# Simultaneous estimations of plasma parameters using quantitative spectroscopy

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The observed spectra from a plasma source is quite rich in information content. Basically, it is combination of effects of electron density, electron temperature, ion temperature, ground state atomic density, ground state ion density, metastable state density, plasma motions, impurity concentrations, etc. A few of these quantities can be measured quite straightforwardly in a separate manner. However, for the simultaneous measurements, accurate knowledge of atomic properties, such as, emitted wavelength, transition probabilities, collisional cross-sections, etc. and also all the processes of populating and depopulating the levels by mean of excitation, de-excitation, spontaneous emission, ionization, recombination from adjacent ionization stages, etc. are highly required. Very recently we have developed a method on the basis of experimentally observed absolute intensities of a number of spectral lines of helium/hydrogen in the visible region to infer large number of plasma parameters simultaneously for laboratory based plasma systems [1-2]. The collisional-radiative (CR) model code of atomic data and analysis structure (ADAS) database has been used for this purpose. With an approximation of optical thin plasma, the electron density, electron temperature, ground-state atom and ion densities and also the triplet metastable state ($2\ ^3S$) density are the parameters estimated [1]. The derived plasma parameters are then used to theoretically obtain the absolute intensities of a few lines in the vacuum ultraviolet (VUV) region. These have been compared with the observed VUV spectral lines, recorded simultaneously with the visible spectra, using a VUV-spectrometer-detector system for which intensity calibration was not available. This analysis has helped to generate a calibration curve for VUV-spectrometer-detector system. The developed method is much cost-effective in comparison to the commonly known branching ratio method used in Tokamak plasmas [3-4]. It is found that for a penning plasma discharge source the inclusion of opacity in the observed spectral lines through CR-model based photo emission coefficients (PECs) and addition of diffusion of neutrals and metastable state species in the CR-model code improves the electron temperature estimation in the simultaneous measurements [5]. The results of this analysis and the development work of laboratory based VUV-spectrometer-detector system calibration technique [1-2,5] using penning plasma discharge source [6] will be presented.

## References

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