The Delaware Asteroseismic Research Center

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A Brief History of Multisite Campaigns and DARC

- First coordinated multisite campaign held in the later 1950s.
- The Whole Earth Telescope was founded in the 1980's by R. E. Nather and D. E. Winget at the University of Texas
- Lengthy multisite campaigns have become a standard tool variable star research
- WET moved to Iowa in the 1990s.
- DARC founded in 2005, WET moves to Delaware

Mission Statement

- To promote and facilitate the study of stellar seismology
- To support and develop international collaboration in observational and theoretical stellar seismology

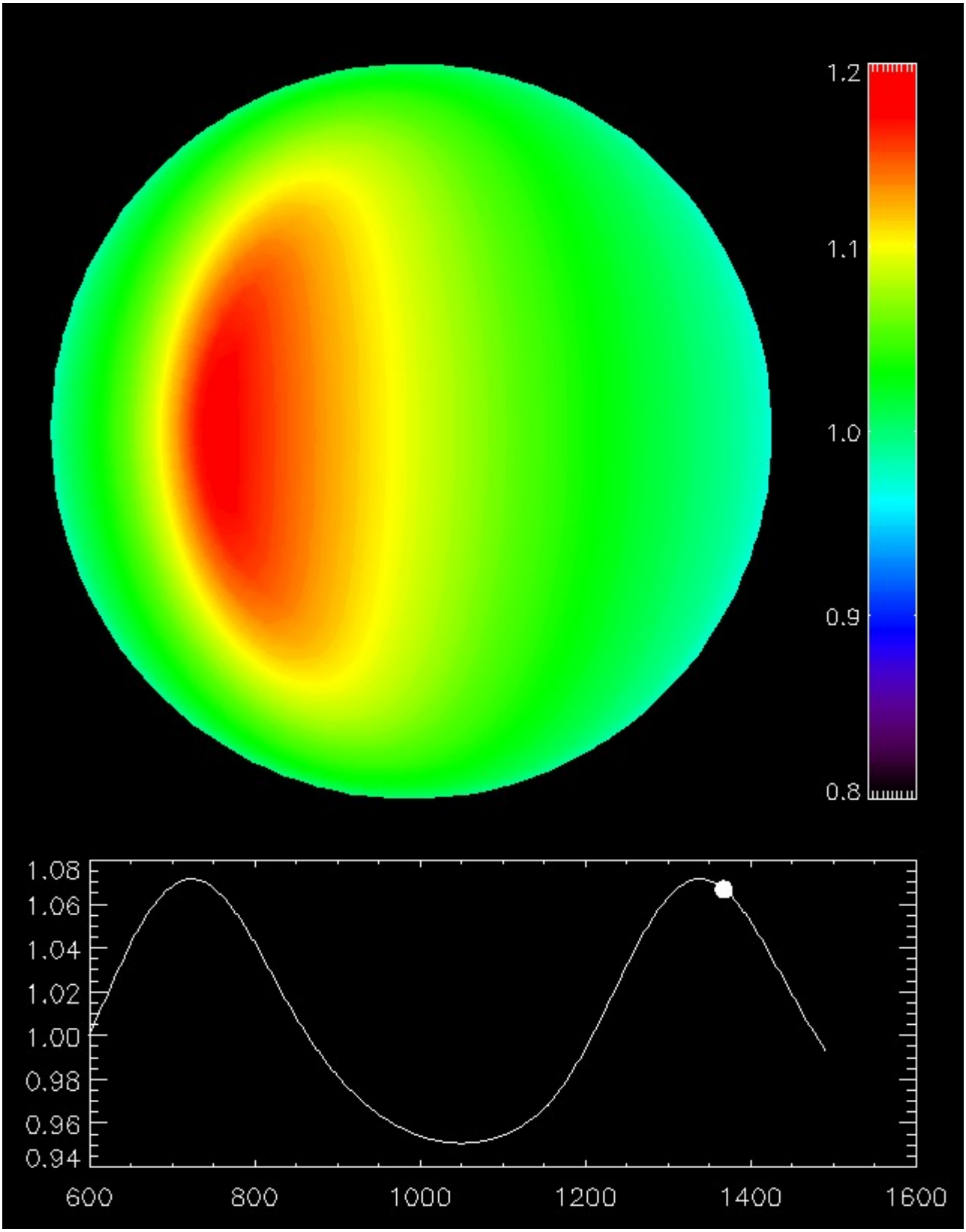
Asteroseismological Target Selection

- Reasonable pulsation period
- Multiple pulsation modes
- Reasonable expectation to identify l, m, and k values
- Reasonable brightness
- Astronomical significance/interest

GD358 and the Fundamental Problem of Convection

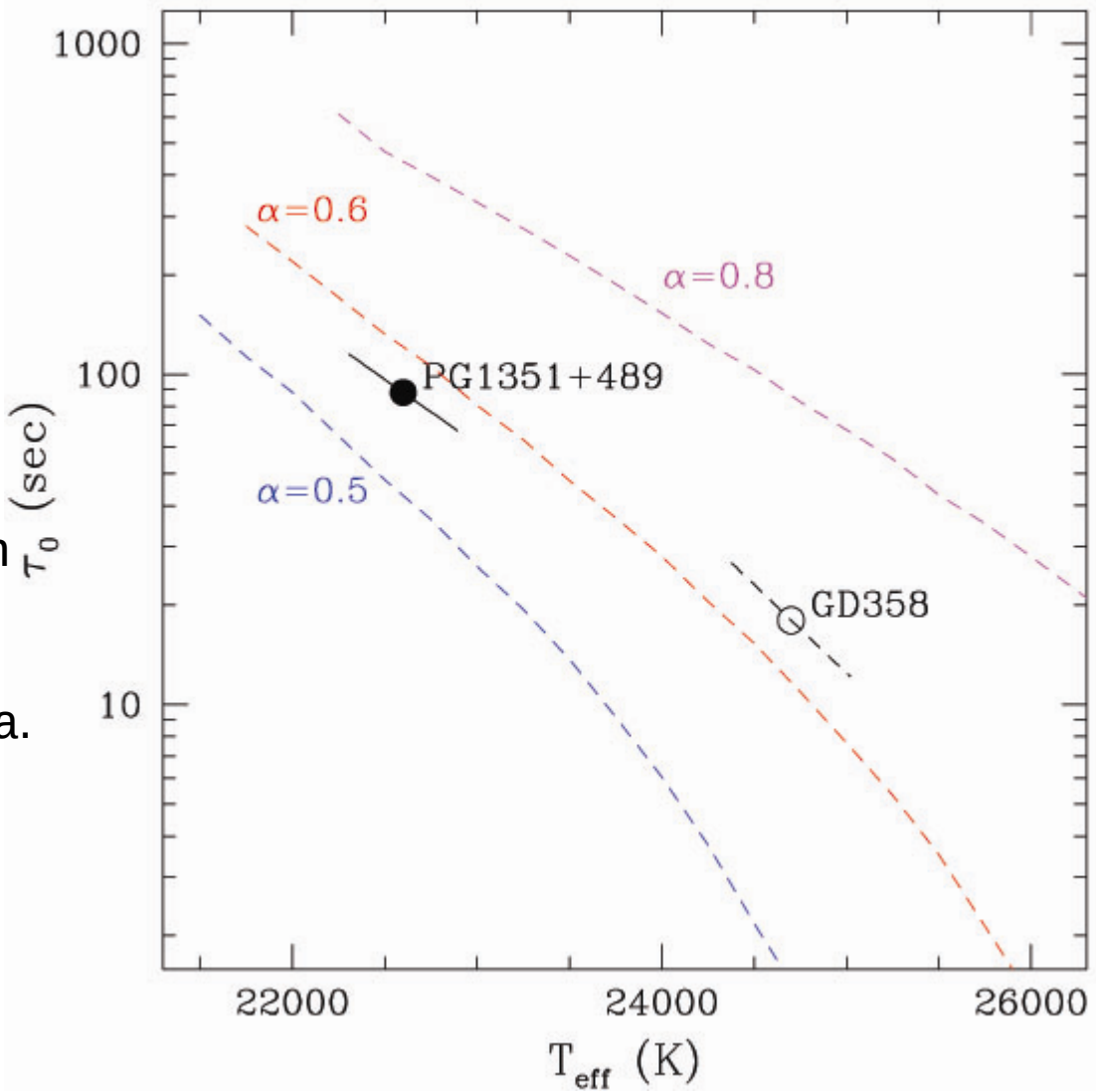
- Upcoming Whole Earth Telescope Run May 18-23 2006
- Purpose: Empirical determination of convection parameters in a white dwarf star
- Theoretical Basis:
- Montgomery, M. 2005

GD358, m=13.5

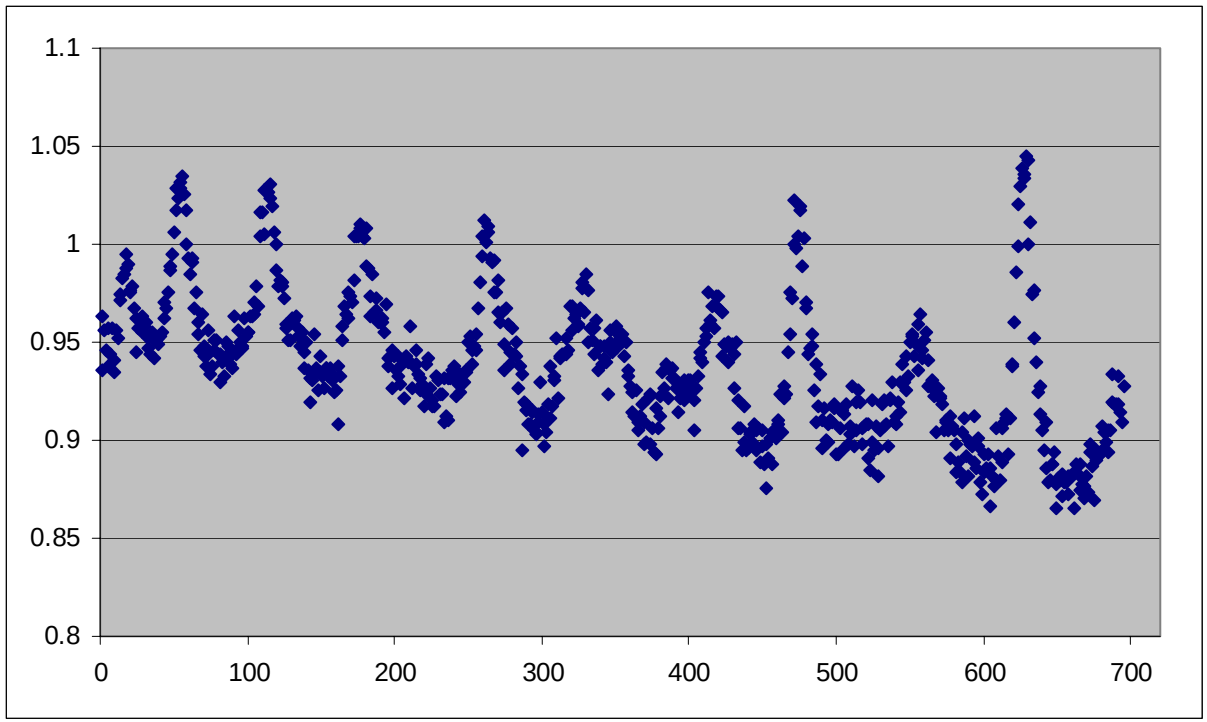

1.2
1.1
1.0
0.9
0.8
1.08
1.06
1.04
1.02
1.00
0.98
0.96
0.94
600
800
1000
1200
1400
1600

Convection in White Dwarfs

Theoretical calculations of the thermal response timescale of the convection zone as a function of effective temperature and the mixing parameter alpha.



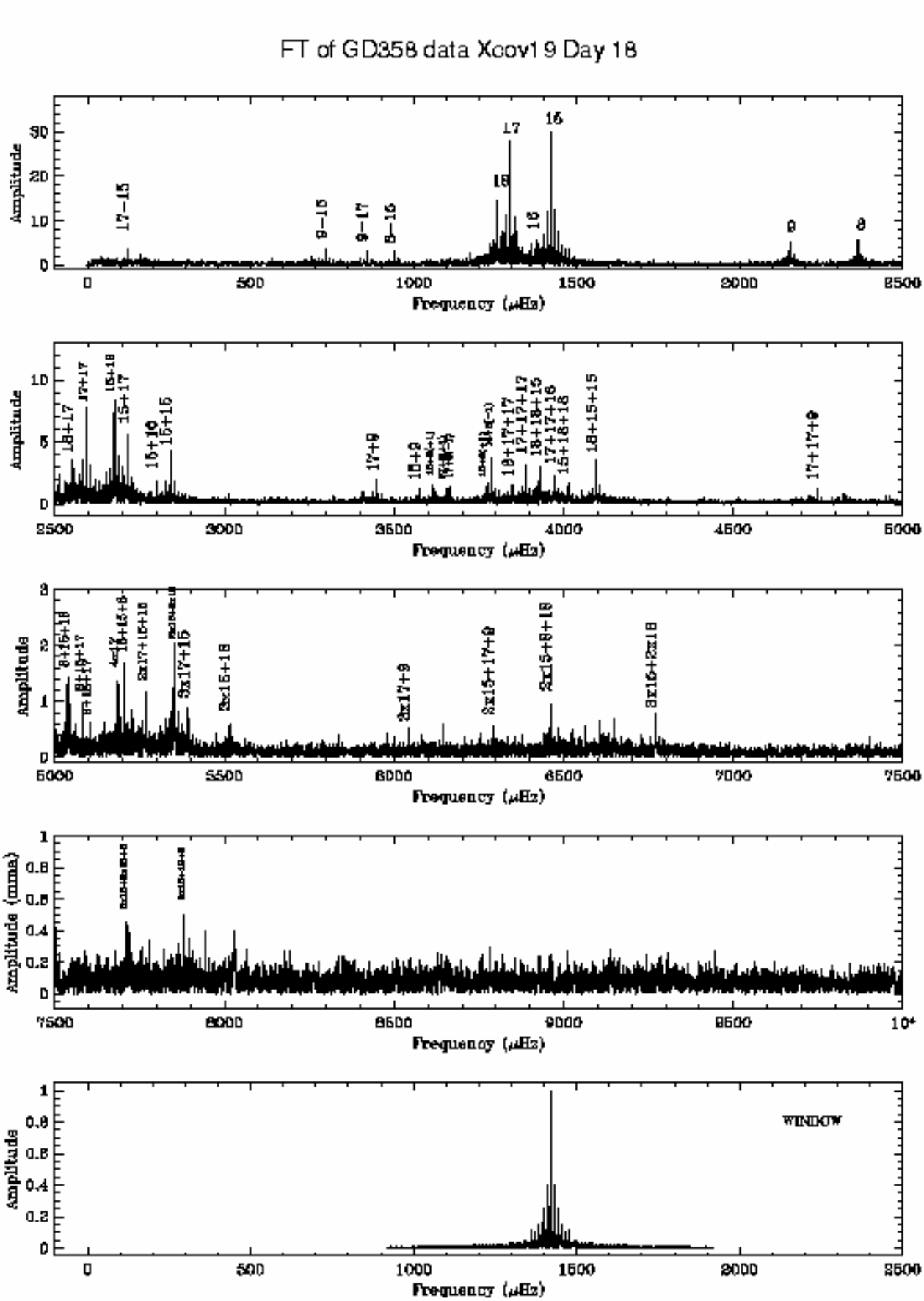
GD358 in Action



Light Curve from Mt. Cuba Observatory

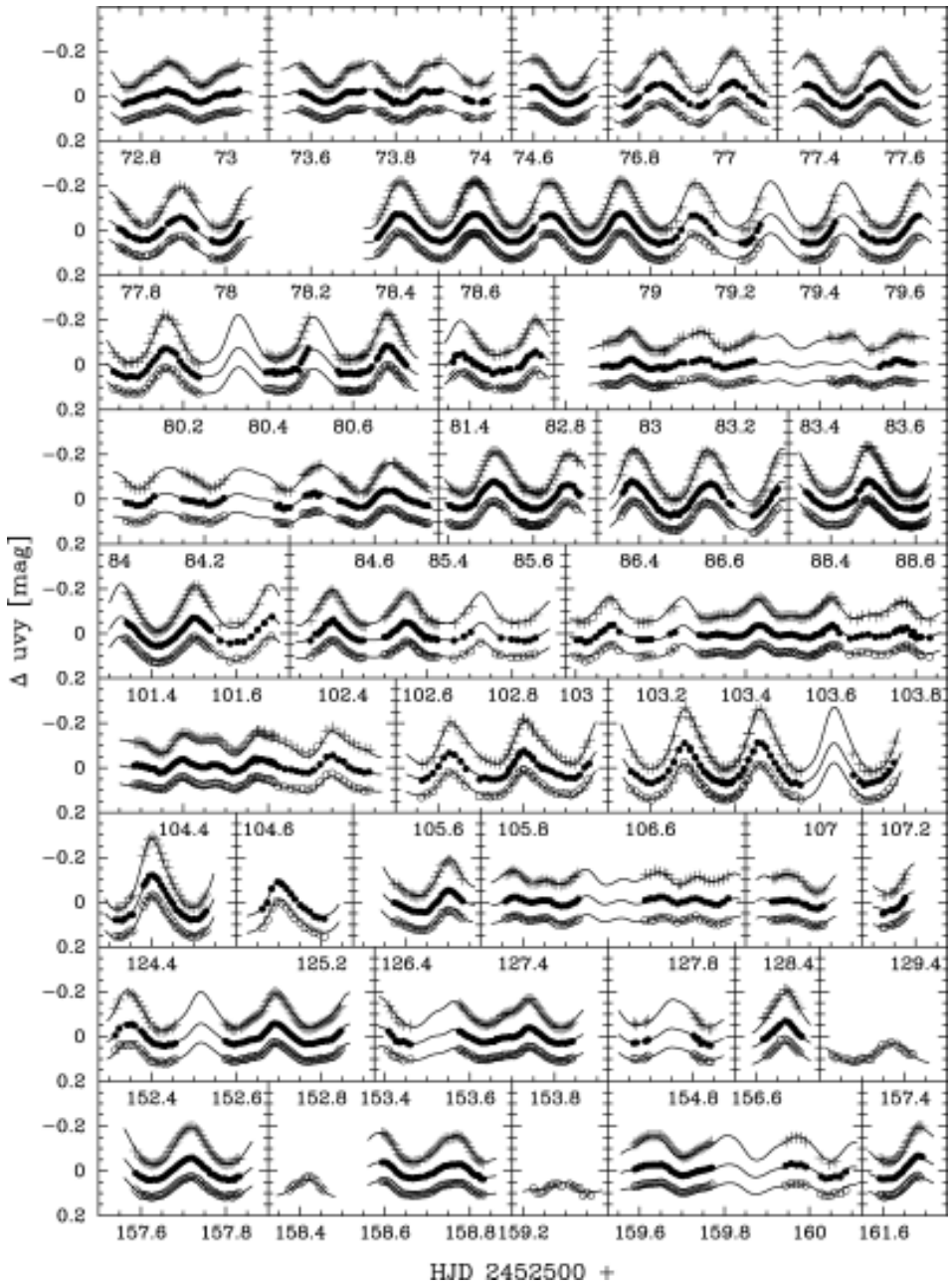
Known Physical Characteristics

- Mass = 0.61±0.03 solar masses
- L = 0.05±0.012 solar luminosities
- B = 1300±300 G
- $M_{He}=2.0(\pm1.0)x10^{-6}\ M_{*}$
- Differential Rotation???
- Pulsation periods ~ 500-900 s
- l, k, m values of pulsation modes are known


FT of GD358 data Xcov19 Day 18
Amplitude
Frequency (μHz)
17−15
9−15
9−17
8−16
17
16
15
18
9
8
18+17
17+17
15+18
15+17
15+16
16+16
17+9
15+9
18+15+15
17+17+9
Amplitude (mma)
WINDOW

Main Sequence Pulsation

- Growing field
- Improved techniques/instrumentation is leading to detection of more modes in individual stars
- The more modes, the more information can be determined
- Cluster seismology
- Impact:
  - Driving mechanisms
  - Convective overshooting,
  - Interior magnetic field structure
  - Improve/calibrate main sequence stellar evolution models for more accurate extrapolation to supernova
  - Constrain spectral and chemical evolution of galaxies.



Beta Ceph-type light curves

HR diagrams (from http://outreach.atnf.csiro.au) detailing the location of various pulsating stars.

The pulse shape tells the story of the interaction of pulsation with the surface convection zone.

Cluster seismology in NGC6910. B Cephei stars are marked. Image is a 5 s exposure from Mt. Cuba Observatory

GD358 Fourier Transform from Winget et al. 1994

References

- http://outreach.atnf.csiro.au
- Handler et al. 2004, MNRAS, 347,454
- Handler et al., 2005, MNRAS, 365, 327
- Kepler, S. O., et al. 2003, A&A, 401,639
- Montgomery, M. 2005, ApJ, 633, 1142
- Winget, D. E., et al. 1994, Ap7, 430,839

Current Activities

- See www.physics.udel.edu/~jlp/darc.html