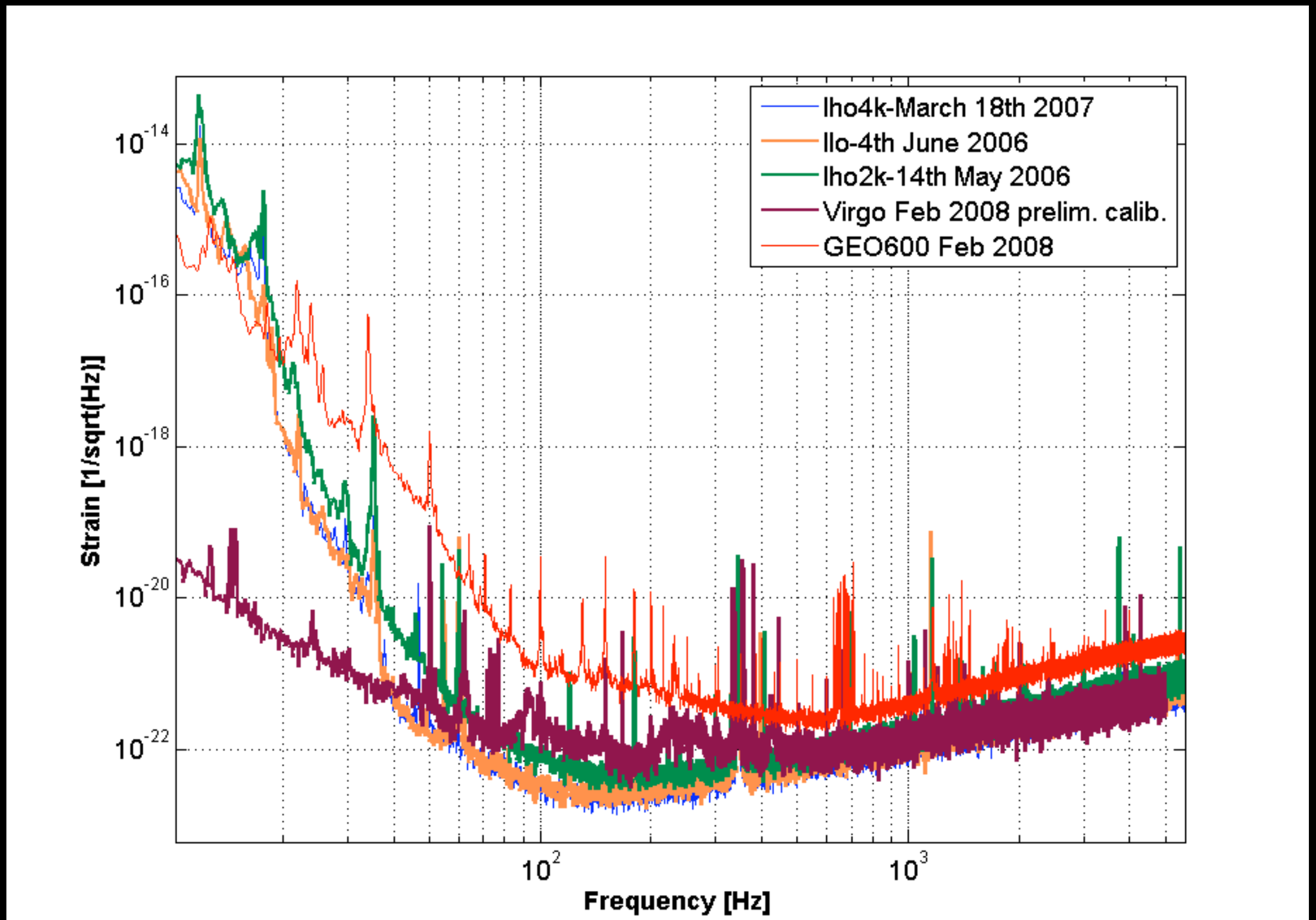
# The status of GEO

Matthew Pitkin (greatly inspired by Harald Lück's talk from GWADW)

LIGO-G080344-00-Z

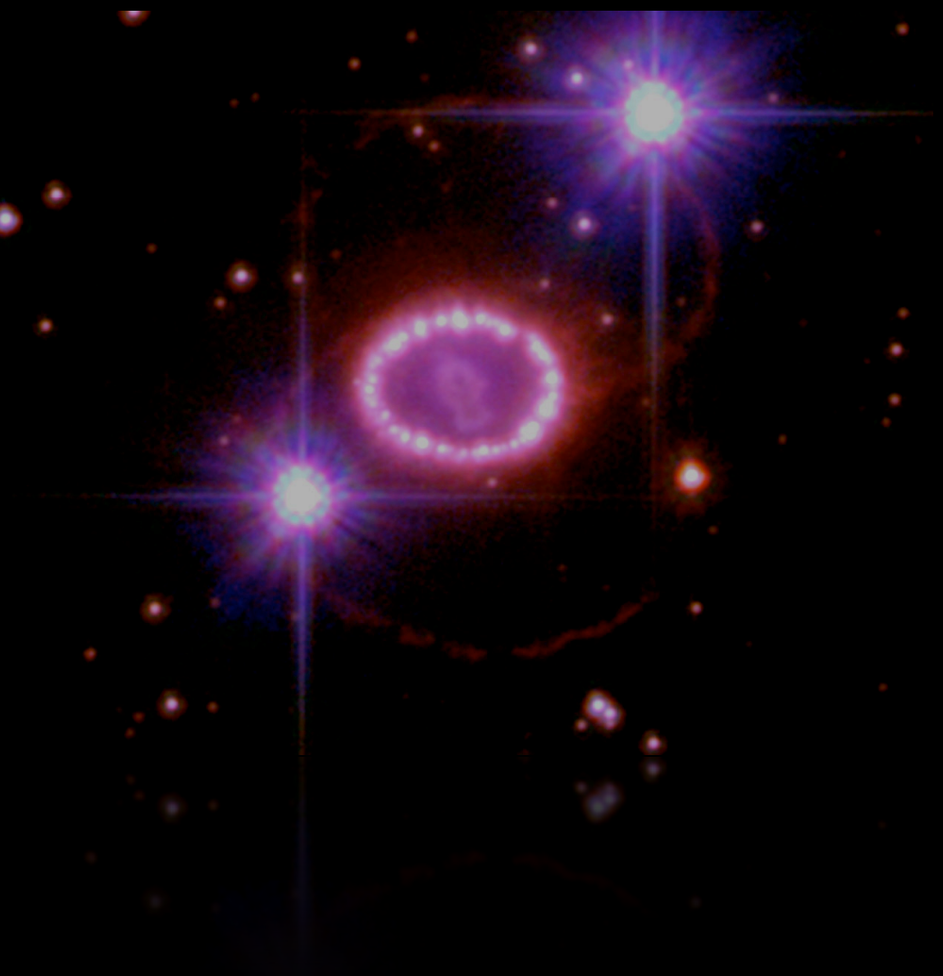
# Current sensitivity



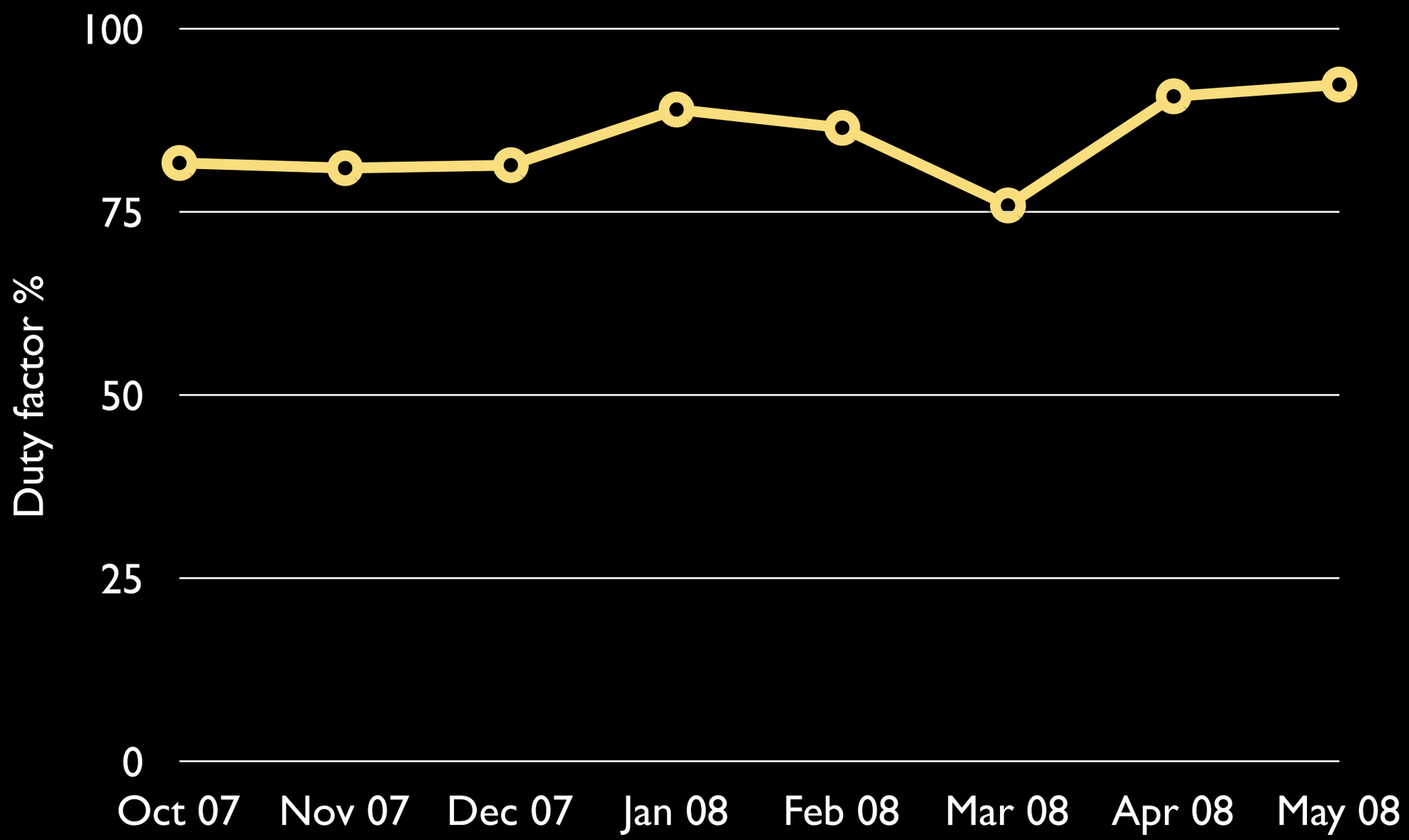
# Current status

## Astrowatch

- Watch out for serendipitous local events
- Started following on from end of S5 in October 2007
- Will continue until early 2009
  - aim for ~80% duty factor
  - carry out low risk commissioning work



# Duty factor

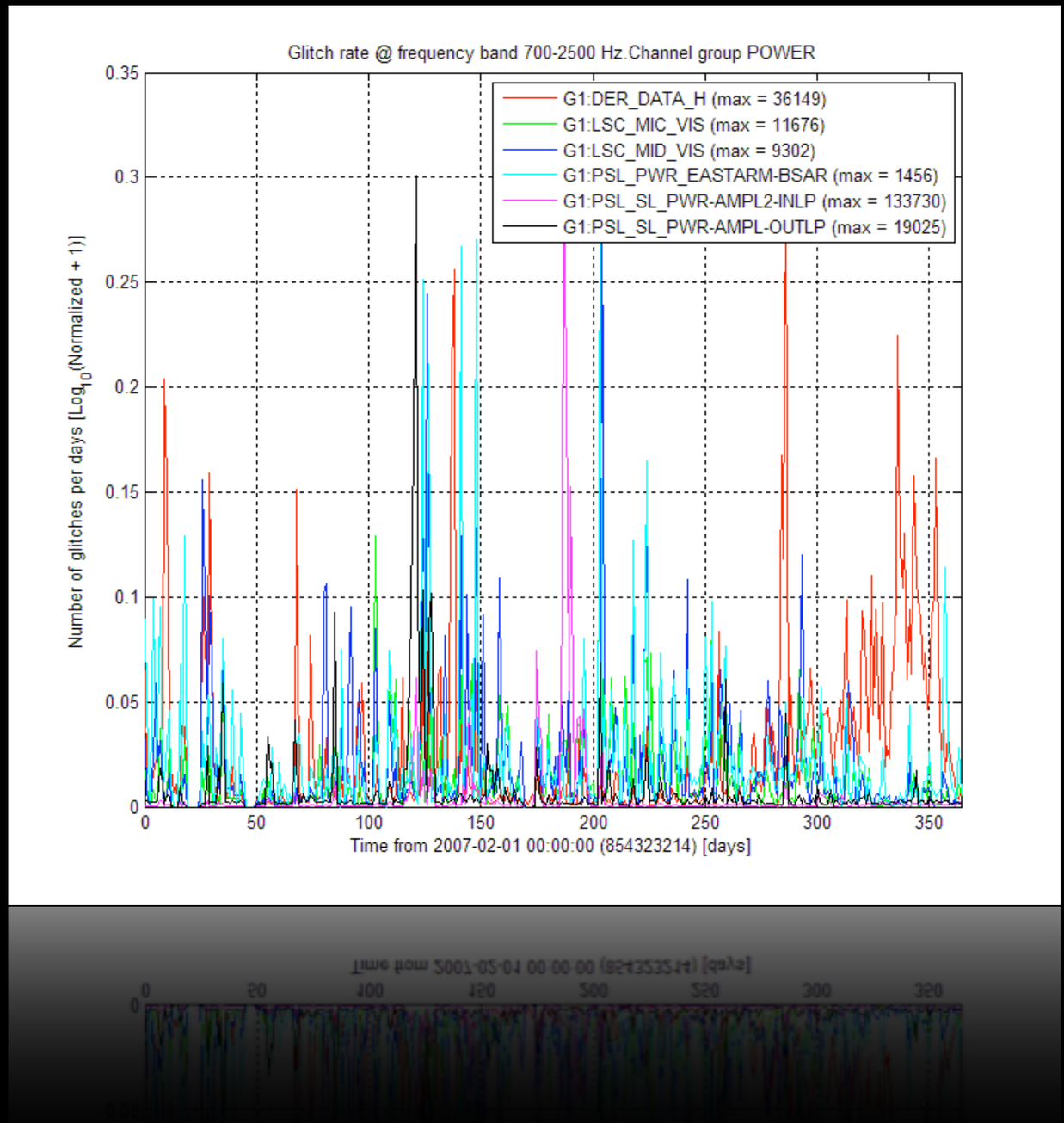

100
75
50
25
0
Duty factor %
Oct 07
Nov 07
Dec 07
Jan 08
Feb 08
Mar 08
Apr 08
May 08

# Online analysis

- Online Q-pipeline analysis running on Astrowatch data
- see http://ldas-jobs.caltech.edu/~qonline/G1


# Detector characterisation

- Looking at glitch rates
- Looking at patterns in glitches
- Looking at correlations of glitches between channels
- Characterising the source of glitches



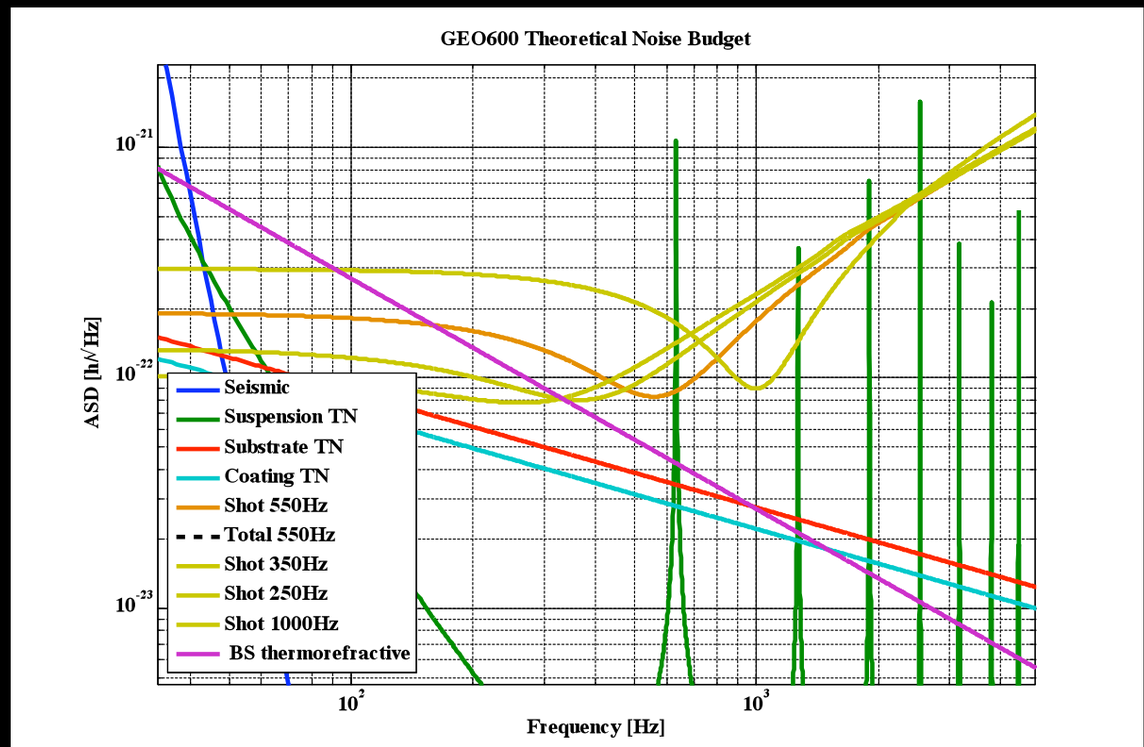
# Where now?

## GEO HF

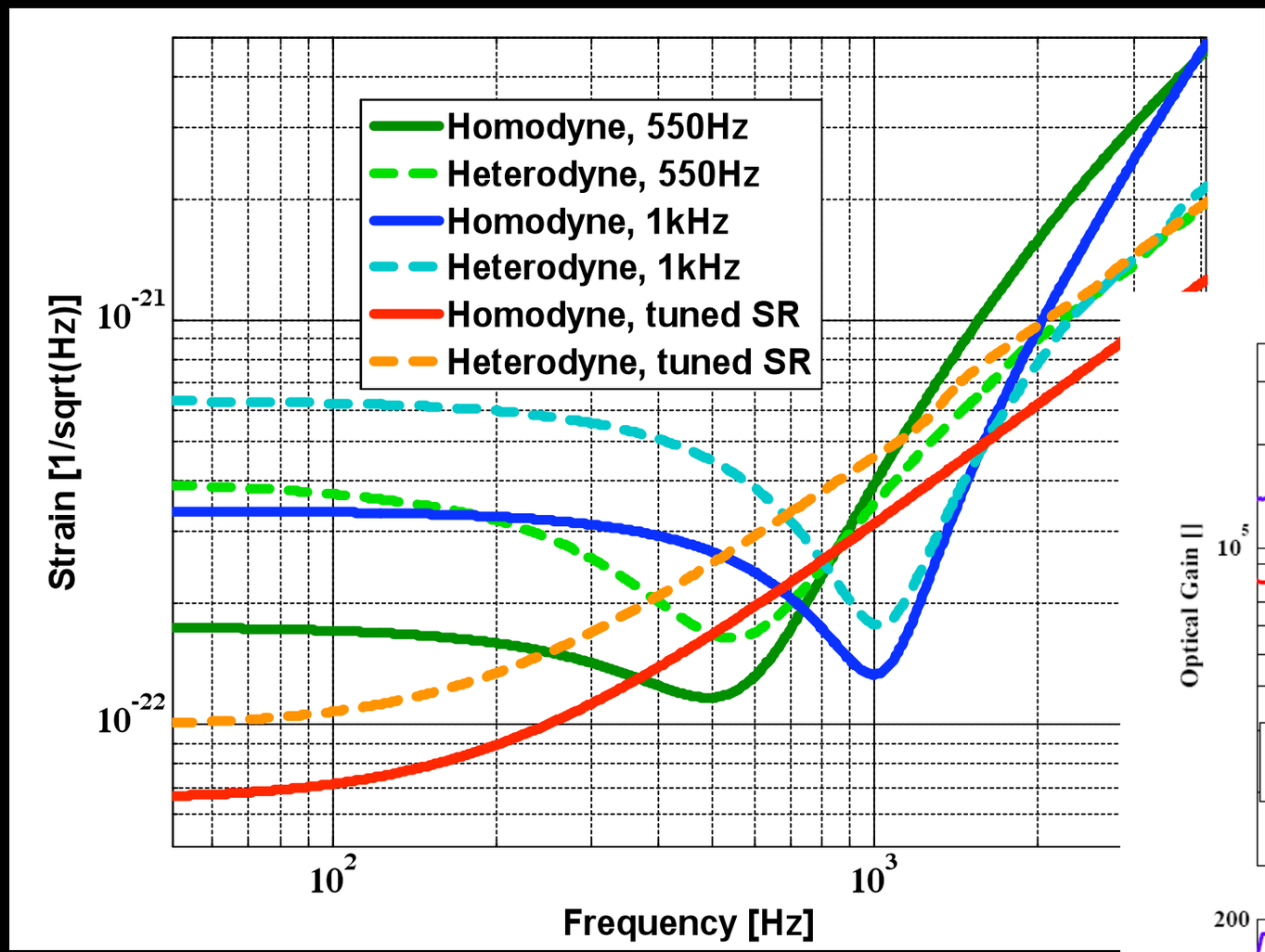
- Following Astrowatch (some time Spring 2009) upgrade to GEO HF
- Goals
  - Improve sensitivity to give scientifically relevant data in the time of "enhanced" detectors
  - Demonstrate stable and reliable squeezing in a GW detector
  - As with GEO600 it will prototype advanced techniques

# Options for GEO HF

- Limited by thermal noise at low frequencies
- But, we can gain at high frequencies (> 1kHz)
- Need to reduce shot noise
  - DC readout
  - Use squeezed light
  - Broadband recycling
  - Enhance light power

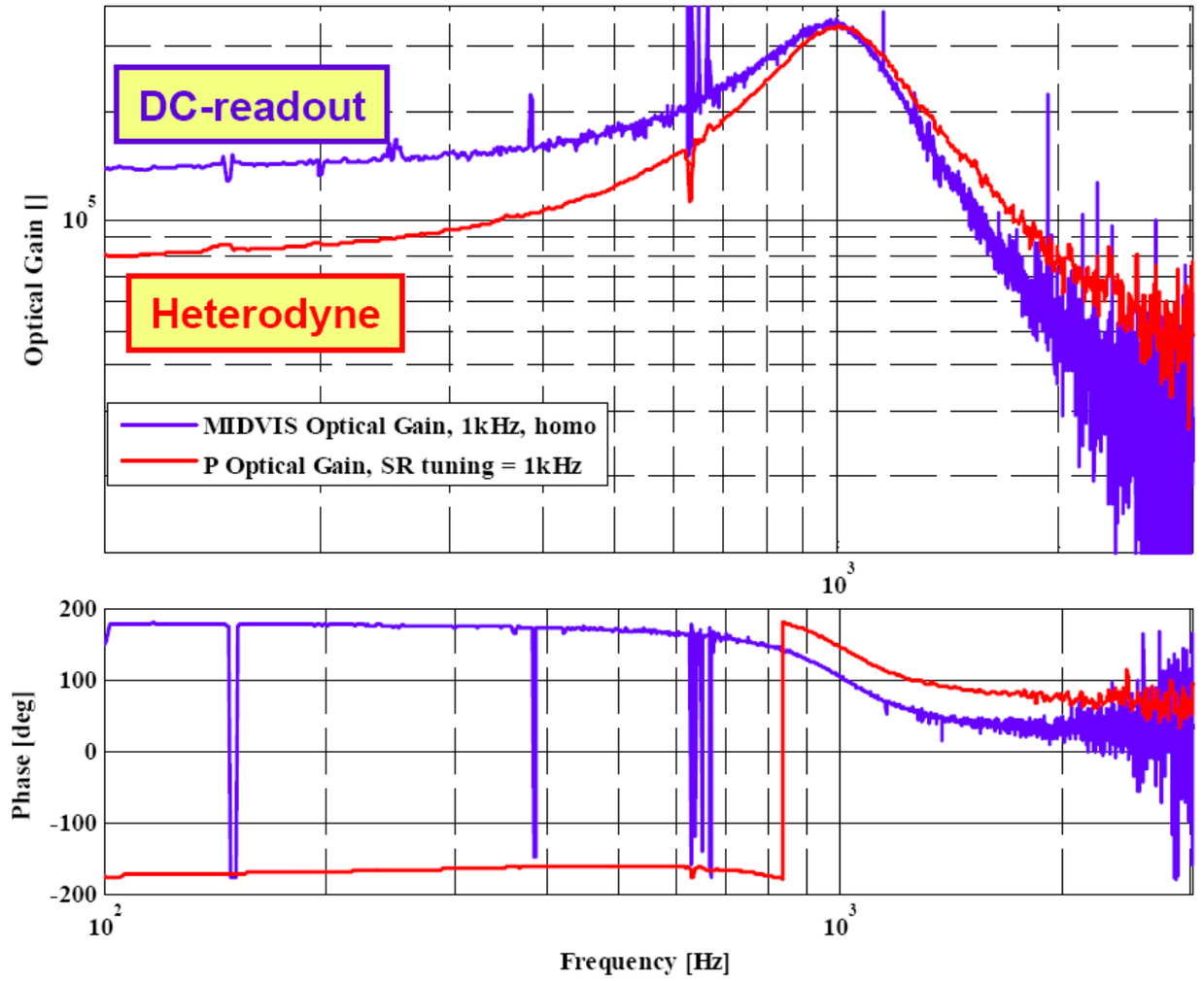


# DC readout vs heterodyne readout



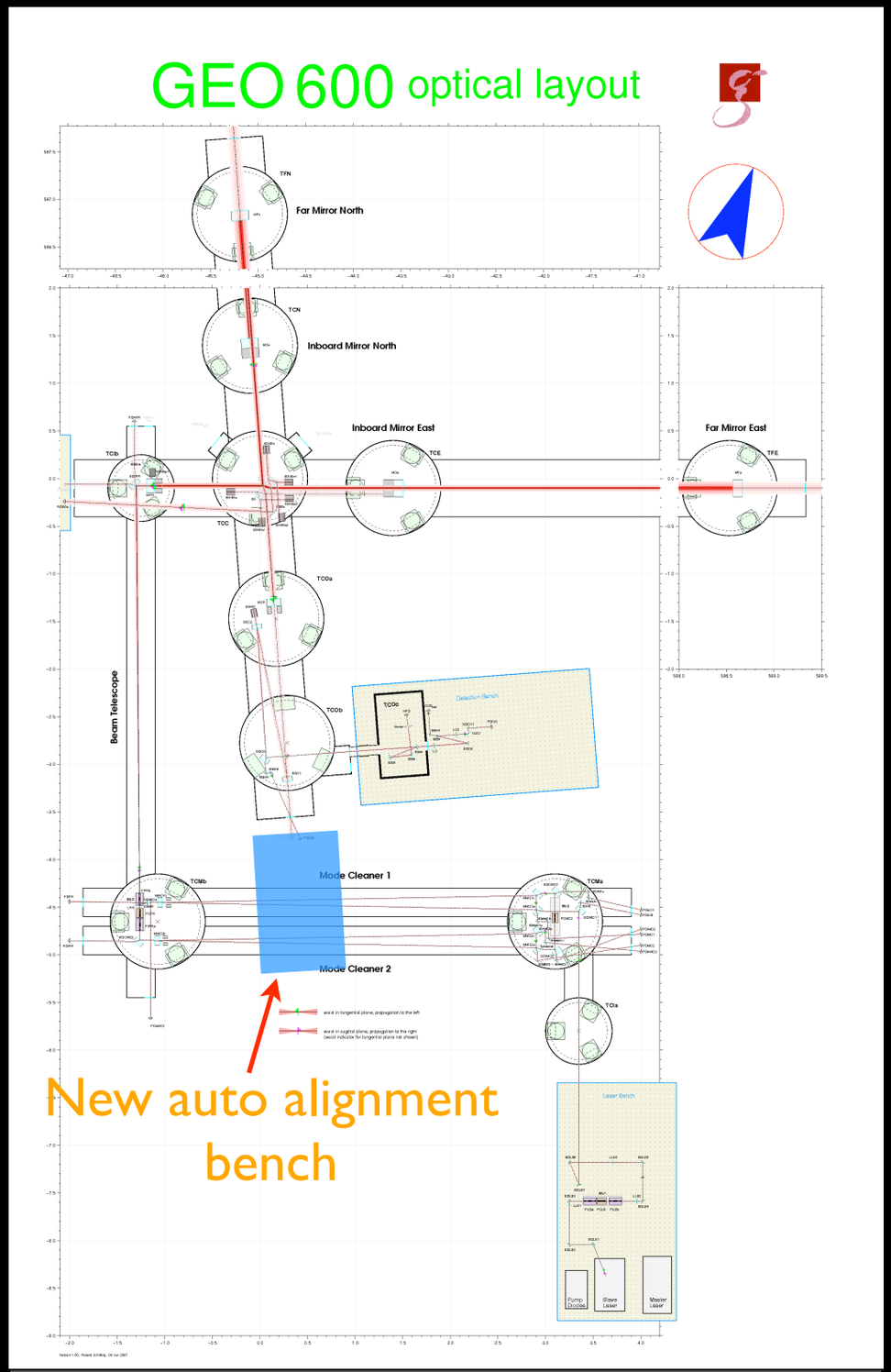

## Theoretical expectation

## Experimental verification

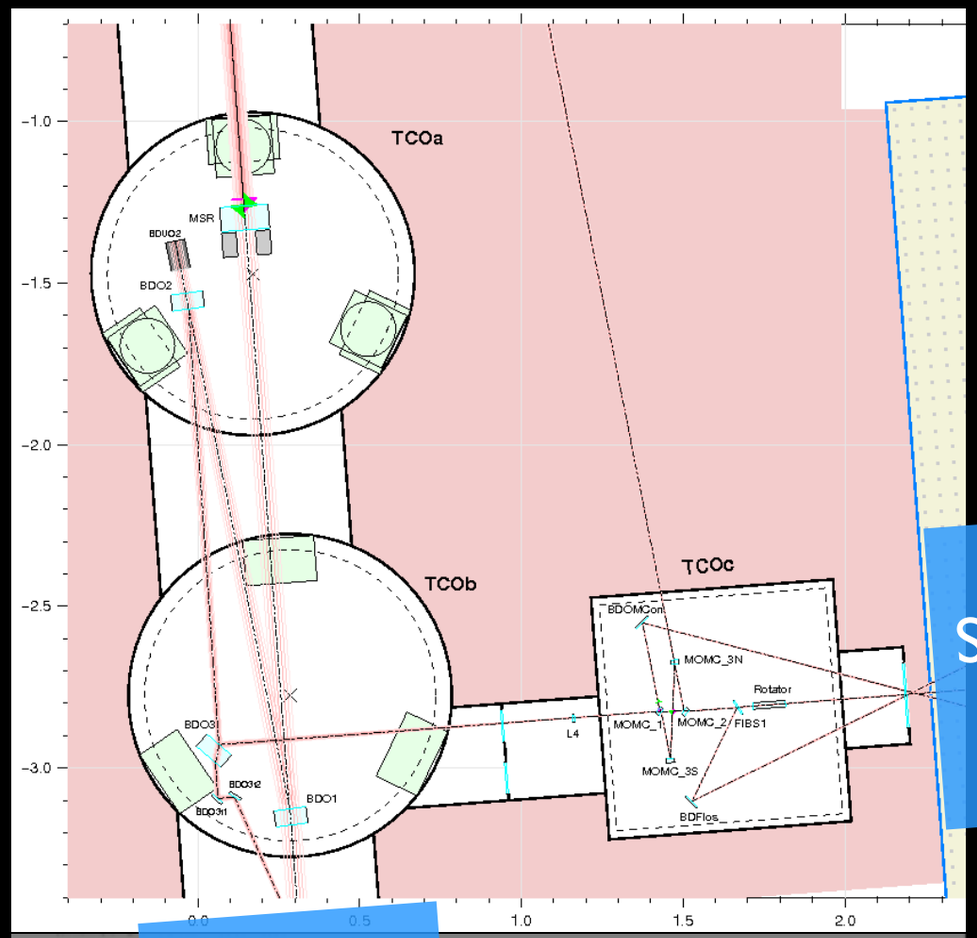


# Changes to GEO setup

- Move auto alignment from detection bench to a new dedicated bench
- Put main photo-detector into its own vacuum tank (outside vacuum system at the moment)
- Add an output mode cleaner to reduce higher order modes in detected light

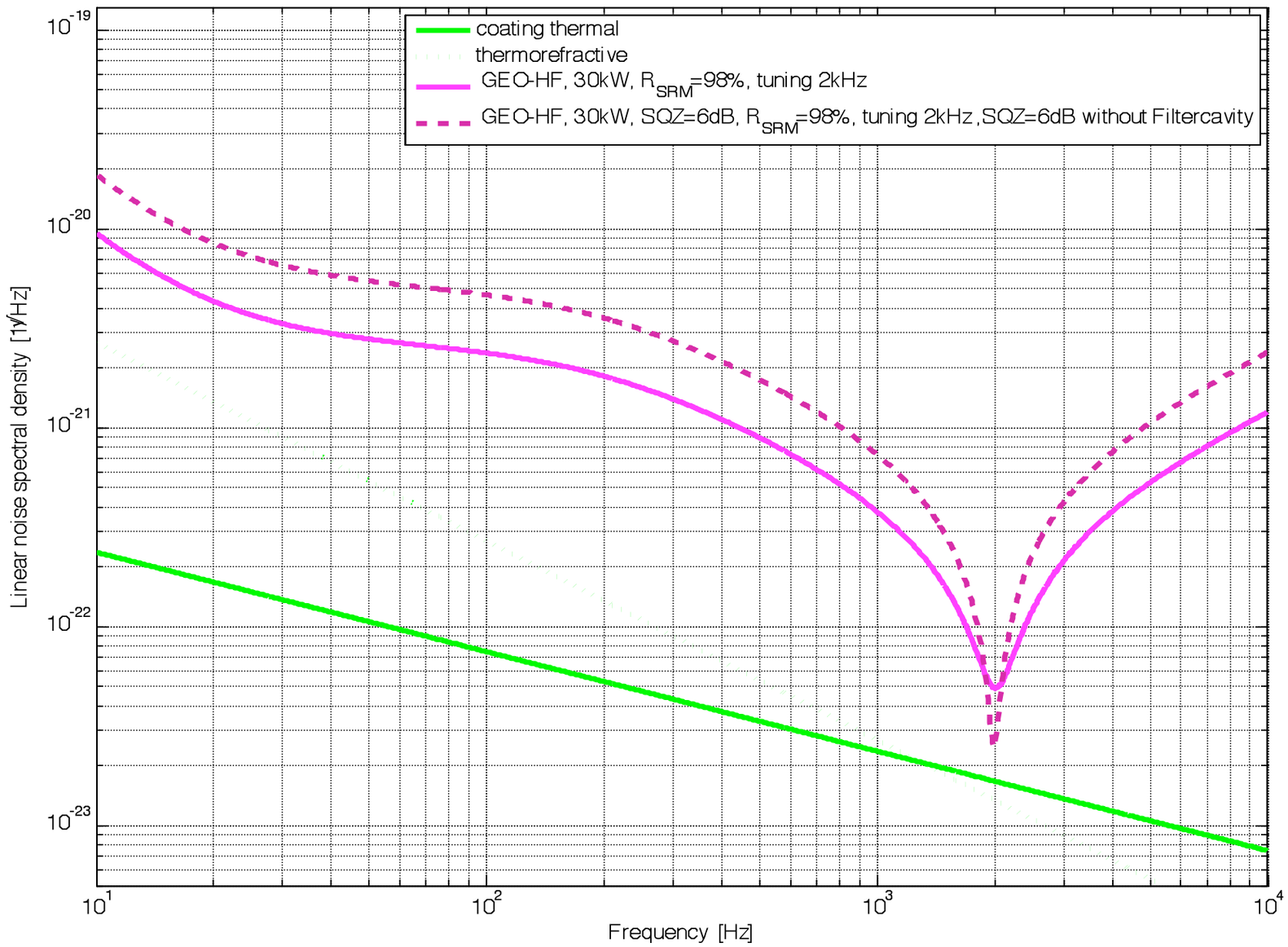


# Adding squeezed light




Inject squeezed light to lower shot noise

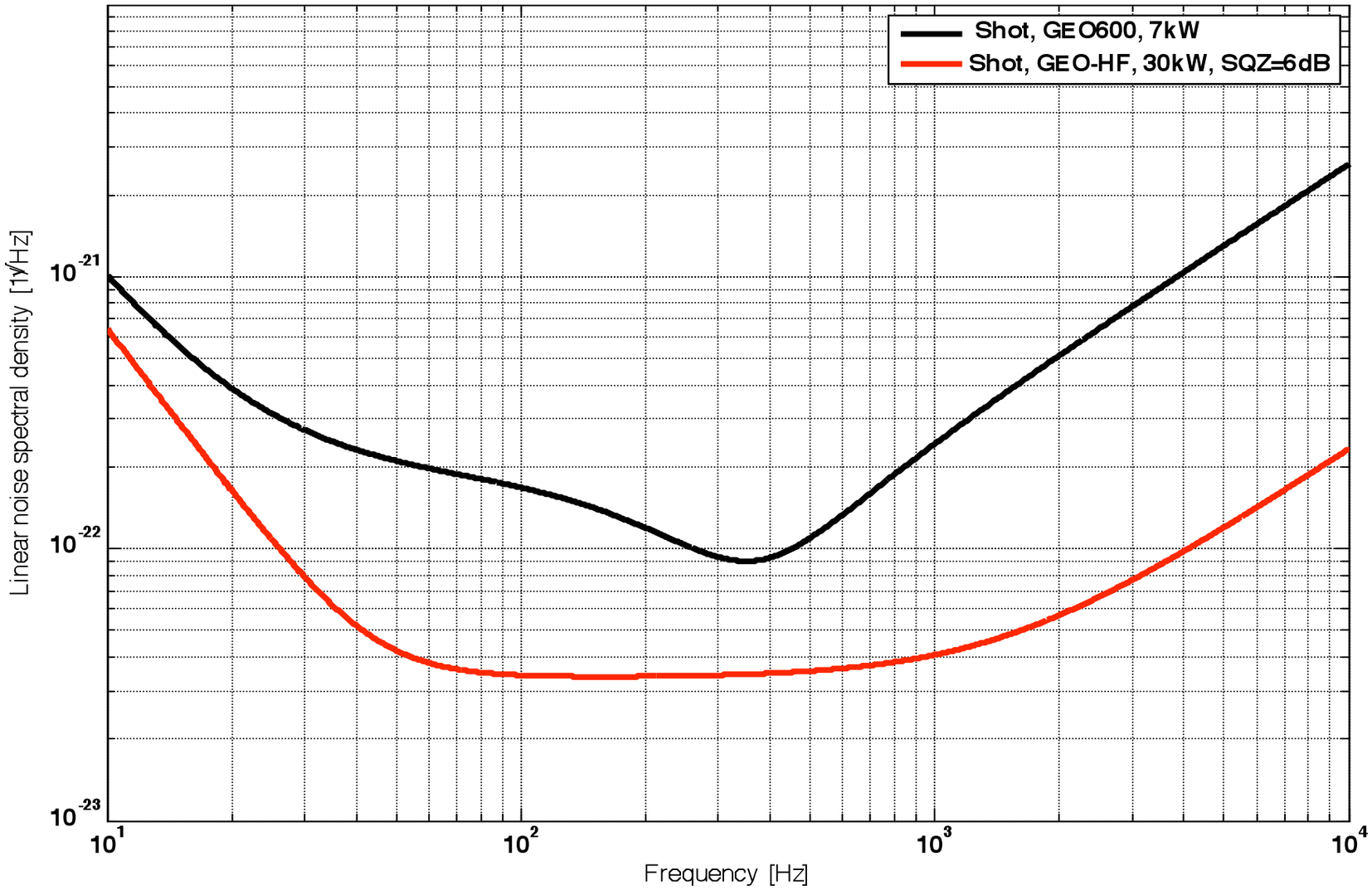
# What can be gained with squeezed light



# Power increase

- Currently at 3.5 kW at power recycling mirror
- Increase laser power from 10 W (6 W) to 35 W
- Exchange mode cleaner mirrors to increase throughput by factor of two
- Aim for 35 kW at power recycling mirror

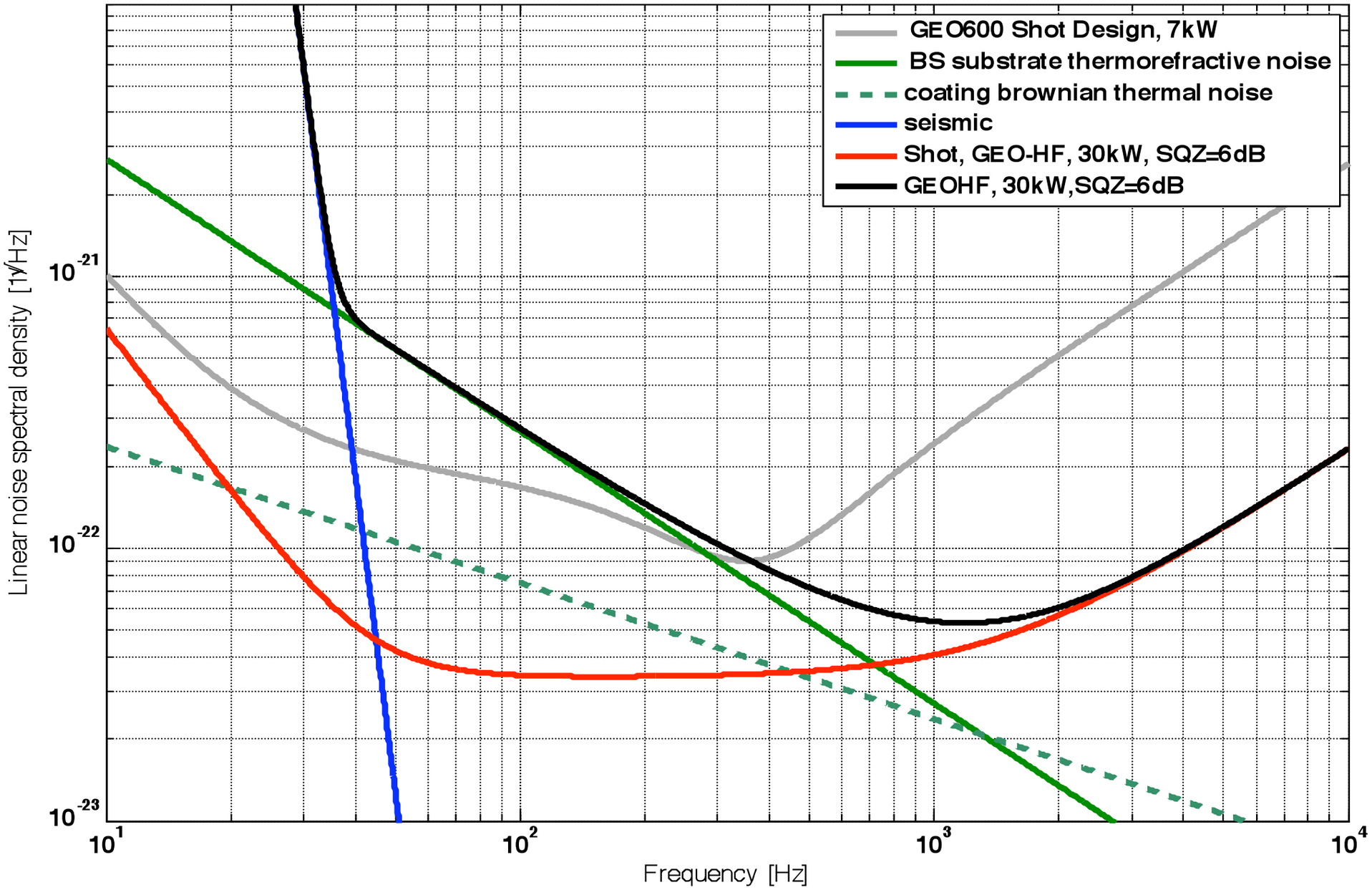
# Shot noise for GEO HF vs GEO600



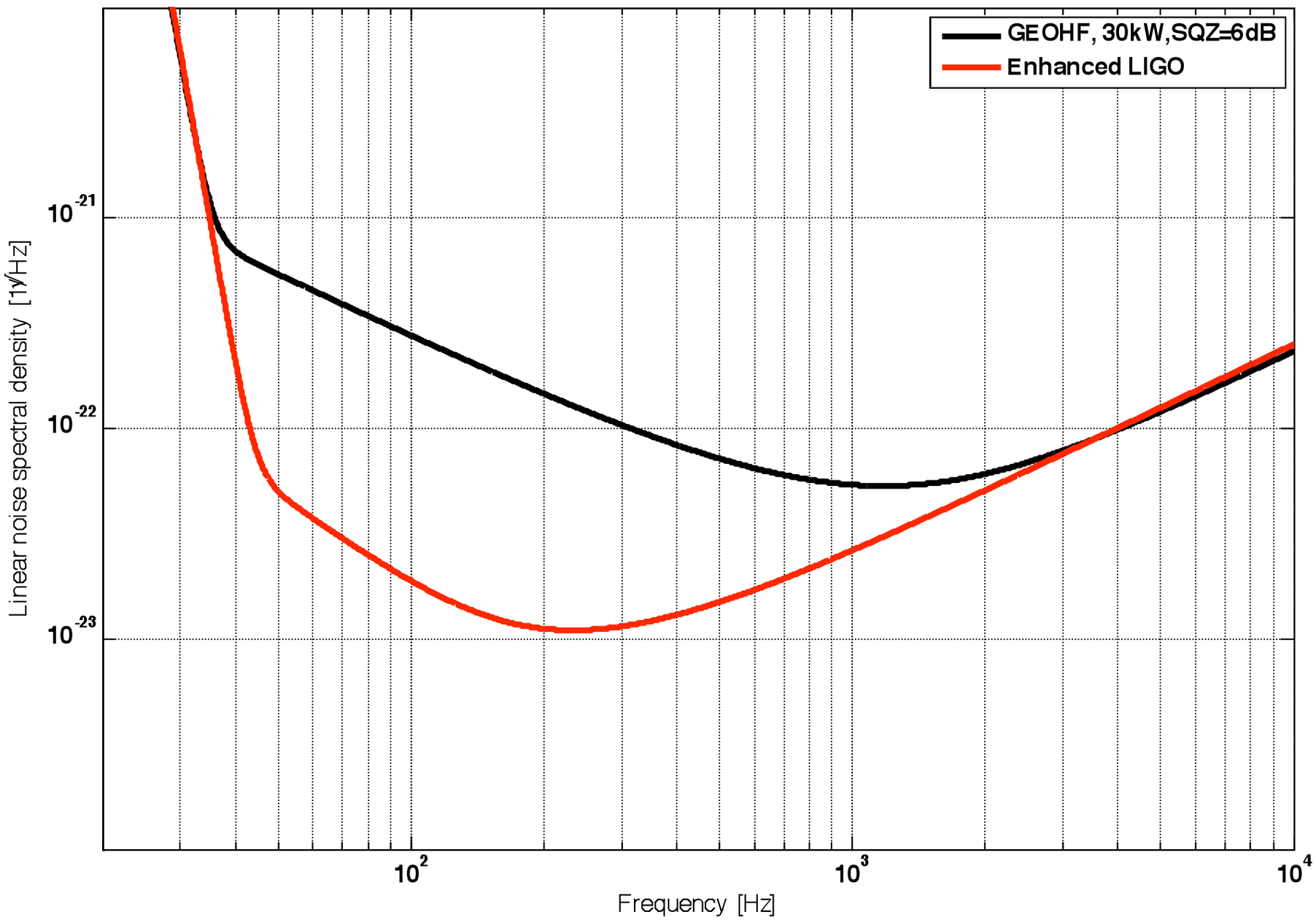

GEO600: 7 kW, RF readout, 550 Hz detuned

GEO HF: 30 kW, DC readout, output mode cleaner, tuned, broadband

# GEO HF noise sources



# GEO HF vs Enhanced LIGO



# Timeline

- Spring 2009
  - DC readout
  - output mode cleaner
  - in vacuum readout
  - squeezed light into output port
- Autumn 2009
  - Increase laser power
  - Exchange main mirrors