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Towards a platform for macroscopic quantum experiments in space

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Tremendous progress has been made in space technology over the last decades. This technological heritage promises enabling applications of quantum technology in space already now or in the near future. Heritage in laser and optical technologies from LISA Pathfinder comprises core technologies required for quantum optical experiments. Low-noise micro-thruster technology from GAIA allows achieving impressive microgravity levels, and passive as well as active cryogenic cooling has been harnessed in a harnessed in missions ranging from Planck to the James Webb Space Telescope and may be adapted for the requirements of quantum experiments. Developments like these have rendered space an increasingly attractive platform for quantum-enhanced sensing and for fundamental tests of physics using quantum technology. In particular, there already have been significant efforts towards realizing atom interferometry and atomic clocks in space as well as efforts to harness space as an environment for fundamental tests of physics using quantum optomechanics and high-mass matter-wave interferometry. Here, we will present recent efforts in mission planning, spacecraft design and technology development towards this latter goal in the context of the mission proposal MAQRO and ESA's recent call for New Science Ideas.

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