

# GEO 600

## Status of the gravitational wave detector

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### What is GEO 600?

- German-British contribution to the first worldwide network of ground based **gravitational wave (GW) interferometric detectors**.
- Location: Ruthe, 20 km south of Hannover, Germany.
- Construction began 1995. First data-taking 2002.

### Main laser power increase

*Original laser:* Nd:YAG master/slave system, 12W @ 1064nm.  
*New laser:* NPRO maser laser with 4 amplification stages providing up to 35W @ 1064nm.  
 Direct improvement of sensitivity by reducing shot noise. But EOMs need to be replaced and thermal lensing effects in the beamsplitter substrate corrected.  
 Input mode cleaner finesse lowered to decrease radiation pressure noise, providing 20kW at the beam splitter (BS).

### GEO-HF upgrade (started 2009)

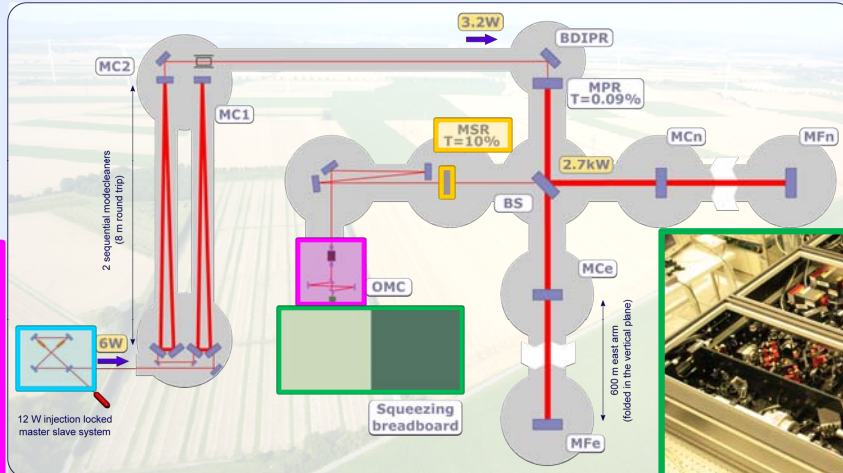
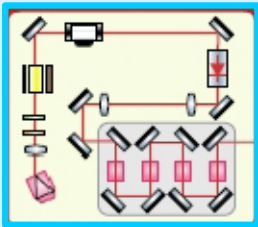
The aim is to **improve detector's sensitivity at high frequencies** (from several hundred Hz to a few kHz) where the limiting factor is photon shot-noise. The changes either increase the signal size at high frequency or reduce the detection noise.

### Signal recycling adjustment

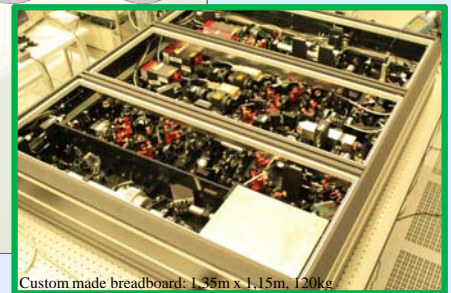
This allows shaping of detector's response and increases sensitivity in a certain frequency band. Signal recycling mirror transmission was increased from 2% to 10% to increase detector bandwidth (from 200Hz to 1kHz) and enhance the shot noise performance in the higher frequency band. The SR is now tuned to give peak sensitivity at DC.

### Homodyne readout

The carrier light is used as an optical local oscillator for the interferometer readout.



Optical layout of the GEO 600 interferometer



Custom made breadboard: 1.35m x 1.15m, 120kg.



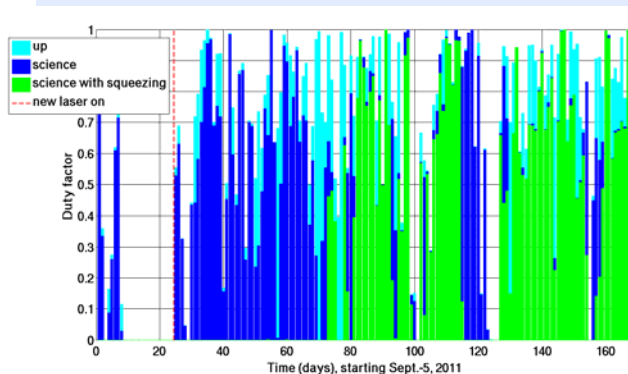
### OMC installation

This filtering cavity (with full automated lock acquisition) suppresses higher order spatial and temporal modes in the interferometer's output beam, thereby reducing the shot noise and enhancing sensitivity.

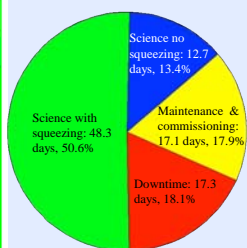
### Injection of squeezed vacuum states

Photon shot noise is due to fluctuations in the phase of the detected light. By injecting squeezed optical states into the instrument the fluctuations in the phase quadrature can be reduced and thus the shot noise level decreases.

### Science / Commissioning time



Astrowatch / Science time 64%



From 16/11/11 until 19/02/12

### GEO-HF Noise budget

