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## Cascaded Optomechanical Sensing

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We present a novel approach for detecting the weak gravitational field generated at the Large Hadron Collider (LHC) using cascaded optomechanical cavities. Our methodology exploits coherent averaging to potentially reach Heisenberg-limited sensitivity without entangled resources. In this configuration,  $N$  sequentially arranged optomechanical cavities interact with a single laser pulse in the stroboscopic regime. This approach overcomes Standard Quantum Limit constraints, enabling distributed sensing across multiple LHC locations. Our analysis addresses implementation challenges including thermal noise and transmission losses. Beyond LHC applications, this methodology shows promise for other fundamental physics investigations requiring unprecedented force sensitivity, including dark matter detection and tests of quantum collapse models.

**Primary author:** MARCHESE, Marta Maria (Institute of Science and Technology Austria)

**Presenter:** MARCHESE, Marta Maria (Institute of Science and Technology Austria)

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