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Wave ray dynamics of rotating spherical fluid domains

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Understanding wave dynamics in a rotating spherical fluid domain has clearly broad implications in both geophysical and astrophysical contexts. In this work, by means of three dimensional ray tracing, we investigate the nature of purely inertial internal waves in a sphere, filled with homogeneous fluid, in a linear, inviscid framework.
In order to identify the modes of the system, we look for closed trajectories of the characteristics.
Differently from literature, where an axisymmetrical forcing is always assumed, equivalent to rays restricted to meridional planes, rays are here initiated outside a meridional plane, allowing us to observe the existence of fully three dimensional closed orbits.
These periodic patterns correspond to a new class of solutions (complementary to the purely meridional ones), presented here for the first time.
Remarkably, some of the observed closed trajectories have a winding number larger than one (multiple revolutions are needed before the orbit is closed). This striking behaviour suggests a preliminary analytical interpretation in terms of Legendre polynomials with *rational* degree and order.
The three dimensional wave field is still far from being completely understood, nevertheless three dimensional ray tracing has revealed to be a robust tool of investigation, bringing new insight in this intriguing and fundamental problem.