Relationship between the observations of electron distributions in the solar wind and interplanetary magnetic field fluctuations

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Resumen

The space between the Sun and our planet is filled with a tenuous plasma called the Solar Wind, which is weakly collisional 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 the distribution function, and associated with the commonly observed kinetic instabilities such as the whistler-cyclotron, firehose and whistler-heat flux. In this work we carry out a statistical study of correlations of various plasma moments and interplanetary magnetic fluctuations as a function of time, in order to describe the role and evolution of these parameters in the solar plasma through the solar cycle. We consider a large time interval during solar cycle 23, ranging from solar minimum (1995-1996) to solar maximum (2000-2001). Using NASA's Wind space mission and its SWE and MFI instruments, we show kinetic instabilities (whistler-cyclotron, firehose and whistler-heat flux) can regulate the shape of electron distribution, such regulation is more effective during solar minimum. Subsequently, the magnetic fluctuations level increases as the electron VDF acquires a configuration close to the thresholds. In addition, we note that there is a high difference in the distribution between the fast and slow wind regimes. In summary, our results indicate that kinetic processes and Coulomb collisions effects coexist and both seem to play relevant roles in shaping the observed electron distributions.

Referencias

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