

Project for “Action Fédératrice Etoiles” (second call)

Title: Laboratory astrophysics and analysis of stellar spectra

PI: Lydia Tchang-Brillet (LERMA)

Members of the project:

1. Nicole Feautrier (LERMA), Elisabetta Caffau (GEPI)
2. Lydia Tchang-Brillet, C. Balança, N. Champion (LERMA), Coralie Neiner, Richard Monier (LESIA),

Expected duration: 2 years

Description of the project: The chemical composition of a star is deduced from its spectrum derived from its stellar atmosphere. Significant results have been achieved in the past few years, making use of rapid advances in different areas, i.e. observations, analysis of the data, development of increasing sophisticated models, that all contribute to better diagnostics of the stellar atmospheres. In parallel, an important need of atomic data arises in order to characterize in details the chemical composition and the physical conditions of the observed stars. Our project proposes an interdisciplinary strategy, combining new developments in experimental or theoretical laboratory works in view of the best interpretation of the observed stellar spectra. This projects includes two parts:

1: Modeling of stellar atmospheres at the area of GAIA: Complementarily with the building of a very large set of LTE-1D spectra of stars, galaxies and quasi-stellar objects, it is important to build a set of 3D models, coupling hydrodynamics and radiative transfer. Departures from LTE (NLTE) must be taken into account. Our models are now able to take into account at the same time non-LTE and granulation effects of the stellar atmospheres using radiative transfer and 3D hydrodynamical simulations. However a common problem on non-LTE calculations comes from uncertainties in atomic data, of which the inelastic neutral hydrogen collisional rates are the most significant source. A realistic description of atomic collisions with H atoms will bring an improvement in that domain. Our project combines new developments in quantum chemistry and theory of collisions. The work will firstly focus on H-collisions with CaI, CaII, OI species, with perspectives for iron. It also includes the development of new theoretical models giving good estimates of rate coefficients for a large number of species. The impact of the data for non-LTE modeling of stellar atmospheres will be investigated. Collaborations: M. Guitou, A. K Mitrushenkov (Paris-Est University).

2: Contribution to the preparation of POLLUX: The POLLUX project is a high-resolution spectropolarimeter for the LUVOIR space mission. C. Neiner, J.-C. Bourret are positioned as french PI's for the construction of this instrument. The skills of the LERMA team in the field of UV/VUV spectroscopy (wavelengths, intensities, Landé factors) will contribute to the preparation of this important project, this could require the acquisition of new laboratory spectra. Collaborations: A. Meftah (Tizi Ouzou University), J. F. Wyart (Aimé Cotton laboratory).

Requested budget 2017: For 2017, our priority is to invite Pr. A. Belyaev (St Petersburg University) for a short stay (2-3 weeks) as his contribution to the development of realistic H-collision models is highly expected for OI and Fe spectra analysis. A contribution of 800-1000 euros for his living expenses is requested.