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Study of the Effect of Magnetic Expansion in Snowflake Divertor on Impurity Screening for CFETR

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Snowflake divertor is considered as a possible choice for CFETR design due to its dramatic ability in reducing the peak heat load onto divertor targets. It was pointed out that, such a reduction of peak heat load is due to both larger plasma-wetted area and larger fraction of power radiated in the edge [M.V. Umansky, et al., Nucl. Fusion 49 (2009) 075005]. Therefore, to achieve the best level of peak heat load reduction, which is crucial for solving the heat exhaust problem in a future fusion reactor, it is necessary to find a proper way to maximize the impurity radiation without degradation of core plasma performance. In this work, to understand the effect of magnetic flux expansion on impurity screening, a parameter scan simulation is performed. For the compatibility with ITER-like divertor, present snowflake is indeed a SF-plus configuration, where the distance between two nulls is from 0.3 to 1.0 (normalized to minor radius). The geometry is modified accordingly to keep the total angle between field line and the target surface as 1 degree and the length of divertor legs are kept constant. D_2 gas is puffed at out mid-plane of main chamber, and two puffing rates are used to provide a high density and a low density case. Ne and Ar are chosen for this study, to see the difference in impurity screening due to different atomic number. The injecting locations of radiative impurity are selected from inner target, dome and outer target. Injection flux is scanned to find the dependence of effective charge number, as an estimation of effectiveness of impurity screening, on magnetic flux expansion. The dependence of radiation power and peak heat flux will also be addressed, to find the trade-off between impurity radiation and impurity screening.

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