



Newsletter N°2

April 2024

Discover the latest news
from the CARIOQA-PMP project !



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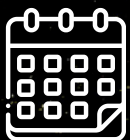
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1. The CARIOQA-PMP mission continues with the launch of CARIOQA-PHA



On January 16, 2024, the CARIOQA Quantum Pathfinder Mission programme initiated its Phase A. CARIOQA-PHA, an abbreviation for “Cold Atom Rubidium Interferometer in Orbit for Quantum Accelerometry – Phase A”, is part of the Horizon Europe EU-funded programme focusing on quantum technologies for space gravimetry. The project marks a significant continuation of the CARIOQA-PMP project. Its overarching goal is to showcase the feasibility of a Quantum Space Gravimetry Pathfinder Mission within the next decade. This endeavor holds the promise of enabling the European Union to deploy quantum gravimeters/accelerometers in the vast expanse of space.

As the inaugural phase of the programme, CARIOQA-PHA plays a crucial role in defining project requirements and constraints, formulating technical and functional specifications, and identifying mission-compatible concepts.

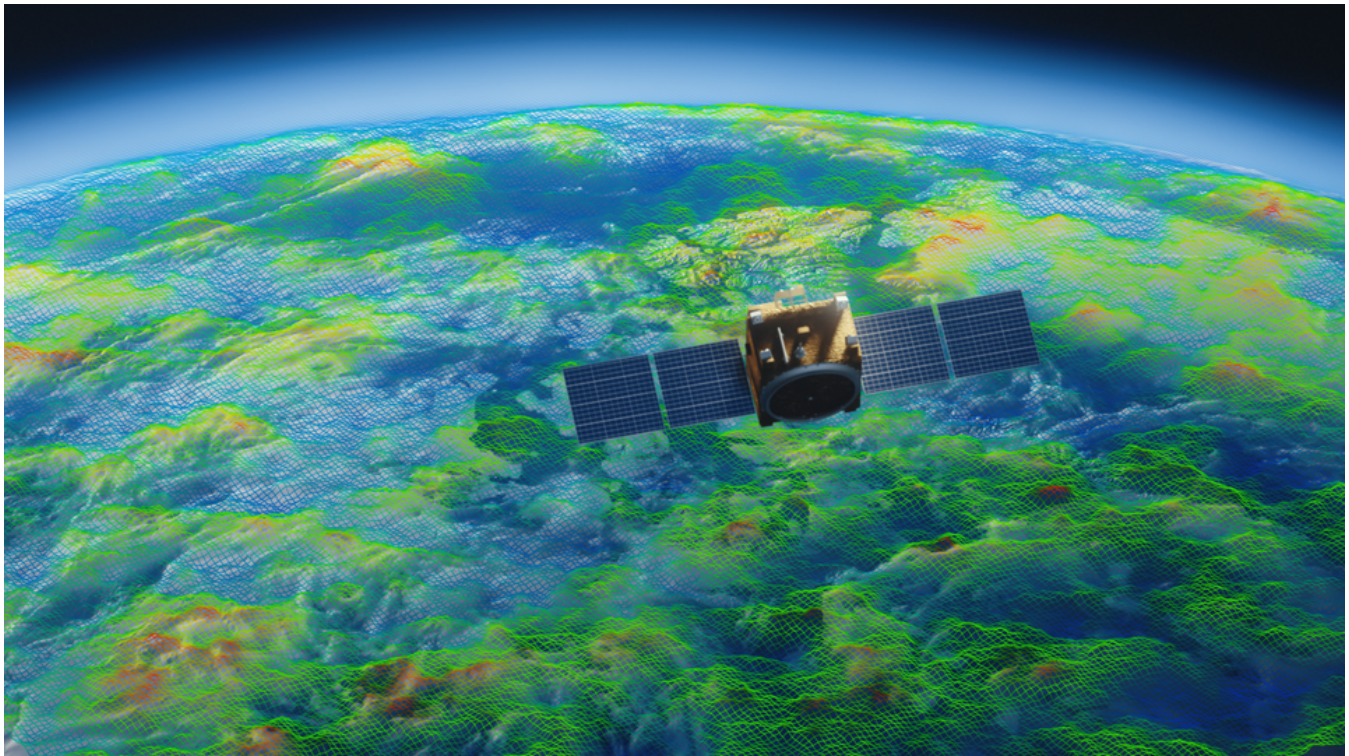
The consortium behind CARIOQA-PHA consists of esteemed partners, including CNES, DLR, ADS-F, ADS-G, and FORTH, who are also part of the CARIOQA-PMP consortium. Additionally, a new industrial partner, GMV, joins the project for mission analysis. Four primary objectives guide the scope and duration of CARIOQA-PHA:

- Formalise technical demonstration needs
- Study system and operations concepts
- Confirm mission feasibility
- Maximise impact

With its comprehensive approach and collaboration among key stakeholders, the project is poised to pave the way for groundbreaking advancements in the field of space gravimetry. You can follow CARIOQA-PHA activities through the mission channels:



2. CARIOQA programme under the spotlight



Artist's impression of the CARIOQA satellite measuring gravity on Earth
(Extract from the project presentation video) © CARIOQA-PMP/Pharos Digital

The CARIOQA mission has benefited from extensive media coverage following the launch of the CARIOQA-PHA. Indeed, several articles and podcasts have been published on this occasion. This media exposure has helped raising public awareness about the project.

Find some of these articles below :

- [Un accéléromètre quantique envoyé dans l'espace pour mesurer la gravité terrestre \(Le Monde\)](#)
- [CARIOQA : l'échelle quantique appliquée à la masse gravitationnelle de la Terre \(Sciences et Avenir\)](#)

Additionally, the European Commission has released a video emphasising the importance of quantum technologies in measuring gravity to better monitor climatic events such as rising sea levels and soil desertification. You can find the European Commission video [here](#)

A more detailed video outlining the project's functions and main objectives has also been unveiled on the project's youtube channel on April 14th, 2024, in celebration of Quantum Day. Let's discover the video on our YouTube channel by clicking here :



[**Exploring Gravity from Space with the CARIOQA Mission**](#)

3. Uniting Physics and Geodesy in Satellite Simulation during a workshop

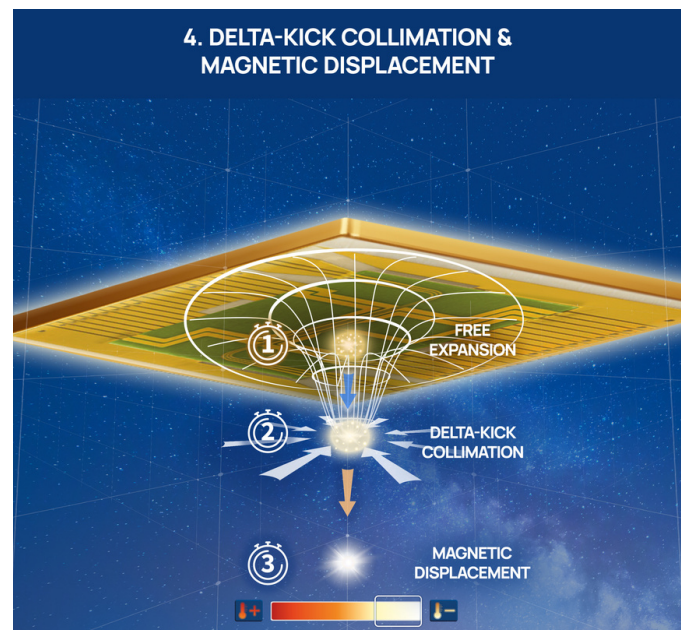
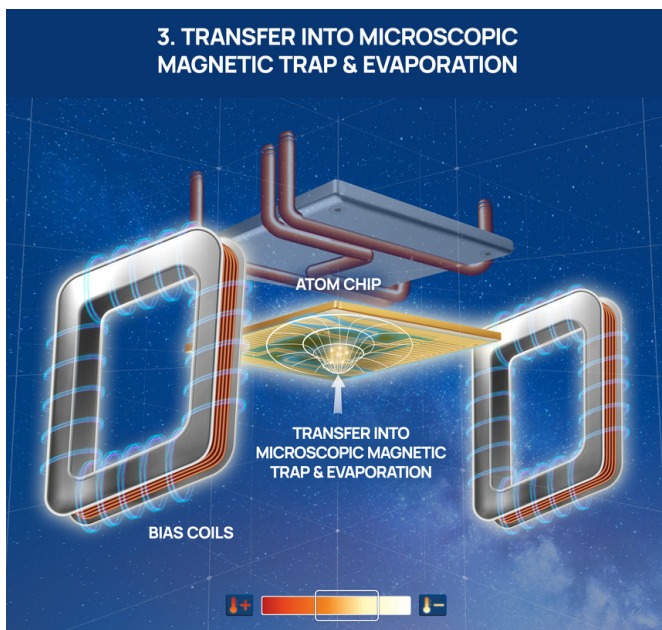
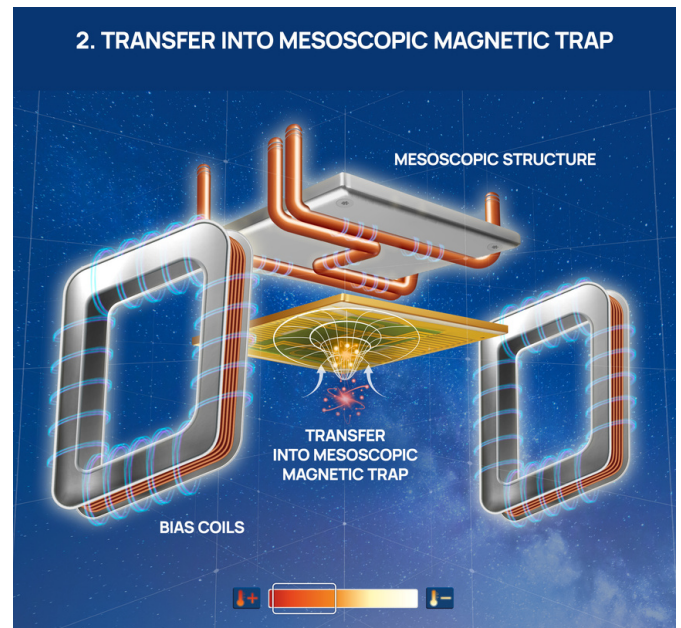
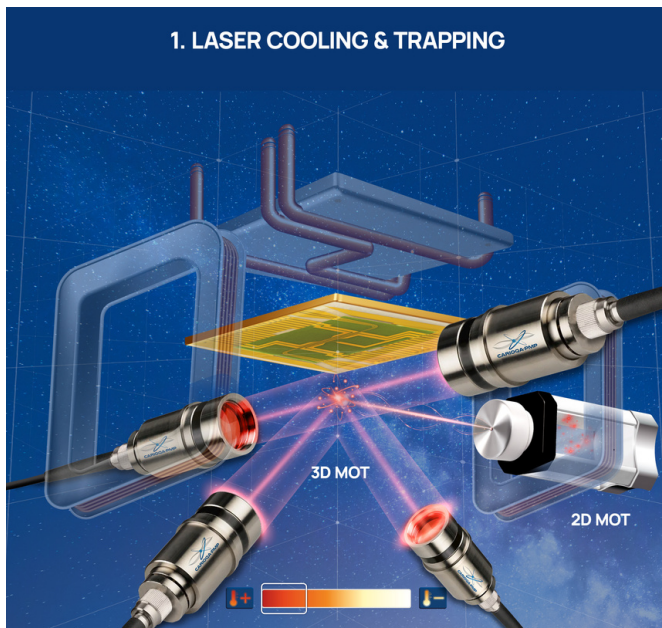


The second workshop within CARIOQA-PMP convened esteemed partners from CNES, CNRS, DTU, FORTH, LUH, ONERA, and POLIMI at DLR in Hannover last 27 March 2024. The primary aim of this event was to facilitate collaboration between physics and geodesy experts, enabling the seamless integration of their quantum sensor simulations into geodetic satellite missions. This integration aims to enhance the realism of both pathfinder missions and satellite gravimetry endeavors.

Building upon the foundational meeting held in 2023, the workshop has successfully defined and implemented interfaces crucial to CARIOQA-PMP project's advancement.

At the heart of this gathering was the refinement of the simulation modeling and the exploration of potential pathfinder mission scenarios. Central to the discussions were the intricate trade-offs inherent in scenario selection.

4. Presentation of the Bose-Einstein condensate creation and quantum state engineering



The sequence starts with laser cooling and trapping Rubidium atoms at the vicinity of the atom chip surface to form a magneto-optical trap (MOT). Taking advantage of the magnetic fields created by the mesoscopic structures and bias coils, this cold cloud of atoms is transferred to a first magnetic trap (step 2) before it is moved to a microscopic one made by the different layers of the atom chip (step 3). In this trap, the atoms are evaporated down to nK temperatures reaching the BEC condensed state. Finally, a quantum state engineering step (4) takes place, where the atomic cloud is magnetically pushed away and delta-kick-collimated to extremely low expansion energies of 100s pK. This final state is optimal as input of the atom interferometer.

5. Women in science : Come discover the dedicated CARIOQA interview series

CARIOQA-PMP launched its interview series! Women experts involved in the project will be interviewed about their professional career and their main missions in the project.

According to Unesco even with the abundance of talent among girls and women, systemic obstacles persist, impeding their involvement in STEM and ICT domains. Within the European Union, merely a third of STEM graduates (encompassing Science, Technology, Engineering, and Mathematics) are women, and only 19% are represented among ICT specialists (Information and Communications Technology).

Consequently, the goal of this interview series is to promote the role of women in science and suggest role models to female students who would like to engage themselves in the scientific field.

Discover the first episode of the series by watching the interview of Célia PELLUET, Postdoctoral researcher at LP2N: learn about Celia's experience with the LP2N laboratory and the Young Talent Award from the L'Oréal-UNESCO Foundation for Women and Science she has won which highlights the indispensable role of women in this field.



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👉 Episode 1: Women leading the way in Science : Interview of Célia Pelluet, Postdoctoral researcher at LP2N

Stay tuned for a second interview series to learn about the project and its main challenges through experts partners looking at CARIOQA from different angles!

6. Discover the project partners LUH and Exail



Founded on 2 May 1831 as Higher Vocational School, Leibniz University Hannover holds a leading international position in six established key research areas: Biomedical Research and Engineering, Quantum Optics and Gravitational Physics, Optical Technologies, Production Engineering, Interdisciplinary Studies of Science and Energy Research.

In the frame of CARIOQA-PMP, LUH develops new technologies (hardware and software), methods, tools and frameworks to enhance its know-how in deploying quantum sensors in the field and in space. LUH will also develop its simulation capabilities for using quantum technology in geodesy and beyond. By collaborating with end-users and key stakeholders, the development on portable atomic sensors will enhance in TRL (through own services, spinoffs and early-stage start-ups). LUH will also engage in training and education activities.

Exail is a leading high-tech industrial group specialising in cutting-edge robotics, maritime, navigation, aerospace and photonics technologies. It was formed by ECA Group and iXblue joining forces in 2022. Employing a workforce of 1500 people, the company benefits from a global footprint and conducts its business in over 80 countries.

In the CARIOQA-PMP project, the Exail Quantum Systems division (formerly Muquans) is in charge of developing the Laser source Engineering Model (EM) required for the trapping of the atoms, and their quantum manipulation for the implementation of the matter-wave accelerometer. Exail has designed a solution complying with the performances objectives of the mission. This EM will be delivered to ADS by the end of year 2024 for the integration to the instrument and experimental tests with the atoms. In parallel, Exail is starting to address the development of a space grade control electronics of the laser source.



Future events related to CARIOQA-PMP

Upcoming events :

- End of April: Factsheet No. 2 on the usefulness of the cold atom quantum sensor
- Beginning of May: Launch of the interview series on the CARIOQA mission with Felix PEROSANZ, Solid Earth Thematic Expert at CNES



The **CARIOQA-PMP** team thanks you for
your interest in the project !



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