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## THERMAL CONVECTION IN ROTATING FLUID SPHERES

Marta Net<sup>1</sup>, Ferran Garcia<sup>1</sup> & Juan Sánchez<sup>1</sup>

<sup>1</sup>*Department of Applied Physics, Universitat Politècnica de Catalunya, Barcelona, Spain*

*Abstract* Thermal convection, spherical geometry, rotation, auto-gravitating fluids, linear stability analysis.

The knowledge of thermal convection in rotating, auto-gravitating fluid spheres is fundamental in astrophysical fluid dynamics. Its study allows estimating the transport of energy in the interior of planets and stars, determining their internal structure and its influence on the patterns observed in the upper atmospheres of the giant planets, etc.

A numerical linear stability analysis of the onset of thermal convection in rotating, auto-gravitating fluid spheres at low Ekman numbers is presented.

The equations are solved by expanding each eigenfunction of azimuthal wavenumber  $m$ ,  $X_m(r, \theta, \varphi)$ , in spherical harmonic series up to degree  $L$ , namely

$$X_m(r, \theta, \varphi) = \sum_{l=m}^L X_l^m(r) Y_l^m(\theta, \varphi), \quad (1)$$

with  $Y_l^m(\theta, \varphi) = P_l^m(\cos \theta) e^{im\varphi}$ , and  $P_l^m$  being the normalized associated Legendre functions of degree  $l$  and order  $m$ . In the radial direction, a collocation method on a Gauss-Lobatto mesh is employed to avoid the singularity along the axis of rotation and to get a good accuracy.

The neutral stability curves and preferred eigenfunctions at the onset of convection are computed by applying an Arnoldi method and using a complex shift selected adaptively along the curve. The critical parameters are compared with the values given by the asymptotic theories reported in [1, 3, 4], and those previously obtained in fluid spherical shells [2].

### References

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