



Newsletter N°1

September 2023

Here are the CARIOQA-PMP news !



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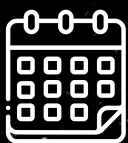
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Welcoming words from the coordinator



Christine **FALLET** (CNES)

Coordinator of the project

Dear Reader,

Welcome to the CARIOQA-PMP community!

We are thrilled to launch the very first issue of the CARIOQA-PMP newsletter. CARIOQA-PMP, which stands for Cold Atom Rubidium Interferometer in Orbit for Quantum Accelerometry-Pathfinder Mission Preparation, is a journey of three and half years we embarked on last December 2022. Sixteen organisations from five different European countries joined forces to work on a common goal: prepare the implementation of atom accelerometers in space, in particular for applications in Earth observation.

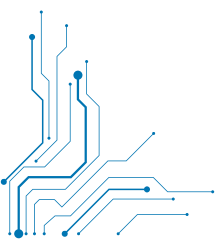
Indeed, the use of these quantum sensors for future space geodesy missions will contribute to improve the resolution of the gravity mapping thanks to a high-level definition of data observation. The improvement of the gravity mapping will have a strong impact in Earth sciences in particular for ground water management, natural disasters forecast and, more generally, the monitoring and understanding of global warming.

CARIOQA-PMP relies on a high-level consortium of world leaders of quantum sensors, European leading space actors from industry and academia in order to deploy a European Quantum Space Gravimetry pathfinder mission in space and hence secure EU leadership in space research and development.

Last June, the signature of a Joint Declaration between CNES, DLR and the European Commission reaffirmed our commitment to join efforts and deploy a Quantum Space Gravimetry Pathfinder Mission within the decade. This signature is an important milestone as it contributes to pave the way for the next phases of the project.

Sincerely,

Christine FALLET



1. Presentation of the Pathfinder for a Quantum Space Gravimetry Mission

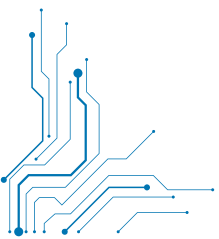


The motivation for CARIOQA-PMP is the potential benefit of accelerometers based on atom interferometry for future Earth observation missions.

In this context, the state of the art in missions for Earth observation and developments of quantum sensors for space are assessed as the basis for the extrapolation for a future quantum sensor enhanced mission. As a consequence, we outline required technology developments - of which CARIOQA-PMP is the essential part.

Therein, the demonstration activities focus on the quantum sensor payload. To anticipate future utilisation of the payload on a satellite, we engage with building the quantum pathfinder mission scenario.

This includes the definition of scientific objectives along with the implications for the satellite platform and the orbit. Driven by the scientific objectives, we specify characteristics of the quantum sensor and the science programme to investigate them.



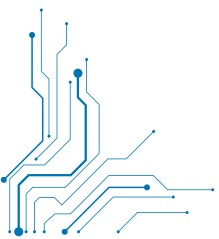
2. Workshop on simulation tools hosted by DLR



DLR (Deutsches Zentrum für Luft- und Raumfahrt) organised a workshop last 30 May in Hannover around the theme of simulation tools. The workshop was attended by about 20 participants from DLR, DTU, LUH, ONERA, POLIMI, SYRTE and TUM.

The discussion centered on mission specific parameters such as cycle time, sensitivity and dynamic range of the atom interferometer/engineering model. This included an in-depth comparison between Pathfinder and the potential Quantum Satellite Gravity (QSG) mission, and the potential impact of satellite and orbit design on meeting Earth Observation (EO) user requirements and additional science objectives. The evaluation process and current EO user needs were presented and discussed in the context of other projects and larger programmes at NASA and ESA.

The simulation tools used within the currently active tasks were the main focus of the workshop. The simulation tools considered fall into two main categories: physics (atom interferometer simulation) and geodesy (mission and gravity field simulation). The interface of these two categories, the simulation of an atomic interferometer on a satellite platform and the tools or data needed to achieve this, was a major point of discussion. The meeting led to engaging discussions on satellite/orbit parameters for sensor simulation, hybrid concepts and potential strategies. Mission scenarios were explored, considering factors such as cost and temporal/spatial resolution, and identified the need to define a potential "start" scenario. A key outcome is the planning of two dedicated meetings in the coming months on QSG mission scenarios and sensor hybridisation strategies.



3. Creation of the Scientific and Technical Advisory Board

The Scientific and Technical Advisory Board (STAB) consists in a group of independent experts that will gather at different phases of the project to provide advice and technical insights. This external support seems particularly relevant in the CARIOQA-PMP project according to its high-level technical expertise and crucial implications for the future of European space research.

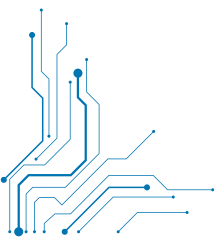


The STAB of the CARIOQA-PMP project is composed of ten scientists from EU Member States, specialised in the fields of quantum sensors, geodesy and Earth sciences. STAB members operate independently, as individual experts until the end of the project. The CARIOQA-PMP Project Coordinator provides the necessary access to services, including access to communication and project management services, for the seamless operation of the STAB.

The STAB mission on the CARIOQA-PMP project will mainly be:

- To provide critical feedback on the development of the project and the addressed research.
- To provide advice on impact-related aspects such as stakeholder involvement and exploitation.
- To give recommendations on relevant technological and scientific, as well as programmatic aspects of the project, for the Quantum Pathfinder Mission scenarios and the Post-Pathfinder roadmap.
- To provide expert advice on the Whitepaper with policy recommendations.
- To review key documents.
- To gather the exchanges and conclusions in STAB meeting minutes.

After a first online meeting, the CARIOQA-PMP team and the STAB will meet physically during the general assembly in November 2023 in Milan.



4. Launch of the Preliminary Design Review of the Engineering Model instrument

The Engineering Model (EM) instrument Preliminary Design Review (PDR) of CARIOQA-PMP took place in Toulouse last 12 September 2023, following the conclusion of the specification and preliminary definition phases of the EM instrument.

It presented a preliminary definition that meets all identified requirements, mission, interfaces and operations constraints, as well as recommendations and decisions for the next phase. These recommendations have been drawn up by the review group composed of members of CNES and DLR and formalised in a report.

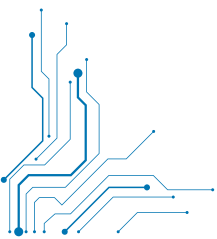
A PDR steering committee further decided on the recommendations submitted for the next phases of the project.

The PDR presentation involved the two space agencies (CNES, DLR), the industrial partners (ADS-F, ADS-G, EXAIL, TELETTEL, LEONARDO) and the scientific partners of the project for quantum sensors technologies (LUH-IQO, SYRTE, LP2N, LCAR, ONERA).



The CARIOQA-PMP team at the Preliminary Design Review

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5. Presentation of the project partners CNES and DLR

CARIOQA-PMP brings together the main players of quantum sensors in Europe. It gathers unique skills among 16 partners from 5 EU Member States including 2 space agencies, 8 research organisations and 6 industries. The coordination of the project is led by the French and the German space agencies presented below.



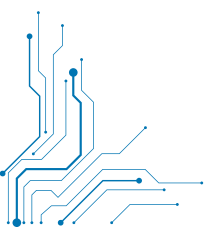
CNES, Centre National d'Études Spatiales, is the French Space Agency, a governmental organisation founded in 1961. As programme-focused agency and centre of technical expertise, CNES is responsible for shaping and implementing France's space policy within the framework of international cooperation, particularly within Europe.

CNES has the coordination lead on the CARIOQA-PMP project, and leads therefore the "Project Management Plan". In this context, the CNES takes care of the implementation plan and EM Instrument Development Plan, the Risk Management Plan, the Project Quality Assurance Plan, the Data Management Plan and the selection of the STAB members (previously presented). Moreover, the CNES has the lead on a technical work package to define and specify the Pathfinder Engineering Model instrument.



DLR, Deutsches Zentrum für Luft- und Raumfahrt, is the German centre for aerospace, energy and transportation research. Its headquarters are located in Cologne and it has offices in multiple locations throughout Germany. DLR is responsible for planning and implementing the German space programme.

DLR is engaged in a wide range of research and development projects in national and international partnerships. In this context, DLR works on the CARIOQA-PMP project as co-coordinator under CNES lead. DLR is in charge of the activities of two work packages. The first one focuses on the definition of the Pathfinder mission for a Quantum Space Gravimetry Mission and the second on the Post-Pathfinder scientific applications.



Past and future events related to CARIOQA-PMP

Back on past events :

CARIOQA-PMP was present at the 28th General Assembly of the International Union of Geodesy and Geophysics (IUGG2023), held in Berlin from 11 to 20 July 2023. The IUGG is an umbrella organisation covering geodesy, cryosphere, hydrology, volcanology, the physics of the oceans and the Earth's interior, among others, making it an ideal event to reach a wide range of potential users of a future quantum gravimetry mission. In the session "Modern Gravimetric Techniques for Geosciences", Christian Schubert (DLR) presented a talk on the technology and the overall concept of CARIOQA-PMP. Manuel Schilling (DLR) introduced the design and simulation of a quantum pathfinder mission and a possible future gravity field mission in a poster session. IUGG 2023 was co-sponsored by CARIOQA-PMP partner Leibniz Universität Hannover represented by the Cluster of Excellence Quantum Frontiers and Collaborative Research Center TerraQ.

Upcoming events :

16-20 October 2023: European Quantum Technology Conference (EQTC)

The EQTC which takes place in Hannover (Germany), is set to be the beating heart of the European quantum world for a full week. During this event partners from DLR will be present.

2-3 November 2023 : MAGICScience and Applications Workshop 2023

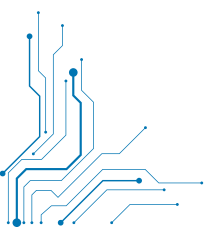
ESA and NASA organise a Workshop sponsored by DLR on the future Mass Change and Geosciences International Constellation (MAGIC). This workshop, which takes place in Assisi, (Italy) aims to discuss about topics close to the themes covered by the CARIOQA-PMP project.

7-8 November 2023: CARIOQA-PMP General Assembly

This event will be the occasion for the partners to share the progress and their questions after almost one year of collaboration on CARIOQA-PMP.

May 2024 : Release of the next newsletter !

Stay tuned!





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



CARIOQA-PMP Kick-Off meeting
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