

Pattern transition of the 2D density fluctuation in the peripheral region of the LHD

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The radial transport of magnetically confined plasma is considered to be caused by fluctuations. Understanding the fluctuations and related transport is important to be studied. Rapid improvements in confinement have been observed in various regions of the magnetically confined plasmas. H-mode transition is a typical example and is observed near the tokamak peripheral region. Although extensive research has been conducted over the past several decades, not all aspects of the transition phenomena have been clarified.

In this study, we report the results of observations of transitions in the two-dimensional fluctuation patterns of the plasma in the Large Helical Device (LHD), where H-mode-like transitions are observed [1]. Though 2D fluctuation in the peripheral region is quite complicated, stripe-like fluctuations parallel to the magnetic field lines (left-bottom to right-top in the spatial component shown in Fig. 1 u1-u4) are observed using the Gas Puff Imaging system [2]. The change in the pattern can be understood by organizing it in terms of the time evolution of the wavenumber in the direction perpendicular to the magnetic field lines. From shortly before the H-mode transition, the fluctuations with higher mode-number

decrease, while the total fluctuation level increases. The direction of the perpendicular rotation of the fluctuations reverses with the transition, which is similar to the time evolution of the rotation measured by the reflectometer. Furthermore, the two-dimensional nature of the oscillation is changed, as the correlation length in the direction of the magnetic field lines becomes longer after the transition.

After the transition, the particle confinement is improved and the pressure gradient increases as well. Resistive interchange modes are thus excited and limit the increase in confinement improvements. When we observe out of the closed surfaces, oscillations of the plasma surface and emitting of the plasmoids are observed. It is possible that emitting is synchronized with bursts of magnetic field oscillations caused by resistive interchange mode.

References

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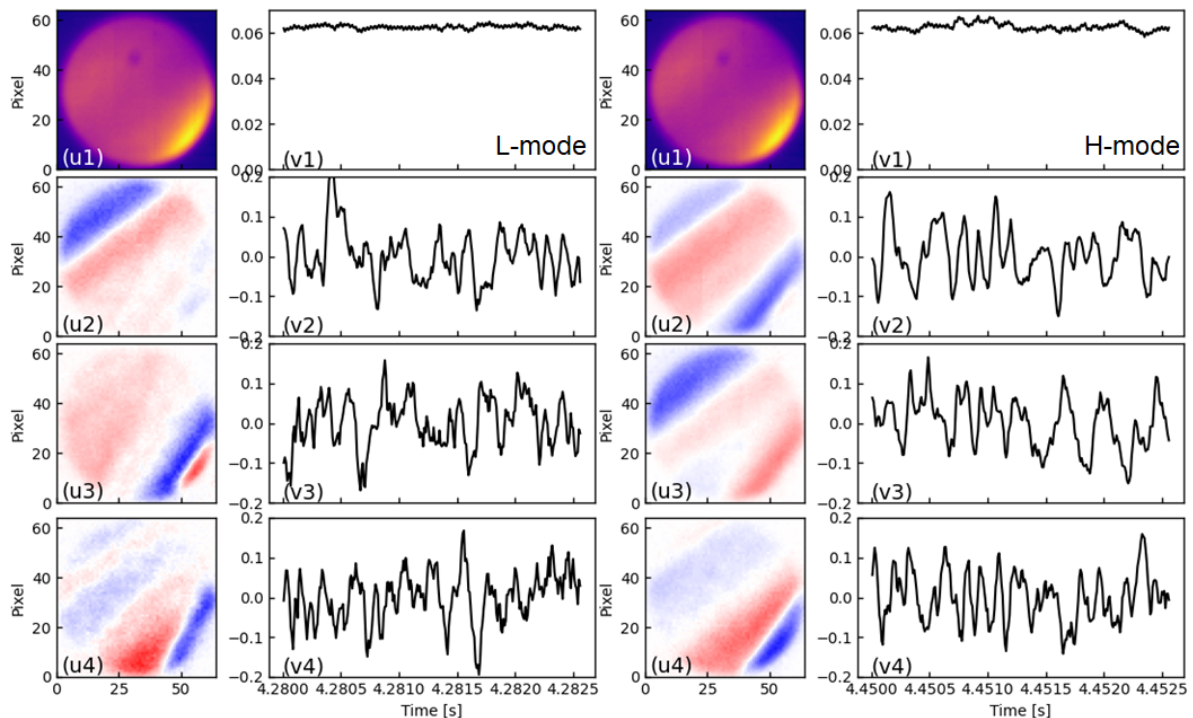


Figure 1: Singular-value decomposed images [3] of the GPI measurement. u1-u4 and v1-v4 are spatial and temporal component, respectively. Left/Right hand side figure shows images in the L/H mode, respectively.