Detector Characterization Needs

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LIGO

The Next Year

Likely to start S5 run sometime before the end of 2005

- **24/7 operations for 6 months? 1 year?**
- **Will want the analysis to keep up**
- **Timely detector studies & data quality flagging will be challenging**

Fred's AstroWatch proposal (next talk) requires comparable level of effort between now and S5

So what support do we need in detector characterization?

Detector Characterization Needs - Categories

Real time (~1 minute latency):

- **New or improved DMT background monitors for figures of merit and alarms**
- **New or improved interactive tools for investigations**
- **More scientists at the observatories**

Online astrophysical analysis (~1 hour latency):

- **Good calibration information (in good shape already)**
- **First-order data quality information (much work needed in automation)**

Offline analysis (~week to ~month latency):

- **Refined data quality information (requires human vetting)**
- **Intensive or long-integration detector studies**

Real-Time Needs

New or improved background DMT monitors we'd like to have:

- **Specific glitch finders: (thanks to Fred for many suggestions)**

-- Optical lever lasers (*)
-- Dewar creaks (*)
-- Airplanes (*)
-- DAC's
-- ADC saturation (*)
-- Photodiode saturation (*)
-- Dust
-- Coil saturation
-- Gimpy cable
-- Tank firings
-- Well explosions
-- Oil pipeline turbulence
-- Excitation channel goofups (*)
-- Things we don't yet know about (!)

(*) Some work ongoing - but not yet ready/complete or some uncertainty in delivery time

Patrick Brady: "How could we embarrass ourselves in the future?"

One answer: By not vetoing problems we already know about or problems we should have known about

Real-Time Needs

New or improved background DMT monitors (cont):

- **Servo control artifacts:**

  Unity gain frequency too high (or too low!) – induced oscillations

- **Migration of offline analyses to online DMT (e.g., KleineWelle!)**

- **Integration of known offline data quality trigger thresholds into alarms**

  Should be straightforward, but shouldn't fall through a crack

- **Taking over orphaned SpectrumArchiver monitor**

  -- Almost useful now, but spectral choices need attention

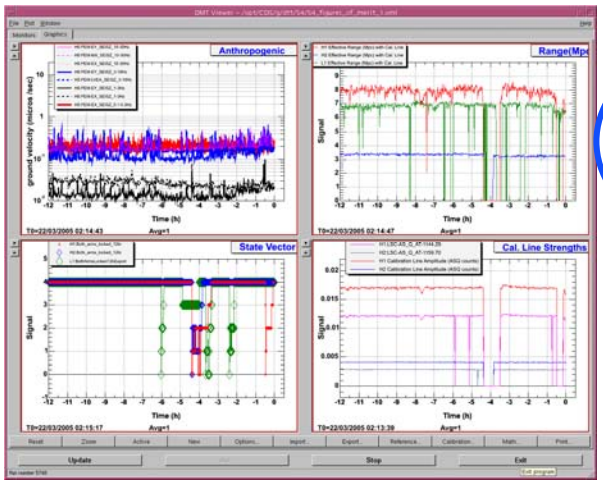
  -- DTT retrieval of spectra is too cumbersome

- **Maintaining existing monitors between data runs – Complete documentation**

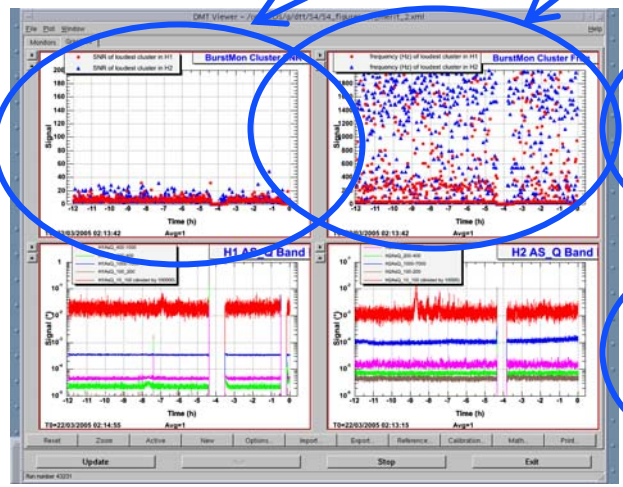
Real-Time Needs

New since the S3 run

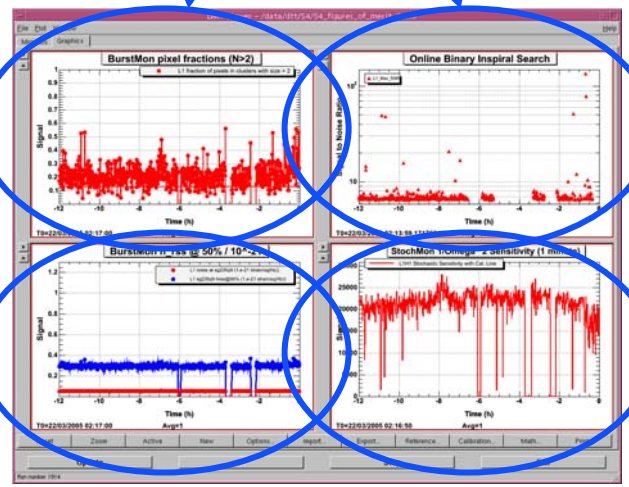
Sampling of S4 figures of merit on control room walls (this morning)



LHO FOM1



LHO FOM2



LLO FOM3

Challenge:

Can you make a figure of merit good enough to replace one of these FOM's?

(or useful enough to convince Fred and Mike to buy another projector)

Real-Time Needs

It's not trivial to meet that challenge:

- **DMT infrastructure is easy to plug into – lots of bells/whistles to exploit**

  (if DMT already installed, that is)

- **BUT writing code is small part of required effort**
  - **Must validate code to run online 24/7 (e.g., no memory leaks)**
  - **Must tune configuration parameters to give useful results**
  - **Must keep parameters tuned as interferometers improve**
  - **Must document both code and usage**
  - **Must be attentive to online monitor output and respond to bug reports**

Real-Time Needs

New or improved interactive tools for investigations

- **Spectrograms / Rayleighgrams (RayleighMonitor – P. Sutton)**

  (Works well in scroll / real-time mode – need easier pointing to recorded data)
- **Bilinear noise measure (BicoViewer – S. Penn)**

  (Ditto)
- **Matlab tools for quick studies (again, easier pointing to data is key)**

Real-Time Needs

Need more scientists at the observatories carrying out investigations

Why do investigations at Hanford or Livingston?

- **Easy access to all channels (real-time or playback)**
- **Interferometer experts on hand for consulting – Learn something new!**
- **Invasive tests possible**
- **Excellent training for students & postdocs**

→ **Must nurture next generation of experimenters**

Real-Time Needs

More scientists at the observatories (cont)

Where is help needed?

- **Calibration measurements & modelling (!!!)**
- **Tracking down, fixing excitation channel glitches / dropouts**
- **Studies of duty cycle: what limits it, what causes lock losses; improvements**
- **Studies of drifts, extreme controls values & operating conditions**
- **Studies of bilinear effects (upconversion)**

→ **Data quality; effects on astrophysics searches**

Real-Time Needs

Scimons can help!

But new scimon model is needed:

- **Too many scimons lost at sea, despite verbose web page instructions and last year's detector investigation camp archive**
  - **Inadequately trained**
  - **Unenthusiastic – unconvinced of usefulness**
- **Need knowledgeable and engaged scimons**
  - → **Fewer scimons doing more shifts per scimon seems desirable**
  - → **Long stays at the observatories to do shifts and investigations**
  - → **Natural to carry out investigations relevant to one's analysis group**
  - → **More effective and likely cheaper due to reduced travel overhead**

Online Analysis Needs

Good calibration information

→ **With DARM_ERR channel, should be in very good shape already**

→ **Imminent real-time h(t) generation will be even nice**

First-order data quality information

→ **We already know of some conditions to flag without further investigation**

→ **Need to automate DQ flag "publishing" with latency < 1 hour**
(remove KR bottleneck)

→ **Technical details to be worked out with DASWG folks**

→ **Some DMT authors will need to assist**

→ **Volunteers for infrastructure development welcome**
(eg., database tools)

Offline Analysis Needs

Refined data quality information (requires human vetting)

- **Need scientists willing to take responsibility for regular (e.g., weekly) updates of database data quality information based on particular investigations**
- **Need infrastructure flexible enough to allow automatic updates, manual updates and correction of errors – Revision of flags will occur!**

Intensive or long-integration detector studies

- **Studying / fixing H1-H2 coherence via auxiliary channel studies**

  (stochastic analysis)
- **Studying / fixing instrumental lines in GW channel**

  (pulsar and stochastic analysis)