EP 5: Sun and Heliosphere III

Time: Wednesday 14:00–15:45 Location: H-HS VIII

Invited Talk EP 5.1 Wed 14:00 H-HS VIII

New Opportunities with the Regularized $\kappa-$Distribution — •Edin Husidic — Institut für Theoretische Physik, Lehrstuhl IV: Plasma-Astroteilchenphysik, Ruhr-Universität Bochum, D-44780 Bochum, Germany

The solar wind is a rich field for various plasma waves and instabilites, which can be studied by solving the kinetic dispersion relation. By assuming small perturbations, a linear dispersion analysis is often sufficient, and except some special cases, the general solutions of the dispersion relation are usually obtained using numerical solvers. Among the standard solvers dedicated to a certain family of model distribution functions, e.g., Maxwellian or Kappa power-laws, those that allow for arbitraty distributions are more practical, as the measured particle distributions do not follow idealized distributions. In the solar wind the observed distributions deviate from a Maxwellian, showing enhanced suprathermal tails, which can be well fitted by the so-called standard $\kappa-$distribution (SKD). Due to a series of unphysical limitations and characteristics of the SKD, such as diverging velocity moments, a non-extensive entropy and a non-desirable contribution to macroscopic quantities from unphysical superluminal particles, the regularized κ-distribution (RKD) has been introduced. The RKD can reproduce as limit cases both the Maxwellian and the SKD with the benefit of overcoming the limitations of an SKD. The dispersion curves as well as growth and damping rates of different plasma instabilities based on the (anisotropic) RKD are computed and discussed.

EP 5.2 Wed 14:30 H-HS VIII

A numerical model of solar wind turbulence beyond the termination shock — •Jens Kleimann[1], Sean Oughton[2], and Horst Fichtner[1] — [1]Ruhr-Universität Bochum, 44780 Bochum, Germany — [2]University of Waikato, Hamilton 3216, New Zealand

A pre-existing self-consistent model (Wiengarten et al. 2015, 2016) of incompressible MHD fluctuations and their transport in and interaction with the solar wind is extended into the inner heliosheath. This region has been explored in recent years by the two Voyager spacecraft that, particularly, provided evidence for compressive fluctuations. Dynamical equations for the Reynolds-averaged turbulence quantities, such as total fluctuation energy, cross-helicity and the associated lengthscales, are coupled to the large-scale single-fluid MHD equations and numerically integrated using the CRONOS code until a steady state is reached. This includes non-linear interactions with the background fields, as well as turbulence driving by pick-up ions and possibly other sources such as velocity shear. The resulting configurations are discussed and compared to those from other groups such as Usmanov et al. (2011, 2016).

EP 5.3 Wed 14:45 H-HS VIII

The relevance of suprathermal particles for the pressure equilibrium in the heliosheath — •Hans Jörg Fahr — Argelander Institut für Astronomie, Universität Bonn

We are studying solar wind electrons and protons in the heliosheath, after passage over the solar wind termination shock. Due to the electric nature of this shock, downstream electrons become highly energized with non-equilibrium distribution functions. The moments of these functions show that the electron pressure is higher than the proton pressures. Even when pressure contributions from superluminal particles are removed it turns out that electron and proton pressures are of the same order of magnitude. When this is taken into account, it is revealed that there is no pressure deficit in the heliosheath with respect to the ram pressure of the surrounding LISM plasma as recently claimed by Rankin et al.(2019).

Invited Talk EP 5.4 Wed 15:00 H-HS VIII

The journey of the Voyagers into the interstellar medium — •Klaus Scherer — Ruhr Universität Bochum, Institute for Theoretical Physics IV

The Voyager mission was original planned as planetary mission to visit Jupiter and Saturn. Voyager 2 was then sent to Uranus and Neptune. The final destination of both spacecraft was after the crossing of the termination shock, that is the discontinuity where the supersonic solar wind becomes subsonic, to go beyond the heliopause, i.e. the tangential discontinuity separating the solar wind from the interstellar medium. Voyager 1 has crossed the heliopause in 2012 and recently Voyager 2 passed also through it, so that both are in the interstellar medium now. It is very interesting to compare the two crossings, because of the large separation of the two spacecraft. Moreover, only Voyager 2 has an operating plasma instrument on-board, while that of Voyager 1 was damaged during the Jupiter flyby. I will present a short history and the highlights of these missions, especially with respect of the heliopause crossing of Voyager 2.

EP 5.5 Wed 15:30 H-HS VIII

Potential Insights about the Heliosphere from ENA Measurements with an Interstellar Probe — Andre Galli[1], Peter Wurz[1], •Horst Fichtner[2], Yoshifumi Futaana[3], and Stas Barabash[3] — [1]Physics Institute, University of Bern, Switzerland — [2]Fakultät für Physik und Astronomie, Lehrstuhl IV, Ruhr-Universität Bochum, Germany — [3]IRF Swedish Institue of Space Physicsm Kiruna, Sweden

Several concepts for heliospheric missions operating at heliocentric distances far beyond Earth orbit are currently investigated by the scientific community. The mission concept of an Interstellar Probe aims at reaching a heliocentric distance of 1000 au within this century. Such mission would not only allow for a direct sampling of the unperturbed interstellar medium, but also for visits to Kuiper Belt objects, a comprehensive view on the interplanetary dust populations, or infrared astronomy free from the foreground emission of the zodiacal cloud. Particularly, it would also allow to obtain a global view of the heliosphere from an outside vantage point by measuring energetic neutral atoms (ENAs) originating from various heliospheric plasma regions. In the presentation a simple empirical model of ENAs from the heliosphere will be discussed and basic requirements for an ENA instrumentation on board an Interstellar Probe. For this purpose the full energy range of heliospheric ENAs from 10 eV to 100 keV is considered because each part of the energy spectrum has its merits for heliospheric science. The sensitivity of corresponding ENA measurements to the global shape of the heliosphere is quantitatively analyzed.