PSM128:
Seismic data analysis exercises

•••

Martin Bo Nielsen

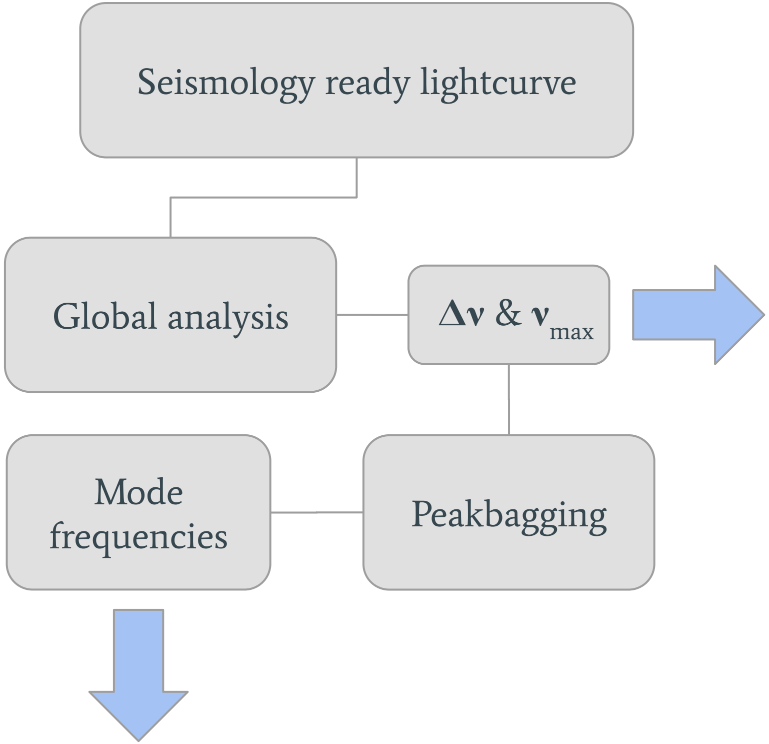
Guy Davies, Bill Chaplin, Patrick Gaulme, Benoit Mosser, Enrico Corsaro, Othman Benomar, Ian Roxburgh, Keaton Bell, Mathieu Vrard, Dennis Stello, Savita Mathur, Mathieu Vrard, James Kuszlewicz, Antonio Jimenez, Antonio García Hernádez, Mikkel Lund, Tim White, Jerome Ballot, Saskia Hekker, Rafa Garcia, et al.

UNIVERSITY OF BIRMINGHAM

Goals

- Identify:
  - Teams with global analysis codes
  - Teams with peakbagging codes
  - Strengths/weaknesses
- Pick the best approach(s) to apply to PLATO
- Fully automate the chosen approach(s)

Procedure



Goals

- Identify:
  - Teams with global analysis codes
  - Teams with peakbagging codes
  - Strengths/weaknesses
- Pick the best approach(s) to apply to PLATO
- Fully automate the chosen approach(s)

Teams

Ian Roxburgh

Enrico Corsaro

Keaton Bell

Mathieu Vrard

Dennis Stello

Juan Carlos Suárez

Othman Benomar

Benoit Mosser

Patrick Gaulme

Savita Mathur

Mathieu Vrard

Mariel Lares Martiz

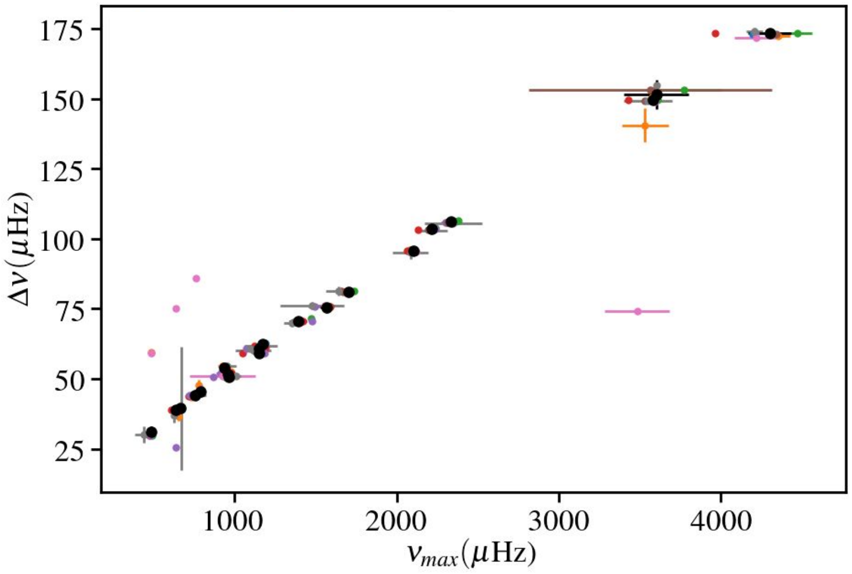
Antonio García Hernádez

Antonio Jimenez

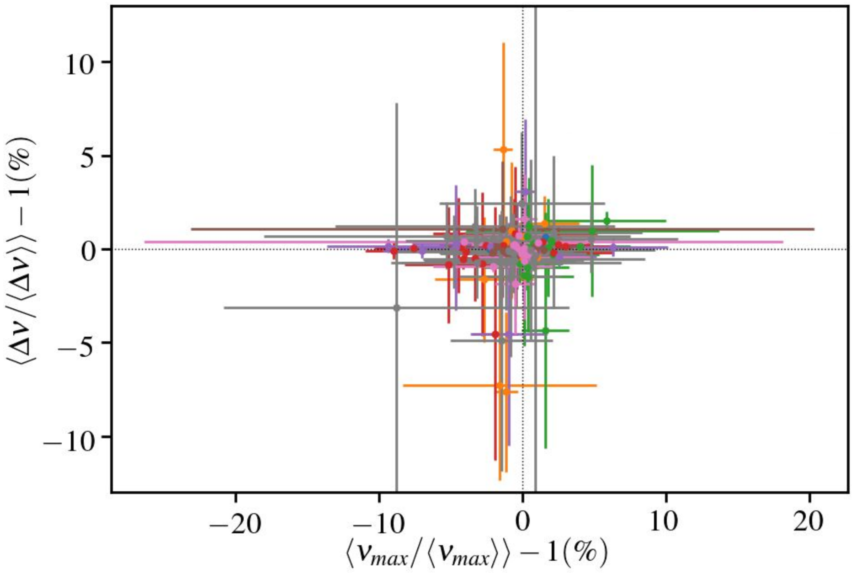
James Kuszlewicz

Exercise 1 - Measuring global parameters

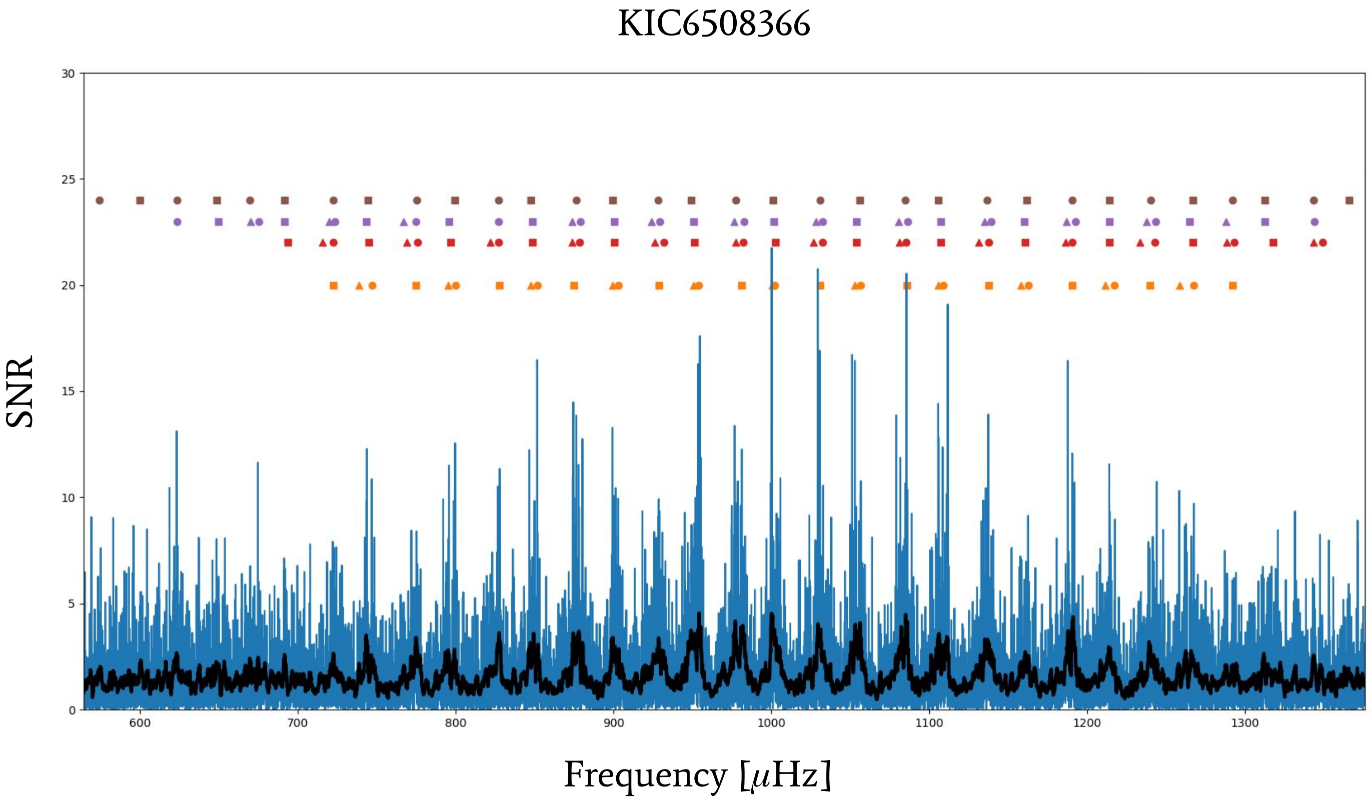
Measurements of $\Delta\nu$ and ν_{max}



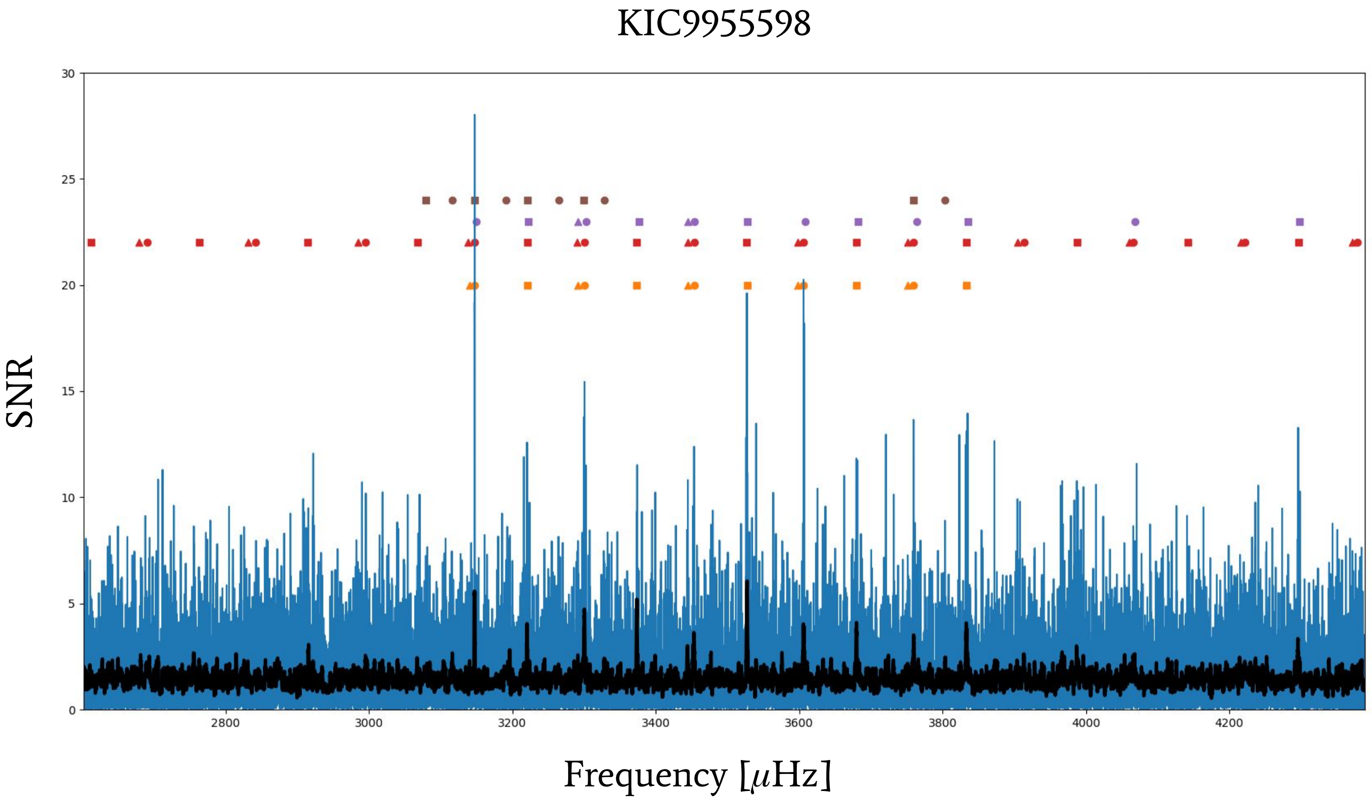
Relative differences to the mean



Exercise 1 - Mode ID



Exercise 1 - Mode ID



Lessons learned from Exercise 1

1. Global parameters are OK (slight bias)
2. Mode ID and detection are hurdles for peakbagging
3. Even with ‘manual’ approaches

Moving to Exercise 2

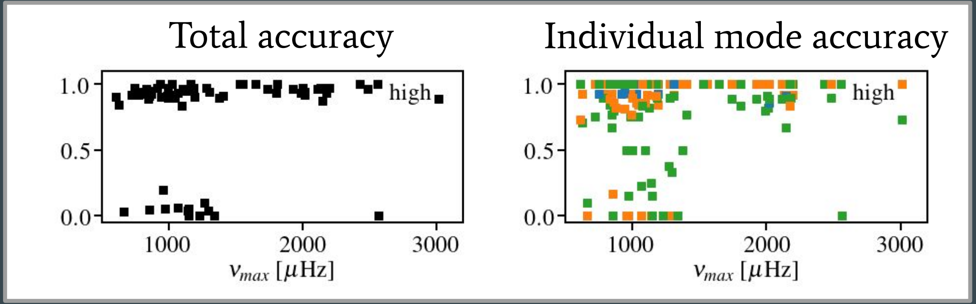
- Let the teams tinker with their codes
- Send simulated spectra
- Ask to recover mode ID and frequency (**automated**!)

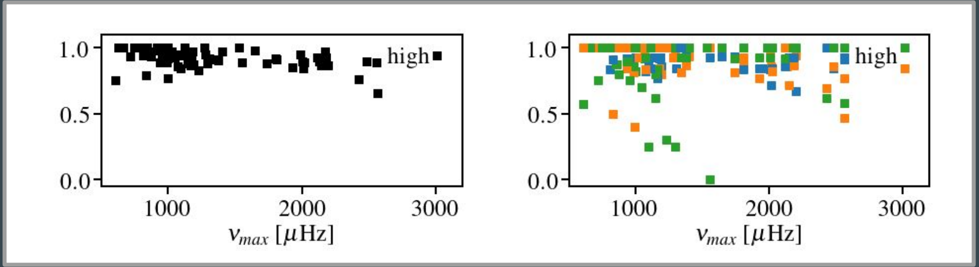
Exercise 2 - Mode ID

Approaches to mode ID

- Convolutional neural network
- Universal pattern
- DIAMONDS
- By-eye

Universal pattern approaches



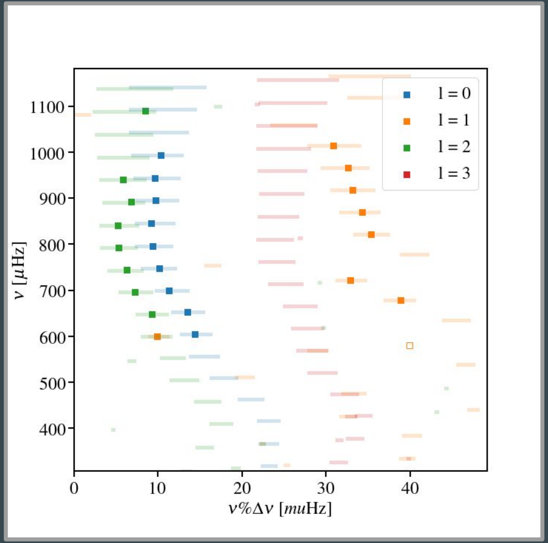


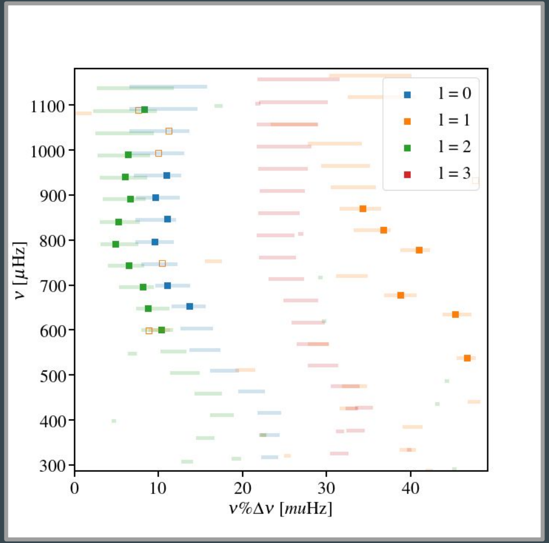
Exercise 2 - Mode ID

Universal pattern approaches

Approaches to mode ID

- Convolutional neural network
- Universal pattern
- DIAMONDS / FAMED
- By-eye





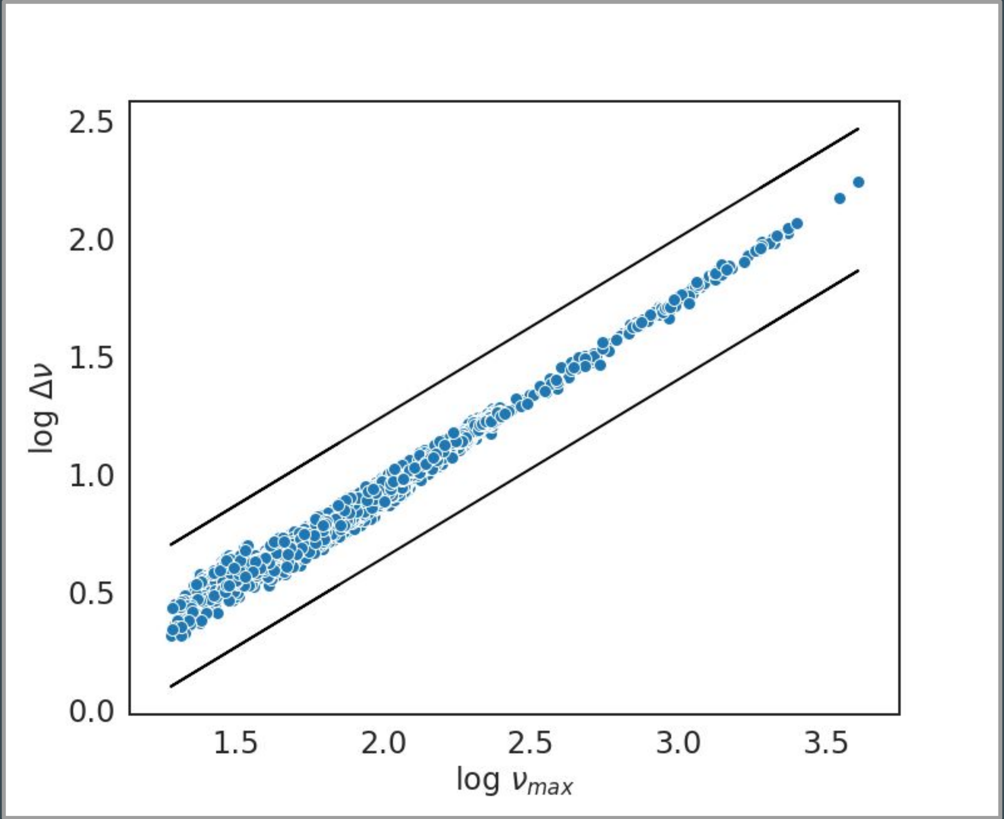
Using Knowledge From Previous Missions

Using Knowledge From Previous Missions

- Collect time series from CoRoT, Kepler, K2, TESS …
- Fit a model and store fit parameters
  - Asymptotic relation / Universal pattern
  - Power laws
- Compute a multi-dimensional KDE
- Use this KDE as prior on future fits

Trivial example

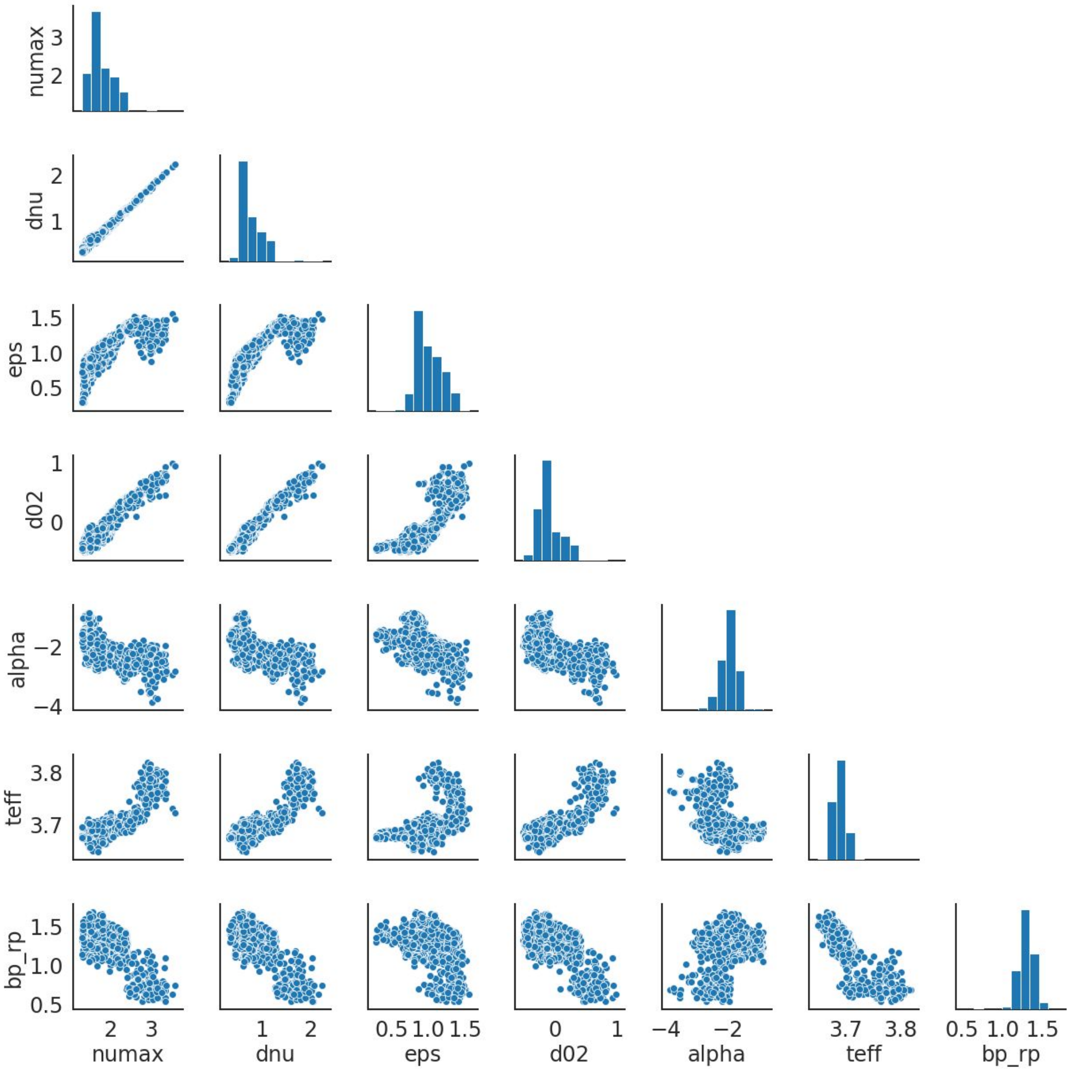
1. Tight relation between **Δν** and **ν**$_{\mathrm{max}}$
2. Typically fit with a power law
3. Use a KDE instead



Less trivial example

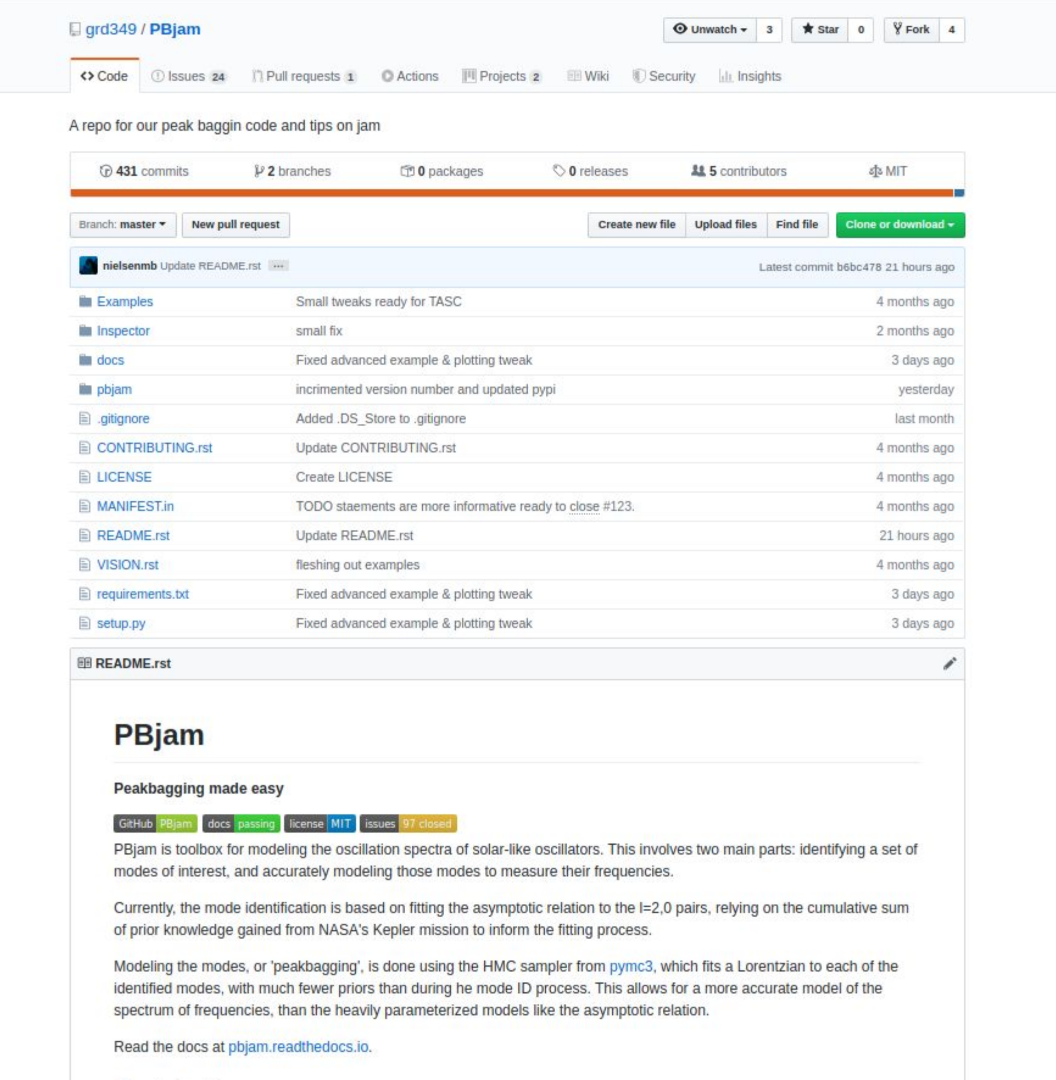
- Asymptotic relation
- 10 parameters in total
- More can be added

- ~12300 stars currently
- More **need** to be added



PBjam

- Collection of modules for peakbagging
- At the moment:
  - KDE based peakbagging
  - l=2,0
  - Basic l=1 (p-mode like)
- Future:
  - Integrate lessons from exercises
  - Mixed modes
  - Optimal sampling



A repo for our peak baggin code and tips on jam

431 commits · 2 branches · 0 packages · 0 releases · 5 contributors · MIT

nielsenmb Update README.rst ... Latest commit b6bc478 21 hours ago

Examples	Small tweaks ready for TASC	4 months ago
Inspector	small fix	2 months ago
docs	Fixed advanced example & plotting tweak	3 days ago
pbjam	incrimented version number and updated pypi	yesterday
.gitignore	Added .DS_Store to .gitignore	last month
CONTRIBUTING.rst	Update CONTRIBUTING.rst	4 months ago
LICENSE	Create LICENSE	4 months ago
MANIFEST.in	TODO staements are more informative ready to close #123.	4 months ago
README.rst	Update README.rst	21 hours ago
VISION.rst	fleshing out examples	4 months ago
requirements.txt	Fixed advanced example & plotting tweak	3 days ago
setup.py	Fixed advanced example & plotting tweak	3 days ago

PBjam

Peakbagging made easy

GitHub PBjam · docs passing · license MIT · issues 97 closed

PBjam is toolbox for modeling the oscillation spectra of solar-like oscillators. This involves two main parts: identifying a set of modes of interest, and accurately modeling those modes to measure their frequencies.

Currently, the mode identification is based on fitting the asymptotic relation to the l=2,0 pairs, relying on the cumulative sum of prior knowledge gained from NASA's Kepler mission to inform the fitting process.

Modeling the modes, or 'peakbagging', is done using the HMC sampler from pymc3, which fits a Lorentzian to each of the identified modes, with much fewer priors than during he mode ID process. This allows for a more accurate model of the spectrum of frequencies, than the heavily parameterized models like the asymptotic relation.

Read the docs at pbjam.readthedocs.io.

Thank you for your attention

Stay tuned for more PBjam...