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P5.1075 Investigation of strong isotope effect in energy confinement for high density FT-2 tokamak discharges

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In contrast to theory expectations, the hydrogen isotope effect results in the improvement of tokamak energy confinement in numerous experiments as the hydrogen isotope mass increases, which has remained a long-standing puzzle [1]. This effect is beneficial and important for the success of Iter, where a fuel mixture of deuterium and tritium will be used. Explanation of the effect involves the delicate balance of microturbulence and large-scale flows, with an effect on particle confinement that has been demonstrated in FT-2 tokamak [2] for various pairs of similar hydrogen (H) and deuterium (D) Ohmic discharges with modest central electron density varying in the range (2.3 - 4)×10^19 m^-3. Recently the strong difference in energy confinement between hydrogen and deuterium plasmas has been demonstrated in the FT-2 tokamak [3] in high density regimes of <ne> ~ (7-9)×10^19 m^-3, Te 600 ÷ 700 eV, Ti ≈ 200 eV. In a particular series of Ohmic discharges performed in H and D plasmas the difference of energy confinement time increased as plasma density was increased, based on calculations using measured kinetic profiles. Close to the operational density limit (<ne>~ 9×10^19 m^-3) the energy confinement time in D was twice as high as in H. In the present paper the detailed analysis of density and temperature profiles in high density D and H discharges is performed. It is shown that improvement of confinement in D-discharge is accompanied by the steepening of the electron density profile at the edge and a flattening in the central region, which demonstrates distinct features of an Ohmic H-mode. Using experimentally obtained profiles gyrokinetic modeling of drift instabilities for these highdensity discharges is carried out using GENE and ELMFIRE codes. Reasonable agreement of gyrokinetic calculations with experimental results (behavior of the thermal diffusivity estimated from the ASTRA modeling and turbulence spectra provided by reflectometry) is demonstrated.

Refrences

[1] C F Maggi et al 2018 Plasma Phys. Control. Fusion 60 014045
[2] P. Niskala, et al., 2018 Nuclear Fusion 58, 112006.
[3] D V Kouprienko et al., 45th EPS Conference on Plasma Physics, P4.1097 (2018)

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