Geophysical Research Abstracts
Vol. 19, EGU2017-13382, 2017
EGU General Assembly 2017

Differential kinetic physics of solar-wind minor ions

Denise Perrone (1), Francesco Valentini (2), Sergio Servidio (2), Sara Stabile (2), Oreste Pezzi (2), Luca Sorriso-Valvo (3), Rossana De Marco (4), Federica Marcucci (4), Daniele Brienza (4), Roberto Bruno (4), Benoit Lavraud (5), Alessandro Retinò (6), Andris Vaivads (7), Giuseppe Consolini (4), Johan De Keyser (8), Mario Salatti (9), and Pierluigi Veltri (2)

(1) European Space Agency / ESAC, Madrid, Spain (denise.perrone@esa.int), (2) Dipartimento di Fisica, Università della Calabria, Rende, Italy, (3) CNR-Nanotec, Rende, Italy, (4) INAF-IAPS Istituto di Astrofisica e Planetologia Spaziali, Roma, Italy, (5) Institut de Recherche en Astrophysique et Planétologie, Université de Toulouse, France, (6) Laboratoire de Physique des Plasmas, Ecole Polytechnique, Palaiseau, France, (7) Swedish Institute of Space Physics, Uppsala, Sweden, (8) Royal Belgian Institute for Space Aeronomy, Belgium, (9) Agenzia Spaziale Italiana, Roma, Italy

The solar wind, although predominantly constituted of protons, is also made up of a finite amount of alpha particles, together with a few percent of heavier ions. The kinetic properties of heavy ions in the solar wind are known to behave in a well organized way under most solar-wind flow conditions: their speeds are faster than that of hydrogen by about the local Alfvén speed, and their kinetic temperatures are more than proportional to their mass. Preferential heating and acceleration of heavy ions in the solar wind and corona represent a long-standing theoretical problem in space physics, and are distinct experimental signatures of kinetic processes occurring in collisionless plasmas. However, due to very scarce measurements of heavy ions at time resolutions comparable with their kinetic scales, energy partition between species in turbulent plasma dissipation is basically unexplored. For the moment, most of the information comes from numerical simulations and a crucial support is given by self-consistent, fully nonlinear Vlasov models.

Here, hybrid Vlasov-Maxwell simulations are used to investigate the role of kinetic effects in a two-dimensional turbulent multi-ion plasma, composed of kinetic protons and alpha particles, and fluid electrons. The response of different ion species to the fluctuating electromagnetic fields appears to be different. In particular, a significant differential heating of alpha particles with respect to protons is observed, localized nearby the peaks of ion vorticity and where strong deviations from thermodynamic equilibrium are recovered. Then, the understanding of the complex process of particle heating results strongly related to the study of the non-Maxwellian features on the three-dimensional ion velocity distributions. These numerical results highlight the importance for the future space missions to provide detailed ion measurements to make a significant step forward in the problem of heating in turbulent space plasmas.