Data Analysis Team of the Seismology Working Group

report

by

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Sequence of events

- Tuesday
  - Hare-and-hound exercises: where are we? (TA)
  - Results from HH3_bis: how to tag the frequencies as Corot's?
  - Results from HH4
- Wednesday
  - Time frequency analysis (Baudin)
  - Curvelet analysis (Lambert)
  - Light curve simulator for Corot observations (Baudin and Samadi)
  - Analysis methods applied to "classical" pulsators (Garrido)
  - SigSpec (P.Reegen)

Wednesday session (I)

- Time frequency analysis
  - Tool exists
  - Help to understand excitation mechanism (saturation if any)
  - Help to identify excitation by stellar flares (X-ray observations)
- Analysis methods applied to “classical” pulsators
  - Mode identification
  - Frequency ratio method (asymptotic mode frequencies)
  - Needs for coeval intensity and velocity observations
- SigSpec
  - Deals with fundamental limitation of DFT
  - Adapted for unresolved modes (lifetime > observation) acting as pure sine waves
  - Modes excited by κ mechanism

Wednesday session (II)

- Curvelet analysis
  - Powerful denoising of the power spectrum
  - Adaptative ‘smoothing’ technique
- Light curve simulator
  - Tool available
  - Could be part of the COROT time series simulator

Tuesday session:

Hare-and-hound excercises

Hare-and-hound excercises: where are we?

- HH1(2000): time series produced from asymptotic frequencies and simplified linewidths, amplitude and stellar background
- HH2 (2002): time series produced from model frequencies, linewitdhs, amplitudes, simple stellar background and stellar inclination (time series generation recipe)
- HH3 (2003): choice of COROT target (See next VG). Remaining to be done: splitting.
- HH3_bis (2005): Parameters comparison
- HH4 (2005): Can we detect modes when the S/N is low?

HH4: what if the S/N is very low? The Procyon syndrome…

- Time series generated with the code of Baudin and Samadi
- Tweaked by TA such that modes are not easily detectable
- Some work done by Garcia et al, TA…

Simulated signal = modes + noise

Modes :

- **Theoretical mode excitation rates** are calculated according to Samadi et al (2003, A&A, 404, 1129)
- **Theoretical mode damping rates** are obtained from the tables calculated by Houdek et al (1999, A&A 351, 582)
- The **mode light-curves** are simulated according to Anderson et al (1990, Apj, 364, 699)

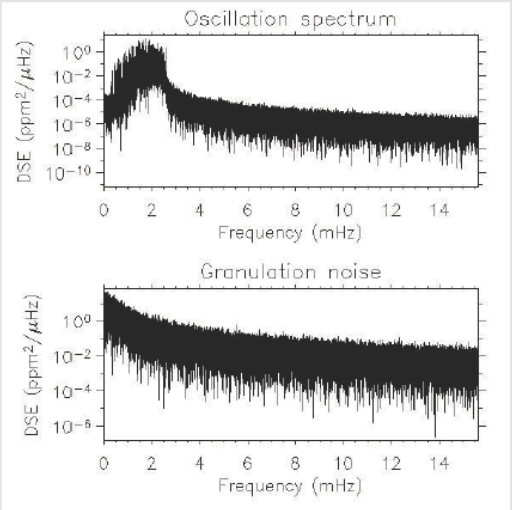
Noise :

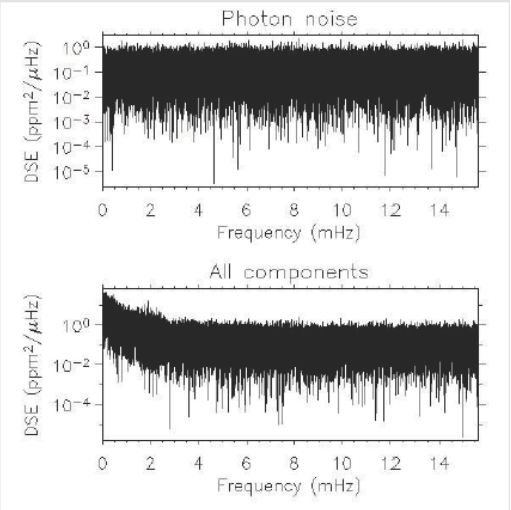
Noise = photon noise + stellar (granulation) « noise »

✗ No other instrumental noise than photon noise
✗ No activity noise

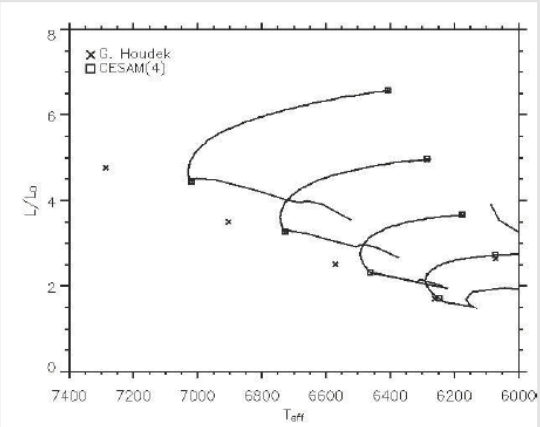
- **Stellar granulation** simulation is based on : Harvey (1985, ESA-SP235, p.199)
- **Instrumental photon noise** is computed in the case of COROT but can been changed.

Some results





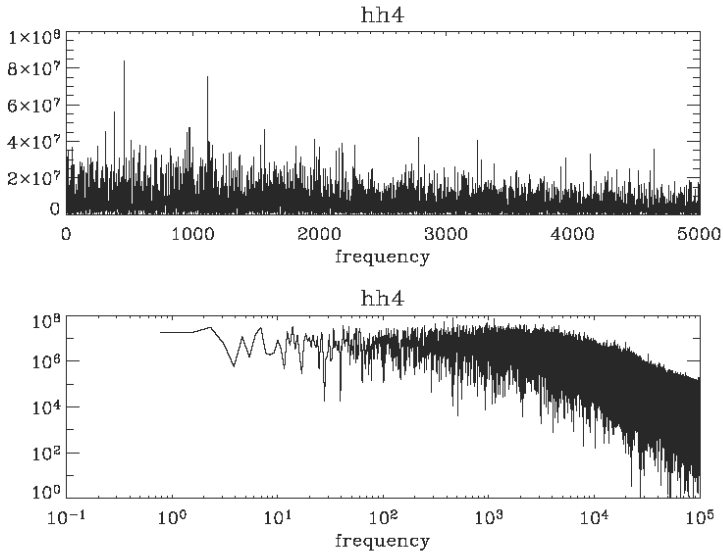
Available models



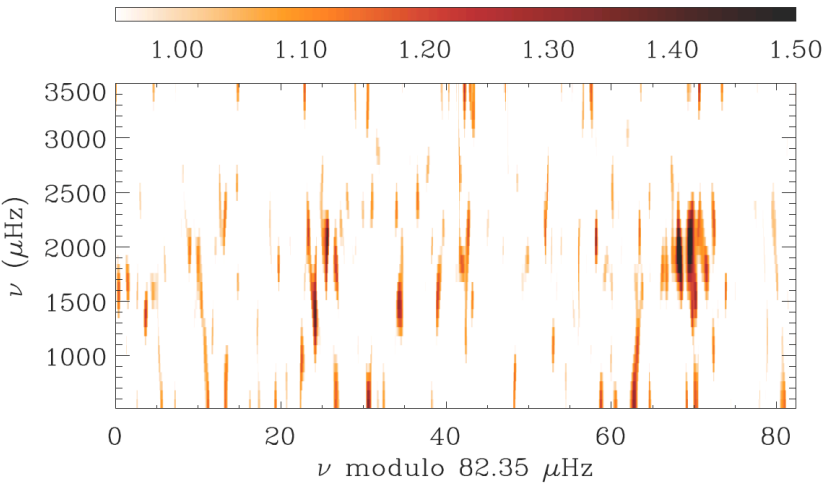
- Masses : 1.2 ; 1.3 ; 1.4 ; 1.5 ; 1.6
- Ages : ZAMS et TAMS

☞ the simulator as well as some representatives time series can be downloaded at :

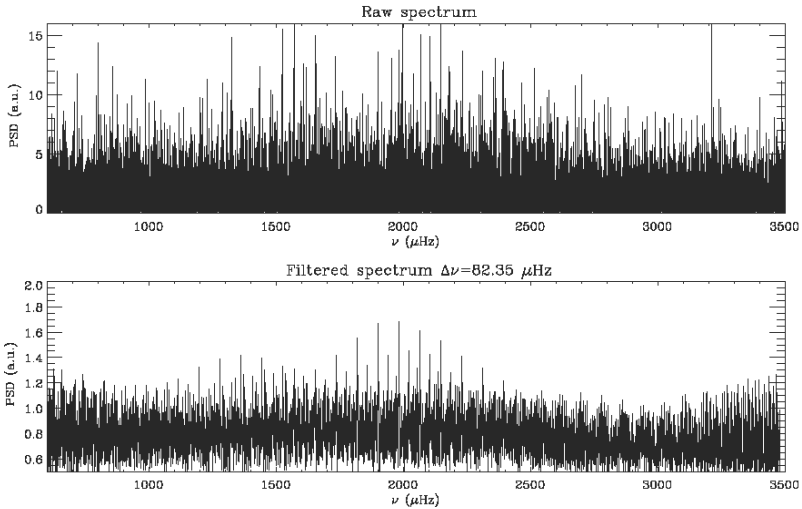
http://www.lesia.obspm.fr/~corotswg/


hh4
1×10^8
8×10^7
6×10^7
4×10^7
2×10^7
0
0
1000
2000
3000
4000
5000
frequency
hh4
10^8
10^6
10^4
10^2
10^0
10^-1
10^0
10^1
10^2
10^3
10^4
10^5
frequency

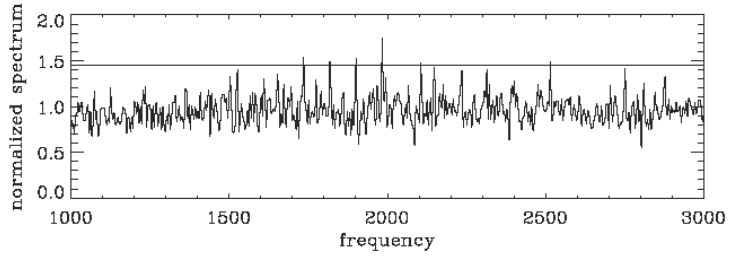
Echelle diagramme with Curvelet
Lambert et al

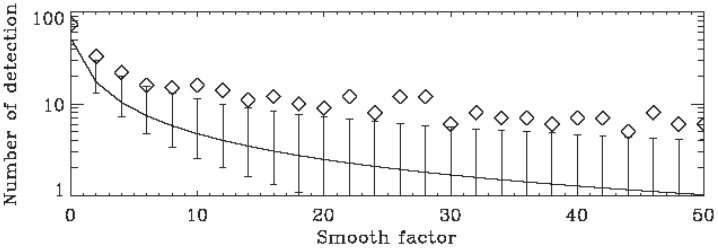


Curvelet analysis
Lambert et al



Detection procedure (after Appourchaux, 2005)





HH4

- Work in progress
- Seems that we can detect at S/N=1 level
- The more, the better…data are available at:
  ftp.estec.esa.nl/pub/loitenerife/corot/hh4/hh4_ta
- Fits file, sampling: 32 s, 150 days, Mass: 1.2 solar mass

HH3_bis and labelling of frequencies

Frequencies labelled as COROT's: Proposal to the SC

- Frequencies labelled as COROT's
- No censorship
- Anybody can fit

Frequencies labelled as COROT's: Background

- The example of GONG
  - GONG time series available to the community
  - GONG mode parameters available to the community and derived from a known recipe
  - Open data policy
  - Open fitting policy
  - No censorship

Frequencies labelled as COROT's:HH3_bis Do the data fitters agree on frequencies?

- Use of Hare-and-Hound exercise
- 3 out of 4 agree on:
  - Mode identification
  - Mode frequency within 0.5 σ
  - Error bars within $\pm 10\%$ (or less)
  - l=1 frequency underestimation at high frequency (-1 σ)
- Differences arise from:
  - Wrong mode identification
  - Fitting strategy (amplitude of |m|, windows,…)

Frequencies labelled as COROT's: Proposal to the SC

- COROT frequencies used as reference and properly referenced
- Data reduction group provides generic recipe for:
  - Solar-like stars, heavier stars
  - Classical pulsators (Cepheids, β cepheids, etc…)
  - Other stars
- Frequencies are produced using this recipe by one or many data fitters (to be set)
- Various cases:
  - Generic recipe works: OK!
  - Generic recipe fails:
    - » no COROT frequencies
    - » needs for more elaborate techniques

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