VAMDC FP7 project and STARK-B database: C II Stark broadening parameters for white dwarf atmospheres research

N. Larbi-Terzi[1], S. Sahal-Bréchot [2],N. Ben Nessib [1], M. S. Dimitrijević[2,3]

[1]*Institut National des Sciences Appliquées et de Technologie, University of 7 November at Carthage, 1080 Tunis Cedex, Tunisia*

[2] *Observatoire de Paris-Meudon, 92195 Meudon Cedex, France*

[3]*Astronomical Observatory, Volgina 7, 11060 Belgrade 38, Serbia*

Stark broadening is dominant pressure broadening mechanism in white dwarf atmospheres and in particular data on spectral line widths are important for analysis, synthesis and interpretation of their spectra, for radiative transfer considerations, abundance determination, and for the investigation, diagnostics and modelling of plasma of such stars. Carbon is often present in white dwarf spectra and if in their spectra are present traces of carbon, either as neutral carbon lines or molecular C_2 Swan bands, they are collectively known as DQ stars. In hotter DQ stars C II spectral lines are also present. For example Thejll et al. (1990) for the modelling of the spectrum of the carbon rich DQ white dwarf G35-26 (Gr 469, WD 0203+207), used data on the Stark broadening of C II lines. A new type of white dwarfs has recently been discovered by Dufour et al. (2007). The surface composition of these stars is mostly composed of carbon. There is hardly neither hydrogen nor helium in the atmosphere. In order to understand the origin and evolution of this new type of stars, the determination of gravity is essential, and it is necessary to develop a new generation of accurate models. In fact, the inclusion of accurate spectral line broadening is crucial for this type of white dwarf atmosphere modellisation. At these temperatures and pressures of interest (effective temperatures within 19,000-23,000K, electron density within 10^{15}cm^{-3}-10^{18}cm^{-3}), the dominant ion is C II. There is a contribution of C III for the most profound layers or for very hot models but it can be neglected. The predominant cause of broadening of CII lines is Stark broadening, i.e. broadening by electron impact and ion interactions. In the present work, we calculate the full Stark width at half maximum FWHM and the shift of C II spectral lines due to collisions with electrons using the semiclassical perturbation formalism We have obtained ab initio Stark broadening parameters for 148 C II multiplets. Energy levels and oscillator strengths are taken from the TOPBase data base.Results are obtained as a function of temperature, for a perturber density of 10^{17} cm^{-3}. In addition to electron-impact full halfwidths and shifts, Stark broadening parameters due to singly ionized carbon-impacts have been calculated. Thus, we have provided Stark broadening data for all the important charged perturbers in stellar atmospheres. Our results are compared with available experimental and theoretical data. Obtained results will be included in STARK-B database containing Stark broadening parameters obtained theoretically within the semiclassical perturbation approach (http://stark-b.obspm.fr/). entering in the FP7 project of European Virtual Atomic and Molecular Data Center VAMDC aiming at building an interoperable e-Infrastructure for the exchange of atomic and molecular data (http://www.vamdc.org/).