GWADW2021

Summary Session

Summary of Low-Frequency Workshop

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Low-Frequency Workshop 1

Low frequency workshop #1 (Tuesday, 18 May)

Newtonian Noise Mitigation and Related Topics

- Newtonian-noise cancellation

  Jan Harms (GSGC)
- Development Update for the TorPeDO Experiment
  - A Newtonian Noise Sensor for 3G Observatories

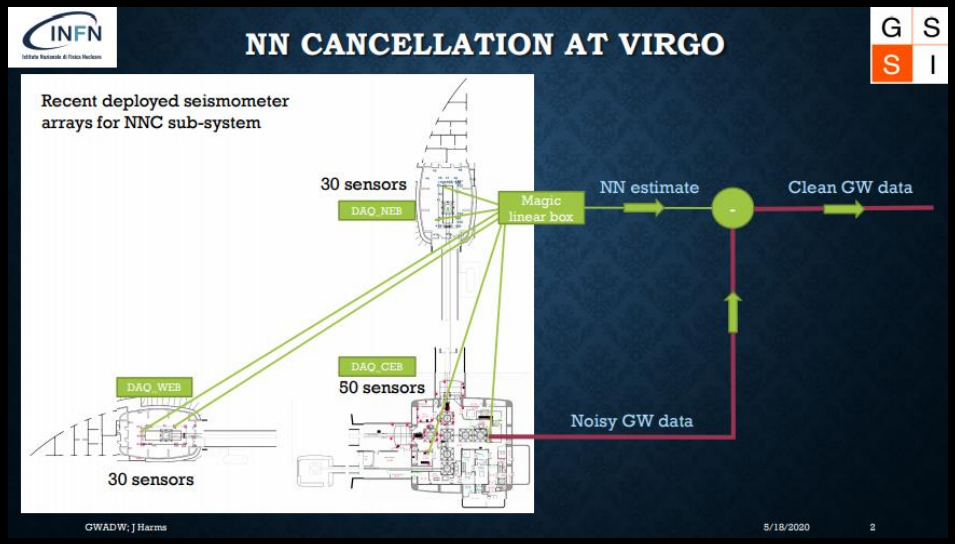
  Nathan Holland (The Australian National University)
- The Current Status of TOBA

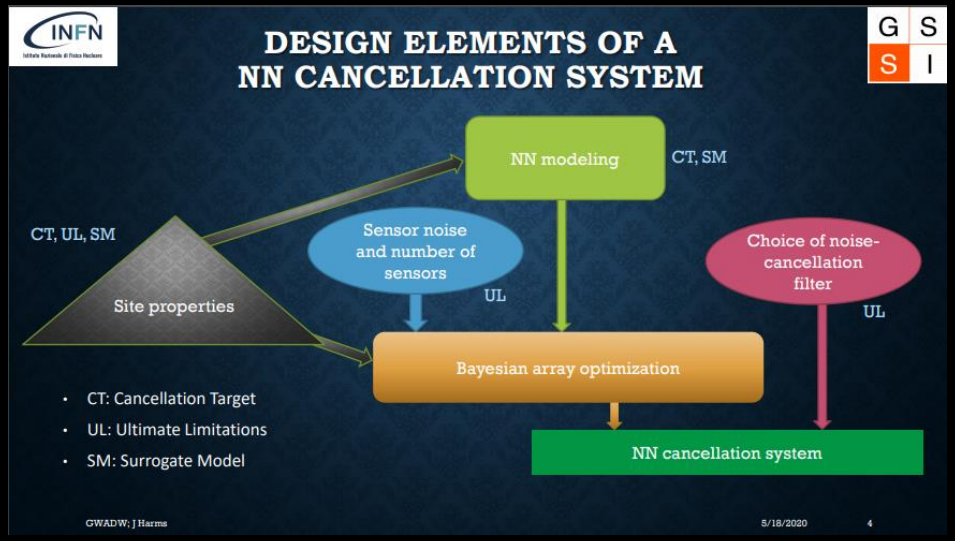
  Satoru Takano (The University of Tokyo)
- Low-frequency ground deformation observed by the geophysics interferometer (GIF) in the KAGRA tunnel

  Akito Araya (Earthquake Research Institute, U-Tokyo)
- Update on Cryogenic Silicon Suspension Activities at Glasgow

  Graeme Eddolls (University of Glasgow)

Newtonian-Noise Cancellation [Jan Harms]

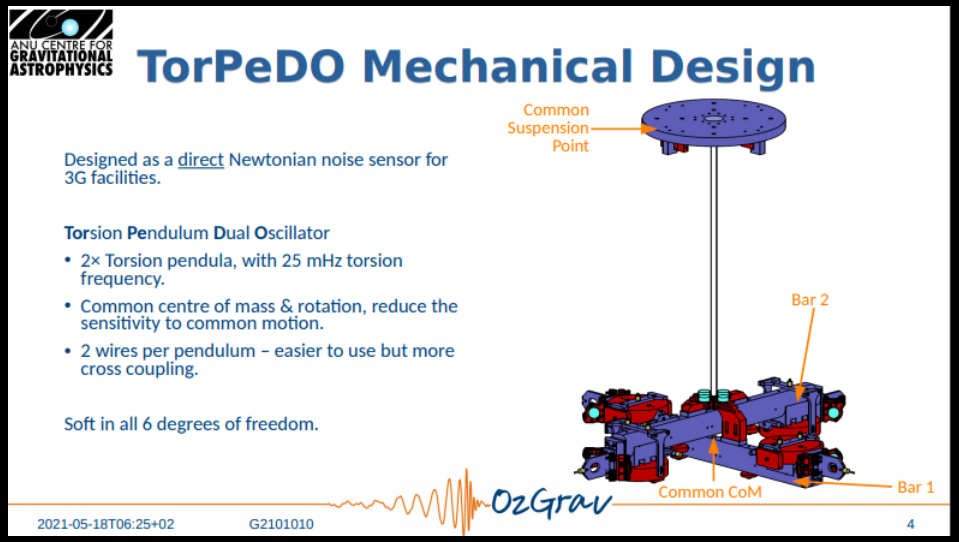


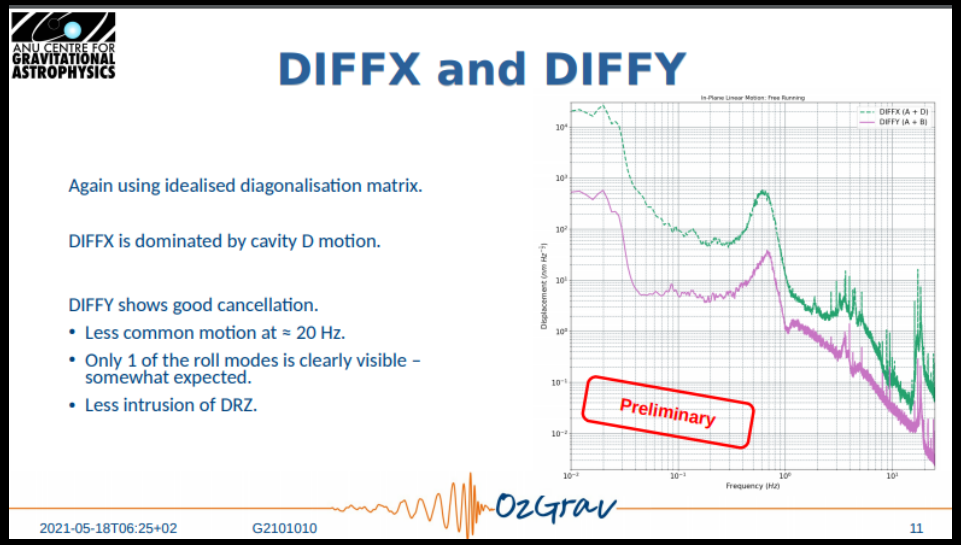


Concept and results of Newtonian noise cancellation using seismometer array were presented.

- Optimization study of the sensor array at VIRGO site.
- Optimal liner filtering.
- Experimental results at the LIGO Hanford site.
- ET Newtonian noise model, cancellation concept, and Numerical simulation.

TorPeDO [Nathan Holland]



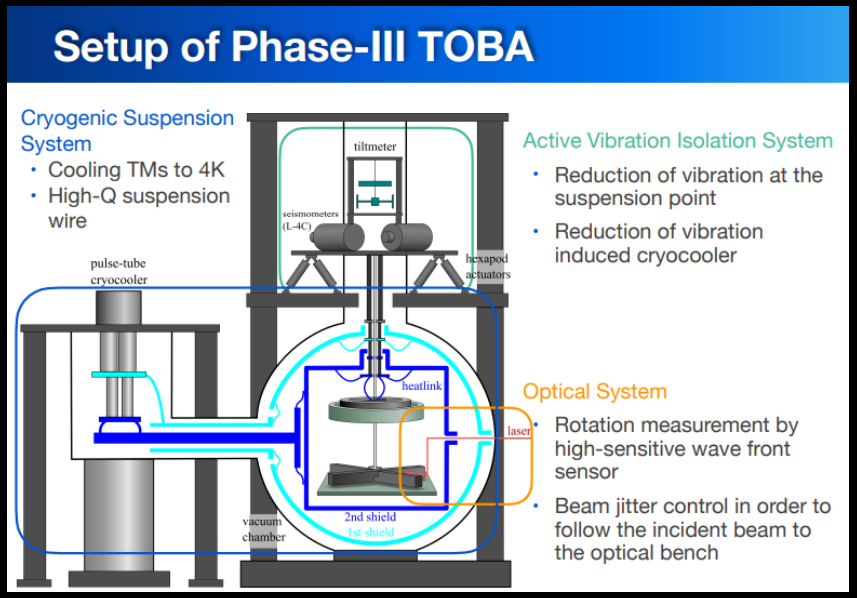


Recent update of TorPeDO development was presented.

- Motivation of Newtonian noise mitigation using gravity gradiometer.
- Mechanical, Interferometer sensors, control design.
- Current sensitivity.
- Upgrade activities:
  Seismic isolation chain,
  Local sensors, quadrupole
  Newtonian noise generator.

TOBA [Satoru Takano]

Setup of Phase-III TOBA

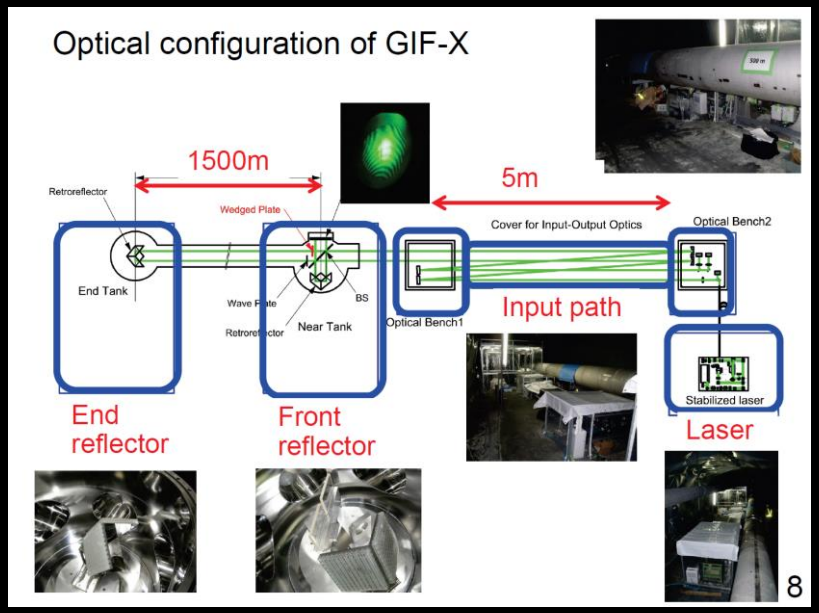


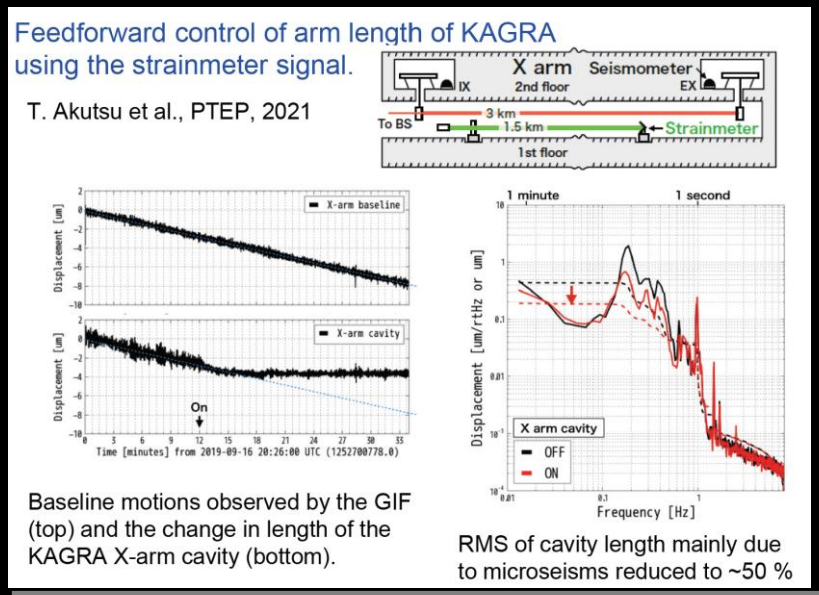
Current Setup

Recent update of TOBA development was presented.

- Motivation for development of gravity gradiometer.
- Design, Requirement and target sensitivity.
- Results of cryogenic operation and active vibration isolation system.
- Upgrade activities: Optical sensor, Silicon test mass and monolithic bench

KAGRA Site Results [Akito Araya]

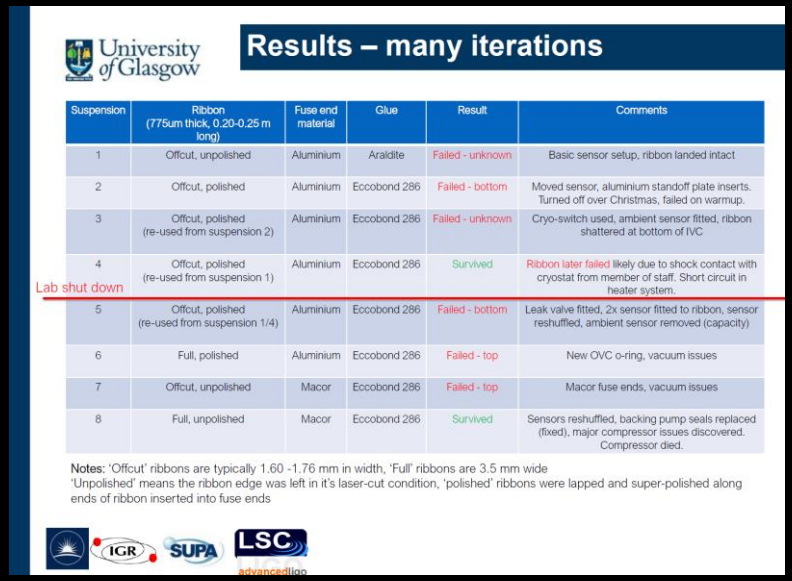




Results by laser strain meter at the KAGRA site were presented.

- Overview of 1,500m laser strain meter placed at the KAGRA site.
- Low-frequency strain variations.
- Earth tides and Topographic effects
- Barometric response at the site.
- Long-term strain drifts caused by rain, snow, and tectonic motion.
- Feed forward control of arm-length of the KAGRA interferometer.

Cryogenic Silicon Suspension [Graeme Eddolls]



Suspension	Ribbon (775um thick, 0.20-0.25 m long)	Fuse end material	Glue	Result	Comments
1	Offcut, unpolished	Aluminium	Araldite	Failed - unknown	Basic sensor setup, ribbon landed intact
2	Offcut, polished	Aluminium	Eccobond 286	Failed - bottom	Moved sensor, aluminium standoff plate inserts. Turned off over Christmas, failed on warmup.
3	Offcut, polished (re-used from suspension 2)	Aluminium	Eccobond 286	Failed - unknown	Cryo-switch used, ambient sensor fitted, ribbon shattered at bottom of IVC
4	Offcut, polished (re-used from suspension 1)	Aluminium	Eccobond 286	Survived	Ribbon later failed likely due to shock contact with cryostat from member of staff. Short circuit in heater system.
5	Offcut, polished (re-used from suspension 1/4)	Aluminium	Eccobond 286	Failed - bottom	Leak valve fitted, 2x sensor fitted to ribbon, sensor reshuffled, ambient sensor removed (capacity)
6	Full, polished	Aluminium	Eccobond 286	Failed - top	New OVC o-ring, vacuum issues
7	Offcut, unpolished	Macor	Eccobond 286	Failed - top	Macor fuse ends, vacuum issues
8	Full, unpolished	Macor	Eccobond 286	Survived	Sensors reshuffled, backing pump seals replaced (fixed), major compressor issues discovered. Compressor died.

Recent updates of cryogenic Silicon suspension development were presented.

- Motivation for cryogenic Silicon suspension.
- Design and assemble procedure of the suspension
- Overview of the cryogenic system.
- Hanging results and interpretations.
- Lessons learned and future Prospects.

Summary of Session #1

- Newtonian-noise cancellation using array of seismometers is tested at the 2G detectors and being considered for the 3rd generation detectors.
- Sensitive gravity-gradiometers for direct measurement of Newtonian noise are being developed : TorPrDO and TOBA.
- Knowledge on environment is also important for long-term stability of the cancellation. Results obtained at the KAGRA site results are presented.
- As a related technology, recent results of cryogenic Silicon suspension is also presented in the session.