A brown dwarf responsible for the late inwards migration of GJ 436 b? Insight from new observations using VLT/SPHERE

In the context of the study of the formation and evolution of planetary systems, the question of exoplanet migration mechanisms is crucial. On the one hand, theoretical models show that exoplanets can migrate inwards through interactions with the disk during the first million years of the system. On the other hand, there are systems in which we know that the migration has to happen gigayears later.

The planetary system GJ436 is an archetypal example: it hosts a Neptune-mass planet named GJ436b. This exoplanet orbits its host star in 2.6 days with a misaligned, eccentric orbit. Due to its proximity to its host star, its atmosphere is strongly escaping. However, the system is old, between 4 and 8 Gyr. As a result, the atmosphere of GJ436b should have migrated recently, via the mechanism of high-eccentric migration (HEM). This mechanism implies the presence of an additional companion, GJ436c. We obtained VLT/SPHERE data revealing a promising brown dwarf candidate for GJ436c. Our GJ436c candidate should be confirmed in the coming year thanks to our new accepted SPHERE observations. In my talk, I will present our brown dwarf candidate GJ436c, which is about 25MJup, its orbital and atmospheric properties, and also its consistency with Gaia complementary information.

All in all, the system GJ436 is currently the most ideal system to constrain the HEM scenario observationally. It will enable a better understanding of the dynamical evolution of exoplanets orbiting close to the stars, including those located in the so-called “hot Neptune desert” (see Figure). Our pilot study paves the way for a larger high-contrast imaging program in the future, to trace back the dynamical evolution of other exoplanets located in the “hot Neptune desert”. In practice, we would search for outer companions in those systems and assess whether late-migration could also have happened, based on deep observational constraints (and new companion detections) using VLT/ERIS or ELT/METIS, coupled to HEM simulations.

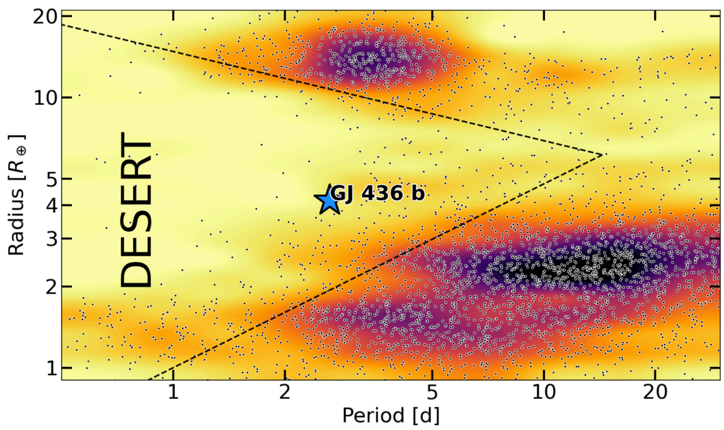

Figure: Dots represent the radius of exoplanets as a function of their orbital period. The triangle emphasizes a region often called the “hot Neptune desert”, where exoplanets should not be, because they should have lost their atmosphere.