Lengvųjų elementų santykių tyrimas žvaigždėse su planetomis

Probing the light element ratios in planet-host stars

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Research on exoplanetary systems has become a leading area of study in modern astrophysics. Thanks to space missions like Kepler & Transiting Exoplanet Survey Satellite (TESS) and ground-based telescopes, over 5,500 exoplanets have been confirmed so far. A fundamental aspect of this research involves the study of chemical composition of the host stars as it can provide critical insights into the formation and characteristics of exoplanets.

Several studies have reported a correlation between the metallicity of stars and the presence of planets around them. It was found that stars with giant planets tend to have higher metallicity than those without planets [1]. An overabundance of alpha elements (e.g., Mg, Si, Ca, Ti) is also demonstrated in stars with planets [2]. Carbon and oxygen abundances and their ratios carbon-to-oxygen (C/O) & magnesium-to-silicon (Mg/Si) could also have a significant impact on exoplanets [3].

The aim of this work is to conduct a spectroscopic analysis of planets-host stars, focusing on determining the main atmospheric parameters (effective temperature T_{eff}; surface gravity log(*g*); microturbulence v*t*; and metallicity [Fe/H]) and detailed chemical elemental abundances. In this conference, I will present my recent results on stellar chemical composition, in particular C/O and Mg/Si ratios and planet mass relation.

The targets were chosen from the confirmed exoplanet list by TESS available at NASA Exoplanet Archive. Observations were carried out with the 1.65-m telescope installed at Moletai Astronomical Observatory of Vilnius University in Moletai, Lithuania. The telescope is equipped with a high-resolution Vilnius University Echelle Spectrograph (VUES). Planetary parameters were also taken from NASA Exoplanet Archive. In this work, I have investigated 174 planets orbiting around 131 bright planet hosts. Most of the exoplanets investigated are Gas Giants followed by Neptune-like, Super Earths and Terrestrials (see Fig. 1).

The main atmospheric parameters were determined by the classical equivalent width approach using a combination of the DAOSPEC and MOOG codes the same way as the Vilnius node used in the Gaia-ESO Survey. To determine the precise chemical element abundances, we used the spectral synthesis method with the TURBOSPECTRUM code. The spectral analysis was done using a grid of MARCS stellar atmosphere models and the solar abundances. Atomic lines were selected from the Gaia-ESO line-list.

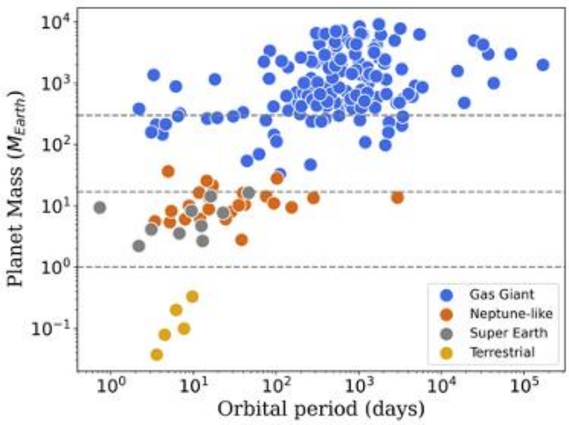

Fig 1. Mass and orbital period distribution of exoplanets.

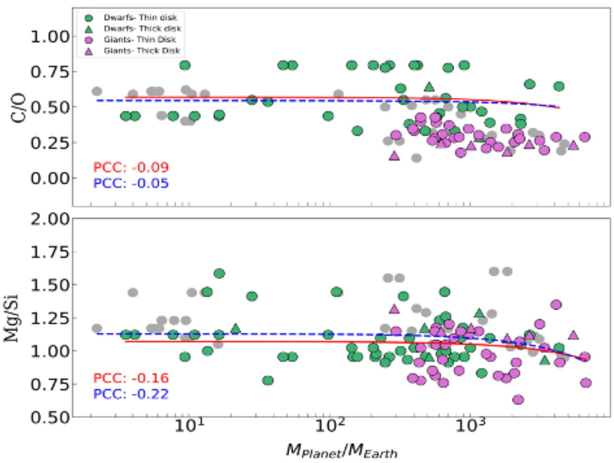

Fig 2. C/O and Mg/Si distributions in planet-hosts vs planetary masses. Green and pink dots represent dwarf and giant hosts from this work. A comparison sample of 25 planet-hosts (grey dots) were taken from [4].

In Fig. 2 we see a weak negative C/O slope for dwarf planet-hosts towards the stars hosting high-mass planets whereas for both dwarf & giant hosts, there is a negative Mg/Si slope towards the stars hosting high-mass planets.

Key words: High resolution spectroscopy; Chemical abundances; Planet-harbouring stars; Exoplanets.

Literature

[1] D. A. Fischer, and J. Valenti, ApJ, **622**, 1102 (2005).
[2] V. Z. Adibekyan, N. C. Santos, et al., A&A, **543**, A89 (2012).
[3] C. Bond, D. P. O'Brien, D. S. Lauretta, ApJ, **715**, 1050-1070 (2010).
[4] G. Tautvaišienė, Š. Mikolaitis, et al., ApJS, **259**, 45 (2022).