

Medium and High-Degree Peak-Bagging Techniques

Spaceln 4.1 “Peak-Bagging in Helio- and Asteroseismology”
Tenerife

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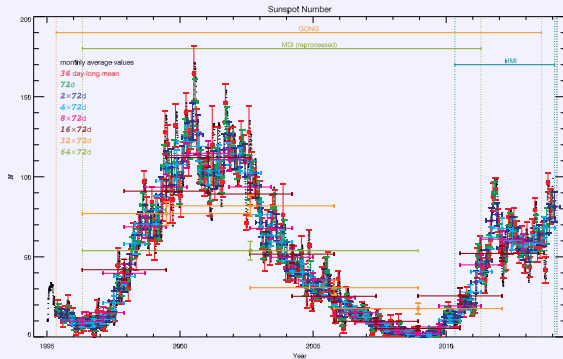
Harvard-Smithsonian Center for Astrophysics, Cambridge MA, USA.

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Introduction

- ▶ My Peak-Bagging Method
 - ▶ Motivation:
 - ▶ Stanford produced a very long time series (2088-day long).
 - ▶ Fitting methods were decades old and thus had well known flaws.
 - ▶ Had adequate computer power (esp. SI/HPC).
 - ▶ Highlights:
 - ▶ *Simultaneous* fitting of all m as *individual* peaks.
 - ▶ Uses *optimal* multi-taper spectral estimator.
 - ▶ Uses *complete* leakage matrix, *asymmetric* peak profile, n -contamination.
 - ▶ Includes a sanity rejection (SNR threshold, no grass fitting).
 - ▶ Evolved to fit time-series of varying lengths: trade-off between temporal resolution and precision.
- ▶ Some Results
- ▶ Some Questions

Introduction – Activity

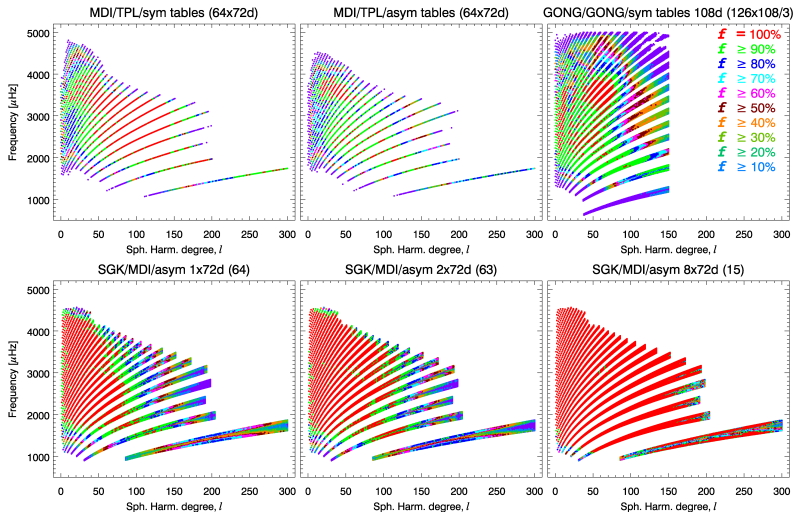


- ▶ We have 18.2, 15.0 & 3.64 years of GONG, MDI and HMI data resp.
- ▶ Fitted epochs of varying lengths:
from 36-day long to 4608-day long (64x72d or 12.6 years)

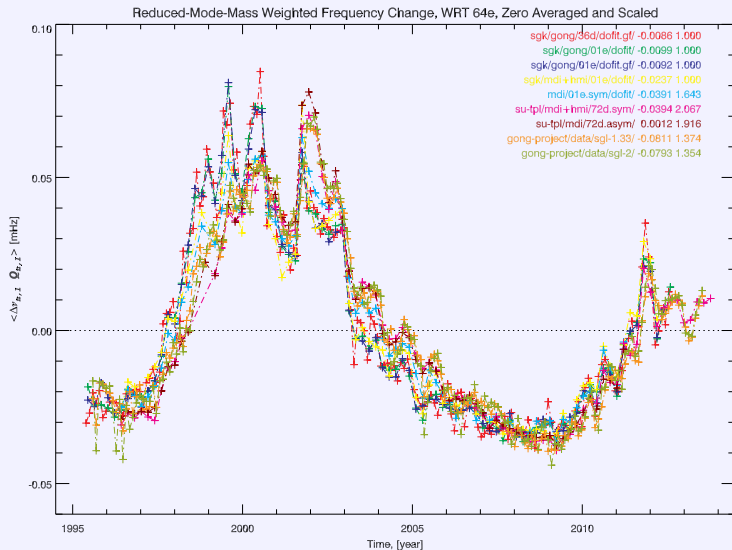
Various Cases & Mode Attrition

- ▶ GONG:
 - ▶ raw or gap-filled,
 - ▶ leakage matrices: JS or SGK (2: w/ or w/o PSF)
- ▶ MDI:
 - ▶ leakage matrices: JS or SGK (2: $B_o = 0$ or $< B_o >$)
 - ▶ 72d: forced symmetric peak
- ▶ HMI: work in progress (leaks, re-processed data, etc...)
- ▶ Mode attrition: are the *same* modes fitted at each epoch?

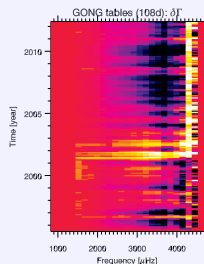
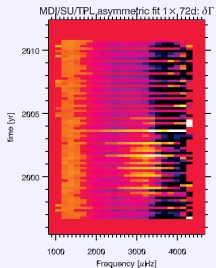
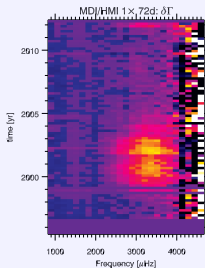
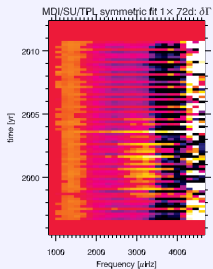
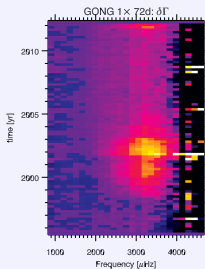
Mode Attrition



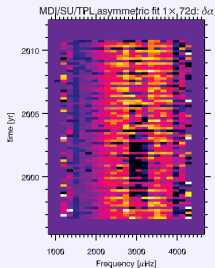
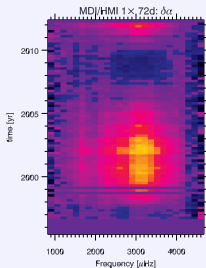
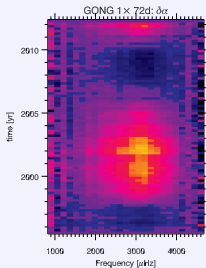
Changes with Activity: $\langle \Delta\nu_{n,l} Q_{n,l} \rangle$



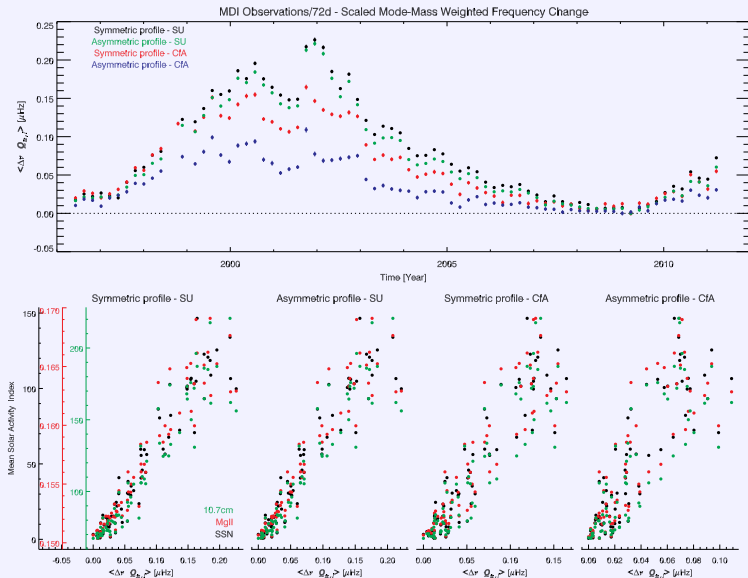
Changes in FWHM



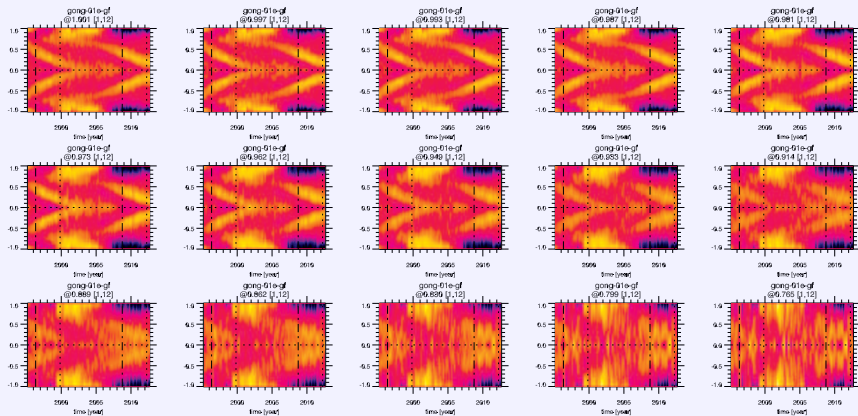
Changes in Asymmetry



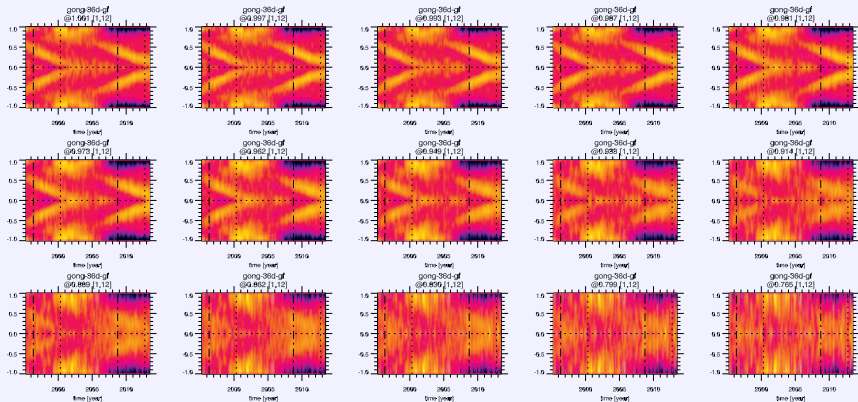
Changes with Activity: $\langle \Delta\nu_{n,l} Q_{n,l} \rangle$ vs Indices



Changes with Activity: $\Delta\Omega(r, \theta)$



Changes with Activity: $\Delta\Omega(r, \theta)$



Question 1.

(1) Is it possible to have a peak fitting code covering low, medium and high degree modes?

- ▶ Maybe, but why?
- ▶ Spatially Integrated (no imaging): $\ell = 0, 1, 2, 3, 4$
- ▶ Spatially Resolved (imaging)
 - ▶ Low degrees ($\ell \leq 10$):
precision.
 - ▶ Intermediate degrees ($\ell \leq 200$ or $\ell \leq 300$):
modes are resolved – except for closest leak.
 - ▶ High degrees ($200 \leq \ell \leq 1000$):
merged into ridges – modes cannot be resolved.
- ▶ Spectrum estimator and resolution.

Question 2.

(2) do we have to apply different methodologies depending on the degree range we are interested in?

- ▶ Most likely, esp. on the fitting side.
- ▶ Resolved vs merged modes (peaks vs ridges).
- ▶ Importance of the leakage matrix.

Question 3.

(3) Which methodology to follow to deliver software that anybody could use to fit a custom time-series? A code anybody could download and run it? Some sort of web page interface?

▶ TBD

