Abstract Submitted
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Towards First-principles Control-oriented Modeling of the Magnetic and Kinetic Plasma Profile Evolutions in ITER[1] JUSTIN E. BARTON, EUGENIO SCHUSTER, Lehigh University, KARIM BESSEGHIR, JONATHAN LISTER, Ecole Polytechnique Federale de Lausanne (EPFL), Centre de Recherches en Physique des Plasmas (CRPP) — The "hybrid" and "steady-state" advanced scenarios are characterized by q profiles higher or equal to one to mitigate plasma instabilities and improve confinement, which are key for ITER to achieve its operational objectives. To achieve these scenarios, active model-based control of the current profile and thermal state of the plasma is required. Towards this goal, two control-oriented, plasma-response models are proposed. First, the poloidal flux diffusion equation is combined with empirical models of the electron density and temperature profiles, plasma resistivity, and non-inductive current drives to obtain a physics-based model of the poloidal flux and stored energy evolutions. Second, the empirical electron temperature model is replaced by the electron heat transport equation, which is combined with empirical models of the electron heat conductivity and heat sources to obtain a physics-based model of the poloidal flux and electron temperature evolutions. Simulation results comparing the evolution of the plasma parameters predicted by the control-oriented, physic-based models and the DINA-CH+CRONOS simulation code are presented for ITER, and the control objectives and challenges are discussed.

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