Topic 2:

Young δ Scuti stars observed with the TESS satellite in long cadence and short cadence

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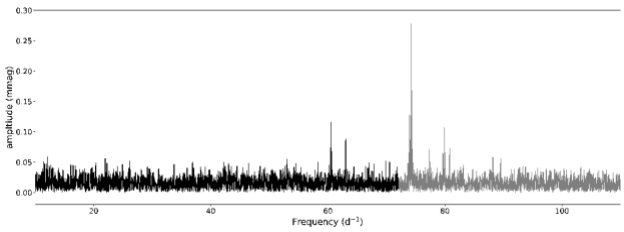
Work focus: *The aim of this bachelor thesis is to quantify the limitations of long cadence TESS data when analyzing young δ Scuti pulsators in comparison to short cadence TESS data.*

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 image to the left, source: NASA) immediately become public and are available in an online archive.



TESS observations are conducted either in long or in short cadence: The cadence describes how often a data point is measured or – in other words – how long the gap is between subsequent data points. Short cadence (SC) data obtained by TESS usually have a cadence of 2 minutes, while for long cadence (LC) data one measurement is taken every 30 minutes. As a consequence, LC data have limitations on detections of light variations on short time scales. If a given star's variability is on shorter time scales than about 2.5 hours, its detection based on LC data alone is basically impossible. An example is shown in the Figure to the right which shows an amplitude spectrum based on SC (grey) and LC (black) data. In this case, without SC data, the pulsational frequencies would not have been detected correctly.

Pulsations of δ Scuti type are driven by the heat engine mechanism and their restoring force is pressure. Therefore, they are named "pressure (p-)" modes. Their pulsation periods lie in the range from about 15 minutes to 6 hours. δ Scuti type stars are intermediate mass stars of spectral types A to early F, corresponding to effective temperatures lying between about 7000 K and 10000 K.
Since its launch in 2018, TESS has observed several young δ Scuti stars. Due to the range of their pulsation periods, for some of them LC data are sufficient to describe the oscillations, but for many of them they are not. Fortunately, there are several δ Scuti pulsators with measurements in both, SC and LC, that can be compared.

After a brief introduction into the topics of pulsations (with a focus on young δ Scuti stars) and the methods used to analyze pulsation frequencies, 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.
The aim of your bachelor thesis is the analysis of the pulsation properties of a sample of young δ Scuti pulsators observed by TESS, to compare results obtained based on LC and SC data and to test the impact of LC data on describing the "real" pulsational content.

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