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Kinetic Modeling of Classical and Neo-Classical Transport for High-Z Impurities in Fusion SOL/Divertor Plasmas Using Binary Collision Method

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Effects of the classical and neo-classical impurity transport across the magnetic B-field in the Scrape-Off Layer (SOL) of fusion plasmas, have been studied with a new kinetic model using Binary Collision method (BCM). Our model is able to simulate the following two effects, which have been theoretically predicted but neglected in all the existing kinetic impurity transport simulations in the SOL/Divertor plasmas; (1) the inward pinch (IWP) due to density gradient of background plasmas and (2) the temperature screening effect (TSE, outward transport) caused by temperature gradient.

The IWP and TSE, which are proportional to the impurity charge Z , become more important for high- Z impurities such as tungsten. Under typical parameters of fusion SOL/Divertor plasma, the simulated IWP and TSE flow have shown non-negligible magnitudes (several meters per second) compared with the anomalous diffusive flow.

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