17TH ANNUAL INTERNATIONAL ASTROPHYSICS CONFERENCE
POSTER ABSTRACTS

Bourdin, Philippe-A.	***Plasma beta in a mixed-polarity solar atmosphere*** Philippe-A. Bourdin, Space Research Institute, Austria One fundamental quantity in the solar atmosphere is the ratio between magnetic and thermal pressure. It tells about the dominance of either the plasma motion over the magnetic field evolution, or vice versa. Therefore, it is of high importance to estimate and consider beta for different regions within the solar atmosphere, starting from the photosphere and up to the outer corona. Earlier works gave such estimates based on a simple extrapolation of an atmospheric column above a sunspot. With more recent 3D magneto-hydrodynamic models of the solar corona above an active region, including quiet Sun, we are now able to provide more realistic beta estimates. It turns out, not surprisingly, that beta varies stronger than if extrapolated only from sunspots. Furthermore, we find that beta may indeed reach unity at practically all heights in the solar atmosphere, if also inclined, non-vertical magnetic field configurations in a mixed-polarity environment are considered. We provide beta value ranges from the photosphere to the outer corona for active regions and plage areas, as well as quiet Sun regions. As a consequence, we present a new idea on the formation of a sunspot penumbra that requires beta around unity in the vicinity of the sunspot.
Hu, Qiang	***Detection of Small-scale Magnetic Flux Ropes from Ulysses In-situ Measurements*** Yu Chen, Qiang Hu, Jinlei Zheng, and Jakobus le Roux, Department of Space Science/CSPAR, The University of Alabama in Huntsville, USA Small-scale magnetic flux ropes, which have similar magnetic field configuration as their large-scale counterparts (i.e., magnetic clouds), but with different sizes and origin, constitute an important element of solar wind structures. They are also considered to be associated with local particle energization and other processes. In order to better characterize and understand their characteristics at various heliocentric distances and heliographic latitudes, we apply the Grad-Shafranov (GS) reconstruction method to detect these small-scale flux ropes with a set of quantitative criteria by utilizing Ulysses spacecraft data. We conduct full range automatic detection for years 1994, 1996, 2004 and 2005 during the solar minimum phases. Based on solar wind speed/helio-latitude ranges, these periods are categorized into two groups: one of high solar wind speeds/latitudes (1994 and 1996) and the other of low solar wind speeds/latitudes (2004 and 2005). The event occurrence counts and a range of parameters and their distributions, such as duration, size, magnetic field magnitude, proton temperature and beta values, will be presented. Additional analysis results based on the identified events and the GS model output will also be reported and compared with the corresponding results obtained from the Wind spacecraft measurements at 1 AU.
Matthaeus, William	***Diffusion of Charged Particles in Fully Isotropic Random Magnetic Fields*** P. Subedi, U of Delaware, US W. Sonsrettee, Mahidol U., Thailand P. Blasi, INAF, Italy D. Ruffolo, Mahidol U., Thailand W H Matthaeus, U. of Delaware, US D. Montgomery, Dartmouth, US P. Chuychai, U. of Delaware US P. Dmitruk, U. Buenos Aires, Argentina M. Wan, Southern U. of Science and Technology, China T. N. Parashar, U. of Delaware, US R. Chhiber, U. of Delaware, US The investigation of the diffusive transport of charged particles in a turbulent magnetic field remains a subject of considerable interest. Research has most frequently concentrated on determining the diffusion coefficient in the presence of a mean magnetic field. A considerable modification to the existing theories is required when the fluctuations are isotropic with zero (or very small) mean field. Such modification turns out to be of the highest importance when describing the transport of cosmic rays (CRs) in the Galaxy, as well as for the modeling of diffusive CR acceleration in astrophysical sources. Here we consider diffusion of charged particles in fully three-dimensional isotropic turbulent magnetic fields with no mean field. We identify different ranges of particle energy depending upon the ratio of the Larmor radius of the charged particle to the characteristic outer length scale of the turbulence. Two different theoretical models are proposed to calculate the diffusion coefficient, each applicable to a distinct range of particle energies. The theoretical results are compared with those from computer simulations, showing good agreement.

Matthaeus, William	***Cosmic Ray Diffusion Coefficients Throughout The Inner Heliosphere From Global Solar Wind Simulation*** R. Chhiber, University of Delaware, US A. Usmanov, University of Delaware, US P. Subedi, Univesity of Delaware, US M. L. Goldstein, University of Delaware, US W. Matthaeus, University of Delaware, US We use a three-dimensional magnetohydrodynamic simulation of the solar wind to calculate cosmic ray diffusion coefficients throughout the inner heliosphere ($2~R_\odot - 3$ AU). The simulation resolves the large-scale solar wind flow, which is coupled to the small-scale random fluctuations through a turbulence model. Simulation results specify the background solar wind fields and turbulence parameters, which are used to compute the diagonal components of the diffusion tensor and study its behavior in the inner heliosphere. The parallel mean free path is evaluated using quasi-linear theory, while the perpendicular mean free path is determined by non-linear guiding center theory with the random ballistic interpretation. Several runs examine varying turbulent energy and different solar source dipole tilts. We find that (1) for most of the inner heliosphere, the radial mean free path (mfp) is dominated by diffusion parallel to the mean magnetic field; (2) the parallel mfp remains at least an order of magnitude larger than the perpendicular mfp, except in the heliospheric current sheet, where the perpendicular mfp may be a few times larger than the parallel mfp; (3) our estimations of the parallel mfp in the ecliptic plane at 1 AU agree very well with the Palmer ``consensus" range; (4) increasing turbulent power increases perpendicular diffusion and reduces parallel diffusion, as expected; (5) in the energy range 0.05 MeV - 10 GeV, the parallel mfp varies with rigidity (P) as $P^{.33}$, and the perpendicular mfp is weakly dependent on P, consistent with observations; (6) solar activity enhances the effects of perpendicular diffusion; (7) the mfps are weakly influenced by the choice of power spectra used to represent the large scale fluctuations.