Predictive modelling of the H-mode power threshold in JET

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The dependence of the threshold power, P_{th} , for the L-H transition on various plasma parameters has been analyzed with 1.5D transport code JETTO [1]. Transport coefficients were computed using RITM transport model [2]. The model predicts strong reduction of the turbulent transport at the edge, if the local temperature gradient increases above some critical level, which, so far, has not been seen from non-linear computations.

Computations done for conditions of JET discharges predict the increase of P_{th} with the magnetic field and the density, for medium and high densities, in agreement with the inter-machine scaling law [3]. At low densities, computations predict the minimum of the power threshold in agreement with experimental observations [4], but in contradiction to the scaling. The increase of P_{th} towards low densities is explained by lager fraction of recycling neutrals penetrating in to confined volume. The enhanced contribution of the particle convection to heat losses at the edge results in lower temperature and its gradient, and therefore, more power is required to trigger the L-H transition. The critical fraction of convective energy losses, corresponding to the minimum of P_{th} (n_e) dependence, is roughly 0.4-0.5 of total heat losses, which is close to 0.5 obtained previously with stand alone RITM transport code for conditions of limiter tokamak TEXTOR [5].

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