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Observation of multi-scale turbulence and non-local transport in LHD plasmas[1]

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Recent studies of relation between heat/particle/momentum flux and temperature/density/flow gradient show that the flux is not necessarily determined by the local plasma parameters [1]. This violation of local closure in transport is accompanied by peculiar change in the amplitude of turbulent fluctuation. This talk reports recent experimental observations of multi-scale turbulence by the microwave diagnostics with high temporal and spatial resolution in LHD, and discusses its relation to non-local transport. These observations suggest that the micro turbulence in the plasma is coupled with meso- and macro-scale turbulence and it is strongly influenced by the plasma parameters at different and separated radii, which causes "non-local" transport. In order to investigate the response of multi-scale turbulence at the event of non-local transport phenomenon, (1) accurate measurements of the distinctive multi-scale turbulence, and (2) identification of the causal relationship between turbulence with different scale length, have been developed in LHD. In this paper, the following experimental results are discussed: (a) long range fluctuation, (b) hysteresis in the flux-gradient relation, and turbulence propagation after (c) an ELM collapse and (d) limiter biasing. Based on the high temporal spatial resolved turbulence measurements in LHD, how the multi scale turbulence plays a role on non-local of ballistic transport is documented.

[1] K. Ida, et al., Proc. 24th IAEA Fusion Energy Conference 2012 San Diego OV/3-4. "Towards an Emerging Understanding of Nonlocal Transport"

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