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Toward constraining Saturn's rotation rate by interior modeling

Nadine Nettelmann¹ and Jonathan J. Fortney²

¹Institute of Planetary Research, German Aerospace Center, Berlin, Germany (nadine.nettelmann@dlr.de)

²Dept. of Astronomy and Astrophysics, University of California, Santa Cruz, USA

The rotation rate of the outer planet Saturn is not well constrained by classical measurements of periodic signals [1]. Recent and diverse approaches using a broad spectrum of Cassini and other observational data related to shape, winds, and oscillations are converging toward a value about 6 to 7 minutes faster than the Voyager rotation period.

Here we present our method of using zonal wind data and the even harmonics J_2 to J_{10} measured during the Cassini Grand Finale tour [2] to infer the deep rotation rate of Saturn. We assume differential rotation on cylinders and generate adiabatic density profiles that match the low-order J_2 and J_4

values. Theory of Figures to 7th order is applied to estimate the differences in the high-order moments J_6 to J_{10} that may result from the winds and the assumed reference rotation rate. Presented results are preliminary as the method is under construction [3].

[1] Fortney, Helled, Nettelmann et al, in: 'Saturn in the 21st century', Cambridge U Press (2018)

[2] Iess, Militzer, Kaspi, Science 364:2965 (2019)

[3] Nettelmann, AGU Fall Meeting, P066-0007 (2020)