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Impact of Isotopic Effect on Density Limit and LHCD Efficiency in the FT-2 Experiments

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Current drive by lower hybrid waves (LHCD) is the most effective method to keep the plasma current, but it is feasible only at the plasma density not exceeding some density limit n_DL. In the present work the main attention is paid to investigation of this effect on the FT-2 (R=0.55 m, a=0.08 m, B_T ≤ 3T, I_p=19÷40 kA, f_0 = 920MHz) tokamak. The dependence of LHCD efficiency on isotopic plasma content (hydrogen/deuterium) is studied. On the FT-2 tokamak, where a large experience has been accumulated in the area of plasma –LH wave interaction observation, the long-continued experimental run on LHCD efficiency study has been realized. Characteristic features of such experiment are strong influence of the isotope plasma composition on the LH resonance density nLH. For hydrogen plasma n_LH ~ 3.5 10^13 см^-3, whiles for deuterium n_LH ~ 10^14см^-3. The suppression of the LHCD and beginning of the interaction of LH waves with ions is controlled by the hydrogen/deuterium plasma density rise. In the hot hydrogen plasma (Te(r=0cm) ≈ 700eV) the density limit n_DL of LHCD is approximately equal to the resonance value n_LH at which the interaction of the LH wave with the electron component is replaced by direct absorption by plasma ions (nLH≈ nLC =3.5•10^13 cm^-3 is the point of linear conversion). In the hot deuterium plasma one could expect an increase of nDL because of a much higher value of n_LH ≥ n_LC ≈ 10^14 cm^-3. However it appeared that the observed density limit for LHCD generation n_DL ≈ (3.5÷4)•10^13 cm^-3 is not determined by nLC. Role of parametric instabilities in CD switch-off is considered in both cases. The cooling of the plasma column and density rise could lead to a reduction of the threshold for the parametric decay of f0 and result in the earlier suppression of LHCD. In both cases the LHCD was inversely proportional to the density, which corresponds to the theoretical predictions. In order to analyze the experimentally observed effects the GRILL3D and FRTC codes have been used. The important role of the synergetic effect caused by the interaction of different spectral components of the excited RF waves was revealed. Next step of LHCD modeling is devoted to a dynamic modeling of LHCD plasma shots at rather low plasma densities <n_e >= $0.5 \div 2 \bullet 10\hat{}13 cm\hat{} - 3, when role of run away electrons is significant at the FT-2 conditions.$

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Author: Dr LASHKUL, Sergey (Ioffe Physical-Technical Institute, RAS, Russia)

Co-authors: Dr ALTUKHOV, Alexey (Ioffe Physical-Technical Institute); Dr GURCHENKO, Alexey (Ioffe Physical-Technical Institute, RUS); Dr SAVELIEV, Alexsandr (Ioffe Physical-Technical Institute); Dr STEPANOV, Alexsandr (Ioffe Physical-Technical Institute); Dr KOUPRIENKO, Denis (Ioffe Physical-Technical Institute); Prof. GUSAKOV, Evgeniy (Ioffe Physical-Technical Institute); Mr ESIPOV, Lev (Ioffe Physical-Technical Institute); Dr

IRZAK, Michail (Ioffe Physical-Technical Institute, RAS); Dr KANTOR, Michail (Ioffe Physical-Technical Institute); Dr SHATALIN, Sergey (St.Petersburg State Polytekhnical University); Dr DYACHENKO, Valeriy (Ioffe Physical-Technical Institute, RUS)

Presenter: Dr LASHKUL, Sergey (Ioffe Physical-Technical Institute, RAS, Russia)

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