GEO600 Status

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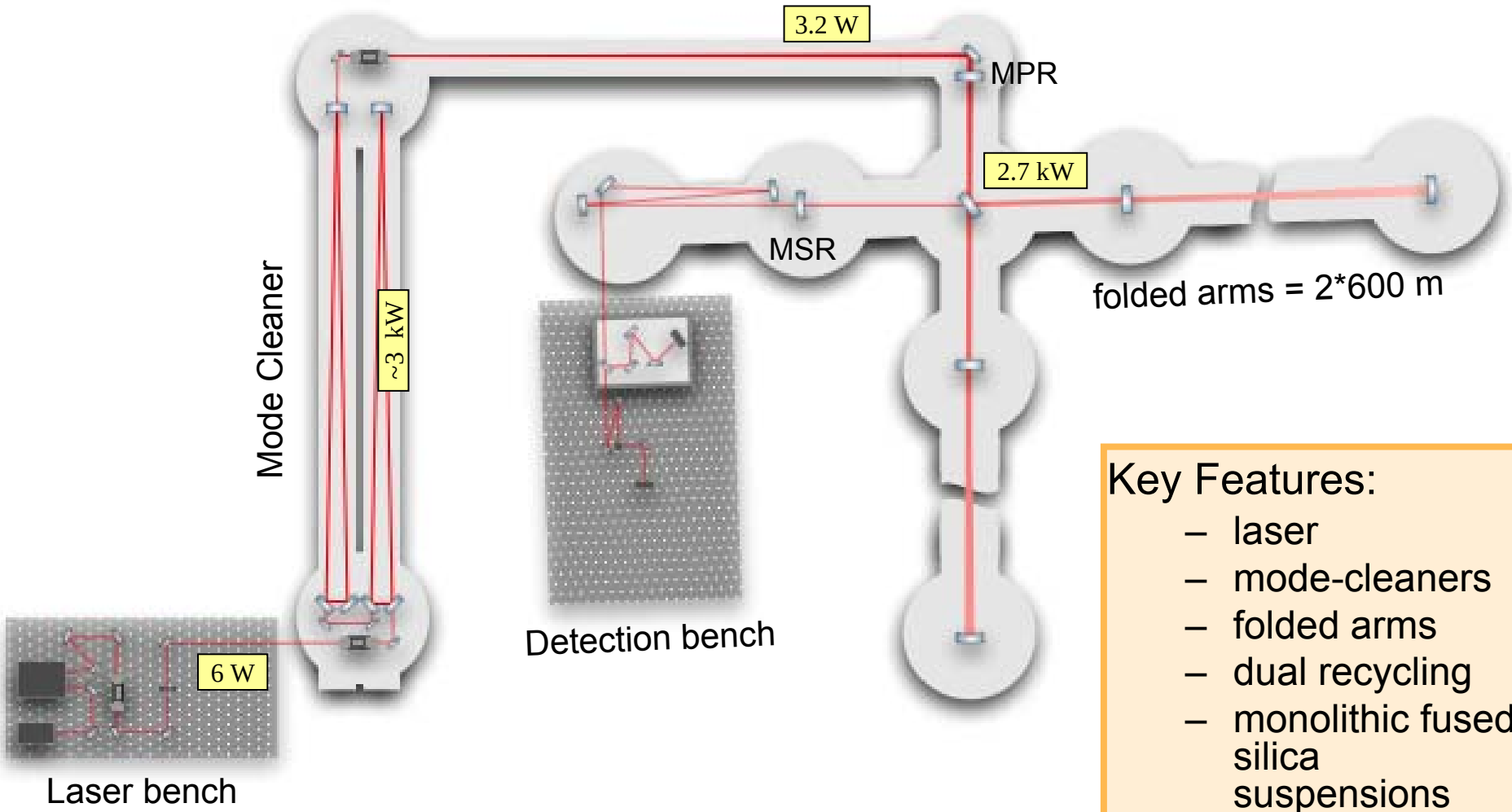
for the Ruthe Team

LSC/Virgo meeting, Hannover
October 2007

LIGO-G070706-00-Z

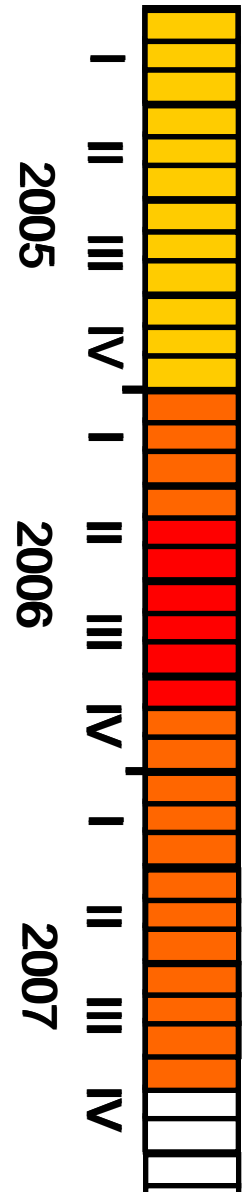
GEO600 Optical Layout



Key Features:

- laser
- mode-cleaners
- folded arms
- dual recycling
- monolithic fused silica suspensions
- Electro Static Drives

S5 operation of GEO 600

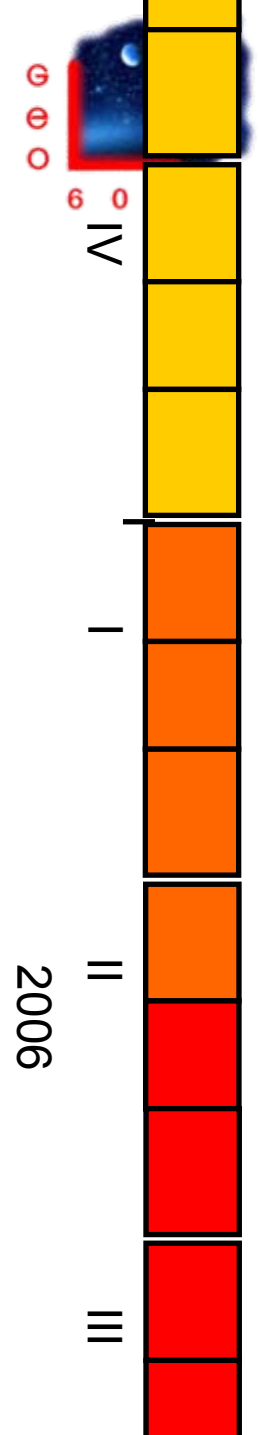


- Commissioning in late 2005:
  - improving sensitivity and reliability
  - improving detector characterisation
- S5 in *overnight & weekend mode* January 20th 2006
  - continuing improvements
  - science data (~50 % of the time)
- S5 in *24/7 mode* May 1st 2006
- S5 in *overnight & weekend* mode
  Oct. 2006 – Oct. 2007
  - continuing improvements
  - science data (~60 % of the time)

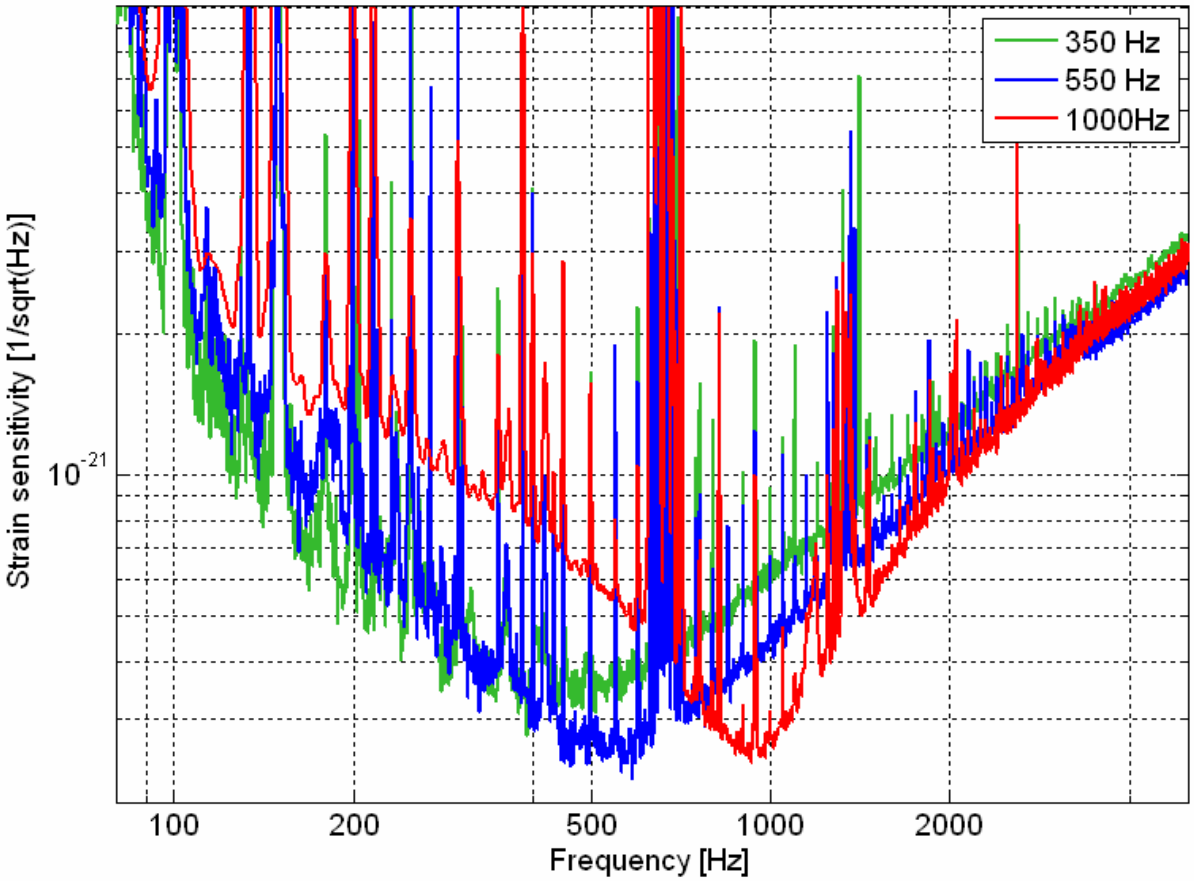
GEO 600 in S5 - O&WE Mode

January – May 2006

- Started participating in S5 on Jan. 20th
- Commissioning work during normal working hours (8-20 CET)
- Data taking during nights, weekends, holidays and whenever no commissioning work done
- Moderate efforts to keep detector locked during data taking times, i.e. no operator shifts.



Tuning options



Changed tuning on April 3rd from 350 Hz to 550 Hz to improve SNR @ fs above 400 Hz.

Optimized all parameters and combining filters.

Lost only little SNR @ low fs as we have excess noise there anyway.

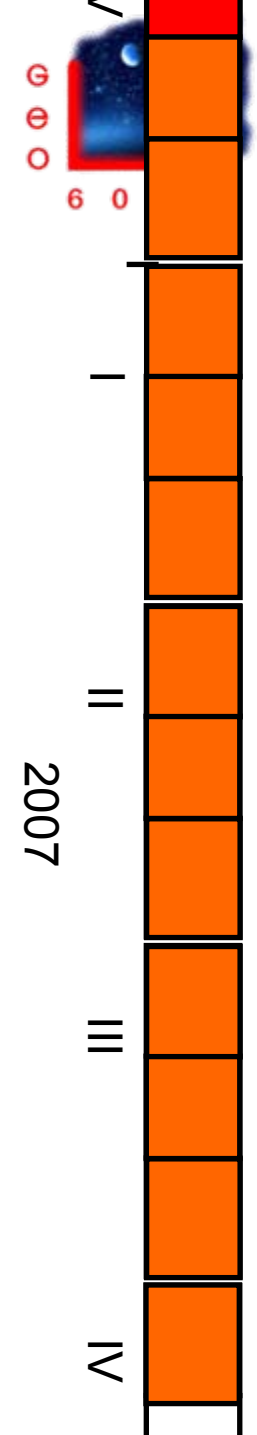
GEO 600 in S5 – 24/7 mode

May – October 2006

- Full time data taking with 3 operators on site in 2 shifts, during working days
- SMS - alarm system calls operator on duty if predefined problem occurs
- Fall-back procedure in place to deal with more serious problems
- Maintenance times for measuring loop gains, transfer functions, noise projections etc.

GEO600 in S5 - O&WE Mode

October 2006 – October 2007



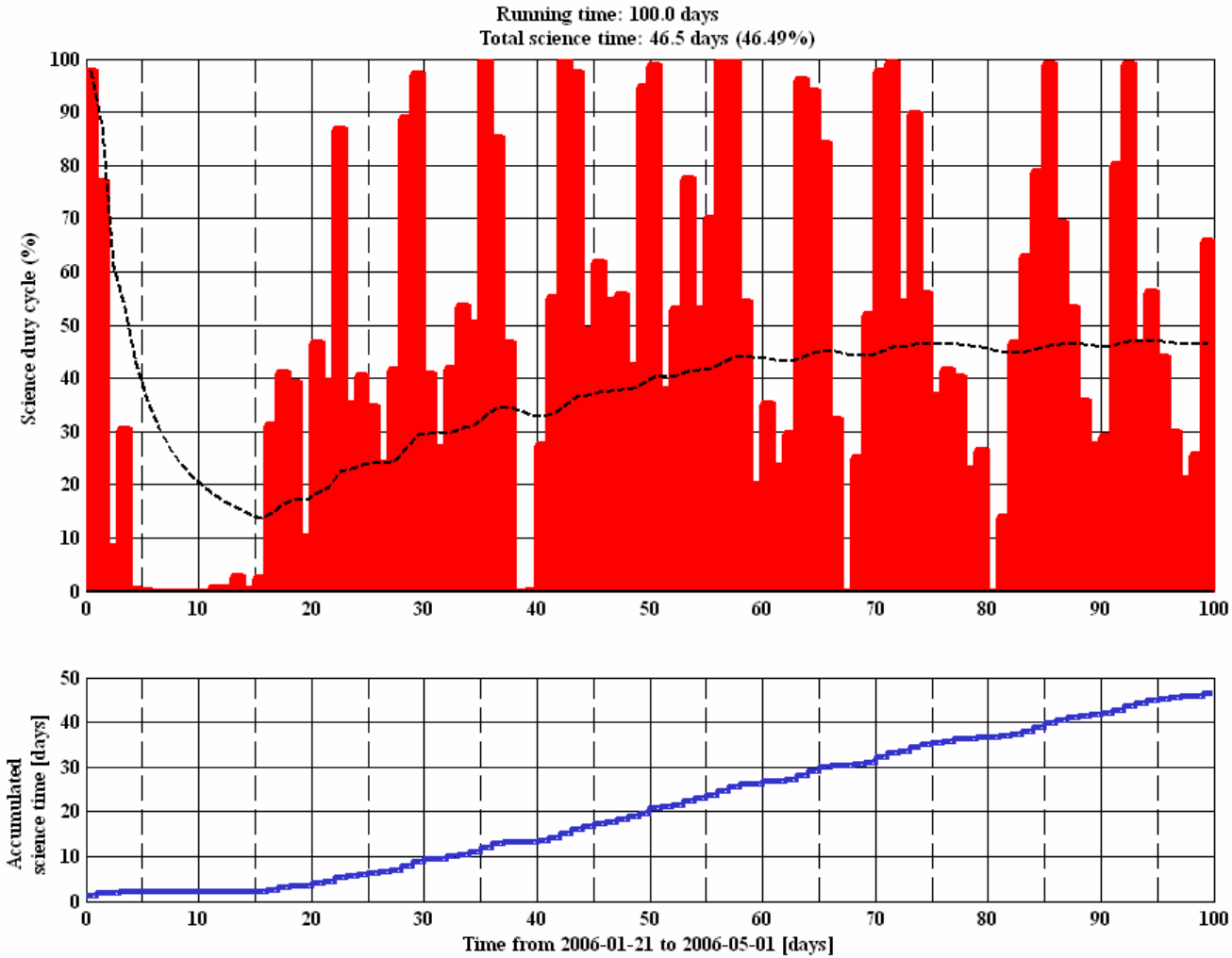
- **Went back into commissioning mode in October 2006**
- **Goal: improve sensitivity and data quality to cover down time of LIGO/Virgo upgrades to enhanced versions in 2008**

S5 Duty Cycle

January 2006 - May 2007

January -May, (100 days)

- science time duty cycle: 46.5 %

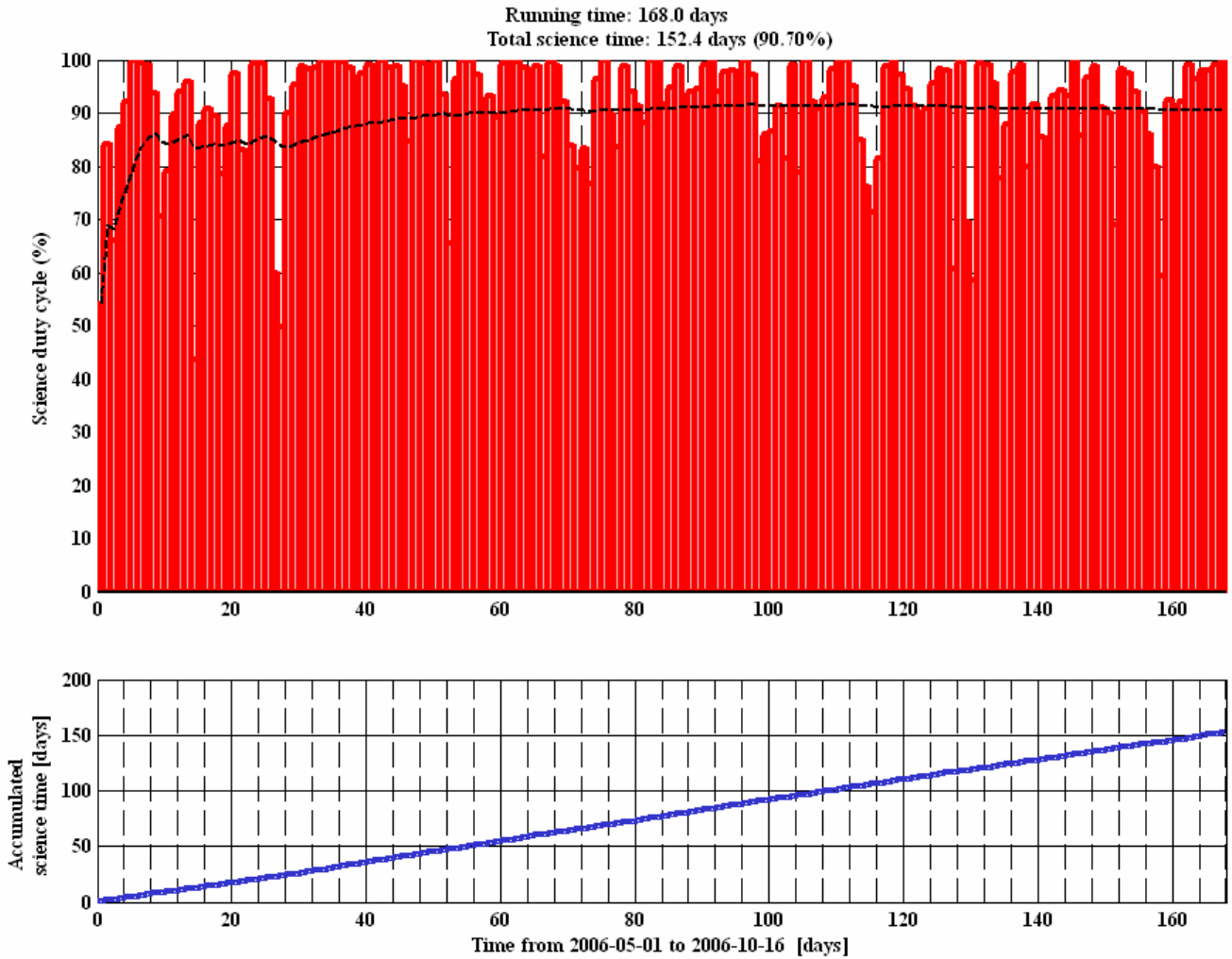


S5 Duty Cycle 24/7

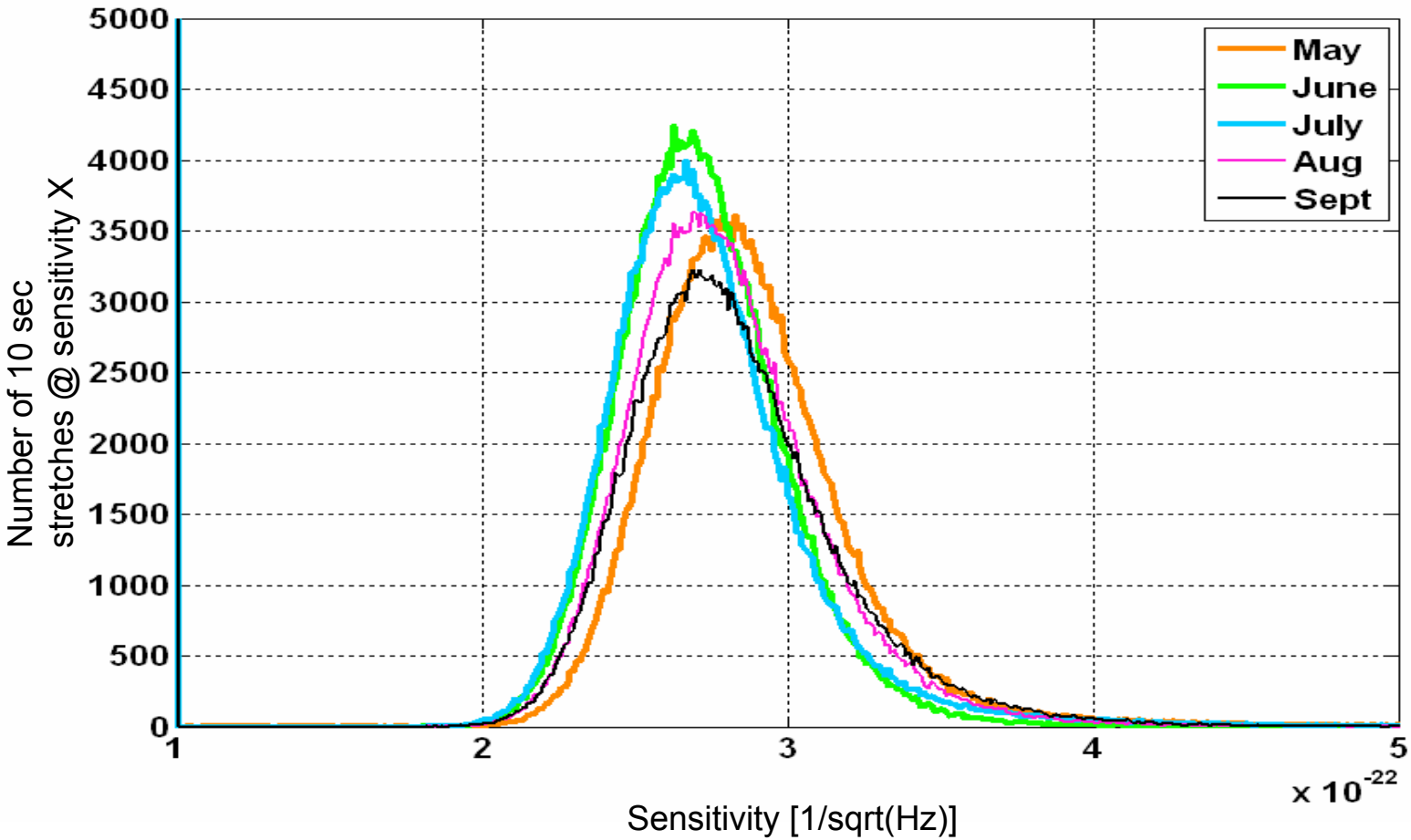
May 2006 – October 2006

May-October, (168 days)

- instrumental duty cycle: 94.3 %
- science time duty cycle: 90.7 %
- longest lock: 102 hours
- typical relock ~ 5 minutes



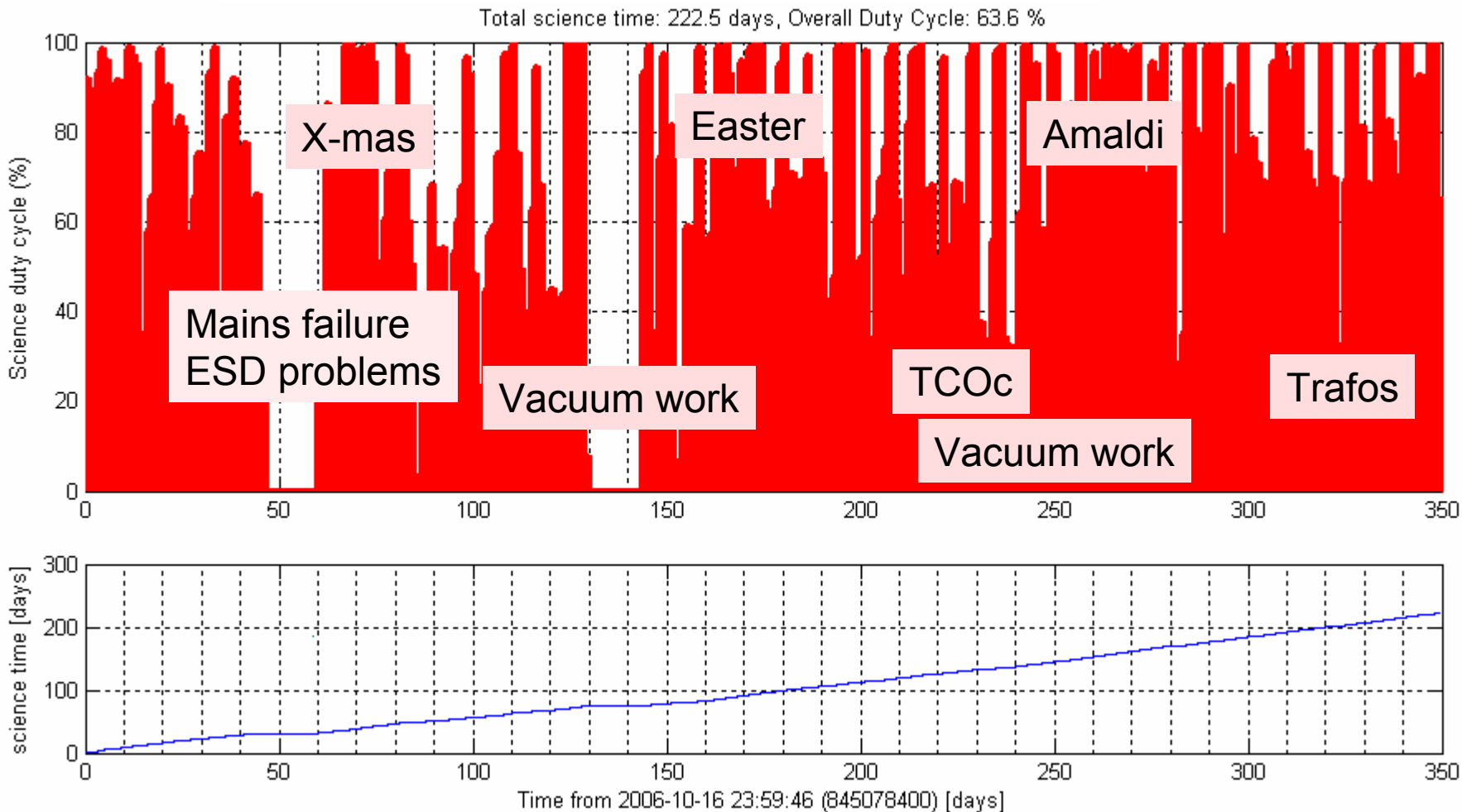
BLRMS 555 - 565 Hz Histogram for 24/7 period



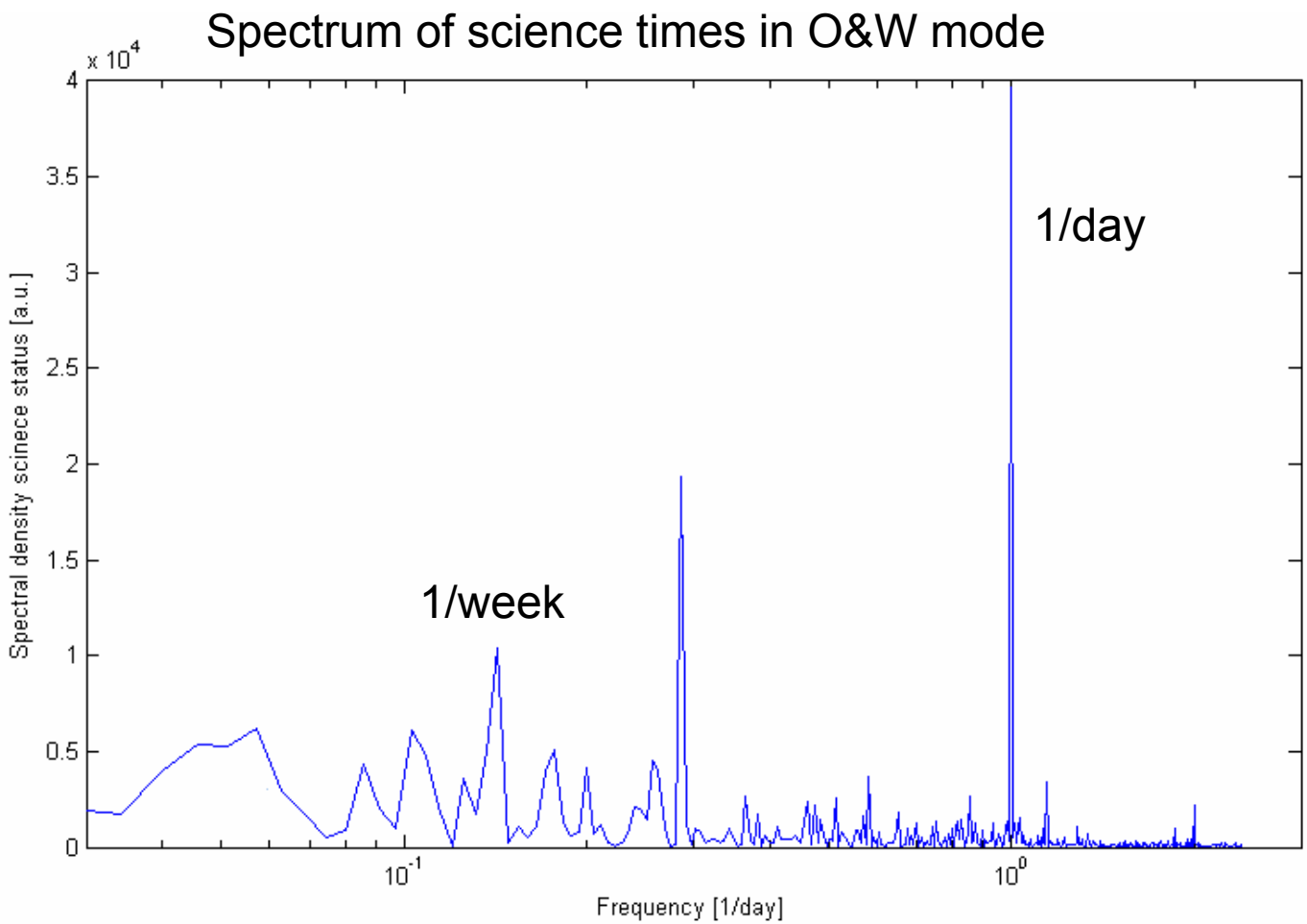
S5 Duty Cycle

October 16 2006 – October 01 2007, (350 days)

- **Instrumental duty cycle: 77.3%**
- **science time duty cycle: 63.6 %**
- **longest lock: 92 hours**

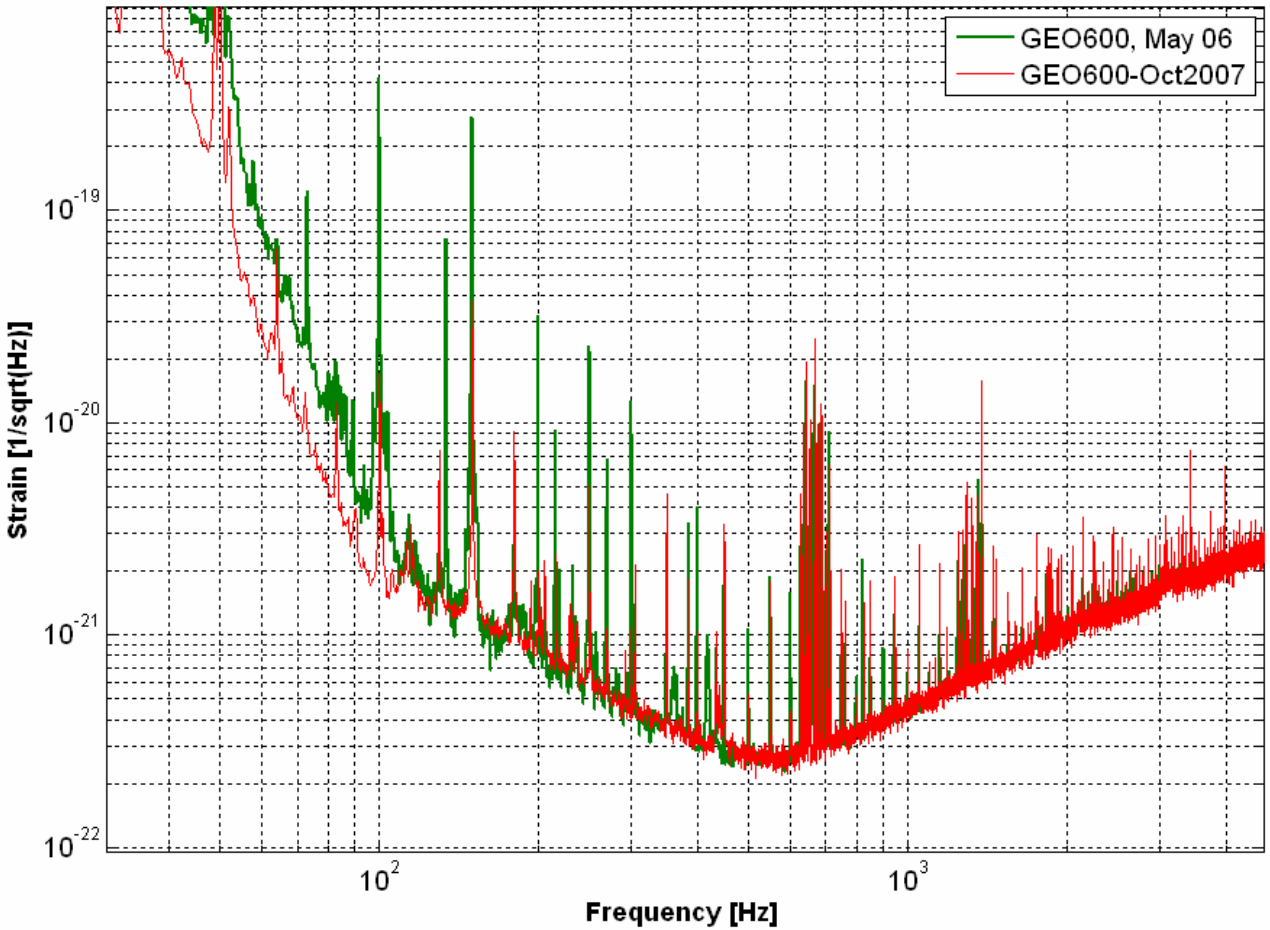


Why do we call it Over-night&Weekend mode?

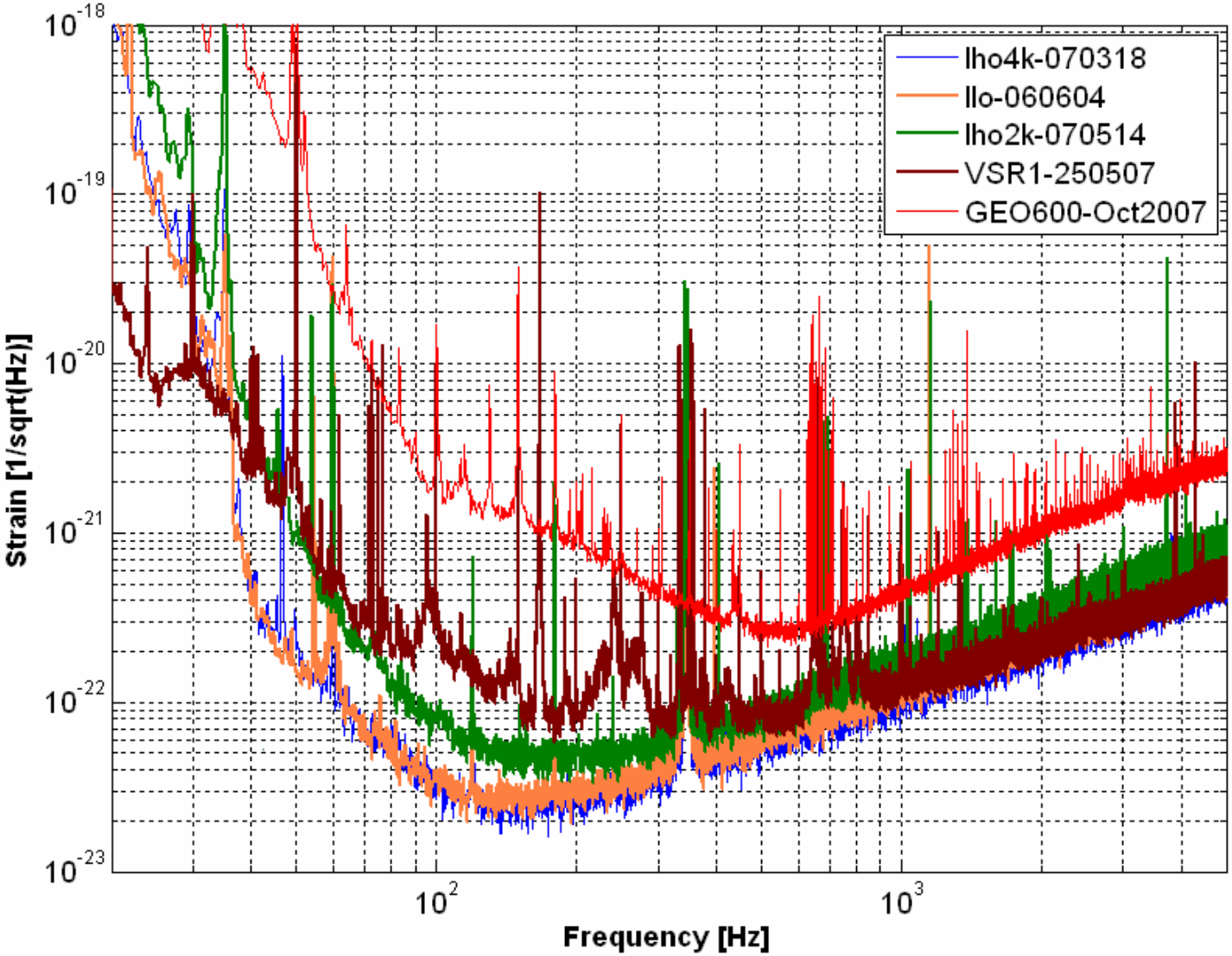


GEO600 S5 summary

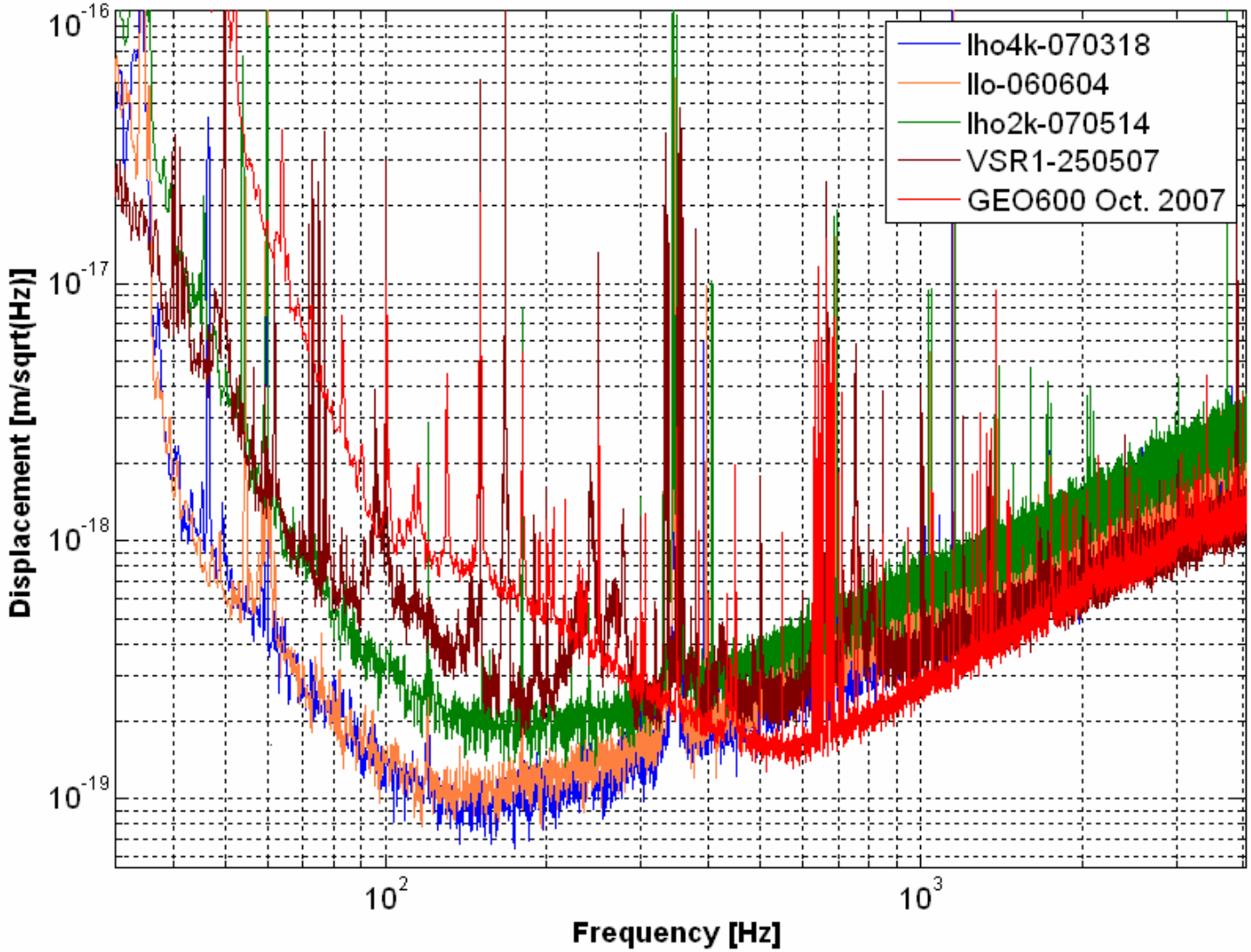
- **Collected ~ 421 days of science data**
- **Overall S5 (Jan. 06 – Oct. 07) duty cycle 68%**



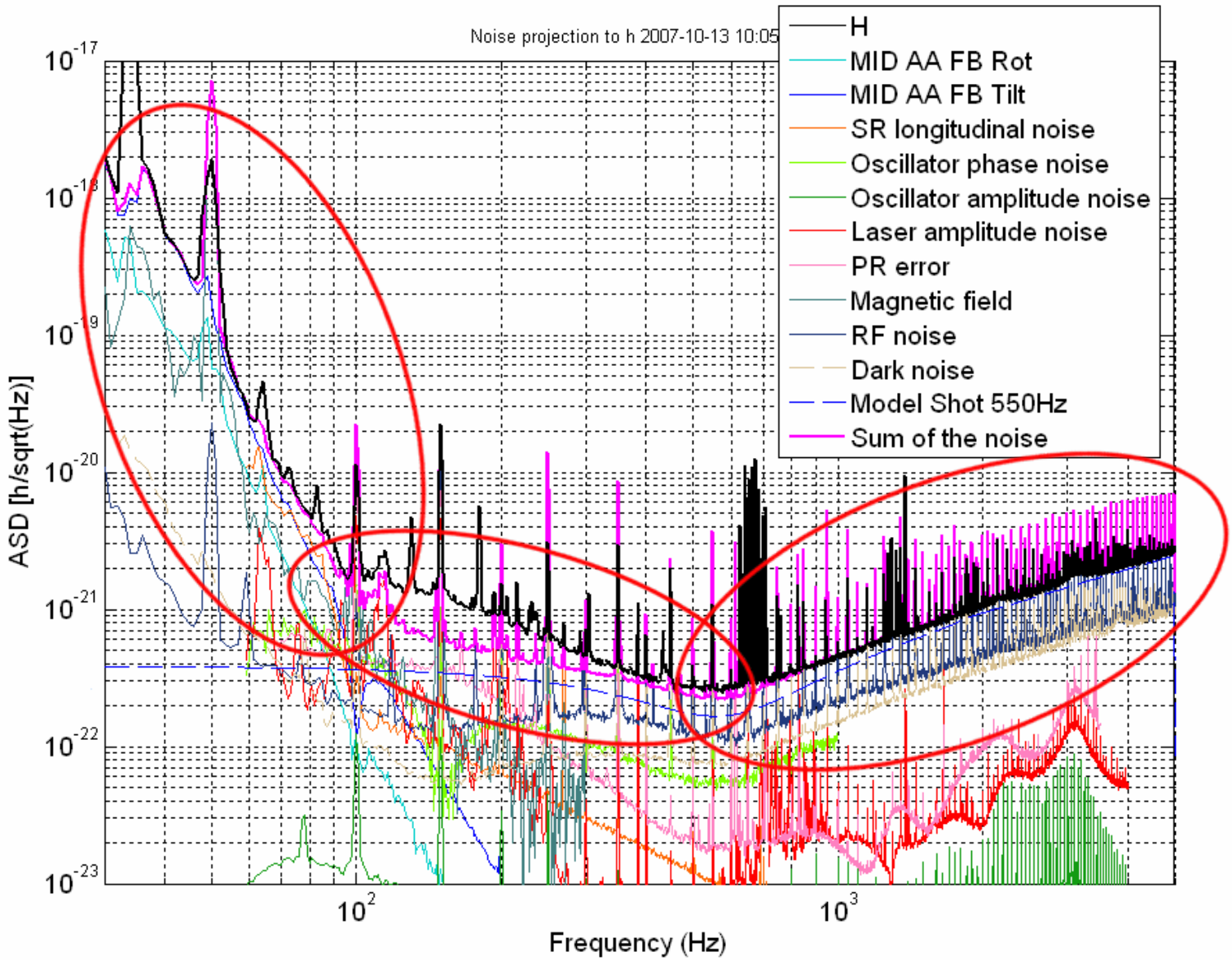
Current Strain Sensitivities of LSC/Virgo



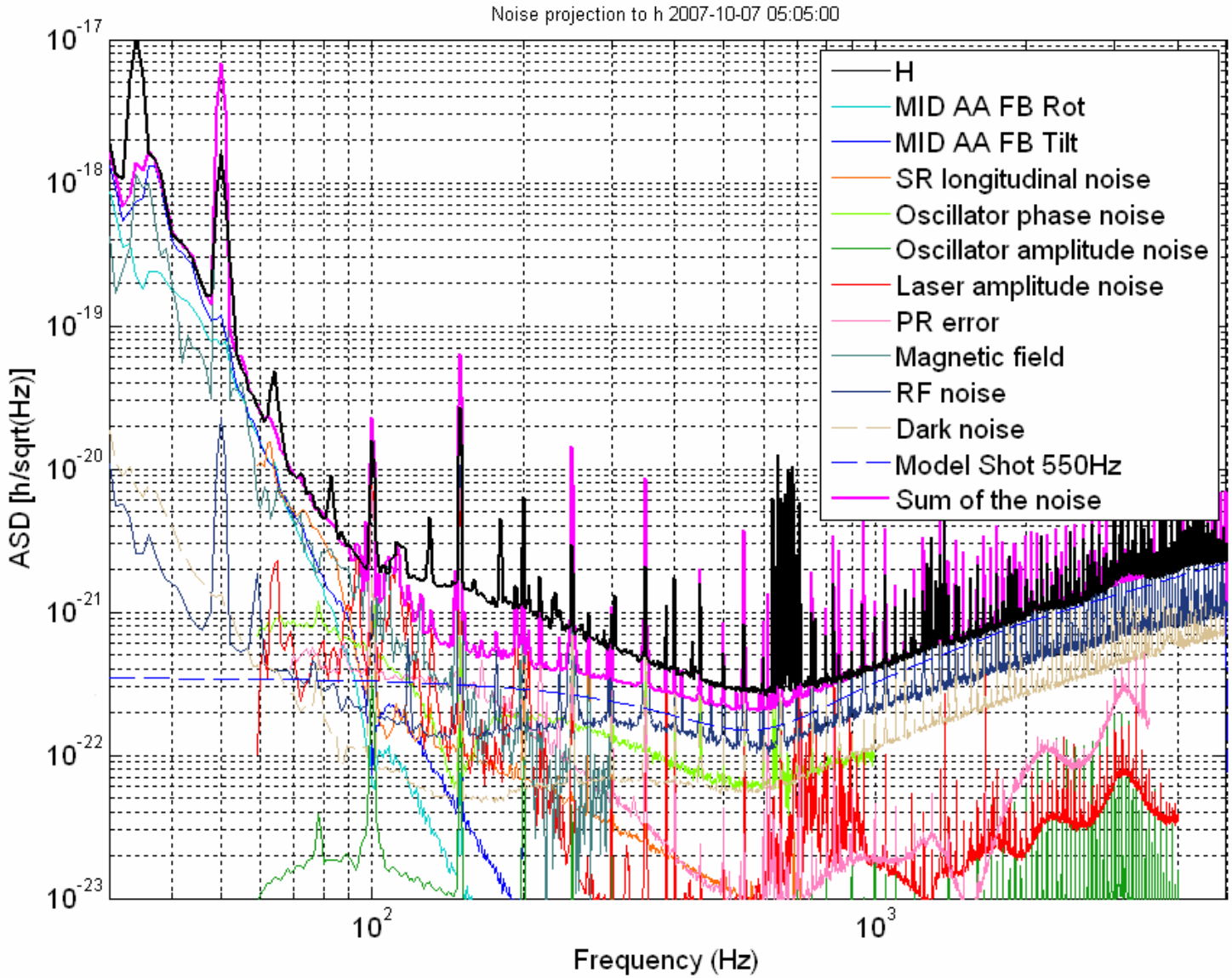
Displacement Sensitivities of LSC/Virgo



Noise projections

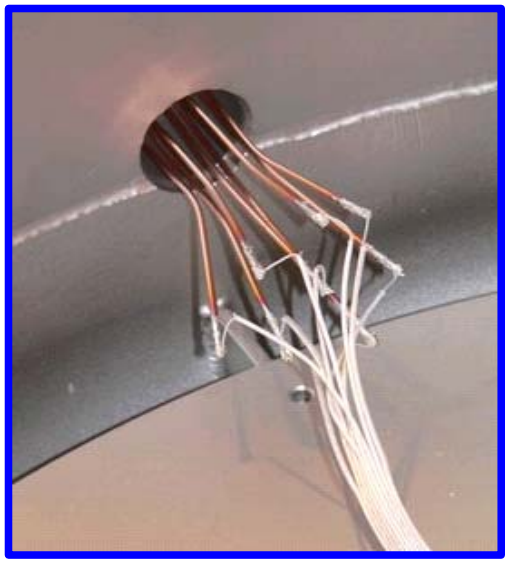


Noise projections

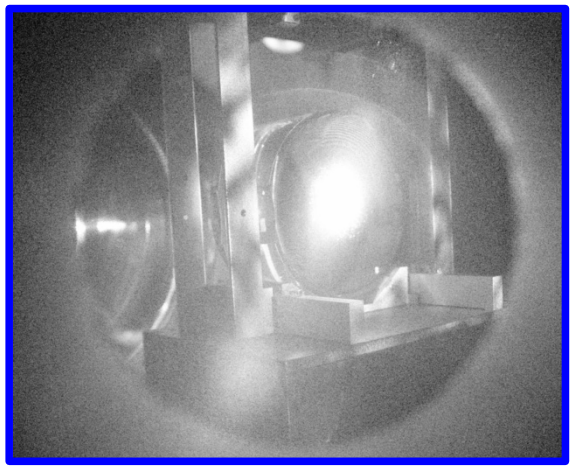


Power 75

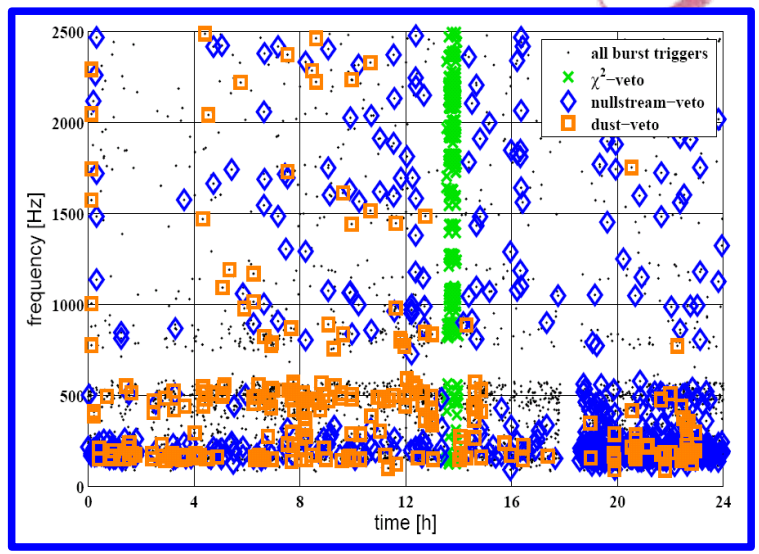
Samples of commissioning work



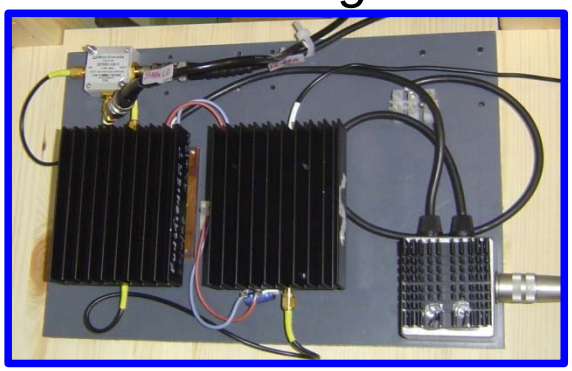
New high voltage feedthrough



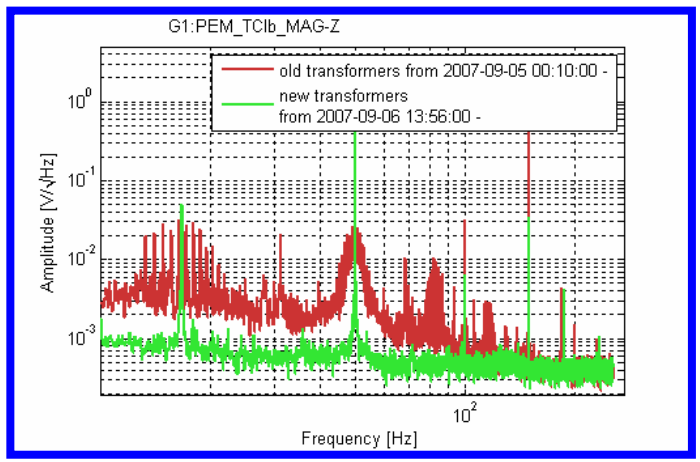
Investigate test mass scattering & view port exchange



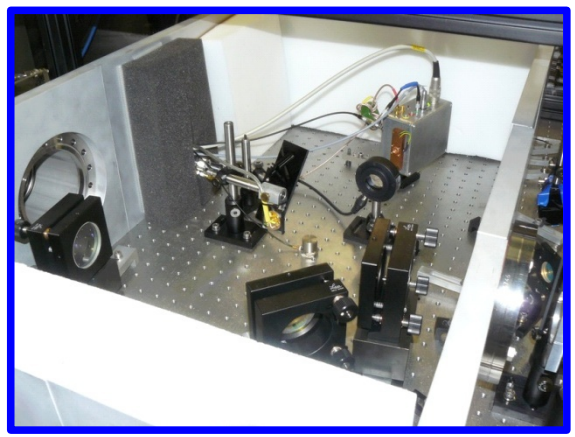
Powerful glitch veto



New low noise RF bench for PR loop

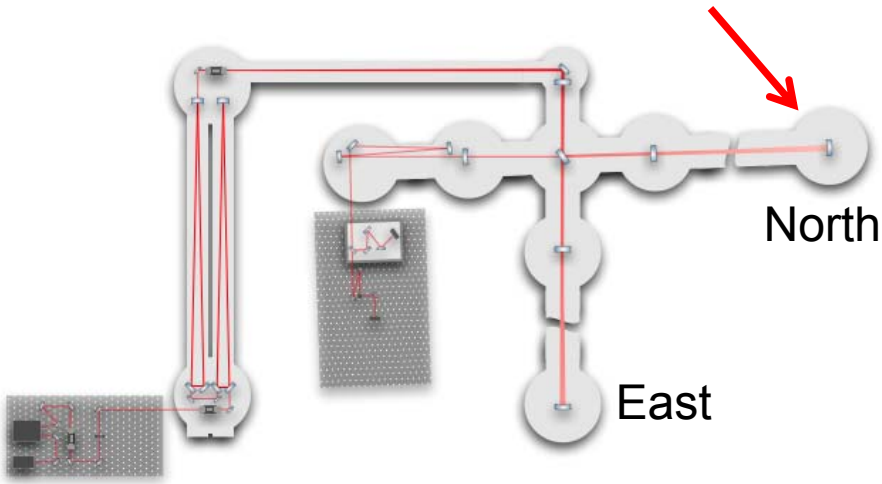


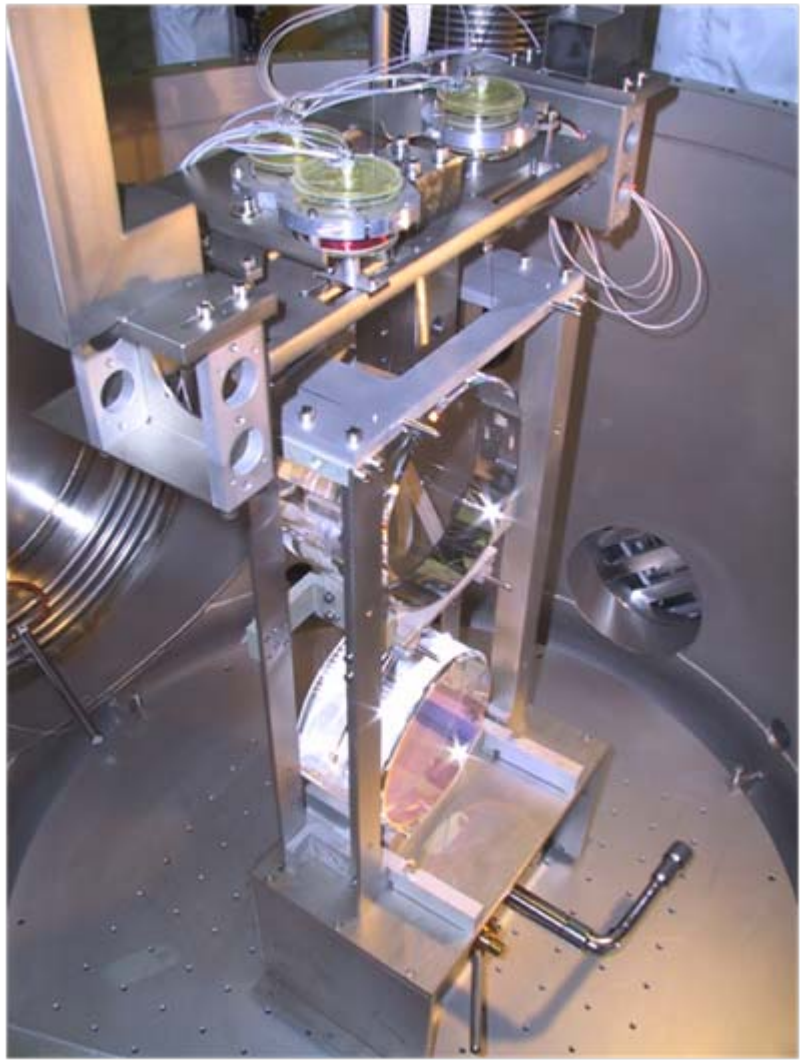
Transformer exchange

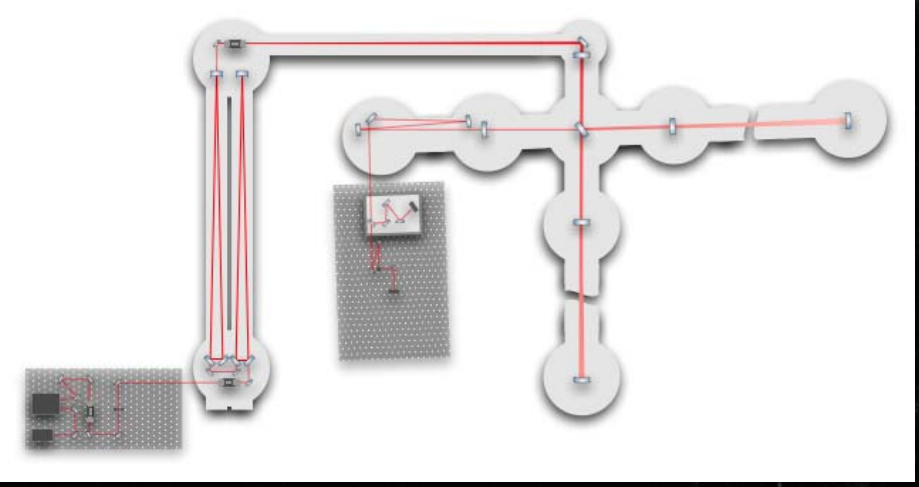


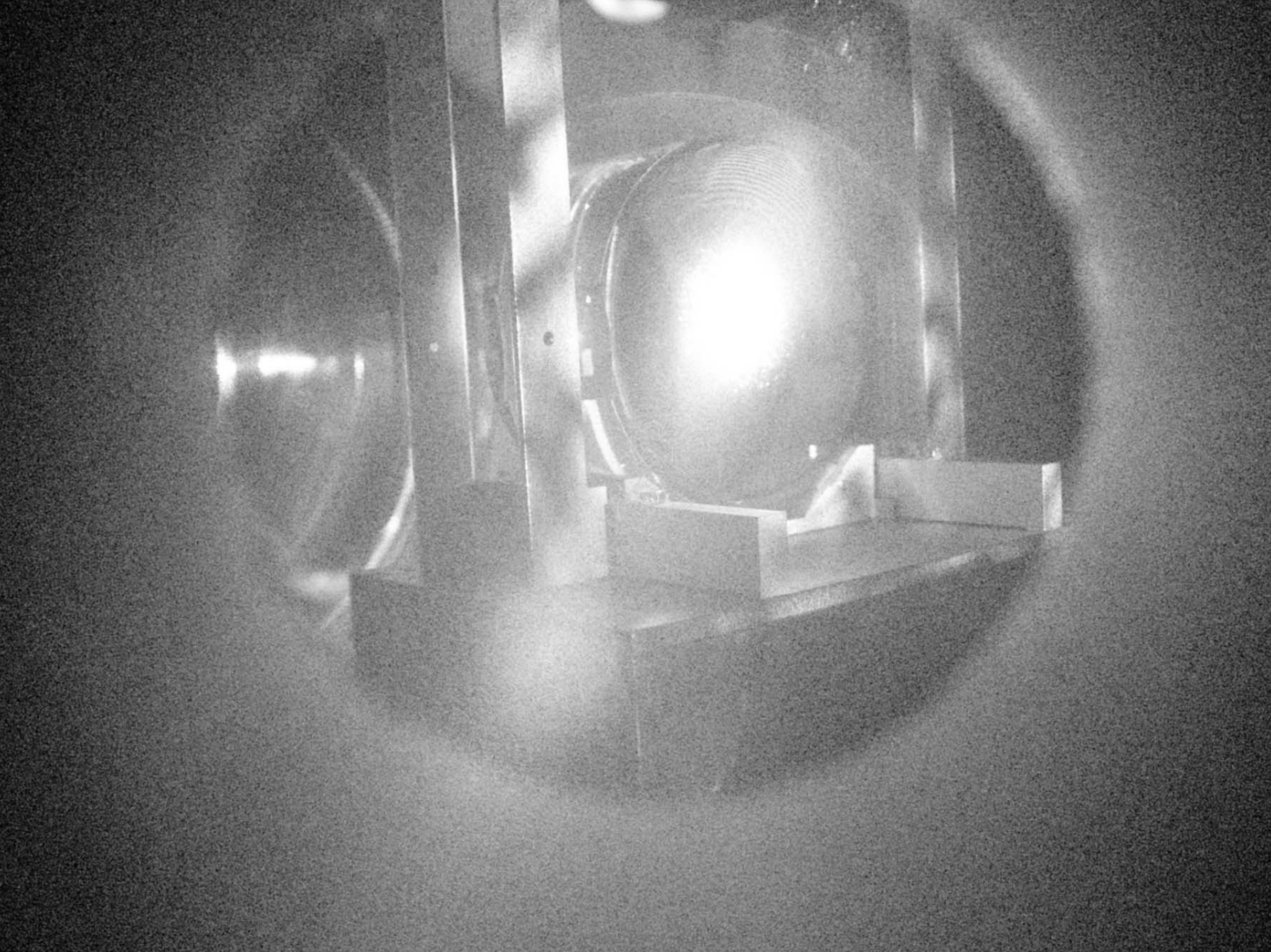
Re-design the detection bench

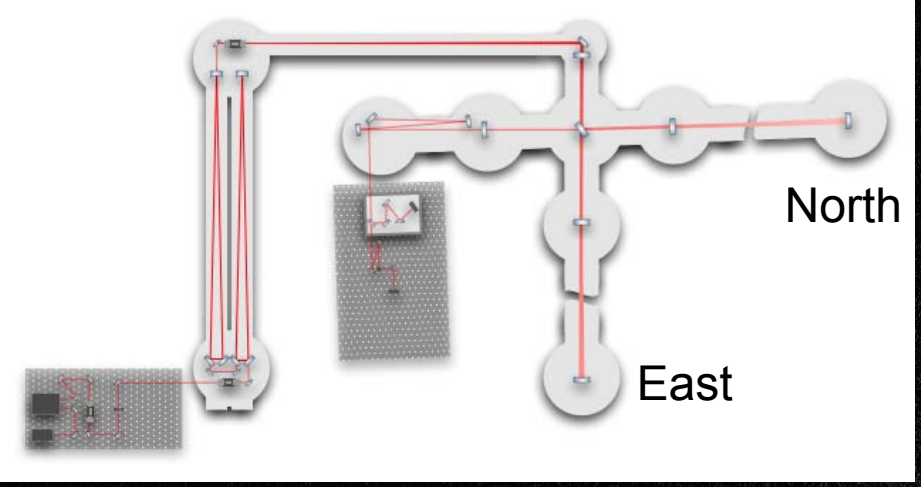
Losses & Scattered light

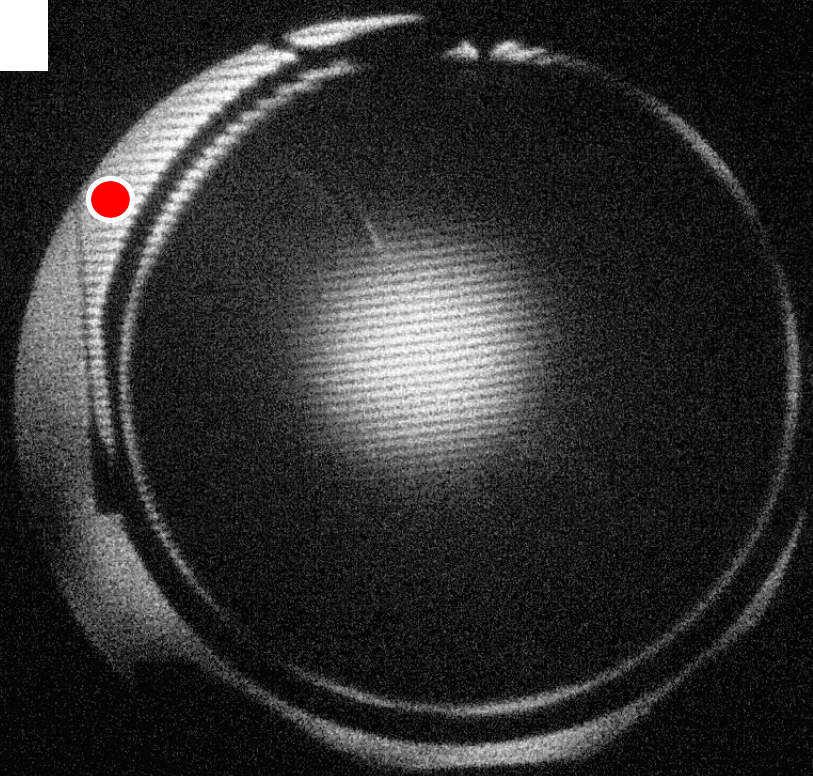












Measured intensity of
1.8mW/cm^2
Estimated integrated power:
~ 200mW =~ 10^{-4}/mirror

Scattering function:

$$f_{\mathrm{MCN}}(\theta) = \frac{\delta P_{\mathrm{MCN}}}{P_{\mathrm{MCN}} \cdot \delta\Omega} \quad \text{with} \quad \delta\Omega = \frac{A}{r^2}$$

$$f_{\mathrm{MCN}}(0.17\mathrm{mrad}) = 2.57 \cdot 10^3$$

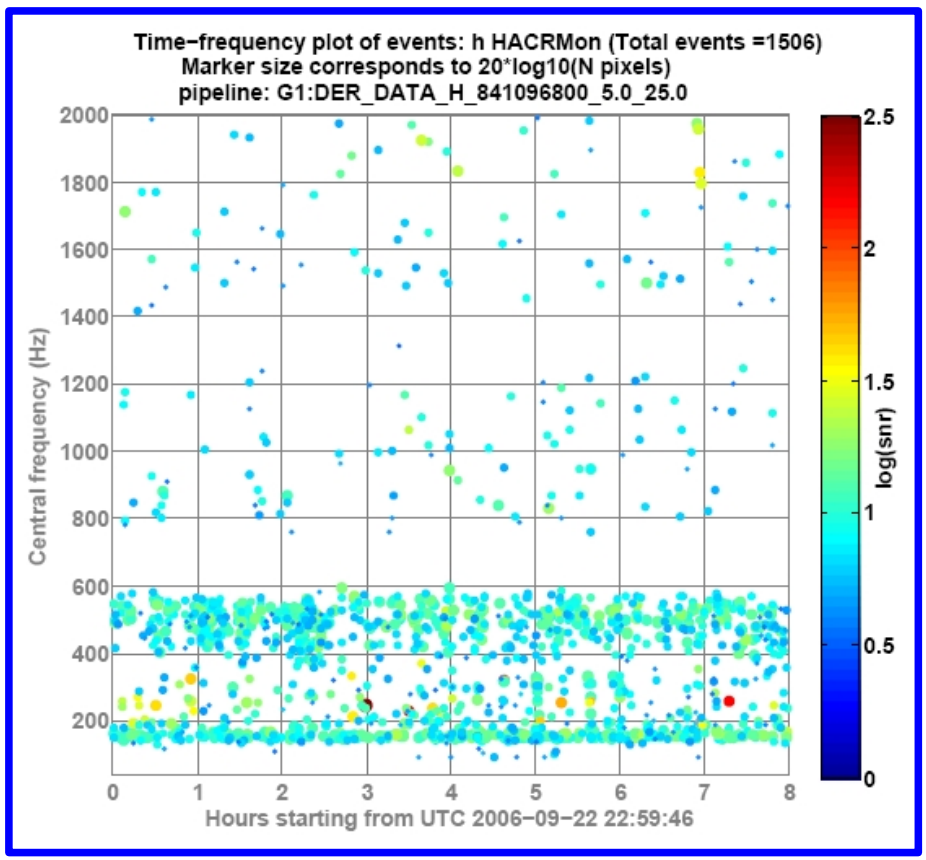
(LIGO-T070259-00-Z)

Decrease glitch rate

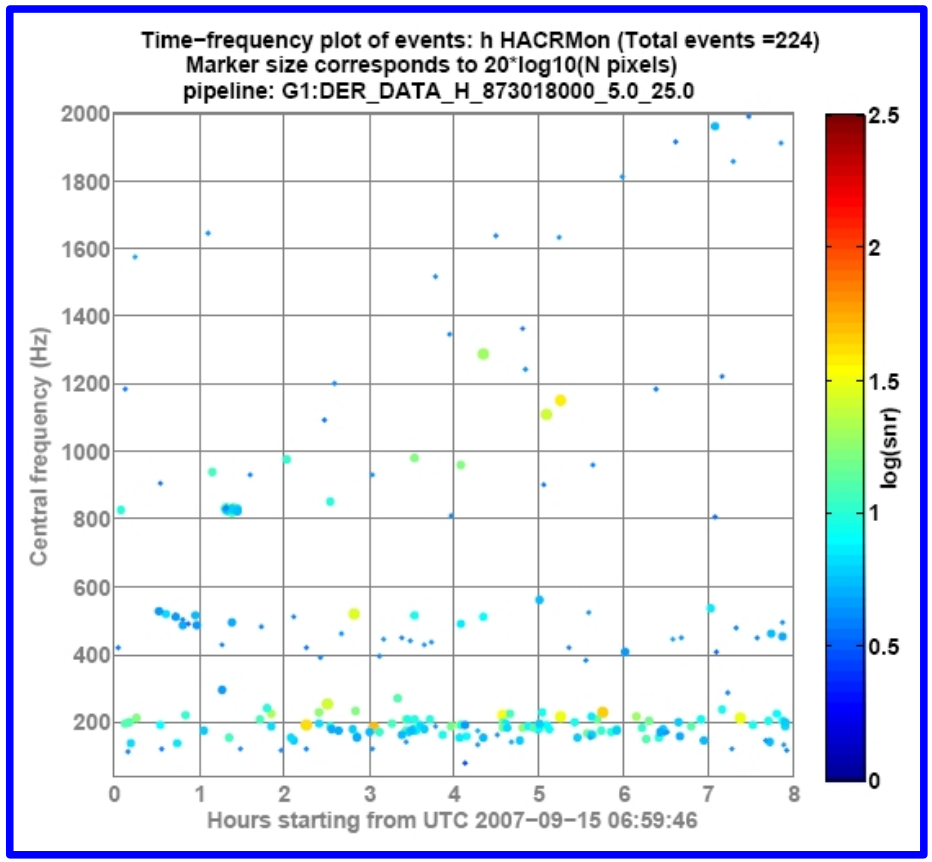
Example for 8 hours:

S5, September 06

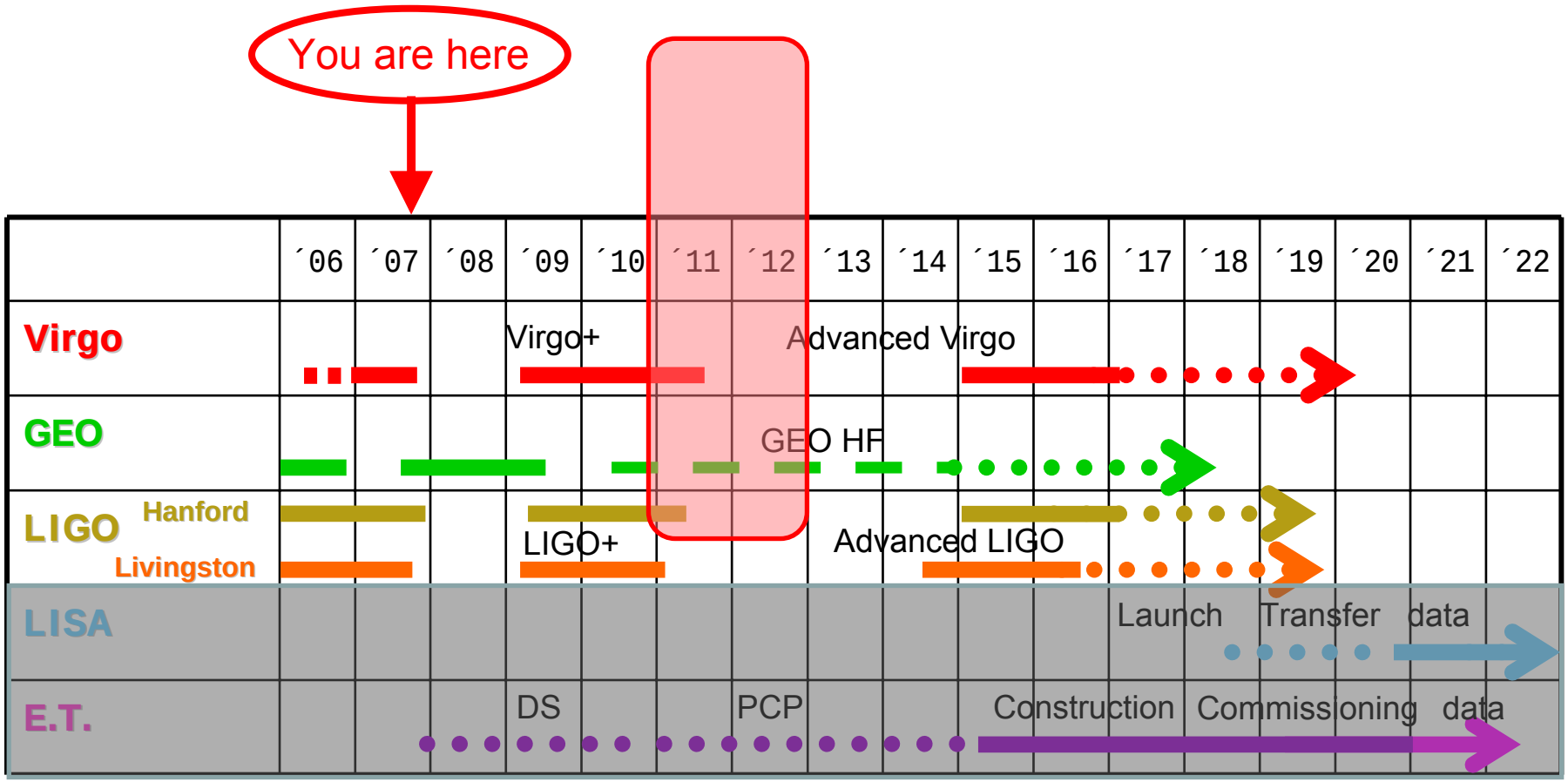
Glitch rate comparable to LIGO



September 07



Timelines



1st Generation	2nd Generation	3rd Gen.

Astrowatch (2008)

- What ?
  - GEO600 science run starting Nov. 2007
- Why ?
  - Cover the time when LIGO/VIRGO are upgrading
- Who ?
  - GEO600, bars and LIGO H2 as upgrades permit
- How?
  - Heterodyne, detuned 500 Hz (same as S5)
  - Improvement work at low level
    aim at ~80% science duty cycle

Image from members.cox.net/~k5xi/summer_milky_way.jpg

GEO600 Site Tour: Thursday 14:00

ILIAS WG1 GW meeting incl. Mystery Noise Discussion: Tuesday 18:30