Hybridizing an atom interferometer with an opto-mechanical resonator

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Atom interferometers can perform absolute measurements of inertial effects with extremely high sensitivities and long term stability in comparison to its classical counterparts. Their measurement accuracy and long term stability have made them an ideal candidate in areas such as inertial sensing and navigation . While performing measurements in dynamic field environments an atom interferometer's sensitivity decreases due to inertial noise coupling. Furthermore it can only perform cyclic measurements therefore limiting its high frequency measurement capability. Hybridizing the atom interferometer with a classical inertial sensor by means of correlation will enhance sensitivity and dynamic range over its reciprocal response. With hybridization we have a quantum and classical sensor measuring acceleration with respect to a joint inertial reference thereby enabling common mode noise rejection. We have used a novel opto-mechanical resonator in order to suppress the effects of inertial noise coupling in our atom interferometer. The OMR possesses a very small form factor, therefore apart from eradicating the need to use a vibration isolation system it also allows for compact dimensions of the sensor head. Therefore, considering the complimentary benefits of the quantum sensor and OMR we foresee the potential for a highly sensitive, portable, compact and robust hybrid quantum inertial navigation sensor.

Reference:

1. Richardson, L.L., Rajagopalan, A., Albers, H. et al. Optomechanical resonator-enhanced atom interferometry. Commun Phys 3, 208 (2020). https://doi.org/10.1038/s42005-020-00473-4