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Report
LSC Astrophysical Source Identification & Signature (ASIS) working group

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Last 6 Months

- **ASIS has been "dormant"**
  - » Active members working hard in the upper limits groups
  - » SLUG now the forum for daily and weekly LDAS activities
- **Source Working Groups have been formed**
  - » Thorne/Brady initiative; focus of the March LSC meeting
  - » Five groups now in place
  - » Relation to ASIS: each group has a formal "Data Analysis Liason" who is an LSC member and will serve as a point-of-contact within ASIS
  - » ASIS Charter changed by LSC Executive Committee (June): will participate in Source Working Groups, and vice-versa. (Some) ASIS sessions now open to non-LSC members.

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Highlights from this meeting

Bose (U. Washington – Pullman)

- (Relatively) new LSC member
- Making significant contributions to the stochastic background and binary inspiral upper limit groups
  - » Simulation code for stochastic background
  - » Multi-detector analysis code for binary inspiral
- Has implemented (and put into LAL) code to implement optimal filtering for binary inspiral for two detectors
- Reported work on N-detector network analysis, and computational cost estimates (without/with hierarchical stage)
- Experimenters:
  - » This is not much use unless instrument sensitivities are comparable.
  - » Likewise, N-detector analysis not much use unless there are N comparable instruments!

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Highlights from this meeting

Dhurandar (IUCCA)

- "Decimation in time" as a hierarchical filtering strategy for inspiral. Computational gain as large as 70.
- "First pass" with down-sampled data (say 512 Hz)
- "Second pass" at higher sample rate
- This is one of many ways to implement hierarchical search
  - Decimation in time
  - Low freq/High frequency bank (Mours)
  - Traditional "mass hierarchy" coarse/fine bank with low/high thresholds
- Currently a hierarchical inspiral code exists but not in use by inspiral upper limit group. This is because
  - » More complicated
  - » Not (currently) computationally limited
  - » Correct parameters for hierarchical search depends on the noise statistics. (currently a moving target)

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Highlights from this meeting

T. Creighton (Caltech)

Status of the Fast Chirp Transform (FCT) method

"Non-bank" based implementation of matched filtering

- Ideal for searches over parametric families of templates with ill-defined parameter sets
- Easily implements over/under sampling as hierarchical method
- Hard to respect boundaries of regions in parameter space, so might not be the best choice for well-known waveform families
- Next step: systematic testing with simulated Gaussian noise

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Highlights from this meeting

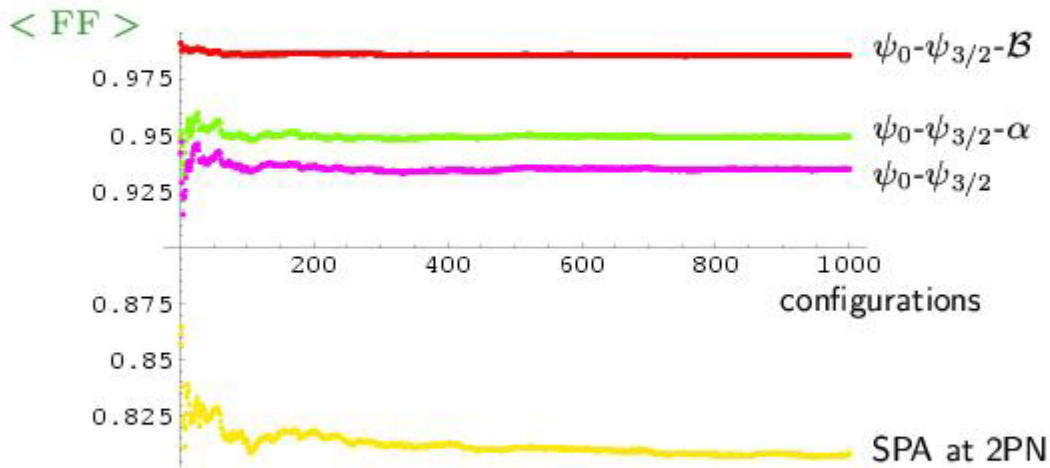
Buonanno/Chen/Vallisneri (Caltech)

- Modeling of 10-40 solar mass binary black holes
- Promising LIGO-I source, but no reliable waveforms
- Two important new results:
  - Constructed a family of frequency-domain templates that are a good match to *all* known approximation schemes for non-spinning sources. This introduces a pair of new parameters: ~40,000 templates needed to go to ~10 solar masses.
  - Used an ansatz to include spin effects in template family. This provides a practical template bank to search for such systems (much smaller than if all spin degrees of freedom are included).

Highlights from this meeting

Convergence of the average FF for BBH with $M = (15 + 15)\, M_\odot$

$$< \mathrm{FF} >= \left(\frac{\sum_n \mathrm{overlap}^2(n)}{\sum_n 1} \right)^{1/2}$$



We chose 1000 initial configurations for the spins

Highlights from this meeting

Compact binaries: projection onto ψ_0-$\psi_{3/2}$–plane of modulated DTF

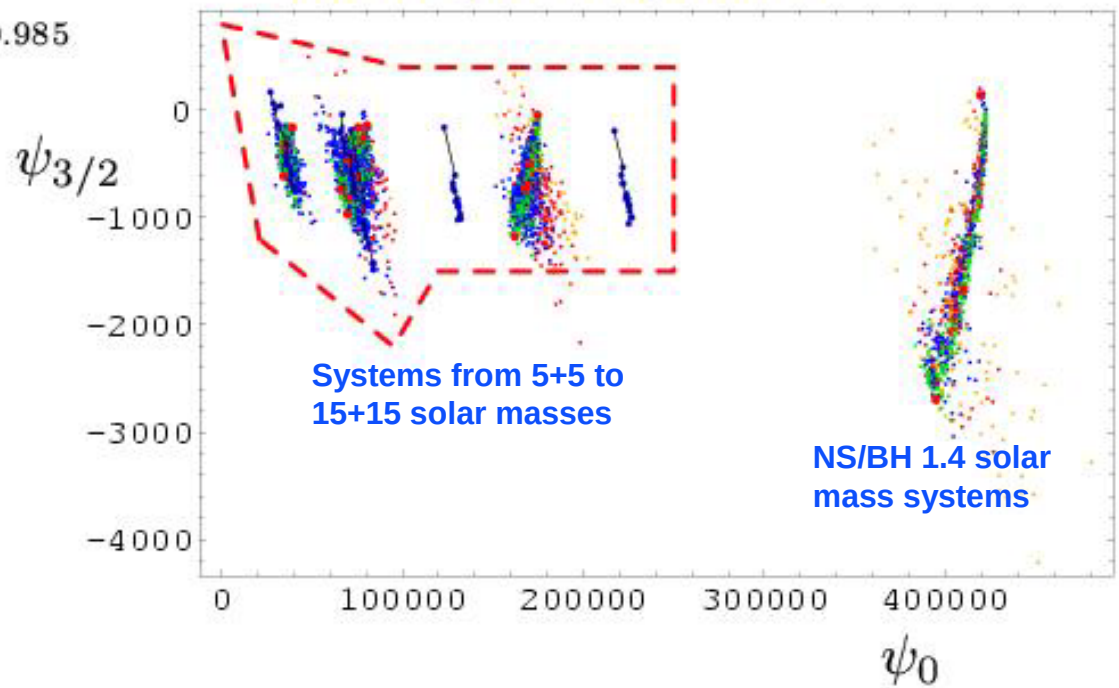
yellow dots $\rightarrow \overline{\mathrm{FF}} < 0.9$

red dots $\rightarrow 0.9 < \overline{\mathrm{FF}} < 0.95$

blue dots $\rightarrow 0.95 < \overline{\mathrm{FF}} < 0.985$

green dots $\rightarrow \overline{\mathrm{FF}} > 0.985$

Generic spin configurations



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Highlights from this meeting

Sathyaprakash (Cardiff)

- Discussed Effective One Body (EOB) approach to modeling inspiral/plunge phase at 3rd pN order, pioneered by Buonanno and Damour.
- Approximation scheme gives rise to certain undetermined (or partly-determined) constants
- Investigated the effects of different values of these constants – discovered that they have only small effects on the fitting factor
- Good news: potential family of inspiral/plunge/merger templates

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Highlights from this meeting

J. Creighton (UWM)

Status of binary inspiral search code

- Uses time-domain or 2pN stationary phase frequency domain templates
- Incorporates $\chi 2$ time/freq as discriminant
- Software injection of simulated signals
- Random testing of filter bank
- Extremely efficient: 20% filter generation, 80% FFT
- Discussed E7 playground data results
- Inspiral Upper Limit Group results will say more

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Highlights from this meeting

Whelan & McHugh (Loyola)

- Discussed how to do correlation between Allegro bar and LLO for stochastic background detection
- Have modified stochastic background DSO for this purpose
- Allegro output can now be converted to FRAME format (Ed Daw) for such correlation
- Have two days of E7 bar data with maximum overlap orientation, two days of E7 bar data with null overlap orientation, and two days of E7 bar data with an intermediate orientation.

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Highlights from this meeting

Klimenko (UFL)

- Robust methods of stochastic background detection
- Basic ideas: average Sign(x)Sign(y) rather than x y.
- Gives statistic which is not as efficient with Gaussian noise, but insensitive to statistics of the detector
- Use wavelet transforms to implement optimal filtering
- Is experimenting with E7 data

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Highlights from this meeting

Ram Valluri

Zak Gelfand Transforms for pulsar detection

- Uses an integral transform to provide matched filter for pulsars, provided that
  - » No spindown
  - » Earth orbit circular
  - » Earth rotation uniform
  - » No relativistic time delay effects or real-world effects (Jupiter, Moon, etc)
- Does not appear to generalize for the real-world case of interest

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Highlights from this meeting

Additional items (but no time to summarize!)

- Wagoner: revival of r-modes as potential advanced LIGO source
- Stuver: block normal analysis for burst detection
- Ganezer: update of SNEWS/LIGO-I neutrino correlations
- Schnittman: spin-orbit resonance effects for binary sources
- Allen: optimal detection techniques for “unresolved” sinusoidal signals
- Koranda: description of the LIGO Data Replicator (LDR) software system