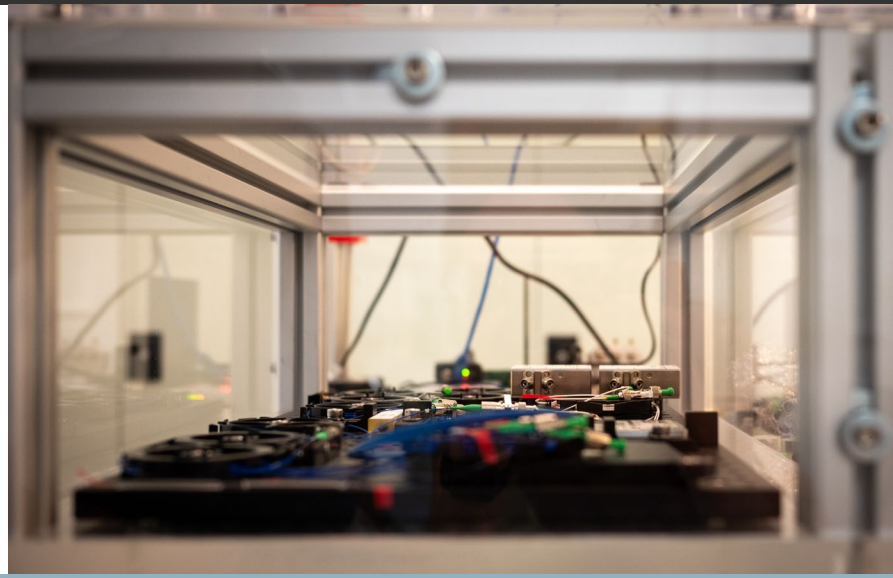
Australian National University

Sensing seismic platform relative motion using Digital Interferometry



ANU CENTRE FOR GRAVITATIONAL ASTROPHYSICS

OzGrav

Sheon Chua, Ya Zhang, Bram Slagmolen

Centre for Gravitational Astrophysics (CGA), Research School of Physics, ANU
OzGrav-ANU, Centre for Gravitational Astrophysics, Research School of Physics

LIGO's Seismic Struggle

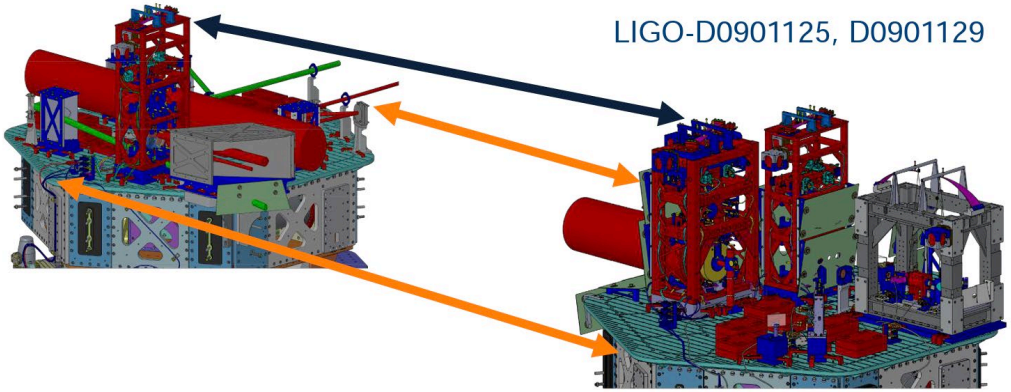
Concerned with seismic motion in the context of GW detection

LIGO has 11 seismic isolation platforms (BSC & HAM)

Suspension platform interferometer (SPI) helps control differential motion < 1Hz

D. E. Clark, "Control of differential motion between adjacent advanced LIGO seismic isolation platforms", PhD thesis, 2013.

Suspension Platform Interferometer (SPI)



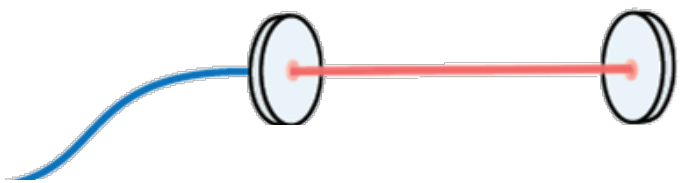
AKA suspension point interferometer

Optical interferometry ↔ optical sensitivity

Efforts at Stanford and AEI

Vacuum and convenience of operation call for optically simple setup

Suspension Platform Interferometer (SPI)



Michelson interferometer

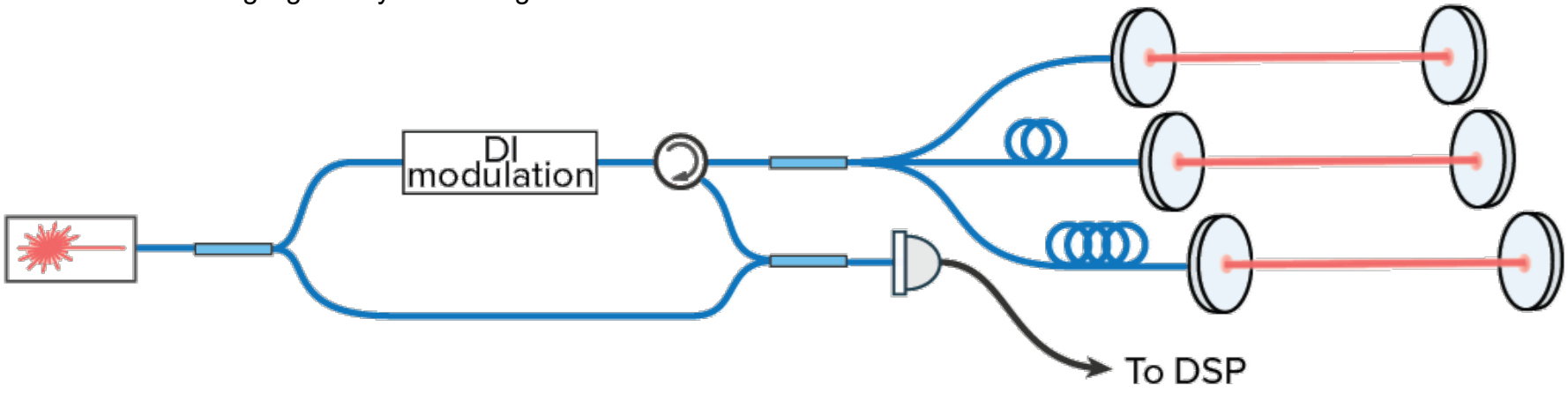
Multiplexing using digital interferometry (DI)

Suspension Platform Interferometer (SPI)

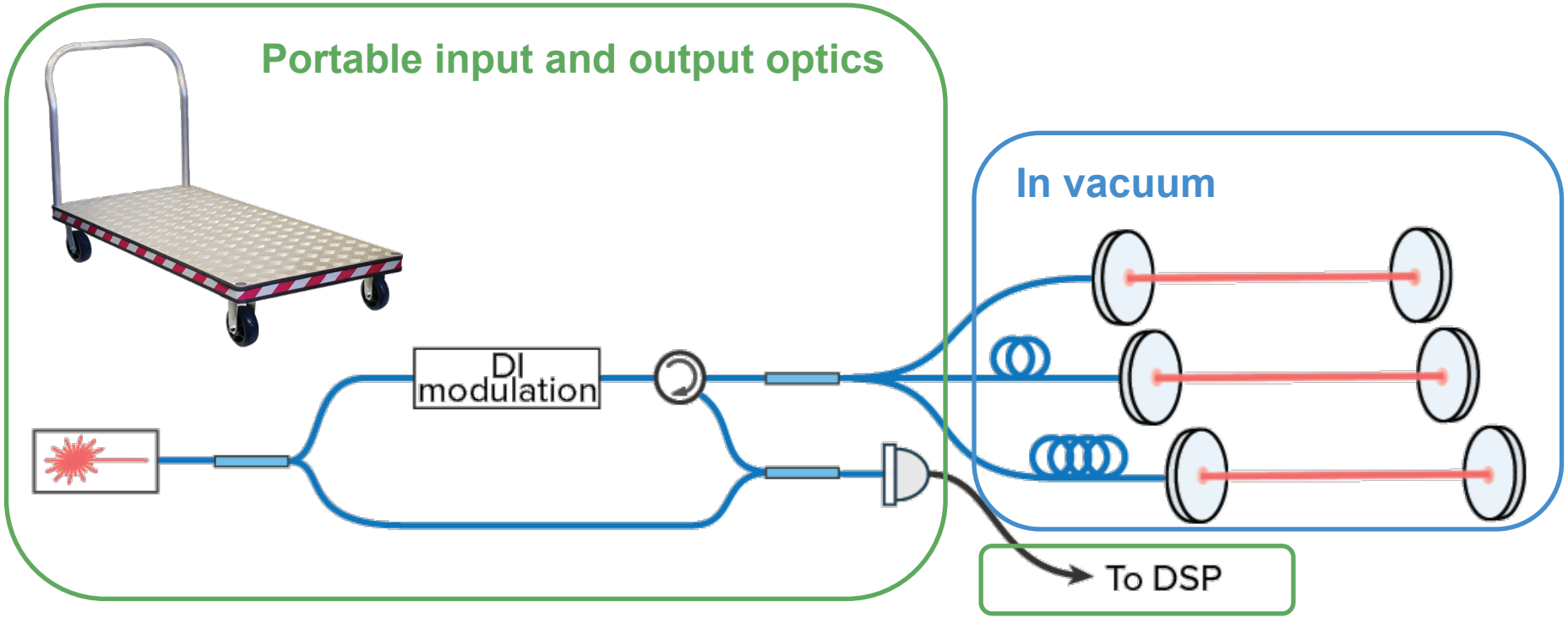
Michelson interferometer

Multiplexing using digital interferometry (DI)

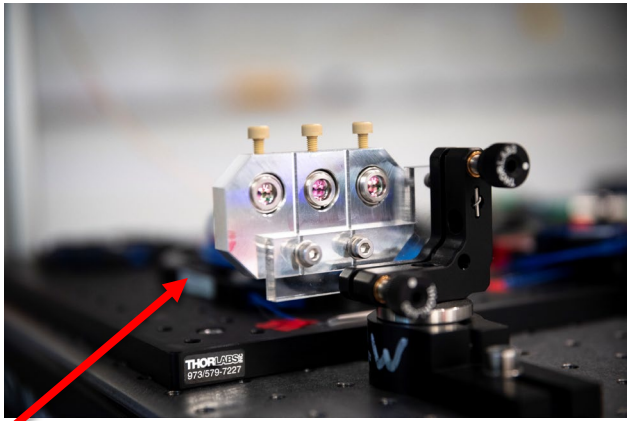
DI – differentiating signals by time-of-flight



Suspension Platform Interferometer (SPI)

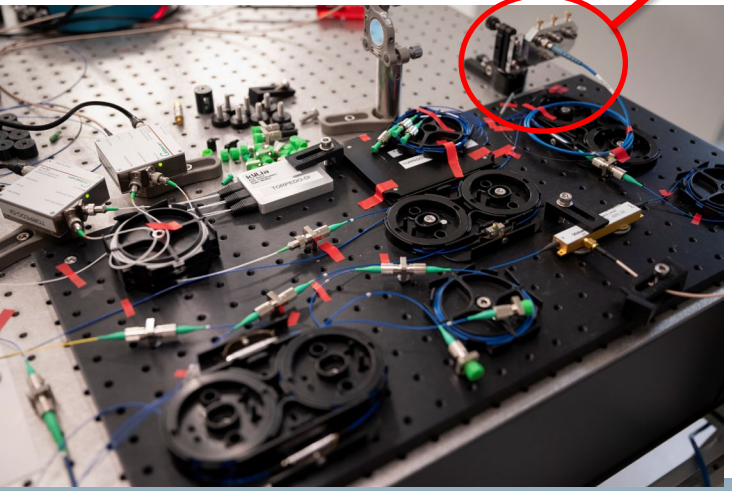


Taking it into the lab

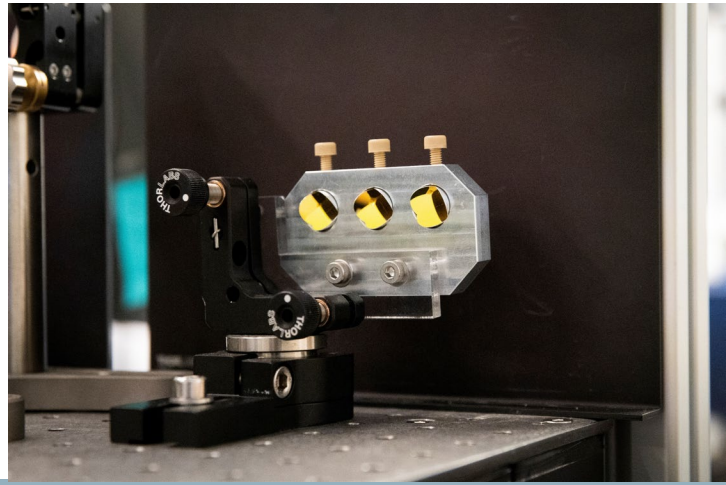


Fibre collimator/partial reflectors

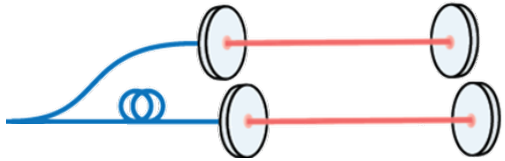
Input & output optics

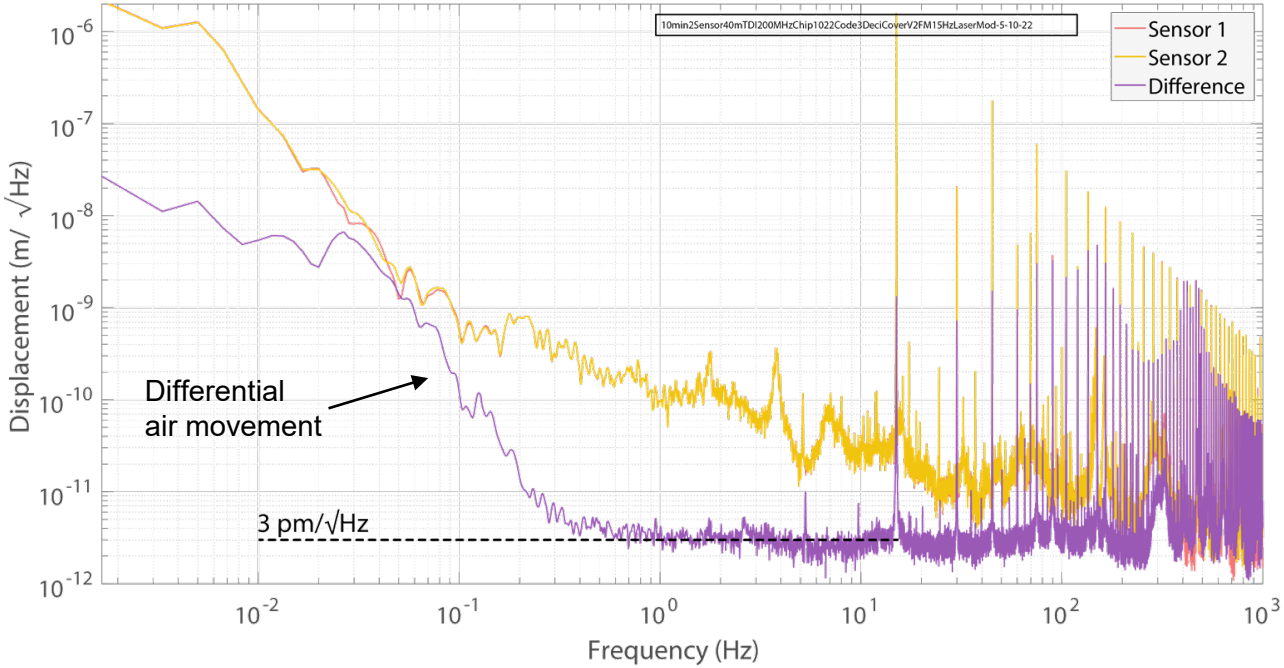


Final reflectors



Readout and Sensitivity





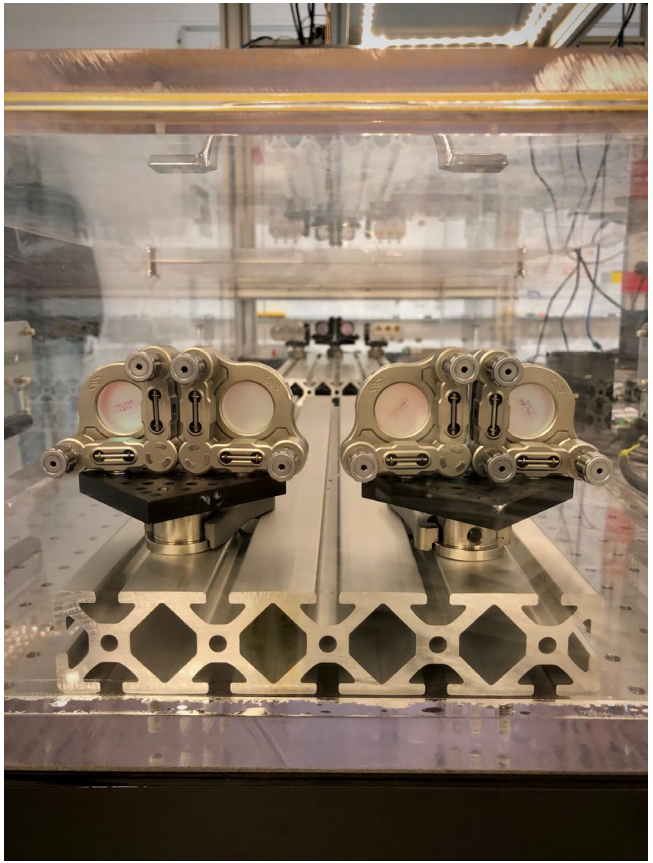
2 sensors to test the noise floor

3 pm/√Hz down to 0.4 Hz

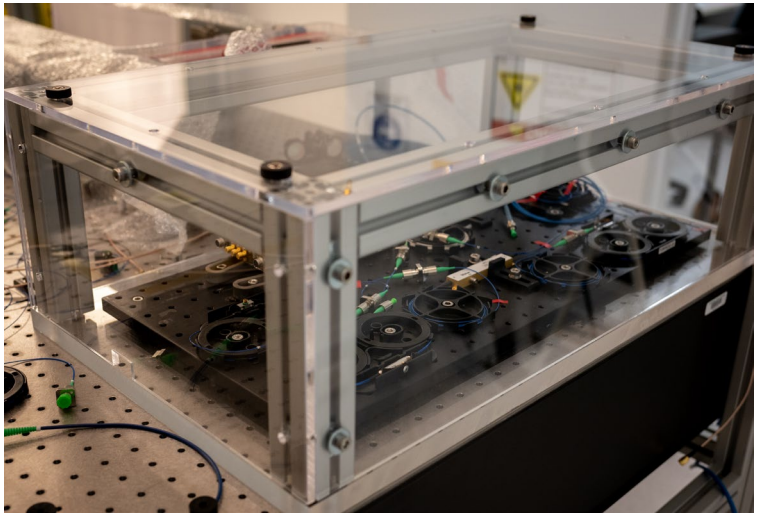
Limited by differential air movement between the two sensors

Ongoing Work

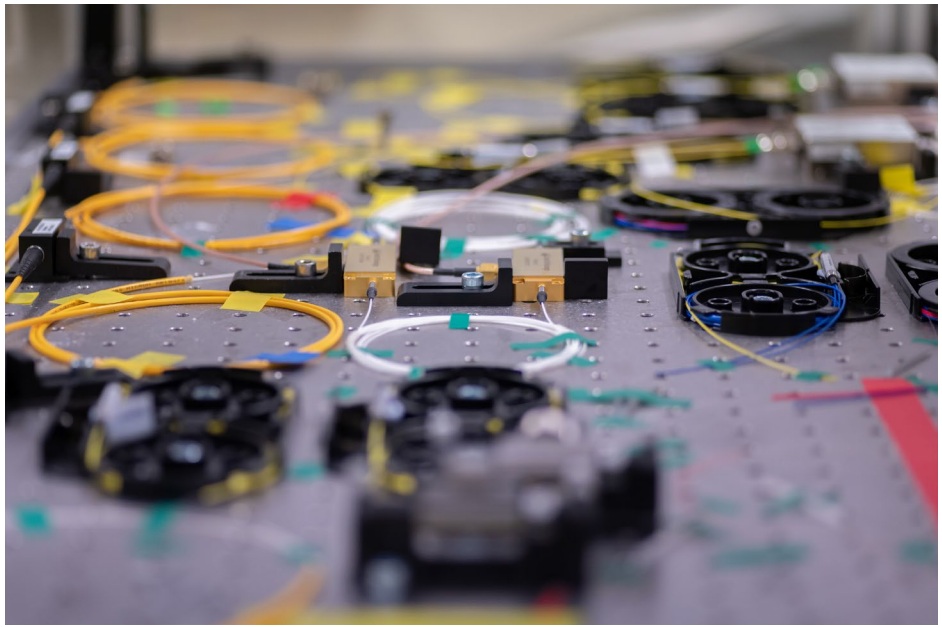
Sensing enclosure
To remove air current



Enclosure for input optics for portability



My Other Work – Fibre Frequency Reference



Dec 13th (Tue) 12pm
ANZCOP 7 - Fibre and Communtications, Rm E2

"An Ultra-Sensitive Fibre Frequency Reference for Short-term Laser Stabilisation", Ya Zhang, Chathura P. Bandutunga, Terry G. McRae, Malcolm B. Gray, Jong H. Chow

thanks