§6. Observation of the Pre-Cursors in the Core Density Collapse Event

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Core density collapse (CDC) is a large-scale relaxation event observed in internal diffusion barrier (IDB) plasmas. It has been shown that the CDC appears where the ideal ballooning modes are unstable [1]. Pre-cursor oscillations just before the events are reported here.

Figure 1 shows the equilibrium using the pressure profile measured before the CDC. The rotational transform profile (Fig. 1(B) circles) measured by the MSE system agrees well with the calculated profile (solid line). The growth rate of ideal high–n ballooning mode is calculated using Hn-bal code [2] ; the ballooning mode is locally unstable around $\rho \sim 0.8$ (Fig. 1(D)). The magnetic shear is negative in that region; this mode might be high-n ballooning mode that is expected only in helical system.

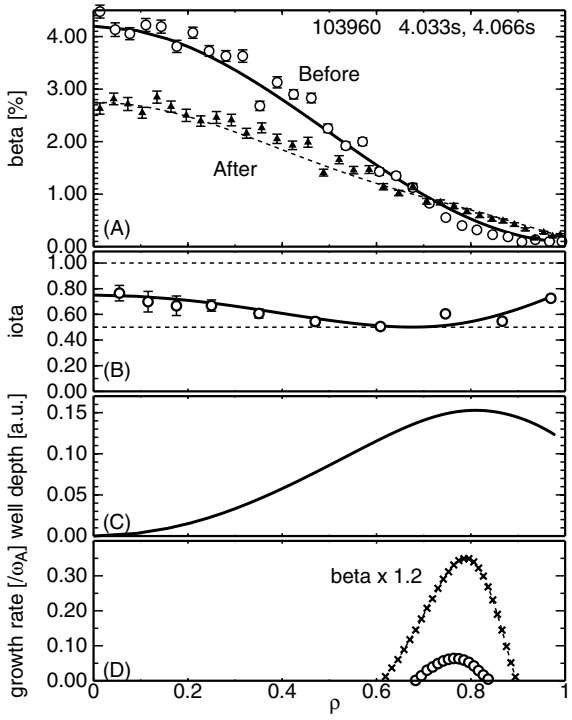

Fig. 1: *Equilibrium profile just before the CDC is shown. The beta profile (A), the rotational transform (B), the magnetic well depth (C) and the growth rate of the ballooning mode (D) are shown together.*

In the IDB plasmas, most of the diagnostics for fluctuations does not work due to the high electron density. However, we can compare the fluctuations at inboard and outboard side with an 80ch-CO_2 interferometer system [3]. The location of the chord and the flux surface are shown in Fig. 2(A). Coherent oscillations with a frequency of about 8kHz are observed at several hundreds of micro second before the events only in the outboard side of the plasma as is shown in Fig. 2(B). There are two peaks; while a larger peak ($\rho \sim 0.8$) agrees well with the prediction by the Hn-Bal code, other peak ($\rho \sim 0.3$) does not. One explanation is the line integration of the interferometer. The measuring chord around $\rho \sim 0.3$ also measures the edge region; fluctuations observed there might be caused by the edge oscillations. We need to study 3D mode structure to resolve this mystery.

In summary, relation of the CDC event and the high–n ballooning modes becomes more concrete since pre-cursor oscillations localized only in the outboard side are observed.

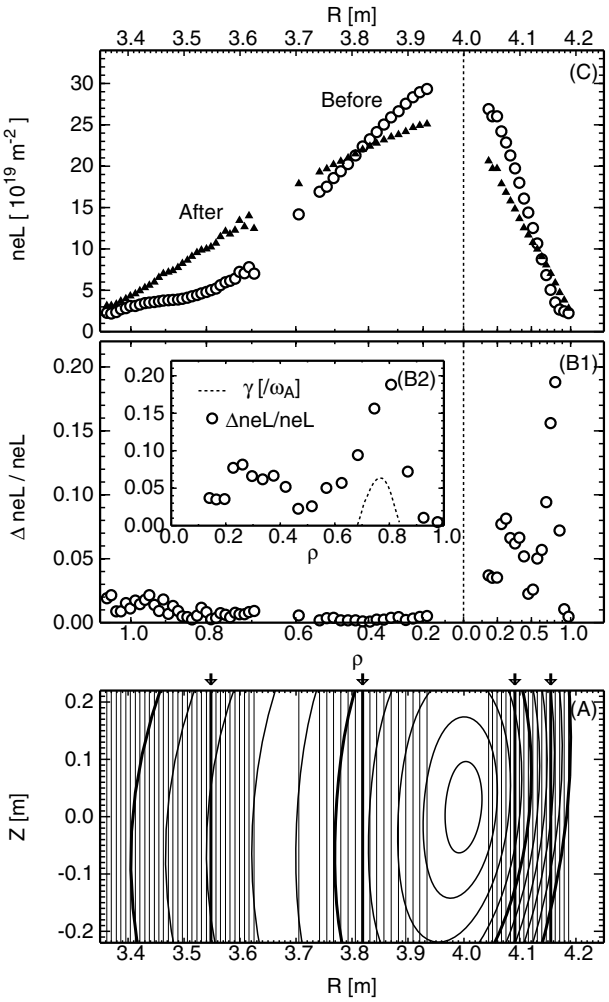

Fig. 2: *The flux surface and the location of the chord are shown in (A). The fluctuation level as a function of the major radius (B1) and of the averaged minor radius (B2) is shown. The line-integrated density profile is shown in (C).*

1) S. Ohdachi, et. al., Contrib. Plasma Phys. **50** (2010) 552.

2) N. Nakajima, et. al., Fusion. Sci. Tech. **51** (2007) 79.

3) K. Tanaka, et. al., Rev. Sci. Instrum. **75** (2004) 3429.