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# Strong tidal interactions in close planetary systems

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## Résumé

Tidal interactions play a crucial role in shaping the orbital architecture and rotational evolution of close stellar and planetary systems. The dissipation of the tidal flow energy inside the fluid convective envelopes of stars and planets is an efficient way of exchanging angular momentum, especially in the infancy of star-planet systems. Furthermore, when the tidal forcing is strong, namely in compact systems such as hot Jupiter systems, tidal flows are sensitive to non-linear effects, in addition to magnetism and differential rotation. Although these physical processes are likely to be ubiquitous in the convective region(s) of host solar-like stars and giant gaseous planets, most studies give tidal interaction predictions based on linear two-dimensional hydrodynamic models using uniform rotation.

Recently, we have developed a numerical model to study stellar and planetary tidal flows in a 3D spherical convective shell that is magnetised and subject to sheared zonal flows. More specifically, we make use of the nonlinear MHD code MagIC which we have modified to include and study tidal interactions. In our simulations, we find a strong interplay between tidal flows and differential rotation or magnetism, which ultimately significantly alters the tidal dissipation estimates from prior linear hydrodynamical predictions with uniform rotation. Thus, we aim to provide a comprehensive model of tidal flows and their dissipation in stellar and planetary convective envelopes, adapted to the complexity and specificity of host stars and their planets. In particular, these tailored tidal dissipation prescriptions could be used in n-body numerical models to study the orbital and rotation evolution of planets subject to tides.

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