ORAL ABSTRACTS

Abbas, Mian 3/11/2014, 2:20PM-2:45PM	***Experimental Investigations of the Physical & Optical Properties of Individual Micron/Submicron-Size Dust Grains in Astrophysical Environments*** N/A N/A
Adhikari, Laxman 3/13/2014, 8:00AM-8:25AM	***Turbulence Transport Throughout the Heliosphere*** Laxman Adhikari, Gary Zank, Peter Hunana, University of Alabama in Huntsville, USA Turbulence is an intrinsic characteristic of collisionless plasmas. Models that describe the transport of low frequency magnetic and velocity fluctuations in the solar wind have been restricted to regions of super-Alfvenic flow. Zank et.al 2012 developed a system of 6 coupled transport equations that describe the transport of energy corresponding to forward propagating modes (g) and backward propagating modes (f), the residual energy (E_d), the correlation lengths corresponding to forward modes (lambda^+) and backward propagating modes (lambda^-), and the correlation length (lambda_D) corresponding to residual energy. The Zank et al. models can be applied in both Sub-Alfvenic and Super-Alfvenic flows. This allows us to exploit related formalisms to consider the transport of turbulence in regions such as the lower solar corona, the supersonic solar wind, the inner heliosheath and the outer heliosheath. A useful simplification of the full system of turbulence transport equations s to assume that the three correlation lengths are related via lambda^+=lambda^-=(lambda_D)/2. In this case, the 6 coupled equations reduces to 4 coupled equations. By way of example, we describe an application of the model to the solar corona below the Alfven critical point using steady-state solutions, and we also consider solutions throughout the supersonic wind. An important element of the solutions is the generation of backward propagating modes due to the forward propagating modes. This has important implications for coronal heating models and the heating of the solar wind.
Ben-Jaffel, Lotfi 3/11/2014, 9:15AM-9:40AM	***Helium Abundance in Giant Planets and the Local Interstellar Medium*** Lotfi Ben-Jafel, Institut Astrophysique de Paris, CNRS-UPMC, France Ilyes Abbas, Institut Astrophysique de Paris, CNRS-UPMC, France The Sun and giant planets are generally thought to have the same He abundance as that in the solar nebula from which they were formed 4.6 billion years ago. In contrast, the local interstellar medium reflects current galactic conditions. When compared to the primordial He abundance that prevailed in the beginning of the Universe and to the protosolar value at the beginning of the solar nebula formation, the departure of current abundances may help trace the processes that drive the nucleosynthesis evolution of the Galaxy and planetary interior formation and evolution. During the Voyagers' deep space cruises, the He abundance derived for the outer planets suggested that processes in the interior of Jupiter and Saturn may have substantially modified the original ratio derived for the Sun. The Galileo probe measured the He abundance in situ the atmosphere of Jupiter, showing that He is only slightly depleted compared to the solar value, contrary to initial Voyager data analysis. For Saturn, contradictory estimates thus far reported from past Voyager observations make its He abundance very uncertain. Here, we use the He first resonance line (58.4 nm) dayglow measured from the outer planets by the Voyager ultraviolet spectrometers (UVS) to derive the He abundance in the atmosphere of Jupiter and Saturn. We also use the solar He 58.4 nm measured by SoHO/SUMER to derive the He abundance inside the focusing cone. Finally, we compare giant planets and LISM He abundance levels derived here with primordial and protosolar values.
Bertaux, Jean-Loup 3/12/2014, 11:45AM-12:10PM	***On the Stability of the Interstellar Wind through the Solar System.*** Jean-Loup Bertaux, LATMOS/IPSL, Université de Versailles Saint Quentin, INSU/CNRS, France GEPI/Observatoire de Paris, CNRS, Université Paris Diderot, France It has been recently claimed that the direction and the velocity of the interstellar helium flow has changed significantly over the last forty years. One major argument is the first analysis of the IBEX-Lo direct detection of Helium neutrals that yielded the "new" values λ= 79.0±0.47°, β=-4.98±0.21°, V= 23.2+-0.3 km/s, significantly different from λ= 75.4°± 0.6°, β=−5.3°± 0.3°, and V= 26.3 ± 0.5 km/s, the “old” parameters previously deduced from a combination of Helium glow (58.4 nm) and Ulysses in-situ neutral He measurements. There are two types of IBEX-Lo very precise and unambiguous measurements which do not rely on the linearity response of the instrument: the direction of count rate maxima as a function of the spin angle, which determines the ecliptic latitude of the flow, and the count rate maxima as a function of IBEX position ecliptic longitude, which determines a tight relationship between the ecliptic longitude of the flow and its velocity far from the Sun. These measurements provide parameters (and couples of parameters in the second case) remarkably similar to the canonical, old values. If we believe the interstellar flow temporal drift, the probability of such simultaneous coincidences is estimated to be ~1-2 %. In contrast, we show that the retrieval of a lower velocity and higher longitude from IBEX data is based only on the count rate variation (around each spin phase maximum) as a function of the satellite longitude, when drifting across the region of high fluxes. We have examined the consequences of possible instrumental dead time counting effects (non-linearity response between low and high He fluxes), and conclude that their inclusion at a realistic level (compatible with published estimates) is sufficient to reconcile the IBEX data with the “old” parameters. We will also report some latest Hydrogen Lyman alpha glow collected near the heliopause by Voyager 1 UVS (Ultra-Violet Spectrometer) from Quémerais et al. (2014). We suggest that the observed unexpected shape as a function of distance to sun is due to massive charge exchange processes in the inner heliosheath.

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Bhattacharjee, Amitava 3/10/2014, 2:20PM-2:45PM	***Flux Rope Dynamics and Self-Generated Turbulence in High-Lundquist-Number 3D Reconnection*** A. Bhattacharjee and Y.-M. Huang, Princeton University, USA It has been established in recent years that the extended Sweet-Parker current layer in large scale, high-Lundquist-number reconnection is unstable to a super-Alfvenic plasmoid instability Past two-dimensional (2D) magnetohydrodynamic simulations have demonstrated that the Sweet-Parker current layer is transformed into a chain of plasmoids connected by secondary current sheets, which, in turn, becomes generically unstable to tearing instabilities. Eventually the reconnection layer will tend to a statistical steady state where plasmoid loss due to advection and coalescence is balanced by the formation of new plasmoids. The averaged reconnection rate in this regime is nearly independent of S. In this work, we extend our previous 2D simulations to three dimension (3D) with a non-zero guide field, and make detailed comparison between 2D and 3D results. The extra degree of freedom in 3D allows unstable modes to grow at different oblique angles and exhibit the complex dynamics of flux ropes. Kinematic and magnetic energy fluctuations are observed to form cigar-shaped eddies with long wavelengths parallel and short wavelengths perpendicular to local field lines, which is a well-known signature of anisotropic MHD turbulence, first discussed in the context of interstellar turbulence. The overall reconnection rate in fully developed nonlinear regime is found to be similar in 2D and 3D. The applicability of the phenomenology of 3D anisotropic MHD turbulence to this problem of turbulent reconnection will be discussed.
Boldyrev, Stanislav 3/12/2014, 8:25AM-8:50AM	***Transition from Hydrodynamic to Kinetic Turbulence in the Solar Wind*** Stanislav Boldyrev, U. Wisconsin-Madison, USA Observations show that magnetic turbulence in the nearly colisionless solar wind plasma extends to scales smaller than the plasma microscales, such as ion gyroradius and ion inertial length. Measured breaks in the spectra of magnetic, electric, and density fluctuations at high frequencies are thought to be related to the transition from large-scale hydromagnetic to small-scale kinetic turbulence. General analytic description of such a transition is presented. The physical interpretation of subproton plasma turbulence is proposed.
Burlaga, Leonard 3/10/2014, 10:30AM-10:55AM	***Voyager 1 Observations of the Interstellar Magnetic Field*** L. F. Burlaga N. F. Ness Voyager 1 (V1) has been observing interstellar magnetic fields (ISMF) for more than one year, from 2012/209 to at least 2013.6. Preliminary results indicate interstellar magnetic fields were observed until at least 2013/365. From 2013.0 to 2013.6 the difference between the azimuthal angle of the ISMF from the Parker spiral angle at the latitude 34.6deg of V1 was (22 ± 3)deg and the corresponding difference of the elevation angle was (0 ± 8)deg. During 2012 the deviation from the Parker spiral angle was somewhat smaller. The interstellar magnetic field has a West to East polarity, opposite to the direction of planetary motions. The magnitude of the ISMF varied smoothly in the range 0.38 nT to 0.59 nT with an average strength 0.49nT. The strongest interstellar fields were observed behind a shock at 2012/297 that was preceded by 2.2 KHz plasma oscillations, which implies an interstellar electron density n = 0.05/cc. The ISMF was observed after V1 crossed a current sheet CS0 having the structure of a tangential discontinuity. The inclination of this current sheet is consistent with an interstellar magnetic field draped on a blunt heliopause. Two other current sheets (sector boundaries) were observed earlier in the heliosheath at 2012/167 and 2011/276 with high inclinations (99 +/-10)deg and (89 ± 10)deg, respectively). The transition from heliosheath to interstellar magnetic fields is related to a two-step increase in the cosmic ray intensity observed by V1 from 2012.30 to 2012.65. The first step-increase began near the end of an unusual away-polarity sector, and it reached a plateau when V1 moved in a toward-polarity sector that ended at CS0. The second step-increase began slowly after V1 crossed CS0, and it ended abruptly at 2012/237.728.

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Bzowski, Maciej 3/10/2014, 8:00AM-8:25AM	***Warm Helium Breeze from the Starboard Bow discovered in the Heliosphere*** M.A. Kubiak, Space Research Centre PAS, Poland M. Bzowski, Space Research Centre PAS, Poland J.M. Sokół, Space Research Centre PAS, Poland P. Swczyna, Space Research Centre PAS, Poland S. Grzedzielski, Space Research Centre PAS, Poland D.B. Alexashov, , Space Research Institute RAN and Institute for Problems in Mechanics, Russia V.V. Izmodenov, Space Research Institute RAN and Institute for Problems in Mechanics, Russia E.Moebius, Space Research Center and Department of Physics of th University of New Hampshire, USA T. Leonard, Space Research Center and Department of Physics of th University of New Hampshire, USA S.A. Fuselier, Southwest Research Institute and University of Texas at San Antonio, USA P. Wurz, Physics Institute, University of Bern, Switzerland D.J. McComas, Southwest Research Institute and University of Texas at San Antonio, USA Signals from neutral helium atoms observed in situ from Earth orbit in 2010 by the Interstellar Boundary Explorer (IBEX) are investigated. The full helium signal observed during the 2010 observation season can be explained as a superposition of pristine neutral interstellar He gas and an additional population of neutral helium that we call the Warm Breeze. The Warm Breeze is approximately two-fold slower and 2.5 times warmer than the primary interstellar He population, and its density in front of the heliosphere is ~7% that of the neutral interstellar helium. The inflow direction of the Warm Breeze differs by ~19 deg from the inflow direction of interstellar gas. The Warm Breeze seems a long-term, perhaps permanent feature of the heliospheric environment. It has not been detected earlier because it is strongly ionized inside the heliosphere. This effect brings it below the threshold of detection via pickup ion and heliospheric backscatter glow observations, as well as by the direct sampling of GAS/Ulysses. We discuss possible sources for the Warm Breeze, including (1) the secondary population of interstellar helium, created via charge exchange and perhaps elastic scattering of neutral interstellar He atoms on interstellar He^+ ions in the outer heliosheath, or (2) a gust of interstellar He originating from a hypothetic wave train in the Local Interstellar Cloud. A secondary population is expected from models, but the characteristics of the Warm Breeze do not fully conform to modeling results. If, nevertheless, this is the explanation, IBEX-Lo observations of the Warm Breeze provide key insights into the physical state of plasma in the outer heliosheath. If the second hypothesis is true, the source is likely to be located within a few thousand of AU from the Sun, which is the propagation range of possible gusts of interstellar neutral helium with the Warm Breeze characteristics against dissipation via elastic scattering in the Local Cloud. Whatever the nature of the Warm Breeze, its discovery exposes a critical new feature of our heliospheric environment.
Chapman, Sandra 3/11/2014, 9:40AM-10:05AM	***Plasma Turbulence, Reconnection and Particle Energization- What We Can Learn from Large-scale Kinetic Simulations and Solar Wind Observations*** S. C. Chapman, K. T. Osman, B. Hnat, CFSA, Physics, Univ. of Warwick, UK K. H. Kiyani, F. Sahraoui, LPP, École Polytechnique, France E. Leonardis, Univ. Calabria, Italy W S Daughton, Los Alamos Lab., USA V Roytershteyn, H Karimabadi, SciberQuest, Inc., USA Satellite observations of plasma parameters in-situ suitable for the study of turbulence in the solar wind cover timescales from below ion kinetic scales up to days, providing a 'laboratory' to explore the fundamental physics. In addition, recent large scale self-consistent fully kinetic simulations in three dimensions are able to begin to capture both dynamic reconnection and self-generation of turbulence. Central to the idea of using these natural systems as physics laboratories, are methods that allow direct quantitative comparison between the predictions of theory and simulation, and the observations. Anisotropy and intermittency are properties central to the characterization of the turbulent cascade; they also directly specify the relevant class of stochastic model for the turbulent fluctuations. This talk will discuss how they have recently been found to be quantitatively different in the magnetohydrodynamic and kinetic ranges of turbulence in the solar wind, and in turbulence generated in kinetic simulations of reconnection.

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Christian, Eric 3/12/2014, 2:45PM-3:10PM	***Motions in the Ribbon of Energetic Neutral Atoms (ENAs) observed by the Interstellar Boundary Explorer (IBEX)*** McComas, David, SWRI, USA Schwadron, Nathan, UNH, USA Funsten, Herbert, LANL, USA The origin of the bright ribbon of ENAs seen by IBEX (McComas et al., 2009, doi:10.1126/science.1180906) is still uncertain. Most theories place the ribbon near the heliopause boundary between the solar wind and the interstellar medium, a distance of roughly 150 AU. Because IBEX collects ENAs from the same "slice" of sky every six months, it might be possible to observe astronomical parallax in alternating maps. Using parallax to determine the distance to the ribbon is complicated because the ribbon is a diffuse structure and there are time variations in the ENA intensities. Even so, with the completed IBEX all-sky maps, it is possible to set a lower limit for the distance to the IBEX ENA Ribbon. In addition, the ribbon averaging required to obtain the best limits on parallax can be used to look for small linear motions of the ribbon, perhaps due to the relative motion of the heliosphere and the interstellar medium, a motion of more than 3 billion km (.0003 ly) since the launch of IBEX.
Coles, William 3/11/2014, 4:45PM-5:10PM	***Radio Measurements of AU Scale Structure in the Interstellar Plasma*** William A. Coles and Barney J. Rickett, University of California, USA Recent advances in radio observations have greatly improved our understanding of the fluctuations in N_e on spatial scales of 1000 km to 300 AU. These measurements are not local - the distances are of order 10 pc to 300 pc, but the AU scales are interesting for the problem of interaction of the heliosphere with the local IISM and they are otherwise very difficult to measure. In summary, the IISM is quite inhomogeneous. If our observations are typical of the local IISM, observers of the interaction of the heliosphere with the IISM can expect to see isolated high-density sub-AU structures which are fully turbulent, i.e. the electron density fluctuations are comparable with the mean density. Variations in local flow speeds may exceed 15 km/s.
Cummings, Alan 3/13/2014, 10:30AM-10:55AM	***Voyager Observations of Galactic Cosmic Rays in the Local Interstellar Medium*** E. C. Stone, Caltech, USA B. C. Heikkila, NASA/GSFC, USA N. Lal, NASA/GSFC, USA W. R. Webber, New Mexico State University, USA Since late August 2012 the Voyager 1 spacecraft has been exploring the local interstellar medium. The local interstellar spectra of galactic cosmic ray nuclei are being observed for the first time down to a few MeV/nucleon and galactic cosmic ray electrons down to a few MeV. All observations of energetic particles at these energies inside the heliopause have been fully or partly obscured by particles of heliospheric origin and affected by solar modulation effects. This has resulted in reduced galactic cosmic ray intensities and in the observation of particles that had higher energies in interstellar space. We will report on observations from the Cosmic Ray Subsystem on the energy spectra of galactic cosmic ray nuclei with nuclear charge in the range Z = 1 to 28 and on the energy spectrum of galactic cosmic ray electrons. This work was supported by NASA under contract NNN12AA012.
Decker, Rob 3/10/2014, 3:55PM-4:20PM	***Recent Particle Measurements from Voyagers 1 and 2*** S. M. Krimigis, JHU/APL, USA E. C. Roelof, JHU/APL, USA M. E. Hill, JHU/APL, USA Voyager 1 (at 127 AU, lat. N35 deg. in March 2014) evidently made a transition from the heliosheath into the local interstellar medium on or about doy 238 of 2012 at 121.6 AU. Prior to the transition, Voyager 1 passed through two partial "depletion regions" during 2012 doys 210-215 and 226-234. In the depletion regions, intensities of charged particles of heliospheric origin (low-energy electrons, suprathermal ions, ACRs) decreased, while those of galactic origin (GCR ions and electrons) increased. Low-energy heliosheath electrons 26-70 keV begin decreasing ~2012.5, dropped sharply at the 1st GCR increase, made a weak recovery between 1st and 2nd GCR increase, and dropped to background levels after 2nd GCR increase. Within the two depletion regions the fractional intensity drops of ions from at least 0.04 to 30 MeV increased with decreasing energy. Protons 3-30 MeV showed pancake-like pitch-angle distributions that lasted for about twenty days as their intensities decreased beyond 2012/238. At Voyager 2 (at 104 AU, lat. S31 deg.) in the heliosheath, low-energy ions from at least 0.03 to ~30 MeV showed steadily increasing 1st order anisotropies during the period 2013.0-2013.3 that were directed in the +T direction, i.e., away from the heliosheath nose toward its flank from the perspective of Voyager 2 (at a longitude 45 deg. from the nose). Both the intensities and associated partial pressures of low-energy heliosheath ions had decreased at Voyager 2 since its termination shock crossing on 2007/242. Intensities of suprathermal ions ≈100 keV, which dropped by a factor ≈7 from the shock crossing to 2013.3, have since increased by a factor ≈3, possibly in response to a transient disturbance that may also be associated with the enhanced tangential streaming of energetic ions in the +T direction.

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Desai, Mihir 3/12/2014, 9:15AM-9:40AM	***ENAs from IBEX: Evidence for Multiple Heliosheath Populations*** F. A. ALLEGRINI, SwRI, USA M. BZOWSKI, Space Research Centre, Poland M. A. DAYEH, SwRI, USA H. FUNSTEN, Los Alamos National Laboratory, USA S. A. FUSELIER, SwRI, USA J. HEERIKHUISEN, University of Alabama in Huntsville, USA M. A. KUBIAK, Space Research Centre, Poland D. J. MCCOMAS, SwRI, USA N.V. POGORELOV, University of Alabama in Huntsville, USA N. A. SCHWADRON, University of New Hampshire, USA J. M. SOKÓŁ, Space Research Centre, Poland G. P. ZANK, University of Alabama in Huntsville, USA E. J. ZIRNSTEIN, University of Alabama in Huntsville, USA Energetic Neutral Atoms (ENAs) observed by the Interstellar Boundary Explorer (IBEX) provide powerful diagnostics about the origin of the progenitor ion populations and the physical mechanisms responsible for their production. In this paper, we extend the work of Desai et al. (2012) and Fuselier et al. (2012) and combine and compare ENA spectra from the first three years of observations by the IBEX-Hi and –Lo ENA imagers along the lines-of-sights (LOS) from the inner heliosphere through to the locations of Voyager 1 and 2 with results from an updated physics-based model of the 3D heliosphere and its constituent ion populations. Our results show that (1) IBEX ENA fluxes and spectra above ~0.7 keV measured along the LOS of the Voyagers are consistent with several models in which the parent pickup (PUI) populations originate in the inner heliosheath, and (2) a significant fraction of lower-energy ENAs between ~0.1–0.5 keV may originate from interstellar neutral gas charge-exchanging with a non-thermalized (hot) population of PUIs in the outer heliosheath beyond the heliopause. We discuss the implications of ENAs observed by IBEX originating from distinct parent populations as well as from two distinct locations in the heliospheric interface. These results indicate that ENA spectral measurements at various energies can be used to remotely probe distinct physical processes operating in vastly different regions of the distant heliosphere.

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Drake, James 3/11/2014, 8:25AM-8:50AM	***Is the magnetic field in the heliosheath laminar?*** J. F. Drake, University of Maryland, USA M. Swisdak, University of Maryland, USA M. Opher, Boston University, USA MHD simulations reveal that heliospheric sectored magnetic field compresses across the termination shock and that the sectors continue to thin in the heliosheath as the radial flows decrease. Theory and modeling suggests that the sectors reconnect, forming a bath of magnetic islands in the heliosheath that drive reconnection at the heliopause. In such a scenario the transport properties of the heliosheath (especially in the azimuthal direction) are dramatically different from a laminar magnetic field model and the heliopause becomes a porous boundary. A number of Voyager 1 & 2 observations favor such a model. The dropouts in the galactic and energetic electron populations at Voyager 2 as it exits the sector zone suggests that the sectored region confines energetic particles as expected in a magnetic bubble model. The loss of magnetic flux measured by Voyager 1 can be explained by reconnection of the sectored field. The loss of energetic electrons on day 190 of 2012, well before the heliopause crossing on day 209, suggests that the heliosheath near the heliopause is stochastic rather than laminar. Finally, the multiple dropouts measured as Voyager 1 crossed the heliopause, with no corresponding measurable change in direction of the magnetic field, are consistent with crossings of multiple magnetic separatrices, suggesting that the region around the heliopause has a complex magnetic structure. Is there is direct evidence that reconnection of the sectored heliosheath magnetic field has taken place? PIC simulations have revealed that magnetic reconnection in the high-β sectored heliosheath differs greatly from elsewhere in the heliosphere. The cores of growing magnetic islands rapidly bump against the marginal firehose condition, which eliminates the magnetic tension driving reconnection. The result of reconnection is a bath of highly elongated, nested magnetic islands or bubbles that only occasionally merge with one another. A spacecraft traversing such islands would continue to measure a dominant azimuthal magnetic field BT in most regions as in the pre-reconnection sectored heliosheath with none of the usual signatures of ongoing reconnection. Thus, directly distinguishing whether reconnection has taken place in the heliosheath is a challenge. We present PIC simulations of the sectored heliosheath with the goal of seeking reconnection signatures that can be compared with Voyager observations. Specifically there is a much greater probability of crossing the magnetic separatrix of the magnetic island than the region around the x-line region. On entry into the magnetic island across the separatrix the magnetic field strength decreases sharply and the plasma pressure increases so that the total pressure is nearly constant. There is very little directional change in the magnetic field across the separatrix layer. Such boundary layer crossings are reminiscent of the “Proton Boundary Layers” identified in the Voyager data, which have occurrence periods of around 12 days.
Drews, Christian 3/14/2014, 8:25AM-8:50AM	***Pickup Ions as a Tracer for Parameters of the Very Local Interstellar Medium*** Christian Drews, Christian-Albrechts-Universität zu Kiel, Germany Lars Berger, Christian-Albrechts-Universität zu Kiel, Germany Robert F. Wimmer-Schweingruber, Christian-Albrechts-Universität zu Kiel, Germany The persistent wind of interstellar neutral atoms inside our heliosphere allows us to determine parameters of the Very Local Interstellar Medium (VLISM) with different observation techniques, i.e. a direct observation of the interstellar neutral gas, optical observation of backscattered UV light, or the measurement of ionized interstellar particles - the so-called interstellar pickup ions. Although the observation of interstellar pickup ions is a more indirect method to infer parameters of the VLISM compared to a measurement of the interstellar neutral atom population, pickup ions have proven to be a consistent source of new and exciting discoveries that have improved our understanding of the VLISM considerably over the past 30 years. Since the first in-situ measurement of interstellar He+ pickup ion with the SULEICA instrument aboard AMPTE in 1985, the new generation of time-of-flight mass spectrometers such as Ulysses/SWICS, SOHO/CTOF, or STEREO/PLASTIC have allowed us to determine the flow velocity vector, temperature, and composition of the VLISM with unprecedented quality. Here we report on recent observations of interstellar He+, O+, and Ne+ pickup ions with the PLASTIC instrument aboard the two STEREO spacecraft. We will describe two analysis techniques to infer the flow velocity vector (and possibly temperature) of the VLISM using the observed signatures of the focusing cone and crescent of interstellar He+, O+, and, Ne+ pickup ions. Furthermore, we present our observations of the anisotropy of interstellar He+ velocity distribution functions, so-called ring-beam distributions, and would like to discuss the implications of our finding with the pickup ion community. In a concluding remark, we will talk about the scientific potential of future interstellar probes that, within 15 to 35 years, could allow us to study the VLISM in-situ. For that, we address some of the technical challenges and the exciting scientific opportunities that come along with such a mission.

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Fayock, Brian 3/11/2014, 3:55PM-4:20PM	***Lyman-Alpha Backscatter: A Simulation of Reduced Data from Voyager's Ultraviolet Spectrometer*** Brian Fayock, CSPAR at UAH, USA Gary Zank, CSPAR at UAH, USA Jacob Heerikhuisen, CSPAR at UAH, USA A multitude of instruments on board the Voyager spacecraft have been collecting data that has proven to be essential for the testing of heliospheric models for decades. We have focused our attention on Lyman-alpha backscatter intensity that has been reduced from ultraviolet spectrometer measurements made between launch and 1992. While this data has been used for many model comparisons, we have produced the first simulation to agree with spacecraft observations, matching nearly perfectly with that from Voyager 2. Our simulation is a 3D Monte Carlo radiative transfer code that generates millions of photons from the sun to scatter among a neutral hydrogen distribution resulting from a state-of-the-art 3D MHD-kinetic neutral heliospheric model, both of which have been developed within the Center for Space Physics and Aeronomic Research at the University of Alabama in Huntsville. In this presentation, we will discuss the core mechanisms driving the radiative transfer code, the statistical quantities collected, and the interpretation of the results relative to the spacecraft data.
Ferriere, Katia 3/11/2014, 1:30PM-1:55PM	***Interstellar Magnetic Fields*** Katia Ferriere, Observatoire Midi-Pyrenees, France I will review the observational properties (strength, direction, spatial distribution) of interstellar magnetic fields in our Galaxy, moving outward from the immediate Galactic vicinity of the Sun out to the large scales of the Galaxy as a whole.
Fisk, Len 3/12/2014, 1:30PM-1:55PM	***A Model for the Nose Region of the Heliosheath*** L. A. Fisk, University of Michigan, USA G. Gloeckler, University of Michigan, USA The nose region of the heliosheath, which the Voyager spacecraft are current exploring, has the unusual property that the dominant pressure is contained in the mobile interstellar pickup ions and energetic particles accelerated in the heliosheath; pressure that is of order 150 times the thermal pressure of the solar wind observed by Voyager 2 (which has a functioning plasma detector). Thus, in the nose region of the heliosheath we have two independent and essentially uncoupled gases: a relatively cold solar wind, which contains the mass, and hot and mobile pickup ions and energetic particles, which contain the pressure. Voyager 1 also observes through observations of the anisotropies of 50-keV ions that the solar wind flows primarily in the azimuthal and radial directions, not in the polar direction. The independent behavior of the solar wind from that of the pickup ions and energetic particles results in several unanticipated physical processes: despite the subsonic nature of the heliosheath it is both possible and expected that the solar wind can be compressed; the observed magnetic field is not the magnetic field that is convected with the solar wind. These unusual physical processes, plus the observed flow directions of the solar wind, allow the development of an analytic model for the nose region of the heliosheath, which, as is discussed in the next talk, can account for all Voyager observations, and which makes the testable prediction that Voyager 1 remains well within the heliosheath.
Florinski, Vladimir 3/13/2014, 1:30PM-1:55PM	***Magnetic Shear, Turbulence, and Energetic Particles at the Heliospheric Interface*** V. Florinski, University of Alabama, Huntsville, USA X. Guo, University of Alabama, Huntsville, USA We examine the time histories of galactic and anomalous cosmic rays near the heliopause and the heliocliff, during their crossing by Voyager 1 in 2012. Different models are developed to analyze the behavior of galactic and anomalous cosmic rays at multiple energies within about +/-2 AU from the heliopause. The models are, in part, inspired by our earlier work showing how "pancake" pitch angle distributions could develop at a magnetic shear layer that acts as an efficient barrier to cross-field transport. In this presentation we explore possible mechanisms for the large amount of galactic cosmic-ray modulation within 1 AU radial distance from the heliopause. The implications for the intensity of turbulent fluctuations in the inner and outer heliosheaths are discussed. Finally, we discuss the dynamical importance of pickup ions and anomalous cosmic rays near the heliopause.

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Frisch, Priscilla 3/11/2014, 1:55PM-2:20PM	***The Local Interstellar Magnetic Field: What it tells us about the Galactic Environment of the Heliosphere*** P. C. Frisch, Univ. Chicago, USA B-G Andersson, USRA/SOFIA, USA A. Berdyugin, Univ. Turku, Finland H. O. Funsten, LANL, USA A. M. Magalhaes, Univ. de Sao Paulo, Brazil D. J. McComas, SWRI, USA V. Piirola, Univ. Turku, Finland N. A. Schwadron, Univ. New Hampshire, USA D. S. Seriacopi, Univ. de Sao Paulo, Brazil J. D. Slavin, Harvard-Smithsonian CFA, USA S. J. Wiktorowicz, Univ Calif Santa Cruz USA The interstellar magnetic field traced by the IBEX Ribbon of energetic neutral atoms provides a remarkable opportunity to directly relate the interstellar material at the heliosphere with the magnetic structure of the local interstellar medium. Starlight polarized by aligned interstellar dust grains provides a viable tracer of the local interstellar magnetic field beyond the influence of the heliosphere. Using measurements of polarized starlight, we show that the evolved superbubble known as Loop I orders the interstellar magnetic field and gas kinematics within tens of parsecs, including the magnetic field that creates the IBEX Ribbon. In regions of high fluxes of ultraviolet radiation (with energy over 13.6 eV), the compositions of the polarizing dust grains are subject to large uncertainties due to the unknown ionization corrections. Both the polarization data, and the calculated dust compositions, support a scenario where the local cloud is extended. Our measurements of starlight polarized in the nearby interstellar medium indicate that the interstellar magnetic field traced by the IBEX Ribbon, and local interstellar clouds, are related to the nearest regions of Loop I. These polarization data have been acquired using the Pico dos Dias Observatory in Brazil, the 60 cm KVA telescope at the Observatory of Roque de los Muchachos in the Canary Islands, and Lick Observatory in California.

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Funsten, Herbert 3/11/2014, 2:45PM-3:10PM	***Symmetry of the IBEX Ribbon of Enhanced Energetic Neutral Atom (ENA) Flux*** D.M. Cai, Los Alamos National Laboratory,USA M. Dayeh, Southwest Research Institute, San Antonio,USA R. DeMajistre, Applied Physics Laboratory, Johns Hopkins University,USA P.C. Frisch, University of Chicago, USA J. Heerikhuisen, University of Alabama in Huntsville,USA D.M. Higdon, Los Alamos National Laboratory, USA P. Janzen, University of Montana, USA B.A. Larsen, Los Alamos National Laboratory, USA G. Livadiotis, Southwest Research Institute, San Antonio, USA D.J. McComas, Southwest Research Institute, San Antonio, and University of Texas at San Antonio, USA E. Möbius, University of New Hampshire, USA C.S. Reese, Brigham Young University, USA E.C. Roelof, Applied Physics Laboratory, Johns Hopkins University, USA D.B. Reisenfeld, University of Montana, USA N.A. Schwadron, University of New Hampshire, USA E.J. Zirnstein, University of Alabama in Huntsville, USA The ribbon of enhanced energetic neutral atom (ENA) emission observed by the Interstellar Boundary Explorer (IBEX) mission remains a critical signature for understanding the interaction of the heliosphere and the interstellar medium through which we are moving. IBEX all-sky maps of energetic neutral atom (ENA) flux have revealed the unexpected circular ribbon of enhanced ENA emission spanning multiple energies, and this circularity provides a fundamental ordering parameter for the underlying emission structure of the ribbon. The variation of ENA flux around the circular ribbon is notably variable and strongly dependent on ENA energy. Here, we study the spatial symmetry of ENA flux around the ribbon and find strong mirror symmetry of the flux at all energies in the range 0.7-4.3 keV. The distribution of ENA flux around the ribbon is unimodal at 0.7 and 1.1 keV, distinctly bimodal at 2.7 and 4.3 keV, and a mixture of both unimodal and bimodal distributions at 1.7 keV. The high energy bilateral lobes are found to be slightly non-opposing. Although we find no obvious correlation of the symmetry axes with heliospheric latitude or direction of motion of the Sun through the interstellar medium, the symmetry axis at 2.7 and 4.3 keV corresponds to a rotation of the ecliptic plane to the latitude of the ribbon center. Like the ribbon circularity, the ribbon symmetry appears to be a low-dimensional ordering parameter for the underlying structure of the dynamic processes that generate the ribbon.
Fuselier, Stephen 3/13/2014, 4:45PM-5:10PM	***Low Energy Neutral Atoms from the Heliosheath*** Representing the IBEX Science Team In the heliosheath beyond the termination shock, low-energy (<0.5 keV) neutral atoms are created by charge exchange with interstellar neutrals. Detecting these neutrals from Earth orbit is difficult because their flux is reduced substantially by ionization losses as they propagate from about 100 AU to 1 AU and because there are a variety of other signals and backgrounds that compete with this weak signal. Using observations from IBEX-Lo and -Hi from two opposing vantage points in Earth orbit, a lower energy limit of about 0.1 keV on measurements of ENAs from the heliosphere and the form of the energy spectrum from about 0.1 to 6 keV is established in two directions in the sky. Below 0.1 keV, the detailed ENA spectrum is not known and IBEX provides only upper limits on the fluxes. However, using some assumptions and taking constraints on the spectrum into account, there are indications that the spectrum turns over at an energy between 0.1 and 0.2 keV. This talk focuses on the ENA spectrum at low energies and the implications for these low energy fluxes.
Gloeckler, George 3/12/2014, 1:55PM-2:20PM	***Predictions for what Voyager 1 will Encounter*** G. Gloeckler, University of Michigan, USA L.A. Fisk, University of Michigan, USA In the Fisk and Gloeckler talk, "A Model for the Nose Region of the Heliosheath", we presented an analytic model for the nose region of the heliosheath. In this talk we demonstrate that the model can account for all Voyager observations, including the high densities measured on Voyager 1 from plasma wave observations by Gurnett et al.; in this model the high densities are due to compressed solar wind, not interstellar gas. The model predicts that Voyager 1 remains well within the heliosheath, and is still tens of AU from the heliopause. The model further provides a testable prediction; Voyager 1 will encounter a sector boundary, at which the behavior of the ACRs and GCRs will differ from what Voyager 1 is now observing. A detailed discussion will be provided as to when the sector crossing should be expected.

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Gry, Cecile 3/12/2014, 4:45PM-5:10PM	***A New Perspective on the Local Interstellar Cloud from UV Absorption Lines Results*** Cecile Gry, Laboratoire d'Astrophysique de Marseille, France Edward B. Jenkins, Princeton University, USA We show that published results for the Mg II and Fe II UV absorption lines for the local interstellar medium are consistent with a single, monolithic cloud that surrounds the Sun in all directions. Our study of velocities indicates that the cloud does not behave like a rigid body: gas within the cloud is being differentially decelerated in the direction of motion, and the cloud is expanding in directions perpendicular to this flow, much like the squashing of a balloon. The outer boundary of the cloud is about 10 parsecs away from us but is highly irregular, with possibly a few extensions up to 20 pc. Average H I volume densities vary between 0.03 and 0.1 cm-3 over different sight lines. Metals appear to be significantly depleted onto grains, and there is a steady increase in this effect from the rear of the cloud to the apex of motion. There is no evidence that changes in the ionizing radiation influence the apparent abundances. Additional, secondary velocity components are detected in 60% of the sight lines. Almost all of them appear to be interior to the volume holding the gas that we identify with the main cloud. Half of the sight lines exhibit a secondary component moving at ~ -7.2 km/s with respect to the main component, which may be the signature of an implosive shock propagating toward the cloud's interior.
Guo, Fan 3/14/2014, 9:40AM-10:05AM	***The Acceleration of Energetic Charged Particles in a Shock-turbulence System*** Fan Guo, Los Alamos National Laboratory Xiaocan Li, University of Alabama in Huntsville Shengtai Li, Los Alamos National Laboratory Hui Li, Los Alamos National Laboratory We study the acceleration of particles in a shock-turbulence system that is relevant to the acceleration of anomalous cosmic rays at the solar wind termination shock and in the heliosheath. The Parker transport equation is solved in the time-dependent fields generated from a two-dimensional MHD simulation for a shock propagating through a turbulent medium. We show that the planar-shock results can be significantly altered as a consequence of large-scale turbulence that interacts with the shock front and further evolves in the downstream region. Both acceleration at the shock and in the downstream region are discussed.
Gurnett, Don 3/10/2014, 10:55AM-11:20AM	***A Comparison of Voyager Radio Remote Sensing and In-situ Measurements of the Nearby Interstellar Plasma Density*** D.A. Gurnett W.S. Kurth University of Iowa, USA For over thirty years radio emissions have been observed by the Voyagers 1 and 2 radio/plasma wave instruments in the frequency range from about 2 to 3 kHz. These radio emissions are believed to be generated at the local electron plasma frequency in the region near and just beyond the heliopause in response to outward propagating interplanetary shocks. With the recent Voyager 1 observations of locally generated electron plasma oscillations in this same region, we now have an unprecedented opportunity to not only confirm the validity of the radio remote sensing observations, but also to better understand the structure of the interstellar plasma in the region immediately beyond the heliopause. In this paper we show that both the remote and in-situ measurements are remarkably consistent. These measurements show that the interstellar plasma density on the upstream side of the heliosphere starts at a density of about 0.05 cm^{-3} at the heliopause (at 122 AU for Voyager 1 crossing) and ramps up to a peak density of about 0.15 cm^{-3} over a distance of about 5 AU. For the radio measurements the density ramp is indicated by a rising emission frequency as the shock propagates into the density ramp. What happens beyond the roughly 5 AU thickness of the density ramp is not known, since the heliospheric 2 to 3 kHz radio emissions typically reach an asymptotic upper frequency limit of about 3.5 kHz, which corresponds to the peak density of 0.15 cm^{-3}. That almost all of the heliospheric radio emission events have a similar increasing frequency after an initial onset at 2 kHz (i.e., a density of 0.05 cm^{-3}), strongly indicates that the density ramp being measured by the Voyager radio/plasma wave instrument is a steady state feature of the interstellar plasma just beyond the heliopause and not some transient feature that might arise, for example, from a Kelvin-Helmholtz or an interchange instability.

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Hill, Matthew 3/10/2014, 4:45PM-5:10PM	***Voyager 1 Transitions into the Interstellar Medium and Voyager 2 Skirts the Interface Between the Unipolar and Sectored Heliosheath*** M.E. Hill, Johns Hopkins University Applied Physics Laboratory, USA R.B. Decker, Johns Hopkins University Applied Physics Laboratory, USA D.C. Hamilton, University of Maryland, College Park, USA S.M. Krimigis, Johns Hopkins University Applied Physics Laboratory, USA Voyager 1 (V1) traveled into a region of space dominated by interstellar particles and a high magnetic field strength in August 2012. Whether V1 crossed a traditional heliopause or some other sort of "heliocliff," is not universally agreed upon, but the dramatic disappearance of heliospheric particles that accompanied the other changes leaves no doubt as to the importance of this boundary. While both spacecraft were within the heliosheath, from 2007 to 2012, Voyager 2 (V2) passed back and forth across the boundary between the unipolar and sectored heliosheath. When V2 was inside the sector zone, ions and electrons spanning four orders of magnitude in gyroradius all coherently increased intensity by roughly an order of magnitude compared to the intensities outside the sector region. Voyager 1, during this period, remained almost continually within the sectored heliosheath, with high, steady intensities to match. We present observations from the Low Energy Charged Particle experiment at these two boundaries and highlight their relationship to the heliosphere as a whole.
Isenberg, Phil 3/13/2014, 2:20PM-2:45PM	***Spatial Confinement of the IBEX Ribbon - Further Work on the Dominant Turbulence Model*** Philip A. Isenberg, University of New Hampshire, USA The IBEX ribbon is a narrow region in the sky emitting enhanced fluxes of energetic neutral atoms (ENAs). It appears to be oriented normal to the interstellar magnetic field, encircling the heliosphere. A completely satisfactory explanation for this structure does not yet exist. An attractive scenario identifies the source particles as secondary neutral hydrogen resulting from the charge-exchange of solar wind protons. This neutral solar wind is ionized and picked up in the outer heliosheath and local interstellar space. If these local pickup protons were only weakly scattered in pitch angle before their next charge-exchange interaction, a ribbon similar to that observed would be produced, but such weak pitch-angle scattering is difficult to obtain. An alternative was suggested by Schwadron & McComas (2013), who pointed out that reasonable levels of pitch-angle scattering could lead to local wave enhancements, which could diffusively confine the (now nearly isotropic) pickup protons to the spatial region of the observed ribbon. We recently followed that suggestion with a computational model of such a confined structure in the upwind plane, using the "dominant turbulence" picture originally developed in the outer solar wind (Isenberg, 2014). In this talk, we describe that work and extend it to treat the 3D volume around the heliosphere. We present our latest results and discuss the viability of this ribbon hypothesis.
Janzen, Paul 3/14/2014, 8:50AM-9:15AM	***N/A*** N/A N/A
Jokipii, Jack (Randy) 3/13/2014, 10:55AM-11:20AM	***Effects of Simple Plasma-Velocity Shear on a Turbulent Magnetic Field.*** J. R. Jokipii Joe Giacalone Astrophysical plasma flows frequently exhibit simple velocity shear in which the flow speed, in a given direction, varies in a direction normal to this direction. This effect occurs in solar differential rotation and also occurs in the radially flowing solar wind, where the flow velocity varies with latitude or longitude. In this shear, if the ambient magnetic field has a (possibly fluctuating) initial component normal to the flow velocity, in the direction of the shear gradient, the component of the magnetic field parallel to the flow direction is amplified by the flow. This amplification occurs in a turbulent magnetic field even if the mean or average magnetic field is parallel to the flow direction, because of the fluctuating normal component. The general theory of this effect is discussed. Application to the solar wind and its turbulent magnetic field suggests that latitudinal or longitudinal velocity shear in the radially flowing solar wind produces regions of significant (radial) deviations from the Parker spiral magnetic field which last for periods of hours. This effect may contribute significantly to the observed periods of nearly radial or underwound magnetic field. This new mechanism will be compared and contrasted with previously proposed explanations of this observation by other authors.

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Krimigis, Stamatios 3/10/2014, 4:20PM-4:45PM	***Overview of Voyager 1, 2 Energetic Particle Measurements 2012-2014*** S. M. Krimigis, Johns Hopkins Applied Physics Laboratory, USA, and Academy of Athens, Greece R. B. Decker, Johns Hopkins Applied Physics Laboratory, USA M. E. Hill, Johns Hopkins Applied Physics Laboratory, USA E. C. Roelof, Johns Hopkins Applied Physics Laboratory, USA L. J. Lanzerotti, New Jersey Institute of Technology, USA The two Voyager spacecraft at 127 AU (V1) and 104 AU (V2), are currently exploring the near interstellar medium and the southern heliosheath, respectively. The anisotropy in galactic cosmic rays (GCR) seen upon crossing the putative heliopause at 121.6 AU on August 25, 2012 (Krimigis et al, 2013) reached a maximum of 8.5% in March 2013 between the field-aligned and normal components but then decreased rapidly to zero by mid-August 2013, suggesting that V1 entered an apparently undisturbed region of nearby interstellar space, some 4 AU after the crossing. GCR intensities at V1 have been constant since then, while those at V2 are about 4.2 % lower, i.e. a radial gradient of only ~ 0.2 %/AU or a latitudinal gradient of ~ 0.1 %/deg, at E > 211 Mev. The anomalous cosmic ray intensities (ACR) characteristic of heliosheath matter (H, He, O) at ≤ 20 Mev/nucleon continue to be absent from the region upstream of the heliopause to this date. Intensities of ACR at V2 are currently about the same as those at V1 just prior to crossing the heliopause. The intensity of O at V1 since the crossing has been ~ 2x10-6 (cm2 s sr Mev/nucleon)-1 in the range ~ 0.5 to ~ 5 Mev/nuc, about 5x lower than that measured over the south ecliptic pole by Ulysses in the 1993-94 time frame (Lanzerotti and Maclennan, 1995). More importantly, the spectra from ~0.5 to ~ 10 Mev/nucleon measured by both V1 and Ulysses are relatively flat over the energy range measured at all three locations. We have suggested (Krimigis et al, 2013) that interstellar magnetic field lines may have direct connection to the high latitude inner heliosphere allowing low energy (< 10 Mev/nucleon) galactic particles to enter just as solar energetic particles have access to Earth's polar caps. This, however, raises the question of why GCRs were still modulated over the poles at ~ 2 AU, as observed by Ulysses. In any case, the interconnection between the polar heliosphere with the local interstellar magnetic field has implications on the stability of the interface and the issue of open vs closed heliosphere and needs to be modeled appropriately.
Kucharek, Harald 3/13/2014, 4:20PM-4:45PM	***Global 3D Oxygen Sky Maps from IBEX*** H. Kucharek, J. Park, E. Moebius, P. Bochsler, University of New Hampshire, USA Most of the current IBEX investigations concentrated on neutral hydrogen. The so-called direct inflow of interstellar hydrogen was used to characterize the neutral atom distribution in terms of temperature, bulk speed, and inflow direction. The results of these observations questioned the existence of the heliospheric bow shock. These measurements also reveal the so-called heliospheric Ribbon; a relative stable feature, which spans across the sky. This intensity enhancement of energetic neutral atoms (ENAs) appears to be almost oriented perpendicular to the interstellar magnetic field. However, the source population and the generation mechanism(s) are still under debate. The IBEX-lo detector is designed to distinguish between oxygen and hydrogen ENAs. Oxygen atoms are of particular interest because they are strongly coupled with protons through charge exchange, and because they are observed as pick-up ions and as anomalous cosmic rays. Hence, these different oxygen populations are very characteristic for different heliospheric regions, neutral oxygen observation can provide unique information about physical processes at the heliospheric boundaries. These global maps can be used to identify acceleration regions and processes, and to determine the number density of neutral oxygen and hydrogen, which can be used to improve models of the heliospheric interfaces. Although, a Ribbon structure could be observed in the energy rage of IBEX-lo, the current 3D background and sputtering corrected oxygen maps do not show Ribbon structure. Clearly observed is the direct inflow and there are signatures of oxygen ENA enhancements at the flanks of the heliosphere, which could be related to a possible tail structure. In this presentation we will discuss these results in the context of the current hydrogen observations and model predictions.

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Kurth, Bill 3/10/2014, 1:55PM-2:20PM	***Solar Triggers of Interstellar Electron Plasma Oscillations*** W.S. Kurth, University of Iowa, USA D.A. Gurnett, University of Iowa, USA D.J. McComas, Southwest Research Institute and University of Texas/San Antonio, USA H.A. Elliot, Southwest Research Institute, USA R.L. McNutt, Johns Hopkins University Applied Physics Laboratory, USA M.E. Hill, Johns Hopkins University Applied Physics Laboratory, USA E.C. Roelof, Johns Hopkins University Applied Physics Laboratory, USA Electron plasma oscillations in the frequency range of 2.2 to 2.6 kHz have recently been observed by Voyager 1 at heliocentric distances beyond 122 AU. These plasma waves occur at the electron plasma frequency f_{pe} indicating an electron density of 0.05 to 0.08 cm^{-3}. Given the factor of 50 increase in density from that measured in the outer heliosphere and the similarity of the density to that expected in the interstellar plasma, Gurnett et al. (Science, 2013) concluded that these observations were made in the interstellar plasma. Previously detected heliospheric radio emissions observed beginning in 1983, 1992, and 2002 drifted from frequencies of about 1.9 kHz upwards to maxima near 3.5 kHz. This led to the inference that the radio emissions were being generated on a density gradient just outside the heliopause at f_{pe} or its harmonic in response to plasma oscillations excited by an electron beam associated with a global merged interaction region shock. Radio emissions observed in 1983 and 1992 occurred just over 400 days after the two most intense Forbush decreases on record. The recently observed plasma oscillations are almost certainly related to those postulated to be responsible for the heliospheric radio emissions. Gurnett et al. (2013) suggested that solar activity associated with the so-called St Patrick's Day solar activity in March 2012 is likely responsible for the plasma oscillations observed in April – May 2013. In this paper we investigate this claim and identify coronal mass ejections on and about 7 March 2012 as the likely triggering events and look for a trigger for the October-November 2012 plasma oscillations also observed by Voyager 1. We use observations of solar wind plasma and energetic particles by New Horizons on its trajectory to Pluto and low-frequency enhancement events in Saturn kilometric radiation by Cassini as indicators of the progress of solar wind disturbances propagating through the heliosphere toward Voyager 1 as a means of determining the propagation speed of the associated interplanetary shock. Finally, we identify a shock observed by New Horizons in July 2012 and estimate that if it results in interstellar plasma oscillations, these should appear at Voyager 1 in the spring of 2014.
Lallement, Rosine 3/11/2014, 3:30PM-3:55PM	***Local Interstellar Medium past history as viewed in the light of its present 3D maps.*** Lallement Rosine, GEPI/Observatoire de Paris, France New 3D maps of the nearby interstellar medium based on stellar light reddening reveal a conspicuous, one kpc wide dust-free cavity located beyond the well-known Canis Major empty region. All Gould belt cloud complexes form a bow-shaped structure at the near end of the cavity, a structure that seems to be oriented along its main axis. On the other hand, comparisons with diffuse X-ray background maps and interstellar absorption line measurements show that the giant cavity is filled with hot, X-ray emitting gas but also with a large fraction of ionized, dust-free, non X-ray emitting gas. I will discuss the nearby ISM history in the light of this present global picture, in particular the hypothesized impact of a ballistic 10**7 solar masses supercloud 70 Myrs ago (Olano, 2001) or a strong explosive event such as a nearby gamma-ray burst (Perrot and Grenier, 2003), both invoked as origins of the Gould belt. I speculate about a third scenario that may explain the dynamics, the ionization, the D/H variability and the K-T mass extinction.
Lee, Martin 3/12/2014, 3:30PM-3:55PM	***An Analytical Description of the Ribbon ENA Hydrogen and the Distribution and Stability of Its Parent Pickup Protons in Local Interstellar Space*** Martin Lee, University of New Hampshire, USA According to the model of Heerikhuisen et al. (Astrophys. J., 708, L126, 2010) the energetic neutral atom (ENA) enhancement known as the "Ribbon" originates from a sequence of three charge exchange interactions. The first takes place in the solar wind and produces a neutral hydrogen solar wind. The second takes place in the local interstellar medium and produces pickup protons spiraling in the interstellar magnetic field as they are advected by the component of the interstellar plasma velocity normal to the magnetic field. The final charge exchange, between a pickup proton and an interstellar neutral hydrogen atom, produces a hydrogen ENA that may be detected by IBEX. Assuming a spherically-symmetric neutral solar wind and constant interstellar magnetic field and plasma velocity, which ignores draping effects due to the interstellar plasma flow about the heliopause, the three-dimensional distribution function of the interstellar pickup protons is calculated. The linear instability of this distribution to the growth of hydromagnetic and ion cyclotron waves is investigated. In addition, the total wave enhancement of the higher-frequency ion cyclotron waves due to the Ribbon is calculated within a Born approximation. Finally, the distribution of the ENAs in the inner heliosphere resulting from this process is predicted and compared with the IBEX observations of the Ribbon.

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Lembege, Bertrand 3/13/2014, 9:15AM-9:40AM	***Dynamics of the supercritical heliospheric termination shock front in presence of pick up ions: Self-consistent nonstationarity and impact on the energy partition*** B. LEMBEGE, LATMOS-IPSL-UVSQ-CNRS, France Z. YANG, SKLSW, National Space Science Center, P.R. China Q. LU, SESS, Univ. Science and Technology of China, P. R. China The dynamic of the perpendicular supercritical heliospheric termination shock front in presence of pick-up ions (PUI) is analyzed with the help of a one-dimensional PIC (particle-in-cell) simulation code. Solar wind ions (SWI) and PUI are described respectively as Maxwellian and a shell distribution. This work is stimulated by Voyager 2 data which evidenced the nonstationary behavior of the termination shock -TS- (Burlaga et al., 2008). Recent hybrid and PIC simulation (Wu et al., 2010; Scholer et Matsukyio, 2011) have clarified the strong contribution of PUI in the global energy partition at the TS. Present work focusses on the nonstationary behavior of the shock front in presence of PUI (with different percentages) and its impact on the global energy partition (between reflected/directly transmitted SWI and PUI) in the downstream region. Our results (i) evidence that the TS front is still nonstationary even of presence of 25% of PUI (self reformation of the shock front due to the accumulation of SW ions), and even for a moderate supercritical Ma regime, (ii) show that the multi-crossing of the TS by Voyager 2 (Burlaga et al., 2008) may be associated to the change in the shock front location (and its velocity) due to the front self-reformation, (iii) confirm in average that 15% and 85% of the upstream SW energy is transfered to protons and to PUI respectively as evidenced in previous works for a fixed shock profile (at given time), and (iv) evidence the dominant role of "old" reflected PUI gyrating in the downstream region in this energy transfert. Moreover, present results show also quantitatively the weak impact of the front selfreformation on the energy partition (in the present moderate MA regime).
Leske, Richard 3/14/2014, 8:00AM-8:25AM	***The Composition of Anomalous Cosmic Rays and Implications for the Local Interstellar Medium*** R. A. Leske (1), A. C. Cummings (1), R. A. Mewaldt (1), E. C. Stone (1), M. E. Wiedenbeck (2), T. T. von Rosenvinge (3) (1) California Institute of Technology, USA (2) Jet Propulsion Laboratory, California Institute of Technology, USA (3) NASA/Goddard Space Flight Center, USA Anomalous cosmic rays (ACRs) constitute a processed sample of the neutral interstellar medium (ISM) that is accessible throughout the heliosphere, even at 1 AU. After being swept into the heliosphere as neutral atoms, ionized, picked up and convected outwards by the solar wind, these particles were accelerated to multi-MeV/nucleon energies somewhere in the outer heliosphere. Measurements of ACRs can provide information on the present-day composition of the nearby ISM, and comparison with solar wind, solar, and meteoritic abundances can shed light on the evolution of the ISM since the formation of the solar system. Using data from the Solar Isotope Spectrometer (SIS) on the ACE spacecraft, we have measured not only the elemental but also the isotopic composition of ACRs throughout both the 1997 and the 2009 solar minimum periods. These measurements confirm that neon in the ISM is isotopically lighter than that in the source of galactic cosmic rays, which is enriched in 22Ne, while the isotopic composition of ACR oxygen and nitrogen appear similar to that of solar system material, within uncertainties. We review existing knowledge of the ACR composition and present the latest ACR isotopic measurements from ACE/SIS, updated through the last solar minimum, in an effort to better constrain the composition of the neutral local interstellar medium.
Linsky, Jeffrey 3/11/2014, 10:55AM-11:20AM	***What Fills the Space Between the Partially-ionized Clouds in the Local Interstellar Medium?*** Jeffrey L. Linsky, University of Colorado, USA Seth Redfield, Wesleyan University, USA Fifteen warm partially-ionized gas clouds are known to exist in the local interstellar medium (LISM) within about 15 pc of the Sun, but they occupy only a small percentage of the LISM volume. The location, physical properties, and kinematics of these clouds are described by Redfield & Linsky (ApJ 673, 283 (2008)), and in his talk at this meeting Seth Redfield will present our recent work to identify the three dimensional morphology of these clouds and newly identified clouds. The properties of gas that occupies the space between these clouds has been controversial. Although theoretical models and diffuse X-ray emission were thought to identify a very low density million degree plasma between the clouds, this plasma has never been observed and the X-ray emission can be explained entirely or in large part by charge exchange between solar wind ions and neutral gas inside the heliosphere. The intercloud gas must therefore be cooler and mostly ionized in order to be undetected. Following the suggestion of Tat and Terzian (PASP 111, 1258 (1999)), we propose that the intercloud gas consists of interconnected Stromgren spheres ionized by the EUV radiation of hot stars and white dwarfs. The Stromgren sphere of Sirius B extends almost to the Local Interstellar Cloud (LIC), and the very luminous EUV radiation from Epsilon CMa and Beta CMa also shapes the LIC. We note that these three stars are all located in the direction of lowest neutral hydrogen column density as seen from the center of the LIC. We also suggest that some of the partially ionized clouds may be the outer shells of Stromgren spheres.

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Livadiotis, George 3/13/2014, 3:55PM-4:20PM	***Application of the large-scale quantization to the inner heliosheath plasma*** George Livadiotis, Southwest Research Institute, USA David J McComas, Southwest Research Institute, USA Large-scale quantization characterizes the phase-space of certain physical systems that retain local correlations between their particles. Plasmas are such systems where the large-scale quantization, ħ*, is some 12 orders of magnitude larger than the Planck constant. This was determined by examining a wide range of space plasmas, from the solar wind in the inner heliosphere to the distant plasma in the inner heliosheath and the local interstellar medium. One of the practical applications of the large-scale quantization constant, ħ*, is to derive unknown plasma parameters when some key observable is missing or unknown. Here we present the implementations of this application to the inner heliosheath plasma to derive the magnetic field, using the radially average plasma parameters determined from IBEX data. Finally, we compare the estimated magnetic field with the respective in-situ measurements at the Voyager's directions.
Macek, Wieslaw 3/10/2014, 2:45PM-3:10PM	***On Turbulence and Reconnection at the Heliospheric Boundaries*** Wieslaw M. Macek, Space Research Centre, Polish Academy of Sciences and Faculty of Mathematics and Natural Sciences, Cardinal Stefan Wyszynski University, Poland Anna Wawrzaszek, Space Research Centre, Polish Academy of Sciences, Poland Marek Strumik, Space Research Centre, Polish Academy of Sciences, Poland We present results of the multifractal scaling of the fluctuations of the interplanetary magnetic field strength as measured onboard both Voyager spacecraft in the outer heliosphere and the heliosheath [1, 2], before crossing the heliopause at heliospheric distances of 122 astronomical units (AU) in 2012, as suggested by numerical simulations, e.g., Ref. [3] and finally verified by Gurnett et al. (2013). More specifically, we analyze the spectra observed by Voyager 1 between 7 and 115 AU that are compared with those of Voyager 2 , which is still in the heliosheath [2]. We focus on the multifractal spectrum before and after crossing the termination heliospheric shock by Voyager 1 at 94 AU from the Sun, ahead of the heliopause. It is worth noting that the spectrum is prevalently right-skewed inside the whole heliosphere. We have observed a change of the asymmetry of the spectrum at the termination shock. We also show that the degree of multifractality falls steadily with the distance from the Sun and the multifractal structure is modulated by the solar activity, resulting from the evolution of the whole heliosphere. Hence these basic results also bring significant support to some earlier claims suggesting that the solar wind termination shock is asymmetric. In addition, we also show that magnetic reconnection processes at the heliopause may play an important role for transport of interstellar plasma into the heliosphere [4], see poster by Strumik et al.. [1] W. M. Macek, A. Wawrzaszek, V. Carbone (2011), Observation of the multifractal spectrum at the termination shock by Voyager 1, Geophys. Res. Lett., 38, L19103, doi:10.1029/2011GL049261. [2] W. M. Macek, A. Wawrzaszek, V. Carbone (2012), Observation of the multifractal spectrum in the heliosphere and the heliosheath by Voyager 1 and 2, J. Geophys. Res., 117, A12101, doi:10.1029/2012JA018129. [3] M. Strumik, A. Czechowski, S. Grzedzielski, W. M. Macek, R. Ratkiewicz, Small-scale local phenomena related to the magnetic reconnection and turbulence in the proximity of the heliopause, Astrophys. J. Lett., 773: L23, 2013, doi: 10.1088/2041-8205/773/2/L23. [4] M. Strumik, S. Grzedzielski, A. Czechowski, W. M. Macek, R. Ratkiewicz, Advective transport of interstellar plasma into the heliosphere across the reconnecting heliopause, Astrophys. J. Lett., 782: L7, 2014, doi: 10.1088/2041-8205/782/1/L7.
McComas, David 3/11/2014, 11:20AM-12:10PM	***IBEX: Five Years of Observing the Outer Heliosphere*** D.J. McComas, Southwest Research Institute, USA IBEX – the Interstellar Boundary Explorer has now returned five full years of observations of the outer heliosphere. Because of how IBEX makes these observations, the data set comprises 10 full sets of energy resolved all-sky maps. In this study we briefly review previous IBEX observations and results that have already provided key insights into the physics and workings of the outer heliosphere and its interaction with the local interstellar medium. We then go on to examine the combined five-year (2009-2013) set of observations for the first time. With this much data, many features that were previously statistically uncertain, now become clear. These data also provide the best insights thus far into time variations in the outer heliosphere as it responds to both 11-year solar cycle variations and longer term secular evolution of the three dimensional solar wind. With nearly half a solar cycle of observations, IBEX is finally showing us about the heliosphere – our home in the galaxy – not just in space, but in time too.
Medvedev, Mikhail 3/13/2014, 11:20AM-11:45AM	***On Cosmic Ray Propagation in the Heliosphere*** Mikhail Medvedev, University of Kansas Cosmic Ray propagation is diffusive because of pitch angle scattering by waves. Here we are interested whether the sign of charge matters. As a toy model, we explore how the difference of the diffusion coefficient for positively and negatively charged species may affect their distribution throughout the heliosphere. The result is mostly relevant to low energy particles. The implications of the results are discussed. Supported by grant DOE grant DE-FG02-07ER54940 and NSF grant AST-1209665.

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Mewaldt, Richard 3/13/2014, 2:45PM-3:10PM	***Cosmic-Ray Energy Loss in the Heliosphere – A Study of Electron-Capture Isotopes from 1997 to 2013*** R. A. Mewaldt1, M. E. Wiedenbeck2, K. A. Lave3, W. R. Binns3, E. R. Christian4, A. C. Cummings1, A. J. Davis1, G. A. de Nolfo4, M. H. Israel3, A. W. Labrador1, R. A. Leske1, E. C. Stone1, and T. T. von Rosenvinge4 1 Caltech, USA 2 Jet Propulsion Laboratory, Caltech, USA 3 Washington University, USA 4 NASA/Goddard Space Flight Center, USA In a 2003 paper Niebur et al. reported ACE/CRIS measurements of the electron-capture-decay isotopes 49V and 51Cr in cosmic rays and used these measurements to deduce the increase in adiabatic energy-loss that cosmic rays suffered as the solar cycle proceeded from solar minimum to solar maximum. This approach is based on the fact that the cross section for attaching an electron from the interstellar medium decreases by about a factor of 100 going from 100 to 1000 MeV/nucleon. Subsequent investigations by Mewaldt et al. (2004) and Caballero-Lopez et al. (2007) compared these same measurements with cosmic-ray solar-modulation models to place limits on the local interstellar spectra of cosmic-ray nuclei. During the 2009 solar minimum, cosmic-ray intensities at Earth reached the highest levels of the space era, suggesting that the energy-loss experienced by cosmic rays in entering the heliosphere was further reduced. Voyager data have recently provided a first look at the local interstellar spectra of cosmic rays just outside the heliopause. This talk will compare ACE/CRIS measurements of the daughter-to-parent ratios 49Ti/49V and 51V/51Cr in the ~150-400 MeV/nucleon energy interval with cosmic-ray modulation calculations in an effort to assess how cosmic-ray energy-loss varies over the solar cycle.
Mitchell, Donald 3/10/2014, 3:30PM-3:55PM	***The global heliosphere during the declining phase of SC23 and the beginning of SC24 as seen in Energetic Neutral Atoms using Cassini/INCA measurements*** K. Dialynas, D. G. Mitchell, S. M. Krimigis, R. B. Decker, and E. C. Roelof After 11 years of heliospheric Energetic Neutral Atom (ENA) imaging using the Cassini/INCA measurements, the “Belt” (Krimigis et al., 2009), an unexpected heliospheric signature identified as a relatively wide region of enhanced ENA intensities for energies >5.5 keV, still remains as one of the most striking features in the sky. The Belt's ENAs are most likely associated with a region of enhanced particle pressure that is formed inside the heliosheath (Krimigis et al. 2010), a “reservoir” of particles that exist within the heliosheath and moves in a rough circle along the nose to tail direction (in ecliptic coordinates), passing through the ecliptic poles, constantly replenished by new particles from the solar wind (Dialynas et al. 2013). Consequently, while the heliosheath has been identified as the most probable source of the ENAs that INCA detects, the question of how the heliosheath responds to the variability of solar wind conditions and in what manner this response is connected to solar activity through the solar cycle (SC) on a global scale has not been resolved. For example, the variation in solar wind flow during the solar cycle is expected to produce changes in the ENAs that we can measure with INCA through the years. Here, we produce all-sky, energy-resolved (in four discrete energy passbands from 5 to 55 keV), yearly Hydrogen ENA maps of the heliosphere (from 2003 to 2013) in ecliptic coordinates, to examine the time evolution of the ENA intensities over the declining phase of SC23 towards solar minimum and the beginning of SC24. Our conclusions are summarized as follows: a) the beginning of the declining phase (year 2003) of SC23 where solar activity is high enough (SSN~100) is associated with high ENA intensities in the Belt (e.g. ~5-8 (cm2 sr sec keV)-1 for the 5-13 keV energy range) from the direction of the heliospheric tail, relative to solar minimum; b) the intensity gradient over the 2003 ENA data formed from the low intensity regions (Basins) to the heliotail for all channels is relatively sharp (~2% per degree) but is minimized by the end of 2011; c) ENA intensities gradually decrease by a factor of ~2 in all INCA channels from 2003 to 2011, the observed minimum, i.e. approximately one year after the minimum in solar activity of SC23 (where SSN~20); d) the decrease in 5-55 keV heliotail ENAs during the years 2009 to 2011 is consistent with the decrease in the >40 keV ion intensities (by a factor of 2-3) during the same time interval, as measured by VGR1 and VGR2 in the heliosheath (Decker et al, 2012), and the onset of the new solar cycle (SC24); e) although the spatial coverage of the ENA data through the heliosphere over the 2009 to 2011 time span is rather poor toward the nose (and both the VGR1 and VGR2 locations are obscured by Saturn during 2011), the ~130 AU distance between the two Voyagers (both sides of the ecliptic equator, in the nose direction) implies that the ion decrease, which results in the observed ENA decrease, is global throughout the heliosheath; and f) the 2013 ENA map that corresponds to the ascending phase of SC24 (well after the SC23 solar minimum), shows an increase in the Belt intensities in the tailward direction (compared to the 2011 ENAs, for which tailward intensities are al! so avail able), a fact that provides further evidence on the response of the global ENA heliosphere on the solar wind changes through the solar cycle. 1. Krimigis, S. M., Mitchell, D. G., Roelof, E. C., Hsieh, K. C., & McComas, D. J. 2009, Sci, 326, 971 2. Krimigis, S. M., Mitchell, D. G., Roelof, E. C., & Decker, R. B. 2010, in AIP Conf. Proc., 1302, Pickup Ions Throughout the Heliosphere and Beyond, ed.J. Roux, G. Zank, A. J. Coates, & V. Florinski (College Park, MD: AIP), 79 3. Decker, R. B., Krimigis, S. M., Roelof, E. C., & Hill, M. E. 2012, Nature,489, 124 4. Dialynas, K., S. M. Krimigis, D. G. Mitchell, E. C. Roelof and R. B. Decker, 2013, ApJ, 778:40

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Moebius, Eberhard 3/10/2014, 8:50AM-9:15AM	***Interstellar Gas Flow Vector and Temperature Determination based on 5 Years of IBEX Data*** E. Möbius, Space Science Center & Department of Physics, University of New Hampshire, USA M. Bzowski, Space Research Centre, Polish Academy of Sciences, Poland S.A. Fuselier, Southwest Research Institute, USA D. Heirtzler, Space Science Center & Department of Physics, University of New Hampshire, USA M. A. Kubiak, Space Research Centre, Polish Academy of Sciences, Poland H. Kucharek, Space Science Center & Department of Physics, University of New Hampshire, USA M.A. Lee, Space Science Center & Department of Physics, University of New Hampshire, USA T. Leonard, Space Science Center & Department of Physics, University of New Hampshire, USA D.J. McComas, Southwest Research Institute & University of Texas at San Antonio, USA N. Schwadron, Space Science Center & Department of Physics, University of New Hampshire, USA J.M. Sokół, Space Research Centre, Polish Academy of Sciences, Poland P. Wurz, Physikalisches Institut, Universität Bern, Switzerland The Interstellar Boundary Explorer (IBEX) observes the interstellar neutral gas flow trajectories at their perihelion in Earth's orbit every year from December through late March, when the Earth moves into the oncoming flow. These observations have provided a very tightly coupled parameter space, with inflow speed and latitude as well as temperature being a well-defined function of inflow longitude. The best fitting flow vector turned out to be different by ≈ 3 deg and lower by ≈ 3 km/s than obtained previously with Ulysses GAS, but at comparable temperature. The possible coupled parameter space reaches almost to the previous flow vector, but with a substantially higher temperature by ≈ 2000 K. Along with recent pickup ion observations and including historical observations of the interstellar gas, these findings have led to a discussion whether the interstellar gas flow into the solar system is stable or variable over time. These intriguing possibilities call for more detailed analysis and a longer database. Up to now, the accumulation of five interstellar flow seasons with IBEX is complete and the sixth year is in progress. To optimize the interstellar flow measurements the IBEX observation strategy has been varied from year to year. We will review our observations and refinements in the analysis, in particular, towards narrowing the uncertainties in the flow vector and temperature determination. We will also discuss related implications on the LIC and its interaction with the heliosphere.
Opher, Merav 3/12/2014, 10:55AM-11:20AM	***On the Rotation the Interstellar Magnetic Field Ahead of the Heliopause*** Merav Opher, Boston University, USA James Drake, University of Maryland, USA Based on the difference between the orientation of the interstellar and the solar magnetic fields, there was an expectation by the community that the magnetic field direction will rotate dramatically across the heliopause (HP). Recently, the Voyager team concluded that Voyager 1 (V1) crossed into interstellar space last year. The question is then why there was no significant rotation in the direction of the magnetic field across the HP. Here we present simulations that reveal that strong rotations in the direction of the magnetic field at the HP at the location of V1 (and Voyager 2) are not expected. The solar magnetic field strongly affects the draping of the interstellar magnetic field (BISM) around the HP. BISM twists as it approaches the HP and acquires a strong T component (East–West). The strong increase in the T component occurs where the interstellar flow stagnates in front of the HP. At this same location the N component BN is significantly reduced. Above and below, the neighboring BISM lines also twist into the T direction. This behavior occurs for a wide range of orientations of BISM. The angle δ = a sin(BN /B) is small (around 10°–20°), as seen in the observations. Only after some significant distance outside the HP is the direction of the interstellar field distinguishably different from that of the Parker spiral. In the twist region (after the HP) there is a fast variation of the angle δ/AU and then a slower one farther away as seen in the observations (Burlaga & Ness 2014). We will discuss, as well in this talk, the mechanism responsible for the twist. The same twist is seen ahead of the magnetopause, where the field in the magnetosheath (equivalent to BISM) (in cases where reconnection is small) rotates toward the direction of the magnetospheric magnetic field (equivalent to the HS magnetic field) well upstream of the magnetopause (Phan et al. 1994). The IBEX ribbon, the band of increased intensity of energetic neutral atoms at 1 keV in the outer heliosphere, was originally believed to be aligned with the BISM · r = 0 just outside the HP. These results indicate that the draping of BISM is strongly influenced by the solar magnetic field. Only beyond ≈10 AU outside the HP is the centroid of the band of BISM · r = 0 is aligned with the original BISM direction.

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Pogorelov, Nikolai 3/12/2014, 11:20AM-11:45AM	***Voyager 1 Near the Heliopause*** N. V. Pogorelov, Department of Space Science and CSPAR, University of Alabama in Huntsville, USA S. N. Borovikov, CSPAR, University of Alabama in Huntsville, USA Recent observations from the Voyager 1 spacecraft show that it is in the local interstellar medium (LISM). This is quite surprising because no realistic, steady-state model of the solar wind (SW) interaction with the LISM gives the inner heliosheath width as narrow as 30 AU and the heliopause at 120 AU from the Sun. This includes such models that assume a strong redistribution of the ion energy to the tails in the pickup ion distribution function. We show that the heliopause (HP), which separates the SW from the LISM, is not a smooth tangential discontinuity, but rather a surface subject to Rayleigh--Taylor-type instabilities which can result in the LISM material penetration deep inside the SW. We also show that the HP flanks are always subject to a Kelvin--Helmholtz instability. The instabilities are considerably suppressed near the HP nose by the heliospheric magnetic field in steady-state models, but reveal themselves in the presence of solar cycle effects. We argue that Voyager 1 may be in one of such instability regions and therefore observing plasma densities much higher than those in the pristine SW. These results may be an explanation of the Voyager 1 early penetration into the LISM. They also show that there is a possibility that the spacecraft may start sampling the SW again before it finally leaves the heliosphere. On the basis of this numerical simulation, Voyager 2 is likely to cross the heliopause in 5-7 years.
Qin, Gang 3/13/2014, 9:40AM-10:05AM	***Anomalous Cosmic Rays Acceleration by the Termination Shock*** Gang Qin, Center for Space Science and Applied Research, China Lihua Zhang, Center for Space Science and Applied Research, China When crossing the termination shock (TS), Voyager 1 and 2 observed Anomalous Cosmic Rays (ACRs) different as expected by diffusive shock acceleration. In this work, we study the ACRs acceleration by analyzing test particles trajectories from numerical solution of Newton-Lorentz equation. As a preliminary work, simple toy models of plasma, magnetic field, and TS are assumed. In addition, our modeling results of ACRs spectra will be compared with Voyager 1 and 2 observations.
Randol, Brent 3/13/2014, 1:55PM- 2:20PM	***Investigating the heliospheric ion suprathermal tail with Voyager LECP data*** Brent Randol, NASA Goddard, USA Eric Christian, NASA Goddard, USA Rob Decker, JHU-APL, USA Using publicly available data from the Voyager Low Energy Charged Particle (LECP) instruments, we investigate the form of the solar wind ion suprathermal tail in the outer heliosphere inside of the termination shock. This tail has a commonly observed form in the inner heliosphere, that is, a power law with a particular spectral index. The Voyager spacecraft have taken data beyond 100 AU, farther than any other spacecraft. However, during extended periods of time, the data appears to be mostly background. We have developed a technique to self-consistently estimate the background seen by LECP due to cosmic rays using data from the Voyager cosmic ray instruments and a model of the LECP instruments. In this presentation, we discuss the development of our background removal technique and results of applying it to studying the suprathermal ion tail in the solar wind.
Ratkiewicz, Romana 3/12/2014, 2:20PM- 2:45PM	***Low Ram Pressure of the Solar Wind: Comparison of Global Modeling Results with Voyager and IBEX Observations*** Romana Ratkiewicz, Institute of Aviation and Space Research Center PAS, Poland Marek Strumik and Jolanta Grygorczuk, Space Research Center PAS, Poland We discuss results of global modeling of the heliosphere for low ram pressure of the solar wind. A quasi-stationary approach is used to simulate interaction of the solar wind and the interstellar medium for exceptionally deep recent solar minimum. It is shown that the global model explains the heliopause position strongly shifted towards the Sun. Detailed comparison of the model results with available observations of the Voyager and IBEX spacecraft is presented.

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Raymond, John 3/13/2014, 8:25AM-8:50AM	***Pickup Ions in the Solar Corona: Comet Lovejoy*** J. Raymond, CfA, USA P.I. McCauley, CfA, USA S. Cranmer, CfA, USA C. Downs, Predictive Sciences, Inc., USA Comet Lovejoy passed 0.2 solar radii above the surface of the Sun. It produced water vapor at up to 10,000 tons/s. The resulting oxygen atoms were moving at more than 500 km/s when they became ionized and behaved as pickup ions in the solar magnetic field. The cloud of oxygen ions moves along the field and spreads along the field as it emits EUV lines detected in AIA images. Using the MAS MHD model of the solar corona, we compare the observations of the striations seen in AIA images with predictions based on the formation of a bispherical shell.
Redfield, Seth 3/10/2014, 9:15AM-9:40AM	***Properties of the Interstellar Medium Surrounding the Sun and Nearby Stars*** Seth Redfield, Wesleyan University, USA The Sun and nearby stars are surrounded by warm, partially ionized gas. This material dictates the structure of the heliosphere and astrospheres around other stars. Therefore, a thorough understanding of the physical properties of the surrounding local interstellar medium (LISM) is critical. The ISM displays dramatic variations in properties (e.g., density, relative velocity, turbulence, temperature, ionization), which argues for comparably dramatic variations in the heliosphere and astrospheres. I will review the attributes of the local ISM as revealed by high resolution spectroscopic observations of nearby stars. These observations provide important independent measurements of the properties of the LISM directly beyond the heliosphere, and are the only way in which the surrounding ISM properties can be derived for nearby stars, or for the Sun in its recent past or near future. In addition, many, if not all, nearby stars have exoplanets and are likewise surrounded by the LISM. The unique properties of a star's electromagnetic radiation, particle wind, and the size of the astrosphere can all influence an exoplanet's atmospheric structure. As our capability to discover and characterize exoplanets and their atmospheres continues to improve, the habitability of these planets will become a central and potentially radical scientific research question. At the heart of this question will be the relationship of the planet with its host star within its astrosphere. Which in turn, will require an understanding of the relationship between our own solar system planets and the Sun within our heliosphere since it is the gold standard by which all astrospheres are evaluated. These issues will be discussed in the context of our recent work on a three-dimensional physical and morphological model of the Local Interstellar Cloud, and other clouds in the LISM.
Reisenfeld, Daniel 3/14/2014, 9:15AM-9:40AM	***Time-Variation of ENA Flux Observed by IBEX at the Heliospheric Poles: Has the Recovery Begun?*** N/A N/A
Richardson, John 3/10/2014, 9:40AM-10:05AM	***Voyager 2 Plasma Observations*** John Richardson, MIT, USA Voyager 2 is now 20 AU deep into the heliosheath; if the width is similar to that in the Voyager 1 direction it is 2/3 of the way to the heliopause. We present recent observations, compare with observations from Voyager 1, and compare with model predictions. The speed of the flows observed by Voyager 2 in the heliosheath have been, on average, remarkably constant at 150 km/s. The flow angle has changed dramatically, however, and is now 60 degrees from radial, with more of the turning occurring in the RT than RN planes. After 2011, the average density and temperature of the plasma have also not changed. These flows are very different than at V1, where the speed was always below 100 km/s and decreased across the heliosheath. Models predict VR at Voyager 2 well, the the flow angle predictions differ from the observations.

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Roelof, Edmond 3/11/2014, 10:30AM-10:55AM	***Contributions of Co-rotating Interaction Regions (CIRs) to Energetic Neutral Atom Images of the Heliosheath and Beyond*** E. C.Roelof, Johns Hopkins U./Applied Physics Lab., USA S. M. Krimigis, Johns Hopkins U./Applied Physics Lab, USA and Office for Space Research and Technology, Academy of Athens, Greece D. G. Mitchell, Johns Hopkins U./Applied Physics Lab., USA R. DeMajistre, Johns Hopkins U./Applied Physics Lab., USA K. Dianlynas, Office for Space Research and Technology, Academy of Athens, Greece Well prior to the launches of Cassini and IBEX, it was anticipated that transient energetic proton distributions in the solar wind with energies above several keV would generate measureable intensities of energetic neutral atoms (ENAs). In particular, co-rotating interaction regions (CIRs) in the solar wind would contribute ENAs to all-sky images of the regions beyond the heliospheric termination shock [Hsieh et al., 1992; Roelof, 1992; both in COSPAR Proc. Solar Wind 7] when viewed from Saturn's orbit at 9.6AU. The latter study simulated Cassini/INCA ENA images based on in-situ CIR energetic ion spectra obtained (over the same energy range as INCA) by Voyager 2 in the ecliptic at 13AU and Voyager 1 at 18AU at 22deg north latitude. Both studies made the point that even if the CIR ENA contributions were comparable to those from the heliosheath and beyond the heliopause, the transient passage of the CIR through any pixel in the imager field of view would last only a few days and thereby mitigate the obscuration of more distant features. On the other hand, this raised the interesting possibility of imaging CIRs using Cassini/INCA [Krimigis et al., Space Sci. Rev., 2004]. We did not know at the time the heliolatitude dependence of ion intensities obtained from Ulysses observations within CIRs [e.g., Roelof et al., Space Sci. Rev., 1999], nor did we know the actual intensity of the ENAs from the heliosheath and beyond. Now we have, from 2010 onwards, contemporaneous all-sky ENA intensity maps from IBEX-HI [McComas et al., Ap. J. Supplement, 2012] and Cassini/INCA over adjacent energy ranges 0.5-6.0keV and 5-55keV, respectively. Examination of 6-month all-sky INCA maps from Saturn reveals patterns in all of the energy channels similar to those in new ENA simulations of CIR contributions (based on the heliolatitude dependence of Ulysses ion intensities). Possible CIR contributions in the published IBEX all-sky maps seem to appear mainly in the highest two IBEX-HI channels (centered on 2.7keV and 4.3keV). The patterns in IBEX-HI should differ from those in INCA because of the different viewpoints (1AU vs. 9.6AU), since IBEX lies within the ionization "cavity" of the interstellar H-atoms that produce the ENAs (roughly a sphere of radius 3AU), while Cassini lies outside it.
Schwadron, Nathan 3/12/2014, 8:00AM-8:25AM	***IBEX views the global structure of the heliosphere influenced by the Interstellar Magnetic Field*** N. A. Schwadron, UNH, USA and the IBEX Team The IBEX ribbon has been separated from the surrounding globally distributed flux (GDF), revealing ENA emission largely from the inner heliosheath. The line-of-sight (LOS) integrated pressure in the GDF is quite large, requiring that the interstellar magnetic field be sufficiently strong (e.g. ~3 microG) to balance the pressure of the inner heliosheath. The LOS emissions from the GDF have revealed signatures of the nose of the heliosphere, and the heliotail, which has been examined carefully. The strong interstellar magnetic field has broad implications for the structure of the heliosphere and the existence or lack of a bow shock. These global heliospheric structures also filter primary interstellar neutral atoms and lead to creation of secondary atoms through charge-exchange in the outer heliosheath. IBEX observations of H atoms from the Local Interstellar Medium reveal remarkable signatures of both filtration and the secondary component likely reflecting influences of the interstellar magnetic field on the outer heliosheath. New determinations of the LISM velocity from neutral atom measurments and the LISM magnetic field direction from the IBEX ribbon are shown to be consistent with the interstellar modulation of TeV cosmic rays revealed in global anisotropy maps of Milagro, As-gamma and IceCube. Thus, IBEX observations reveal a new picture of heliospheric structures and interactions that are strongly influenced by the interstellar magnetic field.
Snowden, Steve 3/12/2014, 10:30AM-10:55AM	***Diffuse X-ray Background Constraints on Models of the Local Interstellar Medium*** S. L. Snowden NASA/GSFC USA There is a flux of soft X-rays (0.07-0.284 keV) of diffuse origin observable over the entire sky. As X-rays of this energy are strongly absorbed by the interstellar medium, one optical depth is 1e19 -1e20 H cm-2, they provide a unique probe of neutral material in the solar vicinity. However, to be an effective probe requires that the distribution of emission be well understood, a requirement that is currently unfulfilled with unclear fractions originating in the Galactic halo, Local Hot Bubble, heliosphere, and Earth's magnetosheath. The various available data, their consistency (or lack thereof), and their implications for understanding the very local interstellar medium are discussed.

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Spangler, Steven 3/11/2014, 4:20PM-4:45PM	***Stellar Bubbles: Scaled-Up Versions of the Heliosphere*** Steven R. Spangler, University of Iowa, USA Allison H. Savage, University of Iowa, USA This meeting is primarily concerned with studies of the boundary between the solar wind and the interstellar medium. We know of other stars with mass loss rates 8 orders of magnitude larger, and wind speeds up to an order of magnitude greater than the solar wind. Stars are formed in clusters that can have several stars of this type. These powerful winds produce cavities, called stellar bubbles, with radii of tens of light years. Many of these stellar bubbles are famous, such as the Rosette Nebula (NGC2244) and Heart Nebula (IC1805). These bubbles possess a structure similar to the regions of the heliosphere that have been explored in-situ. An important topic in the study of stellar bubbles, as in the case of the heliosphere, is the role played by the interstellar magnetic field. In the case of stellar bubbles, we can employ the technique of Faraday rotation, specifically measurement of the Faraday rotation of radio sources behind the stellar bubbles, to measure the magnetic field interior to the outer shock. We have completed one such study of the magnetic field in the Rosette Nebula (Savage et al, ApJ 765, 42, 2013), have analysed additional measurements for the Rosette, and collected Faraday rotation data on many lines of sight through the Heart Nebula. In this talk, we will describe the observations of stellar bubbles, present measurements of Faraday rotation through one of them (the Rosette Nebula), and present our results on the magnetic field in the Rosette Nebula bubble.
Stone, Ed 3/10/2014, 11:20AM-12:10PM	***Voyager 1 Observations of the Heliopause Region*** Edward C. Stone, Caltech, USA Voyager 1 found a complex transition from the region dominated by solar wind plasma to one dominated by interstellar plasma. Following a current sheet crossing at 121.3 AU on July 26, 2012, Voyager 1 observed a series of abrupt changes in the magnetic field intensities that were correlated with rapid changes in the intensities of low energy heliospheric ions and galactic cosmic rays. On August 25, 2012, at 121.6 AU, the intensity of 10 MeV cosmic ray electrons increased to their current level, indicating that Voyager 1 had durably entered a new region. Subsequent observations of plasma oscillations revealed that the plasma density in this region was as expected for having crossed the heliopause into the local interstellar medium. Effects of the nearby heliopause continued to be observed in the pitch angle anisotropy of galactic cosmic rays until 125 AU in July 2013. The nature of this complex transition from the heliosphere to interstellar space will be discussed.
Swisdak, Marc 3/13/2014, 11:45AM-12:10PM	***The Structure of the Heliopause during the Crossing of Voyager 1*** M. Swisdak, University of Maryland, USA J. F. Drake, University of Maryland, USA M. Opher, Boston University, USA The picture of the heliopause as a pristine interface with a large rotation in the magnetic field fails to describe reality, as evidenced by the revelation that Voyager 1 crossed the heliopause without seeing such a change. However, there is still some controversy as to when the crossing actually occurred. We will argue that a picture where Voyager crosses multiple magnetic islands arising from reconnection at the heliopause is both consistent with the data and suggests that the crossing occurred 30 days earlier than the accepted value (day 209 of 2012 rather than day 238). A key prediction of this picture of a reconnecting heliopause is the presence of anisotropies in ion distributions arising from the escape along field lines into the interstellar medium. We will present an analysis of how these anisotropies should depend on energy and the comparison between the measurements and the reconnecting model's predictions.
Van Marle, Jan 3/11/2014, 8:50AM-9:15AM	***N/A*** N/A N/A

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Verscharen, Daniel 3/13/2014, 8:50AM-9:15AM	***Resonant Instabilities Driven by Anisotropic Alpha-Particle Beams in Collisionless Plasmas*** Daniel Verscharen, University of New Hampshire, USA Sofiane Bourouaine, University of New Hampshire, USA Benjamin D. G. Chandran, University of New Hampshire, USA Bennett A. Maruca, University of California at Berkeley, USA Justin C. Kasper, Harvard-Smithsonian Center for Astrophysics, USA Alpha particles are a dynamically and thermodynamically important plasma species in the solar wind. They typically drift with respect to the protons along the direction of the background magnetic field. This relative drift can induce various kinetic instabilities depending on the background parameters such as the temperatures and temperature anisotropies of all particle species, as well as on the local Alfvén speed. Once the threshold for such an instability is crossed, the plasma generates waves and decelerates the drifting ion species. The thresholds for these instabilities are of order the local Alfvén speed under typical solar-wind conditions. Since the Alfvén speed decreases with increasing distance from the Sun, the alpha particles are continuously decelerated by these instabilities in collisionless solar-wind streams. We discuss the nature of the drift instabilities and present our analytical description of their thresholds depending on the temperature, density, and temperature anisotropy of the alpha particles. We compare our analytical thresholds with numerical solutions of the full hot-plasma dispersion relation and with in-situ solar-wind observations. The observations imply that the solar-wind plasma is constrained in parameter space by the kinetic instabilities. This result supports the scenario of the continuous deceleration of alpha particles during their transit from the acceleration region in the Corona into the heliosphere. We quantify the energy release by instability-induced particle deceleration depending on heliocentric distance and demonstrate that this effect can significantly contribute to particle heating. We compare the contribution of heating by drift instabilities with the contribution of turbulent heating and discuss the relevance of both processes for the overall solar-wind heating.
Washimi, Haruichi 3/10/2014, 1:30PM-1:55PM	***A Static MHD Model of the Outer Heliospheric Structures*** H. Washimi, G. P. Zank, Q. Hu, University of Alabama in Huntsville, USA T. Tanaka, Kyushu University, Japan K. Munakata, Shinshu University, Japan Voyager 1 (V1) crossed the heliopause (HP) in July-August, 2012, at 122 AU from the Sun. The V1 magnetic field observations show that the ‘toward’-polarity changed to the ‘away’-polarity in late July, 2012 at the current sheet which is identified as the HP. The orientation of the ‘away’-polarity in the local interstellar medium (LISM) is 22 deg different from that of the Parker field (Burlaga et al., Science, 2013; Burlaga et al., AGUFM, 2013). Our three-dimensional MHD simulation aims to reproduce the outer heliospheric structures. Before simulation we found that the solar-wind ram-pressure is latitudinally invariant using solar-wind data of Ulysses, OMNI and ACE. This enables us to get smaller scale heliopause satisfying the V1 observations than the case in which the ram-pressure is higher at high latitudes. We performed simulations using 4 cases of the LISM magnetic field of angles to the interstellar flow 30°, 35°, 45°, and 55°, respectively, that was assigned on the outer boundary of the simulations. We study the ‘away’-polarity in the LISM and also estimate the ratio of the V2-HP-crossing/ V1-HP-crossing radial distances for respective angles to make clear the outer heliospheric structures.
Wiedenbeck, Mark 3/13/2014, 3:30PM-3:55PM	***A Model of Cosmic-Ray Propagation in the Galaxy Constrained Using Observations from Voyager 1, ACE, and HEAO-C*** M. E. Wiedenbeck, JPL/Caltech, USA A. C. Cummings, Caltech, USA E. C. Stone, Caltech, USA Heavy-element composition and energy spectra observed near Earth by instrumentation on spacecraft such as ACE and HEAO-C have often been interpreted using very simple "leaky-box" models of propagation in the Galaxy together with a single-parameter model of the solar modulation that takes place between the local interstellar medium and Earth. Considering the greatly simplified description that such models use of the galactic and heliospheric processes that come into play, these models have been reasonably successful in reproducing the observations. Because of the energy loss that the cosmic rays undergo in penetrating to the inner heliosphere, near-Earth cosmic-ray energy spectra do not provide significant constraints on the local interstellar spectra at energies below a few hundred MeV/nucleon nor on the low-energy portion of the "source spectrum" to which the particles are accelerated in the Galaxy. Voyager 1 is now providing important new constraints by measuring local interstellar cosmic-ray element spectra down to energies below 10 MeV/nucleon. This became possible starting in August 2012 when the spacecraft entered into interstellar plasma where galactic cosmic rays can be observed without the effects of solar modulation. Using a combination of cosmic-ray heavy-element data from ACE, HEAO-C, and Voyager 1 we evaluate the success of previous leaky-box model calculations in light of the new interstellar spectra and discuss the roles of various galactic processes in determining these spectra.

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Wiegmann, Bruce 3/11/2014, 8:00AM-8:25AM	***Heliopause Electrostatic Rapid Transit System (HERTS)*** Bruce M. Wiegmann, NASA-MSFC Advanced Concepts office, USA The motivation for this technology need comes from the Heliophysics Decadal Survey. The Heliophysics Decadal Survey, Section 10.5.2.7 states in part; "… recent in situ measurements by the Voyagers, combined with all-sky heliospheric images from IBEX and Cassini, have made outer-heliospheric science one of the most exciting and fastest-developing fields of heliophysics... The proposed Interstellar Probe Mission would make comprehensive, state-of-the-art, in situ measurements…required for understanding the nature of the outer heliosphere and exploring our local galactic environment." It goes on to say, "The main technical hurdle is propulsion. Advanced propulsion options should aim to reach the Heliopause considerably faster than Voyager 1 (3.6 AU/yr)… It has high priority for the Solar and Heliospheric Physics (SHP) Panel that NASA develops the necessary propulsion technology for visionary missions like The Solar Polar Imager (SPI) and Interstellar Probe to enable the vision in the coming decades." The concept proposed herein has been named the Heliopause Electrostatic Rapid Transit System (HERTS) by the MSFC Advanced Concepts Office (ACO) team. The HERTS is a revolutionary propellant-less propulsion concept that is ideal for deep space missions to the outer planets, Heliopause, and beyond. It is unique in that it uses momentum exchange from naturally occurring solar wind protons to propel a spacecraft within the heliosphere. The propulsion system consists of an array of electrically biased wires that extend outward 10 to 30 km from a rotating spacecraft This past year, MSFC's Advanced Concepts Office (ACO) performed a top level feasibility study of this concept and determined that the HERTS system can accelerate a spacecraft to velocities as much as three to four times that possible by any realistic extrapolation of current state-of-the-art propulsion technologies—including solar electric and solar sail propulsion systems. Moreover, it can be reasonably expected that this system could be developed within a decade and provide meaningful Heliophysics Science in the 2025-2030 timeframe.
Wood, Brian 3/10/2014, 8:25AM-8:50AM	***A Reassessment of the Interstellar He Flow Observed by Ulysses*** Brian E. Wood (Naval Research Laboratory, USA) Hans-Reinhard Mueller (Dartmouth College, USA) Manfred Witte (Max Planck Institute for Solar System Research, Germany) Recent observations of interstellar helium flowing through the solar system from IBEX have generated new interest in the He particle data, particularly since the flow properties suggested by IBEX are significantly different from those previously inferred from Ulysses/GAS observations. This has provided impetus for revisiting the archival Ulysses data, and a new reduction of the data has been completed for this purpose. We focus our attention on observations made during Ulysses's three fast latitude scans, in the periods 1994-1996, 2000-2002, and 2006-2007. The data in the last of these three periods has not before been fully analyzed or published. One interpretation of the Ulysses/IBEX discrepancy is that the He flow vector is actually changing with time. In particular, Frisch et al. 2013 (Science, 341, 1080) present evidence for a 0.17 deg/yr increase in longitude. However, this appears to be inconsistent with the Ulysses data, as we find no evidence that the locations or shapes of the He beam observed by Ulysses change at all from the first scan period (1994-1996) to the last (2006-2007). Finally, we report on a reassessment of the He flow vector using an analysis different and independent from previously published analyses. Our approach fits the entire Ulysses data set simultaneously, as opposed to fitting each separate He beam map independently. This global approach, simultaneously considering He beam maps from very different locations in Ulysses's orbit, reduces the degeneracies that exist in the flow parameters when only a single map from a single location is considered.
Wu, Yihong 3/12/2014, 4:20PM-4:45PM	***Spatial Evolution of Pickup Ion Spectra in the Heliosphere and their Diagnostics by Fluxes of Energetic Neutral Atoms*** Yihong Wu, UAH/CSPAR, United States We solved the transport equation to examine the detailed spatial evolution of the pickup ion (PUI) distribution in supersonic solar wind. The effects of second-order Fermi process, i.e. velocity diffusion, convection with the solar wind, adiabatic cooling and continual injection of newly born PUIs are all included. We analyzed the transition of PUIs at the heliospheric termination shock (TS) and described the heliosheath PUI distribution taking into account ongoing velocity diffusion. A three-dimensional, MHD-kinetic model for flows of a thermal plasma, neutral atoms and PUIs has been developed. The flow of the plasma is modeled using solutions to MHD equations. The PUI transport module analyzes the spatial evolution of the PUI distribution function as a separate component, on a kinetic level. Fluxes of energetic neutral atoms (ENA) with energies of about 0.2-6 keV originating through charge exchange of H atoms with the compressed solar wind and with PUIs behind the TS and arriving at 1 AU are calculated. Our results are directly comparable with the actual IBEX distributed ENA sky maps. A comparison of our numerical results with measurements performed by IBEX will allow us to answer the challenging questions: how the PUI distribution affects the ENA fluxes from the heliosheath.

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Wurz, Peter 3/12/2014, 3:50PM-4:20PM	***Measurement of Deuterium in the Local Interstellar Medium*** P. Wurz, D.F. Rodríguez M., L. Saul, Physics Institute, University of Bern, Switzerland M. Bzowski, M.A. Kubiak, J.M. Sokół , Space Research Centre, Polish Academy of Sciences, Poland P. Frisch, Department of Astronomy and Astrophysics, University of Chicago, USA S.A. Fuselier, D.J. McComas, Southwest Research Institute, and University of Texas at San Antonio, USA H. Kucharek, E. Möbius and N. Schwadron, Space Science Center and Department of Physics, University of New Hampshire, USA The Interstellar Boundary Explorer (IBEX) satellite of NASA measures signals of from local the interstellar particle environment via Energetic Neutral Atoms (ENA) observations from Earth orbit. Part of these observations are the investigation of the interstellar wind penetrating our solar system all the way to Earth's orbit. The deuterium measurements in this interstellar wind were performed with the IBEX-Lo camera on IBEX. This interstellar D signal, which is expected to be a few counts per year, is extracted from a strong terrestrial background signal, consisting of sputter products from the sensor's conversion surface. As reference we accurately measure the terrestrial D/H ratio in these sputtered products and then discriminate this terrestrial background source. During the three years of the mission time when the deuterium signal was visible to IBEX, the observation geometry and orbit allowed for a total observation time of 115.3 days. Because of the spinning of the spacecraft and the stepping through 8 energy channels the actual observing time of the interstellar wind was only 1.44 days. With the optimised data analysis we found three counts that could be attributed to interstellar deuterium. These results update our earlier work.
Zank, Gary 3/12/2014, 9:40AM-10:05AM	***Plasma Physics of the Local Interstellar Medium*** G.P. Zank, Center for Space Plasma and Aeronomic Research -and- Department of Space Science, University of Alabama in Huntsville, USA P. Hunana, Center for Space Plasma and Aeronomic Research University of Alabama in Huntsville, USA X. Ao, Center for Space Plasma and Aeronomic Research, University of Alabama in Huntsville, USA Self-consistent models of the large-scale heliosphere show that the very local interstellar medium (VLISM), bounded by the heliopause and either a bow wave or bow shock, experiences significant heating by the deposition of neutral hydrogen (H) originating from the hot inner heliosheath. As the hot neutrals stream into the interstellar medium, they experience charge exchange with the background cooler interstellar protons, creating a population of energetic (~1 keV) pickup ions. Similarly, fast neutrals created in the supersonic solar wind stream into the local interstellar medium and create a pickup ion population in the VLISM. The importance of these pickup ions is thought to manifest itself in the creation of the IBEX ribbon. Like the outer regions of the supersonic solar wind and possibly the inner heliosheath, the VLISM is a pickup ion mediated plasma. Here we derive a fully self-consistent model of a pickup ion mediated plasma using an approach analogous to a Chapman-Enskog expansion. We derive the anomalous heat flux and viscosity transport coefficients and obtain a self-consistent three-fluid model comprising electrons, thermal protons, and pickup ions. We investigate linear waves in a pickup ion mediated plasma, comparing the basic properties to those of the better known two-fluid model. We also present results that describe the structure and propagation of low Mach number shock waves in a pickup ion mediated plasma.
Zirnstein, Eric 3/12/2014, 8:50AM-9:15AM	***A Time-Dependent Simulation of the IBEX Ribbon*** Jacob Heerikhuisen, UAH/CSPAR, USA Nikolai V. Pogorelov, UAH/CSPAR, USA The Interstellar Boundary Explorer (IBEX) measures fluxes of hydrogen (H) energetic neutral atoms (ENAs) at 1 AU from every direction in space. IBEX is able to create all-sky flux maps as it spins on a Sun-pointing axis, continually producing results every 6 months. Over the course of its operation, measurements from IBEX have shown variations in flux over time, including in the IBEX ribbon flux. In light of these observations, we will present preliminary time-dependent simulations of H ENA fluxes measured at the IBEX spacecraft, focusing on flux from the ribbon only. We use results from an MHD-plasma/kinetic-neutral simulation of a time-dependent heliosphere, which includes approximations of solar wind boundary conditions collected from in situ measurements, as the "background" for our post-process H ENA flux simulations. We then simulate H ENA fluxes measured at the IBEX spacecraft by integrating backwards in time along H ENA trajectories coinciding with IBEX lines-of-sight, through the time-dependent heliosphere. We simulate the re-ionization times of pickup ions in the outer heliosheath, as well as the propagation times of ENAs as they travel from their source to 1 AU. We will present results simulated during times of IBEX operation, as well as offer predictions for IBEX ribbon flux for the next few years. Our results may offer insight into time-dependent effects in past and future observations of the IBEX ribbon.