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Burning Plasma Simulation with Alpha-Particle Heating

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To achieve self-sustained ignited operation in a high energy Tokamak, it is important to understand and maximize the energy confinement time, which falls in the domain of transport theory. To analyze and understand dynamics of plasma in Tokamak, performing a one-dimensional transport simulation is still one of the best approaches. In our work we focus on burning plasma simulation and study the alpha particle heating in high energy Tokamaks like ITER. Transport simulations can be performed by solving 1D transport equations using codes such as LCPFCT (Laboratory for Computational Physics Flux-Corrected Transport)[1], which is used to solve 1D generalized coupled continuity, momentum and energy equations along with Maxwell's equations. The transport equations are solved in flux coordinates by coupling with 2-D tokamak equilibrium. In this model, the effects of fusion reactions, coulomb collisional losses, radiation losses, alpha-heating, auxiliary heating and neo-classical Ware pinch are included. This will predict the performance of tokamak based fusion reactor for obtaining the steady state operation. This model is being developed and will be bench marked with published results. This will be use to predict the performance of SST2-like [2] and ITER-like [3] cases and results will be presented in this paper.

References:

[1] Boris, J.P.; A.M. Landsberg; E.S. Oran; and J.H. Gardner. 1993. "LCPFCT - A Flux-Corrected Transport Algorithm for Solving Generalized Continuity Equations." NRL Memorandum Report 93-7192.

[2] R Srinivasan and the Indian DEMO Team, Fusion Engineering Design, 112 (2016) 240

[3] Progress in the ITER Physics Basis, Nuclear Fusion, 47 (2007)

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