

QUASI-THERMAL NOISE SPECTROSCOPY: DIAGNOSTICS IN SPACE MEDIA

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ABSTRACT

Quasi-thermal noise spectroscopy used for in situ diagnostics in space plasmas is presented.

In a stable plasma, the thermal motion of the ambient particles produces electrostatic fluctuations. The concept can be easily generalized to the quasi-thermal conditions arising in space. This "quasi-thermal noise" is detected by any sensitive receiver at the ports of an electric antenna immersed in a plasma. It can be formally calculated as a function of both the particles velocity distributions and the antenna geometry, and so, conversely, the "spectroscopy" of this noise reveals the local plasma properties. The technique provides mainly an accurate measurement of the electron density (a few %) because it is based on the detection of a strong signal peak near the local plasma frequency (which is close to a resonance for electrostatic waves). As explained in [1], the overall shape and level reveals the thermal temperature whereas the very fine structure of the peak yields the suprathermal electrons. For magnetized plasmas, the wave spectrum is modified since the electron thermal motion excites Bernstein waves. The modulus of the magnetic field is thus simply determined. The method has the advantage of being relatively immune to spacecraft potential and photoelectrons perturbations, since it senses a large plasma volume, and can be used to cross-check other plasma sensors. The method was successfully applied in cometary plasma tail with ICE spacecraft, and routinely used in magnetized or not planetary environments as well as in the solar wind, in particular on board Ulysses and Wind spacecraft. Finally, the technique will be implemented on BepiColombo/MMO probe to measure the plasma parameters in Mercury environment.

REFERENCES

[1] K. Issautier, M. Moncuquet, N. Meyer-Vernet, S. Hoang, R. Manning, Quasi-thermal noise diagnostics in space plasmas, *Astrophys. Space Sci*, 277, pp. 309-311, 2001.