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Effects of different particle injection models on the results of PIC simulation

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Abstract: In particle-in-cell (PIC)simulation, different particle injection method is used to maintain the plasma source term. Common particle injection methods include a) constant flux injection in which a fixed number of ion-electron pairs are injected each time step and b) pair re-injection in which the number of ion-electron pairs injected is according to the number of positive ions removed. With different particle injection methods, there will be different results in particle simulation. For example, with the condition of negative ion surface strong production, there will be differences between the simulation results with conditions of pair re-injection and constant flux re-injection.

In this paper, a 1D3v PIC model is used to analyze the evolution of plasma state and parameters in the formation of SCL sheath and reverse sheath, and the differences in the formation of plasma sheath with different particle injection methods are compared. According to the simulation result, with the condition of surface production, the simulation result with pair re-injection does not match experiment result. In this paper, the advantages and disadvantages of different injection methods are analyzed. And a new conditional re-injection method, in which the number of injected ion-electron pair is changed according to the density of plasma, is proposed, and the applicable scene will be analyzed, so as to provide guidance for future PIC simulation and plasma research work.

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