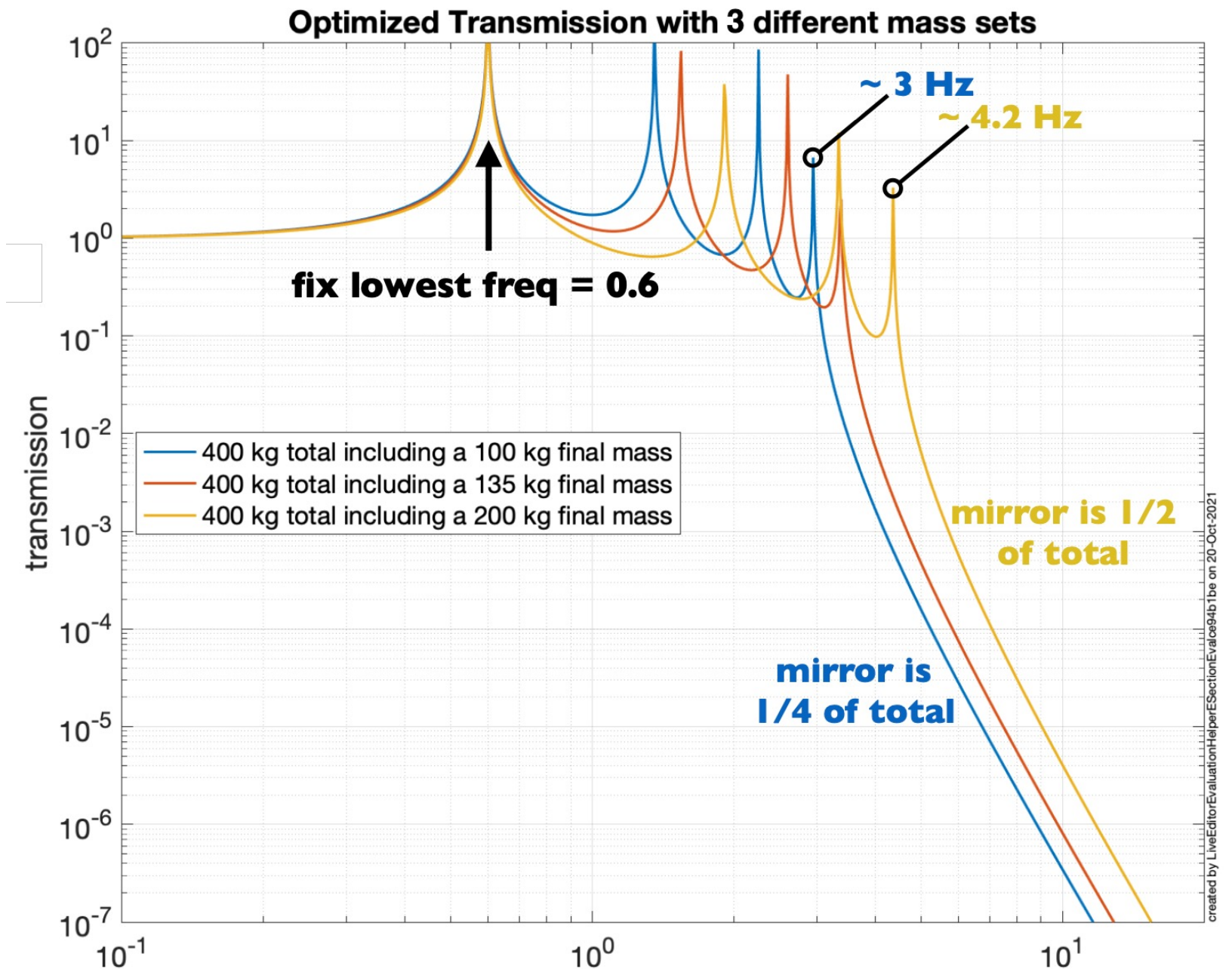
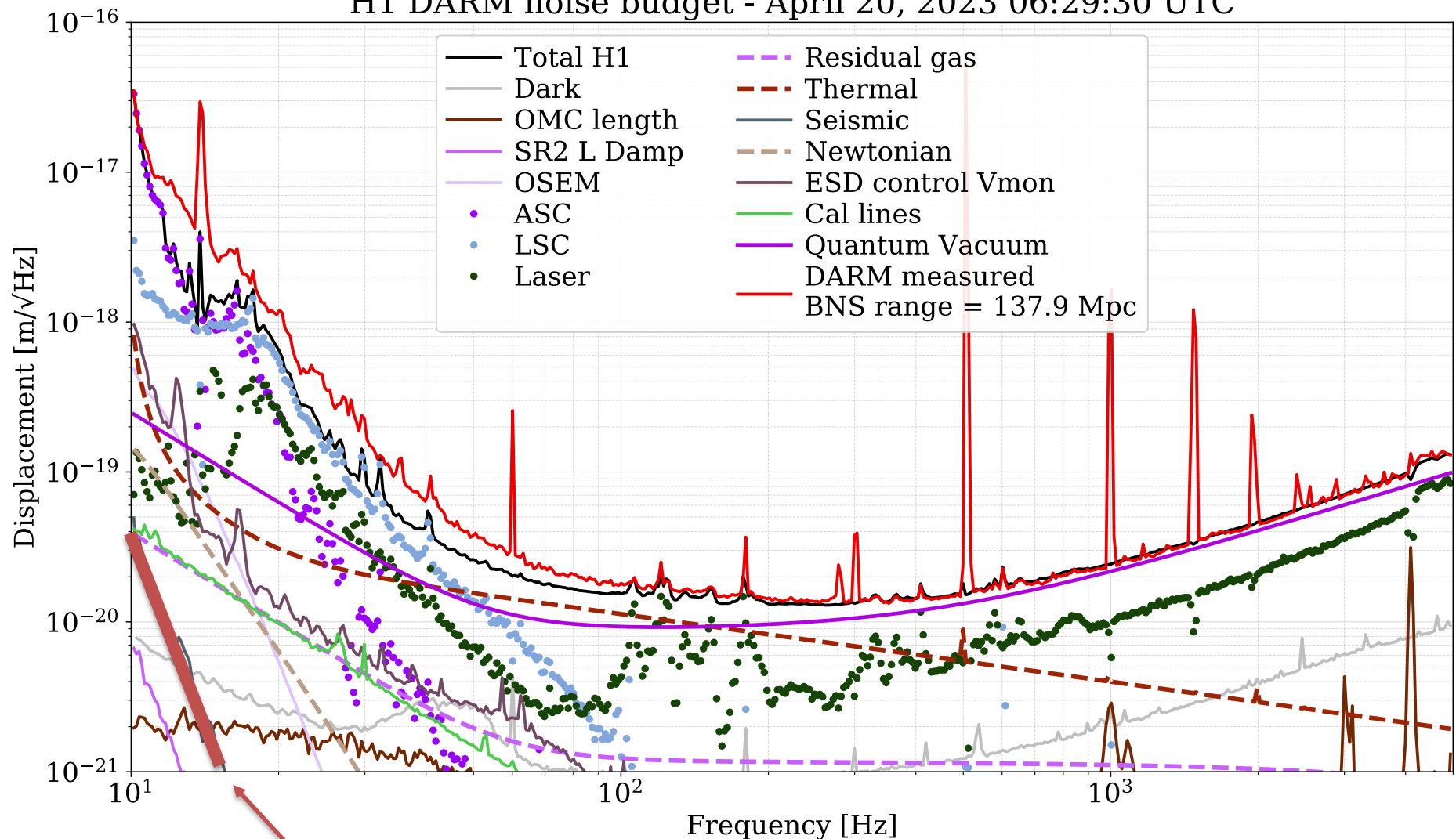


From L. Trozzo, New Generation Super Attenuator for Einstein Telescope-NGSA: status of the project



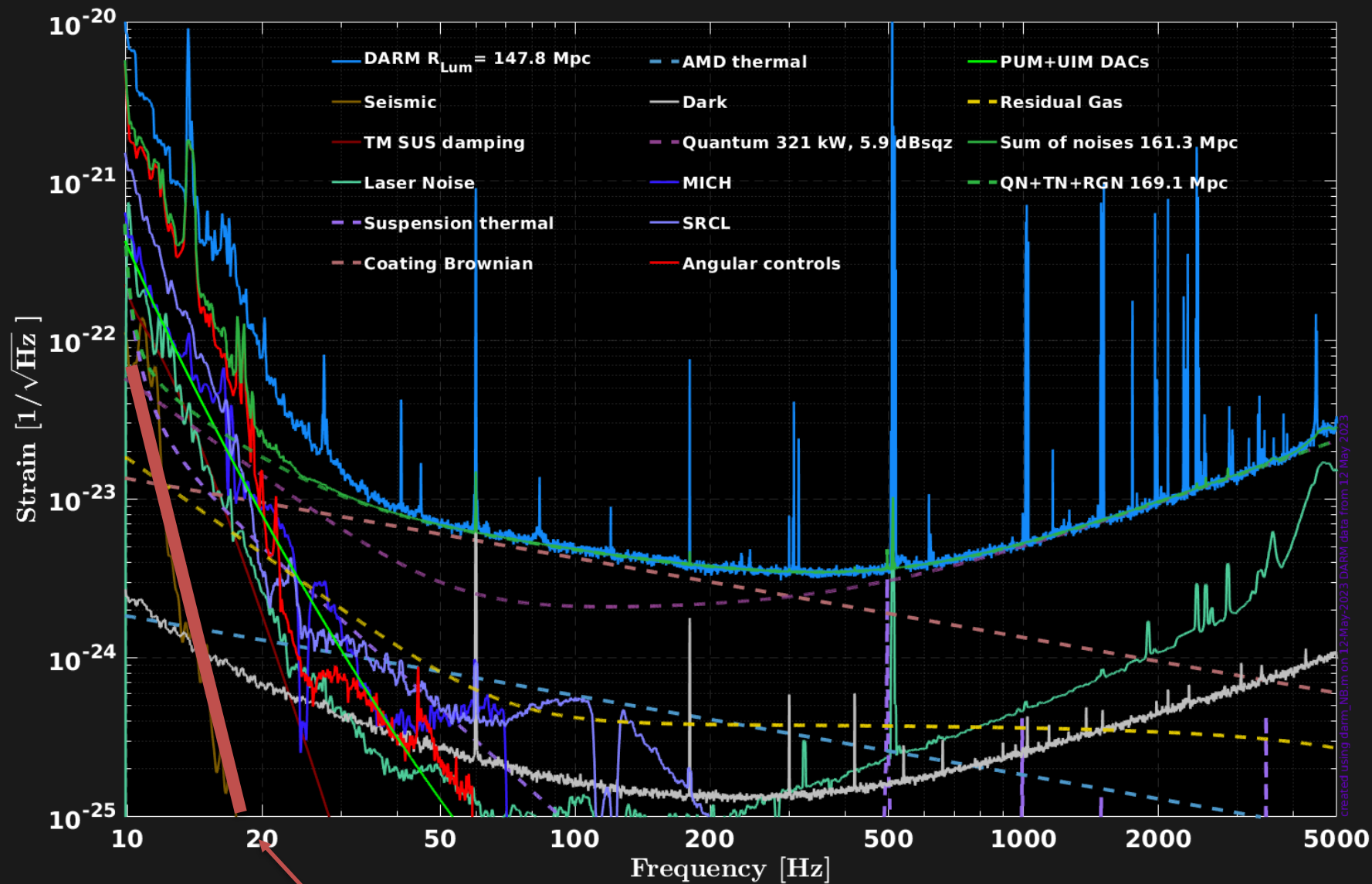
B. Lantz, 100 kg optic with upgraded suspension for LIGO A#

H1 DARM noise budget - April 20, 2023 06:29:30 UTC



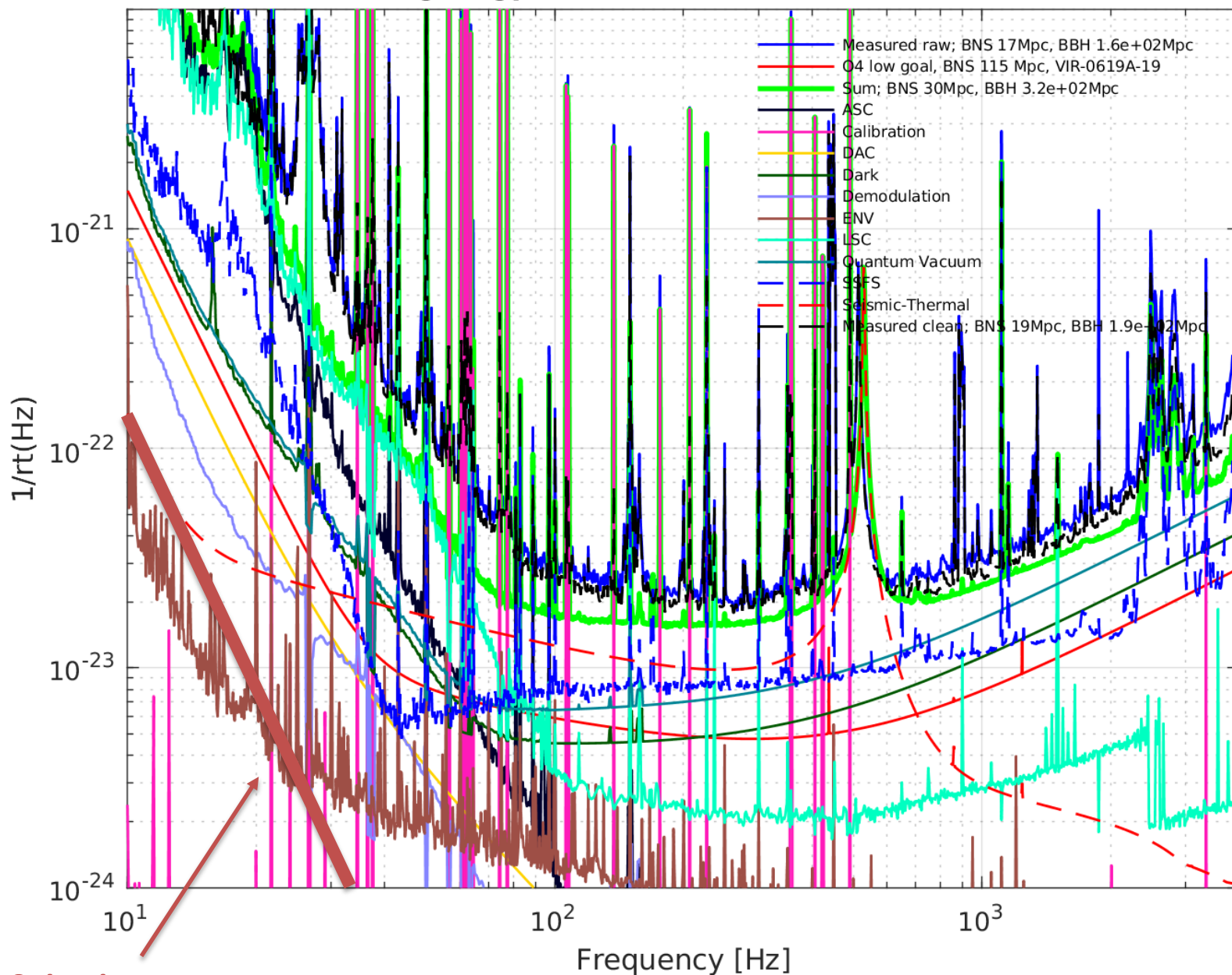
start = 1366007388 span = 450 s DARM channel H1:CAL-DELTA_EXTERNAL_DQ

Seismic

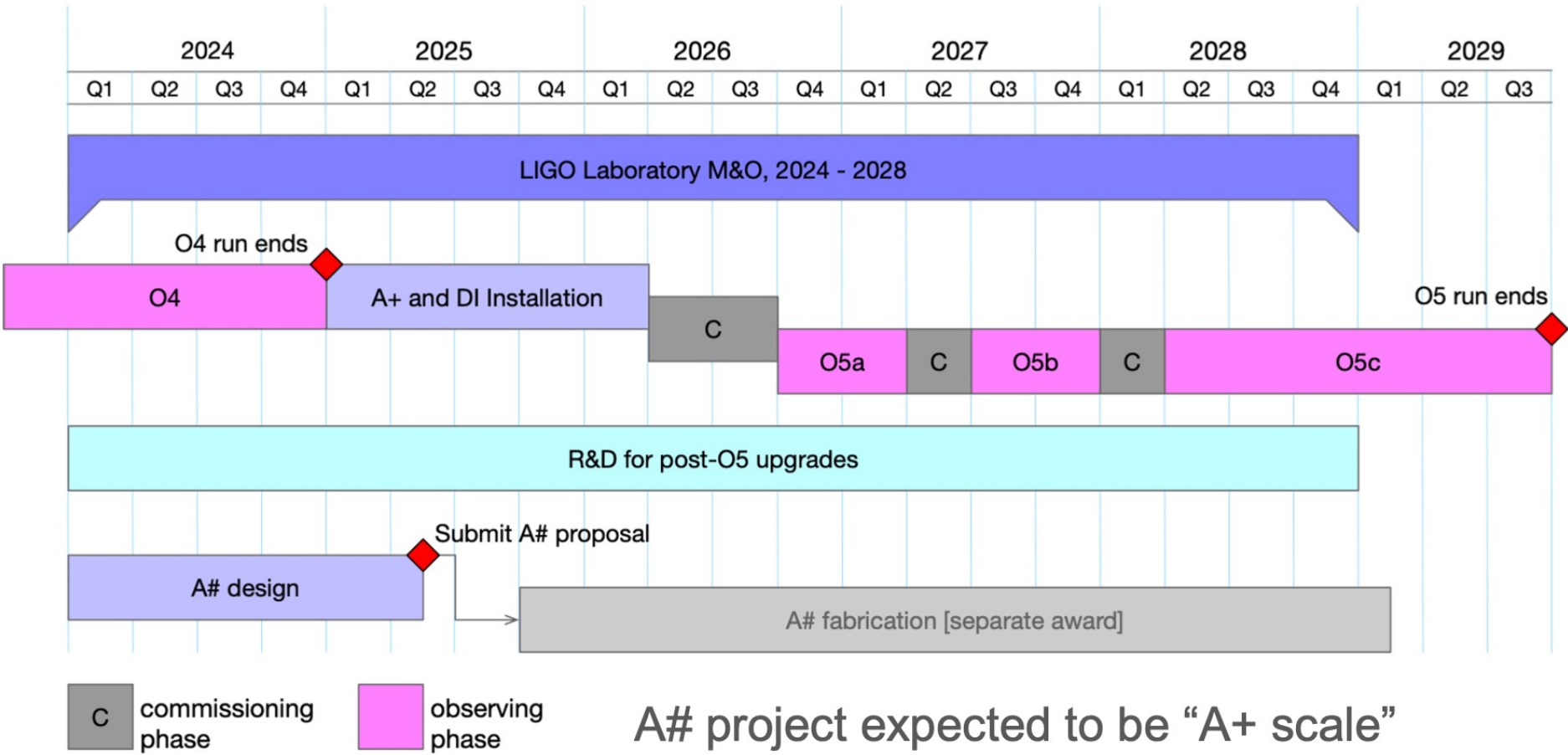


Seismic

STRAIN NoiseBudget; gps = 1367365739 (2023-05-05 23:48:41 UTC)



Seismic



A# project expected to be “A+ scale”
Detailed costing not yet done

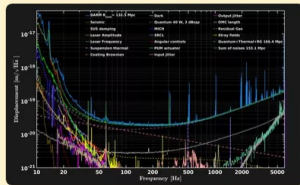
https://padlet.com/vajente/missing-noise-sources-at-low-frequency-4pd0ze1iqdh2cgq3

vajente + 3 • 1yr

Missing noise sources at low frequency

What are some potential noise sources that we haven't investigated / modeled enough?

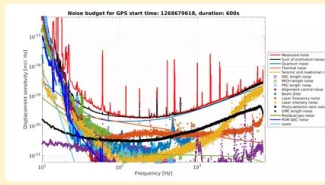
LHO noise budget from May 2020



<https://alog.ligo-la.caltech.edu/a/LOG/index.php?callRep=51967>

An example of the gap between measured sensitivity and total sum of understood noises

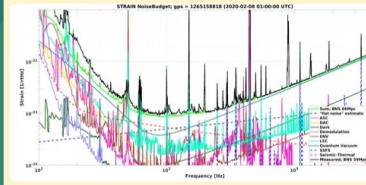
LHO noise budget from O3b



<https://alog.ligo-wa.caltech.edu/a/LOG/index.php?callRep=55755>

An example of the gap between measured sensitivity and total sum of understood noises

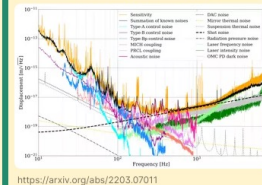
Virgo noise budget from O3b



<https://dcc.ligo.org/LIGO-G2001566>

An example of the gap between measured sensitivity and total sum of understood noises

KAGRA noise budget from O3GK



<https://arxiv.org/abs/2203.07011>

An example of the gap between measured sensitivity and total sum of understood noises

Accurate measurements of infrasound near 10 Hz: i.e., not confused by stagnation pressure interactions, wind turbulence, or sensor noise.

- Some speculation that the global infrasound median (1 mPa/rHz) is sensor noise limited, and the true median might be lower (Zumberge 2003)

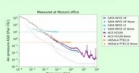
- Fiorucci et al measurements at Virgo were wind-limited outdoors

NN from stagnation pressure and wind turbulence: order-of-magnitude analytical estimates computed by Teviet Creighton — are there numerical estimates? more accurate analytical calculations? Probably little attention because current estimates are small.

NN from aeroacoustic effect sourced by fully developed turbulence in the open atmosphere: analytical estimates given by Cafaro and Ali, and in Harms; result is small, but does this need to be verified numerically?

NN from temperature variations from turbulent mixing — this is calculated by Creighton, who is also doing numerical simulations.

Test of infrasound sensors in KAGRA



We have many infrasound sensors and tested them in KAGRA.

Better displacement readout sensor sub-femtometer readout precision (?)

Timing and fiber noise

Timing distribution over km: fibers are sensitive to seismic noise. Could be a problem if we need accurate timing information over long baseline

Noises and mechanical/optical properties associated with large substrates, potentially with multiple domains: e.g., the recent Glasgow measurements on directionally solidified silicon

Verifying thermal noise scalings at low frequency: e.g., coating Brownian noise at <10 Hz? E.g. are we extrapolating material properties, like mechanical loss, measured at high frequencies down to low frequencies, and if there are no measurements is this justified?

Reference cavity measurements should be used here.

Excess thermal noise, for example in bonds

Although I expect somebodies measured HCB mechanical loss, is it not true?

Has anyone calculated vertical suspension thermoelectric noise?

Thermoelectric noise is caused by inhomogeneous strain. The vertical mode of fiber does not matter because strain is homogeneous. But it is not true in the case of cantilever for vertical isolation.

My poster (G. Eddolls from Glasgow) covers bond loss issues for HC bonded silicon suspension. DCC link: <https://dcc.ligo.org/LIGO-G2200823>

Non-technical risks

A generation of detector builders are retiring. What kinds of expert knowledge are we (unknowingly) losing?

What are IFO requirements?

What is DARM closed-loop RMS? How many other DOFs have similar requirements with some provenance?

This has a profound effect on design decisions

Upconversion due to RMS of angular and longitudinal DOFs. How to compute the requirement including non-linearities

Soft saturation of sensors and actuators

Beam jitter (input and output)

Slide 12 of

<https://www.gravity.phys.titech.ac.jp/GWADW2022/talks/Was.pdf>

Also "higher-order modes beam jitter" (i.e. beam size fluctuation)

Magnetic fields: are we missing anything by just extrapolating the couplings from the current detectors?

Magnetic field interacting with auxiliary optics, isolation benches, etc. In particular large magnets of Faraday Isolators

https://tds.virgo-qw.eu/?call_file=VIR-0310A-22_AdvTechnicalNoisesExternalMagn.pdf and <https://tds.virgo-qw.eu/?content=3&r=19709> show measurements of magnetic noise and effects at Virgo, and some kind scary projections for ET

After mitigating as much as possible, how much feed-forward cancellation can we expect here? Is coherence seen in current interferometers? more vertical

(above Virgo doc are not public... PDFs?)

KAGRA: <https://www.mdol.com/2075-4434/10/3/63>

LIGO: <https://arxiv.org/abs/2101.09935>

all LSC members should be able to request an EGO active directory, and the documents are LVK viewable, like the DCC.

Control noise up-conversion / modulation / non-linear coupling

Specific for LIGO: noise from ASC channels slowly modulated, sensed by OPLEV sensors?..

See also this paper <https://www.frontiersin.org/articles/10.3389/ftai.2022.811563/full> and this <https://journals.aps.org/prd/abstract/10.1103/PhysRevD.10.5.102005>

Actuation noise

Dissection of Actuation noise at Virgo and implications for ET-LF <https://apps.et-qw.eu/tds/?content=3&r=17713> more vertical

ASC noise seems like the worst problem here. How do we get beam motion to below 100 um? more vertical

(that Virgo doc is not easily accessible... PDF?)

ASC is not an issue in Virgo currently - it is comparable to Suspension Thermal Noise

100um or 1mm is the rms not the DC offset. Maybe we are missing something there.

Marionette control noise from AdvVirgo to ET
Piero Rugge - EGO

PDF
<https://dcc.ligo.org/LIGO-G2200847>

Instrumented baffle at Virgo

<https://dcc.ligo.org/LIGO-G2200847>

GEO suspended baffles

<https://doi.org/10.1088/0264-9381/33/7/075009>

Accurate measurements of in-chamber electric fields: LIGO's measurements are just upper limits. Has Virgo had better luck?

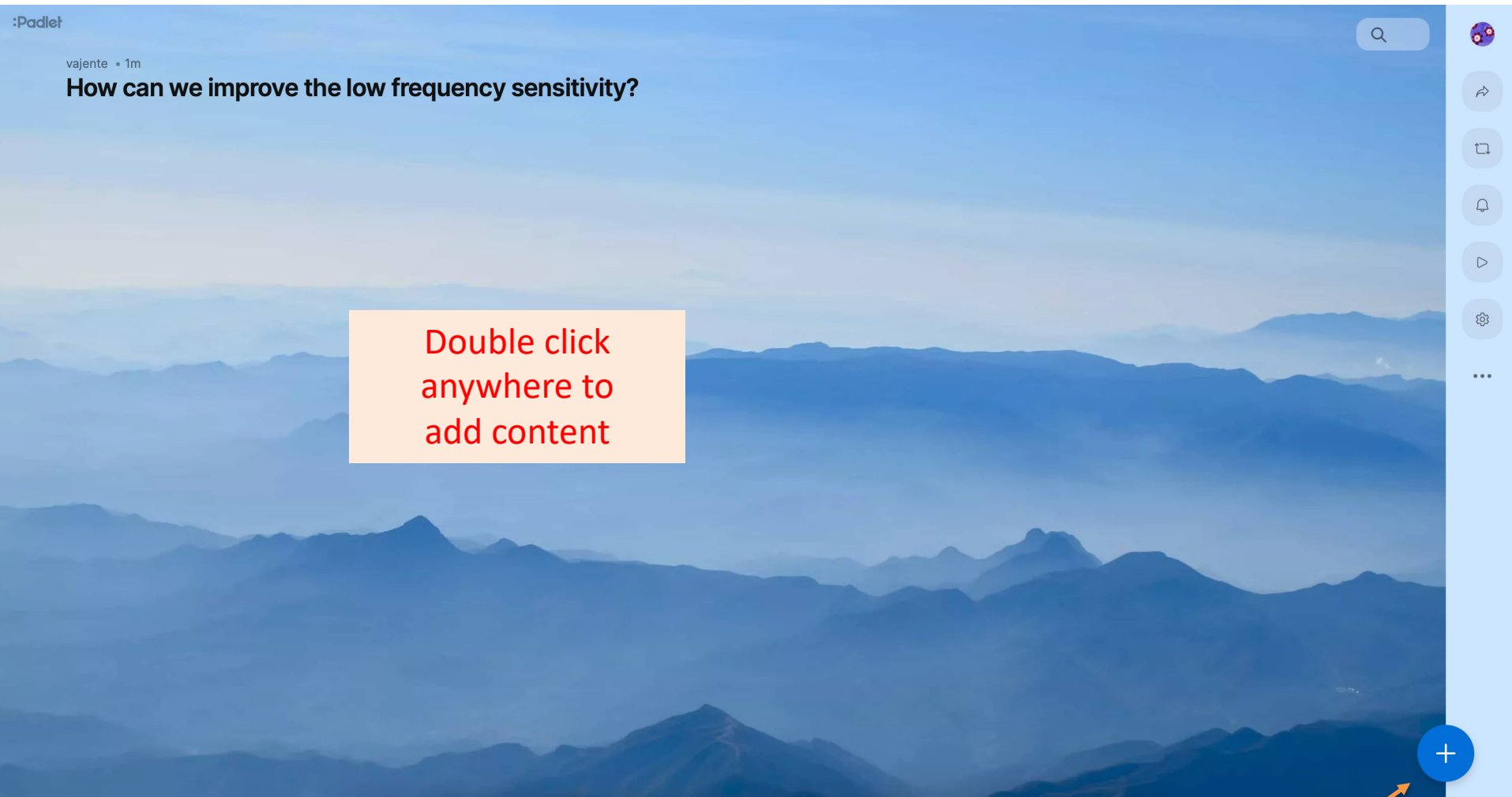
LIGO results: <https://dcc.ligo.org/LIGO-G1801249>

Patch potentials and their time variation ("charge hopping")

Initial Electric Field Meter results for Advanced LIGO and Beyond
Craig Calhoun June 16, 2018

PDF
Initial Electric Field Meter Results for Advanced LIGO and Beyond(1)

<https://tinyurl.com/gwadw23>



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