Project Details

ROSES ID: NNH14ZDA001N
Selection Year: 2014
Program Element: Physics of the Inner Heliosphere

Topic: Physics-based methods to predict connectivity of SEP sources to points in the inner heliosphere, tested by location, timing, and longitudinal separation of SEPs

Project Title:
Understanding Wave-Particle Interactions between Solar Wind Plasma Waves and Heavy Ions

PI Name: Thomas Broiles
PI Email: tbroiles@swri.edu
Affiliation: Southwest Research Institute
Project Member(s):
- Jian, Lan ; Co-I; Goddard Space Flight Center
- Gary, Stephen Peter; Co-I; Los Alamos National Laboratory

Summary:
Solar wind heavy ions are preferentially heated and accelerated by plasma waves in the solar wind. However, very little is known about this wave-particle interaction, and it generally remains poorly understood. For example, it is unknown which types of waves are most responsible.

Our goal is to better understand wave-particle interactions in the solar wind. Our specific objectives are to determine the relative importance of each type of wave, and further constrain the physical conditions when wave-particle interactions occur. We will meet these objectives by identifying the various waves present at the Advanced Composition Explorer (ACE). We will then statistically compare the properties of observed wave modes to sources of free energy in the bulk plasma, and to heavy ion observations. These comparisons will tell us how the waves form, and how they heat and accelerate heavy ions.

We will then repeat this analysis at Ulysses to determine whether the wave-particle interaction changes with heliographic latitude and radial distance. Performing the same analysis at Ulysses' aphelion and perihelion will allow us to study the wave production and heavy ion energization processes as the free energy sources in the bulk plasma become more collisionally aged. Additionally, we will perform this analysis when Ulysses is at high heliolatitude, where the solar wind and IMF conditions are significantly different.

This study will be the first to directly link observations of waves to observations of solar wind plasma and heavy ions. We also point out that the technique proposed in this study is directly applicable to the Solar Orbiter and Solar Probe Plus missions.

Publication References:

Summary: no summary

Reference: Gary, S. Peter; Jian, Lan K.; Broiles, Thomas W.; Stevens, Michael L.; Podesta, John J.; Kasper, Justin C.; (2016), Ion-driven instabilities in the solar wind: Wind observations of 19 March 2005, Journal of Geophysical Research: Space Physics, Volume 121, Issue 1, pp. 30-41, doi: 10.1002/2015JA021935