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Superdiffusion to normal diffusion: particle motion in three-dimensional force-free magnetic fields F. HOLGUIN, A.K. RAM, MIT, V. KRISHNAMURTHY, George Mason, B. DASGUPTA, CSPAR, Alabama — Magnetic fields in regions of low plasma pressure and large currents, such as in interstellar space and gaseous nebulae, are force-free as the Lorentz force vanishes. The Arnold-Beltrami-Childress (ABC) field is an example of a three-dimensional, force-free, helical magnetic field. The field lines form complex and varied structures in space that are a mix of regular and chaotic lines of force. Charged particles moving in the region of chaotic field lines exhibit anomalous superdiffusion [1]. The sine field, or the Archontis field, is a special case of ABC field with the cosine terms left out. The lines of force of a sine field are completely chaotic in space. However, the diffusion of particles in the sine field is normal. The time evolution of an ensemble of particles can be divided into three domains. For short times, the motion is essentially ballistic. For intermediate times, the motion is characterized by a decay of the velocity autocorrelation function. For longer times, the particles undergo diffusion. We present results on the diffusion of field lines, and of particles, in the ABC and sine fields. In particular, the transition from superdiffusion to normal diffusion is discussed.

[1] A.K. Ram *et al.*, *Phys. Plasmas* **21**, 072309 (2014).

Abhay Ram
Massachusetts Inst of Tech-MIT

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