

MAGIS-100: A Matter-wave Atomic Gradiometer with Sensitivities to Dark Matter

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MAGIS-100 is a next-generation atom interferometer under construction at Fermilab that aims to explore fundamental physics over a 100-metre baseline, using the latest atomic clock technologies [1]. The experiment will search for ultra-light dark matter [2] and new forces, while also providing an opportunity to test quantum mechanics at new length scales. The 100-metre baseline will also serve as a technology pathfinder to future gravitational wave detectors in a previously unexplored frequency band.

The collaboration will extend the work done with state-of-the-art atom interferometers [3] by applying the same techniques to a system of up to three 10-metre interferometers, organised into two 50-metre drop chambers and connected across a vertical baseline of 100 metres. Each interferometer utilizes strontium atoms in superposition and allows them to fall freely under gravity. The difference in output between the two interferometers can be interpreted as a measure of either dark matter or new physics, providing backgrounds are fully accounted for. Operating two interferometers in this vertical configuration on a shared laser baseline enables the removal of common-mode background noise.

The 100-metre experiment will be a step towards the future construction of a 1 km detector, which will be sensitive to gravitational waves in the frequency range 0.1 Hz - 10 Hz, in between the projected ranges of the Advanced LIGO and proposed LISA experiments.

- [1] J. Coleman, ICHEP Proceedings, arXiv:1812.00482v1 (2018).
- [2] A. Arvanitaki, *et al.*, Phys. Rev. D. **97**, 075020 (2016).
- [3] J. Rudolph, *et al.*, Phys. Rev. Lett. **124**, 083604 (2020).