# Abstract

Since the discovery of first exoplanet by the end of the twentieth century, technological advancements have hugely extended our understanding of planetary systems. The large number of discovered exoplanets has unveiled a staggering diversity in their nature, leading to the surprising conclusion that our Solar System may not be a typical system. One of the key objective of planetary science is to understand the composition and internal structure of planets, which can then be linked to their formation and evolution path. The characterization of exoplanet interior results challenging, and requires a strong interaction between theory and observations. A combination of several detection techniques is needed to infer planet fundamental parameters as the mass, radius, or equlibrium temperature, and these observables allow to put constraints on theoretical models. On the other hand, theoretical models are crucial to guide observational campaigns. This thesis represents an effort to advance in the interplay between observations and theory to understand the underlying nature of planets.

A substantial part of this work is dedicated to the investigation of the exoplanet demography. We are entering an era in which we can compare and classify exoplanet in distinct populations based on many parameters as mass, radius, incoming radiation, stellar type, etc. We present a new as reliable as possible exoplanet catalog based on robust mass and radius measurements. This revisited catalog allows to identify trends and exoplanet subpopulations that were not seen before. The large exoplanet diversity also extend to the architecture of multi-planetary systems. We also use the revisited exoplanet catalog to perform an in-depth analysis of the similarity in mass, radius, and density of multi-planetary systems.

Besides the demographic studies, we have also focused on the characterization of the internal structure of individual planets. Building on a previous structure model, we updated several parts of the core, water and volatile envelope models, and use it to characterize various discovered exoplanets. We also use these internal models to study several aspects that affect the characterization of super-Earths and sub-Neptunes, such as observational uncertainties, location in the mass-radius diagram, or model assumptions.

This thesis aims to be an additional step towards a deeper understanding of the exoplanetary nature.