

STEREO/WAVES Science Nugget  
October 18, 2012

### **Langmuir waves in magnetic holes: clues to a new model of wave emission**

Magnetic holes are commonly observed in the solar wind. According to their size, their dynamics are governed by MHD or kinetic processes. The presence of such magnetic depressions can affect the transport properties of the particles. Studying magnetic holes can therefore provide information on large scale structures of the solar wind. All magnetic hole formation mechanisms involve adiabatic processes. On the other hand, the presence of waves requires rapid fluctuations of the environment. How can we reconcile these two aspects? Observations with Cluster, STEREO/IMPACT and STEREO/WAVES have provided new evidence to answer this question.

We have shown that (i) the waves are generated inside the holes, (ii) their presence is strongly correlated with the presence of a well developed strahl in the distribution of electrons of the ambient solar wind, and (iii) the electrons are more isotropic inside the hole than in the surrounding solar wind.

These observations lead us to a new model to explain the generation of waves in magnetic holes. Suprathermal electrons can penetrate the magnetic hole which is convected by the solar wind. They then undergo two effects that modify their distribution: (i) magnetic focusing, (ii) particle drift associated with magnetic field gradient and electric field inside the hole. The plasma may thus become unstable and waves occur. Unlike models in the literature, we highlight the crucial role played by the suprathermal electrons.

C. Briand, J. Soucek P.Henri, A. Mangeney, 2010, Journal of Geophysical Research, Volume 115, Issue A12, CiteID A12113, « Waves at the electron plasma frequency associated with solar wind magnetic holes: STEREO/Cluster observations »

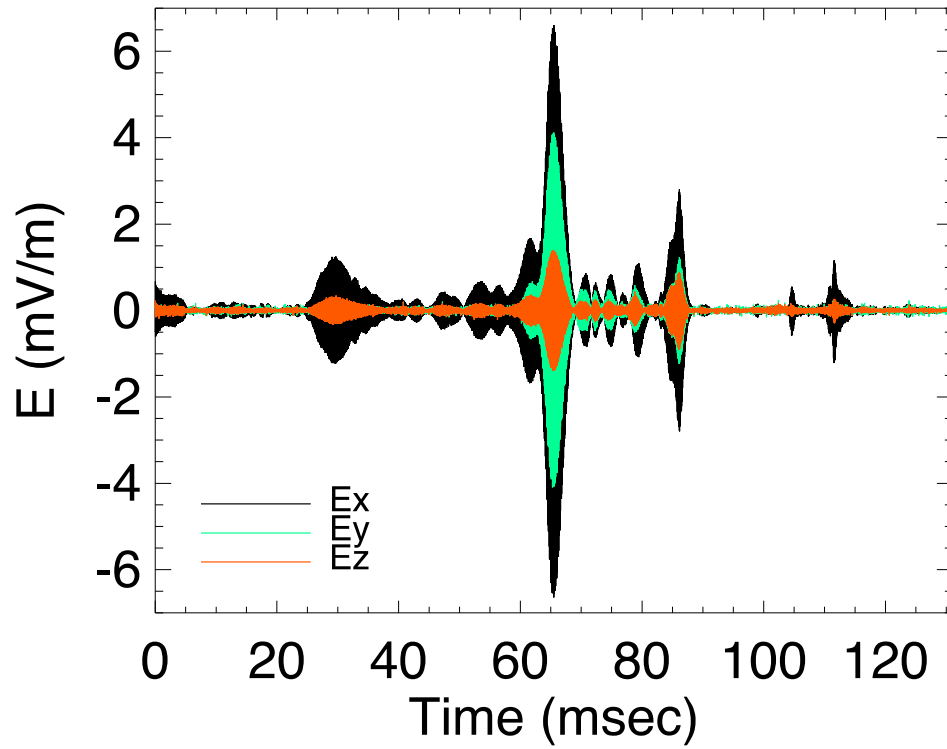


Figure 1: Example of waves at the plasma frequency observed with the Time Domain Sampler of S/WAVES. Changes in the polarization can be appreciated by the variations of the relative amplitude along the three components inside short time wavepackets.