Mini-groupwork 4, 2016

Space Physics, EF2240

Jupiter's magnetic dipole moment is $a = 1.6 \cdot 10^{27}$ Am^2, and its radius is $R_J = 7.1 \cdot 10^7$ m. Assume that at Jupiter's orbit the solar wind has a velocity of 400 km/s and a particle density of 0.1 cm^{-3}.

a) Estimate the stand-off distance of Jupiter's magnetosphere by assuming pressure balance between the solar wind and the dipole magnetic field. Give the answer in Jupiter radii.

b) The plasma density in the equatorial plane of the Jupiter magnetosphere can be modelled by the expression

$$n_e = n_{e0} \left(\frac{R_J}{r} \right)^3$$

where $n_{e0} = 3.6 \cdot 10^9$ m^{-3}, and r is the distance from the centre of Jupiter. From this, estimate the standoff distance, but now include the thermal pressure of the magneto-spheric plasma in the pressure balance. Assume that the temperature T of the Jupiter magnetospheric plasma is constant with $T = 10^8$ K. Which of the two estimates is closest to the observed stand-off distance, which typically is 60-80 R_J?