

Comparison of electron density obtained by measurements of Geotail spacecraft

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An electron density in the magnetosphere and solar wind has been obtained from the spacecraft potential, the plasma waves and plasma particle measurements. The spacecraft potential measured by single probe system correlates closely with the electron density surrounding the spacecraft. We have obtained an empirical formula to show their relation in the solar wind and almost all the regions of the magnetosphere, except for the high-density plasmasphere [Ishisaka et al., 2001]. The empirical formula is effective in the range of spacecraft potential from few volts up to 90 V, corresponding to the electron density from 0.001 to 50 /cc. The electron density is also estimated by the lower cutoff frequency of continuum radiation and the center frequency of Langmuir waves. We compare the electron density obtained by the empirical formula ($N_{s/c}$) with that given by the characteristic frequency of the plasma waves (N_{pwi}) and the plasma particle measurements (N_{LEP}). In the distant tail region the densities obtained by three methods are about the same value. On the other hand, N_{pwi} and N_{LEP} are nearly equal, and $N_{s/c}$ is larger than N_{pwi} and N_{LEP} in the near tail region and the dayside magnetosphere. In the dayside magnetosphere, we do not always see the characteristic frequency of the plasma waves. In this region, $N_{s/c}$ is larger than N_{LEP} at the dawn side region, when the intense plasma waves, such as chorus, are seen. Therefore we not only examine the correlation between the plasma waves and spacecraft potential but also investigate the characteristic (plasma density, temperature and so on) of plasma surrounding the spacecraft. The spacecraft potential actually depends on the electron temperature. When the electron temperature is high, the spacecraft potential become low. We overestimate the electron density by using our empirical formula and the measured spacecraft potential. In this study we examine why $N_{s/c}$ is overestimated as compared with the density given by two other methods. In particular we also discuss about the relationship between the differences in the electron density and the plasma waves surrounding the spacecraft. And we modify our empirical formula that estimates the electron density form the spacecraft potential adding the characteristic of ambient plasma effect. We obtain the electron density by using the spacecraft potential and a modified empirical formula, when we cannot see the characteristic frequency of plasma waves.

Reference

Ishisaka et al., JGR, Vol.106, No.A4, pp.6309-6319, 2001