Project Details

ROSES ID: NRA-03-OSS-01
Selection Year: 2004
Program Element: Independent Investigation: LWS

Project Title:
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Summary:
In the previous funding period, we developed our "kinetic shell" model of the maximal resonant cyclotron interaction for the energization of coronal hole protons by parallel-propagating ion cyclotron waves. Preliminary dispersionless results were encouraging, and we expected to obtain the evolution of both the fast wind proton distribution function and the wave spectra as functions of heliocentric radius in a coronal hole. However, we found that the addition of wave dispersion drastically limited the amount of wave energy which could be absorbed by the protons, and the perpendicular heating required to drive the fast wind could not be produced by this interaction. We concluded that some other energization process must be responsible for the bulk heating and acceleration of the protons. The situation is very different for heavy ions since, in contrast to protons, they can resonate with both sunward- and antisunward-propagating waves simultaneously. This capability results in second-order Fermi acceleration of the heavy ions, heating them primarily perpendicular to the magnetic field, in a manner not accessible to protons. We propose to model the radial evolution of a heavy ion distributions under the action of this Fermi acceleration along with the ion response to the standard gravitational and electromagnetic forces in the coronal hole. We will start with trace populations, like O5+ and Mg9+, seeking to match the UVCS observations of these species. We will determine the required intensities of counter-propagating resonant waves and compare these results to recent theories of Alfven wave reflection and turbulent processes in coronal holes. We will then consider the case of alpha particles, whose bulk properties will affect the dispersion relation of the waves, leading to a more complicated interaction. Our goal will be to obtain a detailed kinetic description of the coronal hole heavy ion distributions, explaining the source of the preferential acceleration and heating of these ions which is consistently observed in the fast solar wind. This proposal seeks to address the Living With a Star RFA's under Goal II, SEC Theme, 1(a) and 2(a), which additionally support Goal I, SEC Theme 1(a).

Publication References:

Summary: ''

Reference: Philip Isenberg / University of New Hampshire - A Kinetic Model for Preferential Acceleration and Heating of Solar Wind Heavy Ions