

UNIVERSITY OF
BIRMINGHAM



AsteroFLAG: from the Sun to the Stars

<http://www.issi.unibe.ch/teams/Astflag>

**Bill Chaplin, School of Physics and Astronomy,
University of Birmingham**

First Kepler Workshop, 2007 October 30

What is asteroFLAG?

- **Collaboration involving observers and theoreticians**
- **Aim: To help develop and test analysis methods for asteroseismology, in particular for Sun-like oscillators**
- **Cover gamut of analysis methods, from**
 - **Parameter extraction, “peak bagging”**
 - **To inference on stellar parameters**

asteroFLAG: involved thus far...

**W. J. Chaplin, T. Appourchaux, T. Arentoft,
J. Ballot, F. Baudin, M. Bazot, T. R. Bedding,
J. Christensen-Dalsgaard, O. L. Creevey, V. Duez,
Y. Elsworth, S. T. Fletcher, R. A. García,
D. O. Gough, A. Jiménez, S. J. Jiménez-Reyes,
G. Houdek, H. Kjeldsen, M. Lazrek,
J. W. Leibacher, M. J. P. F. G. Monteiro, C. Neiner,
R. New, C. Régulo, D. Salabert, R. Samadi,
T. Sekii, S. G. Sousa, T. Toutain, S. Turck-Chièze**

asteroFLAG: getting started

- **“Kick-started” by help from International Space Science Institute (ISSI) Workshop Programme award**
- **Support from HELAS Forum (help with costs for ISSI workshops)**



asteroFLAG: antecedence & expertise

- “Sun-as-a-star” community:
 - solar Fitting at Low Angular degree Group (solarFLAG)



bison.ph.bham.ac.uk/~wjc/Research/FLAG.html

- CoRoT Data Analysis Team (DAT)

asteroFLAG: antecedence & expertise

- **Stellar community (e.g., ground-based observers)**
- **Theoreticians (structure, dynamics, excitation and damping)**
- **Data interpretation**

How can asteroFLAG help the KAI?

□ Forum

- Help co-ordinate work to support development of analysis pipelines for KASOC

□ asteroFLAG simulator

- Sun-like oscillators
- Initially configured to simulate observations by Kepler

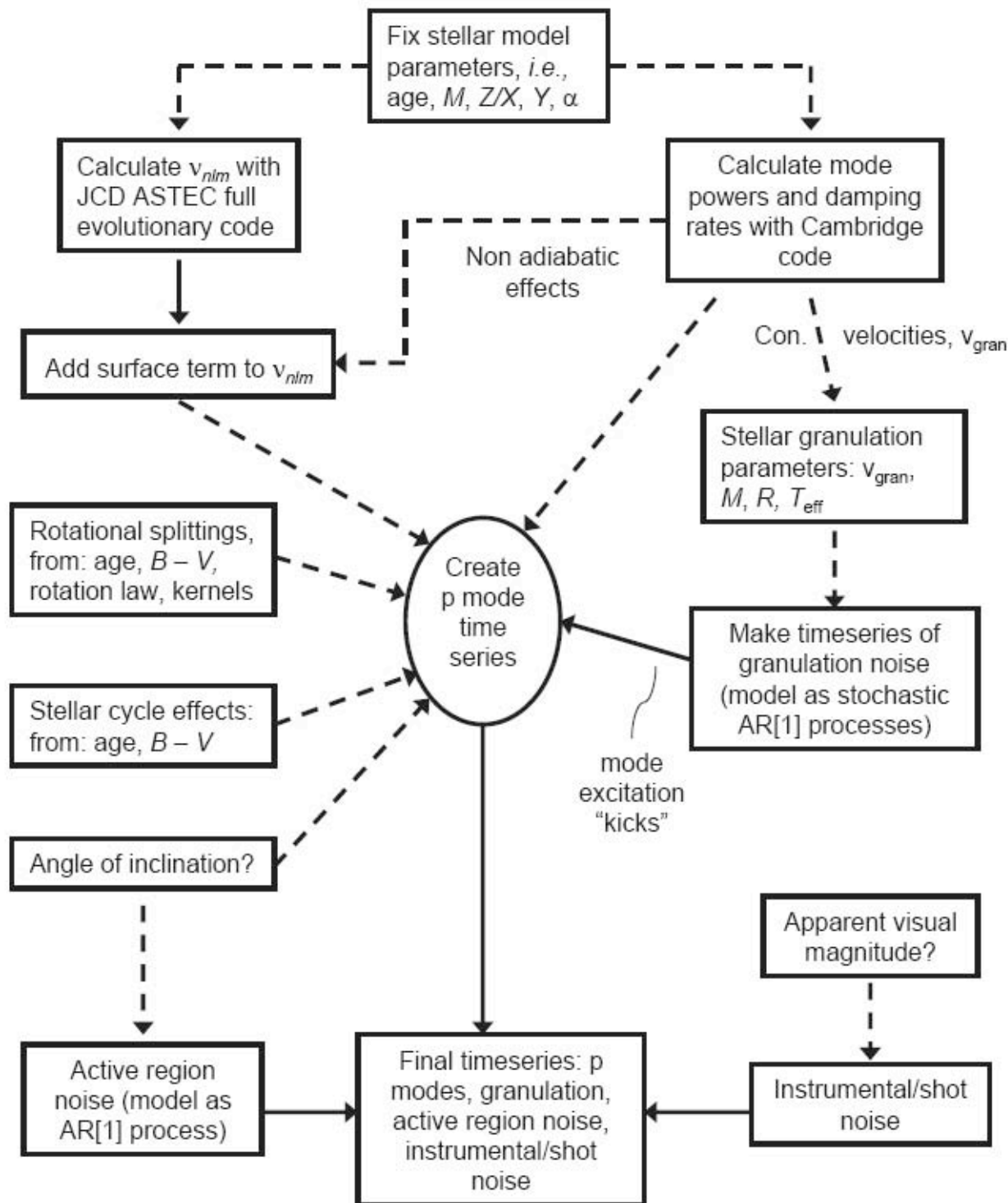
Recipes and rules for “peak-bagging”

- **Need to test mode fitting (“peak bagging”) scenarios for Sun-like oscillators on different parts of main sequence**
- **Make use of asteroFLAG simulator...**

How can asteroFLAG help the KAI?

- **Test, validate and deliver peak-bagging codes for KASOC pipeline**
 - **Angular-degree tagging**

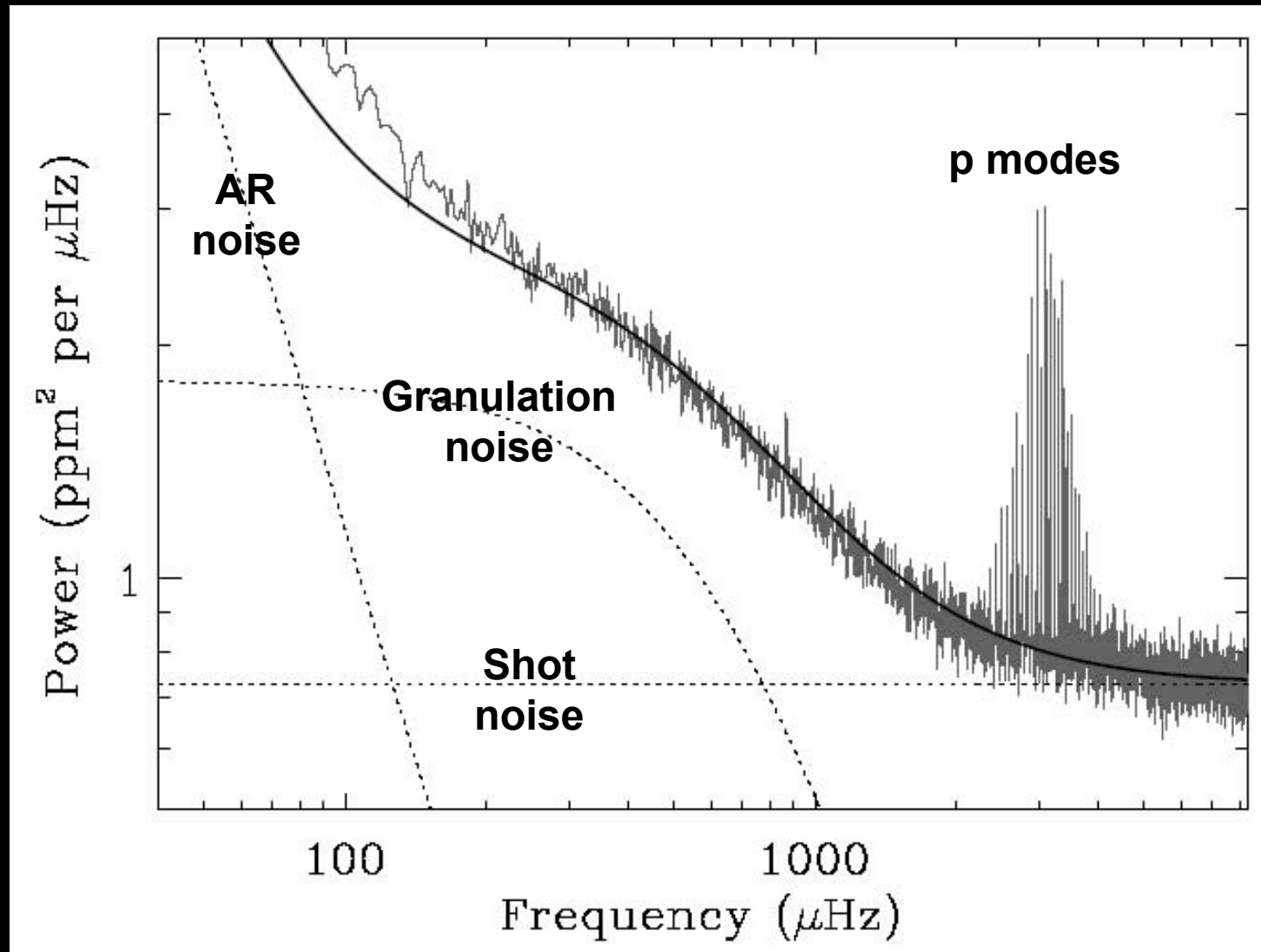
The asteroFLAG simulator



- P modes
- Granulation
- Active-region noise
- Instrumental & shot noise

How Kepler would see the Sun

4 years of data, 9th magnitude



AsteroFLAG simulator

- **Stellar activity cycles and near-surface effects:**
 - **Cycle parameter shifts**
 - **Surface distribution of activity**
 - **Asymmetric frequency splittings**
- **Surface term added to frequencies**

AsteroFLAG simulator

- **Stellar granulation:**
 - **Granulation noise excites modes**
 - **Gives: asymmetry of mode peaks**

AstroFLAG simulator

- **Rotation:**

- **Differential rotation in convective envelopes**

What we've done already

□ Hare-and-hounds Exercise #1

- Estimation of stellar radii
- First phase of exercise: test extraction of large frequency spacings, $\Delta\nu$, for Kepler observations

Kepler-like datasets

- Several artificial stars:

 - Arthur, Boris, Gus, Hector, Katrina, Myrtille & Pancho**

- Multiple sets on Boris, Katrina and Pancho for first phase of Exercise #1

 - Different angles of inclination
 - Different rates of rotation
 - Different apparent visual magnitudes
 - With, and without, stellar activity cycles

~~Hare and
Hounds~~

Cat and Mouse



fat cat \neq big star

Pancho

Dwarf (V) $T_{\text{eff}} = 6444 \pm 40$ K



Boris

Dwarf (V) $T_{\text{eff}} = 5793 \pm 25 \text{ K}$



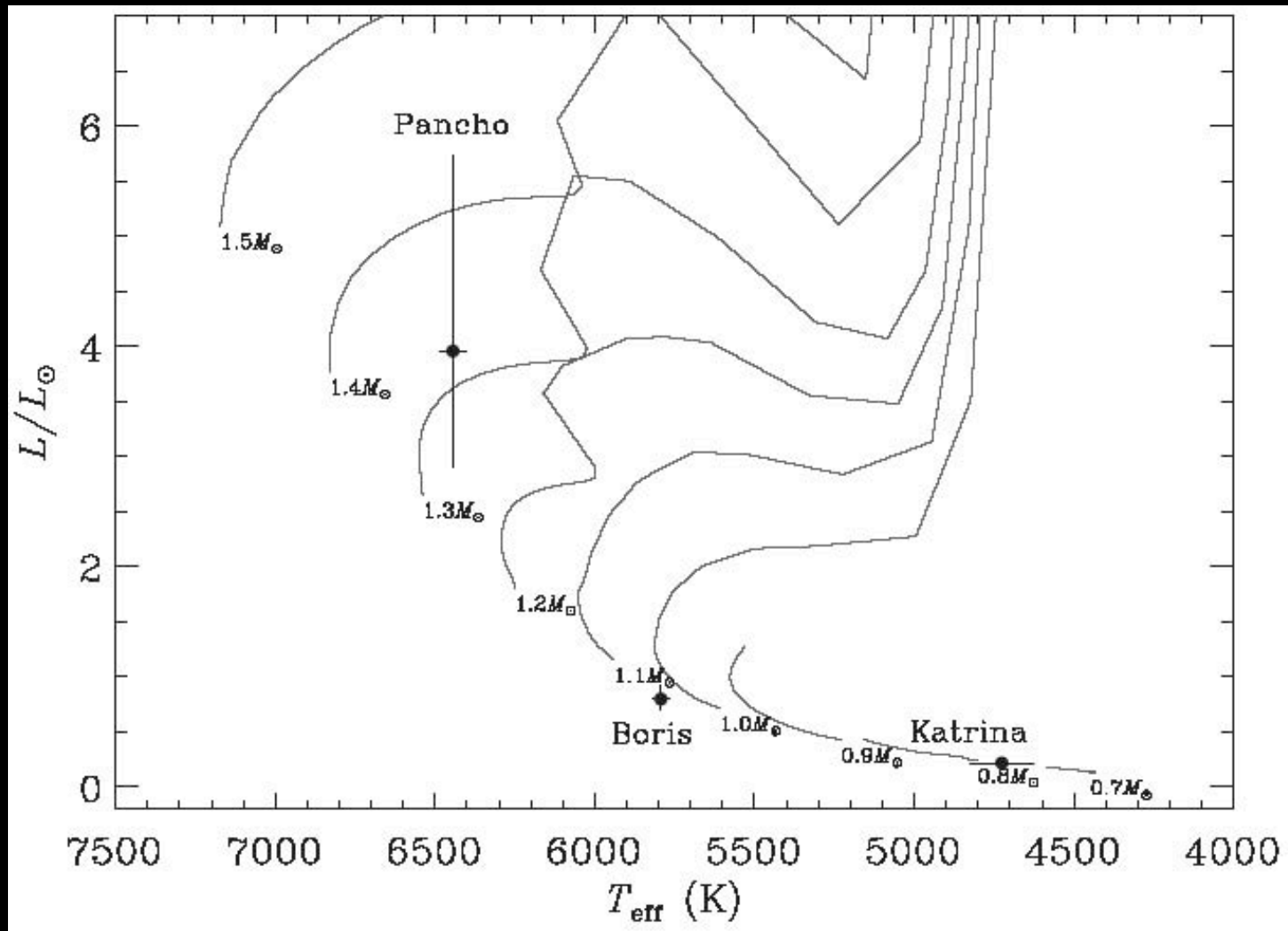
Katrina

Dwarf (V) $T_{\text{eff}} = 4726 \pm 100 \text{ K}$



Pancho, Boris and Katrina

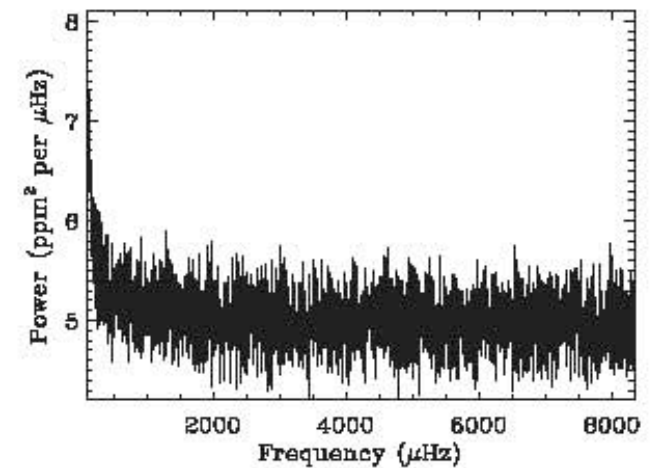
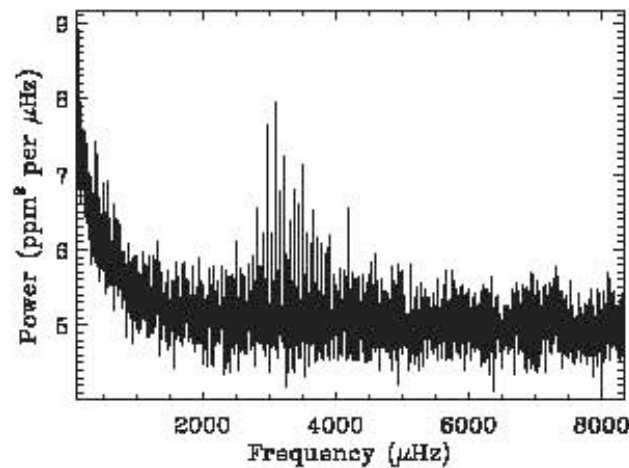
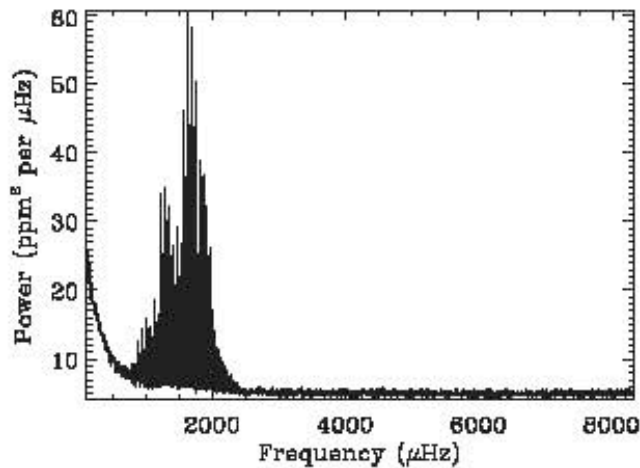
From “traditional” data on 9th mag. obs.



Hounds, Exercise #1

- T. Arentoft
- J. Ballot, R. A. García, S. J. Jiménez-Reyes
- O. L. Creevey
- S. T. Fletcher
- C. Régulo
- D. Salabert

Example frequency power spectra (11th magnitude)

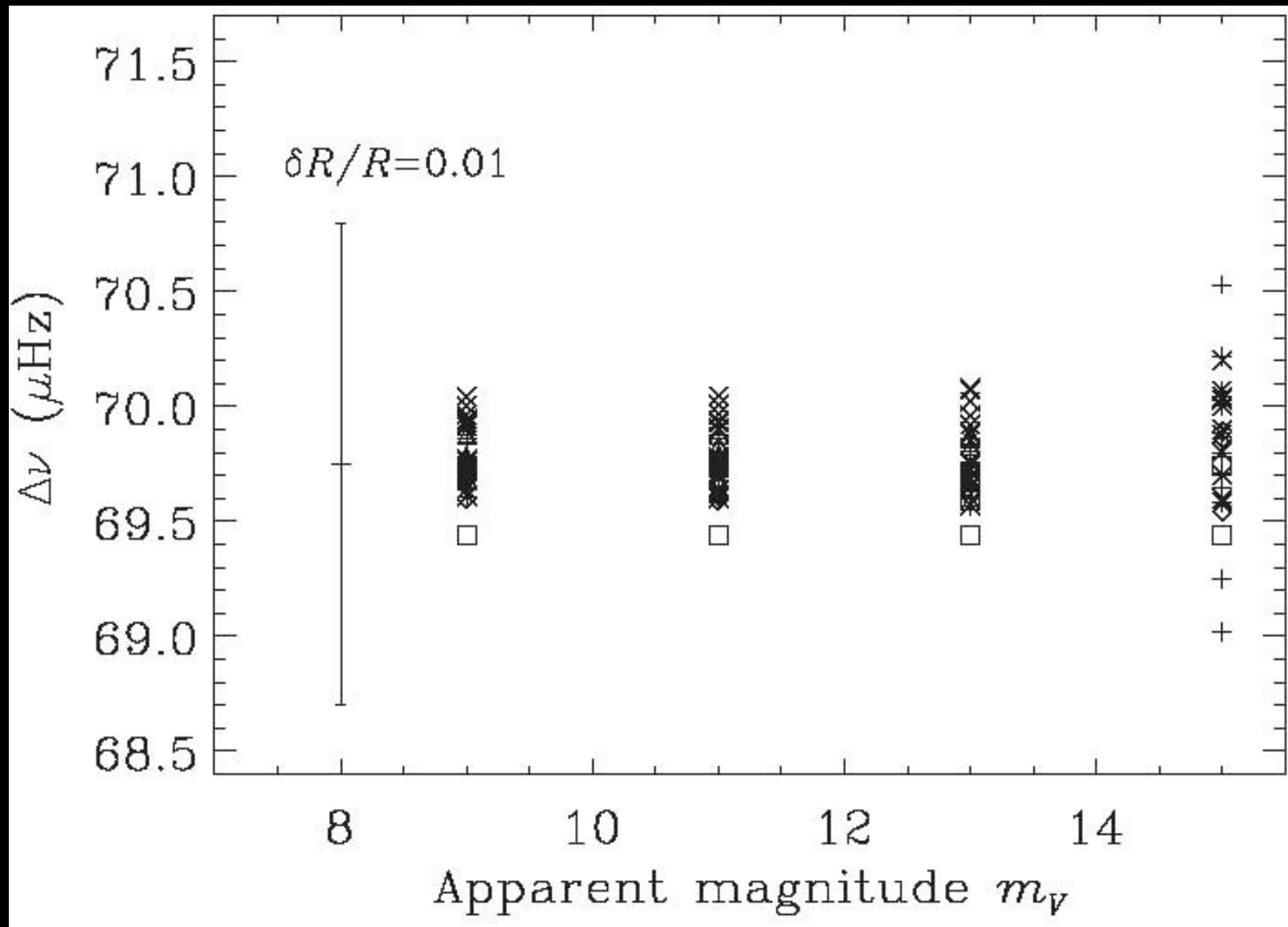


Pancho

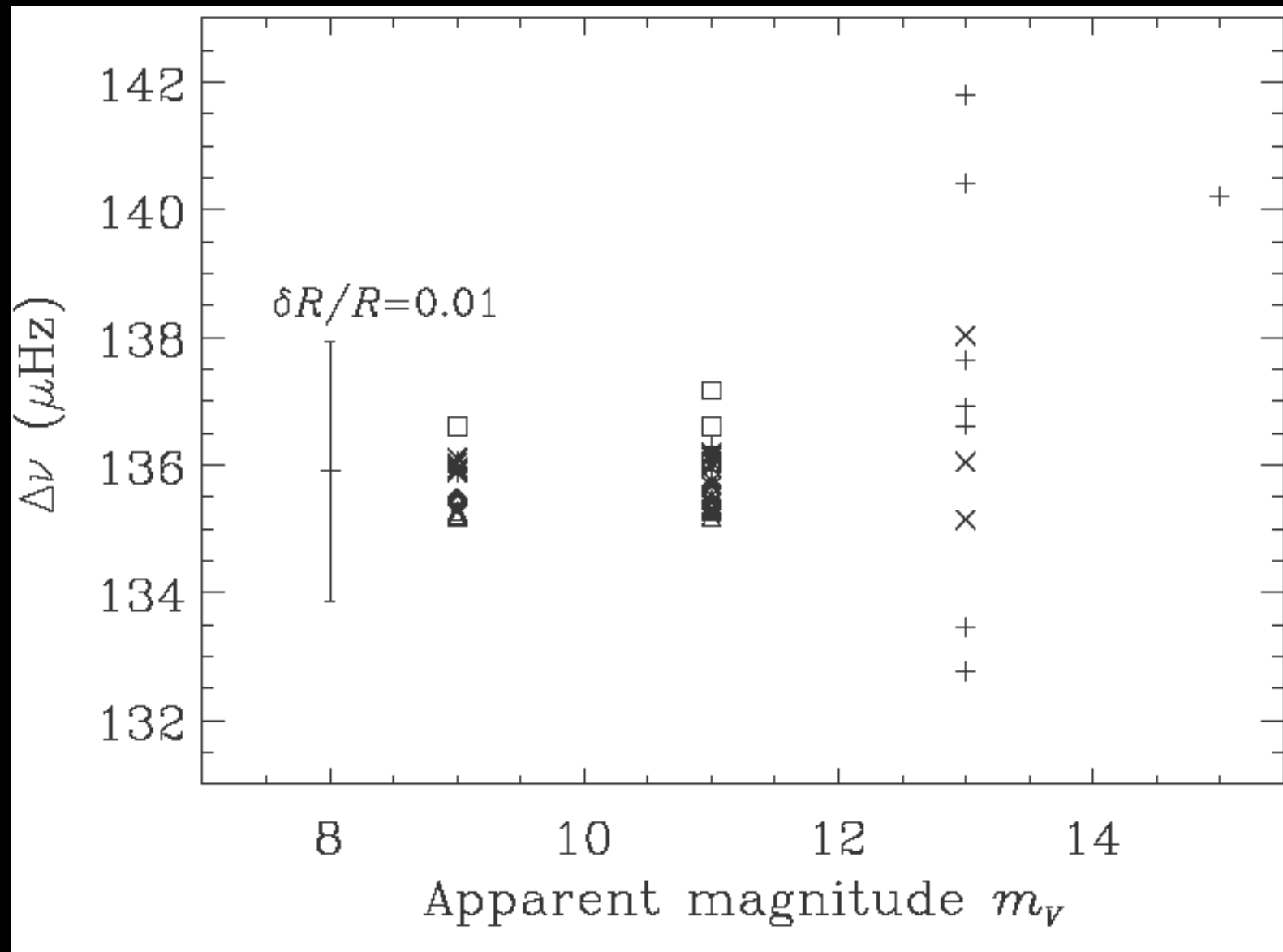
Boris

Katrina

Pancho



Boris



Katrina

