Edge Coherent Mode Providing Nearly Continuous Transport during ELM Mitigation by *n* = 1 RMP in HL-2A

Y. Liu[1], T.F. Sun[1], X.Q. Ji[1], Y.Q. Liu[2], R. Ke[1], J.M. Gao[1], N. Wu[1], W. Deng[1], M. Xu[1]and X.R. Duan[1]

[1]*Southwestern Institute of Physics, P. O. Box 432, Chengdu, Sichuan 610041, China*

[2]*General Atomics, PO Box 85608, San Diego, CA 92186-5608, USA*

Recently, an edge coherent mode was identified exhausting the accumulated energy and particles, in a more moderate and nearly continuous manner, in a long-pulse H-mode discharge on EAST [1]. In fact, similar coherent oscillations were also observed in earlier time during ELM suppression by RMP in DIII-D, leading to a dynamical state in which the integrated transport during one cycle of oscillation is equivalent to that during a single ELM burst, but with the exhaust process being extended over a longer period of time [2]. These early studies provide indication that the coherent mode may play an important role in the transport dynamics of the resulting H-mode plasmas after application of RMP, though its onset mechanism has been largely unexplored.

An edge coherent mode (ECM) with a bursting feature was observed in the steep-gradient pedestal region of the H-mode plasmas in HL-2A tokamak[3], where the type-I edge-localized modes (ELMs) were mitigated by application of the n = 1 (n is the toroidal mode number) resonant magnetic perturbation (RMP). Utilizing a newly developed beam emission spectroscopy system (BES), it was found that the ECM with frequency of about 2 kHz is located at the edge pedestal region as shown in figure **1**, and is excited by three-wave interaction of turbulence enhanced by the RMP field through the change of electron density gradient in the pedestal region because of pump-out effect. The mode drives a significant outflow of particles as directly measured by probes, thus providing a channel for a nearly continuous extra particle transport across the pedestal during the ELM mitigation by RMP.

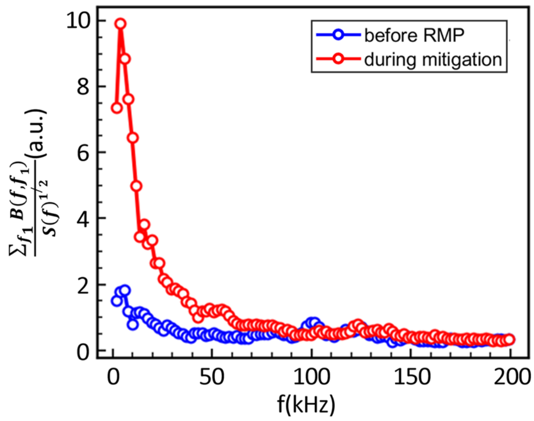

Figure 1. Total-coherence of density fluctuations at ρ = *0.9* before RMP and during ELM mitigation phase

[1] Sun Y. *et al* 2016 *Phys. Rev. Lett.* **117** 115001

[2] Evans T.E. *et al* 2004 *Phys. Rev. Lett.* **92** 235003

[3] Sun T.F. *et al*2021*Nucl. Fusion* **61** 036020