Exploring gravity with the MIGA large scale Atom Interferometer

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We are building a new, hybrid detector that couples laser and matter-wave interferometry to study sub Hertz variations of the strain tensor of space-time and gravitation. Using a novel approach exploiting a set of atomic interferometers simultaneously manipulated by the resonant optical field of a 200 m cavity, this instrument will allow at the same time a better understanding of the evolution of the gravitational field and a new tool for gravitational waves (GW) detection. This new infrastructure will be embedded into the LSBB underground laboratory, ideally located away from major anthropogenic disturbances and benefitting from very low background noise.

Each atomic ensemble of the antenna will be manipulated by cavity enhanced Bragg pulses to create an atom interferometer (AI) that will simultaneously read out motion of the cavity, GW and inertial effects. The use of the spatial resolution offered by the different AIs placed along the cavity will permit to discriminate between these contributions. This will bring to unprecedented sensitivities to gravity gradients fluctuations and open new perspectives for sub Hertz GW detection.

The project is carried out by a consortium that gathers 17 expert French laboratories and companies in atomic physics, metrology, optics, geosciences and gravitational physics, with the aim to build the MIGA infrastructure by end 2019. In this paper, we present the main objectives of the project, the status of the construction of the instrument and the motivation for the applications of MIGA in GW physics.