



## MW-Gaia STSM

### Stark broadening of Si II spectral lines

Dr. Milan Dimitrijevic from Astronomical Observatory (Belgrade) spent two weeks (20/02-06/03/2022) at the Observatoire de Paris (France) to work with Magdalena D. Christova.

First of all, we made a model of Si II ion, i.e. the system of energy levels to which the dipoly allowed transitions from the upper and lower atomic energy level of the considered transition are possible. Then we identified transitions for which a sophisticated semi-classical calculation of Stark broadening parameters is possible. For each such transition we prepared a set of input data. Then we calculated line widths and shifts determining a Lorentz profile, for 62 transitions in the spectrum of singly charged silicon ion (Sn II). Calculations were performed for broadening of spectral lines due to collisions of emitter/absorber with electrons, protons and singly charged helium ions. For calculations was used the semi-classical perturbation theoretical method. We also collected all, numerous references about experimental and theoretical works for collisional broadening with charged particles of Si II spectral lines. Then, we analysed possibilities for the Stark broadening calculations of Stark broadening of Si II lines within  $3s3p(3P_o)nl$  configuration, important due to a number of strong lines in the visible part of the spectrum. For spectral lines in this configuration there is no a sufficiently complete set of atomic data needed for the semi-classical perturbation calculation in an adequate way. So we calculated electron impact widths for 13 Si II multiplets, belonging to the  $3s3p(3P_o)nl$  configuration, by using the modified semi-empirical method. The obtained results have been compared with available experimental and theoretical data and used for the investigation of regularities within supermultiplets. An article has been prepared for Stark broadening of Si II lines belonging to the  $3s3p(3P_o)nl$  configuration, and sent to "Advances in Space Research".

#### **Description of the STSM main achievements and planned follow-up activities**

All planned goals and expected outcomes of the STSM have been achieved. We obtained Stark broadening parameters defining a Lorentzian profile for 62 transitions in the spectrum of ionized silicon, by using the semi-classical perturbation method. Results are for collisions of emitter/absorber with electrons, protons and ionized helium, in function of perturber density and temperature. Electron densities are from  $10^{14} \text{ cm}^{-3}$  to  $10^{19} \text{ cm}^{-3}$  and temperatures from 5 000 K up to 100 000 K. These data will enter in STARK-B database and will be available online. STARK-B is one of 38 atomic and molecular databases in the European Virtual Atomic and Molecular Data Center - VAMDC. Additionally, we calculated electron-impact widths for 13 Si II multiplets, belonging to the  $3s3p(3P_o)nl$  configuration, by using the modified semi-empirical method. The obtained results have been compared with available experimental and theoretical data and used for the investigation of regularities within supermultiplets. An article has been prepared for Stark broadening of Si II lines belonging to the  $3s3p(3P_o)nl$  configuration, and sent to "Advances in Space Research".

Now we are working on the article, which will contain results and the corresponding analysis and comparison with existing experimental and theoretical data, concerning other 62 transitions. It will be submitted in Monthly Notices of the Royal Astronomical Society. A close collaboration on theoretical determination of line profiles broadened by collisions with electrons, protons and various ions, in order to provide high quality data needed in various domains of physics, astrophysics and for technological applications will continue.

Milan S. Dimitrijevic, Magdalena D. Christova, Cristina Yubero. "Stark broadening data for Si II multiplets within  $3s3p(3P^o)nl$  configuration. Advances in Space Research 71 (2023) 1275–1280.