NEWS

H2020-MSCA-RISE-2016 — Grant Agreement N° 734303

GW Physics

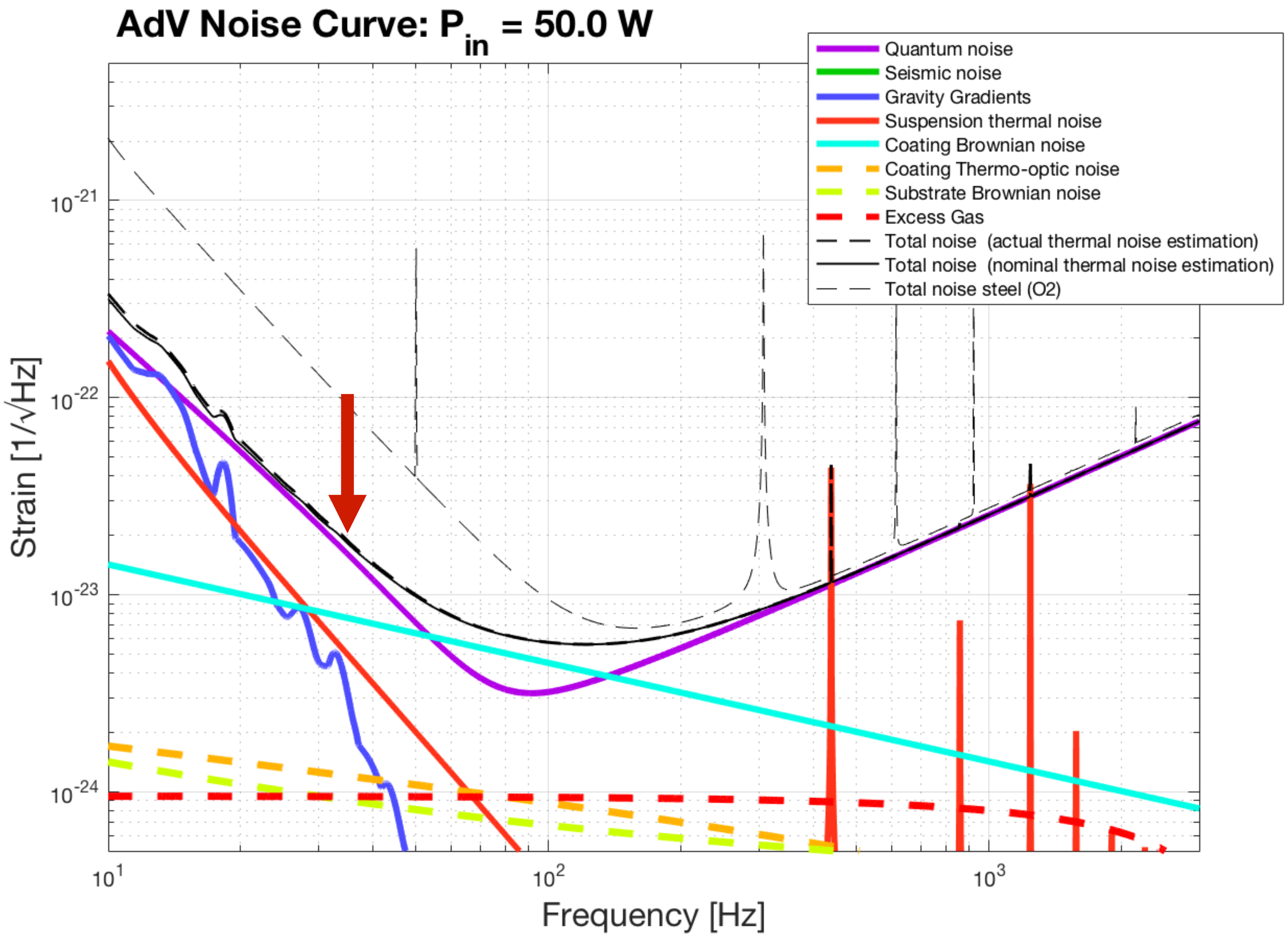
Massimiliano Razzano

SB Meeting - June 25, 2018

NEWS from GW Physics

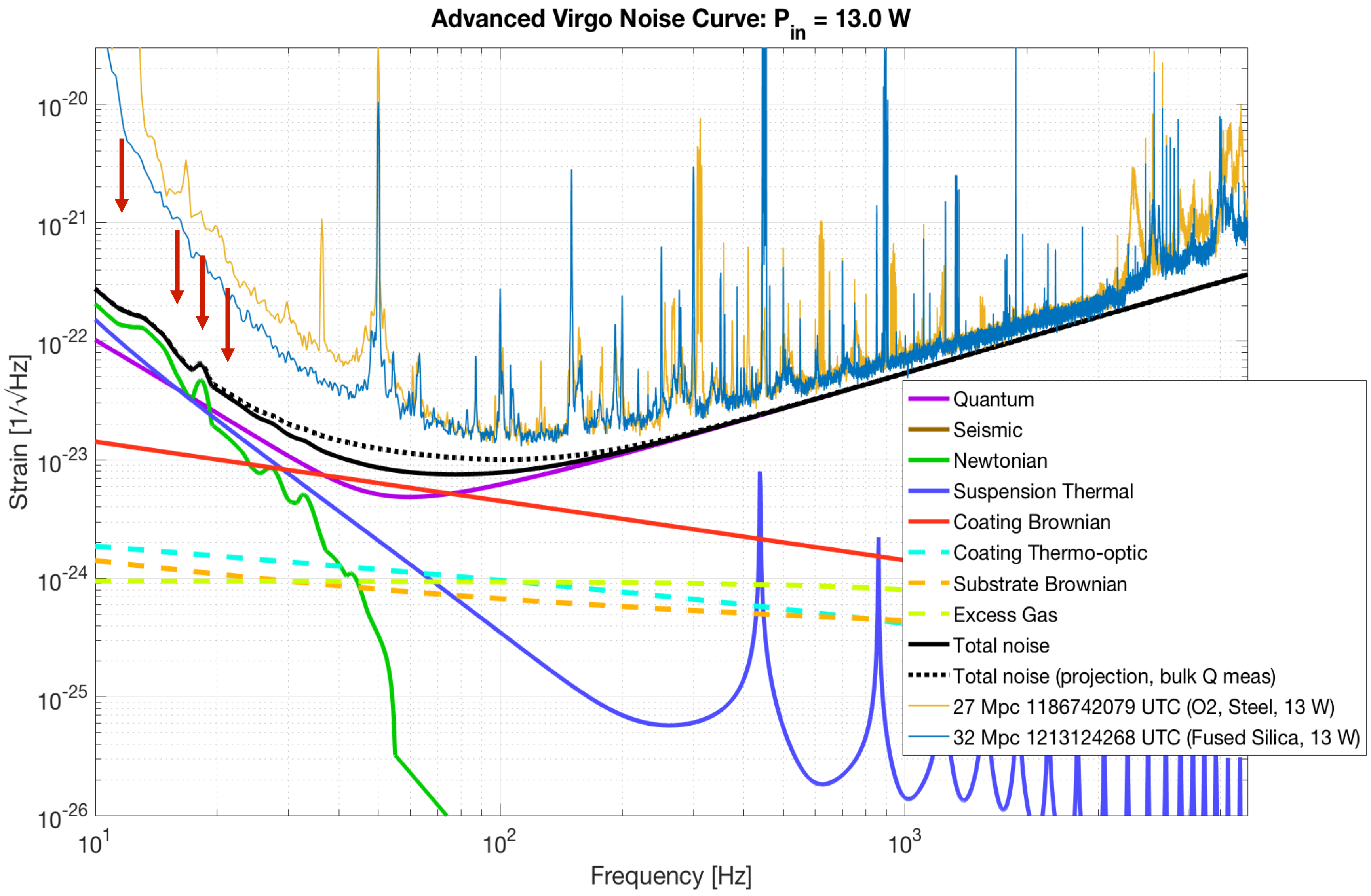
- Second observing run (O2) finished successfully this summer
- Joint LIGO-Virgo run (1-25 August) yielded 2 detections
- Now moving toward O3
- Improving detectors and data analysis infrastructures
- Higher sensitivity → higher events (and noise transients rate)
- Both search pipelines and detector characterization activities
- Aiming at lowest latency possible

Summary
O3 Target

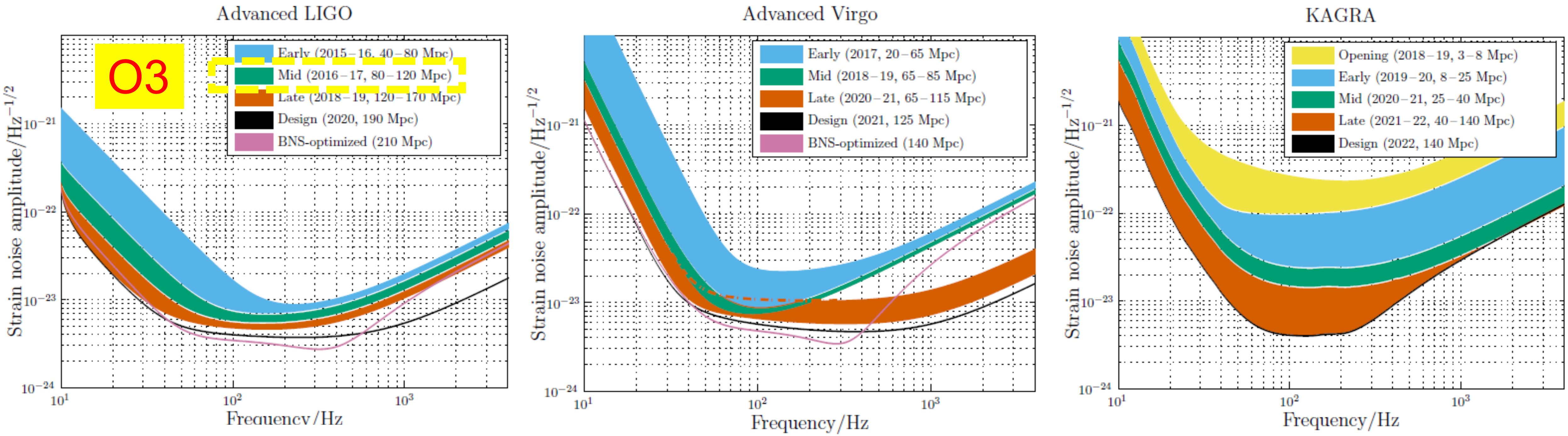


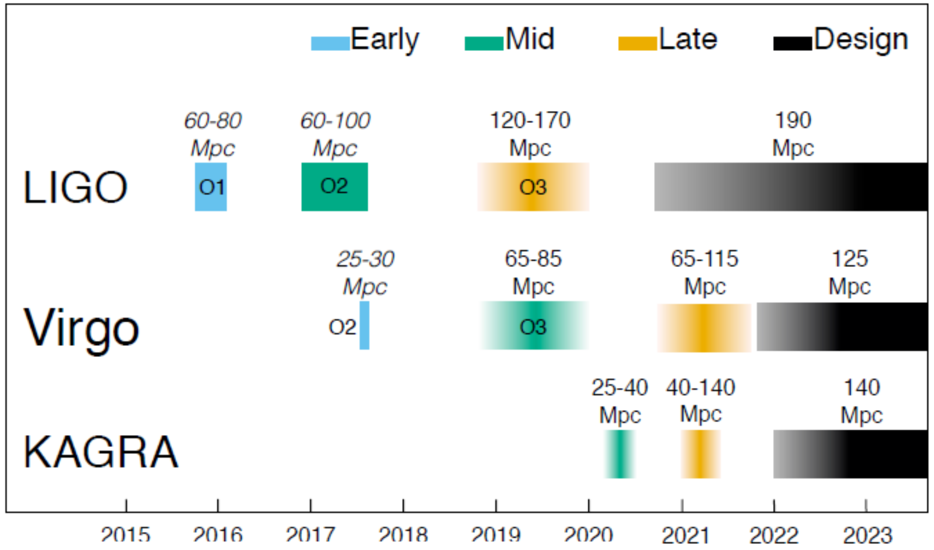
Mid June

- LF gradually improving
- Preliminary estimate of bulk TN on going
- Effect of fused silica fibres clear
- Noise hunting dedicated to:
  - Control noise
  - Environmental
  - Stray light



LIGO-Virgo-KAGRA observing scenario





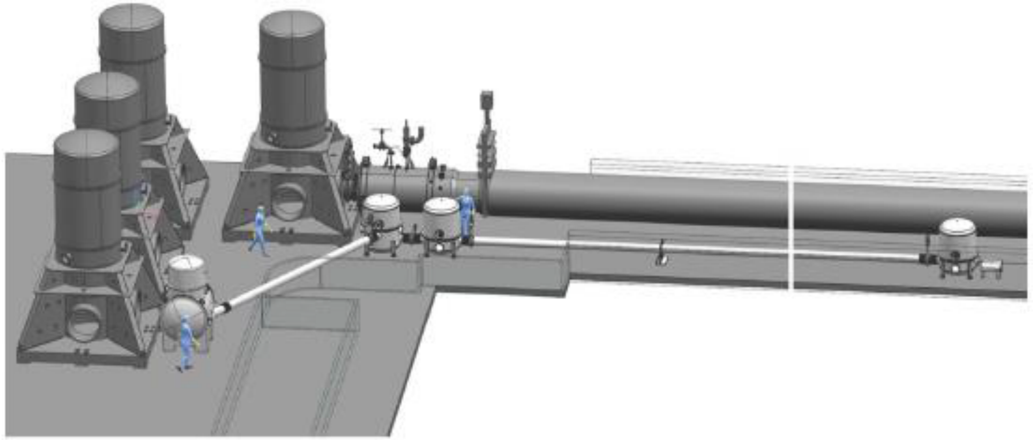
Living Rev. Relativ. (2016) 19: 1

- O3 is a very exciting scenario (including KAGRA, a **seed of 3G detector)**
- What can we do after AdV to exploiting at the best the infrastructure ?
- **AdV+ vision document submitted** to Virgo Council: a two-step approach, 160 Mpc/300 Mpc, 6-year

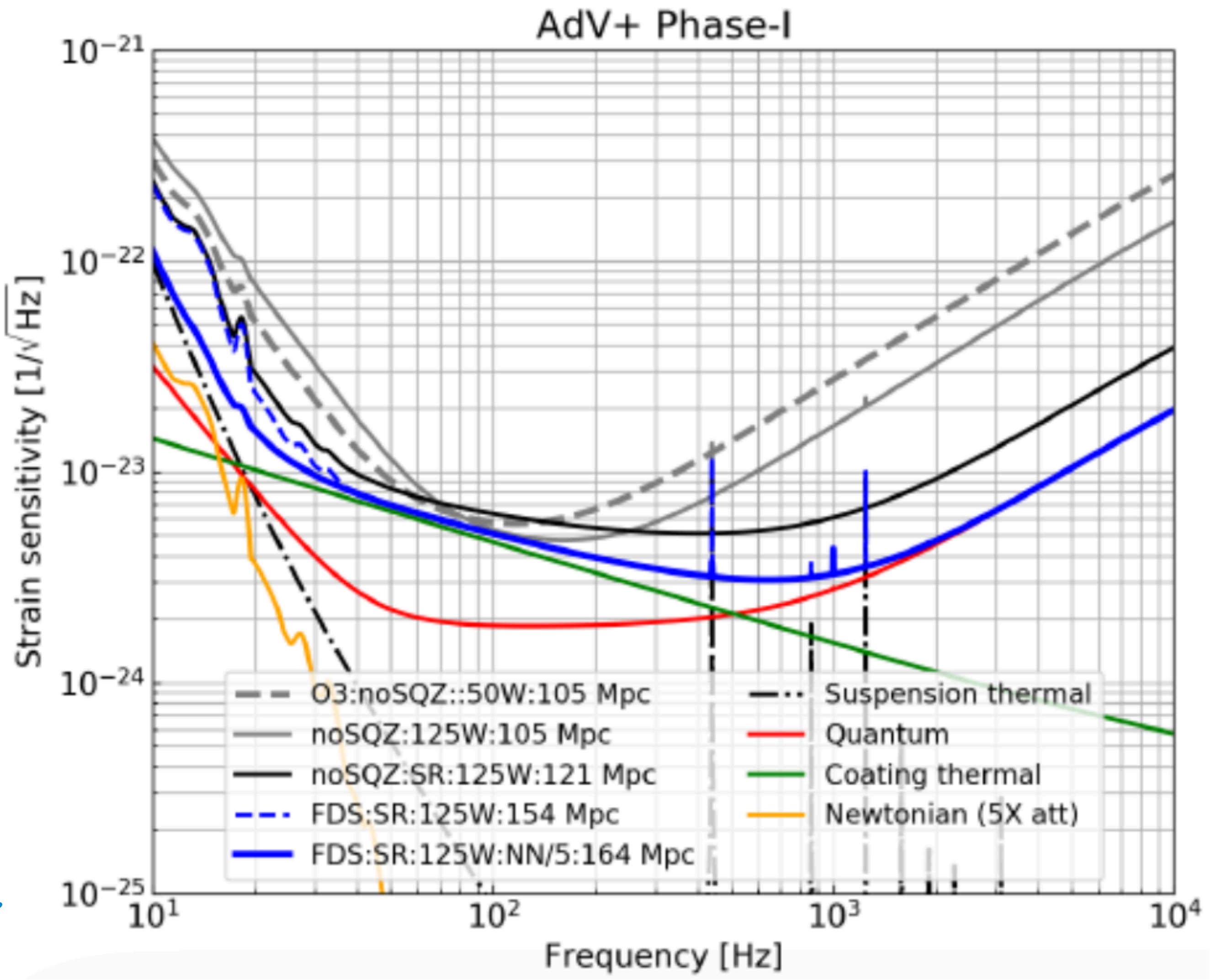
AdV+ vision document, phase I: *reaching AdV full target*

Complete the AdV program:
200 W laser; 125W at the ITF input
Signal recycling → 120 Mpc range

Frequency Dependent Squeezing
300 m-long filter cavity →150 Mpc range



Newtonian Noise Cancellation →160 Mpc range



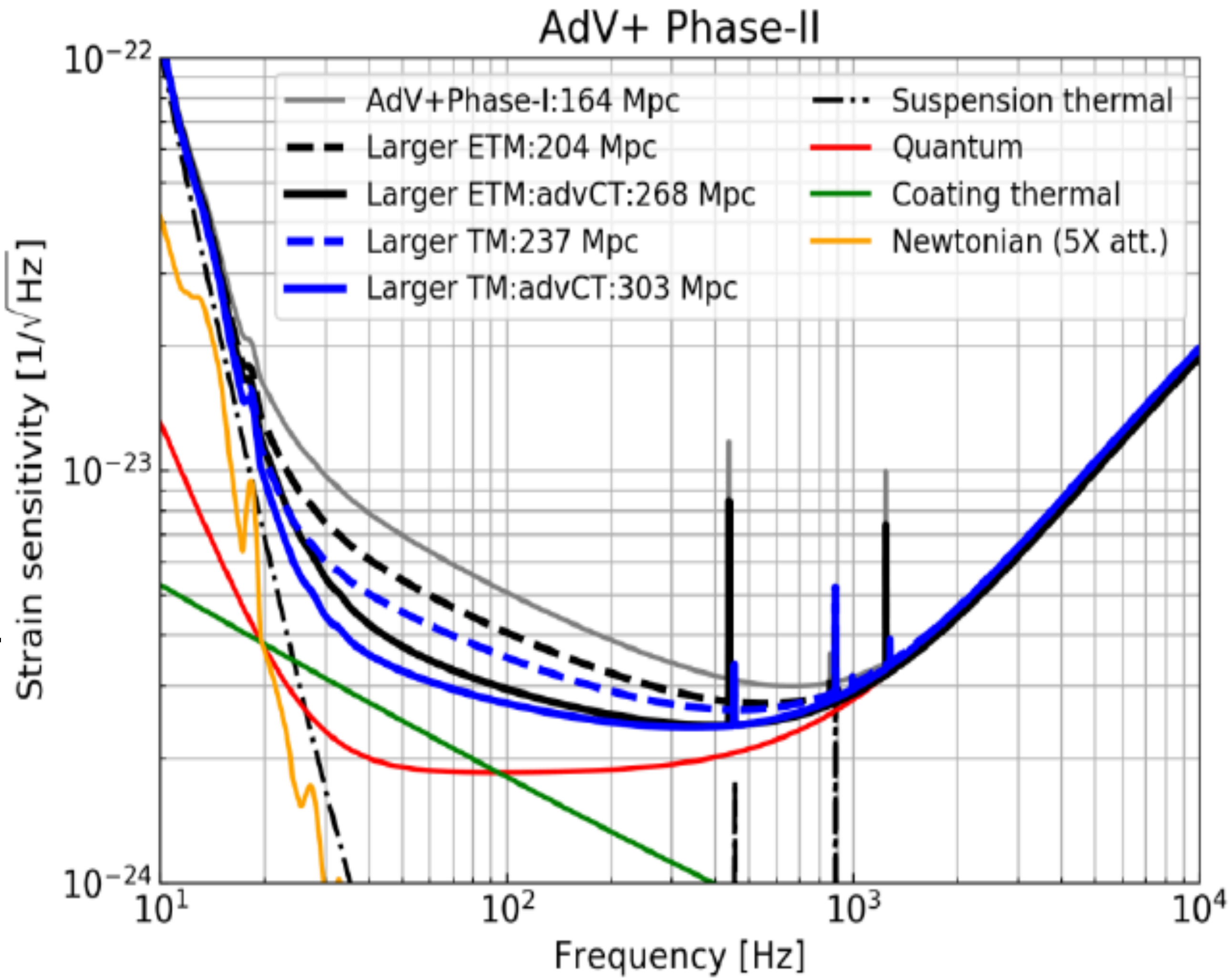
AdV+ vision document phase II: *Thermal noise reduction large beams*

Larger mirrors
Diameter: 550 mm, thickness: 200 mm, mass: 100-120 kg
Scenario 1: **ETM-only** → 200 Mpc range
Scenario 2: **Full** → 230 Mpc range

In parallel coating improvements:
If factor 3 reduction in **Coating TN**:
Scenario 1: ETM-only → 260 Mpc range
Scenario 2: full upgrade → 300 Mpc range

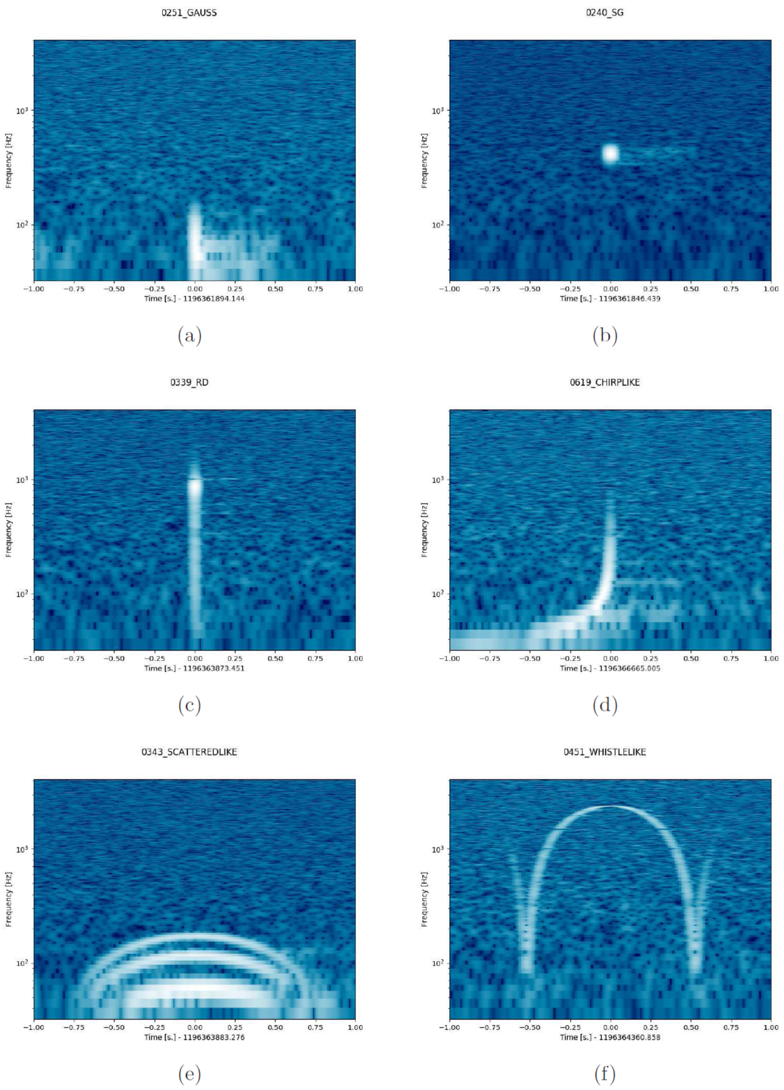
Several challenges, **feasibility under study**:

- Handling large masses (100kg-150kg for BS)
- Handling and integrating the payloads into present modified VACUUM system
- Folded VS marginally stable Recycling FP
- Design of very large baffles .....



Ongoing projects – detector characterization

- Deep learning based pipeline implemented
- Tested on simulations
  - Details in Razzano & Cuoco, 218, CQG,35,9
- Now moving to Virgo data, in progress



DONE

US **G. Intini**, 1 secondment new algorithm to observe the presence of non-GR polarization is crucial for testing the Einstein equations for General Relativity

5-vectors with non-GR polarizations

Non GR polarization: introduction

2

$h_{\mu\nu}$:

- 16 **Components**
- -6 **Symmetry**
- -4 **Reference frame**
- 6 **Different Polarizations**

→ h_{ij}

The GR has 4 more relations

SPIN $3 \otimes 3 = 5 \oplus 3 \oplus 1$

SPIN	Part of the matrix	Mode group
0	Trace	Scalar
1	Antisymmetric	Vectorial
2	Symmetric Traceless	Tensorial

Symmetric Matrix

Difference with respect to Max Isi (2015, PRD 91)

5

$\begin{pmatrix}1&0&0\\0&1&0\\0&0&0\end{pmatrix}$ **Breathing:** $e_b = 2e_t + \frac{2}{3}e_d$

$\begin{pmatrix}0&0&0\\0&0&0\\0&0&1\end{pmatrix}$ **Longitudinal:** $e_l = e_t - \frac{2}{3}e_d$

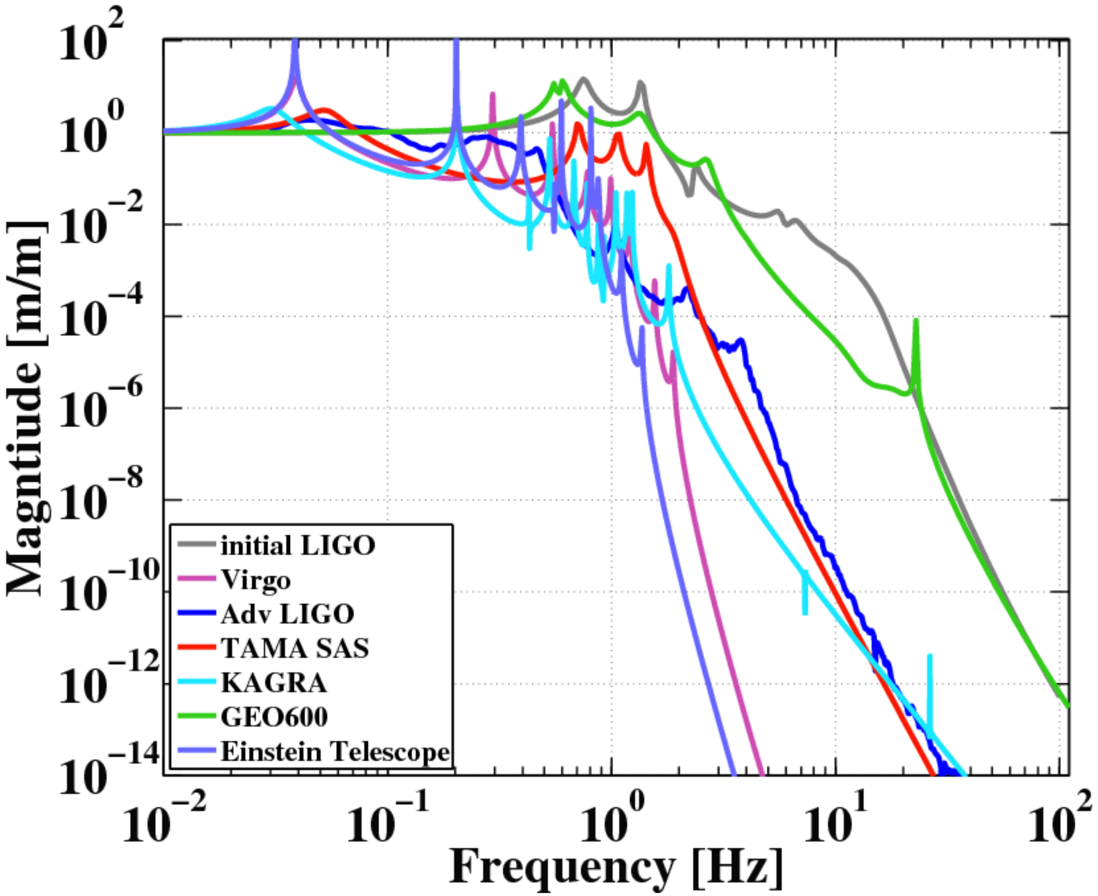
- **In the (b,l) base:**
  - there are no undetectable polarizations
  - b and l are degenerate and undistinguishable (same antenna pattern)
  - we are mixing different spin particle
- **In the (d,t) base:**
  - there are no degenerate polarizations
  - t is undetectable in Virgo/LIGO but may be detectable in other interferometers

ON GOING

JAPAN

E. Majorana, 1 secondment from June 27° 2018 :

- 4° International KAGRA Workshop
- Sesimic Suspension performance tests for KAGRA
- Payload works
- 3° Generation detector roadmap

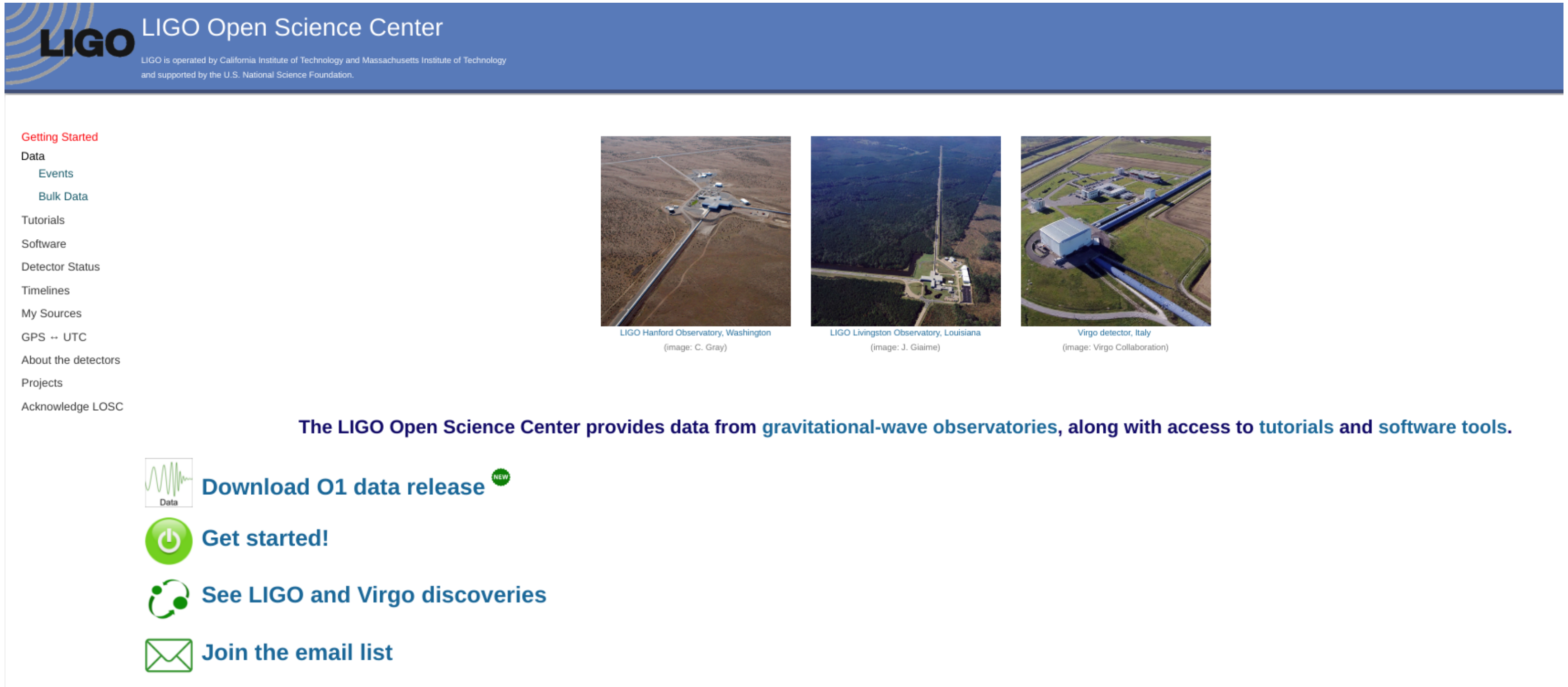


US

M. Razzano, 1 secondment from July 2018

Ongoing projects – Open Data portal

- Working with LIGO colleagues to new portal for GW open data
- New version of existing LOSC
- Close collaboration with Caltech researchers
- Hope to launch soon



Conclusions

- GW astronomy has begun
- Dawn of multimessenger observations
- Activities toward next run (O3)
- Main topics
  - Detector characterization
  - Open data portal
  - Other?
- Secondments started, will continue during this year