Seismic analysis of HD 49330 from CoRoT and spectroscopic data

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Outline

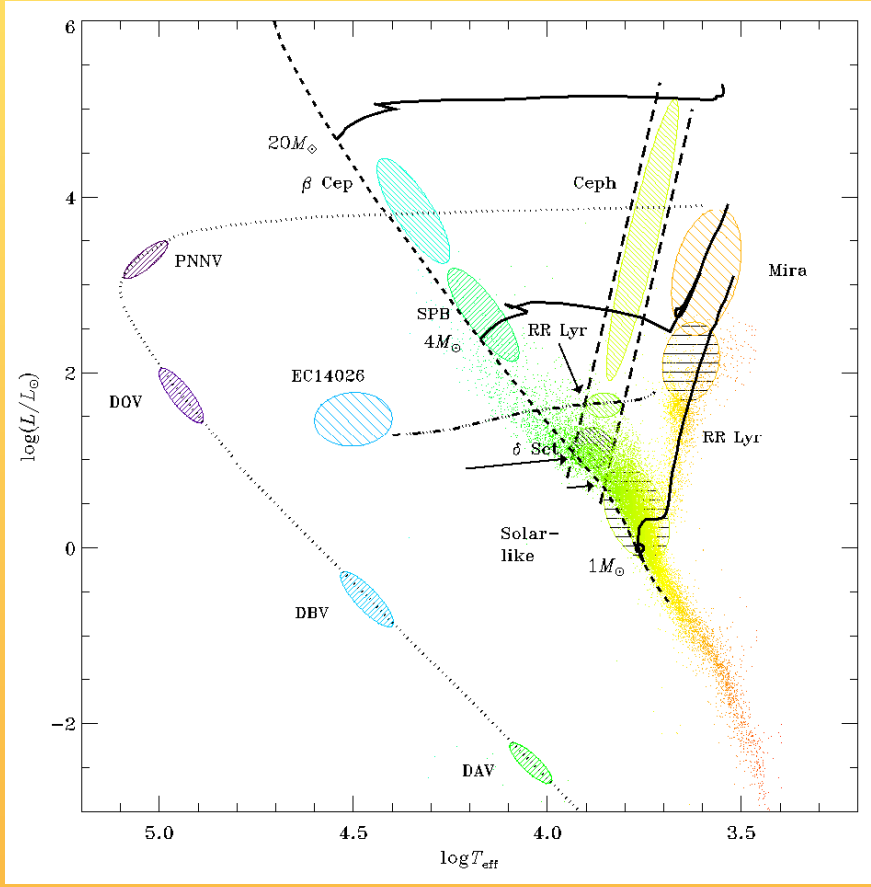
- Be stars
- HD 49330
- Previous observations of HD 49330
- CoRoT photometric analysis
- Ground-based spectroscopic analysis
- Conclusion

Be stars

- Main sequence B stars with **Balmer emission lines**
- Circumstellar disk
- **Outbursts**
- **Rapidly rotators** (88% critical velocity)
- 20% of B stars

- **Photometric & spectroscopic variabilities**
- Located in instability strips (β Cep, SPB)
- Non Radial Pulsations
- **p & g modes**

Be stars



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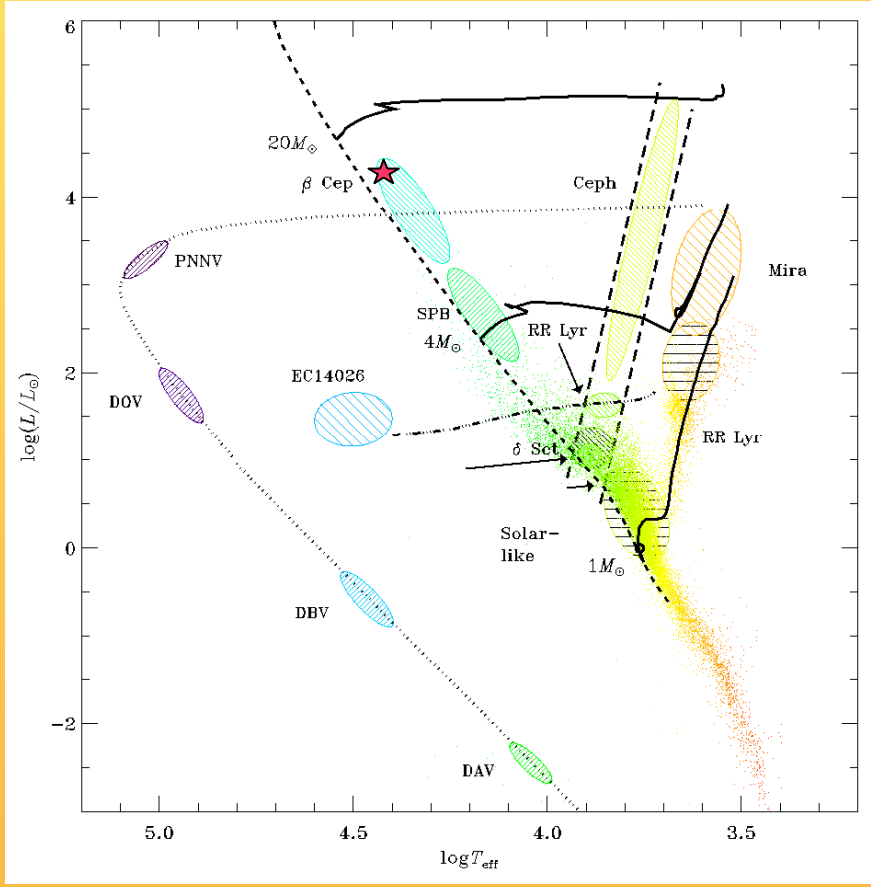
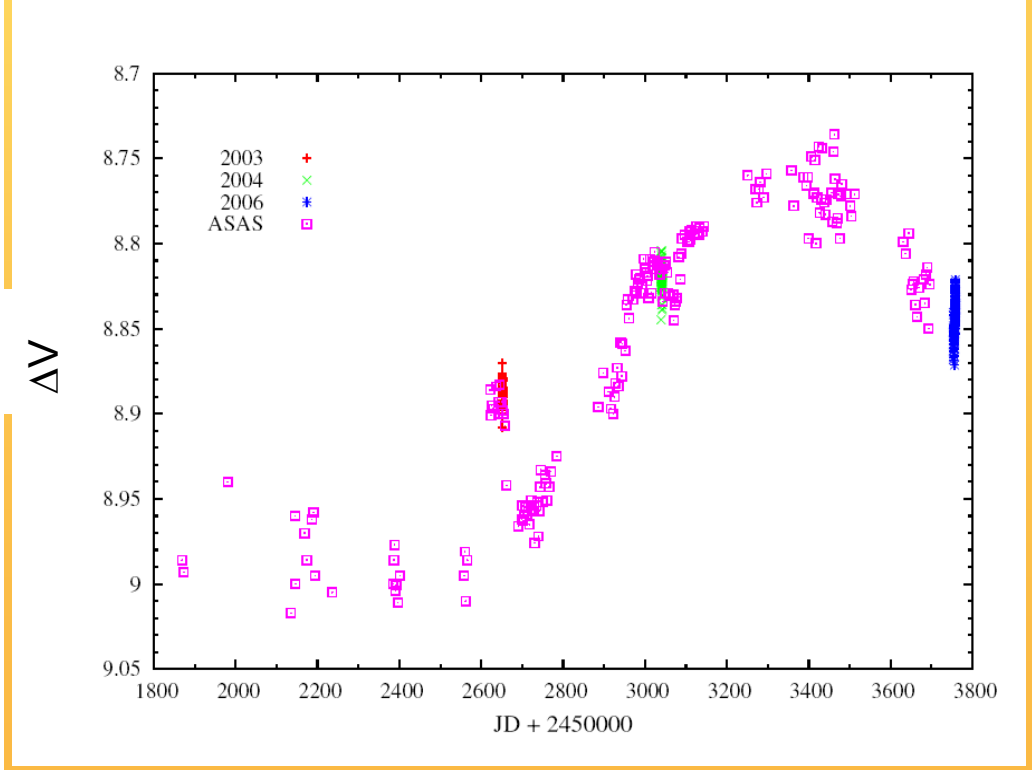
HD 49330



- **Early Be star (B0.5IVe)**
- Located in the β Cep instability strip in the HR diagram
- Fundamental parameters (Frémat et al. 2006)
- Teff ≃ 27000K
- Log g = 3.8
- **V sin i = 270 km/s**
- Log $L/L_\odot$ = 4.30
- $M/M_\odot$ =12.80

HD 49330

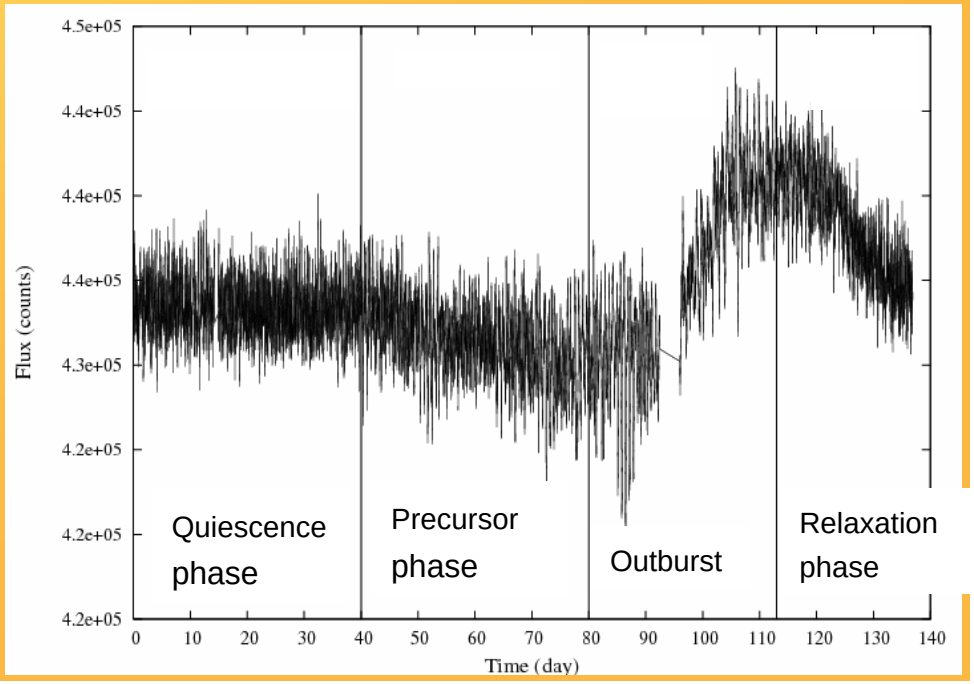
- Observed during **ground-based campaign** (ASAS , OSN) (Gutiérrez-Soto et al. 2006)



- **Light variability with several time scales**
- Long term variability (~ 2000 days)
- Short term variability (2.13 c/d – 24.65 μHz & 3.53 c/d – 40.86 μHz)
- **Outbursts**

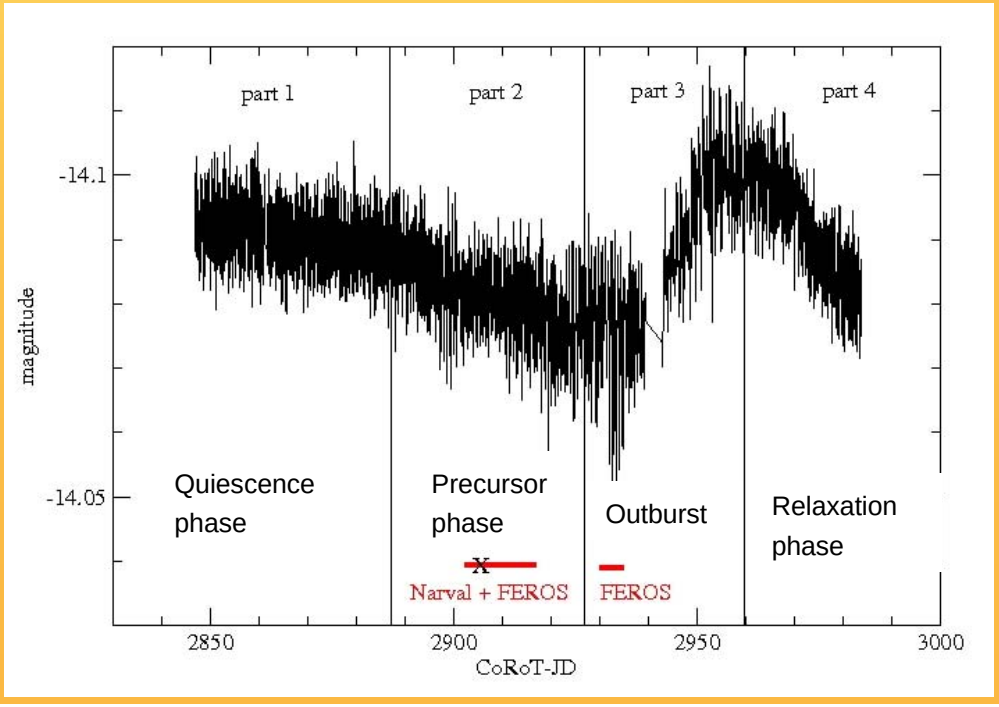
CoRoT observations

- **LRA01 anticenter** observed from October 18 2007 to March 3 2008
- Loss of data
- Light curve shows an **outburst of 0.03 mag**
- Analogy with μ Cen
  (Rivinius et al. 1998)
  - **Quiescence phase**
  - **Precursor phase**
  - **Outburst**
  - **Relaxation phase**



Spectroscopic observations

- **Narval** @ TBL, Pic du Midi, France (Dec. 12-19 2007)
- **FEROS** @ La Silla, Chile (Dec. 18-28 2007 & Jan. 10-14 2008)
- Lucky because observations just before the outburst

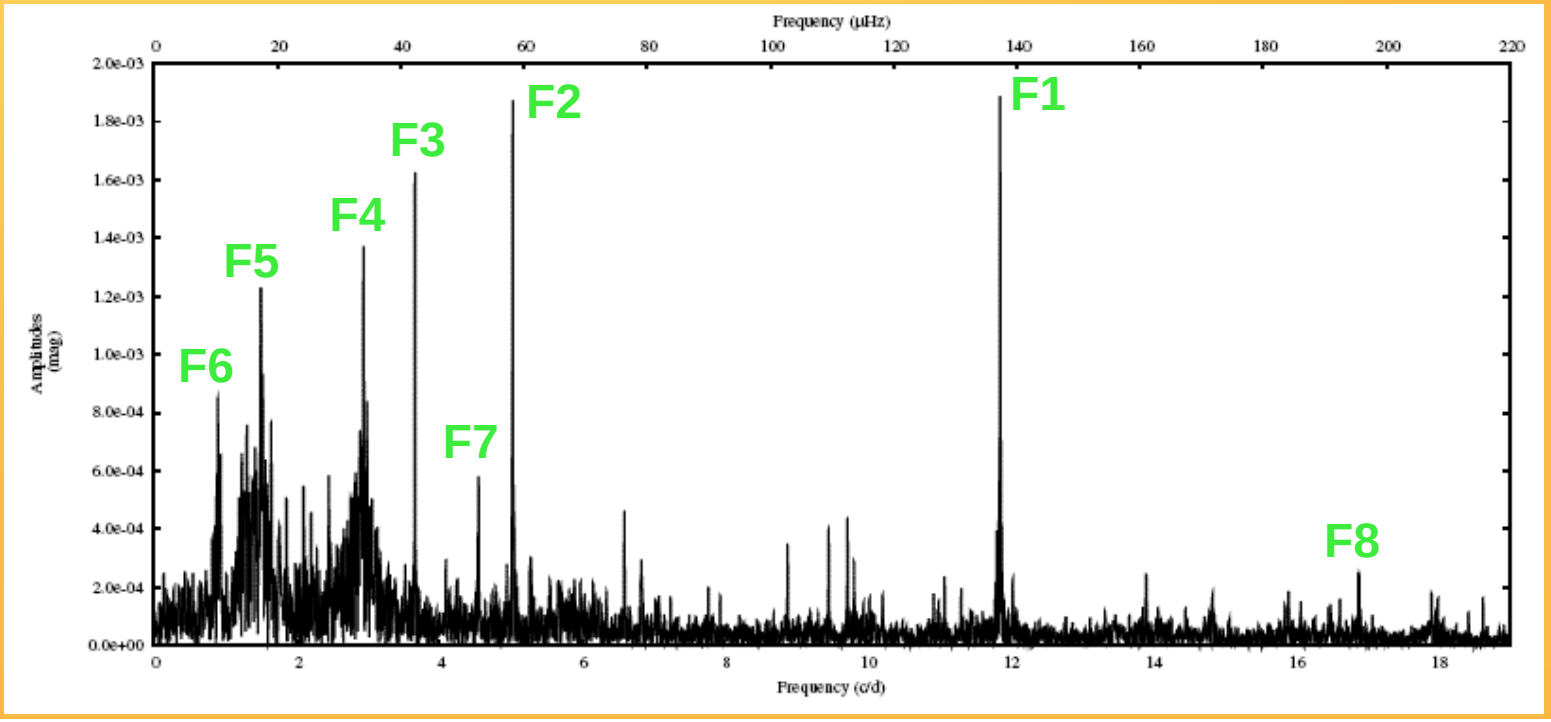


Analysis of CoRoT data

- Analysis of the whole light curve
- Analysis of the four phases of the outburst
- Time-frequency analysis

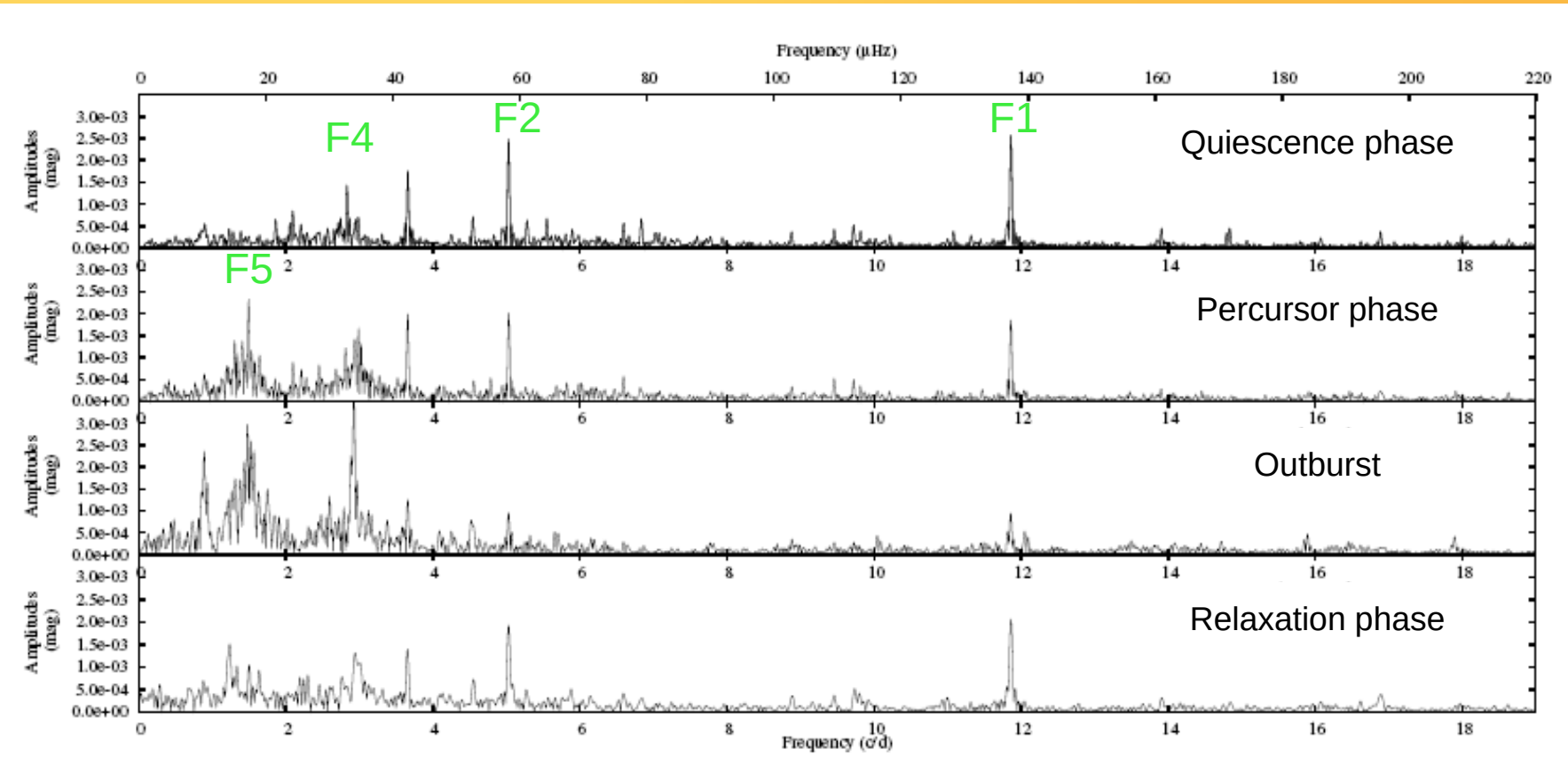
Global analysis

- **F1 = 11.86 c/d** – 137.22 μHz
- **F2 = 5.03 c/d** – 60.97 μHz
- F3 = 3.65 c/d – 42.35 μHz
- **F4 = 2.94 c/d** – 34 μHz
- **F5 = 1.47 c/d** – 17.01 μHz
- F6 = 0.89 c/d – 10.30 μHz
- F7 = 4.55 c/d – 52.66 μHz
- **F8 = 16.89 c/d** – 195.49 μHz

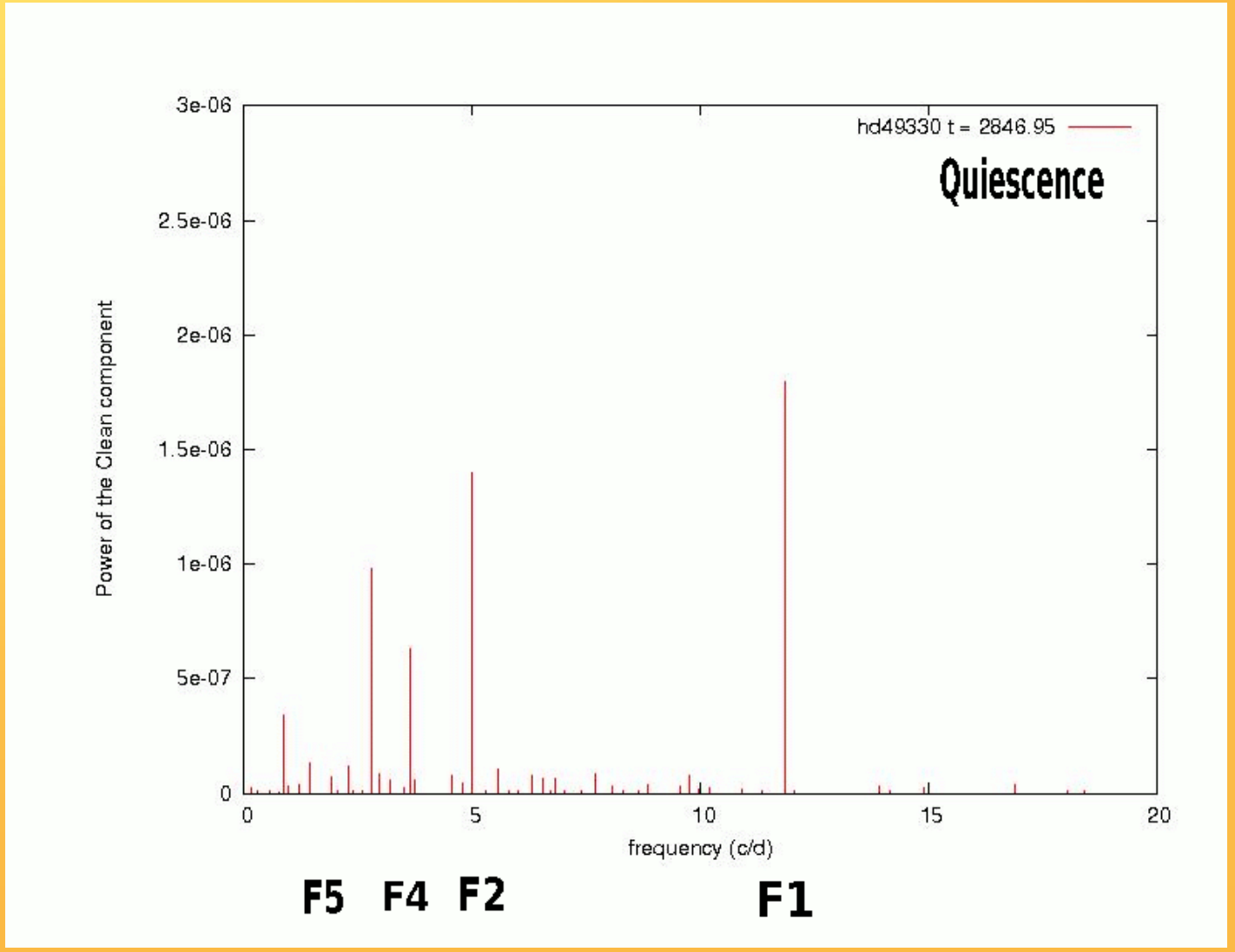


Analysis by parts

- Evolution of amplitudes
- **Anti-correlated** evolution of F1 and F4 / F5 groups

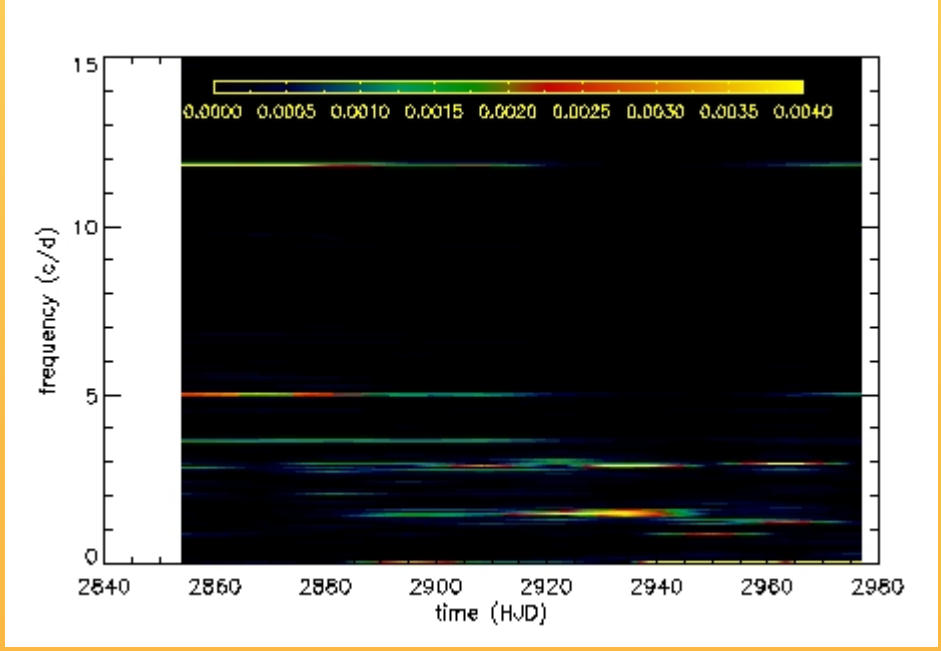


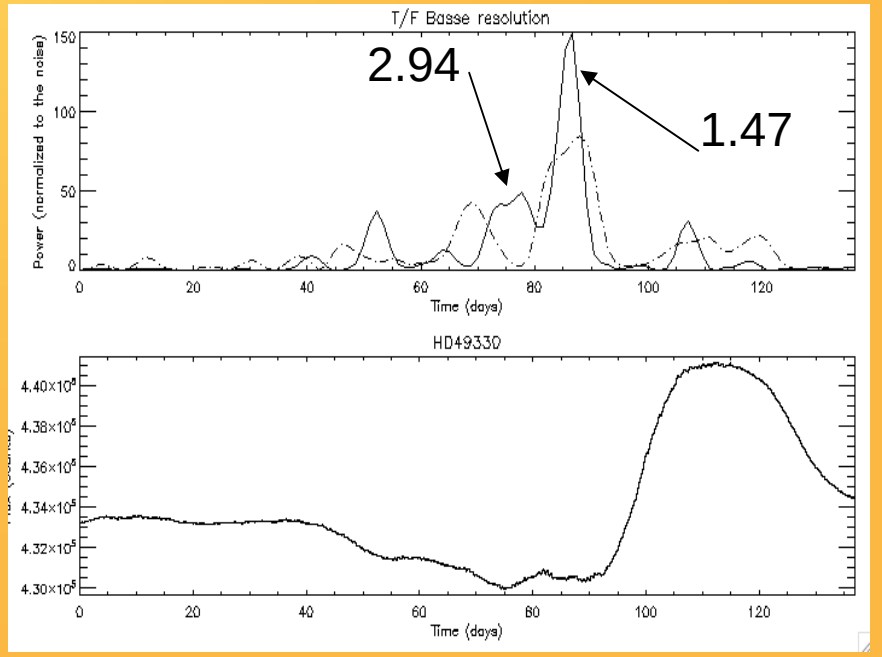
Time-frequency analysis



Time-frequency analysis

- 11.86 & 5.03 c/d decrease during outburst
- 1.47 / 2.94 c/d : Oscillations in **anti-phase** then they **synchronize**, then outburst





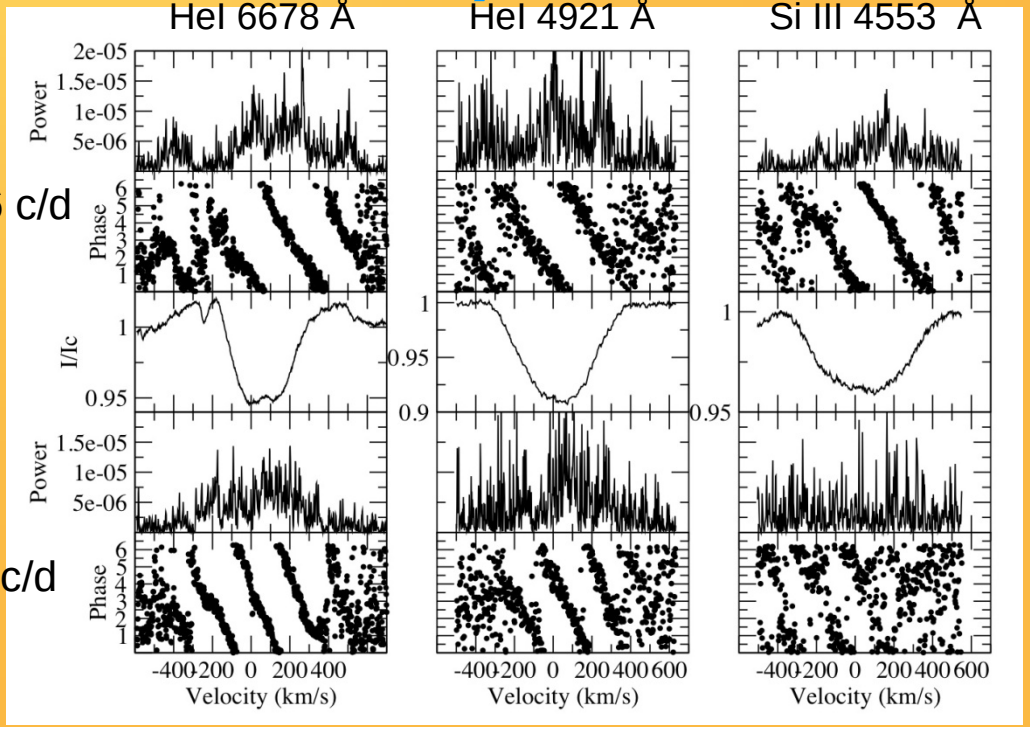
Spectroscopic analysis

- **Matter outflow** in Dec. 2007 prior to the photometric outburst seen in CoRoT light curve
- **F2 = 5.03 c/d not present** and corresponds exactly to **F8 – F1 (16.89 – 11.86 c/d)**
- Mode identifications

  p modes l ~4 & l =6

See poster P-VI-69

by Floquet et al.



Conclusion

- HD 49330 = Very interesting star
- Light curve with an **outburst**
- Photometric and spectroscopic **variations of amplitudes correlated with the outburst**
- **Mode identification** thanks to spectroscopy
  p & g modes
- Ongoing **modelling** (see talk by Coralie Neiner)