Simultaneous measurement of electron and ion temperatures with heliumlike argon spectrum for LHD

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The heliumlike argon spectrum is measured with a crystal spectrometer for plasmas in the Large Helical Device (LHD). The electron temperature T_e in the range of 400 eV to 1 keV is derived from intensity ratio of a dielectronic satellite line ($1s^2 2p\,^2P_{1/2} - 1s2p^2\,^2D_{3/2}$) to the resonance line ($1s^2\,^1S_0 - 1s2p\,^1P_1$). The minimum sampling time is 4 ms.

When the electron density n_e has peaked or flat profiles, the derived T_e is found close to the central T_e measured with the Thomson scattering method. For hollow n_e profiles, however, the obtained T_e is significantly lower than the Thomson's result. This discrepancy is ascribable to the displacement of dominant emission region from the plasma center.

Since the ion temperature T_i can be also determined from the Doppler width of the resonance line, simultaneous measurement of T_e and T_i is realized. We have measured the temporal behaviors of T_e and T_i for a discharge in which n_e is abruptly increased by injection of hydrogen pellets. At the beginning of the discharge when n_e is kept low ($\sim 1 \times 10^{19}\,m^{-3}$), T_e is clearly higher than T_i, whereas after n_e is increased up to $2 \times 10^{20}\,m^{-3}$, T_i immediately grows up and eventually coincides with T_e. The establishment of thermal equipartition between electrons and ions due to increase of n_e is thus confirmed.