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Chirality evolution in plasma with magnetic monopoles

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We study the electrodynamics of the chiral medium with electric and magnetic charges using the effective Maxwell–Chern–Simons theory extended to include the magnetic current. The exchange of helicity between the chiral medium and the magnetic field, known as the inverse cascade, is controlled by the chiral anomaly equation. In the presence of the magnetic current, the magnetic helicity is dissipated, so that the inverse cascade stops when the magnetic helicity vanishes while the chiral conductivity reaches a non-vanishing stationary value satisfying $\sigma_\chi^2 < 4\sigma_e\sigma_m$, where σ_e , σ_m and σ_χ are the electric, magnetic and chiral conductivities respectively. We argue that this state is superconducting and exhibits the Meissner effect for both electric and magnetic fields. Moreover, this state is stable with respect to small magnetic helicity fluctuations; the magnetic helicity becomes unstable only when the inequality mentioned above is violated.

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