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COLLISIONS WITH CHARGED PARTICLES AND SPECTRAL LINE SHAPES IN ASTROPHYSICAL PLASMAS – RESEARCH ON BELGRADE ASTRONOMICAL OBSERVATORY 2002-2005

Milan S. Dimitrijević

Astronomical Observatory, Volgina 7, 11160 Belgrade, Serbia

Abstract Activities on the project "Influence of collisional processes on the astrophysical plasma spectra", supported by the Ministry of Science and Environment protection of Serbia from 1st January 2002 up to 31st December 2005 are reviewed, and selected bibliography of the project participants, including other scientific results, is presented.

1. INTRODUCTION

The project "Influence of collisions with charged particles on astrophysical plasma spectral line shapes" was financialy supported by Ministry of Science and Environment protection of Republic of Serbia under the contract number GA-1195, starting with 2002 up to 2005. The contract 146001 for the project under the same name is signed also for the 2006-2010 period. The objective of this contribution is to present the results obtained up to now. Since our main scientific activity was realized through this project, our aim is to inform Belarussian colleagues on our achievments and directions of future activities in order to stimulate the development of Serbian – Belarussian collaboration within this research field.

2. RESEARCH ON THE INFLUENCE OF COLLISIONAL PROCESSES ON THE ASTROPHYSICAL PLASMA SPECTRA ON BELGRADE ASTRONOMICAL OBSERVATORY

Investigations made within the frame of the Project concern plasma in astrophysics, laboratory and technology and the corresponding modelling, determination and research of atomic and molecular processes, optical properties and spectra, with a particular accent on the role of collisional processes. The

particular attention has been paid to the investigation of spectral line profiles, broadened by collisions with charged particles (Stark effect). Such investigations are of interest for the diagnostics and modelling of stellar plasma, plasma in laboratory and technological plasma.

Semiclasical perturbation and Modified semiempirical methods were used, tested and investigated. Stark broadening parameters, line width and shift, were determined for a large number of spectral lines of Ag I, Ar I, Cd I, Ga I, Ge I, Kr I, Ne I, F II, In II, Ne II, Ti II, Be III, Cd III, Co III, Cu III, F III, S III, Si III, Zn III, and Si IV. The results obtained were applied for the investigation of the influence of Stark broadening of spectral lines in stellar atmospheres.

Particularly was investigated the role of Stark broadening at chemically peculiar A type (Ap) stars, as for example Stark broadening of the neutral chromium spectral lines in the spectrum of chromium rich star Beta CrB and of neutral silicon spectral lines in the roAp 10 Aql star atmosphere. Ab initio calculations of Stark broadening parameters of Ne V spectral lines, observed by cosmical Rendgen telescope "Chandra" was made by using the SUPERSTRUCTURE code and the semiclassical perturbation Stark broadening theory. The Modified semiempirical theory was adapted to use more accurate collision strengths from literature, instead of semiempirical Gaunt factor. The adapted theory was applied and tested on ionized oxygen spectral lines.

The large optical flare was observed on AT Microscopii, and modelled using PHOENIX code for the modelling of stellar atmospheres.

The influence of the (n - n') mixing in Rydberg H*(n) atom - H(1s) collisions in Solar atmosphere was investigated, as well as the influence of symmetrical chemi-ionization and chemi-recombination processes in low temperature atmospheric layers of helium rich DB white dwarfs. Moreover, the influence of these processes on hydrogen Rydberg energy level populations in atmospheres of M type red dwarfs, was investigated with PHOENIX code.

Transition probabilities for Kr II, Ne II, Kr III were also investigated. The influence of Stark broadening of Cd II spectral laser lines, on the hollow cathode discharge laser working mode was considered.

The influence of the radiation pressure on micron-size individual dust grains was experimentally investigated, as well as rotation and alignment of the analogs of interstellar dust grains.

By modelling with PHOENIX, lithium in GJ117 atmosphere was considered.

One of the objectives of the Project is development of database BELDATA. Participants of the Project published 43 papers in leading international journals, from which 29 are part of the Project and 14 are connected with other research fields. In total, Project participants published 261 bibliographic items, and 156 are related to the Project while 107 are not.

3. COLLABORATION AND ORGANIZATION OF CONFERENCES

Participants of the project collaborate with colleagues in Bulgaria, Russia, France, Greece, Ukraine, Tunisia, Spain, Hungary, United Kingdom, Germany, Holland and USA.

In order to stimulate collaboration, and professional discussion of results obtained, particular efforts were made in organization of conferences. Participants of the Project have not only take part in organization of 17 scientific conferences as members of Scientific Committees, but five of them organized directly, giving in such a way their contribution to the development of scientific collaboration. Conferences organized by the participants of the Project are: **1.** DEVELOPMENT OF ASTRONOMY AMONG SERBS II, Belgrade 5-7. IV **2002; 2.** IV SERBIAN CONFERENCE ON SPECTRAL LINE SHAPES, Arandjelovac, 10-15. X 2003**; 3.** IV SERBIAN-BULGARIAN ASTRONOMICAL CONFERENCE, Belgrade, 21-24. IV 2004**; 4.** DEVELOPMENT OF ASTRONOMY AMONG SERBS III, Belgrade 25-28. IV 2004**. 5.** 5th SERBIAN CONFERENCE ON SPECTRAL LINE SHAPES IN ASTROPHYSICS, Vršac 6 - 10 June 2005**.**

4. PARTICIPANTS

From 2002 to 2004, 10 researchers were working on this project, and in 2005 seven, all from Belgrade Astronomical Observatory. The coordinator of the project during all period (1st January 2002 - 31st December 2005) was M. S. Dimitrijević, and the participants are: Edi Bon (not in 2005), Miodrag Dačić, Milan S. Dimitrijević, Darko Jevremović, Predrag Jovanović (not in 2005), Nenad Milovanović, Luka Č. Popović, Zoran Simić, Dragana Tankosić, and Zorica Cvetković (not in 2005).

During four years, ten participants were engaged for 227 research months, i.e. 18.9 years. The average age was around 40 years (or year of birth 1963.5).

5. CONCLUSION

Review of our activities during the 2002-2005 period and the corresponding bibliography of the project participants, is an illustration of our results and and might be helpful and inspirative for ideas on the collaboration development with our colleagues. In order to show all our interests and demonstrate possibilities for possible collaboration, all bibliographic items in international journals, and not only references related to the project, are included.

APPENDIX

With an asterisk are denoted papers which are not a part of the considered project.

1. PAPERS IN THE LEADING INTERNATIONAL JOURNALS

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