# Timeline and Framework for Future Detectors

Where do we go from here?

#### Thanks

- Thanks to the organizers for putting together this year's GWADW and for bringing us to the beautiful place!
- Thanks to David McClelland, Rana Adhikari, Stefan Ballmer, Lisa Barsotti, Garrett Cole, and others who have contributed to the work I will be presenting
- Thanks to Mark Coles for helping us to shape realistic plans!

#### A Lot of Great Ideas

At this GWADW we have heard a lot of great ideas

- ✤ How will we use them?
- When will they be ready for deployment?
- ✤ On the demand side, at least for LIGO...
  - ♦ What detector upgrades to we expect?
  - ♦ When might new facilities be built?

# LIGO Upgrade Path

- ♦ Quantum LIGO
  - Brief, near-term upgrade (less than \$5M per detector)
  - Goal is a factor of 2 improvement, at least a high frequencies
- Voyager a major upgrade in the current facility
  - Result of RGB design synthesis
  - ✤ Goal is 700Mpc range
- ✤ Ultimate new facility
  - ✤ Goal is to significantly increase scientific output relative to Voyager, or anything possible in the current facility













## Quantum LIGO

- This is a near term upgrade to Advanced LIGO
  - "Enhanced Advanced LIGO" is too long of a name
- After first major science run, and hopefully after first detections are made (2017-2018)
  - Dark time must be short (few months)
  - Budget will be modest (less than \$5M per site)



# Near Term LIGO R&D

- What technologies can we include in Quantum LIGO?
- Potential "quick" improvements
  - ✤ Squeezing, with a filter cavity
  - New coatings for lower thermal noise
  - ✤ Larger test-masses, longer suspensions



#### Squeezing Upgrade (for 2 IFOs)

12 the grade

#### END 2015: Final Design & Decision Point:

Is a filter cavity going to be part of this first upgrade?





#### Technology Timeline

2019

2020

Squeezing (possibly with filter cavity)

2017

NOW

2015

2016

2018

Crystalline Coating on fused silica

2021 2022

2023

Squeezing with filter cavity (if not before)

## Quantum LIGO R&D

- What technologies can we include in Quantum LIGO?
- Potential "quick" improvements
  - Squeezing, with a filter cavity On track for ~6dB
  - New coatings for lower thermal noise
  - Larger test-masses, longer suspensions



Coating scalability R&D must start NOW for 2021 upgrade.

## The Message

- There is still a lot we can do in the current facilities
- The RGB designs identified compatible technologies
- We also need to count backwards from our planned installation date to determine if these technologies are on the a useful readiness trajectory
  - ✤ Are we doing the right R&D?
  - ✤ Will we be ready in time?
- We need to start thinking about new US facilities
  - Many thanks to the ET team for lighting the way!

# Ultimate LIGO commissioners!





## Squeezing

Squeezing is now "conventional technology"

