STUDY OF THE RELATIONSHIP BETWEEN SOLAR WIND ELECTRON DISTRIBUTION OBSERVATIONS AND INTERPLANETARY MAGNETIC FLUCTUATIONS

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The space between the Sun and our planet is not empty. It is filled with the expanding plasma of the solar corona called the solar wind, which is a tenuous weakly collisionless plasma composed mainly by protons and electrons. Due to the lack of sufficient collisions, the electron velocity distribution function in the solar wind usually exhibits a variety of non-thermal characteristics that deviate from the thermodynamic equilibrium. These deviations from equilibrium provide a local source for electromagnetic fluctuations, intimately related to the shape of distribution function, and associated with the commonly observed kinetic instabilities such as whistler-cyclotron and firehose. Various space missions have been dedicated to the in situ study of the solar wind. Among them, the NASA Wind spacecraft is one of the most successful and longest-lived missions, and has monitored the physics of the solar wind for more than 25 years.

As the physics of solar wind electrons has not been explored at the same level as protons since electrons can be much more collisional than ions, thus there are several interesting questions that deserve answer and we address here, such as: what are the main physical process that regulate the shape and stability of the velocity distribution?, or how collisional or collisionless are solar wind electrons? In this work we carry out systematic analysis of electrons and magnetic field data measured by Wind between 1995 and 2001, studying the relationship between moments of the distribution function and the properties of magnetic field fluctuations. We expect our results to be relevant for the understanding of the physics of weakly collisional plasmas, and of especially particular interest in connection to the recently launched Parker Solar Probe and Solar Orbiter missions.

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