Electron Temperature Fluctuations and Cross-Field Heat Transport in the Edge of DIII-D*

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Electron temperature (T_e) fluctuations and cross-field heat transport have been studied in edge and scrape-off layer (SOL) plasmas in the DIII–D tokamak using a reciprocating Langmuir probe array equipped with a fast (100 kHz bandwidth) T_e diagnostic [1]. T_e fluctuations in DIII–D have relative root-mean-square (RMS) levels ranging from 0.1–0.2 at the separatrix to 0.5–0.6 in the SOL, comparable to the respective levels of the density and floating potential (V_f/T_e) fluctuations. At frequencies below 30 kHz electron temperature fluctuations tend to be approximately in phase with both the electron density and the poloidal electric field fluctuations. Both convective (associated with the turbulent particle flux) and conductive (due to correlation between T_e and poloidal electric field fluctuations) terms of turbulent heat flux were measured in L– and low power H–mode discharges. In H–mode the two terms are comparable near the separatrix and fall off rapidly with radius. In L–mode the convective term is usually larger than the conductive one and radial decay is much slower. Though T_e fluctuations are broadband with significant energy throughout the measurable range (up to 100 kHz), most of the heat transport occurs at frequencies below 30 kHz. Time-resolved heat flux has "bursty" character with up to 50% of the total flux carried by intermittent large amplitude (> 10 times the average level) events. In H–mode significant part of the heat flux is often driven by coherent or quasi-coherent modes localized near the separatrix. Total heat flux through the separatrix at the probe location (near outer mid-plane) in L–mode and low-power H–mode shots is typically around 10 W/cm^2 which is higher than expected from the power balance assuming poloidally symmetric transport. Possible explanations of this discrepancy including poloidal asymmetry of the transport and various corrections to the flux measurements are discussed.

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