Thermal transport in H and D JET L-mode plasmas

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Results of the analysis of experimental data obtained in JET ILW L-mode Hydrogen plasmas and their comparison with L-mode Deuterium plasmas with similar machine parameters (B_0~3,1-3,3 T, I_p~2 MA, $n_{e,0}$~2,5-4·10^{19} m^{-3}, q_{95}~5) will be shown. The heating scheme was also the same: 2.5 – 7 MW of ICRH deposited on ions using ^{3}He minority with concentration n_{3He}/n_e ~ ~6/2% for D/H plasmas, or on electrons going to mode conversion with n_{3He}/n_e ~18/6% in D/H plasmas; 1.5 - 8 MW of NBI using H-ion beams in H plasmas and D-ion beams in D plasmas. By depositing the RF power on- and off-axis, we measure and compare not just temperature profiles and power-balance diffusivities, but also ion and electron turbulent transport threshold and stiffness level, so providing additional physical insight to understand the experimental observations. The experimental data are studied also through gyrokinetic linear and non-linear analysis using the GENE code [1].

Experimentally, both T_e and T_i are lower in H plasmas, the difference starting at the plasma edge. In low power plasmas, the ion heat flux in the plasma core does not deviate from the gyro-Bohm scaling law outside error bars, but, as the strong influence of T_i dominates over the mass one in the gyro-Bohm normalization, it is difficult to make a certain conclusion from our data. A difference in the normalized ion heat flux has been observed at higher power, in the situation where a stabilization of ITG modes by fast ions is expected [2, 3]. In this case, the stabilization of the ion heat transport is less strong in H plasmas with respect to D plasmas. A possible explanation of this difference has been found in the difference of the fast ion pressure in H and D plasmas, in H plasmas being ~1/2 of the one in D plasmas when high NBI or ICRH heating is applied. This is mainly due, in the case of NBI fast ions, to the lower beam injection energies and shorter beam slowing down time in H plasmas and, in the case of ICRH fast ions, to the lower 3He concentration needed for the ICRH minority scheme heating in H. Linear gyrokinetic simulations support this picture. The electron heat transport shows in general higher values of R/L_{Te} in H plasmas. Also, the strong correlation between R/L_{Te} and $\tau=Z_{eff}\cdot T_e/T_i$ observed in D plasmas has not been observed in H plasmas, indicating a possible different role of ETG modes. Another difference between H and D plasmas is the accumulation of heavy impurities in the plasma core observed in H plasmas with dominant ICRH ion heating and not observed in similar conditions in D plasmas. No accumulation has been observed using dominant electron ICRH heating.

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Topic 1: Effect of isotope mass on transport and confinement.