I-10

**Measurements and modelling of charge-exchange neutral flux to the first wall on EAST**

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In future fusion reactors such as ITER and DEMO, the charge-exchange neutrals (CXN) flux to the first wall will be increased by several orders of magnitude compared to the present tokamaks. CXN-induced erosion will play an important role on the lifetime of first wall materials, the core plasma confinement, and the overall fuel retention, especially in magnetically shadowed regions where plasma ions cannot reach. To make reliable numerical predictions for future devices, it is essential to know the generation mechanism of CXN, and also the fluxes, energy and angular distributions of the CXN on the first wall. Recent experiments on EAST reveal the dependence of CXN flux to the first wall on different plasma conditions, which help to elucidate the key physics of CXN production and transport with the help of edge simulations using the grids extended to the first wall.

A low-energy neutral particle analyzer (LENPA) diagnostic system has been developed on EAST to measure the CXN flux to the outer wall in the energy range of 20-3000 eV [1]. Recent measurements show that the energy distribution of CXN flux strongly depends on the heating power, plasma density, fueling method and wall condition. Higher heating power leads to higher flux of both low and high energy CXNs. During plasma density ramp up experiments, lower energy CXN flux (<150 eV) increases, while higher energy CXN flux decreases. Improving fueling depth and wall conditioning can decrease the CXN flux to the first wall, which is related to the edge neutral pressure.

New EIRENE diagnostic options have been developed in SOLPS-ITER code to model the LENPA measured CXN spectrum. Based on the computational grid fully extended to the wall, simulations reproduce the measured edge plasma profiles, and obtain the CXN energy spectrum matching well with the LENPA diagnostic (differences are within 40%). The dependency of the CXN energy spectrum on the heating power, plasma density, fueling, and wall condition are reproduced by simulations. The source and loss of CXN with different energy are elucidated in detail for the first time. Based on the source analysis, the energy spectrum shape has been well explained and verified by experiments. The loss processes of CXN in flight pathway is dominated by charge exchange, and also impacted by ionization. The loss fraction increases with particle energy. These results are valuable for understanding CXN behavior and prediction of its induced first wall erosion in future fusion reactors.

[1] N.X. Liu, R. Ding, L. Mu, et al., Nucl. Mater. Energy 33, 101258 (2022)