Confessions of a Transient Organizer

Fred Raab

March 5, 1999

Confession:

- Offered to organize group at Aug 98 LSC meeting if interested parties forwarded statement of interests by Sep 99
- Underwhelmed by response -- Sorry!
- Diagnosed problem as due to lack of data stream
- Set out to get a data stream generated -- trickle has started
- Trying to get it together at this meeting

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Tranients in a Laser Interferometer

- Most detectability arguments for anticipated sources are based on smooth stationary gaussian noise spectra with $\Delta f \approx f$; is this reasonable?
- Excess (non-gaussian) noise must be eliminated through environmental vetoes and coincidence techniques.
- Coincidence strategies often assume stationary rates for non-gaussian events. For LIGO:

$$R_{TRIPLE} \approx \tau_{12}\tau_{13}R_1R_2R_3$$

where τ_{ij} refer to coincidence window widths and R_k refer to the post-veto singles rates for interferometers 1, 2 and 3.

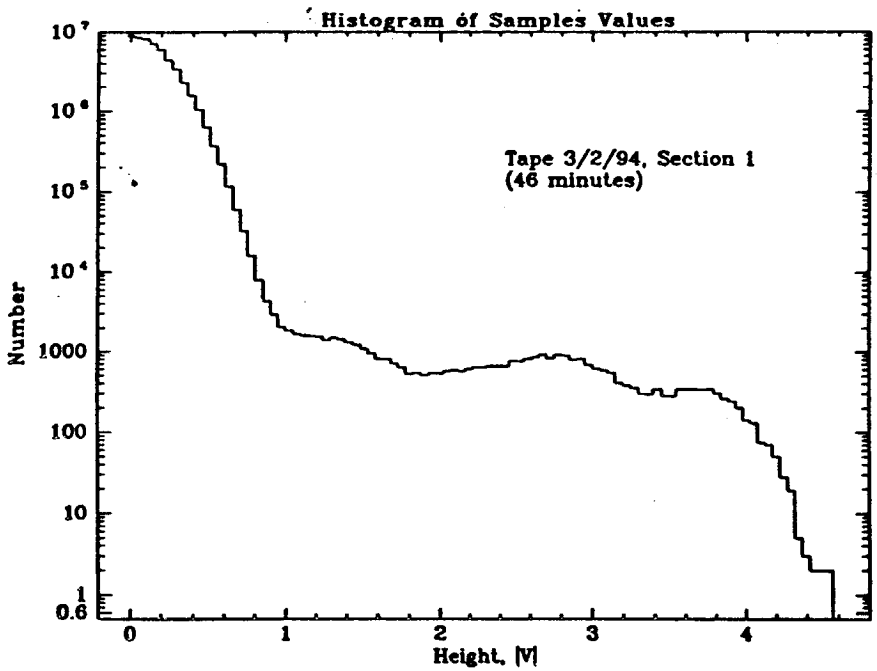
Why Worry About Transients?

- Transients may pollute searches for expected signals, but may not trigger sharply even in extensive template sets.
- Discriminators need to be developed to separate transient artifacts from expected signals.
- Templates are great for finding the expected, but surprises could get away! Ability to isolate rare transients is needed to identify new and surprising sources.
- Tool kit needed for identifying and characterizing "events". Automated technique allows concentration on rare events.
- We need to test "events" for stationarity.
- Sample histograms not very useful for wide-band channel.

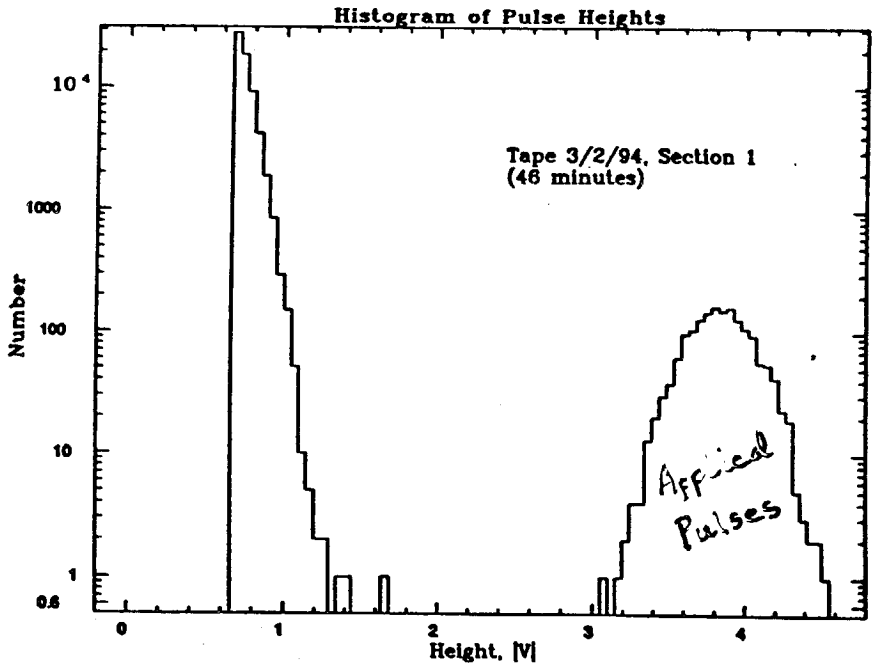
Utility of a Simple Event Finder Algorithm

- Threshold for event turn-on, variable dead time filter

Sample Histogram



Event Histogram



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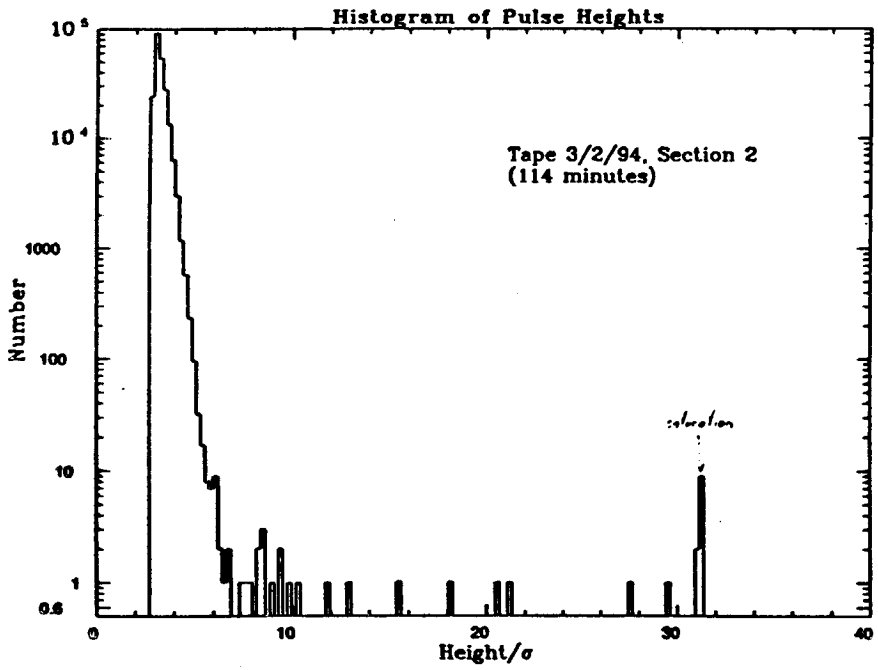
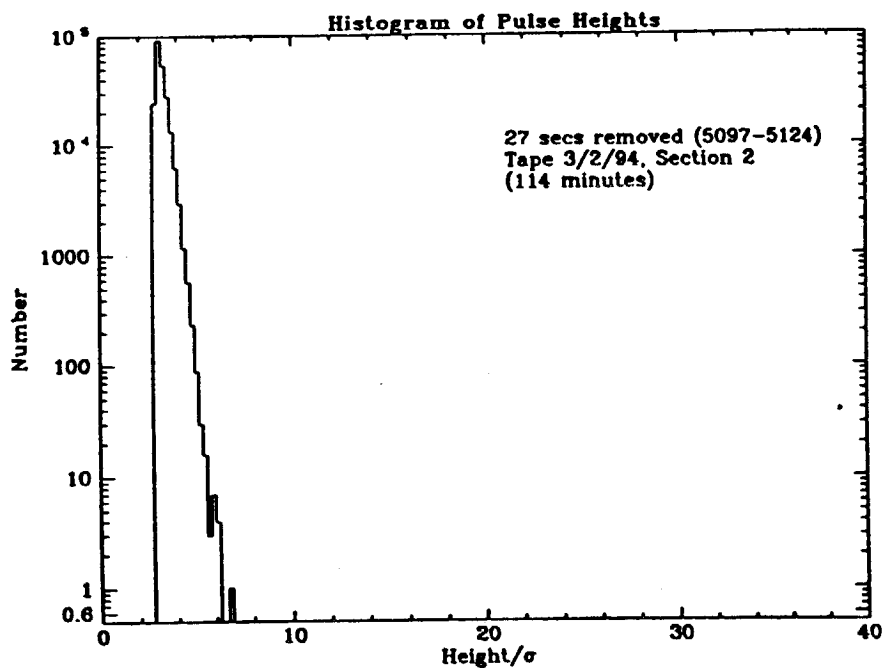
An Example of Non-Stationary Non-Gaussian Events

- Event histogram for this locked section is almost purely gaussian, except for a "minute" interval:





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Findings From Preliminary Look at 40-Meter IFO Data

- Observed non-gaussian events are non-stationary
- Events vary in character: clicks, "the scraper", "the howler", "the whistler", etc.
- Causes which have been identified:
  - ››higher-order transverse optical modes
  - ››maladies in test-mass damping servos
  - ››connector noise
  - ››edge effects on photodiodes
- Promising news: event rates are sometimes very low!
- To keep rates always low will require comprehensive data on machine status and environment.

How to Get Going (Step 1)

- Look over web page at http://apex.ligo-wa.caltech.edu/sub_transient.html
- Send e-mail with material to list your group as members of the LIGO Working Group on Transient Analysis Techniques
  - ››institution
  - ››who (names, e-mail addresses, optional phone numbers)
  - ››previous (related) work & interests to pursue
  - ››indicate whether "serious time" or "keeper upper" category
- Postings will be made to an "Active Groups" web page with separate (passworded) directory

Listing Example

LIGO Hanford Observatory

Fred Raab raab_f@ligo.caltech.edu 509-372-8125
Rick Savage savage_r@ligo.caltech.edu
Daniel Sigg sigg_d@ligo.caltech.edu

Previous Work &/or Area of Interest:

Fred and Torrey Lyons have developed a simple event-finding algorithm for 40-meter and used it to characterize glitches from the 40-meter interferometer. Rick has begun a monitoring EPICs data from the 2K PSL at Hanford, since mid-December, 1998 and Daniel has been coordinating programming work on the Global Diagnostics System for LIGO. We hope to begin running frequency-banding and event-finder routines on LHO seismic data by this summer. Norm Graham, a physics teacher at Kamiakin High School in Kennewick, WA, will work with us this summer and then form a student/teacher team to hunt for correlations between seismic events and activities in the surrounding communities, such as traffic, railroad actvity, dam operations, Hanford Works operations, etc. We hope to extend these techniques to other LHO subsystems as they come on line in 99.

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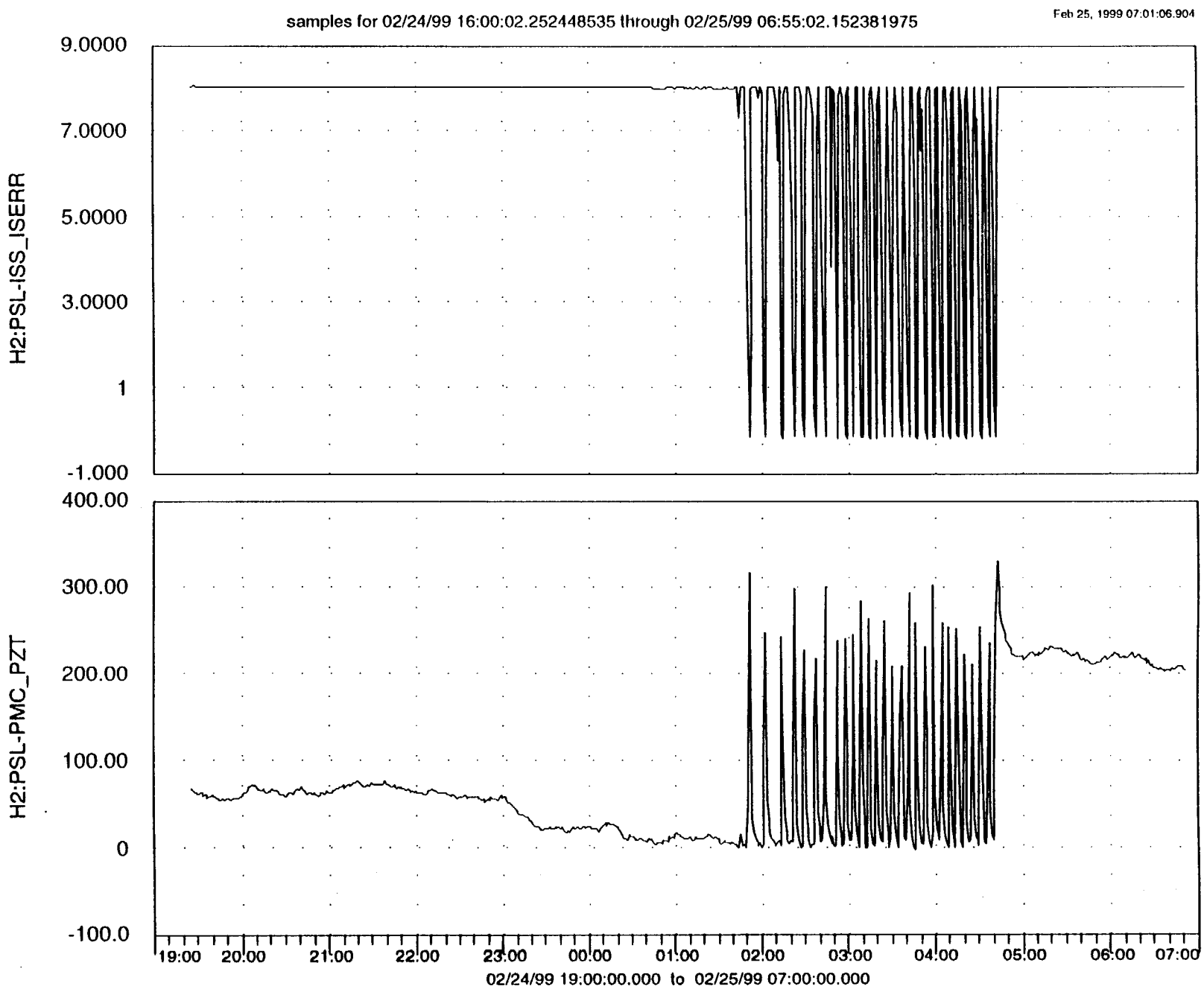
How to Get Going (Step 2)

- Start coordinating "serious time" work on transients, with MOUs, grant proposals, etc., reflecting these commitments.
- Establish regular meetings to establish work directions, review work accomplished and coordinate future activities.
- Get a data stream going!
  - ››40-meter data still available
  - ››LHO PSL on line since mid-December
  - ››LHO PEM coming on-line, beginning mid-February
  - ››simulated data sets available in ????
  - ››LHO Mode Cleaner data by mid-99?
- Develop & test software on LHO 2K data by early 00

LIGO


samples for 02/24/99 16:00:02.252448535 through 02/25/99 06:55:02.152381975
Feb 25, 1999 07:01:06.904
H2:PSL-ISS_ISERR
9.0000
7.0000
5.0000
3.0000
1
-1.000
H2:PSL-PMC_PZT
400.00
300.00
200.00
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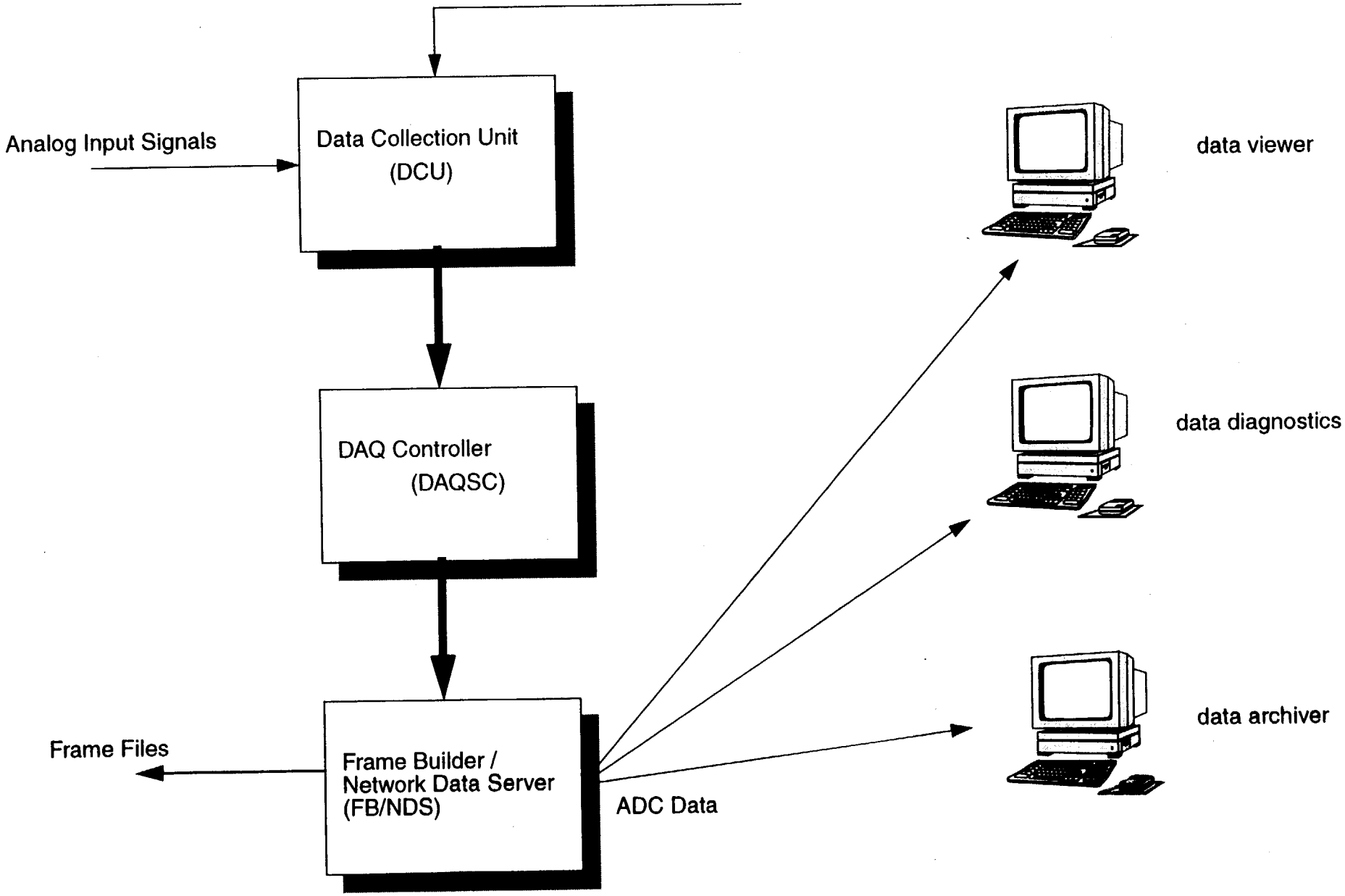
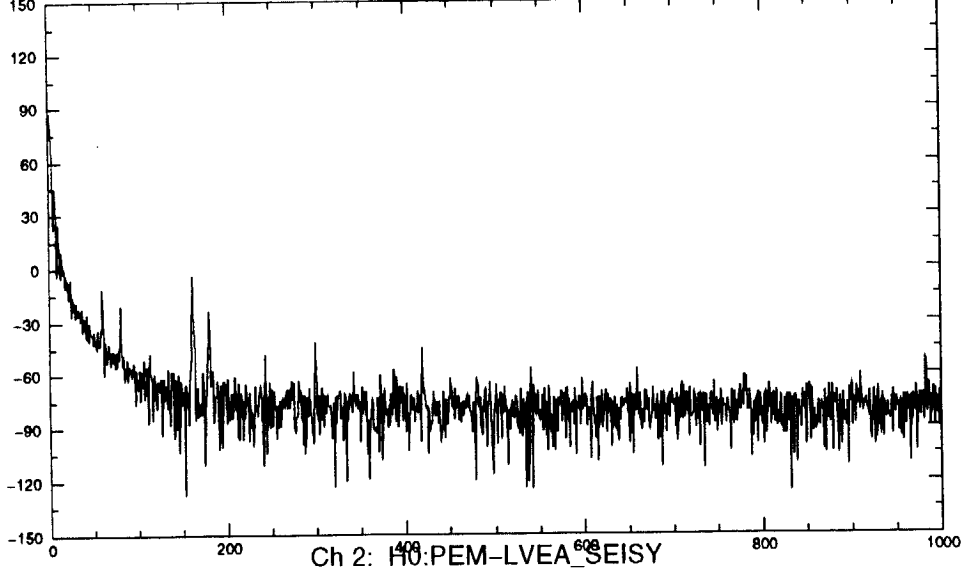
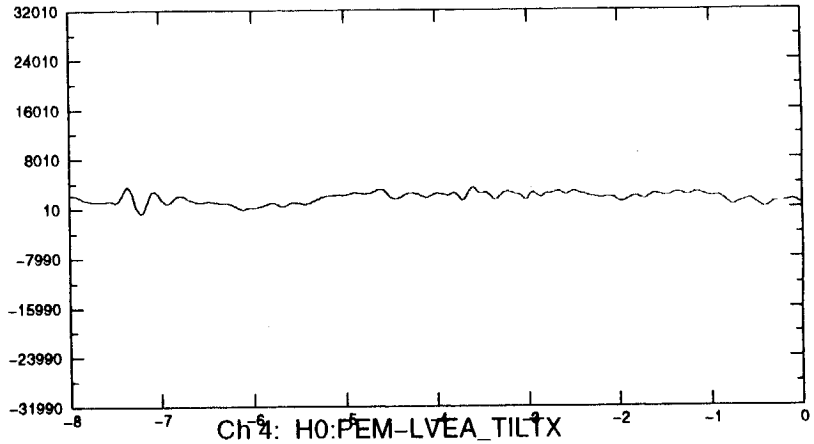


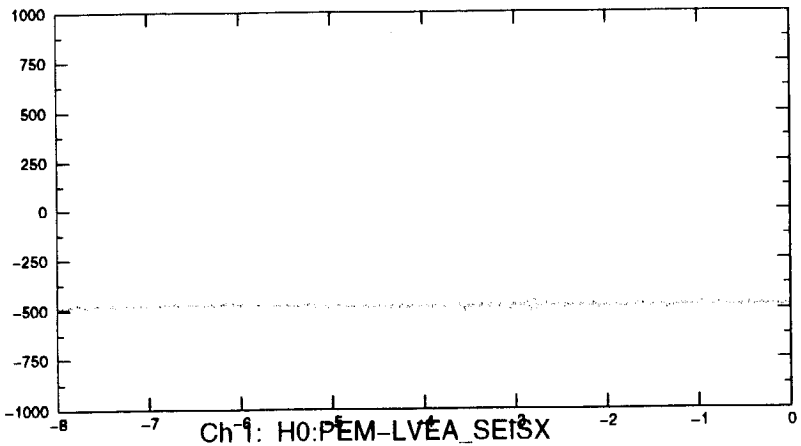
LHO DAQ Overview.



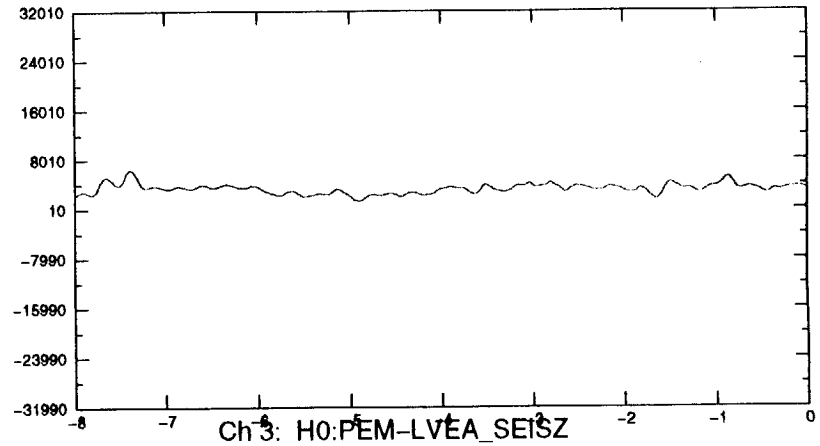
Ch 5: H0:PEM-LVEA_TILTY



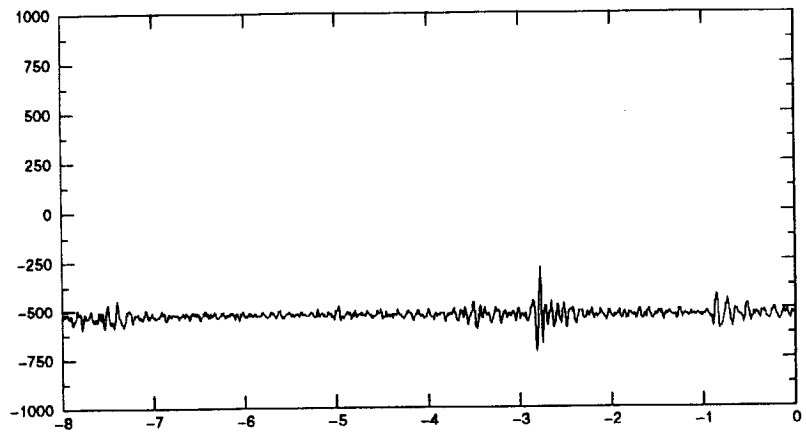
Ch 2: H0:PEM-LVEA_SEISY



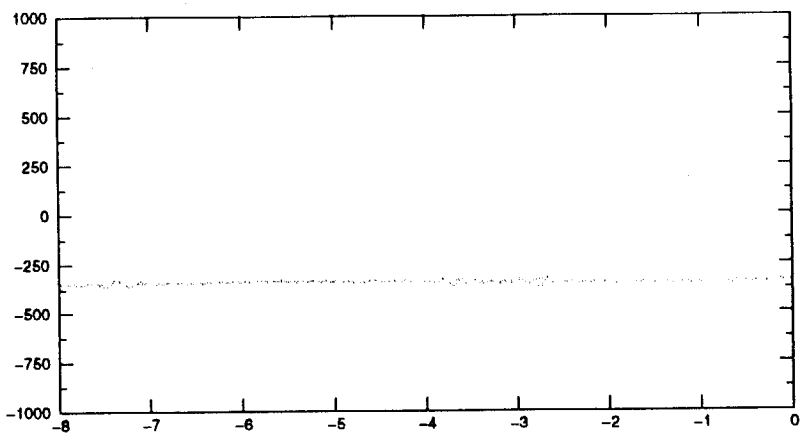
Ch 4: H0:PEM-LVEA_TILTX



Ch 1: H0:PEM-LVEA_SEISX



Ch 3: H0:PEM-LVEA_SEISZ



Channels Up by Summer 99

1) All five weather stations:

   ›› one per station building

   ›› .temperature inside and outside the building

   ›› .wind speed and direction

   ›› .barometric pressure inside the buildings

- 2) All five seismometers (three axes):

   ›› one per station building

- 3) Accelerometers (three axes) and microphones on HAM7 and HAM8 (i.e., mode cleaner)
- 4) PSL fast channels
- 5) IOO (mode cleaner) fast channels

Future Plan

- Transients working group home page is posted
  ››http://apex.ligo-wa.caltech.edu/sub_transient.html
- Flesh out membership page and directory page at this meeting and post on Monday, March 8
- Get posting directory for incoming postings and mark ups in place by Monday, March 15
- Start flesh out of menu page (ready for sign-ups and delivery dates) and get it posted by April 1
- Organize by e-mail, with telecons & meetings if needed