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Self-Organization and Turbulent Transport in Partially Magnetized Plasmas with Crossed Electric and Magnetic Fields[1]

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Partially magnetized plasmas with crossed electric and magnetic fields are of interest for a number of applications in plasma material processing, electric propulsion, and space physics. In such plasmas, external electric field and weak ion magnetization result in large equilibrium flows of electrons and ions that lead to a number of instabilities and turbulent transport. In this talk, nonlinear simulations demonstrating self-organization and anomalous transport in partially magnetized plasma with crossed electric and magnetic field are presented. The turbulence simulations show complex interaction of small scale modes with large scale zonal flow modes, vortices, and streamers resulting in strongly intermittent anomalous transport that significantly exceeds the classical collisional values. The development of large scale structures and flows is shown to occur as a result of the inverse energy cascade from short wavelength instabilities. The turbulence driven secondary instabilities and large scale structures are shown to dominate the anomalous electron current which is strongly intermittent. Such anomalous transport and structures are consistent with a number of experimental observations in laboratory plasmas, in particular, the plasmas relevant to electric propulsion devices.

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