BRASS

The Belgian Repository of fundamental Atomic data and Stellar Spectra

DURATION
15/12/2014 – 15/03/2019

BUDGET
526.362 €

PROJECT DESCRIPTION

Context
Accurate atomic line transition data are fundamental input parameters in astrophysics. They are crucial for the development of complex models that describe, analyse and explain stars, their internal structures, atmospheres, and evolution in relation to the stellar environment. Uncertainties and errors in adopted fundamental atomic data may systematically propagate throughout all fields of astrophysics, from star formation to galactic evolution.

Research questions
It is very difficult to obtain accurate fundamental atomic data of astrophysical interest from laboratory measurements. There are only a limited number of repositories that offer these important atomic data values. The atomic repositories are often complementary rather than redundant, and can provide incomplete or inaccurate information. Important quality assessments of the provided atomic data values are scarce (and mostly absent), which very much complicates the validation of results that follow from their application.

Objectives
This project takes a first, although crucial, step towards removing all systematic errors in atomic input data required for quantitative stellar spectroscopy. We thoroughly assess the quality of fundamental atomic data available in the largest repositories by comparing very high-quality observed stellar spectra with state-of-the-art theoretical spectra. Whereas this type of study has currently been carried out for very few stars at the time, and mostly limited to comparable spectral types assembled from various sources, we will combine, analyse, and offer the community the first uniform large collection of benchmark and reference stars, three to ten times larger than the existing datasets. Our study will be more complete than any other to date in terms of coverage of the stellar parameter space, as well as the spectral wavelength coverage.

Methodology
We will develop a new public database providing accurate fundamental atomic data of vital importance for spectroscopic research. The BRASS database will offer atomic line data we thoroughly test by comparing theoretical and observed stellar spectra. We perform extensive quality assessments of selected atomic input data with advanced radiative transfer spectrum synthesis calculations that we compare in detail to high-resolution Mercator-HERMES and ESO-VLT-UVES spectra of high signal-to-noise ratios for a large number of hot and cool stars (BAFGK-types). The new database will interactively provide the tested and validated values of absorption lines we retrieve from various existing atomic repositories. The validated datasets, combined with the observed and theoretical spectra, will be interactively offered in BRASS. The combination of these datasets is a novel approach for its development, which will provide a universal reference for advanced stellar spectroscopic research.

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Impact on science and society
The impact of the project will be multiple. The high-quality input spectra and output datasets (e.g. fully quality-assessed atomic data) will be published and offered to the community. They will be unique by size, quality, and coverage of the stellar parameters space, and consequently benefit a large array of astrophysical research topics, including important feed-back for atomic physics. The publication of reliable fundamental atomic data is long awaited, and will reverberate throughout all fields of astrophysics. BRASS will be important for several very large spectroscopic surveys, currently planned or on going, such as the ESA-Gaia cornerstone mission and its ground-based counterpart ESO-GES (both with substantial involvement of the Belgian scientific community.) Accurate spectral templates in BRASS that combine broad wavelength coverage and dense sampling of the Hertzsprung-Russell diagram, will improve the accuracy of all studies relying on radial velocity measurements. They will also help to improve the quality of automatic spectral classification methods. Both aspects are critical for Gaia data analysis.

Interdisciplinarity
The BRASS project combines the scientific know-how of several national and international research groups in quantitative stellar spectroscopy. It unites complementary expertise required for addressing various aspects related to observational and theoretical astrophysics, atomic physics, and software development. To accomplish these goals we will utilize a very large sample of stellar spectra we collected from Belgian and European observing facilities over the last five years. The datasets are exceptional in many respects and will be accessible to the scientific community at large.

Outcome
The first goal of this project is to produce a uniform catalogue of very high-quality spectra and spectral templates from these data. The catalogue will be made freely available to the astronomical community. As a second step, the chief goals of the project will be accomplished by comparing the observed spectra to state-of-the-art spectral modelling in order to assess fundamental atomic parameters. Our measurements will allow us to critically evaluate the quality of the data offered in various atomic repositories. The BRASS database will provide access infrastructure to a wide range of users in both academia and industry, and for science education. Finally, this project also comprises a PhD study.

CONTACT INFORMATION

Coordinator

Alex LOBEL
Royal Observatory of Belgium
Dept. Astronomy and Astrophysics
Alex.Lobel@oma.be

Partners

Pierre ROYER
Katholieke Universiteit Leuven (KUL)
Instituut voor Sterrenkunde
pierre.royer@ster.kuleuven.be

International partners

Christophe MARTAYAN
European Southern Observatory
Science Operations
cmartaya@eso.org

LINKS

http://alobel.freeshell.org/brass.html