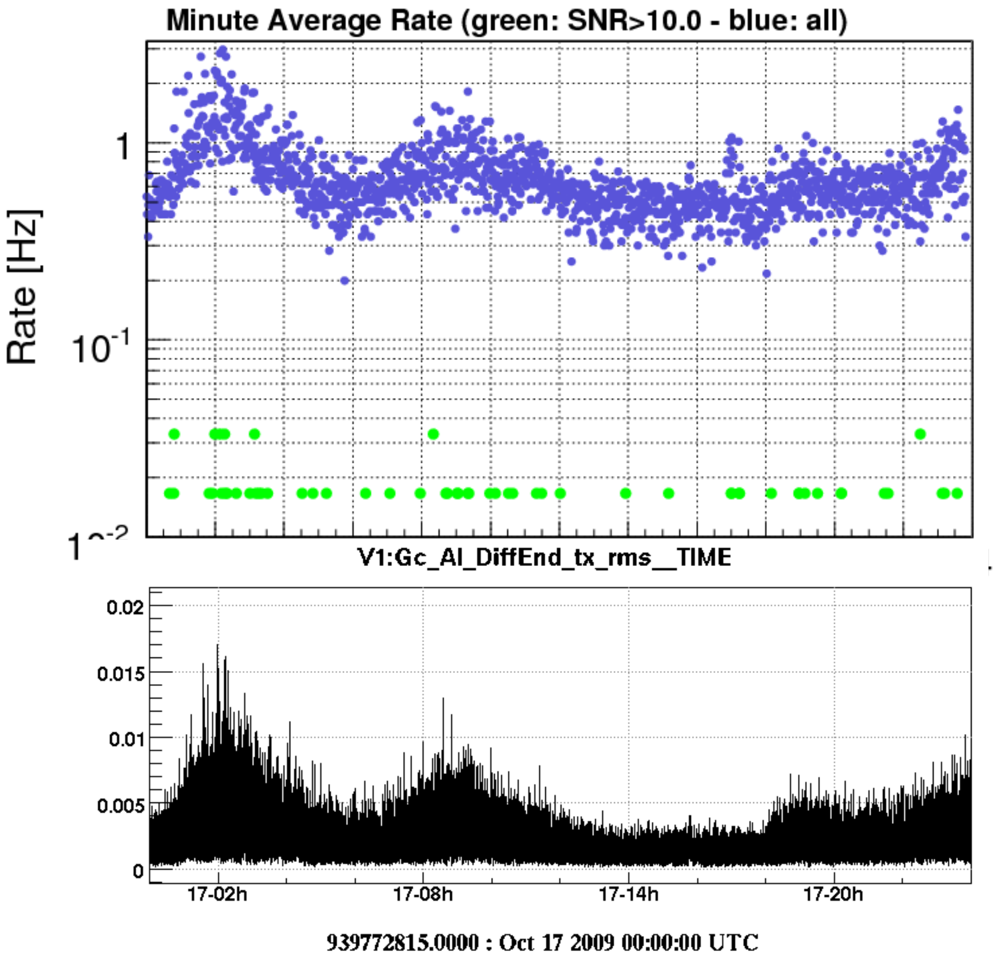
Glitches from alignment fluctuations

&

scattered light

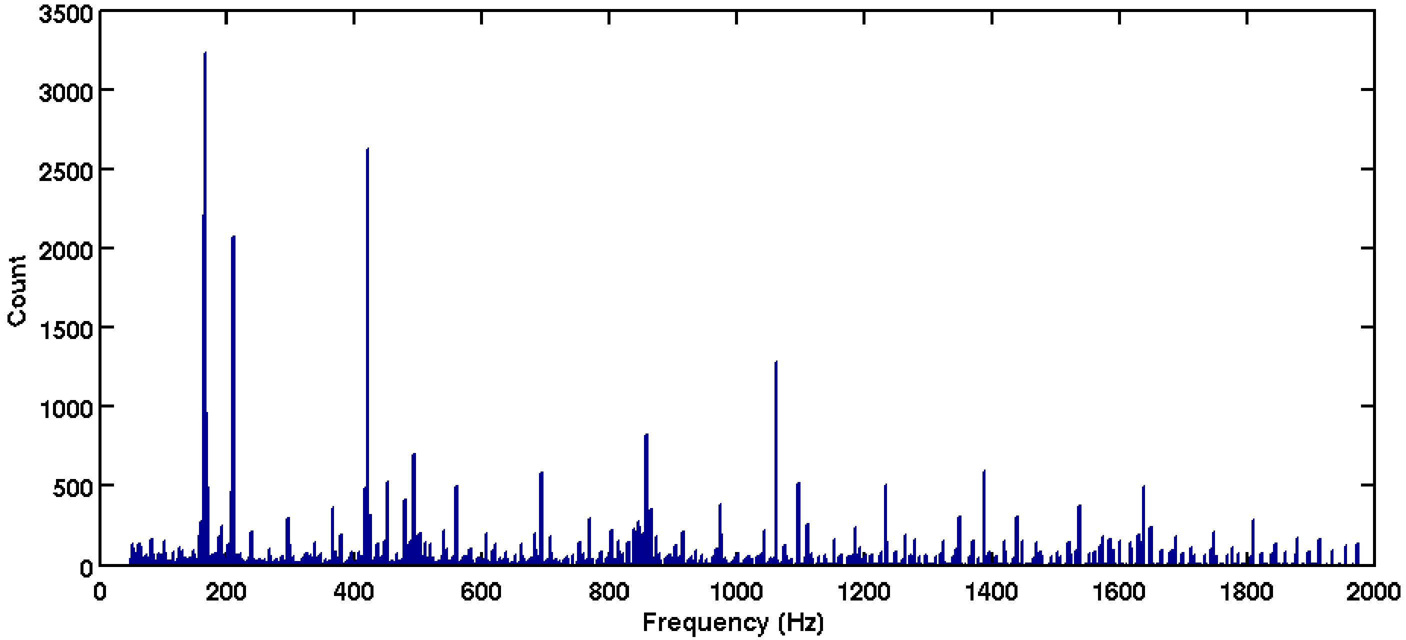
Bas Swinkels

Glitch rate vs DiffEnd_tx



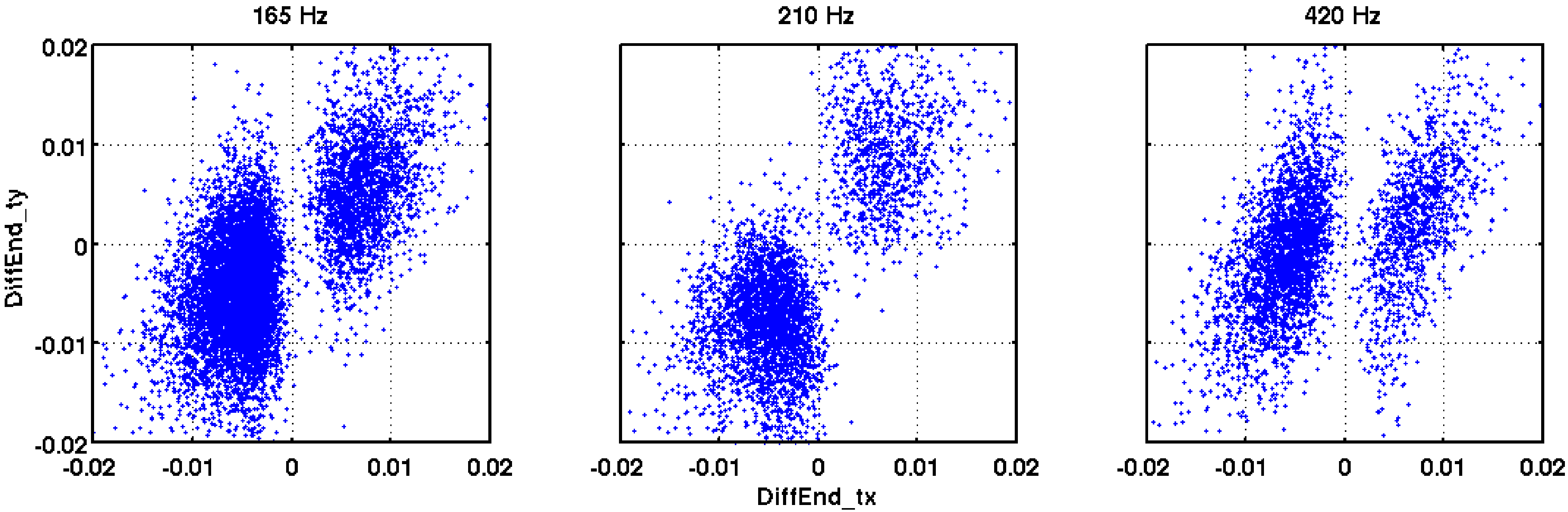
- Glitch rate correlates with accuracy of DiffEnd_tx (Paolo entry #25283)
- Excited by 700 mHz useism, hard to improve controls (#25211)

Glitches vs frequency



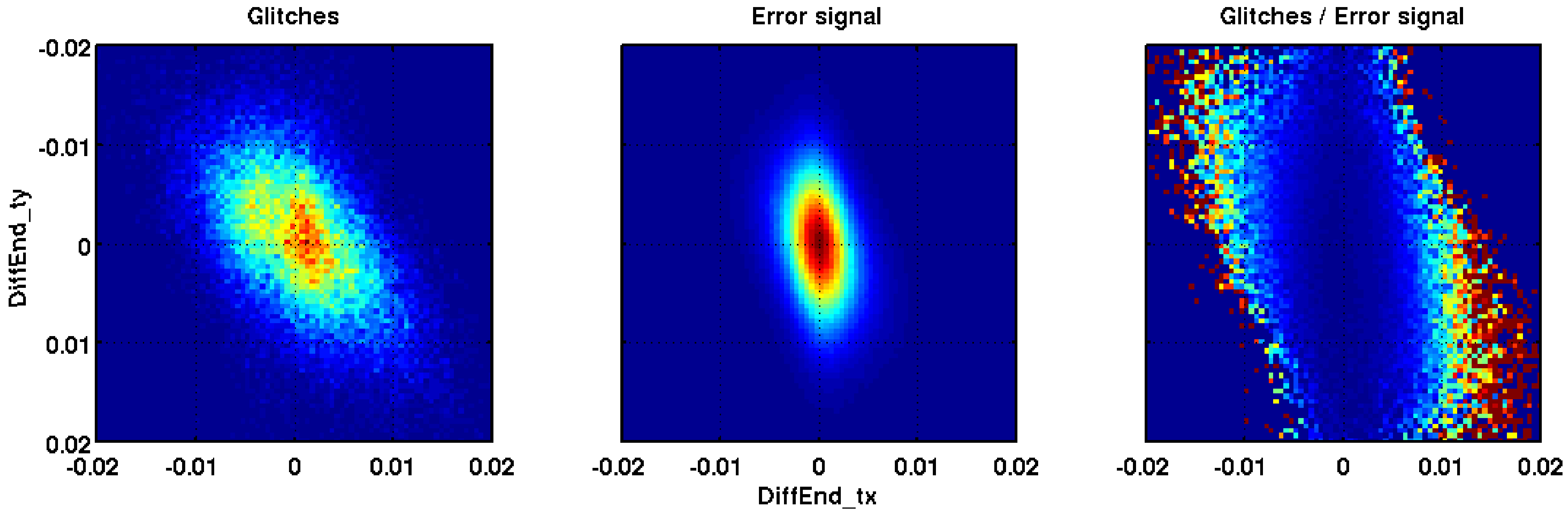
- Histogram of Omega triggers shows many glitches (~20 %) at known resonance frequencies of mounts on suspended detection bench
- 165, 210 and 420 Hz (+some at 800-1000Hz?)
- Mostly low SNR
- Probably not 'real glitches', but noise bumps with non-stationary amplitude

Glitches vs DiffEnd position



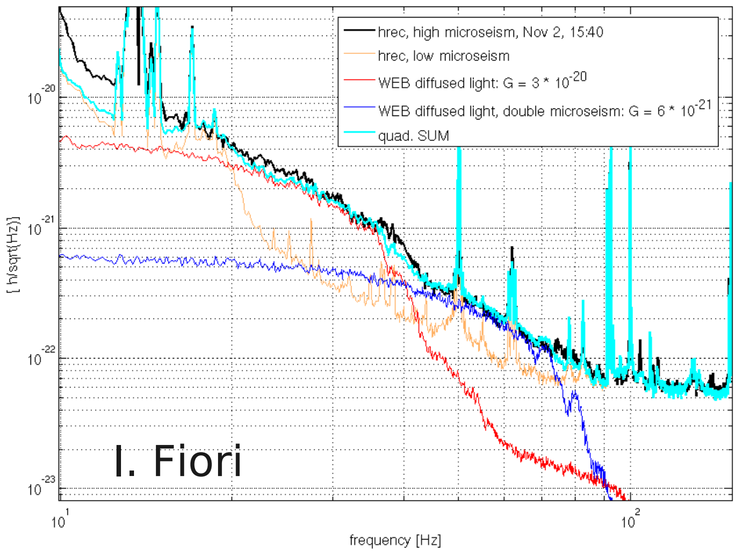
- Alignment position at moment of glitch shows different patterns for different frequencies
- DiffEnd alignment controls 'darkness' and size of B1
- Each frequency might correspond to clipping/scattering by different mount
- Easy solution might be to throw away all glitches at these frequencies, but DQ people have moral problems with that

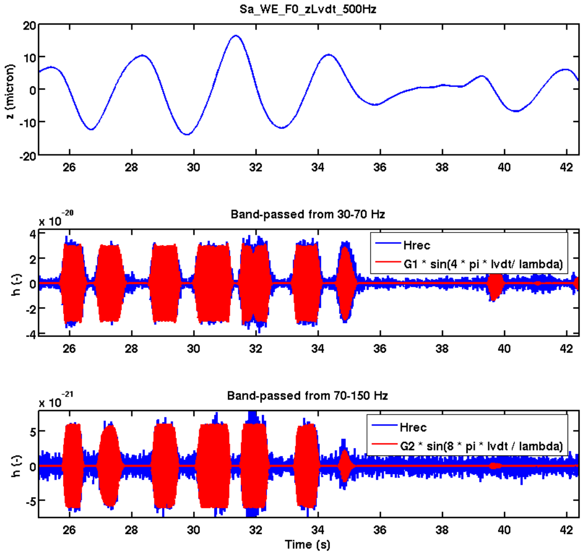
2D histograms



- Patterns not visible when plotting glitches at all frequencies, but cloud of glitches larger than expected from error signal
- Glitch probability depends mainly on tx
- Quick test using threshold on abs(DiffEnd_tx) shows 12% efficiency for 1% of dead-time (threshold = 0.008)
- More tests needed

Scattered light





- Well understood problem, see old presentations by Fiori / Tournefier
- Biggest problem at WE, due to higher mirror transmission
- Single bounce

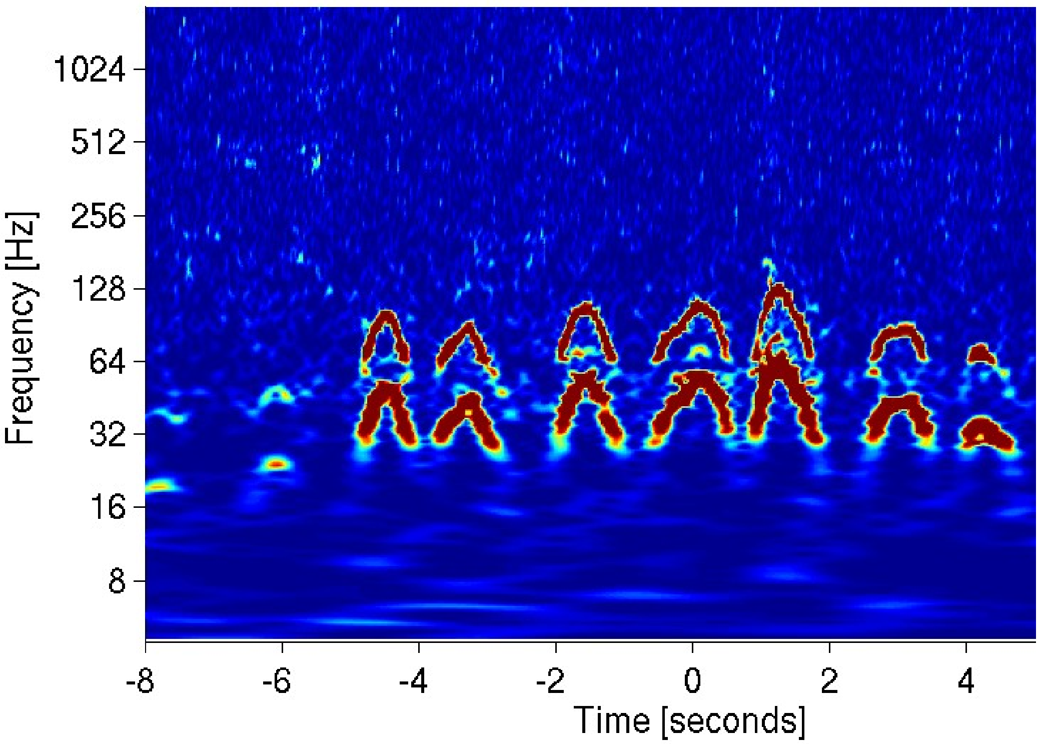
  h(t) = G1 * sin(4 * pi * x(t) / lambda)

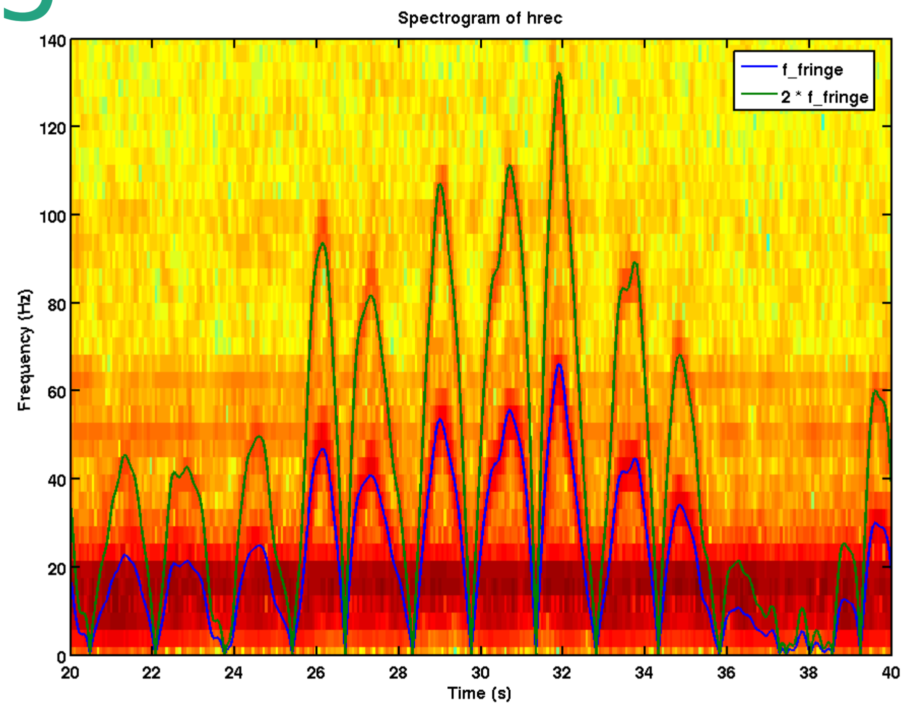
- Double bounce

  h(t) = G2 * sin(8 * pi * x(t) / lambda)

- Model works well in both time and frequency domain

Spectrograms





- Arched fringes in spectrogram, similar to swinging baffles
- 1 cycle in hrec when scatter path changes by 1 fringe, so fringe frequency proportional to velocity

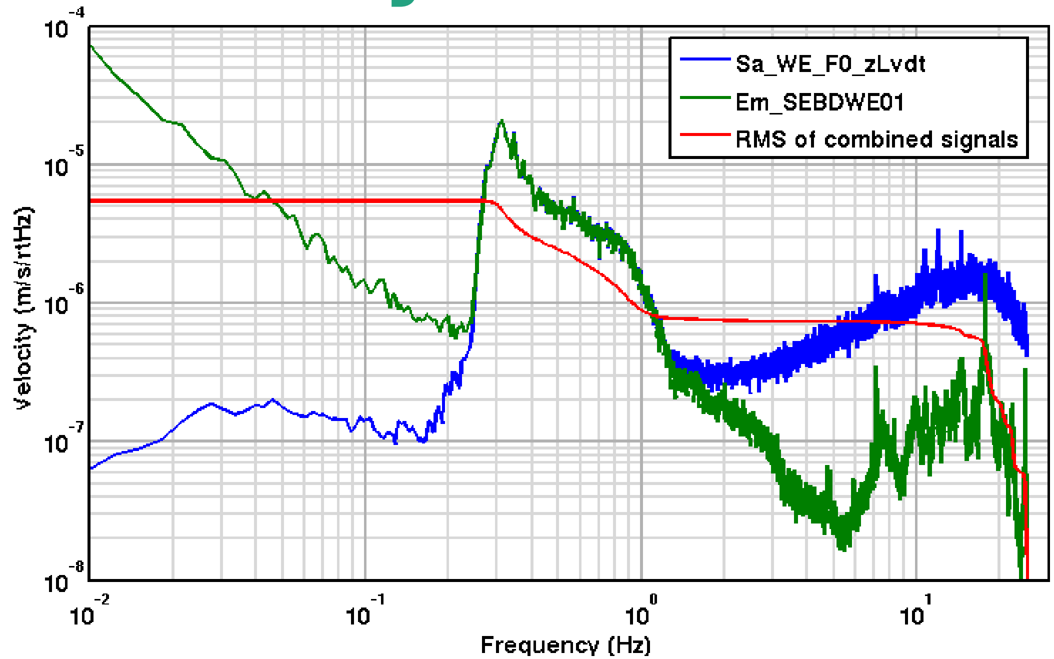
f_fringe = 2 * abs(V / lambda)

- 'Double bounce' path

f_fringe = 4 * abs(V / lambda)

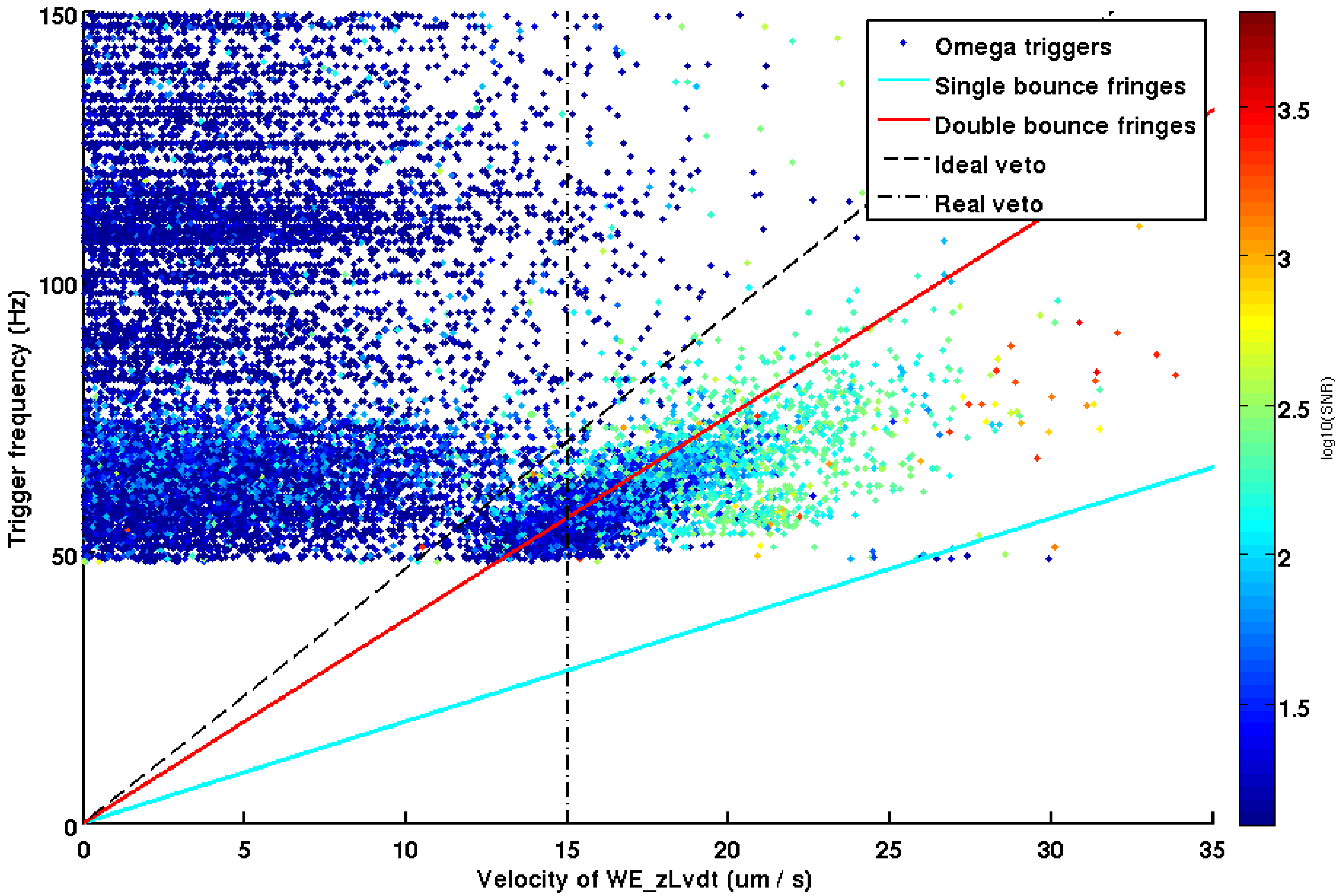
i'm lovin' it™

Velocity estimation



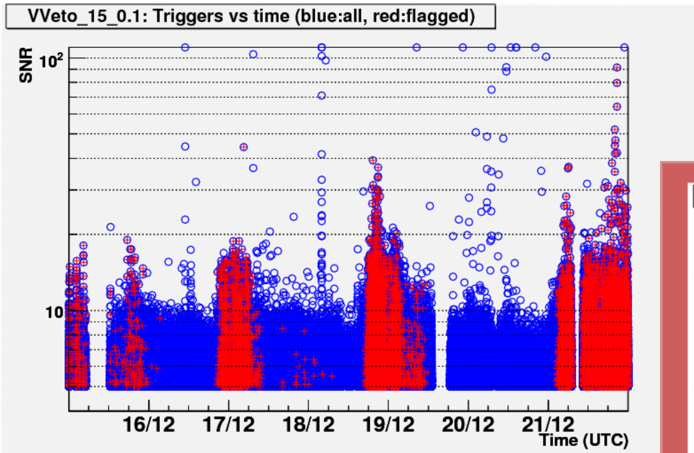
- End-mirror is fixed in space by controls, rest of the world moving at useism frequencies (0.25 - 1Hz) when weather is bad
- Seen by several sensors
  - IP top stage position sensor: Sa_WE_F0_zLvdt
  - Local control camera: Gx_WE_z
  - Bench seismometer: Em_SEBDWE01
- LVDT works best for determining velocity

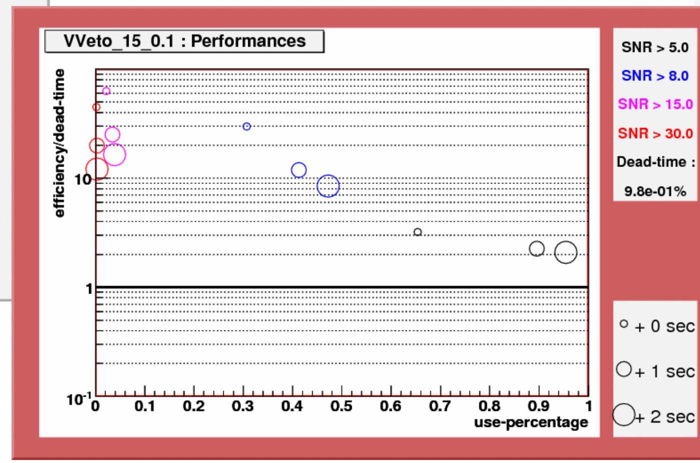
Glitch frequency vs velocity

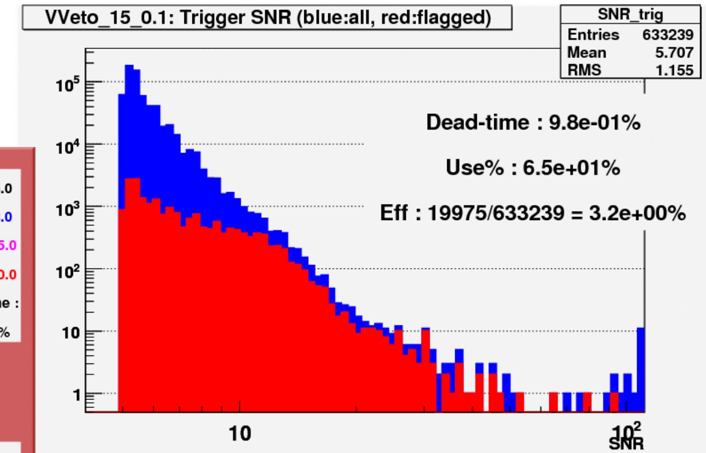


- Distinct cloud of points due to 'double bounce fringes'
- Ideal veto based on frequency and velocity, but 'unsafe'
- Real veto based on velocity only

Veto performance







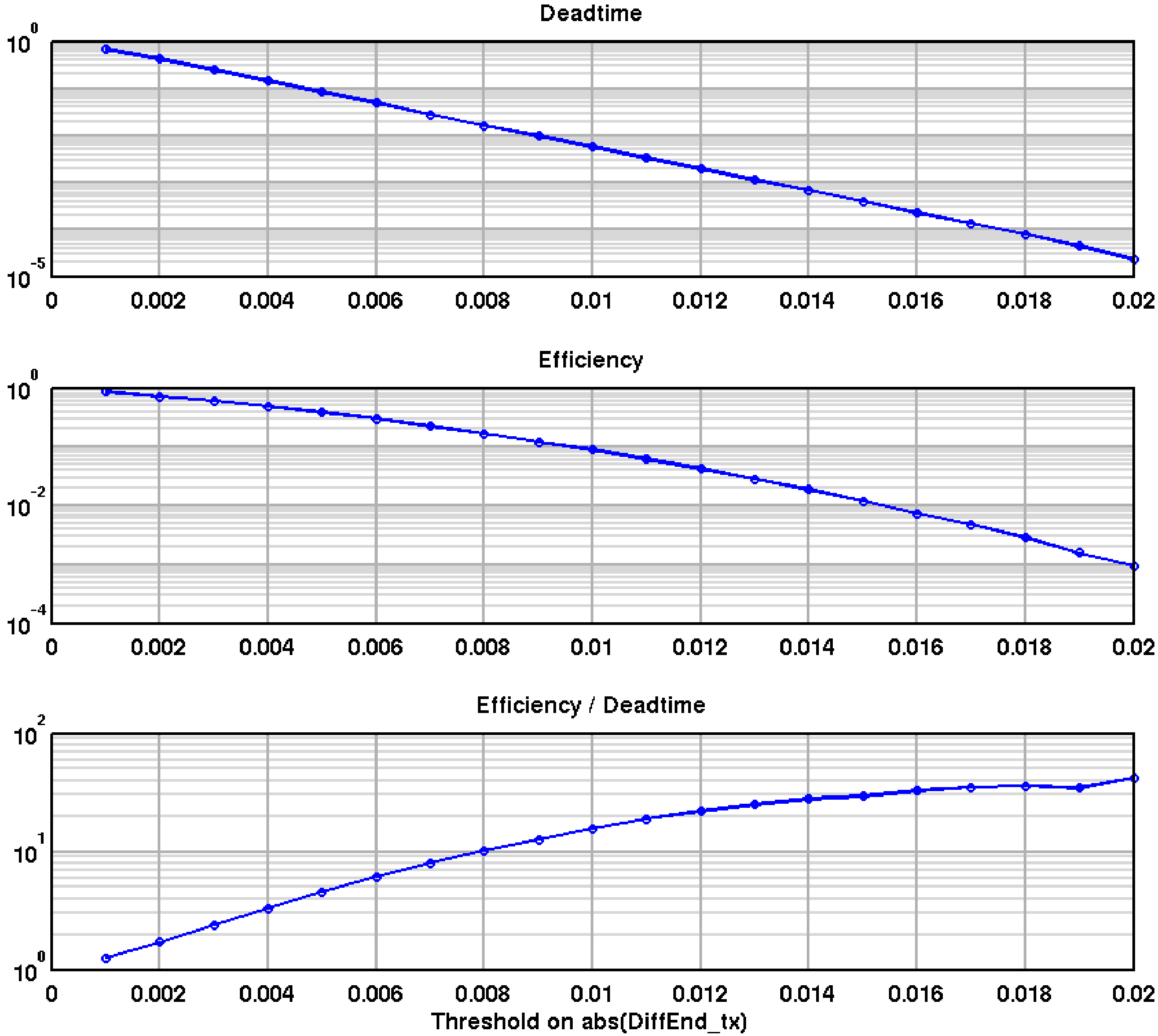
- New sub-second veto based on velocity implemented by F. Robinet http://wwwcascina.virgo.infn.it/DataAnalysis/Burst/dqtest/perf_SE/
- Very selective, high efficiency/dead-time
- Might be used as CAT 2 veto
- Kills most high SNR glitches, but does not solve all scattered light and useism problems
- Old veto based on BRMS (0.25-1Hz) of seismometers will probably remain as CAT 3 veto to flag periods with high useism

Concluding

- Family of glitches at frequency of output bench resonances, modulated by DiffEnd alignment fluctuations
  - possible veto to be tested
- WE scattered light glitches
  - glitch frequency well modeled by velocity
  - veto based on velocity only shows good performance
  - might efficiently kill a class of big glitches, but no silver bullet for scattered light problems
- Also look at > 1Hz value of signals instead of <= 1 Hz BRMS only!
- In case of known problems: make histograms vs relevant parameters
- Check other DOFs, nothing found so far

End

Backup


Deadtime
10^0
10^-5
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
0.02
Efficiency
10^0
10^-2
10^-4
Efficiency / Deadtime
10^2
10^1
10^0
Threshold on abs(DiffEnd_tx)