Method for determination of maximum electron temperature and electron density of pinch plasma

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X-ray spectroscopy is a basic approach for determination of parameters of high temperature and dense plasma. Method is created and developed during few decades. The main point of the method is construction and further development of analytical models describing relative intensities of neighboring X-ray lines as well as designing and application of equipment for their registration. In the first stage of experiment registered spectra are averaged in space and time. In this case the application of steady state analytical models is approved if the emission of diagnostic lines coincides in space and time. Averaged in space and time plasma parameters extracted from relative intensities of those lines are associated with the corresponding plasma region and it’s life time. The maximal plasma parameters of this plasma region during considered time interval might be essentially larger. Obviously, the adequate determination of maximal plasma parameters is one of the prior task to find optimal ways to reach thermonuclear fusion conditions.

Present paper describes the new method of determination of maximal plasma parameters, based on the comparison of registered time-dependent intensities of X-ray lines with their calculated values. Analytical approach consists of zero-dimensional model combined with collisional radiative model. Zero-dimensional model describes time variation of plasma energy under the influence of magnetic field pressure, joule heating, radiation losses. Collisional radiative model calculates time-dependent intensities of hydrogen like and helium-like resonance lines and their satellites. Finally time-dependent plasma electron temperature and density are obtained as well as electron beam yield, intensities of diagnostic lines, etc. Variation of input parameters of the model provides the good coincidence of calculated intensities of lines with their measured values. The maximal values of electron temperature and density, taken within this procedure is considered enough reliable and characterize considered plasma region.

References

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