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Toroidally Localized Turbulence with Applied 3D Fields in the DIII-D Tokamak

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When resonant magnetic perturbations are applied to suppress edge localized modes using the internal coil set in the DIII-D tokamak with toroidal mode number $n=3$, measurements of density fluctuations at toroidally separate locations using beam emission spectroscopy (BES) and Doppler back-scattering show larger fluctuation amplitudes in one toroidal phasing than the other. This relationship is consistent regardless of the amplitude of the applied $n=3$ field, whereas the global density confinement characteristics change, demonstrating a decoupling of the locally measured density fluctuations from the globally observed density pumpout. Plasma rotation and E_r scale with the amplitude of the applied field and with density pumpout, indicating that changes in rotation shearing are not responsible for the observed changes to the turbulence. Although changes to the magnetic flux surface shaping are small, changes to the density within a surface based on 2-fluid M3D-C1 simulations are large enough to significantly alter the density gradient scale length. Flux bundles with modeled increases to the density gradient scale length correspond to those with increased fluctuation amplitudes. Reflectometer measurements in a geometrically similar location as BES observe an increase in the gradient scale length in the same phases that BES observes larger amplitude fluctuations, in qualitative agreement with the M3D-C1 modeling, suggesting a possible mechanism for turbulence destabilization in toroidally localized flux tubes.

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