7th Asia-Pacific Conference on Plasma Physics, 12-17 Nov, 2023 at Port Messe Nagoya

Characterization of SOL profiles and turbulence in ICRF-heated plasmas in EAST

You Li[1,2],Ning Yan[1],Guosheng Xu[1],Shaocheng Liu[1],Ziqiang Zhou[1,2], Hua Yang[1],Miaohui Li[1], Binfu Gao[1],Yifeng Wang[1] and Xin Lin[1]

[1]Institute of Plasma Physics, Hefei Institutes of Physical Science, Chinese Academy of Sciences,Hefei 230031, People's Republic of China,

[2] University of Science and Technology of China, Hefei 230026, People's Republic of China;

e-mail (speaker):you.li@ipp.ac.cn

The characterizations of scrape-off layer (SOL) profiles and turbulence in ICRF-heated plasmas is investigated by the reciprocating probe diagnostic system (RCP) and Gas-puff imaging diagnostic (GPI) in EAST. A RF sheath potential up to 100V is determined near the ICRF antenna.[1] The amplitude of the RF sheath potential varies with different experimental parameters. It is observed to increase with ICRF power and plasma current Ip. As the plasma density decreases, the RF sheath potential tends to increases nonlinearly.

With the presence of RF sheath potential in the far SOL, the density profile in front of ICRF antenna is piled up to form a "density shoulder", and the density decay length λn in the far SOL is larger than it without ICRF. Serious local hotspots are generated in the plasma facing components, especially the ICRF antenna.[2] A sharp increase of tungsten impurity is observed in the plasma, which originates from the enhanced interaction between the SOL plasma and wall material. GPI detect a strongly sheared poloidal flow of the plasma in front of the antenna, indicating a localized radial electric field Er induced by ICRF heating.[3] With the depiction of the poloidal wave number-frequency spectrum, it is found that the high-frequency turbulence in far SOL is suppressed by RF sheath. Meanwhile, the low frequency turbulence reverses their poloidal propagation direction at the location of RF sheath.

However, when the ICRF antenna is moved outward, the RF sheath is shifted to the shaded area of the antenna, the "density shoulder" disappears in the SOL. In contrast, the SOL density profile is depleted by ICRF heating in this situation. The hotspots on the ICRF antenna are mitigated significantly. It is speculated that regulations far SOL profiles and turbulence is related to the RF-induced E×B drifts.

References

[1] L. Colas.et al, Nucl. Fusion 62 016014 (2022)

[2] R Hong.et al , Plasma Phys. Control. Fusion 59 105008 (2017)

[3] X. Litaudon et al, Nucl. Fusion 53 083012(2013)

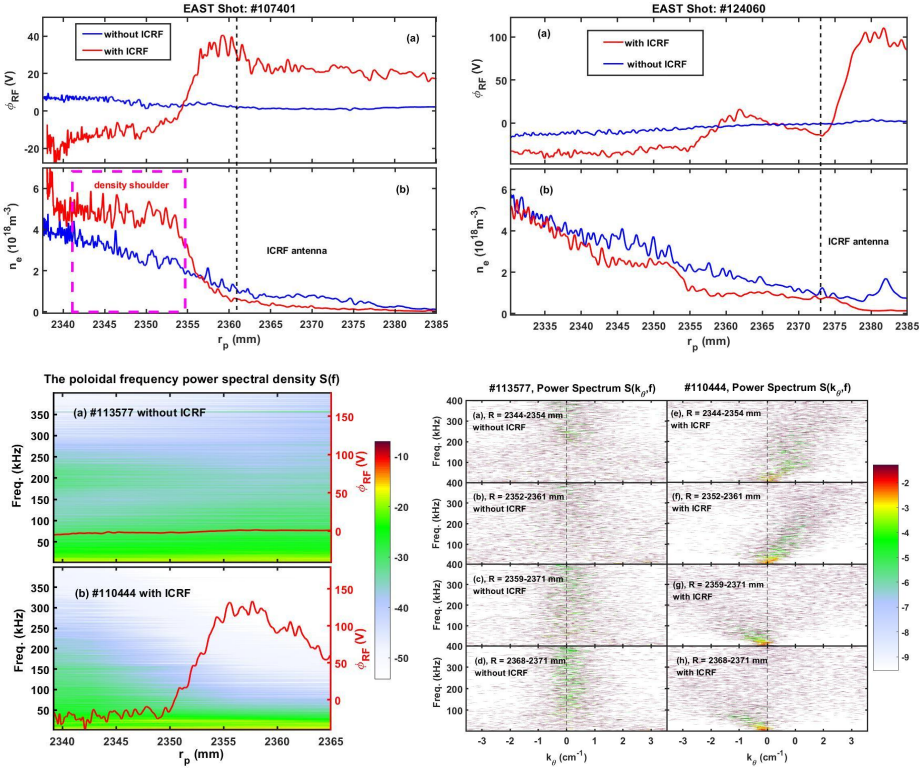

Figure 1. "density shoulder" under RF sheath measured by probe and density deplete(upper);The poloidal frequency power spectral density S(f) and the poloidal wave number-frequency power spectral density k_θ (nether).