Abstract

The analysis of the first solar-like targets done by CoRoT has shown that the oscillation amplitudes are about 25% below the theoretical amplitudes while the convective backgrounds are up to three times higher than in the solar case (Michel et al. 2008). In such conditions, the Comb-like structure of the acoustic modes has smaller signal-to-noise ratios than initially expected complicating the characterization of individual modes. In the present work we apply the curvelet filtering to the solar-like targets already observed by CoRoT as well as a partial reconstruction of the signal from the obtained spacing of the comb-like structure of the acoustic modes. It enables us to enhance the signal-to-noise ratio of the ridges in the echelle diagrams. Finally, we study how the analysis of the p modes can be improved.

Partial reconstruction of the signal

- A possible way of enhancing the signal-to-noise ratio (SNR) of solar-like stars is to take advantage of the asymptotic properties of their p modes.
- In the Fourier spectrum of these stars, the peaks that correspond to the acoustic modes are almost equally spaced in a given frequency range.
- To increase the SNR of the periodic structures (the modes) we perform a selective filtering of the power spectrum of the power spectrum (PSPP) (see Régholo and Roca Cortés, 2002).
- The resultant PSPP is filtered in multiplying it by a window function which is 1 for all the equally spaced bins around multiples of the large separation of the p-modes (that should have been estimated before) starting at zero, while the rest of the bins are settled to zero.
- The inverse Fourier Transform of this filtered PSPP produces a "recovered" power spectrum of the stellar p-modes with a higher SNR.
- The "recovered" amplitudes and linewidths of the modes are modified.

Curvelet filtering

- Echelle Diagrams can help on the mode tagging.
- To improve the SNR Bedding et al. 2004 proposed to use it by smoothing in the vertical direction.
- Only works well where the ridglets are quasi-vertical.
- A very good a priori of the large separation (Δν) is needed.
- Only works properly in the asymptotical part.
- The filtering becomes more efficient when the SNR is smaller.
- It needs an estimation of the large separation.

The top figures correspond to the original, full resolution, PSD of each star in the range where the acoustic modes display an excess of energy. The bottom panels show the "recovered" PSD, where the p-mode pattern is clearly visible.

References

- Michel et al. 2006, Science, 322, 558
- Michel et al. 2006, Science, 322, 558