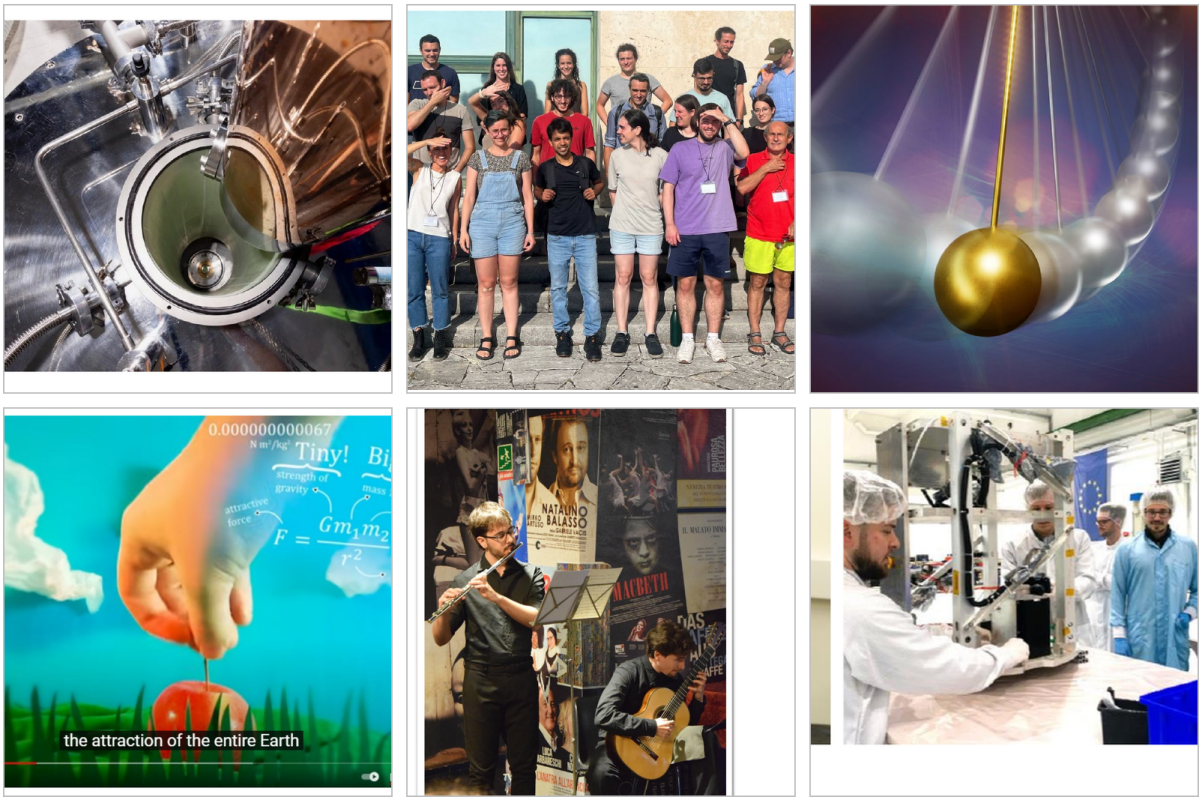
NEWSLETTER N.7, Summary Edition



Selected cover images from Newsletters N.1–N.6, illustrating the evolution of QuCoM from project launch to final milestones.

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Work done

This summary issue brings together the main scientific, experimental and communication milestones reported across the first six QuCoM newsletters.

Launching the project and building a common platform. QuCoM began with a coordinated press release in October 2022 and the launch of the project website. These early steps gave the consortium a clear common identity, explained the mission of studying gravity and quantum mechanics with levitated systems, and created a shared online space for news, publications, events and dissemination materials. The early seminar series on optomechanical systems in Trieste also helped translate the project objectives into a first structured programme of scientific discussion.

Control of levitated motion. During the first year, the consortium developed feedback-based schemes for cooling, squeezing and controlling optically and magnetically levitated particles. Detection was improved through optimized collection of scattered light in optical traps and better SQUID-based pickup geometries in superconducting Meissner traps. In parallel, work on pulsed control of Duffing-type nonlinearities opened a route toward non-Gaussian states and, in the longer term, toward spatial quantum superpositions.

First gravity-sensing milestones. A major early highlight was the Magnetic Zeppelin result, which demonstrated detection of a gravitational drive in the Hertz regime with a levitated magnetic particle. This result provided an important steppingstone toward future experiments in which small source and test masses interact gravitationally under highly isolated cryogenic conditions. Subsequent work further advanced vibration isolation, trap engineering, source-mass modulation strategies and control of systematic effects.

Theory at the gravity–quantum interface. Alongside the experimental programme, QuCoM developed a broad theoretical portfolio. Teams studied continuous spontaneous localization as a benchmark for gravity-related precision measurements, analyzed the role of quantum resources in non-equilibrium parameter estimation, and examined models such as the Schrödinger–Newton, Károlyházy and Diósi–Penrose proposals. Later work explored gravity-induced diffusion in classical-local models, amplification strategies for Schrödinger–Newton signatures, thermodynamic consistency in quantum Brownian motion, and schemes to witness whether gravity can entangle massive systems.

Coordination, review and consortium growth. Regular online meetings between experimental groups in Leiden and Southampton, combined with in-person project workshops and steering committee meetings, supported close coordination across work packages. The 2023 review meeting and the report shared in March 2024 gave QuCoM an excellent overall assessment, praising the scientific quality of the results, the smooth collaboration between academic and industrial partners, and the breadth of dissemination already achieved. The reviewers also encouraged continued exploitation-oriented activities and broad public engagement.

Public visibility and major media attention. A turning point in external visibility came with the Science Advances paper "Measuring gravity with milligram levitated masses". The associated press release triggered extensive coverage in general and specialist media, including the Guardian, BBC Science Focus, The Times, New Scientist, IFL Science, Space.com, Physics World and Popular Mechanics. The newsletters report more than 53 general press outlets covering the story, a total estimated reach above 405 million accesses, and a top 5% Altmetric performance for the article.

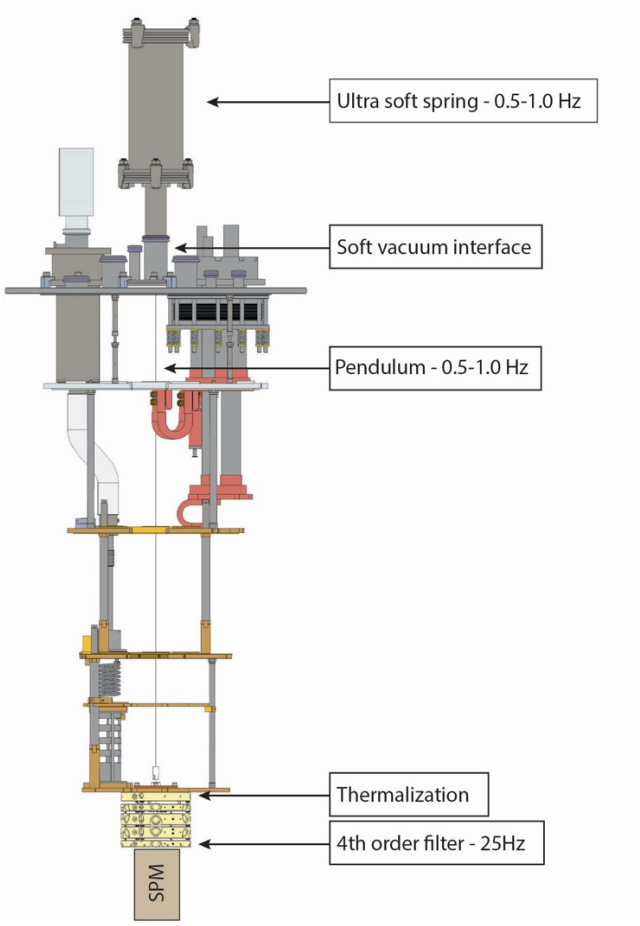
Workshops, schools and community building. The newsletters document a sustained effort to build a research community around levitated mechanics, collapse models and quantum foundations. Highlights included the QuCoM scientific workshop in Leiden, the COLMO workshop on quantum collapse models, repeated editions of "A look at the interface between gravity and quantum theory", and the Fundamental Problems in Quantum Physics schools in Trieste. The 2024 edition of the school, together with the Trieste project meeting and steering committee, showed how QuCoM combined technical progress with training, networking and planning for the final phase of the project.

Communication to the public. Communication remained a core component throughout the project. Beyond the website and press coverage, the consortium produced a short QuCoM video to explain its scientific goals to a broad audience. In 2025, outreach expanded further through Angelo Bassi's appearance on Sky TG24's "Science, please" podcast and the return of the Quantum Café in Trieste, where scientific discussion was paired with theatre readings and live music. These initiatives showed the project's commitment to connecting frontier research with the public in accessible and creative forms.

Final milestones in 2025. The last newsletter reported several concluding milestones that captured the maturity of the project. The Trieste group advanced new theoretical tests at the quantum-classical boundary of gravity; the Tübingen and QUB/Palermo teams deepened work on decoherence, quantumness and stochastic thermodynamics; the University of Southampton flew the OptToSpace payload to test levitated

mechanics in space; Leiden completed a second-generation gravity generator optimized for 0.1–100 milligram source masses; and Mauro Paternostro was inducted into the Royal Irish Academy. Taken together, these achievements show a project that moved from launch and proof-of-concept results to internationally visible, technically ambitious and conceptually mature work.

Update from 2026. In the last period, LSI focused on the ongoing productization of the technology developed within the QuCoM project, with particular attention to a "zero-spring" solution designed to require only minimal adaptations to the cryostat and therefore fit multiple models from different vendors. Using STM imaging of HOPG (graphite) as a benchmark, the team achieved very encouraging test results: while the starting configuration still showed pulse-tube disturbances larger than a single atomic step, recent optimizations, including additional isolation and damping, have reduced these effects to nearly negligible levels. The best results obtained so far show atomic rows resolved on HOPG with the pulse tube both on and off at room temperature, demonstrating the strong potential of the solution (see figure below). With the full cooling infrastructure now in place, the next step will be to extend these tests to low-temperature operation.



Publications

Across the six newsletters, QuCoM reported a steady stream of 57 papers spanning levitated mechanics, collapse models, quantum thermodynamics, gravity tests and space-related platforms. The table below lists the latest new publications of the last 6 months.

Authors	Title	Journal	Year
T. Wilson et al.	Oligonucleotide Selective Detection by Levitated Optomechanics	ACS Nanoscience Au 6, 26	2026
M. Cromb et al.	Creation of a black hole bomb instability in an electromagnetic system	Science Advances 11, 4595	2025
D. W. P. Amaral et al.	Magnetic levitation as a new probe of non-Newtonian gravity	Physical Review D 113, L021101	2026
A. Bassi	Quantum foundations for quantum technologies in the International Year of Quantum (2025)	Quantum Science and Technology 11, 020501	2026
J. L. Gaona-Reyes et al.	Theoretical limits of protocols for distinguishing different unravelings	Physical Review Research 7, 043295	2025
N. Piccione and A. Bassi	Hybrid classical-quantum Newtonian gravity with stable vacuum	Classical and Quantum Gravity 42, 225002	2025
J. Barr et al.	A machine learning based approach to the identification of spectral densities in quantum open systems	The European Physical Journal Special Topics, 1	2025
O. Angeli and M. Carlesso	Entanglement in Markovian hybrid classical-quantum theories of gravity	Physical Review D 112, 024047	2025
D. G. A. Altamura et al.	Improved bounds on collapse models from rotational noise of the Laser Interferometer Space Antenna Pathfinder mission	Physical Review A 111, L020203	2025
S. Artini et al.	Nonequilibrium thermodynamics of gravitational objective-collapse models	Physical Review Research 7, 043017	2025

Moreover, have completed and posted on the ArXiv the following preprints

Authors	Title	Source	Year
J. Homans, et al.	Macroscopic Quantum Resonators Path Finder (MAQRO-PF) White Paper	arXiv:2512.01777	2025

Authors	Title	Source	Year
J. K. Jose, et al.	Cryogenic pressure sensing with an ultrafast Meissner-levitated microrotor	arXiv:2509.24964	2025
S. Bose, et al.	A spin-based pathway to testing the quantum nature of gravity	arXiv:2509.01586	2025
D.G.A. Altamura, et al.	Enhancement of the effects due to the Schrödinger-Newton equation	arXiv:2501.13030	2025
O. Angeli, et al.	Probing the Quantum Nature of Gravity through Classical Diffusion	arXiv:2507.02845	2025

Dissemination activities

The second cycle of **Caffè dei Quanti** took place in autumn 2025, with three public events held at Bar Knulp on 29 October, 11 November and 26 November. Organised by the Department of Physics of the University of Trieste, and supported by QuCoM, the series confirmed the success of this original outreach format, combining science, literature and music in an informal setting. The three evenings, gathered under the title “Epifanie del Fuoco”, featured seminars by Gabriele Cescutti, Valter Sergo and Giacomo Margagliotti, and explored themes ranging from the origin of the elements in stars to fire, matter and generation in physics.

The dissemination story told by the newsletters shows a project that steadily broadened its reach: from foundational communication tools and specialist seminars to international media coverage, public events and creative outreach formats.

Period	Highlights
2022–2023	Launch press release, project website, early seminar series in Trieste, and the first dense programme of talks and specialist dissemination.
2023	QuCoM scientific workshop in Leiden, COLMO, the gravity–quantum interface workshop, the quantum sensing workshop, and the Fundamental Problems in Quantum Physics school.
Early 2024	Strong international media response to the milligram-gravity measurement paper, with broad general press pickup and outstanding online attention.
Mid to late 2024	CAT workshop in Trieste, San Vito “A look at the interface between gravity and quantum theory” workshop, FPQP 2024, the Trieste project meeting and steering committee, and publication of the QuCoM video.
2025	Steering Committee meeting + workshop in Palermo (IT), Sky TG24 podcast, Quantum Café in Trieste, continued seminars and talks across Europe, and communication of space-flight and gravity-sensor milestones.
2026	The legacy of QuCoM will continue with the 2Fundamental Problems in Quantum Physics” school in Trieste (15-18 June) and the summer “A look at the interface between gravity and quantum theory” workshop in the Alps (Merano, 14-17 July)

Across the six issues, QuCoM combined specialist dissemination with broad public engagement, documenting both the scientific development of the consortium and its growing visibility outside the immediate research community.