Evolution of the turbulence radial wavenumber spectrum near the L-H transition in NSTX Ohmic discharges* EX-C

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The measurement of radially extended meso-scale structures such as zonal flows and streamers, as well as the underlying microinstabilities driving them, is critical for understanding turbulence-driven transport in plasma devices [1]. In particular, the shape and evolution of the radial wavenumber spectrum can indicate details of the nonlinear spectral energy transfer [2], the spreading of turbulence [3], as well as the formation of transport barriers [4]. In the National Spherical Torus Experiment (NSTX), the FMCW backscattering diagnostic [5] is used to simultaneously probe the turbulence radial wavenumber spectrum (k_r =0-22 cm^{-1}) across the outboard minor radius near the L- to H-mode transition in Ohmic discharges. During the L-mode phase, a broad spectral component (k_r~2-10 cm^{-1}) extends over a significant portion of the edge-core from R=120 to 155 cm (ρ=.4-0.95). At the L-H transition, turbulence is quenched across the measurable k_r range at the ETB location, where the radial correlation length drops from ~1.5 to 0.5 cm. The k_r spectrum away from the ETB location is modified on a time scale of tens of μs, indicating that nonlocal turbulence dynamics is playing a strong role. Close to the L-H transition, oscillations in the density gradient and edge turbulence quenching become highly correlated. These oscillations are also present in Ohmic discharges without an L-H transition, but are far less frequent. Similar behavior is also seen near the L-H transition in NB-heated discharges.

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