Characteristics of tokamak edge-plasma turbulence from 3D simulations*

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Abstract

Edge-plasma turbulence plays key roles in determining when the edge pedestal can form, and in the amplitude and distribution of plasma fluxes to divertors and walls. We report on simulations using the 3D BOUT fluid code [1] as applied to present-day divertor tokamaks. BOUT is unique in spanning the magnetic separatrix, thereby including both the pedestal region and the scrape-off layer (SOL). Two aspects of the turbulence are focused on here. The first topic is the correlation between midplane turbulence and that in the divertor leg begun in Ref. 2. Detailed analysis with the GKV diagnostic package shows that the correlation is weak on flux surfaces very close to the separatrix, but partially returns on outer flux surfaces. This effect is anticipated based on magnetic shearing of the flux tube near the X-point. The shearing can produce an effective resistive layer near the X-point, driving both midplane modes and divertor-leg modes [3]. The relation between these modes and the BOUT results will be discussed. The second topic is an examination of the character of the turbulence during evolution of the density profile owing to a particle source from neutrals that can lead to a density pedestal. The turbulence in these long-running cases is characterized by a reasonably steady fluctuation level, punctuated by occasion bursts that originate in the pedestal region and appear to propagate into the SOL. The nature and possible origin of these bursts will be discussed.

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*Work performed under auspices of US DOE by University of California Lawrence Livermore National Laboratory under contract No. W-7405-ENG-48 and is partially supported by LDRD project 03-ERD-009.

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