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A peek into Jupiter's normal modes from Juno gravity data

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As of April 2021, Juno is close to complete its nominal mission, awaiting to enter its extended mission. Thanks to the extremely accurate Doppler data (having an accuracy as low as 10 micron/s at an integration time of 60 s) acquired during close perijove passes in the last 4 years, Juno provided an unprecedented view of Jupiter's gravity field, which is crucial to determine its interior structure. In order to recover the gravity field of the planet, the orbits of Juno have to be reconstructed to a very high accuracy. The latest gravity field reconstruction showed hints to a non-static and/or non-axially symmetric field, possibly related to several different phenomena, such as normal modes, localized atmospheric or deeply-rooted dynamics. These tiny phenomena produces a residual signal at a level of few tens of micron/s in Juno Doppler data. To confidently study these tiny unconventional phenomena, the dynamical model of Juno's spacecraft have been accurately characterized and possible error sources investigated and ruled out.

The focus of this study is Jupiter's normal modes. Our main goal is to assess whether the residuals signatures can be explained by the gravitational disturbances induced by normal modes inside the planet, assuming reasonable physical constraints. Ground-based observations of Jupiter' normal modes can be used as a guide.