# Searching for frequency multiplets in the pulsating subdwarf B star PG 1219+534

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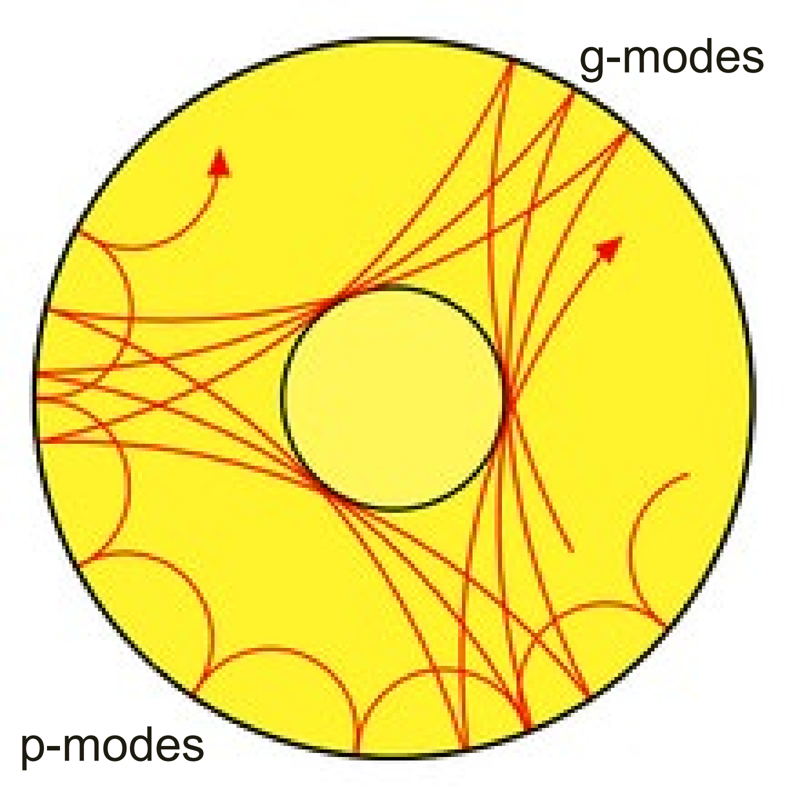
# Asteroseismology

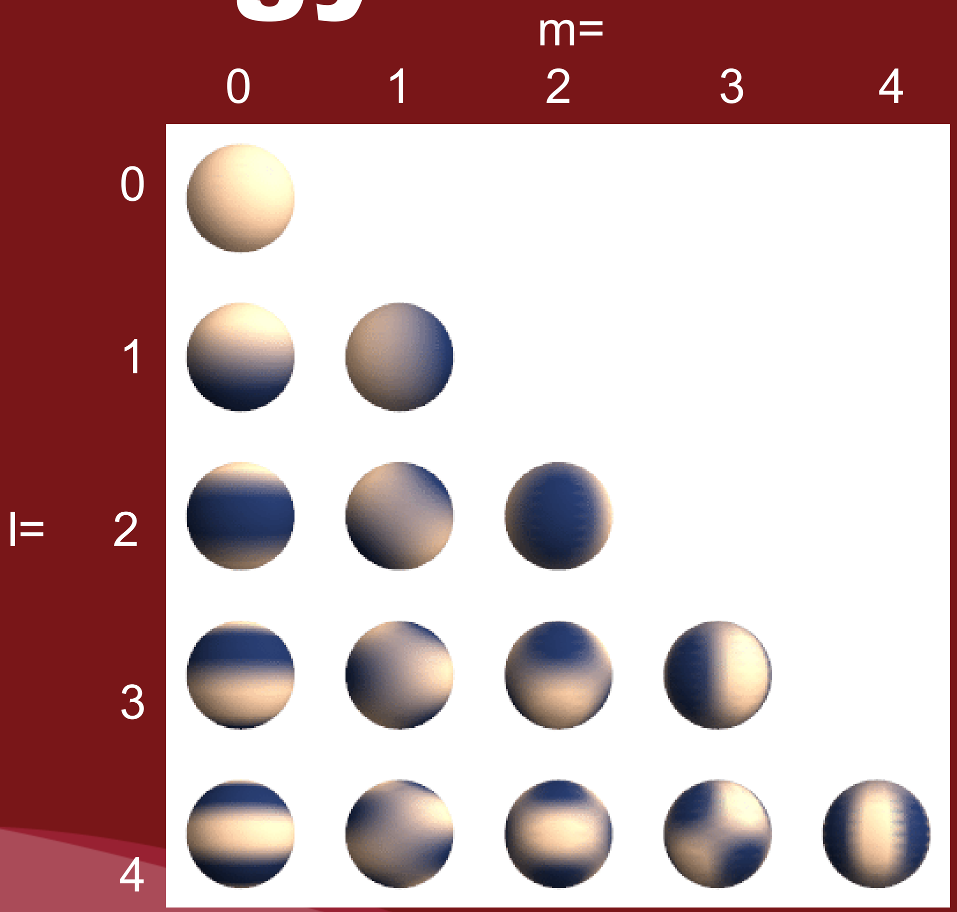
- Study of pulsations to infer internal structure
  - Only way to "observe" the inside of a star
- Two oscillation modes
  - p: pressure mode, high frequency
  - g: gravity mode, low frequency



# Asteroseismology

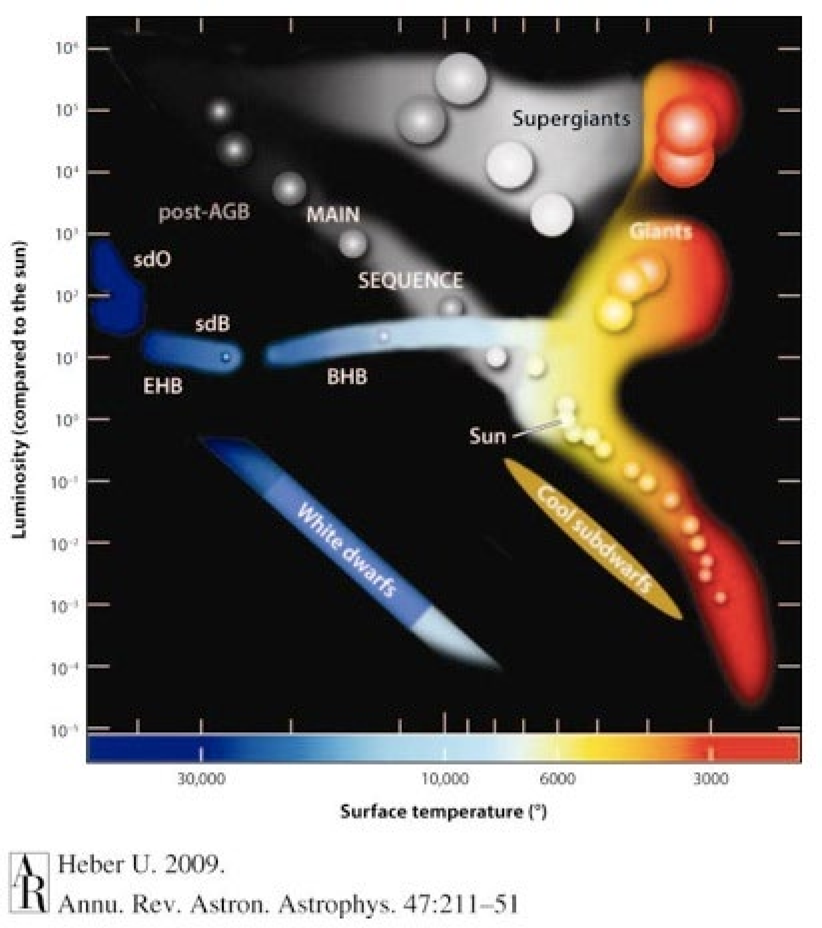
- Using frequency multiplets (rotation period), it is possible to remove azimuthal degeneracy and associate pulsations with spherical harmonics

- Angular degree: l
  - # of nodal lines
- Azimuthal order: m
  - # of nodal lines crossing equator
- Radial order: n
  - # of nodal lines along radius



# Subdwarf B (sdB) stars

- 0.5 $M_{sun}$, 0.2 $R_{sun}$
- 20,000 – 30,000 K
- Horizontal Branch
  - post helium-flash
- Thin, inert envelopes[1]
- Helium fusing cores



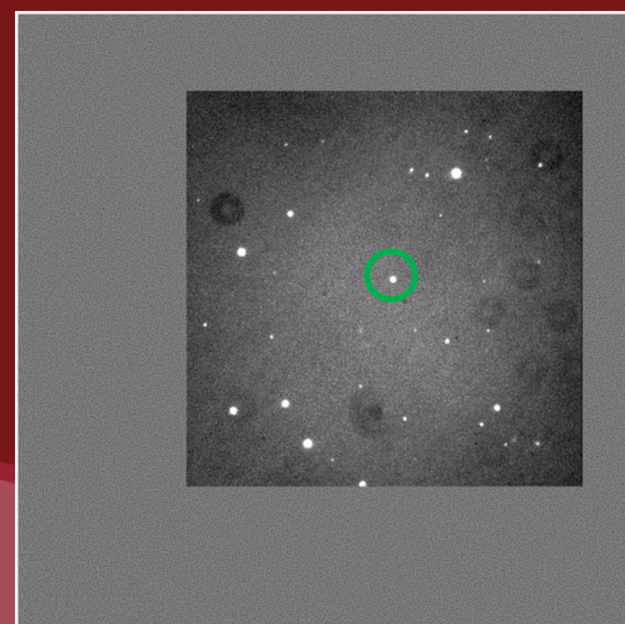
# Previous Work on PG1219+534

- Four dominant pulsation frequencies[2]
  - 6721 μHZ, 148.8 seconds
  - 6961 μHZ, 143.7 seconds
  - 7590 μHZ, 131.8 seconds
  - 7807 μHZ, 128.1 seconds

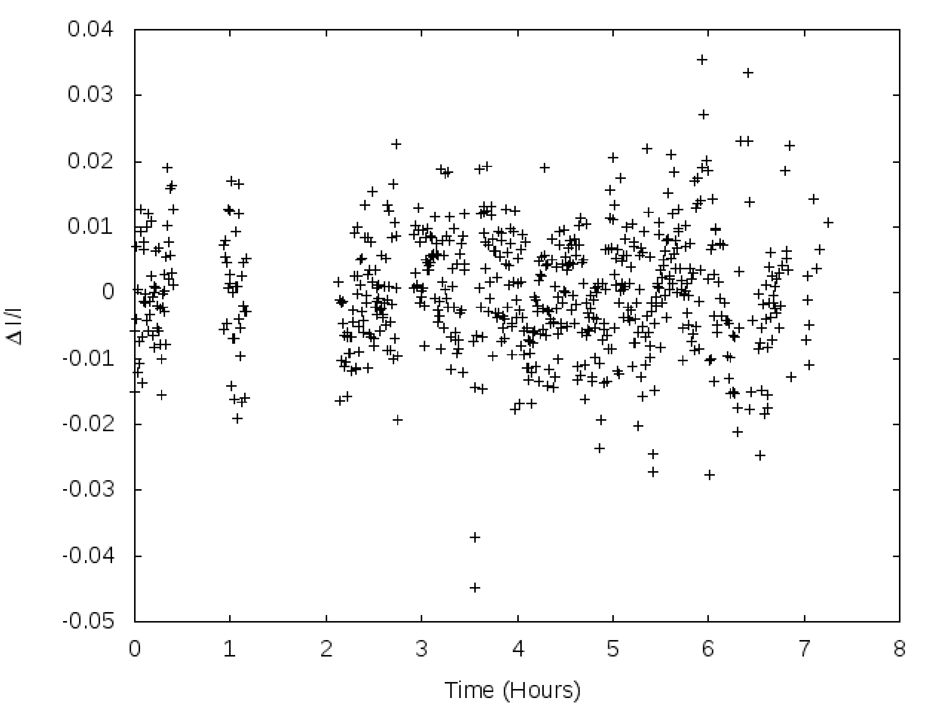
- Frequency multiplets indicating rotation period of ~35 days[3]
  - No evidence or data published
- Goal of project is to find evidence of this rotation

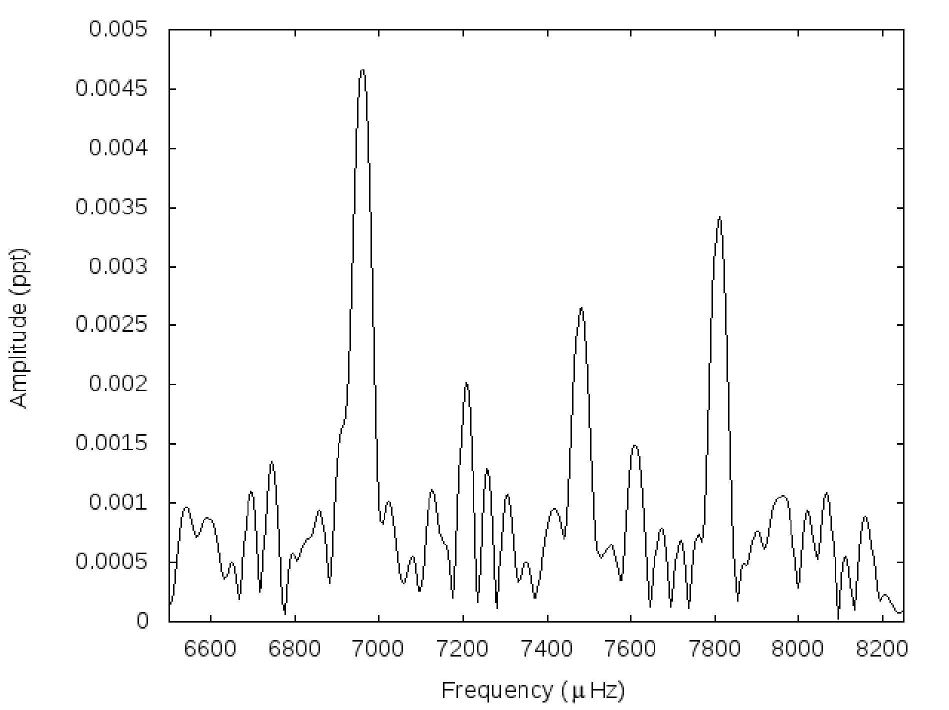
# Observations

- January-August 2015, Baker Observatory
  - Baker Observatory Robotic Autonomous Telescope (BORAT)
    - 16-inch Schmidt-Cassegrain with Apogee U47 CCD
- 44 nights processed (28 usable), 125 hours of images total



# Analysis




Sample lightcurve and Fourier Transform from March 31, 2015

# Analysis

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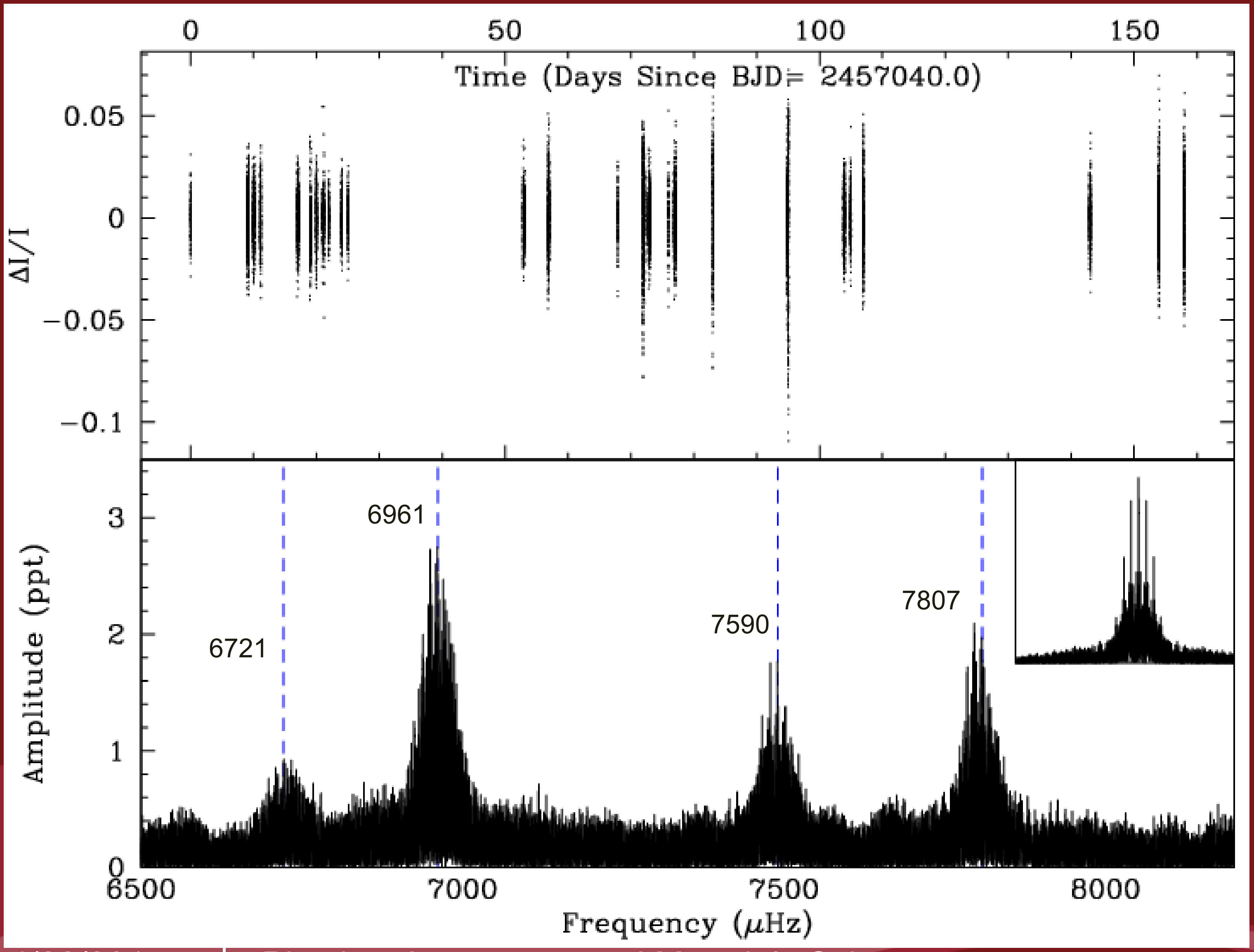
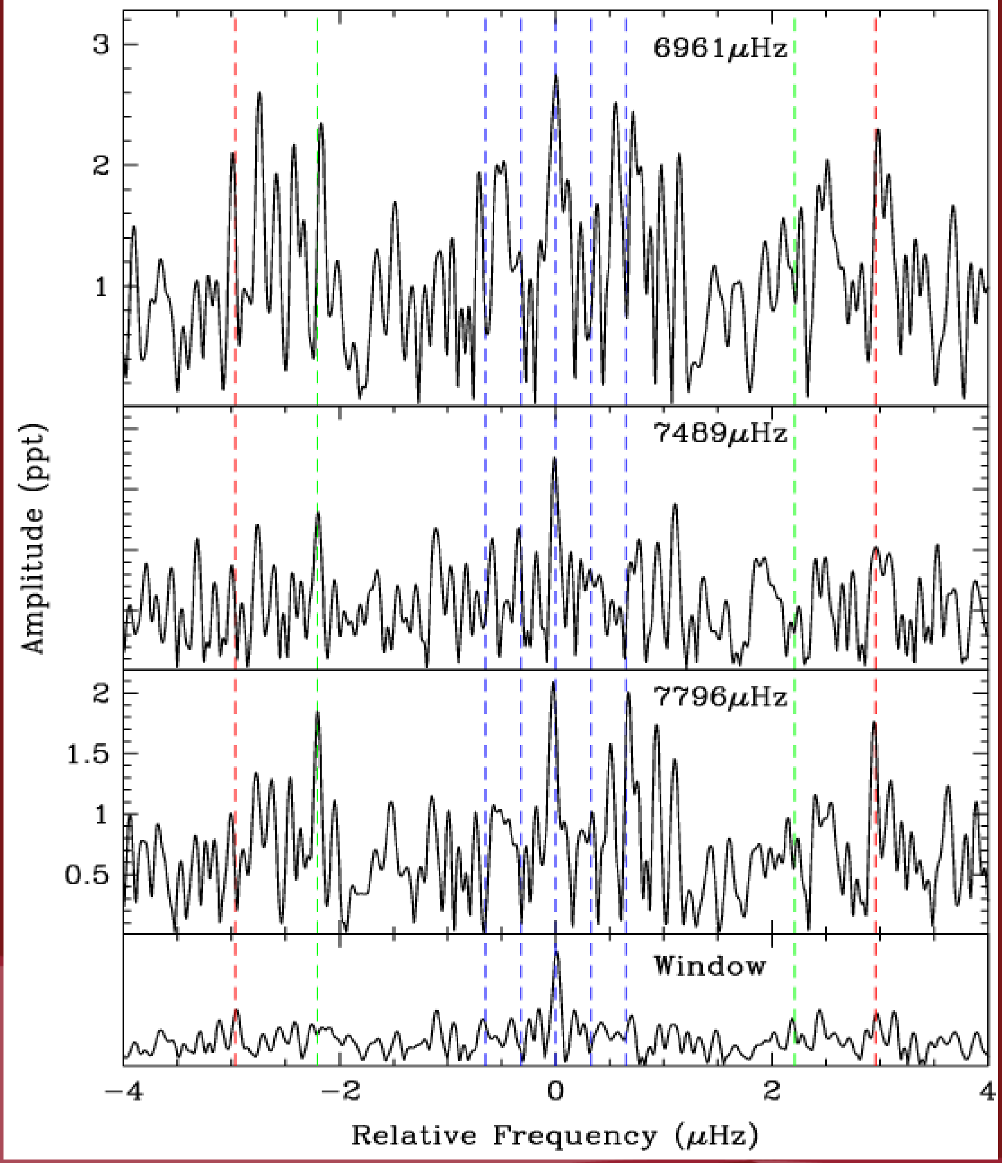


# Analysis

- Close-up view of dominant frequencies
- Blue lines have 0.3 μHz separation
  - Not consistent
- Green and red show that structure is not evenly split



# Conclusions

- Recovered three of four reported frequencies, fourth at low amplitude
- Do not see frequency multiplets indicating reported rotation period of 35 days
  - Should see it, data spans 160 days
- Have shown BORAT works for asteroseismology but with data density issues

# References / Acknowledgements


1. Heber, U., 2016, PASP, 128, 2001.
2. Reed, M., et al., 2013, A&A.
3. Fontaine, G., et al., 2014 ASPC, 481, 19.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