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Daily modulation parameter ϕ validated with AMS-02 for estimating GCR fluxes

Heliospheric modulation parameter (potential) ϕ based on a simple force-field approximation can be used to parametrize heliospheric modulation of galactic cosmic rays (GCRs) with a single term, which describes the average rigidity loss of a particle during heliospheric transport. Using this parameter with a LIS modulation model such as Vos & Potgieter (2015), we can estimate GCR fluxes that are arriving at Earth. Understanding the background GCR flux is important for assessing the background radiation and space weather environment at Earth.

Using a daily ϕ timeseries (Väisänen et al. 2023) obtained from NM monitor count rates with utilizing a yield function from Mishev et al. (2020), we have made a detailed comparison of ϕ-estimated GCR fluxes to fluxes measured by the AMS-02 instrument (Väisänen et al. 2025, Submitted). Results showed that the simple approximation works exceptionally well for mid rigidities around ~ 5-20 GV, and moderately with other rigidity ranges. Results and obtained fits have been openly published for the community, and improvements to the work are already well underway.

In this presentation we will present results, possibilities for interpolating and extrapolating AMS-02 datasets, and possible ways to improve performance at all rigidities. These improvements include assessing the effects of diffusion, charge-sign dependency, particle type and local heliospheric magnetic field and solar wind conditions. Also, the quality and precision of the input data and the used modulation and yield models play a part.

The ultimate goal of these analyses and developments is to find ways to better assess and estimate the local GCR modulation environment in a way that allows cross-analysis between particle measurements across different instruments/datasets and heliospheric locations. Later on, these empirical top-down approach models and results will need to be cross-analysed and validated with theoretical approaches.

References:
Mishev, A. L., Koldobskiy, S. A., Kovaltsov, G. A., Gil, A., & Usoskin, I. G. (2020). Updated neutron-monitor yield function: Bridging between in situ and ground-based cosmic ray measurements. Journal of Geophysical Research: Space Physics, 125, e2019JA027433. https://doi.org/10.1029/2019JA027433
Vos, E.E., and M. S. Potgieter (2015) New modeling of galactic proton modulation during the minimum of solar cycle 23/24, Astrophys. J., 815, 119. http://dx.doi.org/10.1088/0004-637X/815/2/119
Väisänen, P., Usoskin, I., Kähkönen, R., Koldobskiy, S., & Mursula, K. (2023). Revised reconstruction of the heliospheric modulation potential for 1964–2022. Journal of Geophysical Research: Space Physics, 128, e2023JA031352. https://doi.org/10.1029/2023JA031352
Väisänen, P., Bertucci, B., Tomassetti, N., Orcinha, M., Koldobskiy, S., Usoskin, I. 2025. Simulation of Galactic cosmic ray proton fluxes with the daily modulation potential: Validation with AMS02 data for 2011-2019. Journal of Geophysical Research: Space Physics (in Review, preprint: https://doi.org/10.22541/essoar.173532496.66800900/v2).

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