

INTERPRETATION OF SOFT X-RAY SPECTRA IN THE T-15MD TOKAMAK ^{*)}

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The results of interpretation of measurements of the spectrum of soft X-ray radiation in the tokamak T-15MD in the energy range of 2-10 keV, including discharges in the first campaign [1] with a steel first wall and a graphite diaphragm and the next campaign with a graphite lining of most of the first wall, are presented.

An algorithm for determination of the density of the main heavy impurity (iron) from the soft X-ray spectrum at known temperature profiles T_e and electron density n_e on the observation chord is presented. Since the projections (on the poloidal plane) of the soft X-ray and Thomson scattering diagnostics' observation chords in T-15MD are very close, the values of T_e and n_e were taken to be the same as on the Thomson scattering observation chord. Interferometry data were also used for determination of n_e . Calculations were performed for various impurity density profiles. The distribution of impurity ions by ionization degrees was determined by the quasi-stationary kinetics of ionization and recombination, considering cascade processes (the corresponding effective ionization and recombination rates from the database [2] were used). Bremsstrahlung and recombination radiation on impurity ions and bremsstrahlung radiation on hydrogen ions were considered.

In addition to comparing the calculated spectrum with the experimentally measured soft X-ray spectrum, the accuracy of the well-known method for estimating T_e in the plasma center using the exponential slope of the spectrum in the soft X-ray region was verified. It is also shown that using the effective charge approximation can give a significant error in calculating the absolute values of the soft X-rays intensity.

Calculations of the contribution of soft X-ray in the specified spectral range to the spectrum-integral bolometric measurements have been carried out. The contribution of radiation mechanisms in hot thermonuclear plasma with heavy impurities in a softer spectral range is estimated: polarization radiation of multielectron ions in their collisions with electrons [3], spectral lines of multielectron ions as a quasi-continuum [4] emitted due to dynamic polarizability of a quantum plasma ensemble described in a model close to the Thomas-Fermi ion.

References

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^{*)} [abstracts of this report in Russian](#)