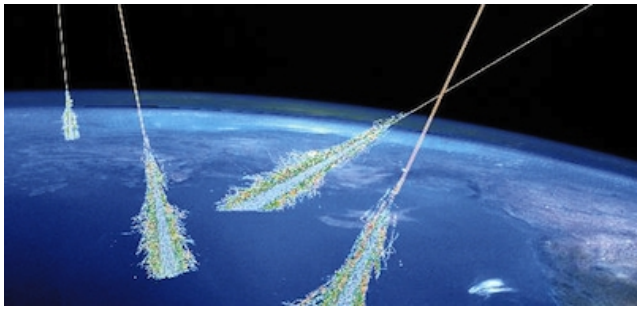

Spectral Breaks as a Signature of Cosmic Ray Induced Turbulence in the Galaxy

Pasquale Blasi, Elena Amato, and Pasquale D. Serpico, Phys. Rev. Lett. 109, 061101 (2012).

This article has been selected as a special highlight in Physics Synopsis

Cosmic Rays propagate in the interstellar medium *diffusively*, i.e. by scattering with magnetic inhomogeneities. How the power in such magnetic waves is distributed at different length scales determines the energy dependence of the cosmic ray diffusion coefficient. This property, together with the cosmic ray injection spectrum, determines in turn the cosmic ray spectrum measured at the Earth.

But what is responsible for the properties of magnetic inhomogeneities? It is generally believed that power injected by astrophysical shock waves (likely created in supernova explosions) and then reprocessed by "universal" turbulent phenomena is responsible for a sort of external, passive background of magnetic fluctuations onto which cosmic ray diffuse. This is simply fit to the data with parametric functions, usually a single power-law.

In a recent article published in Phys. Rev. Letters, P. Blasi and E. Amato of the Observatory of Florence and P. Serpico of LAPTh have shown that this picture changes when accounting for *self-induced turbulence*
, i.e. for magnetic waves generated the cosmic rays themselves. Given the observed properties of Cosmic Rays at the Earth and the known values of interstellar medium parameters, the energy dependence of the diffusion coefficient should change below a couple of hundred GeV, while turbulence in preexisting magnetic fields dominates diffusion above this energy.

Interestingly enough, several experiments, including the earth-orbiting satellite PAMELA, have recently observed that the cosmic ray flux falls off slightly faster with energy below 230 GeV, as expected in this theory if injection spectra are universal. Other spectral features inferred at low

energies from diffuse Fermi gamma ray data may be also consistent with a universal cosmic ray momentum spectrum at injection, if one accounts for a transition from diffusive to convective propagation, again with a magnitude consistent with simple astrophysical estimates.
This new paradigm has several important implications for example for the energy behavior of cosmic ray secondary to primary ratios, as well as for the expected anisotropy level in cosmic rays. Such measurements will be soon achieved with exquisite precision by the AMS-02 detector on board the International Space Station.

The article has appeared in Phys. Rev. Lett. 109, 061101 (2012).

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It can be found on the arXiv. e-Print: **arXiv:1207.3706** **[astro-ph.HE]** **PDF**

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