



First Analyses: Gravitational Wave Bursts and LIGO

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Finn/Penn State/LIGO Review

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Goals

- Early analyses with engineering data
 - » First Science!
- Exercise acquisition and analysis systems
- Test science analysis model
 - » Organizational
 - » Scientific
- Caveats:
 - » Not all components ready, or ready in final form
 - » Analyses schematic compared to final goal
- Four analysis groups
 - » *Bursts - co-Chairs: Finn, Saulson*
 - » *Inspirals - co-Chairs: Brady, Gonzalez*
 - » *Periodic - co-Chairs: Anderson, Zucker*
 - » *Stochastic - co-Chairs: Fritschel, Romano*

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Burst Analysis Group

- Target source: unstructured, unmodeled or unanticipated gravitational wave bursts
 - » Unstructured/unmodeled: no waveforms, or uninformative waveforms
 - » Unanticipated: things that go “bump” in the night
- Membership
- Organization
 - » Detector diagnostics and monitors: Shoemaker & Zweizig
 - » External data sets: Marka
 - » Monte Carlo: Weinstein
 - » Filters: Katsavounidis
 - » Cluster analysis tools: Sigg



Analysis Approach: Overview

- Two approaches
 - » Self-triggered
 - » External triggered
- External triggered
 - » in-depth examination of short epochs triggered by, e.g., SNEWS, BACODINE, etc.
- Cross-correlate over burst epoch
 - » Trigger identifies epoch, position
 - Optical SN trigger: 8--12 h previous for red supergiant, 1-2 for blue
 - SN neutrinos: 0-1s
 - Gamma-ray burst: 0-1 or 30-300s (internal vs. external shock model)
- Identify control-set
 - » Cross-correlate over other sky positions, uncorrelated time
 - » Characterize triggered x-correlation relative to control
 - » Statistically significant excess power in sub-bands
 - Cf. Finn, Mohanty & Romano, Phys. Rev. D. **60**:121101(R)
- Classify/characterize events
 - » Commonality in spectra, duration, power, etc.

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Self-triggered analysis

- Single-detector event lists
 - » Events from strain channel, vetos from diagnostics, PEM channels
 - » Power-in-band analysis
 - Time-frequency, time-scale,
 - » Change-point analysis
 - » Select “waveforms”
 - Zwerger-Mueller SN catalog
- Multi-detector event lists
 - » Compare event lists for “coincidences”
 - Timing, power, spectrum, etc.
- » Evaluate PEM channels for inter-detector correlations, incorporated as vetos
- » Include also ALLEGRO, GEO generated event lists
- Classify/characterize residual events
 - » Cross-correlate detector outputs over coincident epochs
 - » Commonality in spectra, duration, power, etc.



Results

- Events & event rates
 - » Characterization in terms of standard candles
- Upper limits
 - » Excluded region in rate-strength plane for hypothetical “standard candles”
- Characterization of detector noise, performance
 - » (non) stationarity and timescales
 - » Outlier event rate
 - » Correlation with PEM channels
 - » Non-normal noise components