High resolution compact vertical inertial sensor for atomic quantum gravimeter hybridizing

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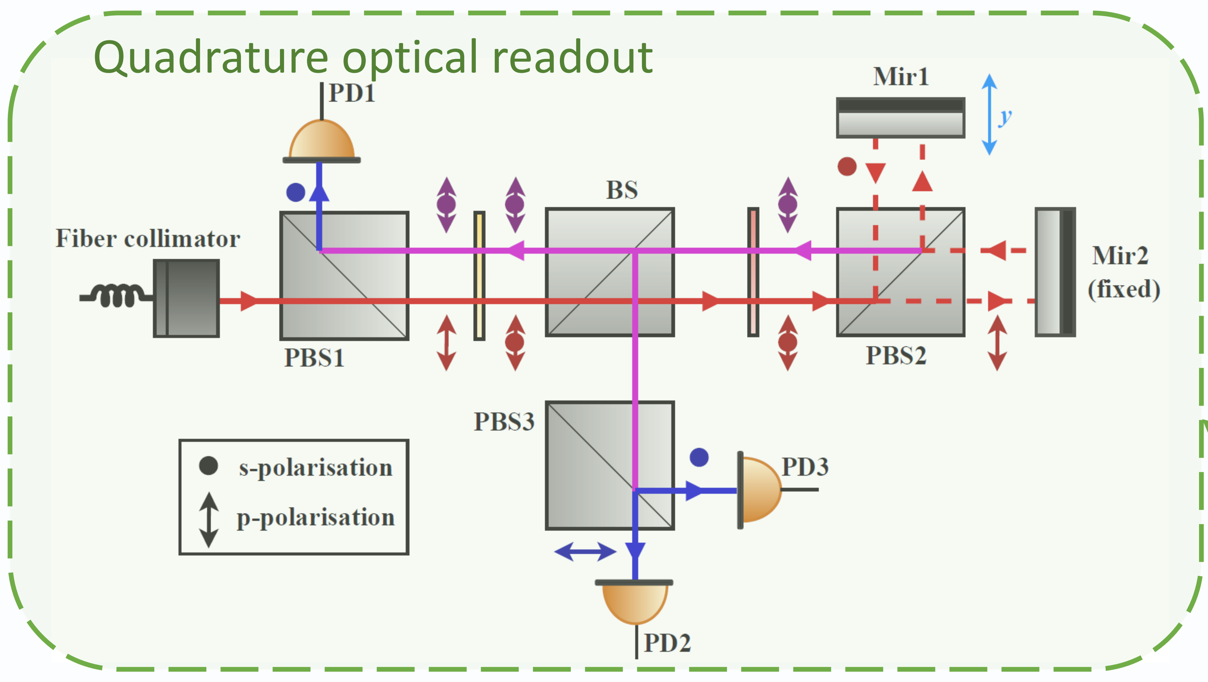
Abstract

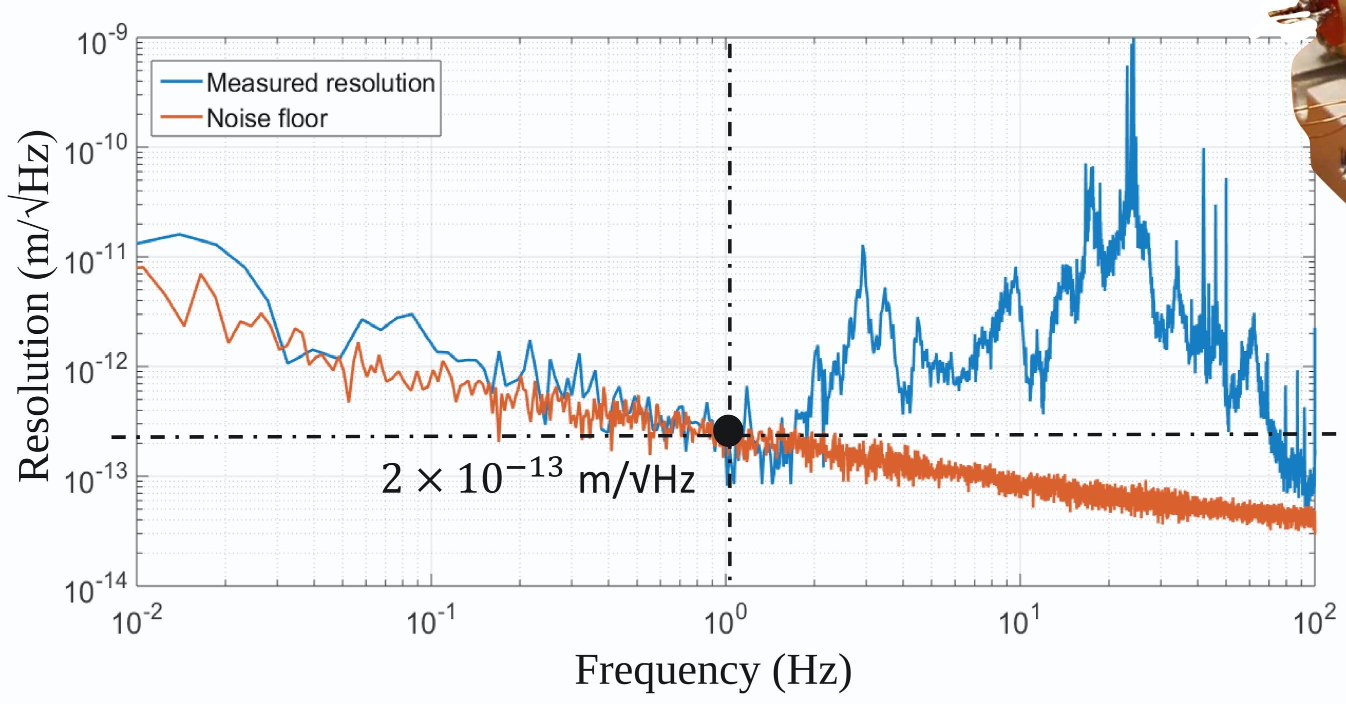
Quantum gravimeters are instruments capable of measuring gravitational fluctuation with a long run µGal accuracy. Their drift-free characteristic makes them potential candidates for application in Newtonian noise cancellation and improved active isolation. A major limitation in these instruments is ground vibration and dead times coming from their discrete functioning [1]. Hybridizing with a classical accelerometer allow to mitigate these two issues [2].

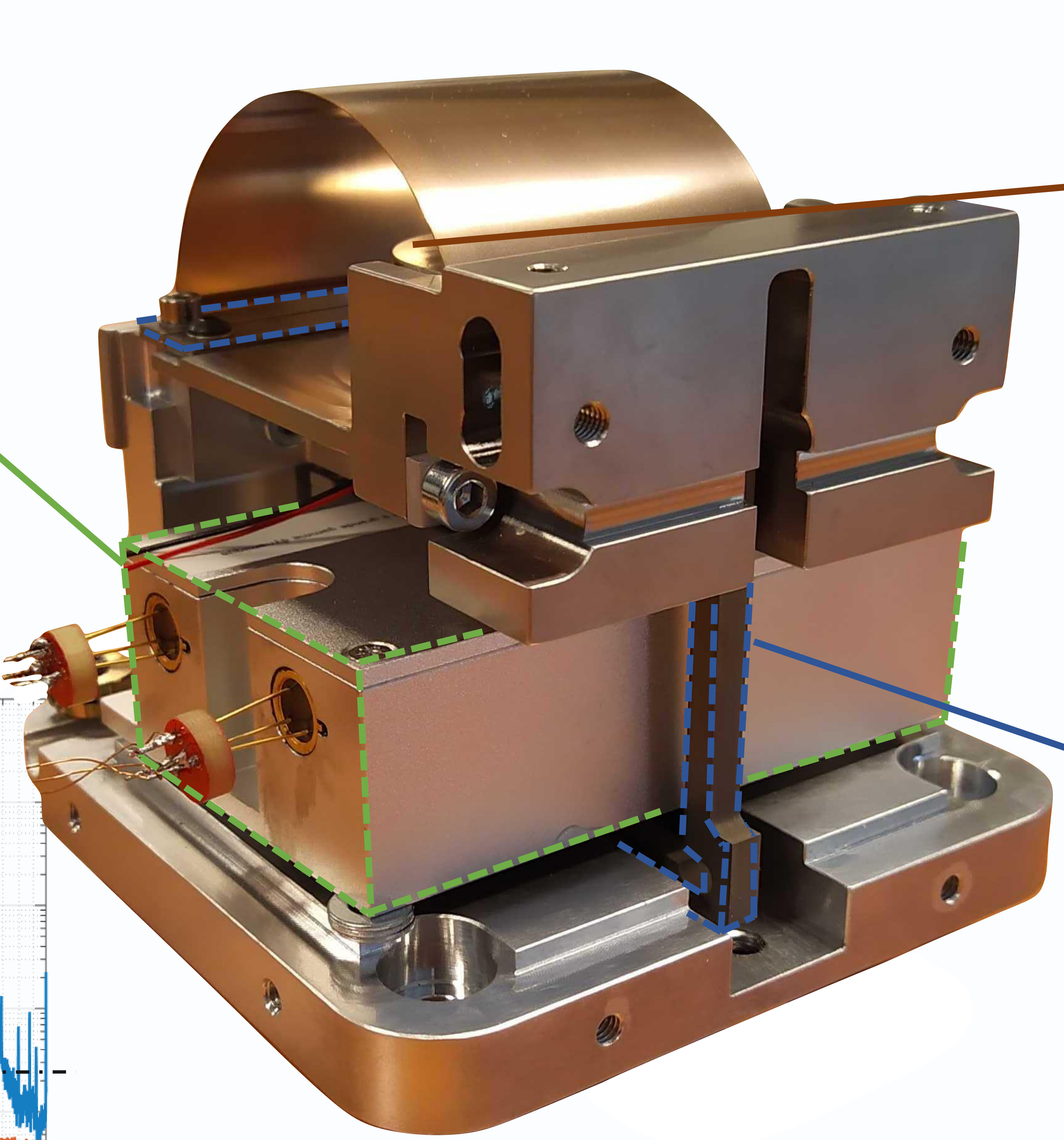
The Precision Mechatronics Laboratory, based in ULiège and ULB, Belgium, has a large experience in developing high-resolution optical inertial sensors intended to be used in active control [3]. The latest inertial sensors, HINS and VINS, are based on a Long-range, Michelson-type, optical readout with a sensitivity of $2{\cdot}10^{-13}$ m/√Hz at 1 Hz. They have a resolution of $2{\cdot}10^{-12}$ m/√Hz at 1 Hz, $1{\cdot}10^{-13}$ m/√Hz at 10 Hz and $3{\cdot}10^{-14}$ m/√Hz at 100 Hz [4].

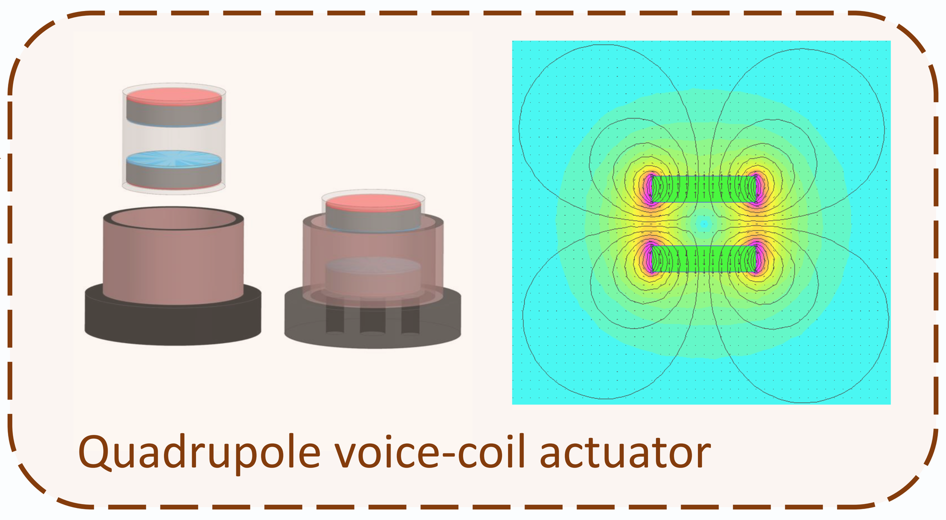
A new, compact, design of the sensors is being developed. The sensor is designed to fit a 10 x 10 x 10 cm box, reducing the original design of VINS by a factor of 8. The mechanics also features fused-silica joints for and reduced low-frequency thermal noise. Ringdown tests demonstrate a Q-factor of 2800 in open-air.

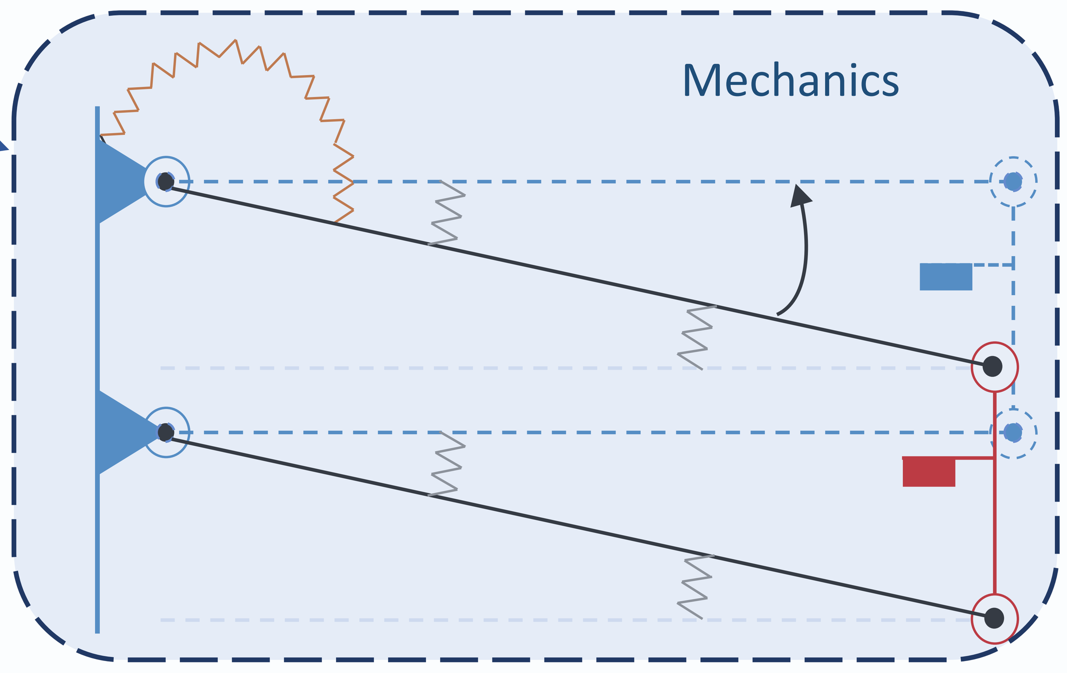
µVINS



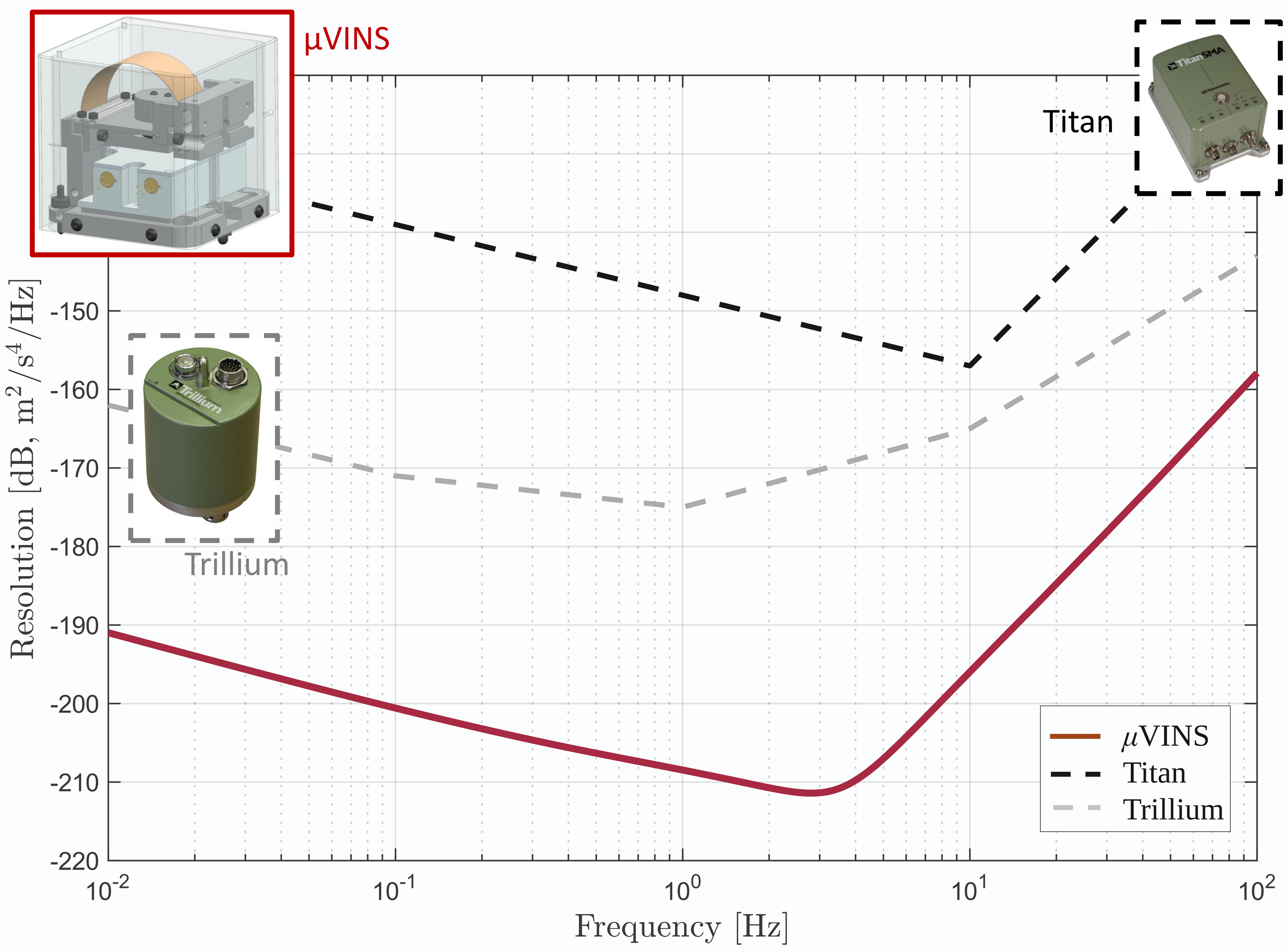








Estimated performance



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