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HOW CRITICALLY SELECT THEORETICAL STARK BROADENING DATA NEEDED FOR THE INVESTIGATION OF ASTROPHYSICAL, LABORATORY AND LASER PRODUCED PLASMAS

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The interest for a very extensive list of line broadening data is stimulated by laboratory and stellar plasmas investigation and modelling. For users of such data it is of interest to discuss how critically select from the literature, the needed theoretical or experimental data. Such question is of interest as well for the preliminary evaluation of theoretical or experimental values during research.

The most sophysticated theoretical method for the calculation of a Stark broadened line profile is of course the quantum mechanical strong coupling approach. However, due to its complexity and numerical difficulties, only a small number of such calculations exist. In a lot of cases such as e.g. complex spectra, heavy elements or transitions between more excited energy levels, the semiclassical approach remains the most efficient method for Stark broadening calculations. Whenever line broadening data for a large number of lines are required, and the high precision of every particular result is not so important, simple approximative formulae with good average accuracy may be very useful. Moreover, in the case of more complex atoms or multiply charged ions the lack of the accurate atomic data needed for more sophysticated calculations, makes that the reliability of the semiclassical results decreases. In such cases approximate methods might be very interesting.

It will be discussed here the accuracy of particular methods, as well as the variations of accuracy within the same method. E.g. for resonance line the accuracy of the semiclassical method is usually lower due to the importance of short range effects. Also, the width data are more reliable than the shift data, since shift calculations are more sensitive to the small variations of various parameters. The reason is because shifts are smaller than widths and produced in average by more distant collisions. The shift data are more reliable when they have value similar to the corresponding width value, than when they are smaller than widths.

The knowledge on regularities and systematic trends of line broadening parameters can be used very effectively for the critical evaluation and selection of needed data, as well as for quick estimates e.g. during experiment. When reliable data do not exist, such investigations may be of help for quick acquisition of new data as well, especially when high accuracy of each particular value is not needed.

The broadening of a line depends on both the dynamics of the individual emitter--perturber collisions and on the collective effect of all the perturbers interacting with the emitter. The relative importance of these factors depends on whether the perturber density is low or high. Line broadening depends also on the particle properties and consideration of the structure of emitting (or absorbing atom) indicates that similarities should exist for lines within a multiplet or supermultiplet. Widths also depend on perturber properties such as polarisability and should have a regular behaviour along spectral series, for corresponding transitions in homologous emitters, and for isoelectronic sequences.

Regularities and systemic trends for the widths of isolated non–hydrogenic spectral lines in plasmas have been studied recently in a number of papers. The aim of such studies is to find out if regularities and systematic trends can be used to predict line widths and to critically evaluate experimental data.

Finally, it will be discussed as well how critically select reliable experimental data.