LIGO Activity

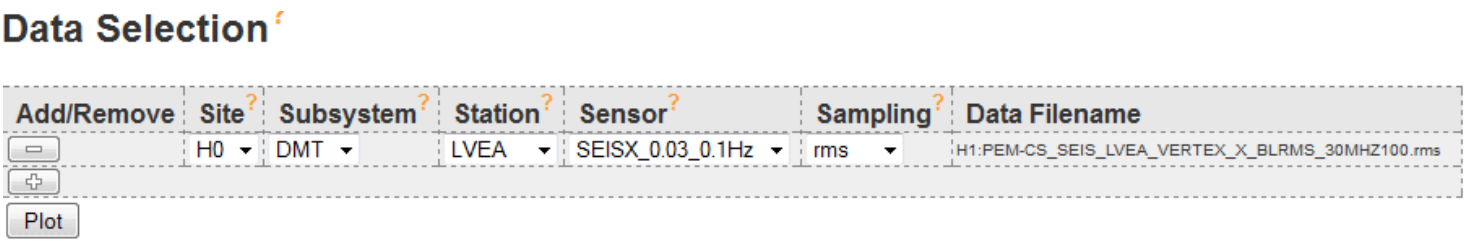
Sunday, February 23, 2014 6:22 PM

In this activity, you will use data from the LIGO.

Step 1: Go to: http://www.i2u2.org/elab/ligo/current/index.jsp
You may have to hit the "Enter as a guest" link

Step 2: Select your data range at the top

Step 3: Set parameters for your observation



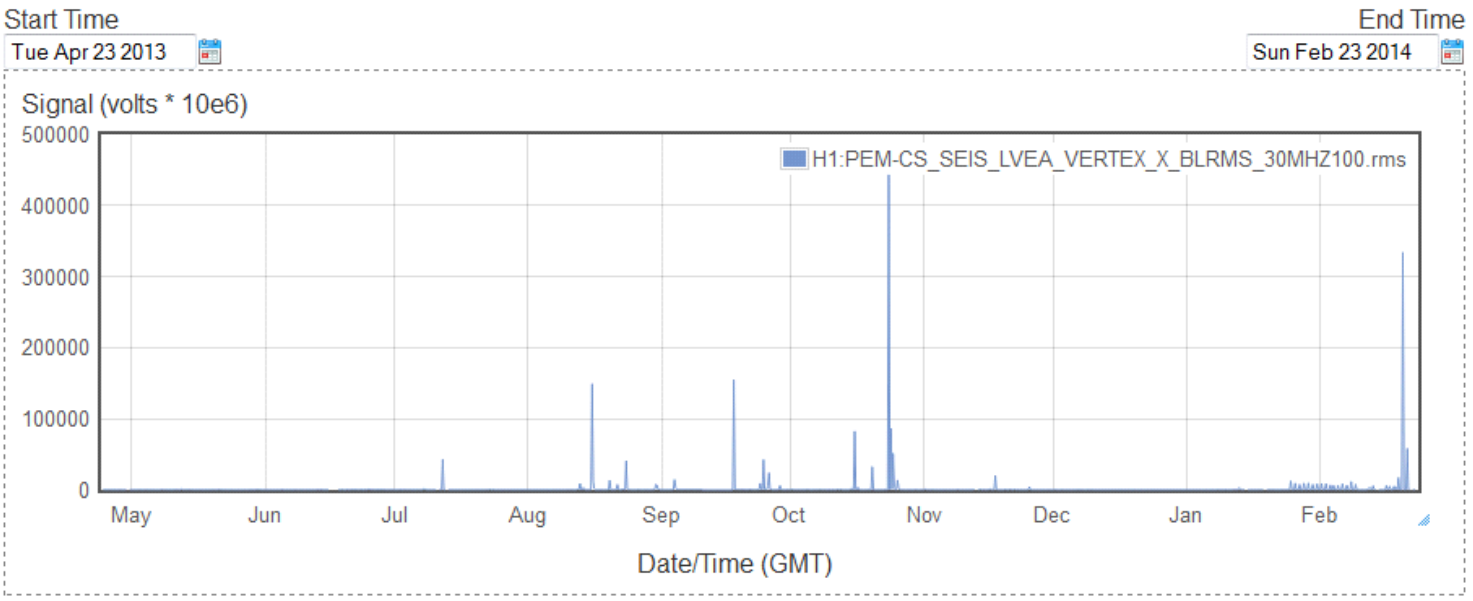
Add/Remove will allow you to look at multiple, overlaying plots of data
Site will allow you to choose between sensors at the two gravitational wave detector facilities. **H0** in the Bluestone **Site** field refers to LIGO Hanford Observatory in southeastern Washington. **L0** refers to LIGO Livingston Observatory in Louisiana.
Subsystem will allow you to select between three data subsystems:

- Data Monitoring Tool (DMT)
- Physics Environment Monitoring (PEM)
- Global Diagnostic System (GDS)

Station refers to the LIGO building in which a particular seismometer is located. LIGO Livingston has four stations, the LVEA (also called the corner station), the End X station (EX), the End Y station (EY) and a Vault. LIGO Hanford has the same four stations plus two more, the Mid X station (MX) and the Mid Y station (MY). The "Vault" stations are concrete vaults in the ground outside of LIGO's buildings.
Sensor allows you to select the specific sensor in the seismograph to examine. Each seismometer at LIGO contains three individual sensors labeled x, y and z. The x and y sensors measure horizontal vibrations in perpendicular directions, in the directions of the x and y arms of the interferometer. The z sensor measures vertical vibrations. In the DMT subsystem, data from each of these sensors on each seismometer is filtered into five different frequency bands. That's why you see so many entries on the sensor list in the DMT subsystem.
There are six seismometers at the LIGO Hanford site and four at LIGO Livingston, one in each station.
Sampling allows you to change between "Root Mean Square" and mean. Root Mean Square and is calculated by squaring each individual value in the data set, summing all the squared values, dividing the sum by the number of values and taking the square root. ***I recommend staying with RMS and leaving the other option alone***
The Data Filename is just a long, boring, and complicated method of describing what plot is being observed.

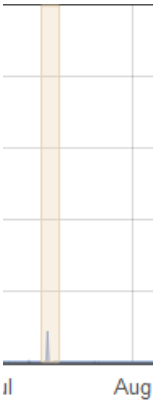
Once you have set your parameters, hit "Plot"

Step 4: Search through a sea of data points

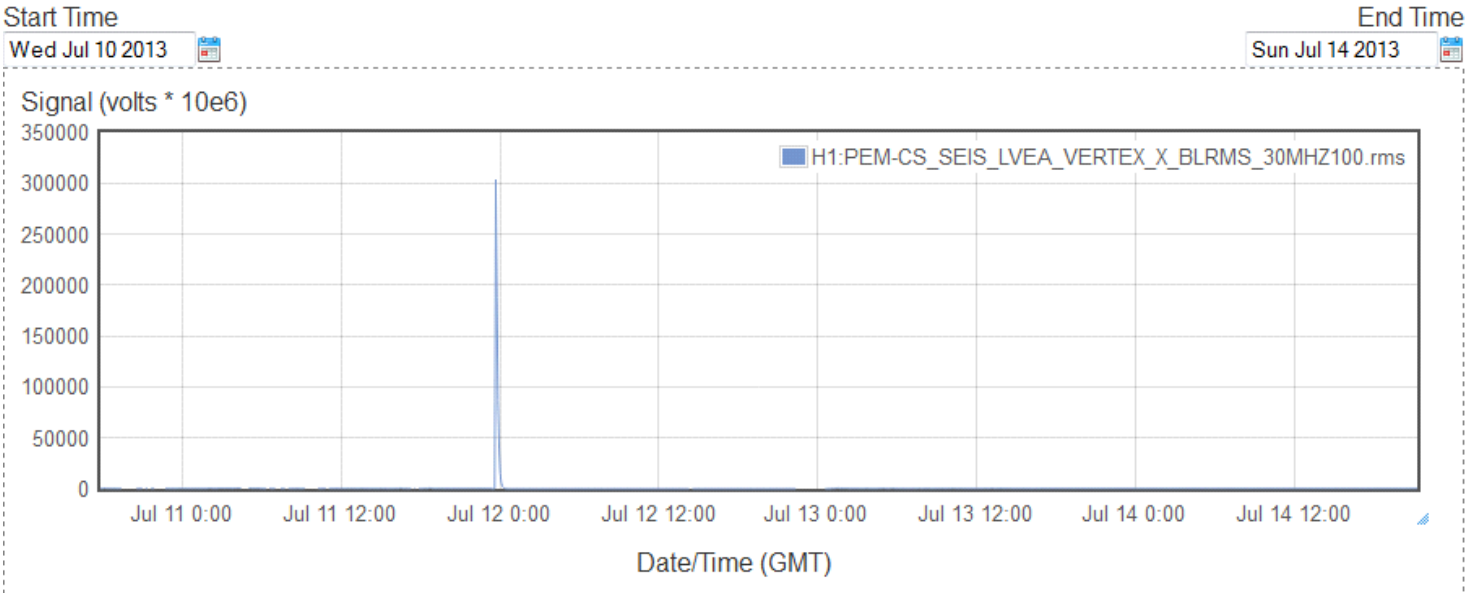


Your graph window should look a lot more interesting now.
Start time is the date this graph begins (will change as you narrow your plots)
End Time is the date this graph ends (see note above)
Signal (Y Axis) This is the strength of the signal larger spikes on the graph correspond with a larger disturbance in the force
Date (X Axis) This will begin to be divided into hours as your zoom in to a particular selection
Note GMT and UTC are essentially interchangeable. For the purpose of this activity, let's pretend they're one and the same

Now that we have this graph, select an area to investigate. Click and drag your mouse over the area until it is highlighted



Once you have this area selected, press the "Plot" button again



Note the Signal has autoscaled to better fit the window and the date now has hours on the X Axis. You may select and zoom again until your are satisfied.

Step 5: Decoding the signal

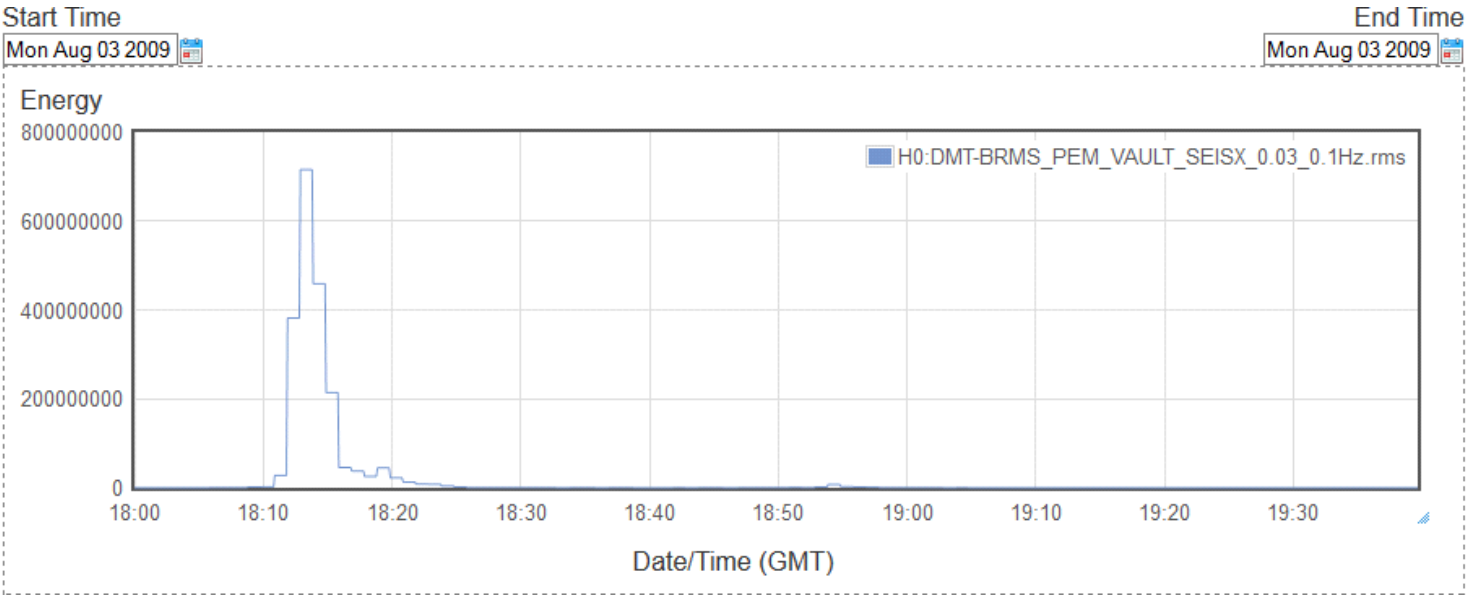
Now is the fun part. Go find what event made your spike! You can use Google, Wikipedia (one of the few times I will let you use it and get away with it), USGS, whatever! Find out what disturbances happened that day. Lots of these will be earthquakes, but some can be mine collapses, land slides, volcanoes, etc.

Step 6: Analyze the Data

After finding I would like you to find some basic information for ***five*** disturbances. To find distance, please use **46 27 18.528 N, 119 24 27.5657 W** for the Hanford LIGO and **30°33'42.9"N 90°46'34.6"W** for the Livingston LIGO. If the datum does not work for you, Google Maps does a fair good job getting you directions. You can use this calculator to find the distance between the disturbance event and the LIGO seismograph: http://boulter.com/gps/distance/

Please make a screen clipping of your data plot (step 4) and paste them below. Do this for each of your disturbances!

Name of event	Time of event (UTC)	Time LIGO registered the event	Location of Event (Lat/Long)	Focus depth (for earthquakes)	Distance from LIGO	Speed of wave	Justification for why you believe this to be the cause of the disturbance
1							
2							
3							
4							
5							



Screen clipping taken: 2/26/2014, 1:09 PM