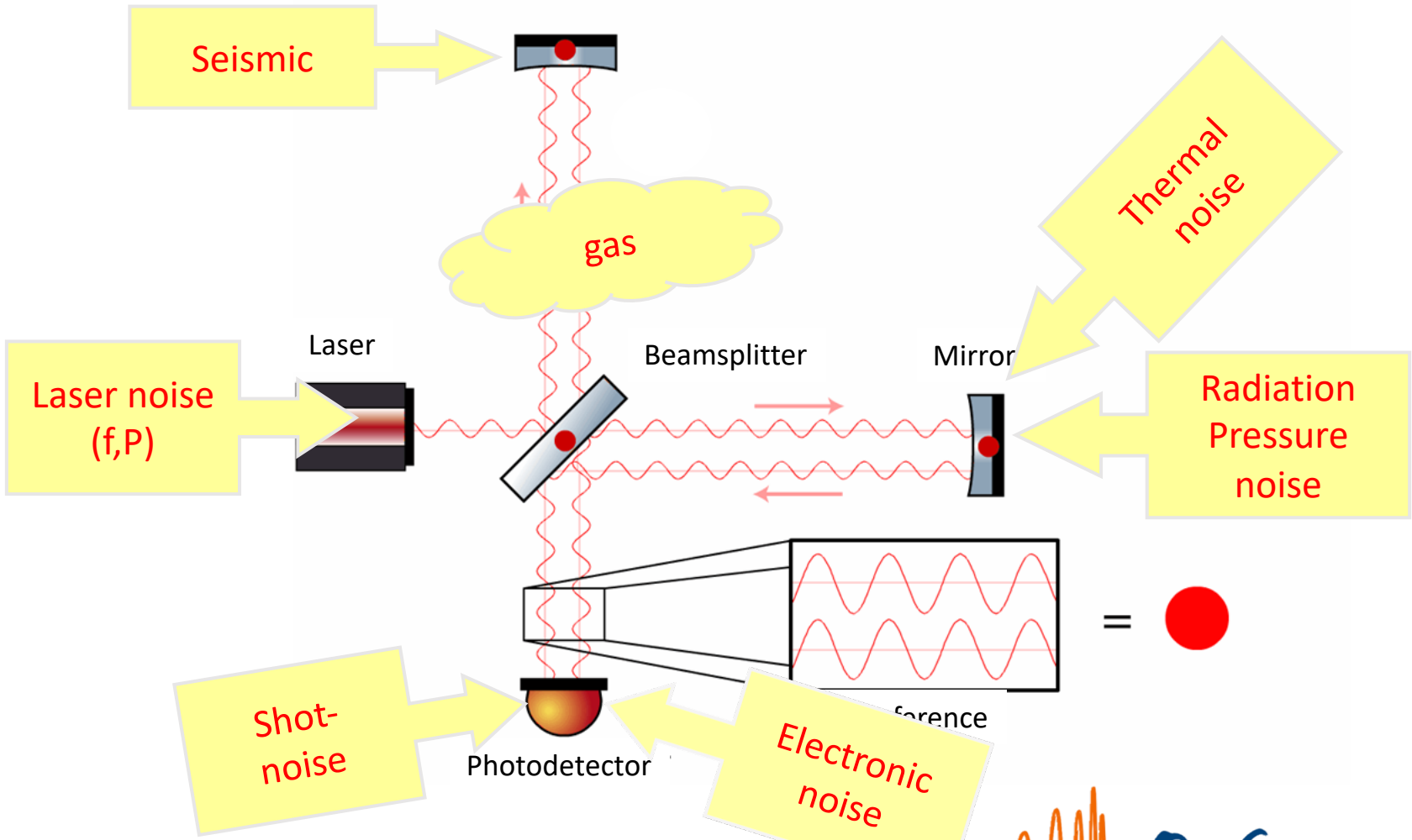
Wanna measure a gravitational wave?

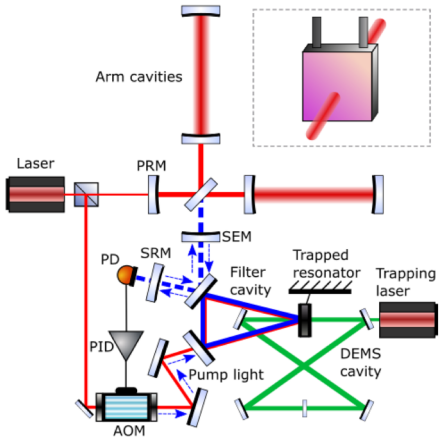


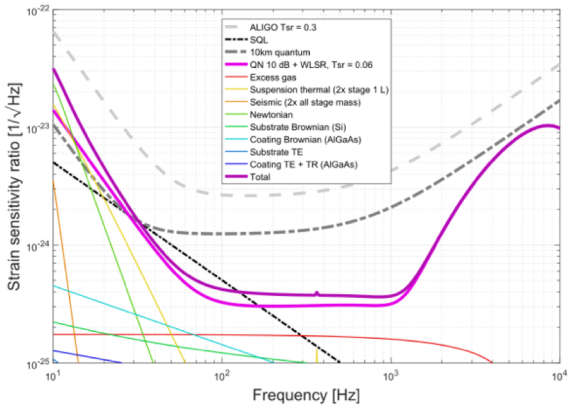
- 40 kg mirrors perform a quantum measurement;
- The most precise measurement is made over 24 orders of magnitude;
- Our goals are astrophysical, our challenges very quantum engineering-y.

Performing quantum measurement!

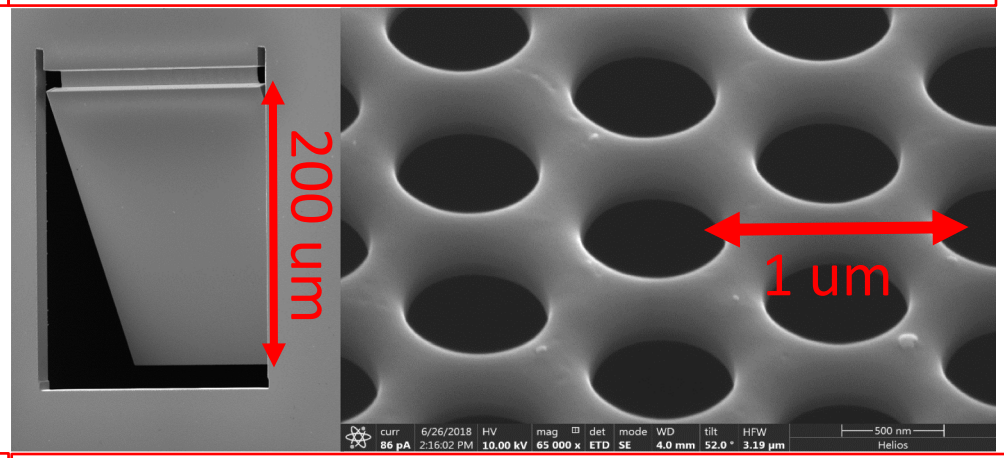
THE UNIVERSITY OF WESTERN AUSTRALIA

New readout schemes





Microscale optical resonators

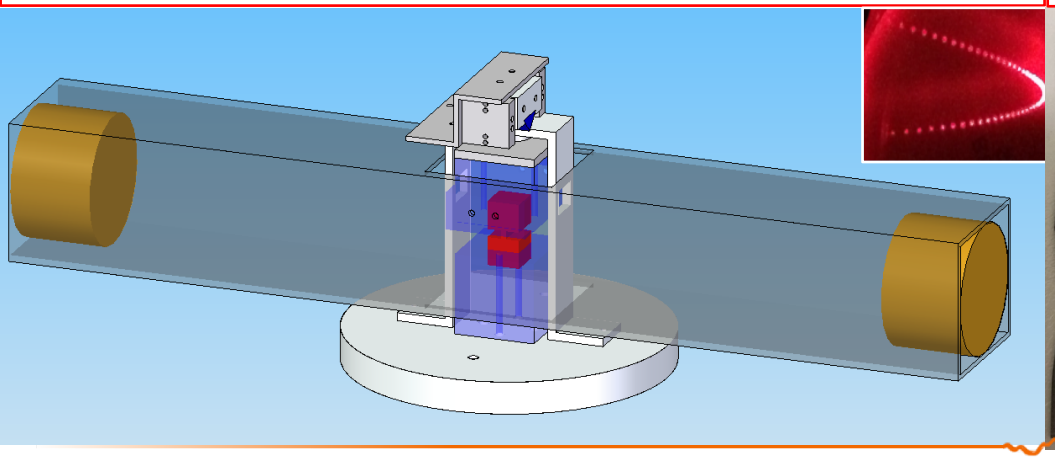


LIGO Scientific Collaboration

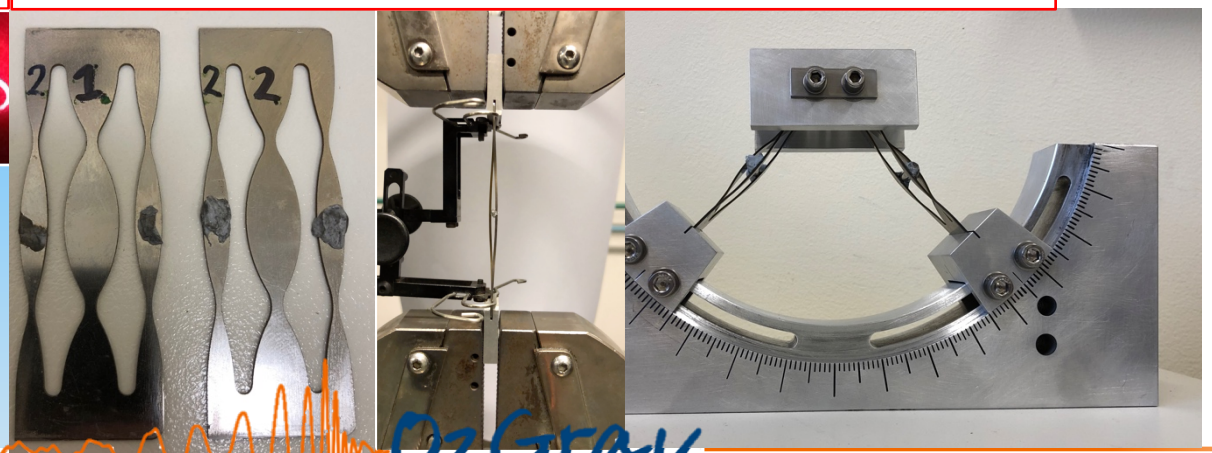
OzGrav

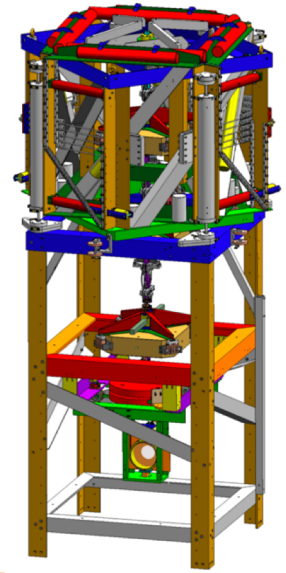
gravity discovery centre and observatory

Low frequency tilt meter

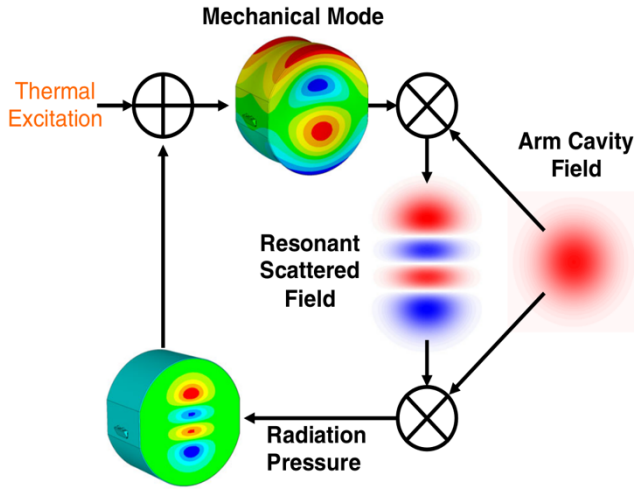


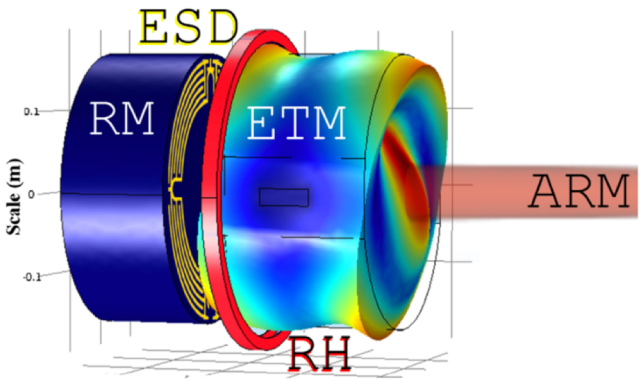
Vibration isolation



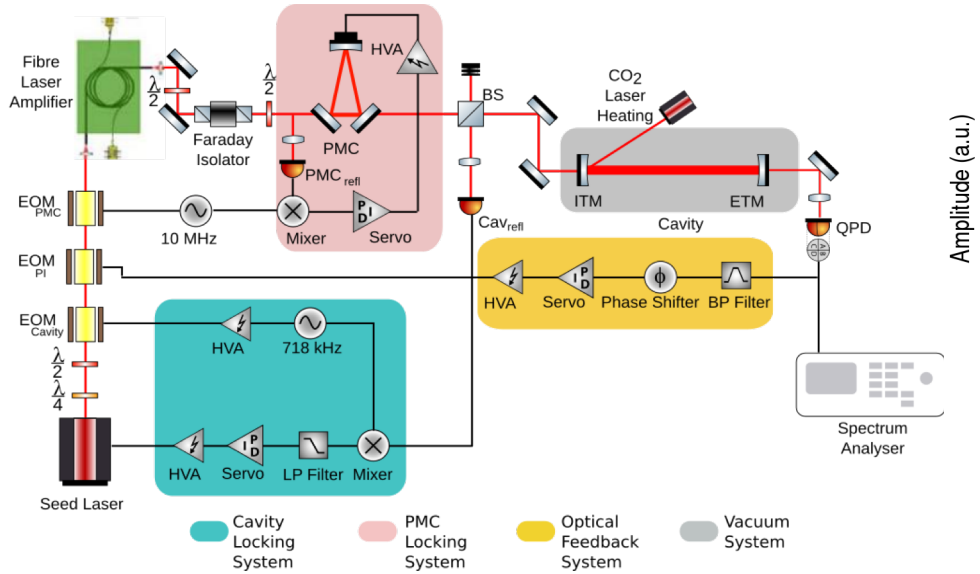


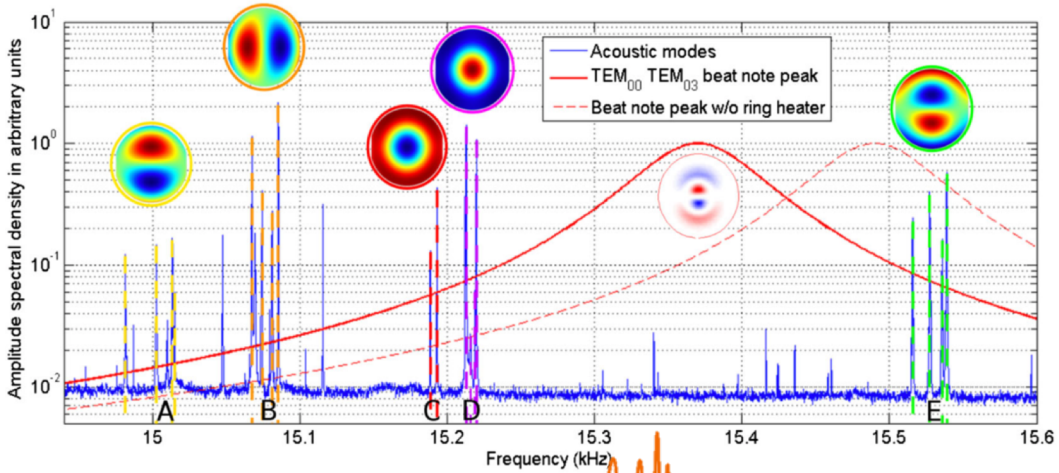
Example LIGO projects on parametric instability

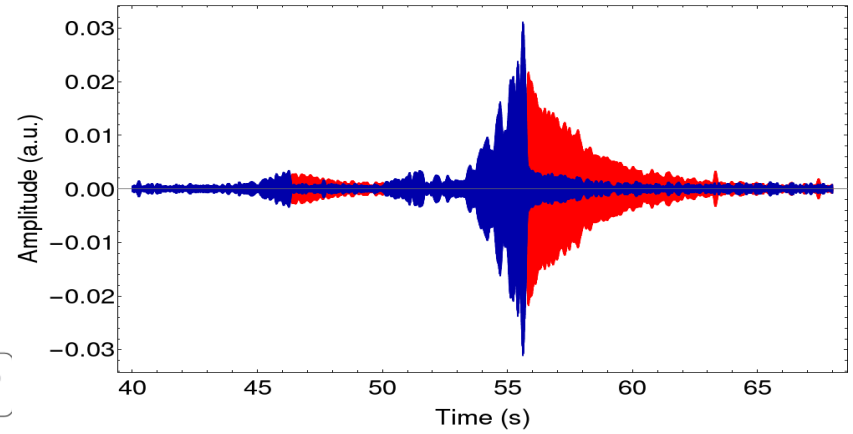


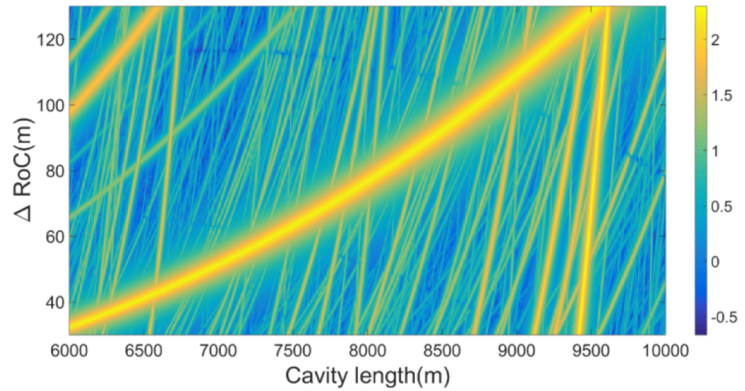


from C. Blair *et al.* "First Demonstration of Electrostatic Damping of Parametric Instability at Advanced LIGO", PRL 118, 151102 (2017)



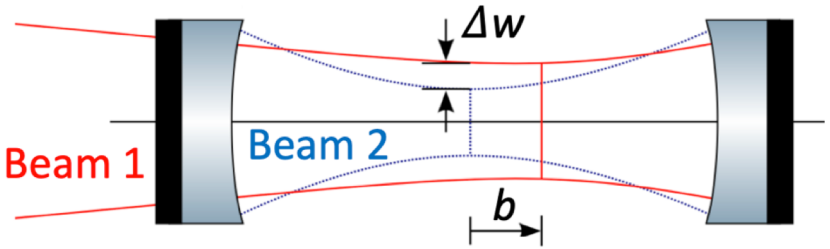


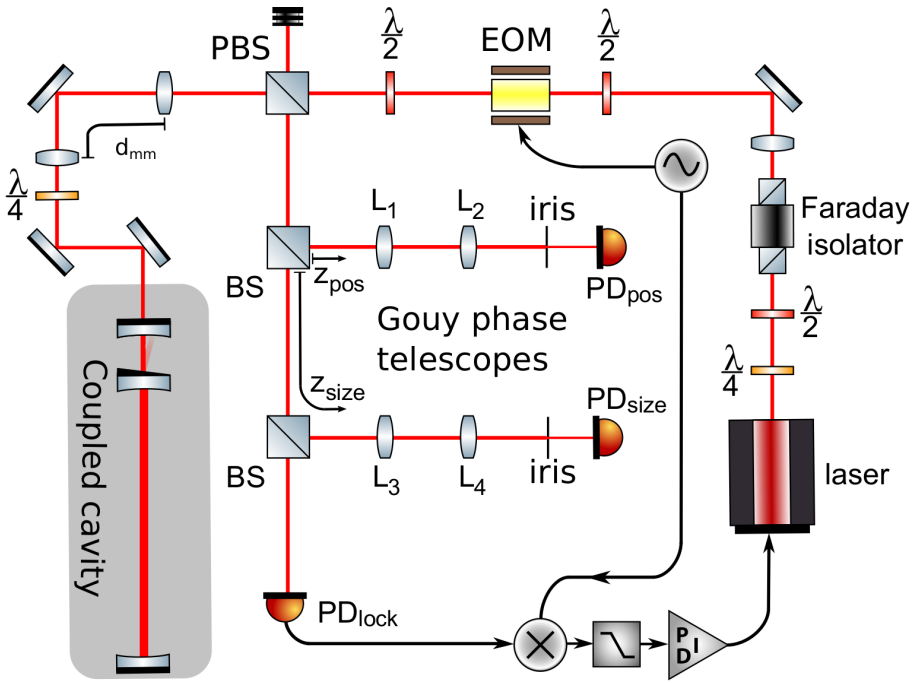




This could be your way to future overseas work!

Example project in our group's new cleanrooms



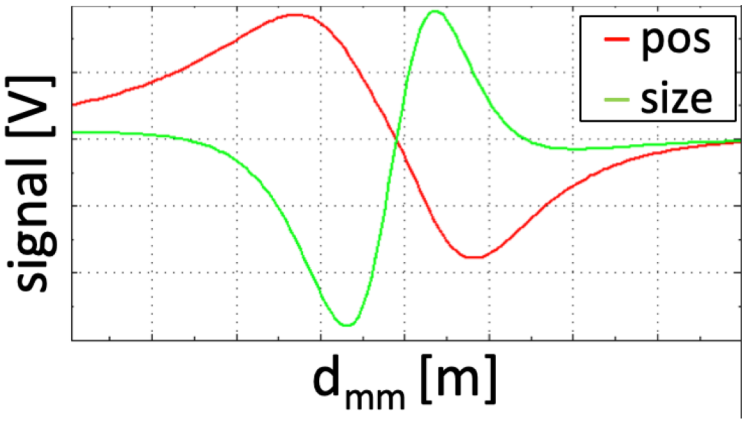


b ≡ waist position mismatch

Δw ≡ waist size mismatch

$$E_{\text{pos}} \propto \left[\Psi_0 + \boldsymbol{i}\,\frac{b}{2kw_0^2}(\Psi_0 + \Psi_2)\right]$$

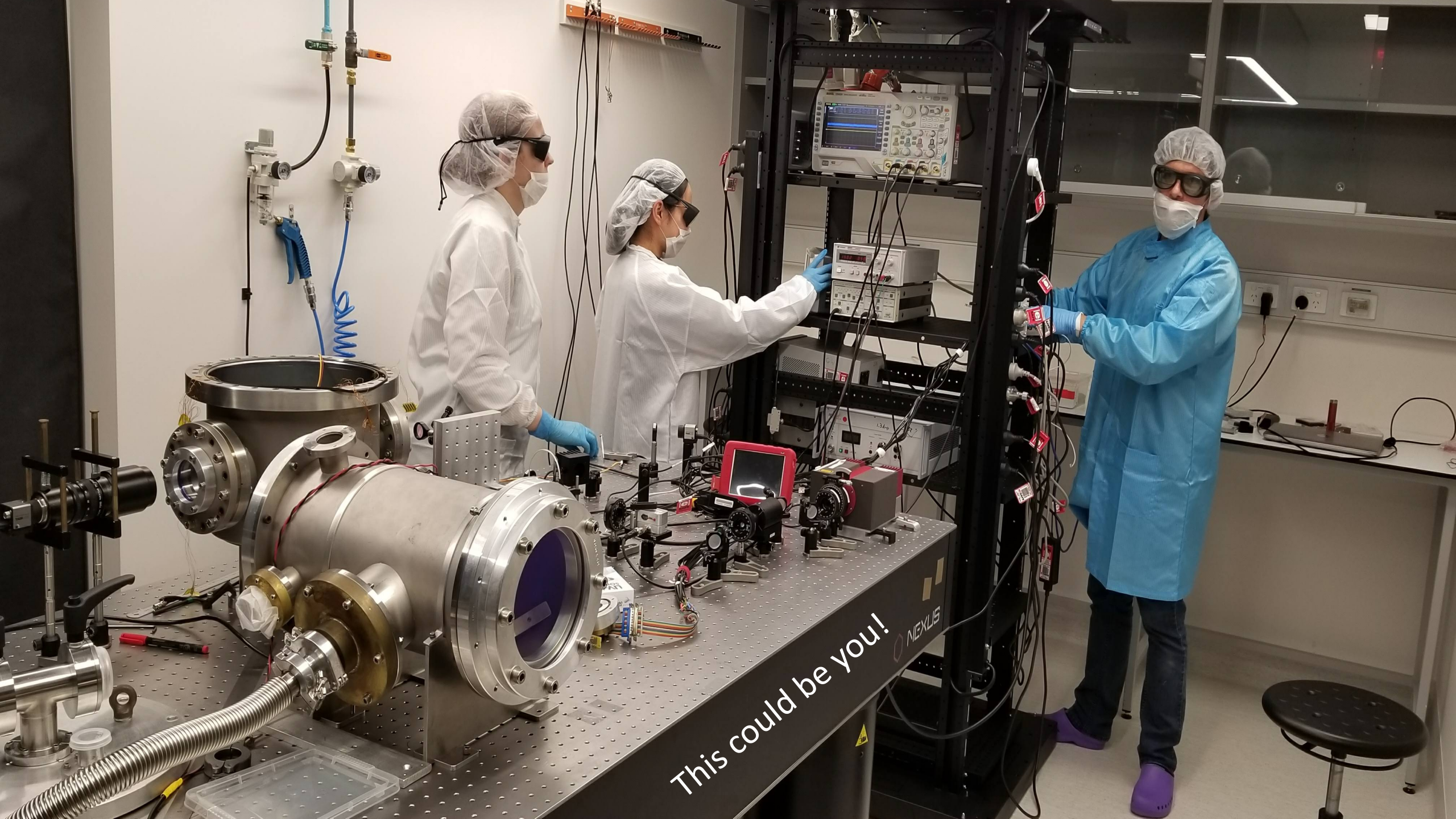
$$E_{\text{size}} \propto \left[\Psi_0 + \frac{\Delta w}{2w_0}\Psi_2\right]$$



Finesse (optical simulation software) simulations show we can make the error signals we need!

We plan using this setup in our 2 µm, 80 meter Silicon coupled cavity

Find poster down the hallway


This could be you!
NEXUS

ARC Centre of Excellence for Gravitational Wave Discovery

Swinburne University of Technology

Australian National University

Monash University

AAO

The University of Western Australia

The University of Adelaide

The University of Melbourne

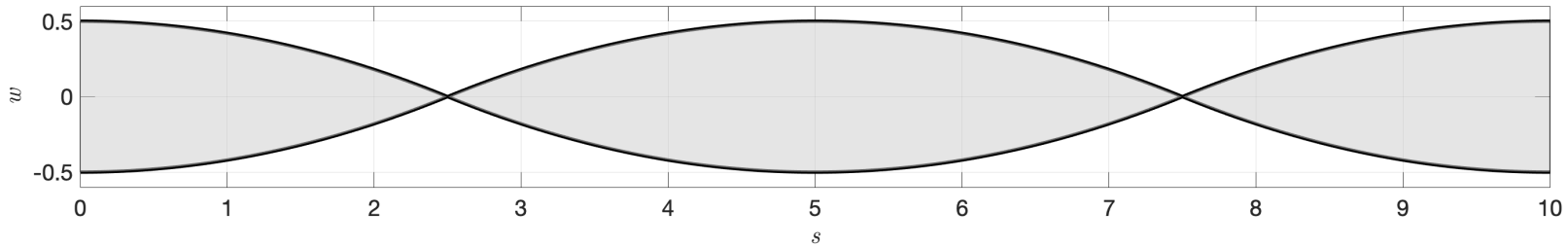
CSIRO

Australian Government

Australian Research Council

Optimised Euler Spring blade

$$w(s) = \frac{\pm w_0}{2 + 2\cos\left(\frac{\ell}{8\pi R}\right)}\left[\cos\left(\frac{s_{\mathrm{pw}}}{2\pi R}\right) - \cos\left(\frac{\ell}{8\pi R}\right)\right]$$
$$= \frac{\pm w_0}{4}\left[\cos\left(\frac{s_{\mathrm{pw}}}{2\pi R}\right) - \cos\left(\frac{\ell}{8\pi R}\right)\right]\csc^2\left(\frac{\ell}{16\pi R}\right)$$



$$F_{\mathrm{buck}} = \Bigg(- Yt^3 w_0 \csc^2\left[\frac{\arccos\left(\frac{\ell - x}{\ell}\right)}{4\pi}\right]\left[2\pi \arccos\left(1 - \frac{x}{\ell}\right)\left(1 + 2\cos\left[\frac{\arccos\left(1 - \frac{x}{\ell}\right)}{2\pi}\right]\right)\right]$$
$$+ \arccos^2\left(1 - \frac{x}{\ell}\right)\cot\left[\frac{\arccos\left(1 - \frac{x}{\ell}\right)}{4\pi}\right] + 4\pi^2 \sin\left[\frac{\arccos\left(1 - \frac{x}{\ell}\right)}{2\pi}\right]\Bigg)\left(6\ell^2\pi\sqrt{\frac{(2\ell - x)x}{\ell^2}}\right)^{-1}$$

$$1 + \frac{(3 + 28\pi^2)x}{84\pi^2} + \frac{(3 + 60\pi^2 + 448\pi^4)x^2}{3360\pi^4}.$$