Poster

ESTIMATION OF THE QUASI THERMAL NOISE SPECTRUM AROUND THE PLASMA FREQUENCY

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Quasi-thermal noise (QTN) spectroscopy enables precise determination of plasma density and temperature by analysing the voltage fluctuations spectrum measured at the terminals of an antenna embedded in the plasma. The main characteristic of the QTN spectrum is a noise peak just above the plasma frequency, which allows a very accurate measurement of the electron density. Properties of the peak and, consequently, the quality of measurements, are dependent of both antenna geometry and plasma parameters. In this work, we review both the antenna and the plasma contributions and also give some general remarks on the instrument design requirements. Condition for the peak to be detectable, it is necessary for the dipole antenna arm length to be at least 10^4 times larger than its radius, and at least 2 times larger then the plasma Debye length. For the plasma contribution it turns out that size and shape of the peak are determined by supra-thermal (non-Maxwellian) electrons, where density of the non-thermal particles determines the width, while the peak intensity dominantly depends on their temperature. On the other hand, in the ionosphere and magnetosphere of Earth, where the velocity distribution is Maxwellian, the plasma peak shape is determined by either electrons-to-neutrals collision rate (lower ionosphere) or local magnetic field strength (magnetosphere and higher ionosphere). While collisions damp the plasma oscillations and therefore broaden and reduce the amplitude of the peak, magnetic field affection changes the peak location in the spectrum from the plasma frequency to upper hybrid electron frequency, making density measurements significantly more complicated.