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The new Absolute Quantum Gravimeter (AQG): first results and perspectives

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Cold atom gravimetry represents one of the most innovative evolution in gravity instrumentation since the last 20 years. The concept of measuring the gravitational acceleration by dropping atoms and the development of the first instrumental devices during this last decade quickly revealed the promising perspectives of this new generation of gravity meters enabling accurate and absolute measurements of the Earth's gravity field for a wide range of applications (geophysics, geodesy, metrology, etc.).

The Absolute Quantum Gravimeter (AQG) gravity meter, developed by MUQUANS (Talence, France - http://www.muquans.com/) with the support of RESIF, the French Seismologic and Geodetic Network (http://www.resif.fr/) belongs to this new generation of instruments. It also represents the first commercial device based on the utilization of advanced matter-wave interferometry techniques, which allow to characterize precisely the vertical acceleration experienced by a cloud of cold atoms.

Recently, the first operational unit (AQG01) has been achieved as a compact transportable gravimeter with the aim of satisfying absolute gravity measurements in laboratory conditions under the following specifications: measurements the μGal level at a few Hz cycling frequency, sensitivity of 50μGal/$\sqrt{}$Hz, immunity to ground vibrations, easy and quickness of operation, automated continuous data acquisition for several months, etc. In order to evaluate the current performances of the AQG01, several experiments are carried out in collaboration between RESIF user's teams and the MUQUANS manufacturer on different reference gravity sites and laboratories in France. These measurements performed in indoor conditions including simultaneous observations with classical reference gravity instruments (corner-cube absolute gravity meters, relative superconducting meters) as well with the Cold Atom Gravity meter (CAG) developed by LNE-SYRTE, lead to a first objective characterization of the performances of the AQG01.

This paper summarizes the latest results obtained from these experiments. The evaluation of the AQG01 is still in progress but this study confirmed that the AQG01 enables absolute gravity measurements with a sensitivity of 2 μGal standard deviation after 1000 s of data integration. Perspectives of expected instrumental developments for monitoring both spatial and temporal gravity variations at the microGal level in both laboratory and field conditions will be also discussed.