both ground- and space-based instruments, but a number of obstacles have prevented us from truly extending this yet to smaller, terrestrial exoplanets. Studying exoplanets of increasingly lower masses, radii, and temperatures is crucial as we work towards eventually characterising Earth-like exoplanets to assess potential habitability and astrobiological activity — but considering the vastness of factors required for life to originate and propagate, Earth-like exoplanets must be characterised in significantly high detail before one may comment on this. The mere presence of "Earth-like" atmospheric species does not automatically mean an "Earth-like" climate; instead, one must also meaningfully distinguish between a range of atmospheres whose surface climates differ in practice in spite of having chemically similar compositions. In this talk, I will present simulated observations using ROCKE-3D and NASA Planetary Spectrum Generator that model how different hypothetical GCM climate scenarios might appear on Earth-sized exoplanet TRAPPIST-1 e from both the ground (ELT/ANDES) and space (JWST/NIRSpec). The results of these simulations allow us to discuss whether our current methodology is capable of distinguishing different scenarios from one another,

and how to overcome this challenge in the broader context of transmission spectroscopy.

Study of exoplanet populations and their correlations with a multi-technique approach

Bonomo, Aldo
Invited

In this talk we will show that a multi-technique approach using transits, radial velocities, astrometry, and possibly imaging, is needed to i) characterize the architectures of exoplanet systems from the innermost to the outermost orbits, and ii) carry out statistical studies of exoplanet populations. Concerning the latter, we will focus on cold Jupiters (CJs), inner small planets (SPs), and their possible relation as a function of stellar and planetary parameters. We will illustrate the fundamental role of the upcoming PLATO space mission and its radial-velocity follow-up with ESO facilities both in investigating the SP-CJ relation with unprecedented precision and in determining for the first time the occurrence rate of Solar System analogs.

Ariel

Boro Saikia, Sudeshna
Invited

Ariel (Atmospheric Remote-sensing Infrared Exoplanet Large-survey) is a European Space Agency mission dedicated to characterising the atmospheres of approximately 1,000 exoplanets. By combining visible and infrared observations, Ariel will investigate the chemical composition, temperature structure, and cloud properties of exoplanetary atmospheres. Through a systematic, population-level survey, Ariel will provide a comparative framework for understanding planetary systems beyond our own. In this talk, I will introduce the Ariel mission and outline the key questions it aims to address.

Synergy of ESO's Extreme Precise Radial Velocity facilities with photometric space missions for exoplanet population studies

Bouchy, François

ESA's PLATO mission, scheduled for launch in January 2027, aims to discover and characterize extrasolar planetary systems, with a particular focus on terrestrial planets located in the habitable zone. The properties of both planets and their host stars will be derived, including their precise radii, masses and ages. To achieve these scientific objectives, in addition to the exquisite space-based photometry expected

from the satellite, a large Ground-based Observation Program (GOP) is being implemented within the PLATO consortium. Its role is to provide fundamental complementary data to establish the nature of the transit events detected in the PLATO light curves, help to determining the optimal stellar parameters of the host stars, and provide accurate estimates of the mass and bulk density of validated exoplanets for population studies. In this context, the HARPS/NIRPS tandem on ESO's 3.6m telescope and the ESPRESSO spectrograph on ESO's VLT are key instruments for characterizing transiting exoplanets revealed by space mission such as TESS and soon PLATO. Maintaining and improving these facilities is essential to ensure their ultimate long-term performance. We will present an overview of the TESS exoplanets characterization done these last years using these 3 instruments, describe the PLATO GOP organization, and discuss some foreseen upgrades for these unique planet hunters, such as laser frequency combs for absolute wavelength calibration, a mono-mode fibre-fed K-band spectrograph for simultaneous observation with HARPS and NIRPS covering 378 – 2400 nm in one shot, and optimisation of their data reduction pipeline.

The ESA PLATO mission

Brandeker, Alexis
Invited

Following sixteen years of preparation since the initial proposal, the PLATO (PLAnetary Transits and Oscillations of stars) mission is finally approaching its launch, scheduled for next year. While the scientific landscape has evolved during the years, the primary objectives remain as relevant as ever: to detect Earth analogues and to use asteroseismic observations of a large sample of stars to precisely determine their fundamental properties (mass, age, radius). To reach the overarching goal of placing our Solar System into a broader context, complementary information from other space missions (such as Gaia) as well as ground-based observations (e.g. spectroscopy), range from useful to critical. In this presentation, we will review the scientific objectives, methods, current status and expectations of the PLATO mission.

Overview of climate models, strengths and limitations

Chaverot, Guillaume
Invited

limate models are essential tools for interpreting current and future observations of exoplanets and for assessing their atmospheric properties, climate regimes, and potential habitability. This review presents an overview of the main classes of exoplanet climate models, ranging from computationally efficient one-dimensional (1D) radiative-convective models to three-dimensional (3D) General Circulation Models (GCMs). We discuss the key physical and chemical processes commonly included in these models, such as radiative transfer, atmospheric dynamics, convection, cloud formation, chemistry, and surface-atmosphere interactions. The respective strengths and limitations of 1D and 3D approaches are highlighted, emphasizing the trade-off between physical realism and computational efficiency. The development of increasingly accurate and efficient climate models is crucial for exoplanet science, enabling a more robust interpretation of observational data and an improved characterization of diverse planetary environments. As the next

generation of observatories delivers increasingly precise measurements, advances in climate modelling will play a central role in transforming observations into physical understanding.

Direct Imaging of Protoplanet Candidates in Protoplanetary Disks Using VLT/ERIS NIX L-band Observation

Chowbay, Swastik

We present our study using the VLT/ERIS NIX imager observations at 3.8 µm to directly detect protoplanet candidates responsible for the observed kinematic signatures in protoplanetary disks. By taking advantage of the long-wavelength sensitivity of the L-band, we aim to reduce the impact of circumstellar and circumplanetary dust extinction, significantly improving our ability to resolve thermal emissions from embedded protoplanets. Our targets, identified through ALMA observations of prominent spiral structures and kinematic deviations, are ideal candidates for direct imaging. This work aims to confirm the planetary nature of these features and provides initial constraints on the luminosities of the detected planets. These observations represent a crucial step in integrating kinematic and photometric techniques to calibrate the mass-luminosity relationship of young protoplanets and enhance our understanding of planet formation processes. Our findings highlight the potential of combining ALMA and NIX data to advance the study of planetary genesis in diverse disk environments.

Super-Earth formation in systems with cold giants

Danti, Claudia

Exoplanetary demographic statistics shows that super-Earths are the most abundant exoplanets, orbiting approximately every other solar-like star. In the solar system, however, the inner terrestrial planets did not grow beyond Earth in mass. It remains unclear what role wide-orbit gas giants play in this process. Here, we study the "pebble filtering" mechanism as a means of preventing super-Earth formation. We perform a parameter study based on pebble accretion simulations, with pebble sizes limited by drift and fragmentation. The initial planetary seeds are taken from the top of the streaming instability and the disc temperature profile is set both by irradiation and viscous heating. We show that one of the key uncertainty is the degree of viscous heating in the inner disc. The role of mutual pebble filtering is limited, unless it is paired with some mechanism that already delays the inner embryo's growth, such as strong viscous heating. This is consistent with the fact that no strong suppression is seen in the occurrence rate of super-Earths in systems with known gas giants. We conclude that the diversity in exoplanetary systems may be due to complex, and as of yet poorly understood, disc accretion physics inside the water ice line.

Exploring PLATO's detectability of small planets via injection-recovery simulations

Davoult, Jeanne

PLATO will deliver a major sample of small transiting exoplanets, including terrestrial planets around bright stars. Interpreting this catalogue requires a quantitative selection function: which planets are detected, which are missed, and how incompleteness and purity affect occurrence-rate estimates such as $\eta_\oplus$. We present injection-recovery simulations in which synthetic transits are inserted into realistic PLATO-like light curves including instrumental noise, stellar variability, diverse stellar properties, orbital geometries, and observing baselines. Recovery tests yield completeness maps versus radius, period, magnitude, variability, geometry, and duration. These maps support yield predictions, follow-up prioritisation, bias corrections, and robust population-level constraints on small-planet occurrence and formation models.

Vertical wind shears hints at magnetically damped circulation in an Ultra-Hot Jupiter

De Lia, Valentin

High-Resolution Spectroscopy has recently demonstrated that it is a powerful tool to investigate the dynamical structure of exoplanet atmospheres. We recently achieved one of the highest signal-to-noise ratio observation for an exoplanet using MAROON-X, a spectrograph similar to ESPRESSO. Our observations allowed us to directly measure the vertical wind shear of the Ultra-Hot Jupiter KELT-20b with unprecedented precision. We used different chemical species as probes of the layers of the atmosphere, and developed a robust method to estimate which pressure was corresponding to each species. We could further split the iron contribution into weak and strong lines, confirming the vertical wind gradient with multi-species and single-species measurements. We measured that the wind speed decreases with altitude. This challenges current hydrodynamical Global Circulation Models, which predict the opposite. We interpret this by the presence of magnetic drag that dampens the circulation in these ionized parts of the atmosphere. Using two analytical models, we find that our data are compatible with magnetically driven circulation. However, precise fits of parameters such as the magnetic field would require more complex models.

ESO Facilities I: Past and Present

de Rosa, Robert
Invited

ESO instruments and facilities have played a central role in exoplanet science for more than three decades. I will briefly trace the development of ESO's capabilities in precision spectroscopy, adaptive optics, high-contrast imaging, and interferometry, before highlighting current facilities and recent results spanning

planet detection, system architectures, atmospheric characterisation, and planet formation. I will conclude by outlining the limits of current facilities, and how these define the opportunities for the next generation of ESO instruments.

Future ground-based instrumentation

Desgrange, Célia
Invited

An ensemble view of stars with proper motion anomaly in the first PLATO field

Desidera, Silvano

We will present an ensemble view of the stars with astrometric accelerations detected as significant Gaia-Hipparcos proper motion anomaly in the first field that will be observed by the PLATO space mission, merging the constraints from astrometry to literature and archive results for radial velocity and direct imaging. A large variety of companion configurations is retrieved, from confirmed or suspected stellar companions, which may represent a potential source of false positive for the transit survey, to a number of confirmed and unconfirmed planetary companions, including a transiting one and several very promising cases. These latter objects are of special interest to study the frequency of substellar companions at the snow line and beyond, the link between the various zones of the planetary systems and, for young targets, promising targets for direct detection with high-contrast imaging. Perspectives for further developments, considering the upcoming release of Gaia DR4 and PLATO follow-up observations with ESO instrumentation will be discussed.

Giant planets

Duer-Milner, Keren
Invited

ESPRESSO reveals that warm Jupiters are dynamically colder than hot Jupiters

Espinoza-Retamal, Juan Ignacio

The obliquities of warm Jupiter host stars provide important information about their formation and dynamical evolution, as they are less affected by tidal realignment compared to their closer-in hot Jupiter counterparts. We are conducting a program to measure the obliquities of warm giants identified by our WINE survey using VLT/ESPRESSO. I will present the current status of this effort. We find that, around single stars, warm Jupiters tend to be more aligned than hot Jupiters, regardless of their orbital eccentricities. This suggests that warm Jupiters form in primordially aligned protoplanetary disks and subsequently evolve in a more quiescent way than hot Jupiters. We also find tentative evidence that warm Saturns may exhibit higher obliquities than warm Jupiters, potentially hinting at different evolutionary pathways.

A new Bayesian framework for exoplanet occurrence rates

Faria, João

After thirty years of discoveries, radial-velocity (RV) surveys are transitioning from the detection of individual planets to the precise characterization of exoplanet populations and planetary system architectures. Nevertheless, extracting robust occurrence rates from these decade-long datasets remains computationally challenging, relying on expensive injection–recovery tests and ad-hoc statistical significance thresholds. In this talk, I will present a new Bayesian framework to infer planet occurrence rates directly from RV observations, by combining the analysis of individual datasets. The method entirely bypasses the need for injection-recovery tests and detection thresholds, naturally propagating detection and modelling uncertainties to the population level. This approach enables a scalable and statistically consistent characterization of exoplanet populations. Applied to observations from ESPRESSO, HARPS, and CORALIE, the framework reveals new connections between outer giant planets and inner low-mass planets, a key prediction of planet-formation theory that remains observationally debated. I will also discuss how RVs can be combined with complementary observations from space-based missions like Gaia and PLATO, to place stronger and more comprehensive constraints on the exoplanet population.

The population of cold Jupiters with direct imaging

Fontanive, Clémence
Invited

Direct imaging has opened a window onto giant planets on the widest orbits, a population that remains mostly out of reach for other detection techniques and that carries distinctive information about how and where planets form. In this talk I will review what large-scale imaging surveys have taught us about

the demographics of this population, and how these constraints compare to the predictions of competing formation scenarios. I will discuss the growing effort to connect orbital architectures, atmospheric properties, and the characteristics of the host stars, as well as the prospects offered by the next generation of facilities.

Mars

Forget, François
Invited

Exploring Giant Planets Around Low-Mass Stars with NIRPS

Frensch, Yolanda

With the advent of high-precision near-infrared spectrographs, we are able to characterise exoplanets around intrinsically faint M dwarfs. However, near-infrared observations are particularly affected by telluric contamination. We present a new technique to mitigate telluric residuals in the cross-correlation functions, enabling more robust radial-velocity measurements and improved planet characterisation. We apply this technique to the recently published giant planets TOI-3288 b and TOI-4666 b observed with NIRPS. Together with a growing sample of giant planets transiting low-mass stars, these systems reveal emerging population-level trends. We find that late M dwarfs preferentially host lower-mass giant planets compared to early M dwarfs. Systems hosting more massive giant planets that deviate from this trend are predominantly metal-rich. We further identify a higher binary fraction among low-mass stars hosting giant planets, suggesting that stellar companions may help enable giant-planet formation in this regime. Together, these observations suggest that metallicity and stellar multiplicity play a key role in enabling giant-planet formation around the lowest stellar masses.

Detection limits for satellites of directly imaged substellar companions with high resolution spectroscopy: from VLT to ELT

Giovannini, Ilaria

As of today, the Solar System counts more than 400 natural satellites. However, no satellite has been confirmed around any exoplanet or substellar companion. Satellites are fundamental for understanding the formation and dynamical evolution of their system. We target spatially resolved giant exoplanets and

brown dwarfs with the radial velocity (RV) technique. Our approach aims to extract the RV measurement from the high-resolution spectrum of the planet itself, rather than from the host star's. For each target, we estimated the expected RV precision to understand the detection limits of CRIRES+ and HiRISE at VLT, and ANDES at ELT. We considered 1) the mass of the planetary object, 2) host star angular separation, 3) contrast, 4) instrument properties, and 5) fraction of stellar contamination in the planet's spectrum. Some of our recent results proved the effectiveness of this approach, detecting a 0.9 MJ satellite with a semimajor axis of 0.2 au orbiting a directly imaged brown dwarf companion to a young star. After the demonstration of the feasibility of this approach, the potential for detecting satellites will expand towards lower-mass satellites and target a significantly larger number of objects with ANDES at ELT, opening the path for population studies.

Combining Gaia DR4 and GRAVITY+ to search for exoplanets in resolved binary systems

González, Daniela

Although half of all Sun-like stars are found in binary systems, to date only about 800 S-type exoplanets (orbiting a single star) are known. Therefore, statistics on exoplanets in binaries are largely incomplete. Radial velocity studies suffer from spectral mixing in very close systems, and transit depths are diluted by the flux of the companion with which they mix. In this context, astrometry offers a promising alternative for improving the number of known S-type planets. Leveraging the synergy between Gaia DR4 and VLTI/GRAVITY+ differential astrometry, we will search for planets in ∼38 resolved pairs within 20 pc of the Sun. The presence of an orbiting S-type planet induces a periodic reflex wobble of its host star, that we will detect as a perturbation on the stellar two-body Keplerian trajectory. Combining Gaia epoch astrometry and GRAVITY+ will provide us with a longer time baseline than the DR4 alone, giving us access to longer-period planets. The high accuracy of GRAVITY+ (∼10s of µas) will also result in a higher planet mass sensitivity, that we expect in the Neptune-to-Jupiter-mass regime. Our GRAVITY+ observing program is currently in progress, and I will present its first preliminary results. Obtaining new detections in these nearby systems will provide valuable constraints on planet formation and demographics in binary stars.

Weighing the mass of LHS 3844 b

Hacker, Alejandro

Ultra-short-period rocky planets provide key laboratories for understanding the diversity of terrestrial exoplanets and for interpreting atmospheric observations from facilities such as JWST. LHS 3844 b (TOI-136 b), discovered by TESS, is one of the most favourable targets for atmospheric and surface studies, but its dynamical mass had not previously been measured. We analyse 25 high-precision radial-velocity measurements obtained with ESPRESSO at the VLT to determine the planet's mass and assess the robustness of the signal under different noise and orbital modelling assumptions. The data are modelled within a fully Bayesian framework exploring competing radial-velocity models that differ in their treatment

of correlated stellar variability through Gaussian Process kernels and in the inclusion of long-term trends. Bayesian model comparison based on marginal likelihoods is used to evaluate these hypotheses and derive evidence-weighted parameter estimates. The planetary signal is robustly recovered across all tested models, yielding a mass of $2.27 \pm 0.23\,M_\oplus$ and a bulk density of $5.67 \pm 0.65\,\mathrm{g\,cm^{-3}}$, consistent with a predominantly rocky composition. With its well-constrained bulk properties and extensive JWST programme, LHS 3844 b remains a benchmark target for studies of atmospheres and surfaces of rocky exoplanets.

ESPRESSO characterizes the small transiting exoplanet population with extreme precision radial velocities

Hobson, Melissa

The most common exoplanets are super-Earths and sub-Neptunes. They are promising candidates for habitability, but their likely compositions are unclear, and due to their small size and low mass, they are difficult to observe. The ESPRESSO spectrograph at the VLT is the leading instrument for characterizing low-mass planets, with 10 cm/s instrumental RV precision. The VLT's large collection area enables high SNR even for fainter stars. The ESPRESSO GTO consortium observed 50 stars hosting small transiting planet candidates from K2 and TESS in 2018-2023. We give a global overview of 55 planets in 24 systems thus confirmed, including super-Mercuries, super-Earths, water worlds and sub-Neptunes. They represent a significant addition to the precisely-characterized small planets. We highlight emerging population trends: an insolation-dependent mass threshold between rocky and volatile rich planets; the clear emergence of a group of high-mass rocky "stripped core" planets at high insolation; increasing planet mass with higher stellar metallicity. Comparing planet masses to typical protoplanetary disks, planets must form early in the disk's lifetime, with high formation efficiency, or in massive disks. Finally, we discuss lessons learned for observing and analysis strategies. In the context of PLATO, this is vital knowledge for the follow-up of Earth-sized candidates.

Exosatellite Detected Around a Companion Brown Dwarf

Hoy, Kevin

The search for exomoons has yielded a few candidates, yet none has ever been confirmed. In this work, we apply the radial velocity method to search for satellites around directly-imaged brown dwarf companions and giant exoplanets. We have found strong evidence for at least one satellite orbiting a brown dwarf companion, although this satellite's status as exomoon or exoplanet is uncertain. We also present progress on the search for satellites around a giant exoplanet, which would more clearly qualify as proper exomoons.

Two populations of exocomets in Beta Pictoris: matching theory to observations

Jaworska, Klaudia

Transiting exocomets have been observed in the nearby Beta Pictoris system as time-variable, Doppler-shifted spectral absorption features. Exocomets provide a unique opportunity of directly observing planet forming material, otherwise invisible planetesimals. They are the link between debris disks and late stage planetary formation. Despite decades of observations, several questions remain unanswered about these bodies. It is not clear where in the system they originate from and if their composition is volatile rich, resembling Solar system comets, or if the Beta Pictoris exocomets are more similar to Solar system asteroids. In my talk, I will present N-body simulations which predict two possible exocomet reservoirs from where planetesimals are driven into the vicinity of the star due to gravitational interactions with the system's two planets. Our simulations are the first to predict two possible populations of exocomets in Beta Pictoris, something that has been an observational fact for over ten years. Additionally, I will discuss our recent analysis of the HARPS archive which uncovered new observational signatures of exocomets.

The exceptional planetary system orbiting TOI-201: An eccentric brown dwarf in a 8-yr orbit coplanar to a warm Jupiter and a hot super Earth

Jones, Matias

In this talk I will present a long-term RV and transit/TTV monitoring of the relatively young star TOI-201, which hosts an exceptional multi-planet system composed of a hot super-Earth size planet transiting every 5.8 days, a transiting warm Jupiter on a 53-day orbit, and an eccentric low-mass brown dwarf on an approximately 8-year orbit. The BD is the longest-period transiting substellar object ever characterized via RVs, and the only one known to be coplanar with inner planets. This system represents a unique multi-planet system, offering a rare window into the processes of planet formation and dynamical evolution. Its rare configuration provides invaluable insights into the formation and evolution pathways, suggesting a dynamically mild, coplanar and almost in-situ formation of a WJ, a highly eccentric BD, and a lone inner SE, within a common protoplanetary disk.

ENTROPY: studying accretion signatures in the large separation companion YSES 1b

Jorquera, Sebastian

Accretion processes are expected to heavily influence the evolution of massive planetary companions,

determining aspects such as their initial internal entropy, composition of possible circumplanetary disks (CPD), planet-disk migration, and even the formation of one or several exo-moons. However, accretion in the planetary mass regime is currently poorly constrained, initially relying on scaled-down stellar models to predict the conditions present in forming planets. One way to study these processes is through spectroscopic observations aimed at the detection of particular emission lines expected to arise from the heating of the gas as it is being accreted, observed from the UV to the NIR. Several properties of these accretion lines (total flux, variability, line ratios, among others) can be directly compared with predictions from recent dedicated planetary accretion models, providing for the first time empirical backup to the theories of accretion in the planetary mass regime. In the context of the broader ExoplaNeT accRetion mOnitoring sPectroscopic surveY (ENTROPY) campaign, we present the obsevations form the 16 Myr, 14Mjup companion YSES 1b obtained with the UVES and MUSE instruments at VLT. We were able to resolve Halpha, Hbeta and He I emission lines arising from the companion, with fluxes of 8.3 $\pm$ 0.1x 10^{-16} , 5.8 $\pm$ 0.4 1x 10^{-16} and 0.47 $\pm$ 0.11x 10^{-16} erg/s/cm^2, suggesting active accretion taking place in this source. The high resolution of the retrieved lines also allows for direct comparison with predictions from accretion shock and magnetospheric accretion models, aiming to determine the dominant regime for this particular system. Finally, we contextualize these results with respect to other targets monitored by ENTROPY, and the overall population of actively accreting brown dwarfs and massive planets.

Gaia Astrometric Substellar Companions: DR3 RV Follow-Up and DR4/DR5 Forecasts for Mutual Inclinations

Kalinowski, Kamil

Gaia astrometry is starting to reveal the wide-orbit companion population—brown dwarfs and giant planets. As with any exoplanet detection technique, astrometry has a false-positive channel. The reflex motion of a single star induced by a substellar companion can be mimicked by an unresolved double-lined spectroscopic binary via its photocenter motion. We address this with a spectroscopic program covering both hemispheres using, among other instruments, NIRPS on the ESO 3.6 m, obtaining multi-epoch radial velocities and line-profile diagnostics for Gaia DR3 astrometric companion candidates. In a sample of more than 50 DR3 candidates, roughly two-thirds are false positives. For the vetted remainder, we combine RV constraints with DR3 astrometric solutions to refine companion-orbit posteriors. We summarize our vetting workflow relevant for the much larger DR4 (scheduled for December 2026) and DR5 candidate samples, enabling comprehensive demographics of wide-separation giants and brown dwarfs. We will also present our forecast of what we can learn about mutual inclinations in already-known multi-giant RV systems by adding Gaia epoch astrometry from DR4/DR5. We quantify how the results depend on the sky-projected geometry of those systems, rank the best targets, and show that Gaia+RV will measure mutual inclinations to a few-degree precision for a handful of the most favorable systems—enabling tests of dynamically cold versus hot giant-planet architectures.

Bridging exoplanet demographics across generations: Predicting the population reach of ELT/PCS

Kammerer, Jens

Current exoplanet population studies with VLT instruments have established the demographic framework of giant planets and brown dwarfs at wide separations through direct imaging surveys, while also revealing the limitations imposed by sensitivity and angular resolution at smaller orbital separations. The upcoming Planetary Camera and Spectrograph (PCS) for the ELT will extend this parameter space by enabling high-contrast imaging of planets at significantly smaller separations and lower masses, opening a new regime for population studies. We present ongoing yield predictions for ELT/PCS based on simulated observing campaigns and population-driven target ensembles. We explore yield estimates in the context of exoplanet demographics: Identifying the regions of planet mass vs. semi-major axis space that PCS will newly access, quantifying expected detections under different instrument assumptions, and assessing the resulting constraints on occurrence rates and formation pathways. These simulations provide a direct link between current VLT direct-imaging surveys and future ELT capabilities, illustrating how PCS will transform exoplanet population studies from the currently accessible wide-separation regime toward the architectures of mature planetary systems at Solar-System scales.

Icy moons

Khawaja, Nozair
Invited

Bridging high-angular resolution for exoplanet studies: from current VLTI to the proposed VLTI/SHARPS instrument

Kraus, Stefan

We present the exoplanet science case for a 3rd-generation VLTI instrument, named SHARPS. Employing dual-field capabilities and new sophisticated measures for vibration and wavefront control, it will enable spectroscopy of giant and rocky planets in the 0.025” to 1” separation range, including GAIA DR4 and RV giant planets. Operating in YJH bands the instrument will access important new molecular tracers of exoplanet atmospheres, enabling atmospheric retrieval for large sample of giant planets on Solar system scales. At the same time, SHARPS’ unique combination of high angular and high spectral resolution (up to R=30,000) will enable detailed studies of gas kinematic, tracing spectral lines associated with CPDs and circumplanetary accretion/ejection processes. We will put SHARPS in the context of current/upcoming VLTI visitor instruments and outline the complementarity with 1st and 2nd-generation ELT instruments and space-based missions.

Accreting gas giants: faint accretors waiting to be revealed, and resolved hydrogen lines with RISTRETTO, METIS, and UVES

Marleau, Gabriel-Dominique

The formation of Earth analogues, including their semimajor axis distribution, is tied to that of gas giants. Direct-imaging surveys have looked for forming gas giants through accretion tracers such as Halpha but have been not as fruitful as expected. To explain this, we predict the line-emission intensity during the formation phase of planetary-mass companions, following the material accreting onto a gas giant and its circumplanetary disc (CPD). We confirm that the line-emitting accretion rate can be a minuscule fraction of the gas inflow into the Hill sphere. Forming planets are mostly fainter than PDS 70 bc or WISPIT 2 b, and most surveys have not been sensitive to such faint planets. Secondly, we present predictions of resolved shock-emitted hydrogen lines as the R=140,000 spectrograph RISTRETTO or the first-generation, R=100,000 spectrograph ELT/METIS will study them. The upcoming Gaia DR4 should yield numerous gas giants that could be accreting. Studying their demographics, accretion rate, and accretion geometry can reveal the relative importance and the physical details of the non-exclusive formation channels of planetary-mass companions. We highlight this with striking results from the ENTROPY Large Program on VLT/UVES, which provides flux-calibrated, high-resolution 1D spectra of accreting planetary-mass objects.

An empirical determination of the Cosmic Shoreline

Meni Gallardo, Pedro Pablo

The Cosmic Shoreline concept was introduced as a way to separate planets with and without atmosphere, based on the relationship between the cumulative XUV instellation and the escape velocity observed in the Solar System. The exoplanet community has tried to refine the way we understand the cosmic shoreline in order to provide a consistent tool for establishing the hierarchy for exoplanet observations. This is particularly relevant when trying to unveil small exoplanet atmospheres with the JWST or the upcoming ELTs. Here, our goal is to use an empirical approach to refine the Cosmic Shoreline concept. In particular, we used the data provided by the ExoAtmospheres database, using the largest available sample of exoplanets with confirmed atmospheric detections, and the NASA Exoplanet Archive, along with solar system data. We reconcile limitations in the classical shoreline definition by anchoring our Empirical Exoplanet Cosmic Shoreline (EECS) simultaneously to Mars, GJ 9827 d, L 98–59 d, GJ 3090 b, and Pi Mensae c (all having tentative atmospheric detections). Interestingly, the resulting relation also aligns with 55 Cnc e, which hosts a secondary atmosphere under extreme irradiation. The EECS exhibits a significantly steeper slope than previously theorized,while consistently categorising Solar System moons and dwarf planets according to their atmospheric properties. Applied to planets orbiting M dwarfs, prime targets for habitable-zone studies, the EECS suggests that a larger fraction retain atmospheres than predicted by classical models when using standard I_{XUV} estimates. However, incorporating revised XUV fluence histories for low-mass M dwarfs (Msun $<$ 0.35 Mstar) reveals severe atmospheric vulnerability: only seven small planets (R $<$ 1.7Rearth) orbit securely within the retention zone of these stars. We finally identify high-priority targets for future missions focused on atmosphere observations based on their EECS

positioning and Transmission/Emission Spectroscopy Metrics. Future efforts must focus on expanding the empirical validations of the EECS, particularly through high-precision observations of borderline candidates and systems with well-constrained XUV histories.

In the Company of Two: NIRPS Hunts Planets in Binary Systems

Messamah, Lina

Understanding planet formation in multiple-star systems requires access to close visual binary configurations that have long remained observationally challenging. Flux contamination, limited angular resolution, and stellar activity have historically hindered precise radial-velocity follow-up of transiting planets in binary systems, particularly around low-mass stars. I will present a dedicated NIRPS (Near Infra-Red Planet Searcher) Guaranteed Time sub-program aimed at the radial-velocity follow-up of transiting exoplanets in binary systems, with a particular focus on short angular separations that were previously inaccessible. Thanks to its near-infrared wavelength coverage, adaptive optics system, and small on-sky fiber (0.4 arcsec), NIRPS enables precise Doppler measurements while mitigating contamination from close stellar companions—opening a new observational window on planets in multiple-star environments. This program targets transiting exoplanets orbiting low-mass stars (K5–M9) in binary systems, with the goal of accurately measuring planetary masses and bulk densities in regimes that have remained largely unexplored. In this talk, I will present the first results and initial detections from this program, illustrating the unique potential of NIRPS to probe planet formation and evolution in close visual stellar binaries.

Optical polarimetry reveals auroral magnetism in planetary-like atmospheres

Miles-Páez, Paulo

Recent optical observations of radio-loud ultra-cool dwarfs reveal short, phase-locked bursts of linear polarization aligned with auroral radio pulses. In this talk, we will show that these polarimetric bursts arise from scattering by magnetically structured clouds in the atmosphere, providing a direct observable imprint of auroral magnetism at optical wavelengths. The polarization bursts can be interpreted with single-scattering Mie models, constraining both the magnetic geometry and the characteristic sizes of cloud-forming particles. Because auroral radio emission is strongly beamed, current detections are likely subject to geometric biases, limiting population-level studies of magnetism in planetary-like atmospheres. In contrast, the optical polarization bursts can be detected over a wider range of viewing angles, enabling the identification of new auroral candidates in the optical for targeted radio follow-up. Existing VLT polarimetric capabilities already provide direct access to magnetically shaped clouds, opening a new observational window on cool atmospheres and enabling the extension of these diagnostics to directly imaged exoplanets with current and future ESO facilities.

ESO Facilities II: Future

Nielsen, Louise
Invited

Understanding the overarching architecture and nature of planetary systems requires moving beyond individual detections to robust population statistics. In this talk, I will discuss how ESO's future facilities can lead this effort through in-depth characterisation of exoplanet atmospheres, direct imaging and astrometry. Next-generation instrumentation at the ELT - particularly METIS, ANDES and PCS - will be complemented by ongoing VLT/VLTI and ALMA surveys to dramatically expand our demographic reach. By leveraging extreme adaptive optics and high-fidelity, high-resolution spectroscopy, these facilities will probe previously inaccessible regimes, including cold giants and temperate, small worlds.

Rocky planet detections

Osborne, Hannah
Invited

Rocky exoplanets orbiting nearby stars are among the most compelling targets for exoplanet science, but detecting and characterizing them remains challenging. In the first part of this talk, we will review how radial-velocity surveys are uncovering rocky planets around nearby stars, the main challenges such as stellar activity, and the prospects for finding Earth-like planets. We will also address how individual detections are making way for larger demographic studies of small planet populations. In the second part, we will discuss what we can learn about their atmospheres, from current observations of hot rocky worlds to the reflected light characterization of temperate planets with the VLT and the ELT. We will present what signals we may expect to detect and the role of climate and radiative transfer models in interpreting them, also using Earth as a benchmark for reflected light observations of rocky exoplanets.

Accelerating atmospheric characterisation with Optimal Estimation

Palma-Bifani, Paulina

Exoplanet science is transitioning from an era of discovery toward the in-depth spectroscopic characterization of distant climates and formation histories. However, as data sophistication grows, traditional modeling faces bottlenecks in the form of parameter degeneracies and enormous computational costs. To address this, I introduce Optex, a high-performance retrieval tool that adapts Earth-science inversion techniques, specifically the Optimal Estimation algorithm (Rodgers 2000), for directly-imaged exoplanetary atmospheres. Integrated with the Exo_k library (Leconte 2021), Optex achieves superior computational speed and vertical resolution compared to traditional sampling, while providing a rigorous framework for uncertainty quantification and bias mitigation. I will demonstrate Optex's unique ability to resolve complex

structures by presenting results for the T-dwarf W1935, where JWST observations revealed unexpected methane emission from auroral heating. Finally, I will highlight Optex's scalability to multidimensional modeling, offering a high-performance pathway to move beyond static 1D atmospheric descriptions.

Adapting the YOSO Gaussian Motion Filter for Direct Exoplanet Imaging

Pandey, Nitya

Direct imaging of exoplanets with instruments such as VLT/SPHERE is limited by quasi-static speckle noise and signal losses introduced during post-processing. In pupil-stabilized observations, planetary signals evolve with parallactic rotation while most stellar residuals remain relatively stable. Exploiting these different temporal behaviors may improve the detectability of faint companions at small angular separations. We investigate whether the Gaussian Motion Filter (GMoF) module of the YOSO (You Only Stack Once) pipeline (Pandey et al. 2026), originally developed for faint Solar System object detection, can be adapted to high-contrast imaging data. Rather than tracking linear motion, the method is reformulated to analyze temporal pixel-intensity variations along rotational trajectories in pupil-stabilized sequences. The objective is to enhance signals consistent with planetary motion while suppressing quasi-static residuals and mitigating self-subtraction effects. The approach is being tested on archival VLT/SPHERE IRDIS observations of known planetary systems, including HR 8799, and is evaluated against standard PCA-based Angular Differential Imaging reductions using the VIP package. In parallel, Differential Tip-Tilt Sensor telemetry is incorporated to characterize image-quality variations and explore quality-based weighting during frame combination. This study serves as a proof of concept for adaptive post-processing strategies that combine temporal signal evolution with observational quality metrics, with potential applications to future ELT high-angular-resolution observations.

Preparing the ground for 3D retrievals for high-resolution spectroscopy phase-curves and eclipse mapping

Panwar, Vatsal

Global variations in thermal structure, chemistry, cloud-coverage, and wind speeds of strongly irradiated gas-giant exoplanets have long been expected and confirmed observationally (from visible to near-infrared wavelengths) through high-resolution spectroscopy (HRS) with existing ESO instruments (ESPRESSO and CRIRES+). Constraining these variations is important because they reflect the key properties of the an exoplanet's climate e.g. the efficiency of day to night circulation, the balance between incident stellar radiation and internal heat, and spatial distribution of clouds. However, atmospheric retrieval frameworks with capabilities to obtain statistical constraints on the 3D atmospheric properties from HRS observations are at nascent stages and can be computationally intensive. I will present an in-development retrieval framework with spatially resolved parametrizations for chemical abundances, thermal structure, and winds. I will demonstrate its application to HRS phase curves and eclipse mapping of ultra-hot Jupiters using archival observations, and discuss the key advantages and outstanding challenges with this approach. I will

also discuss the potential paths forward for resolving them in preparation for extracting 3D constraints from HRS observations of exoplanet atmospheres with the ELT.

Planet populations around cool stars with TESS

Parashivamurthy, Harshitha Mysore

Exoplanet demographics around low-mass stars are crucial for constraining planet formation and evolution models. Kepler has shown that the distribution of planets around M dwarfs and Sun-like stars vary, while nearly every M dwarf hosts at least one super-Earth size planet; the presence of sub-Neptunes gradually starts to decrease around M dwarfs. To further investigate these planet populations, we use the Transiting Exoplanet Survey Satellite planet candidates to observe the radius valley. We observed the radius valley shift to smaller radii with decreasing stellar mass, consistent with Kepler observations, suggesting mechanisms shaping the radius distribution of planets around FGK stars, such as photo-evaporation or core-powered mass loss, may also extend to M dwarfs. However, the observed flatter scaling for M dwarfs aligns well with pebble accretion models including water worlds. Our completeness-corrected TESS occurrence rates reveal a sharp increase in super-Earths at the transition from K to M dwarfs, suggesting a distinct formation mechanism that may also explain the sub-Neptune deficit around early M dwarfs. These results provide a good segue to extend occurrence rate calculations using upcoming Plato planets and test different mechanisms of planet formation among low mass stars.

Neptunes

Parmentier, Vivien

Invited

Dynamical evolution of planetary systems

Petit, Antoine

Invited

High-Eccentricity Migration of Close-in Neptune-Mass

Planets

Petrovich, Cristobal

A growing population of close-in Neptune-mass planets with orbital periods of ∼36 days are being discovered on highly misaligned, and in some cases nearly polar, orbits around their host stars. Many of these systems also exhibit residual eccentricities and inflated atmospheres, hinting at a dynamically active origin followed by tidal evolution. In this talk, I will discuss possible formation pathways for these systems based on new models of high-eccentricity tidal migration arising from planet–planet scattering and secular interactions among Neptune-mass planets. I will also discuss the potential role of tidal dissipation within Neptune-like interiors and its implications for the orbital evolution of these planets. Finally, I will highlight several observational avenues that may help test these scenarios in the coming years.

Unlocking Gaia DR4 exoplanetary populations: combining predictive simulations and ground-based follow-up

Pinamonti, Matteo

The upcoming Gaia DR4 is poised to revolutionize exoplanetary science by delivering an unprecedented census of giant planets and brown dwarfs. Capitalizing on this wealth of data for robust population studies requires a deep understanding of selection functions, with ground-based synergies playing a critical role in identifying and mitigating false-positive rates. We present a comprehensive framework designed to prepare the community for the DR4 population era. First, we introduce a novel simulation pipeline that injects and recovers substellar signals within realistic Gaia time-series, using DR3 as a validated testbed. This framework forecasts Gaia's sensitivity limits, providing quantitative strategies to correct future catalogs for completeness. Second, we address the critical issue of false positives through the lens of the GAPS collaboration's HARPS-N radial velocity (RV) campaign. By monitoring Gaia astrometric candidates, we quantify binary contamination and demonstrate how high-precision RV follow-up breaks mass degeneracies and reveals multi-body architectures. By bridging predictive simulations with ground-based RV campaigns, this work establishes the methodological framework necessary to interpret DR4 orbital solutions. These synergies between Gaia's astrometry and ground-based facilities will be vital to mitigating false positives, optimizing future follow-up strategies, and unlocking the true statistical distributions of exoplanetary populations.

Atmospheric Composition and the Vertical Wind Profile of Ultra-Hot Jupiters with CRIRES+

Rahmati, Hossein

Observations of blue-shifted and red-shifted signals in the transmission and emission spectra of ultra-hot

Jupiters have sparked discussions about the nature of their wind profiles and atmospheric dynamics. We aim to investigate the atmospheric dynamics and chemical composition of ultra-hot Jupiters using high-resolution CRIRES+ transmission and emission spectroscopy. In particular, we examine how the measured Vsys shifts and Kp values vary with orbital phase and atmospheric species in order to assess their connection to the planets' wind structures. We also aim to characterize the atmospheric composition of these planets by investigating all relevant species accessible in the current CRIRES+ datasets, including CO, H_2O, CO_2, CH_4, and OH. We used ESO archival data covering both the pre-eclipse and post-eclipse phases of the target. We analyzed the A and B nodding datasets separately and used the CRIRES+ pipeline for data reduction. Stellar and telluric lines were removed using SYSREM, and we applied the cross-correlation technique to search for a range of molecular species. By combining the pre- and post-eclipse datasets for both A and B nodding, we detected emission signals of CO (10.78) with Kp=217±0.24 km s^1 and a velocity shift of 1±0.13 km s^1. We also detected H_2O (6.37 σ) with Kp=219±1.2 km s^1. We also derived the velocity shift of each species separately for the A and B nodding datasets. However, the velocity shift derived from the combined pre- and post-eclipse datasets provides a more reliable estimate of the atmospheric wind signal than measurements obtained from either the pre-eclipse or post-eclipse datasets alone. Moreover, the combined pre- and post-eclipse also leads to a more reliable determination of Kp, with values closer to the expected orbital velocity.

Close in super-Earth formation using GPU-Accelerated N-Body simulations with pebble accretion

Ramírez Vargas, Sebastían Roberto

Super-Earth formation is composed of multiple stages of growth, from dust coagulation and planetesimal formation, up to giant impacts between massive bodies. In between, pebble accretion serves as an efficient planetesimal growth mechanism via centimeter-sized solids, or pebbles. Existing models reproduce several observed exoplanet properties, but often rely on one-dimensional treatments or only a few interacting bodies, and often don't account for multiplanetary architectures. In this work, we study the dynamical evolution of systems formed through pebble accretion, using GPU-accelerated N-body simulations. This allows us to model thousands of planetesimal seeds and examine how gravitational interactions shape final orbital architectures. We also include pebble growth directly in the simulations to investigate its coupling with N-body dynamics. Our results show that systems initialized with more seeds tend to form planets with lower inclinations, increasing planetary multiplicity. Including both pebble growth and N-body interactions reveals that chaotic planetesimal merging can produce bodies exceeding the local pebble-isolation mass, suppressing inner super-Earth formation. Overall, simulations with an increased particle count are able to sustain the uniformity in size and spacing of super-Earth systems.

Rocky planet atmospheres

Roccetti, Giulia
Invited

Rocky exoplanets orbiting nearby stars are among the most compelling targets for exoplanet science,

but detecting and characterizing them remains challenging. In the first part of this talk, we will review how radial-velocity surveys are uncovering rocky planets around nearby stars, the main challenges such as stellar activity, and the prospects for finding Earth-like planets. We will also address how individual detections are making way for larger demographic studies of small planet populations. In the second part, we will discuss what we can learn about their atmospheres, from current observations of hot rocky worlds to the reflected light characterization of temperate planets with the VLT and the ELT. We will present what signals we may expect to detect and the role of climate and radiative transfer models in interpreting them, also using Earth as a benchmark for reflected light observations of rocky exoplanets.

RV-Astrometry Synergy in the Detection of Warm Giants

Rojas Molina, Joanne

The characterization of warm giant planets is frequently limited by the orbital inclination degeneracy inherent in radial velocity (RV) studies, yielding only minimum masses (M sin i). I will present a comprehensive analysis of a sample of stars hosting warm giant candidates, combining archival RVs with astrometric constraints to resolve the true planetary masses. The analysis employs the EMPEROR code (Peña & Jenkins 2025), utilizing MCMC sampling with parallel tempering to robustly model Keplerian signals within a Bayesian framework. By integrating data from CORALIE and HARPS with Gaia astrometry, we aim to break the inclination degeneracy and refine the orbital parameters. I will present the derived solutions and true mass constraints for these systems, demonstrating the efficiency of this multi-technique synergy in accurately characterizing the warm giant population.

Comparing planetary populations: controlling for biases in host star properties by matching distributions

Royle, Scarlett

Known correlations between stellar and exoplanet properties play havoc on exoplanet demographic studies that aim to compare two or more populations. For example, planet mass scales with stellar metallicity and mass. Thus, if one's stellar subsamples have different mass or metallicity distributions, one can expect to observe differences in their giant planet occurrence rates. Controlling for such correlations is essential for robust exoplanet demographic studies. We present a novel method to control for unwanted differences between host star populations, namely, multi-variate bin matching. We apply the method to match subsamples' mass, effective temperature, luminosity, metallicity, surface gravity, and distance distributions in two science cases: investigating differences in exoplanet demographics in (1) regions of low and high stellar position-velocity clustering, and (2) single- and multi-star systems. As well as studies of known exoplanets, multi-variate bin matching may be employed to achieve balanced target selection for stellar and exoplanet surveys, such as the Ariel and PLATO missions.

First brown dwarf mid-infrared spectrum with VLTI/MATISSE: HD984B

Scigliuto, Jules

Interferometry is opening a new window on the study of substellar companions by extending spectral characterization beyond the limits of direct imaging. After the successes of GRAVITY in the K band, the MATISSE instrument now enables the observation of exoplanets and brown dwarfs in the mid-infrared, where the star–companion contrast is more favorable and molecular signatures become particularly rich. With its four-telescope beam combination, long baselines, and the GRA4MAT off-axis fringe tracking upgrade, MATISSE provides the sensitivity and stability required to isolate faint companion signals at angular separations inaccessible to single- aperture facilities. In this presentation, I will present the mid-infrared interferometric characterization of HD 984 B, a young brown dwarf orbiting at a small angular separation from its host star. The L, M, and N bands covered by MATISSE probe deep atmospheric layers and contain key diagnostic features, including absorption from H2O, CO, and CH4, as well as signatures of silicate and iron clouds. These spectral constraints allow us to probe the effective temperature, surface gravity, cloud properties, and atmospheric composition of HD 984 B, providing valuable insight into the physics of young, low-mass substellar atmospheres. HD 984 B is significantly fainter and closer to its host star than previously studied targets such as beta Pictoris b, placing it near the sensitivity limits of MATISSE. Its observation therefore con- stitutes a stringent test of mid-infrared interferometric techniques. To enable this measurement, I developed dedicated data processing tools and optimized observational strategies designed to enhance signal extraction for low-flux companions. These results demonstrate that MATISSE can now access a new regime of colder and more challenging substellar objects, paving the way for the systematic interferometric characterization of brown dwarfs and young giant exoplanets in the mid-infrared.

Hot and ultra-hot Jupiters

Simonnin, Adrien
Invited

A dip in the past: revisiting direct imaging archives with novel algorithms

Squicciarini, Vito
Invited

The scientific value of high-contrast imaging observations extends well beyond the studies for which they were originally acquired. As post-processing algorithms continue to improve, archival datasets can be revisited to achieve deeper detection limits and extract information that was previously inaccessible.

These observations represent a treasure trove for exoplanet research: their reanalysis can reveal previously undetected companions, provide crucial constraints on planets discovered years later with other instruments, and improve survey completeness, ultimately leading to tighter constraints on giant planet occurrence rates. In this talk, I will review recent efforts to unlock the potential of ESO's direct imaging archives, highlighting the discoveries and demographic insights enabled by advances in data reduction techniques.

Modeling the interiors of super-Earths and sub-Neptunes

Steinmeyer, Marie-Luise
Invited

A planet's mass and radius offer a unique opportunity to infer the composition and internal structure of distant worlds. Doing so requires comparing observations against theoretical interior structure models. In this talk, I will provide a brief overview of the foundations of modelling planetary interiors, with a focus on super-Earths and sub-Neptunes. Even though these planets represent the most common types of exoplanets discovered to date, their precise composition remains uncertain as they occupy a highly degenerate region in the mass-radius space. I will discuss how critical model assumptions, such as detailled mineralogy, the choice of Equation of State, and volatile distribution, further influence mass-radius relations. Finally, I will highlight key pathways to break mass-radius degeneracy, outlining how complementary constraints can help us better understand the nature of these planets.

Exocomets as deliverers of water in the young PDS 70 system

Stockwell Murphy, Alexandra

Small-body reservoirs provide a crucial link between planet formation, migration, volatile transport, and the long-term evolution of planetary systems. The young (∼5 Myr) system PDS 70, hosting two directly imaged giant planets embedded in a gas-rich disk, offers a unique laboratory for studying the emergence of exocomet populations during planet formation. I present N-body simulations of planetesimals originating in the outer disk and evolving under the gravitational influence of PDS 70 b and c, with additional models including the candidate planet PDS 70 d. The simulations track the scattering, transport, and survival of comet-like bodies while accounting for gas drag and thermal ablation. I calculate ablation rates for inward-scattered planetesimals and show that many are completely destroyed as they reach the inner system, releasing substantial amounts of water into the disk. This mechanism may contribute to the water-rich inner disk recently revealed by observations from the James Webb Space Telescope. The simulations produce distinct dynamical populations, including transient scatterers and a potential long-lived reservoir coincident with the emission peak observed by the Atacama Large Millimeter/submillimeter Array. The results highlight the strong dependence of exocomet dynamics on planetary masses and orbital configurations, motivating future observations to better constrain the architecture of PDS 70 and to search for exocomets across multiple wavelengths. Such observations will provide critical tests of exocomet-driven volatile delivery in young planetary systems.

Venus

Stolzenbach, Aurélien
Invited

Results and take-aways from the WIde Separation Planets In Time (WISPIT) survey

van Capelleveen, Richelle

The WISPIT survey is a VLT/SPHERE snapshot survey targeting 178 solar-mass stars with ages ranging from <5 to 20 Myr spanning the entire sky observable by VLT. Its goal is to detect and characterize wide-separation planetary mass companions. Published discoveries from this survey are the WISPIT 1 and WISPIT 2 systems. WISPIT 1 is a ∼16 Myr binary with a solar-type primary that hosts a ∼10 Jupiter mass and ∼5 Jupiter mass companion at separations of 338 au and 840 au, respectively, making it among the widest separation directly imaged planets to date. WISPIT 2 is another multi-planet system; this ∼5 Myr version of our sun hosts a spectacular multi-ringed disk with two embedded planets; its discovery marked the first unambiguous detection of a gap-carving embedded planet. Both the WISPIT 1 and WISPIT 2 systems are novel and unexpected in their own way, and not only revealed new planets but also redefined where we should search for planets and how future direct imaging surveys should be designed. The second epoch of 88 WISPIT survey targets will be observed between October 2025 and April 2026, so the main survey results and take-aways are expected to be complete by November 2026.

The diversity of winds in hot Jupiters

Van den Broeck, Ragnar

Extreme day-night temperature contrasts in hot Jupiters drive strong winds that control their climate. General circulation models (GCMs) predict that these winds come in two patterns: a global flow from the day-side to the night-side of the planet, or a superrotating jet along the equator. However, the transition between these two regimes and the speed of the winds remain poorly understood. High-resolution spectroscopy can provide measurements of the speed and shape of circulation. Prime examples are the CRIRES+ observations of HD 209458b and WASP-127b. Despite their similar parameters, the Doppler signal of HD 209458b hints at a day-to-night flow, whereas WASP-127b shows a clear signature of a fast super-rotating jet. Here, we present a consistent reduction of both datasets and show how data cleaning techniques such as PCA distort the shape of complex Doppler signals, which will become common with ELT-instruments. We propose an alternative method that overcomes these biases, allowing a more robust signal recovery. We compare these results to GCMs and show how our model reproduces the flow on HD 209458b well, but strongly underpredicts the speed of the WASP-127b jet. We discuss potential explanations and propose the exciting possibility that the planet may not be tidally locked.

Gaia Astrometry and the Future of Long-period Giant Exoplanet Research

Venner, Alexander
Invited

The ESA Gaia mission has completed the deepest and most precise all-sky astrometric survey ever performed, bringing the large-scale detection of exoplanets using astrometry within reach. The imminent publication of Gaia Data Release 4 (DR4) is expected to represent a paradigm shift in the study of long-period giant planets, greatly increasing the number of known exoplanets beyond 1 AU. I will discuss the opportunities provided by this extraordinary dataset as well as some of its limitations, and the unique opportunities for synergy with ground-based instruments offered by ESO's instrument arsenal. Looking towards the next decade, I will highlight the advances in parameter coverage presented by the whole-mission Gaia DR5 (expected by 2030), and the strong avenues for synergy with the ELT.

Planet formation

Venturini, Julia
Invited

Abstracts of posters

Is the hot neptune desert really empty? A comparison of Tess vs Kepler

Ambalapatta Kannancheri, Bhavya

The hot Neptune desert is a region in the period–radius plane where Neptune-sized planets at very short orbital periods appear to be rare. In this work, we compare Kepler and TESS samples to investigate whether the apparent emptiness of this desert is consistent across the two surveys. Using planet radius and orbital period data from the NASA Exoplanet Archive, we classify planets into hot and warm super-Earths, mini-Neptunes, and Neptunes, and compare their distributions through period–radius diagrams, subclass counts, and hot-to-warm ratios. We also explore a normalized metric to probe the population near the desert edge. Our preliminary results suggest that the inferred contrast between Kepler and TESS depends on both sample selection and the adopted desert boundaries. In particular, comparisons using TESS candidates and confirmed planets do not always lead to the same conclusion, indicating that the apparent structure of the desert is sensitive to dataset definition. We are therefore testing alternative literature-based boundary choices and estimating uncertainties to assess the robustness of these trends. This work serves as a first step toward a more reliable completeness-corrected occurrence-rate analysis of the hot Neptune desert in Kepler and TESS.

SaNDi-SHoP: Searching for Satellites'N'Disks with a Star-Hopping Program

Bernardi, Andrea

Over the past decade, advances in high-contrast imaging and extreme adaptive optics have enabled the discovery of planets and brown dwarfs at wide separations from their host stars, challenging current planet-formation paradigms. We present SaNDi-SHoP, a VLT/SPHERE star-hopping survey aimed at searching for satellites and circumplanetary disks around directly imaged companions. Our sample includes thirteen planetary-mass and brown dwarf companions observed between June 2023 and July 2025. The survey also provides updated near-infrared photometry, new high-precision astrometry, and low-resolution IFS spectra for three companions. We identify extended residuals around TYC 8047-232-1 B consistent with a possible 3-6 Jupiter masses satellite companion, and marginal residuals around DH Tau b compatible with a 1 Jupiter mass satellite. Our analysis generally excludes companions more massive than a few Jupiter masses beyond 1-5 au. Combining our astrometry with literature measurements, we derive updated orbital solutions for all systems, including the first orbital fits for four of them. The updated orbital constraints favor eccentric, non-circular orbits, supporting formation scenarios involving gravitational

instability, molecular cloud fragmentation, or planet–planet scattering.

Mapping Exoplanets Across the Milky Way: A Representative Transit Census of the Galactic Disk with Rubin

Corley, Suber

We present a plan for a post-LSST Rubin transit survey that samples the Milky Way disk, to measure how planet occurrence varies with Galactic environment. Combining a stellar-population model with transit detectability and injection-and-recovery tests, we estimate what such a survey could recover, with what reliability, and how much follow-up it would need. We discuss the stellar characterization and follow-up this requires and where facilities such as ESO's could contribute.

Optical and Near-Infrared Analysis of NGC 2539: an open cluster hosting lithium-enriched giant stars

Flaulhabe, Thiago

We present a thorough chemical and astrometric analysis of 13 members of the intermediate-age open cluster NGC 2539 based on high-resolution optical (FEROS) and near-infrared (IGRINS) spectra . We derived atmospheric parameters and abundances for 23 elements, and report for the first time the oxygen isotopic ratios 16O/17O and 16O/18O in this cluster. The sample includes two lithium-enriched giants, which comprise a very rare class of chemically peculiar stars whose formation mechanism is largely debated in the literature. The presence of these objects makes NGC 2539 a valuable asset to help unveil the nature of these stars. Furthermore, lithium enrichment may be associated with planet engulfment. Infrared spectroscopy enabled the first analysis of poorly studied elements, such as F, P, K and Yb. Particularly, our analysis can offer valuable constraints about the intriguing and debated cosmic origin of fluorine. Our analyses combined provide valuable insights into Galactic chemical evolution models, evolutionary stages of Li-enriched giants and allow us to address various stellar aspects such as: the mixing processes in stellar interiors; stellar rotation, its binary nature and chemical peculiarities; and the Galactic chemical enrichment history. Our results also underscore the value of open clusters in studying chemically peculiar stars.

A Survey of Warm Jupiters: Orbital Architectures and Eccentricities

Heidari, Neda

Most known transiting exoplanets orbit very close to their host stars, where intense irradiation and tidal forces can significantly alter their physical properties. In contrast, warm Jupiters (10 d < P < 200 d), which reside on wider orbits, are less affected by these processes and therefore potentially provide a clearer view of giant planet formation and migration. Despite the large number of confirmed exoplanets, transiting warm Jupiters remains relatively rare. In this talk, I will present an overview of our TESS–SOPHIE follow-up survey of long-period transiting planet candidates, including both confirmed planets and systems initially identified as giant planets but later revealed to be low-mass stellar companions. I will then focus on 11 newly detected warm Jupiters identified with SOPHIE and TESS. These planets have orbital periods ranging from 16 to 94 days, masses between 0.05 and 2.9 M_{Jup}, and radii spanning 0.3 to 1.5 R_{Jup}. I will highlight several interesting properties of these systems, particularly their dynamical architectures and orbital eccentricities. Notably, TOI-7025b, TOI-6883b, and TOI-5110b exhibit remarkably high eccentricities, between 0.6 and 0.8—among the most eccentric planets to date. In addition, TOI-6883b, TOI-6457b, TOI-2537b, TOI-2295b, TOI-5893b, TOI-7176b, and TOI-7025b, with equilibrium temperatures between 307 and 800 K, provide valuable low-irradiation benchmarks for testing models of hot-Jupiter inflation. Finally, I will present dynamical analyses of the multi-planet systems TOI-6041 b & c and TOI-2537 b & c, based on transit timing variations (TTVs).

Synergy of the ELT with an external occulter for characterising exoplanetary Earths and Solar System analogs

Janson, Markus

The unprecedented size and instrumentation of the ELT will facilitate the opportunity to study individual potentially habitable planets in detail for the first time. However, the prospect of building a statistically meaningful census of habitability and life in the Universe is beyond the currently foreseen capabilities even of the ELT. Here, we discuss the opportunity to combine the ELT with a free-flying starshade in space, in order to drastically enhance its achievable contrast at visible-light wavelengths. This would open up sensitivity to Earth-analog planets in the habitable zones of several tens of nearby Sun-like stars. With the much larger aperture size of the ELT compared to any feasible space observatory, Earths could be detected in a matter of minutes, and characterised at much higher spectral resolution than would be possible with any other envisioned facility. We will discuss the main features of an ELT+starshade synergy in context of the general effort to characterise habitable planets. We will also discuss the main aspects on the ELT instrumentation side for optimising synergy with a starshade. With a starshade synergy in view, the ESO ELT may hold the key to the fastest, cheapest and highest fidelity pathway to studying habitability and life in the Universe at statistically large scale, and in great physical detail.

Unveiling the kinematics and 3D geometry of eruptive young stellar objects: the case study of the FU Orionis system

Montoya Calderón, Erick Franco

Some young stellar objects (YSOs) undergo abrupt, episodic increases in their luminosities attributed to accretion variability. Having an accurate physical picture of these eruptive YSOs is necessary if we are to investigate the mechanisms triggering their outbursts and the physical parameters that shape their current appearance and overall evolution. We present our first case study looking to address these points: the binary system FU Orionis. By analyzing multi-wavelength and multi-epoch data, we reconstruct a 3D model capable of reproducing the appearance and kinematics of the structures of this system. We find that the spiral arm located to the East of the northern star is actually a projected superposition of two different structures: one corresponding to an outflow with an expansion velocity of ∼10 km/s (consistent with the current outburst of this object, which began in 1936), and the other corresponding to a pre-existing structure whose southern end seems to be infalling onto the northern star, suggesting that it could trigger an outburst in the future. We also estimate the orbital parameters of the southern star to determine its role in the evolution of the whole system.

Sublimating exocomets in the PDS 70 system

Novais, Aline

PDS 70 is a young T Tauri star hosting a circumstellar disc and at least two gas giant protoplanets. A detailed inspection of archival High Accuracy Radial velocity Planet Searcher (HARPS) spectra of PDS 70 acquired throughout 1.5 month reveals variable absorption lines of neutral sodium (Na I), indicating this material is transiting the star. These absorption lines are strongly blue-shifted to radial velocities that vary stochastically on a daily basis. Our measurements show these are optically thick and partially cover the projected stellar disc, suggesting this transiting sodium is not only rapidly variable, but also fast-moving and spatially compact. The characteristics of these sodium lines are best interpreted as being from exocomets, i.e. planetesimals that sublimate as they pass close to the star on highly elliptical orbits, ejecting material such as sodium at high velocities. Complementary N-body simulations show that planetesimals from the outer parts of the system can indeed be effectively scattered towards the inner regions of the system, as a result of gravitational interactions with the planets. Given that James Webb Space Telescope (JWST) observations have indicated the presence of water in the inner regions of the disc around PDS 70, we propose that sublimating exocomets could be one of the mechanisms responsible for transporting volatiles to the inner, terrestrial planet-forming region of the PDS 70 system, where HARPS data strongly suggests evidence of exocomet activity. This is further supported by new high-resolution observations of PDS 70 obtained in 2025 with the Gemini High-resolution Optical SpecTrograph (GHOST) and in 2026 with the Ultraviolet and Visual Echelle Spectrograph (UVES).

Planet populations around cool stars with TESS

Parashivamurthy, Harshitha M

Exoplanet demographics around low-mass stars are crucial for constraining planet formation and evolution models. Kepler has shown that the distribution of planets around M dwarfs and Sun-like stars vary, while nearly every M dwarf hosts at least one super-Earth size planet; the presence of sub-Neptunes gradually starts to decrease around M dwarfs. To further investigate these planet populations, we use the

Transiting Exoplanet Survey Satellite planet candidates to observe the radius valley. We observed the radius valley shift to smaller radii with decreasing stellar mass, consistent with Kepler observations, suggesting mechanisms shaping the radius distribution of planets around FGK stars, such as photo-evaporation or core-powered mass loss, may also extend to M dwarfs. However, the observed flatter scaling for M dwarfs aligns well with pebble accretion models including water worlds. Our completeness-corrected TESS occurrence rates reveal a sharp increase in super-Earths at the transition from K to M dwarfs, suggesting a distinct formation mechanism that may also explain the sub-Neptune deficit around early M dwarfs. These results provide a good segue to extend occurrence rate calculations using upcoming Plato planets and test different mechanisms of planet formation among low mass stars.

A VLT/MUSE Framework for Detecting H_α Accretion Signatures in Wide-Orbit Planetary-Mass Companions

Ramírez Reyes, Ricardo Leonardo

The detection of accretion signatures in wide-orbit planetary-mass companions is challenging because faint companion emission must be separated from stellar residuals, structured backgrounds, and instrumental systematics. We present a VLT/MUSE analysis framework designed to search for spatially resolved optical accretion tracers, especially H_α, in young planetary-mass companions. The pipeline includes cube alignment, wavelength-shift diagnostics, stripe-wise and spaxel-wise cross-correlation corrections, continuum normalization, fake-continuum removal, PCA-based subtraction, local surface-background modeling, and science/control aperture comparisons. We validate the method using PDS 70 b, recovering its known H_α emission, and then apply it to ROXs 42_B b and ROXs 12 b. The analysis yields no H_α detection for ROXs 42_B b, while revealing a possible H_α emission toward ROXs 12 b. These results demonstrate the potential of MUSE to probe accretion at wide separations, while also emphasizing the importance of robust validation and local background treatment when interpreting faint line emission from planetary-mass companions.

Deepermoments: deep learning for moment maps

Rickmers Blamey, Ian

Understanding the processes governing planet formation is essential for interpreting newly formed planets. Protoplanetary disks are the environments where these processes take place, with gas providing key insights into disk dynamics. Gas properties are commonly investigated through spectral line observations, resulting in spectral cubes that encode spatial and velocity information. A common approach is to study disk kinematics through Moment 1 maps, which trace the line-of-sight velocity of the gas. While effective at capturing large-scale motions, they have a major limitation: they collapse line-of-sight emission into a single value. However, protoplanetary disks are vertically structured, with gas distributed across multiple layers. As a result, important physical processes can be lost by mixing contributions from different layers. In this talk, we present preliminary results from Deepermoments, a deep learning framework designed to recover the kinematics of the upper and lower disk layers from simulated spectral cubes. We

compare two neural-network approaches, DeepONet and a custom architecture, highlighting the still largely unexplored potential of AI-assisted analysis for multidimensional data in the exoplanet and planet formation community.

The effect of stellar position-velocity clustering on exoplanet properties and demographics

Royle, Scarlett E

Recent studies suggest that stellar phase-space (position-velocity) clustering may shape planetary system architectures, with hot Jupiters preferring hosts in over-dense phase-space environments. The origin of the detected correlation remains debated: explanations include known correlations between stellar and planet properties (e.g. stellar metallicity and planet mass), age dependencies, and galactic perturbations triggering inward migration. Using precise stellar astrometry, we re-calculate the phase-space densities of exoplanet host stars and draw two subsamples of > 200 systems with similar stellar parameters in regions of low and high stellar position-velocity clustering. After controlling for host star parameters, critically effective temperature, [M/H], and distance (but not age), we find no difference between the two populations' exoplanet properties or populations. This demonstrates the importance of controlling for relationships between stellar and planet parameters, and suggests that main sequence host star age has little impact on planetary demographics.

SEARCHING FOR ACCRETION SIGNATURES IN YOUNG PLANET-FORMING SYSTEMS

Sarkar, Soumyadeep C.

Accretion onto forming planets provides crucial insights into their growth and evolution. This study develops a new data-analysis workflow to identify accretion signatures in young planet-forming systems using Hα emission in Very Large Telescope (VLT)/MUSE Narrow Field Mode observations. We apply the workflow to pre-reduced data cubes obtained from the ESO Science Portal for four systems: PDS 70, LkCa 15, MP Mus, and HD 34282. We recover significant Hα emission from PDS 70 b and c, consistent with ongoing accretion, while results for MP Mus and LkCa 15 remain inconclusive. In HD 34282, we identify an extended emission structure that requires further investigation. Future work will extend the workflow to raw data cubes, improve stellar-light subtraction, and quantify detection limits through injection-recovery tests.