Summary of GWADW2012

Kazuaki Kuroda

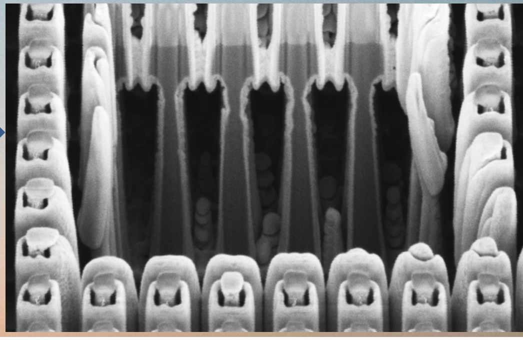
ICRR, University of Tokyo

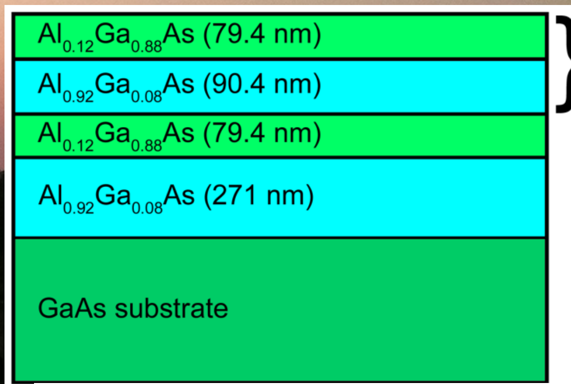
Monday AM (1): Welcome by Syd and chaired by Sathya

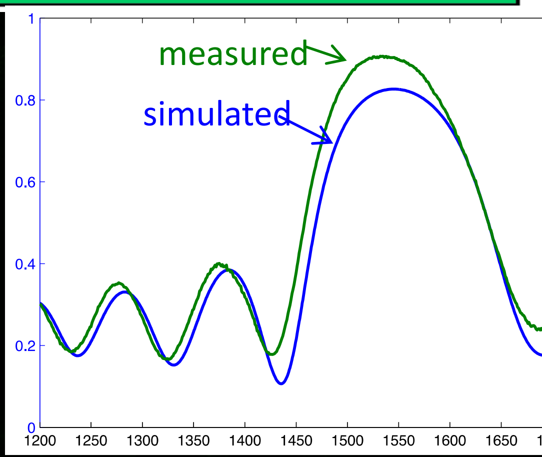
- Dave (Caltech) set the stage
- Cole Miller (Maryland) reviewed GW sources and mentioned massive WD & IMBH as new sources
- Sathya (Cardiff) summarized the significance of the detection of BNS coalescence to solely determine the apparent cosmological distance by chirp mass, which leads to the determination of the red-shift by estimating its intrinsic mass by Messenger-Read Method or by Taylor-Gair-Mandel Method
- C. Van Den Broeck (NIKHEF) stressed BNS coalescence signal is the genuine test of strong field dynamics of gravitation field and summarized the TIGER analysis pipeline for practice

Monday AM(2): chaired by Eric and Sheila

- Stephanie (FSU) talked the achievement of waveguide grating mirrors
- Garrett Cole (VCQ) presented the progress of transferred crystalline coating
- Angie (Stanford) reported the success of epitaxial integration of III-V coating on Si and got preliminary result of high reflectivity
- Tobias (AEI) summarized the effort of coating TNI to reach TN level.
- Andreas (Birmingham) produced 21W, LG33 (>95%) from 120W LG00 mode by improving optical system
- Huan Yang mentioned the two kinds of coating thermal noise with estimation

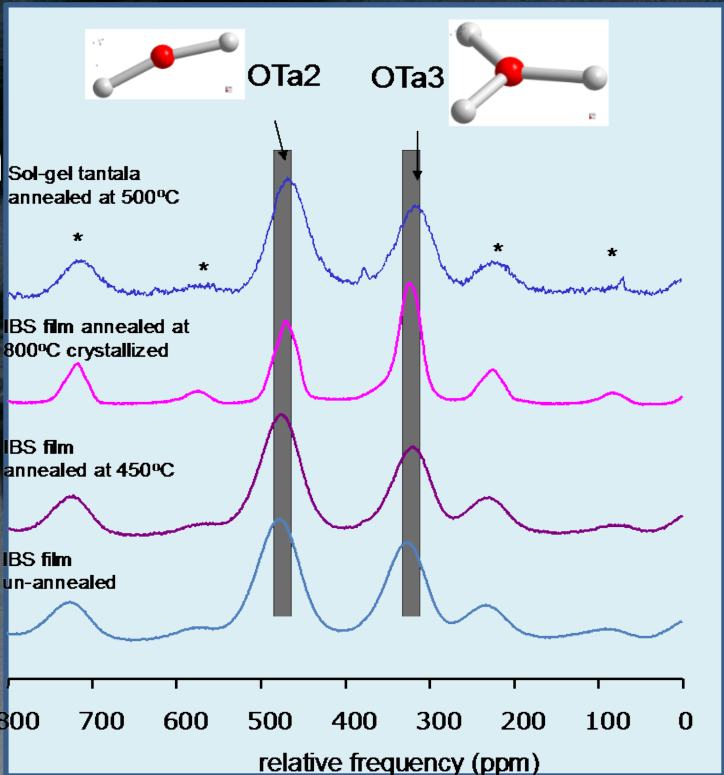


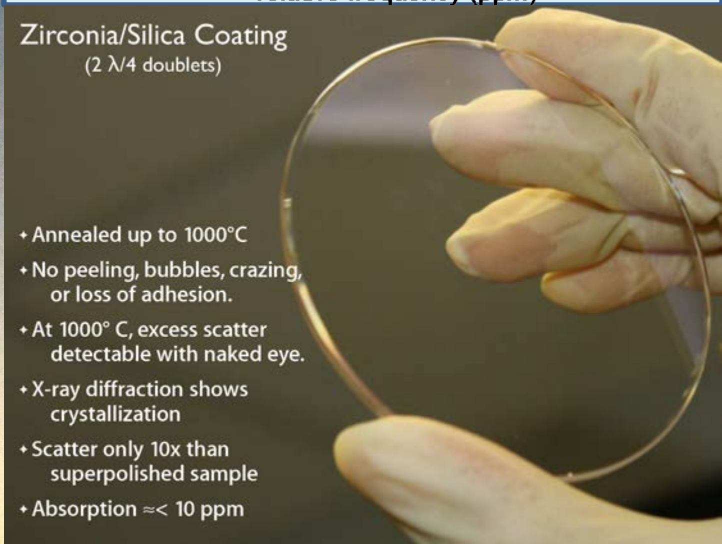




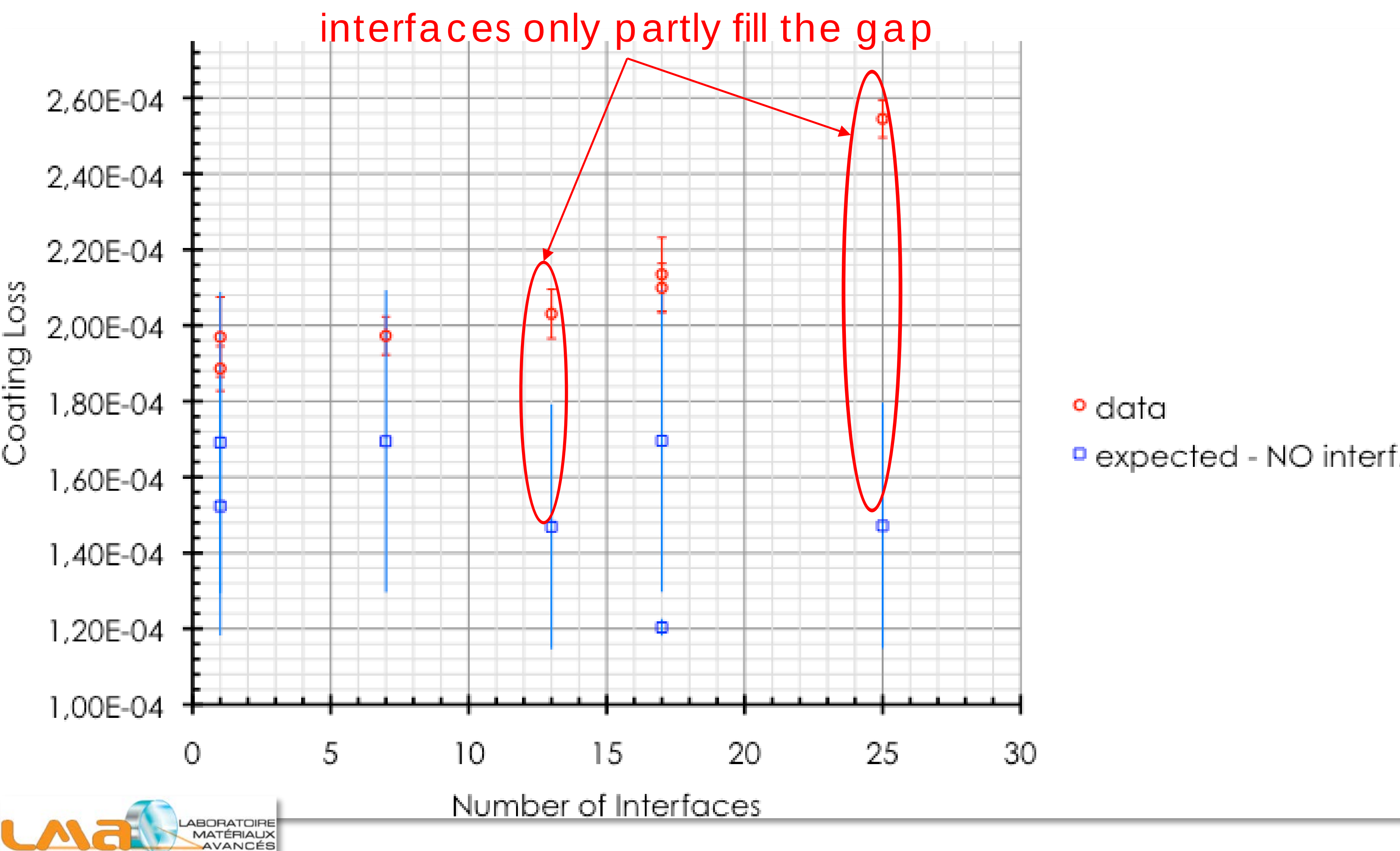
Monday PM chaired by Sheila

- R. Bassiri (Stanford) reported on the optical absorption measurement from the viewpoint of atomic structure and presented deeper understanding
- Riccardo (Sannio) introduced the importance of nano-coating technology and the possibility of reduction of mechanical loss by stressed coating
- Steve (H&W College) showed big improvement of silica-doped zirconia amorphous coating
- Ian Martin (Glasgow) summarized the progress of Glasgow with Stuart's aggressive non-coated grating surface development



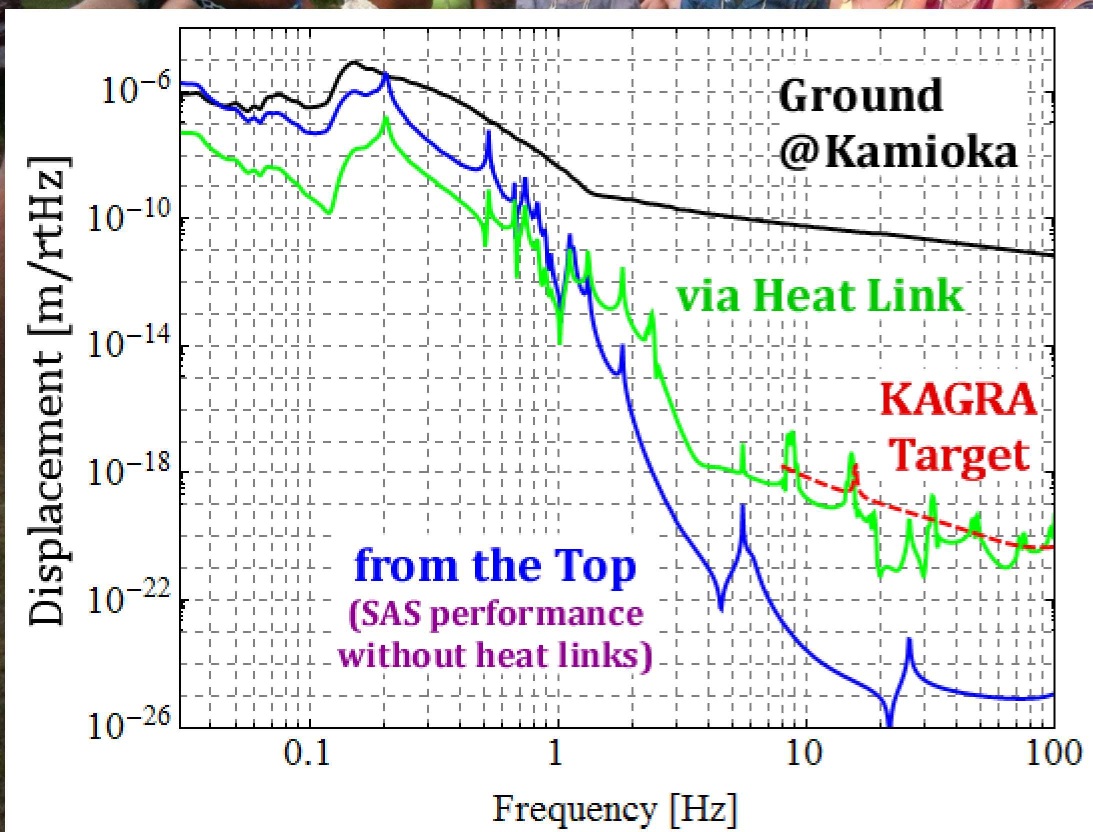


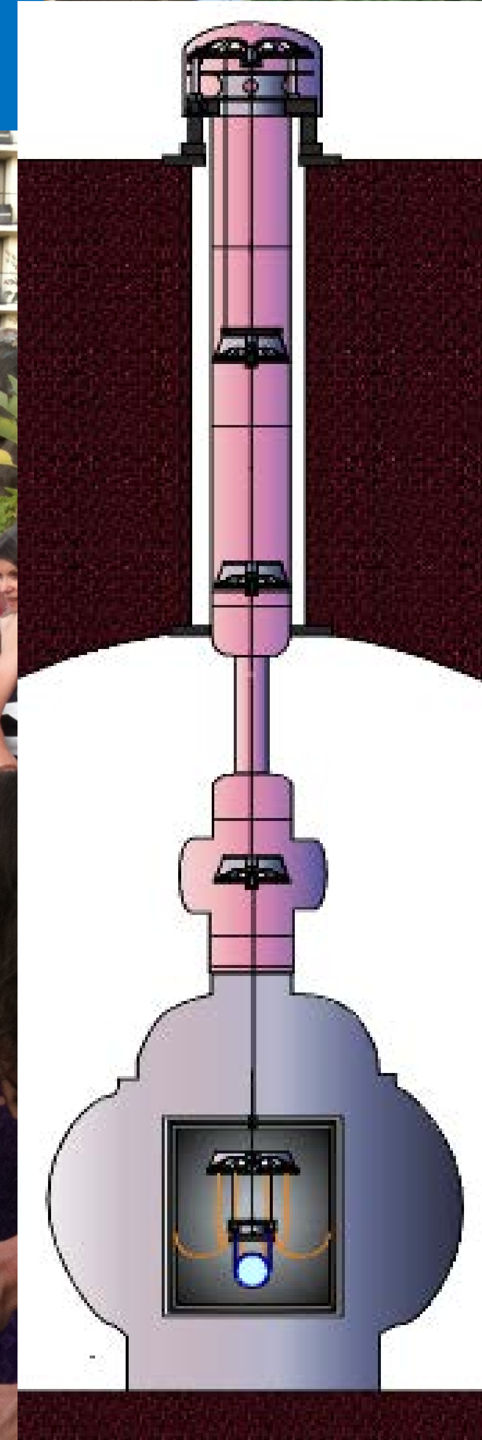
Massimo (LMA) presented recent result on multi-layer coating loss and described the update of atomic layer deposition



Tuesday AM(1) chaired by F

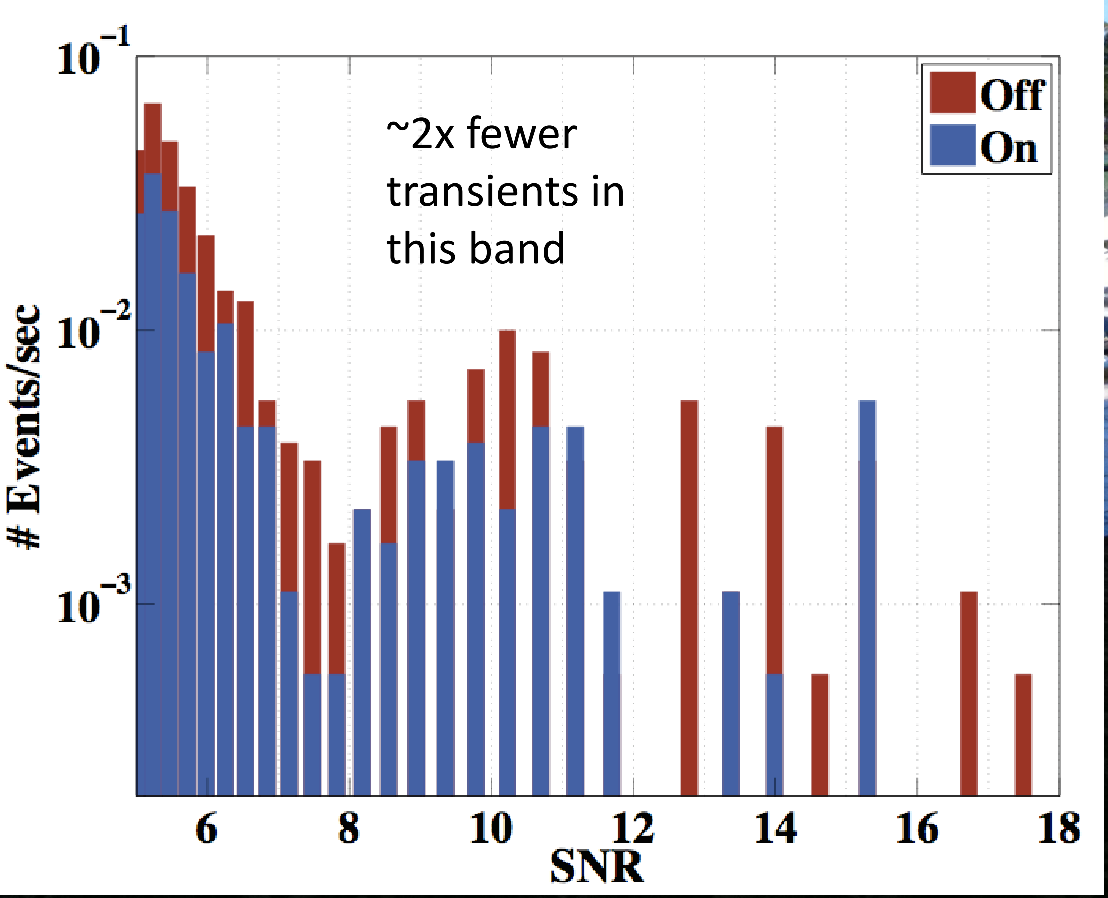
- Takanori (UT) showed the design of KAGAR SAS for cryogenic interferometer with a rid body simulation





Ryan (LSU) tackled to suppress seismic peaks by feed-forward subtraction at S5/S6 showing transient rate improvement

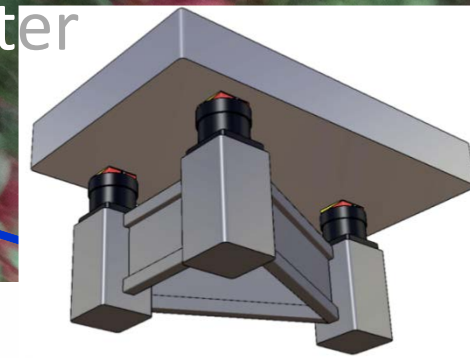
- On/off test reveals effect of reducing the control signal at low frequencies (only triggers between 50 and 200 Hz shown)
- Stationary noise level did not significantly change during test



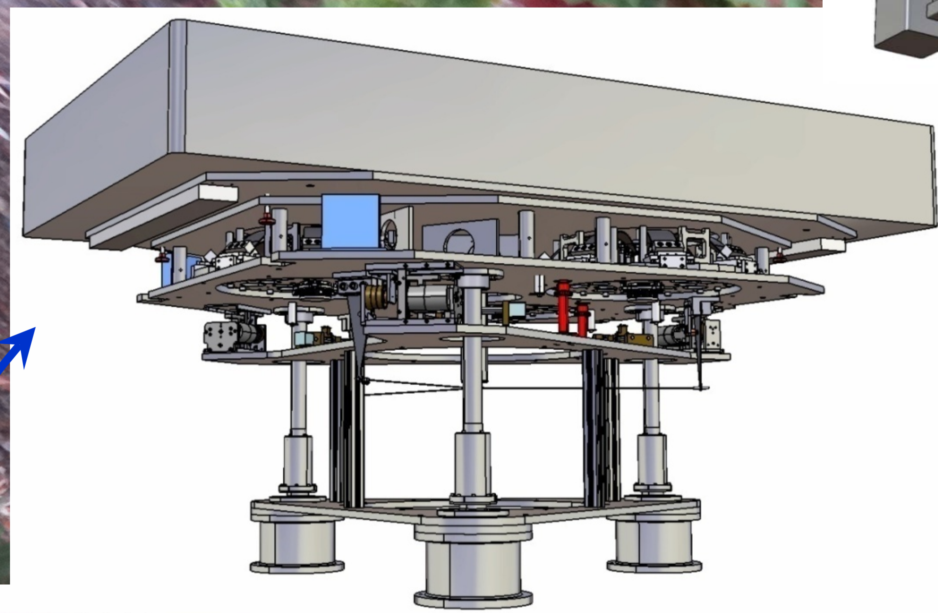
Ryan DeRosa

Eric (NIKHEF)reported EIB-SAS, multi-SAS and high sensitive thermally limited accelerometer

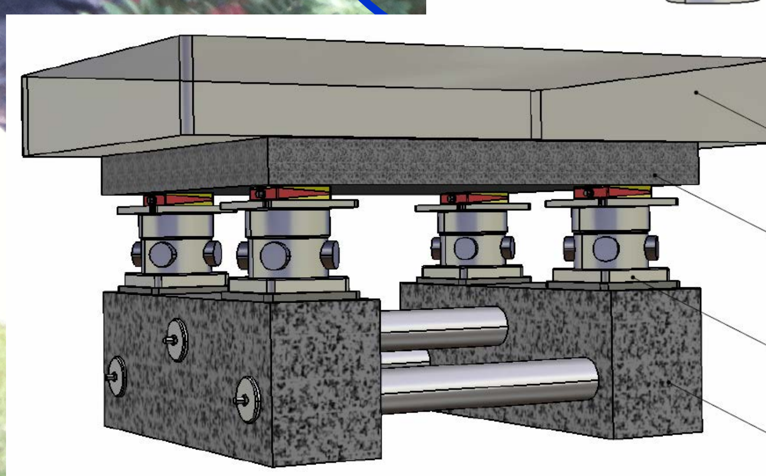
EIB-SAS Solution option history



Chosen solution:
Highly-compliant suspension



Stiffer legs



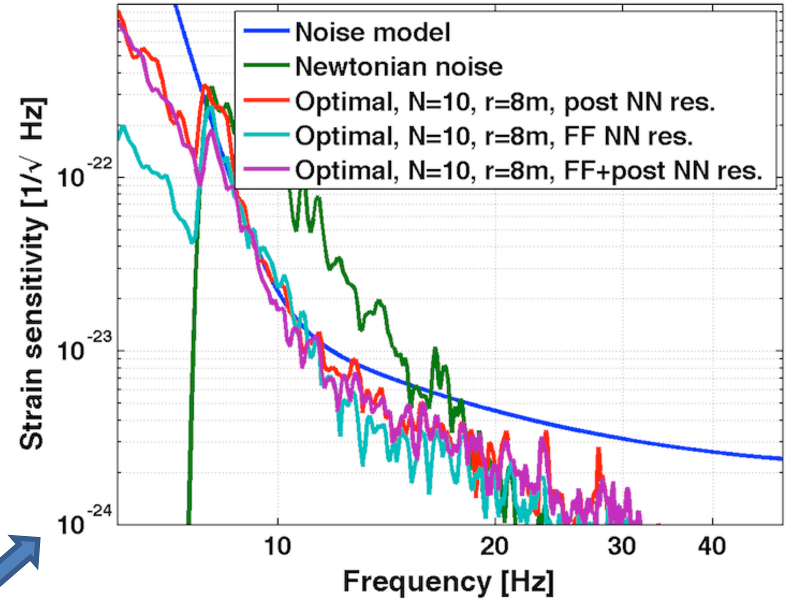
Stiffer suppor

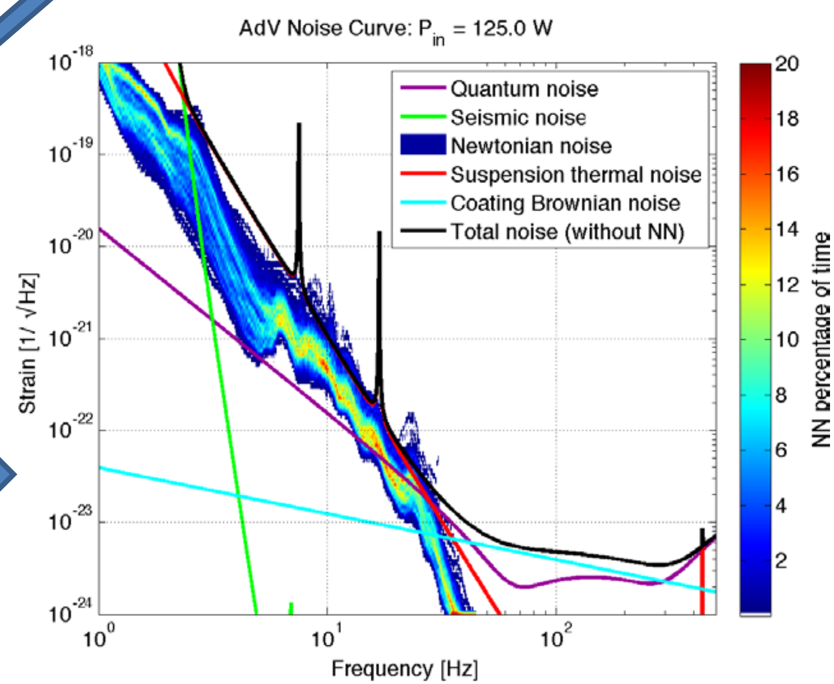
Active isolation (TMC-Stacis)

Eric (NIKHEF)

Tuesday AM(2) chaired by Jan

- Sergey (UF) removed line noise with bi-linear coupling using wavelet analysis for S5/S6 data
- Nick (Strathclyde) reviewed multi-pole expansion of gravity field by test mass for simpler calculation
- Jenne (Caltech) measured Newtonian noise against simulation
- Mark (NIKHEF) analyzed Newtonian noise by simulation and subtracted for ET and aVirgo.





Tuesday PM chaired by Hiro and Andreas

- GariLynn (Caltech) talked the reality of mirror
- Jan (Caltech) estimated scattered loss in cavities and concluded loss changes as function of length
- Antonio (EGO) made FFT calculation for baffles to reduce scattered noise in a cavity
- Daniel (Birmingham)) reviewed the characteristic features of FFT, mode models and rigorous simulations (FDTD)
- Richard (EGO) developed FFT simulator: FOG
- Marie (LAL) devised TDM for adaptive optics
- R. Bonnard (LMA) presented corrective coating that satisfies aVirgo specification

Cavity loss – 2 surfaces (ppm)	Budget 2010 based on specs (ppm)	Actuals 2012 based on (n of 20) (ppm)
Microroughness scatter	8	2.2 (avg. of 20)
Defects (Polish, Coating, Contamination)	26	15 (sample of 2) pol, coat
Coating Absorption*	0.6	0.6 (sample of 2)
Surface Figure Error & Diffraction	24	3 ppm on coated ITM 21 ppm estimated on coated ETM
ETM Transmission	5	No data yet
Total (required < 75 ppm)	64	42+ ETM trans.

GariLynn

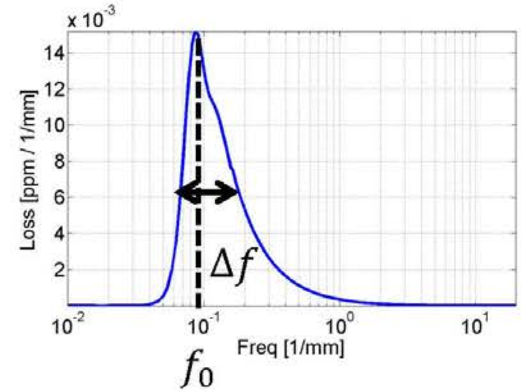
Loss as Function of Length

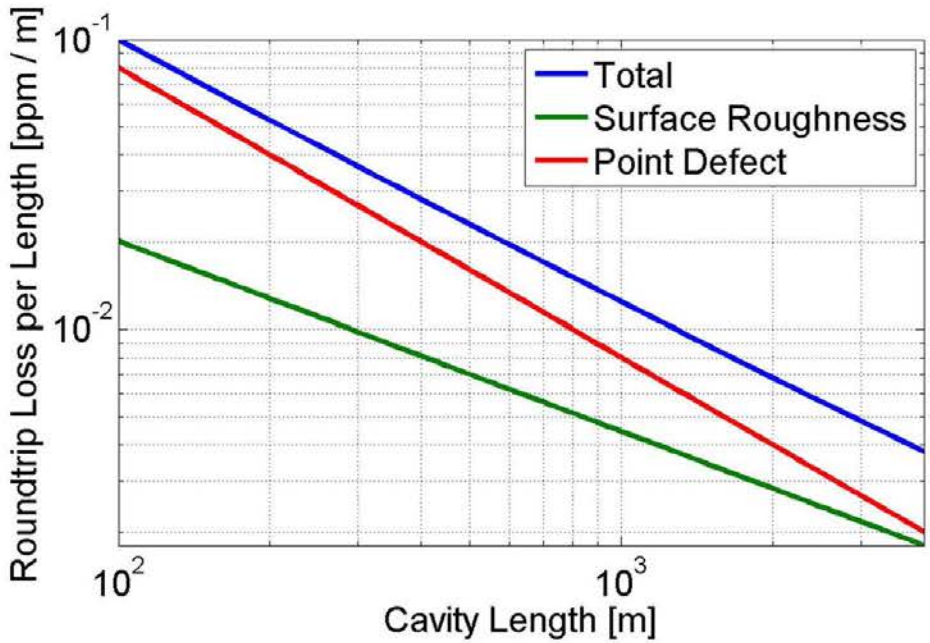
Surface roughness 1D PSD:

$$S_1(f) \propto f^{-p}$$

Cavity loss:

$$\text{loss} \propto S_1(f_0) \cdot \Delta f \propto L^{(p-1)/2}$$



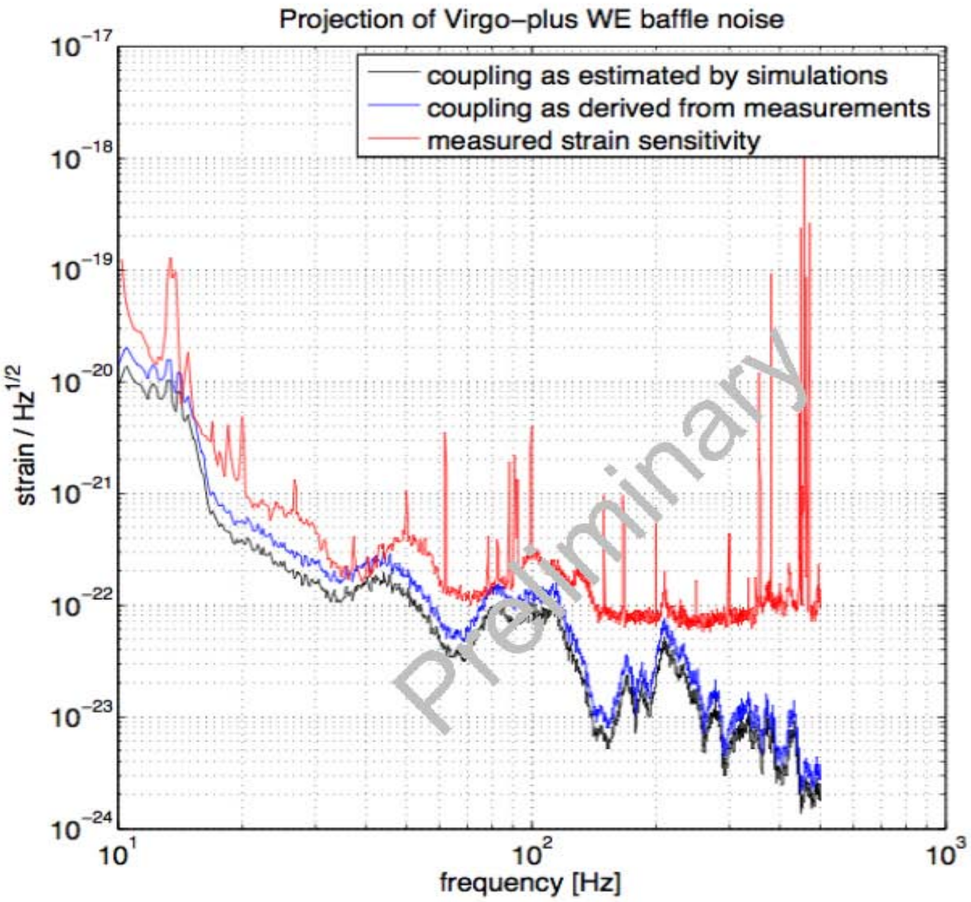


Modeling surface-roughness spectra of available optics:

The longer the better

Jan

- **How to validate this procedure?**



Apply the procedure to Vp:

- measured maps for West Arm mirrors (LMA)

- "virtual baffle" of stainless steel around West End Mirror

- baffle outer diameter: inner aperture of the reference mass

- baffle BRDF = 2 sr^{-1} (assume same value measured for arm tube)

- baffle residual motion: as measured by seismometers on WE tower walls

Quite good agreement with experimental data

Antonio

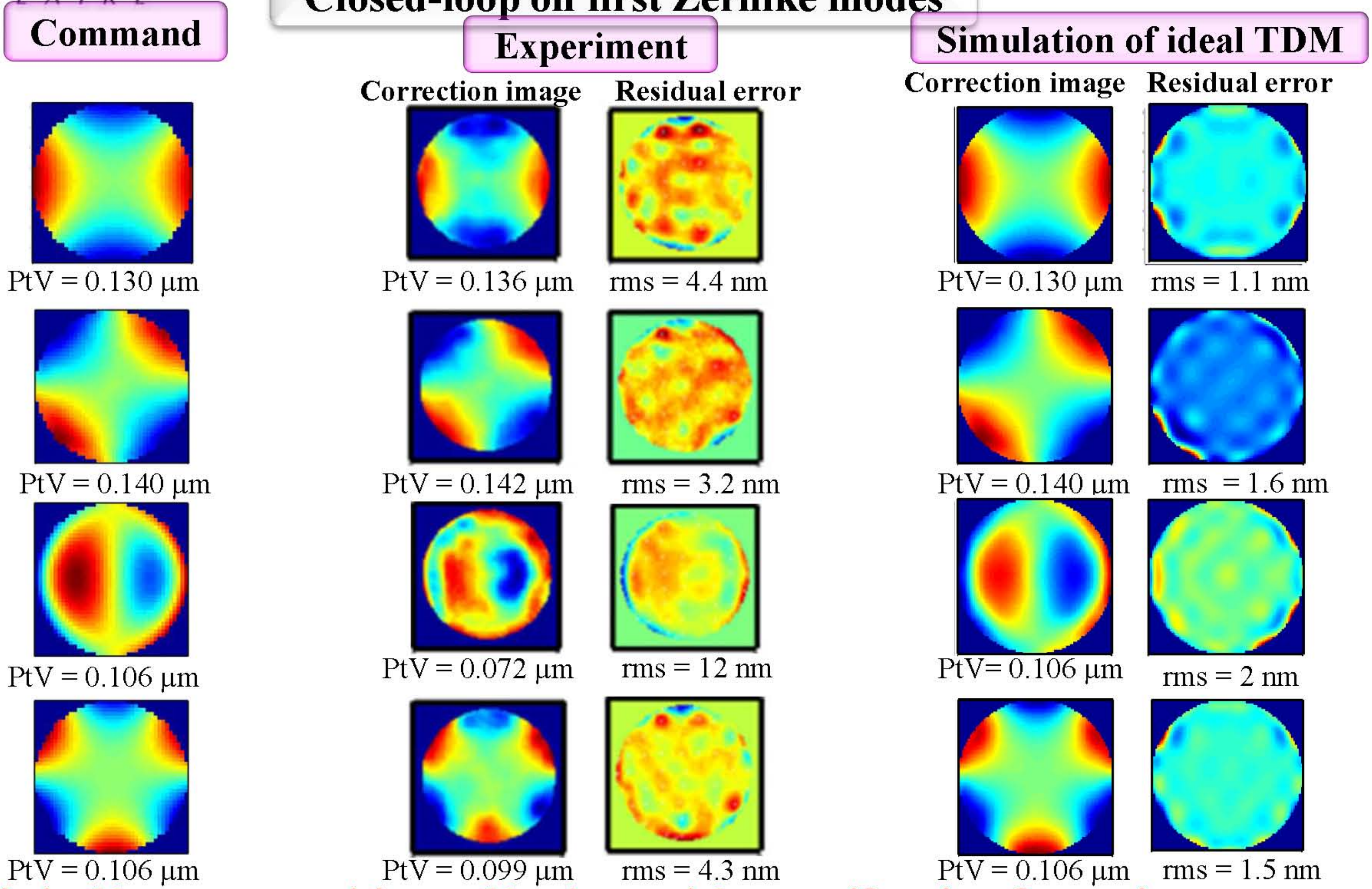
Marie

Experimental results

EUROPEAN GRAVITATIONAL OBSERVATORY

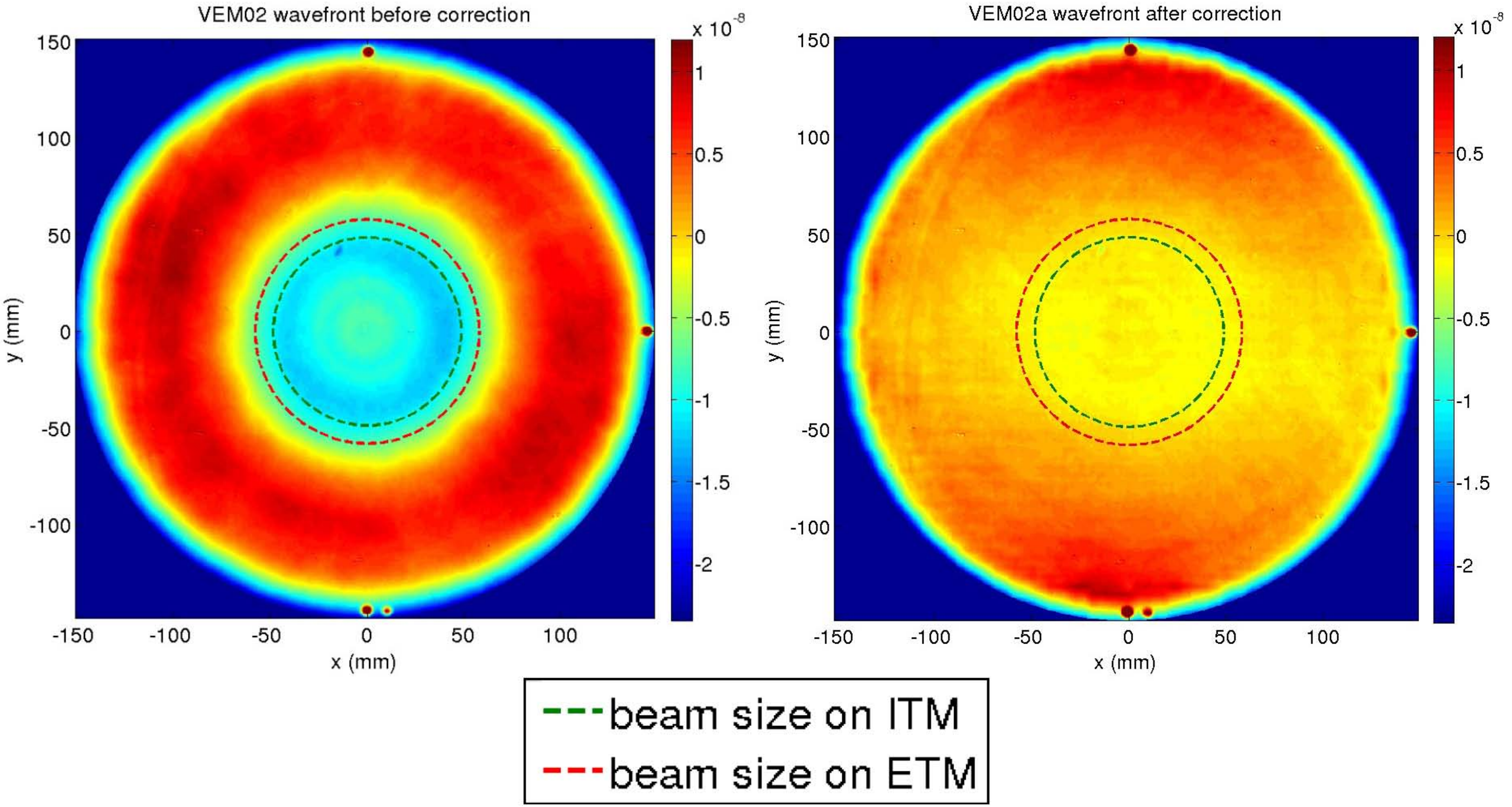
LABORATOIRE DE L'ACCÉLÉRATEUR LINÉAIRE

Closed-loop on first Zernike modes



→ **Limited by sensor precision and by the spatial non uniformity of actuation**

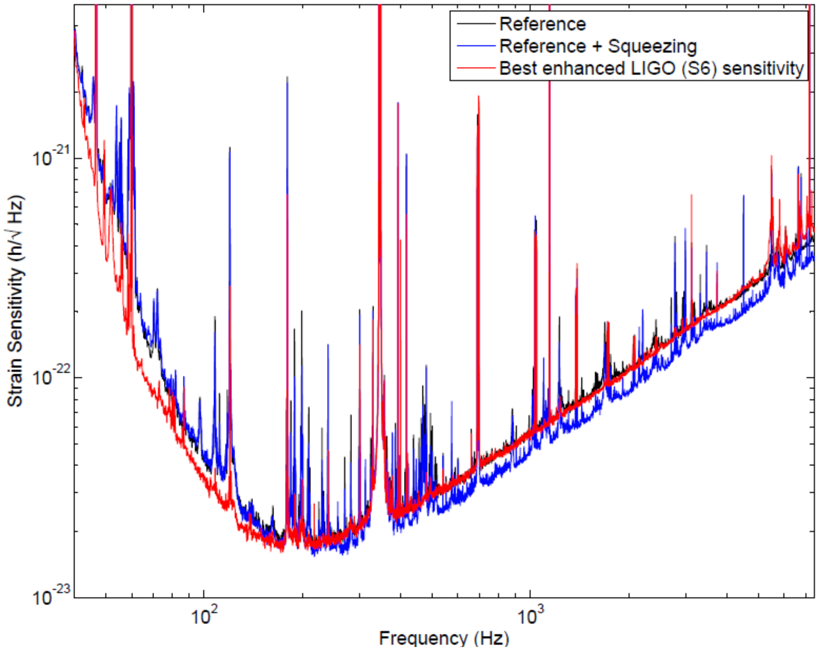
Adv. Virgo arm cavity simulation



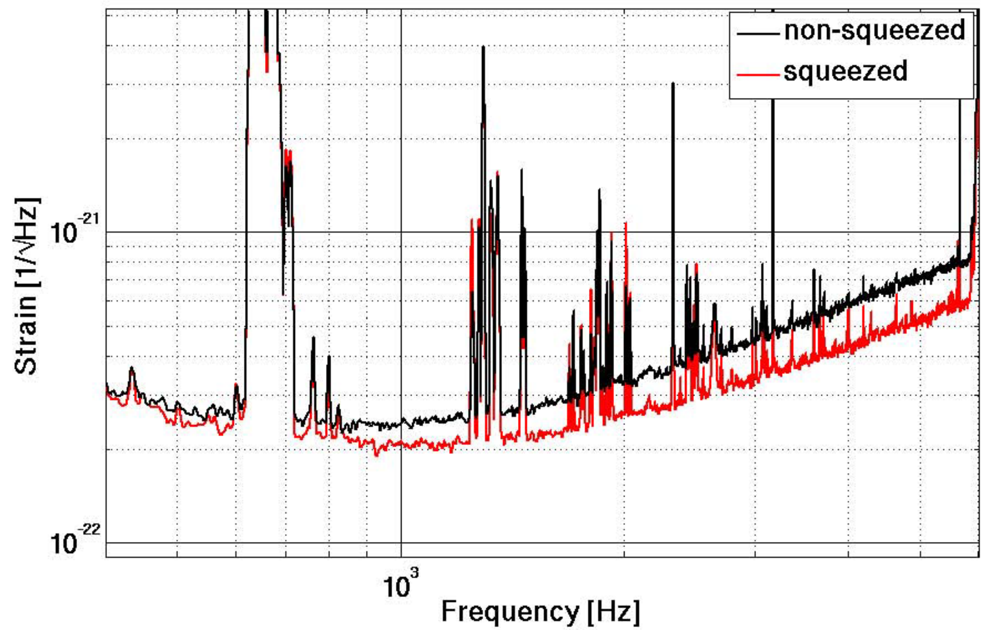
Wednesday AM chaired by Roman

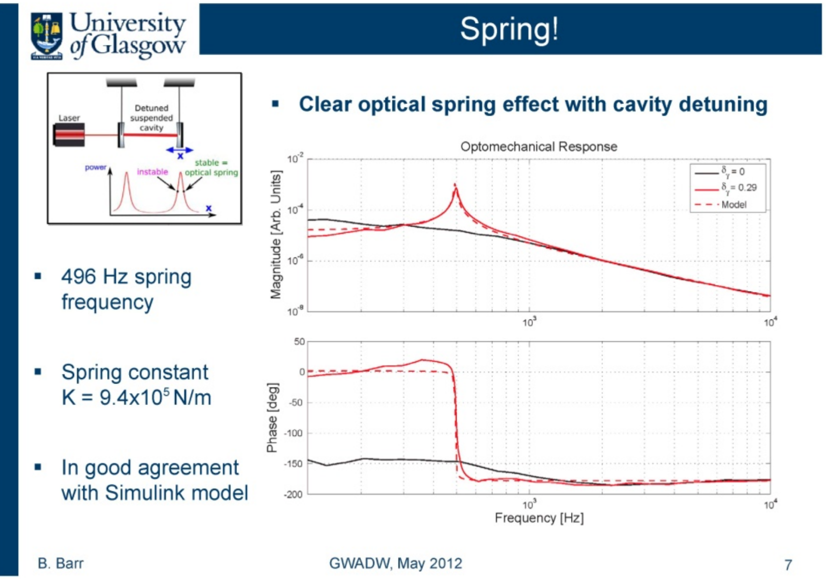
- Roman (AEI) introduced why SQ is remarkable
- Sheila (MIT) summarized H1 SQ experiment
- Hartmut (AEI) reviewed squeezing GEO600
- Miao (Caltech) pointed the evidence of QRP
- Patrick (MIT) experimentally challenges a filter cavity
- Robert (ANU) presented an opto-mechanically coupled filter for SQ
- Zach (Caltech) analyzed OMIT
- Bryan (Glasgow) tries to observe optical spring by 10m interferometer
- Garrett (VCQ) summarized QOM
- Henning (AEI) showed optical cooling by 50ng membrane
- Agatsuma (ICRR) precisely calibrated optical power
- Daniel (ICRR) tries to measure QRPN using 20mg tiny mirror suspended by 10miron silica fiber

Broadband sensitivityLIGO: H1 - 2.1dB

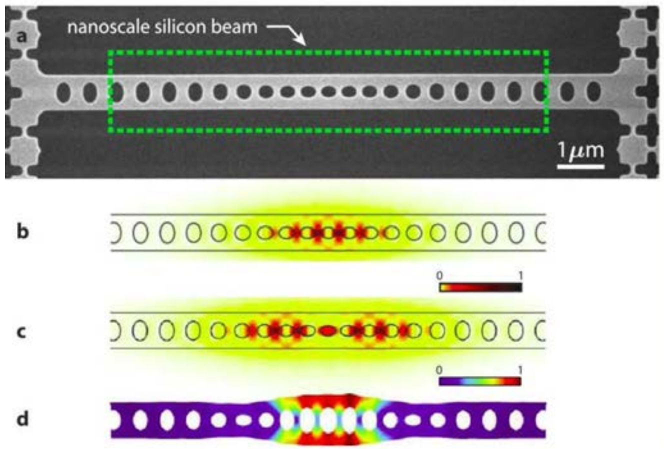


Recent sensitivity GEO600 -2.8dB





Experimental Evidence for QRP

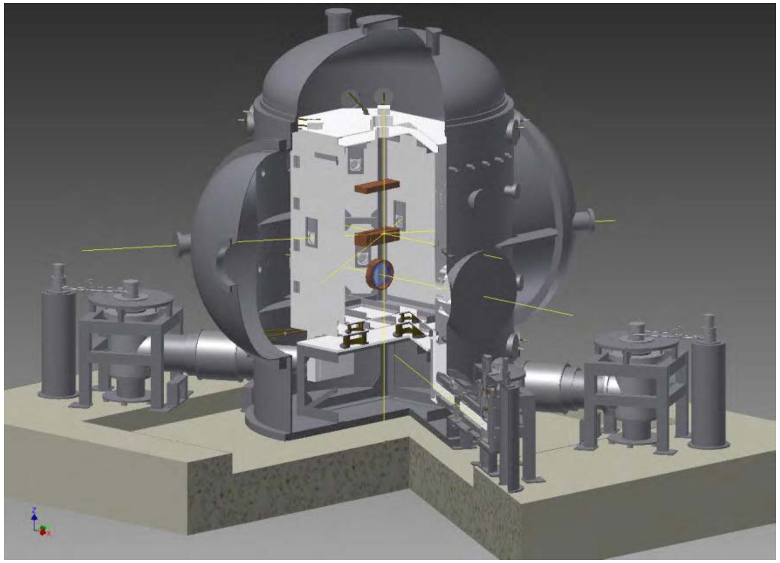


Cavity parameters

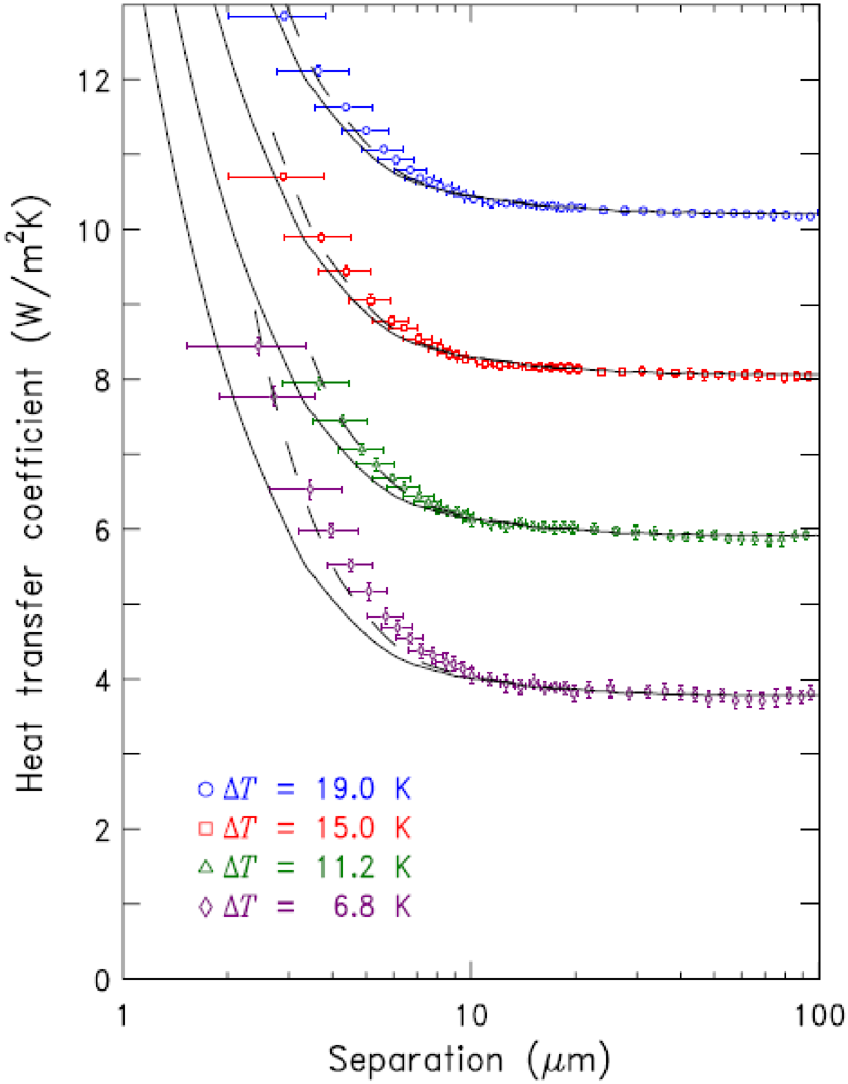
$$\omega_c/2\pi = 205.3\ \text{THz}$$
$$\kappa_c/2\pi = 390\ \text{MHz}$$
$$g_c/2\pi = 960\ \text{KHz}$$
$$\omega_r/2\pi = 194.1\ \text{THz}$$
$$\kappa_r/2\pi = 1\ \text{GHz}$$
$$g_r/2\pi = 430\ \text{KHz}$$
$$\omega_m/2\pi = 3.99\ \text{GHz}$$

Wednesday PM chaired by Ronny & Kazuhiro

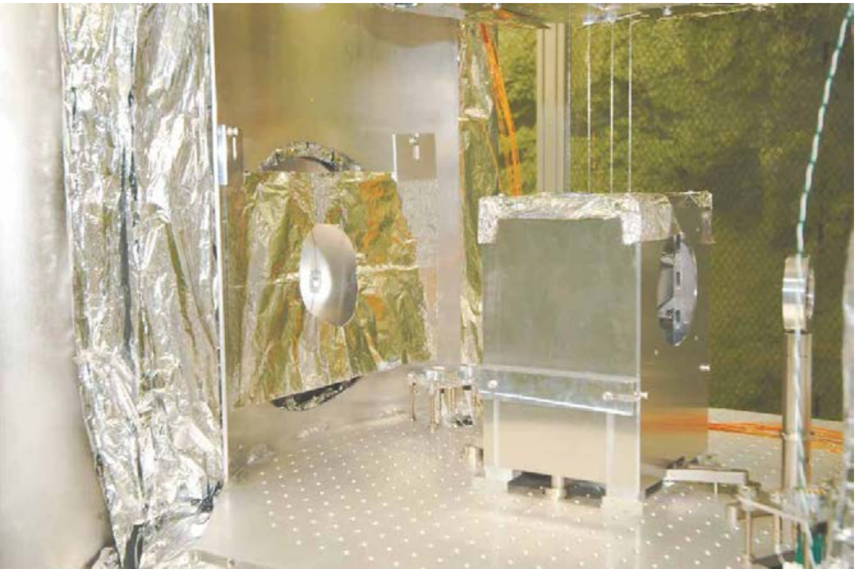
Kazuhiro (ICRR) summarized KAGRA cryogenics



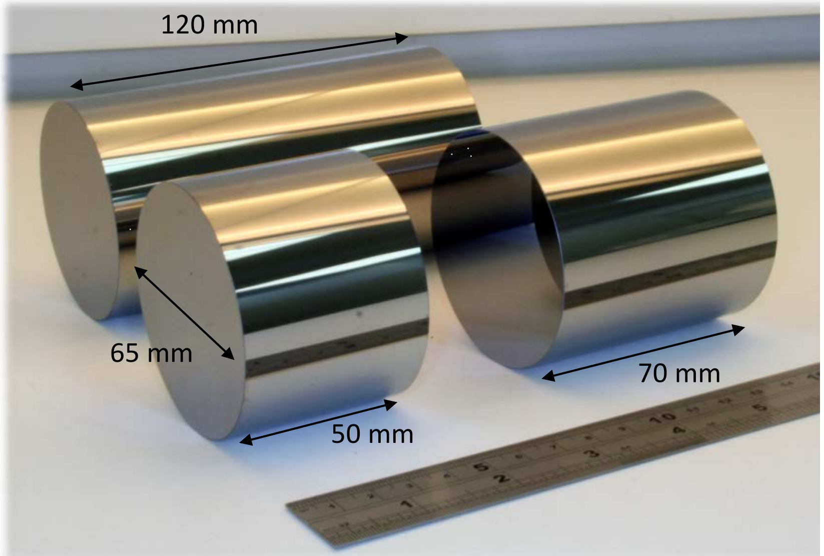
Richard (Florida) devised new technique of heat transfer by evanescent waves



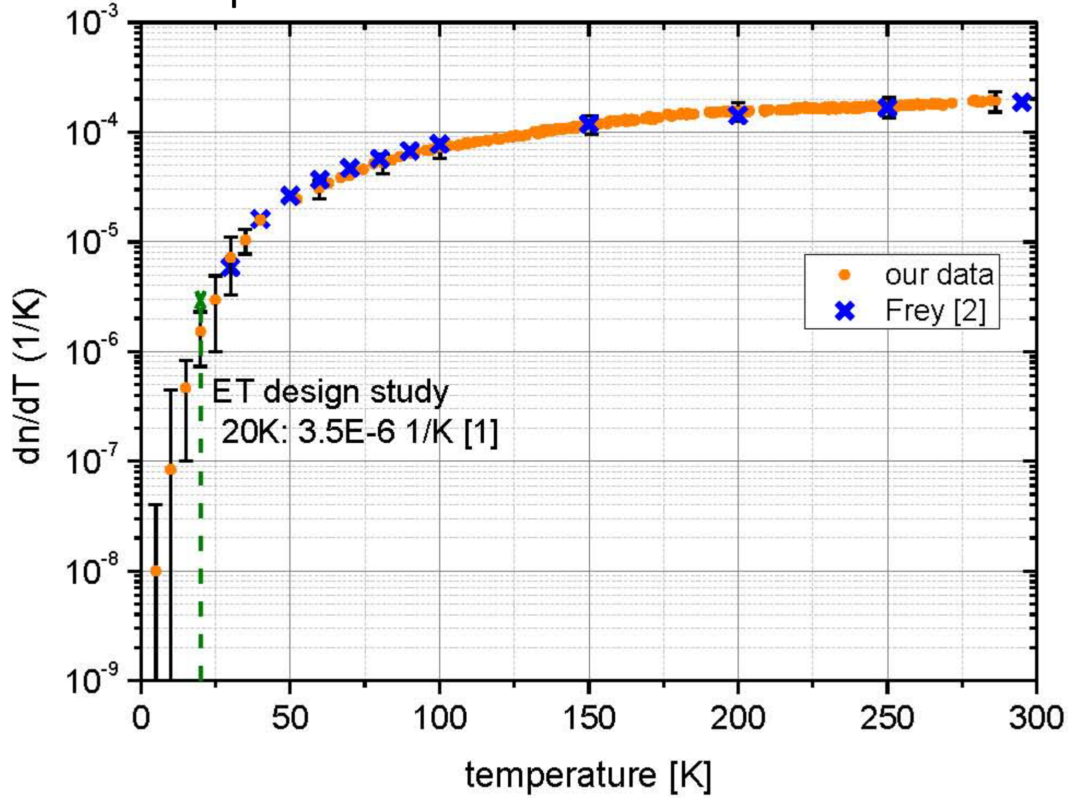
Masatake Ohashi presented the lessons from CLIO

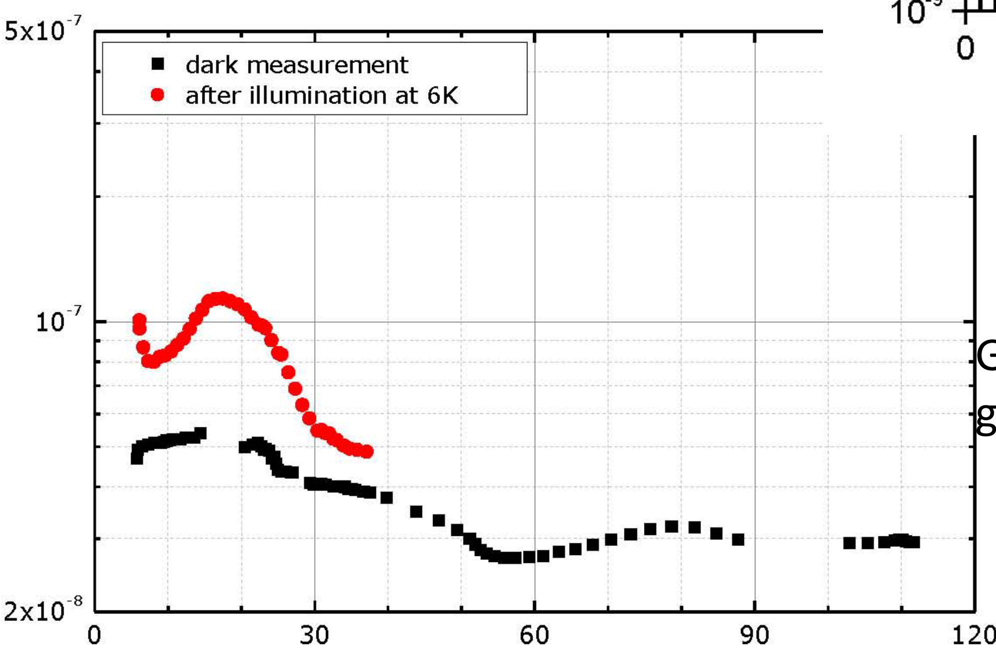


Karen (Glasgow) described hydro-catalysis bonding



J. Komma (Jena) measured dn/dT at cryogenic temperature

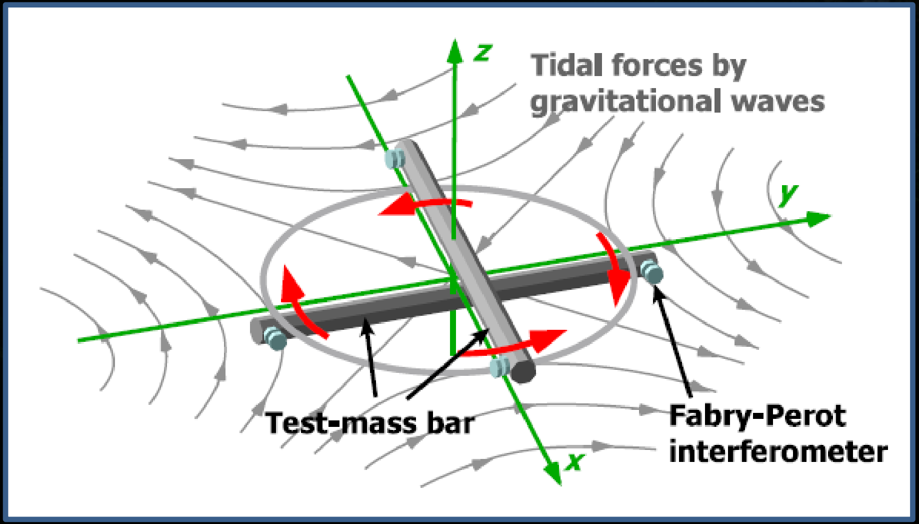


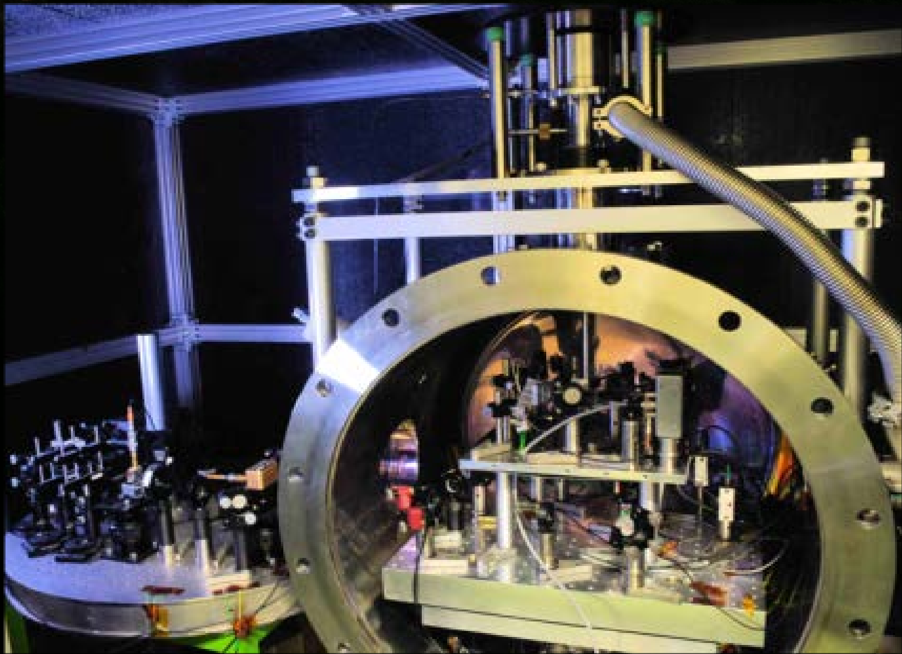


Gerd (Glasgow) introduced silicon-sapphire-gallium arsenide

Thursday AM chaired by David

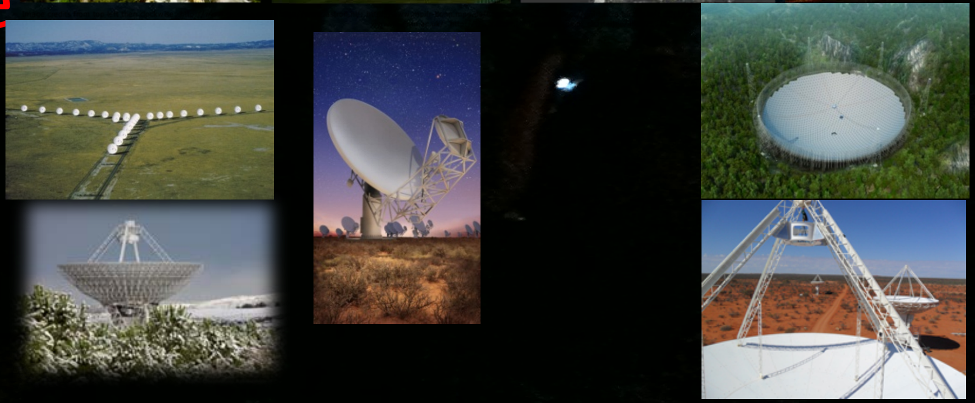
- Ando(Kyoto) plans TOBA covering frequencies between ground and space
- Ayaka (UT) summarized observational result by prototype system

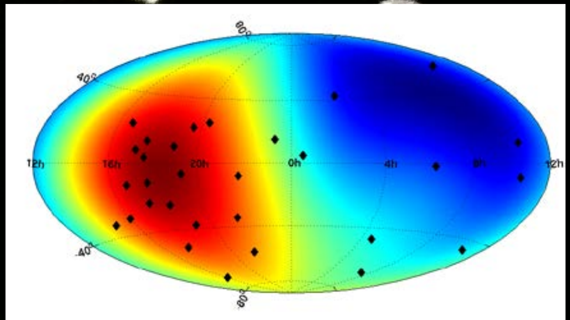




Thursday AM chaired by David

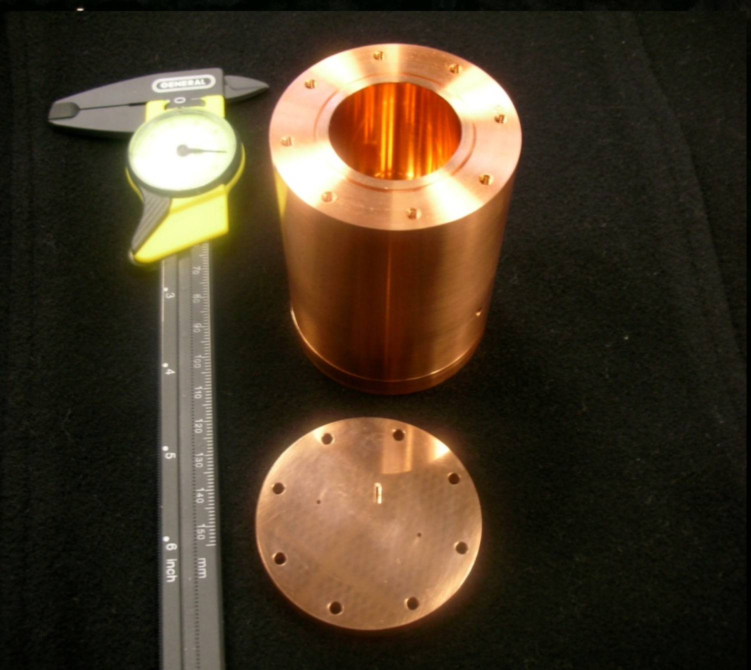
- Lee (PSU) summarized the detection of nano-hertz GW by pulsar timing
- James (Cornell) analyzed physics and techniques of pulsar timing GW detection
- Joseph (JPL) scoped the global array





Thursday AM chaired by David

- Keith (Caltech) proposed a new antenna using superfluid ^4He
- Holger (Berkeley) reviewed Atomic wave interferometer



Thursday AM chaired by Sathya

- Lisa (MIT) summarized current status of SQ
  - toward 6dB
  - 10dB is not easy
  - 15dB is a dream
- Stefan reviewed Jun’s theorem
  - tradeoff among bandwidth, power, and wave length “you can’t take both”

Thursday PM chaired by David

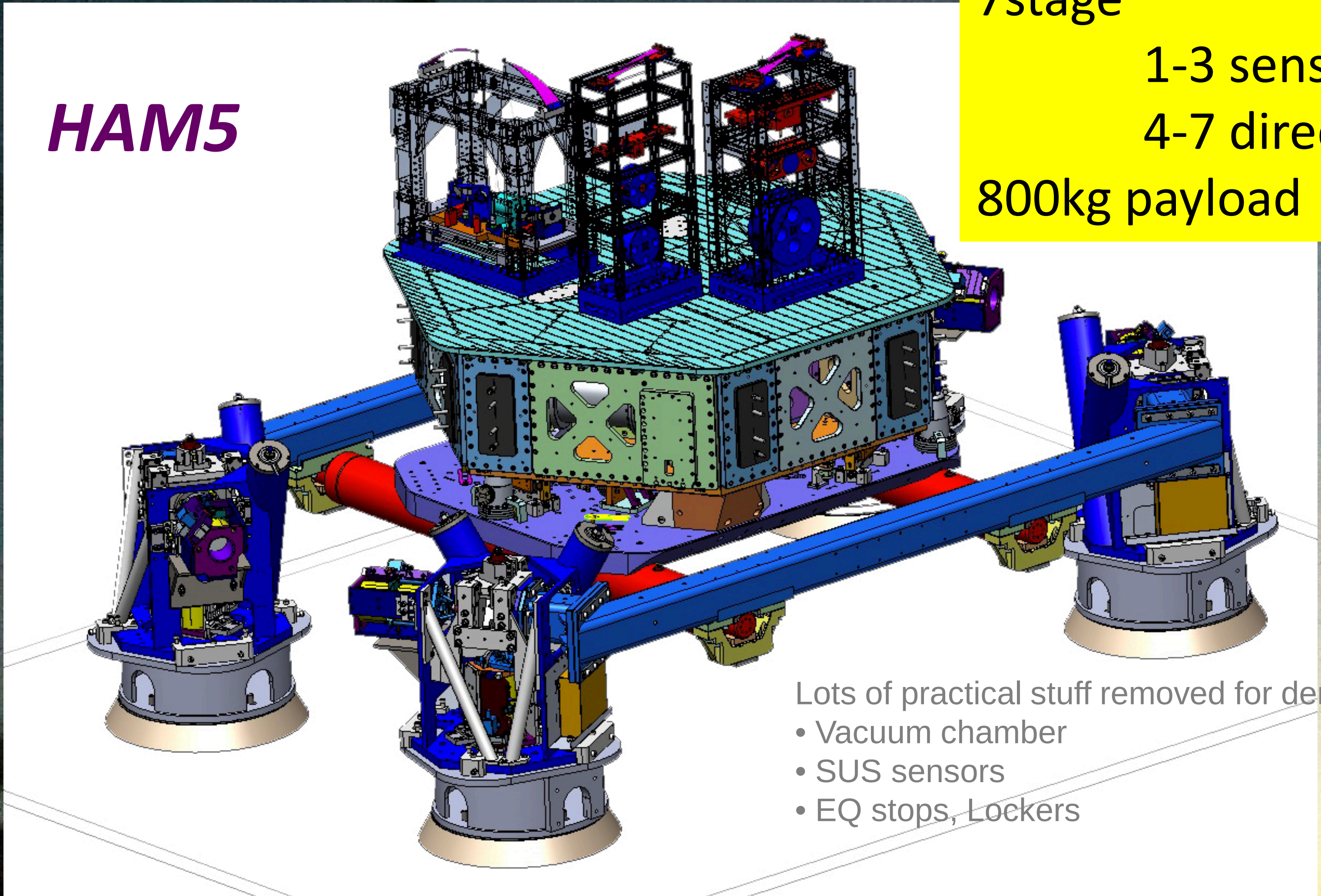
- Jeff (MIT) talked about seismic system in advanced LIGO

7stage

1-3 sensor noise

4-7 direct coupling

800kg payload

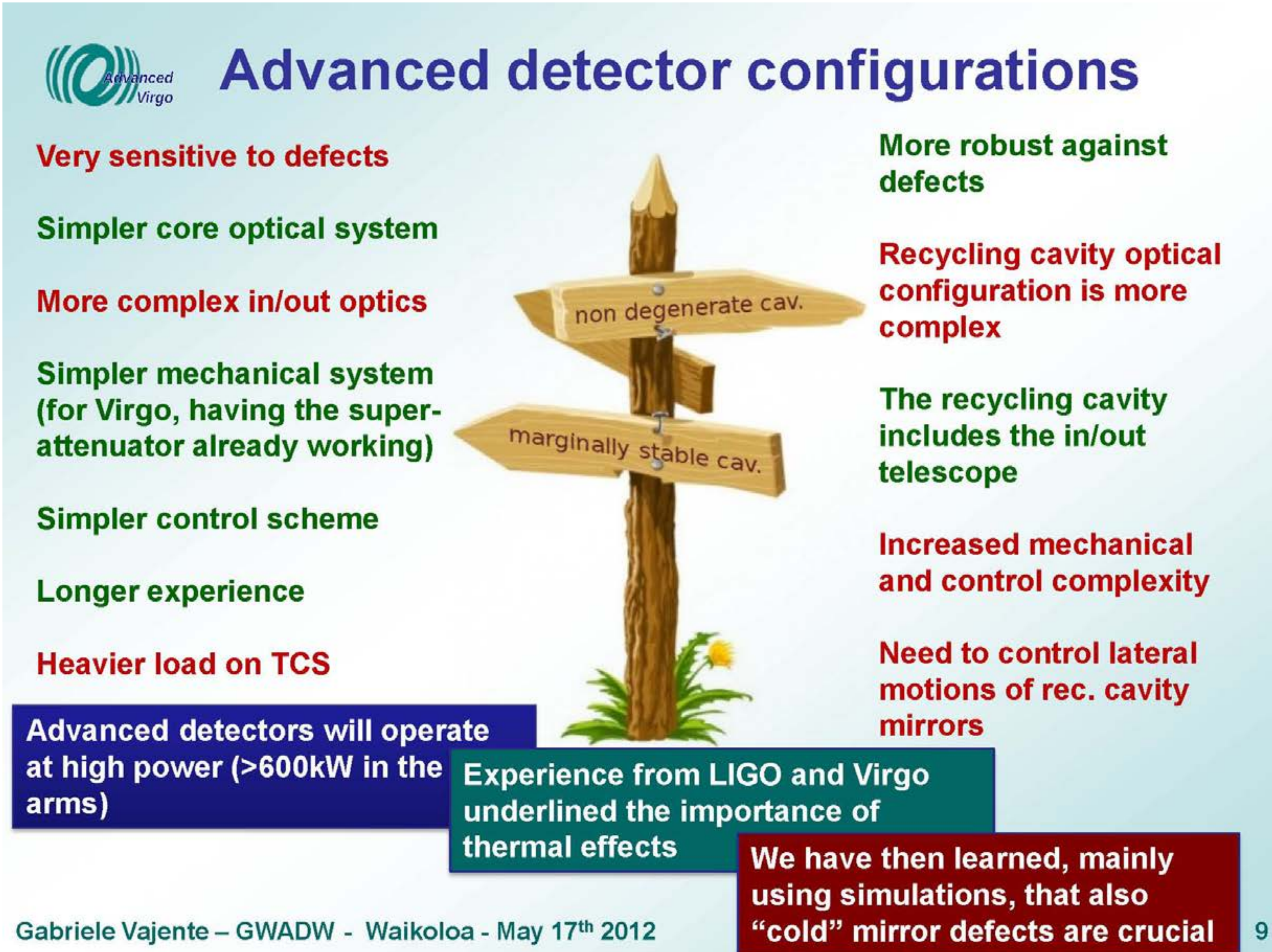


Thursday PM chaired by David

- Kazuhiro (ICRR) introduced the construction of KAGRA struggling for chasing aLIGO/AdVirgo

Thursday PM chaired by David

- Gabriele summarized the design and R&D for AdVirgo



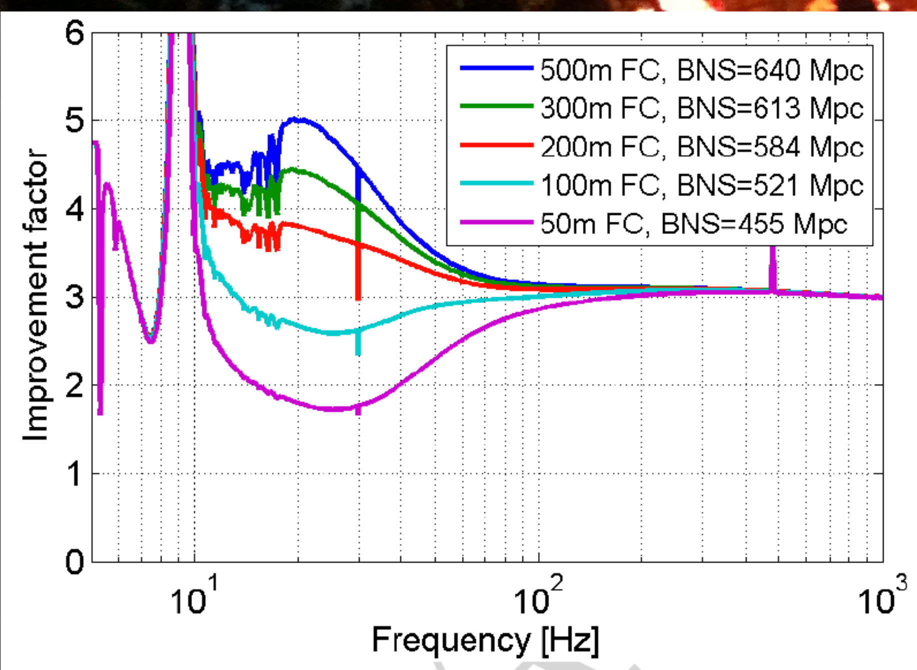
Thursday PM(2) chaired by Daniel

- K. McKenzie (JPL) introduced new mission concept succeeding LISA
- S. Sato (Hosei) summarized DECIGO and its pathfinder
- Robert (ANU) presented Laser Ranging Mission, GRACE, with its scientific & useful result
- Eric Hultgren (Stanford) advertized "LAGRANGE" project of space laser interferometer mission

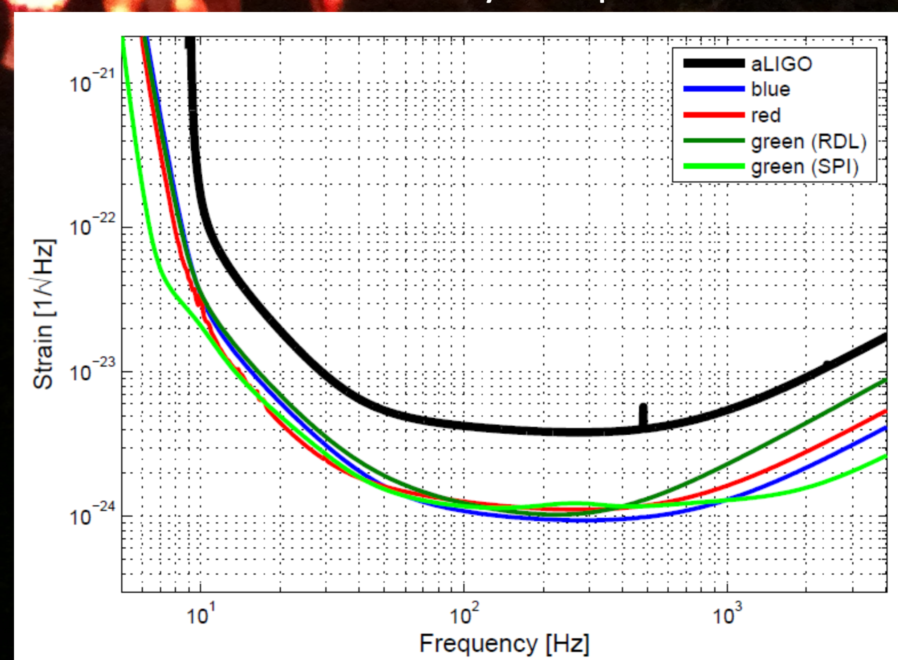
Friday AM chaired by Rana

- Miao (Caltech) summarized interferometer configurations with possible frequency bandwidths
- Stefan Hild (Glasgow) talked about LIGO-3G red design
  - Xylophone: cryogenic at low frequencies/high power at high frequencies
- Rana (Caltech) introduced LIGO-3G blue design
  - Xylophone is nonsense! 120K silicon mass, AlGaX coat, 3MW, 1/30 GGN
- Stefan Ballmer (Syracuse) took LIGO-3G green design

Frequency dependent loss



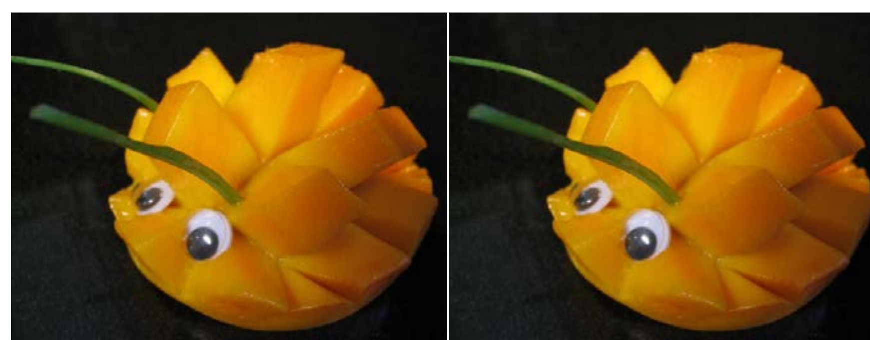
RGB sensitivity comparison



Friday AM (2) chaired by Rana

- Harald (AEI) summarized ET
  - Full review of presentations
  - 1dB / year improvement in SQZ (Lisa Barsotti)

- Matt (MIT) proposed MANGO
  - 2Mg TMs
  - 10dB SQZ
  - 300m
  - 2mHz SUS



Summary of this summary

- Steady advancement of improving sensitivity
- Extensive discussion for 3G detector --- more novel ideas
- Convincing funding agency by continuous effort --- Never give up !!
- Open GW astronomy by first detection !!
- See you in Elba next year