Modal stability analysis of mechanically-driven flows in rigid rotating ellipsoids

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Abstract

Because of gravitational torques generated by their orbital partners, most of planets, moons and stars have ellipsoidal shapes and undergo mechanical forcings. It has been proposed that mechanical forcings may be viable alternatives to thermo-chemical convectionas driving mechanisms for planetary dynamos. We investigate the hydrodynamic global stability of incompressible and inviscid fluids enclosed in mechanically forced rigid ellipsoids. We are able to get the growth rate and the velocity structure of any mechanically-driven instability in the linear growth. The method is valid for ellipsoids of arbitrary shape. As examples, stability analysis of libration-driven and precession-driven flows are shown. We predict new domains of instabilities, some of them being valid for laboratory experiments, numerical simulations or planets. Finally, we outline how to use free inertial modes to build weakly non-linear models of any mechanically-driven instability.

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