Journée AdvancedVirgo+ du 31 mai

09:30 → 10:00 **Accueil** 30m

10:00 → 10:30 **Introduction: la stratégie d'upgrade d'Advanced Virgo** 30m

15 + 15 minutes

Orateur: Benoit Mours (LAPP Annecy)

10:30 → 11:15 **AdV+ science** 45m

La science que nous pouvons faire avec des détecteurs de type AdV+ , A+, Kagra et l'astronomie multimessager; 25+20

Orateur: Patrice Hello (LAL-Orsay)

11:15 → 11:45 **Les challenges de l'optique** 30m

Augmenter la taille des miroirs, la lumière diffusée,... 20+10

Orateur: Jérome Degallaix (LMA)

11:45 → 12:15 **L'augmentation de la puissance du laser et les enjeux associés** 30m

20+10

Orateur: Nelson Christensen (ARTEMIS)

12:15 → 13:30 **Déjeuner sur place (pour les personnes inscrites)** 1h 15m

13:30 → 14:00 **La réduction du bruit quantique** 30m

20+10

Orateur: Pierre-François Cohadon (LKB)

14:00 → 14:30 **Noise budget et La réduction des bruits techniques** 30m

20+10

Orateur: Michal Was (LAPP)

14:30 → 15:15 **- L'organisation de l'analyse des données, les contacts avec les partenaires multimessager, le calcul** 45m

25+20

Orateur: Marie Anne Bizouard (LAL)

15:15 → 15:45 **L'organisation de Virgo, le programme de base** 30m

15+15

Orateur: Frédérique MARION (LAPP)

15:45 → 16:00 **Opportunités à EGO** 15m

10+5

Orateur: Stavros KATSANEVAS (CNRS/IN2P3)

16:00 → 16:30 **Discussion** 30m

- Organisée avec le soutien du GdR Ondes Gravitationnelles.
  - http://gdrgw.in2p3.fr/
- Agenda: https://indico.in2p3.fr/event/17271/

Groupement de recherche
Ondes gravitationnelles

La stratégie d'upgrade d'Advanced Virgo AdV+

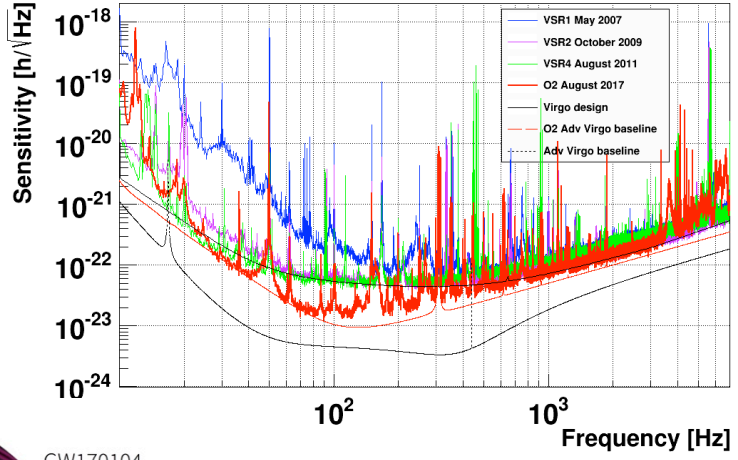
B. Mours (LAPP-Annecy)

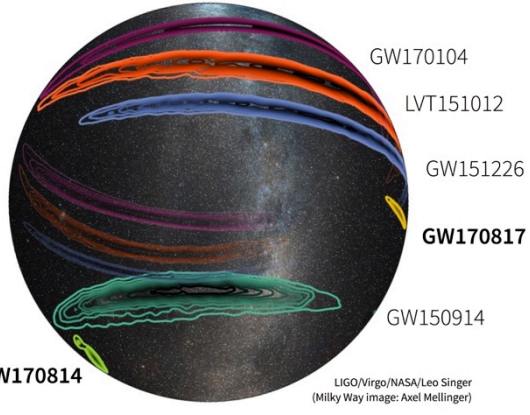
May 31, 2018

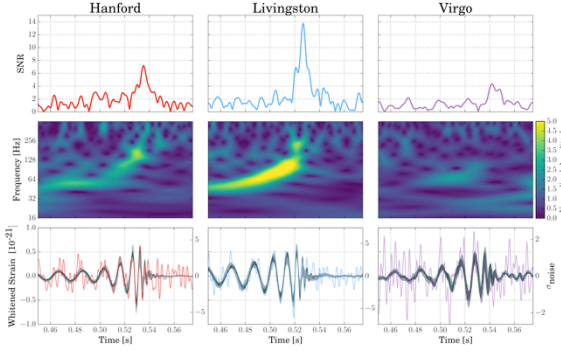
VIRGO

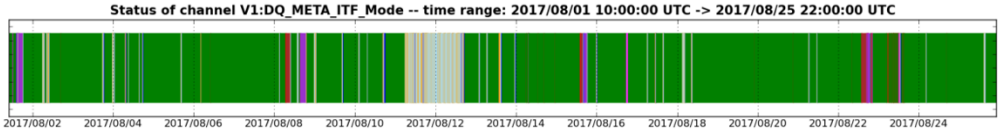
GW science is driven by detector progress

- Best BNS range for initial detectors
  - LIGO: ~ 20 Mpc
  - Virgo: ~ 12 Mpc
- Advanced detectors
  - LIGO O1: ~ 60-80 Mpc
  - LIGO O2: ~ 70-105 Mpc
  - AdV O2: 25-28 Mpc
- Sources
  - GW150914: BBH @ 410 Mpc
  - GW170814: BBH @ 540 Mpc
  - GW170817: BNS @ 40 Mpc



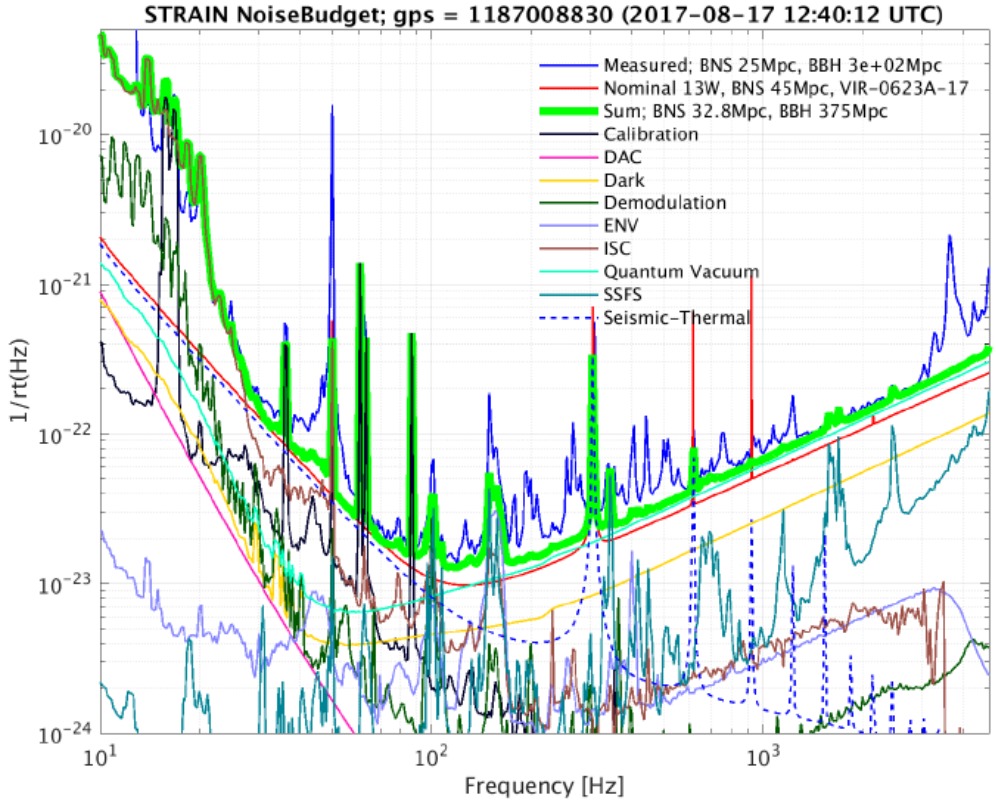




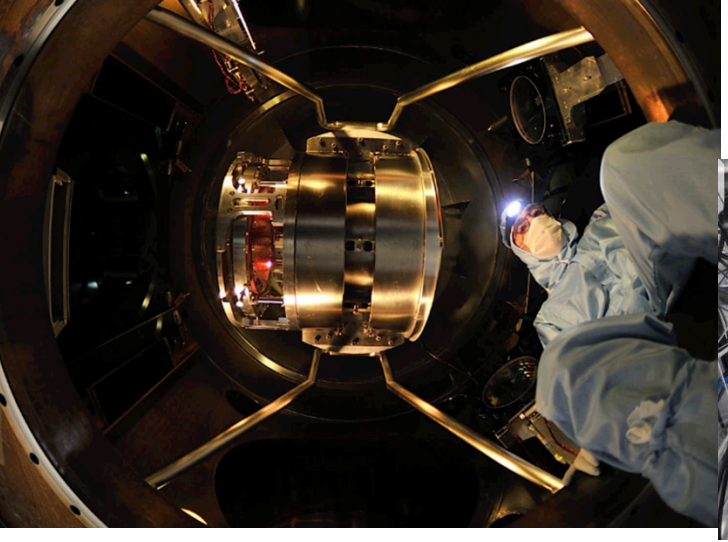


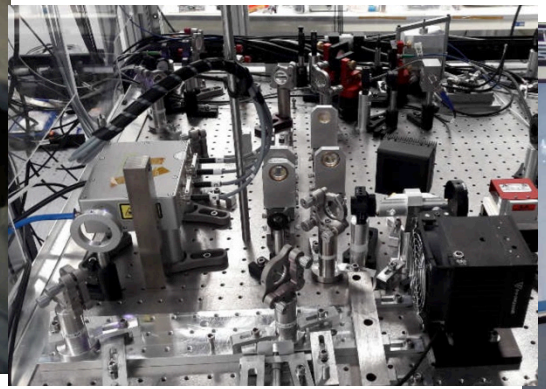
O2 Detector Summary

- 85 % duty cycle
  - Longest lock segment: 69 hours
- Mean BNS range: 25-28 Mpc
  - Limit was 45 Mpc
- Noise budget
  - Many bumps and lines and some extra broadband noise

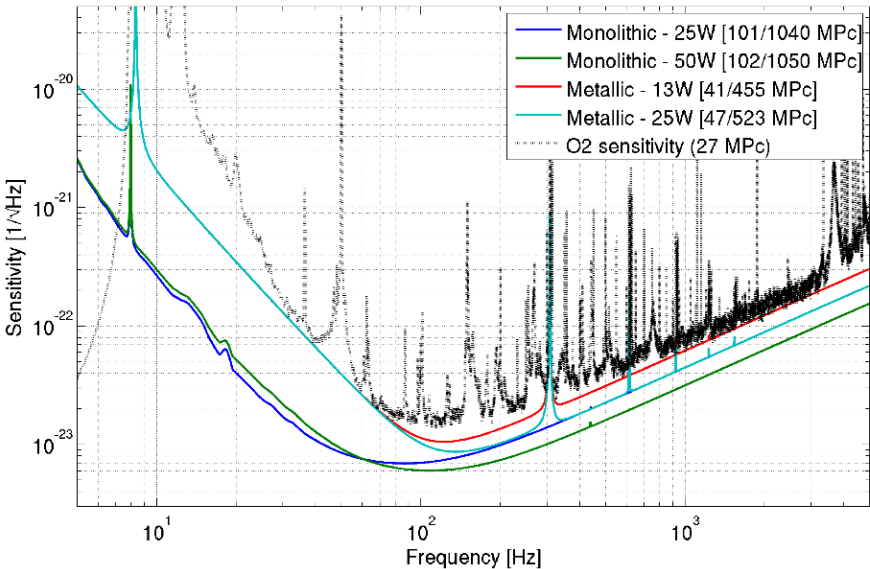


From O2 to O3



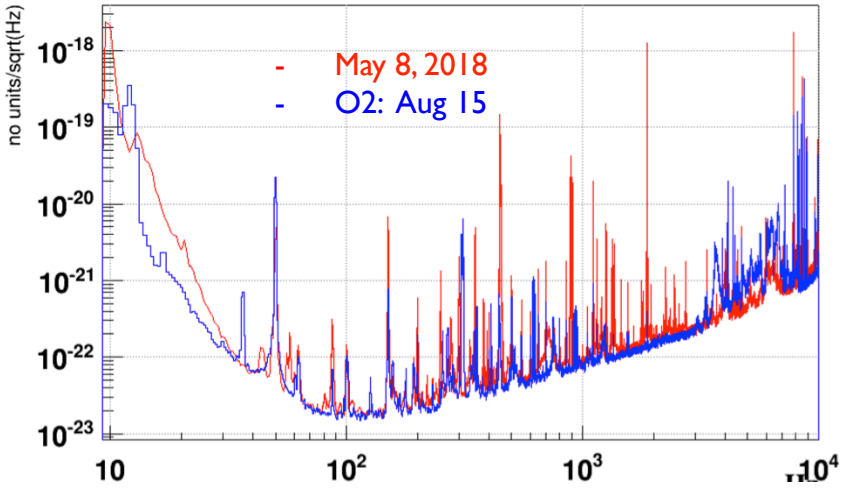


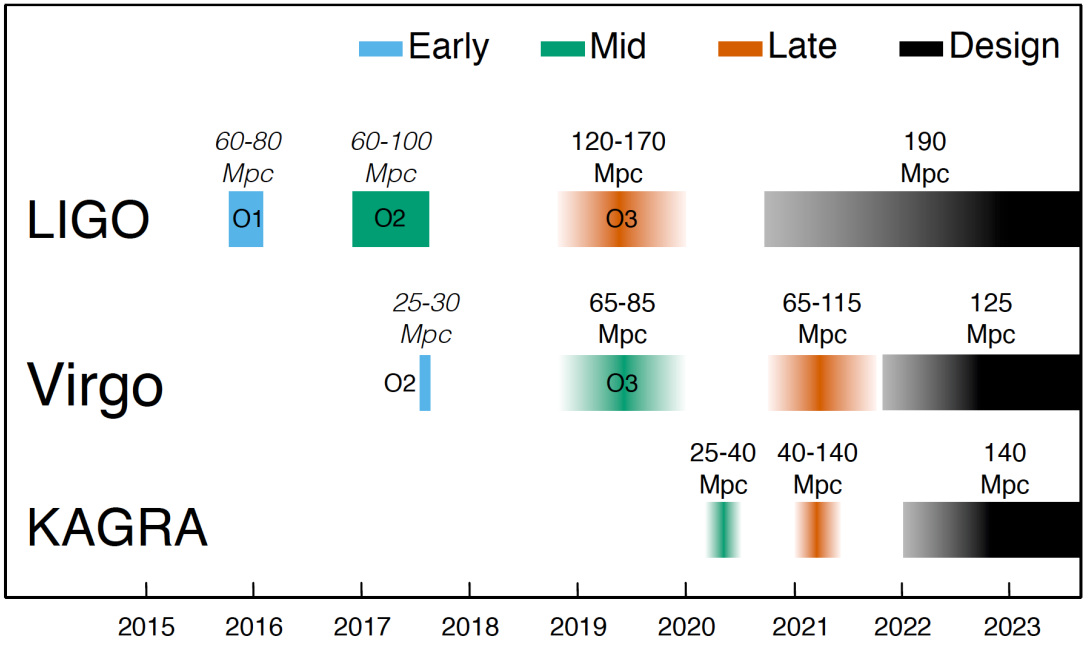
- Main changes
  - Monolithic suspensions
  - Laser power: 70 W → 100 W
  - Frequency independent squeezer
- O3 Goal: 60 Mpc
- Installation completed on April 19
  - Back to commissioning



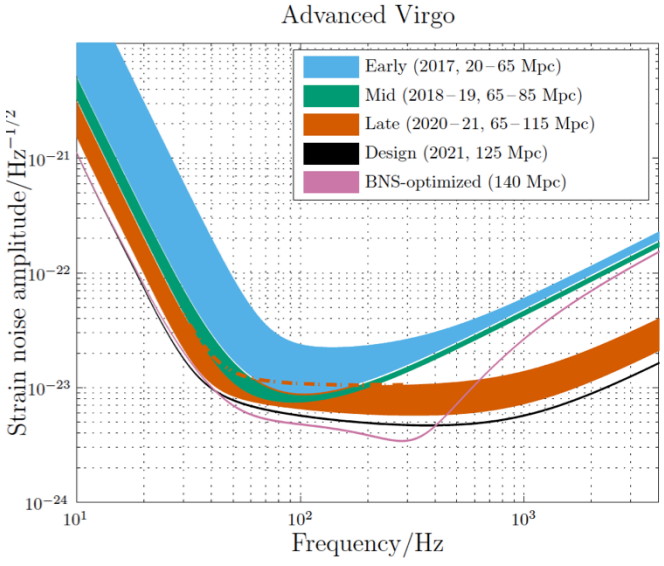
Toward O3: back to commissioning

- Back in "low noise 3" on May 2nd,
  - Reach up to 25 Mpc (BNS range)
- Long commissioning period
  - No major shutdown scheduled before O3
  - O3 start: Feb. 2019, aligned with LIGO
  - Commissioning activities
    - Usual noises/glitches reduction
    - Robustness
    - Commissioning of the squeezer
    - Power increase; max for O3: 50W
- Engineering Runs
  - Once per month over a weekend
  - Long engineering run prior to O3





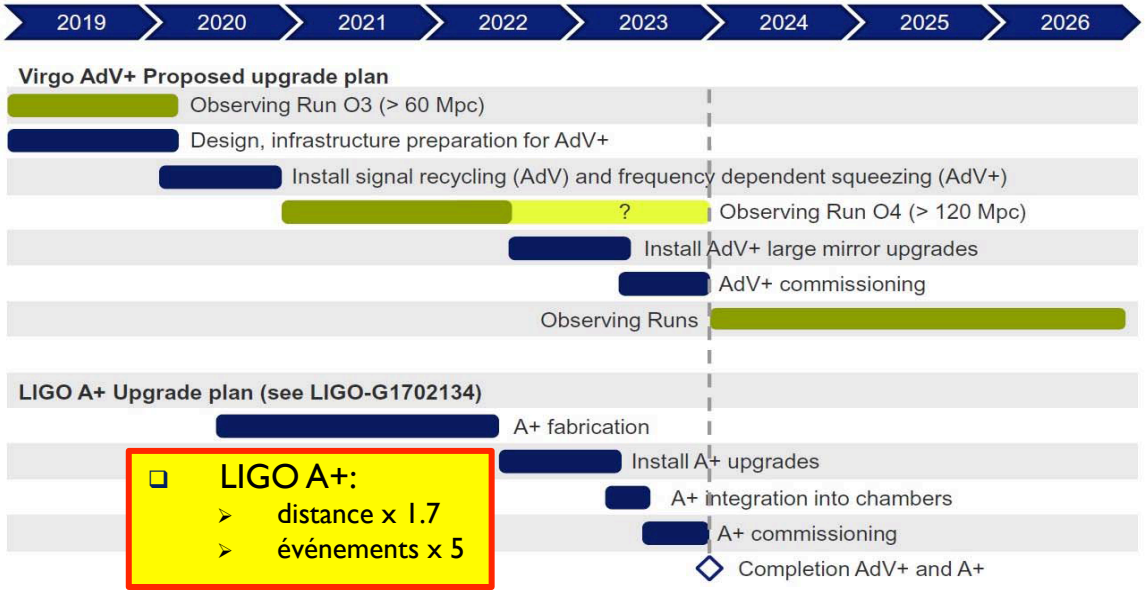
Beyond O3 ?



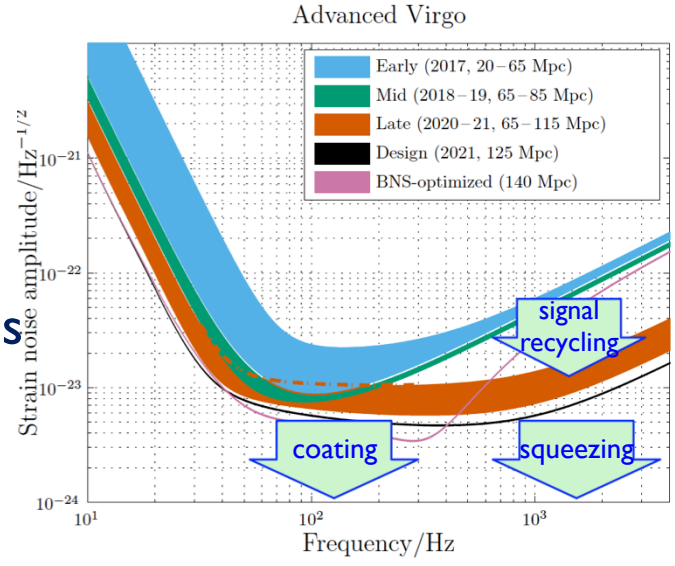
- AdV design range: 125 Mpc

- Could we do better than AdV?
- Could we stay competitive?
- Could we prepare the way to ET?

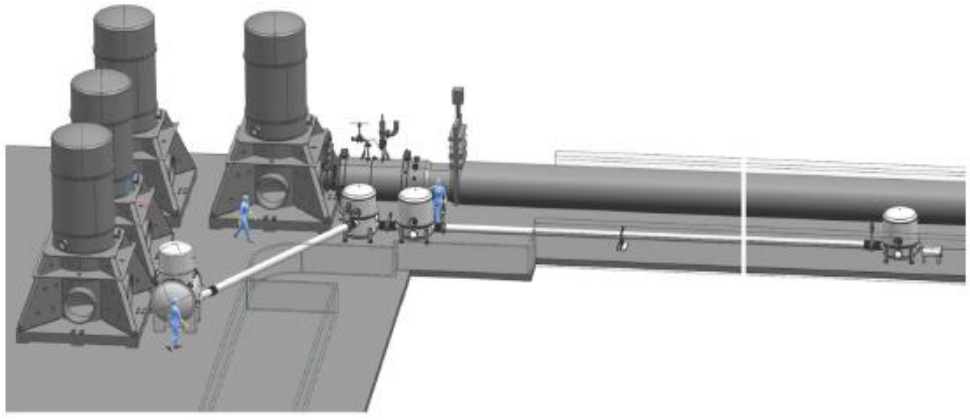
Beyond O3: AdV+



- LIGO A+:
  - distance x 1.7
  - événements x 5

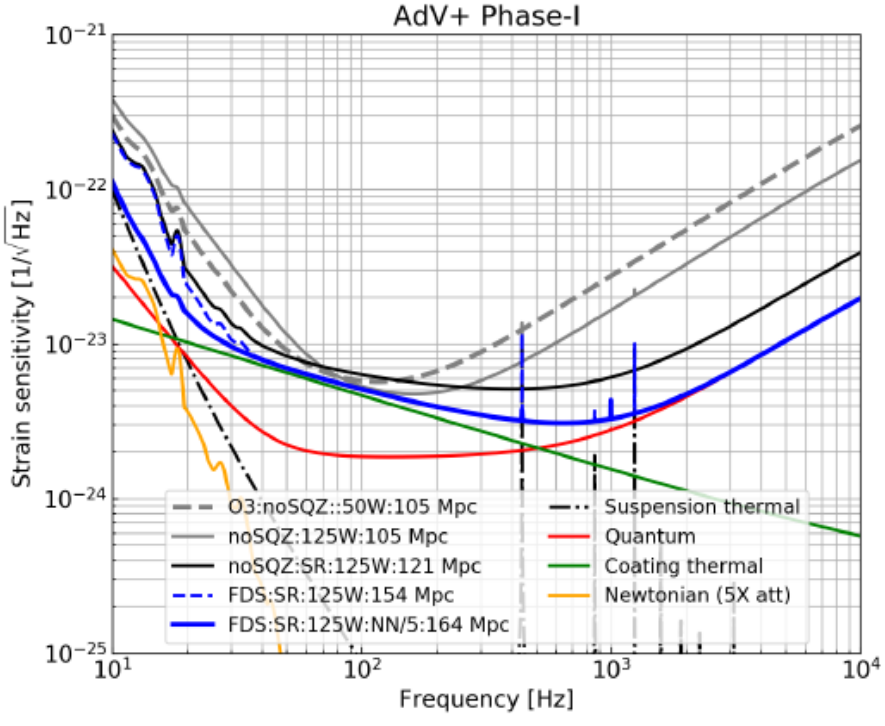


- Strategy: long observing runs and AdV+ upgrades
- A two step approach:
  - For O4: Frequency dependent squeezing
    - + Complete AdV: signal recycling
  - For O5: Reduce the coating thermal noise
    - Larger beam: Four test masses or just the end test masses?
    - Improved coating
- AdV+ proposed to the EGO Council last December



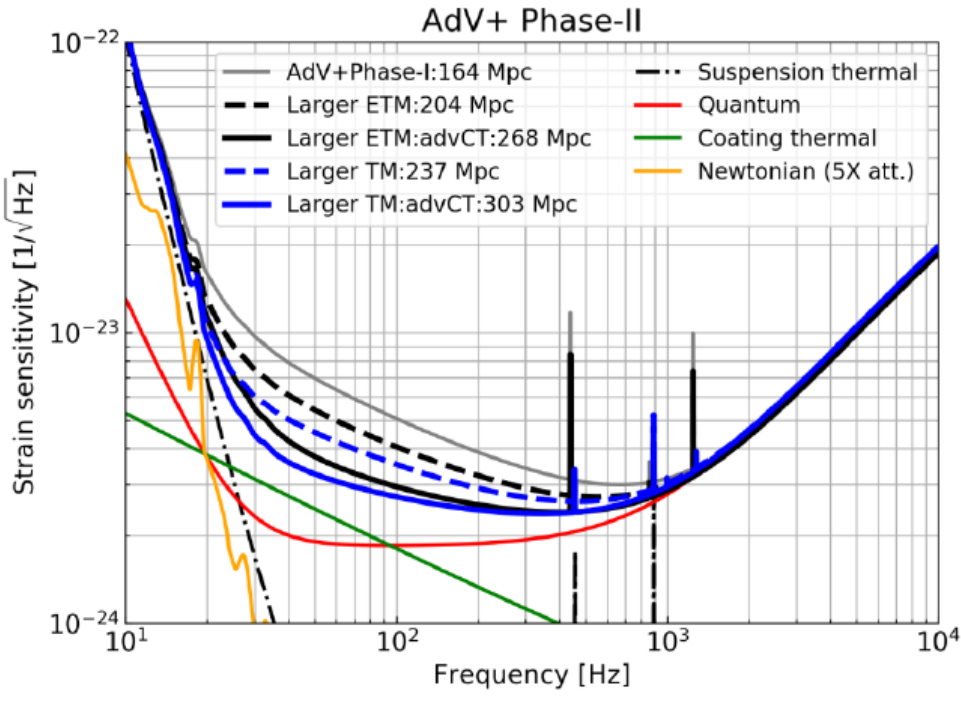
AdV+ phase I

- Complete the AdV program:
  - 200 W laser; 125W at the ITF input
  - Signal recycling → 120 Mpc
- Frequency dependent squeezing
  - New filtering cavity
  - →150 Mpc
- Newtonian noise cancellation
  - →160 Mpc



AdV+ Phase II

- Larger mirrors
  - Diameter: 550 mm, thickness: 200 mm, mass: 105 kg (?)
  - Scenario 1: ETM-only → 200 Mpc
  - Scenario 2: full upgrade → 230 Mpc
- Coating improvements
  - If factor three reduction in CTN:
    - Scenario 1: ETM-only → 260 Mpc
    - Scenario 2: full upgrade → 300 Mpc
- Many challenges and activities
  - Grand Coater upgrade
  - Vacuum, infrastructure
  - Payloads and superattenuators
  - Aberration control



Budget

Phase	Item	Completed	BNS range [Mpc]	Cost [M€]
AdV-O3		2019	65 - 80	
AdV design	Tuned signal recycling + 125 W	2021	120	
Phase I	Frequency dependent squeezing (FDS)	2021	150	3.5
	Newtonian noise cancellation (NNC)	2021	160	1.0
Phase II	Scenario 1: Large mirrors, ETM-only (LM1)			11.7
	Scenario 1 net cost: FDS + NNC + LM1			16.2
	Contingency (20 %)			3.2
	Scenario 1 - ETM-only upgrade cost	2023	200 - 260	**19.5**
	Scenario 2: Large mirrors, full upgrade (LM2)			20.8
	Scenario 2 net cost: FDS + NNC + LM2			25.3
	Contingency (20 %)			5.1
	Scenario 2 - Full upgrade cost		230 - 300	**30.4**
	Risk reduction NDRC			8.5

Not yet reviewed

- Hope to get (some) approval during the June EGO Council meeting…

AdV+: a step toward 3G

- 3G detectors
  - Could see some sources all over the Universe
- Detector and Data Analysis challenges