Predictions of fast ion parameters in ITER plasmas

R.V. Budny
PPPL

Time-dependent integrated predictive modeling is carried out using the PTRANSP code[1] to predict fusion power and parameters such as alpha particle density and pressure in ITER plasmas. Auxiliary heating by neutral beam injection and ion-cyclotron heating of He^3 minority ions are modeled, and the GLF23 transport model is used in the prediction of the evolution of plasma temperature profiles. Effects of beam steering, beam torque, plasma rotation, beam current drive, pedestal temperatures, sawtooth oscillations, magnetic diffusion, and accumulation of He ash are treated self-consistently. Variations in assumptions associated with physics uncertainties for standard base-line (Scenario 2) DT H-mode plasmas (with I_p=15 MA, B_{TF}=5.3 T, and Greenwald fraction=0.86) lead to a range of predictions for DT fusion power. Ranges of beam and alpha parameters such as $-R\nabla(\beta_{beam})$ and $-R\nabla(\beta_\alpha)$ are presented. Examples of the predictions are that $-R\nabla(\beta_{beam})$ dominates $-R\nabla(\beta_\alpha)$ in the core region, and that steering of the negative ion neutral beam injection has a strong effect on the fast ion drive. Another prediction is that sawtooth crashes are predicted to shift the peaks of n_{beam} and n_α past the half radius.

Also alternative plasmas such as more optimistic scenario 1 H-mode plasmas with density close to the Greenwald limit are considered, as well as reduced performance plasmas such as H-only and reduced B_{TF} plasmas.

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[1]Predictions of H-mode performance in ITER, R.V. Budny, R.Andre, G.Bateman, F.Halpern, C.E.Kessel, and A.Kritz, submitted