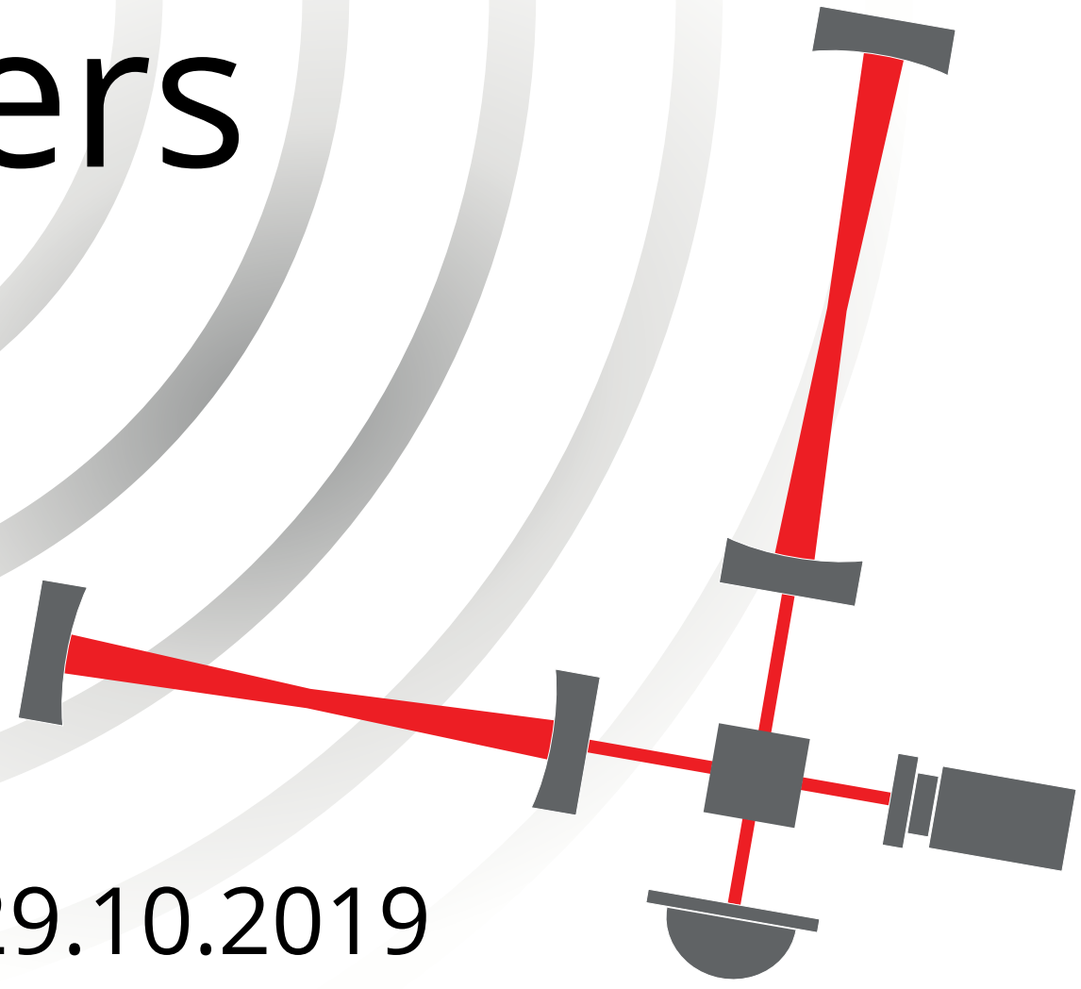
Simulating Interferometers



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GrEAT School, Birmingham, 29.10.2019

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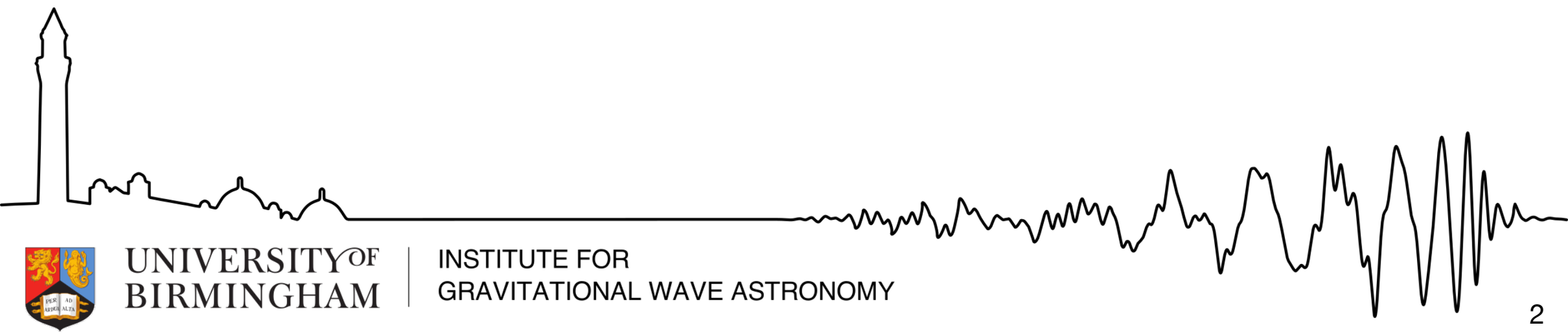
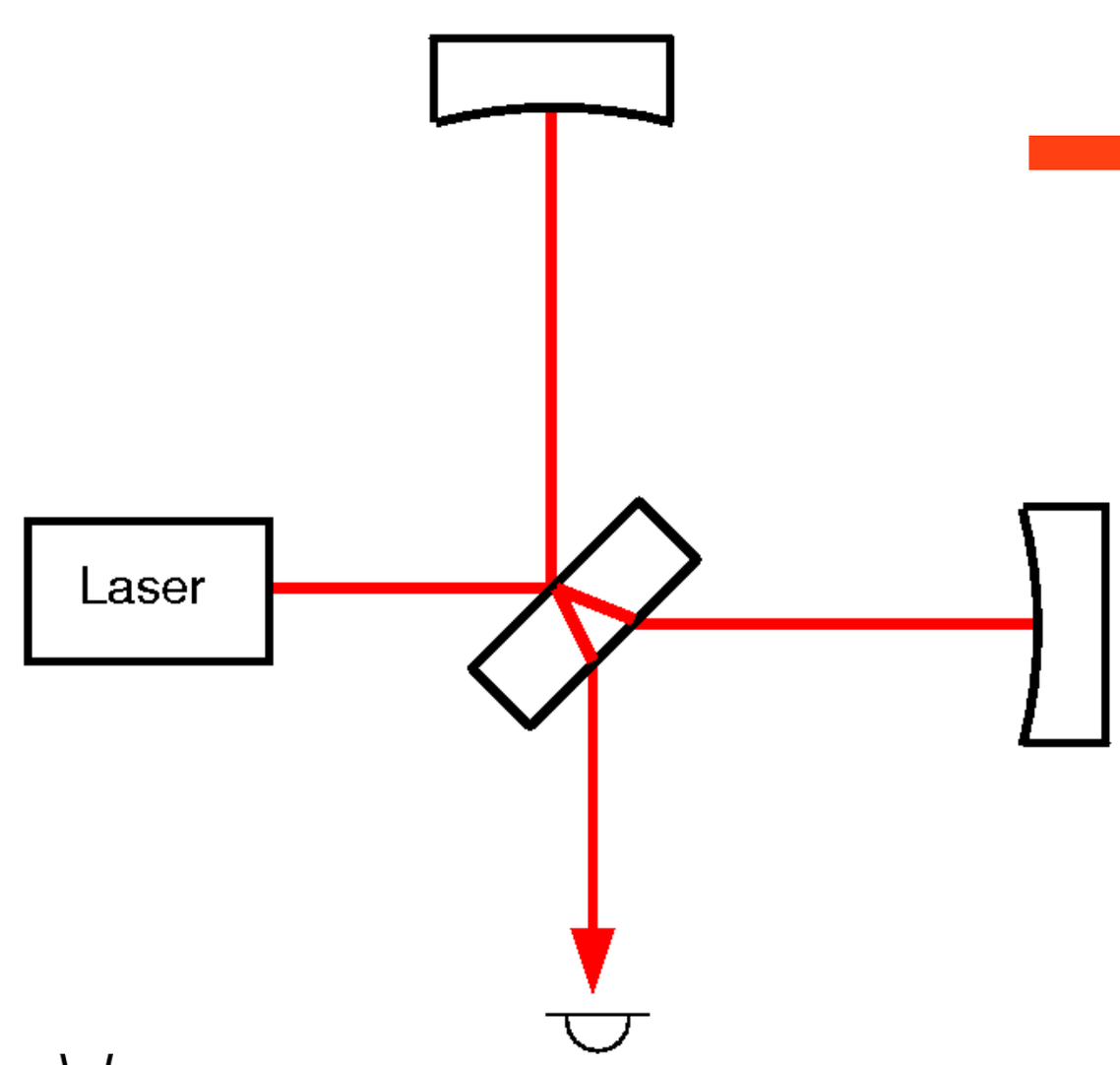
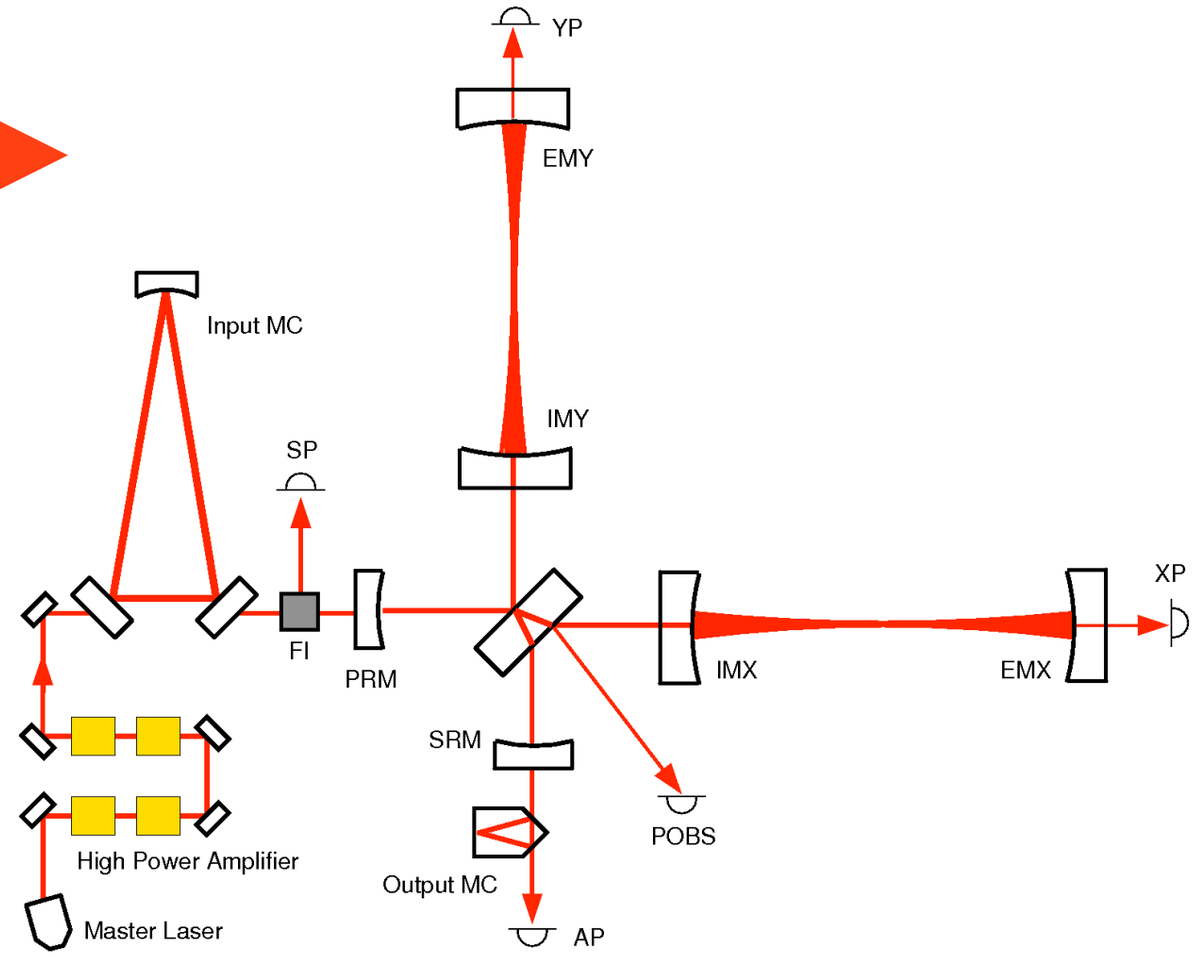
Overview

- Why do we need interferometer simultions
- Overview of typical simulation methods
- Hands-on demonstration of Finesse



Advanced Interferometry





Advanced Detector (exemplary design)

Power Recycling cavity to increase light power in interferometer

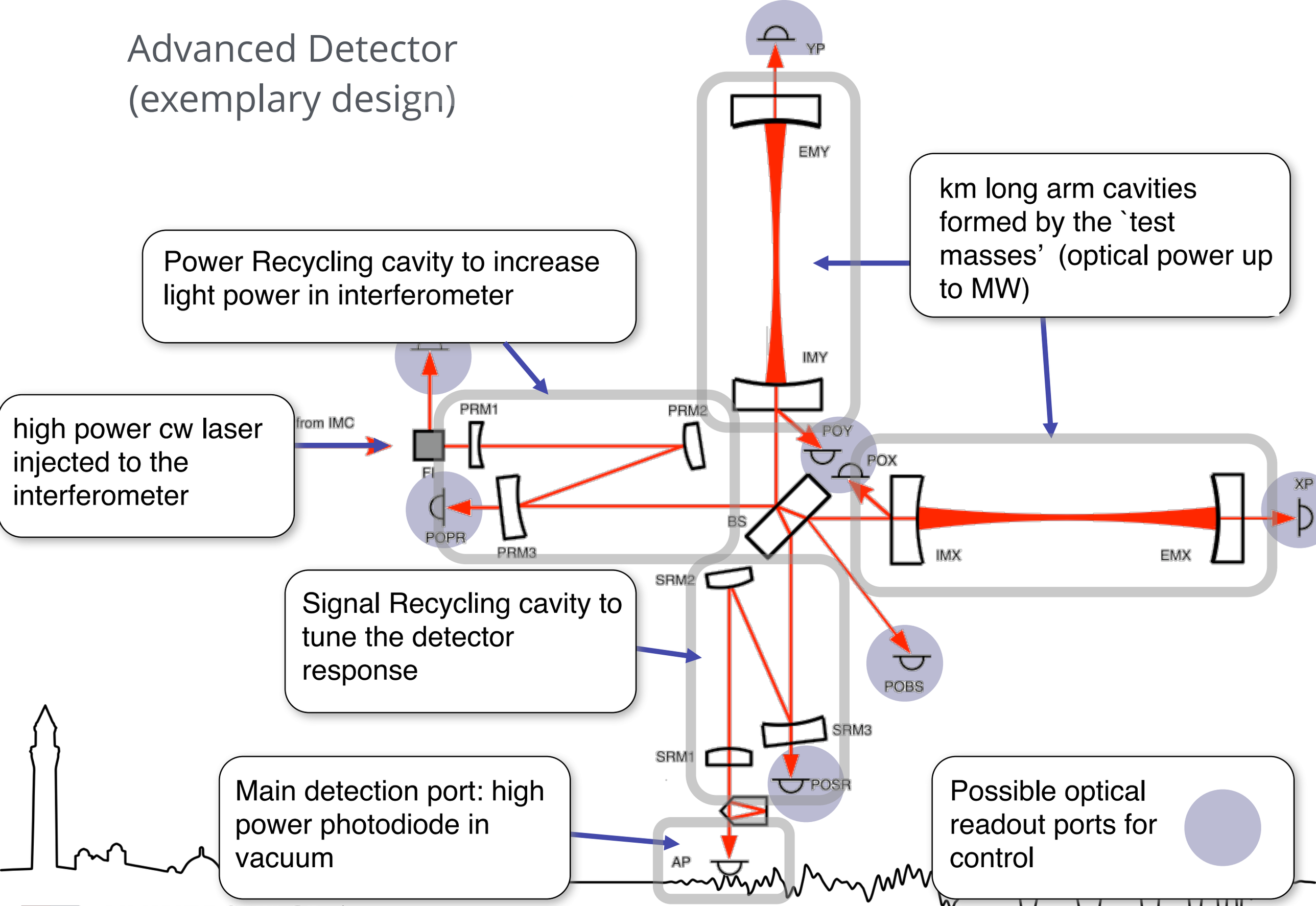
km long arm cavities formed by the `test masses' (optical power up to MW)

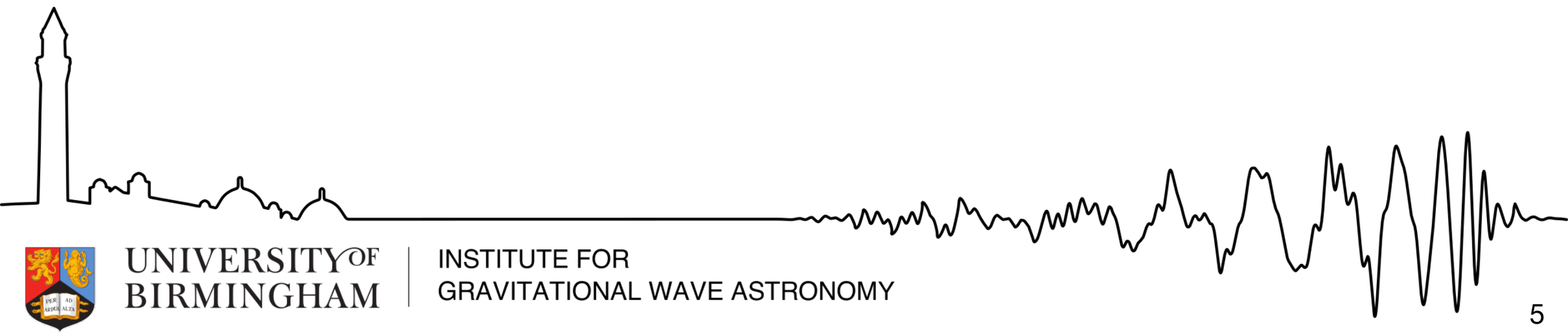
high power cw laser injected to the interferometer

Signal Recycling cavity to tune the detector response

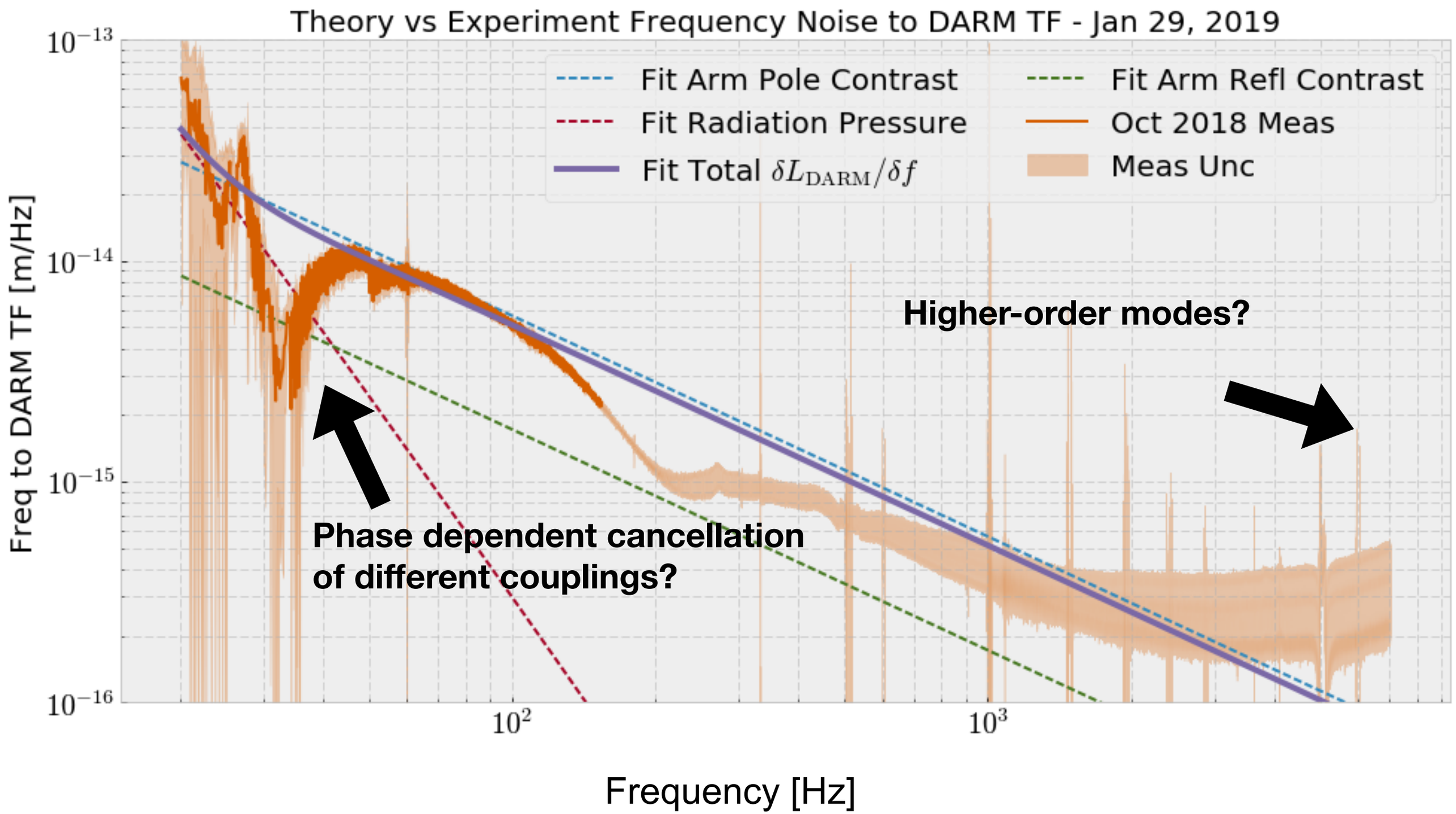
Main detection port: high power photodiode in vacuum

Possible optical readout ports for control



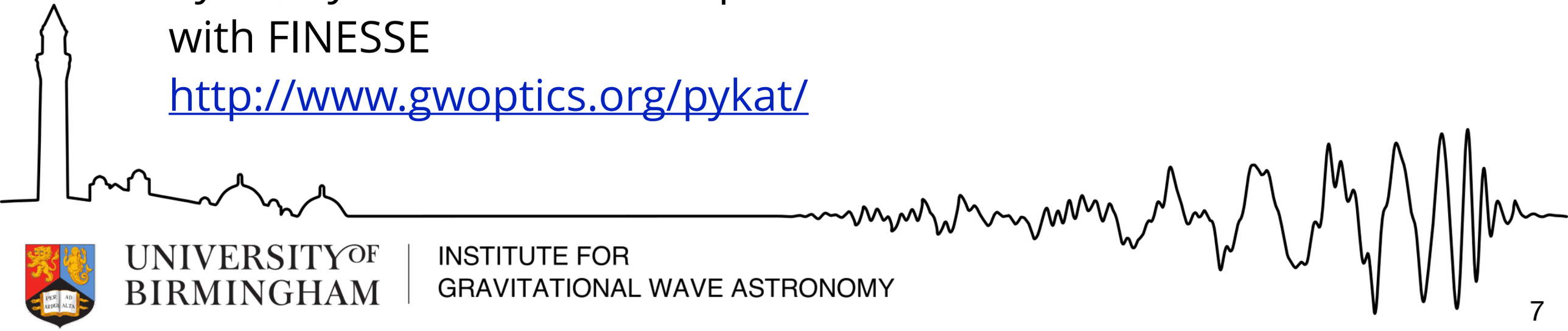


Example task: M4

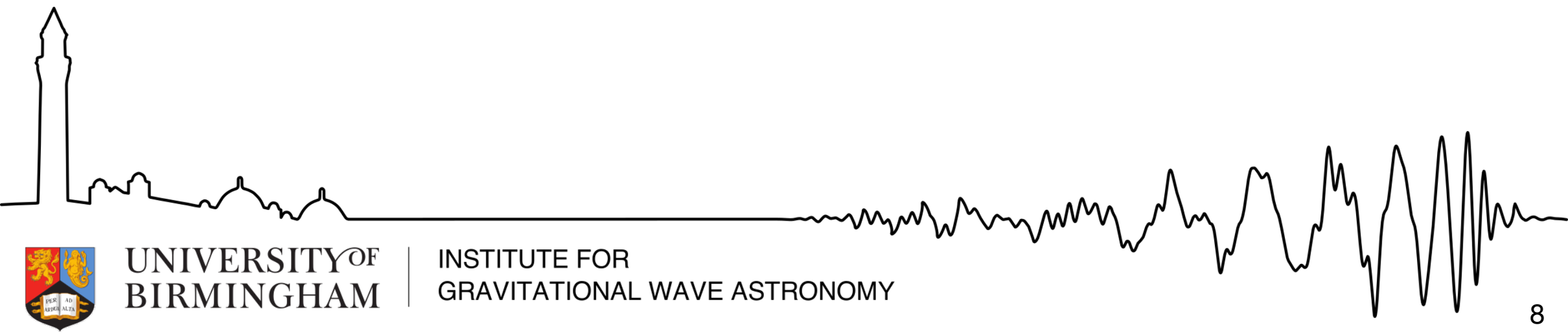


Learning Resources

- Interferometer techniques for gravitational wave detection, Living Rev. Relativity (2017): https://link.springer.com/article/10.1007/s41114-016-0002-8
- Learn Laser Interferometry, a self-study course on interferometry using Finesse and Pykat: http://www.gwoptics.org/learn/
- FINESSE, numerical modelling software for interferometers: http://www.gwoptics.org/finesse/
- Pykat, Python toolbox for optical simulations and to interface with FINESSE http://www.gwoptics.org/pykat/



Extra Slides



Interferometer simulation: FINESSE

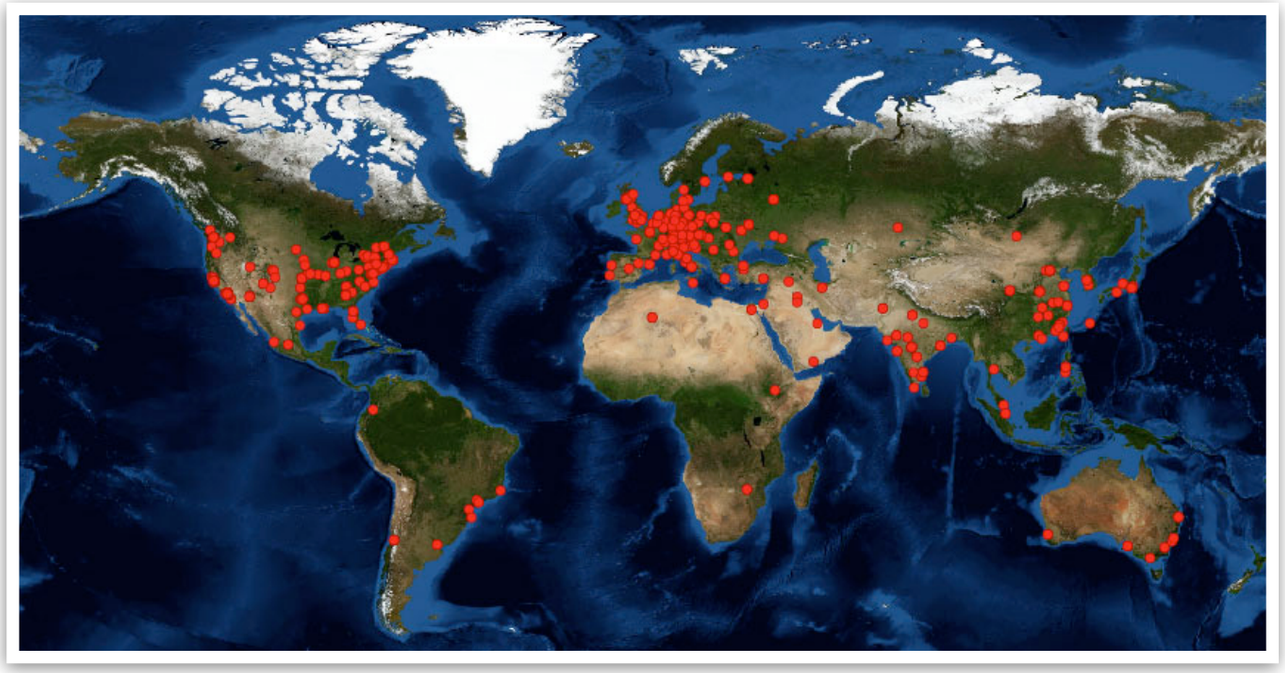
- Powerful and easy to use interferometer simulation software
- Used and developed, since 20 year, open source
- Complete LIGO, Virgo, KAGRA

  input files are available
- Used extensively worldwide,

  for commissioning support,

  detectors design, and

  table-top experiments



Get involved: IFOsim

- Wiki, subtopic of AIC Wiki: https://wiki.ligo.org/AIC/IFOsim
- Mailing list: https://grouper.ligo.org/mailinglists/ifosim
- Group on Caltech gitlab server: https://git.ligo.org/IFOsim
- Chat channels, such as Finesse, Optickle at https://chat.ligo.org/ligo/