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Polhode Motion of the Gravity Probe-B Gyroscopes[1] MICHAEL DOLPHIN, ALEX SILBERGLEIT, MICHAEL SALOMON, PAUL WORDEN, DANIEL DEBRA, Stanford University — The Gravity Probe B gyroscopes exhibit a torque-free, periodic motion of the spin axis in the rotor body frame as governed by Euler's equations of motion; this effect is known as polhode motion. Polhode motion is characterized by inertial asymmetry of the rotor, the ratio of the differences of the moments of inertia about the principal axes. The period was found to be slowly changing on-orbit, due to extremely small kinetic energy dissipation in the rotor body. This slowly varying effect must be accounted for in the science data analysis. Two novel methods were employed to model the polhode behavior. One method establishes a model of adiabatic energy dissipation in rotor that is used together with the measured polhode period to estimate the rotor inertial asymmetry. Another method uses the polhode modulated spin frequency component of rotor position measurements in the housing arising from gyro mass unbalance. By fitting the theoretical Euler solution to the measured data, the asymmetry parameter is found. The consistent results of both approaches are presented. Other significant parameters, such as the characteristic time of dissipation, and mass unbalance measured to sub-nanometer level, are also given.

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