Use of h[t] in the stochastic GW background search

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Use of h[t] in stochastic searches

- S3 - performed exploratory, sanity check analyses
  - » Targeted at understanding interferometer non-stationarity
    - – 60s vs. 16s vs. 4s vs. 1s results were consistent within 0.07σ
  - » Did not use h[t] further in analysis

- S4 - evaluation of consistency between h[t]->h[f] and AS_Q[f]*R[f] is in progress
  - » First step : compare RMS for h[t] and AS_Q[f]*R[f] in band used for stochastic search
  - » Look for epochs of inconsistency
  - » Systematics, etc.
  - » Generate h[f] from h[t] in a manner identical to AS_Q[f]*R[f] (without applying a calibration):
    - – Downsample h(t) to 1024 Hz
    - – High-pass filter above f_1 = 70 Hz
    - – Apply the window function to h(t)
    - – Pad with zeroes
    - – Take the DFT
    - – Coarse grain down to the specified frequency spacing (0.25 Hz in this case)

Comparison

- RMS in SGWB band:

$$\rho_i \equiv \sqrt{\int_{f_1}^{f_2} df |h_i[f]|^2}$$

  - » f_1 = 70 Hz; f_2 = 220 Hz;

- Define relative difference between ρ_1(AS_Q(f)*R(f)) and ρ_2 (h[f]):

$$y = 2\frac{\rho_1 - \rho_2}{\rho_1 + \rho_2}$$

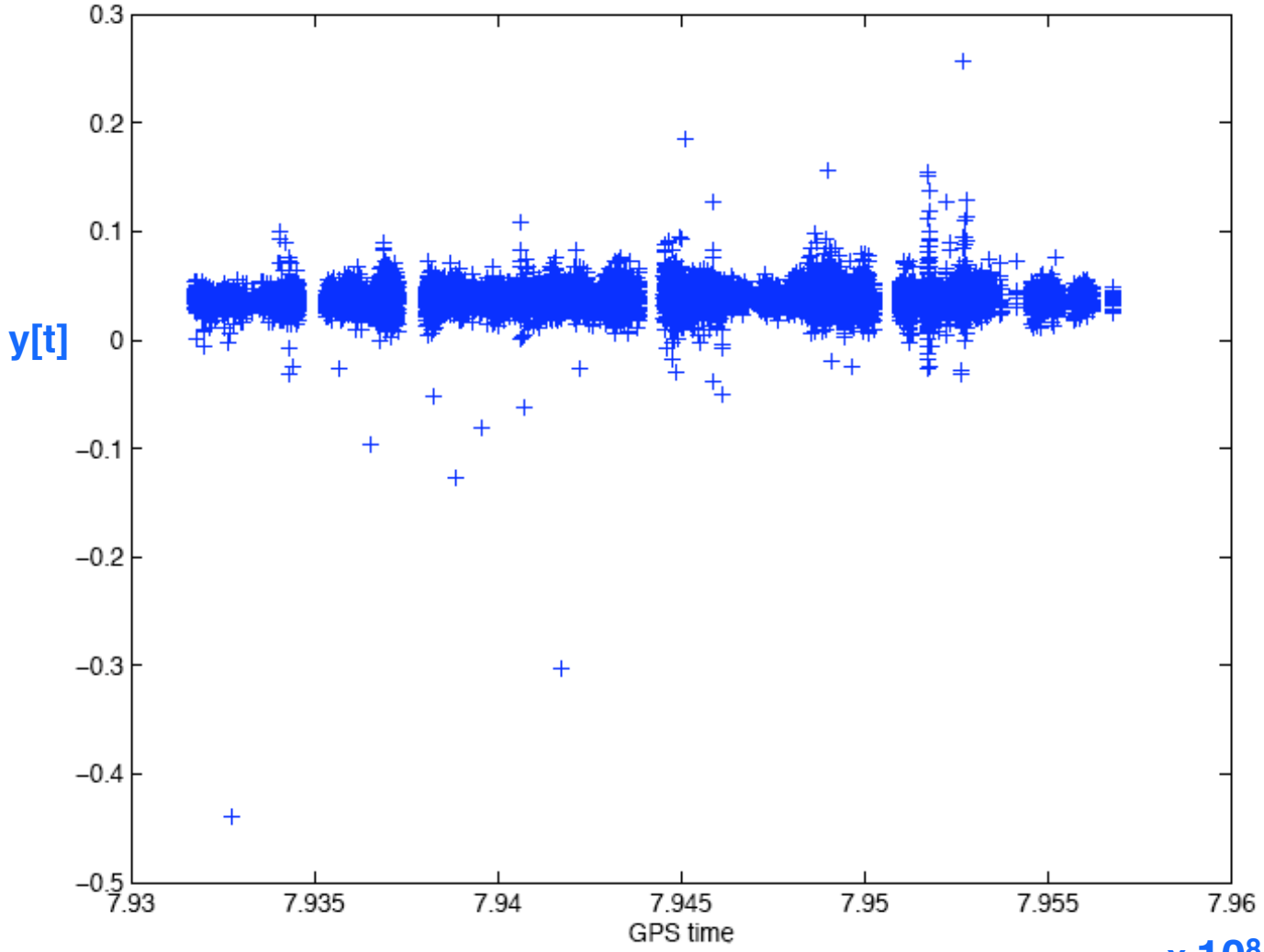
- Generate y[t] for 60s segments used in stochastic analysis

Results of work in progress

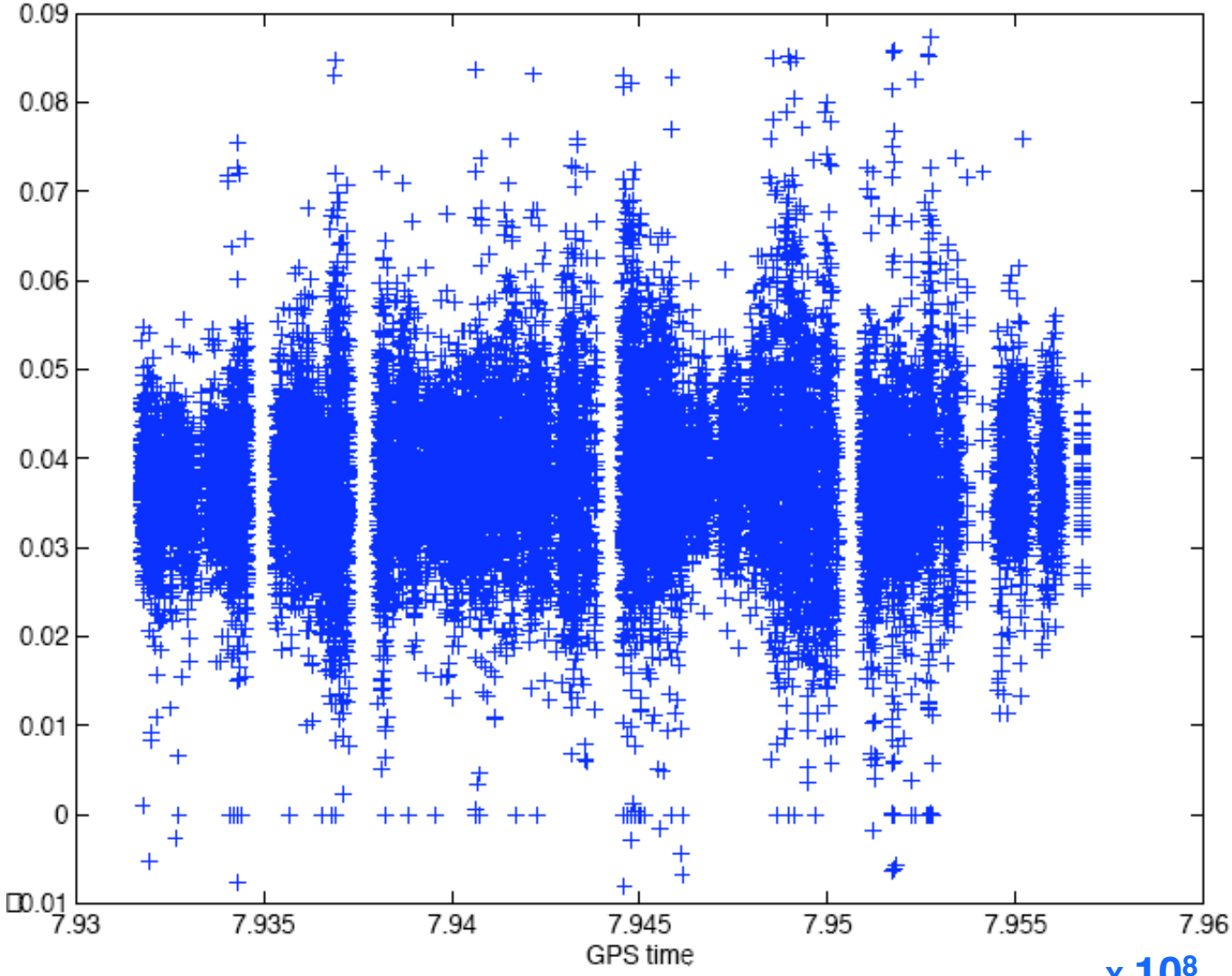
- H1:
  - » $\langle y[t] \rangle \sim 0.038$ (bias)
  - » $\sigma_y \sim 0.010$
- H2:
  - » $\langle y[t] \rangle \sim 0.034$ (bias)
  - » $\sigma_y \sim 0.011$
- L1:
  - » $\langle y[t] \rangle \sim 0.00098$ (bias)
  - » $\sigma_y \sim 0.00077$

- Source of H1, H2 biases still being explored
- May be related to band-limiting filters used in h[t] -> h[f]
- A number of outliers observed
  - » Largest outliers traced to calibration line dropouts

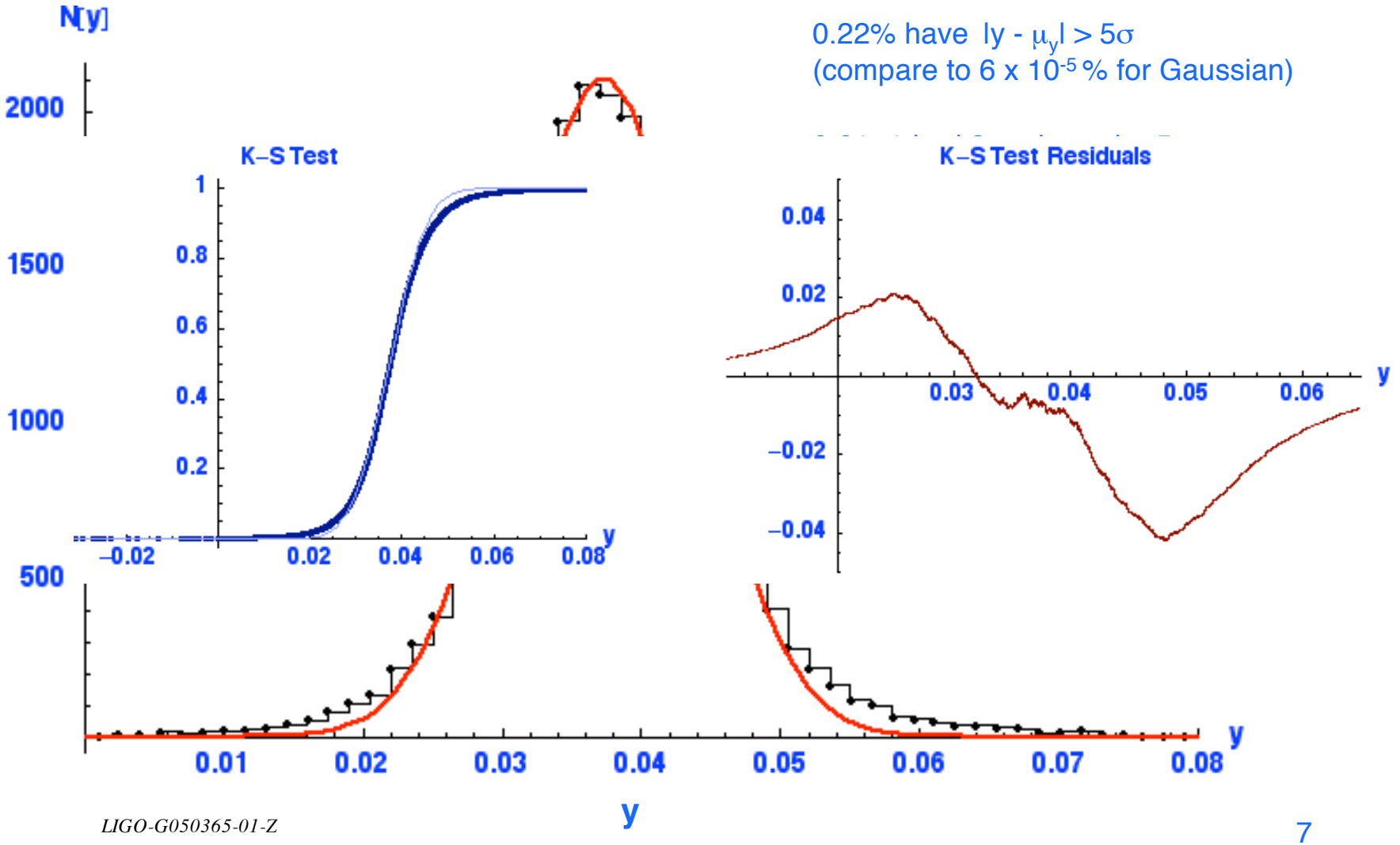
H1 h[t] comparisons minute-by-minute over S4



H1 h[t] comparison with largest outliers removed



Histogram of y for H1 -- S4



0.22% have $|y - \mu_y| > 5\sigma$
(compare to 6 x 10^{-5} % for Gaussian)

Further work

- Need to explore source of bias in H1, H2
- Consider amplitude differences

$$y' \equiv 2\frac{\sqrt{\int_{f_1}^{f_2} df\,|h_1[f] - h_2[f]|^2}}{\rho_1 + \rho_2}$$

- Once issues are resolved, plan to use for analyses
  - » Removes constraint to 60s stride in analysis
  - » Allows tracking of higher frequency calibration fluctuations