Toward constraining Saturn's rotation rate by interior modeling

Nadine Nettelmann\textsuperscript{1} and Jonathan J. Fortney\textsuperscript{2}
\textsuperscript{1}Institute of Planetary Research, German Aerospace Center, Berlin, Germany (nadine.nettelmann@dlr.de)
\textsuperscript{2}Dept. 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 \cite{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 \cite{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 \cite{3}.

\cite{2} Iess, Militzer, Kaspi, Science 364:2965 (2019)
\cite{3} Nettelmann, AGU Fall Meeting, P066-0007 (2020)