Geophysical Research Abstracts, Vol. 8, 03559, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03559

A problem of effective length of a receiving antenna in space plasmas

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The performance of a receiving antenna in plasmas is important for wave measurements in space experiments, particularly devoted to noise and regular electromagnetic emissions in inter-planetary environment. We consider the root-mean-square (r.m.s.) voltage induced on the receiving dipole antenna by the field of incoming waves in plasma in the resonance frequency bands, characteristic for planetary magnetospheres, ionospheres, and solar wind plasmas. It is shown that under similar conditions the effective length can differ strongly from vacuum value. For isotropic plasma (e.g., solar wind) both the cases of the stream velocity greater or lower than the electron thermal velocity are considered. The effective length increases strongly as compared to non-streaming plasma for waves propagating downstream with frequencies close to the electron plasma frequency even for plasma streaming with a sub-thermal velocity. In fact a receiving antenna can operate as an effective “frequency-angular filter” which emphasizes emissions with definite spatio-temporal properties. A theory developed can be applied for interpretation of relevant measurements in terms of the nature, mechanisms of generation, and adequate estimation of a signal level for electromagnetic emissions registered in space.