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Radial Localization of Toroidal Alfven Eigenmode in Tokamak Plasmas ZHIXUAN WANG, ZHIHONG LIN, WILLIAM HEIDBRINK, University of California, Irvine, BENJAMIN TOBIAS, Princeton Plasma Physics Lab, MICHAEL VAN ZEELAND, General Atomics — Toroidal Alfven eigenmode (TAE) with radially extended structures can be driven unstable by pressure gradients of energetic particles (EP). These unstable Alfveneigenmodes (AE) have been routinely observed in fusion experiments to induce a large EP transport, whichcould degrade overall plasma confinement and damagefusion devices.In the well-accepted paradigm,the growth rate of the AEs can be calculated from a perturbative EP contribution to a fixedmode structure and real frequency given by magnetohydrodynamic (MHD) properties of thermal plasmas. However, linear and nonlinear kinetic effects of both EP and thermal plasmasare important and should be treated on the same footing. The gyrokinetic simulation has thus emerged as anecessary and powerful tool for studying the linear andnonlinear dynamics of AEs. In the current work, the gyrokinetic toroidal code(GTC) linear simulation of the tokamak-experiment finds a radial localization of the TAE dueto the non-perturbative EP contribution. The EP-drivenTAE has a radial mode width much smaller than that-predicted by the MHD theory. The TAE radial positionpeaks at and moves with the location of the strongest EPpressure gradients. Experimental data confirms that the eigenfunction drifts quicklyoutward radially. The non-perturbativeEP contribution also breaks the radial symmetry of the mode structure and induces a TAE frequency dependence on the toroidal mode number, in excellent agreement with the experimental measurements.

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