28E12P

RELAXプラズマのパラメータ領域
Plasma Parameter Regimes in RELAX

田中裕之[1]，出口和明[1]，中木聖也[1]，西村香苗[1]，三瓶明希夫[1]，比村治彦[1]，政宗貞男[1]，
江尻晶[2]，川端一男[3]，秋山毅志[3]，D. J. Den Hartog[4]，小口治久[5]
Hiroyuki Tanaka, Kazuaki Deguchi, Seiya Nakaki, Kanae Nishimura,
Akio Sanpei, Haruhiko Himura and Sadao Masamune et al.

[1]京都工芸繊維大学，[2]東京大学，[3]NIFS，[4]ウィスコンシン大学，[5]産総研
[1]Kyoto Institute of Technology, [2]The Univ. Tokyo, [3]National Institute for Fusion Science,
[4]Univ. Wosconsin , [5]National Institute of Advanced Industrial Science and Technology

1． Introduction

The reversed field pinch (RFP) is one of the magnetic confinement systems for fusion energy research. The RFP, high beta plasmas can be confined with weak external magnetic fields; magnetic pressure at the toroidal field coils is about 1/10 of that in tokamaks. The RFP thus has a potential for commercially attractive fusion reactor.

Some theories have predicted that pressure driven bootstrap current fraction increases as the aspect ratio A is lowered; an equilibrium analysis has shown that the bootstrap fraction higher than 90% is expected, if the beta value of ~60% could be achieved in reactor-relevant plasmas. Thus, the aspect ratio is an important parameter for optimization of the RFP configuration.

2． RELAX machine and diagnostics

RELAX is a RFP machine at Kyoto Institute of Technology. It uses a SS vacuum vessel with major radius R of 0.5m, and minor radius a, 0.25m. Major objectives of RELAX includes the MHD studies in low-A RFP configuration, experimental verification of the bootstrap current in the RFP configuration by achieving the beta values of 20-30%. For the latter experiments, the target (achieved) plasma parameters are as follows: pasma current Ip~100kA(125kA), entral electron temperature Te(0)~200-300eV (150eV), with line-averaged electron density $n_e \sim 2\text{-}4 \times 10^{19}\text{m}^{-3}$ ($2 \times 10^{19}\text{m}^{-3}$).

Equilibrium and MHD stability control systems characterizing the RELAX machine are as follows: passive equilibrium control with distributed poloidal windings for Ohmic heating, feedback controlled saddle coils at the insulated poloidal gaps to compensate for the m=1 field errors localized at the gaps, and saddle coil array (×16 toroidally , ×4 poloidally) for feedback control of MHD instabilities.

Thomson scattering system using a Nd:YAG laser can measure the central electron temperature, and a 104GHz interferometer provides the line-averaged electron density. Some soft-X ray (SXR) diagnostics such as a high-speed SXR pin-hole camera and 20 chord photo-diode arrays with thin-foil filters, have provided electron pressure profile information.

3． Results

Figure 1 shows an example of 100kA discharge. The feedback control of a single MHD mode (m=1/n=2 RWM in this case) is inevitable in achieving discharges longer than ~2ms. Figure 2 shows the central electron temperature measured at 1ms into the discharge vs. plasma current. The electron temperature increases with plasma current, and ~150eV at Ip~100kA. The achieved parameter regimes are as follows: Ip~125kA, $n_e \sim 0/2\text{-}2.0 \times 10^{19}\text{m}^{-3}$, Te(0)~150eV, and discharge duration ~3ms. Further optimization of the discharge is in progress for improving the plasma performance particularly at high current (Ip>100kA) regime.

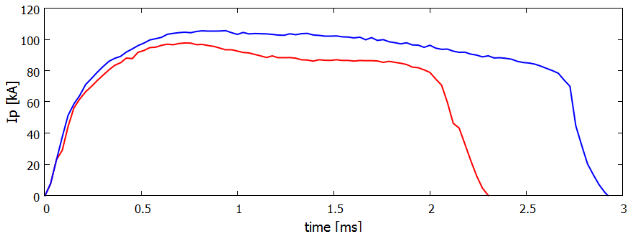

Fig.1：feedback control effect
(red：without control, blue: with control)

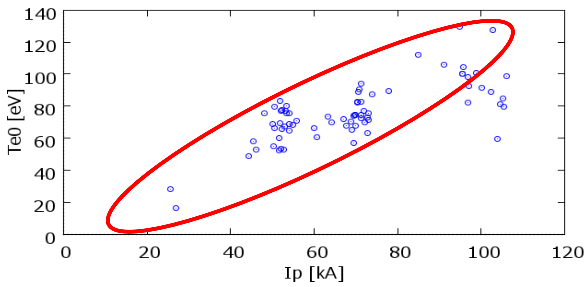

Fig.2：Electron temperature obtained by Thomson scattering system