Seismic Analysis of the Pulsating Subdwarf B Star EPIC 212508753 Using Data From NASA's Kepler Space Telescope

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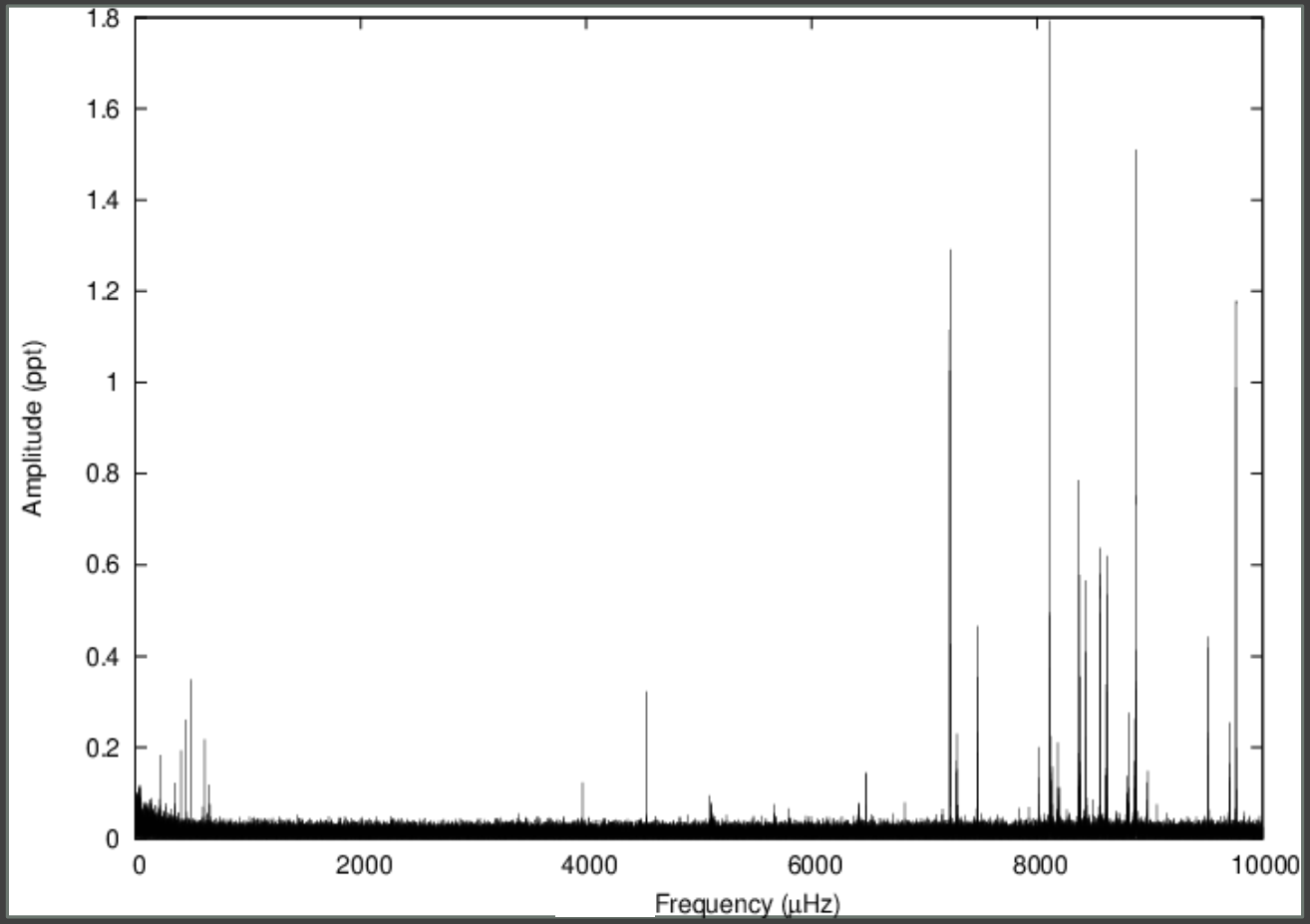
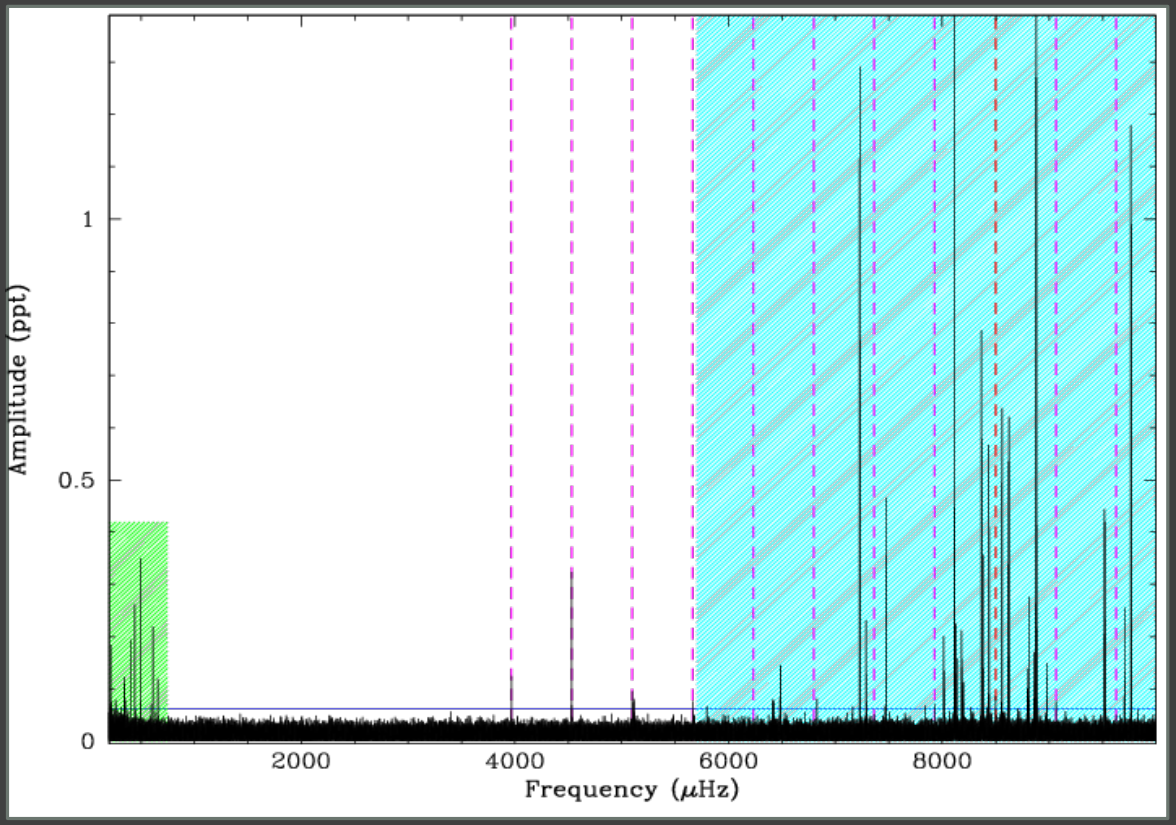
Fourier Transform (FT)



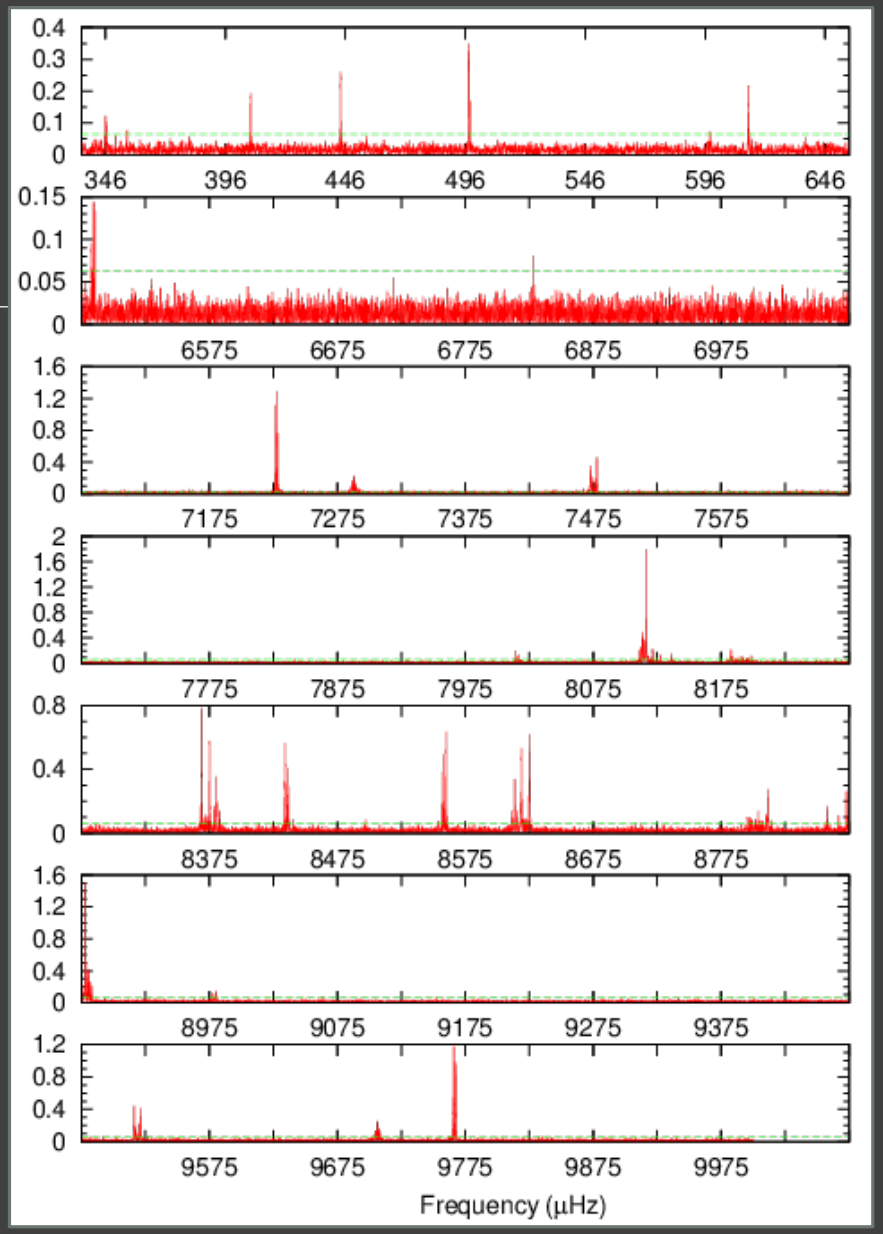
Fourier Transform (FT)

- Resolution of 0.147 μHz
- Green = g-modes
- Blue = p-modes
- Purple = artifacts
- Red = Nyquist



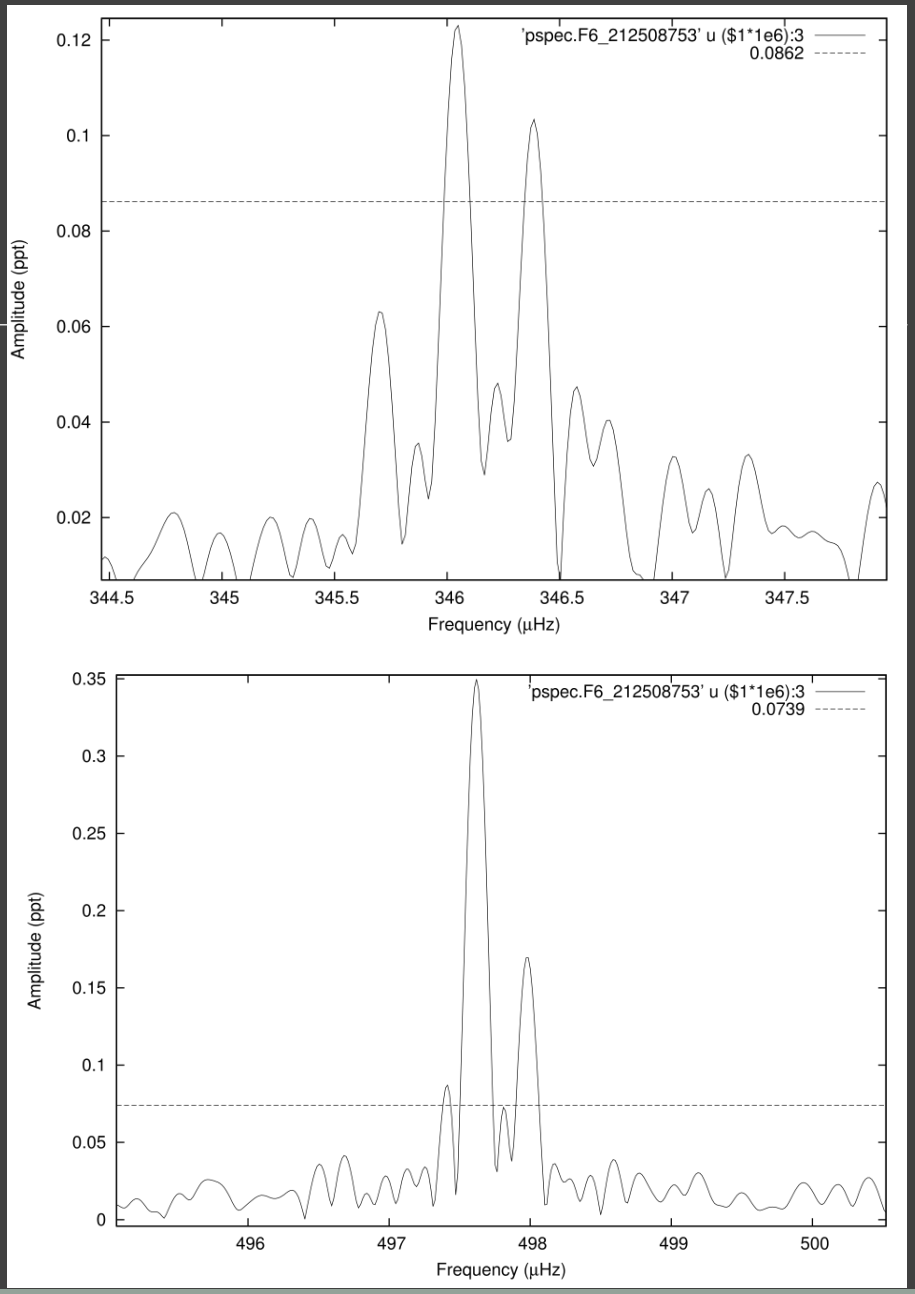
Analysis

- Pulsations above or near the detection threshold were examined
  - Known artifacts were ignored



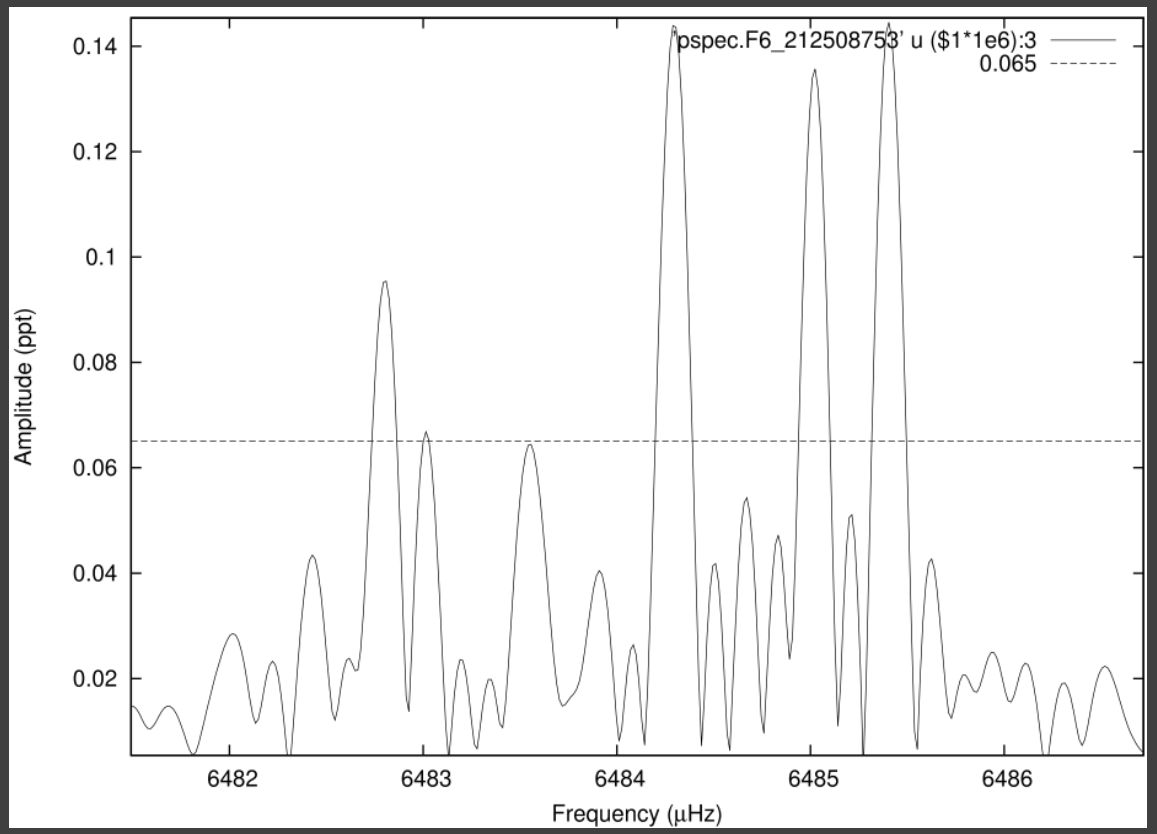
g-modes

- 8 n values found
- Average multiplet splitting of 0.360 μHz
- Average period spacing of 227.7 ± 1.0 s
  - Short side of average



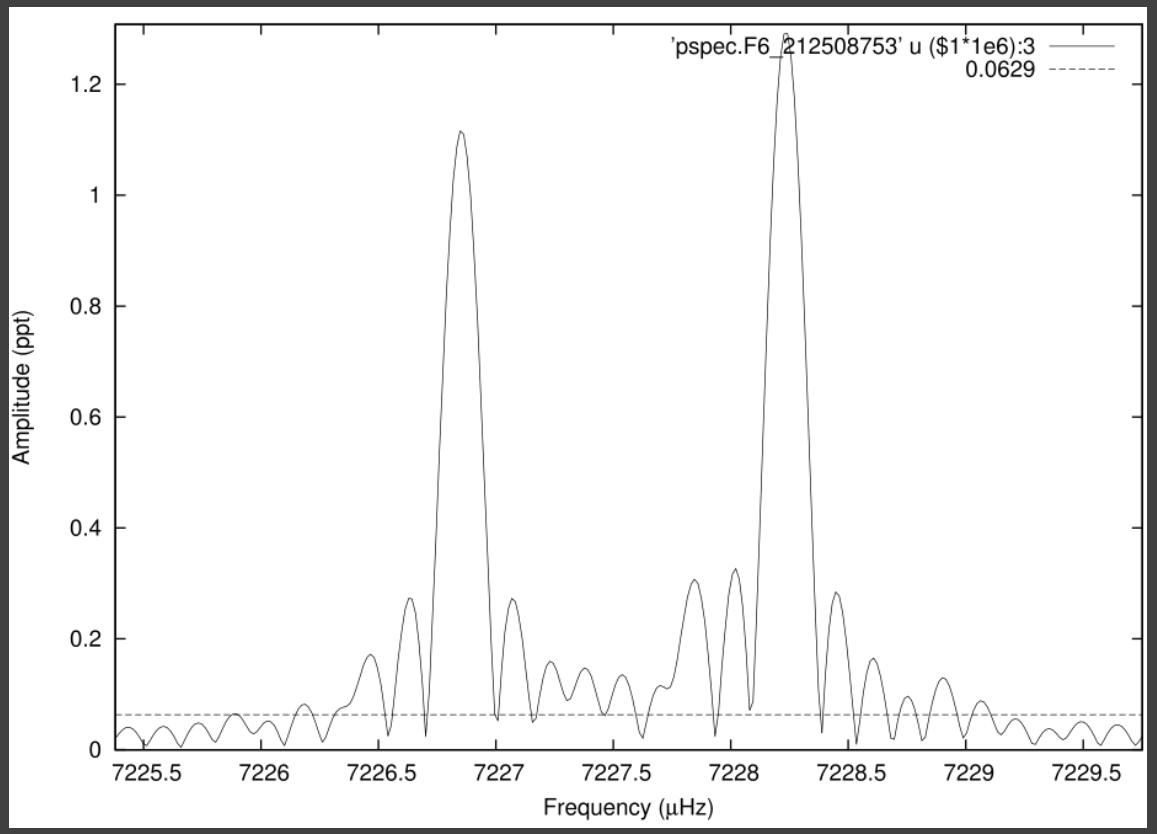
p-modes

- 13 n values identified
- Multiplet splitting of 0.721 μHz
- Example of l=2



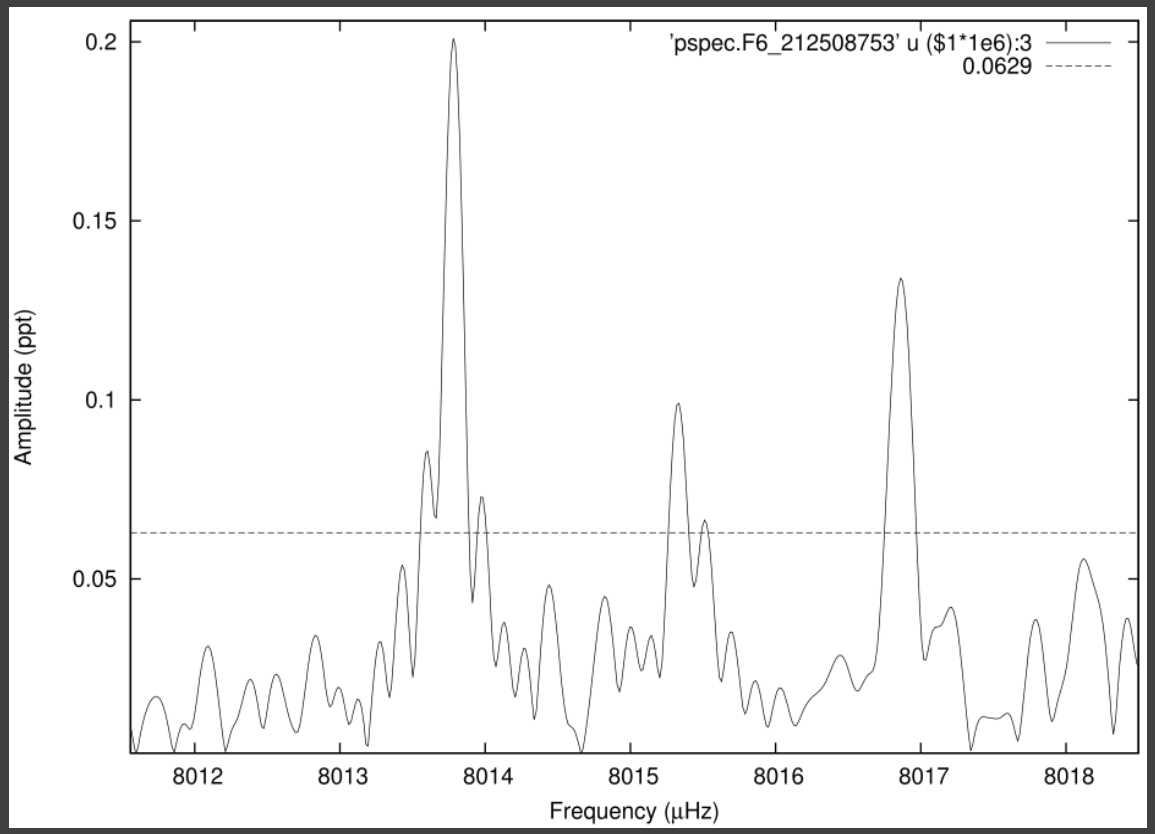
p-modes

- 13 n values identified
- Multiplet splitting of 0.721 μHz
- Example of l=1

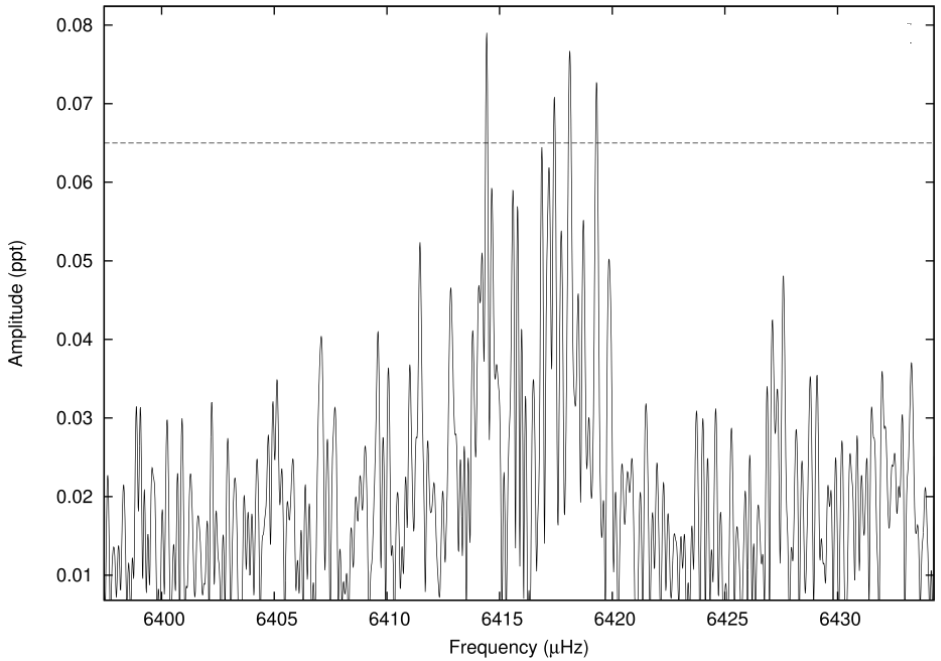


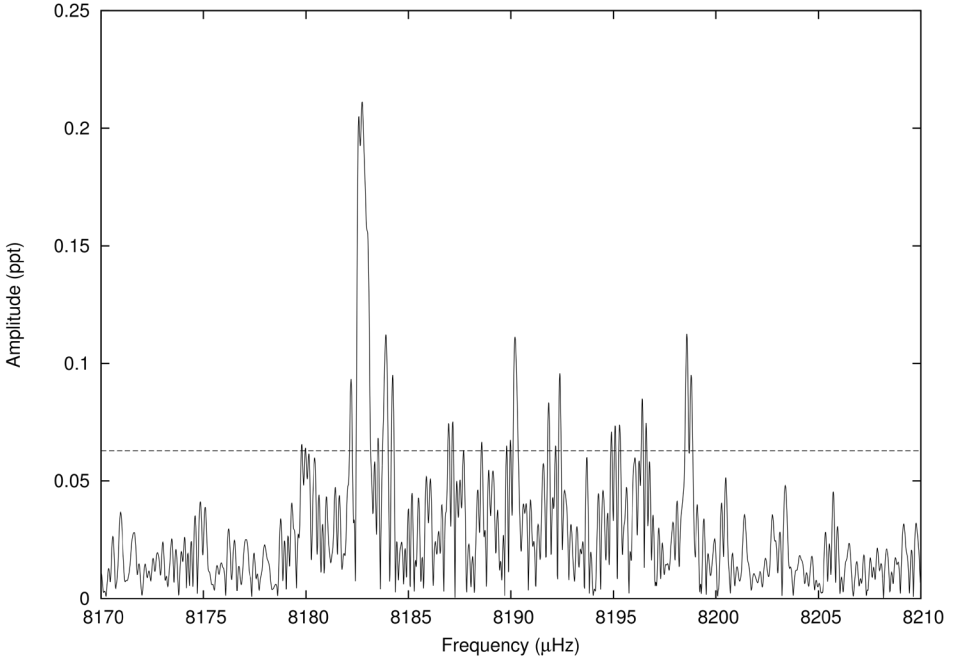
p-modes

- 13 n values identified
- Multiplet splitting of 0.721 μHz
- Example of l=2



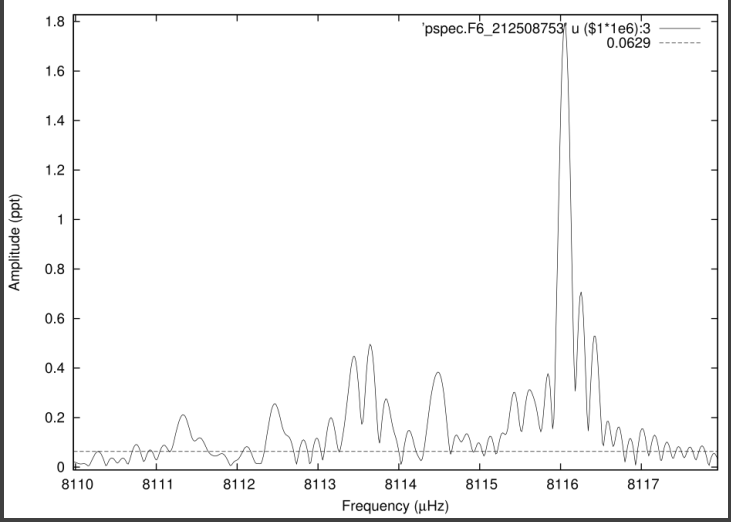
Stochastic Oscillations

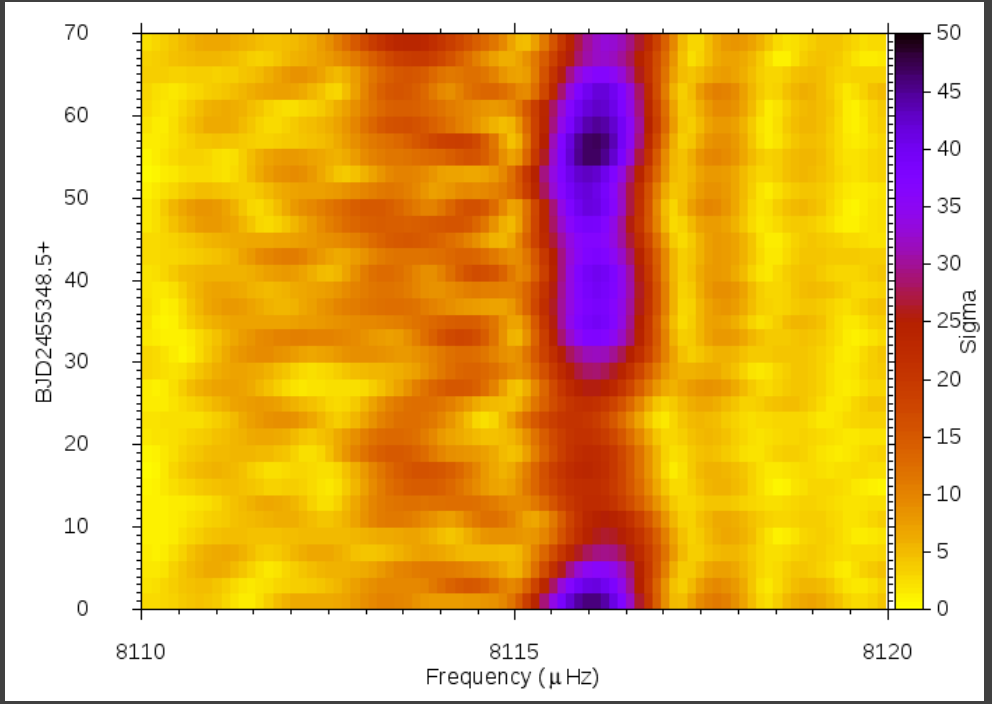




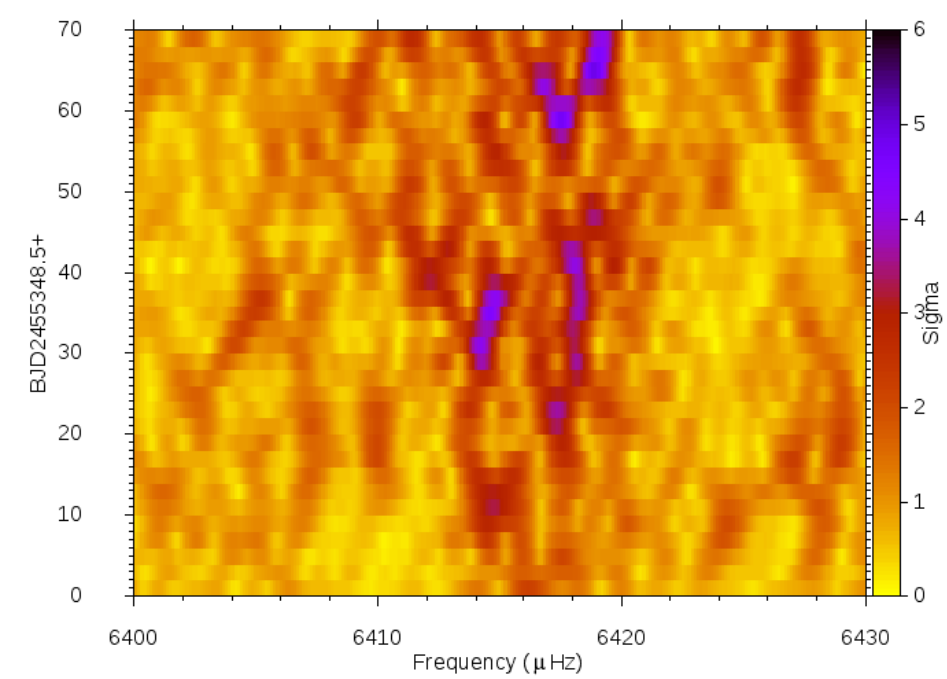
Sliding Fourier Transforms

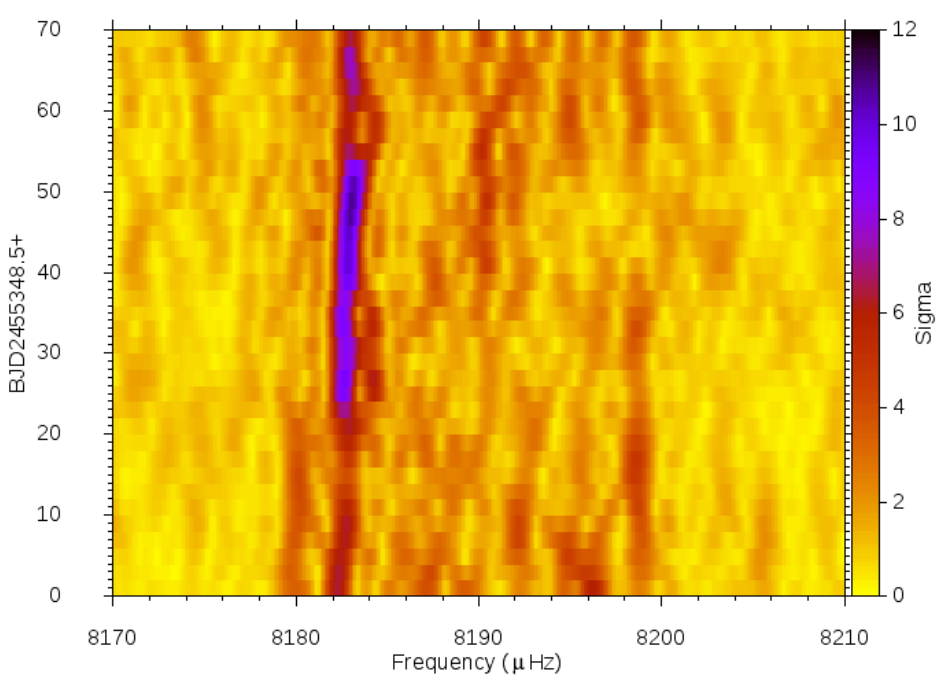
- Used to examine change in pulsations over time
- 10 day bins
- 2 day steps





Stochastic Oscillations





Results

- Ledoux Rotational Splitting Relationship: $v_{n,l,m} = v_{n,l,0} + m\Omega\left(1 - C_{n,l}\right)$
  - Ω: Rotation Period
  - $C_{n,l}$: Ledoux Constant
- g-mode region
  - $C_{n,l} = \frac{1}{l(l+1)} = \frac{1}{2}$
  - $\Delta v = 0.360\ \mu Hz$ for $l, m = 1$
  - $\Omega \approx 16.1\ days$
- p-mode region
  - $C_{n,l} \approx 0$
  - $\Delta v = 0.721\ \mu Hz$ for $m = 1$
  - $\Omega \approx 16.1\ days$
- Solid-body rotation!

Results

- Spectral analysis done by John Telting of the Nordic Optical Telescope

	sdB Component	Main Sequence Companion Component
T_{eff}	$36{,}320\ \pm^{500}_{710}\ K$	$6{,}457\ \pm^{460}_{560}\ K$
$\log(g)$	5.62 ± 0.09	$4.419\ \pm^{0.1}_{0.2}$
$log(\frac{nHe}{nH})$	$-0.98\ \pm^{0.03}_{0.15}$	

- Hottest Kepler-observed sdB pulsator
- Should not have g-modes; models can't drive them past 24,000 K
- F7V companion star

Conclusion

- Hybrid pulsator with most power in the p-mode region
- Very unique Kepler-observed sdBV
  - Hottest!
  - Still has g-modes!
  - Shortest pulsation periods!
  - Stochastic oscillations!
  - Solid-body rotator!
  - Relatively short rotation period!