Differential rotation in Uranus-like and Neptune-like planets

Abstract

We present the effect of differential rotation on the internal structure of Uranus-like and Neptune-like planets. We use the numerical code `DROP` (Basillais and Huré, 2021) that solves the Bernoulli equation together with the Poisson equation. It generates layered planets in equilibrium under the effect of three forces : gravitational force, pressure forces and centrifugal force. The matter is assumed to obey a polytropic equation-of-state (EOS). Each layer possesses its own EOS, rotation law and size. At the interface between two layers, a density discontinuity and rotational discontinuity can take place.

We investigate the effect of rotation profiles on the internal structure and shape of planets. We also report the impact of layers in differential rotation on top of a core in uniform rotation. These results are obtained for planets made of 2 layers and more. We also report numerous degeneracies found as well as the link between properties - mass, size, rotation rate, eccentricity, gravitational moments and moment of inertia - of a planet and its internal structure.

References

Basillais, B. and Huré, J. (2021). A computational method for rotating, multi-layer spheroids with internal jumps. *Monthly Notices of the Royal Astronomical Society*, 506(3):3773–3790.