HIGH PRECISION SPECTROSCOPY: IMPACT IN THE STUDY OF PLANETS, STARS, THE GALAXY AND COSMOLOGY

Jorge Luis Melendez Moreno
Institute of Astronomy, Geophysics and Atmospheric Science / University of São Paulo (USP)
FAPESP Process 2012/24392-2 | Term: May 2013 to Apr 2018

The project intends to perform precision spectroscopy of stars, aiming to study at unprecedented detail planet formation, stellar evolution processes, Galactic chemical evolution and primordial Big Bang nucleosynthesis. By applying a differential analysis technique, we can achieve a precision of about 0.01 dex in chemical composition, which is much better than typical errors (0.05 – 0.1 dex) found in previous works. As part of our project, we are searching for planets at high precision in radial velocity (1 m/s). The synergy of high precision radial velocities and high precision chemical abundances permits a detailed study of the connection between stars and planets. Our high precision work is mainly based on data obtained at the European Southern Observatory (ESO), especially through a large (100 nights) program to search for planets around solar twins.

We have been able to disentangle the chemical signature of planets from the chemical evolution of the Galaxy. Important results have been also obtained regarding nucleosynthesis in stellar interiors, as probed by the lithium and beryllium abundances of solar twins covering a wide range of ages. Precision spectroscopy of metal-poor stars have allowed us to obtain stringent constraints on chemical evolution models. Our Large HARPS/ESO program have resulted already on six papers, including chemical abundance studies, the decay of stellar rotation and activity with increasing ages, and the discovery of new planets around solar twins. Outreach has been also an important component of the project; our most important results have been broadly highlighted by the national and international media. In particular, our discovery of a Jupiter twin around a solar twin was widely communicated to the public.

Artist's impression of a Jupiter twin planet orbiting the solar twin star HIP 11915. The planet was discovered by Bedell, Melendez, Bean et al. (2015) using the European Southern Observatory (ESO). This Jupiter twin planet has a mass similar to Jupiter and orbits at a similar distance from its star as Jupiter does from the Sun. The system is an excellent candidate to host a "Solar System 2.0".

JORGE LUIS MELENDEZ MORENO

Instituto de Astronomia, Geofísica e Ciências Atmosféricas
Universidade de São Paulo (USP)
Departamento de Astronomia
Rua do Matão, 1226
CEP 05508-900 – São Paulo, SP – Brasil

+55-11-3091-2800
jorge.melendez@iag.usp.br