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Constraints on the interior structure of Mars from nutation

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Knowledge about the rotation of Mars provides insight about its global scale atmosphere dynamics and interior structure. In particular, inferences about the core of Mars can be made by observing its nutation as foreseen by the forthcoming RISE and LaRa experiments on InSight and ExoMars. Nutation can be resonantly amplified if the planet's core is liquid and the amplification depends on the core's polar moment of inertia, figure, and capacity to deform. By combining measured nutation amplitudes with the already well known polar moment of inertia and tidal Love number the size of the core and its material properties can be determined more precisely than from the latter quantities alone.

Here, we first reconsider the study of the nutations of a rigidly rotating Mars. Then, we use models of Mars' interior structure that agree with its moments of inertia, tidal Love number, and global dissipation to predict the nutations of the real Mars. Our models have been constructed from depth-dependent material properties and use recent thermoelastic and melting properties of plausible core constituents. For each model we assess what constraints on the interior structure of the core can be expected from RISE and LaRa.