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On a role of energetic particles of solar wind in tracking the Space Weather environment in the heliosphere

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Energetic particles of solar wind are active agents reflecting the key processes in the heliosphere. In this paper we will review the charateristics of solar wind particles originating from the Sun, which undergo various re-acceleration significantly changing their energy and pitch angle distributions, thus, creating additional opportunities for activation of disruptive processes in the heliosphere. By comparing the data from the WIND spacecraft with the advanced 3D Particle-In-Cell (PIC) simulations it was shown (Zharkova & Khabarova, 2012) that there is a constant energisation of electrons and ions to much higher energies than those expected in the regular solar wind during their passes of the heliospheric current sheet (HCS), which undergoes a continuous reconnection. The particle parameters (including energy distributions, their peak velocities, shear, beta parameters, pitch angle, and directivity) are shown to be highly dependent on the magnetic field topology of the HCS. Furthermore, the particle and magnetic field characteristics are found affected by the HCS stability, formation of magnetic islands. This results in additional particle acceleration in these islands that can be the essential factor defining the Space Weather environment (Khabarova et al, 2015). In addition, further observations of accelerated solar wind particles associated with Interplanetary Coronal Mass Ejections (ICMEs) are also shown to be consistent with the interpretation of solar wind particles being accelerated in current sheets formed in the front of ICMEs. The observations show separation of ion and electron fluxes to the opposite sides from the ICME current sheet exhausts (Zharkova and Khabarova, 2015) and can account for the long-standing puzzle about electron fluxes called 'strahls'.