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Stereoscopic observations of kilometric type III solar bursts : Fundamental or Harmonic ?

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Solar type III radio bursts are generated by suprathermal electrons ($v \simeq 0.03 - 0.3c$) ejected from solar active regions. Along their path through the solar corona outward to the interplanetary medium, these electrons trigger intense Langmuir waves at the local plasma frequency f_p where $f_p(kHz) \simeq 9\sqrt{n_e(cm^{-3})}$ and n_e is the plasma density. Some of the energy of the Langmuir waves is converted into radio emission at the fundamental f_p (F) and/or the second harmonic $2f_p$ (H). To identify the radiation mode and estimate the directivity of the type III bursts, we have used simultaneous observations on board the Ulysses and Wind spacecraft (s/c). Wind was in the solar wind upstream of the Earth's bow shock and Ulysses was widely separated from Wind in distance, longitude and latitude. We have selected type IIIs that are observed in association with Langmuir waves detected at one of the s/c. This s/c is then known to be within the electron stream which travels along the approximate spiral field lines that connect the Sun to it where these electrons generate Langmuir waves. The burst intensity time profiles at different frequencies observed simultaneously from the two s/c are then compared with the predicted onset times and distances of the type III source regions at both the F and H emissions, assuming the spiral trajectory of the type III electrons with curvature set by the solar wind speed measured on board. Along the spiral trajectory f_p is assumed to vary as the inverse of the heliodistance, and so, completely determined by its value measured in situ at the s/c. The main results of this study are : (i) Type III bursts radiate at both modes, F and H, with different directivities; (ii) At small angles from the spiral electron stream and at the same frequency, the radiation is initially at F, followed later on by H ; (iii) At large angles, only H is observed ; (iv) As a consequence, a s/c could observe a type III (H) at the lowest frequencies above the local f_p without the type III electron stream intersecting it.