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New solar modulation modeling of the galactic proton measured by the AMS02 and PAMELA experiments

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The flux of Galactic Cosmic Rays near Earth is not representative of the Local Interstellar Spectrum at energies below ~30 GeV due to a variety of physical processes arising in their propagation through the heliosphere. The changes in the GCR intensities and energy spectra are related to the solar activity, and are referred to as CR solar modulation. A thorough understanding of solar effects on the GCR is therefore relevant both to infer the LIS spectrum characteristics and to investigate the dynamics of charged particles in the heliosphere.

We present a newly developed numerical modulation model to study the transport of galactic protons in the heliosphere. The model makes use of the stochastic differential equations approach to solve the Parker' s transport equation in four dimensions (time, energy, and two spatial dimensions) with realistic models of heliospheric magnetic field and solar wind and up-to-dated LIS flux.

The model was applied to the 27-day averaged galactic proton flux recently released by the PAMELA and AMS02 experiments, covering overall an extended time period from mid-2006 to mid-2017. The time evolution of the model parameters and their relationship with solar activity proxies is shown. As we will discuss, our data-driven approach, based on the availability of new precision measurements, leads to new insights on the solar modulation phenomena

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