Chosen aspects of integrated modeling with COREDIV code for JT-60SA tokamak

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The wide use of various modeling tools and efforts taken up worldwide often focus on single phenomenon occurring in plasma or limited space or time scale. This approach is scientifically correct, but often leads to underestimation of global effects or synergies. In this work we propose an application of an integrated model COREDIV to describe plasma on the MHD-relevant detail level. This assumption inherently leads to simplifications. However, the key physics is maintained and, most importantly, the effects of interplay between central and edge plasma regions can be observed.

COREDIV describes self consistently the core and the scrape off layer with the divertor regions of tokamak plasmas. The coupling between core and edge is imposed by continuity condition at separatrix of appropriate values, fluxes, temperatures and densities. In the core the 1D transport equations with semi-empirical transport coefficients for densities and temperatures are used. In the SOL the 2D model based on Braginskii-like equations for the background plasma and on rate equations with each impurity charge state treated separately is applied. The sputtering processes of target material are included in the model, as well as extrinsic impurity seeding and recycling. Neutral particles distribution is simplified and described by an analytic formula. The code has been applied to model a number of JET [1-4], Asdex-U [5] and other device discharges and proved to be a useful analytic tool in explaining observed systematic trends and tendencies [1-5].

The code is applied to a chosen scenario of JT-60SA to analyze the influence of core-SOL coupling on the plasma parameters. It appears that it is crucial for configurations with high Z impurities (W, Xe), for which the impurity line radiation is an important energy loss channel. This is especially important for metallic target configurations, for which radiation-sputtering self-control mechanism is observed. The results show also whether for a selected combination of operational parameters and impurity mix beneficial conditions at the target plate can be realized. Moreover plausibility of achieving detachment for some cases is verified.

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