Astrophysics

and

Reduction of Data Sets

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Areas of Interest

I. ASIS: Astrophysical Source Identification & Signatures

Possible areas

r-modes of oscillation in young neutron stars

Binary systems with precession included

Binary systems

Fisher information matrix established for some cases:

Binary systems, neglecting spins
Binary systems, including spins,
but neglecting spin-induced precession

Preliminary questions

What is the rate of precession for a given binary system?

How many precession cycles will be seen in the frequency band where 90% of the energy will be seen by LIGO I?

Mathematics needed:

Post-Newtonian approximations to General Relativity
Papers by Finn, Cutler & Flanagan, *et al.*,
available as guides

BINARY SYSTEMS
Neutron stars, black holes, or neutron star-black hole

Binary System Parameters

Examples:

- **Masses**
- **Spins**
- **Orbital elements,**
  - **e.g. eccentricity,**
  - **semi-major axis**

***Observable* Gravitational Wave Parameters**

Examples:

- **Amplitude**
- **Polarization**
- **Phase**
- **Rates of change of these parameters**

Establish links:
Express each observable parameter as a function of binary system parameters

Set up "Fisher Information Matrix" containing numerical correspondences between values of waveform parameters and errors on binary system parameters

II. Detector Characterization Working Group

Performance Characterization
Transient Analysis
Reduced Data Sets
Data Set Simulation

Reduced Data Sets

Data compression algorithms needed

Loss-free compression of data with Gaussian noise
- better than gzip (~50% reduction)

Ideas from Sam Finn,

e.g. use a linear filter to whiten noise and make better use of upper bits

and Li-He Zou, LaTech Professor of EE
areas of expertise: image compression

Good area for student involvement

Graduate students – help design and implement algorithms using different techniques, and test

Undergraduates – port code from Matlab to gnu C