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The interior of gas giants as inferred from gravity measurements

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Recently, the interior of Jupiter and Saturn have been investigated thanks to the NASA's Juno and Cassini missions. The two spacecraft revealed almost simultaneously the gravity field of the two gas giants of the Solar System.
The Juno spacecraft arrived in Jupiter's system on July 4th, 2016 and is currently orbiting Jupiter in a highly eccentric orbit, having a perijove altitude of about 4000 km. Up until now, Juno has completed several orbits about Jupiter, revealing fundamental details of Jupiter's interior structure and atmospheric dynamics by discriminating the axially symmetric and asymmetric gravity field of the planet. The radioscience instrumentation on board Juno is capable of providing very accurate Doppler measurements, with an accuracy as low as 10 micron/s at 60 s in the radial velocity of the spacecraft. The extremely accurate gravity measurements are carried out by measuring the Doppler shift of two-way radio links established simultaneously at X-band (7.2-8.4 GHz) and at Ka-band (32.5-34 GHz). The analysis of the first two passes suggested the presence of a diluted core. Then, the Doppler data acquired during the first two gravity-dedicated perijove passes, PJ03 and PJ06, related the North-South asymmetry of Jupiter's gravity field to the surface wind dynamics. In addition, the even gravity harmonics unveil Jupiter's deep interior, suggesting that it is rotating as a rigid body.
The Cassini spacecraft ended its mission on September 15th, 2017 with a deliberate plunge into Saturn's atmosphere, after about 20 years spent in deep space. In the final phase of the mission, the Grand Finale, Cassini provided insights on the interior of Saturn, as well as on Saturn's rings and atmosphere. Out of the 22 Grand Finale orbits, six passes have been devoted to the determination of the gravity field of the planet. The gravity dedicated passes provided the most accurate determination of Saturn's gravity field to date since the spacecraft passed very close to the planet, between the inner edge of the rings and Saturn's cloud tops. The analysis of the Doppler data is complicated by an unexpected non-zonal and/or non-static component of the gravity field. This component of the field may arise from different effects, such as localized surface wind features, Saturn's normal modes, or internal phenomena deep in the interior. Nonetheless, the Cassini's gravity data showed that Saturn's gravity deviates significantly from theoretical expectations of a uniformly rotating Saturn, requiring a strong differential rotation, with the equatorial region moving about 4% faster than the innermost region (closer to the rotation axis). Saturn's surface winds must extend very deep into the planet, to several thousands of kilometers.
The Juno and Cassini missions determined Jupiter's and Saturn's gravity fields with an unprecedented level of accuracy, enabling an accurate comparison between the two gas giants. We will report the resulting measurements and explore the implications of the gravity measurements performed by Juno and Cassini on the interior of their hosting planets.