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# Integrated simulation of runaway electrons: a backward Monte-Carlo approach for a fluid-kinetic self-consistent coupling

*Friday 26 October 2018 14:00 (20 minutes)*

The dynamics of runaway electrons (RE) is a complex process and, although significant progress has been made in the understanding of individual isolated pieces of the puzzle, a predictive capability calls for an Integrated Simulation (IS) effort. In this presentation we report on recent progress on this problem. The goal is to use the BMC method [1] to couple a kinetic description of the RE population to a fluid description of the background plasma and the self-consistent evolution of the electric field. In addition, the IS includes a synchrotron emission (SE) synthetic diagnostic [2] for model validation. The main novel aspects of our contribution are the use of a probabilistic coupling based on the BMC method, the incorporation of the often-ignored configuration space dependent dynamics, and the use of a flux surface averaged transport model along with a Grad-Shafranov 2D equilibrium. At the heart of our IS effort is the recently developed Kinetic Orbit Runaway electron Code (KORC) that computes relativistic RE orbits using either full-orbit 6-D (KORC-FO) or guiding center (gyro-averaged) descriptions (KORC-GC) incorporating the full geometry of the magnetic field, the spatial dependence of the electric field, and synchrotron radiation damping. Collisions are incorporated using a Monte-Carlo method with plasma temperature, plasma density and impurities dependent collision frequencies [3,4,5]. To account for the spatio-temporal variations of plasma parameters in KORC, we developed a fluid code that solves the time-dependent flux surface averaged transport equations [6]. Disruption mitigation is simulated by introducing an impurity neutral gas pellet. The kinetic information computed with KORC is feed back to the plasma state and electric field solvers using the BMC method that computes the RE production rate. As an application of the IS framework we study RE generation during rapid plasma shutdown by impurity injection in DIII-D and ITER-like plasmas. [1] G. Zhang et al., Phys. Plasmas 24, 092511 (2017); [2] L. Carbajal et al., Plasma Phys. Control. Fusion 59, 124001 (2017); [3] L. Carbajal et al., Phys. Plasmas 24, 042512 (2017); [4] D. del-Castillo-Negrete et al., Phys. Plasmas, accepted (2018); [5] D.A. Spong, et al., Submitted to Nuclear Fusion (2018); [6] J. Lore et al., CP11.098 APS DPP Meeting (2017).

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