Session O Abstracts

A close look at the dust clump in the Beta Pictoris debris disk
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Beta Pictoris is a main sequence star that has been the subject of extensive studies due to its unique clump of dust and CO gas within its debris disk. The nature of this feature, however, remains a longstanding question in the field of planetary dynamics, raising uncertainty regarding how such a feature could be linked to the system's evolutionary history. Existing studies disagree on the proper motion of the clump, split between whether it is moving as a part of the disk, or sitting stationary. As of 2024, a new set of mid-infrared images has been captured of the system using Very Large Telescope's (VLT) VISIR imager. In this project, we reduce the data using chop-nod subtraction and PSF matching, measure the clump's position through chi-squared profile shift fitting and Markov chain Monte Carlo (MCMC), ultimately constraining its proper motion. With these results, we can address one of the most well-studied—yet unresolved—debris disk asymmetries, shaping our understanding of how planetary systems may evolve over time.

The dynamical consequences of stellar spin–orbit misalignment in exoplanet systems
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The formation and migration histories of close-in planetary systems remain longstanding problems. The relative orientations of the angular momentum vectors associated with stellar rotation and planetary orbits have emerged as a key diagnostic in differentiating competing theories of their arrival. Among warm sub-Saturn systems, stars with several transiting planets tend to be aligned with their planets, while systems with only one known transiting planet more often show misalignment. This pattern is frequently interpreted as evidence that single-transiting systems underwent a dynamically violent formation or migration history. In this work, we investigate an alternative explanation: a primordial misalignment between the stellar spin axis and an initially flat planetary system may itself excite mutual inclinations and cause a multi-planet system to appear single-transiting. We simulate the primordial evolution of TOI-5398, a well-constrained representative system, and examine how the dispersal of its disk affects the surviving inclination. Preliminary results show that a tilted, rapidly rotating young star can excite enough mutual inclination to reduce the likelihood that both planets transit. If this mechanism operates broadly, the association between single-transiting systems and stellar misalignment is therefore an observational correlation arising from the misalignment itself, as opposed to a tracer of a distinct migration history.

Probing atmospheric mass loss from WASP-33 b with metastable helium
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Gas giant planets on close-in orbits experience intense irradiation that can strip away their atmospheres. This atmospheric mass loss appears to be fastest for hot Jupiters orbiting early-type stars, but to date there are only two published observations of atmospheric escape from planets orbiting A stars. Here, we use the metastable He I 10830 Å triplet to search for evidence of an atmospheric outflow from the ultra-hot Jupiter WASP-33 b. We observed a single transit of WASP-33 b with Palomar/WIRC using a narrowband filter centered on this feature, which we jointly fit while accounting for stellar δ Scuti pulsations and observational systematics. We measure a helium excess depth of 3300 ± 1300 ppm, corresponding to 2.5σ evidence, and infer an outflow temperature of $T_0 = 8500^{+1248}_{-1638}$ K and $\log_{10}(\dot{M}/[\mathrm{g\ s^{-1}}]) = 12.60^{+0.44}_{-0.94}$. This mass-loss rate is in good agreement with the published value for WASP-33 b inferred from excess absorption in the Hα, Hβ, and Hγ lines (Yan et al. 2021). We jointly model the hydrogen and helium absorption using self-consistent mass-loss models and find that they underpredict the strength of metastable helium absorption relative to hydrogen. We conclude that helium may be a more useful tracer than expected for measuring atmospheric mass loss from planets orbiting early-type stars and highlight the need for improved outflow models.

Flume experiments on riverbank erosion with smooth mud walls

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Bank erodibility sets river channel geometry and bank migration rates, directly shaping floodplains, human infrastructure, and local ecosystems. Natural rivers often exhibit boundary stresses far exceeding the entrainment thresholds of sand or gravel, supporting the hypothesis that cohesive mud supports bank structure. However, testing these mechanics in natural channels is challenging due to complexities and spatial variation, and controlled flume experiments directly evaluating bank erosion in cohesive mud are lacking. To address this gap, we performed open-channel flume experiments testing riverbank erosion theories on cohesive mud walls across varied boundary shear stresses.

In our experiments, bank retreat did not occur through individual grain entrainment, but rather through localized cracking, block detachment, and slumping. Additionally, observed erosion thresholds and rates conform to classic shear-stress theory only when applying an erosion threshold sufficiently high for cohesive mud and explicitly correcting boundary shear stresses for wall smoothness. Notably, this boundary stress partition reduces the wall shear stress relative to the channel bed by an order of magnitude. Our results indicate that applying threshold channel theory without accounting for hydraulic stress partitioning on smooth, cohesive banks may lead to substantial overestimates of bank shear stress and bank strength in natural rivers.