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THE STARK-B DATABASE, A NODE OF VIRTUAL ATOMIC AND MOLECULAR DATA CENTER (VAMDC)

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Abstract. STARK-B database (http://stark-b.obspm.fr), a collaborative project between the "Laboratoire d'Étude du Rayonnement et de la matière en Astrophysique" (LERMA) of the Paris Observatory and CNRS, and the Astronomical Observatory of Belgrade (AOB), is described as it was on 1. August 2017 . Database contains widths and shifts of isolated lines of atoms and ions due to electron and ion impacts (Stark broadening parameters) determined theoretically in more than 150 papers by Dimitrijević, Sahal-Bréchot, and colleagues. STARK-B enters also in Virtual Atomic and Molecular Data Center (VAMDC http://www.vamdc.eu).

1. INTRODUCTION

Stark broadening of spectral lines is due to perturbation of emitting or absorbing atom or ion by interactions with surrounding charged particles. The corresponding Stark broadening parameters, line width and shift, are needed for different applications in Astrophysics (e.g. for stellar atmospheres modelling, analyzis and synthesis of stellar spectra, radiative transfer calculations, abundance determination...), Physics (e.g. laboratory plasma diagnostics, laser produced plasmas, inertial fusion plasmas), and for industrial plasmas (discharge lighting, laser welding and piercing of metals...).

More than thirty five years, two of us (MSD-SSB) were calculated at a large scale Stark broadening parameters using the semiclassical perturbation theory and the corresponding computer code (Sahal-Bréchot 1969a, 1969b, see the review of theory and updates in Sahal-Bréchot et al. 2014). During this period the obtained results were published in more than 150 papers so that the need of creation of an on-line database was obvious. So, the creation of a database BELDATA has been initiated in the Astronomical Observatory of Belgrade (AOB), and it was available on-line. A history of BELDATA is presented in detail in Popović et al. (1999a,b), Milovanović et al. (2000a,b), Dimitrijević et al. (2003) and Dimitrijević and Popović (2006). Consequently, we continued this work in Paris as a collaborative project between AOB and LERMA which led to the present database - STARK-B, which is on-line in

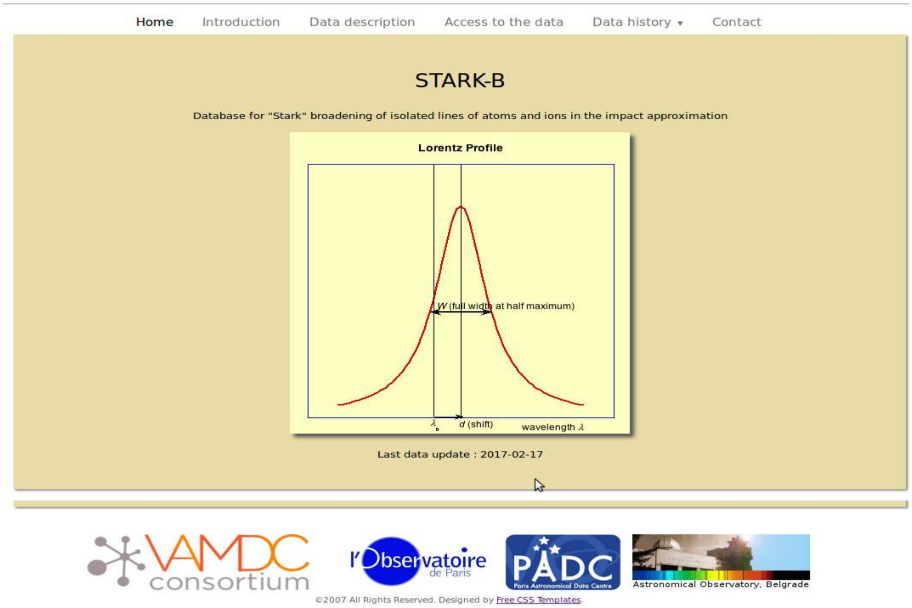

Figure 1: Home page of STARK-B.

free access, since the end of 2008 (http://stark-b.obspm.fr Sahal-Brchot et al. 2015, 2017).We note also, that due to STARK-B database authors of this article entered in the team of the FP7 European project “Research Infrastructures” for creation of the VAMDC (Virtual Atomic and Molecular Data Centre). This project started in the summer of 2009 for 3.5 years and now, VAMDC is an interoperable e-infrastructure for search and exchange of atomic and molecular data (Dubernet et al. 2011, 2016 - http://www.vamdc.eu, and http://portal.vamdc.eu).

In this contribution, the STARK-B database is presented and described.

2. STARK-B DATABASE

Starting from the homepage of STARK-B database, the menu offers: ”Introduction”, ”Data Description”, ”Access to the Data”, ”Data history” and ”Contact”. In ”Introduction”, after a brief discussion of purpose of database, are explained the impact-, isolated line-, and semiclassical perturbation (SCP) - approximations and the modified semiempirical (MSE) method. ”Data Description” offers a detailed description of the tabulated data. ”Access to the Data” is a graphical interface which enables to click on the choosen atom in the Mendeleev periodic table when appear the available ionization stages. Stark broadening parameters are present only for elements in yellow cells, with characters written by boldface. After choosing the element, ionization stage, the colliding perturber(s), the perturber density, the transition(s) (or a domain of wavelegths) and the plasma temperature(s), a table with the Stark full widths at half maximum of intensity and shifts appears. On the beginning is an instruction how to cite the STARK-B, and the bibliographic references for the data in the Table, linked to the publications via the SAO/NASA ADS Physics Abstract Ser-

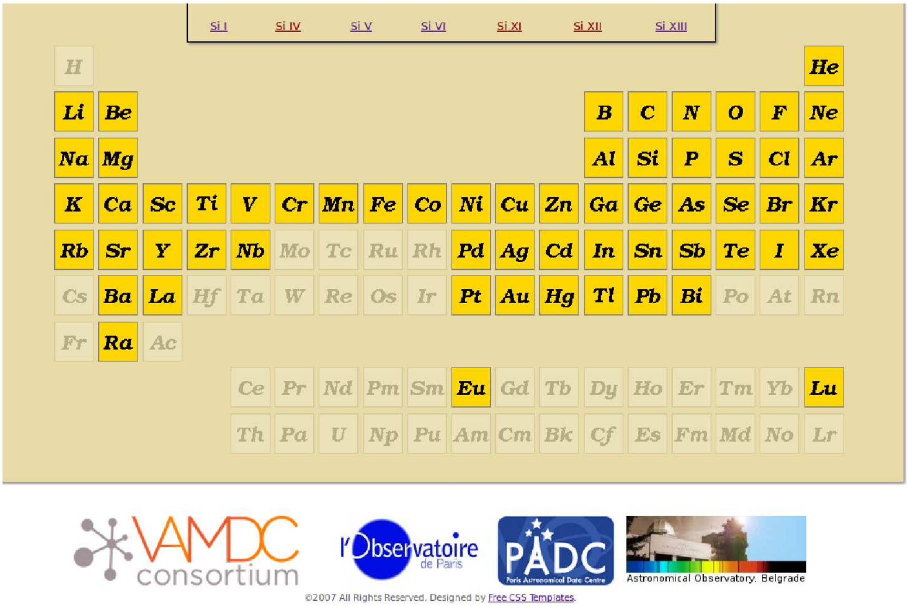

Figure 2: Access to the data: the graphical interface.The status on 1. 08. 2017. After click on an element, available ionisation stages appear, like in this examplee for Si.

vice (http://www.adsabs.harvard.edu/) and/or within DOI. Besides the html table, Stark broadening parameters can be extracted as an ASCII text or in XML format for Virtual Observatories (VOTable). Moreover, under each table with Stark broadening parameters, a table with coefficients a0 , a1, a2 and b0 , b1, b2, is added, in order to enable fitting with the temperature with formula based on a least-square method derived in Sahal-Bréchot et al. (2011).

Actually (1st of August 2017) in the STARK-B are implemented Stark broadening parameters obtained by using the SCP method for 79 transitions of He, 61 Li, 29 Li II, 19 Be, 30 Be II, 27 Be III, 1 B II, 12 B III, 157 B IV, 148 C II, 1 C III, 90 C IV, 25 C V, 1 N, 7 N II, 2 N III, 1 N IV, 30 N V, 4 O I, 12 O II, 5 O III, 5 O IV, 19 O V, 30 O VI, 14 O VII, 8 F I, 5 F II, 5 F III, 2 F V, 2 F VI, 10 F VII, 30 Ne I, 22 Ne II, 5 Ne III, 2 Ne IV, 26 Ne V, 20 Ne VIII, 62 Na, 8 Na IX, 57 Na X, 270 Mg, 66 Mg II, 18 Mg XI, 25 Al, 23 Al III, 7 Al XI, 3 Si, 19 Si II, 39 Si IV, 16 Si V, 15 Si VI, 4 Si XI, 9 Si XII, 61 Si XIII, 114 P IV, 51 P V, 6 S III, 1 S IV, 34 S V, 21 S VI,2 Cl, 10 Cl VII, 18 Ar, 2 Ar II, 9 Ar VIII, 32 Ar III, 51 K, 4 K VIII, 30 K IX, 189 Ca I, 28 Ca II, 8 Ca V, 4 Ca IX, 48 Ca X, 10 Sc III, 4 Sc X, 10 Sc XI,10 Ti IV, 4 Ti XI, 27 Ti XII, 26 V V, 33 V XIII, 9 Cr I, 7 Cr II, 6 Mn II, 3 Fe II, 2 Ni II, 9 Cu I, 32 Zn, 18 Ga, 11 Ge, 3 Ge IV, 16 Se, 4 Br, 11 Kr, 1 Kr II, 6 Kr VIII, 24 Rb, 33 Sr, 32 Y III, 3 Pd, 48 Ag, 70 Cd, 1 Cd II, 18 In II, 20 In III,1 Sn III, 4 Te, 4 I, 4 Xe VI, 14 Ba, 64 Ba II, 6 Au, 7 Hg II, 2 Tl III and 2 Pb IV, in total 2929 transitions.

In STARK-B are also implemented Stark broadening data obtained with the Modified semiempirical method (MSE) (Dimitrijević and Konjević 1980; Dimitrijević and Kršljanin 1986, Dimitrijević and Popović 2001). This method is suitable when the needed atomic data set is not sufficiently complete to perform an adequate semiclassical perturbation calculation. Stark line widths and in some cases also shifts of spectral lines of the following emitters have been implemented up to 1 August 2017 :

Ag II, Al III, Al V, Ar II, Ar III, Ar IV, As II, As III, Au II, B III, B IV, Ba II, Be III, Bi II, Bi III, Br II, C III, C IV, C V, Ca II, Cd II, Cl III, Cl IV, Cl VI, Co II, Cu III, Cu IV, Eu II, Eu III, F III, F V, F VI, Fe II, Ga II, Ga III, Ge III, Ge IV, I II, Kr II, Kr III, La II, La III, Mg II, Mg III, Mg IV, Mn II, N II, N III, N IV, N VI, Na III, Na VI, Nb III, Nd II, Ne III, Ne IV, Ne V, Ne VI,Ne VII, Ne VIII, O II, O III, O IV, O V, P III, P IV, P VI, Pt II, Ra II, S II, S III, S IV, Sb II, Sc II, Se III, Si II, Si III, Si IV, Si V, Si VI, Si XI, Sn III, Sr II, Sr III, Ti II, Ti III, V II, V III, V IV, Xe II, Y II, Zn II, Zn III, Zr II and Zr III.

Under the option "Data history" there are "New datasets" and "Updated datasets" with the description of newly added data with the date of importation as well as the eventual date of the first importation and the importation of the modification for revised data.

At the end, for enquiries or user support, is option "Contact" enabling to send an e-mail with questions.

STARK-B database is devoted to modelling and spectroscopic diagnostics of stellar atmospheres and envelopes, but the implemented data are also of interest for laboratory plasmas, fusion plasma, laser equipment design and technological plasmas investigations and will be useful for a number of different topics not only in astrophysics, but also in physics and technology.

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