Energy Transport Driven by Electron Temperature Gradients

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An experimental study is made of the heat transport associated with controlled electron temperature gradients established in a large magnetized plasma. The phenomena investigated illustrates processes encountered in magnetic fusion as the development of broadband turbulence and increased electron heat transport closely follows the profile evolution. Axial and transverse electron temperature gradients are established in the LAPD-U device by injecting a narrow electron beam into a cold afterglow plasma. The beam energy is less than the ionization energy of the background neutral gas and the conditions approximate a localized heat source embedded in an infinite, strongly magnetized plasma. For low heating powers and/or short times, classical heat transport prevails and temperature gradients are formed both parallel and perpendicular to the applied magnetic field. As the heating power is increased, flows develop and drift-Alfvén waves become unstable. Late in time these features evolve into broadband turbulence and result in anomalous transport that exhibits various spatio-temporal patterns. This study focuses on the properties of the spectral features that trigger the transition from coherent fluctuations to broadband turbulence.