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TS-6合体実験における
オブレートな磁場反転配位の生成と中性粒子ビーム入射

Oblate FRC Formation and Neutral Beam Injection in the TS-6 Merging Experiment

蔡雲漢, 田中遥暁, 土井久瑠美, 田辺博士, 小野靖
Yunhan Cai, Haruaki Tanaka, Kurumi Doi,
Hiroshi Tanabe, Yasushi Ono
東京大学
The University of Tokyo

1. Introduction

An oblate FRC is susceptible to low-n MHD instabilities, but research showed that it can potentially be stabilized with close-fitting shells, and NBI effects [1]. Past studies in TS-4 tested this assumption but stabilization was limited due to low NBI efficiency caused by inserted magnetic probe arrays [2]. It has also been shown that inductive sustainment [3] can help stabilize and sustain an oblate FRC.

In this study, we have established an experimental platform for future testing of global MHD modes stabilization of an oblate FRC in the TS-6 merging device using NBI (with the option of using non-invasive magnetic diagnostics) and inductive sustainment. Results of oblate FRC formation and Monte Carlo simulation of NBI applications to the FRC are presented in the poster.

2. Spheromak merging formation of FRC

TS-6 is a ST/CT device with aspect ratio ~1.5. Oblate FRC formation is enabled by counter-helicity merging of two spheromak plasmas formed with flux-core coils at $z = \pm 0.35m$ and $r = 0.22m$. Separation coils at $z = \pm 0.21m$ and $r = 0.31m$ are utilized to regulate merging speed and to work as shaping coils. Magnetic probes inserted through glass tubes are used to diagnose the plasma. Figure 1 shows the magnetic probe and coil as well as wall locations in the background of a sample of FRC equilibrium profile. Figure 2 shows the Bt contour, poloidal flux contour and ion temperature of merging spheromaks. Annihilation of Bt suggests successful formation of FRC. Significant Ion heating up to 200eV is observed.

Magnetic probes are easily retractable to the edge in either Z or R direction. This setup is used to establish a noninvasive equilibrium reconstruction method by testing the model with probes inserted.

3. NBI calculation

A washer gun type NBI (15kV, 40A) similar to the one used in TS-4 [2] is being installed in the lab. A Monte Carlo orbit simulation code (Figure 3 shows typical orbits) is used to verify the applicability of the NBI system to the oblate FRC experiment, by using the equilibrium profile calculated from experimental data. Particle shine through rate and particle trap rate calculations will be shown in the poster.

In addition, effects of beam current on the equilibrium profile and the implications regarding equilibrium reconstruction will be discussed.

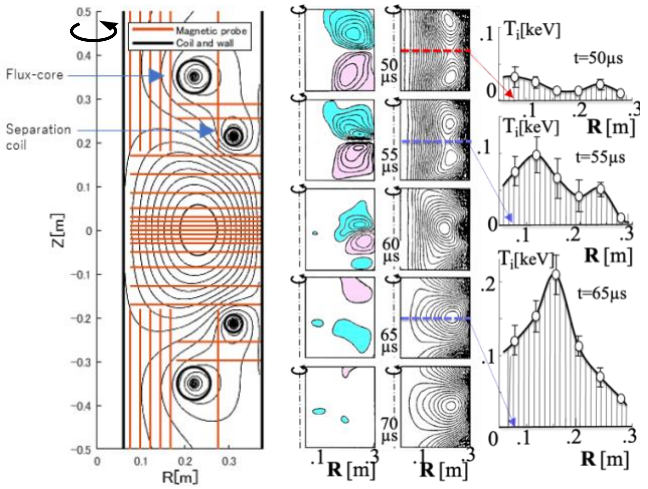

Fig.1: Magnetic probe setup in the TS-6 device.

Fig. 2: Bt contour and poloidal flux contour with Ti for spheromak merging.

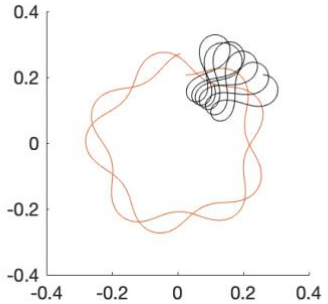

Fig. 3: Simulated examples of typical fast ion orbits (FRC with E～1.1, flux～10mWb; beam energy15keV).

Reference

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[2] T. Ii, *et al.*, Nucl. Fusion **53** 073002 (2013)
[3] Y. Ono, *et al.*, Plasma Physics and Controlled Nuclear Fusion Research **2** 619-625 (1993)