

European 2G to 3G network vision

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LIGO
Scientific
Collaboration
collaboration



Virgo Collaboration has invested in Advanced Virgo

Virgo is a European collaboration with about 400 members from about 80 institutes

Advanced Virgo (AdV) and AdV+: upgrades of the Virgo interferometric detector

Participation by scientists from France, Italy, Belgium, The Netherlands, Poland, Hungary, Spain, Germany

- Institutes in Virgo Steering Committee

- | | | | |
|-----------------------|-------------------------|-------------------------|------------------------|
| - APC Paris | - INFN Pisa | - LAPP Annecy | - RMKI Budapest |
| - ARTEMIS Nice | - INFN Roma La Sapienza | - LKB Paris | - UCLouvain, ULiege |
| - IFAE Barcelona | - INFN Roma Tor Vergata | - LMA Lyon | - Univ. of Barcelona |
| - INFN Firenze-Urbino | - INFN Trento-Padova | - Nikhef Amsterdam | - University of Sannio |
| - INFN Genova | - LAL Orsay – ESPCI | - POLGRAW(Poland) | - Univ. of Valencia |
| - INFN Napoli | | - RADBOUD Uni. Nijmegen | - University of Jena |
| - INFN Perugia | | | |

Advanced Virgo project has been formally completed on July 31, 2017

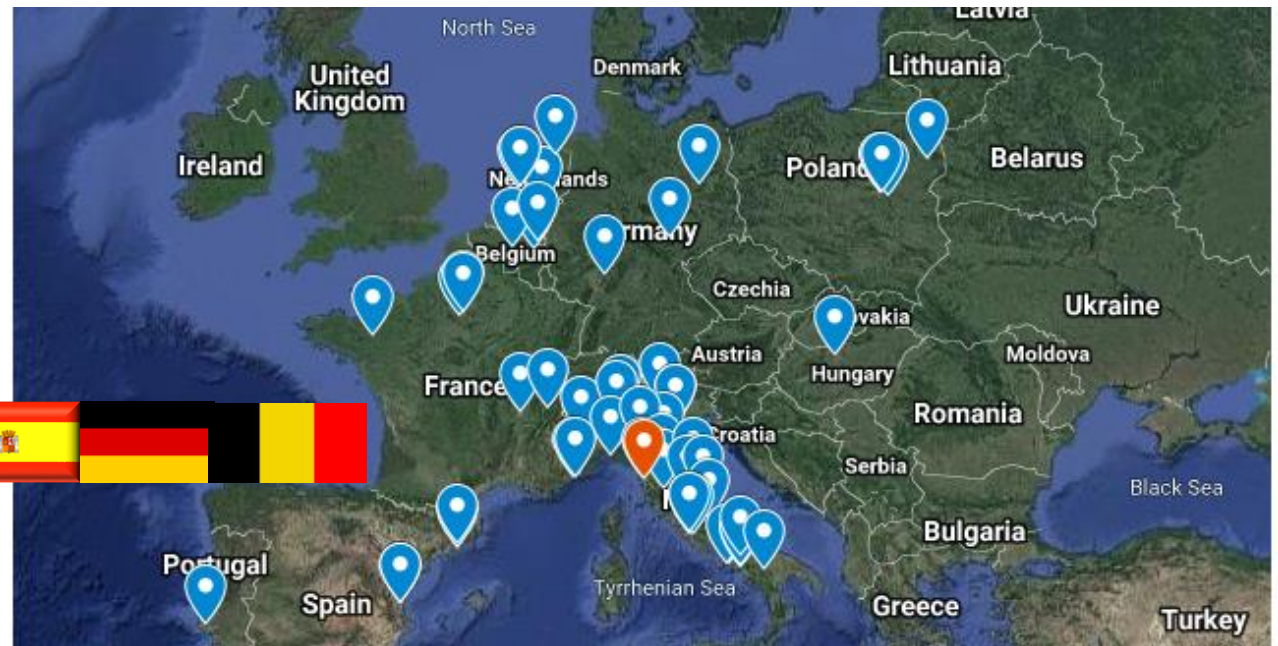
Part of the international network of 2nd generation detectors

Joined the O2 run on August 1, 2017

LIGO and Virgo running of O3



8 European countries



Science harvesting with the global GW detector network

At the same time making Virgo as sensitive and efficient as we can



Fundamental physics

Access to dynamic strong field regime, new tests of General Relativity
Black hole science: inspiral, merger, ringdown, quasi-normal modes, echo's
Lorentz-invariance, equivalence principle, polarization, parity violation, axions

Astrophysics and astronomy

First observation for binary neutron star merger, relation to sGRB, evidence for a kilonova
Start of gravitational wave astronomy, population studies, formation of progenitors, remnant studies

Cosmology

Binary neutron stars and black holes can be used as standard “sirens”, DM and DE, primordial black holes

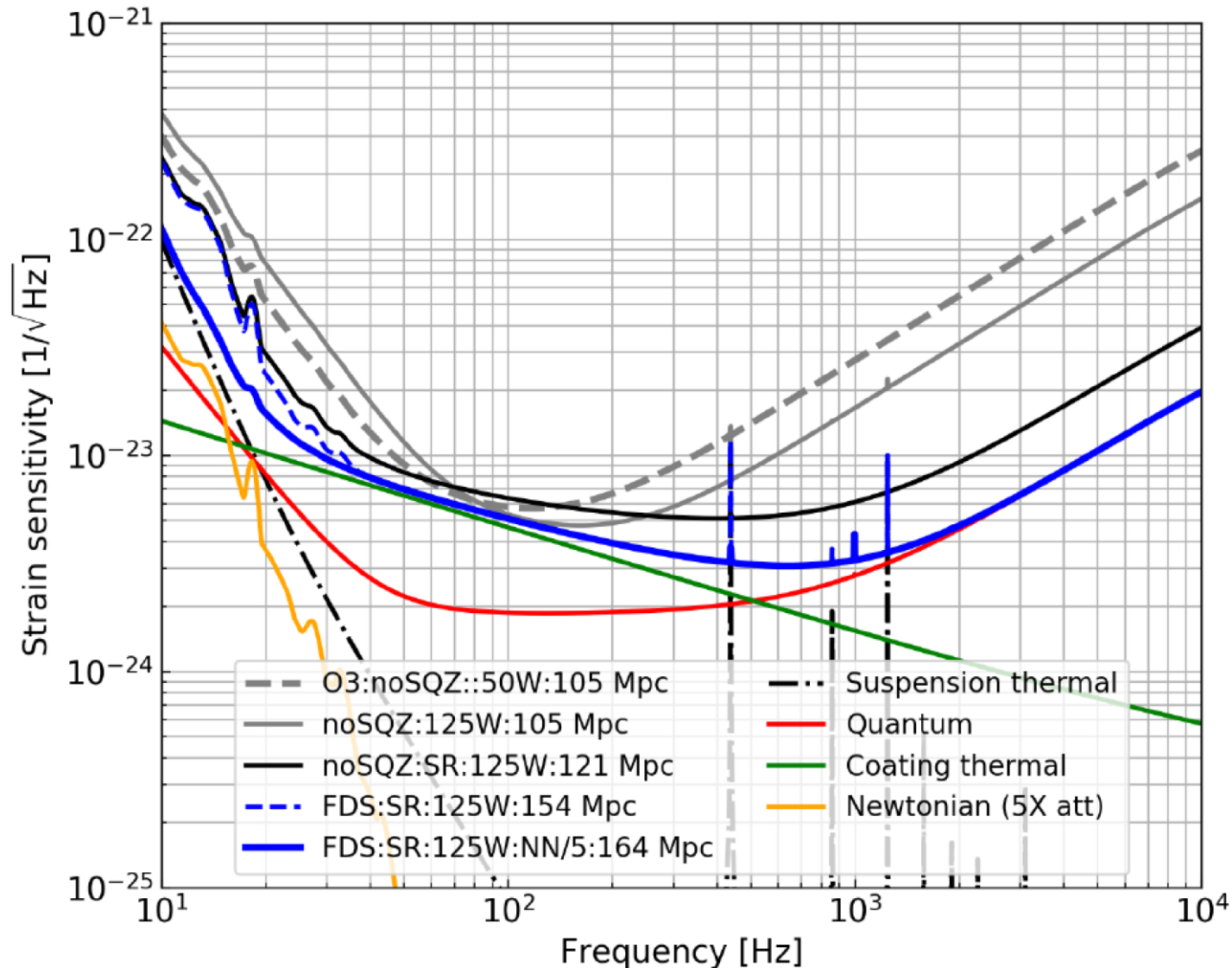
Nuclear physics

Tidal interactions between neutron stars get imprinted on gravitational waves, access to equation of state



Phase 1: reaching the thermal noise wall

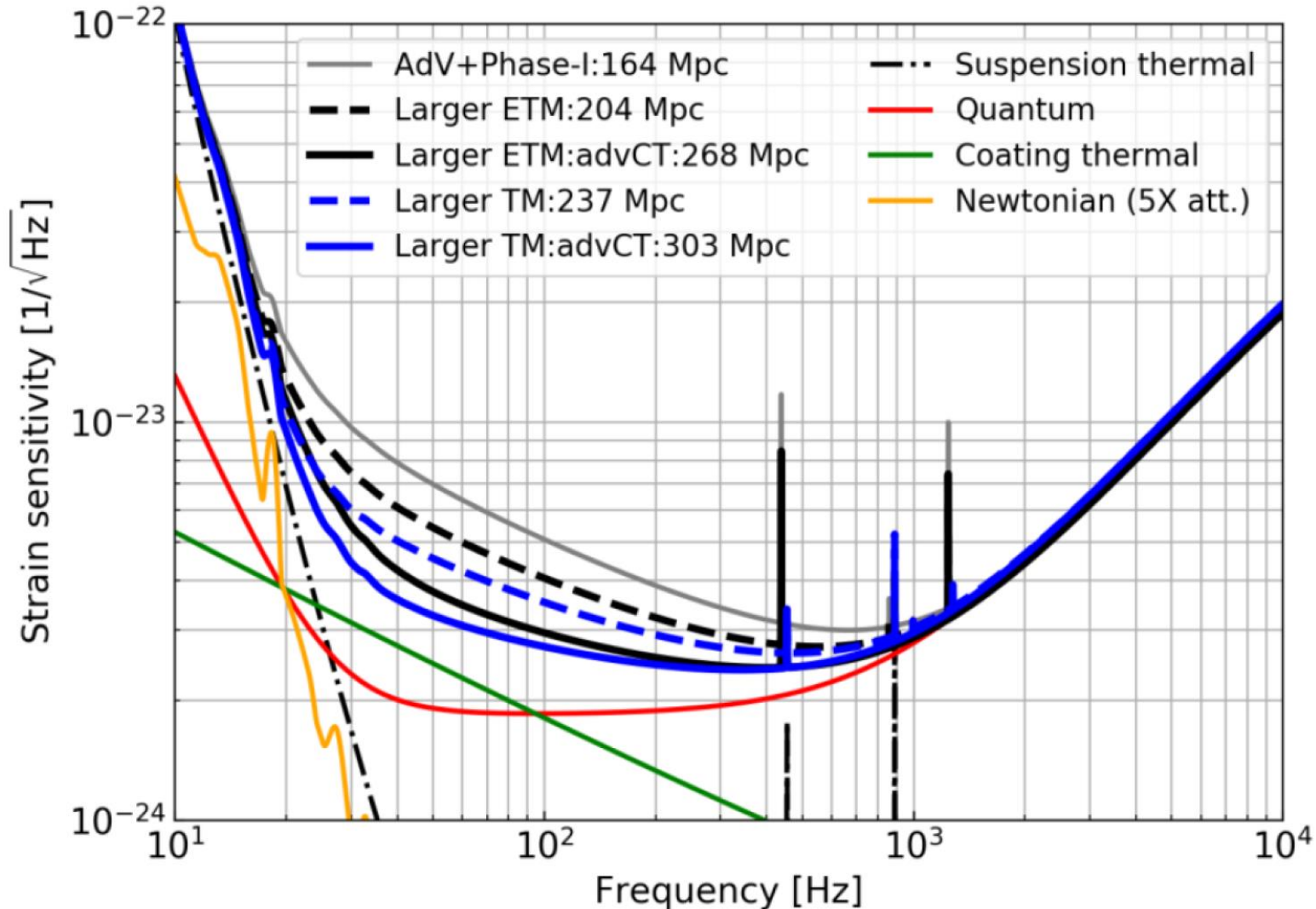
Increase laser power, implement signal recycling, frequency dependent squeezing and Newtonian noise suppression



Phase 2: pushing the thermal noise wall down

Implement larger ETMs and employ better coatings

Even better sensitivity can be obtained by replacing all mirrors, but this would be too invasive



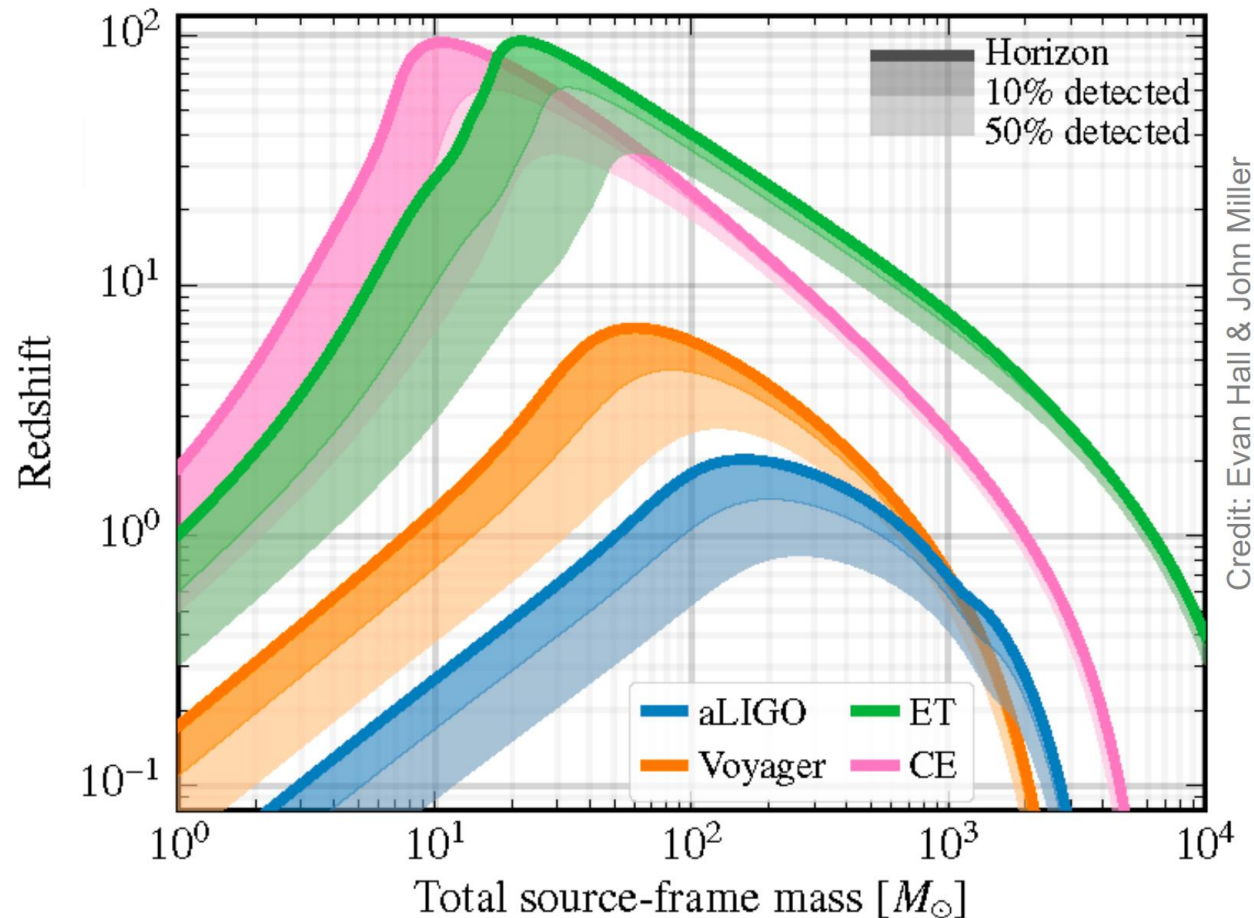
Einstein Telescope

ET as GW observatory with full sky coverage and high uptime



Einstein Telescope

Excellent low-f sensitivity and great discovery potential



For science case, see <https://www.dropbox.com/s/gihpzcue4qd92dt/science-case.pdf?dl=0>

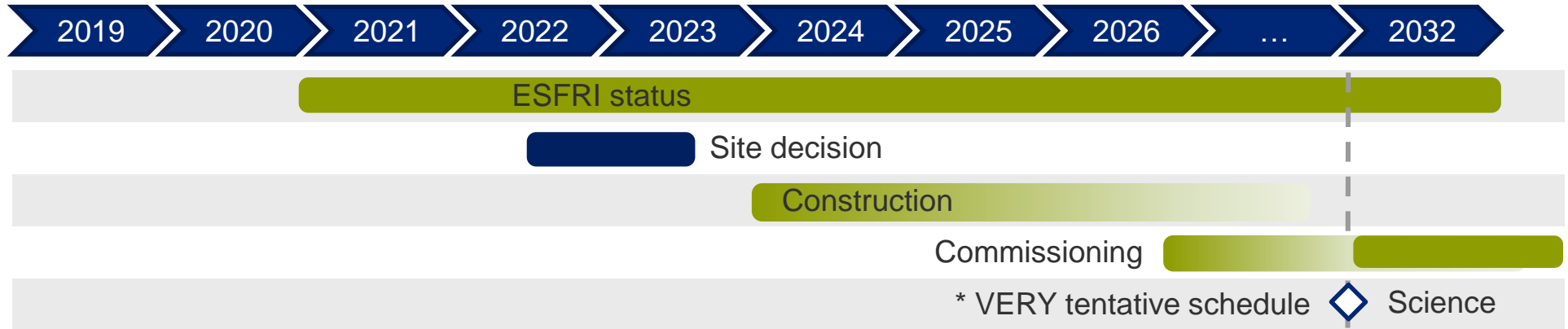
Einstein Telescope

Dreaming about a timeline?



Einstein Telescope

Dreaming about a timeline?



Reality check

TDRs, detailed cost scrutiny, realistic exploitation cost estimate, governance structure

Deadline for EU submission: April 2020

Deadline for the national submissions: January 2020

Formal support must be expressed by a consortium of governments wanting to support ET proposal

**We need to organize the *global* scientific community interested in 3G
(and continuously keep them informed)**

For ESFRI we need to prepare a credible plan for EU funding agencies

ESFRI

Summary

There is great interest in our science

Virgo attracts many new groups, especially from HEP

Many universities are opening a program on GW science

- Several academic positions to be filled

Significant funding will be committed to AdV+

- EGO Council and in-kind contributions from the Netherlands, Poland and Spain

Sizeable funding has been made available for our 3G R&D activities

- Although in some cases from unusual sources

We need to organize the global scientific community interested in 3G

- LVC should embrace 3G activities in their Core Program
- 3G body should continuously inform their interested scientists (e.g. newsletter, website, events)
- Insufficient progress

Insertion of ET in the roadmap of the European Strategic Forum for Research Infrastructures (ESFRI) would be a major milestone for 3G

- Tremendous activity ahead