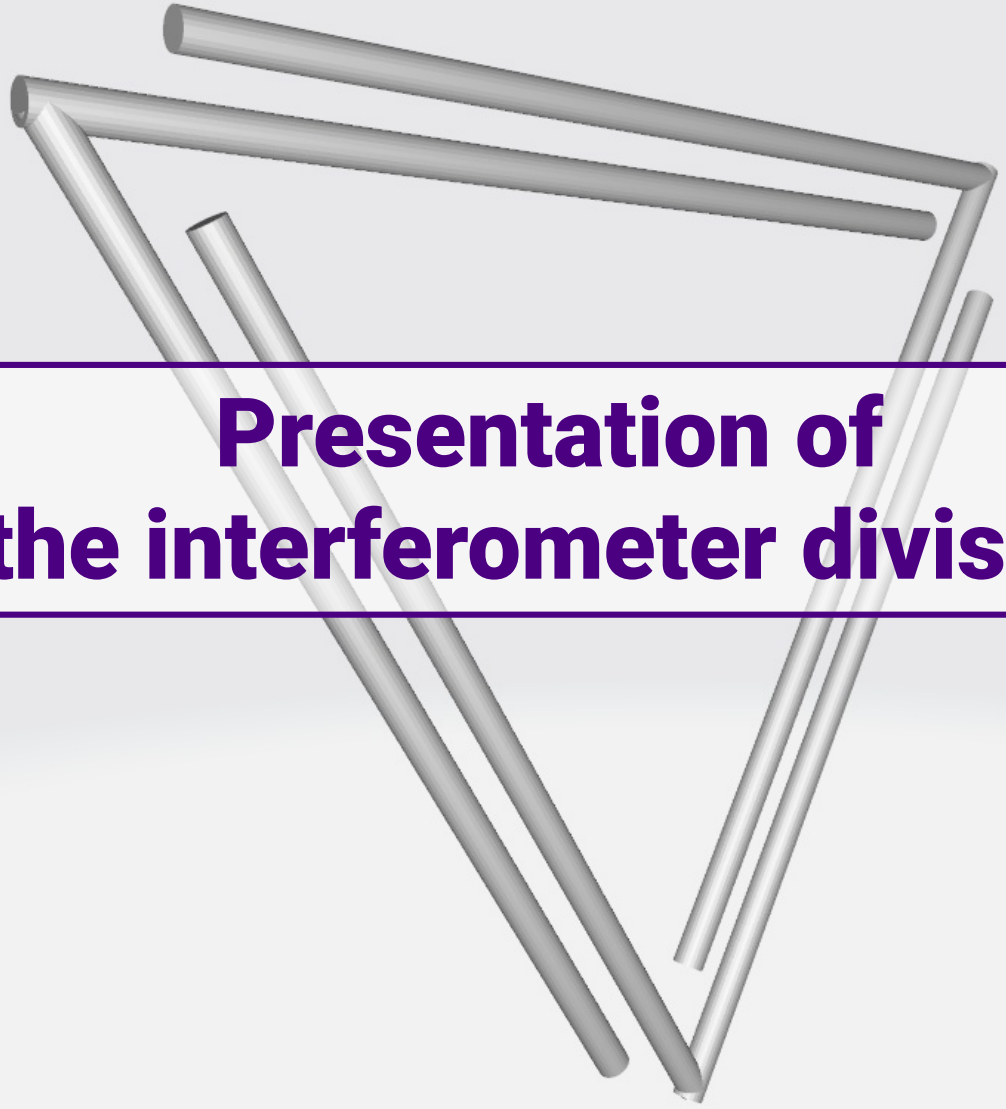


Presentation of the interferometer division

J. Degallaix and S. Hild

ET-0080A-20

11th ET symposium – December 2020

who/what is in this division ?

- 2 co-chairs : J. Degallaix and S. Hild
- 6 work packages :
  - Observatory design and noise budget
  - Optical layout, sensing and control scheme LF
  - Optical layout, sensing and control scheme HF
  - Data acquisition and real time control
  - Noise characterisation
  - Calibration

For each WP, one chair and one deputy

(for the global context see A. Freise presentations ET-0073A-20 and ET-0075A-20)

Observatory design and noise budget

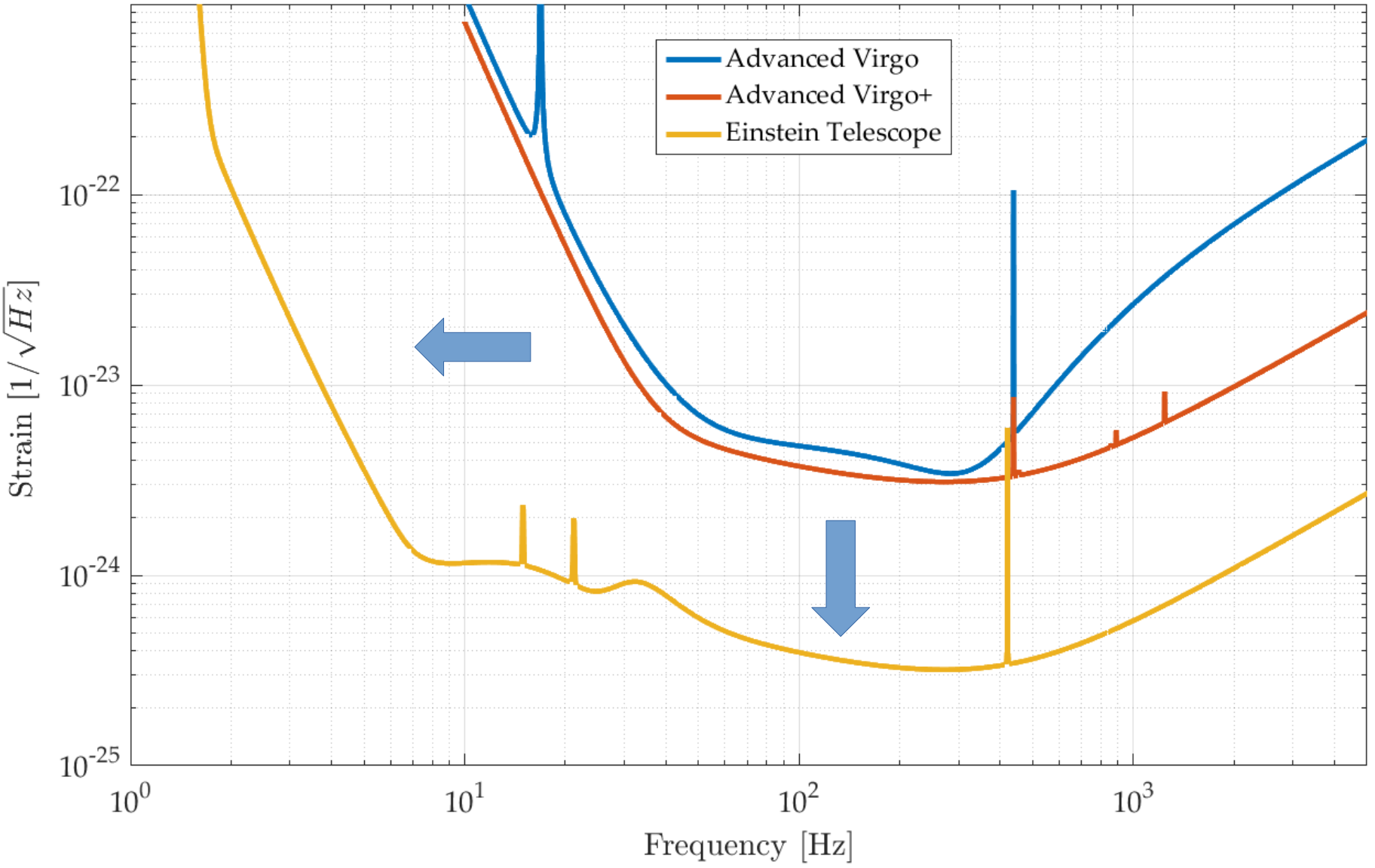
WP1

- Scope :
  - development and updating of theoretical noise budgets
  - acting as interface to the science case
  - optimisation (T, filtering cavities, frequency cross over)
  - prepare scenarii for trade-off

Work already started with a development of a new version of PyGwinc (ET-0067B-20).

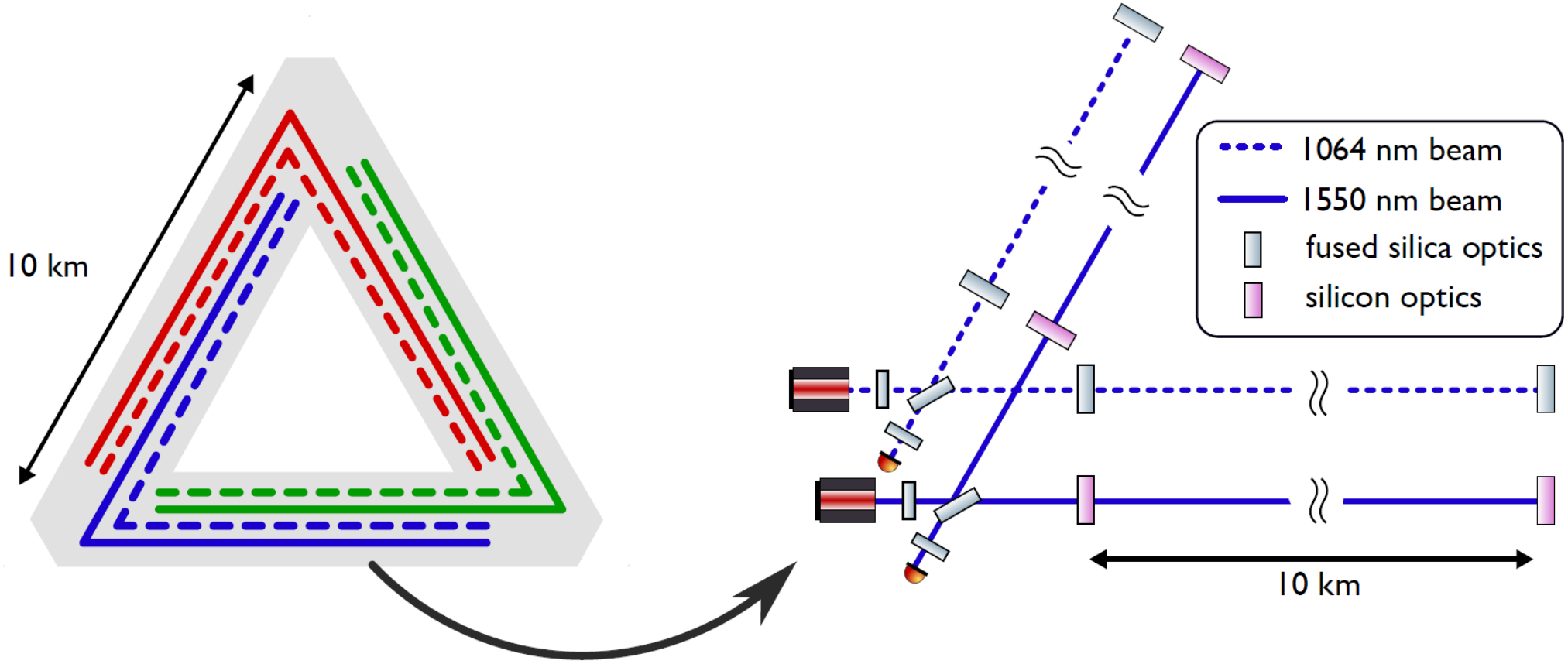
Reminder of the sensitivity goal

Comparison with 2G detectors



The geometry of the detectors

- 3 detectors arranged in triangle.
- each detector is 2 interferometers

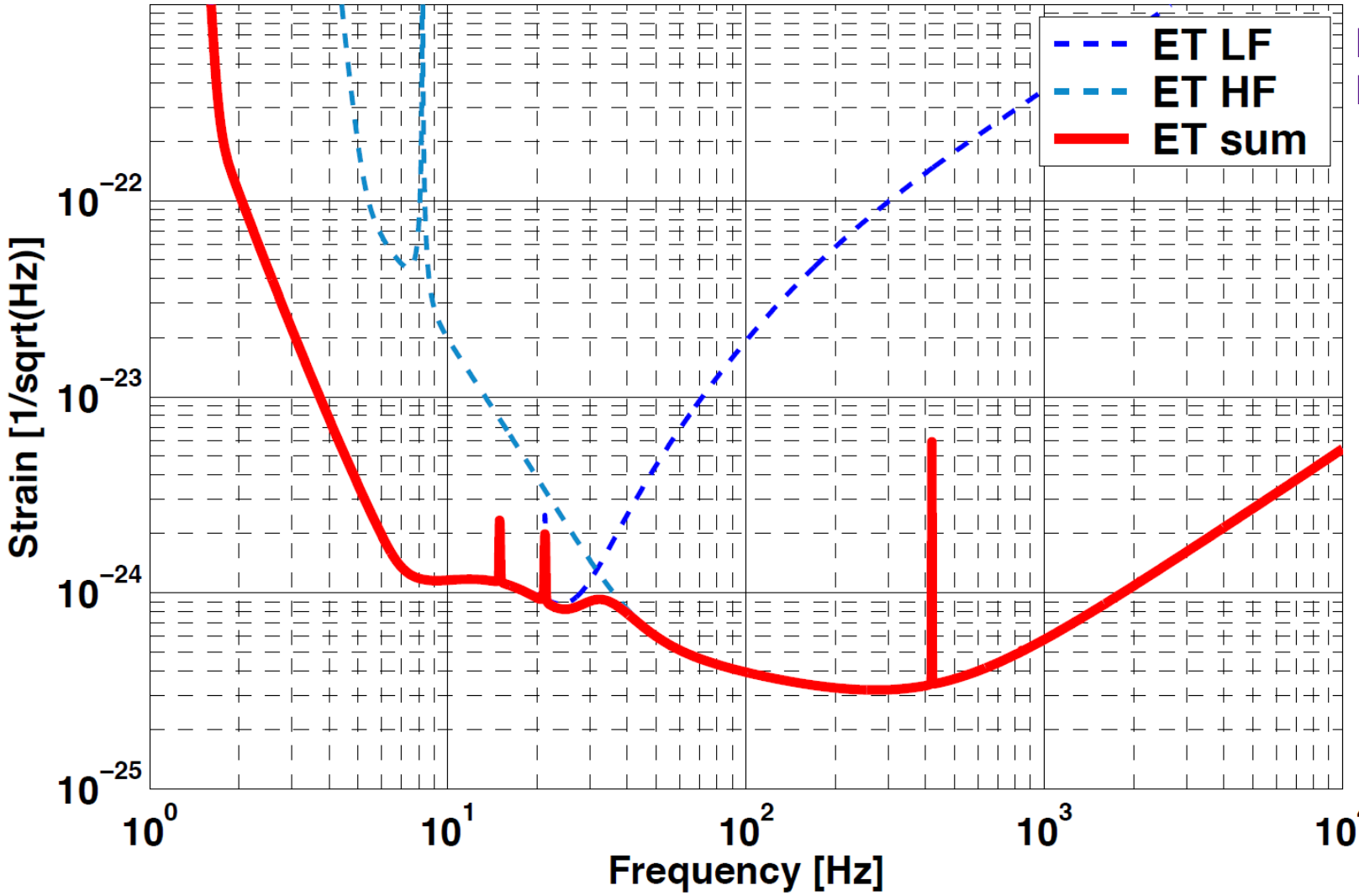


from: ET-0073A-20

Observatory design and noise budget

WP1

The combined sensitivity curves:



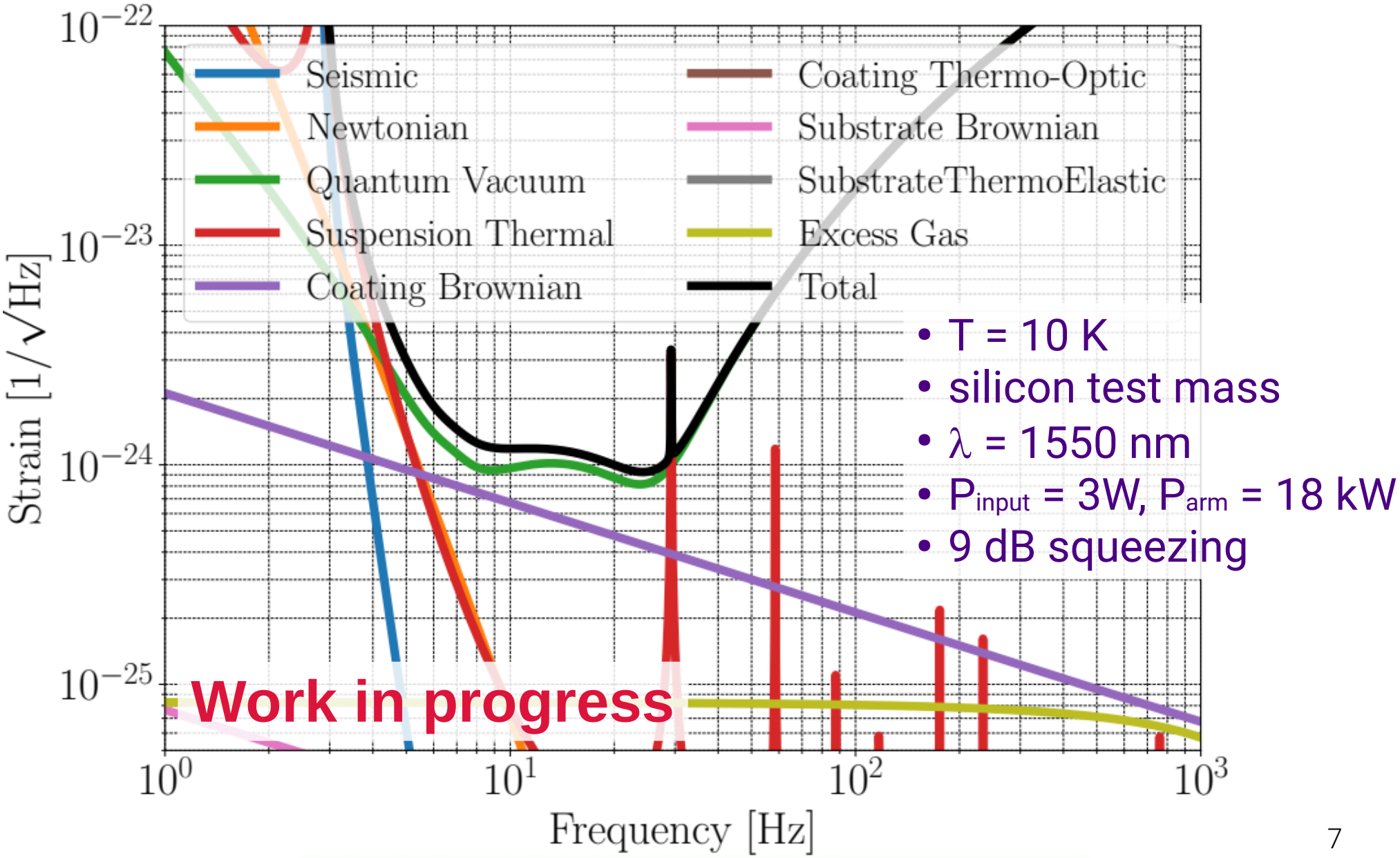
Low Frequency
High Frequency

DOI

Curves reproduced with PyGwinc

Noise budget low frequency

WP1

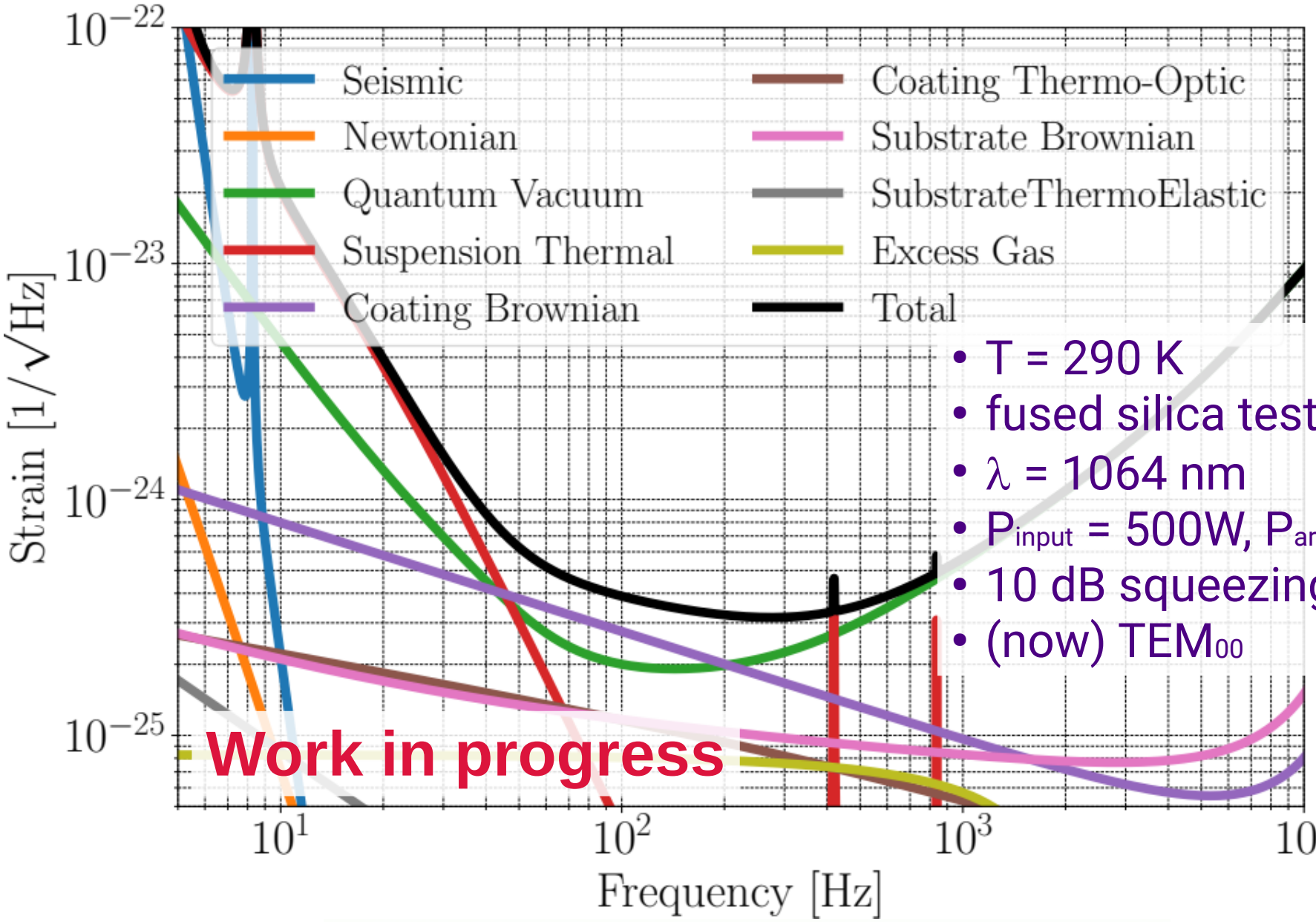


- T = 10 K
- silicon test mass
- λ = 1550 nm
- P_{input} = 3W, P_{arm} = 18 kW
- 9 dB squeezing

Work in progress

Noise budget high frequency

WP1



- T = 290 K
- fused silica test mass
- λ = 1064 nm
- P_{input} = 500W, P_{arm} = 3 MW
- 10 dB squeezing
- (now) TEM_{00}

Work in progress

Optical layout, sensing and control scheme LF/HF

WP2&3

- Scope :
  - development of optical layout of core interferometers
  - main large optics specifications
  - define locking scheme
  - define LSC[1] and ASC[2] strategies

Similar works for the 2 WPs with a lot of common tools/procedures.
However important differences also exists:

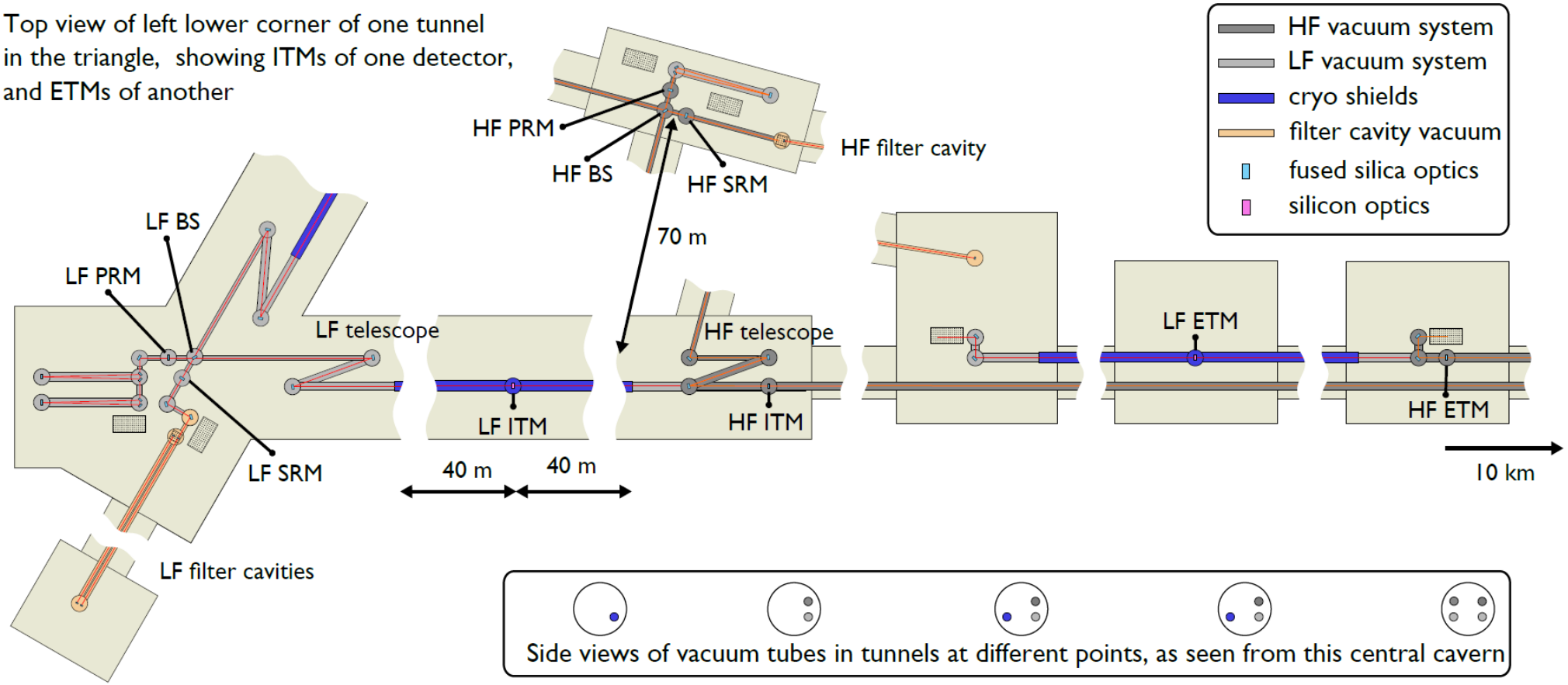
- LF: emphasis on low frequency
- HF: taking care of the very high power

[1] Length Sensing Control [2] Alignment Sensing Control

Optical layout, sensing and control scheme LF/HF

WP2&3

Recent progress about the recycling cavities design:

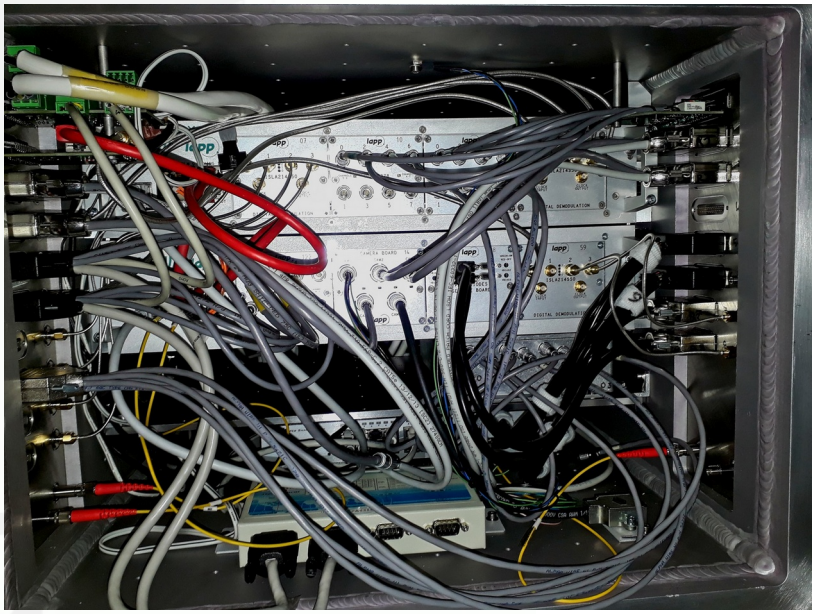


More tomorrow afternoon and on arXiv

Data acquisition and real time control

WP4

- Scope :
  - requirements for the control and data acquisition systems
  - choice of the timing distribution network
  - preliminary budget for the hardware cost



Close interaction with the ET pathfinder (and Virgo upgrade ?)

Data acquisition and real time control

WP4

- More specific questions to be answered:
  - hardware architecture choice (Virgo vs LIGO vs commercial)
  - estimation of data flux for DAQs, real time control
  - DAQs software management / data access
  - investigation digital vs analog demodulation
  - specifications for online software, automation, latency

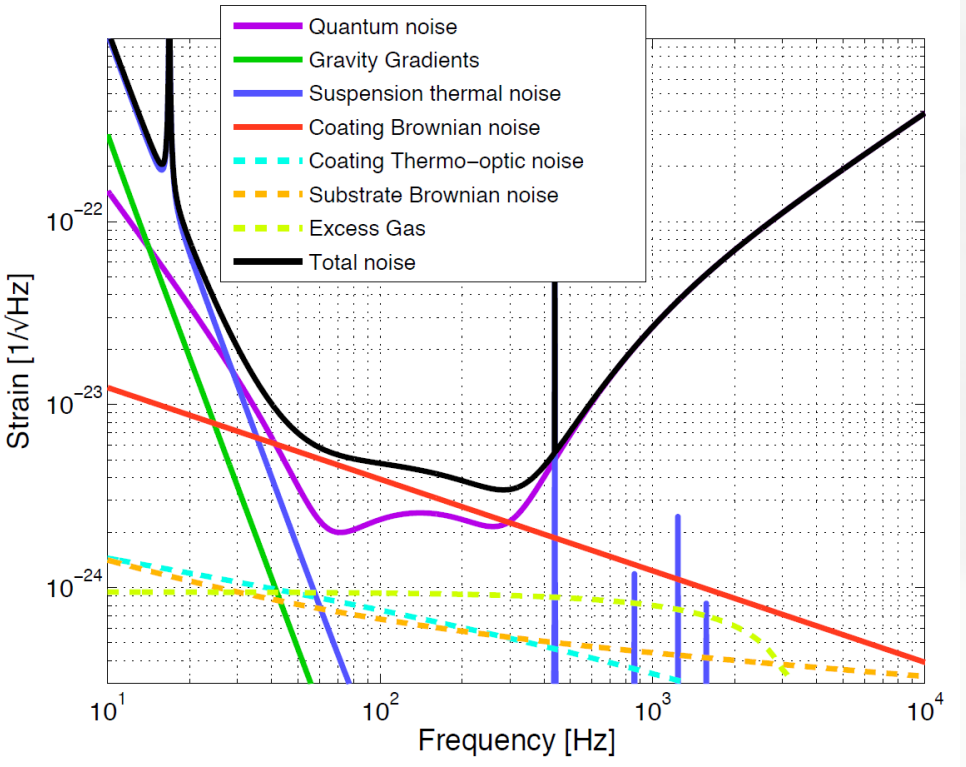
Essential input from other WPs

Noise characterisation

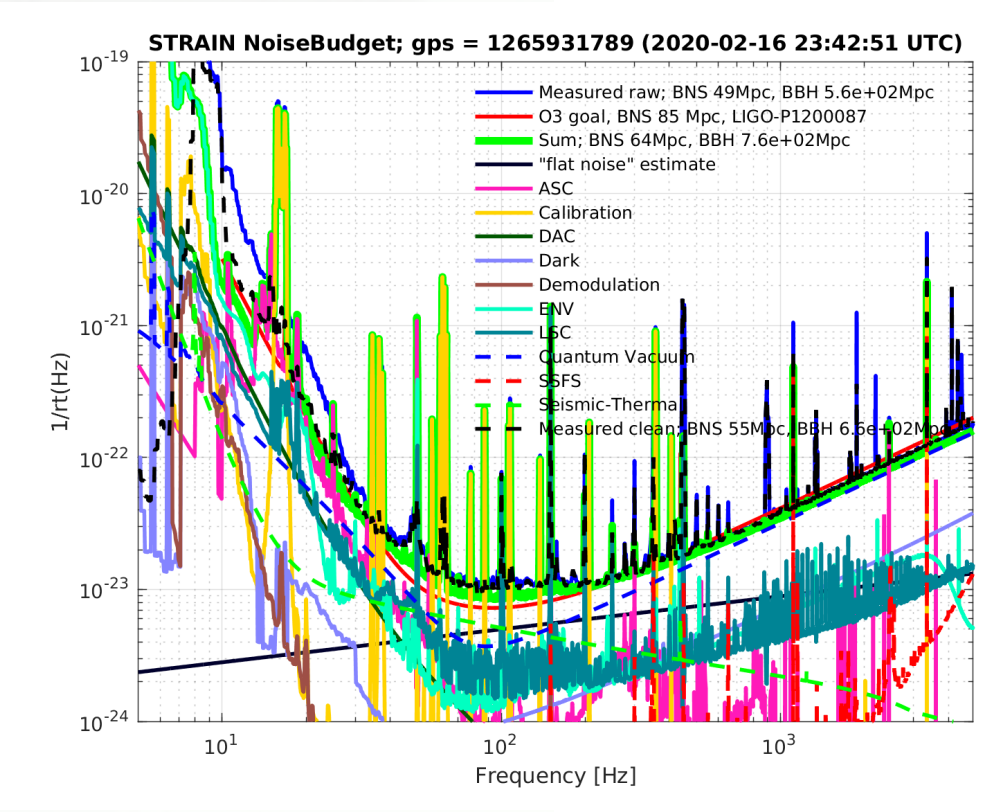
- New WP following the lessons learned from 1G and 2G
- A transverse package to ease the commissioning and all the future noise investigation
- Scope :
  - review the other WPs from the point of view of noise characterisation
  - derive a list of noise for the technical noise budget
  - proposed a strategy to project those noises
  - also essential for glitch investigation and vetoes

Noise characterisation

WP5



What you want...



and what you got

Making sure we will know the level of all the pertinent noises

Calibration

WP6

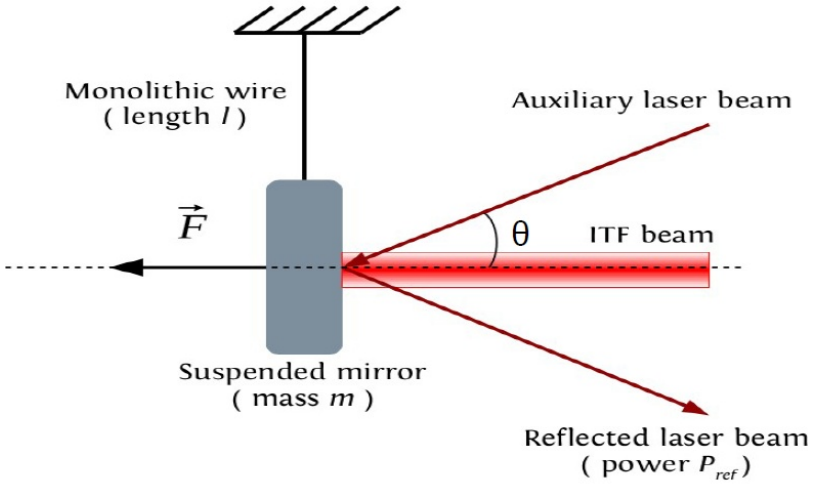
From the output of my detector to the dimensionless amplitude of the GW signals

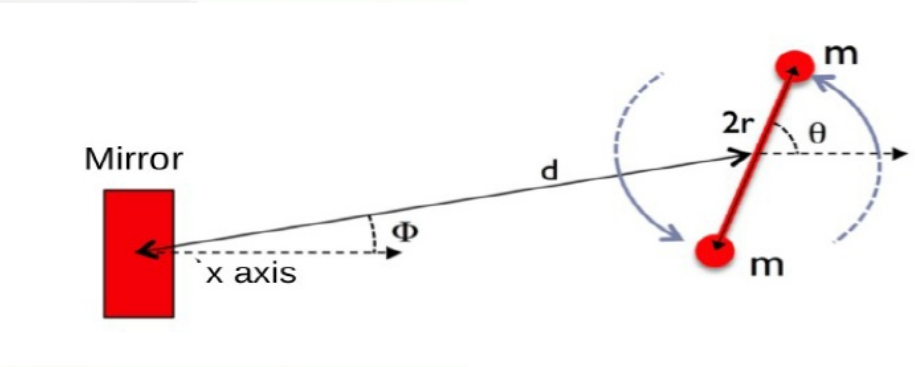
- Scope :
  - calibration requirements (derived from science goals)
  - development of optimal recombination, null-stream
  - design the calibration strategy and relevant hardware
  - cost estimate

Calibration

WP6

- Estimated accuracy requirement :
  - amplitude errors < 0.5%
  - phase errors < 0.1 rad
- 2 ways: photon calibrator Newtonian calibrator





(with a laser beam) (with rotating masses)

Implemented already in 2G detectors

Conclusion

- Chance to design a new observatory
- A long road ahead… with extensive experiences from 2G
- Most urgent work: the tunnel configuration
- Everyone is welcomed to contribute, plenty of tasks within the different WPs

  Would you like to participate ?

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