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The determination of the gravity field and eccentricity tides of Callisto

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Abstract

We investigate the prospects of detecting the presence of a subsurface ocean on the Jovian moon Callisto by Doppler tracking the two spacecraft of the EJSM mission. The method is based upon the determination of the temporal variations of the quadrupole coefficients due to eccentricity tides. The EJSM mission is jointly undertaken by ESA and NASA. The low degree, static gravity field will also be determined together with the variable part.

The gravity field and tidal deformations will be estimated by means of precise Doppler tracking of the two spacecraft in X- and Ka-band (32.5-34 GHz). We report on numerical simulations of the nominal mission scenario, which entails 15 fly-bys of Callisto by the JGO spacecraft. In addition, we exploit the synergies with JEO and consider also data from 9 additional JEO flybys. The information matrices from all fly-bys are combined to generate a single multiarc solution providing the harmonic coefficients to degree and order 5 and the dynamic Love number k2. We find that k2 can be estimated to accuracies ranging from 0.04 to 0.2 depending on the number of fly-bys devoted to gravity science.