§21. Transport Modeling of Plasma Performance in Fusion Reactor

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Transport simulation is a useful tool for prediction of plasma performance in future fusion reactor. A 1.5-D tokamak transport code has been developed, which is combination of 2-D equilibrium solver for determining the magnetic geometry with 1-D transport equations solver for the solution of time dependent plasma profiles evolution. It privides for self-consistent calculation of plasma profiles and dynamic modeling of particle transport process involving plasma fueling (via gaspuffing and pellet injection), and exhaust (via speicfied recylcing at the plasma edge). In particular, helium production, transport and accumulation are solved self-consistently. Since this approach is fully time dependent, it can be applied to investigate the role of plasma heating, fueling and pumping system in operation scenario study for iniation, control and termination of each pulse, in such as IDLT (Inductively operated Day-Long pulsed Tokamak) reactor [1-2]. Progress is also being made to help address the issues of transient dynamics of ITER EDA burning plasmas in detail, which is important in the design and safety assessment for in-vessel system..

we have used this 1.5-D modelling approach to evaluate the feasibility of sustaining the long burn duration by taking the MHD instability and fuel diluting effect of helium accumulation into account, and to determine the accessibility of plasma burn initiation as well as the means of controlling plasma burn termination.

Plasma performance of the IDLT reactor was simulated by this 1.5-D modeling approach with a Bohm scaling transport model. Fig.1 shows the effects of inward pinch on helium accumulation, we could see that with the peaking parameter Cv larger than 2.2, no ignition can be sustained.

The effect of sawtooth is illustrated in Fig.2, which indicate that sawtooth help the removal of helium ash from the core.

The operation scenario of IDLT reactor have been studied by modelling of startup and shutdown, which confirms the feasibility of IDLT operation scenario, and shows that auxiliary heating power of 20 MW is required to avoid the disruption during shutdown.

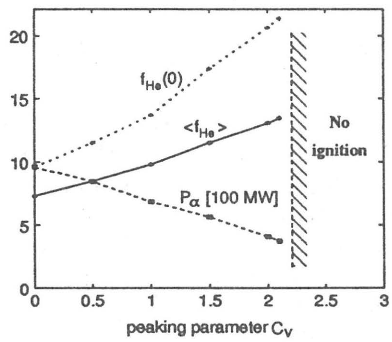

Figure 1: Helium accumulation fraction via peaking parameter C_v.

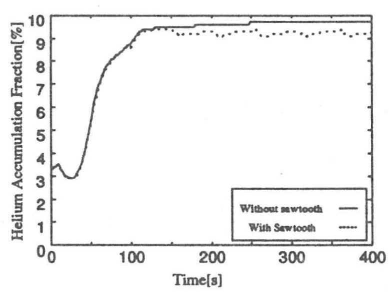

Figure 2: Time evolution of helium accumulation fraction

References

[1] N. Inoue et al., Plasma Phys. and Controlled Nucl. Fusion Res., Würzburg, 1992 (IAEA, Vienna, 1993), Vol.3, p.347.

[2] J.F. Wang et al., Fusion Eng. and Design, **29** (1995) 69.