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Finite element modelling of TdeV edge plasma and beyond

M. Simard, R. Marchand, C. Boucher, J. Gunn, J. Mailloux, B. Stansfield and TdeV team.

Centre Canadien de Fusion Magnétique*

1804 boul. Lionel Boulet, Varennes Qc Canada, J3X 1S1

The finite element code SIGMA is used to model the edge and divertor plasma in TdeV. Two physical effects are examined, which are of particular importance in TdeV. These are E×B drifts and the influence of divertor baffles on the SOL.

The model is based on Braginskii's fluid equations for the conservation of particles, parallel momentum, as well as ion and electron energy. Perpendicular transport is treated empirically with anomalous transport coefficients. For simplicity, neutral particle and energy transport are treated in the diffusion approximation. All transport equations are discretised with finite elements on an unstructured triangular mesh. This approach offers considerable advantages compared with more usual transport models based on a finite volume discretisation on structured quadrilateral and nearly orthogonal meshes. In particular, it remains valid near divertor plates even when those plates are not orthogonal to the local flux surfaces. Its main advantage, however, is its ability to model domains of arbitrary shapes and complexity. Electric fields are calculated from standard sheath conditions at the divertor plates, from the generalized Ohm law in the direction parallel to the magnetic field, from an anomalous conductivity in the perpendicular direction, and from the condition $\nabla \cdot J = 0$ for charge conservation.

Parallel velocities are calculated and compared with experiment. The influence of field reversal is determined for its influence on the relative powers deposited to the inner and outer divertor plates. Finally, the influence of divertor baffles is considered. Accounting for these structures in TdeV is important because of their relative proximity (often within one density decay length) to the separatrix. Their inclusion in the simulations yields results which are much less sensitive to the specific boundary conditions imposed on the outermost flux surfaces.

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