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Invited Lecture

SPECTRAL LINE MERGING IN HYDROGEN-LIKE SPECIES FOR DIAGNOSTIC OF LABORATORY AND SPACE PLASMAS

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Plasma density effects manifest themselves in various atomic phenomena, including spectral line broadening, delocalization of higher excited levels, and merging of the discrete and continuous spectra. A theoretical model successfully explaining benchmark spectroscopic observations is crucial for reliable density measurements.

In this study, laser-induced hydrogen plasma in the density and temperature range of $(0.1 - 5) \times 10^{23}\,\mathrm{m}^{-3}$ and $(6000 - 20000)\,\mathrm{K}$, respectively, was precisely diagnosed using two-color Thomson scattering technique, inferring the electron number density, electron temperature as well as ion temperature. Simultaneously, spectra of the Balmer series of spectral lines from H-β to H-ζ were measured and plasma emission coefficient calculated within the quasicontiguous frequency-fluctuation model. The theoretical spectra are found to be in good agreement with experimental ones, including higher-density data where discrete lines were observed to merge forming a continuum.

This calculational approach can be applied to model spectra of hydrogen-like ions or Rydberg series of any species, providing efficient density diagnostic of laboratory and space plasmas.