Anelastic torsional oscillations in Jupiter's metallic hydrogen region

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We consider torsional Alfvén waves which may be excited in Jupiter's metallic hydrogen region. These axisymmetric zonal flow fluctuations have previously been examined for incompressible fluids in the context of Earth's liquid iron core. Theoretical models of the deep-seated Jovian dynamo, implementing radial changes of density and electrical conductivity in the equilibrium model, have reproduced its strong, dipolar magnetic field. Analysing such models, we find anelastic torsional waves travelling perpendicular to the rotation axis in the metallic region on timescales of at least several years. Being excited by the more vigorous convection in the outer part of the dynamo region, they can propagate both inwards and outwards. When being reflected at a magnetic tangent cylinder at the transition to the molecular region, they can form standing waves. Identifying such reflections in observational data could determine the depth at which the metallic region effectively begins. Also, this may distinguish Jovian torsional waves from those in Earth's core, where observational evidence has suggested waves mainly travelling outwards from the rotation axis. These waves can transport angular momentum and possibly give rise to variations in Jupiter's rotation period of magnitude no greater than tens of milliseconds. In addition these internal disturbances could give rise to a 10% change over time in the zonal flows at a depth of 3000 km below the surface.

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