It is known that radially sheared zonal flows plays a significant role in nonlinear stabilization in tokamak plasmas.[1–3]. Through advection on the sheared zonal flows the turbulent structure in plasma gets deformed and tilted that causes an $E \times B$ nonlinearty.[2,4,5] Zonal flows mediate spectral energy transfer to larger radial wave vectors.[6–8] The strength of the shearing process is the $E \times B$ shearing rate $\omega_{\mathrm{E \times B}}$ which is the radial derivative of the advecting zonal flow velocity.[4,9] The shearing rate $\omega_{\mathrm{E \times B}}$ is defined as

$$\omega_{\mathrm{E \times B}} = \frac{1}{2} \frac{\partial^2 \langle \Phi \rangle}{\partial \psi^2} \tag{1}$$

where $\langle \Phi \rangle$ is the zonal electrostatic potential and ψ the radial coordinate that labels the flux surfaces.[10–12] It was shown that the nonlinear threshold for turbulence is directly related to shear stabilization.[3] Often the shear stabilization is expressed in the empirical Waltz rule $\omega_{\mathrm{E \times B}} \sim \gamma$,[9,13] where γ is defined as the maximum linear growth rate in the unstable mode. In the discovered zonal flows, also known as $E \times B$ staircase[14], exhibit amplitudes in terms of the $E \times B$ shearing rate satisfying the stabilization criteria.[10,15]

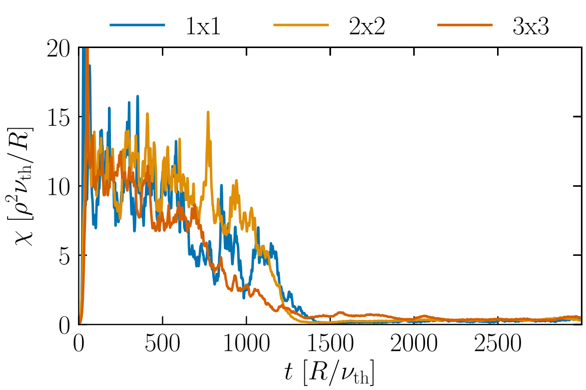

FIG. 1: Test

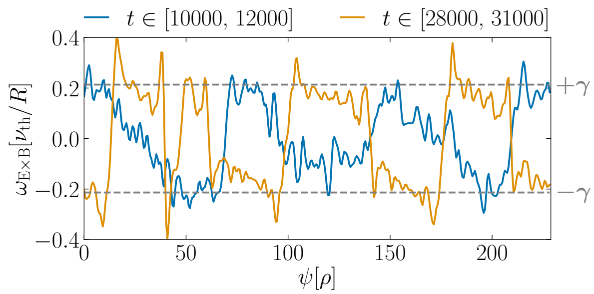

FIG. 2: Test

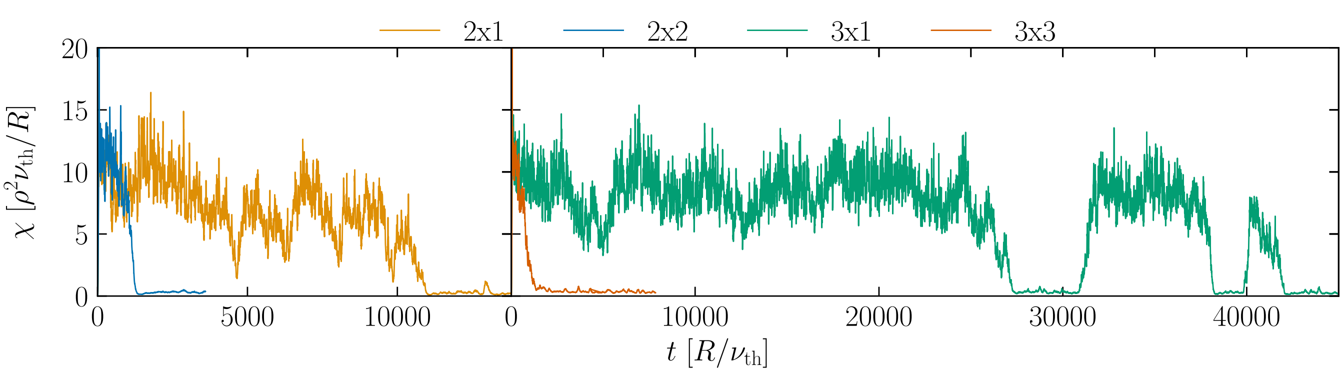

FIG. 4: Test

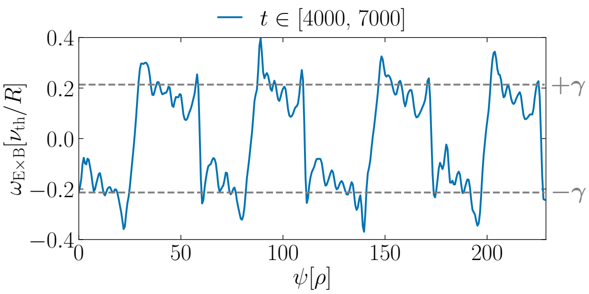

FIG. 3: Test

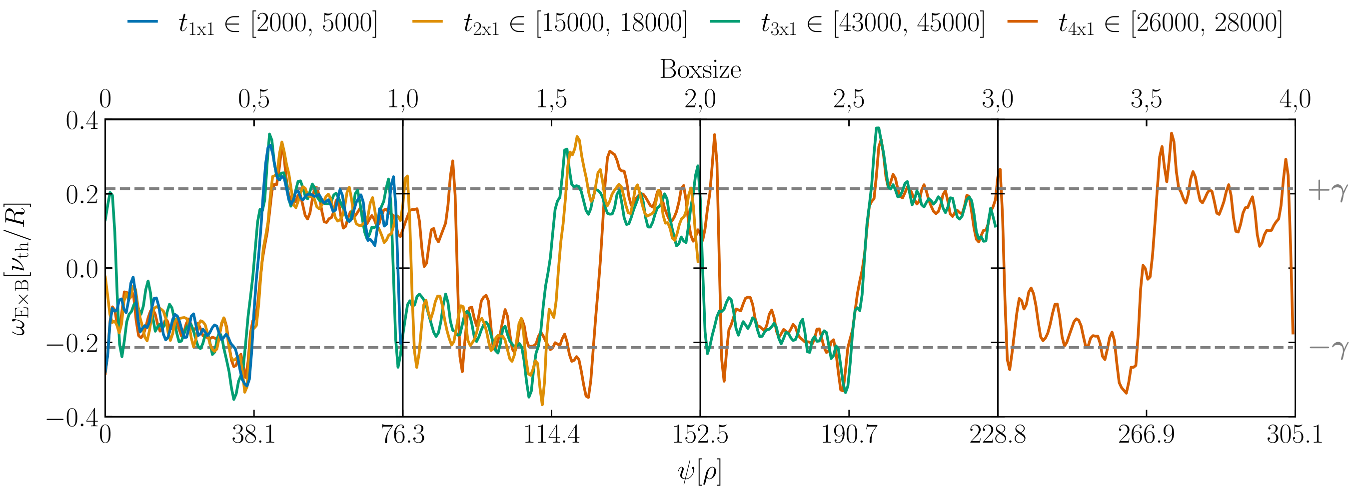

FIG. 5: Test

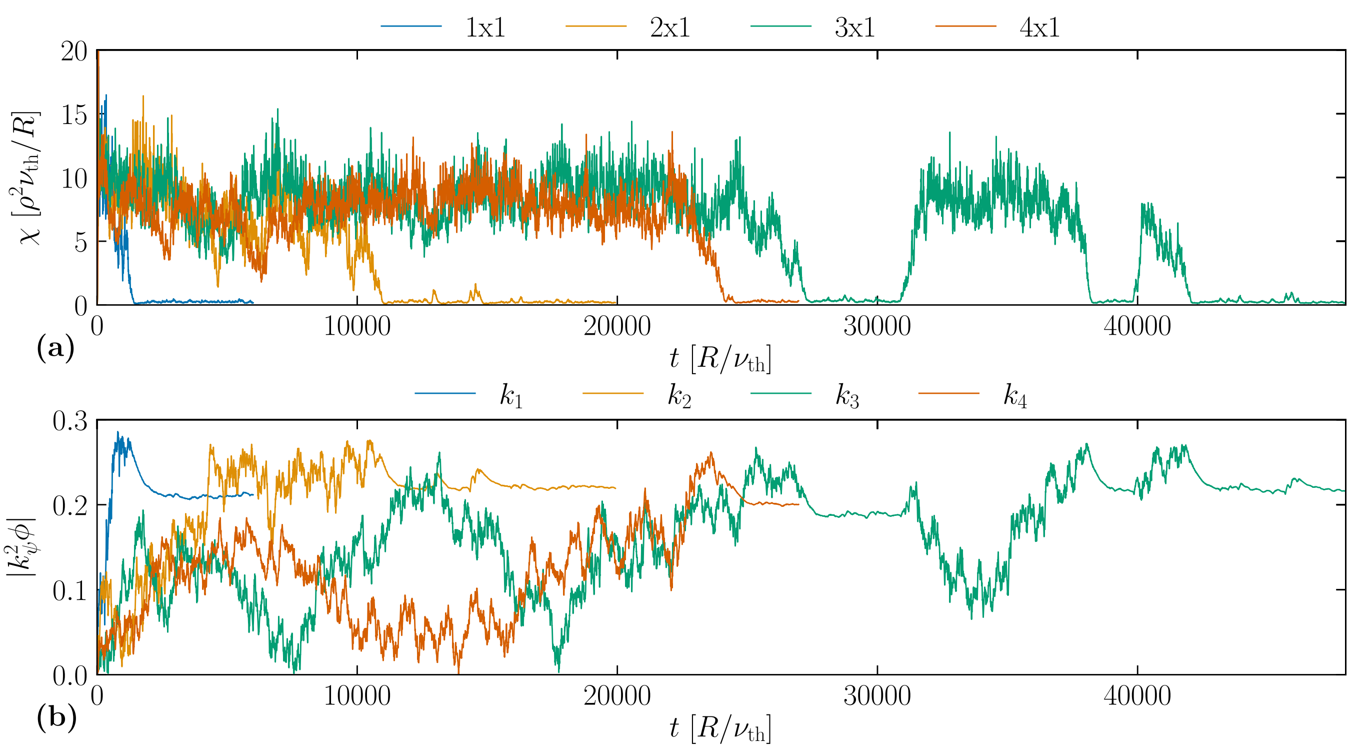

FIG. 6: Test

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Eq Row	0	0	7	13
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