§8. Fast RF Spectrometer System on LHD

Yun, G. (POSTECH), Akiyama, T.

As demonstrated on KSTAR, RF radiations are often accompanied by MHD events such as ELMs [1,2]. Similar measurements of the RF radiation has been conducted on LHD with an in-vessel dipole antenna and the same spectrometers as those on KSTAR. The measurable frequency range of the spectrometer is from 30 MHz to 28 GHz and it corresponds to the second to the hundreds harmonics of the ion cyclotron frequency for standard operation on LHD (Bt=2.75 T). The output of the spectrometer, which is proportional to the intensity of each band-pass frequency range, is digitized with a sampling frequency of 1 MHz. This is sufficient sampling frequency for studies of instability. The raw RF radiation intensity itself is also digitized directly by a fast digitizer with a sampling frequency of 1.25 GS/s.

These days, intense RF radiations were found in high temperature and relatively low density plasmas as shown in Fig. 1. After injection of perpendicular NBIs, the bursty behaviors are observed. These instabilities are thought to be destabilized by a resonant interaction between helically trapped fast ions ($\boldsymbol{v}_{/\!/} \ll \boldsymbol{v}_{\perp}$) and the resistive interchange mode. Hence, this is named "Energetic ion driven resistive InterChange (EIC) mode" [3]. From analyses of ECE data, the mode locates around ρ = 0.8-0.9 and particles are expelled. In this discharge, bursty RF radiation is observed in the frequency range from one to several hundreds MHz. Radiation lower than 300 MHz, especially at the beginning of the bursty signal of magnetics, is strong. On the other hand, at higher frequency (400 MHz), the fast oscillations before the magnetic burst becomes quiet. This will be attributed to spatial redistribution of the population of high energy particles by the EIC mode. The difference of the decay time of the burst might reflect the spatial variation of the confinement of the high energy particles. In addition, oscillation at 100 MHz well correlates with magnetic fluctuations. This result suggests that repeat of small crashes (and expelling of fast ions) follow after the first big crash.

[1] J. Leem, G.S. Yun, H.K. Park, JINST **7**, C01042 (2012)

[2] S. Thatipamula *et. al.*, Plasma Physics and Controlled Fusion 58, 065003 (2016).

[3] X. D. Du *et. al.*, Phys. Rev. Lett. 114, 155003 (2015).

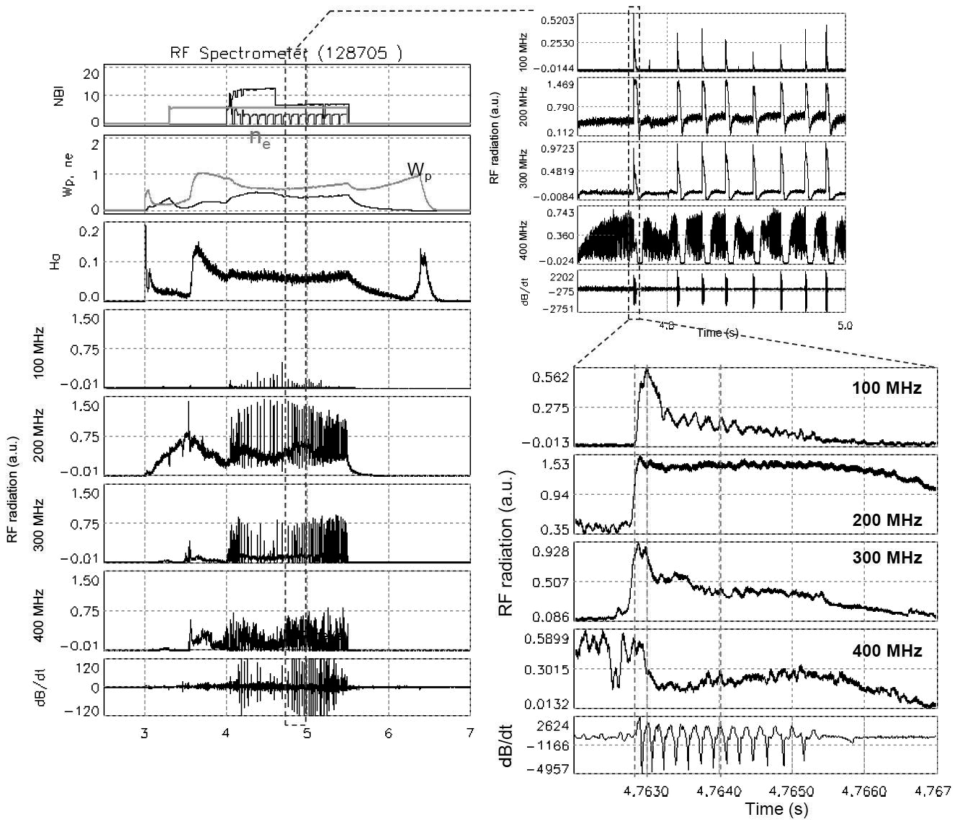

Fig. 1: Plasma parameters and RF radiation intensities of EIC mode.