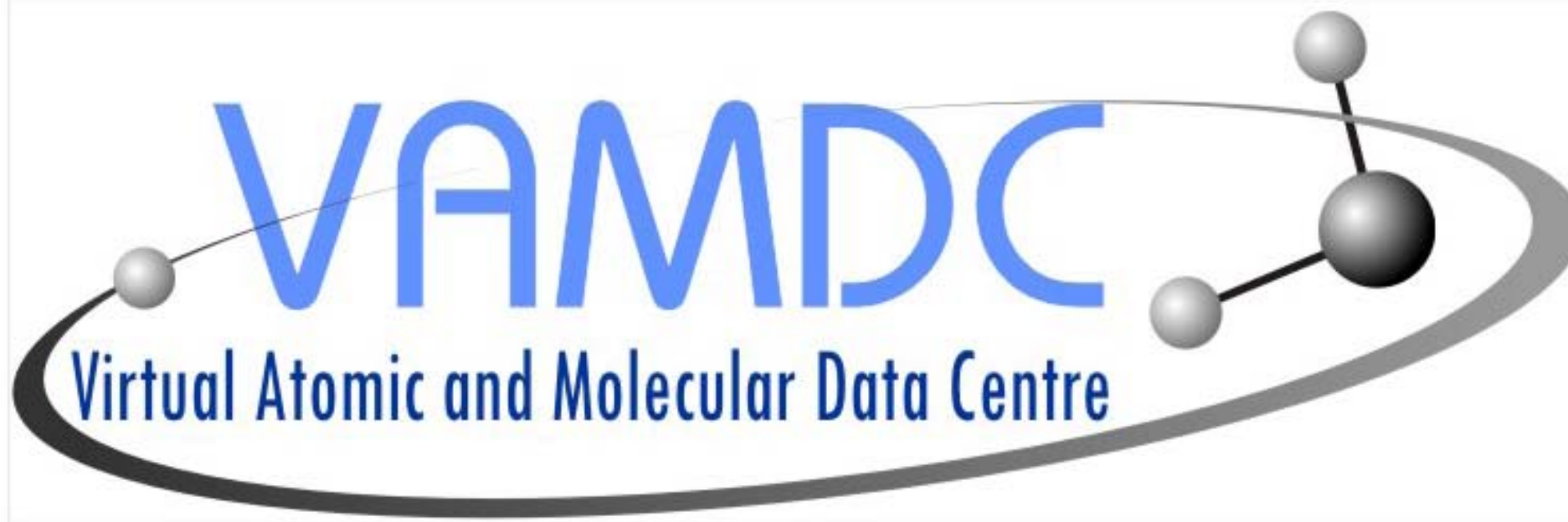,

- # STARK-B DATABASE AND VIRTUAL ATOMIC AND MOLECULAR DATA CENTER - VAMDC

MILAN S. DIMITRIJEVIĆ

VAMDC

Virtual Atomic and Molecular Data Centre

INFORMATION AVALANCHE

HUGE SURVAYS 100 million sources

< 3000sources per night > 100 years of observations

HUGE DATA COLLECTIONS

Sloan Digital Sky Survay SDSS,

Spectra of ~ 230 million objects

Images 16 Terabytes - to download with 10Mb/s ~5 Months

Catalogues 18 Terabytes – to download ~6m
AND ANALYSIS?

VIRTUAL OBSERVATORY

- Success of IUE and HST archives
- Idea of VirtualObservatory end 2000
- 2001-2005 FP5 Project ASTROPHYSICAL VIRTUAL OBSERVATORY – AVO →EUROPEAN VIRTUAL OBSERVATORY- EURO-VO
- http://www.euro-vo.org
- IVOA 2002

SERBIAN VIRTUAL OBSERVATORY - SerVO

- Project 13022 from April 2008
- Project III44002 Astroinformatics – Virtual Observatories from 1 January 2011
- Leader DARKO JEVREMOVIĆ
- Main goals
- - Digitization and publishing in VO photographic plates from archive of AOB
- STARK-B
- DSED
- OTHER SERBIAN DATA
- http://www.servo.aob.rs/~darko

Serbian Virtual Observatory
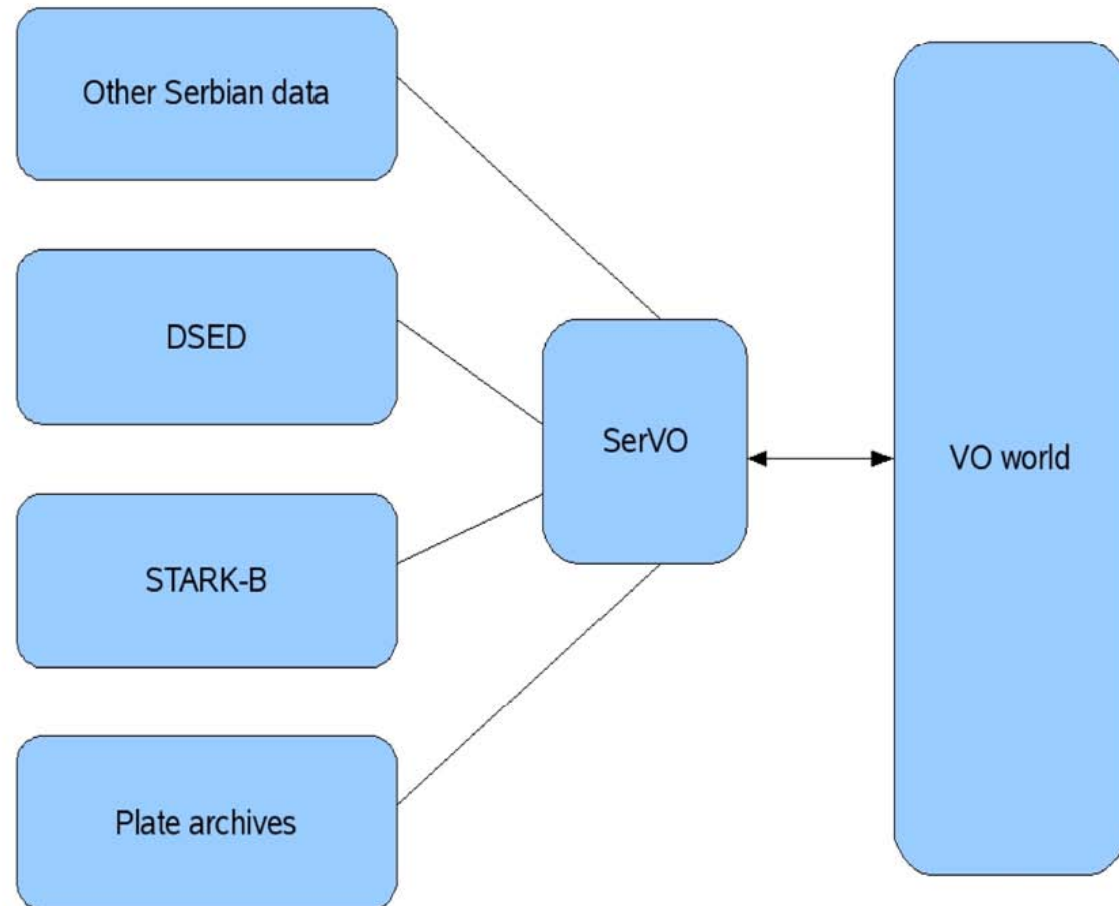
Astronomical Photographical Plates Today

What are the astronomical photographical plates today?

•Scientific heritage representing the previous stage of the present astronomical knowledge.

•Unique source of information for the past of the different astronomical objects.

Present Exploitation of the Archival Plates:

Compiled List of Astronomical Tasks and Results

- Composed light curves of different variable stars for as long as is possible time period;

- Search for long-term brightness variations;

- Search for past eruptions of a pre-main sequence star;

- Observations of small solar system bodies;

- Search for optical analogues of Gamma Ray Bursts;

- Search for photometric variability of quasars;

- Supernovae search in digitized archives;

- Present use of Carte du Ciel plates
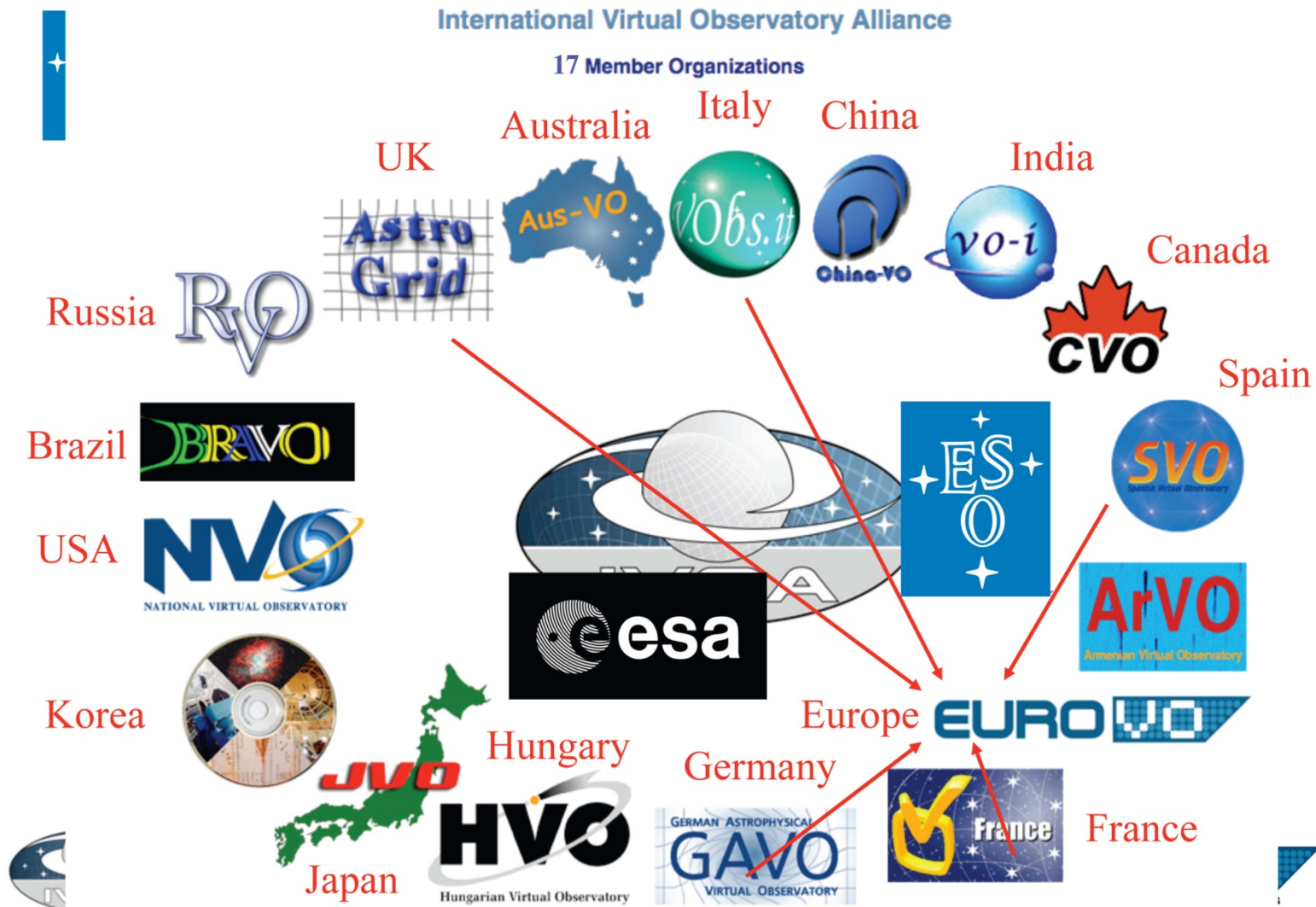
VIRTUAL OBSERVATORY

- VO: ALL ASTRONOMICAL DATABASES IN YOUR PC → DEMOCRATIZATION OF SCIENCE

THIS REQUIRES THAT ALL PLAYERS SPEAK THE SAME LANGUAGE

VO STANDARDS AND PROTOCOLS DEFINED AND ADOPTED WITHIN IVOA

International Virtual Observatory Alliance -IVOA

International Virtual Observatory Alliance

17 Member Organizations

UK • Australia • Italy • China • India • Canada • Russia • Spain • Brazil • USA • Korea • Hungary • Germany • Europe • France • Japan

ASTROINFORMATICS

- e-SCIENCE IN ASTRONOMY
- e-Science → New way to do science – use of huge distributed data reservoirs
- FOURTH PARADIGM OF SCIENCE
- -observations
- -theory
- -experiment

ASTROINFORMATICS

- e-SCIENCE IN ASTRONOMY
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- -observations
- -theory
- -experiment
- -DATA MINING – KNOWLEDGE DISCOVERY

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

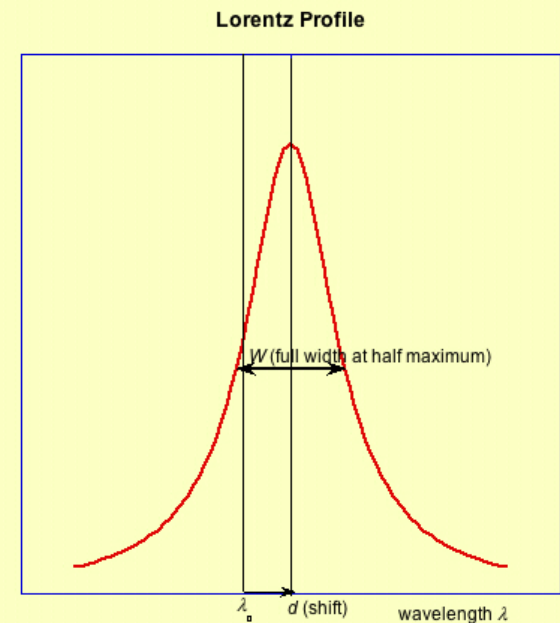**Theoretical widths and shifts** contained i[n] more than **100 publications** (1984-2009)

•**Theory and Numerical code** created by S[.] Sahal-Bréchot *(1969 first version, 1974 complex atoms, 1977 addition of Feshbach resonances for ions):* **SCP** *(about 6-8 basic papers)*

•**Updated** by M.S. Dimitrijević and S. Sahal-Bréchot

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

•**More than 1500 citations** (ADS) for the whol[e] work

80% of the data are currently implemented but the database has been opened since september 2008

Lorentz Profile

W (full width at half maximum)

λ_0 d (shift)   wavelength λ

STARK-B

- http://stark-b.obspm.fr/

-   This database is devoted to modellisation and spectroscopic diagnostics of stellar atmospheres and envelopes, for stellar spectra synthesis. In addition, it is also devoted to laboratory plasmas, fusion plasma, laser equipments and technological plasmas.

STARK BROADENING DATA ARE NEEDED IN ASTROPHYSICS FOR EXAMPLE FOR:
`

- STELLAR PLASMA DIAGNOSTIC
- - ABUNDANCE DETERMINATIONS
- - STELLAR SPECTRA MODELLING, ANALYSIS AND SYNTHESIS
  - CHEMICAL STRATIFICATION
  - SPECTRAL CLASSIFICATION
  - NUCLEAR PROCESSES IN STELLAR INTERIORS
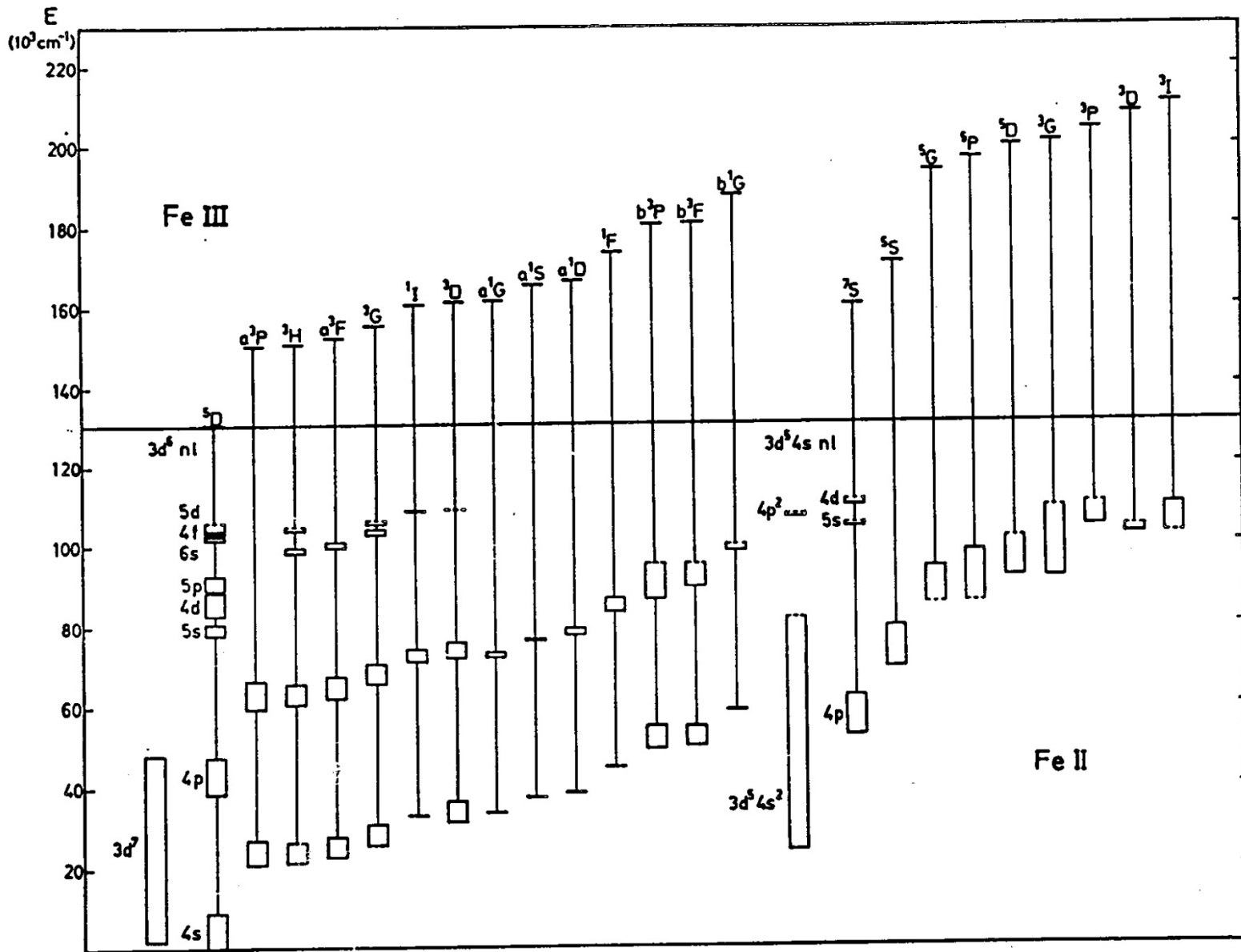 - RADIATIVE TRANSFER
  - STELLAR OPACITIES

Spectral type and effective temperature of a star can be determined by comparing its spectrum with a standard spectrum for a spectral type and effective temperature. In Fig. left are spectral types and right effective temperatures.

$$\tau_\nu = \int_z^\infty \kappa_\nu \rho \, \mathbf{dz},$$
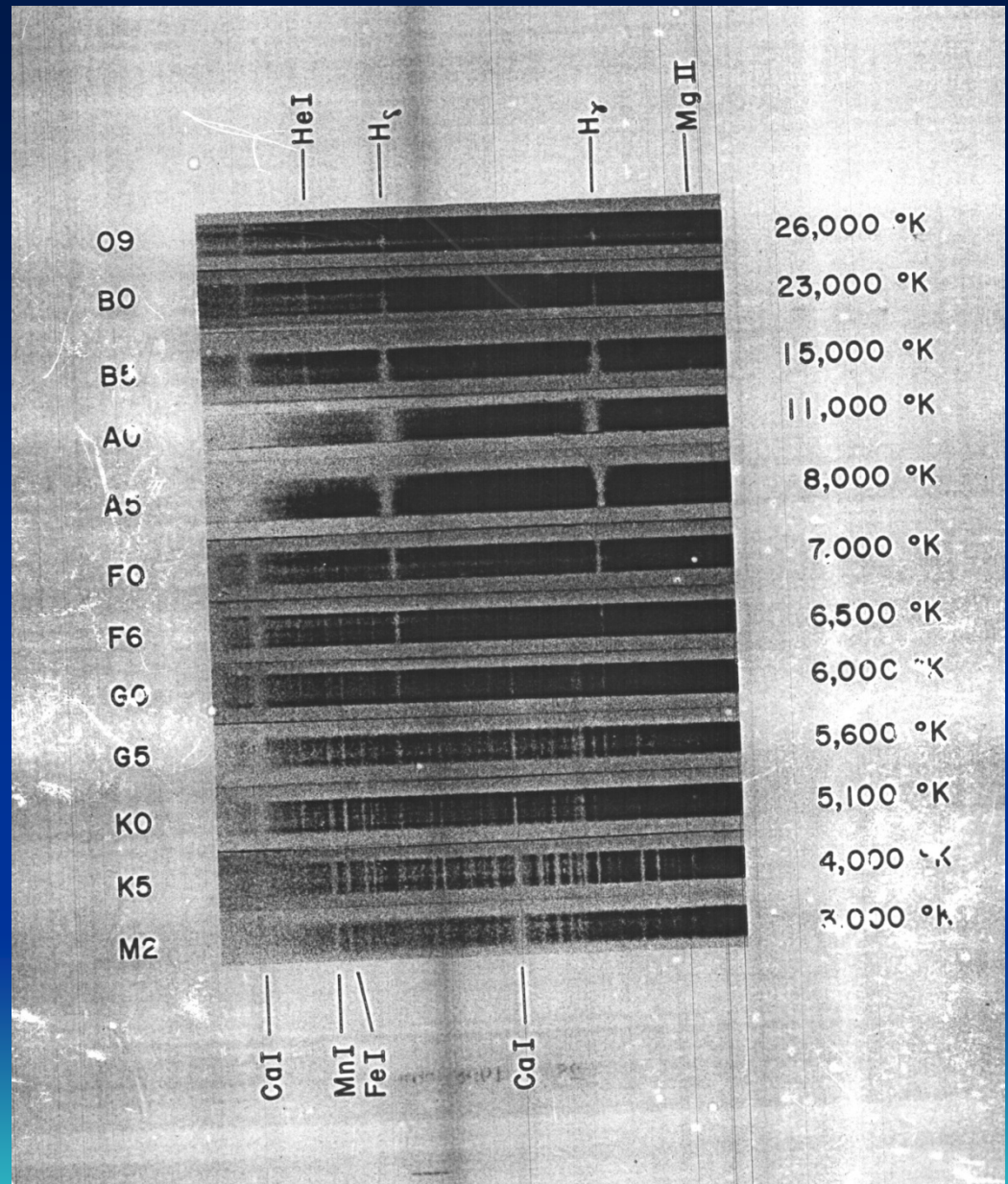
$$\kappa_\nu = \mathbf{N}(\mathbf{A}, \mathbf{i}) \phi_\nu \frac{\pi \mathbf{e}^2}{\mathbf{mc}} \, \mathbf{f_{ij}},$$

- Ca II $3p^6 4s$ – $3p^6 4p$ 3 lines

- Fe II $3d^6 4s$ - $3d^6 4p$ ~ 1500 lines

- **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**
  - **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

PRECURSOR BELDATA

- We started to work in 1998
- NENAD MILOVANOVIĆ
- EDI BON
- VLADIMIR BAJČETA
- LUKA Č. POPOVIĆ
- MILAN S: DIMITRIJEVIĆ

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Start
Organization
Projects
Instruments
History
Publications
Eclipse 1999
BelData
INI YU Branch
Meetings

BelData query results

Query conditions:
Temperature : 100000
Wavelength between 4300 and 5700

J/A+AS/109/551 Stark broadening. XII. OIV & OV (Dimitrijevic+, 1995)

Number of rows : 2

N cm-3	El	Tr	lambda 0.1nm	C 0.1nm/cm3	T K	n_We	We 0.1nm	n_de	de 0.1nm	n_Wp	Wp 0.1nm	n_dp	dp 0.1nm	n_WHeIII	WHeIII	n_dHeIII	dHeIII
1e+17	O V	3P 3D	5591.4	56	100000		0.189		-0.00644		0.00829		-0.0093		0.0162		-0.0187
1e+18	O V	3P 3D	5591.4	56	100000		1.89		-0.0617		0.0829		-0.0916		0.162		-0.179

J/A+AS/115/351 Stark broadening. XIII. C V and P V (Dimitrijevic+, 1996)

Number of rows : 3

N cm-3	El	Tr	lambda 0.1nm	C 0.1nm/cm3	T K	n_We	We 0.1nm	n_de	de 0.1nm	n_Wp	Wp 0.1nm	n_dp	dp 0.1nm	n_WHeIII	WHeIII	n_dHeIII	dHeIII
1e+17	P V	6P 7S	4877	11	100000		2.5		0.36		0.344		0.296	*	0.698	*	0.582
1e+17	P V	5P 5D	5143.7	10	100000		1.19		0.0432		0.159		0.101		0.317		0.201
1e+18	P V	5P 5D	5143.7	10	100000		11.9		0.375	*	1.59	*	0.977		0		0

J/A+AS/127/543 Stark broadening of S V lines (Dimitrijevic+ 1998)

Number of rows : 4

N cm-3	El	Tr	lambda 0.1nm	C 0.1nm/cm3	T K	n_We	We 0.1nm	n_de	de 0.1nm	n_Wp	Wp 0.1nm	n_dp	dp 0.1nm	n_WHeIII	WHeIII	n_dHeIII	dHeIII
1e+17	S V	5P 5D	4483.6	11	100000		0.809		0.0329		0.107		0.0588		0.213		0.117
1e+17	S V	4D 4F	4906.8	49	100000		0.352		-0.0133		0.0334		-0.0146		0.0662		-0.0292
1e+18	S V	5P 5D	4483.6	11	100000		8.09		0.301		1.07		0.569		0		0
1e+18	S V	4D 4F	4906.8	49	100000		3.52		-0.126		0.334		-0.144		0.66		-0.277

12:13 Tuesday 15 October 2002
Author Vladimir Baiceta

Document: Done (43.433 secs)

FROM BELDATA TO STARK-B

- **BELDATA WORKED AT ASTRONOMICAL OBSERVATORY IN BELGRADE UNTIL 2002**
- **ON 2008 BELDATA IS RENAMED IN STARK-B**

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- Andjelka Kovačević
- Darko Jevremović
- Zoran Simić
- Edi Bon
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