

# GWADW2017 + ANU Report



**Yuta Michimura**

Department of Physics, University of Tokyo

# Overview

- Not as festive as GWADW2016, but steady steps towards future detectors reported
- Considerable number of moderators not attended
- Thermal noise & coatings session became plenary
- Low frequency and Controls sessions were parallel
- New light source talks
- Town Hall discussion on 3G, mainly on common design or not discussion
- Too many talks?



# Must-See Talks

- Slawek Gras, [Multi-mode thermal noise experiment @ MIT](#) (beautiful experiment)
- Jeff Kissel, [Calibration Considerations for the 3G Detector Era](#) (Seven Commandments)
- Jeff Kissel, [What Does Low Frequency Control Look Like in the 2G+ and 3G Era?](#) (nice summary)
- Geppo Cagnoli, [Large mirrors](#) (larger sapphire mirror and suspension development proposal)
- Stefan Danilishin, [EPR speedmeter](#) (another speedmeter configuration using 2 readouts of DRFPMI with different bandwidth; see [arXiv:1701.01694](#))

..... and every other talks

# Nice Beach

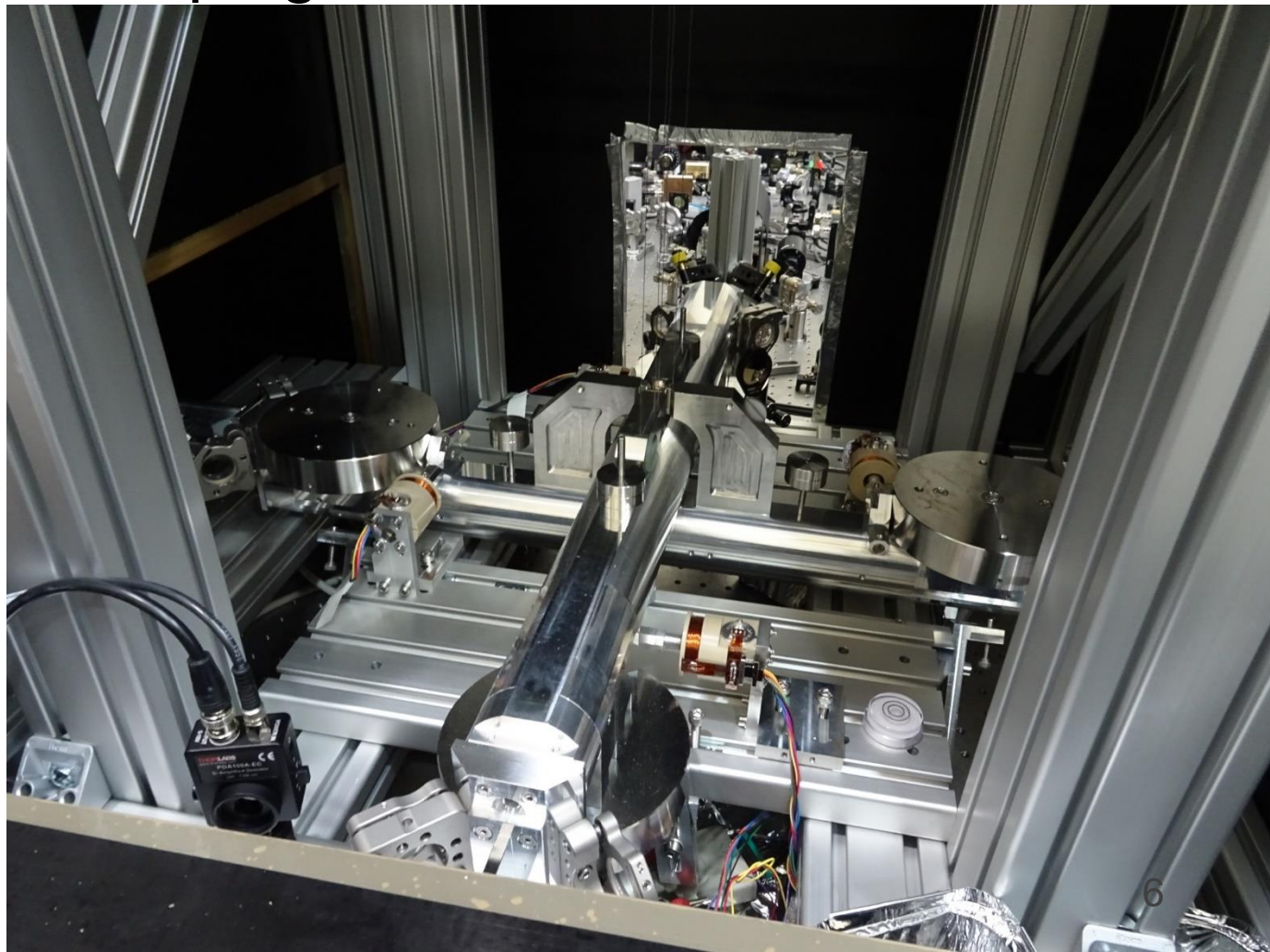


# ANU Visit

- Visited Bram Slagmolen on May 5
  - Centre for Gravitational Physics
  - TorPeDO
  - Vacuum OPO
  - Machine learning for optics
  - 2 um squeezing etc.....
- Visited Ping Koy Lam on May 6
  - Quantum Optics Group
  - Optical levitation
  - Spatial squeezing
  - Hybrid linear amplifier
  - Optical vortex generation etc .....

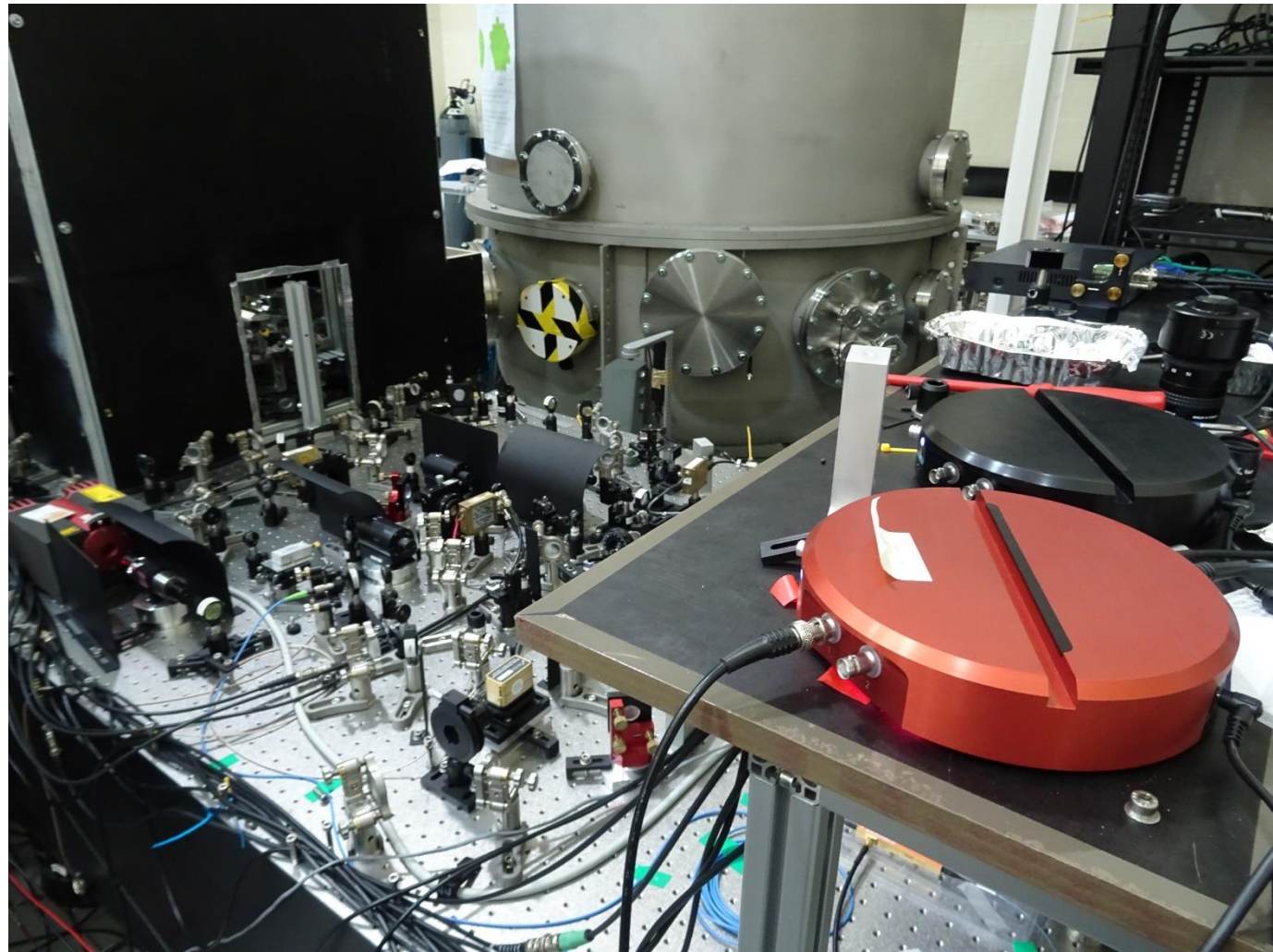
# TorPeDO

- Single pendulum, two wires for each bar
- Magnets for damping translational mode



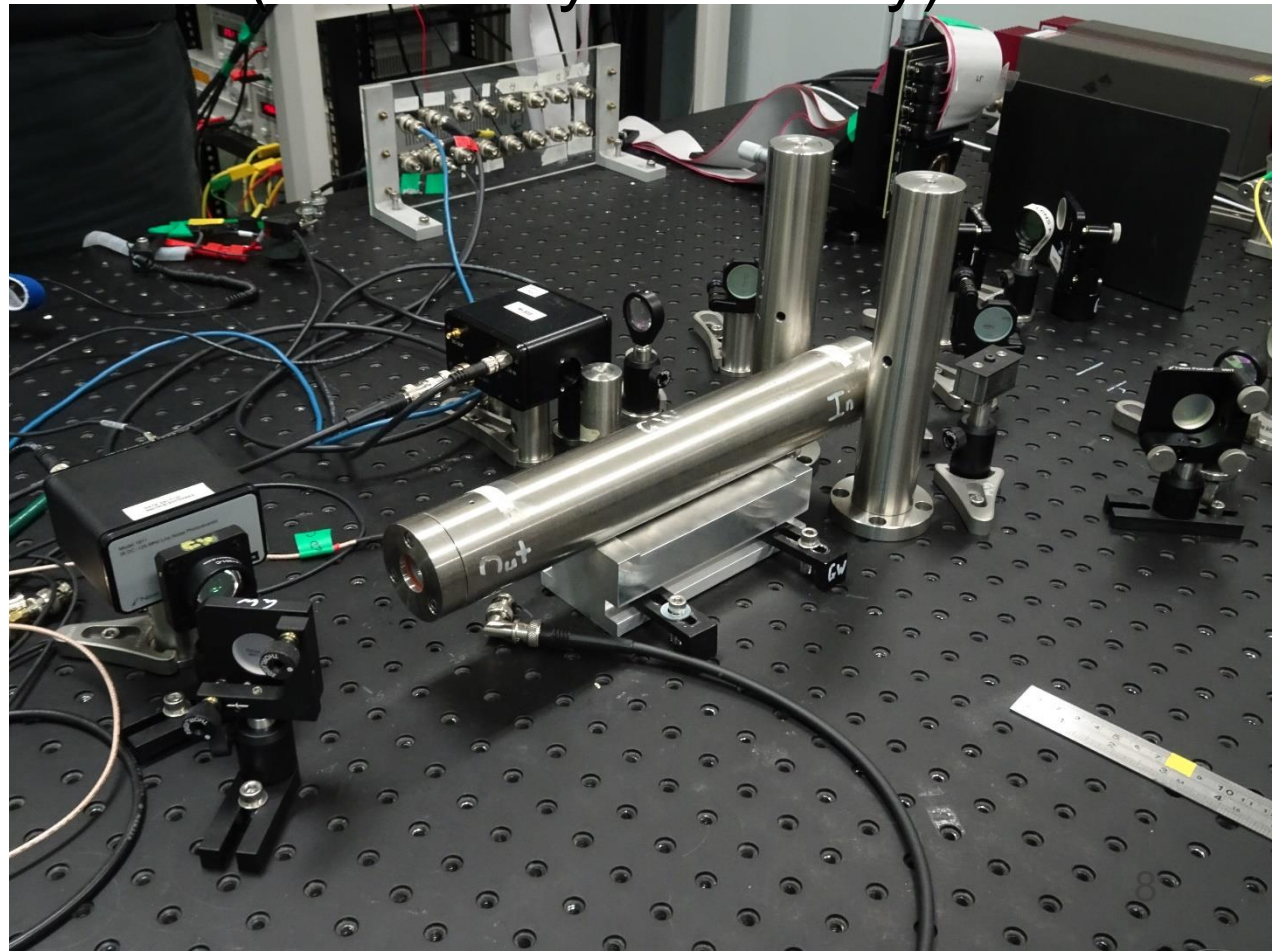
# TorPeDO

- In-air, in soundproof box



# Machine Learning

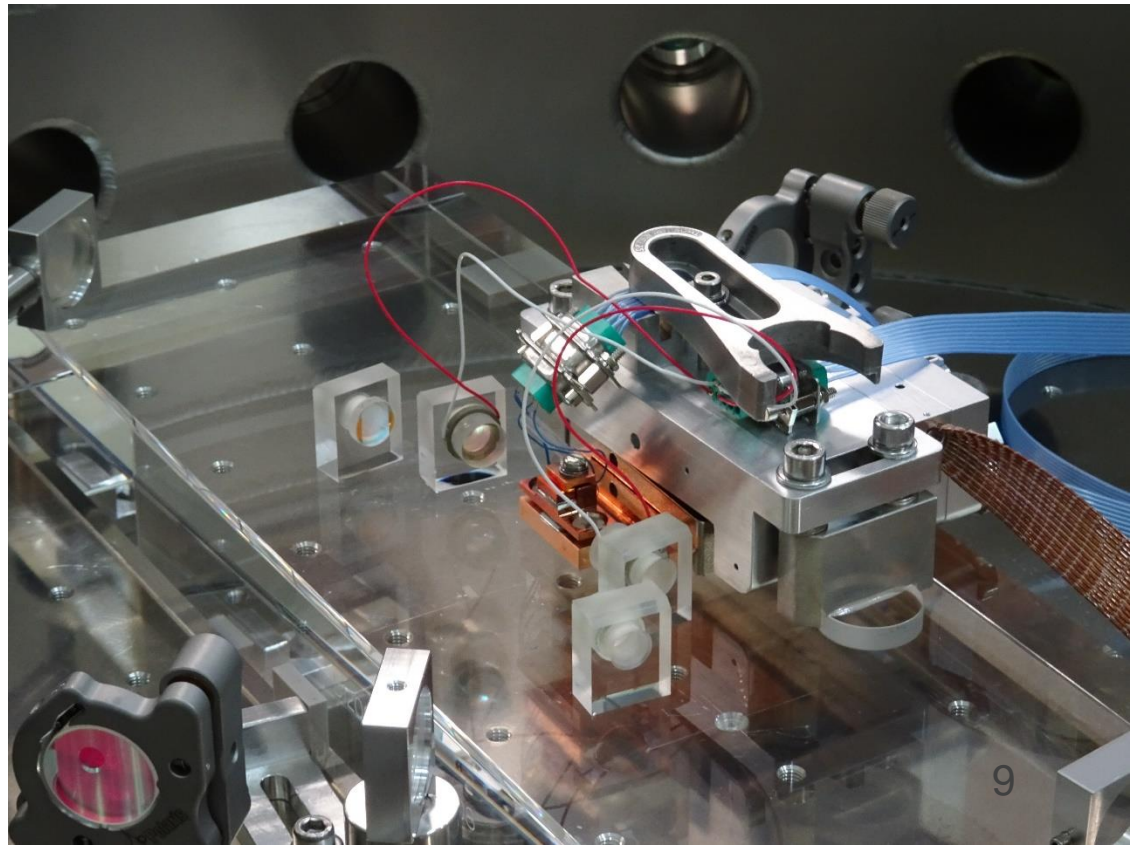
- For cavity alignment and modematching with deformable mirrors
- For TorPeDO control (sensitivity x stability)
- Using MLOOP ([GitHub](#))





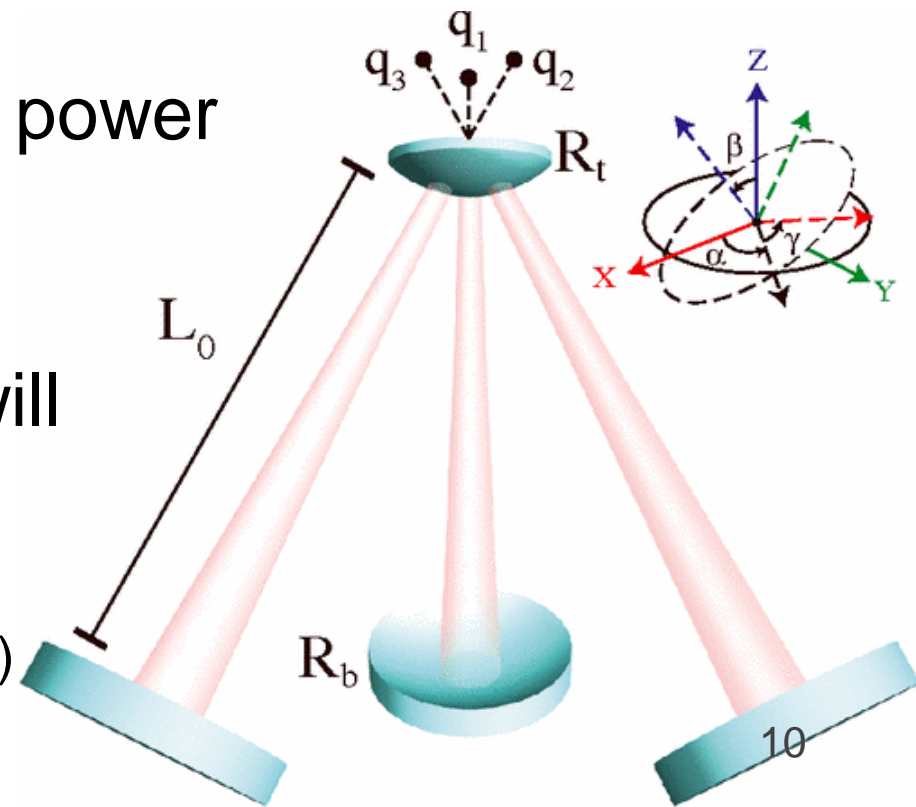
# Vacuum OPO

- Fused Silica baseplate was too hard, decided to use metal for aLIGO
- Squeezing setup to be used for demonstration of EPR frequency dependent squeezing

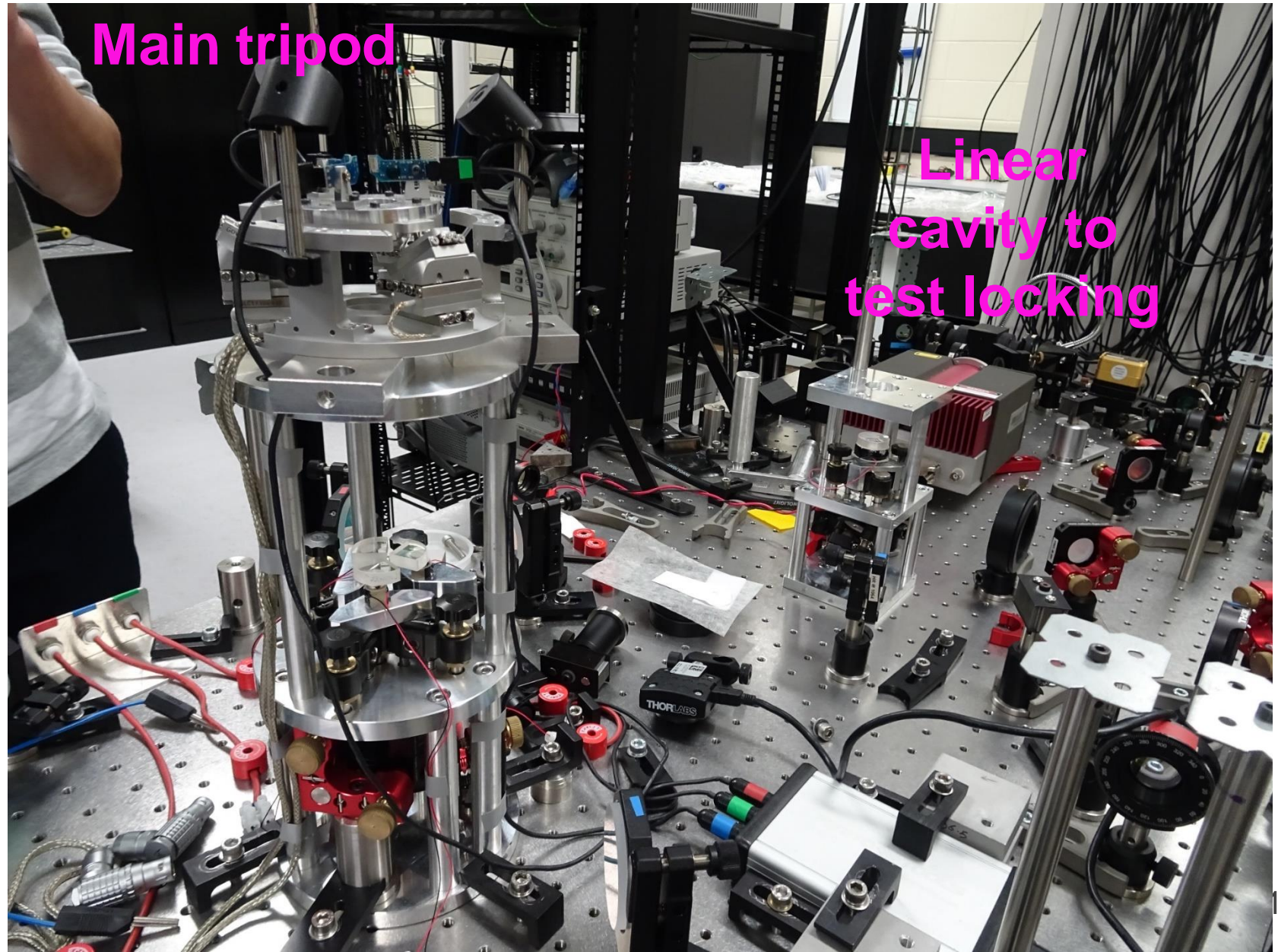


# Optical Levitation: Overview

- Proposal paper  
G. Guccione+, [PRL 111, 183001 \(2013\)](#)
- Succeeded in fabricating small mirrors  
 $\phi 3\text{mm}$ , 0.1 mm thick,  
RoC  $\sim 50\text{ cm}$ ?
- Not stable lock with high power  
thermal effect?
- Currently using vacuum  
deposition coating, but will  
use IBS coating on  
diamond mirror  
(to cope with higher coating stress)

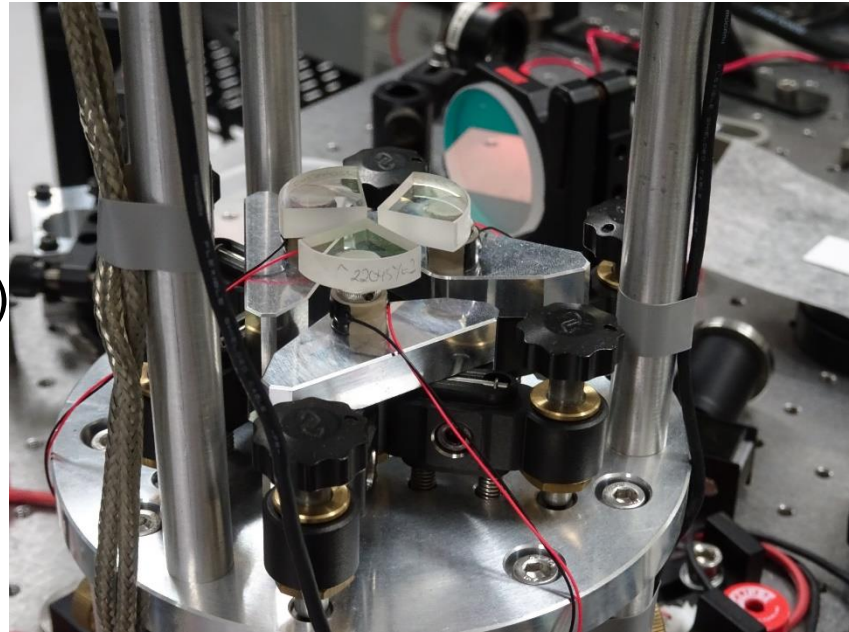
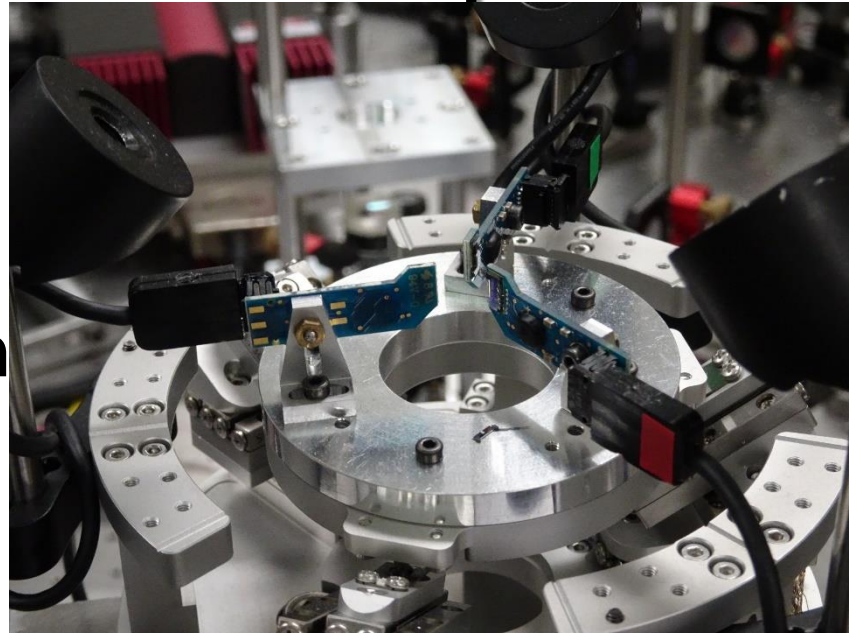


# Optical Levitation: Setup



# Optical Levitation: Setup

- Force sensor with cantilever  
(zigzag to avoid van der Waals force)
- Not enough time resolution
- Alignment issue
- Working on more rigid structure made of Super Invar, and to put them on vibration isolated table (since trapping range is small)

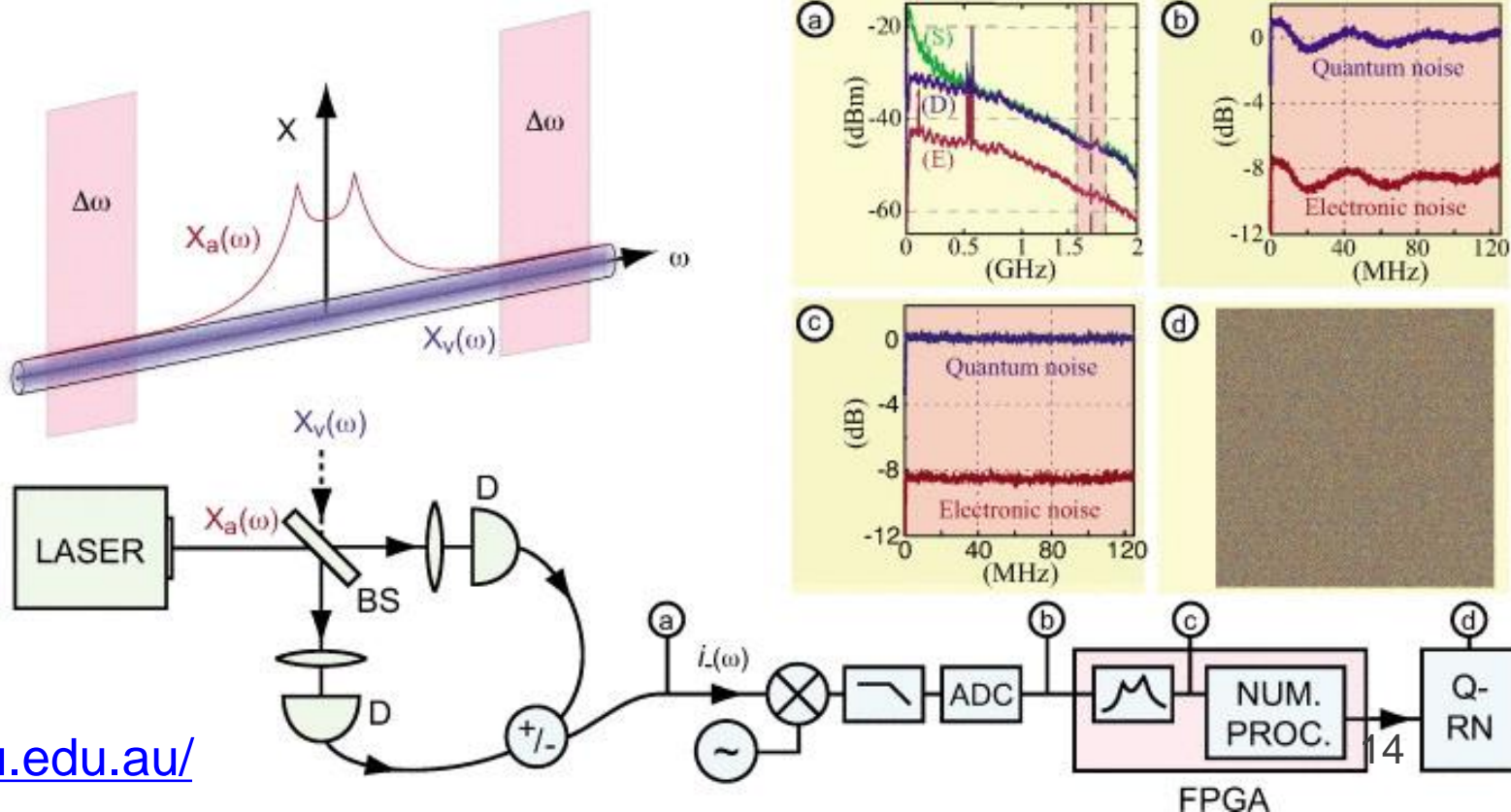


# Optical Levitation: Issues

- Lock without feedback, different behavior for 3 cavities
- Thermal noise issue (?)
  - observed 2 kHz oscillation in transmitted power
  - matched with COMSOL mode analysis
- Expensive mirror
  - maybe we can collaborate to order together

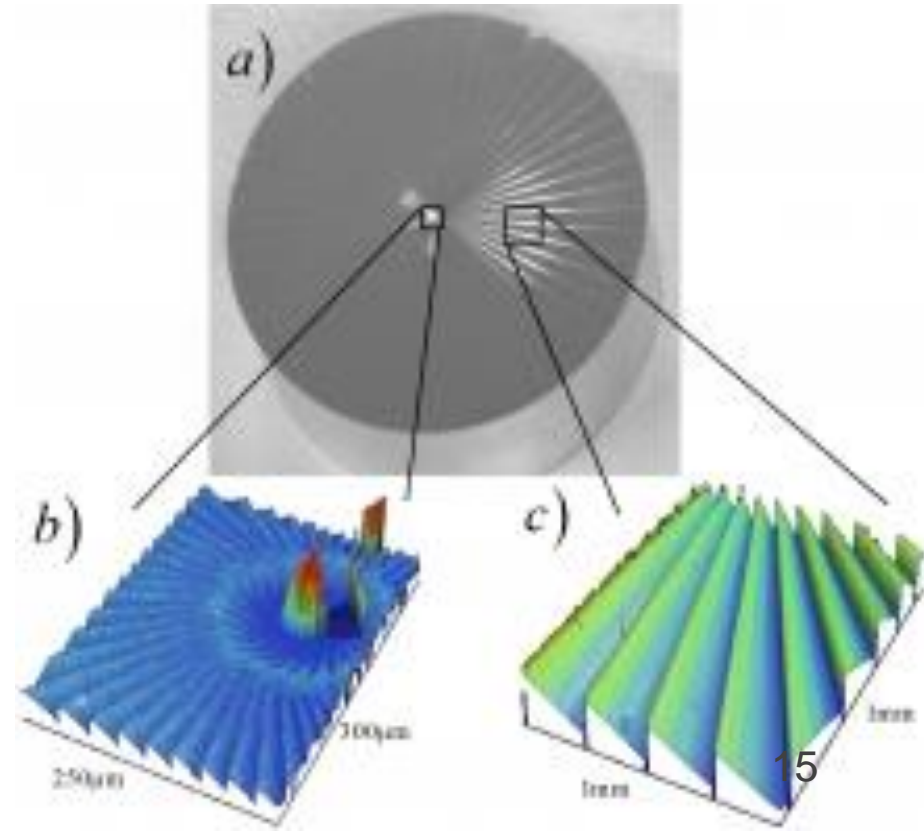
# Random Number Generator

- RNG using shot noise measurement
- T. Symul+, [Appl. Phys. Lett. 98, 231103 \(2011\)](#)  
Real time demonstration of high bitrate quantum random number generation with coherent laser light



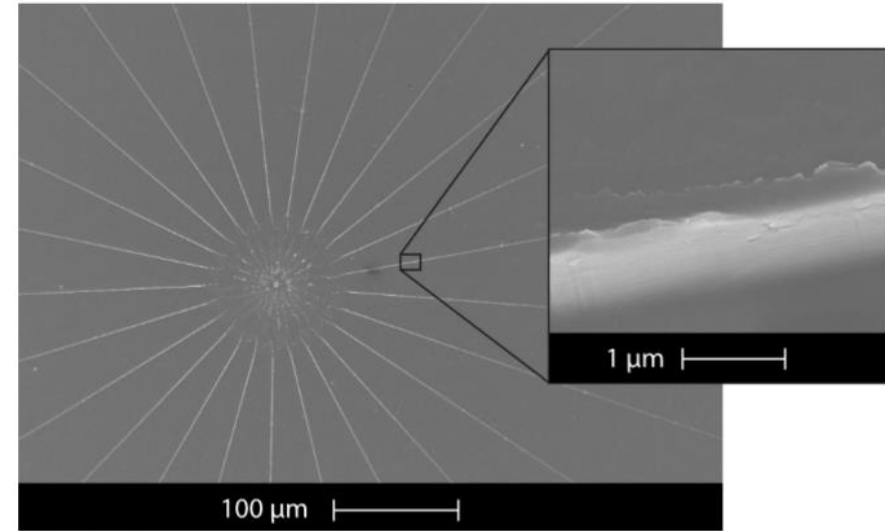
# Optical Vortex

- Impart orbital angular momentum to optical field
- G. Campbell+, [Applied Optics 51, 873 \(2012\)](#)  
Generation of high-order optical vortices using directly machined spiral phase mirrors
- Can be used for optical trapping and encoding of quantum information
- Topological charges 1 to 100



# Single Point Diamond Turning

- Ångström level surface roughness
- Any ideas for usage?



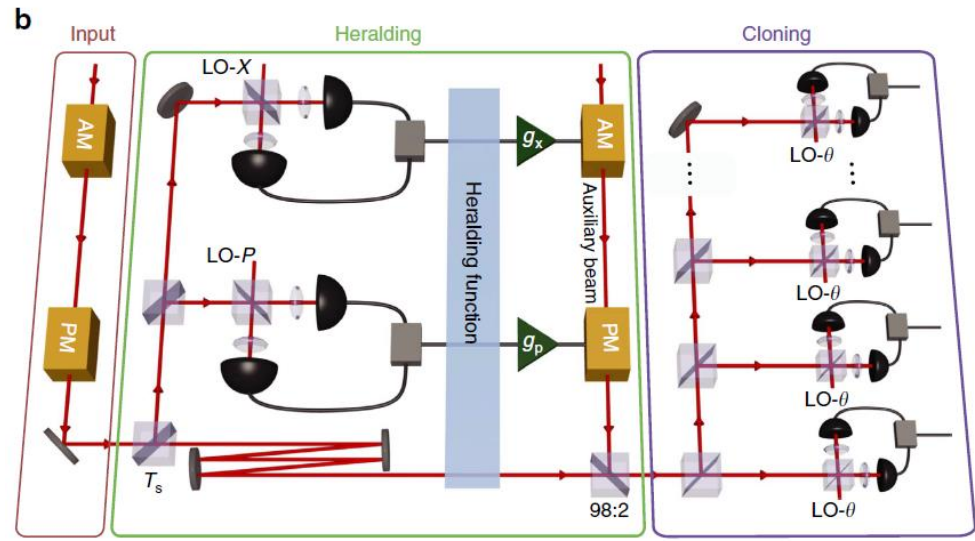
Mirror to focus vacuum





# Hybrid Linear Amplifier

- Probabilistic amplification to surpass non-cloning limit (cannot win statistically)
- J. Y. Haw+, [Nature Commun. 7, 13222 \(2016\)](#)  
Surpassing the no-cloning limit with a heralded hybrid linear amplifier for coherent states



# Summary

- It was a great trip

