Contribution ID: **1311** Type: **Regular Poster**

# Internal Reconnection Events in Versatile Experiment Spherical Torus

*Friday, 14 May 2021 12:10 (20 minutes)*

Recent research on MHD instabilities in the VEST (Versatile Experiment Spherical Torus) (1) has been focused on the IRE (Internal Reconnection Event) which occurs frequently during current ramp down phase in spherical torus (2). Through this study, we investigate mechanism of the IRE, which is known to be closely related to major disruptions in conventional tokamaks. During the IREs, there is a large spike in plasma current, loop voltage, H-alpha and Mirnov signals as shown in Fig. 1(a). Figure 1(a) also shows OV line emission with sawtooth-like-evolution. These sawtooth-like signals are also observed in magnetics such as flux loop and Mirnov coils. Also, safety factor at magnetic axis decreases down to ˜1. From these results, it is thought that IRE may be triggered by an internal MHD mode with low m/n such as sawtooth activity. We will investigate detailed mode dynamics by using the internal magnetic probe arrays. As shown in Fig. 1 (b), there are two different discharges with almost the same operating conditions. In Shot#20955, after the bursting MHD activity plasma current recovers its state. However, the other discharge Shot#20958 goes termination with disruptive behaviour. We observe that there is opposite toroidal rotation between these two discharges. Thus, this rotation increase in Shot#20955 during the IRE may explain stabilization of the discharge.


Figure 1: enter image description here

Figure 1. (a) Temporal evolution of plasma current, H-alpha, loop voltage, Mirnov signals, OV line emission, safety factor at magnetic axis in the Shot#21237 and (b) two kinds of IRE activities in two discharges (Shot#20955 and 20958)

We observe significant toroidal rotation acceleration in counter plasma current direction as well as ion heating during the IRE by using Ion Doppler Spectroscopy (IDS) with high temporal resolution ˜0.2 (ms) (3). Usually a significant ion heating was reported during the IRE in several devices (4, 5), but there is no report of ion rotation variation during the IREs. As shown in Fig. 2 (a), both rotation and ion temperature are changed globally in the entire plasma volume. It clearly shows that some kinds of rotation torque and ion heating are acting on the plasma from the MHD activity. Both rotation and ion temperature increase very fast with the time scale of < 300 (μs) and then recover slowly. Interestingly, ion heating occurs earlier than the rotation acceleration as shown in Fig. 2(b). This result suggests that different mechanisms act on the ion during the IREs. There are several candidates for the mechanism of ion acceleration such as reconnection outflows, toroidal electric field by reconnection process, and NTV (Neoclassical Toroidal Viscosity) torque with offset velocity. Among them, NTV torque by non-axisymmetric magnetic fluctuations from the MHD activity seems to be most probable mechanism by considering observed IRE characteristics.


Figure 2: enter image description here

Figure 2. (a) Toroidal rotation profile and ion temperature profile evolution during the IRE in the Shot#20579 and (b) temporal evolution of plasma current, toroidal rotation and ion temperature in the Shot#20915

*This research was supported by National R&D Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Science, ICT & Future Planning(No. 2020M1A7A1A03089797)

References:
(1) K.J. Chung et al., Plasma. Sci. Technol. 15, 244 (2013).
(2) I. Semenov et al., PoP. 10, 3 (2003).
(3) Y. Kim et al., Fus. Eng. Des. 123, 975 (2017).
(4) A. Ejiri et al., Nucl. Fusion. 43, 547 (2003).
(5) S. Gangadhara et al., PoP. 15, 056121 (2008).

## Affiliation

Seoul National University

## Country or International Organization

Korea, Republic of

**Primary authors:** HWANG, Yong-Seok (Seoul National University); KIM, SeongCheol

**Co-authors:** Mr JANG, Jaeyoung (Seoul National University); Mr KIM, YooSung (Seoul National University)

**Presenter:** KIM, SeongCheol

**Session Classification:** P7 Posters 7

**Track Classification:** Magnetic Fusion Experiments