Master’s thesis project in Space, earth and environment

Search for transit timing variations in TESS light curves

Background

The majority of the currently known exoplanets are transiting exoplanets detected by the NASA’s Kepler and TESS missions. Transiting exoplanets, planets that periodically cross in front of their host stars and block a part of the star which leads to a dip in its observed brightness (called transit), are valuable targets for further characterization since they allow the measurement of their true planetary masses, radii, orbital obliquities, and atmospheres.

One indirect method to detect, confirm and characterize such a transiting planet is through transit timing variations (TTVs). These variations are caused by perturbations of the Keplerian motion of the planet, and can be measured from transit light curves. The strength and periodicity of the TTVs reveal characteristics of the perturbing planet (e.g orbital elements and mass) which we estimate in our group with the Python Tool for Transit Variation (PyTTV). The TTV approach is an ideal method for the characterization of low-mass multi-planet systems orbiting faint stars that are not easy to characterize and observe through other methods.

This thesis focus on the search and validation of TTVs in the light curves from the Transiting Exoplanet Survey Satellite (TESS). If detected this could lead to the detection and confirmation of an exoplanet.

Task description

Precise tasks will be determined depending on the particular interests of the student, however, example aspects include:

1. Searching the light curves from the TESS for TTVs and their validation
2. Searching for new transit signals in the light curves from TESS including the production of own light curves from Full Frame Images
3. Application and development of the PyTTV
4. Interpretation the cause for TTVs and characterization of the exoplanet system

Required education and potential course requirements

Computational skills with Python are helpful, but may also be developed as part of this thesis. The analysis might include developing automated routines to deal with relatively large data sets. Basis knowledge of astrophysics and celestial mechanics is beneficial.

Credits

30 or 60 credits

Contact information for supervisor

Judith Korth, judith.korth@chalmers.se, Astronomy and Plasma Physics

Carina Persson, carina.persson@chalmers.se , Astronomy and Plasma Physics