Polish Academy of Sciences
NICOLAUS COPERNICUS ASTRONOMICAL CENTER
Bartycka 18, 00-716 Warsaw, Poland
tel: +(4822) 841 00 41, +(4822) 3296 100
fax: +(4822) 841 00 46
email: camk@camk.edu.pl
http://www.camk.edu.pl

Chemical abundances in a planet-host star of the Praesepe open cluster

The study of stars hosting planets can help in the understanding of the mechanisms of planet formation and evolution. One link between the presence of planets and their host stars is that main sequence stars hosting giant-planets are more metal rich than typical stars without planets (Gonzalez 1997, Fischer & Valenti 2005). This discovery lead to the suggestion that the formation of gas-giant planets is favored by high metallicity.

The analysis of other chemical elements in stars can also provide clues about planet formation. In particular, the investigation of refractory elements (those with condensation temperatures Tc > 900 K) and volatiles (those with condensation temperatures Tc < 900 K) has caused heated discussions in the literature. Meléndez et al. (2009) found that our Sun is about 20% more deficient in refractory elements than volatiles elements, and that there is a strong correlation between condensation temperature (Tc) and the chemical abundances for other planet-host stars. This was suggested to be a signature of the formation of terrestrial planets. The "missing" refractory elements would be confined inside the terrestrial planets of our solar system.

Nevertheless, González Hernández et al. (2010) did not confirm the trend between abundance ratios and Tc for their sample of solar twins. More recent results, suggest that planet hosts show a variety of abundance x Tc trends, that could be related to a diversity of planet-induced effects in these stars (Liu et al. 2020).

There is huge implications for better understanding the origin of such abundance trends and what they can tell about the types of planets hosted by the stars. *It might become possible to tell if a star host planet(s), and which type of planet(s) it has, just by determining its chemical abundances.* Detecting planets usually requires long monitoring observations. Determining stellar chemical abundances is easier and quicker.

In this project, we propose that the intern determines abundances for more than 30 different elements in three stars of the Praesepe open cluster. One of these stars is a planet host, with a hot-Jupiter type of companion (Quinn et al. 2012). The other two stars have no planets detected. *The goal is to determine with high accuracy if there is a difference in the chemical abundances between stars with and without planets.*

Tasks of the intern and skills to be acquired

The intern will analyze high-resolution spectra of three main sequence stars from the Praesepe open cluster. These stars have the same age, almost the same mass, and formed with the same chemical composition. The intern will learn about stellar spectroscopy, chemical abundance determination, the astrophysics of planets around stars, and about open clusters. The project can potentially give an interesting contribution to the hot topic of detecting planets around stars (subject of the Nobel Prize in Physics of 2019). *Completion of the project might result in a scientific publication of which the intern will be a co-author.*

Some knowledge of astrophysics and of one programming language are expected. The project will be developed at the Nicolaus Copernicus Astronomical Center, the leading astronomical institution of Poland. The institute is located in Warsaw, capital of Poland, a very lively and international city. The project language is English. The research group currently includes two post-docs and three PhD students.

Contact Information:
Internship supervisor: Dr. hab. Rodolfo Smiljanic (e-mail: rsmiljanic@camk.edu.pl)
https://users.camk.edu.pl/rsmiljanic/