Partial Exam Asteroseismology, 11 April 2011

All data are available in files named name-*.dat. In the file name-1.dat, you find CoRoT satellite data and in name-2.dat line profiles. All listed times are Heliocentric Julian Dates of mid-exposure with respect to a reference epoch (the value of which is not of importance for the analyses).

The available software consists of:

- The code "plotdata.f" which allows you to have a quick look at the data set. Adapt the plotting ranges, compile it as "./compile plotdata" and execute it by typing "./plotdata" at the prompt.

- The codes "freq_student.f" and "harmplot_student.f". They read the first two columns of a file and interprete the first line of the file as a comment line. They are executed by typing resp. "./freq_student" and "./harmplot_student" at the prompt.

  Note: you can also use other software packages, e.g. PERIOD04.

- The codes "pdm.f" and "scargle.f" allow you to make a plot of the output of the code "freq_student.f". In these codes you have to change the name of the file to be plotted and the boundaries of the axes before compiling and executing the codes (the latter is done by typing "./pdm" or "./scargle").

- The small code "sn.f" allows you to compute the signal-to-noise ratio in a periodogram over a user-specified frequency range. Compile it and execute as "./sn".

- The software package FAMIAS, which will be introduced to you by its author, Dr. Wolfgang Zima.

This part of the exam consists in itself by two parts. First you have to make a written report of your analyses of **maximum 10 pages** and email it to the lecturer in PDF format (conny@ster.kuleuven.be), at the latest on 8 April 2011. The report must contain the result of the following exercises :

1. In the file name-1.dat you find CoRoT measurements of a pulsating star. Determine the highest-amplitude frequencies that are present in the data. If there are more than 10 of those, then limit yourself to derive these and mention that there is additional variability present in the data. Determine the noise level of the data. Do you detect the signature of rotational splitting among the 10 highest amplitude modes or not? Comment!

2. The file name-2.dat contains a series of data, each one consisting of a time of measurement and a normalised line profile of the Si III spectral line with central wavelength $\lambda_0 = 4552.654$Å in the spectrum of a β Cep star. The spectra are already corrected for the motion of the Earth around the Sun.

   (a) Determine the average radial velocity of the star with respect to the Sun.
   (b) Determine the first three normalised moments of the line profiles of this star.
   (c) Determine the oscillation frequencies that are present in the data.
   (d) Identify the dominant oscillation mode by means of FAMIAS.

The oral exam consists of a talk of 10 minutes followed by questions from the lecturer and from the other students.