Effect of Divertor Geometry on Fueling Profile and Carbon Content of the Core Plasma in Low-Density, Ohmic Plasmas in ASDEX Upgrade and DIII-D*

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To investigate the effect of divertor geometry on the poloidal fueling profile and core carbon content of the core plasma, scrape-off layer (SOL) profiles obtained in low-density, Ohmic plasmas in ASDEX Upgrade and DIII-D are compared and modeled using the UEDGE code. At similar device and plasma parameters (plasma current ≈1.0 MA, toroidal field 2.0 T, lower single null with the ion $\mathbf{B}\times\nabla B$ directed toward lower divertor, normalized density $n/n_{GW} \approx 0.2$, and Ohmic heating power 0.7 MW), a configuration with vertical target plates made of graphite tiles was explored in ASDEX Upgrade, and a horizontal configuration with graphite tiles in DIII-D. Established under the auspices of the International Tokamak Physics Activity Divertor and SOL working group, a SOL profile database, which includes the profiles of upstream electron density and temperature, target particle and heat flux, and deuterium and carbon line emission in the divertor region, facilitates the comparison of the measurements and modeling results.

UEDGE simulations of the DIII-D Ohmic plasma showed that the measured SOL profiles could be reproduced assuming that the radial transport is diffusive, and that recycling and carbon production is dominantly at the divertor plates. Numerical solutions including the effects of ion $\mathbf{B}\times\nabla B$ and $\mathbf{E}\times\mathbf{B}$ indicate a significantly better match to the data in predicting the measured in-out asymmetry of the divertor plasma conditions, resulting in strong core plasma fueling and carbon influx from the high-field SOL. Using similar assumptions in the modeling of the ASDEX Upgrade Ohmic plasma, the poloidal profiles of core plasma fueling and carbon influx are calculated from validated UEDGE solutions.

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