Unveiling the effects of star-planet tidal interactions in the dynamical evolution of one-planet systems

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Resumen

In this talk, we present the dynamical evolution of one-planet systems orbiting a 1 and a 3 Msun stars under the influence of tidal forces with the objective to understand the role of the stellar tidal Love number k2 in the system dynamics. We perform several numerical simulations using the publicly available N-body packages REBOUND and REBOUNDx to compute the star-planet tidal-interaction testing Earth- and Jupiter-like planets at different initial separations. Following the detail evolution of the star from the main sequence to the white dwarf phase computed with the stellar evolution code MESA, we are able to calculate the evolution of the Love number which is simultaneously evolved with the stellar radius and mass. By comparing with simulations where constant values of k2 are used through the whole stellar evolution, we find that the larger the Love number is, the sooner the planet is pulled toward the star, regardless the star and planet mass. Additional simulations show the strong dependence of the star-planet tidal interaction with the planet mass by finding that the distance to avoid tidal engulfment is larger for massive planets in contrast to their lower mass counterparts and the planet's fate is mainly determined in the red giant phase for a 1 Msun star while the planet survival in a 3 Msun star is primarily decided during the thermally pulsating asymptotic giant phase.