A Comprehensive Study of ECM Propagation and Impact in the SOL region and Physical regime in EAST tokamak

F.F. Long[1], Z.Q. Zhou[1,2*], T. Zhang[2*], Z.X. Liu[1], Z. Zhou[1,2], K.N. Geng[2], K.X. Ye[2], F.B. Zhong[3], Q.Q. Shi[1,2], G.S. Li[2], J. Huang[2], L. Yu[1,2], S.Q. Yang[1,2], F. Wen[2], J.Y. Ma[1,2], L.Y. Meng[2], Y. Ye[2], L. Wang[2], X. Gao[2], and EAST team

[1]*University of Science and Technology of China, Hefei 230026, China*

[2]*Heifei Institute of Plasma Physics, Chinese Academy of Sciences, Hefei, 230031, China*

[3]*Key Laboratory of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province, College of Optoelectronic Engineering, Shenzhen University, Shenzhen 518060*

* Corresponding author: zhangt@ipp.ac.cn and lfeifei@ustc.edu.cn

Abstract: The edge coherent mode (ECM), recognized as a natural pedestal turbulence, are inherently compatible with no ELM and ELM-free regime as well as facilitating the extrapolation to burning plasmas as it extends the duration of edge-localized modes (ELMs), increases particle and impurity transport without significantly affecting energy transport, and operates compatibly with high-performance plasma discharges. At the same time, ECMs are also considered a potential strategy for enhancing integrated core performance and managing heat and particle exhaust with edge transport barriers in place. The ECM can also be detected by Langmuir probes on the divertor target plate, indicating that it spreads from the pedestal region into the SOL and propagates to the divertor target plate. Recent investigations on the EAST tokamak have focused on ECM propagation and its characteristics in 215 upper single null discharges. Key findings include: (1) We have experimentally uncovered the pivotal transport mechanism of ECMs in the SOL region. ECMs exhibit a disruption at the strike point and are undetected in the private flux region, suggesting that their transport is severed at the X-point. The primary reason for this is the significant magnetic shear at the X-point, which suppresses the turbulent transport of ECMs [1]. (2) The transport characteristics of ECMs in the SOL exhibit a Gaussian distribution, with peak turbulent intensity at ρ = 1.07 along the magnetic field lines. As one moves towards the vacuum chamber, ECM strength decreases, and their coherence with the pedestal modes diminishes. Intriguingly, the coherence peak shifts closer to the separatrix for higher n modes, while it moves further away for lower n cases, influencing the drift of target plate ion saturation flow [2]. (3) A comparative analysis of pressure profiles with and without ECMs reveals that ECM presence leads to a decrease in plasma pressure. The density-temperature profiles at the pedestal remain on an isobaric surface, but with ECMs, the temperature pedestal decreases as the density pedestal increases, indicating a stronger ECM amplitude. In summary, our study delves into the intricate dynamics of ECMs in

the EAST tokamak, shedding light on their transport behavior, spatial distribution, and their impact on plasma pressure and pedestal characteristics [3].

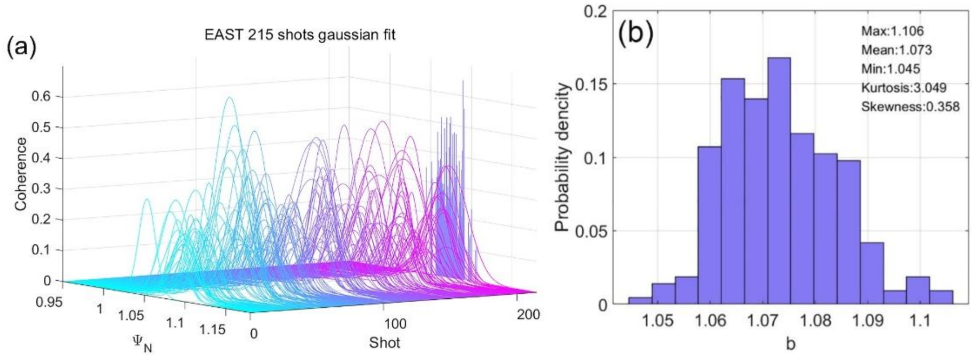

Figure 1: (a) The ECM gaussian distribution statistics of 215 discharges in EAST. The right vertical plane is the projection of each discharge correlation peak a and position *b*; (b) Gaussian fitting the probability density distribution of the peak position *b*.

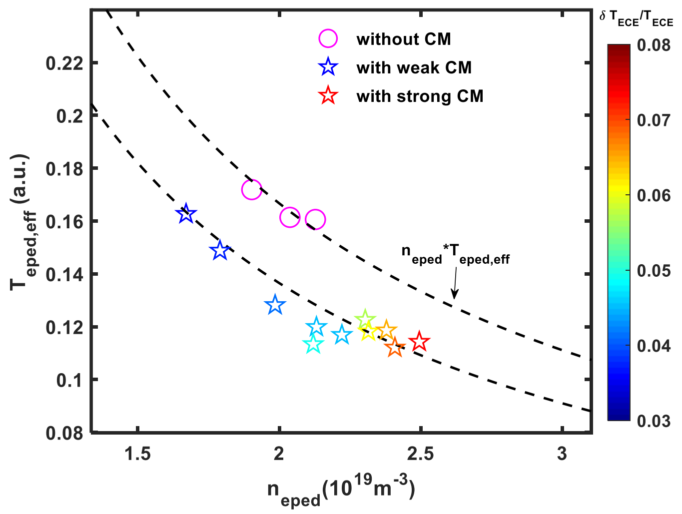

Figure 2: Pedestal isobaric surface without ECM and with different amplitude of ECM

Reference

[1] Ziqiang, Zhou, Tao Zhang*, Feifei Long*,..., X.Gao et al. The guass transport characteristic of edge coherent mode in the SOL in the EAST tokamak. Submitted to NF

[2] Feifei long, Ziqiang, Zhou*, Tao Zhang*,..., X.Gao et al. The effect of high n and low n modes on the divertor particle flux in the EAST tokamak. To be submitted to NF.

[3] Tao Zhang, Feifei Long*, Ziqiang, Zhou*,..., X.Gao et al. The effect of ECM in the ELM-free phase on the pedestal isobaric surface in the EAST tokamak. To be submitted to NF.