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The effects of particle drifts on cosmic-ray modulation in the heliosphere – progress and challenges

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Abstract content
   (Max 300 words)
Formatting &
Special chars

The transport of cosmic rays in the heliosphere (that region of space dominated by solar plasma and solar magnetic field) are governed by diffusion, convection, adiabatic energy changes, and gradient- and curvature drift in the non-uniform heliospheric magnetic field. Cosmic-ray intensities at Earth are lower than the interstellar value outside of the heliosphere, and this decrease is referred to as modulation. The atmosphere of the Sun (the corona) cannot be in static equilibrium and rapidly expands to form the supersonic solar wind, which becomes subsonic at the termination shock. The turbulent heliospheric magnetic field that originates on the Sun is frozen into the solar wind due to its high conductivity, and is drawn into spirals due to the rotation of the Sun. Inside of the termination shock the two hemispheres of the heliosphere with oppositely directed magnetic field are separated by the so-called wavy neutral sheet, across which the magnetic field changes direction.

Particle drifts, especially along the wavy neutral sheet, play a key role in modulation, and the lack of a realistic theoretical expression for the drift coefficient is a major drawback in an ab initio approach to cosmic-ray modulation.

I will give an overview of recent developments to describe drifts in the heliosphere, and how turbulence is taken into account (or not). Recent observations by the two Voyager spacecraft, one of which may (or may not) have entered interstellar space beyond the heliosphere, pose significant challenges to modelers. If certain predictions of MHD models turn out to be correct, describing drifts in the so-called heliosheath will become much more complicated that anything we had to deal with in the supersonic solar wind. I will discuss the observations, predictions and implications for drifts briefly. I will also outline a collaborative approach aimed at gaining a better understanding of the elusive drift coefficient.

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