From Transits to Trends:

The Next Decade of Long-Period Exoplanets

BOOK OF ABSTRACTS

On behalf of the Scientific Organizing Committee:

- Bertram Bitsch (University College Cork)
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FOLLOW-UP AND CHARACTERIZATION

Unveiling TESS transiting temperate exoplanets

Solène Ulmer-Moll - Leiden University

Most detected transiting planets have orbits of a few tens of days, exposing them to intense stellar irradiation and interactions that significantly alter their properties. In contrast, colder planets with longer orbital periods are less affected, offering crucial insights into their formation and migration histories. I will review the detection and characterization of warm and temperate giant planets first found as TESS transit events. In particular I will detail the detection of two multi-planetary systems hosting a transiting temperate Jupiter with orbital periods larger than 100 days and an inner non-transiting planet, thanks to a four-year ground and space-based photometric and radial velocity survey. Combining precise masses, radii, and ages with a state-of-the-art planetary evolution model, I infer the metal enrichment of the newly discovered temperate giants and explore their influence on the mass-metallicity correlation of giant planets.

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TFOP SG1 Coordination of TESS Single and Duo Transit Light Curve Follow-up

Karen Collins - Smithsonian Astrophysical Observatory/CfA

TESS single and duo transit detections often require significant ground-based resources to determine the true orbital period of the planet candidate. Highly uncertain single transit orbital periods may be determined by the combination of TESS and RV data. Then world-wide ground-based transit observations, often covering several days, can be used to pinpoint the precise orbital period. Duo transits often have several to tens of orbital period aliases due to long gaps in the TESS data. Ground-based light curve observations can be used to rule out remaining valid aliases and finally determine the precise orbital period. The TFOP SG1 team has recently enhanced the transit ephemeris prediction tool know as the TESS Transit Finder (TTF) to easily handle both types of follow up. Groups working on these systems may submit candidate lists to the TFOP SG1 lead to enable community-wide TFOP coordinated follow-up. We present the new tools, how to use them, and the overall process to submit candidates and receive progress updates.

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Characterization of long-period planets with the Next-Generation Transit Survey

Peter Wheatley - University of Warwick

The NGTS facility is an array of twelve telescopes at the ESO Paranal Observatory, Chile, that are optimized for high-precision photometry of bright stars and exoplanet transits. The characterization of long-period planets is the primary goal of NGTS, and we are following up tens of candidates identified through single-transit events with TESS (see abstract by Sam Gill). In this talk, I will introduce NGTS and present observations that routinely match TESS for photometric precision. Where necesary, we can allocate a telescope to monitor continuously for whole observing seasons until additional transits are recovered (e.g. NGTS-11b & NGTS-36b). In some cases, periods can be determined more rapidly through precovery of additional transits in archival NGTS data (e.g. NGTS-29b and NGTS-30b). In all cases, determination of precise orbital periods significantly reduce the required number of precious radial velocity measurements. Being co-located with the ESO Very Large Telescope, I will also show how NGTS is ideally suited to provide simultaneous photometry in support of radial velocity and Rossiter-McLaughlin measurements with VLT/ESPRESSO.

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Tackling TESS Transits with the SETI Institute & Unistellar Citizen Science Network

Lauren Sgro - SETI Institute

Unistellar's Exoplanet Transit Campaign allows amateur astronomers to make contributions to the field of long-period exoplanet characterization using Unistellar’s user-friendly, 4.5-inch "enhanced vision telescopes" (eVscopes). Since 2020, observers with the global Unistellar Citizen Science Network (USCN) have recorded more than 2,500 transit observations. The UCSN also includes a NASA Citizen Science Program called Unistellar Network Investigating TESS Exoplanets (UNITE). This program focuses on TESS planet candidates, long-period planets (P>100 days), and long-duration transits (> 8 hours) that cannot be observed in their entirety by individual ground-based telescopes due to the rising Sun. Under the auspice of UNITE, the UCSN has already helped confirm three gas giants. Warm Jupiter TIC 393818343 b was previously found via a single TESS transit, and UCSN citizen astronomers confirmed its RV-determined period of 16.25 days. The UCSN also found evidence for TIC 139270665 c and confirmed TIC 139270665 b, the densest warm sub-Saturn in the TESS family. We will discuss these results, how citizen astronomy can forward the field of long-period planet research, as well as our education and outreach efforts.

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25 new warm & temperate transiting sub-Neptunes from TESS & CHEOPS

Hugh Osborn - University of Bern & ETH Zurich

Transiting sub-Neptunes are at the forefront of exoplanetary science. Their characterisation with radial velocities and JWST spectroscopy will likely reveal important insights into formation, migration & evolution for low-mass planets. The dominant source of transiting sub-Neptunes is TESS. However, due to short continuous photometry outside the ecliptic poles, TESS only reliably detects planets with P<20d, biasing the current sample towards hot sub-Neptunes & M-dwarfs. I will present an ongoing project aimed at confirming warm & temperate sub-Neptunes which show non-consecutive transits in TESS (i.e. duotransits). I will show how such signals can be modelled in order to predict the orbital periods. Subsequent transit observations using the precise CHEOPS space telescope is then able to determine the true orbital period and help confirm their planetary nature. This project has so far revealed 25 additional warm sub-Neptunes. This has doubled the number of characterisable sub-Neptunes with R<4Re, P>20d, & V<10. Our sample includes the brightest transiting resonant chain, the first Neptune-radius planet found to transit a naked-eye star, a temperate sub-Neptune with a 214d orbit, and a 5-planet system in an open cluster.

Warm Jupiters in the TESS era: The WINE collaboration

Rafael Brahm - Universidad Adolfo Ibáñez

TESS is allowing us for the first time to systematically discover and characterize in detail the population of warm Jupiters (giant planets with orbital periods between 10 and ~200 days). These systems are key objects to understand some important challenges regarding the formation, orbital evolution, and internal structure of giant planets in general. In this talk I will describe the work that the Warm gIaNts with tEes collaboration has been doing for 6 years to confirm the planetary nature of most of the TESS warm Jupiters reachable from the Southern hemisphere. I will describe the wide diversity of orbital architectures present in the WINE sample including some interesting highly interacting multi-planet systems. I will also briefly describe a new spectrograph (PLATOSpec) that is starting to play a key role in our discoveries.

Bridging the gap between hot Jupiters and Solar System giants with TESS and NGTS

Samuel Gill - University of Warwick

The current exoplanet population is dominated by super-Earth and sub-Neptunes with short orbital periods around solar-like stars. For unknown reasons (likely Jupiter) these planets are missing in our solar system. Bridging the gap between these planets and the solar system Gas Giants has accelerated in recent years leading to a change in our interpretation of exoplanet demographics. TESS has been a critical part of this, in part due to its observational strategy yielding long-period planets in the continuous viewing zone and single-transit planet candidates away from the ecliptic poles that have long, but unknown orbital periods. I will present our efforts to find such candidates in TESS data. Significant time has been invested from observatories on the ground and in space towards measuring precise the bulk parameters of these planets, constraining their orbital dynamics, and probing their atmospheres through transmission spectroscopy. This project has measured the orbital periods of over 50 planet candidates and provides a good sample of warm giants for subsequent JWST observations. We present 3 temperate planets around a K-dwarf, a 500 day planet around a solar-like star, and a 98-day transiting warm Jupiter around a 1Gyr star.

Tracing giant planet formation with multi-transiting warm and temperate Jupiters

Zitao Lin - Tsinghua University

Despite decades of efforts, significant uncertainties remain regarding the composition and formation of giant planets. Here, we present our project on studying systems hosting multiple warm or temperate Jupiters, with typical orbital periods between 10s and 100s days. On one hand, with equilibrium temperatures between 300 and 600 K, these planets exhibit detectable atmospheric signatures of C, N, and O carriers, making them sensitive probes of planet formation as both C/O and N/O ratios can be constrained observationally. In addition, having a pair of co-natal warm giants will enable intra-system comparative studies, providing more leverages and fewer degeneracies in distinguishing formation models. On the other hand, the coplanar nature of multi-transiting Jupiters suggests cold dynamical histories that may preserve primordial obliquities when they form. Measuring their current obliquities could yield insights into the angular momentum of their original protoplanetary disks. Our project includes JWST observations of transmission spectra, photometric and RV follow-up on TESS discoveries, and RM observations. We present the first results from our program, including new Gemini MAROON-X RVs on three systems.

KIC 8610483: A Nontransiting Circumbinary Planet Candidate

Christopher Martin - San Diego State University

We discuss the circumbinary planet candidate KIC 8610483 b, discovered using the eclipse-timing variation method. Combining Kepler Mission data with TESS and ground-based data, we revise the system parameter estimates: the primary and secondary stars have similar masses of 0.95 Solar masses, their orbital period is 49 days and the eccentricity is 0.5. The planet itself has a mass of ~45 Earth masses, a period of ~390 days, and an eccentricity of ~0.04. As the planet does not currently transit, its radius is unknown and its orbital inclination is not directly measurable. Currently the data is consistent with both a low inclination and, interestingly, a high inclination. If it is high inclination, then this would be the first of its kind for the Kepler circumbinary planets. As part of this investigation, we explore the effect the orbital inclination of the planet has on the precession of the eclipsing binary. In particular we examine the planet-induced periodicity in the O-C diagram of the mid-eclipse times, and its sensitivity to the planet's orbital parameters. We also examine the evolution of the system's orbital parameters over time, specifically the planet's inclination and orbital period.

A Long Period, Aligned Sub Neptune Revealed with MAROON-X

Alex Polanski - Lowell Observatory

The angle between a planet's orbit and its star's spin axis is a key clue to its formation history. While obliquity measurements have been crucial for our understanding of close-in giants, the alignment of smaller planets (≤8 Earth radii) remains largely uncharted territory. This is now changing with the advent of ultra-precise spectrographs. In this talk, I will present MAROON-X data from Gemini North revealing a 1.5 m/s Rossiter-McLaughlin signal for the sub-Neptune TOI-1759 b. With an obliquity of just 4 degrees, TOI-1759 b is well-aligned—the longest-period, single sub-Neptune with a measured obliquity. It adds to a trend that we are now beginning to see: small planets have a tendency towards alignment, reinforcing the idea of a dynamically cool formation history.

A new ground-based transit detection of the long-period extremely low-density planet HIP 41378 f

Juliana Garcia-Mejia - MIT

We present a new ground-based transit detection of HIP 41378 f, a long-period ($P = 542$ d), extremely low-density (\(0.09 \pm 0.02\) g cm\(^{-3}\)) giant exoplanet in a dynamically complex system. Using photometry from \textit{Tierras}, TRAPPIST-N, and multiple LCOGT sites, we constrain the transit center time to $T_{C,6} = 2460438.891 \pm 0.044$ BJD TDB. This represents only the second ground-based detection of HIP 41378 f, currently the longest-period and longest-transit-duration exoplanet to be observed from the ground. We use the transit detection to update the TTV solution for HIP 41378 f and refine the timing prediction for the next two transits in November 2025 and April 2027. We also revisit the system's architecture using updated TESS data and rule out a previously viable orbital solution for HIP 41378 d. Our results underscore the importance of follow-up observations to characterize this enigmatic system.

A Super-Jupiter from a Single Transit: Confirming the Long-Period Giant TOI-4465 b

Zahra Essack - University of New Mexico

We report the discovery and confirmation of TOI-4465 b, a 1.2 RJup, 5.9 MJup giant planet orbiting a G dwarf star. Initially detected as a single-transit event in Sector 40 of the Transiting Exoplanet Survey Satellite (TESS) mission, TOI-4465 b's planetary nature was confirmed through radial velocity observations with the Automated Planet Finder telescope, revealing a 102-day orbital period and an eccentricity of e=0.24. Although TESS later re-observed TOI-4465 in Sectors 53 and 80, no additional transits were detected. A global ground-based photometry campaign, including observations from 24 citizen scientists, successfully captured a second ~12-hour transit of TOI-4465 b from multiple sites worldwide. TOI-4465 b is a relatively dense (3.7 g/cm3), temperate (375–478 K) giant planet and exhibits a relatively low eccentricity compared to similarly massive long-period planets. It is also significantly metal-enriched relative to its host star, consistent with theories involving late-stage accretion of icy planetesimals. Increasing the sample of long-period planets by confirming single-transit events is essential for understanding the frequency and demographics of planet populations in the outer regions of planetary systems.

The Hunt for the Long-Period Sub-Neptune HD60779b

Victoria DiTomasso - Harvard Smithsonian Center for Astrophysics

The composition/structure of sub-Neptunes, as well as how mass loss has contributed to shaping the observed exoplanet population, remain open questions. In order to answer them, we will need to observe the atmospheres of varied sub-Neptunes and probe mass loss through observations of atmospheric escape. Long-period sub-Neptunes that are accessible to in depth follow-up, however, are hard to come by. I will share the 4 year long journey to discover HD60779b, a 2.9 Rearth, 13.6 MEarth planet on a 30d orbit around a bright (Vmag=7.2), sun-like star. Originally detected as a single TESS transit, the ultimate confirmation of this planet was made possible by intensive

HARPS-N RV follow up. Nearly 300 HARPS-N RVs constrained the transiting planet's orbit, as well as the presence of an additional, outer Neptune in the system. Finally, a second transit observed by CHEOPS, precisely determined the planet's period, enabling valuable follow-up observations of this long-period sub-Neptune.

A new super-Earth and brown dwarf in the warm Jupiter system TOI-201

Ismael Mireles - University of New Mexico

We report the discovery of two new companions to a warm Jupiter first discovered by TESS. TOI-201 c is a super-Earth orbiting a young active F star on a 5.85 d orbit interior to the warm Jupiter TOI-201 b. We also identify a long-period brown dwarf, TOI-201 d, exterior to TOI-201 b thanks to a single transit event in TESS sector 64. We confirm the orbital period of this eccentric brown dwarf using RVs from CORALIE and HARPS and find it is by far the longest-period transiting brown dwarf ever discovered. Combined with Hipparcos and Gaia astrometry, we are able to characterize the full 3-dimensional orbit of the brown dwarf. The brown dwarf is also responsible for the transit timing variations seen for the warm Jupiter. The system is a rare case of one with substellar companions spanning a wide range of masses and adds to the growing list of warm Jupiters with nearby companions as well as warm Jupiters with very distant companions. Furthermore, this dynamically active system is ideal for follow-up observations to further characterize their orbits and compositions, which should give insight into the formation and evolutionary history of these types of planetary systems.

Optimising Exposure Times for EPRV Follow-up of Long Period Planets around Sun-like Stars

Brandon Rajkumar - University of Warwick

Characterising long-period transiting exoplanets requires Extreme Precision Radial velocity (EPRV) observations. This is challenging for Earth-like planets around Sun-like stars as they produce RV shifts ~10s of cm/s. Convection in these stars excites pressure-mode (p-mode) oscillations, which manifest as radial motions of the surface and introduce RV signals ~ 10s of cm/s to several m/s, potentially masking planetary signals. However, by tuning exposure times to stellar parameters, p-mode oscillations can be optimally mitigated, improving RV follow-ups. We have developed a tool to determine the ideal exposure time for EPRV surveys, balancing precision considerations and residual p-mode signal. The open-source codes, PBjam and AADG3, are used to analyse the frequency spectra of sun-like stars and simulate the power spectra for typical exoplanet hosts. This allows assessment of the residual p-mode signal as a function of exposure time with comparison to the expected photon noise. We present initial results using the Gr8stars catalogue for potential Terra Hunting Experiment targets, with broader application to the EPRV community to help optimise RV follow-up of temperate, rocky planets, and improve detection and mass recovery.

The Architecture of Compact Exoplanet Systems (ACES) Survey: Spin-Orbit Misalignments and Outer Companions of Moderate-Period Small Planets

Marshall Johnson - The Ohio State University

The architectures of exoplanetary systems encode information on the system's dynamical history. Rossiter-McLaughlin observations of long-period exoplanets have traditionally been challenging due to a lack of targets orbiting bright stars, and infrequent observation opportunities. Small, long-period planets are particularly difficult due to their small transit depths and RV signals. The combination of TESS and the advent of more EPRV spectrographs have eased these issues. I will introduce the Architecture of Compact Exoplanet Systems (ACES) survey, a new effort to characterize the architectures of systems hosting super-Earths and sub-Neptunes. We are obtaining Rossiter-McLaughlin observations with NEID and other facilities of a sample of these small planets, several of which have P>10 days. I will show our initial observations and describe our prospects for longer-period planets. We are also pursuing long-timespan RV observations and high-resolution imaging observations to search for longer-period planetary and stellar companions and constrain the middle-to-outer system architectures. This project will lead to an improved demographic sample of well-characterized system architectures over a broad range of orbital periods.

Searching for Long-Period Giant Planets within K2 Planetary Systems

Maleah Rhem - University of Kansas

Transit and RV surveys have given us insight into the current distribution of exoplanets. Kepler revealed that short-period small planets have an occurrence rate of <1 planet per solar-type star, while RV surveys revealed that long-period giant planets near the snow line are less common, with an occurrence rate of 5-10%. A few formation models of planetary systems with both types of planets have been proposed. However, due to these planets being discovered from stellar samples with different stellar distances, the correlation between small and giant planet formation is unclear. To fix this gap, NASA repurposed the Kepler spacecraft for the K2 mission, whose primary goal was to survey thousands of nearby, bright stars hosting short-period planets. Our study analyzes RVs collected from 28 K2 systems using the High-Resolution Echelle Spectrograph (HIRES) at the W.M. Keck Observatory. Our goal is to detect long-period companions within these systems by looking for long-term RV trends from their host stars; i.e., stellar accelerations induced by larger companions. This study also seeks to measure their occurrence rate within the overall sample, which will help us determine the correlation between small and giant planet formation.

DETECTION

****INVITED SPEAKER****

Jason Dittman - University of Florida

[ABSTRACT FORTHCOMING]

The TESS Single-Transit Planet Candidate Catalogue: Constraining Period Aliases of Long-Period Exoplanets

Brett Skinner - University of New Mexico

Determining orbital parameters for long period, single-transit exoplanets has become simpler due to TESS's extended missions and the observing strategies of Cycle 7 and the upcoming Cycle 8. The daunting task of eliminating period aliases of single-transit candidates has become easier as targets receive multiple TESS sectors of observation. The TESS Single Transit Planet Candidate Working Group has continually been vetting and releasing single-transit candidates and updates. In this talk, I will present the catalogue of single transits and the improvements I have implemented into our pipeline. Additionally, we will present the period aliases with probabilities and solved periods for the candidates in the catalogue to further constrain the orbital parameters for follow-up observation. With continued data and continued pipeline optimization, we prepare updated yield predictions of such long period, single-transit exoplanets which will be complementary to Solar System analogs.

NEMESIS II: Exoplanet TraNsit SurvEy of Nearby M-dwarfs in TESS FFIS – Detection of Transiting Planet Candidates in the Prime TESS Mission

Dax Feliz - Flatiron Institute Center

The next frontier in exoplanet surveys is the sparsely sampled regime of long-period transits, where present observations capture only a small fraction of each orbit. We target such signals around nearby M dwarfs (< 100 pc) by mining all full-frame images (FFIs) from TESS Prime-Mission Sectors 1–26. The open-source NEMESIS pipeline extracts and detrends FFI photometry, then searches for transits, focusing on faint stars (Tmag < 18) omitted from the 2-min target list. Scanning periods of 0.5–100 d—covering M-dwarf habitable zones—NEMESIS fills a key demographic gap and refines occurrence rates.

Each candidate undergoes automated false-positive checks and MCMC parameter fitting. Light curves, diagnostic plots, and ephemerides will be released as High-Level Science Products on MAST, with vetted planets posted to ExoFOP-TESS as Community TOIs to speed follow-up. Designed for TESS but portable to Kepler/K2, PLATO, and ground-based data, NEMESIS offers a uniform framework for long-period transit discovery across cadences. By converting sparse survey data into a roadmap for the next decade of exoplanet characterization, it lays the empirical foundation for probing habitability around the Galaxy's most common stars.

Investigating Cold Planets Around M Dwarfs with TESS

Mallory Harris - University of New Mexico

Whether other planetary systems resemble ours is crucial for exoplanet science and planet formation. Evidence suggests our solar system is rare, but detection biases complicate this conclusion. This has led the exoplanet community to search M dwarf stars for solar system analogs, as their habitable zones are more accessible. Discoveries of compact multiplanet systems like TRAPPIST-1 suggest M dwarf systems form similarly to Sun-like stars, just scaled down. Yet radial velocity surveys have found gas giants orbiting M dwarfs, and both TESS and Kepler have discovered systems with planets beyond the ice-line. To explore these neglected outer planets further, I use TESS data, which includes a sample of millions of low-mass stars. I developed my pipeline to detect single-transit events and compact multiplanet systems. This will help calculate new occurrence rates for M dwarf planets and constrain outer planet frequencies. Even a null detection of cold planets would inform planet formation theories, giving new insight into whether M dwarfs are the right place to search for solar system analogs or if they have unique formation pathways. I will present my current results from the search pipeline.

GERBLS - a fast, efficient Box-Least Squares algorithm to search for transits

Kristo Ment - Pennsylvania State University

Detecting planetary transits in time-series photometric data typically involves a computationally expensive brute-force search over at least three non-linear model parameters (orbital period, transit phase and duration). The computational cost can be particularly large if the range of searched orbital periods covers multiple orders of magnitude. Here, I present GERBLS, a new publicly available and easily accessible software package designed to optimize and accelerate this search. I provide examples and benchmarks by utilizing GERBLS on data from the Transiting Exoplanet Survey Satellite (TESS). The purpose of this software is to provide a fast and efficient algorithm that can effectively search large data sets for transits and/or enable detailed characterization of a transit survey's detection efficiency, while accounting for specific properties of each target star.

Don't FORCES It - The search for circumbinary planets with TESS

Dominic Oddo - University of New Mexico

Circumbinary planets (CBPs; planets orbiting outside of both stars in a tight stellar binary) are an exceptionally interesting population of planets. This is due to the fact that these systems allow us to probe the intricacies both tight binary systems and the planets that orbit them. Because they orbit only beyond the stability limits of their host binaries, they necessarily exist at longer periods than most other transiting planets found to date. CBPs are functionally very difficult to detect. Their transits must be picked out from among binary eclipses. Additionally, due to the unique dynamics of these systems, these planets exhibit transit timing, depth, and duration variability, necessitating single-transit event searches. Despite this, there is much scientific impetus for searching for CBPs. Because of TESS's enormous sky coverage, there are possibly many CBPs hiding in TESS light curves, leading to reasonable estimates for the expected yield of TESS CBPs. I will briefly motivate the study of CBPs, followed by describing our methodology for searching for CBP transits, providing updates on the results of the search so far.

Realizing the Full Potential of Gaia Astrometry for the Characterization of the Population of Long-period Giant Planets

Kevin Schlaufman - University of Colorado

The astrometric detection of giant exoplanets with orbital periods in the range 1 yr < P_orb < 10 yr using Gaia data is one of the most promising opportunities in exoplanet science. Indeed, thousands of long-period giant exoplanet systems are expected to be revealed as part of Gaia Data Release (DR) 4 in 2026. This population of long-period giant exoplanets will be obscured by a much larger population of unresolved equal-mass stellar binaries that mimics the low-amplitude astrometric wobbles produced by long-period giant exoplanets orbiting single stars. To this point, observationally expensive follow-up observations have been necessary to differentiate between these two possibilities. I'll outline a new approach to the differentiation of the long-period giant exoplanet/equal-mass stellar binary scenarios that uses existing Gaia astrometry and archival multiwavelength photometry. This approach scales easily to the tens of thousands of candidates that will be produced as part of Gaia DR4 and will enable a maximally efficient follow-up program with the goal of increasing by an order of magnitude the number of known giant planets with 1 yr < P_orb < 10 yr.

FORMATION

Formation and Evolution of Close-In Exoplanets: Linking Theory to Observed Trends

André Izidoro - Rice University

In this talk, I will review recent theoretical advances on the formation and dynamical evolution of close-in super-Earths and mini-Neptunes. In the "breaking the chain model", planets form at a range of orbital distances and migrate inward due to planet-disk gravitational interactions. As they converge toward the inner edge of the protoplanetary disk, they typically become trapped in compact resonant chains. The subsequent dynamical evolution of these chains often leads to dynamical instabilities and giant impacts, producing planetary system architectures that are broadly consistent with key observed trends, including the period ratio distribution, intra-system radius uniformity, and the bimodal radius distribution with a dip near ~1.8 Earth radii, known as the “radius valley.” Only a small fraction of systems remain in resonance, consistent with iconic observed examples such as TRAPPIST-1, Kepler-223, and TOI-178. I will also discuss recent observational findings indicating an excess of orbital eccentricities among planets within the radius valley ($1.5 \lesssim R \lesssim 2$ Earth radii), and explore possible evolutionary pathways that may explain its origin. Finally, I will conclude by discussing how emerging observational evidence seems to support the “breaking the chain” evolutionary pathway.

Demographics of Gas- and Ice-rich planets vs. Host Star Mass and Orbital Separation: They Might be Giants

Michael Meyer - The University of Michigan

Combining dozens of point estimates for companion frequency over fixed ranges of semi-major axis and companion mass ratio relative to the host star (drawn from RV, microlensing, and direct imaging), we present a new model for the orbital distribution and planet mass function of planets > 30 Earth masses around M dwarfs, FGK, and A stars from < 0.3 to > 300 AU. We also constrain the relative amplitude of brown dwarf companions to this planet populations. We recover the well-known power-law planet mass function for gas giants, and derive a log-normal orbital distribution with a peak near 4 AU, consistent with legacy RV surveys (e.g. Fulton et al. 2021) and confirming previous work (Meyer et al. 2018). The model prefers fitting the companions in mass ratio, rather than planet mass, and we find no evidence for a dependence of planet mass function on orbital separation. We discuss extreme tests of this model including surveys of companions around young B stars in the Sco Cen OB association, as well as JWST observations of companions around Y dwarfs and the search for ice giants beyond 30 AU around young stars in nearby moving groups. These results are discussed in the context of recent models of star and planet formation.

Deciphering the Formation Sequence of Giant Planets from the Mass-Metallicity Relation

Yayaati Chachan - University of California, Santa Cruz

The rate at which giant planets accumulate dust and gas is a critical component of planet formation models, yet it is extremely challenging to predict from first principles. Characterizing the heavy element (everything other than hydrogen and helium) content of giant planets provides important clues about their provenance. Using thermal evolution models with updated H-He EOS and atmospheric boundary condition that varies with envelope metallicity, I quantify the bulk heavy element content of nearly 140 warm (< 1000 K) giant planets with well-measured masses and radii, tripling the sample size studied in Thorngren et al. (2016). These measurements reveal that the population's bulk metallicity follows the relation Zp = Mcore / Mp + fz , with Mcore ~ 14 Earth masses, fz ~ 0.09, and an astrophysical scatter of ~0.68 x Zp. At low planet masses (<< 150 Earth masses), Zp declines linearly with Mp. However, bulk metallicity does not continue to decline with planet mass and instead flattens out at fz ~ 0.09 (~6x solar metallicity). These results offer new insights into how giant planets assemble and explicitly show that heavy elements are preferentially accreted (i.e., enriched over the solar value) during the gas accretion phase.

DEMOGRAPHICS

Towards an understanding of demographics in the habitable zone and beyond

Jessie Christiansen - NASA Exoplanet Science Institute

I will review the current state of demographics of transiting planets, focusing on the trends we are seeing at the longest periods. I will review some of the key questions that we are hoping future transit studies and missions will address, and also how long-period transiting planets fit into the larger picture of long-period demographics across a variety of planet detection techniques.

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How good is TESS at finding long-period planets?

Toby Rodel - Queen's University Belfast

The discovery of longer-period (and therefore cooler) transiting planets with TESS typically requires confirmation via extensive photometric and spectroscopic follow-up programs. To help plan such programs it is vital to have accurate and up-to-date yield predictions which include long period planets. We have created the Transit Investigation and Recoverability Application (TIaRA), a tool for measuring the transit detection sensitivity of lightcurves. We have published one study in which we apply TIaRA to TESS Year 1 and Year 3 SPOC FFI lightcurves and combine the results with occurrence rates derived from Kepler, to obtain yield estimates for the southern ecliptic hemisphere for TESS. We predict 2271+241−138 planets should be detectable from the Year 1 and Year 3 SPOC FFI lightcurves. Our predictions agree well with the current TOIs with periods <25 days. However we find the TOIs to have a ~75% deficit for planets with periods >25 days, at a confidence level of $> 3\sigma$. This indicates ~300+/-50 long-period, cooler transiting planets remain in TESS data which are yet to be discovered. We are currently updating these results with the latest available TESS data and plan on testing how potential future pointing affect yield.

The obliquities of warm Jupiters

Andres Jordan - Universidad Adolfo Ibáñez

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.

Circumbinary Planets: Recent Trends, Puzzles, and Habitability

William Welsh - San Diego State University

One of the myriad fascinating properties of circumbinary planets (CBPs) is the fact that they are mostly long-period systems: the mean orbital period of the ~20 known Kepler+TESS systems is ~270 days. The transiting planet with the longest known (well-characterized) orbital period is the CBP Kepler-1647b, with P=1108 days. In fact, short period CBPs are very rare (shortest known period is 49 days) and there is no analog of short-period hot Jupiters: such close-in orbits are dynamically unstable. It is the stability requirement that leads to the long periods. Yet even with their long orbital periods, a significant fraction of CBPs (~30%) reside in the habitable zone. This is mainly a selection effect, but importantly, the luminosity of a pair of stars is less than the luminosity of a single star of the same mass. Thus the incident flux on a planet at 1 AU from a solar-mass binary pair is lower than the Sun-Earth insolation.

In this talk I will review the latest CBP findings, trends, puzzles, and discuss the implications binarity has on habitability. I will also share population synthesis results on the fraction of binaries that can host habitable zone planets.

Small circumbinary planets are rarer than small single-star planets

Wata Tubthong - Tufts University

All circumbinary planets (CBPs) confirmed up-to-date are gas giants. No circumbinary super Earth has been discovered, despite the super Earths making up ~80% of the planet population around single stars. This is owing to the inherently biased nature of the by-eye discoveries of CBPs. Understanding the population of super Earths (or the lack thereof) around binary stars would shed light into the formation and evolution of planetary systems in a completely different environment than ours. We applied STANLEY, an automated algorithm that employed an N-body simulation to account for TTV, to Kepler eclipsing binary light curves to search for small CBPs. For the first time, we are able to demonstrate that circumbinary super Earths are genuinely rarer than super Earths hosted by single stars.

Biases from Missing a Small Planet in High Multiplicity Systems

Coleman (Alex) Thomas - University of Notre Dame

In an era when we are charting multiple planets per system, one might wonder the extent to which "missing" (or failing to detect) a planet can skew our interpretation of the system architecture. We address this question with a simple experiment: starting from a large, homogeneous catalog, we remove planets and monitor how several metrics of the system architecture change. We first perform this test on a catalog of Kepler exoplanets. We then repeat our test on a catalog of synthetic planetary systems that reproduce the observed systems as faithfully as possible. For both samples, we find that the failure to detect planets tends to create more irregularly spaced planets, whereas the mass similarity and coplanarity are essentially unaffected. One key difference between the synthetic and observed data sets is that the observed systems have more evenly spaced planets than the observation-bias-applied synthetic systems. As our tests show that detection bias tends to increase irregularity in spacing, the even spacing in the observed planetary systems is likely astrophysical rather than driven by detection biases. Our findings reinforce the need to develop an underlying model of planetary architectures that reproduce these observed patterns.

ATMOSPHERES

Towards understanding the molecular inventory of planetary atmospheres across a range of Teq and mass

Jonathan Fortney - University of California, Santa Cruz

Cooler transiting planets allow us to understand a host of chemical transitions in planetary atmospheres. This means the chemical abundances and clouds that are familiar for the close-in (hot!) planets will give rise to different molecules and clouds, at a range of lower Teq values. How these change will depend strongly on the particulars of any given planet, including its mass, age, metallicity, and other physical factors. These cooler and longer-period transiting planets will allow us to make connections to our solar system and directly imaged planets. In this talk I will review theoretical expectations and the latest JWST results, for "cooler" Jupiter-class to sub-Neptune-class exoplanets.

SNAP Judgement – Hydrodynamics in the Outer Solar System and Beyond

Ali Hyder - NASA Jet Propulsion Laboratory

The atmospheres of the gas and ice giants in our Solar System function as templates for the vast variety of exoplanetary systems that have been observed. Ongoing and planned space missions provide critical measurements that constrain the atmospheric composition and dynamics of these planets. Models of exoplanet atmospheres have relied on 1D chemical-diffusion approaches, with an increasing focus on integrating full hydrodynamic simulations. Here, we present our work regarding the use of the SNAP hydrodynamic model as applied to Jupiter and Uranus for improved characterization of their atmospheric constituents, and underlying dynamics. We demonstrate that incorporating full hydrodynamics in a cloud-resolving model with simplified thermochemistry and microphysics leads to notable variations in the inferred abundances of volatile species on these planets, in stark contrast to the values derived from models that use conventional 1D eddy-mixing based methodologies. Our work has important implications for how the underlying assumptions about the atmospheric diffusivity and composition of these exoplanets can lead to variations in the interpretation of observed spectra from these worlds.

Self-consistent 1D radiative-convective atmospheric models for gas giants and sub-neptunes in the JWST era

Mantas Zilinskas (to be given by Renyu Hu) - NASA Jet Propulsion Laboratory

While JWST has enabled characterisation of sub-Neptunes and long period gas giants, robust interpretations of these observations rely on self-consistent atmospheric modeling. We present the ongoing development of our physically motivated 1D radiative-convective chemical kinetics framework (EPACRIS) that realistically accounts for the multicomponent non-dilute pseudoadiabat. We discuss in detail the intricacies of the interplay between condensation, rainout, cloud formation, and atmospheric chemistry that drive physically realistic temperature-pressure profiles and planetary emission/transmission spectra. We apply these models to a diverse distribution of exoplanets, revealing crucial insights for current and future JWST observations of these distant worlds.

Chemistry and Aerosols of Temperate Jupiters

Alastair Claringbold - University of Warwick

Temperate Jupiters are the missing link between hot Jupiters and solar system gas giants. Now with JWST and long-period planet detection, we have finally unlocked this parameter space for atmospheric characterization. Temperate Jupiters are chemically diverse and unlike hot Jupiters are expected to have visible nitrogen-bearing species, permitting measurement of their C/N/O ratio which can be leveraged to understand planet formation. We use 1D photochemistry and aerosol models to find observable transitions shaping the temperate parameter space. We explore the role of nitrogen photochemistry, sulfur and water condensation, and vertical mixing in dividing the parameter space to interpret observations with JWST. We also present a preliminary NIRSpec PRISM transmission spectrum of TOI-1899b, one of only three temperate gas giants observed with JWST and the first with an M dwarf host, making it a key point of comparison to the other two observed temperate Jupiters. The observation offers broad spectral coverage from 0.7-5 microns, sensitive to molecular absorption from H2O, CH4, NH3, HCN, CO2, and aerosols.

The Roasted Planet: JWST's View of the Highly Eccentric Hot Jupiter HD 80606b

James Sikora - Lowell Observatory

High-eccentricity gas giant planets serve as unique laboratories for studying the thermal and chemical properties of H/He dominated atmospheres. In certain cases, the orbit-induced changes in incident flux can significantly alter the atmosphere's temperature profile and allow the thermal timescales, chemical timescales, and the composition of aerosols to be measured. One particularly remarkable case is that of HD80606b, which essentially transitions from a warm Jupiter near apoastron (0.88 AU, T~400 K) to a hot Jupiter near periastron (0.03 AU, T~1500 K) throughout its highly eccentric (e=0.93) 111 day orbital period. Here we will present results from JWST NIRSpec partial phase curve observations of HD80606b's eclipse and periapse passage that reveal a rapidly changing emission spectrum that is primarily driven by the atmosphere's changing thermal structure.

Atmospheric CO_2/CH_4 as a Probe of Deep H_2O/H_2 in Sub-Neptunes: Evidence from K2-18 b and Abiotic Organosulfur Chemistry

Jeehyun Yang - California Institute of Technology

Temperate sub-Neptunes like K2-18 b are promising targets for habitability studies. JWST spectroscopy reveals a hydrogen-rich atmosphere with methane and carbon dioxide, but little water vapor. This CH_4 and CO_2 chemistry suggests a water-rich envelope, while the absence of H_2O implies condensation below the JWST probe region. Using radiative transfer and photochemical kinetics-transport modeling, we introduce a novel framework linking the observed CO_2 to CH_4 ratio to the deep H_2O to H_2 ratio, with broad applications across sub-Neptune atmospheres. Applied to K2-18 b and TOI-270 d, our model suggests both possess water-rich interiors with approximately 25 percent water by volume. Tentative detection of dimethyl sulfide or methyl mercaptan is reported; our photochemical model shows these organosulfur compounds can form abiotically, challenging recent claims of biogenic origin. We also identify sulfur species such as SO_2 and OCS as potential tracers of interior water content in temperate sub-Neptunes.

Mapping the cosmic shoreline of mid-to-late M dwarfs requires long-period exoplanets

Emily Pass - MIT

Characterizing the atmospheres of terrestrial exoplanets is a key goal of exoplanetary astronomy, one that may now be within reach given the upcoming large-scale survey of rocky M-dwarf worlds with JWST. It is imperative that we understand where known planets sit relative to the cosmic shoreline, the boundary for atmosphere retention. Previous works modeled the historic XUV radiation received by mid-to-late M-dwarf planets using a scaling relation

calibrated using more massive stars, but fully convective M dwarfs display unique rotation/activity histories that differ from Sun-like stars and early M dwarfs. We synthesize observations of the active lifetimes of mid-to-late M dwarfs to present an updated estimate of their historic XUV fluence. For known planets of these stars, we calculate a fluence that is 2.1-3.1 times the canonical XUV scaling relation on average, with the larger value including corrections for the PMS phase and energetic flares. We find that only the largest and longest-period terrestrial planets known to transit these stars are likely to have retained atmospheres within the cosmic shoreline paradigm ($R > 1.5$ $R_\oplus$ and $P > 10$ days). These long-period planets will thus be critical for mapping the cosmic shoreline.

FUTURE

Long Period Planets - The GAIA DR4 revolution

Daniel Bayliss - University of Warwick

Gaia DR4, scheduled for release not before mid-2026, will provide high-quality astrometry and photometry for over 2 billion sources. In this presentation I will explore how this revolutionary dataset will impact on our study of long period exoplanets. In particular, I will focus on the cross-over between systems with known long-period transiting exoplanets and systems where we can expect long-period astrometric detections with Gaia DR4. Understanding and working with the Gaia DR4 data will be a key aspect of long period exoplanet research over the next decade.

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TRExS: (long-period) Transits in the Roman galactic EXoplanet Survey

Robert Wilson - NASA Goddard Space Flight Center

The Nancy Grace Roman Space Telescope (Roman), NASA's next flagship mission set to launch as early as September 2026, will conduct community surveys designed to address long-standing questions regarding dark matter, dark energy, and exoplanets. Of particular interest to the exoplanet demographics community is the Galactic Bulge Time Domain Survey (GBTDS), which will continuously monitor a ~1.68 square degree region of the Galactic bulge at a 12.1-minute cadence in the near infrared (0.9-2.0 um). Due to the high stellar density of the Galactic bulge combined with Roman's sensitivity and wide field of view relative to its pixel scale, the GBTDS is expected to yield ~100,000 transiting exoplanets with orbital periods ranging from <1 day to potentially over 20 years. Within this planet yield, approximately 90-95% will be giants (>4 R_Earth) on relatively close-in orbits (a<0.3 AU). However, the GBTDS should also yield thousands of longer period transiting planets, including up to ~1000 with orbital periods greater than a year. In this talk, I will present an overview of Roman, the Galactic Bulge Time Domain Survey, and efforts from the TRExS (Transits in the Roman galactic EXoplanet Survey) collaboration to prepare for this unprecedented dataset and maximize its discovery potential, particularly for long-period transiting planets.

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Long-period Exoplanets with PLATO

Annelies Mortier - University of Birmingham

PLATO (PLAnetary Transits and Oscillations of stars) is the upcoming photometric ESA M3 mission, due to be launched in 2026. One of its primary science goals is to detect and characterise extrasolar planets. Due to its long staring observing strategy, a large field of view, and excellent photometric sensitivity, PLATO will be able to detect small, long-period planets orbiting bright stars, similar to our Solar System rocky bodies. A dedicated ground observation programme will further validate and then characterise these prime targets. In this talk, I will give an overview of the PLATO mission, the observing strategy, its expected yield and the planned follow-up observations.

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POSTERS

The Colibri Telescope Array: A Robotic Facility for Time-Domain Astronomy

Anthony Girmenia - Western University

We present the technical design of the Colibri telescope array, three 50-cm telescopes located at Elginfield Observatory near London, Ontario, Canada. Managed by the University of Western Ontario, Colibri consists of three identical 0.5-meter prime-focus Hercules telescopes, each equipped with a Kepler KL4040 sCMOS camera capable of acquiring images at rates of up to 40 frames per second. The system provides a field of view of 1.43 degrees with a plate scale of 2.52 arcseconds per pixel. Currently, observations are unfiltered in the visible band (380-900 nm), with future expansion into the short-wavelength infrared (SWIR) band (900–1700 nm) under consideration, pending the acquisition of a suitable camera. Colibri is a versatile facility with broad scientific applications, including video astronomy and solar system objects tracking. Colibri is also fully capable of executing deep, long-duration monitoring, allowing it to be used for long-period transit exoplanet follow up observations. Expansion plans include the acquisition of visible-light filters and the development of scripts for scheduling automated guest observations. We welcome collaborative projects in research areas that can utilize Colibri's capabilities.

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Photometric follow-up of young candidate planets

Rosa Hoogenboom - University of Geneva

Young planets form great objects to study the early stages of planetary evolution. Due to the high activity of their host stars however, they are difficult to detect observationally.

Using observations from the TESS satellite, we have compiled a list of candidate planets transiting young stars.

We perform vetting through several steps such as checking background flux from nearby stars for similar signals, comparing odd and even transits to exclude eclipsing binaries, radial velocity measurements to constrain the size of the companion, and eventually photometric follow-up observations with ground-based facilities such as the 1.2 m Euler telescope (La Silla) and the 12 20 cm telescopes from NGTS (Paranal).

I report on the most recent progress for our latest young, candidate planets.

Enhancing Transit Detection to Uncover Long-Period Exoplanets

David Degen - ETH Zurich

Small ($R<4R_\oplus$), long-period (30 days<P) exoplanets with low equilibrium temperatures are an extremely interesting population, promising insights into planet formation, atmospheric chemistry and evolution, and habitability. However, for these planets, the current TESS observing strategy can only capture single transit events in different sectors, if any at all. Traditional detection methods, like median filtering followed by Box Least Squares, prove comparatively ineffective at finding such planets, with only a few shallow transits.

For this reason, we have developed an automated detection pipeline that integrates machine learning-based transit detection with robust vetting techniques to detect long-period exoplanets more efficiently. When we find two or more individual transit events at a star that are sufficiently similar, we assume they stem from the same planet, which limits the compatible periods to a set of aliases and enables cost-effective follow-up observations by CHEOPS.

We have applied our pipeline to a subset of the TESS data and will present a subset of interesting new candidates. When applied to the full TESS data set, we anticipate discovering dozens of newly-detected candidate sub-Neptunes on long orbital periods.

A 43 day transiting Neptune and two 25 day Saturns from the NGTS Long Period Planets Program

Matthew Burleigh - University of Leicester

We present three planets with orbital periods solved through ground-based follow-up efforts by telescopes of the Next Generation Transit Survey (NGTS) Long Period Planets Program, each initially identified as single transit events in TESS Sectors. With an orbital period of 43.1 days, NGTS-34b is one of the longest period well-characterized transiting Neptunes. Orbiting a star that is bright in K band (≃7.9 mag) and with a TSM of 23, it is both amenable and interesting for spectroscopic follow-up with instruments such as MIRI or ARIEL. TOI-4940b and NGTS-35b are warm Saturns on ≃25 day orbits, the latter having moderate eccentricity (e ≃ 0.2). Each has an equilibrium temperature <700K, with NGTS-35b especially cold at ≃450K. It maintains a TSM of 38, high for a cool near-Jupiter sized planet, rendering it another promising candidate for cool atmosphere studies.

Eccentricity distribution drivers in the super-Jovian mass regime

Arvind Gupta - NSF NOIRLab

The increased discovery rate of transiting warm giant exoplanets in the TESS era has enabled detailed investigations of properties beyond mass, radius, and orbital period. Trends have been identified in the eccentricity and obliquity distributions, as well as with stellar temperature and stellar multiplicity. Here, we present an updated analysis of a well-established correlation between exoplanet mass and eccentricity, focusing on transiting giant exoplanets. We assess evidence for a mass break-point that divides the sample into low-eccentricity and moderate-eccentricity populations, and we evaluate the possible underlying physical processes that may shape the mass and eccentricity distributions. We also comment on contributing factors such as stellar multiplicity, metallicity, temperature, and evolutionary state.

Confirmation and characterization of the transiting warm Jupiter HD 278555 b

James Ball - Arizona State University

Studying warm Jupiters is crucial to understanding the processes of planet formation and migration. These planets sit at the boundary between cold giant planets and hot Jupiters, and they can reveal clues to how giant planets migrate inward and evolve. We report the discovery and confirmation of a transiting warm Jupiter, HD 278555 b, which was first detected as a single transit event in a light curve from the Transiting Exoplanet Survey Satellite (TESS). We confirm the planetary nature of the signal using ground based radial velocity (RV) follow-up observations from the NEID spectrograph, and we characterize the planet via a joint fit to the transit and RV signals. We find HD 278555 b has a mass of 0.812 MJ and a radius of 1.01 RJ, and orbits a G-type star with a period of 28.84 days and a low eccentricity of 0.071. These orbital parameters suggest the planet formed beyond the ice line and underwent smooth disk driven migration. This discovery adds to the growing population of well characterized warm Jupiters that will help astronomers test planetary migration theories.

Detection, Validation, and Modeling of Long-Period Exoplanets in TESS Data

Hudson Harner - University of Louisville

The NASA Transiting Exoplanet Survey Satellite (TESS) mission to search for planets beyond our solar system monitors wide field sectors of the sky. The satellite sweeps each sector and develops a database containing signatures of exoplanetary transit events. Because TESS' dwell time on a sector is about a month, most of its confirmed planets have orbital periods of under 14 days and represent planetary systems far different from our own. TESS' extended mission will have new data covering two months containing signatures of planets with longer periods. Additional focus will be given to regions of continuous coverage, increasing the likelihood of detection of planets in Earth-like orbits. This doctoral dissertation project focuses on the detection, validation by ground-based spectroscopy, characterization of the stellar host environment, and modeling of long-period planets given comprehensive multi-spectral data in coordination with NASA TESS and the planetary science community. It will be mentored by an experienced team of advisors, use recent and archived TESS data, and leverage observational and computational resources from the university to identify long-period planets with histories like the planets in our solar system.

Detecting Four New Super Long Period Planets In Systems That Exhibit Transit Timing Variations Within Kepler With Machine Learning and Onboard Spacecraft Diagnostics

Matthew Hansen - University of Florida

We developed a machine learning based pipeline, that utilizes photometry and onboard spacecraft diagnostics of Kepler to detect single transit events. Our pipeline obtains a planet detection efficiency of 22.5% from injection-recovery tests for phase folded planets with radii of 1-2 $R_\oplus$ and periods between 350 and 400 days, a factor of two better than the Kepler pipeline reported in Burke et al (2015). We apply our pipeline to systems with at least one planet that exhibits transit timing variations. We report the discovery of four new candidates. KOI 1476.02 has two self-similar transits with radius 3.375 ± 0.245 $R_\oplus$ and period 777.78 ± 0.02 days. KOI 638.03 has two self-similar transits with radius 2.655 $R_\oplus$ and period 505.495 ± 0.004 days. KOI 2237.02 is a single transit candidate with radius 4.47 ± 0.35 $R_\oplus$. We can fit potential transits of KOI 2237.02 within data gaps consistent with period 342.148 ± 0.004 days. KOI 3066.02 is a single transit candidate with radius 3.121 ± 0.463 $R_\oplus$. The data gaps within Kepler allow for ≥ 500 day periods for the single transit candidates. We present potential future transit times of these candidates for possible follow-up observations in order to confirm these potential long-period systems.

Precision RV Estimates Using the LCCF

William Welsh - San Diego State University

The venerable cross correlation function (CCF) is the standard way to measure the shift ("lag") between two time series. It is widely used to measure wavelengths shifts between spectra, thus providing Doppler radial velocities (RVs). Given the need for extremely precise RVs to detect and characterize long-orbital period planets, especially Earth-mass planet in the habitable zone around Sun-like stars, any improvement of the CCF can be of significant value. Here I present a new functional form for the CCF. The method is based on the concept of a physical resonance and uses a Cauchy-Lorentz function to estimate when the two spectra are best matched in wavelength. Tests indicate that it offers higher resolution than the standard CCF, and this is the method's main advantage. It can also provide an uncertainty estimate, and it is very simple and fast to compute. The method should be particularly well-suited for constructing "CCF images" (where the CCF is plotted versus time or versus orbital phase, akin to a “trailed spectrogram”). The higher resolution can help isolate a faint RV signal against the noisy background.

The T16 Planet Hunt - Machine Learning Based Exoplanet Detection in TESS Light Curves

Joshua T. Roth - Princeton University

We aim to identify new exoplanet candidates in TESS sectors 1-13 using the light curves of 50 million stars with T < 16 mag produced by the T16 project (Hartman et al. 2025). Reductions for sectors 14 through 26 are currently underway and will be included in our search. We apply a combination of the GPU-accelerated CETRA algorithm (Cambridge Exoplanet Transit Recovery Algorithm; Smith et al. 2025) and the BLS algorithm implemented in VARTOOLS (Hartman & Bakos 2016) to systematically search for transit-like signals. Detected threshold crossing events are classified using a hybrid approach that combines machine learning with visual inspection, allowing us to distinguish planetary candidates from eclipsing binaries and systematic artifacts. Our goal is to construct a reliable, high-purity candidate catalog suitable for further vetting and follow-up observations. We furthermore plan to incorporate light curves from the recently commissioned HATPI project, which monitors the entire Southern sky at 45 seconds cadence, and which will dramatically increase our sensitivity for long period transits.

Astrometric Detection of Long-Period Companions: Orbital Dynamics from a 10-Year Baseline

Alexia McKenzie - DePaul University, University of California Santa Cruz

The detection and orbital characterization of long-period companions provide critical insights into stellar system dynamics and demographics. This study presents observations of 48 stars with significant proper motion changes, selected from the Hipparcos-Gaia Catalog of Accelerations (HGCA) with χ^2 values exceeding 11.8, corresponding to a 99.7% confidence level. These targets were cross-referenced with stellar systems identified in An Adaptive Optics Census of Companions to Northern Stars Within 25pc with Robo-AO. By revisiting these systems approximately 10 years after the initial Robo-AO observations in 2012, we obtained astrometric measurements and developed updated orbital models for the identification of stellar companions. This work highlights demographics of long-period exoplanets through the use of archival data and direct imaging follow-ups, demonstrating the potential of long-term astrometric monitoring to uncover long-period companions. These findings contribute to understanding the prevalence and characteristics of stellar system architectures and inform strategies for identifying promising targets for future studies of exoplanets and stellar companions.

Mass Measurement of TOI-2443 b: A Sub-Neptune with a Long-Period Companion in the Habitable Zone

Claire Geneser

A precise radial velocity (RV) monitoring campaign was conducted for TOI-2443 b, a transiting exoplanet candidate identified by TESS. Preliminary estimates of the transmission spectroscopy metric (TSM) indicate that the transiting planet is a promising target for atmospheric follow-up. I perform a multi-planet RV analysis of the TOI-2443 system, combining infrared and optical RV data. The model robustly recovers the signal of TOI-2443 b, an eccentric warm sub-Neptune, with a semi-amplitude of 2.54 ± 0.24 m/s, corresponding to a mass of 7.11 ± 0.67 $M_\oplus$. With a radius of 2.69 ± 0.55 $R_\oplus$ and an equilibrium temperature of 515 K, TOI-2443 b has a TSM value of 157, highlighting it as a strong atmospheric characterization candidate. TOI-2443 c, a potential habitable zone companion orbiting with a period of 92.39 ± 0.95 days, is recovered with a semi-amplitude of 1.67 ± 0.26 m/s and a weakly constrained eccentricity of 0.33 ± 0.18, warranting additional RVs to refine its ephemeris and assess transit probability, ultimately determining whether it is suitable for atmospheric follow-up.

HD 35843 / TOI-4189: A Sun-like star hosting a long period sub-Neptune and inner super-Earth

Katharine Hesse - MIT

TESS has contributed a multitude of new candidates to the sample of sub-Neptunes around bright stars, enabling mass and orbit measurements to further answer questions surrounding sub-Neptunes. With more data TESS is also finding longer period sub-Neptunes such as the TOI-4189 system, consisting of a bright (Vmag~9.36) sun-like star with an inner super-Earth (P ~ 9.9 days) and an outer transiting sub-Neptune (P ~ 46.9 days) on a slightly eccentric orbit (e ~ 0.15). Filling in the sub-Neptune parameter space with such systems will allow better understanding of the composition, formation, and evolution of these planets. We will discuss the new sub-Neptunes found by TESS, particularly the case of TOI-4189, and shared characteristics such as mass, density, and eccentricity of the existing TESS sample.
