§7. Magnetic Axis Position Control for CDC Study

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Core density collapse (CDC) event is a large-scale relaxation event with so–called super dense core plasmas (SDC). They appear when the pressure profile is being peaked after pellet injection. The magnetic axis position exceeds 4.1m in horizontally elongated section when CDC happens. If the Shafranof shift is reduced by the vertical elongation, higher central beta with similar amount of shift are observed[1] when CDC occurs; this phenomena is related with the location of the magnetic axis rather than with the pressure gradient. Here, Using newly introduced polodal–coil power–supply system by which we can control the magnetic axis position, the boundary of the appearance of the CDC is studied in detail.

Figure 1(a) shows the time evolution of plasma parameters. After the ice–pellet injection, high–central–beta plasma is formed. In this reference discharge where the vacuum (preset) magnetic axis R_{ax0} position is kept constant (3.75m), the peaking is broken by a CDC event (2.07s). Eight ice–pellet is injected in this condition. R_{ax0} is then changed as is shown in the Fig 1(b). At the timing of the CDC in the reference, R_{ax0} is located from 3.67m to 3.79m.

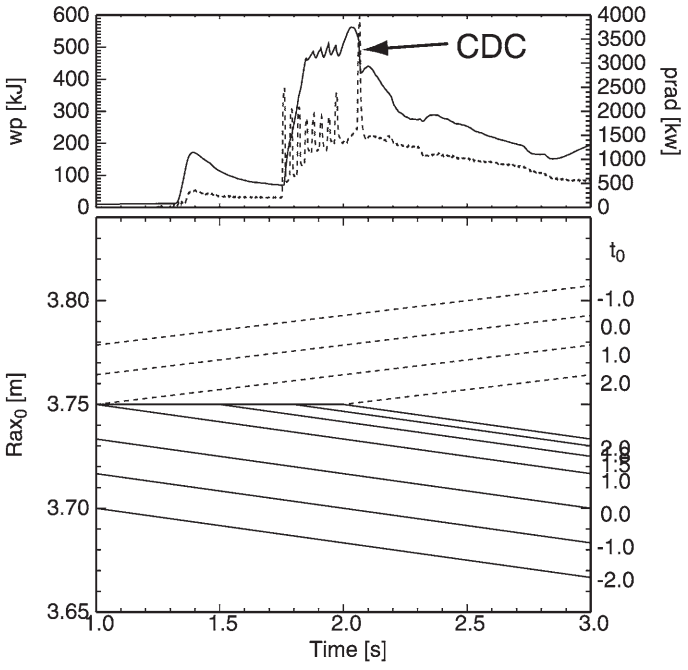

Fig. 1: *Time evolution of the plasma parameter of the high–central–beta discharges. Time evolution of the vacuum magnetic axis position is also shown in the lower figure.*

When R_{ax0} is shifted inward, the timing when CDC appears is delayed, though the central–beta is almost kept constant. After R_{ax0} is smaller than 3.7m, no CDC is observed. When R_{ax0} is shifted outward, CDC is easily triggered. Even when the number of the pellet is reduced to six, CDC occurs with when R_{ax0} reaches 3.9m. The central–beta as a function of the magnetic axis position is shown in Fig. 2. This figure shows that the condition for the appearance of the CDC is strongly depends on the magnetic axis position rather than the central–beta or the pressure gradient.

Mechanism of the CDC has not been clarified. However, pre–cursor oscillations are sometimes observed[2]. And when the collisionality is reduced, we observe MHD activities with a poloidal/toroidal mode number m/n = 1/1. It is reasonable CDC is caused by the pressure driven MHD modes. However, the dependence on the magnetic axis position suggests that the change of the unknown plasma parameter strongly related with magnetic axis position, e.g. the magnetic shear, affects the condition of the appearance of the CDC. Systematic survey including the realistic equilibrium construction is needed to explain the experimental result. Comparison of the growth rate of MHD instabilities, e.g. the ballooning modes, with experiments is also in progress.

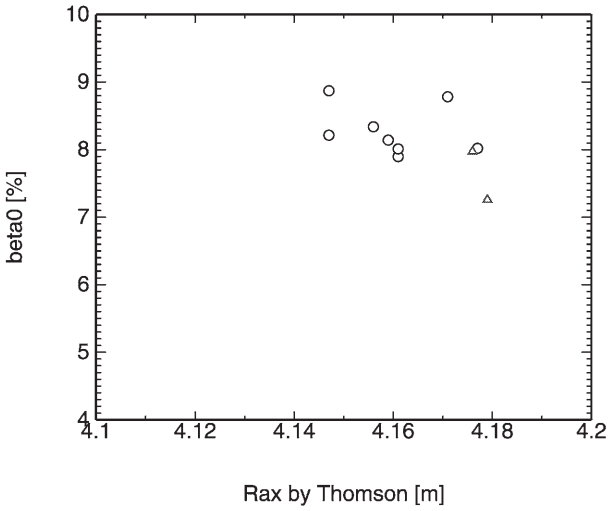

Fig. 2: *Central beta as a function of the magnetic axis position determined by the electron temperature prorile is shown when the CDC event occurs. Red triangle shows the outer–shifted case with 6 ice–pellet injection.*

1) R. Sakamoto, et. al, in Proc. 22th IAEA FEC Conference, Geneve, 2009, EX/8-1Ra

2) S. Ohdachi, et. al, in Proc. 22th IAEA FEC Conference, Geneve, 2009, EX/8-1Rb