MAP-fis Essay Proposal, 2013-2014

Supervisor

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Title

Spin and orbital evolution of “Hot-Jupiters”.

Area

Theoretical Astrophysics

Summary of Proposal

During the last decade, one of the most surprising findings was the discovery of several extrasolar planets with periods down to 3 days and orbiting their parent stars at a distance lower than 0.1 AU. Many of these planets have been detected using the transiting method. The coupling between radial velocity and photometric measurements allows the direct and accurate determination of both their masses and radii. However, the comparison with theoretical evolutionary models of Jovian-mass planets revealed unexpected conflicts between measured and predicted radii. The first to be discovered, HD 209458b, was found 20% larger than expected. Since, new comparisons with models including the effect of strong irradiation from the parent star indicate that three other transiting "hot Jupiters" may still display an anomalously inflated size and low density compared to Jupiter. Many scenarios proposed to explain this discrepancy invoke a missing energy source that would slow down the gravitational contraction and cooling of the planet. The contribution of tidal heating due to an eccentric planet's orbit or a non-zero planet's obliquity was also investigated. Since tides circularize the orbit and affect the obliquity on timescales that are shorter than the typical age of the systems, a continuous tidal dissipation requires a mechanism to maintain the eccentricity and/or the obliquity in a nonzero value. In order to evaluate the role of tidal dissipation inside "Hot-Jupiters", an accurate estimate of tidal heating is required. Moreover, it is important to test whether these scenarios are realistic or not. However, all previous estimates of tidal heating have considered that the rotation period of "Hot-Jupiters" is synchronous with their orbital period. This hypothesis is justified for most of tidally-evolved solid satellites, but could not be valid for fluid planets. In this thesis we want to study the orbital and spin evolution of "Hot-Jupiters" into their present configurations. This will help to determine their climates.

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