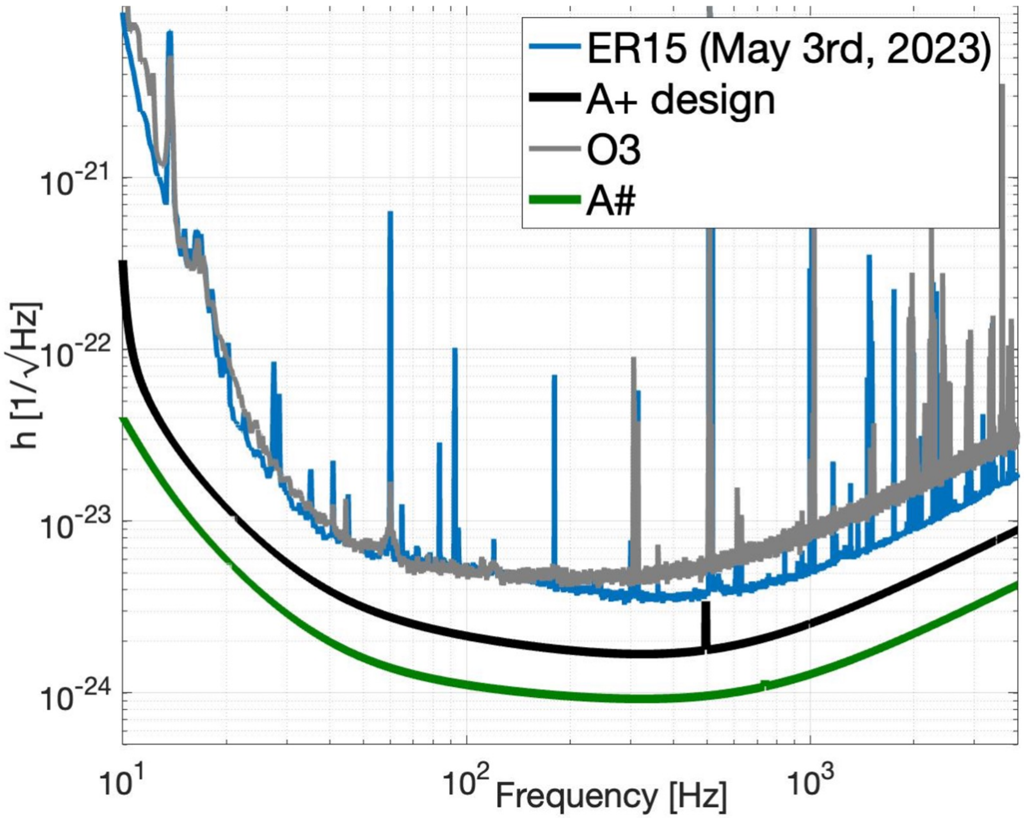
A# Sensitivity Goals

LSC Post-O5 study: A# design

- 1 um laser wavelength, room temperature, fused silica masses
- Stepping stone toward **Cosmic Explorer** and **ET HF**

A♯ versus A+: Low frequencies: close to a factor of 2 reduction

- Larger test mass (40 kg → **100 kg**) for lower radiation pressure
- Higher stress fibers to reduce thermal noise
- Improved seismic isolation to reduce excess control noise



A♯ versus A+: Mid frequencies: close to a factor of 2 reduction

- Improve coating thermal noise a **factor of 2 below A+ design level**

A♯ versus A+: High frequencies: factor of 2 reduction

- Higher laser power (**1.5 MW** arm power, x4 current)
- Improved thermal effect compensation
- Improved squeezed light injection (**10 dB**, 6 dB current)

Adapted from Gabriele Vajente

Technical Risks of A#

- Inability to operate at the power level of 1.5 MW in the arms
  - Thermal distortions in the test masses – can we really get rid of point absorbers?
  - Parametric instabilities
  - Control problems associated with radiation pressure should be mitigated by larger test masses

- Insufficient compensation of thermal distortions at 1.5 MW
  - Resulting optical loss would limit squeezing (particularly at high frequencies)

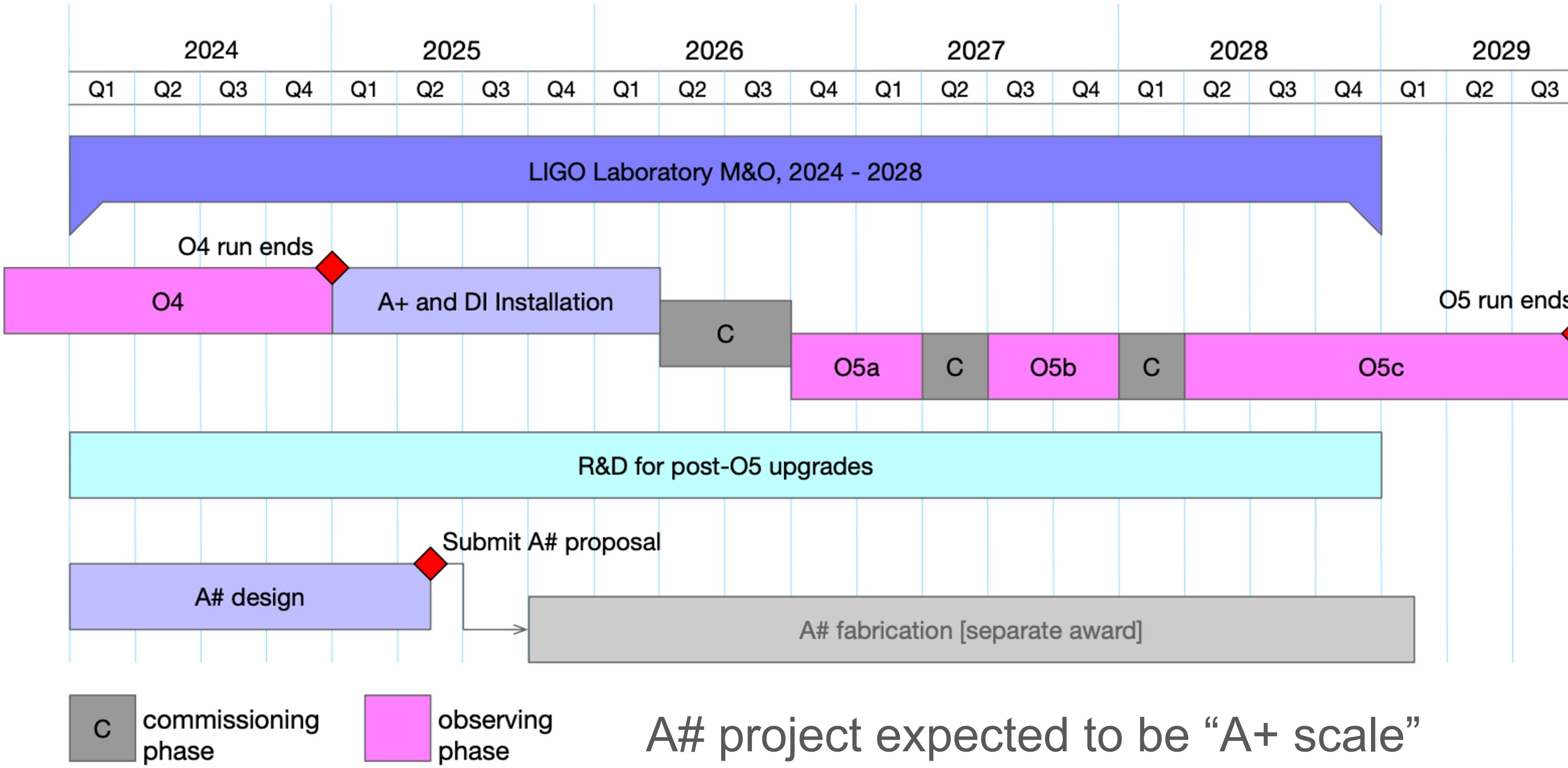
- No improvements in coating thermal noise
  - AlGaAs doesn't work out: has excess noise, or can't fund the large-scale development
  - No improvements in amorphous material mechanical loss

- Inability to identify & mitigate low-frequency technical/mystery noises

A# Research Opportunities

- Suspension re-design, incorporate lessons learned
- Seismic isolation improvements
- High power lasers
- Thermal compensation system (sensors and actuators)
- Parametric instabilities mitigation strategy
- 10 dB frequency-dependent squeezing “challenge”
  - Long list of degradation mechanisms to further mitigate
  - Active wavefront control (sensors and actuators)
  - …
- Coating research
- Control noise reduction
- Long term optimal interferometer tuning
- …

Timeframe for A# development



A# project expected to be "A+ scale"

Detailed costing not yet done

1 um, fused silica @ room temperature

	Arm power	Test Mass Weight	Coating Target	Squeezing
A#	**1.5 MW**	**100 kg**	Best available (target x4 better than adv)	**10 dB**
Virgo_nEXT	**1.5 MW**	**105 kg**	Best available	**10.5 dB**
ET_HF	**3 MW**	**200 kg**	Best available (X2.7 better than adv)	**10 dB**
Cosmic Explorer	**1.5 MW**	**320 kg**	Best available (X2 better than adv)	**10 dB**