

Edge current density distributions in the island divertor configurations on the J-TEXT tokamak

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1. Motivation

It's common to observe currents flowing in the Scrape-Off Layer (SOL) in divertor tokamaks. Measurements and calculations of SOL currents have been conducted in poloidal divertor configurations (which have a two-dimensional magnetic field structure) [1~3], but less emphasis in three-dimensional (3D) magnetic topology. The 3D boundary in the tokamak is attracting more attention. On the one hand, it helps control boundary instability, such as Edge Localized Modes (ELMs); on the other hand, it contributes to impurity screening and divertor heat dissipation. The edge current and its profile will change after the formation of a 3D boundary. And it will have an effect on the stability and transport.

The island divertor configurations were recently operated on the J-TEXT tokamak. The flexible Resonant Magnetic Perturbation (RMP) system enables it to operate with various boundary magnetic field configurations. Meanwhile, a probe called directional electron probe (DEP) is used for measuring current distributions at the plasma boundary in the device, which has been used in EAST and W7-X [4, 5]. The edge current profile and plasma parameters have been measured by DEP with different 3D magnetic structures. This result can help improve understanding the effect of 3D plasma boundary.

2. Experimental Set-up

The J-TEXT tokamak is a medium-sized device with a major radius $R=1.05\text{m}$ and a minor radius $a=0.22\text{m}$. The RMP coils on J-TEXT consist of 24 in-vessel saddle coils [6]. The $m/n=3/1$ magnetic island can be excited by the RMP coils system, where m is poloidal mode number and n is toroidal mode number. The phase of the magnetic island can be controlled by adjusting RMP coils' current. In this experiment, the total plasma current I_p is set as 105kA,

