



The gravity field of Saturn and the mass of its rings

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The gravity measurements carried out by Cassini in the Grand Finale orbits reveal a planet with many surprising features. The observations involved an unprecedented effort from NASA's Deep Space Network and ESA's ESTRACK antennas during six carefully selected orbits, when the spacecraft was continuously tracked for 24 hours around its transit at pericenter. Range rate measurements accurate to 0.02-0.08 mm/s (60 s integration time), in line with the noise model of the Cassini radio link, were used to estimate the zonal field of the planet till degree 10 and the mass of the B-ring.

Surprisingly, and differently from what was found on Jupiter by Juno, Saturn's gravity shows residual, unexplained, accelerations that affected the motion of Cassini and were detected by the Doppler tracking system. Nonetheless the solution for the zonal field and the ring mass is stable and well determined. We find that the even zonal harmonic coefficients J₆, J₈, J₁₀ are so large that only a deep and intense differential rotation can explain their value. The mass of the B-ring is determined to a level that can be used for infer the age of the ring system.