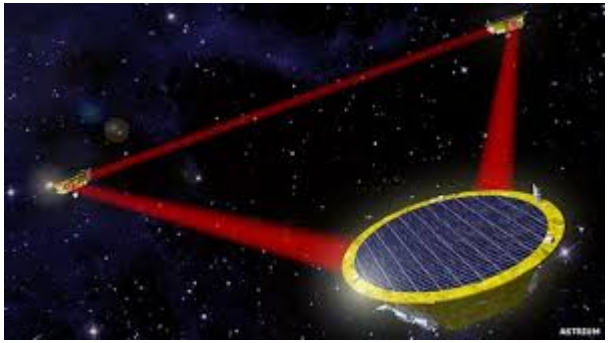
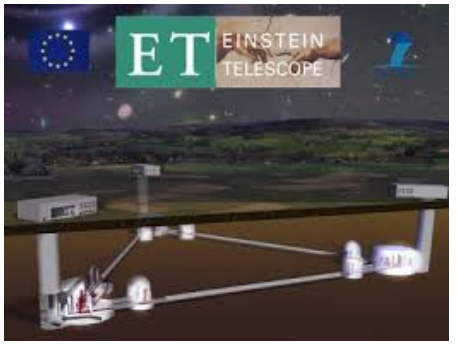
Round table : roadmaps

today

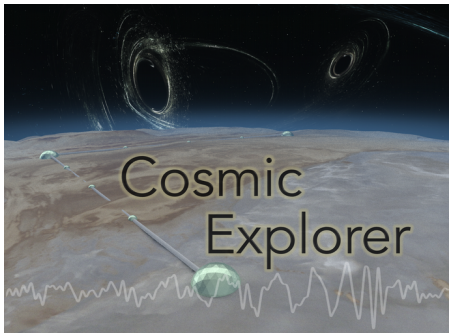
today



tomorrow



- GWIC roadmap
- European roadmaps (ESFRI, APPEC)
- National roadmap (TGIR)



Setting the scene

- LIGO/Virgo discoveries have modified the landscape and validated the global network approach.
- International roadmaps :
  - APPEC 2017-2026 document (release jan 2018): full support to LISA & full support to ET for acquiring ESFRI status.
  - ESFRI 2016 roadmap. GW detectors not in projects nor landmarks despite announced Astronomy & astroparticle science goals :

    (2018 update starting)

    - understand the extremes and origins of the universe
    - observe the formation of galaxies and their evolution
    - understand the formation of stars and planets
    - understand the solar system and life
    - observe gravitational waves
  - US astronomy decadal survey starting end of 2018 : GW astronomy is on their radar.
  - ASTRONET roadmap update for 2020 : any GW input required ?
  - European Particle Physics roadmap update : increase interest for GW physics ?

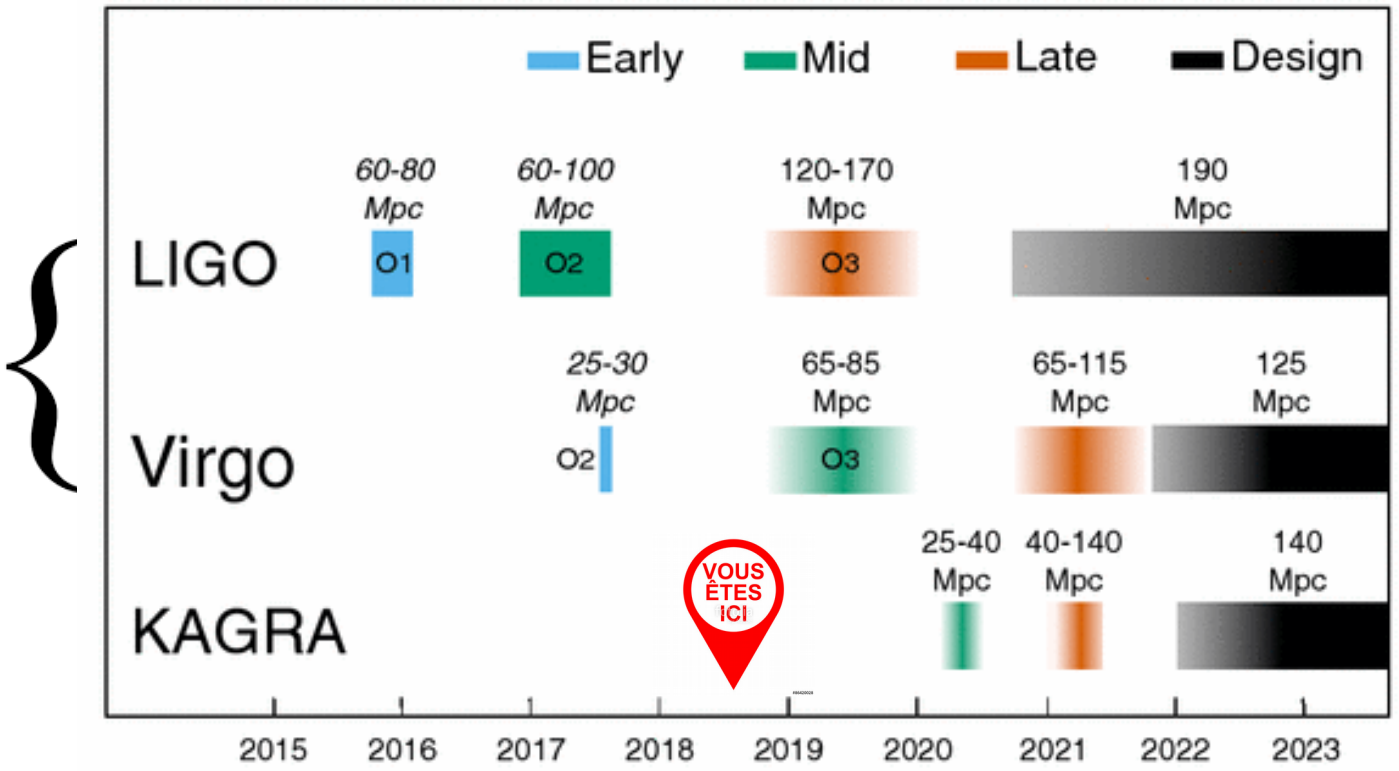
- GW International Committee (GWIC) 3G roadmap has started in 2016. 2 subcommittees :
  - Science case : document release dec. 2018.
  - Detectors R&D.

Before 3G : current detectors upgrade roadmap

Current generation detectors

- Roadmap regularly updated by LVC+KAGRA : Abbott, B.P. et al. Living Rev Relativ (2018) 21: 3. https://doi.org/10.1007/s41114-018-0012-9
- Design sensitivity (LIGO 190Mpc / Virgo 125 Mpc / KAGRA 140 Mpc) : a bit delayed compared to current planning : 2022

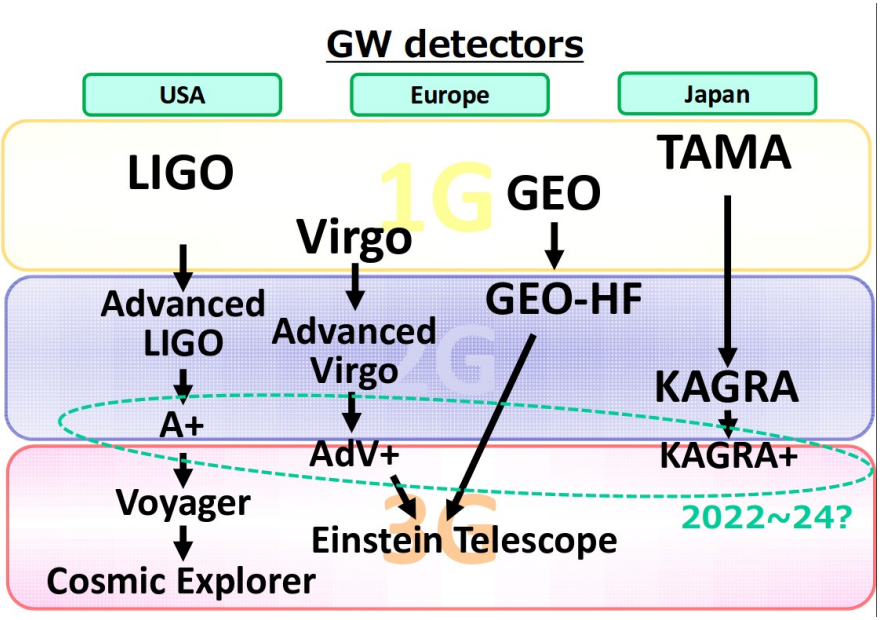
LIGO/Virgo collaboration



- What's new ? : KAGRA PI (Takaaki Kajita) proposed KAGRA to join end of O3 for « scientific results by end of 2019 ». Acceleration of KAGRA original roadmap.

Current generation detectors

- Longer term planning : LIGO A+ and AdV+
- Longer term planning : LIGO India
- And KAGRA+ : ideas for upgrade



Kentaro Somiya, GWADW 2018

Five year plan for observational runs, commissioning and upgrades

2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025

Virgo AdV+ Proposed upgrade plan

- Observing Run O3 (> 60 Mpc)
- Design, infrastructure preparation for AdV+
- Install signal recycling (AdV) and frequency dependent squeezing (AdV+)
- ? Observing Run O4 (> 120 Mpc)
- Install AdV+ large mirror upgrades
- AdV+ commissioning
- Observing Runs

LIGO A+ Upgrade plan (see LIGO-G1702134)

- A+ fabrication
- Install A+ upgrades
- A+ integration into chambers
- A+ commissioning
- Completion AdV+ and A+

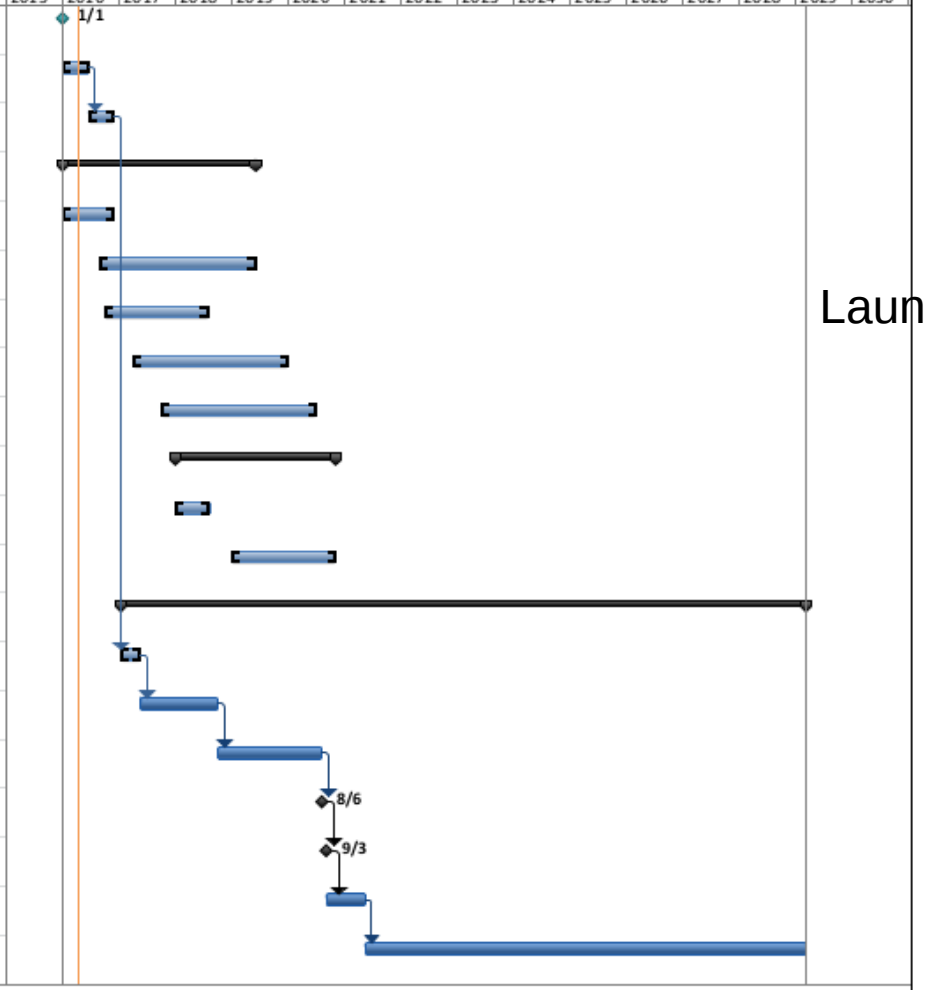
Note: duration of O4 has not been decided at this moment

LISA

LISA proposal [arxiv:1702.00786]

LISA consortium is born (again) in 2018

ID	Task	Task Name	Duration	Start	Finish
1		GOAT recommendations	0 days	Fri 1/1/16	Fri 1/1/16
2		First LISA Pathfinder in-orbit results	6 mons	Fri 1/1/16	Thu 6/16/16
3		Call for L3 Mission	6 mons	Fri 6/17/16	Thu 12/1/16
4		**High priority Technology Developments**	**894 days**	**Fri 1/1/16**	**Wed 6/5/19**
5		ITT process (rolling over 1/month)	12 mons	Fri 1/1/16	Thu 12/1/16
6		High Priority (TDA (for EM, 3 yr)	36 mons	Thu 9/1/16	Wed 6/5/19
7		High prioirty TDA (for EM, 2 yr)	24 mons	Sat 10/1/16	Thu 8/2/18
8		Medium prioirty TDA (for EM)	36 mons	Sat 4/1/17	Thu 1/2/20
9		Lower priority/late developments	36 mons	Sun 10/1/17	Thu 7/2/20
10		**Payload pre-developments**	**741 days**	**Mon 1/1/18**	**Mon 11/2/20**
11		AO for Payload consortium	8 mons	Mon 1/1/18	Fri 8/10/18
12		System risk reduction	24 mons	Tue 1/1/19	Mon 11/2/20
13		**Space system development**	**3170 days**	**Fri 1/13/17**	**Thu 3/8/29**
14		phase A ITT	4.5 mons	Fri 1/13/17	Thu 5/18/17
15		Phase A	18 mons	Fri 5/19/17	Thu 10/4/18
16		Phase B1	24 mons	Fri 10/5/18	Thu 8/6/20
17		Mission adoption review	0 days	Thu 8/6/20	Thu 8/6/20
18		SPC adoption & IPC approval	0 days	Thu 9/3/20	Thu 9/3/20
19		ITT and contractor selection	9 mons	Fri 9/4/20	Thu 5/13/21
20		Phase B2/C/D (8.5 yrs)	102 mons	Fri 5/14/21	Thu 3/8/29



Project: L3 candidate schedule
Date: Fri 4/15/16

Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Deadline
Progress

Page 1

Launch 2034

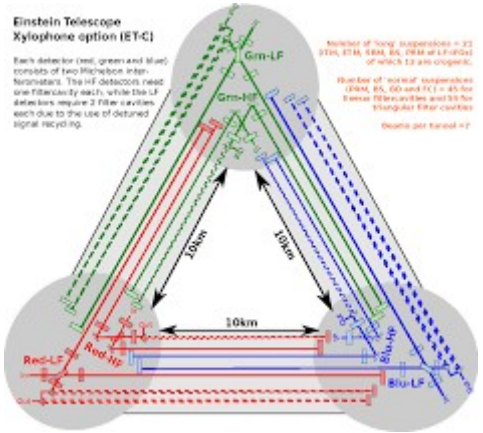
GWIC 3G detectors roadmap

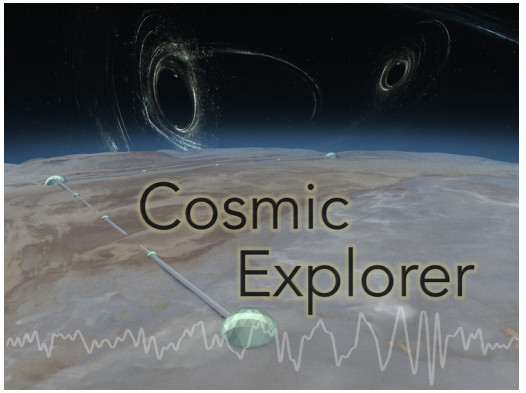
- https://gwic.ligo.org/3Gsubcomm/
- Charge (nov. 2016):
  - Science case → F2F Oct 2018 AEI
  - R&D coordination
  - Community networking
  - Agency interfacing
  - Investigation of Governance Structures

Beverly Berger, Rochester Institute of Technology, USA
Federico Ferrini (co-chair), European Gravitational Observatory, Italy
Gabriela González, Louisiana State University, USA
James Hough, University of Glasgow, UK
Stavros Katsanevas, Astro Particle and Cosmology Laboratory, Paris
Ajit K. Kembhavi, Inter-University Centre for Astronomy and Astrophysics, India
Frank Linde, NIKHEF, Netherlands
Jay Marx (co-chair), Caltech, USA
David McClelland, Australian National University, Australia
Masatake Ohashi, Institute of Cosmic Ray Research, Japan
Fulvio Ricci, Università La Sapienza, Italy
Gary Sanders, Thirty Meter Telescope, USA
Stan Withcomb, Caltech, USA

GWIC 3G roadmap : detectors R&D

- Goal : develop and facilitate coordination mechansicms among the current and future planned and anticipated ground based GW projects.
- Projects : Einstein Telescope (Europe) & Cosmic Explorer (US)





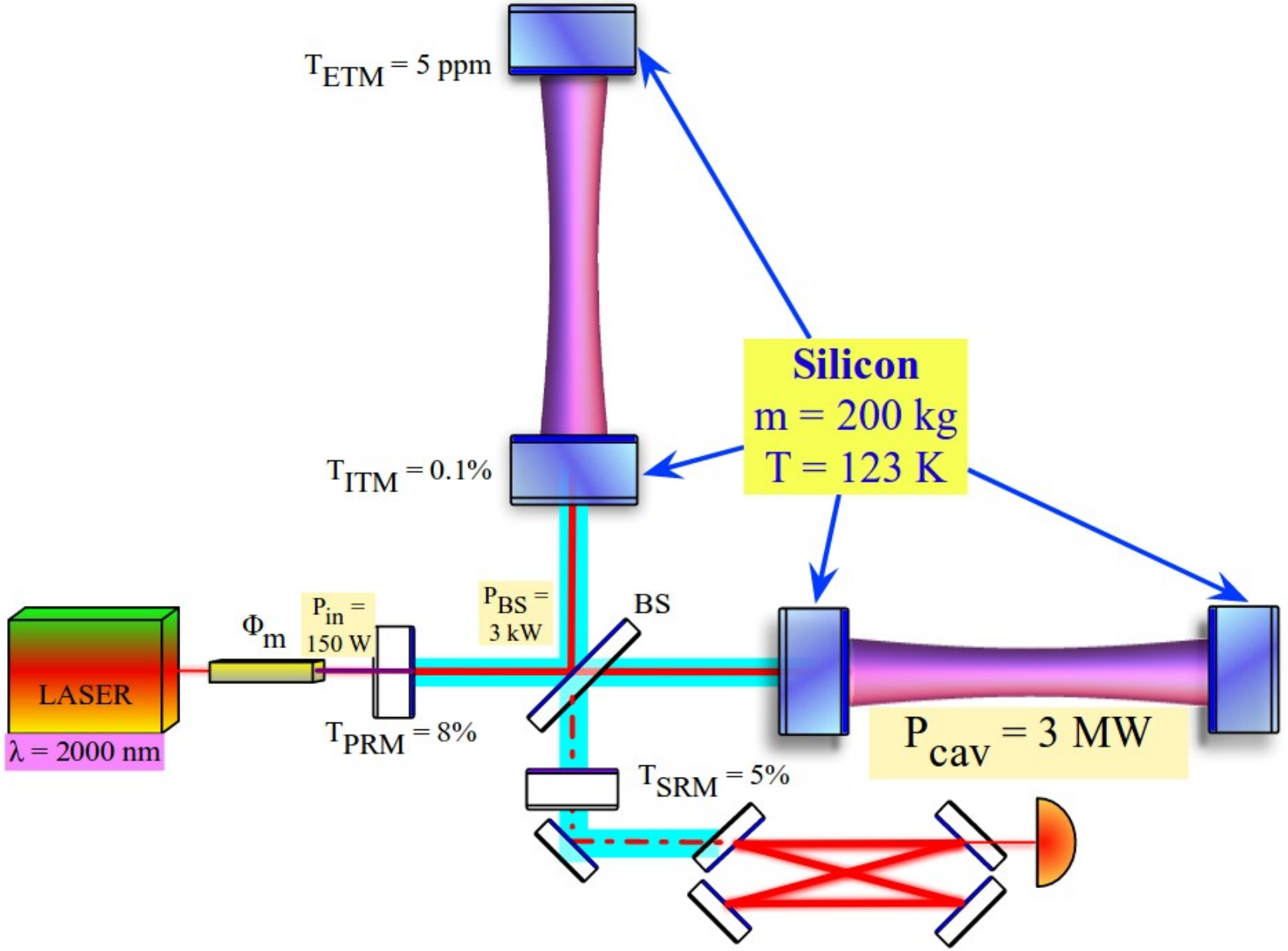
X10 Voyager
40 km arms

- Topics allocated, teams formed, and internal wiki set up.
- Activities:
  - Review current R&D levels of activity and of collaboration amongst detector groups.
  - Evaluate subsystem designs and interdependencies.
- Identify technology shortfalls.

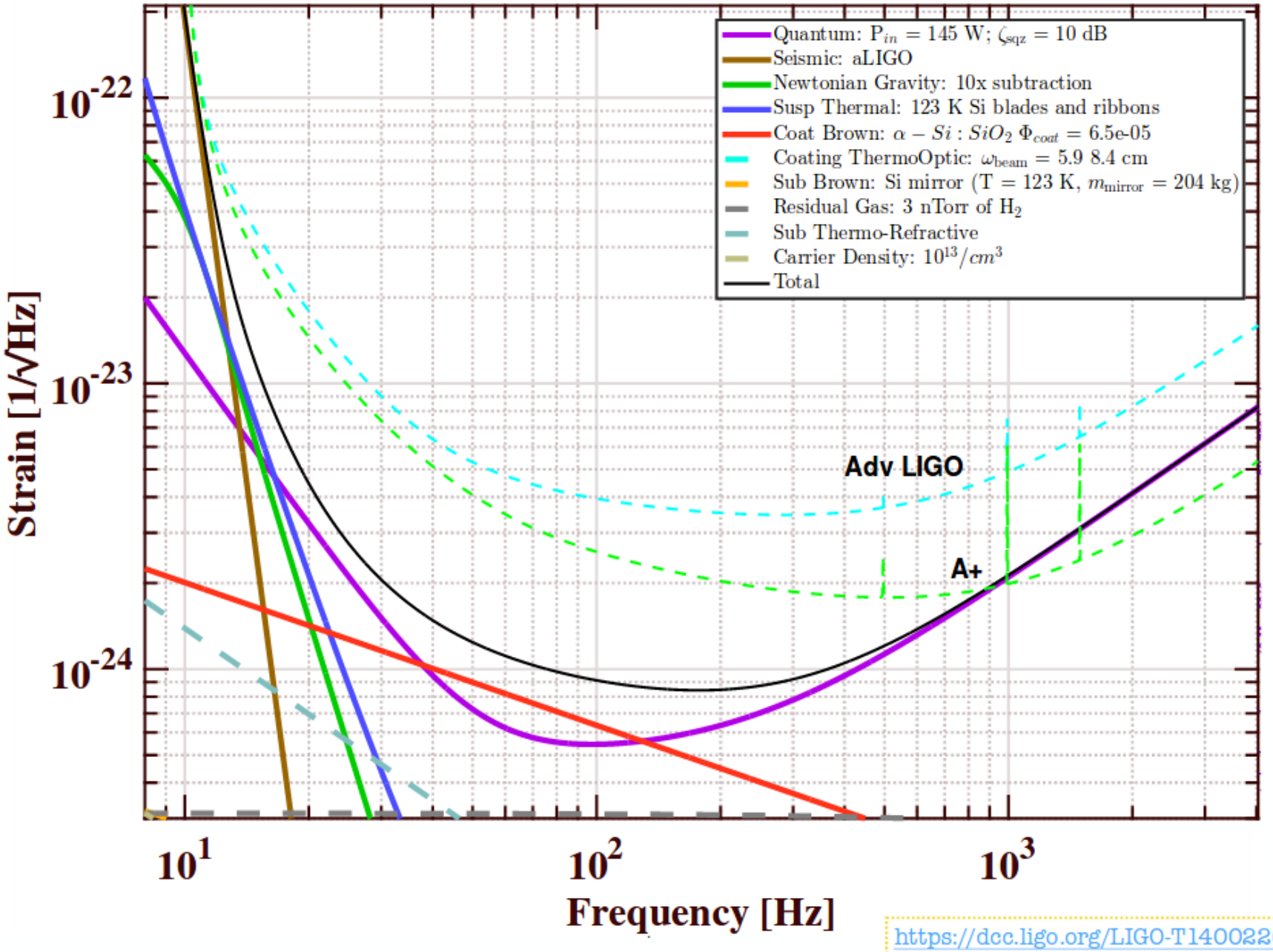
GWIC 3G roadmap : detectors R&D

Topic	Topic coordinators	
Communication with outside	Harald Lück David McClelland	Set up wiki, make sure R&D plans&progress are communicated outside GWIC
Light sources (Lasers + squeezers)	Benno Willke Anil Prabhakar David McClelland	Different λs (1064, 1550, 2100?), different powers, [not interfacing of squeezers]
Coatings	Geppo Cagnoli Marty Fejer	Requires large efforts
Low Frequencies (NN) + site requirements	Jan Harms Stefan Hild	NN subtraction; influence of geology and facility geometry on NN and seism. noise
Simulations & Controls	Andreas Freise Rana Adhikari	Error signal creation, PI, control systems
Facilities & infrastructure	Mike Zucker Fulvio Ricci	Cost saving designs (incl. Op. Costs?) maintain quietness
Cryogenics	Ando Massaki Fulvio Ricci Rana Adhikari	Different cryo regimes (4K, 20K, 124K, 300K)
Suspensions and Isolation	Norna Robertson Gabriela Gonzalez Giovanni Losurdo	Materials, sensing, actuation, coupling (for diff. temperatures)
Core optics	Geppo Cagnoli Marty Fejer	May need ‚internal' x-tal growth facilities not to rely on progress of industry
Aux optics	Anil Prabhakar Matt Evans	New λs, lower loss, TCS
Quantum noise + Configurations	Jan Harms Stefan Hild Giovanni Losurdo Andreas Freise	Include FD squeezing,

LIGO Voyager



LIGO Voyager



https://dcc.ligo.org/LIGO-T1400226

LIGO Voyager

Timeline