

IAU Working Group on High-Accuracy Stellar Spectroscopy

Annual Report 2019

Working group members:

Paul Barklem (Uppsala University, Sweden)
Sultana Nahar (The Ohio State University, USA)
Juliet Pickering (Imperial College London, UK)
Norbert Przybilla (University of Innsbruck, Austria)
Tatiana Ryabchikova (Russian Academy of Sciences, Russia)

The role of this working group is to promote work on the high-accuracy atomic and molecular data required for accurate stellar spectroscopy, especially through encouraging the interplay between theoretical atomic physics, laboratory spectroscopy, and astrophysical observations.

Several conferences and workshops have promoted these themes, either being entirely devoted to or having sessions related to these topics:

- IAU Symposium 350, “Laboratory Astrophysics: from Observations to Interpretation”, April 2019, Cambridge, UK (http://www.astrochemistry.org.uk/IAU_S350/)
- 50th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics, Session: “N09 Atomic and Molecular Databases and Data Applications”, May 2019, Milwaukee, Wisconsin, USA (<http://meetings.aps.org/Meeting/DAMOP19/Session/N09>)
- ASOS2019, “13th International Colloquium on Atomic Spectra and Oscillator Strengths for Astrophysical and Laboratory Plasmas”, June 2019, Fudan, China (<https://asos2019.fudan.edu.cn/>)
- XXI Mendeleev Congress on General and Applied Chemistry, symposium “The Periodic Table through Space and Time”, September 2019, St. Petersburg, Russia (<http://mendeleev2019.ru/index.php/en/>)
- Solvay Workshop, “New Frontiers in Atomic, Nuclear, Plasma and Astrophysics” November 2019, Brussels, Belgium (http://www.solvayinstitutes.be/event/workshop/new_frontiers_2019/new_frontiers_2019.html)

As there was no annual report last year, we also mention the successful Special Session “SS4 STARS: Atomic and molecular data needs for astronomy and astrophysics” at the April 2018 European Week of Astronomy and Space Science (EWASS) meeting, held in Liverpool, UK.

One example from the past year of the type of interplay mentioned above are the experiments carried out at the Advanced Light Source (ALS) of Lawrence Berkeley National Lab on high resolution photoionization cross sections, benchmarked by *ab initio* quantum mechanical calculations using the relativistic Breit-Pauli R-matrix (BPRM) method, such as for Ne III (Nahar et al. 2019, Nahar 2019a). Extensive high precision data for radiative and collisional processes are being carried out by the members of the Iron Project, e.g., photoionization cross sections for Fe XIX (Nahar 2019b). This work is important for resolving the discrepancy between the current solar abundances derived from spectroscopic observations, and those abundances required in opacities for solar structure models to reproduce helioseismic observations.

Finally, we mention two white papers in the American Astronomical Society decadal survey (Astro2020), discussing the needs and challenges in this and related fields, both scientifically and professionally:

- Nave, G., and 30 colleagues 2019. Atomic data for astrophysics: Needs and challenges. Bulletin of the American Astronomical Society 51, 1. (<https://ui.adsabs.harvard.edu/abs/2019BAAS...51g...1N/abstract>)
- Savin, D.W., and 64 colleagues 2019. State of the Profession Considerations for Laboratory Astrophysics. Bulletin of the American Astronomical Society 51, 7. (<https://ui.adsabs.harvard.edu/abs/2019BAAS...51g...7S/abstract>)

References:

-
- S. N. Nahar, A. M. Covington, D. Kilcoyne, V. T. Davis, J. F. Thomson, E. M. Hernández, A. Antillón, A. M. Juárez, A. Morales-Mori, G. Hinojosa, “Single-photon photoionization of oxygen-like Ne III”, International Journal of Mass Spectroscopy (2019) 443, 61-69
- S. N. Nahar, “Photoionization of fine structure levels of Ne III”, New Astronomy (2019a) 67, 97-102
- S.N. Nahar, “Characteristic features in photoionization of Fe~XIX”, New Astronomy (2019b) 73, 101277(1-7)