Status of the underground gravitational wave detector KAGRA

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Gravitational waves as a probe of the universe

New eyes to observe the Universe

K. Kokeyama JGW-G1808116

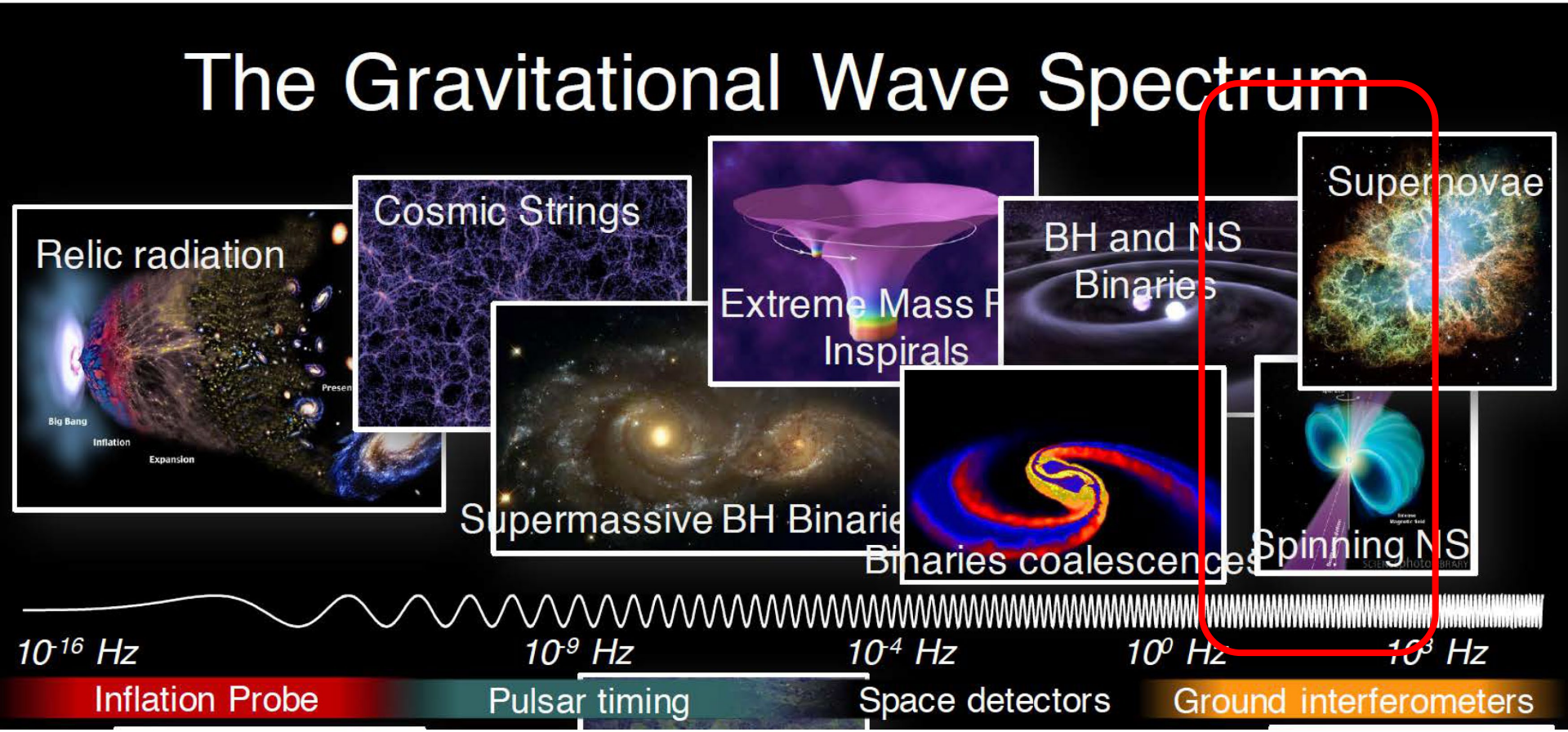
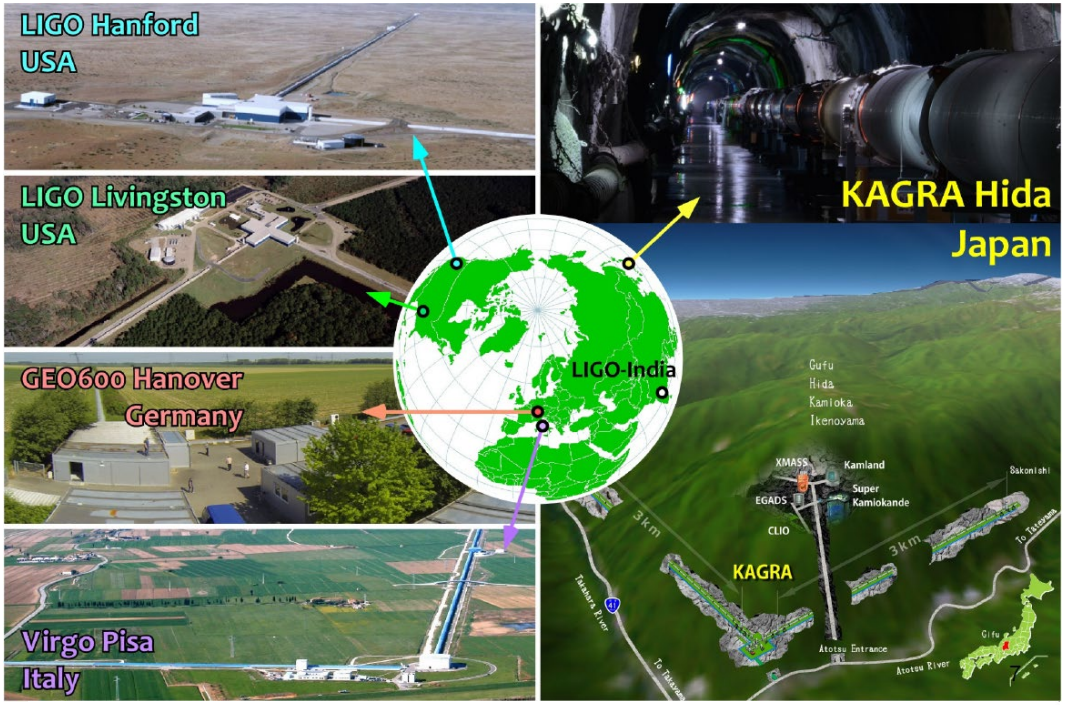


Figure: M Evans

Global network and multi-messenger astronomy



Network duty factor during O3

[1256655618-1269363618]

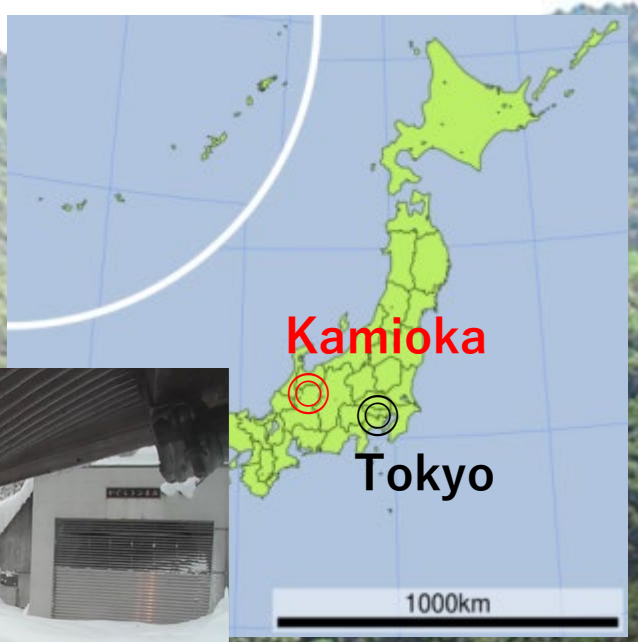
- Triple interferometer [51.1%]
- Double interferometer [34.3%]
- Single interferometer [11.3%]
- No interferometer [3.4%]

- 90 confident events in O1-O3.
- One successful follow-up observation: GW170817
  - GW, short GRB, and afterglow
  - Counterpart was identified.
  - Standard siren etc.
- Multiple-detector observation is essential for:
  - better localization
  - better duty cycle
- Increase of the number of detectors are important.

KAGRA

KAGRA entrance

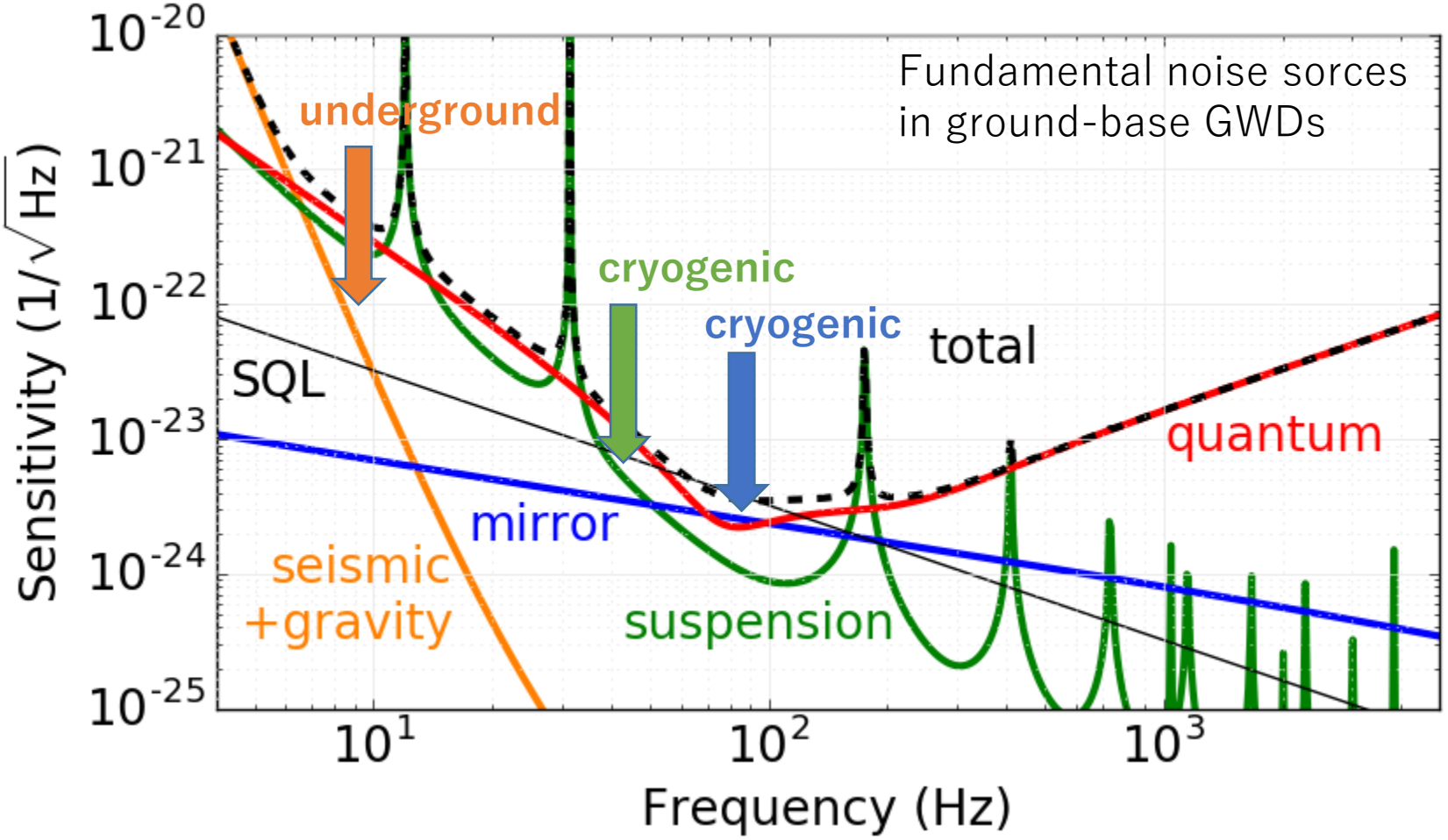
KAGRA entrance in winter season



KAGRA site around BS

KAGRA

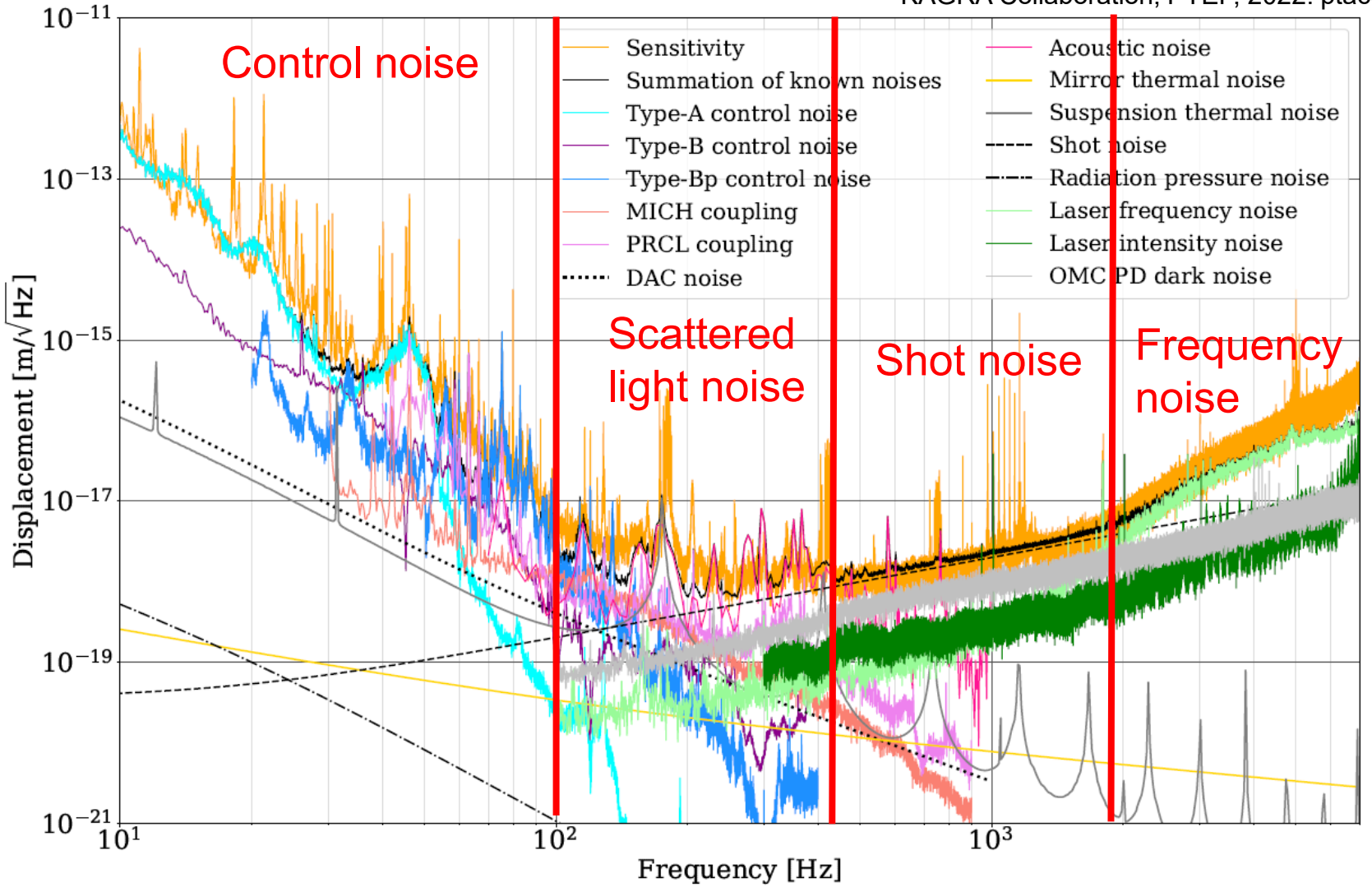
Why underground and cryogenics?



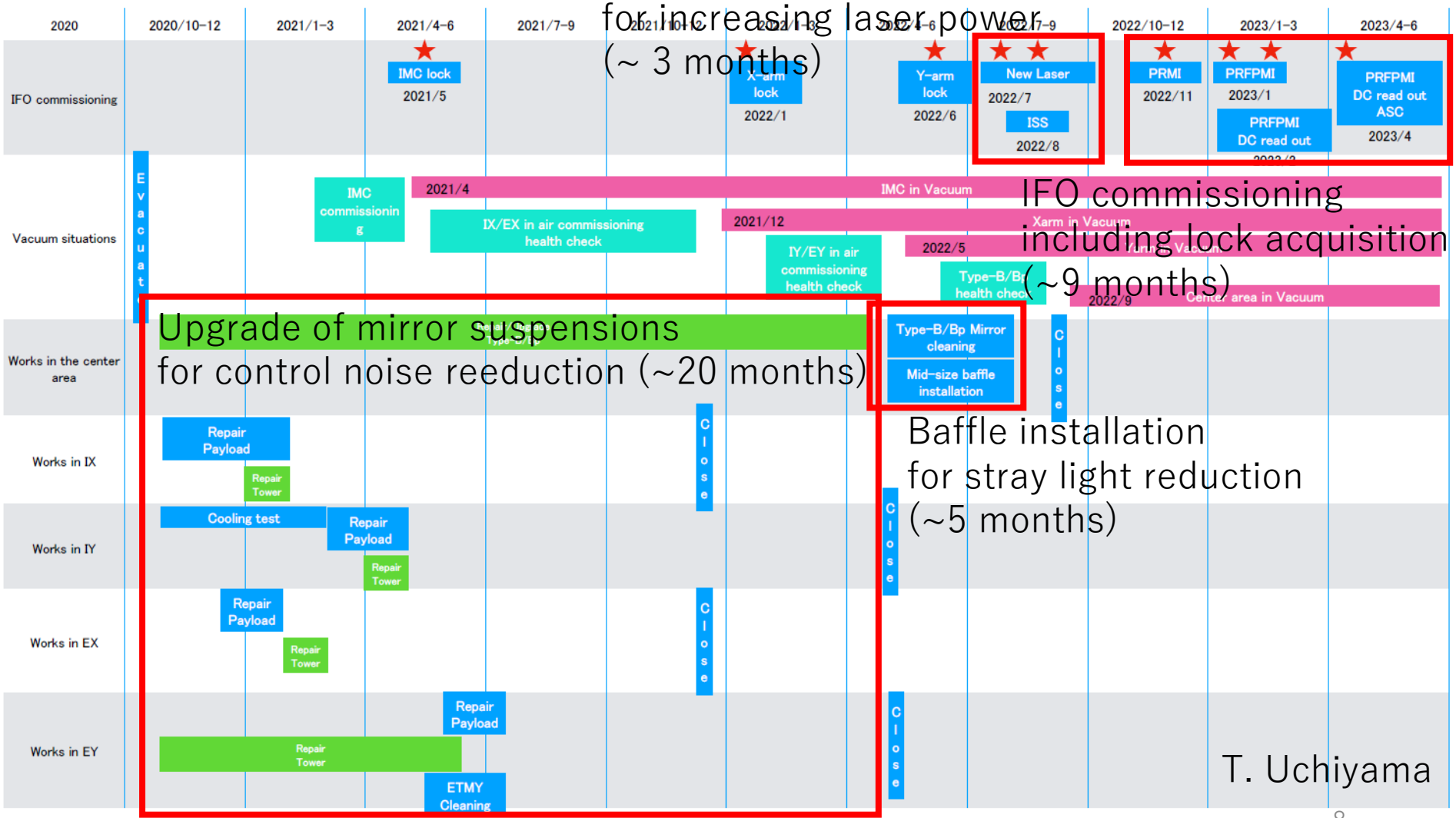
Underground: reduce seismic noise and gravity gradient noise
Cryogenic: reduce suspension and mirror thermal noise
→ Design sensitivity is limited by quantum noise at almost all observation band

Sensitivity and noise budget during O3GK

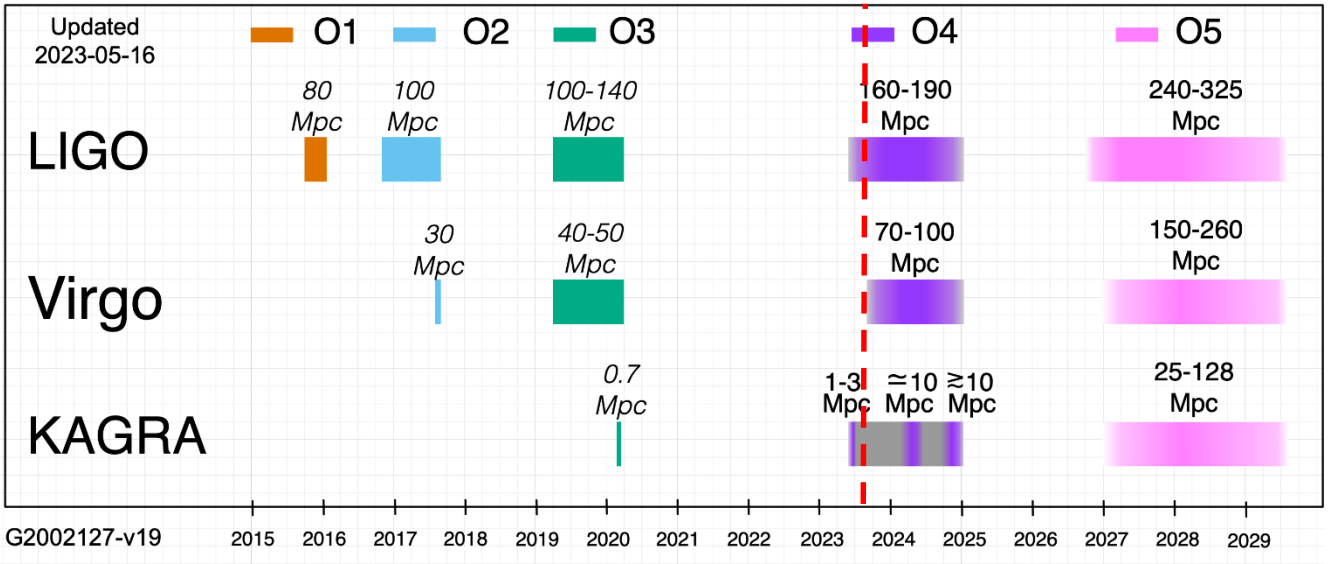
KAGRA Collaboration, PTEP, 2022. ptac093

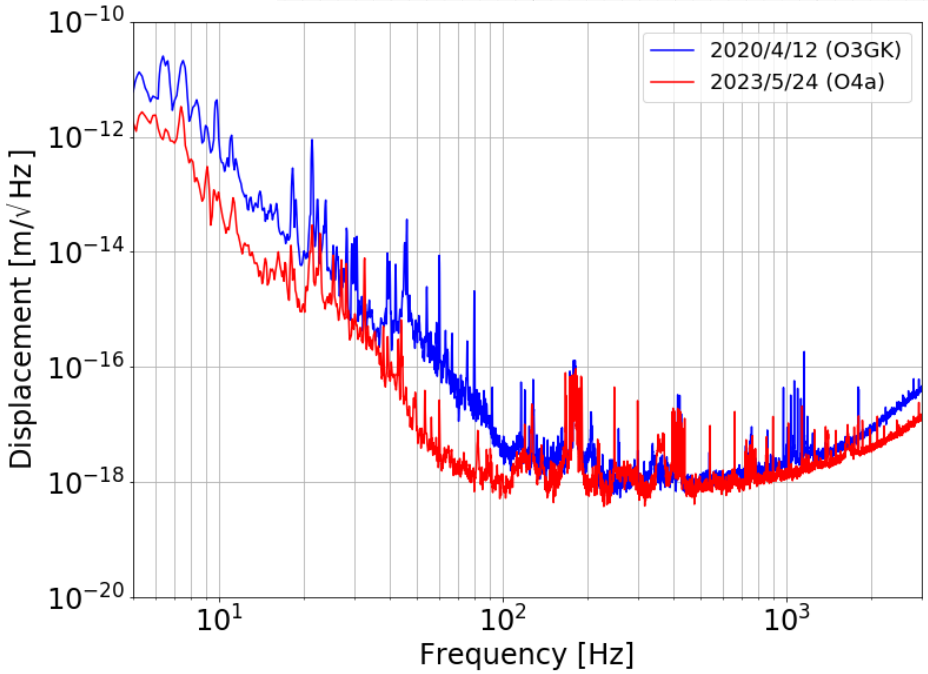


Our 3 years after O3GK (2020 Oct. -)



Joint observing Run

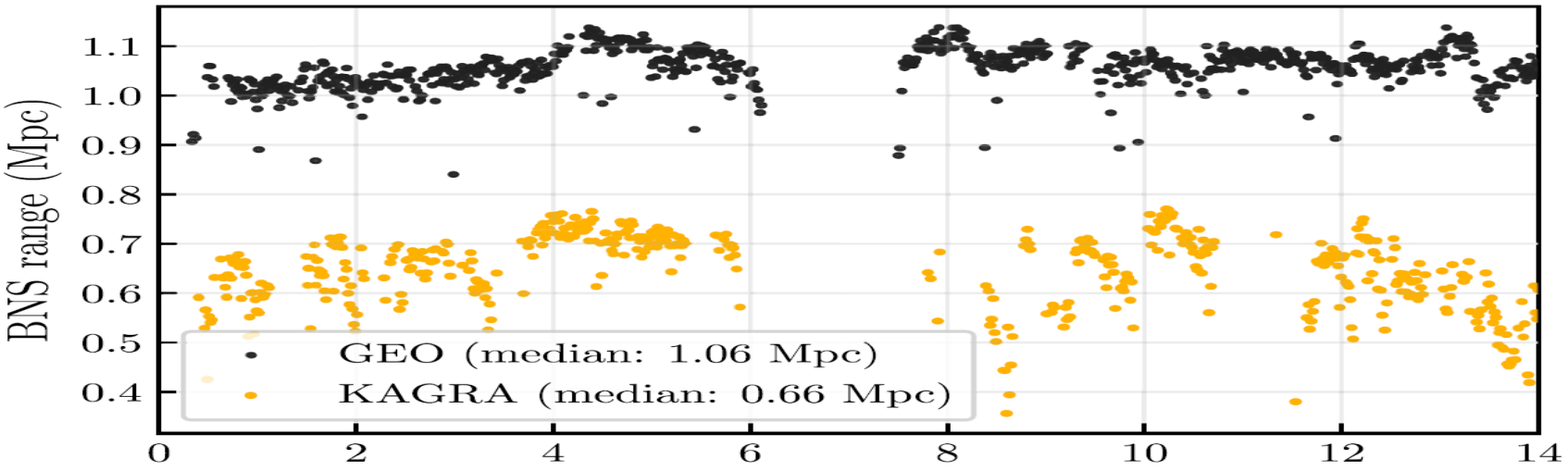


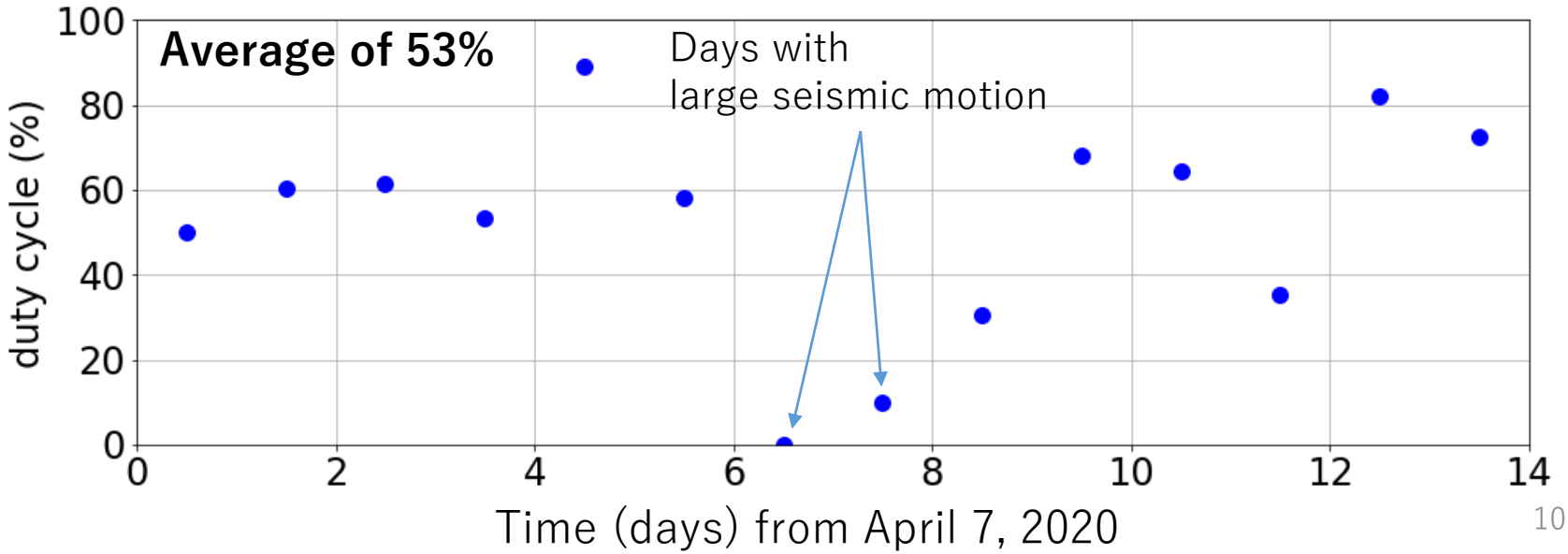


- O4 started from May 24.
- KAGRA joined from May 24 to June 21 with better sensitivity than O3GK.
- KAGRA has commissioning break for improving the sensitivity and will be back to the observing run in next spring.

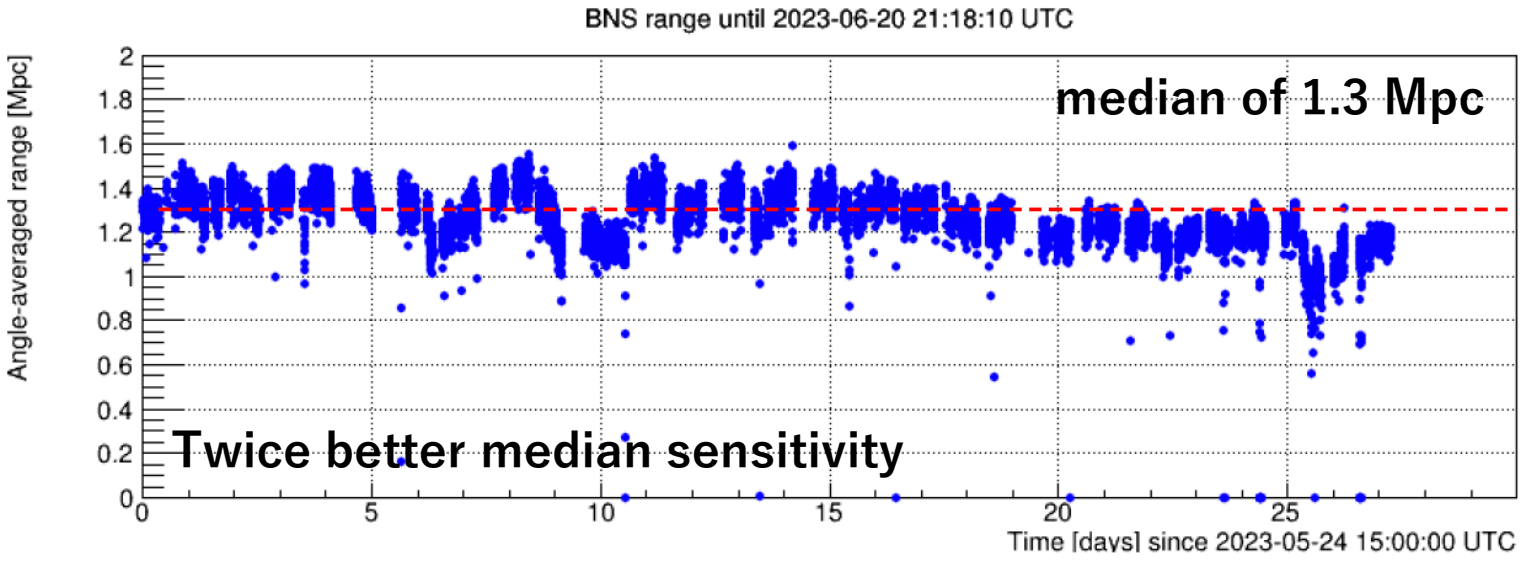
Go back to previous observing run (O3GK)

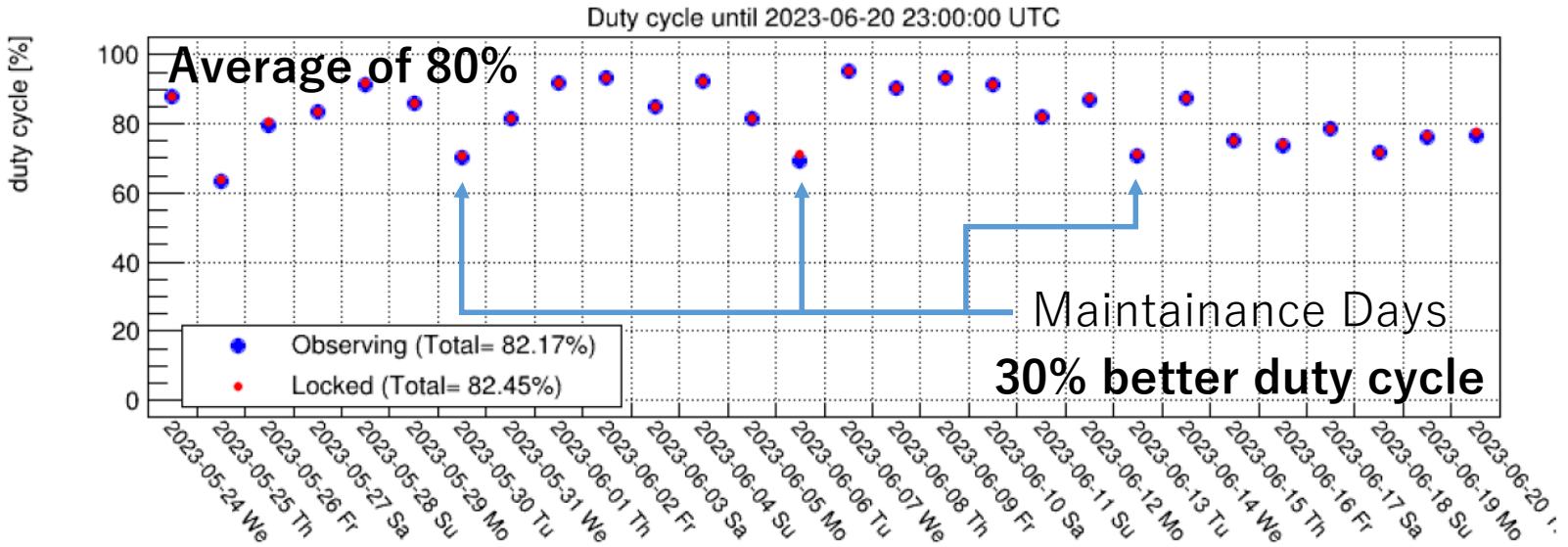
Progress of Theor. and Exp. Phys. 2022, 063F01 (2022)





Sensitivity and duty cycle during O4a





Hightlight of commissioning

T. Akutsu JGW-G2314966

Better stability

Local damping improvement

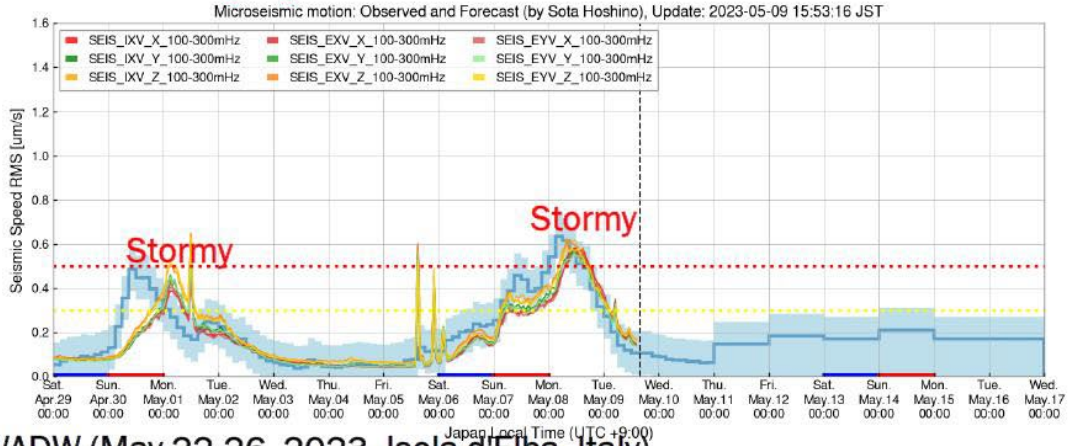
- Now PRFPMI can be maintained even in somewhat stormy days.

Alignment-sensing and control (ASC)

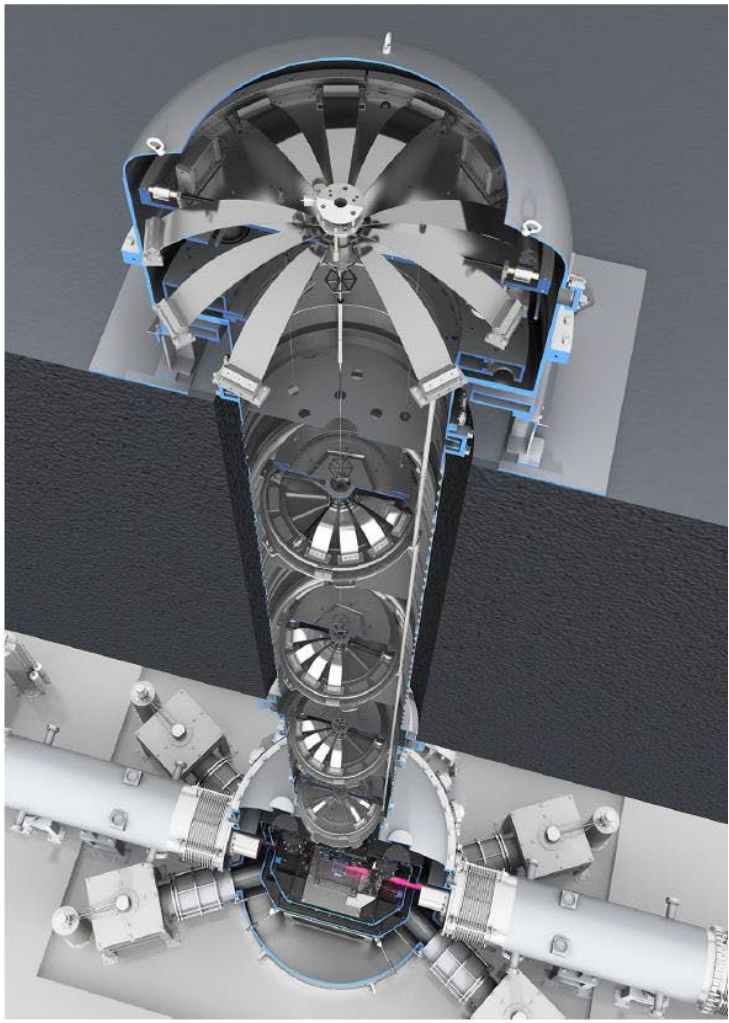
- Took time for wave-front sensing (WFS) in a strategic way; now WFS can be implemented for some global DoFs; drastically improved the contrast fluctuation.
- In addition, some noise structures and noise floor got better in the sensitivity curve.

Doppler phase noise cancellation

- For auxiliary green laser paths; now stable lock acquisition is possible even in somewhat stormy days.



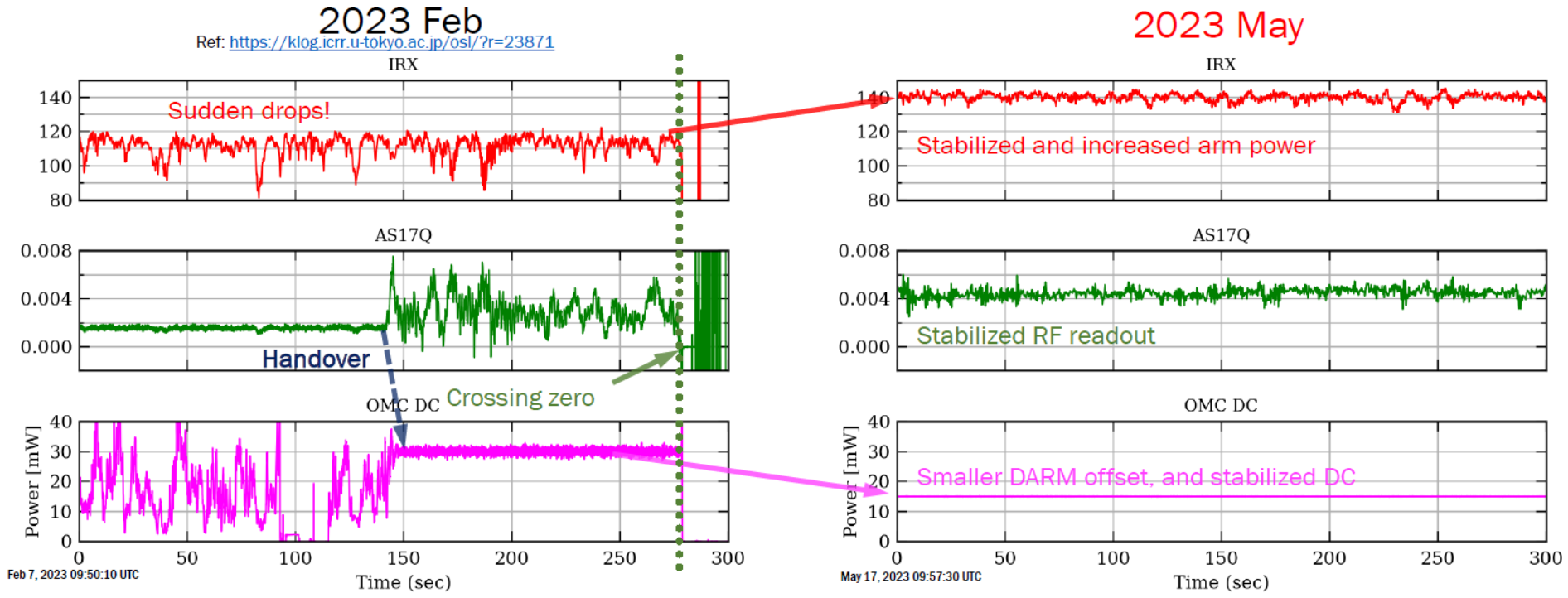
GWADW (May 22-26, 2023, Isola d'Elba, Italy)



Hightlight of commissioning

T. Akutsu JGW-G2314966

Alignment sensing and control

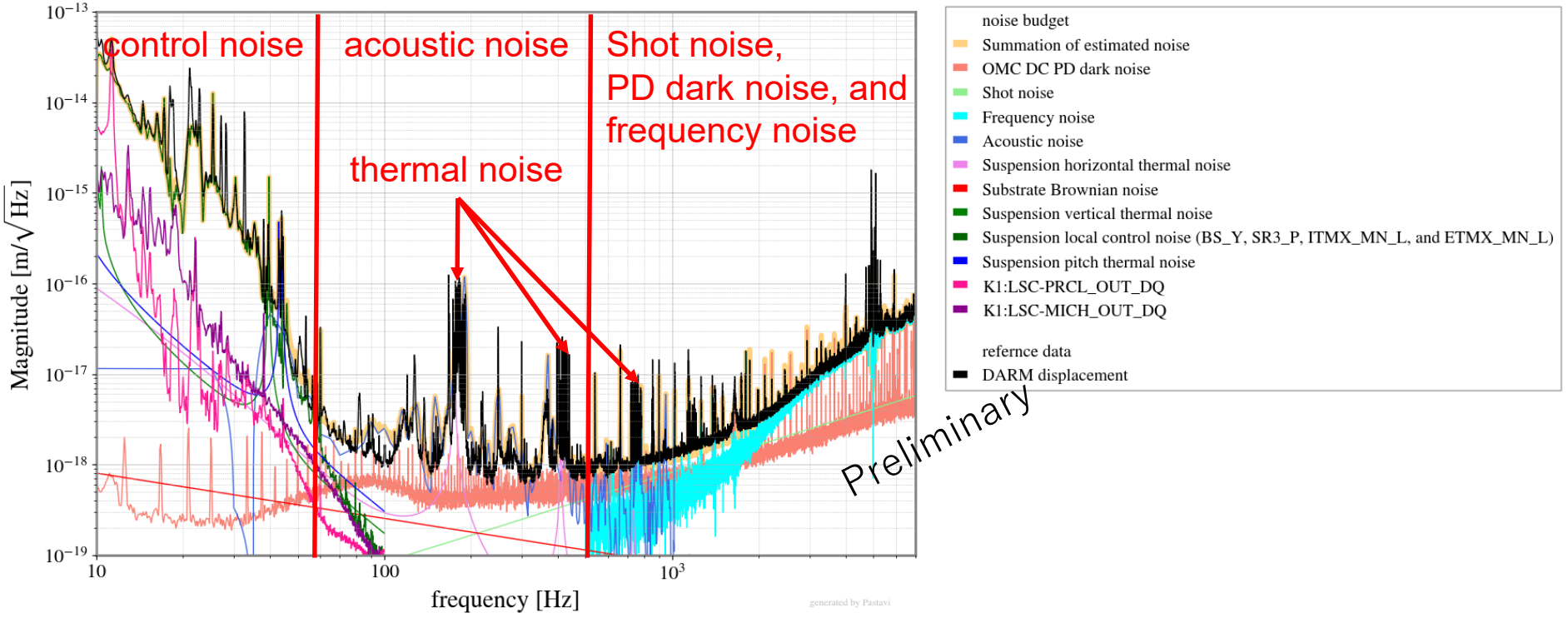


Data access via pastavi

- Internal laser power is drastically stabilized; and increased.
- Better AS contrast allows to do handover with smaller DARM offset.

→ Now ready to increase the input power from 1 W for O4b!

Noise budget of O4a sensitivity



- We have made noise budget of O4a sensitivity.
- It takes two months to make the noise budget, which is much faster than that during O3GK.
- We are now starting noise hunting to obtain better sensitivity.

Summary

- KAGRA has many hardware upgrade after O3GK.
- O4 observing run has started since 24 of May.
- KAGRA joined O4 observing run from 24 of May to 21 of June with better sensitivity than that in O3GK.
- KAGRA made noise budget of O4a sensitivity and understand the current limitation, which promotes noise hunting.
- KAGRA will come back observing run in the next spring with better sensitivity.