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JUPITER: MOMENT OF INERTIA, THE SHAPE-ROTATION RELATION, AND THE CONNECTION TO THE JUNO AND JUICE MISSIONS

Abstract

The NASA Juno mission to Jupiter will provide accurate measurements of Jupiter's gravitational and magnetic fields,providing tighter constraints on Jupiter's internal structure, dynamics, and origin. Juno can also determine Jupiter's moment of inertia (MoI) by measuring Jupiter's pole precession and the Lense-Thirring acceleration of the spacecraft. The moment of inertia of a giant planet reveals important information on the planet's internal density structure. We will present an investigation of the possible range of MoI values for Jupiter. We find that Jupiter's MoI lies in the range 0.2629-0.2645. Implications to Jupiter's core properties (e.g., mass, density) will be presented. We will also address the topic of Jupiter's atmospheric dynamics, which is still not well understood. The physical shape of a giant planet is linked to its centrifugal potential, and therefore, its rotation. We will show that occultation measurements of Jupiter's shape can be used to constrain the depth of its zonal winds. An investigation of the response of Jupiter's shape to differential rotation on cylinders of various cylindrical radii using an equipotential theory suggests that both solid-body rotation and differential rotation on cylinders up to a latitude of 20 degrees are consistent with Jupiter's measured shape. This result can be confirmed by measurements of the upcoming Juno and JUICE missions to Jupiter.