bKAGRA Phase 1 Paper Status

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Status

- Not much progress since May F2F……
- Hope to finish the first draft by the end of September, circulate and finalize it by the next F2F
- Updates:
  - Author list generated
  - ShareLaTeX prepared
- Request to you:
  - Let us know if you plan to write a paper using Phase 1 data to avoid any conflict
  - Please check the author list

Paper Plan

- Authors
  Author list 2016
  + Author list 2017
  + additional
  contributors
- Target journal
  Classical and
  Quantum Gravity

bKAGRA phase 1: first cryogenic test operation of underground km-scale gravitational-wave observatory

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(25 August 2018)

Abstract. KAGRA is a second-generation gravitational-wave interferometer with 3-km arms constructed at Kamioka in Japan, and now in the installation phase towards scientific observations, which we call *bKAGRA* (baseline KAGRA). One of the advantages of KAGRA is that is constructed at least 200 m below the ground surface in order to suppress seismic noise at low frequencies and high stability of the system. One another advantage is that it operates at low temperature. We have installed a cryogenic cooling system to KAGRA and made a 10-days test run (phase 1 operation) in April–May 2018. In this article, we report the advantages of cryogenic operations and the status of KAGRA with our next future plans.

1. Introduction

Direct detections of gravitational wave opened the new era to physics and astronomy. The first detection of gravitational wave (GW150914[1]) by LIGO/Virgo group was the merger of black-holes, which was also the first observation of black-holes, and even of a binary of black-holes, and unexpected combination of their masses enlightened the researches of formation of black holes.

The latest announced event was from a merger of neutron stars (GW170817[2]). This was the first one from a coalescence of neutron stars, and successive observations of the source using γ-ray, X-ray, UV, optical, IR, and Radio telescopes identified the sources, and revealed the new nature of astrophysical gigantic event, such as the plausible evidence of a rapid process of nuclear fusion, constraints to equation of state of nuclear matter, constraints to cosmological scenarios, and so on.

KAGRA is a kilometer-sized laser interferometer, constructed in Kamioka, Gifu,

Section Plan

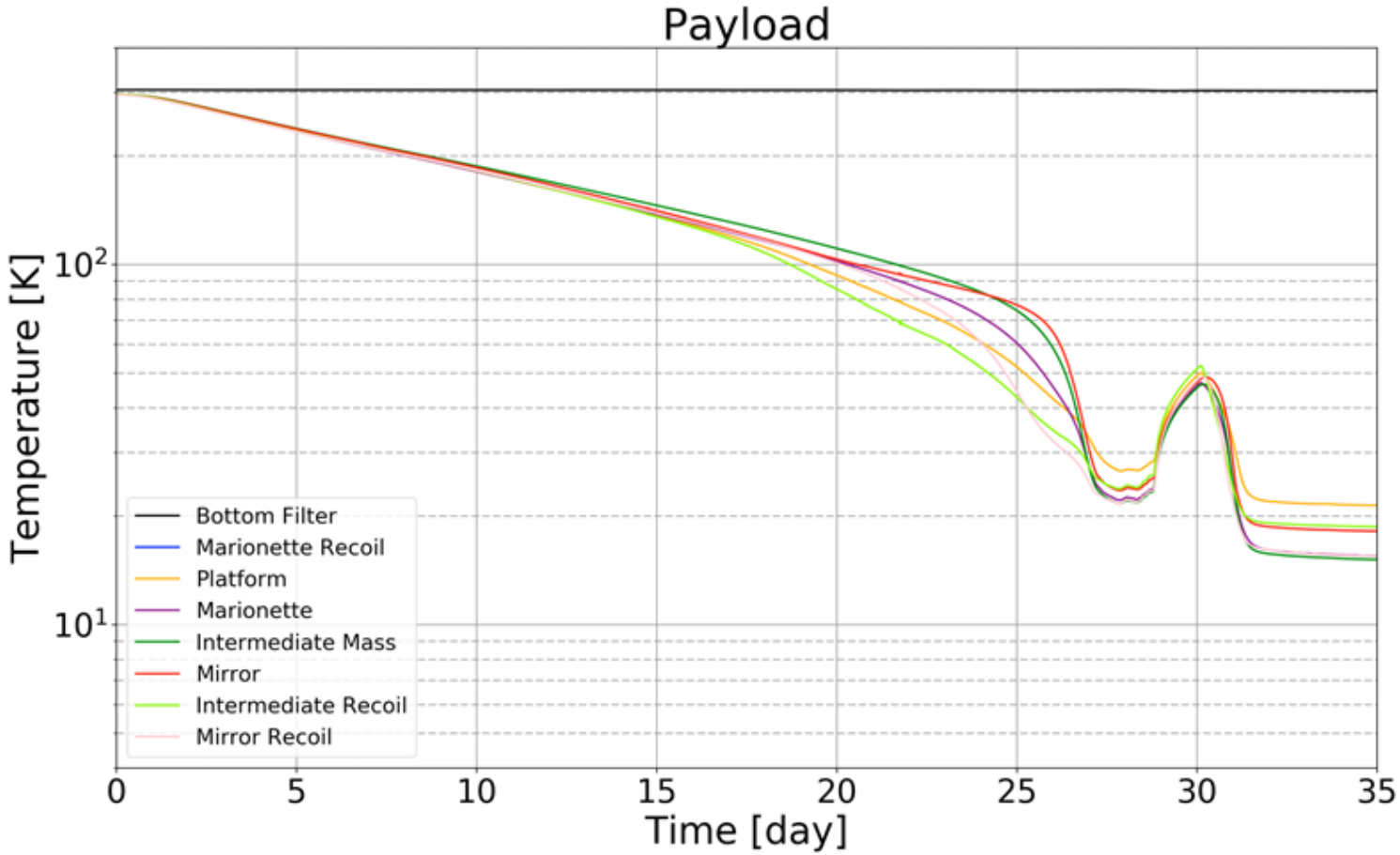
1. Introduction
2. Interferometer configuration
   - suspension and interferometer configurations
   - full and Phase 1 configuration comparison
3. bKAGRA Phase 1 operation
   - initial alignment
   - cryogenic cooling
   - suspensions
   - sensitivity and duty factor
   - calibration, data management, data analysis
4. Discussion
5. Conclusions

Crucial Data for Phase 1 Paper

- Crucial plots
  - Cooling curve of ETMY
  - ETMX/ETMY actuator transfer functions
  - BS actuator transfer function
  - Sensitivity curve with noise budget
  - Duty cycle and inspiral range
- If you have any plan to write a paper and these data will be crucial part of your paper, please let us know.

Plots for Phase 1 Paper

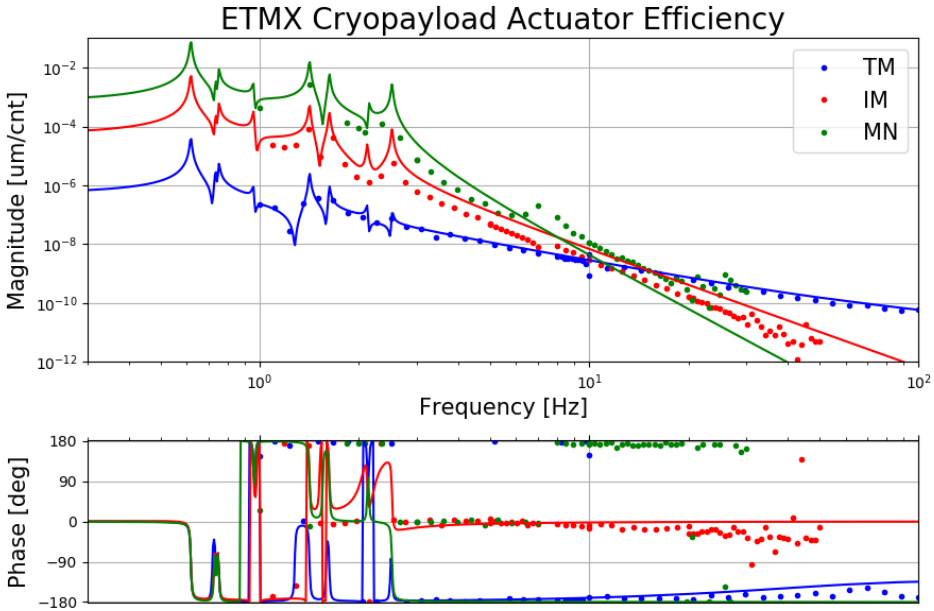
- Cooling curve of ETMY (temperature vs time)

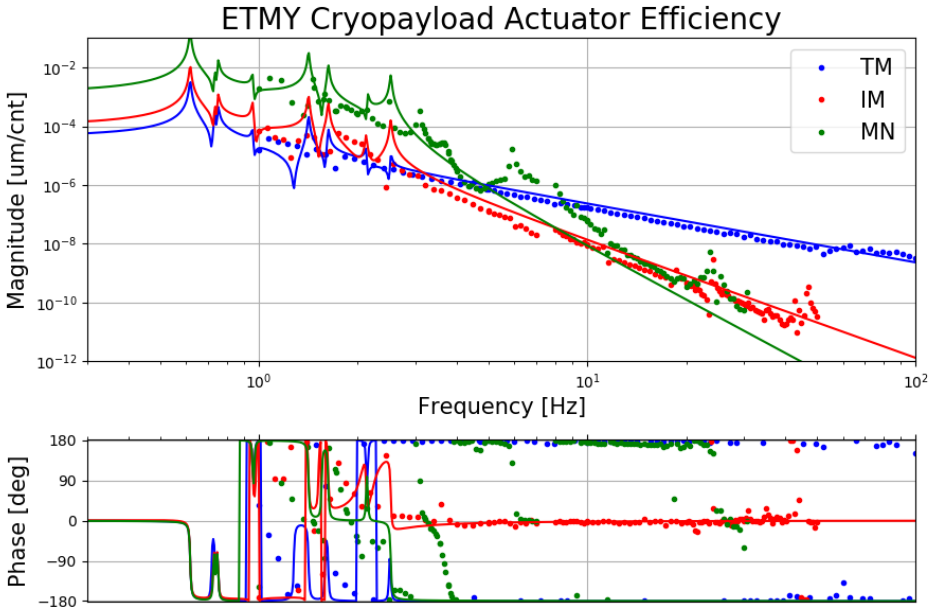


Plot from JGW-G1808095

Plots for Phase 1 Paper

- ETMX (room temperature) and ETMY (cryogenic) actuator efficiency transfer functions (measurement and model)



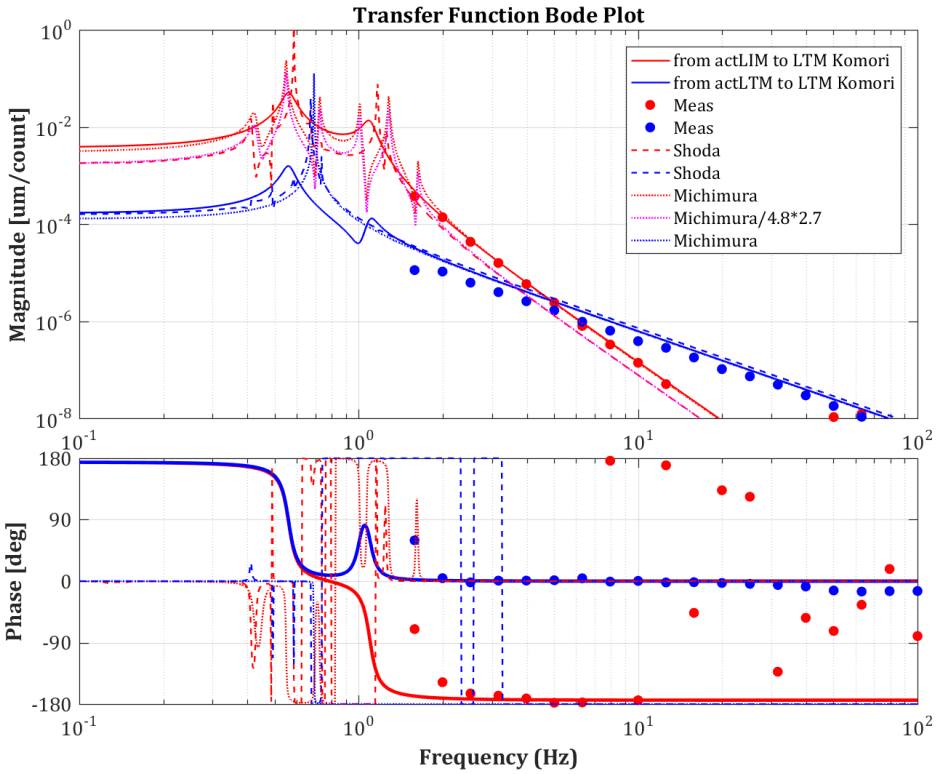


Plot from JGW-G1808217

by Yutaro Enomoto, Takahiro Miyamoto, Yuta Michimura *et al.*

Plots for Phase 1 Paper

- BS actuator efficiency transfer functions (measurement and model)

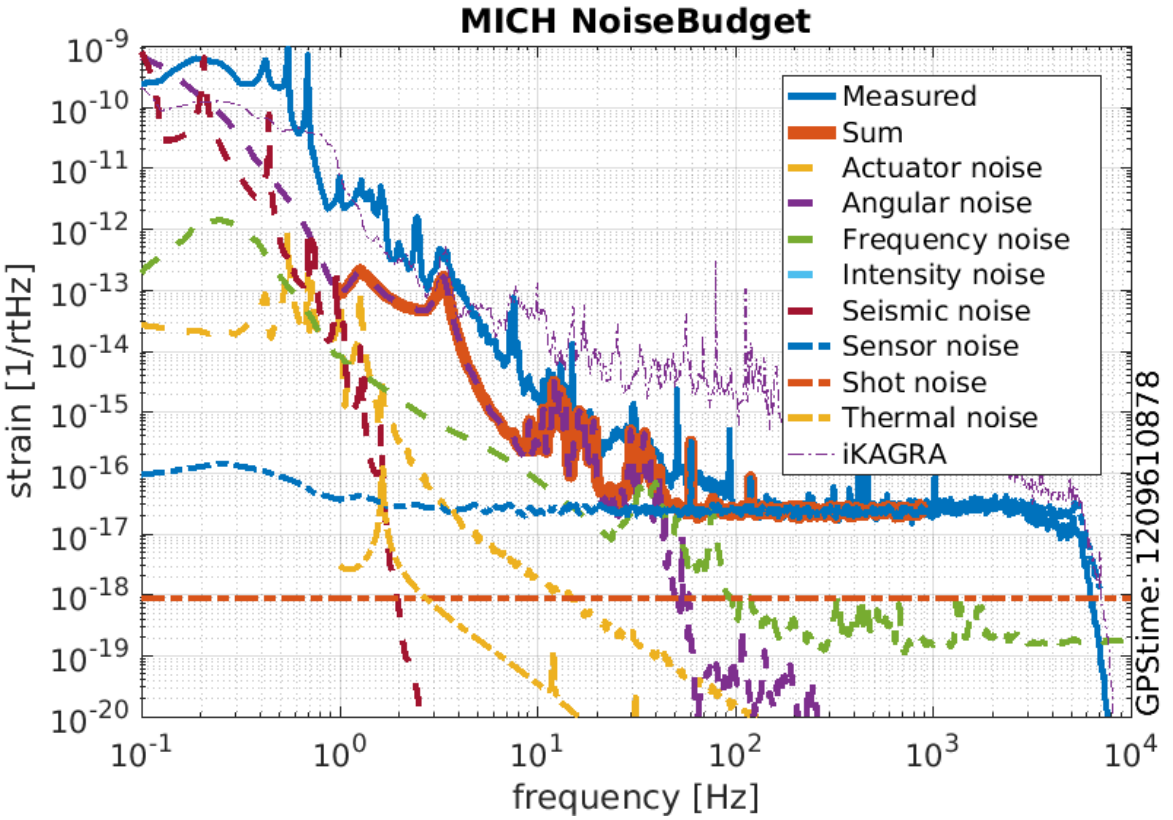


Plot from [klog #4988]

by Ayaka Shoda, Kentaro Komori, Yutaro Enomoto, Kiwamu Izumi, Yuta Michimura *et al.*

Plots for Phase 1 Paper

- Sensitivity curve with noise budget



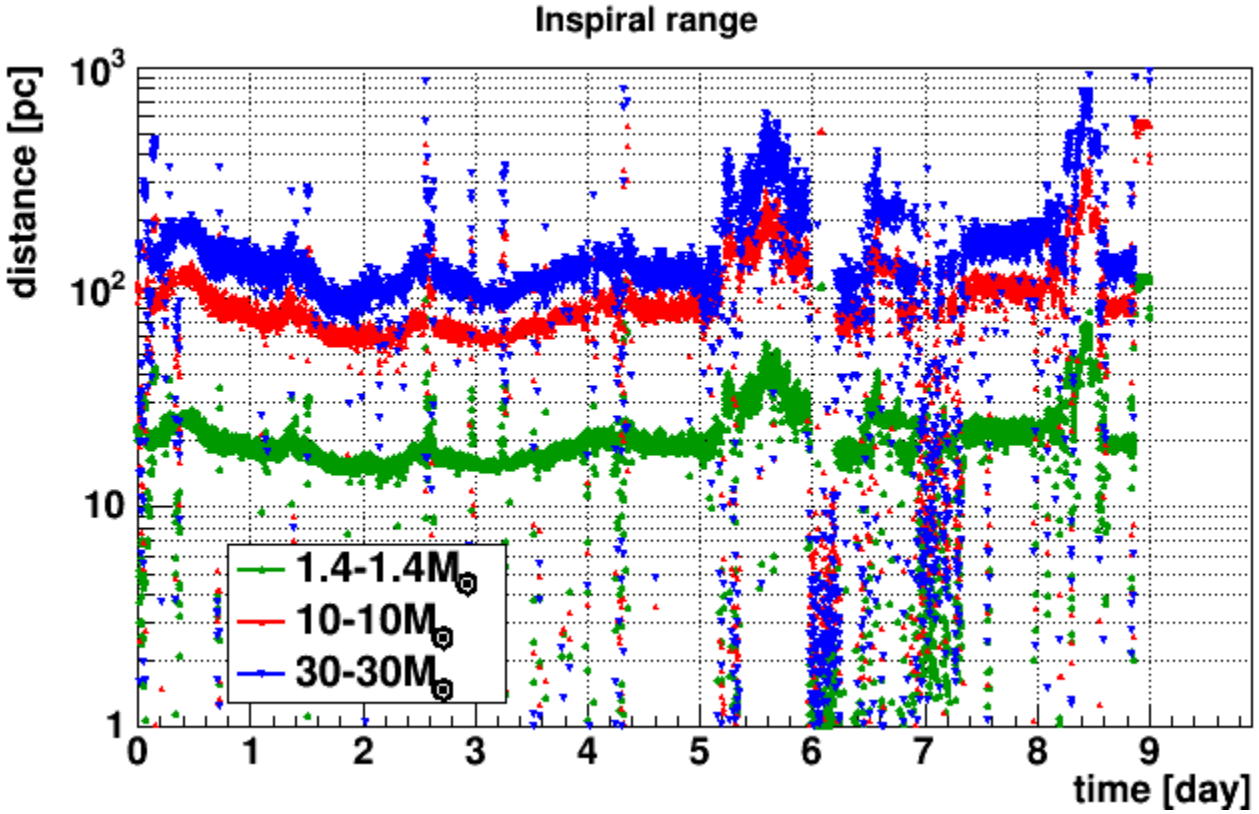
Plot from [JGW-G1808217]

by Yutaro Enomoto, Masayuki Nakano, Kiwamu Izumi, Yuta Michimura *et al.*

Plots for Phase 1 Paper

- Duty cycle and inspiral range

day	duty cycle
April 28	81.66%
April 29	97.00%
April 30	90.36%
May 1	87.09%
May 2	86.88%
May 3	19.97%
May 4	33.58%
May 5	64.18%
May 6	55.36%



Plot and data processing by Takahiro Yamamoto

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Summary

- Please let us know if you have any plan to write a paper and the plots shown will be crucial part of your paper.
- Please let us know if you need correction to the author list (check especially your affiliation(s)).
- We also welcome any other requests, ideas, volunteers, comments, suggestions, complaints etc.

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