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Planetary System Architectures

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In the Solar System, planetary orbits are nearly circular, coplanar, and their planes are only tilted by 7° relative to the Sun's equator. It is neatly ordered with four rocky planets within 2~au, while four gas giants orbit at much larger separations. This regularity formed the blueprint of planetary formation, where planets form in the spinning protoplanetary disk resulting in configurations similar to the Solar System, or so we thought. Recent studies of extra solar planet systems has now led researchers to propose a more chaotic formation process. The diversity in these systems' architecture is huge: orbits with periods from less than a day to many years, perfectly circular and highly eccentric orbits, orbits that are prograde, polar, and even retrograde. Some systems are densely packed, others appear to harbor only a single planet.
Understanding this diversity necessitates knowledge of key orbital parameters. One particularly telling observable is the stellar obliquity–the angle between the stellar spin axis and the orbital axis of the planet. Measuring the obliquity allows us to make inferences about protoplanetary disk orientations, assess how planet-planet interactions have shaped the architecture of the system, and it provides us with insight into stellar physics through planet-star interactions. As more obliquity measurements are carried out, some interesting trends are starting to emerge, most recently a preponderance of perpendicular planets, and a possible connection between orbital eccentricity \& stellar obliquity. Through our program at the NOT we have used FIES to confirm and characterise TESS planet candidates (Knudstrup et al. submitted), as well as measure obliquities through time critical, transit observations (Knudstrup et al. in prep.). In this talk I will present how our results let us explore the eccentricity-obliquity relation, expand on the perplexing pile-up of polar orbiting planets, as well as probe protoplanetary disks. I will also explain how we intend to use FIES in the future to further evince planetary system architectures

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