The Mock LISA Data Archive

Steering Committee:
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AstroGravS

http://astrogravs.nasa.go
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Mock LISA Data Archive

The Mock LISA Data Archive (MLDA) aims to provide realistic simulations of the output from the LISA observatory to interested researchers developing algorithms for analyzing LISA data. Various gravitational wave sources have been modeled using the best tools available, and the resulting waveforms have been run through the LISA Simulator to produce synthetic data streams.

It is hoped that the MLDA will help in the benchmarking of different data analysis procedures by providing a common ground for comparison. New contributions to the MLDA are most welcome - please contact mlda@athena.gsfc.nasa.gov for further information.

The main data products are a collection of interferometer outputs that include simulated detector noise and the fully modulated response of the detector to the input waveforms. The LISA Simulator produces the X, Y and Z Time-Delay Interferometry signals of Estabrook, Tinto & Armstrong, PRD 62, 042002 (2002), as modified by Cornish & Hellings, CQG 20, 4851 (2003), to account for relative spacecraft motion. These data streams are ready for use by data analysts. A short tutorial on how to use the MLDA is available.

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- Scott Hughes, MIT
- Shane Larson, Caltech
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- Alberto Vecchio, Birmingham, UK

Sources classes

- Galactic Binaries
- Galactic Background
- Supermassive Binary Black Holes
- Extreme Mass Ratio Captures

MLDA Vision

- Realistic Benchmarking of LISA Data Analysis Algorithms
- Built by the LISA community for the LISA community
- Open to all (Contributions most welcome)
- Evolutionary (Incorporate Improved Source and Detector Modeling)

Instrument Modeling

The LISA Simulator

- http://www.physics,montana.edu/lisa/

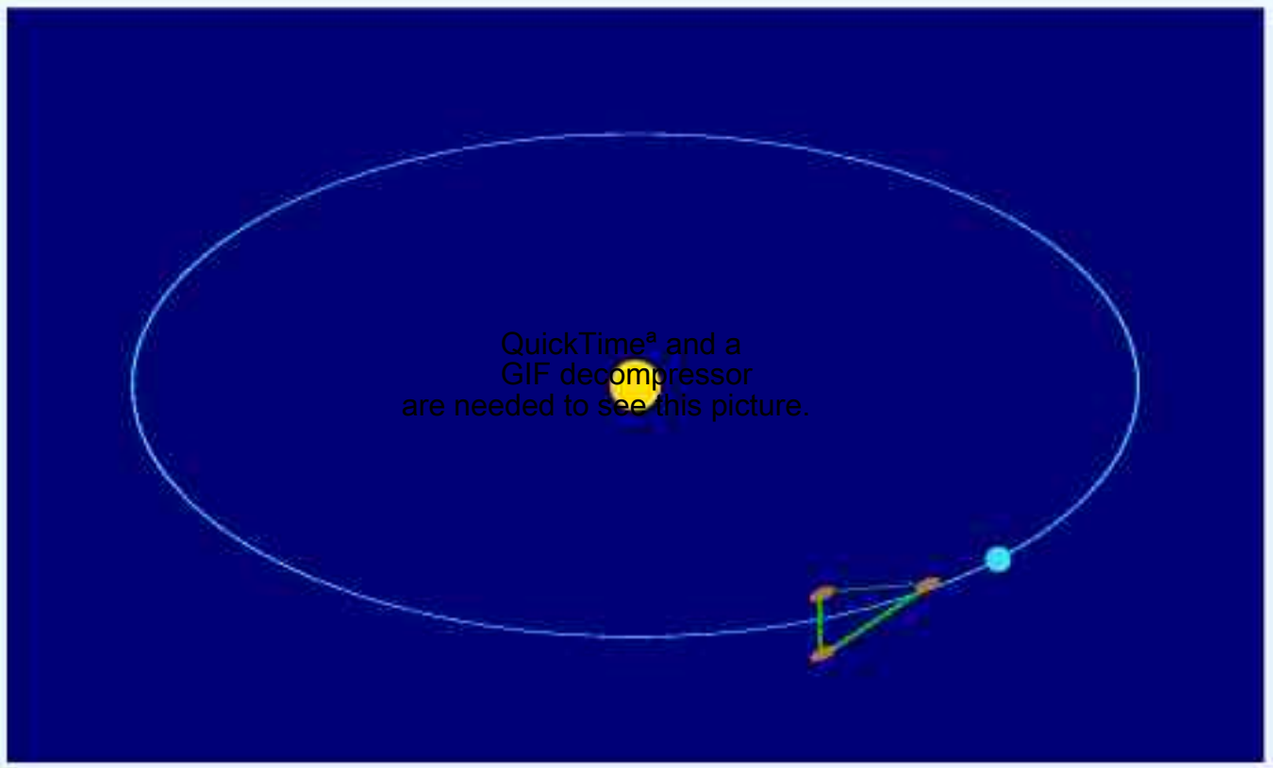
Synthetic LISA

- http://www.vallis.org/research/synthlisa.html

$$\text{Arbitrary } h_+(t),\ h_\times(t) \ \Rightarrow \text{Simulated LISA outputs } X(t)\ Y(t) \text{ etc.}$$

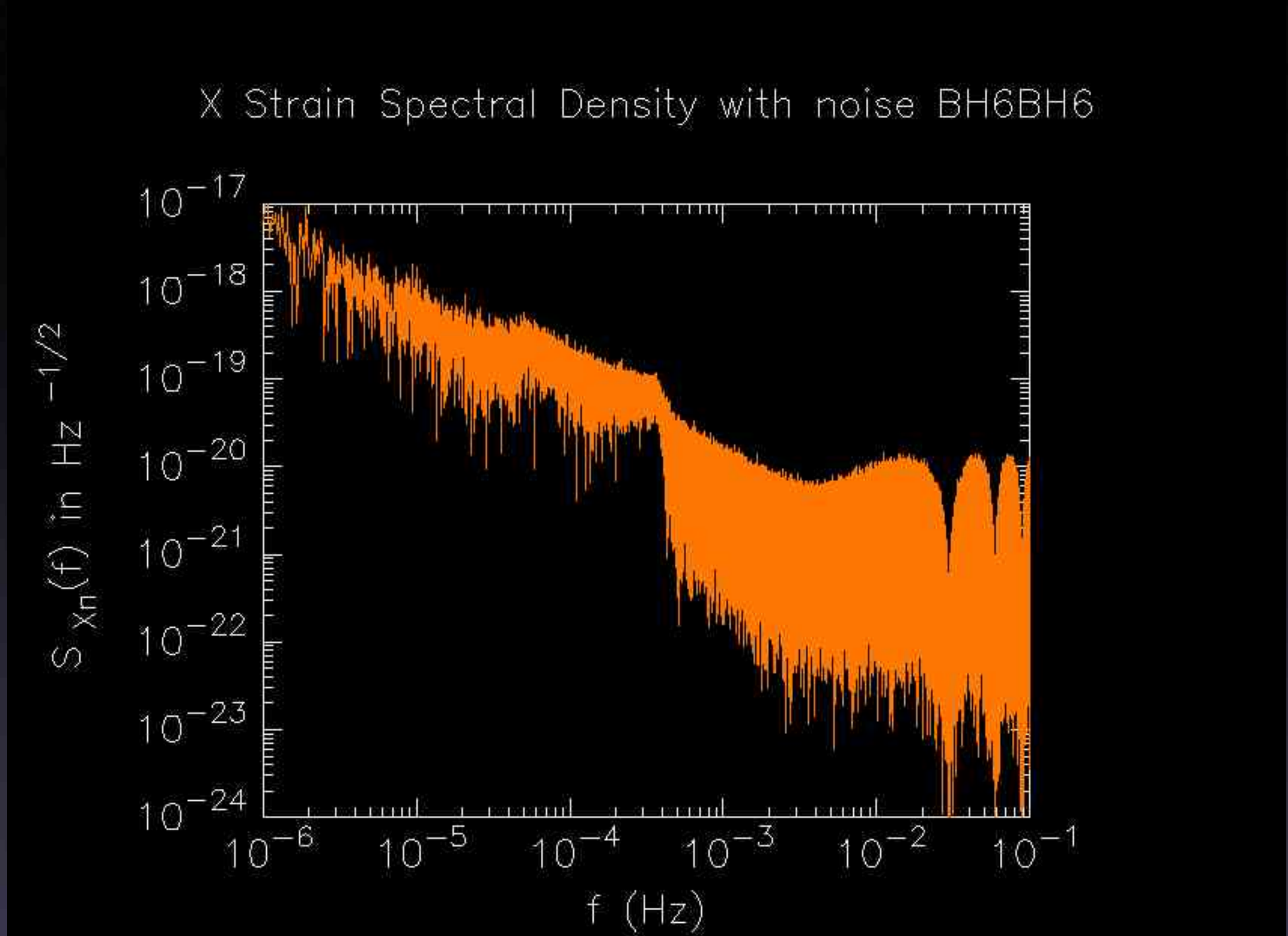
- Adopting a Common Data Format (XML based)
- Developing a Conventions Document

THE LISA SIMULATOR



******** Announcing the Release of Version 2.0 ********

The LISA Simulator is open source software for simulating the response of the Laser Interferometer Space Antenna to an arbitrary gravitational wave signal. Follow the links to find a description of the simulator and the


X Strain Spectral Density with noise BH6BH6
$S_{xn}(f)$ in Hz $^{-1/2}$
10^{-17}
10^{-18}
10^{-19}
10^{-20}
10^{-21}
10^{-22}
10^{-23}
10^{-24}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
f (Hz)

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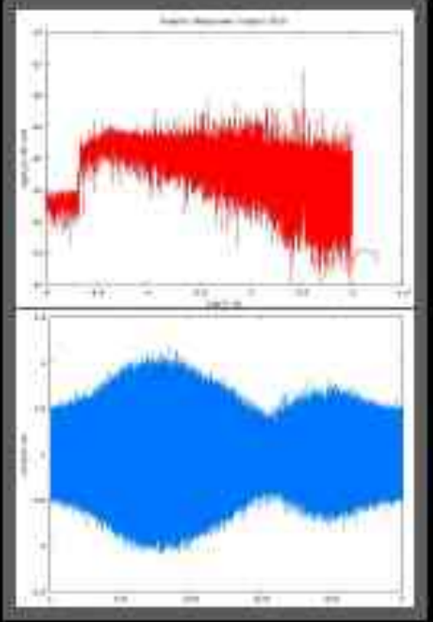
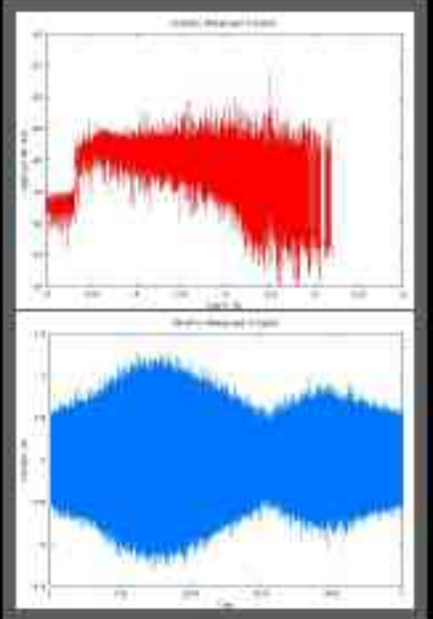
Galactic Background mock data

Jump to:

Montana Group - February 2004

Evens-Iben-Smarr (EIS)
Hills-Bender-Webbink (HBW)

Contributor	Description	Data	Images
Montana Group	Text Description (EIS)	Galactic Background (103 Mb) Parameters (6.7 Mb)	
Montana Group	Text Description (HBW)	Galactic Background (103 Mb) Parameters (6.5 Mb)	

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Supermassive Binary Black Holes

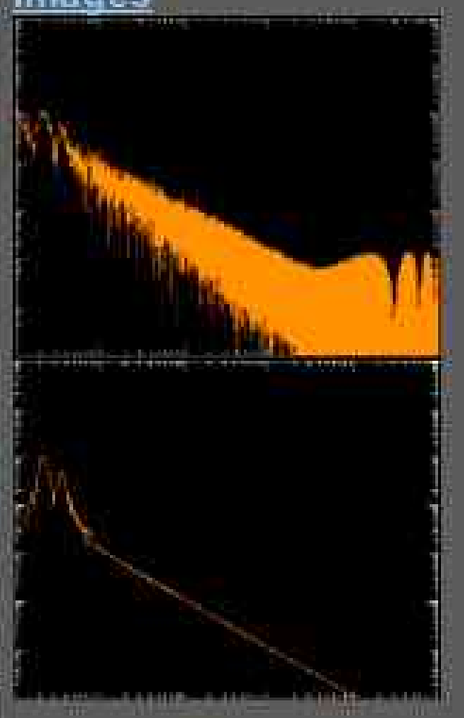
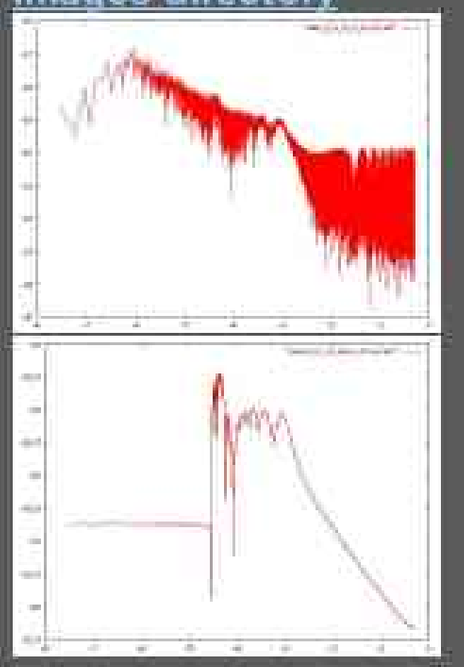
LISA may be able to observe the coalescence of binary systems of supermassive black holes (SMBH-SMBH) out to very high redshift. These observations may provide important new information about the process of structure formation in the young universe.

Several data sets for this class of source are provided below. Each data file set is split into two parts. Both parts will be neededed by researchers developing data analysis techniques SMBH-SMBH systems. The larger LISA Simulator output (lso) file set contains pre-generated LISA Simulator output ready for data analysis study. The smaller "incident wave" (iw) file set, with information about the arriving gravitational waves contains only the data needed by researchers running the LISA Simulator on their own.

SMBH-SMBH mock data

Jump to:

Montana Group - July 2003				
$10^4\ M_{sun} \times 10^4\ M_{sun}$	$10^5\ M_{sun} \times 10^4\ M_{sun}$ $10^5\ M_{sun} \times 10^5\ M_{sun}$	$10^6\ M_{sun} \times 10^4\ M_{sun}$ $10^6\ M_{sun} \times 10^6\ M_{sun}$	$10^7\ M_{sun} \times 10^4\ M_{sun}$ $10^7\ M_{sun} \times 10^5\ M_{sun}$ $10^7\ M_{sun} \times 10^6\ M_{sun}$ $10^7\ M_{sun} \times 10^7\ M_{sun}$	$10^8\ M_{sun} \times 10^4\ M_{sun}$ $10^8\ M_{sun} \times 10^5\ M_{sun}$ $10^8\ M_{sun} \times 10^6\ M_{sun}$ $10^8\ M_{sun} \times 10^7\ M_{sun}$ $10^8\ M_{sun} \times 10^8\ M_{sun}$
Caltech Group - November 2003				
$10^6 + 10^6$ @ Z=1 $10^5 + 10^5$ @ Z=10				

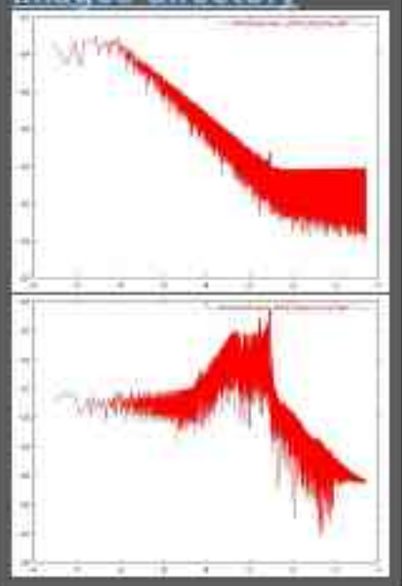
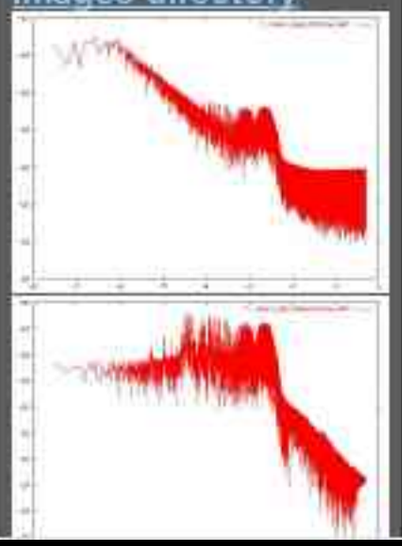
Montana Group	10^8 M_{sun} x 10^8 M_{sun} Simulator Settings	BH8BH8z1-iw.tar.gz (115Mb)	BH8BH8z1-iso.tar.gz (422Mb)	Images 
Caltech Group	Text Description File directory $1x10^6$ + $1x10^6$ @ z=1	Barycenter (545Mb)	Michelson (2Gb) TDI (2Gb)	Images directory 

EMRi mock data

Jump to:

Caltech Group - November 2003

1 + 1x10^7 @ N4742
1 + 3x10^6 @ SgrA*
1 + 1x10^5 @ z=0.5

Contributor	Description	Incident Wave Data	Output Data	Images
Caltech Group	Text Description File directory 1+10^7 @ NGC4742	Barycenter (695Mb)	Michelson (2Gb) TDI (2Gb)	Images directory 
Caltech Group	Text Description File directory 1 + 3x10^6 @ SgrA*	Barycenter (649Mb)	Michelson (2Gb) TDI (2Gb)	Images directory 

Mock Data Challenges

- First LISA mock data challenge in 2006?
  - Meeting minimal science requirements?
- Realistic Challenge Data: Multiple Sources, Multiple Source Types.
- Data Generated by Independent Panel
- Performance Metric? (not so easy)

  Winners given automatic membership to LISA science team.

The Future

- Please submit your input waveforms and processed waveforms
- Help us choose the data format, conventions
- Automated submission and distribution in the works