Impurity Behavior in Edge Multi-Fold Magnetic Structure in Heliotron J Revealed from EMC3-EIRENE Simulation and Spectroscopy

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Impurity behavior is a crucial phenomenon to be clarified in achieving high-performance fusion-relevant plasma.

Extreme ultraviolet (EUV) spectroscopy for the impurity emission in Heliotron J was examined by using the EMC3-EIRENE simulation.

Three Divertor topological structures were identified by virtually extending the vacuum chamber (Fig. 1), calculated using the FLARE code. As the wall distance increased, layer structure was changed from (a), (b), and to an ergodic structure (c). The stochastic feature is hidden for a small chamber size (a)(b).

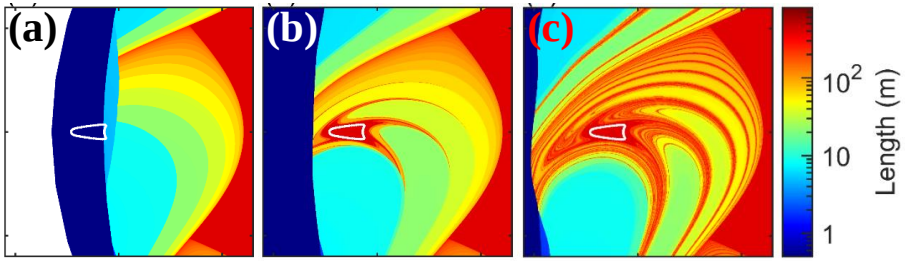


Fig. 1 Divertor topological structures by field line traced distance

Ref.: F. Cai, *et al.*, Contrib. Plasma Phys. 2024, e202300145.

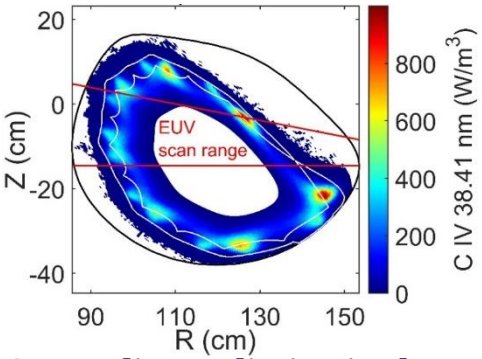
The *Multi-fold Layer* (MFL) can be defined as

$$\begin{cases} k\Delta\phi < \min\{\phi_n, \phi_p\} \le (k+1)\Delta\phi \\ \Delta\phi < \phi_n + \phi_p \end{cases}$$

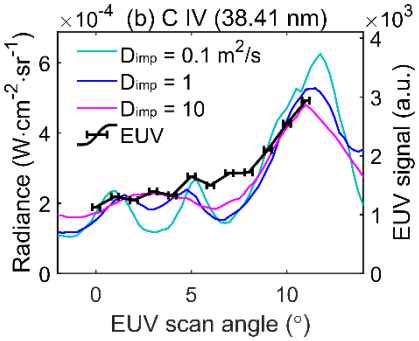
k: Layer number. ϕ_n, ϕ_p: Traced toroidal angles in positive and negative direction.

EMC3-EIRENE Simulation showed that the Lower-charged Carbon ions are found to have a concentration in the 1st MFL owing to the closer distance to the target.

A radiation peak among EUV measurement sightlines due to such impurity concentration are found in the simulation result and is consistent with the experiment.



Strong line radiation in the 1st MFL between the white lines



EUV measurement compared with simulation

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