

University of Washington LIGO Group Overview

Michael Ross

GWANW

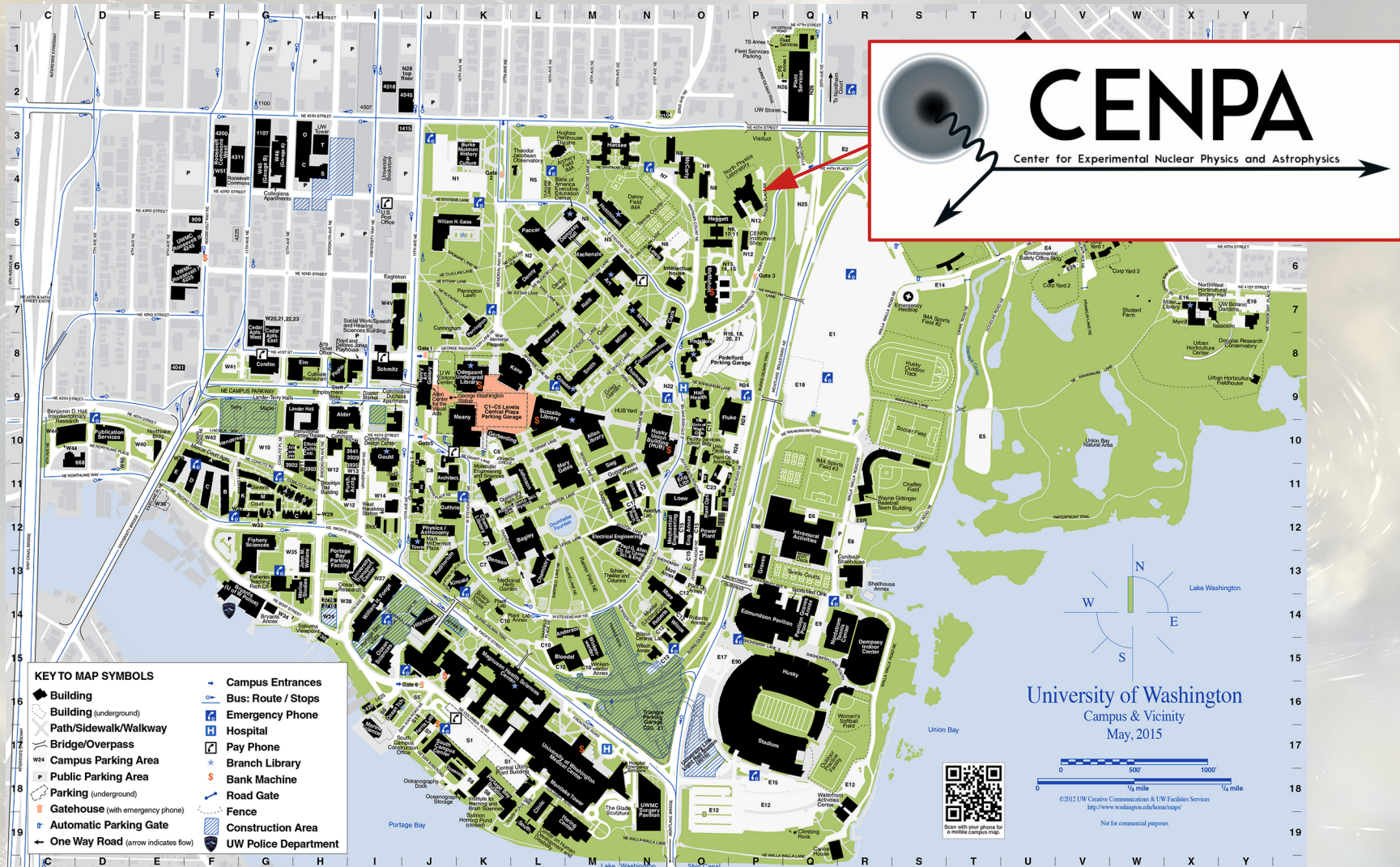
June 2020

LIGO

Center for Experimental Nuclear Physics and Astrophysics

W

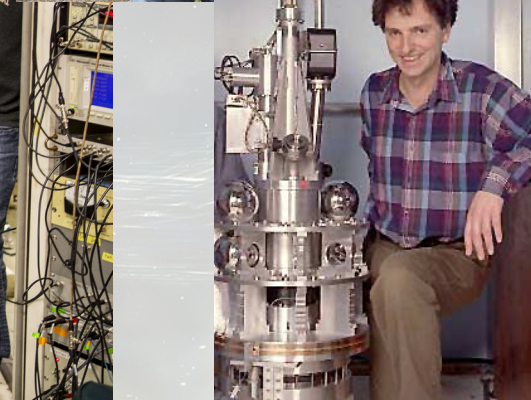
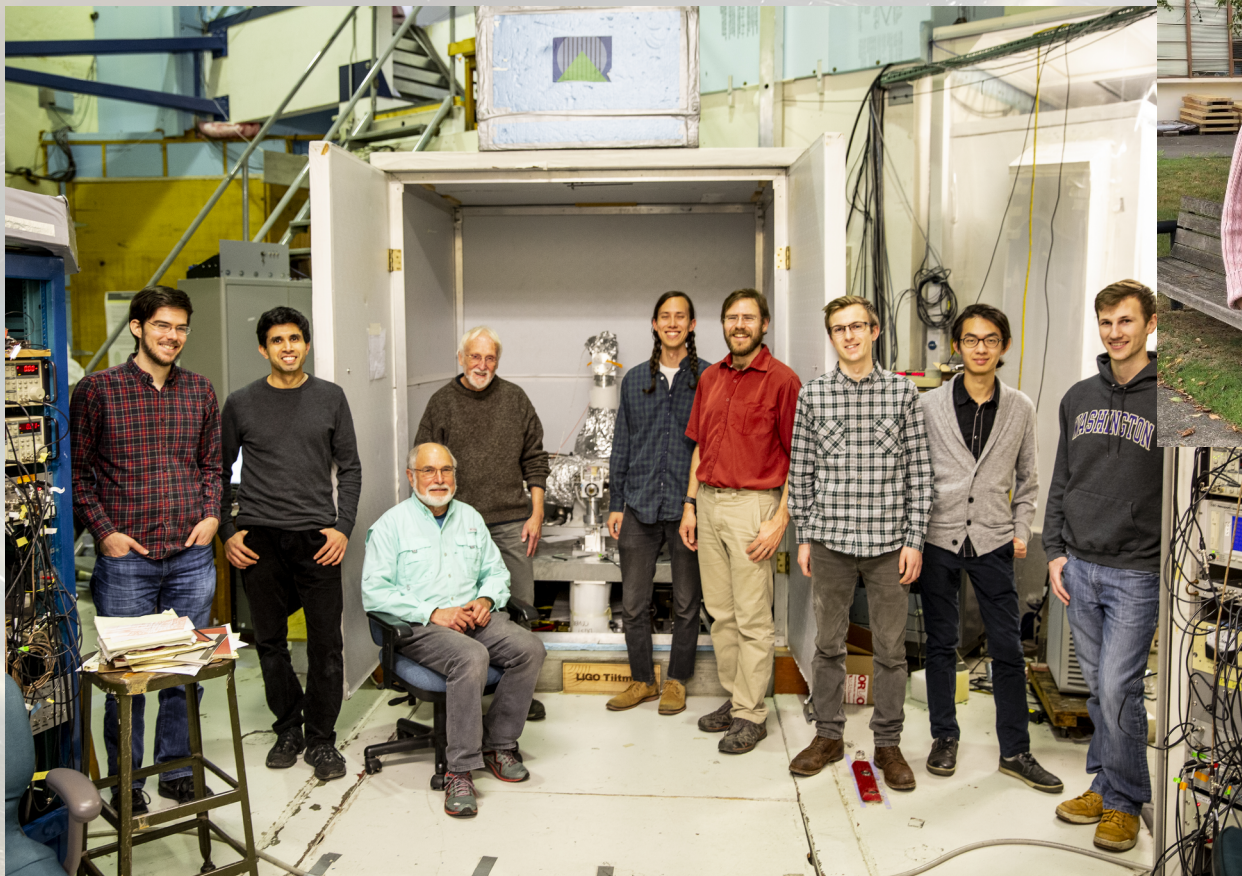
UNIVERSITY of WASHINGTON



LIGO

Eöt-Wash Group

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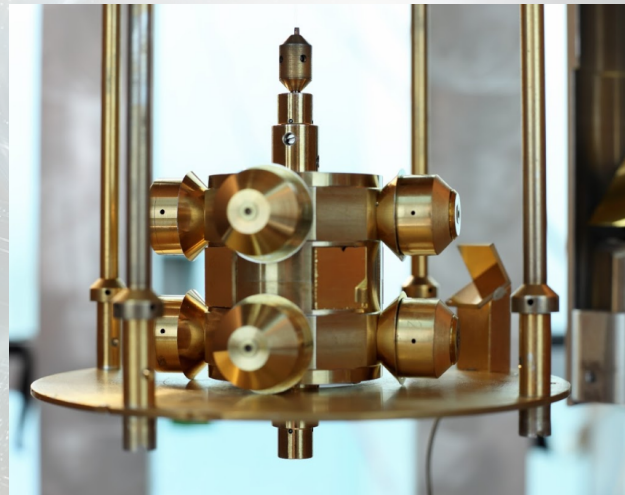


- Testing gravity since 1980s
- Using torsion balances
- Multiple Experiments:
 - Inverse Square Law
 - Weak Equivalence Principle
 - Big G
 - Ultra-light Dark Matter

Inverse Square Law

$$V(r) = -\frac{Gm_1m_2}{r} (1 + \alpha e^{-r/\lambda})$$

<https://arxiv.org/abs/2002.11761>



Equivalence Principle

$$\eta = 2 \frac{a_1 - a_2}{a_1 + a_2}$$

<https://arxiv.org/abs/1207.2442>



Alexandra Lockwood
Post-graduate RA



Colin Weller
Undergraduate RA



Michael Ross
Postdoc

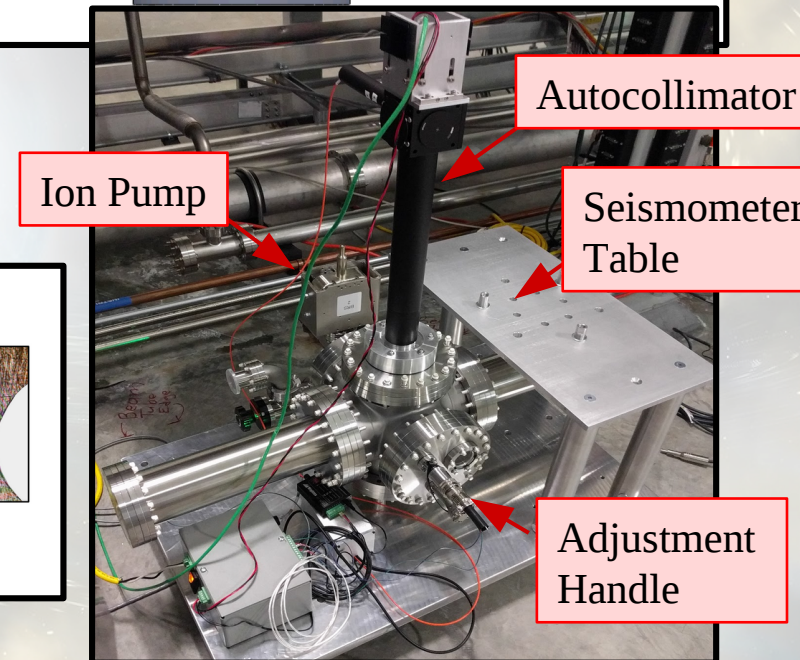
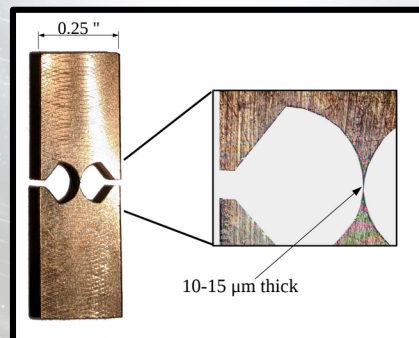
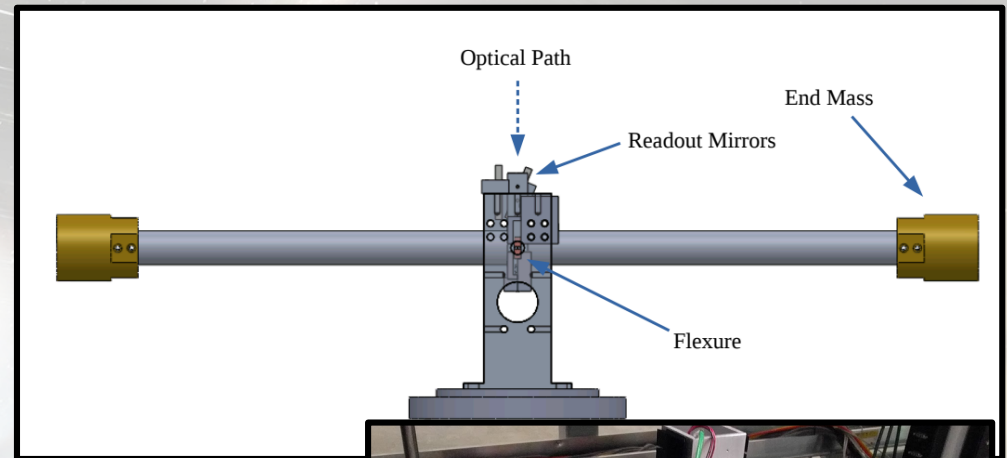


Jens Gundlach
Professor

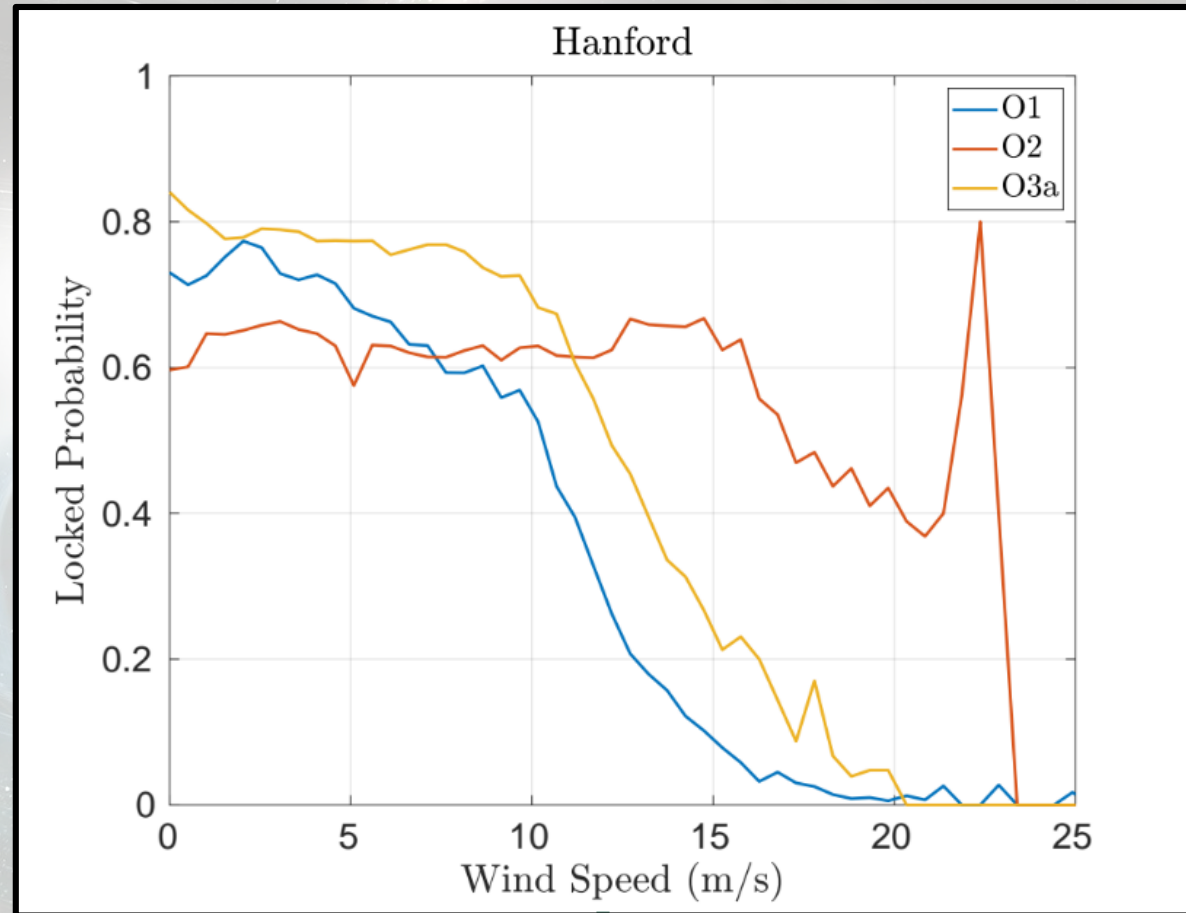


Krishna Venkateswara
Now at Paroscientific Inc.

- 1-m long beam hung from 10-15 μm -thick flexures with 3-8 mHz resonance
- Beam stays inertial while ground rotates around it
- Angle between beam and ground measured with autocollimator ~ 0.3 nrad/ $\sqrt{\text{Hz}}$ sensitivity at 0.1 Hz

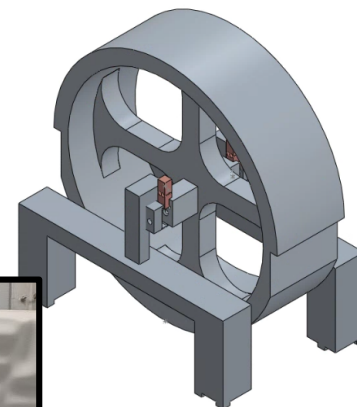


- Deployed at both Hanford and Livingston
- Makes observatory more robust against wind
- Between O1 and O2: +13.1 observing days per year for LHO



- Developing small rotation sensors
- Same concept at BRSs
- Vacuum-compatible On-platform version
- Small high-frequency sensor for Newtonian noise

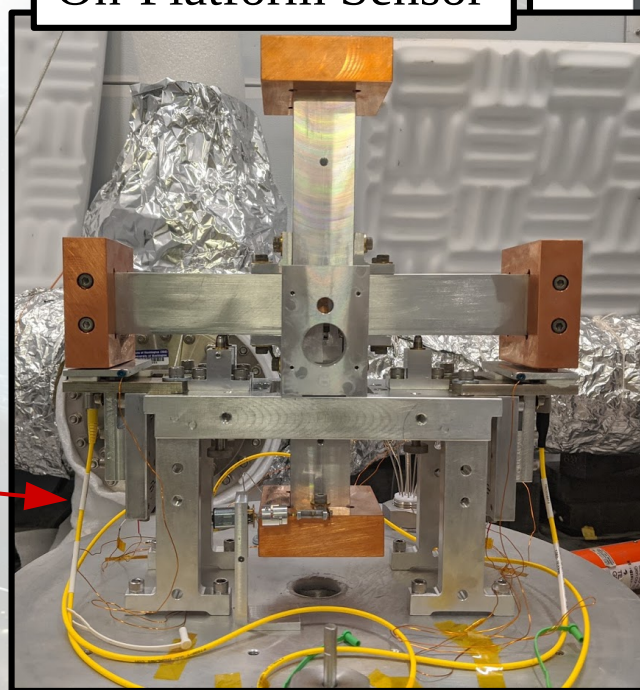
Newtonian Noise Sensor



Designed by Colin W.

<https://arxiv.org/abs/1807.07427>

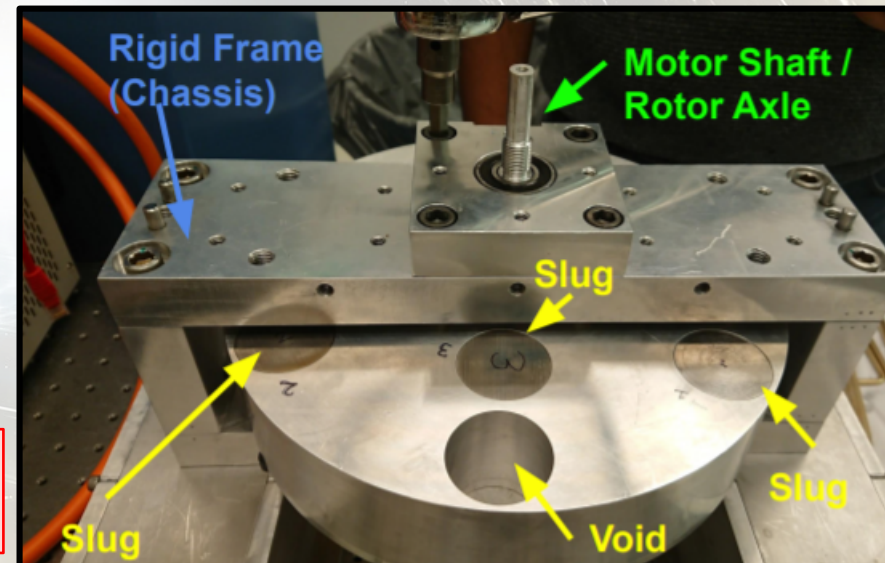
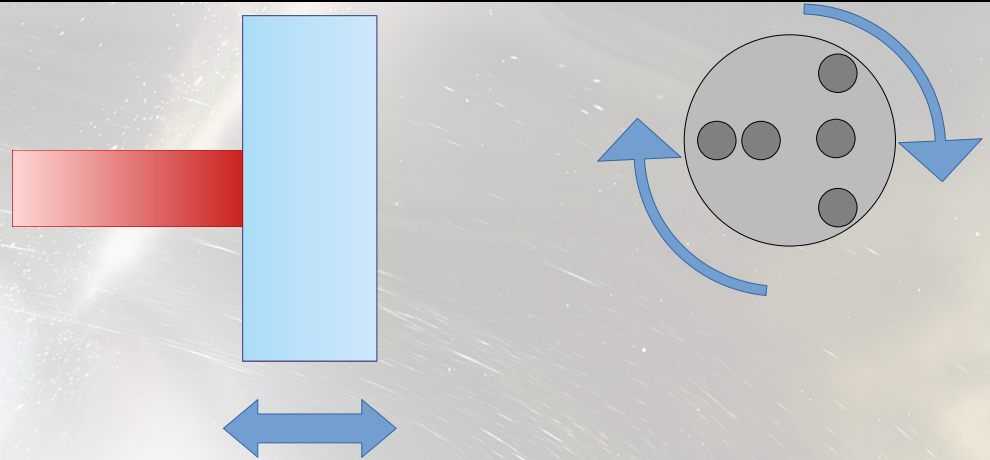
On-Platform Sensor



Alexandra L.
Developed In-Vacuum Fibers

<https://dcc.ligo.org/G2000802-v1>

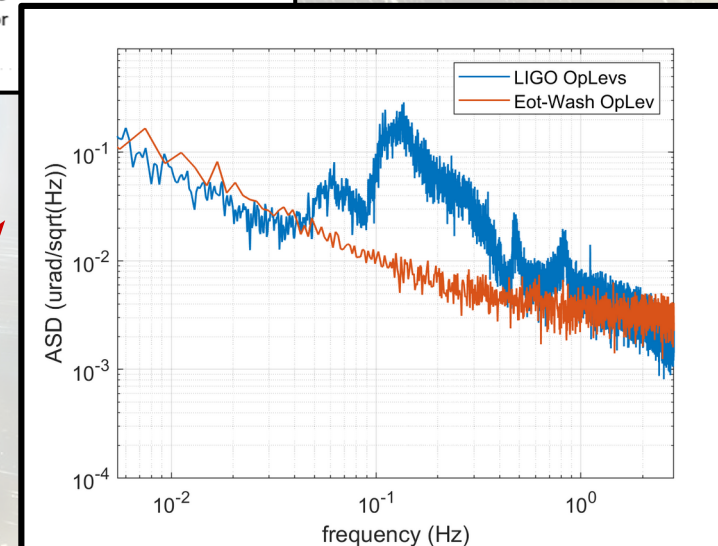
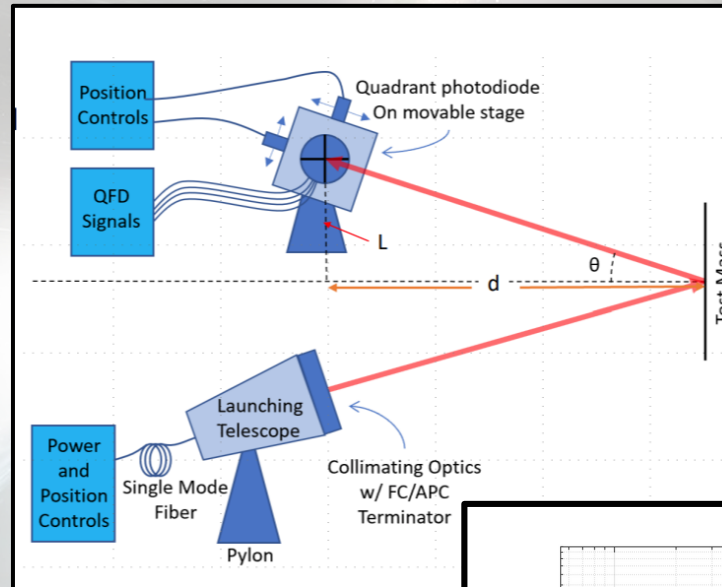
- Rotating mass distribution applies a force on the test mass
- Allows for independent absolute calibration
- Design and built at UW
- Installed at LHO by Timesh Mistry, Jeff Kissel, et. al.
- Gravitational force simulated with FEA and Multipoles
- Results coming soon



Gravitational force simulation
by Colin W.

Optical Levers

- OpLevs used to orient Test Masses
- Exhibit low frequency noise
- Hunting for the noise sources in optics
- Building system from the ground up to study each component



Alexandra L.
Led this entire project

The LIGO logo consists of several concentric, slightly irregular circles in the top-left corner, resembling ripples or gravitational waves. The word "LIGO" is written in a bold, black, sans-serif font to the right of these circles.

LIGO

The University of Washington logo features a large, stylized purple letter "W" at the top. Below it, the words "UNIVERSITY of" and "WASHINGTON" are stacked in a purple, serif font, with "of" in a smaller, italicized font.

W
UNIVERSITY *of*
WASHINGTON

The background of the slide is a visualization of a gravitational well, showing two bright, glowing spheres in the process of merging. The space around them is distorted, with light rays bending and creating a complex, swirling pattern of light and dark regions. The overall color palette is a mix of bright white and yellow at the centers, transitioning to blue and purple in the surrounding space, with a dark background speckled with distant stars.

Thanks!