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Investigating the link between composition and evolution of giant planets

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In the recent years, thanks to ground-based and space-based observations, the number of discovered exoplanets orbiting other stars has greatly increased. As a consequence, the focus in the exoplanetary quest for knowledge is starting to shift from their discovery to their characterization. The composition of exoplanets, in fact, is linked to the formation and evolution of the systems that host them. As in all inverse problems, however, such a link is not easy to unfold. As is shown by the case of our solar system, giant planets offer a unique opportunity to investigate the relationship between formation, evolution and atmospheric composition. The Galileo and Cassini missions, in fact, have revealed that the atmospheric and bulk composition of Jupiter and Saturn significantly deviate from the originally expected ones, each planet being characterized by different enrichment factors in high-Z elements. Different mechanisms have been proposed to explain these deviations, but the Solar System alone does not supply enough constraints to solve this problem. The aim of this work is to investigate how the tools and models developed for the case of the Solar System can be applied to the study of extrasolar planets and shed new light on the early evolution of forming planetary systems. Using N-body simulations that account for the growth and the migration of giant planets and considering a selected sample of observed single-planet extrasolar systems as test cases, we will assess what are the sources and the composition of the material accreted by the forming giant planets and its effects on their atmospheric composition.