Contribution ID: **661** Type: **Poster**

Correlation analysis based magnetic Kubo number estimation during pedestal collapse in BOUT++ simulation

Friday, October 26, 2018 2:00 PM (20 minutes)

We perform a correlation analysis to explore how the magnetic Kubo number evolves during and after an abrupt edge pedestal collapse generating stochastic magnetic fields in the simulation. During abrupt edge pedestal collapse caused by type-I ELM (Edge Localized Mode), the stochastic magnetic field is thought to be a possible way to induce significant cross-field diffusion. We analyze the results obtained by the numerical simulations performed within BOUT++ framework solving a set of three-field reduced magnetohydrodynamics equations for toroidally confined plasmas. We set the equilibrium pressure gradient to be much higher than the stability limit of the initially seeded ballooning mode. The magnetic Kubo number in our simulation is found not to exceed unity. This result indicates that the quasilinear Gaussian diffusion model, not percolation theory, is adequate to explain the cross-field diffusion. Radial correlation length of pressure fluctuations is highly correlated with radial width of the stochastic magnetic fields; while time evolution of poloidal correlation length of pressure fluctuations behaves like that of Chirikov parameter and Kubo number.

Country or International Organization

Korea, Republic of

Paper Number

TH/P8-4

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Session Classification: P8 Posters