

Definition of Bicoherence

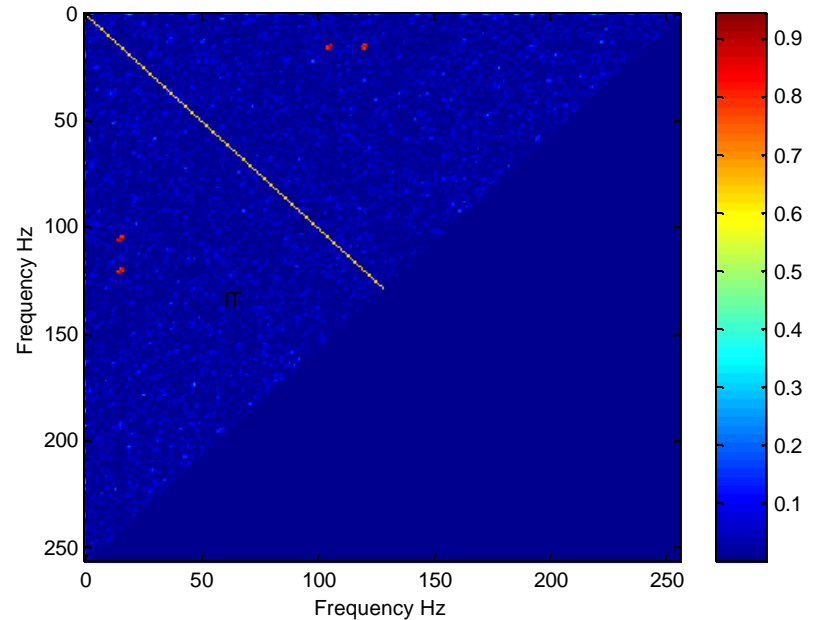
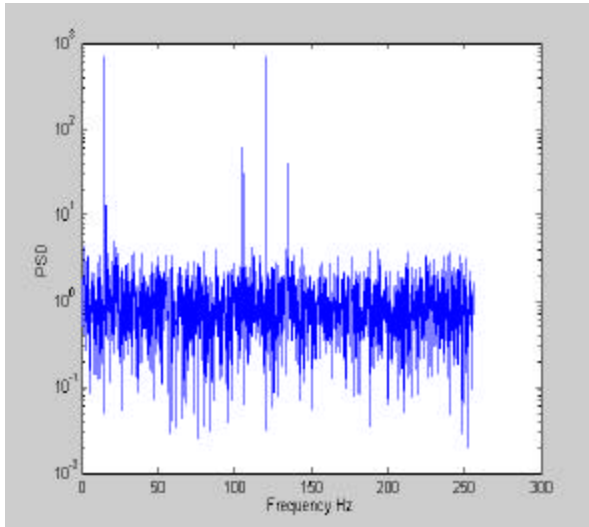
$$b(k, l) = \frac{\langle X_k X_l X_m^* \rangle}{\sqrt{|X_k X_l|^2 |X_m|^2}}$$

Bicoherence => degree of coherence
between k, l and m = k+l

$$e^{if_1} e^{if_2} e^{-i(f_1+f_2)}$$

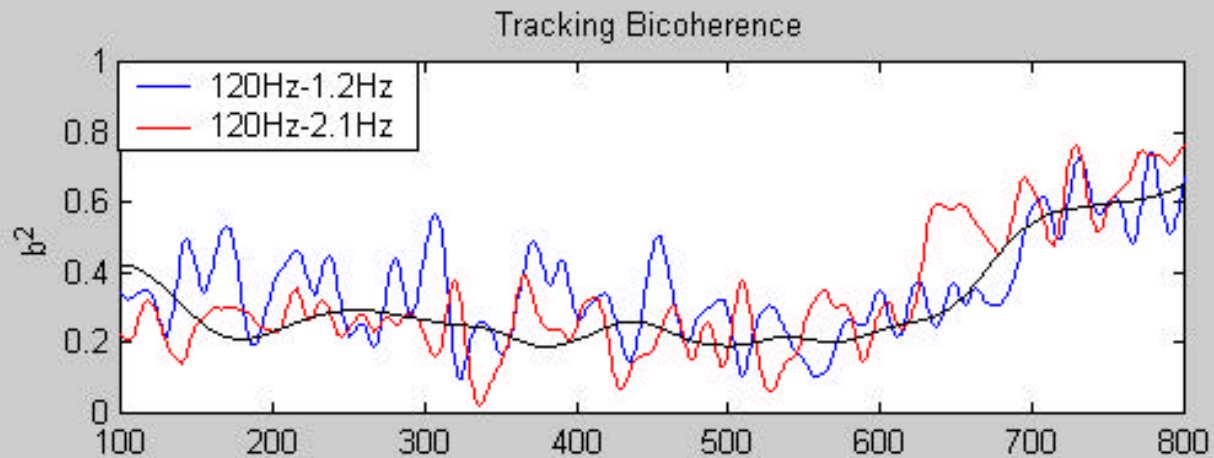
$$|b|^2 = \frac{P_m^{upconv}}{P_m^{upconv} + P_m^{noise}}$$

Y=y1 + y2 + y1*y2 +noise, 15Hz, 120Hz
15+105=120; 15+120=135

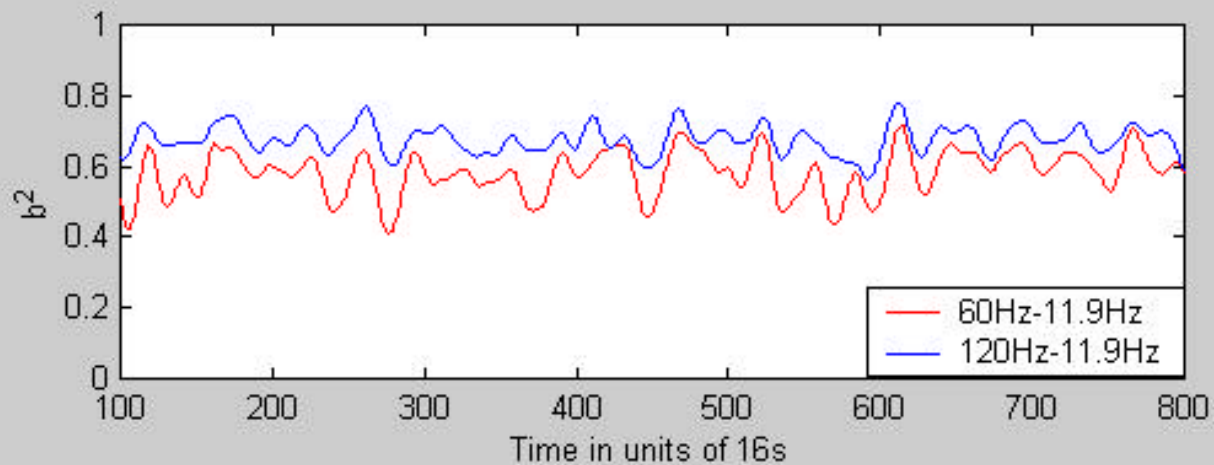


Tracking Bicoherence

Bicoherence trends will be useful to characterise instrument. Which couplings change during the course of a lock? By How much do they change?



Pendular modes

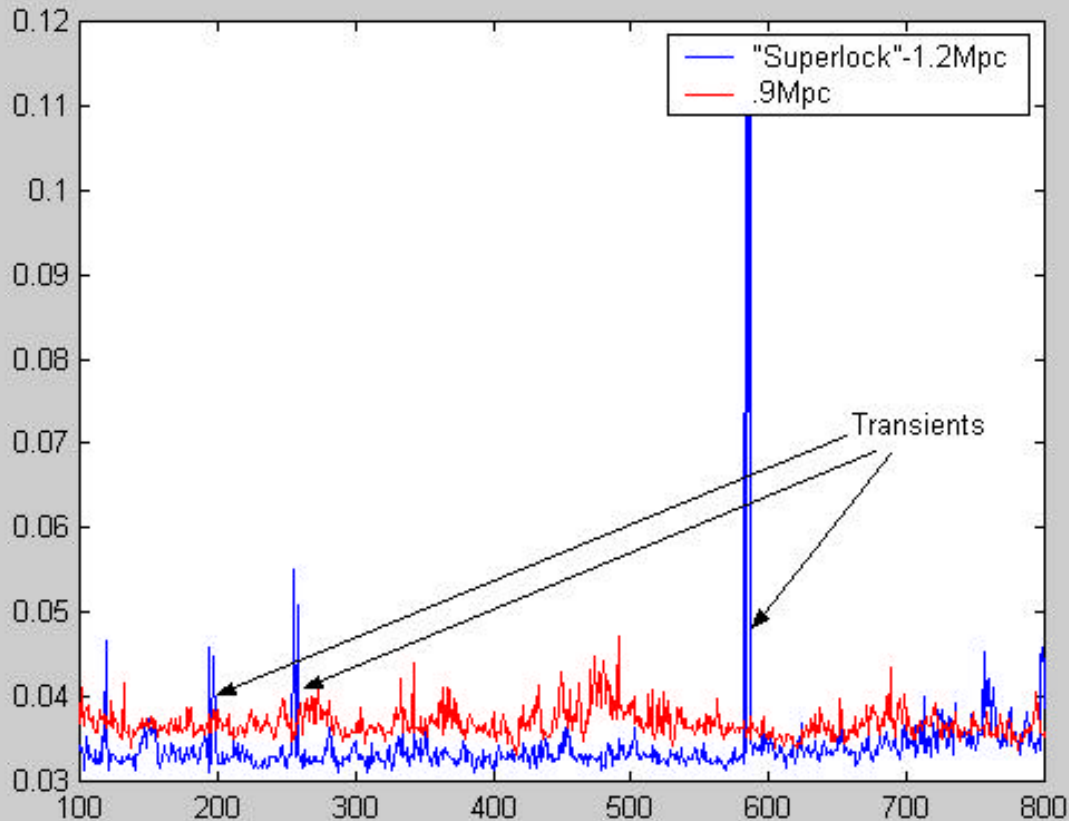


Vibrational modes

Average Bilinearity

$$\mathbf{b} = \frac{\sum_L b^2(k, l)}{L}$$

b Indicates the average bilinearity, chi-sq distributed in 2L deg of freedom, L=number of f1-f2 frequency pairs

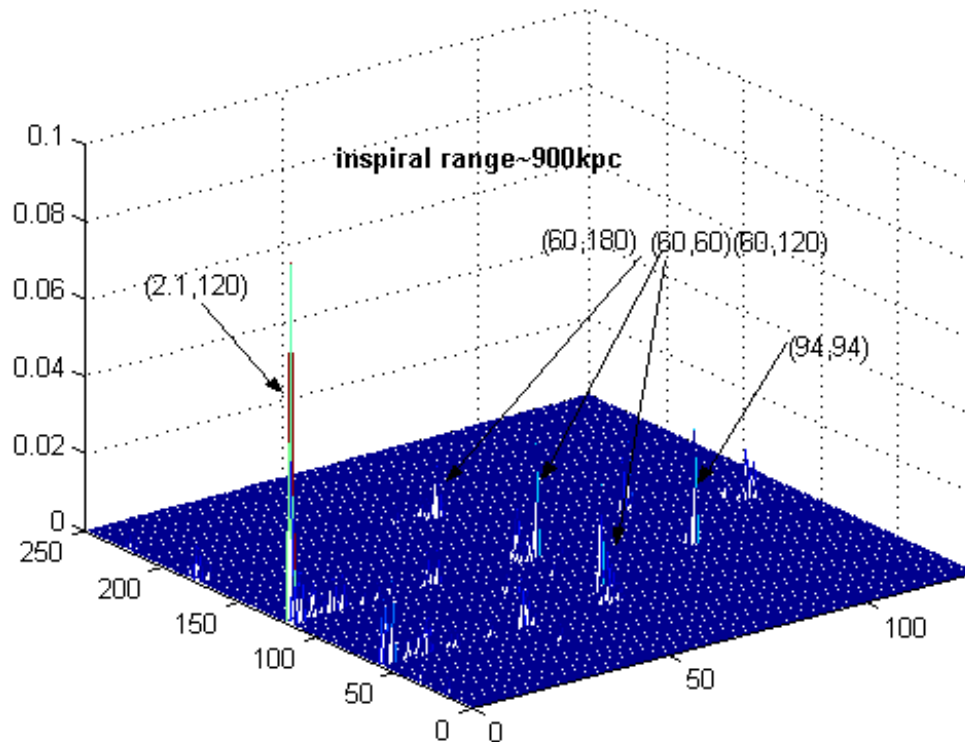


Measure of bilinearity
For diff inspiral ranges

Bilinear Glitchiness

Which couplings are glitchy, thereby causing upconversion to increase/decrease- Do new couplings arise?

Compare Bicoherence from overlapping windows- select a criteria (example: $|\text{bic1}-\text{bic2}| \geq .2$) - write out frequency pairs to text file- Make a 2-D Histogram.



BACKGROUND MONITOR- 3 TASKS

- **Tracking Bicoherence** Identify pairs of frequencies (f1-f2) –compute Bicoherence- Track it for overlapping windows, as selected by user.
- **“Average Bilinearity”** A measure of bilinearity of data, Sum up bicoherence over entire f1-f2 space- Track it for overlapping windows.
- **“Bilinear Glitchiness”** Look for changes in bicoherence in overlapping windows – construct 2-D histogram-relative probability of occurrence of f1-f2.

BicoMon (Current)

- Function: A stand-alone workstation for analyzing the bicoherence.
 - Allows the choice of any channel combination
 - Automatically sets the data rate and duration for the required frequency resolution and range
 - Output of plots to GIF files.
 - Allows simultaneous viewing of bicoherence, bispectrum, and 1–3 power spectra

BicoMon (Pending)

- Utilize FFTW 3. Unify calculation engine method.
- Heterodyning: to allow finer resolution around interesting features (only for autobicoherence).
- Track integrated autobicoherence with time (test for gaussianity)
- Track 2D plot of variance of bicoherence (running average of the difference squared). This is a measure of the “glitchiness” of the data.
- Ability to spawn jobs in background monitor

BicoMon Background

- Track the average bicoherence in a region around an interesting feature. The channels and frequency pairs are stored in a configuration file that is updateable directly or from BicoMon.
- Gaussianity: Track the average autobicoherence of a channel as a measure of its gaussianity.
- Once 2D histogramming is feasible within the DMT Viewer, we should track the mean and variance of the autobicoherence of given channels (AS-Q).

Timeframe

- Steve (and possible one summer student) will work on BicoMon & plan to finish by August
 - calculation upgrade (FFTW3 + unified engine)
 - heterodyning
 - writing jobs to background monitor
- Vijay will work on BicoMon Background and plans to finish by August
 - tracking integrated autobicoherence of AS-Q
 - tracking bicoherence of interesting events as listed in the bicomon configuration file.
- We have set-up weekly telecons for the project. Anyone wishing to join the project or the telecons, please contact us.