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Composition of low-mass exoplanets

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The research field of exoplanets is rapidly advancing with more than 450 objects detected. Furthermore, last year there were two milestone discoveries: CoRoT-7b and GJ 1214b. These are the first two low-mass exoplanets with measured masses and radii. They both have fairly similar masses but very different radii. The first step for characterizing these objects is to infer their composition. Through internal structure and evolution models, atmospheric escape and knowledge of hot-Jupiters I will present the restuls on their composition and origin.

While CoRoT-7b's density is similar to Earth's and thus can be inferred to be rocky, we show that an equally good fit to the data is achieved with some amount of H2O vapor. If CoRoT-7b is terrestrial, it is depleted in iron relative to Earth. On the other hand, GJ 1214b has a substantial amount of volatiles given its relatively large size. However, owing to the intrinsic compositional degeneracy we can only place upper limits to the different compositional end-members (i.e. amount of H2O, silicate mantles, iron cores).

A basic question concerning the composition of low-mass planets is unresolved: in which cases is the ratio of refractory elements similar to that of the star (i.e. Fe/Si ratio)? While this is a reasonable assumption for Earth, it is debated for Mars and not the case for Mercury. It is understood that during the last stages of formation, giant impacts and atmospheric erosion can have a large impact on the final composition of a forming planet. With more super-Earth data and structure models, we will begin to answer this question and in this way learn more about the formation of the solar system planets. However, for this we need to better understand giant impacts and atmospheric erosion on super-Earths. As a first step in this direction, I will present results on atmospheric erosion of highly-irradiated planets (like CoRoT-7b) by considering a hydrodynamically escaping atmosphere to place upper limits to the density of terrestrial exoplanets).