Status of StochMon

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Stochastic Figure of Merit

Basis for figure of merit: Assuming flat GW spectrum ($\Omega_{\mathsf{GW}}(f) = \text{constant}$), the stochastic background strength we could detect in time T is Ω_{s}:

$$\frac{1}{\Omega_{\mathsf{s}}^2} \propto T \left(\int_{f_{\mathsf{min}}}^{f_{\mathsf{max}}} df \frac{\gamma^2(f)}{f^6 P_1(f) P_2(f)} \right)$$

- Use Ω_{s}^{-2} instead of Ω_{s} so sensitivity grows linearly with observation time.

- $P_1(f)$ & $P_2(f)$ are (calibrated) noise PSDs of two detectors

- $\gamma(f)$ is the overlap reduction function (known function of frequency, $\equiv 1$ for H1-H2)

Overlap Reduction Function
LIGO-Livingston / LIGO Hanford
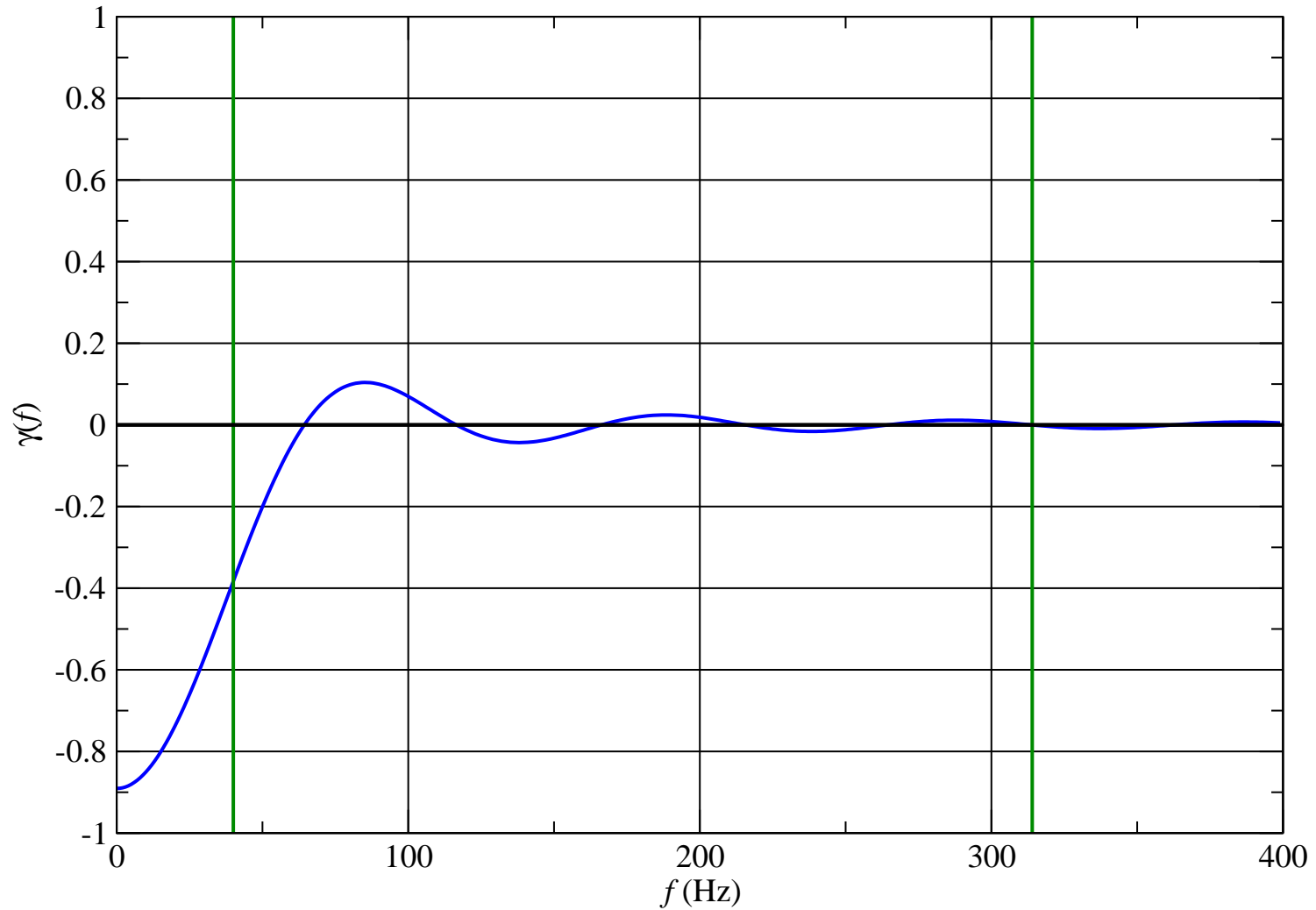
(For correlations between LHO 2km & LHO 4km, $\gamma(f) \equiv 1$)
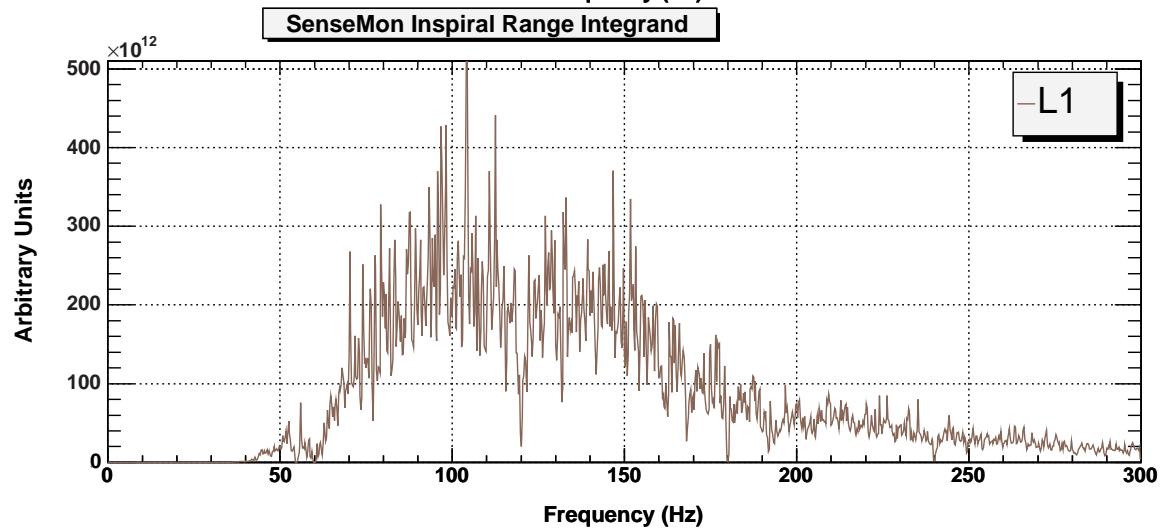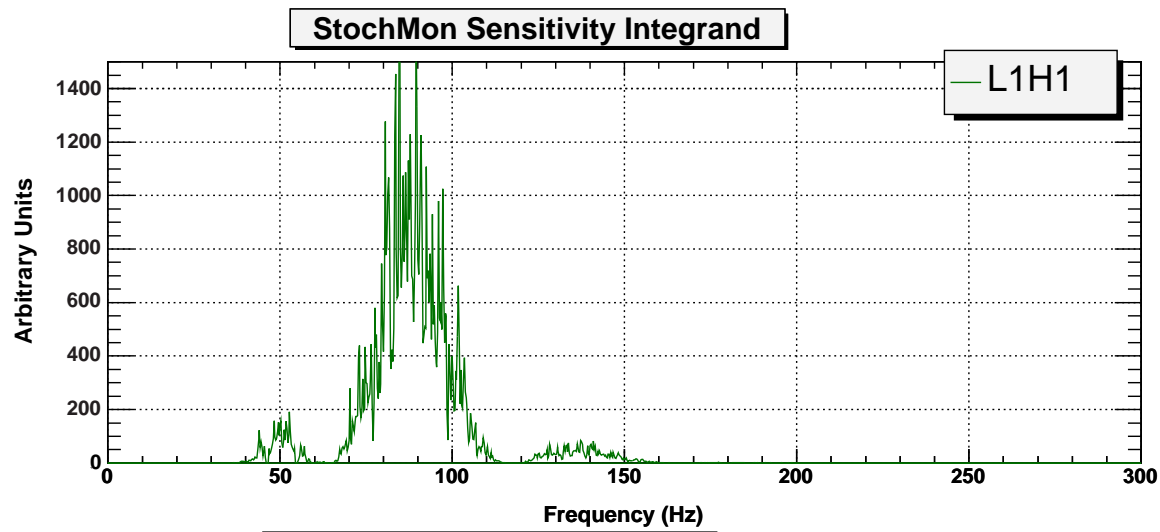
Developments since August

- StochMon now working and running online at both sites

- Overlap reduction function implemented

- StochMon updated to use new EZCalibrate class
  (thanks to P. Sutton for help)

StochMon in S4

- Versions running online(S4): H1H2 H2H1 H1L1 L1H1

- PSD for first IFO is calculated in real time;
  PSD for second IFO is a "good reference spectrum"

- Present reference spectra taken early in S4 from the output
  of SenseMonitor and StochMon

StochMon vs SenseMonitor

StochMon Sensitivity Integrand

L1H1

Arbitrary Units

Frequency (Hz)

SenseMon Inspiral Range Integrand

L1

Arbitrary Units

Frequency (Hz)

T0=22/03/2005 20:45:47   Avg=15

S4 Benchmark Values

- What is a typical FOM for StochMon?

  S4 Stochastic sensitivity benchmark values:

  StochMon_L1H1 or StochMon_H1L1 $\longrightarrow 2.6 \times 10^4$
  (using L1_CalPSD_GPS_793481866.txt
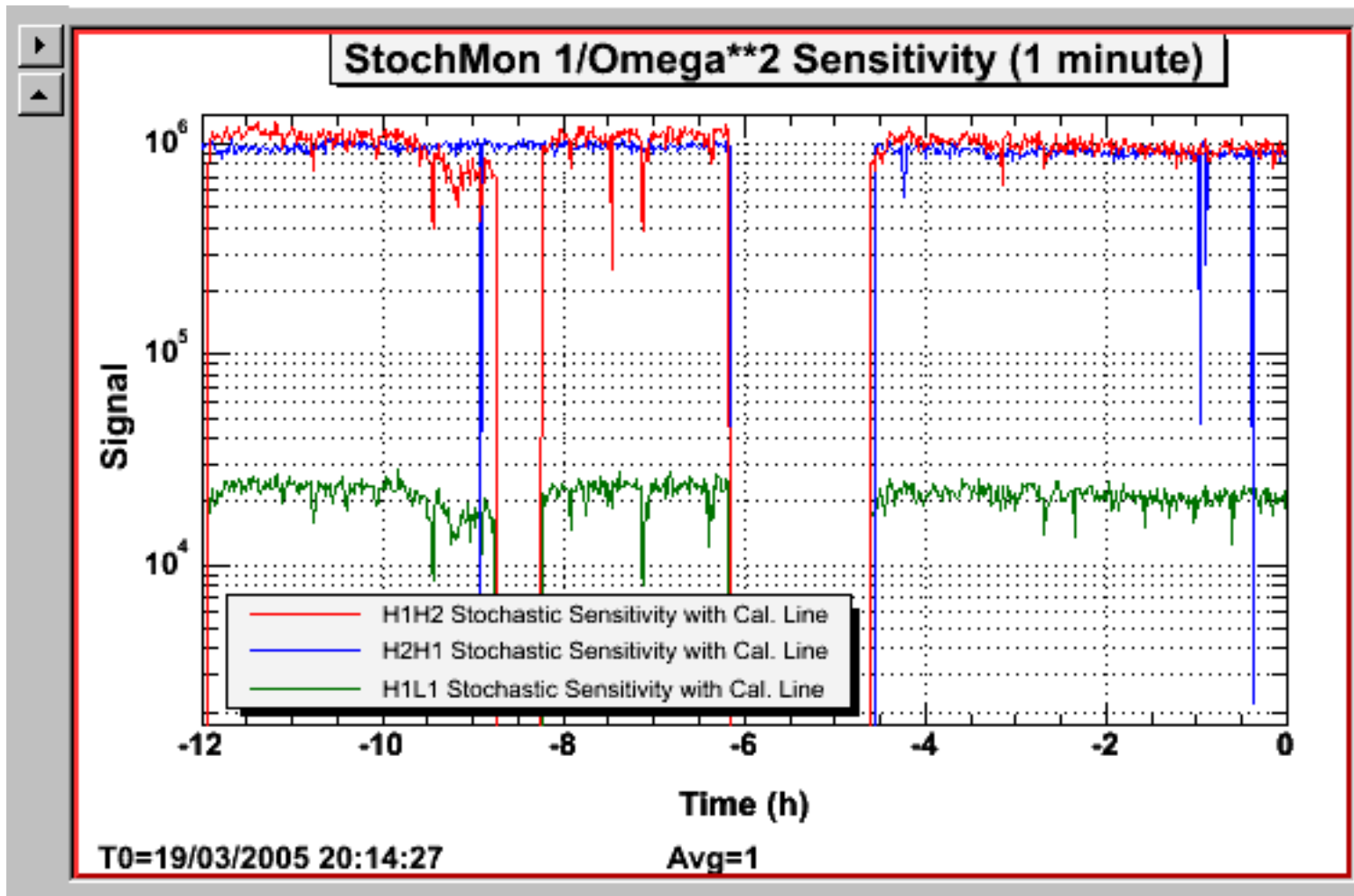 and H1_CalPSD_GPS_793443300.txt)

  StochMon_H1H2 or StochMon_H2H1 $\longrightarrow 1.3 \times 10^6$
  (using H1_CalPSD_GPS_793443300.txt
  and H2_CalPSD_GPS_793481321.txt)

- Running for one year at this noise level, detectable background (Ω_s) would be 8.5×10^{-6} (L1/H1) and 1.2×10^{-6} (H1/H2)
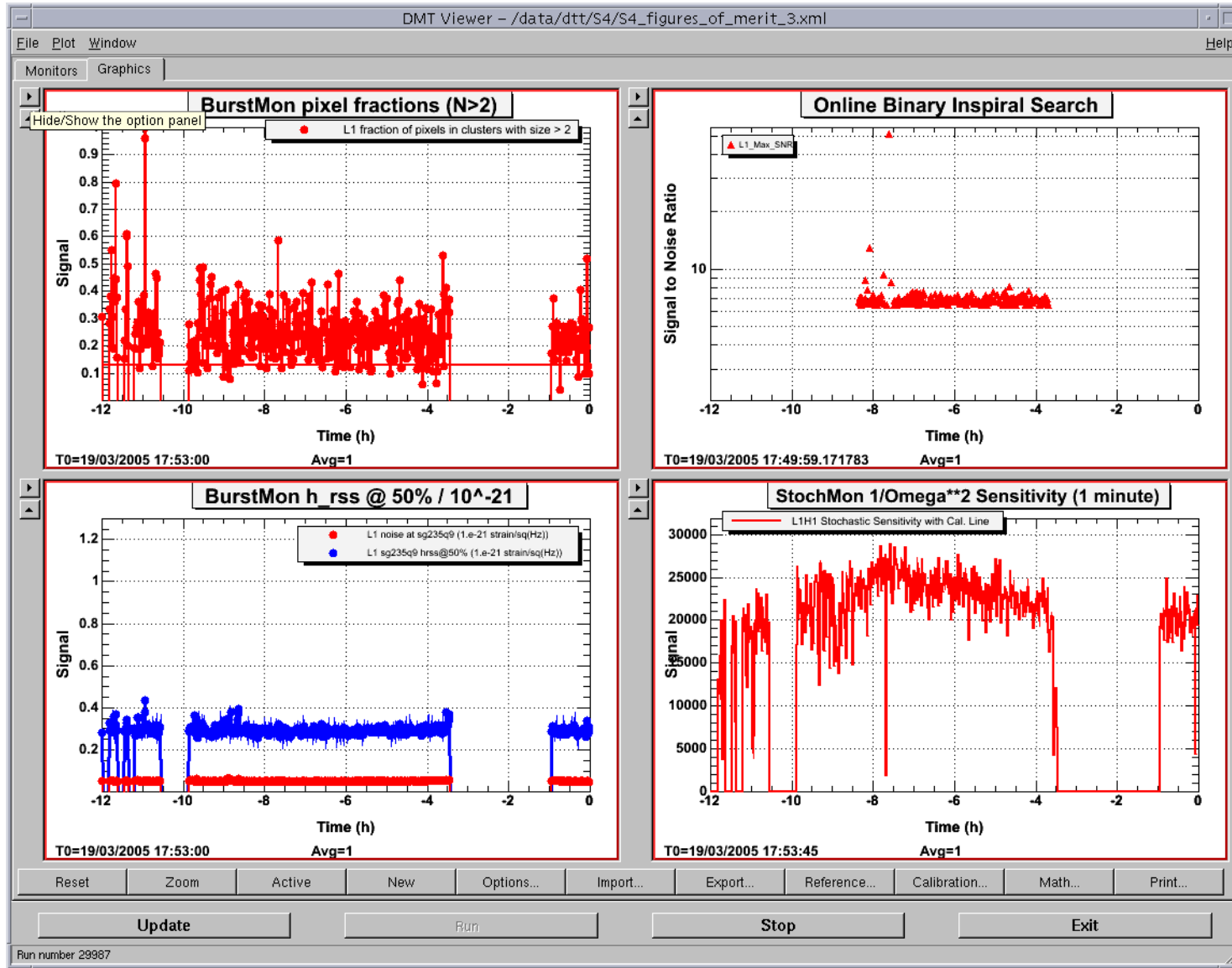
Astro FOM Display from Hanford
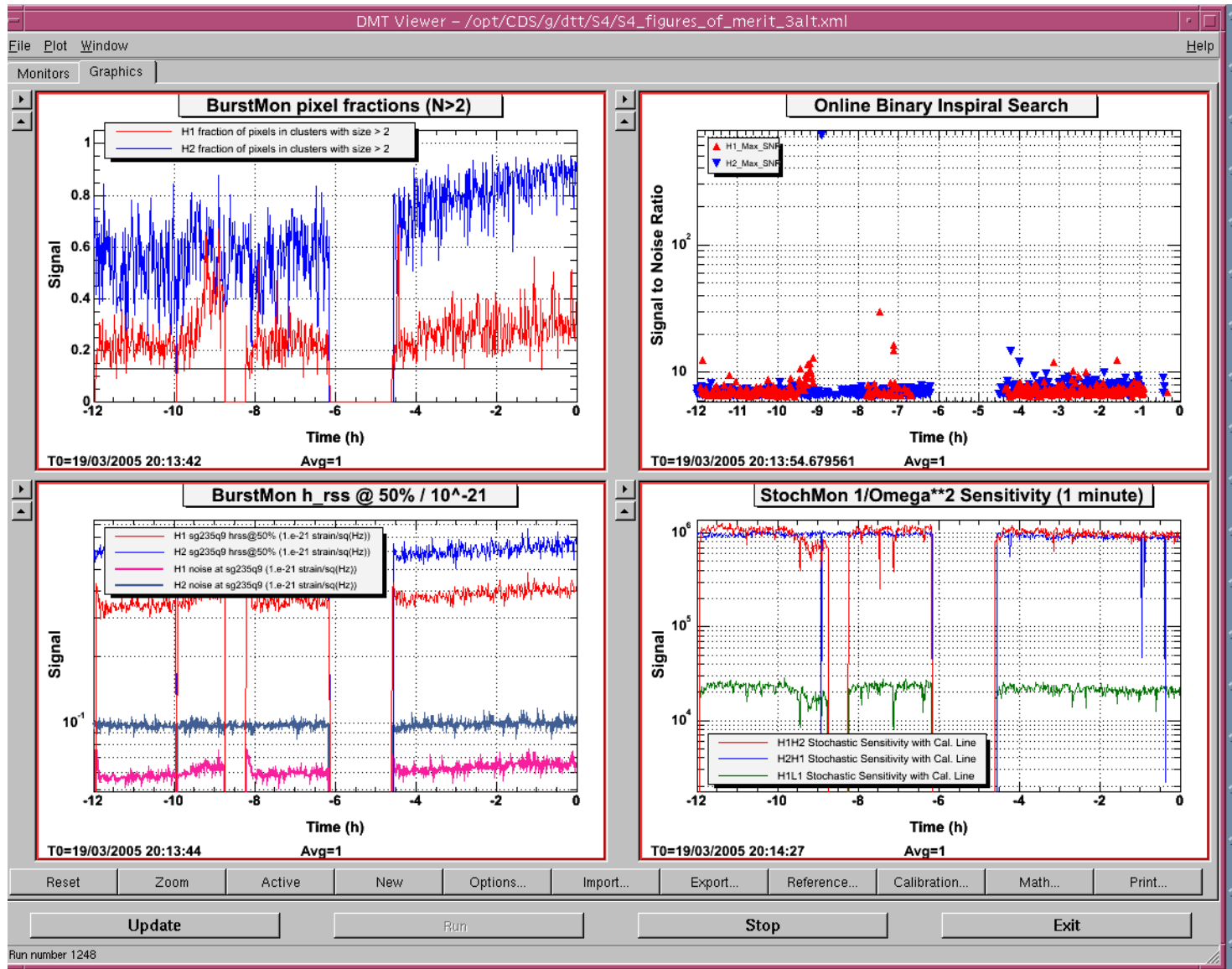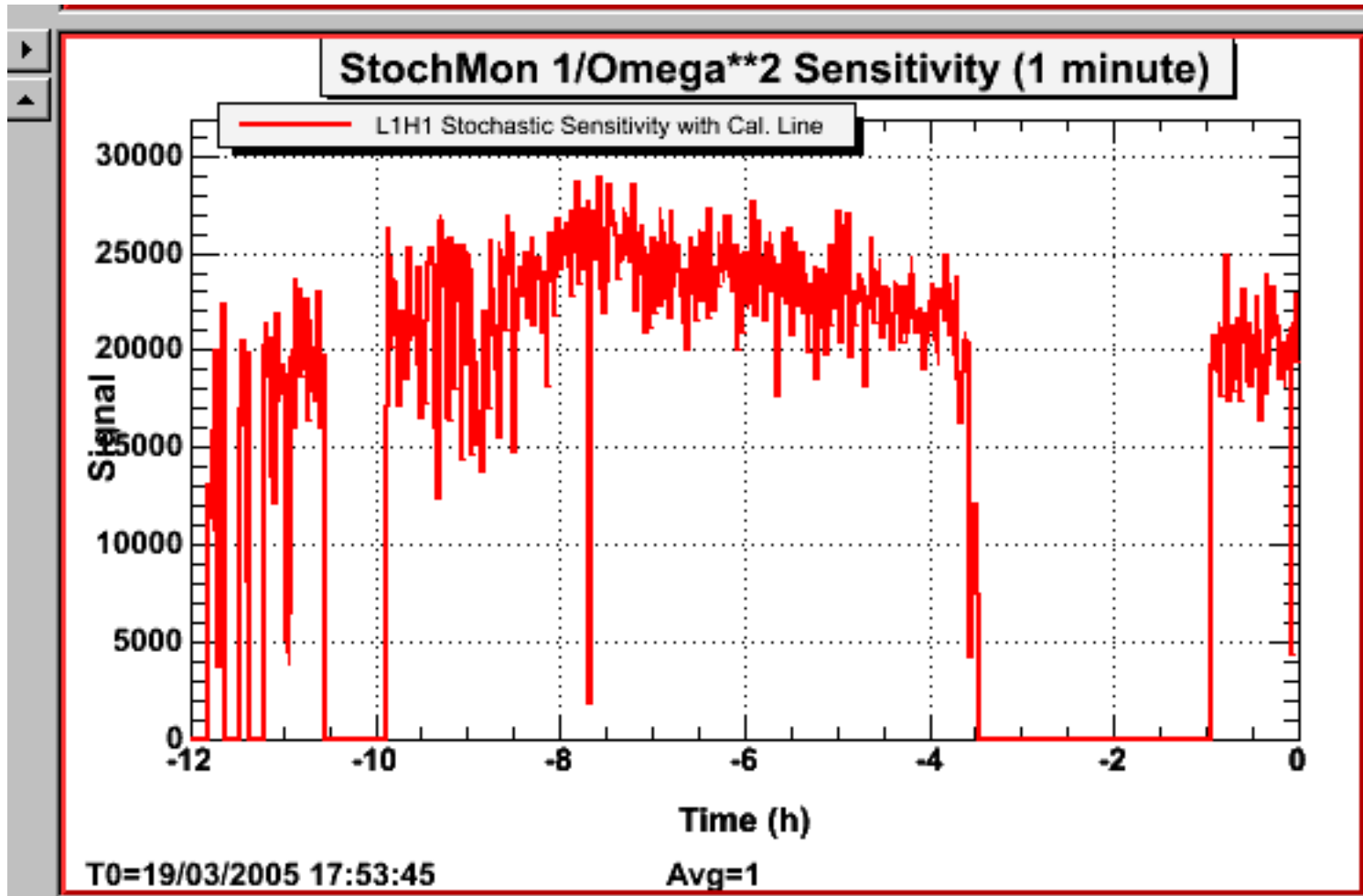
StochMon Traces from Hanford

Note: Vertical scale should really be linear
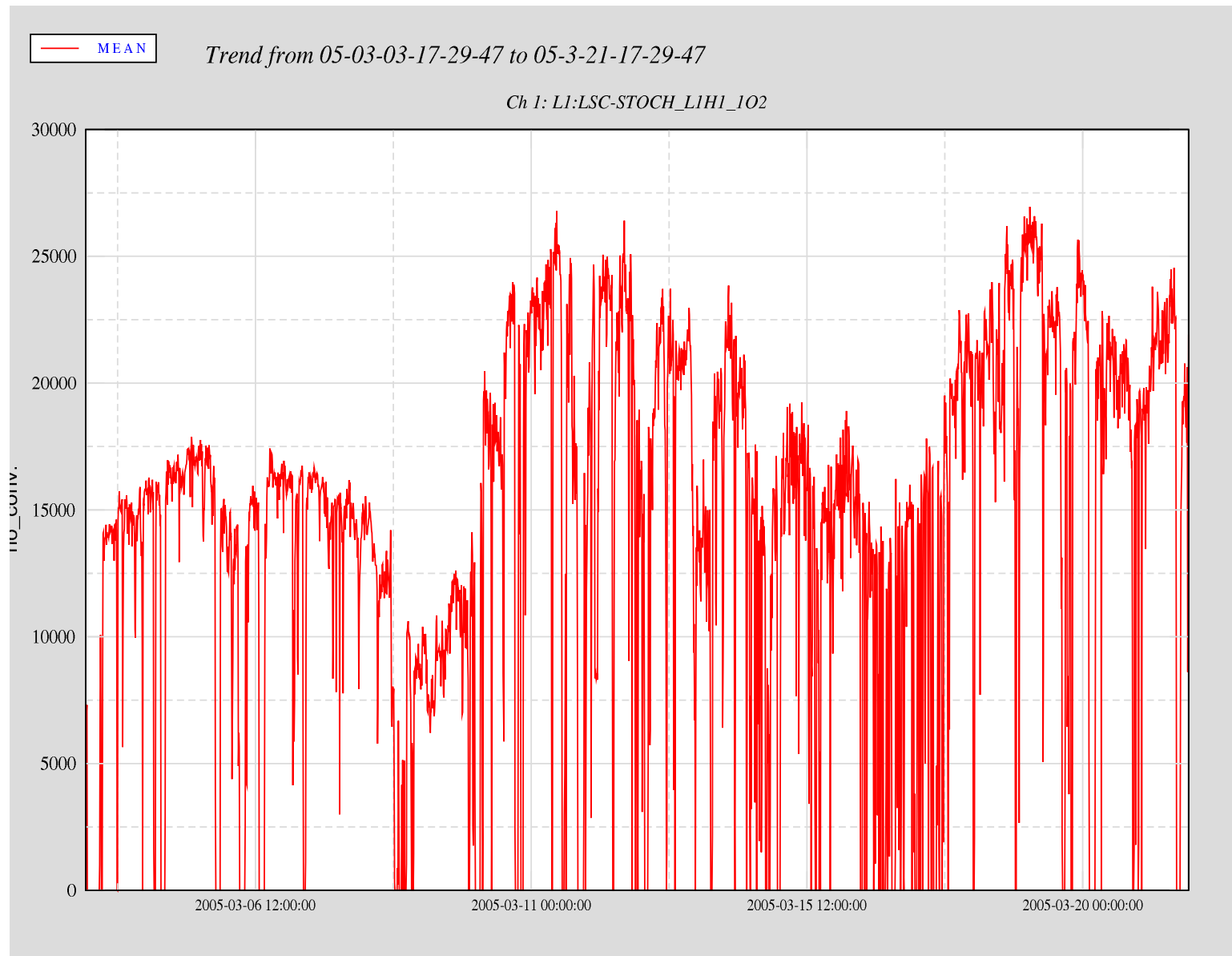
Astro FOM Display from Livingston

StochMon Trace from Livingston

Note: Area under curve is cumulative sensitivity

Weeks-long Time Series for S4

Trend from 05-03-03-17-29-47 to 05-3-21-17-29-47

Ch 1: L1:LSC-STOCH_L1H1_1O2

Planned Enhancements

- Clean up (channel names, file parsing, etc)

- More control over output by-products
  (some redundant with SenseMonitor)

- Output Ω_s as well as $\frac{1}{\Omega_s^2}$

- Add functionality to measure both PSDs in real-time