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Modulation of galactic helium in the heliosphere

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Several space missions have improved our knowledge of the solar modulation of galactic cosmic rays in the heliosphere during the past 40 years (e.g. Pioneer 10 & 11, Voyager 1 & 2, IMP 8, Ulysses, PAMELA and more). These data sets are from solar minimum to solar maximum activity with clear differences in the energy spectra of the positive and negative magnetic polarity cycles. The modulation of galactic helium is studied with a 3D numerical model which includes all major modulation mechanisms (convection, diffusion, drifts, energy changes, etc.) as well as a heliosheath. We use a new heliopause spectrum for helium and compute spectra from the heliopause to the Earth. We are able to obtain a set of diffusion coefficients and a drift coefficient which are applicable from the inner to the outer heliosphere. We also find that the heliosheath plays an important role to establish the total level of modulation for helium, the lower the energy, the more important it becomes, with drifts playing a minor role in the outer heliosphere.

Collaboration

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473

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