

## Electromagnetic Whistler Precursors at Supercritical Interplanetary Shocks

We present observations of electromagnetic precursor waves, identified as whistler mode waves, at supercritical interplanetary shocks using the Wind search coil magnetometer. The precursors propagate obliquely with respect to the local magnetic field, shock normal vector, solar wind velocity, and they are not phase standing structures. All are right-hand polarized with respect to the magnetic field (spacecraft frame), and all but one are right-hand polarized with respect to the shock normal vector in the normal incidence frame. Particle distributions show signatures of specularly reflected gyrating ions, which may be a source of free energy for the observed modes. In one event, we simultaneously observe perpendicular ion heating and parallel electron acceleration, consistent with wave heating/acceleration due to these waves.