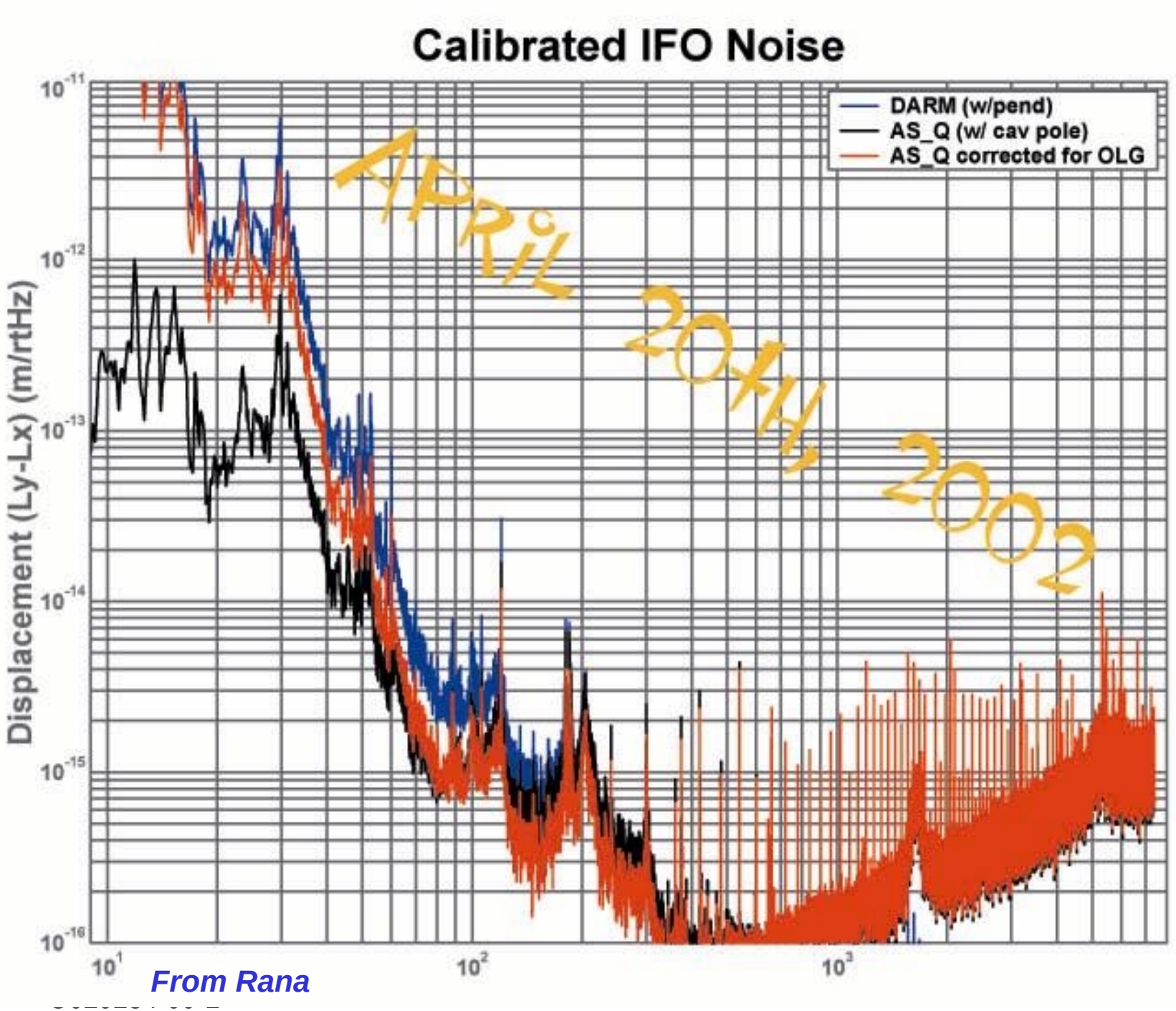
LIGO Livingston Observatory Commissioning Status and Proposed Commissioning Activities Prior to S1

Mark Coles

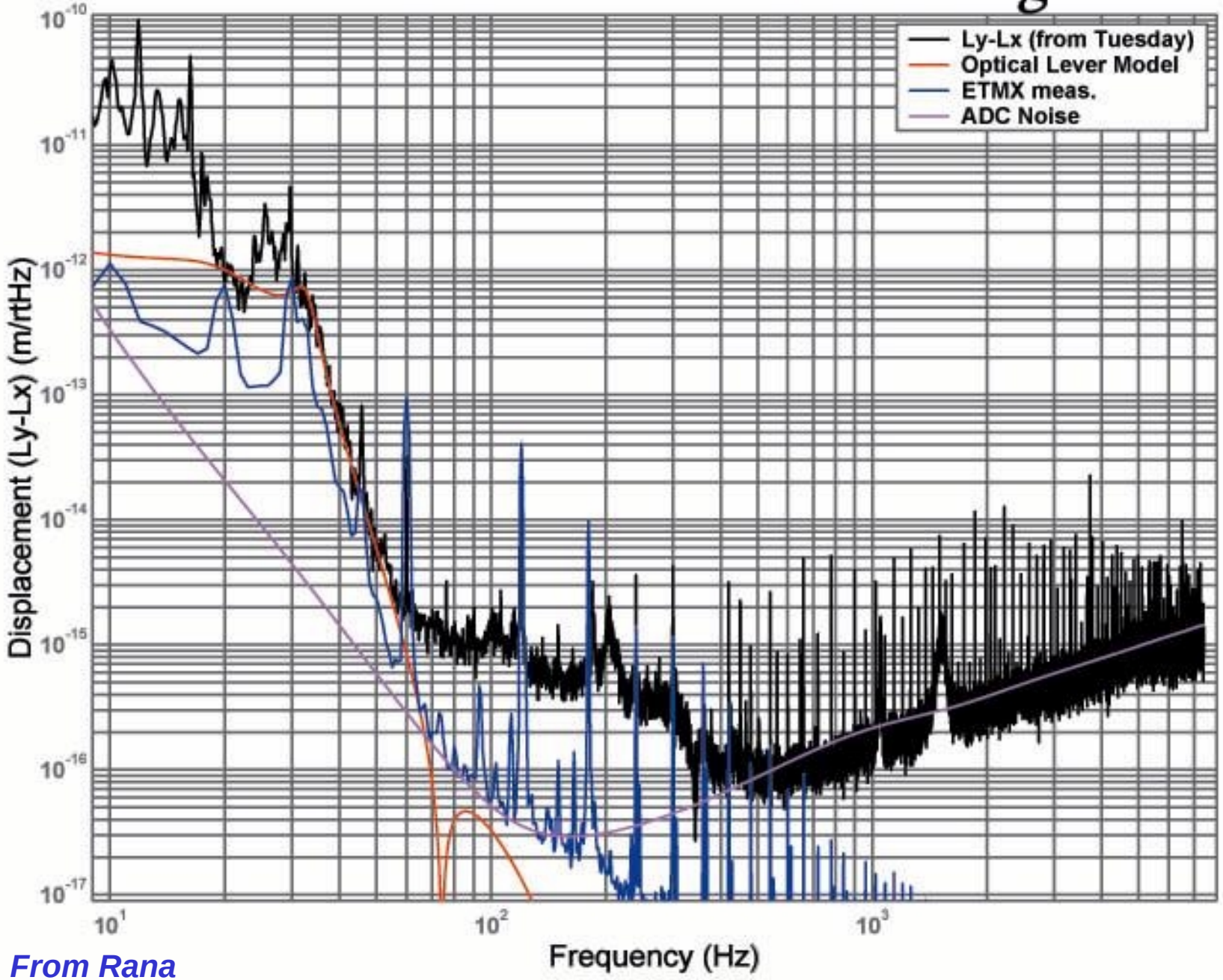
May 13, 2002

LLO Status

- Power recycled locking during periods of low seismic activity
- Tidal feedback servo installed – can maintain recycled lock for hours
- Microseismic feedforward working since before E7
- Wave front sensors – WFS1 works, other installed but not yet tuned up
- Alterations to filters on optical levers and MC have improved noise performance and lock robustness. Transverse beam motion within interferometer is now very small


Calibrated IFO Noise
DARM (w/pend)
AS_Q (w/ cav pole)
AS_Q corrected for OLG
APRIL 20TH, 2002
Displacement (Ly-Lx) (m/rtHz)
10^-11
10^-12
10^-13
10^-14
10^-15
10^-16
10^1
10^2
10^3
From Rana

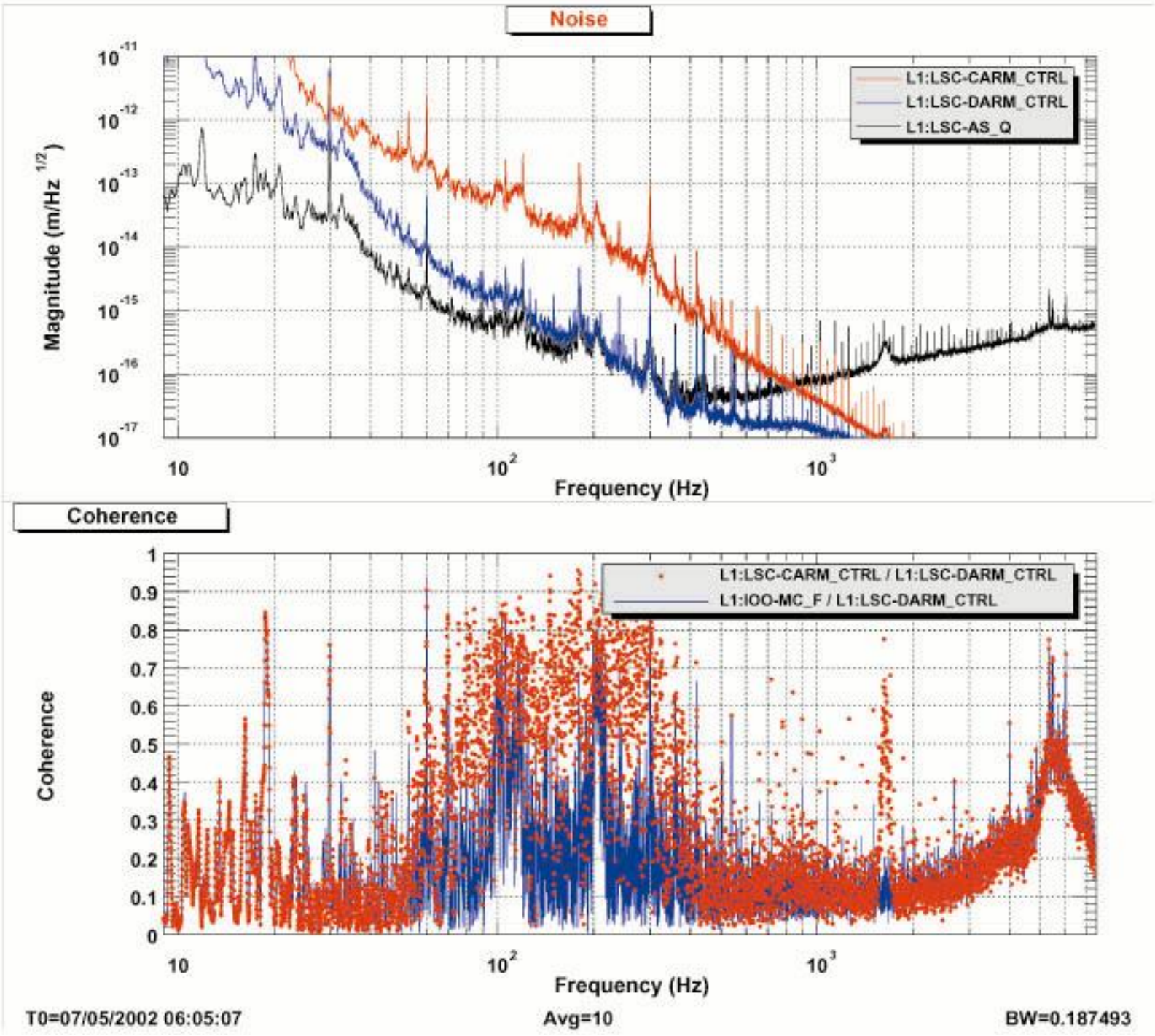
Calculated IFO Noise Budget



From Rana

Major Topics to Address Prior to S1

- Reduce influence of frequency noise on DARM and AS_Q common mode servo:
  - MC elliptic filter
- Reduce the noise at 50 to 100 Hz from the optical levers by further digital filtering
  - Installation and check out of band stop optical lever filters to reduce noise in 40-100 Hz region
  - Digital notch filter to kill 29.5 Hz in DARM


Noise
L1:LSC-CARM_CTRL
L1:LSC-DARM_CTRL
L1:LSC-AS_Q
Magnitude (m/Hz^1/2)
10^-11
10^-12
10^-13
10^-14
10^-15
10^-16
10^-17
10
10^2
10^3
Frequency (Hz)
Coherence
L1:LSC-CARM_CTRL / L1:LSC-DARM_CTRL
L1:IOO-MC_F / L1:LSC-DARM_CTRL
Coherence
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10
10^2
10^3
Frequency (Hz)
T0=07/05/2002 06:05:07
Avg=10
BW=0.187493

Further Performance Improvements

- Bring the remaining wave-front sensor servos into operation:
  - more robust operation
  - further reduction in AS_I
- Try to improve performance f>500 Hz by increasing the light on the photo-detector at the AS port
- Possible for S1 (certainly before S2):
  - put a low noise resistor in the ETM coil drivers and a relay to switch??? Only makes sense if we bring the frequency noise to the level where we are at coil driver noise.

PEPI

- Status:
  - Installation of piezo actuators “PEPI” at both end stations
  - PEPI installed in Y-end, but needs to be reworked to account for the 10 sec filters. All hardware on hand for X-end installation.

- Before S1:
  - Micro-seismic feed forward will be back in business.
  - Expect PEPI operating at x and y ends. Stack resonant peaks at 1.2 and 2.1 Hz reduced by a factor of 7 or more.
  - microseism FF adjusted to operate in the presence of the plant change from PEPI.

PEPI…

- Additional items that may be accomplished before S1:
  - microseism FF low pass filter optimized for additional bandwidth allowed by PEPI.
  - “creative invention” (Joe Giaime)

Hytec is not delivering the ITM hardware until the end of June so it is not possible to get the PEPI completed for S1 although it could still make a difference since much of our seismic noise is at the ends.

- Experiment:
  - Oscillate yaw of ETMX at 11 Hz.
  - scan the axis of yaw across ETMX.
- Measure length response at 11 Hz.
  - Best spot has yaw-length coupling reduced by more than factor of 20.
  - So roughly, beam spot is ~ 5 mm to left of center
- Notice there is also a varying intensity response at 11 Hz
  - A puzzle !!

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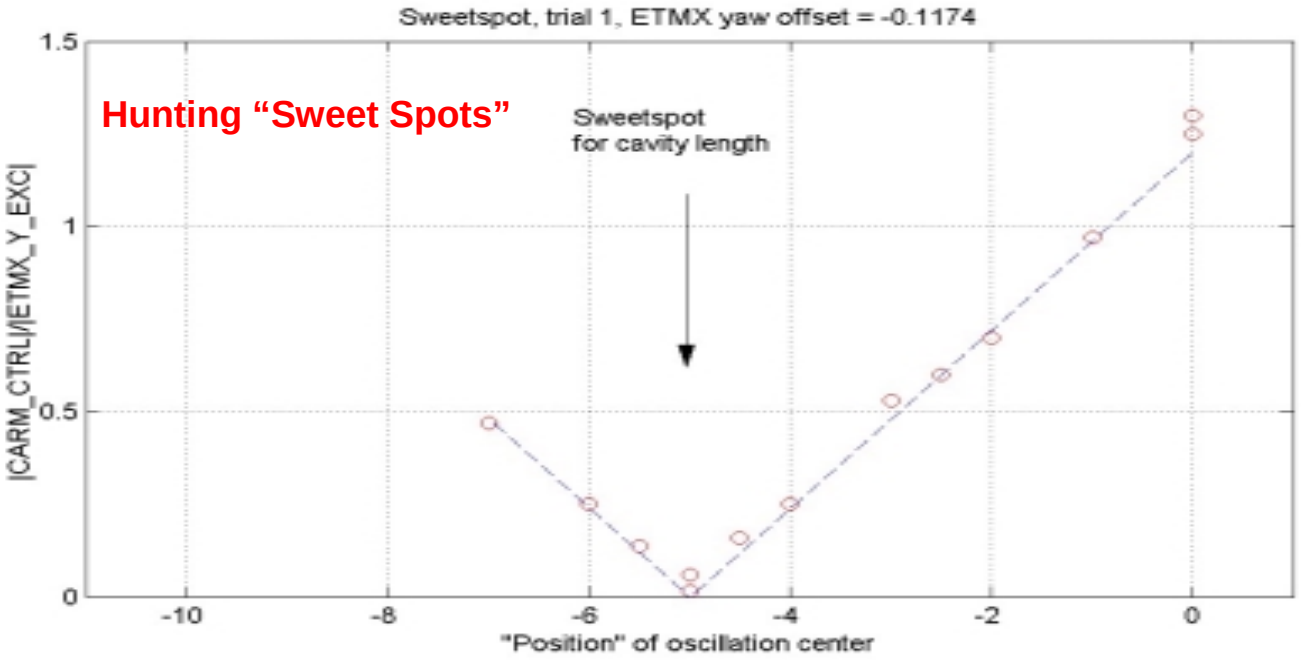
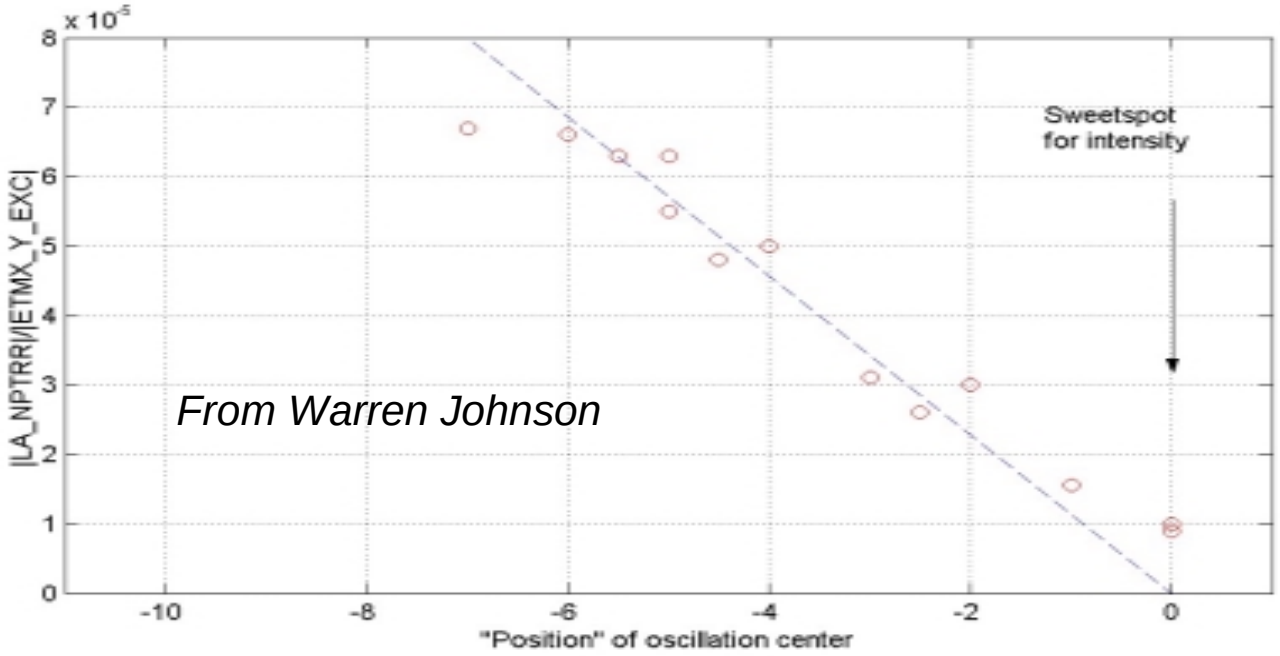




From Warren Johnson

Other Preparation for S1

- Upgrade of DTT
  - installation planned for week of May 13
- Update hint and help files on all screens
  - Lots of effort has gone into making help files, but the commissioning activities cause them to become rapidly obsolete, so we will update them between now and S1.

A few glitch-hunting results

Peter Saulson

A sample of tools

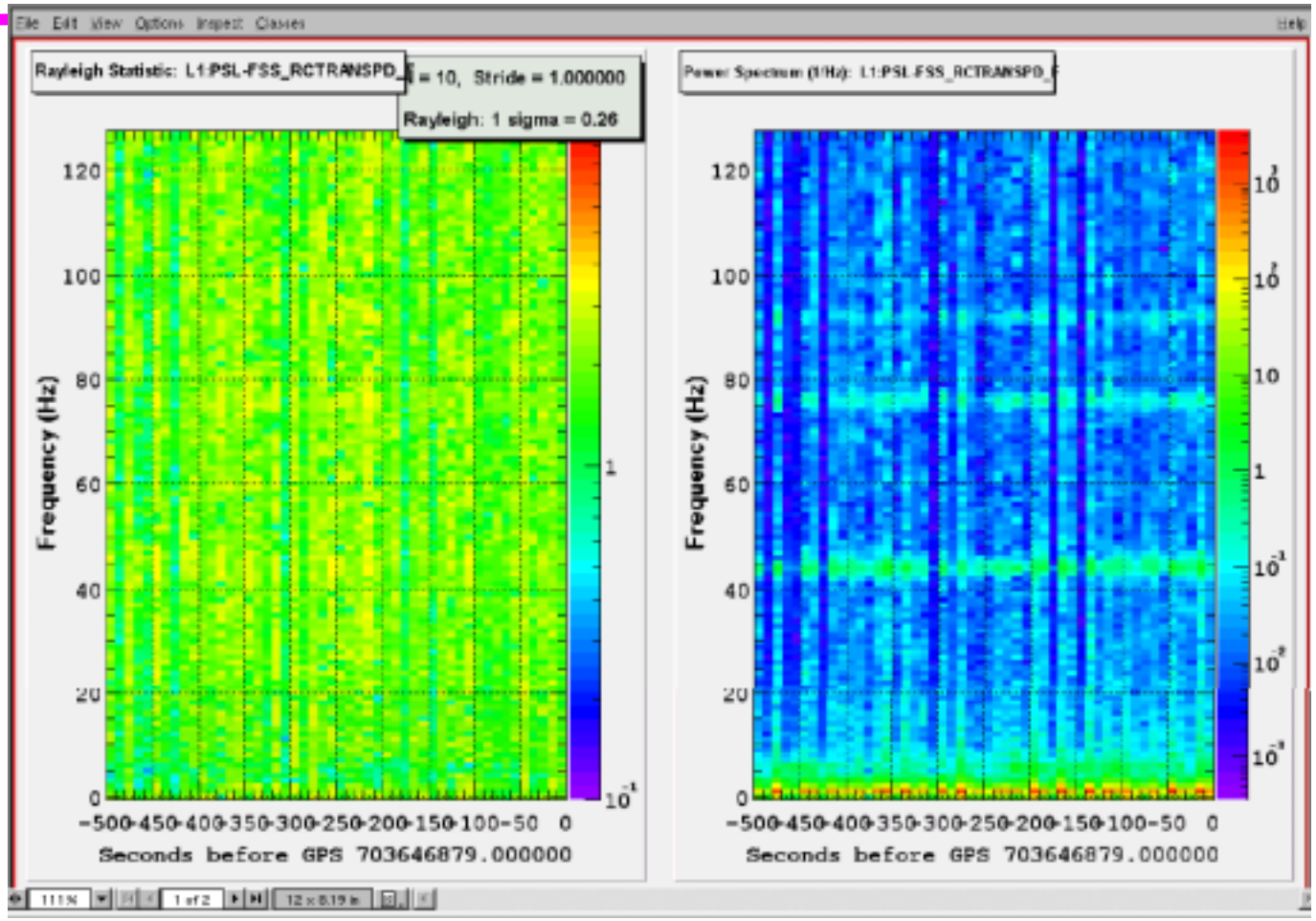
- Rayleigh Monitor a quick way to look for a signal with frequent glitches

  written by Patrick Sutton, PSU
- Histograms best to hunt for rare glitches, as well as other forms of non-Gaussianity
  - PeakMon written by Ed Daw
  - Hist Compr written by John Zweizig

RayleighMonitor, looking at PSL reference cavity transmitted light

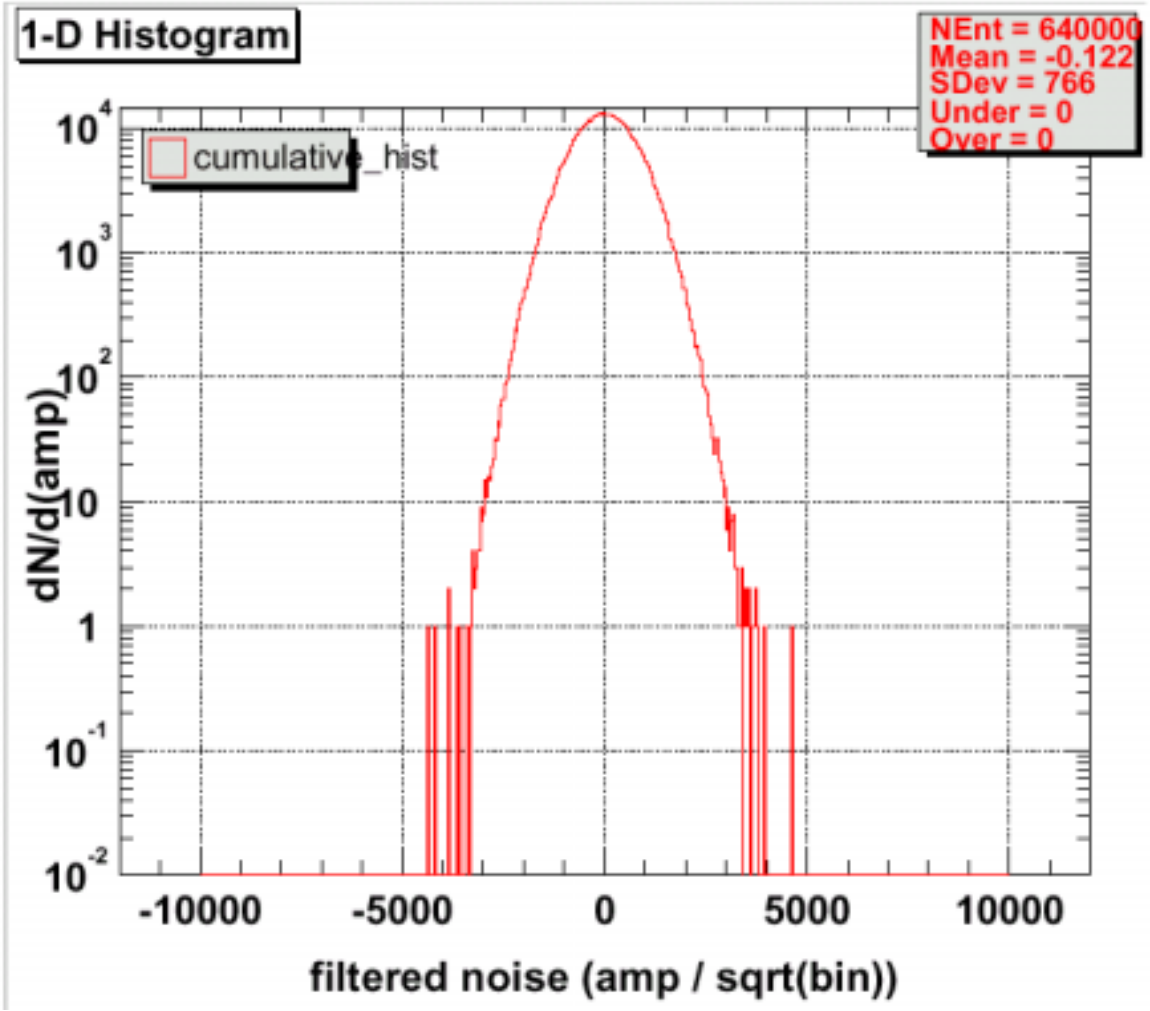
rhs = spectrum
lhs = Rayleigh

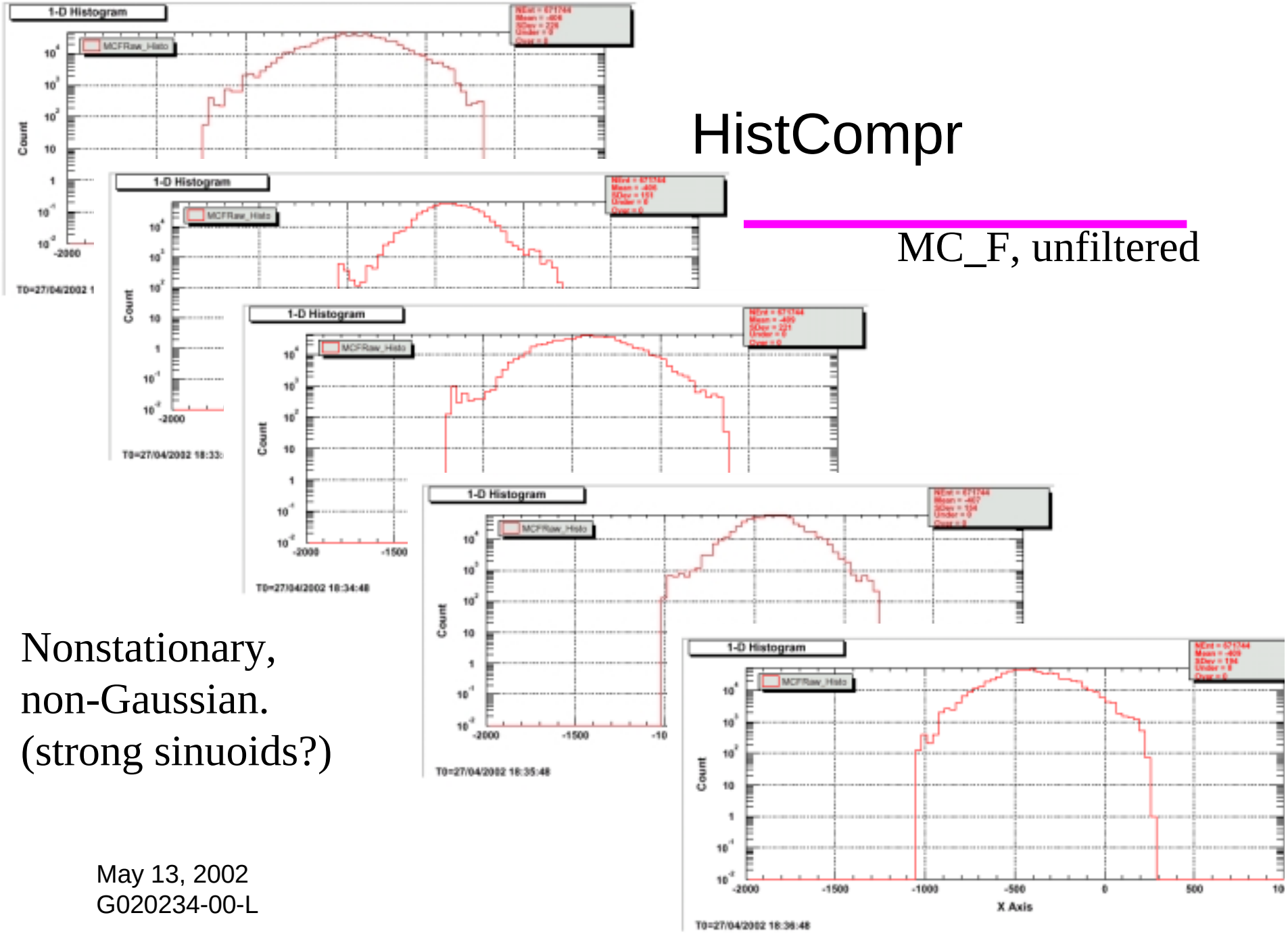
Orange means full of glitches.



PeakMon looking at AS_Q (up to 100 Hz)

Pretty good Gaussian, plus a few outliers.





HistCompr

MC_F, unfiltered

Nonstationary,
non-Gaussian.
(strong sinuoids?)

HistCompr on MC_F, with 100 Hz high pass filter

Filtering matters!

(Compare with unfiltered data.)