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Effects of Modulated Heat Source on Non-local Transport

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Recent study in LHD has shown a correlation between the period of modulated electron cyclotron heating (MECH) and non-local transport events. Moreover, when an avalanche is induced by a minor collapse of electron internal transport barrier, turbulence pulse propagates faster than heat pulse [1].

Inspired from the observations, we utilize the global full-F gyrokinetic code, GYSELA [2] to analyze non-local transport in the presence of modulated heat source, the period of which is in the range of transport timescale. In the near marginal stable case, it is observed that the localized and modulated heat source can establish temporal E×B staircase and trigger an avalanche-like transport. When heat source-stimulated avalanche occurs, propagation speed of turbulent fluctuations is faster than that of heat transfer.

To understand these effects, an analytic study was done to model turbulence spreading forced by modulated source using a two-field critical gradient model [3]. The propagation speed of turbulent fluctuations was found to be inversely proportional to the local pulse length. Since the growth of burst-like fluctuations is higher than the frequency of source, radial propagation of turbulent fluctuations is faster than that of heat transport.

References

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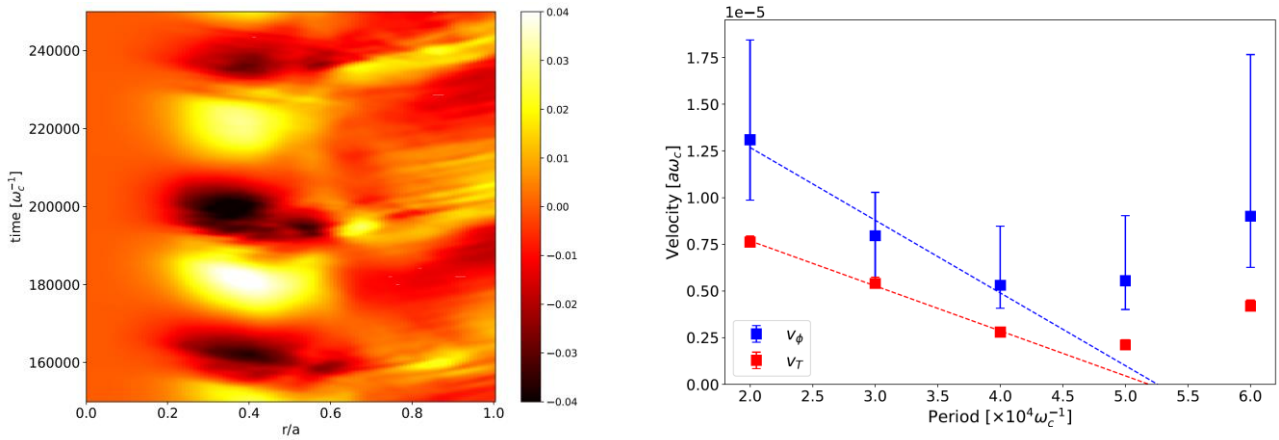

Figure 1 Time evolution of ΔT in the presence of modulated heat source, period of which is $4 \times 10^4 \omega_c^{-1}$(left) and propagation velocities of turbulence intensity and heat with respect to the period of modulated heat source (right). Here, non-local propagation speed is measured when turbulence spreading is dominant.