§19. Time Evolution of Bulk Ion Temperature in a Reversed Magnetic Shear Plasma Produced by Counter Neutral Beam Injection on LHD

Toi, K.,
Nakamura, M. (Dep. Energy Eng. Sci., Nagoya Univ.),
Shimizu, A., Ido, T., Osakabe, M., Morita, S.,
Publant, N., Tanaka, K., Ogawa, K., Isobe, M.,
LHD Experiment Team

Reversed magnetic shear (RS-) configuration in tokamaks is paid much attention. In the RS-plasmas geodesic acoustic mode (GAM) excited by energetic ions[1,2] is often observed together with reversed shear Alfven eigenmodes (RSAEs). The RSAE frequency provides precise information on the minimum value of the safety factor (q_{min}).

In LHD, the RS plasmas are also produced by counter NBCD and they have the rotational transform profile having the minimum ($(\iota/2\pi)_{min}$) [3]. In RS plasmas of LHD, both RSAE and GAM driven by EPs

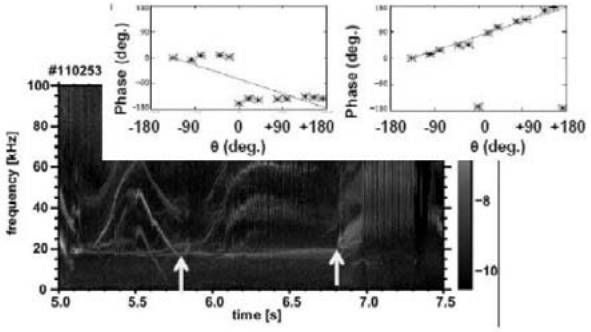

Fig.1 Spectrogram of magnetic probe signal observed in an RS plasma on LHD. Phase shift in magnetic probe signals for EP driven GAM is also shown as a function of poloidal angle (θ) at two time slices shown with the arrows.

are excited concurrently. A typical example of the spectrogram of magnetic probe signal is shown in Fig.1, where EP driven GAM having ~17-19 kHz in the phase without ECH is excited quasi-stationary. At t~5.1 s two EP driven GAMs having slightly different frequency are simultaneously excited. While one of GAMs is excited having nearly constant frequency of ~18 kHz, the other GAM evolves increasing the frequency from ~19 kHz to ~25 kHz and is suppressed. From t~5.5 s, two EP driven GAMs are again excited in a similar manner. Magnetic fluctuations of these GAMs have standing wave structure poloidally, but sometimes exhibit m=1 rotating mode structure, as shown in Fig.1. The spectrogram of the coherence between magnetic and potential fluctuations is shown in Fig.2. High coherence is found at EP driven GAMs. The higher frequency GAM exists more interior of r/a

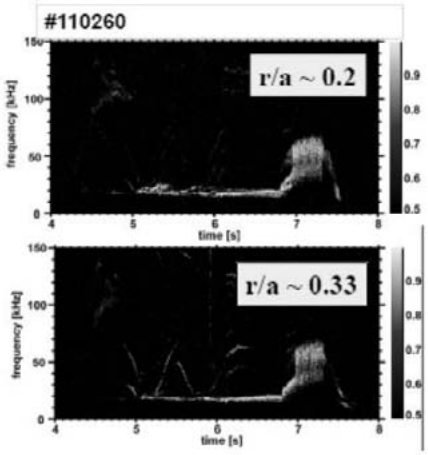

Fig.2 Time evolution of the coherence between magnetic fluctuation and plasma potential measured by heavy ion beam probe. Potential fluctuations are measured at r/a~0.2 and 0.33.

$\lesssim$ 0.2 , while the low frequency one is more radially extended up to at least r/a~0.33.

In the RS plasma, spontaneous ion temperature rise in the plasma central region is often observed, as shown in Fig.3. The bulk ion temperature at the plasma center T_{io} starts to increase from t = 5.6 s. The RSAE frequency indicates that the $(\iota/2\pi)_{min}$ has passed the rational value 1/3 at t = 5.6 s during the decreasing phase. At t~6.5 s, the $(\iota/2\pi)_{min}$ has passed 1/3 during the increasing phase. The mechanism of the spontaneous ion temperature rise is under investigation.

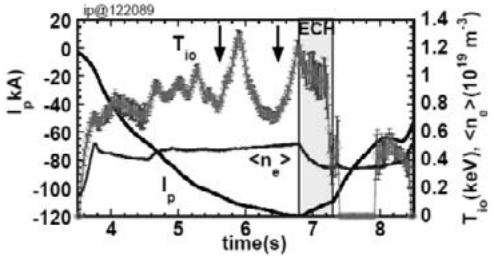

Fig.3 Time evolution of T_{io} in an RS plasma.

1) H.L. Berk et al., Nucl. Fusion **46** (2006) S888.
2) R. Nazikian et al., Phys. Rev. Lett. **101** (2008) 185001.
3) K. Toi et al., Phys. Rev. Lett. **105** (2010)145003.