Stochastic Searches: Status and Plans

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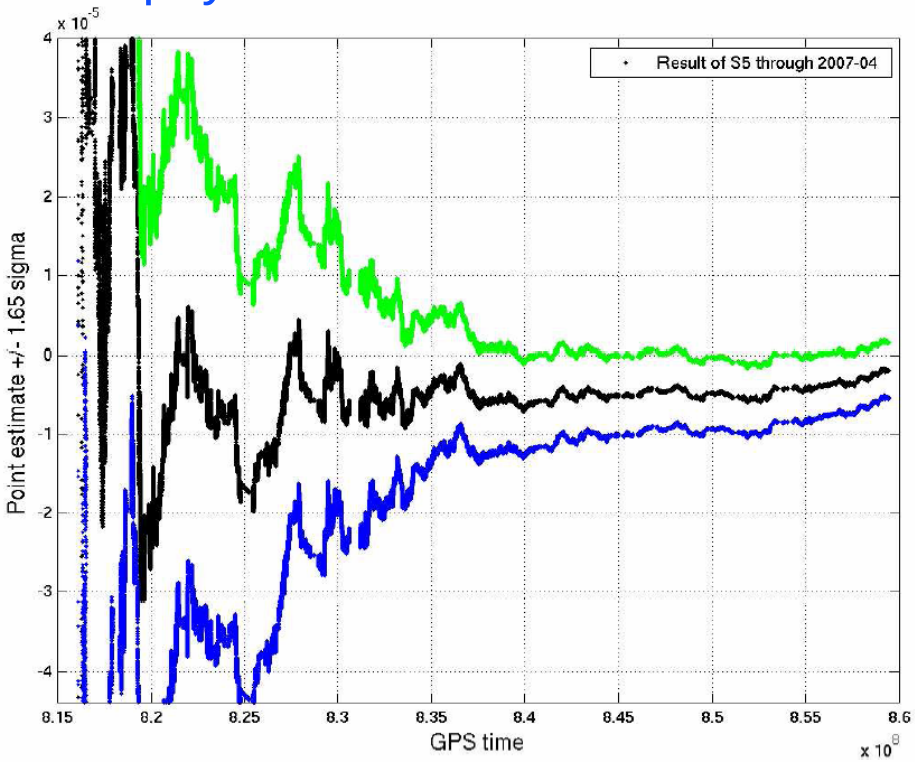
Status of S4 Papers

- Old news: S4 isotropic search using LHO-LLO pairs published in The Astrophysical Journal 659, 918 (2007).
- S4 ALLEGRO-LLO search published in Physical Review D76, 022001 (2007).
- S4 radiometer paper under review in Physical Review D.
- S4 FSR paper (H1H2) under internal review (both calibration and stochastic reviews).

S5 Status: H1L1 Isotropic Search

- S5 H1L1 isotropic search: $\sigma_\Omega = 4.1 \times 10^{-6}$.
  - » With unphysical time-shift.
  - » Using data up to April 1, 2007.
  - » Assuming frequency independent spectrum, and h=0.72.
- Before opening the box:
  - » Data quality cuts to be finalized
  - » Frequency mask to be finalized
- Goal: have the result by September, such that the internal review could be completed by the end of the year.
  - » *Preliminary result to be presented at the AAS meeting in January, 2008.*
- Should beat the BBN bound (1.4×10^{-5} in our frequency band).

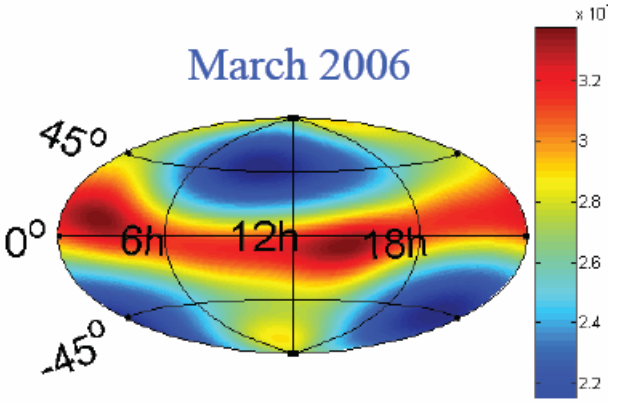
Running Point Estimate with Unphysical Time Shift



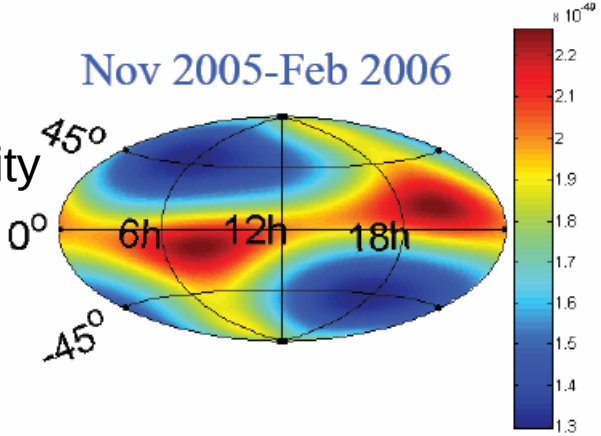
S5 Status: Radiometer Search

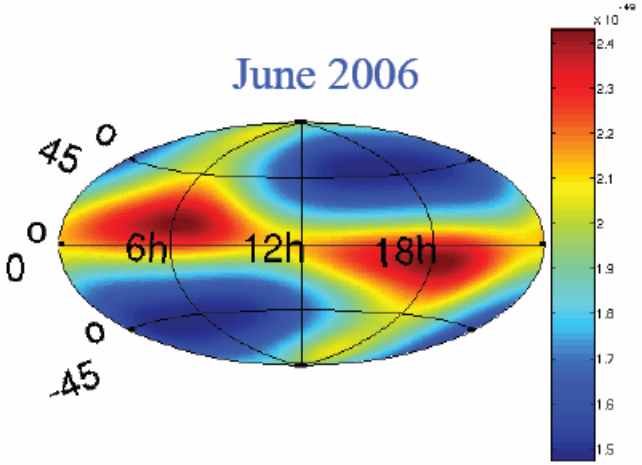
- S5 radiometer search (R. Ward)
  - » Repeat of the S4 radiometer analysis.
  - » Intend to deconvolve the antenna pattern from the maps and estimate covariance matrix on the “cleaned” map.
  - » Also intend to do “narrow-band” searches in different directions on the sky.

Map of sensitivity σ as a function of direction



Since IFOs are most sensitive at night, the region on highest sensitivity moves across the sky as the Earth moves around the Sun.





$$\sigma(\Omega) = (1.3 - 2.27) \times 10^{-49}\ \mathrm{Hz}^{-1}$$

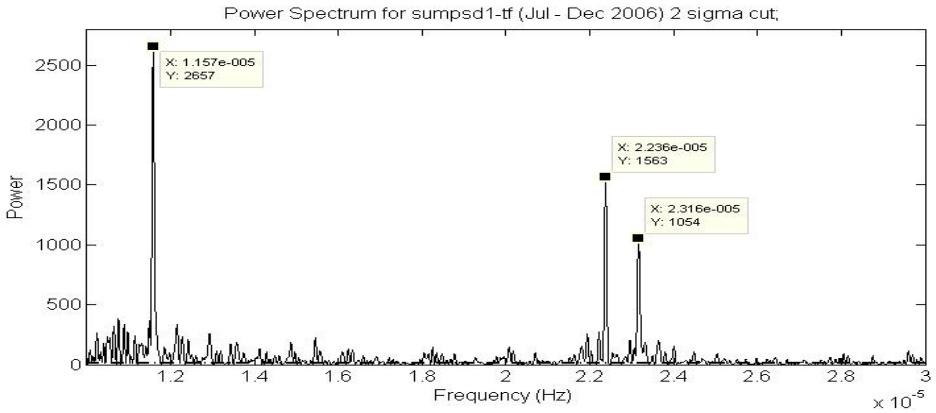
S5 Status: Spherical Harmonics Decomposition

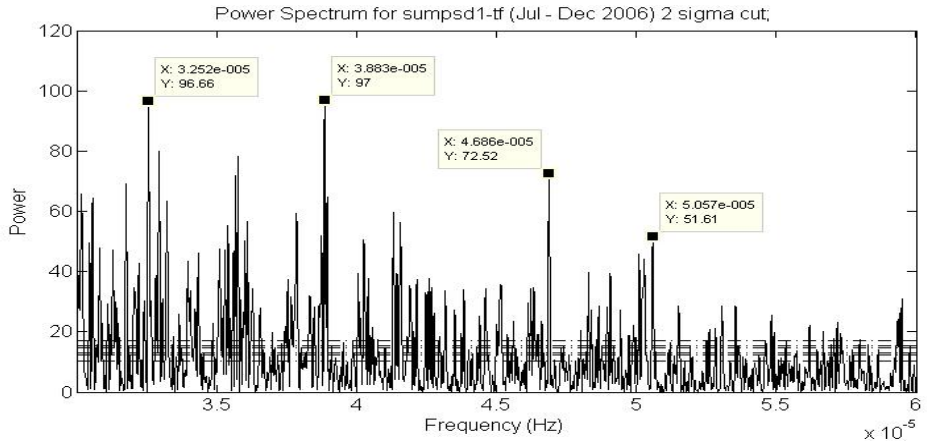
- Attempt to produce a “best” estimate of the background distribution on the sky.
  - » Rather than assuming the background is isotropic or point-like.
- Slightly different formalism (see S. Ballmer’s talk).
- Implement as part of existing pipeline.
- Current efforts:
  - » Produce new simulation code that can inject an arbitrary map.
  - » Perform end-to-end tests of the injection code.
  - » 2 SURF students at Caltech: Madeleine Udell, Grant Meadors.
- To do:
  - » Adjust post-processing procedures.
  - » Finish extensive testing:
    - – Performance of different searches for different sky distributions.

S5 Status: H1H2 FSR Search

By Chad Forrest

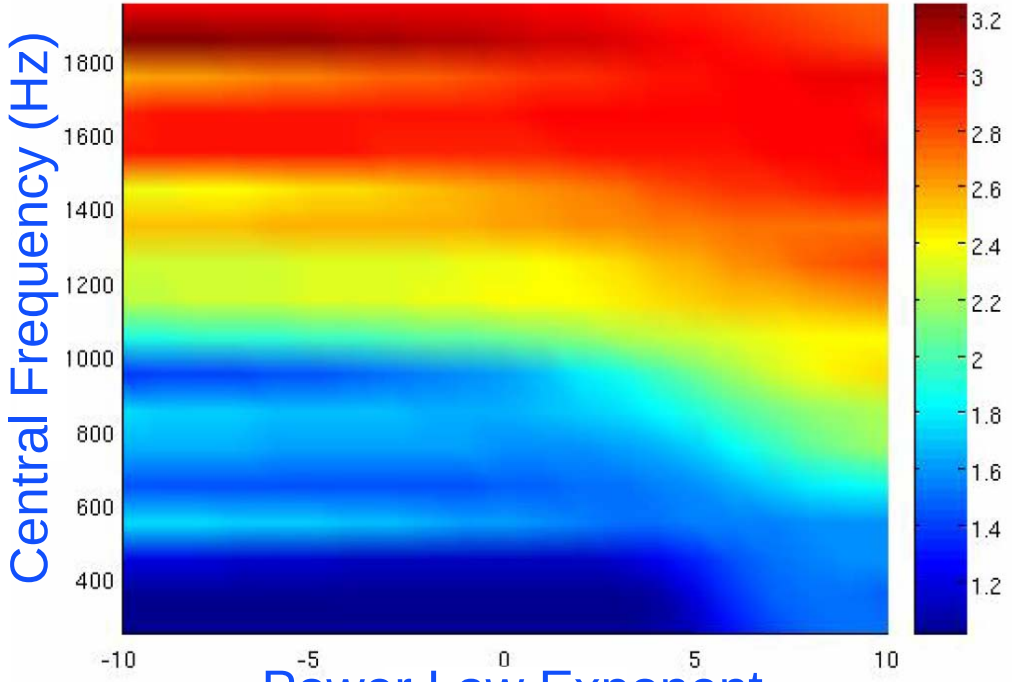
- In the process of repeating the S4 analysis procedure on S5 data.
- Also investigating diurnal variations at FSR:
  - » Integrate H1 PSD in the band ±200 Hz around FSR (for every 64-sec frame).
  - » Calculate frequency power spectrum of this time series using Lomb-Scargle algorithm.
- Observe 1st and 2nd harmonics of the solar daily frequency (not of sidereal day!)
- Other lines not understood, but could be related to the tidal servo.
- Plans: Repeat on the whole dataset, and try to determine upper limits for localized sources (such as the galactic center etc).





S5 Status: LSC-VIRGO

- Cross-correlating LSC-VIRGO pairs could improve the sensitivity and the robustness of the network, especially at high frequencies.
- Considering both isotropic and directional (radiometer) searches with S5 data.
- Analysis of real data to start soon.

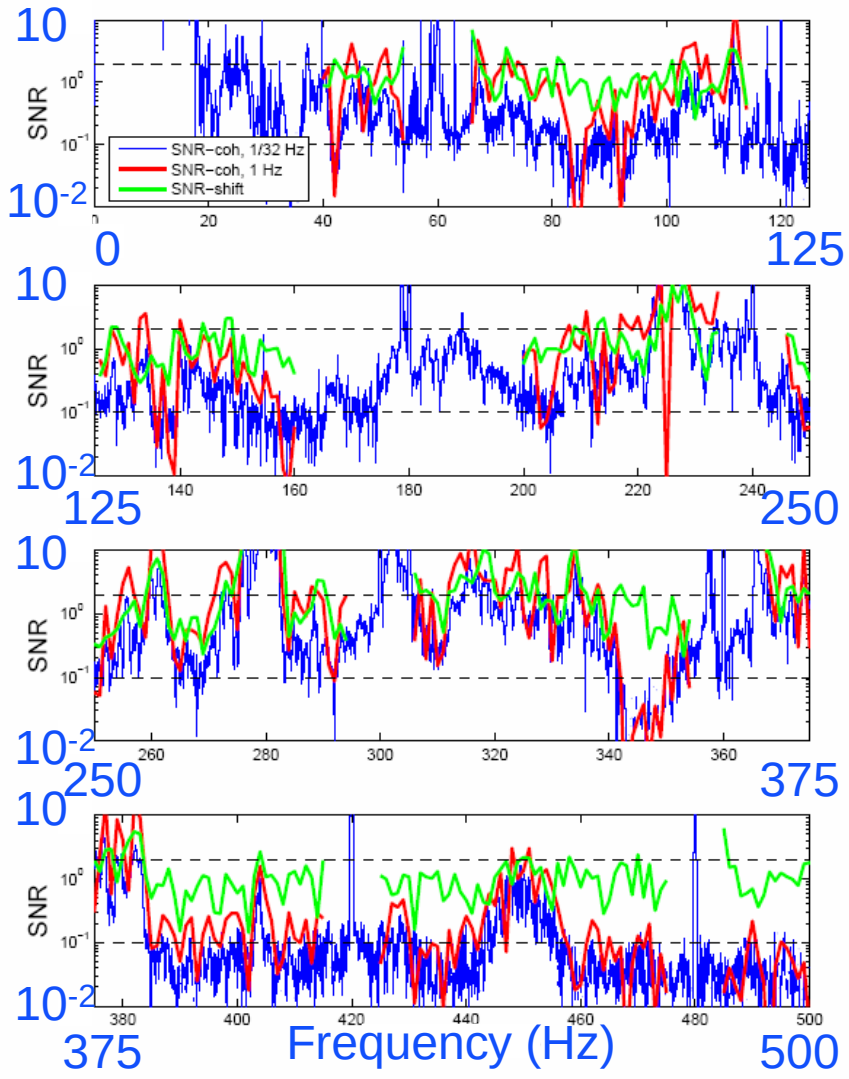


Upper limit improvement factor (WSR10) as a function of

- Power law exponent of the model
- Central frequency of a frequency band used for the analysis, width=250 Hz.

S5 Status: H1H2 Isotropic Search

- Developed 2 techniques for identifying contaminated frequency bands:
  - » IFO-PEM coherence
  - » Time-shift
- IFO-PEM coherence method can be used to estimate the "residual" contamination in the good frequency bands.
  - » Can evaluate the method using contaminated frequency bands.
- Preliminary results (using data up to April 2006) were at the level:
  - » $\sigma_\Omega = 1.4 \times 10^{-6}$
- Current efforts:
  - » Assess time-variability of both techniques.
  - » Bring the IFO-PEM coherence calculation closer to stochastic algorithm in terms of how the data is handled (frequency resolution, windowing etc).



Pipeline Upgrade

- Produce stochastic intermediate data (SID).
  - » Includes Power and Cross Spectral Densities of an IFO pair.
  - » Calculated for every ~minute.
- Individual searches to use SID rather than time-frames.
- Could also be used for:
  - » Detector characterization.
  - » Search for transients on the time-scale of minutes/hours.
  - » Search for narrow-band correlations.
- First-pass SID already produced on the CIT cluster.
  - » Currently checking the data quality.
- Collapse (i.e. average) SID to 1 sidereal day.
  - » Collapsed data could be stored on a laptop…

Publication Plans

- Preliminary S5 LHO-LLO isotropic result to be presented at the AAS Meeting in January 2008.
  - » Relies on the review of S5 h(t) data!
- S5 LHO-LLO isotropic result to be published in a short paper (all of S5).
  - » Beating the BBN bound, implications for some models.
- S5 Radiometer paper to be published in a short paper, ~mid 2008.
  - » Improved sensitivity, deconvolving antenna pattern…
  - » If time-scale is similar, publish radiometer and isotropic results together.
- S5 H1H2 isotropic paper should be long, detailing the analysis procedure.
- S5 Spherical Harmonic Decomposition paper.
  - » Likely to be long, detailing the analysis procedure.
- S5 FSR paper.
  - » Likely to be long, detailing the analysis procedure.
- LSC-VIRGO paper
  - » Isotropic, using several baselines, probably focusing on higher frequencies.
  - » Radiometer search using several baselines?