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RELAXにおけるサドルコイルアレイを用いた抵抗性壁不安定性(RWM)のフィードバック制御
Feedback control of resistive wall mode (RWM) using saddle coil array in RELAX

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The reversed field pinch (RFP) is one of the magnetic confinement concepts for high-beta plasmas. The great advantage of the RFP is it requires weak external toroidal field. RELAX [1] is a low-aspect-ratio experiment (R/a = 0.5 m/0.25 m, $Ip \leq$ 120 kA, $T_{e0} \leq$ 200eV, $n_e \leq 10^{19}m^{-3}$) whose objectives include geometrical optimization of the RFP configuration.

RELAX is equipped with 64 saddle coils (4 in poloidal and 16 in toroidal direction) covering the whole torus on the outer surface of the vacuum vessel. Following the initial stabilization experiment of the single m/n=1/2 resistive wall mode (RWM) with two power supplies and series-connected sensor and actuator saddle coils for active stabilization [2], we modified our control system in order to compensate for the sideband effect arising from two poloidal gaps of the vacuum vessel. In the modified control, additional 6 power supplies control locally the m=1 component at the two poloidal gaps where residual poloidal current in the flanges generated fictitious n=2 magnetic field component. As a result the modification, the discharge duration has been further improved with lower m=1/n=2 field component in the current rise and flat-topped phase [3], as shown in Fig.1.

For further improvement for stabilizing effect and increased flexibility of the control system, we have been developing a new PD controller; 64 saddle coils are powered by 64 independent audio power amplifiers with the controllers. A preliminary test has been performed at one of the 16 poloidal segments; top and bottom coils are connected in series and driven by a single power supply, while inboard and outboard side coils are driven by two independent power supplies and controllers respectively. Figure 2 shows dependence of the sensor signal on the proportional gain at the outboard side saddle coil.

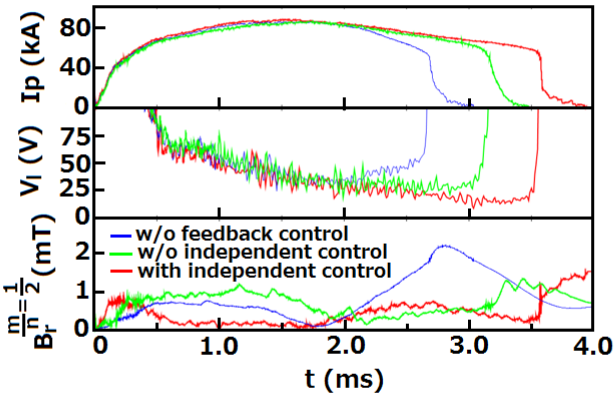

Fig.1. Time evolution of the plasma current, toroidal loop voltage and m/n=1/2 mode amplitude measured with sine and cosine coils for Br on the outer surface of the vessel. A slight increase in Br with previous feedback control (green), is suppressed in the current rise phase by modifying the control system (red), indicating successful compensation for the sideband effect.

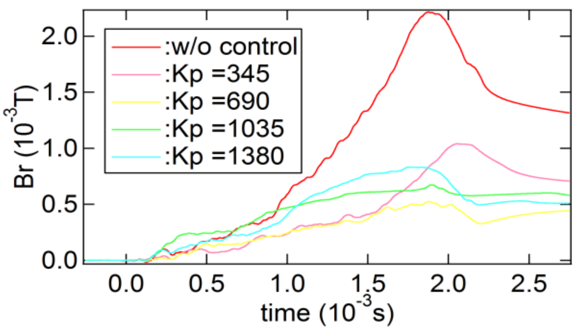

Fig.2. Dependence of the sensor output signal on the proportional gain at the outboard side saddle coil in one of the 16 toroidal segments.

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