3D nonlinear modelling of tides in the envelopes of stars and planets.

Tidal interactions are a key driver of orbital and rotational evolution in close exoplanetary systems. The dissipation of the energy carried by tides within the fluid convective envelopes of stars and planets is an efficient way of exchanging angular momentum in these compact systems. Furthermore, when the tidal forcing is strong, as in hot Jupiter systems, tidal flows are sensitive to nonlinear effects that are usually neglected when giving predictions on the impact of tidal interactions. The same is true for other ubiquitous ingredients in the convective region(s) of low-mass host stars and giant gaseous planets, such as magnetism, differential rotation, or stratification. I will present the recent progress we have made in studying tidal flows in the convective envelopes of stars and planets, towards self-consistent 3D nonlinear simulations with magnetic fields, rotation and/or solar-like density profiles. In particular, I will explain how this modifies the predictions we have on the role of tides diagnosed by the tidal dissipation quantity. Furthermore, when nonlinear effects are taken into account, the internal processes and structure not only modify the transport and dissipation of the tidal flow energy, but are also affected by these flows, especially through the generation of tidally driven zonal flows or new magnetic field components.