Polarisation properties of intense Langmuir wave packets near the electron foreshock: WIND observations and interpretation

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The electron foreshock and the upstream solar wind exhibit a variety of nonlinear phenomena, among which wave-wave interactions around the plasma frequency have received much interest. A conspicuous feature is the occurrence of coherent quasi-monochromatic wave packets with close frequencies. Although such spectra are now known to be the signature of the nonlinear decay of Langmuir waves, many open questions remain.

Here we consider their polarisation properties to put further constraints on their interpretation. Our analysis is based on high-frequency electric field measurements made by the WIND satellite in the terrestrial electron foreshock. Two components of the electric field, sampled at 120 kHz, are available. Using a demodulation technique, we show how to extract the polaristion properties of the waves and compare these to the orientation of the magnetic field. The main observed feature is a quasi co-planarity of the k-vectors of the primary and secondary waves, and their closeness to the direction of the background magnetic field.

These results give a strong argument in favour of the theoretical model of beam-plasma interaction, where the saturation of the wave amplitude is determined by the decay instability. This is further supported by the orientation of the k-vector of the secondary wave, which is preferentially opposite to that of the primary wave.