Geophysical Research Abstracts, Vol. 7, 09106, 2005
SRef-ID: 1607-7962/gra/EGU05-A-09106

Visibility of solar type III kilometric radio bursts : Ulysses-Wind observations

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Solar type III radio bursts are generated by suprathermal electrons ejected from solar active regions. Along their path through the solar corona outward to the interplanetary medium (IPM), these electrons trigger radio emission at the fundamental (F) of the local plasma frequency f_p and/or at the harmonic (H) $2f_p$, where $f_p \simeq 1$ GHz at the base of the corona, decreasing to $\simeq 20 - 30$ kHz at 1 AU and still lower values at greater heliodistances. In the present study, we have used simultaneous observations of solar type III kilometric radio bursts from the Ulysses and Wind spacecraft (s/c) for the purpose of identifying their radiation mode (F or H) and estimating their visibility. Wind was in the solar wind upstream of the Earth's bow shock and Ulysses was widely separated from Wind in heliocentric distance and longitude. We have selected type IIIs that are associated with Langmuir waves detected at one of the s/c. The latter is then known to be within the electron stream which travels along the approximate spiral field lines that connect the Sun to the s/c where these electrons generate Langmuir waves. The burst onset times and intensities at the two s/c, for both the F and H emissions, are then compared with the predicted onset times and distances of the source regions as deduced from the assumed spiral trajectory of the type III electrons. The main results are: (i) Type III bursts radiate at both modes, F and H, with different directivities ; (ii) At large angles up to 180° from the spiral field lines, only the H component could be observed, since it is less scattered by small scale density inhomogeneities in the IPM than the F emission which is furthermore much more refracted and focused by density gradients ; (iii) The same type III can be seen at different modes, F or H, by the two s/c depending on the source direction they observe with respect to the spiral field lines ; (iv) A s/c can observe a type III at lowest frequencies above the local f_p without the electron beam intersecting it.