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What Constitutes a Science Result?

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Principle Source Types

- Stochastic Background
- Binary Inspiral Systems
- Pulsar/CW Sources
- Bursts

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Stochastic Background

- Science Result is limit on the energy density in GW in LIGO band (say 30-300 Hz) with stated confidence
- Needs model of background. Typical assumptions:
  - » isotropic
  - » gaussian
  - » unpolarized
  - » spectral model for $\Omega(f)$ [typically, a power law]
- Simplest method of setting limit is to add simulated signals into the data stream, and study how two-detector correlations depend upon its amplitude [*Could/should one consider hardware injection of simulated signals?*]
- First case to consider is $\Omega(f)$ = constant.

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Binary Inspiral

- Science Result can be of two types:
  - » Limits on coalescence rate for a given source population (example: galactic NS-NS binaries). "Strong" science result (but requires waveforms that can be trusted.)
  - » Limits on rate for systems producing waveforms described by a particular theoretical model. "Weak" science result (since model waveforms might or might not be correct).
- As before, the statistical confidence of these results can be determined by injecting simulated signals into the hardware, or adding simulated signals into the data stream.

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Pulsar/CW Signals

- Limits on known pulsars "easy"
  - » Since phase evolution & sky position are known, GW waveform can be predicted (up to phase & overall amplitude)
  - » Variety of demodulation techniques can be used to search for this waveform.
  - » Science result is statement about energy radiated in GWs
- Limits on unknown pulsars "hard"
  - » In practice, may have to search only limited areas of the sky
  - » Place limits on number of sources (with some assumed spatial distribution) radiating with amplitudes greater than some value

Again, statistical confidence determined by adding simulated signals into either the hardware or the data stream.

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Burst Sources

- Typical results in the literature (from resonant-mass detectors) give limits on the rate of bursts with given amplitude.
- No waveform model needed, because resonant-mass detectors are narrowband
- For broadband detectors, science results will require waveform models.
  - » With trustworthy waveform models for some source type (say, SN, upper limits can be obtained.)
  - » Otherwise, we can only place limits on the waveforms (but not on the sources.)