

Interstellar cosmic-ray spectra (1) just outside the heliosphere and (2) in the local medium: are they the same?

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Interstellar cosmic ray (CR) spectra just outside the heliosphere are accessible thanks to direct measurements of CR, with uncertainties given by the solar modulation. Interstellar CR spectra in the local medium (i.e. within ~ 1 kpc around the Sun) are indirectly accessible thanks to observations of interstellar emissions in radio/microwaves and in gamma rays produced by CR interactions with the interstellar medium and the Galactic magnetic field. Observations of these interstellar emissions are an invaluable tool for understanding densities and spectra of CR in different places of our Galaxy. The derivation of both spectra depends on model assumptions.

Until very recently it was believed that CR as directly measured were resembling CR throughout the Galaxy, after accounting for solar modulation and propagation effects. However, present precise data and sophisticated modeling are posing significant challenges. If interstellar CR spectra just outside the heliosphere and in the local medium are the same is a question that has recently opened again.

We present here our effort in answering this question and our recent results.

What we will present:

We used local multimessenger observations from radio to gamma rays, CR direct measurements and propagation models to obtain CR spectra in the local interstellar medium. In particular we obtained the best local e^+e^- spectrum that fits direct CR measurements, synchrotron, and gamma rays. And this spectrum is independent from solar modulation assumptions, and it also provides information on the propagation scenarios.

We have also obtained the best local proton spectrum that fits local gamma ray data. We concluded that if the local emissivity data are correct the measured AMS02 proton spectrum is not representative for the spectrum in the ~ 1 kpc region, even after correcting for solar modulation effects.