

Cosmic Rays in Random Magnetic Field

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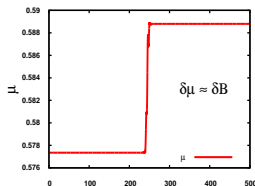
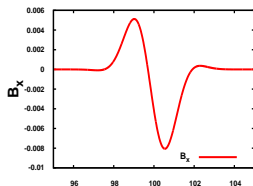
Magnetic Field in the Universe V
IESC, Corsica, France

Pitch Angle Scattering of Cosmic Rays (CR)

Problem: CR propagation is usually analyzed in idealized random magnetic fields (synthetic turbulence)

Aim: Derive cosmic ray diffusion tensor in realistic magnetic fields (dynamo, intermittency, shock compression...)

Pitch Angle Scattering:



$$\mu = \cos(\theta) = \vec{p} \cdot \vec{B} / |\vec{p}| |\vec{B}|$$
$$s = \omega_L t$$

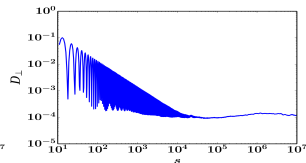
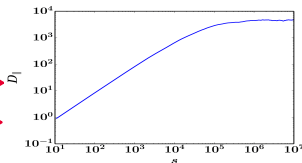
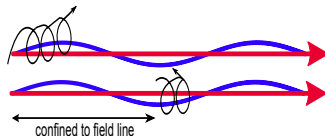
$$\Delta p_z = e \int \left(\frac{\vec{v} \times \vec{B}}{c} \right)_z dz \implies \delta\theta = -\pi \left(\frac{\delta B}{B} \right) \cos(\phi') \implies \text{diffusion in } \vec{x} \text{ space}$$

This work: Compute CR diffusion tensor from trajectories in random magnetic fields.

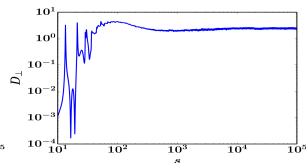
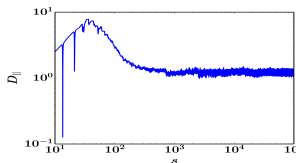
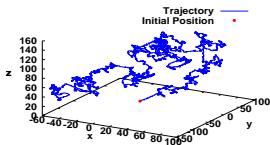
- Track positions of 1024 particles
- $\delta B/B$ of the hot ISM (i.e. most efficient scattering)
- Pitch Angle Scattering: After every Larmor time, a random wave phase is chosen for each particle and then its momentum vector rotated by $\delta\theta$
- Calculated diffusion tensor, \parallel and \perp to the local magnetic field

Results for simple field configurations

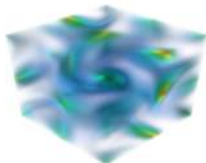
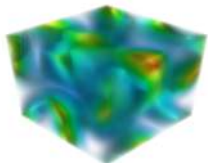
Constant magnetic field:



ABC magnetic field:



Solving Induction equation (changing Rm , structure changes):



Effect of:

- Intermittency ?
- Levy flights ?