Topic 1:

Photometric study of the Orion Nebula Cluster with data from the TESS satellite

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Work focus: *The aim of this bachelor thesis is to investigate the variability of member stars of the Orion Nebula Cluster based on data from the NASA TESS mission. Some selected pulsating stars will be analyzed in more detail. Your study will contribute to the work on young pulsators conducted in the "Stellar Evolution and Asteroseismology" research group.*

The NASA space telescope TESS (https://tess.mit.edu) is currently conducting an all-sky survey to discover transiting exoplanets. A separate science goal is the study of stellar pulsations based on the TESS data. All measurements obtained by TESS (see Figure to the right, source: NASA) immediately become public and are available in an online archive. TESS also observed some star forming regions in our Milky Way and young open clusters.

The Orion Nebula Cluster (NGC 1976 = M42; see image to the left; source: NASA) has an age of about 12.9 million years and is a well-known and well-studied star forming region. It lies at a distance of only about 400 parsecs (= 1304 light years) and contains a variety of different objects spanning the whole range of masses, and, hence, effective temperatures. The most massive O and B stars in the Orion Nebula Cluster have already started to burn hydrogen in their cores. But stars of spectral types A and cooler are still in their so-called pre-main sequence phase, during which they mostly gain energy from contraction and have not reached sufficient core temperatures for hydrogen to ignite.

The Orion Nebula Cluster was observed by TESS twice (in 2018 and 2020) and the data are publicly available. A sample of about 150 stars in the Orion Nebula Cluster was selected for this bachelor thesis to conduct a thorough investigation of their variability types.
After a brief introduction into the topics of young clusters, types of variability and methods of analysis, you can immediately start working on the data.
We will give you access to several tools that were developed in our research group that allow to download, extract and analyze the TESS data. Some basic programming knowledge will be helpful to carry out the work.

For your bachelor thesis, you will conduct a survey of variable stars in the Orion Nebula Cluster based on data from the NASA TESS satellite.
The aim of your work is to find variable member stars of the Orion Nebula Cluster and classify them according to their variability into binaries, pulsators, stars with spots, irregular variables (either "dippers" or "bursters") or semi-regular variables. You should also discuss the probability of the stars' membership to the Orion Nebula Cluster. At the end, a statistical investigation of the analyzed objects should be carried out.

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