Non-transiting exoplanets as a means to understand star-planet interactions in close-in systems

Since 1995, more than 6,000 exoplanets have been discovered, largely thanks to the transit detection method. However, this technique is inherently limited, as it requires a favorable geometric alignment. As a result, only about 10% of existing exoplanets are expected to exhibit transits (Deeg & Alonso, 2018). The radial velocity method has also proven effective, leading to the detection of over 1,100 exoplanets. Nevertheless, this method faces significant limitations when applied to hot and rapidly rotating stars, for which broad and blended spectral lines hinder precise velocity measurements (Shporer, 2017). To achieve a more complete understanding of the architecture and diversity of exoplanetary systems, alternative detection approaches are needed.

Close-in exoplanets are particularly valuable targets, as they experience a variety of intense physical processes, such as tidal heating (e.g. Lanza et al., 2021), atmospheric escape (e.g. Owen et al., 2019), rapid orbital decay (e.g. Collier Cameron & Jardine 2018), and magnetic interactions (Strugarek, 2024). Moreover, close-in exoplanets can have a direct impact on stellar activity and rotation of their host star (Lanza, 2022). Studying these systems can therefore offer key insights into star-planet interactions and the processes driving planetary evolution under extreme conditions. An intriguing pattern in this population was reported by McQuillan et al. (2013), who identified a dearth of close-in exoplanets around fast-rotating stars. More recently, García, Gourvès et al. (2023) proposed that this depletion zone results from the combined effects of intense tidal and magnetic interactions between the planet and its host star. Detecting additional close-in exoplanets undergoing such interactions is therefore essential for constraining the underlying physical mechanisms, and refining models of planetary formation and evolution. Fortunately, some non-transiting close-in exoplanets can be detected in photometry thanks to the signature of their phase curve (Lillo-Box et al., 2021).

In this talk, I will present a new search for non-transiting exoplanets in the *Kepler* data, focusing on very short-period candidates orbiting Solar-like stars. Through the analysis of photometric variations in 55,232 host star light curves, I identified 88 new close-in objects (with orbital periods ranging from 4 hours to 2.3 days) whose signatures are consistent with the presence of a non-transiting exoplanet. I will also show that this sample lies within the depleted region associated with short-timescale orbital evolution around fast rotators, as first identified by McQuillan et al. (2013). This new sample, if confirmed by subsequent spectroscopic ground-based follow-up, could provide valuable insights into star-planet interactions in close-in systems. These results not only deepen our understanding of exoplanetary dynamics but also highlight the potential of phase-curve-based detection methods for future surveys. As already demonstrated with other datasets like TESS (Cullen & Bayliss, 2024), this approach is directly applicable to PLATO, which will deliver high-precision, long-baseline photometry, ideally suited for identifying non-transiting close-in exoplanets and studying their interactions with their host star (Rauer et al., 2024).