

HD 50844

A NEW LOOK TO DELTA SCT STARS FROM SPACE

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(INAF-OA Brera) *Analysis, ground-based spectro and photometric observations*

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F. Baudin (IAS, Orsay)

Analysis and the great merit to have turned a dream into a fact

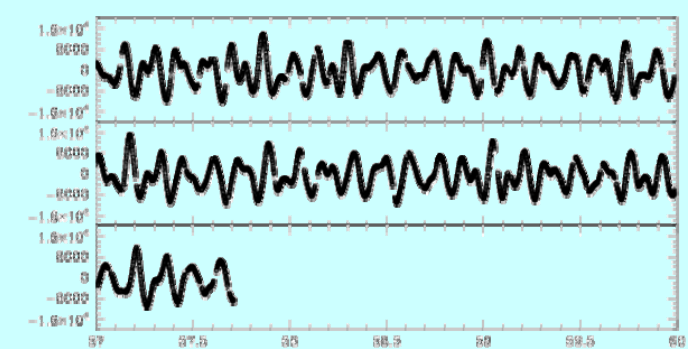
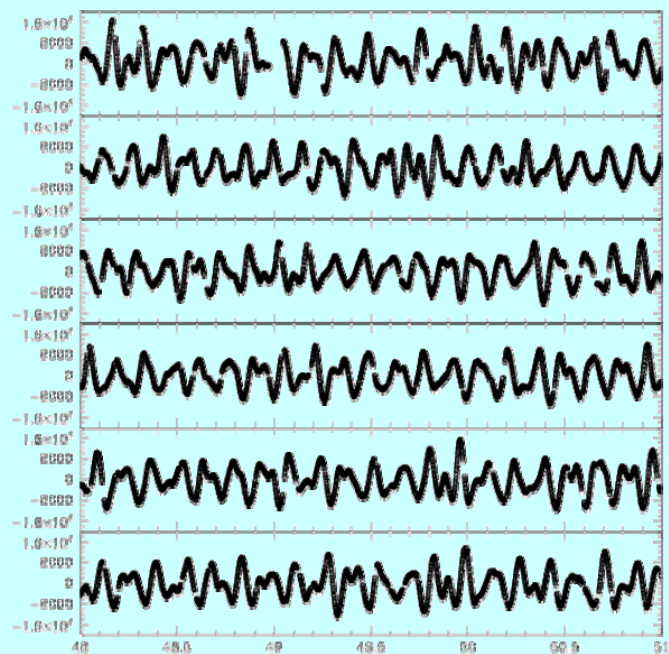
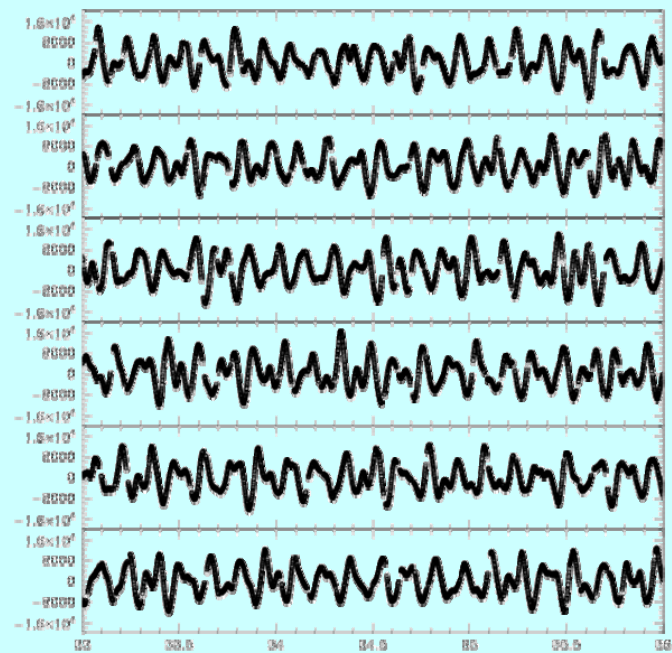
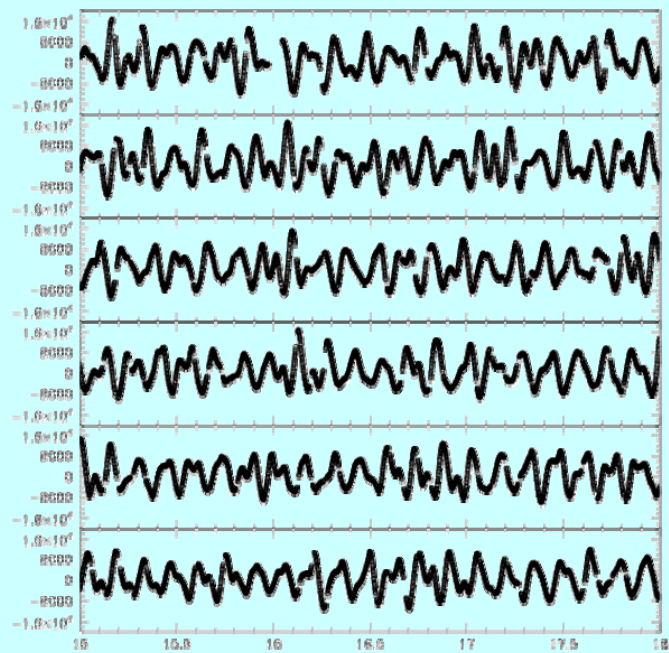
R. Garrido, E. Rodriguez, S. Martin-Ruiz, P. Amado

(IAA Granada) *Analysis, ground-based photometric observations*

M. Alvarez (UNAM, Mexico) *Ground-based photometric observations*

M. Paparo, P. Papics (Konkoly Observatory) *Ground-based photometric observations*

W. Zima (KU Leuven) *Spectroscopic analysis*



Observational progresses in the last decade on Delta Sct stars

Several stars observed by isolated teams: <10 frequencies in few months

(for a summary, Poretti, 2000 and Breger, 2000)

Theta₂ Tauri : 19 days with WIRE (6 cm lens), 12 frequencies *(Poretti et al. 2002)*

FG Vir: multisite, multiyear ground based campaigns, 75 frequencies *(Breger et al. 2005)*

We need intrinsic accurate measurements to progress.

Few data from many observatories do not ensure a real improvement. We are at the top.

Important information from multicolour photometry.

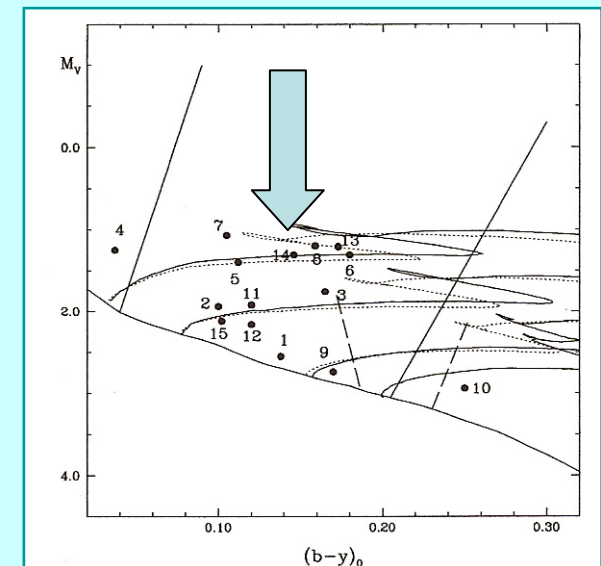
HD 209775 : 14+44 days with MOST, 80 frequencies *(Matthews 2007)*

COROT

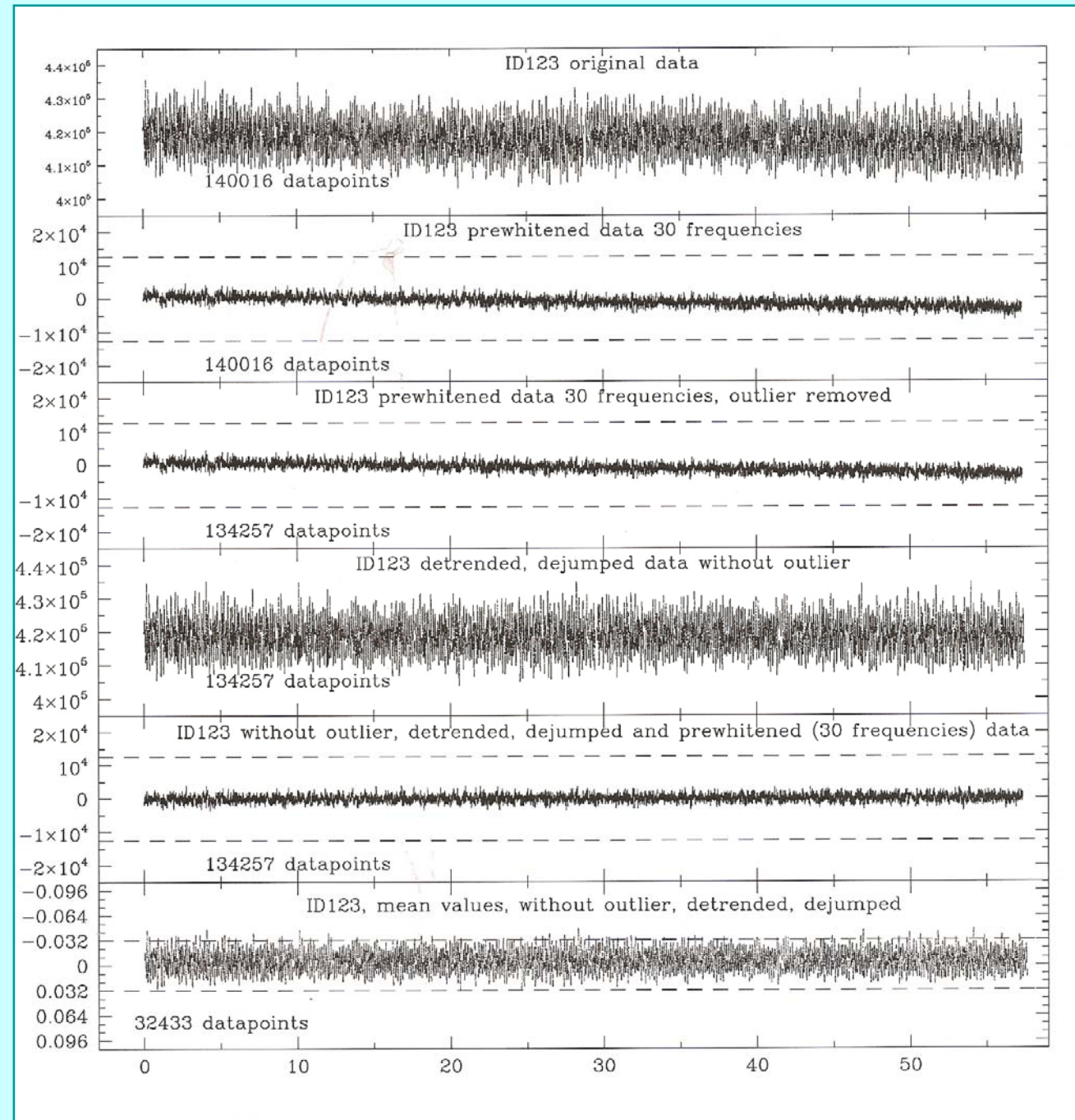
HD 50844, evolved Delta Sct star observed in the IR01.

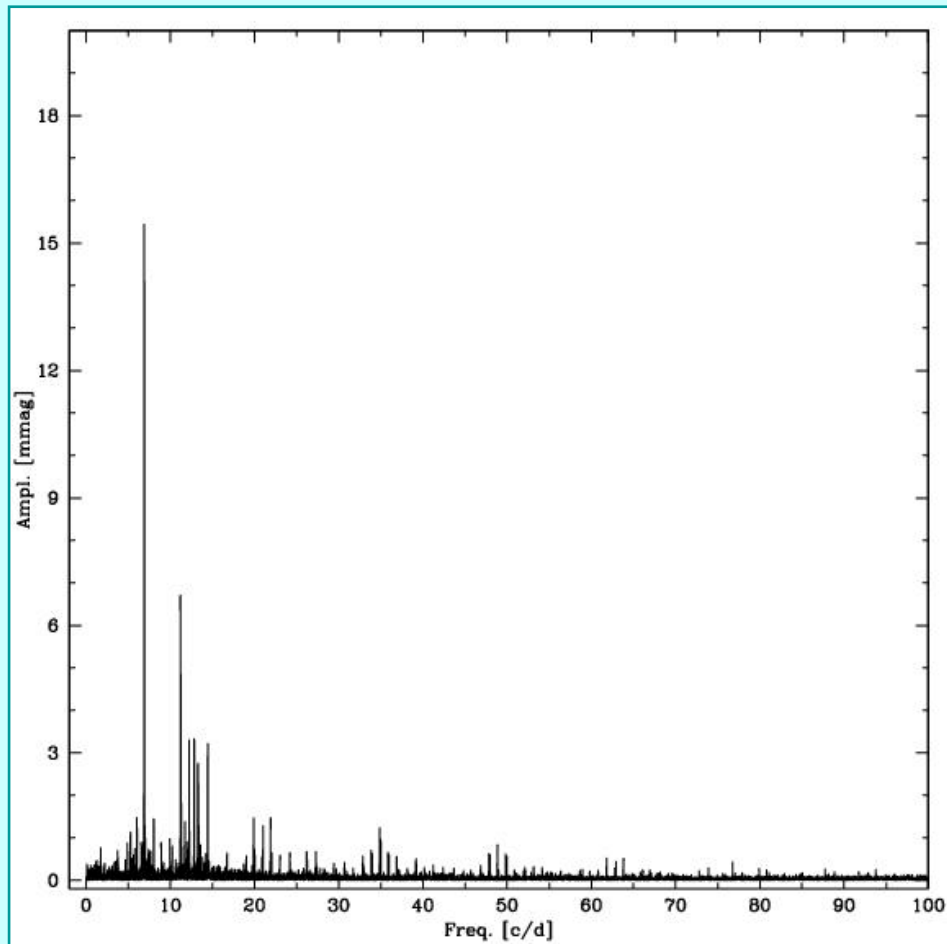
$M_V=1.31$, $T_{\text{eff}}=7500$ K, $\log g=3.6$, $[\text{Fe}/\text{H}]=-0.4$

(from uvbyBeta photometry) confirmed by abundance analysis (Niemczura et al., in preparation)



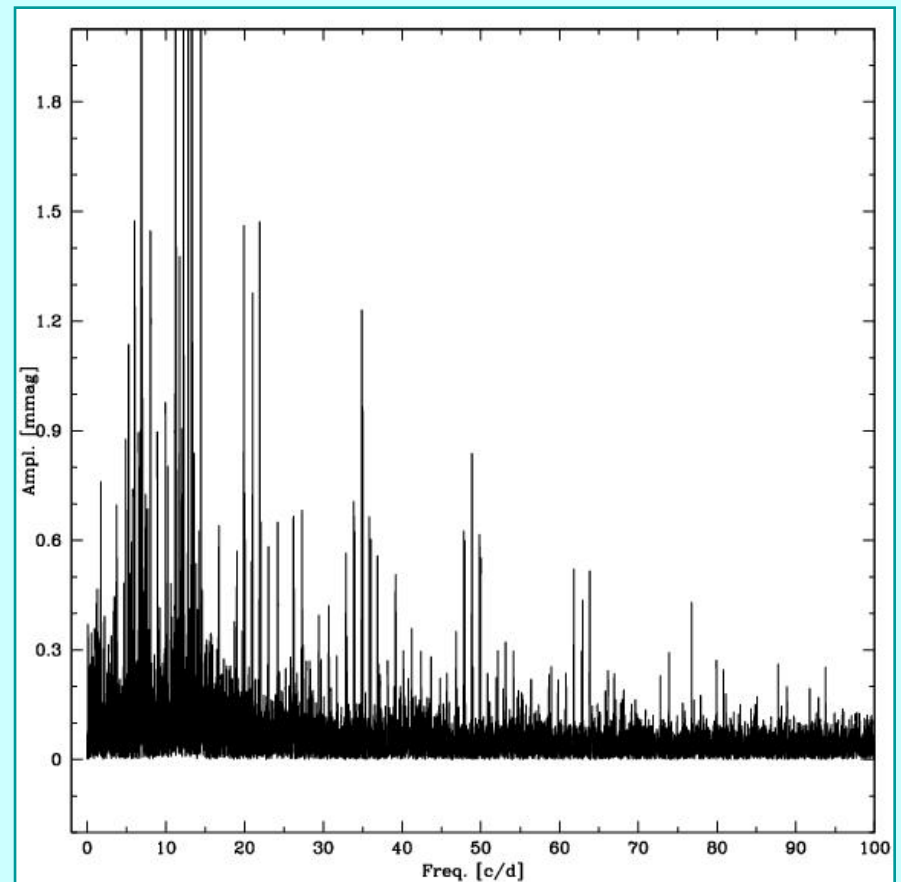
**Light curve of
HD 50844 observed
by CoRoT
(IR01, 57.7 d)**

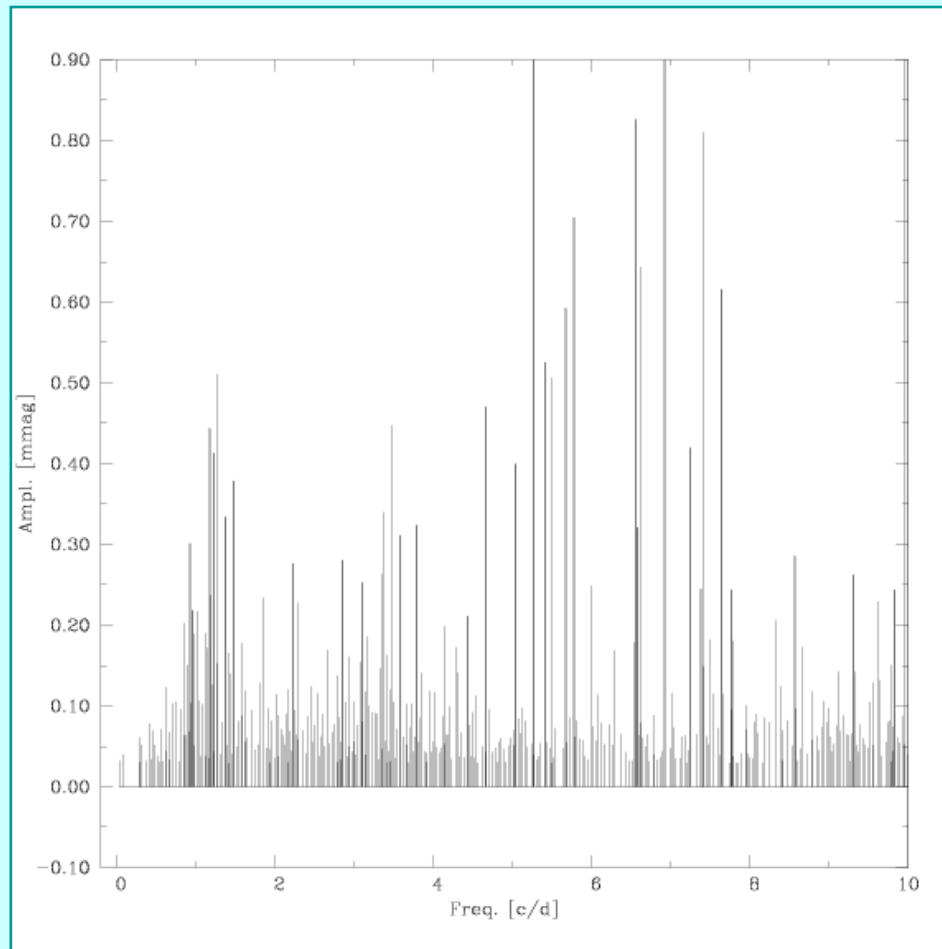




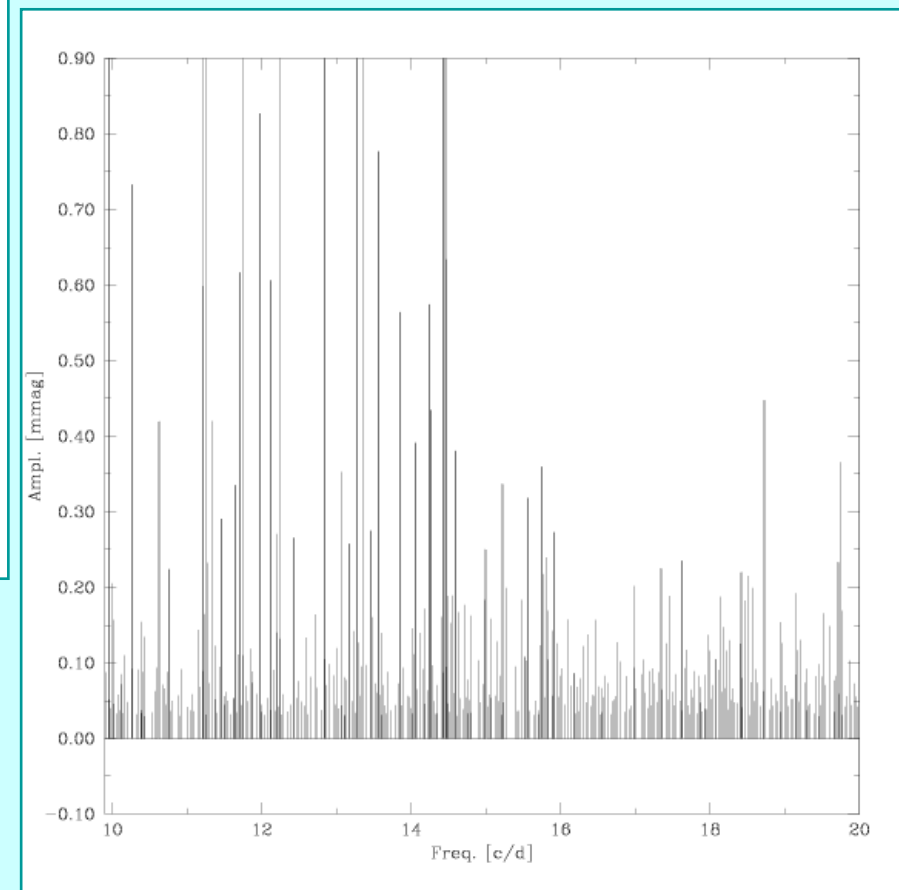
Amplitude spectrum from Period04

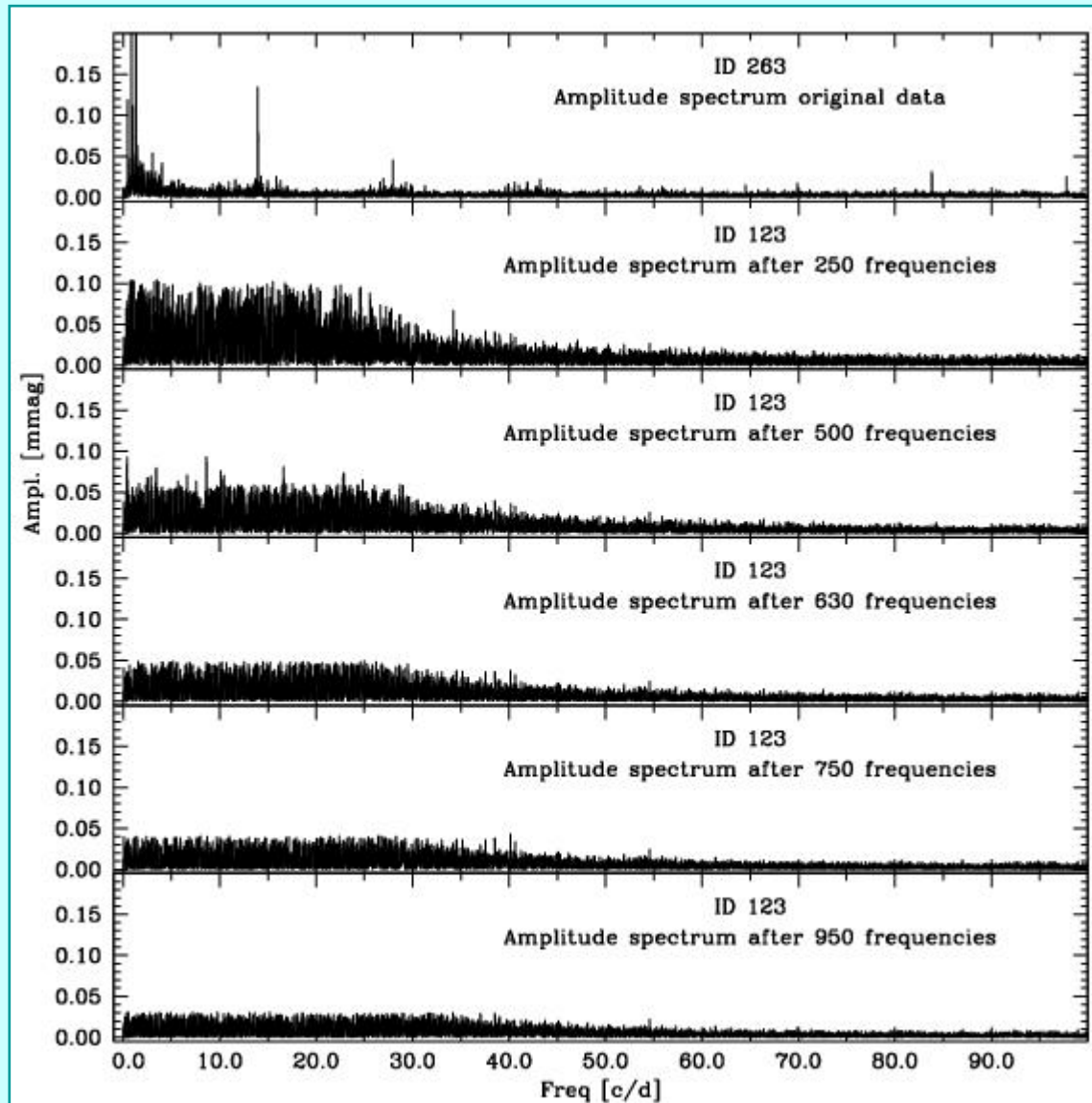
OK, well.
What happens when running a
Frequency search algorithm ?





A look at the lowest amplitudes reveal a lot of peaks at the 0.1 mmag level.





Local noise at 10 c/d:

100-th: 0.05 mmag

250-th: 0.04 mmag

500-th: 0.02 mmag

900-th: 0.01 mmag

Expected noise :

0.008 mmag

Note : the usual criteria for acceptance limit (SNR>4.0, SigSpec) push the frequency detection to the 1500-th rank.

Frequency search by means of iterative sine-wave least squares fitting (*Vanicek 1971*)

CoRoT light curve spanning 1 day

Predominant term.
One cycle disappears.

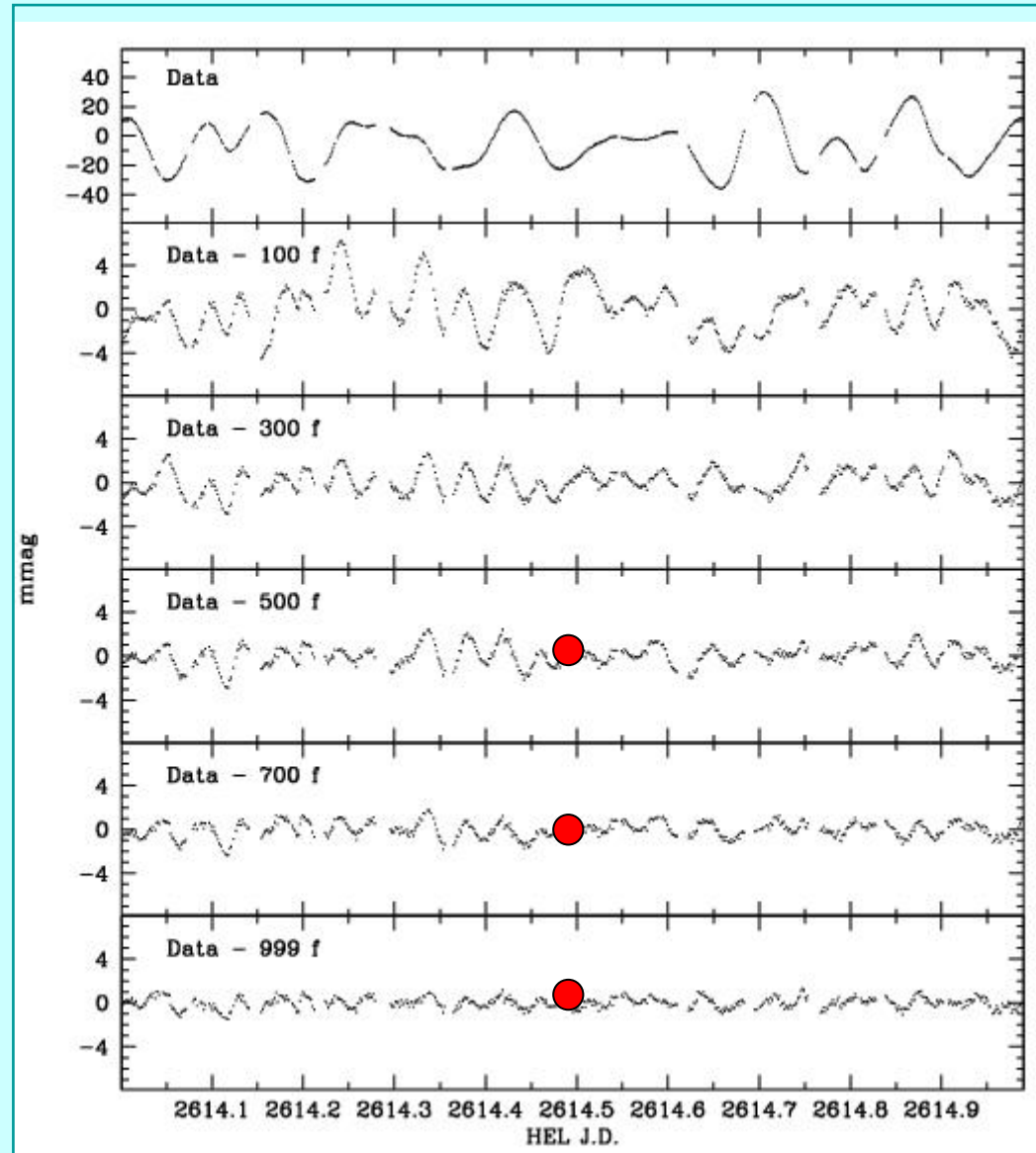
Short and long term oscillations.

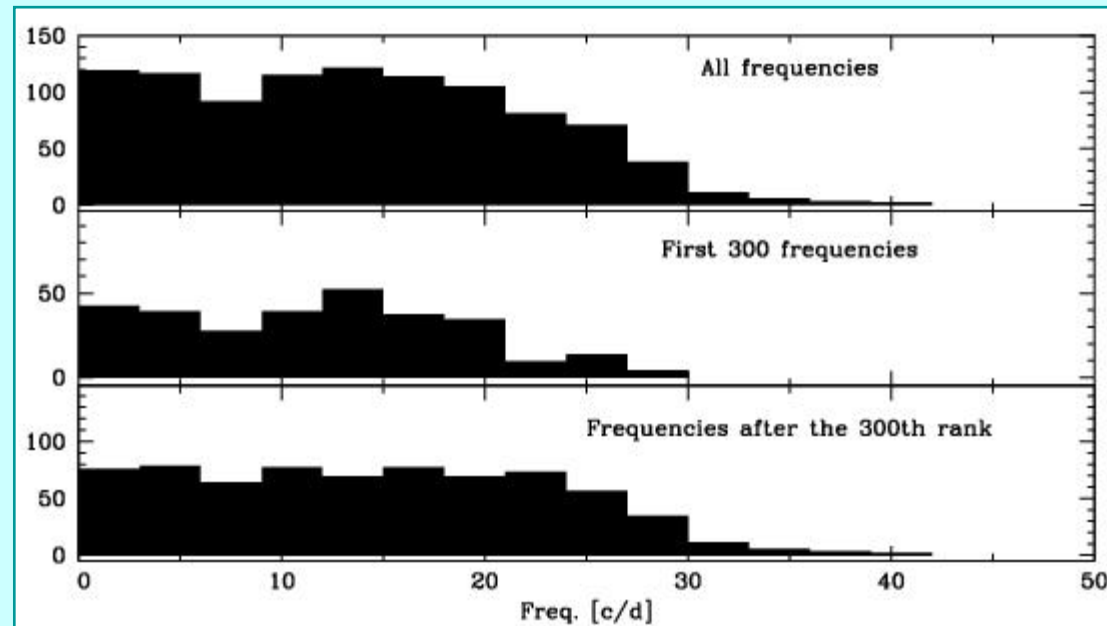
Rapid oscillations. They
continuous beating

Peak-to-peak still 5 mmag.
Red circle : BEST error from
ground-based photometry in
Excellent sites.

Amplitude reduced.

Short term oscillations,
very small amplitude,
still beating.





Number of frequencies vs frequencies at different rank detection. Most of the frequencies in the 20-30 c/d range appears after the 300-th detection.

Hundreds of frequencies. There are some implications :

- high l degree; modes excited;
- rotational splitting;
- different radial order;
- cancellation effects are not effective at the 0.05 mmag level.

NEED FOR SPECTROSCOPIC INPUTS !!!

HD 50844 has been observed in January-February 2007 with FEROS at the 2.2m MPI-ESO telescope (La Silla), in the framework of the Large Programme LP178.D-0361.

Frequency resolution problems owing the time baseline (less than 30 d).

SPECTROSCOPIC RESULTS ON HD 50844 (DSCT, $V=9.1$, $V \sin i = 58$ km/s)

The spectra have been independently analyzed by Mantegazza & Rainer (Brera team) and by Zima (Leuven team). The results are very similar.

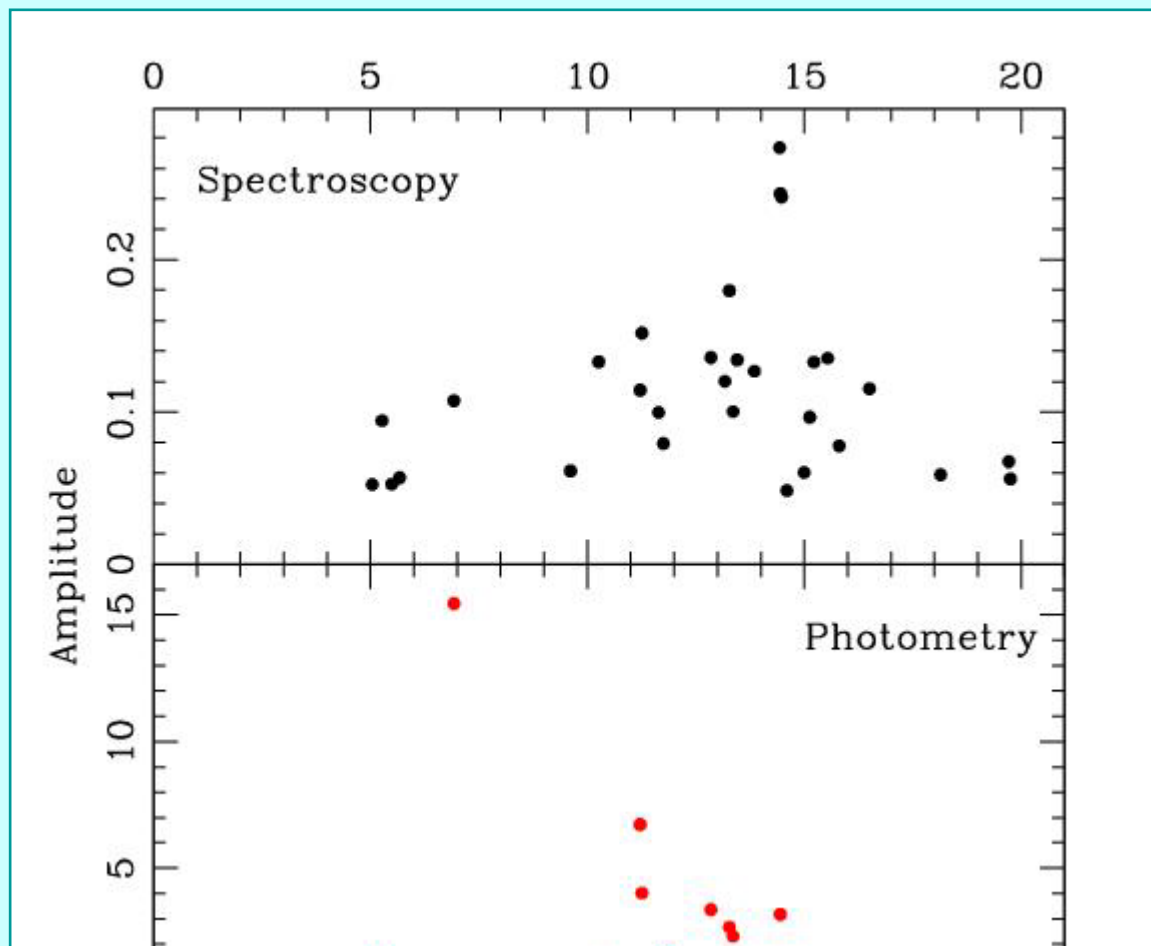
..... *About 30 independent spectroscopic frequencies*

5.26	CoRoT #10
6.92	CoRoT #1. Predominant mode.
10.21	CoRoT : 11.22, 10.26, 11.26, 13.27 (#2, #18, #3, #7)
11.64	CoRoT : 11.71 (#21)
12.16	CoRoT #25
12.24	CoRoT #5, but also 13.27 (#7)
12.85	CoRoT #4
13.16	CoRoT : 13.36 (#8)
14.32, 14.40, 14.48	CoRoT : 14.432 (#12), 14.447 (#6), 14.461 (#11), 14.476 (#22)
15.22	CoRoT #50 (!!)

PHOTOMETRIC IDENTIFICATION OF 30 SPECTROSCOPIC TERMS

...sy, some ambiguities.
...n cases, the photometric
...with the larger amplitude
...een selected.

...ther stars, the hierarchy
...pected moving from
...netry to spectroscopy.



DEGREE IDENTIFICATION

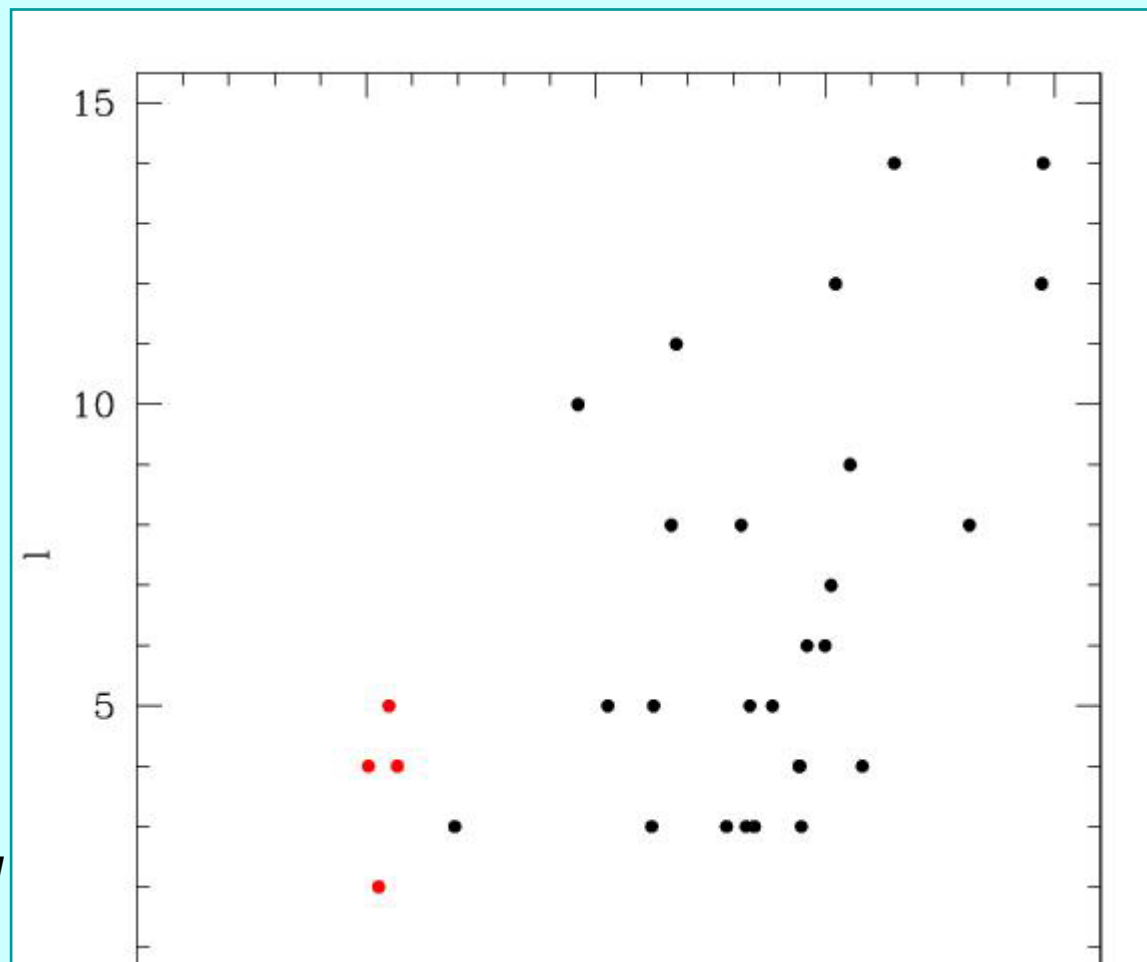
s with l up to 14 have
identified.

ainty : ± 1

etrograde modes

ctroscopic terms
identified with the
ones.

oscopy and ground-based
lour photometry.

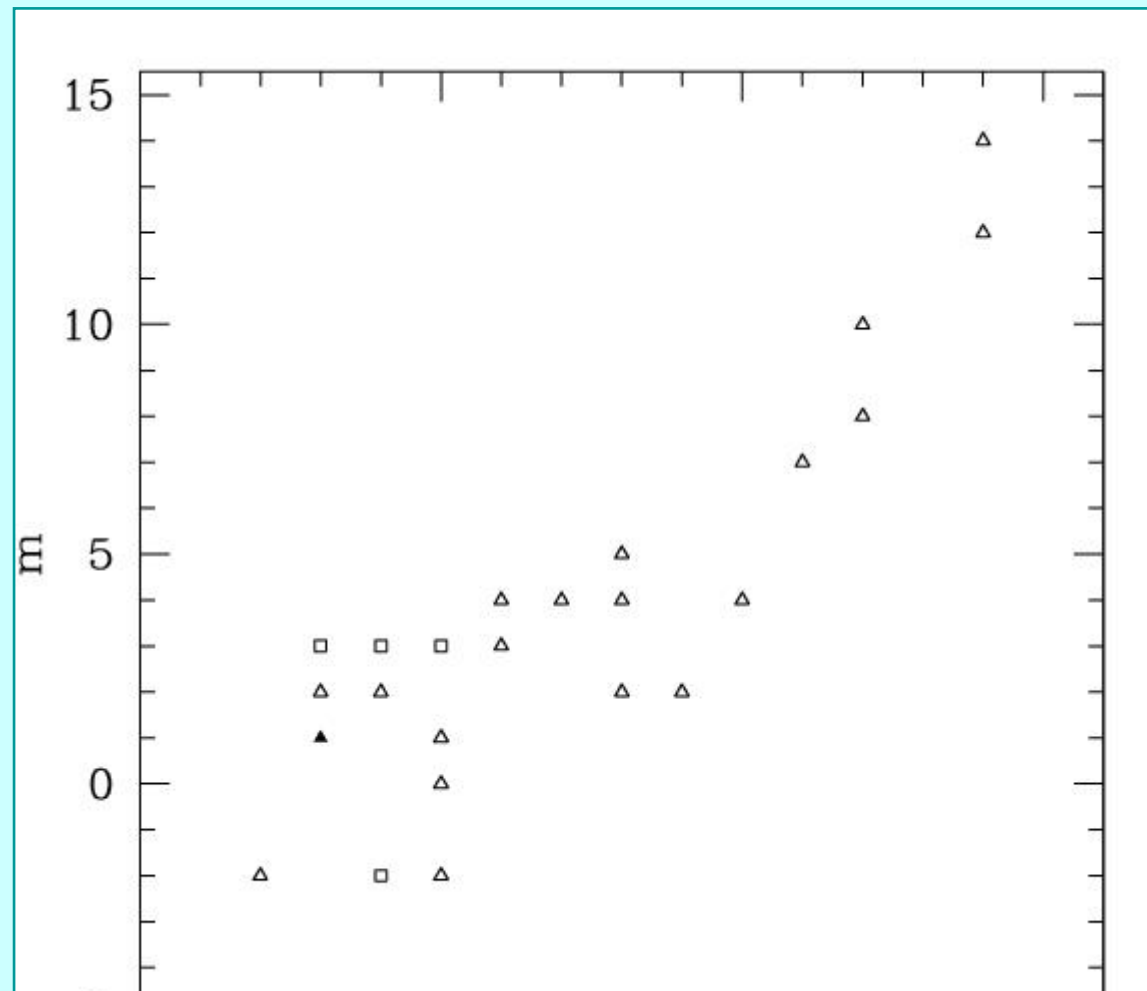


MODE IDENTIFICATION (l,m couples)

triangles: 1 mode
squares: 2 modes
triangle : 3 modes

uncertainty on m : ± 2

incidence angle: 78°



SUMMARY

HD 50844 is an evolved object, close to the TAMS

Light curve of HD 50844 is composed of hundreds of independent terms.

When considering 500 terms we get a residual light curve still showing oscillations.

Regular frequency spacing is observed. A reference system problem ?

Astrospheric observations suggest the presence of modes up to $l=14$.

Star is seen from the equator ($i=78^\circ$).

Explain the high number of frequencies, the cancellation effects of high-degree modes are not effective.