ASTRONOMICAL OBSERVATORY – BELGRADE
Milan S. Dimitrijević

RESEARCH FIELDS AT AOB

1. Influence of collisional processes on spectra of astrophysical plasmas

2. Astrophysical spectroscopy of extragalactic objects

3. Physics of stars and Sun

4. Dynamics of celestial bodies, of Systems and of Populations

5. Stellar interferometry and Spectrophotometry

6. Gaseous and stellar components of Galaxies: Interactions and evolution

7. Chemistry of Galaxy and extragalactic moleculasr clouds

8. History and Epistemology of Natural Sciences

9. Serbian Virtual Observatory - SerVO

AOB AND VAMDC

first paper: VII SCSLSA, Zrenjanin 15-19 June 2009.

New Astronomy Reviews 53 (2009) 222–226

Contents lists available at ScienceDirect

New Astronomy Reviews

journal homepage: www.elsevier.com/locate/newastrev

The project of Serbian Virtual Observatory and data for stellar atmosphere modeling

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ARTICLE INFO

Article history:
Available online 15 September 2009

Keywords:
Virtual Observatory
Databases
Stars: evolution
Stark broadening
Atomic data

ABSTRACT

We review recent developments in Serbian Virtual Observatory (SerVO) as well as developments surrounding Virtual Atomic and Molecular Data Center. Main components of SerVO are going to be the archive of photographic plates, database of Stark broadening parameters and stellar evolution database. Photographic plates were obtained at Belgrade Observatory from 1936 to 1996. Data for Stark broadening were obtained using semiclassical perturbation and modified semiempirical theories. Stellar evolution database is a mirror of Darthmouth evolution database with improvement and VO compatible outputs.

VII Bulgarian Serbian Astronomical Conference, Chepelare 1-4.06.2010

- 1. Milan S. Dimitrijević, Sylvie Sahal-Bréchot: VIRTUAL ATOMIC AND MOLECULAR DATA CENTER (VAMDC) AND STARK-B DATABASE
- 2. Zoran Simić, Milan S. Dimitrijević: STARK-B DATABASE VIRTUAL ATOMIC AND MOLECULAR DATA CENTER (VAMDC) AND DATA FOR WHITE DWARF ATMOSPHERES ANALYSIS
- 3. Darko Jevremović et al: SERBIAN VIRTUAL OBSERVATORY AND VIRTUAL ATOMIC AND MOLECULAR DATA CENTER (VAMDC)
- http://aquila.skyarchive.org/7_BSAC/

THE THIRD INTERNATIONAL SCHOOL IN ASTRONOMY: ASTROINFORMATICS - VIRTUAL OBSERVATORY Belgrade, 29.06 - 01.07.2010

• Thursday, 01.07.2010 09.15-10.15 European Virtual Atomic and Molecular Data Center (VAMDC) and STARK-B Database, M. S. Dimitrijević

•http://poincare.matf.bg.ac.rs/~andjelka/AIVO/program.html

Workshop on "Spectroscopy as a tool to investigate Active Galactic Nuclei and gravitational lenses", Serbia, July 05-09, 2010.

•5. SerVO and VAMDC and AGN research (Moderator: D. Jevremovic)

• -How SerVO and VAMDC could be used for AGN research (discussion on needed data and their organization, presentation and archiving) (D. Jevremovic, M.S. Dimitrijevic, A. Kovacevic, Ph. Pruginiel, N. Gavrilovic)

• -Stark broadening data for SerVO, VAMDC and STARK-B (M. S. Dimitrijevic, Z. Simic, A. Kovacevic, N. Ben Nessib, R. Hamdi, M. Christova)

25th Summer School and International Symposium on the Physics of Ionized Gases

August, 30 - September, 3, 2010, Donji Milanovac, Serbia

- Topical lectures
- Sylvie Sahal-Bréchot, Meudon Observatory, France “Case studies on recent Stark broadening calculations and Stark-b database development”
- Progress reports:Milan S. Dimitrijević, Astronomical Observatory, Belgrade, Serbia
“European Virtual Atomic and Molecular Data Center – VAMDC”

- http://webhost.rcub.bg.ac.rs/~spig2010/

NEEDS FOR STARK BROADENING IN ASTROPHYSICS

- Stellar plasma diagnostics
- Abundance determinations
- Stellar spectra modelling,
- analysis and synthesis
- Chemical stratification
- Spectral classification
- Nuclear processes in stellar interiors
- Radiative transfer
- Stellar opacities

AOB and STARK BROADENING

- Investigation of the influence of Stark broadening on profiles of stellar spectral lines
- Stark broadening and modelling, analyzis and synthezis of stellar spectra
- Spectroscopically detectable influences of collisional processes on electron density in stellar atmospheres
- Quantum mechanical method
- Semiclassical perturbation method
- Modified semiempirical method
- Regularities and systematic trends

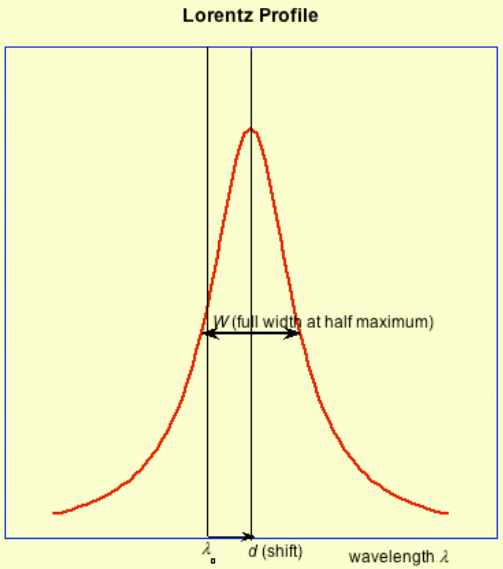
Paris Observatory and STARK BROADENING (Atomic and Molecular Physics group)

Theory and Numerical code created by S. Sahal-Bréchot *(1969 first version, 1974 complex atoms, 1977 addition of Feshbach resonances for ions):*

- ***Atomic and ionic lines***
- ***Impact approximation***
  - *Collisions between radiators and perturbers act independently*
  - *Interactions with charged particles: Debye screening effect (at high densities)*
- ***Isolated lines***
  - *Neighbouring levels do not overlap*
- ***⇒ LORENTZ PROFILE:***
  - ***width** and **shift ARE NOT INTRINSIC DATA***
  - ***Depend on the medium** (density, temperature)*
- ***Semi-Classical Perturbation method (SCP)***

(about 6-8 basic papers)

- **Accuracy** : about 20%, sometimes better, sometimes less



NEEDS FOR LARGE STARK BROADENING DATA SET

- Development of computers

  For example:

  Phoenix code for modelling of stellar atmospheres includes a permanently growing databasa with atomic data for more than 500 millions transitions

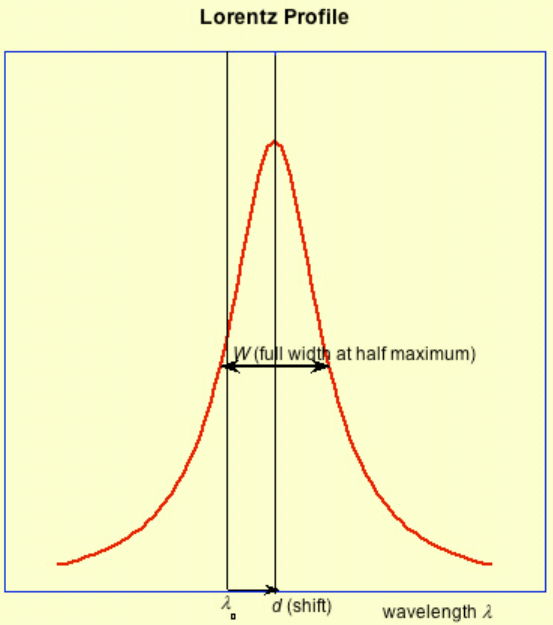
•- Satellite borne spectroscopy

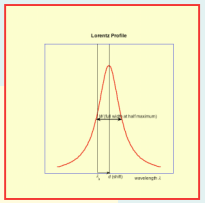
STARK-B

Database for "Stark" broadening of isolated lines of atoms and ions in the impact approximation

S. Sahal-Bréchot*, M.S. Dimitrijević**(scientists responsibles of Stark-b)
and N. Moreau*(Research engineer)
Observatoire de Paris, LERMA, France
*** Astronomical Observatory of Belgrade, Serbia*

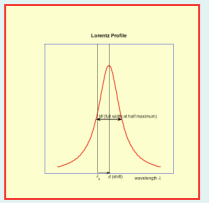
- **SSB theory updated** and **operated** by M.S. Dimitrijević and S. Sahal-Bréchot
- **Calculated widths and shifts** contained in more than **100 publications** (1984-2009)
- **More than 1500 citations** (ADS) for the whole work





STARK-B

- STARK B is currently developed at Paris Observatory (LERMA)
  - *the database has been opened since September 2008: 80% of the data are currently implemented*
- It is a part of the atomic and molecular databases of the Paris Observatory
- There is a link to SerVO - SERBIAN VIRTUAL OBSERVATORY
- And is a part of VAMDC



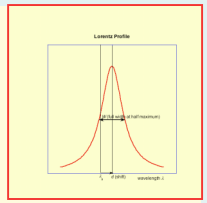
In Cooperation with

M. Christova (University of Sofia, Bulgaria)

N. Ben Nessib (University of Carthago, Tunisia)

H. Elabidi & W. Mahmoudi (University of Bizerte, Tunisia)

STARK-B



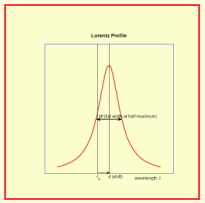
Scientific objectives:

- Spectroscopic diagnostics,
- Modelisation
- Synthetic spectra

Addresses

- Astrophysics
- Virtual Observatories
- Laboratory and technological plasmas

Next steps and future objectives



- **Implementation of the remaining files** *(about 20)*

- **VAMDC European project** ***(Virtual Observatories standards, interoperability, data model, deliverables)***

- **Create a request with the vacuum measured wavelengths** (our wavelengths are calculated ones for multiplets)

Link with the NIST wavelengths databases (if possible)

- **Implementation of our future data** *(SCP or quantum)*

- **Implementation of MSE data** *(Modified Semi Empirical Method)*

by Milan Dimitrijevic et coworkers

N.B. less accurate method, to be used if nothing else exists

- **Extension outside the impact approximation**

- **Automatic SCP calculation code using accurate atomic structure**

(TOPBASE, Cowan code) **in progress**

- **Create graphics and possibilities of interpolation or extrapolations for obtaining missing data** *(use of systematic trends)*

Future project

STARK-C

C as code

SSB semiclassical-perturbation numerical code on line

for calculations on line widths and shifts on line

THANK YOU
FOR YOUR ATTENTION