

Benchmarking and recent development for ORB5's single- and multi-species collision operators

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Collisions cannot generally be neglected when studying turbulent transport in tokamak plasmas. The particle-in-cell code ORB5 has an existing operator to include the effects of collisions of an ion species on itself and on electrons. Here, we present the theory and implementation of a multispecies ion collision operator which conserves energy and momentum[1][2]. We show early progress in testing and in benchmarking the operators against the GENE code.

[1] Z. Lin, W. M. Tang, and W. W. Lee. *Physics of Plasmas*, 2(8):2975-2988, 1995.

[2] S. Brunner, E. Valeo, and J. A. Krommes. *Physics of Plasmas*, 6(12):4504-4521, 1999.