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Particle pressure, inertial force and ring current density in the magnetosphere of Saturn

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We present the most recent radial profiles for the thermal plasma, energetic particle and magnetic field pressures in the equatorial magnetosphere of Saturn, as measured by the MIMI, CAPS and MAG instruments of Cassini, currently orbiting Saturn. Data were obtained between September 2005 and May 2006, when the spacecraft was particularly close ($\pm$0.5 R_S) to the nominal magnetic equator in the range 6 to 15 R_S. The radial gradient of the total pressure is compared to the inertial body force and an average radial profile of the azimuthal current intensity is presented. The results show that: (1) The suprathermal (keV) pressure contribution to the total particle pressure becomes significant outside 8-9 R_S, exceeding 50% for r$>$12 R_S. (2) The plasma beta remains above 1 outside 8 R_S, reaching $\sim$3 to $\sim$10 between 11 and 14 R_S. (3) The inertial body force and the radial pressure gradient are similar at 9-10 R_S, with the pressure gradient prevailing beyond 11 R_S. (4) The ring current develops a maximum between $\sim$8 and 12 R_S, reaching values of 100-150 pA/m^2, and is primarily inertial inside of 8.5 R_S but increasingly pressure gradient-driven in its maximum region and beyond. Farther away, it drops with radial distance much faster than the 1/r rate that several disk current models assume. The distribution of various plasma and energetic particle parameters in SLS phase is also examined in connection with the observed periodicity in the radial and azimuthal components of the magnetic field.