GLOBAL ENERGY BALANCE AND DENSITY LIMIT ON CASTOR TOKAMAK

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Total radiative power losses have been measured by a pyroelectric detector on the CASTOR tokamak in a broad range of plasma parameters. It has been shown that while for the low density operation ($n_e < 10^{19}$ m^{-3}) the most important channel of energy losses is a thermal conductivity, the high density regimes are radiation dominated. Using a simple analytic energy balance model, the connection between such a high level of radiation and shrinking of the current channel resulting in an enhanced MHD activity is discussed.

1. INTRODUCTION

The CASTOR tokamak ($R = 0{\cdot}4$ m, $a = 0{\cdot}085$ m, $B_T \lesssim 1{\cdot}5$ T) is a reconstructed version of the TM-1-MH tokamak, working in the Institute of Plasma Physics, Prague, Czechoslovak Academy of Sciences. Experimental and numerical studies of the plasma energy balance on the TM-1-MH tokamak [1] have shown that:

1) in the density and current ranges $\bar{n}_e = (0{\cdot}7\text{—}2{\cdot}0) \times 10^{19}$ m^{-3} and $I_p = (11-17)$ kA, the central electron and ion temperatures are in the range $T_e(0) = (150\text{—}300)$ eV and $T_i(0) = (50\text{—}100)$ eV, respectively;

2) the energy transport through the electron channel is well described supposing that the electron thermal conductivity is given by the Alcator scaling

$$K_e = \gamma/n_e = 5 \times 10^{19}/n_e \quad [\mathrm{m^2\,s^{-1}}, \mathrm{m^{-3}}]\,; \tag{1}$$

3) the dominant channel of the energy losses from the ion component is a thermal conductivity well described in terms of the neoclassical model. The charge exchange plays some role at the periphery of the plasma column, but its influence on the global ion energy balance is negligible for the investigated density range.

Previous investigations performed on the CASTOR tokamak [2] have shown that the basic plasma parameters have not changed substantially in comparison with the TM-1-MH tokamak. However, for a more detailed understanding of the energy balance, it is necessary to have additional data about such an important channel of energy losses as is the radiation. The radiative power losses are caused predominantly by a line radiation of impurities and the radiation dominated dis-

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