XIII SERBIAN CONFERENCE ON SPECTRAL LINE SHAPES IN ASTROPHYSICS
August 23-27, 2021, Belgrade, Serbia
Book of Abstracts, Eds. A. Kovačević, L. Č. Popović and S. Simić
Astronomical Observatory Belgrade, 2021

Invited Lecture

ADDRESSING THE ACCURACY OF THE COMPUTER SIMULATION METHOD INVOLVED IN STARK BROADENING CALCULATIONS

J. Rosato, I. Hannachi, Y. Marandet and R. Stamm

PIIM, Aix-Marseille Université / CNRS, Marseille, France
E-mail: joel.rosato@univ-amu.fr

In this work, we examine the accuracy of the so-called computer simulation method used for the modeling of Stark-broadened line shapes. The main idea of this tool is to reproduce the power spectrum radiated by the neutrals by retaining the physical mechanisms occurring at the microscopic scale in a way as realistic as possible. One part of the algorithm is devoted to the calculation of the plasma microfield based on the motion of the charged particles located at the vicinity of the atoms. For a set of simulated microfield histories, corresponding to different initial conditions, the time-dependent Schrödinger equation is solved numerically and the resulting dipole operator is evaluated. It is next inserted in the power spectrum formula, which serves in the evaluation of observable spectroscopic signals. The computer simulation method is well established in the plasma spectroscopy community (e.g., Stambulchik and Maron 2010), it has been applied to the diagnostic of laboratory and astrophysical plasmas, but the reliability of the results has not been systematically addressed. By construction, the algorithm involves various causes of uncertainty (discretization, finite number of particles, etc.), which can result in the occurrence of significant error bars in the results. We examine this issue along the lines of a recent work Rosato et al. (2020). We present new simulations of Stark line shapes in conditions relevant to white dwarf atmospheres. The Lyman and Balmer series are considered. The sensitivity of density diagnostics involving Stark broadening models to the model accuracy is examined through calculations in specific cases.

References

Rosato, J., Marandet, Y., Stamm, R.: 2020, Quantifying the statistical noise in computer simulations of Stark broadening, *J. Quant. Spectrosc. Radiat. Transfer*, **249**, 107002.

Stambulchik, E. and Maron, Y.: 2010, Plasma line broadening and computer simulations: A mini-review, *High Energy Density Phys.*, **6**, 9.