Current optical interferometer design of LCGT

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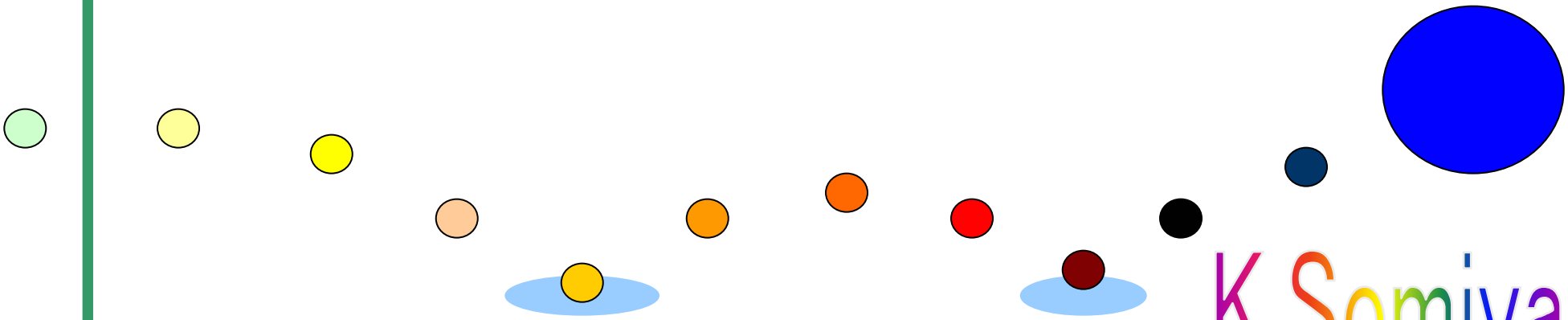
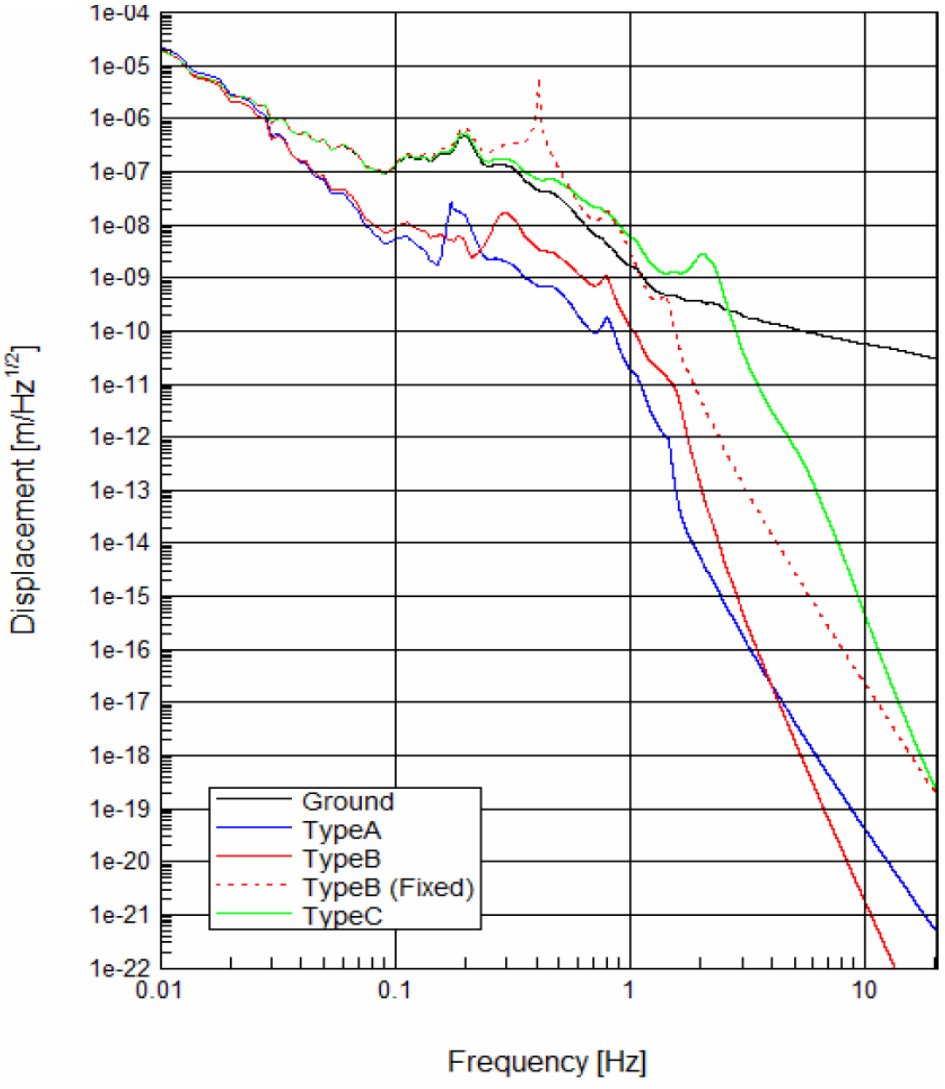
TITech

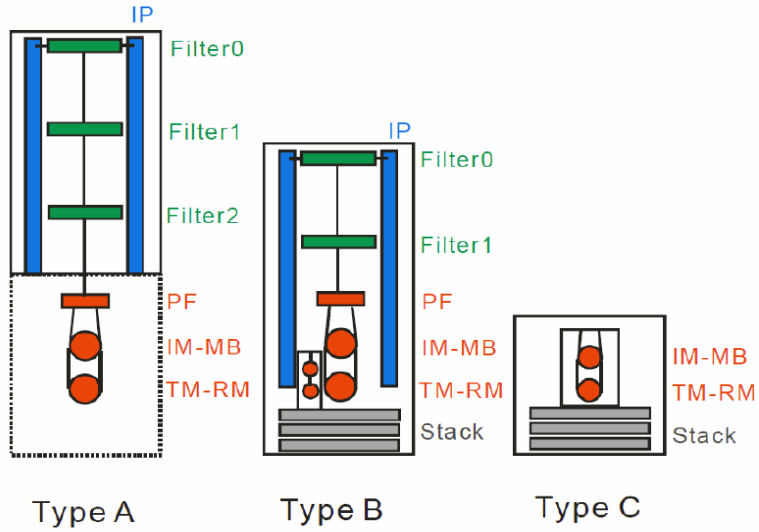


bLCGT

Seismic noise

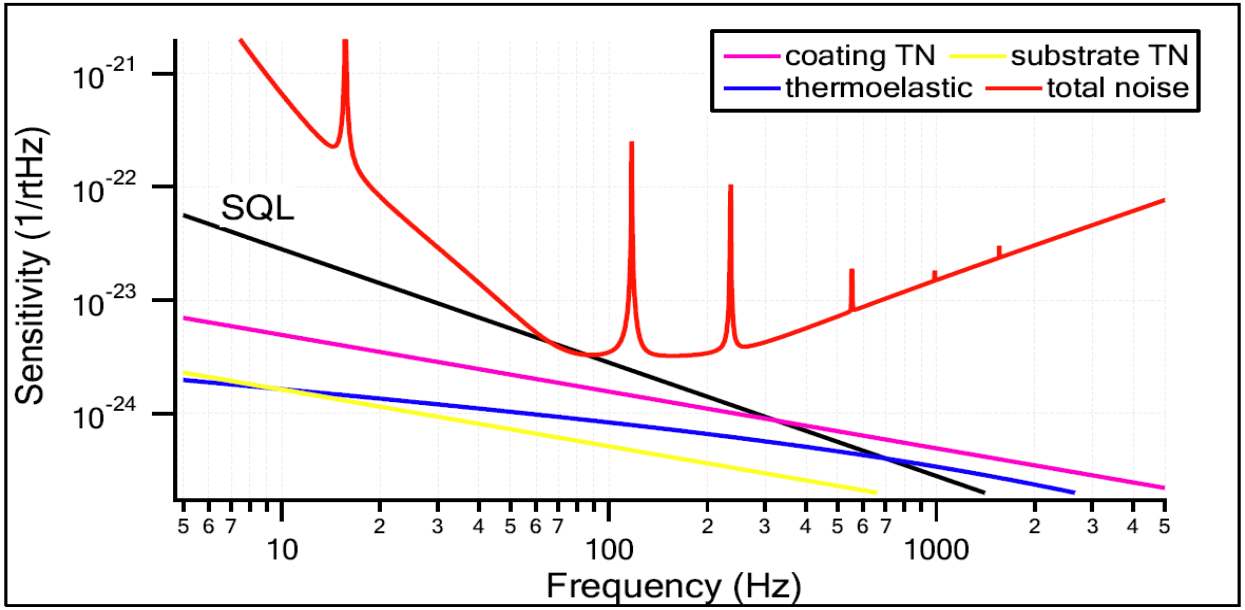


- 4e-20m/rtHz at 10Hz
- 3 types of suspension system
  - Type-A for 20K test masses
  - Type-B for 290K BS and RMs
  - Type-C for MC and PDs



- vertical motion
- heat link vibration

Mirror thermal noise



Coating BR:
mirror distortion by thermal energy in the coatings

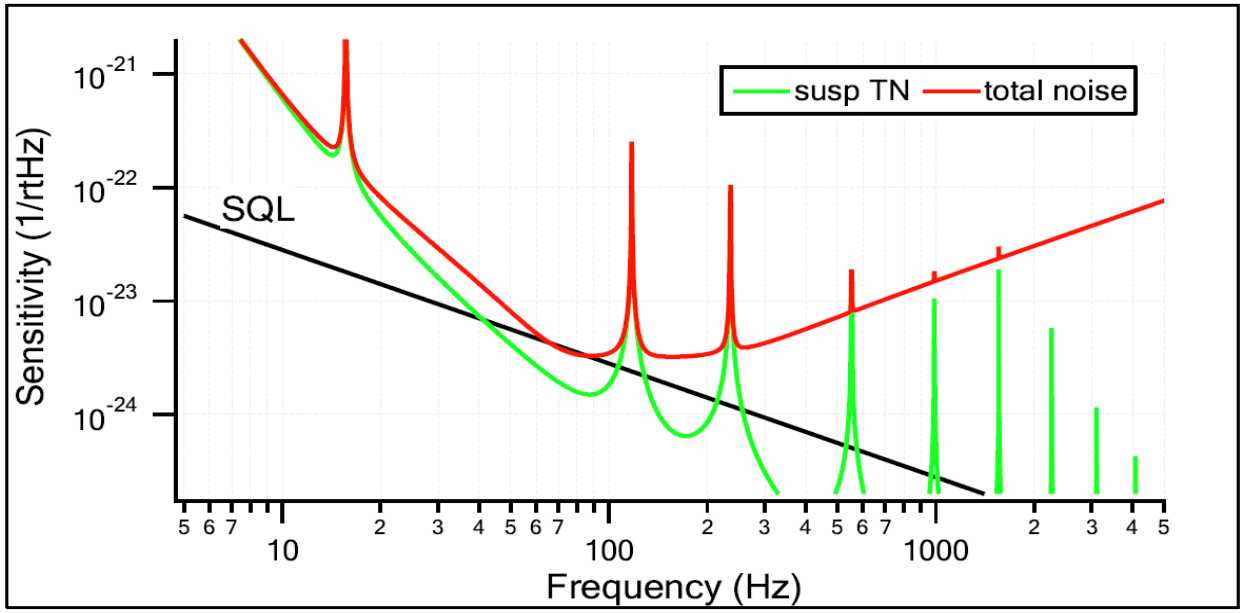
Mirror TE:
mirror expansion by temperature fluctuation via thermal expansion

Mirror BR:
mirror distortion by thermal energy in the substrate

Substrate Q=1e8
Ti-Tantala coating ϕ=5e-4
Silica coating ϕ=3e-4
ITM:9 layer, ETM:18 layer

- Mechanical loss of coatings increases at 20K; aLIGO:2e-4/5e-5
- Sapphire Substrate Q of 1e8 is a measured value
- Beam radii are 3.4cm on ITM, and 4.5cm on ETM
  - ~ should be tuned to avoid HOM resonance (g1=1, g2=0.57)
  - ~ requirement to RoC seems better for the flat ITM

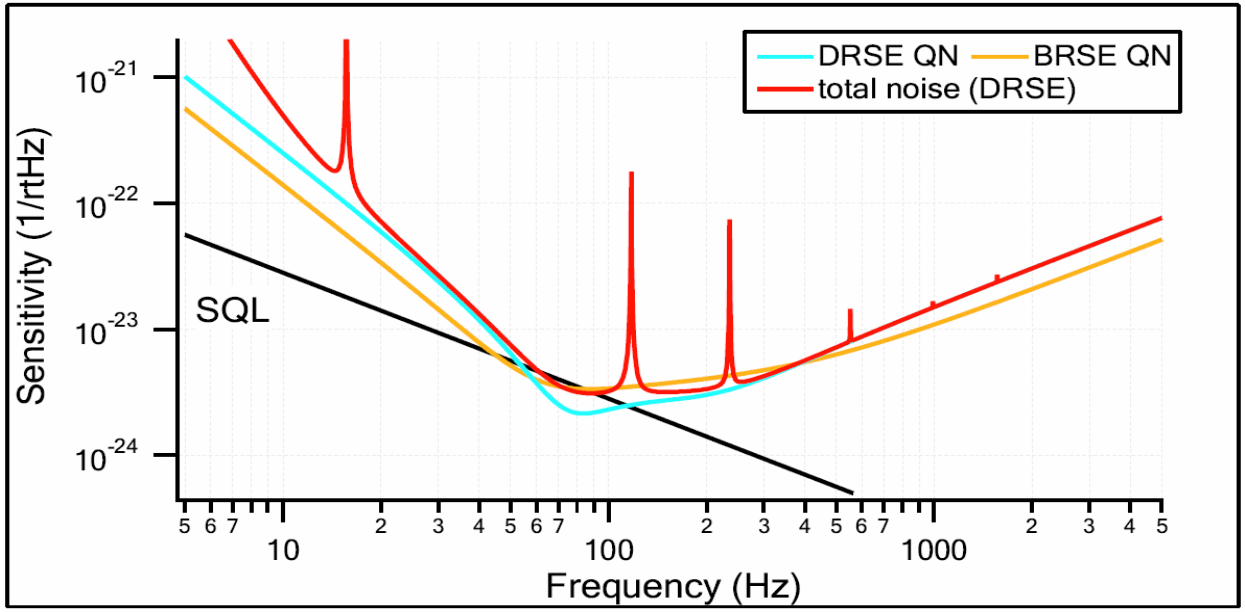
Suspension thermal noise

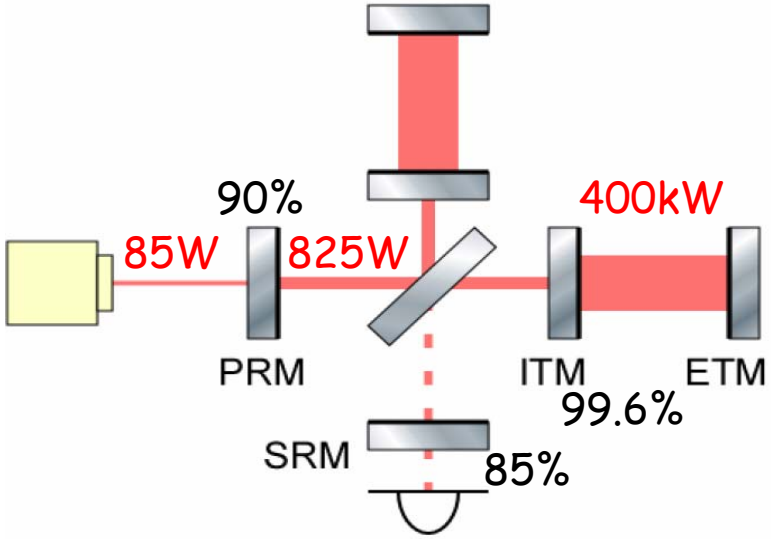


Values are for TM/IM/RM fiber
(test mass/intermediate mass/recoil mass)
Material=Sapphire/Tungsten/BeCu
Structure loss=5e-8/1e-4/5e-6
Fiber length=30cm/50cm/30cm
Fiber d=1.6mm/0.6mm/0.4mm
Clamp loss=0/1e-3/0
Temperature=16K/10K/16K
Mini GAS freq=0.4Hz
HV coupling=1/200
IM/RM mass=60kg/30kg

- Sapphire fiber Q is a measured value
- Fiber length has been reduced to move a violin-mode peak
  *40cm -> 150Hz, 30cm -> 235Hz
- Vertical resonance at 117Hz is hard to move away;
  thus HV coupling and IM/RM loss requirements are strict

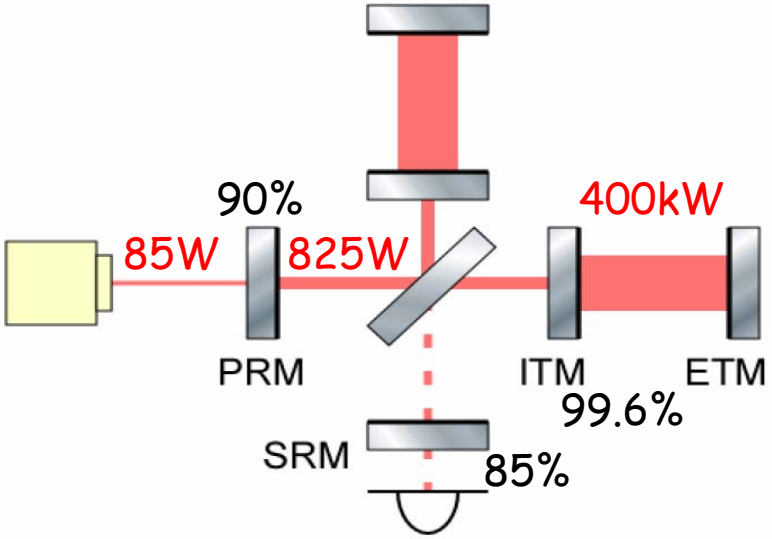
Quantum noise

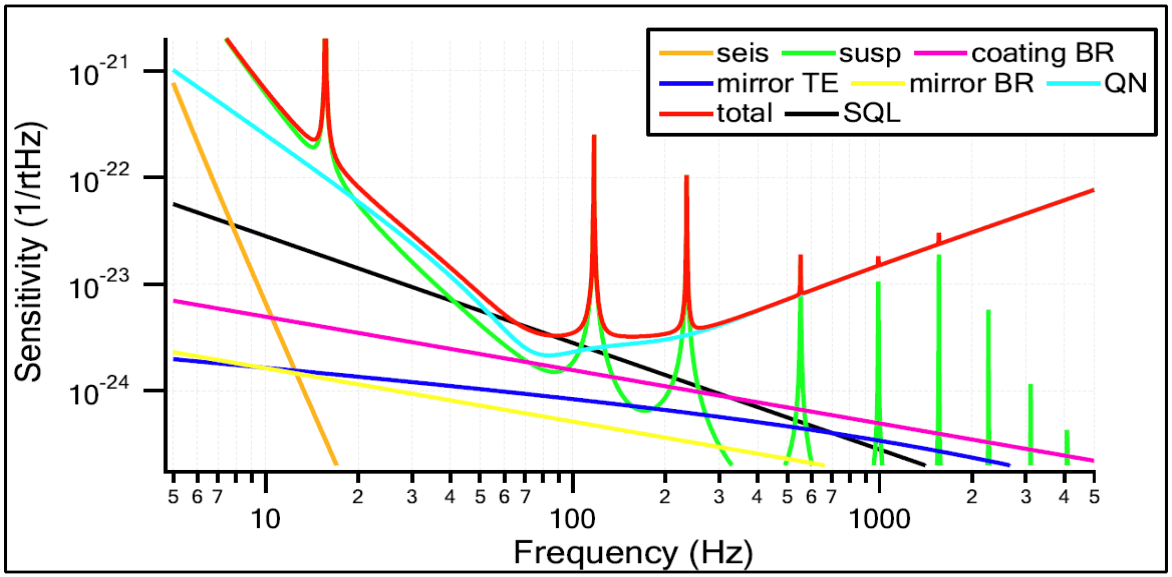




- For DRSE, ϕ=86.5 deg, ζ=134.2 deg
- For BRSE, ζ=119.3 deg
- The best sensitivity is better with DRSE
- Bandwidth is broader with BRSE
- DRSE-BRSE compatible with tunable control

Sensitivity





- Inspiral range for NSNS binaries is 273Mpc
- Default configuration is DRSE but compatible with BRSE
  (IR=245Mpc w/BAE, 232Mpc w/o BAE)
- LCGT goal (multiple-event obs. per year) can be achieved even with 10% sensitivity reduction by technical noise

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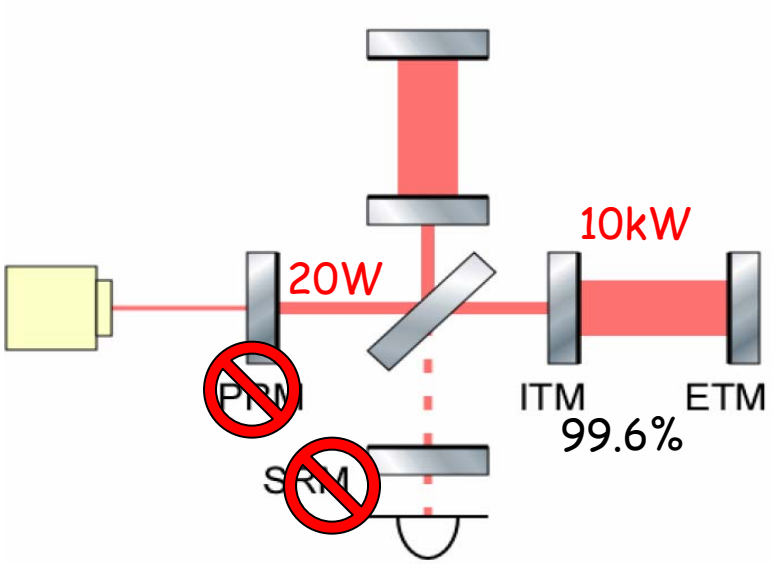
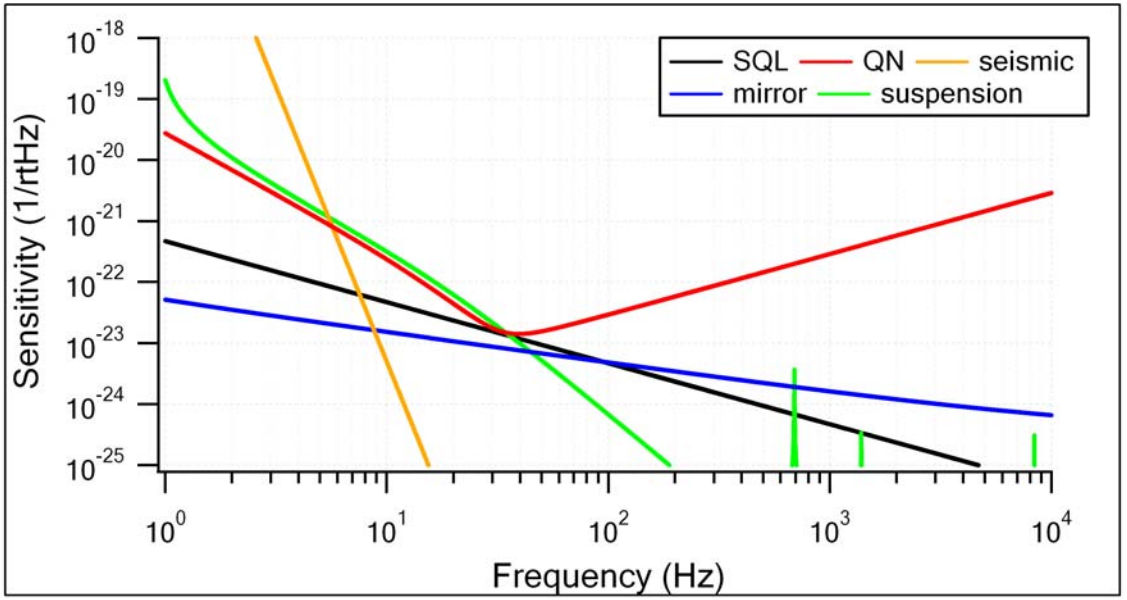
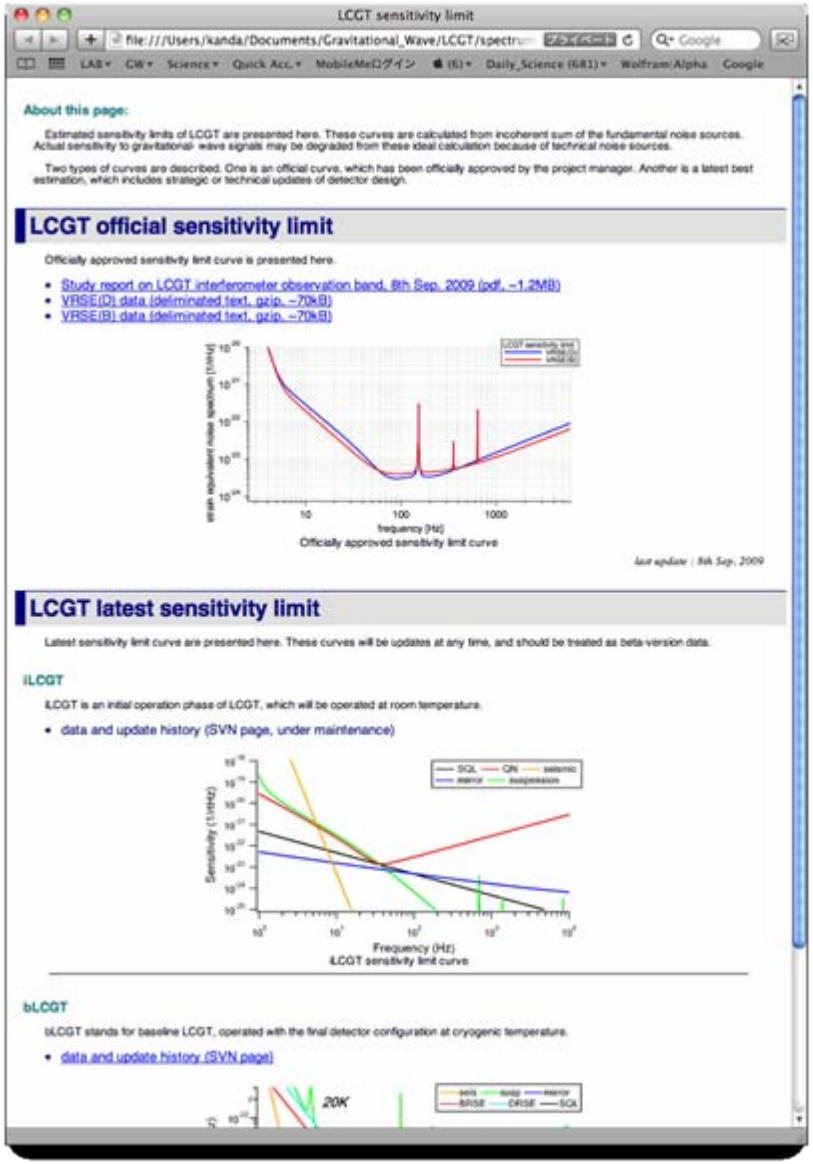
Sensitivity





- 290K FPMI
- m=10.8kg (iLIGO mirror)
- Type-B suspensions
- To be complete in Sep 2014
- NS-NS Inspiral range 70Mpc

"Official" sensitivity curve



[bLCGT]

- Target sensitivity curve has been updated several times
- Current "official" curve is the one in the Bandwidth study report ('09)
- Both the official and the latest curves are shown on the website

[iLCGT]

- No "official" sensitivity curve
- Preliminary sensitivity estimate is shown on the website