Project Details

ROSES ID: NNH05ZDA001N
Selection Year: 2006
Program Element: Data, Tools, & Methods

Topic: Shock acceleration of solar energetic particles by interplanetary CMEs

Project Title:
Turbulent heating of the corona, origin of solar wind fluctuations, and boundary conditions in the inner heliosphere

PI Name: William Matthaeus
PI Email: atn@g.ucla.edu
Affiliation: University of Delaware
Project Member(s):
- Velli, Marco CM; Co-I; University of California, Los Angeles

Summary:
This proposal is to support collaborative work on the origins of the solar wind,

and the boundary conditions for Space Weather effects in the inner

heliosphere, to be carried out during a one year sabbatical that the

PI has been granted by the University of Delaware for calendar year 2006.

The University will supply 75% of the PI's salary in support of the sabbatical,

and this proposal requests support for the remaining 25%.

During the year the PI will spend approximately five months at the University

of Florence to work collaboratively with Prof. Marco Velli. The PI and Prof. Velli

both served on the Solar Probe Science and Technology Definition team

and contributed substantially to the science component of that effort.

The goals of this proposal are based on science issues that came up and

became partially clarified while writing the solar probe Science and Technology

Definition Team document, providing a unique opportunity to continue the

momentum that was established in that series of meetings. The proposed

research is:

(1) to develop a better theoretical understanding of the behavior of

Alfven waves and turbulence in the important regions between the sonic and

Alfven points (approx. 5-20 Rs) in the corona, and between the Alfven point

and 1AU in the solar wind. This includes study of observed 1/f noise, the

development of anisotropy, and the nature of high latitude turbulence. These

will be addressed through a combination of observational and numerical inputs,

and analytical modeling;

(2) to assemble a fully consistent model of the acceleration of the solar wind,

using for the first time an accurate, consistent and tested nonlinear model for MHD turbulence starting in the lower corona. Unlike other similar models, we will include cross helicity and anisotropic cascade effects. These are issues that the PI has worked on in great detail with his collaborators, and in this new collaboration M. Velli will supply valuable expertise in wind equations and modeling of large scale coronal magnetic field. The further understanding of the plasma physics and turbulence theory of these regions will provide extremely valuable insights concerning the "inner boundary conditions" for space weather, and is therefore an essential underpinning of the LWS TRT science in general, directly addressing the 2005 targeted research area: "T3b. Determine the mechanisms that heat and accelerate the solar wind." This is a one year proposal, but the PI agrees to maintain participation in the associated working group.

Publication References:

Summary: no summary

Reference: Smith, Charles W.; Isenberg, Philip A.; Matthaeus, William H.; Richardson, John D.; (2006), Turbulent Heating of the Solar Wind by Newborn Interstellar Pickup Protons, The Astrophysical Journal, Volume 638, Issue 1, pp. 508-517, doi: 10.1086/498671

Summary: no summary

Reference: Breech, B.; Matthaeus, W. H.; Minnie, J.; Bieber, J. W.; Oughton, S.; Smith, C. W.; Isenberg, P. A.; (2008), Turbulence transport throughout the heliosphere, Journal of Geophysical Research: Space Physics, Volume 113, Issue A8, CiteID A08105, doi: 10.1029/2007JA012711

Summary: no summary

Reference: Usmanov, A. V.; Matthaeus, W. H.; Breech, B.; Goldstein, M. L.; (2010), Global Solar Wind Structure: Effects of Turbulence Transport and Heating, TWELFTH INTERNATIONAL SOLAR WIND CONFERENCE. AIP Conference Proceedings, Volume 1216, pp. 206-209, doi: 10.1063/1.3395837

Summary: no summary

Reference: Isenberg, Philip A.; Oughton, Sean; Smith, Charles W.; Matthaeus, William H.; (2010), Solar Wind Turbulent Heating by Interstellar Pickup Protons: 2-Component Model, PICKUP IONS THROUGHOUT THE HELIOSPHERE AND BEYOND: Proceedings of the 9th Annual International Astrophysics Conference. AIP Conference

Proceedings, Volume 1302, pp. 180-185, doi: 10.1063/1.3529967

Summary: no summary

Reference: Usmanov, Arcadi V.; Matthaeus, William H.; Breech, Benjamin A.; Goldstein, Melvyn L.; (2011), Solar Wind Modeling with Turbulence Transport and Heating, The Astrophysical Journal, Volume 727, Issue 2, article id. 84, 13 pp, doi: 10.1088/0004-637X/727/2/84