

Research Results Presentation Meeting of the ICRR Inter-University Research Program FY2024

Tokyo, 29-30 January 2025

Position control system for silicon monolithic suspension in cryogenic gravitational waves detectors

Project Number: 2024i-G-003

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UNIVERSITÀ DEGLI STUDI
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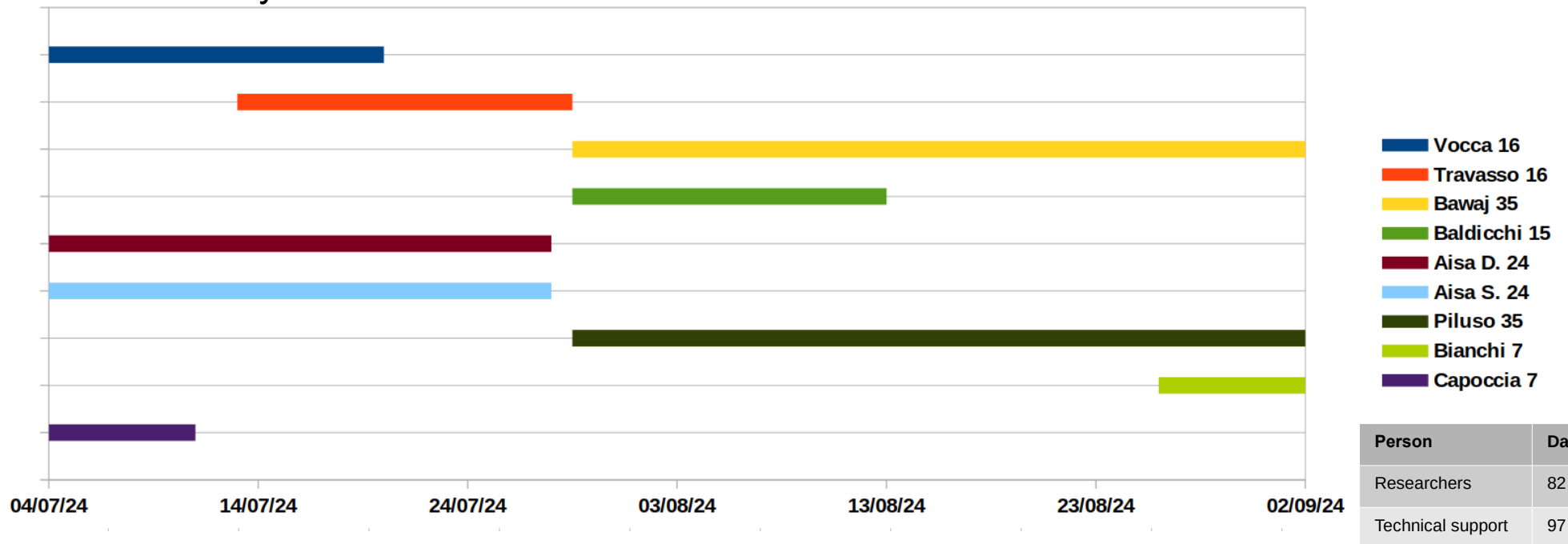


Activities at ICRR during 2024

- monolithic payload preliminary design
- silicon cut of the mirror and the marionette
- dummy monolithic payload manufacturing
- silicon fibres suspension test with the dummy payload
- multi-channel analogue frontend construction
- multi-channel simple controller design

The data acquired during silicon substrate characterisation campaigns are being analysed Preliminary analysis of the substrate quality factor with GENS at the temperature below 45K exhibits values of order $1,75 \cdot 10^7$.

Summer stay





Allocated research fund

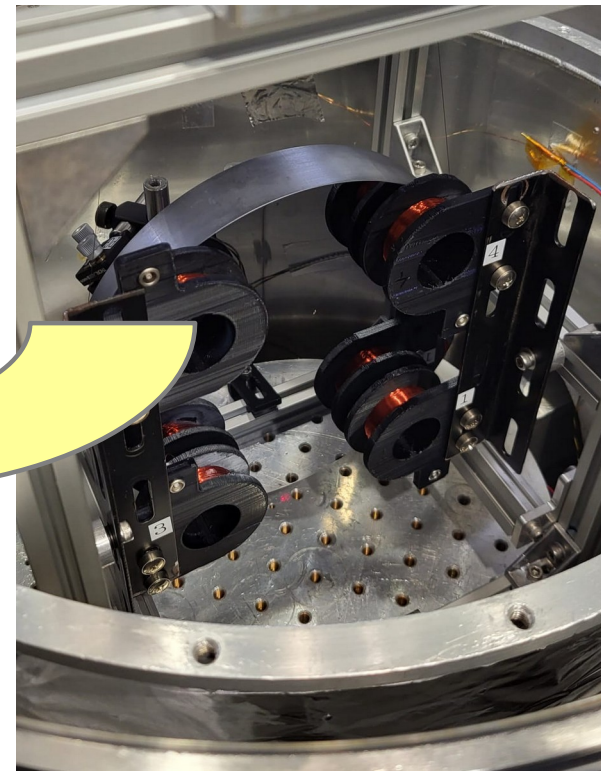
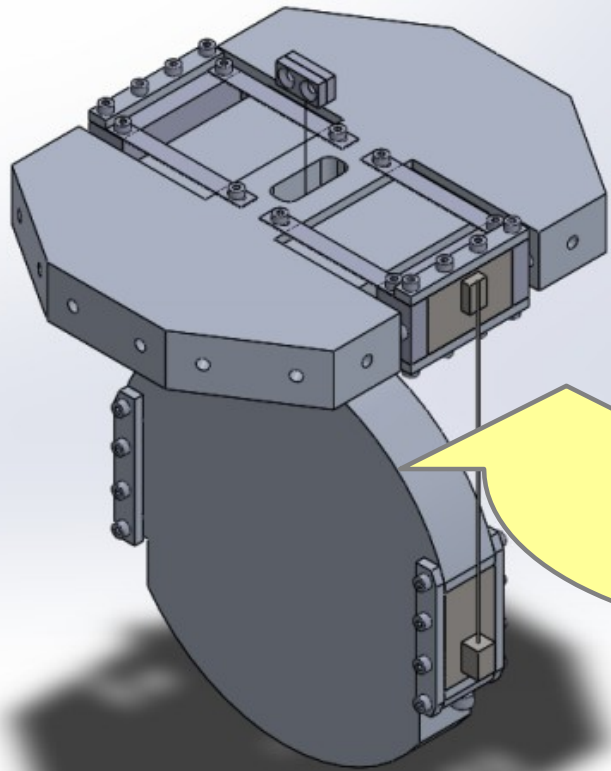
Grand Total: 350,000 JPY

Expenses:

- 3D printer & filament
- aIO adapter production

Monolithic payload design

- mechanical design of the monolithic payload is ongoing
- marionette disk and mirror disk flats have been cut

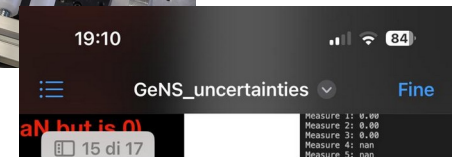
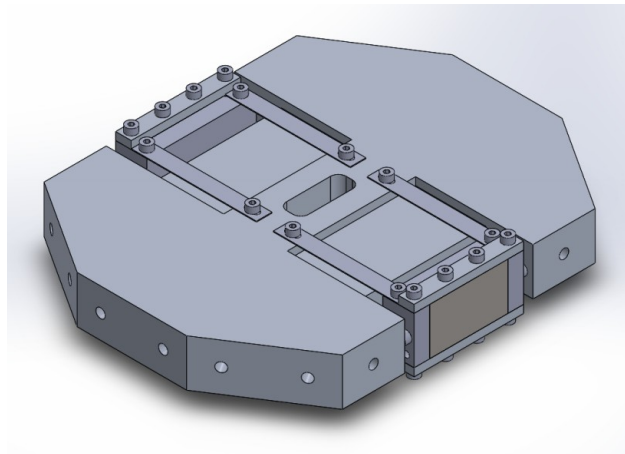
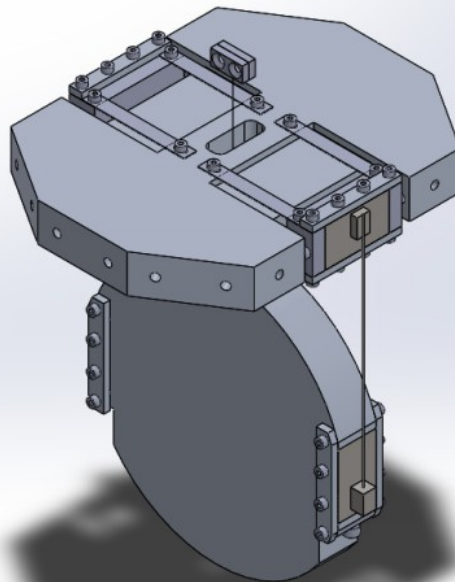
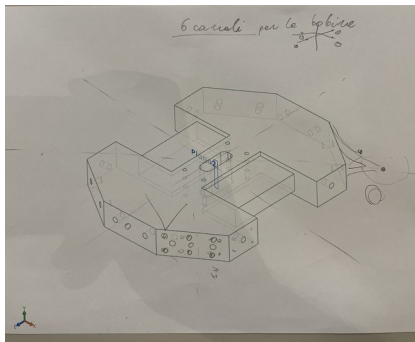


Suspended substrate at ICRR

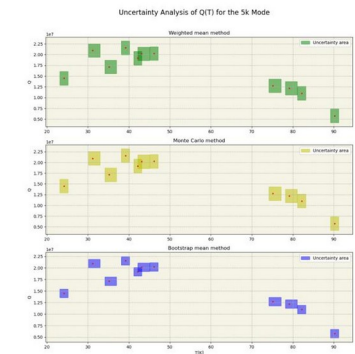
Silicon fibres suspension tests

Components:

- marionette with elastic fibre mounts
- dummy mirror with fibre mounts



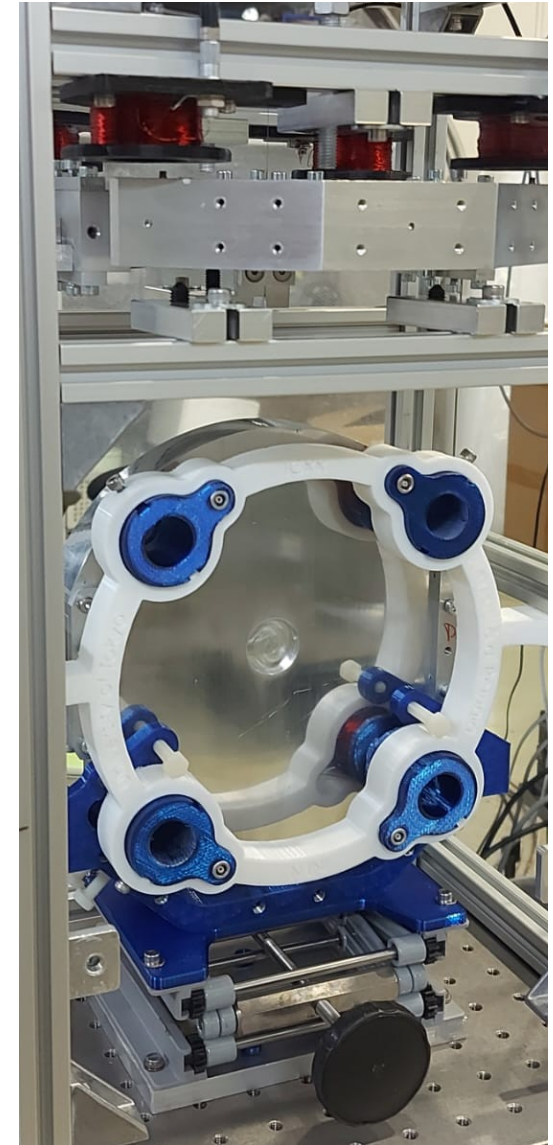
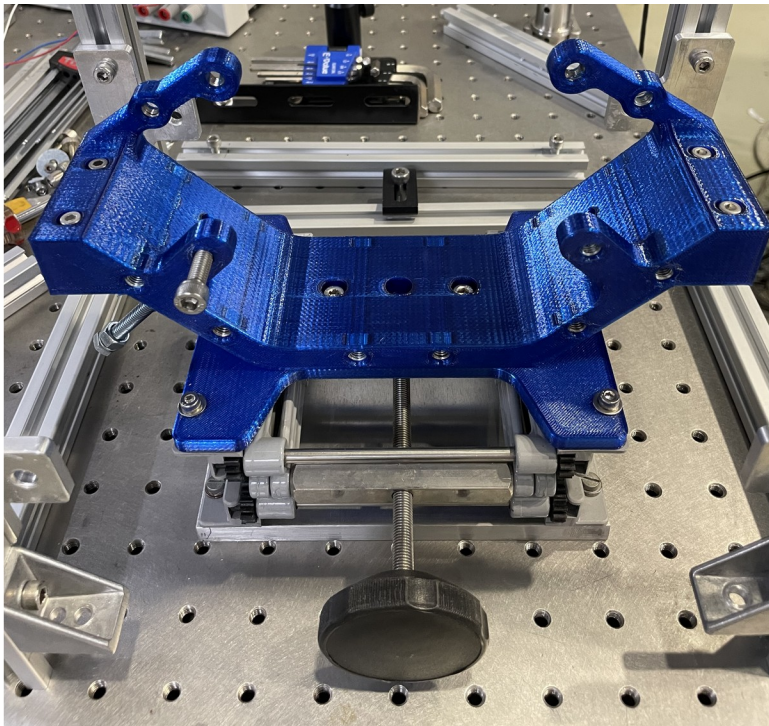
Data analysis



Silicon fibres suspension test

Components:

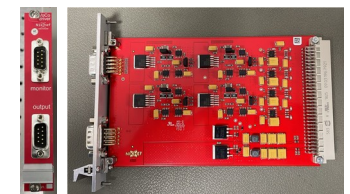
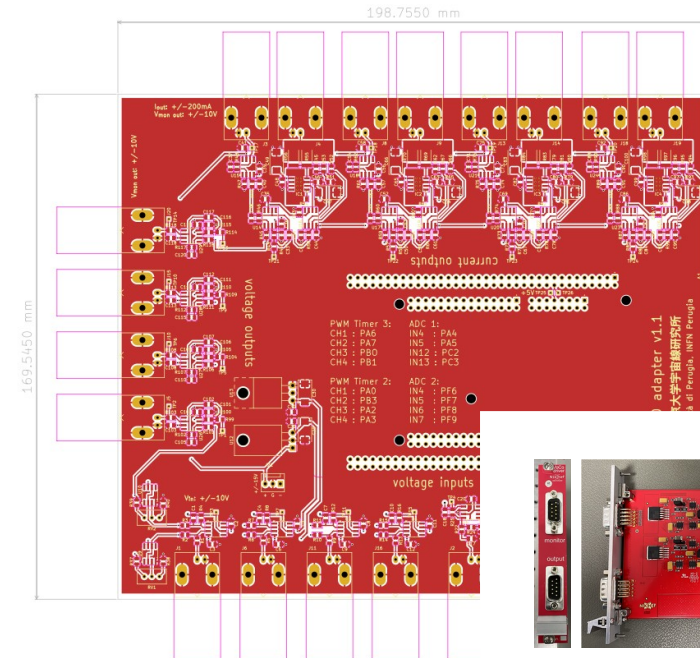
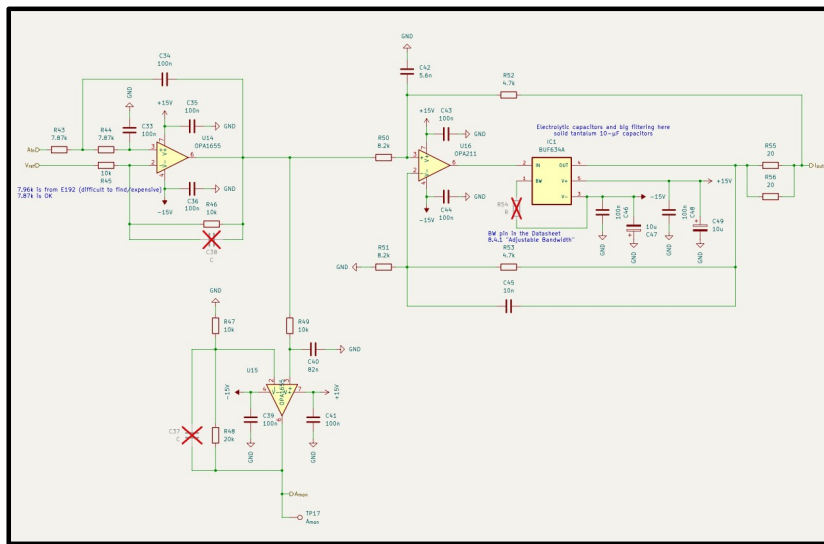
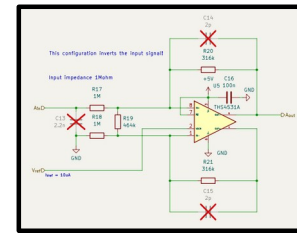
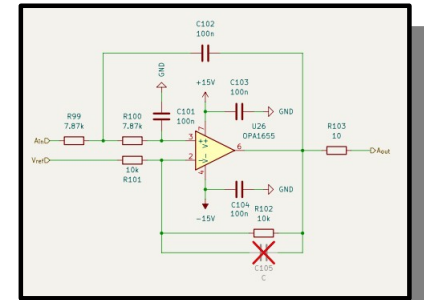
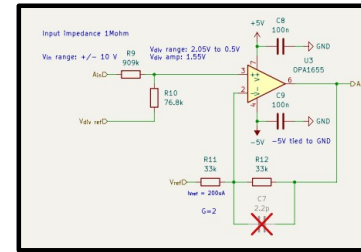
- new cradle
- 4 vertical marionette actuators
- 4 horizontal mirror actuators



Analogue front-end

Components:

- 4 high-impedance inputs type 1
- 4 high-impedance inputs type 2
- 4 high-impedance inputs type 3
- 4 voltage outputs
- 4 current outputs

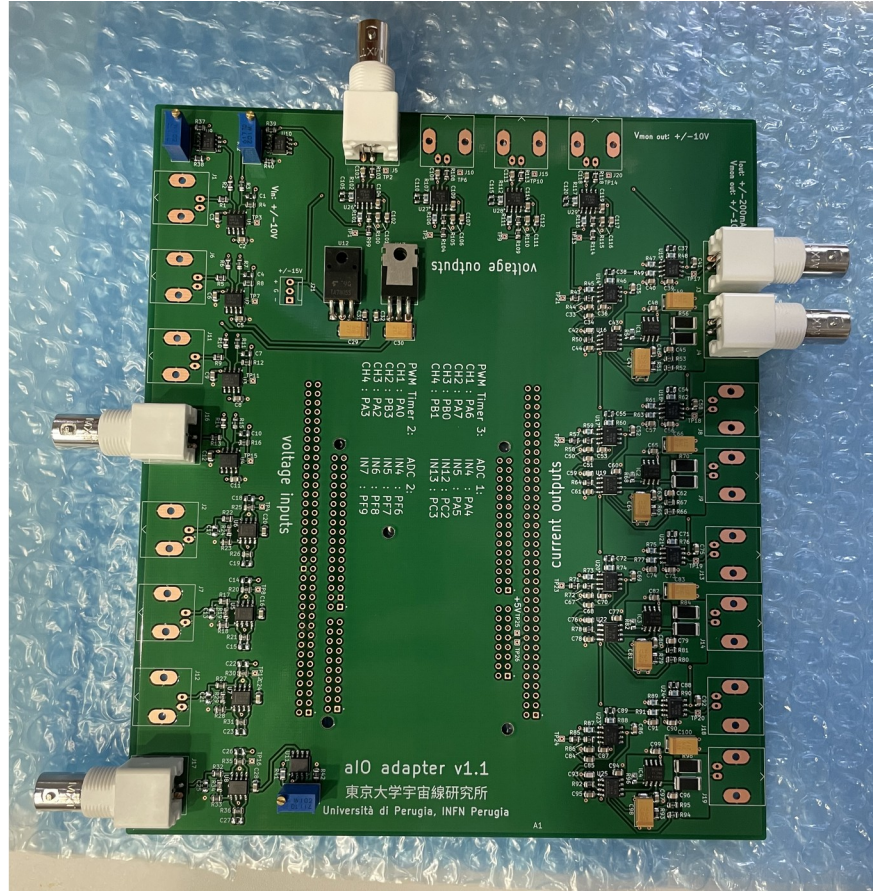
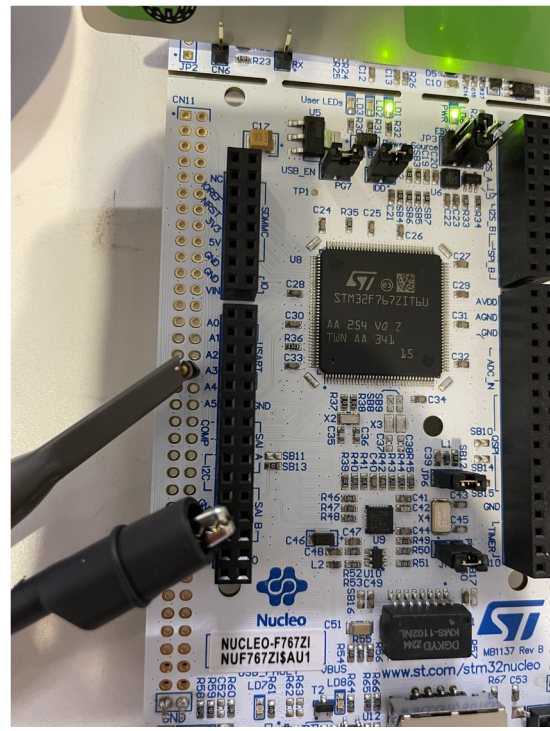


Coil driver

Position control system

Components:

- Nucleo-F767ZI
- aIO adapter



Acknowledgments

- This work was supported by the Collaborative research program of the Institute for Cosmic Ray Research (ICRR), the University of Tokyo. Project Number: 2023i-G-003 and 2024i-G-003
- Co-funded by the European Union

PROBES of new physics and technological advancements from particle and gravitational wave physics experiments. A cooperative Europe - United States - Asia effort. H2020 - MSCA - RISE - 2020 (G.A. 101003460)

NEWS: NEw WindowS on the Universe and technological advancements from trilateral EU-US-Japan collaboration. H2020 - MSCA - RISE - 2020 (G.A. 734303)



European Commission

Plans for 2025

- Testing actuators of the dummy payload
- Further developments of silicon fibres suspension of the substrate
- Continue multi-channel controller development
- Release the summary paper on the cryogenic silicon substrate characterisation with GeNS

