Reaching ultra-high vacuum for a large vacuum vessel in an underground environment

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Abstract

Located far from anthropological disturbances and with low seismic and magnetic background noise profiles, the LSBB facility is the ideal location for a new hybrid detector for the study of space-time strain. This new concept, the MIGA infrastructure [1], utilizes an array of atom interferometers manipulated by the same beam, the resonant optical field of a 150 m long optical cavity. The infrastructure constitutes a new method for geophysics, for the characterization of spatial and temporal variations of the local gravity, and is a demonstrator for future decihertz gravitational wave observation. Such an infrastructure requires ultra-high vacuum (10^{-9} mbar) on a size (150 m) and scale (about 30 m^3) not previously seen in underground laboratories, and especially in underground environments with high humidity and significant dust contamination. Here, we detail the status of the MIGA infrastructure and describe the ongoing generation and analysis of the vacuum works - this comes from tests of the prototype vacuum vessel (see 1), focusing on heating cycles, residual gas and resonant frequency analysis, as well as demonstrating an understanding of the thermal inertia of the system.

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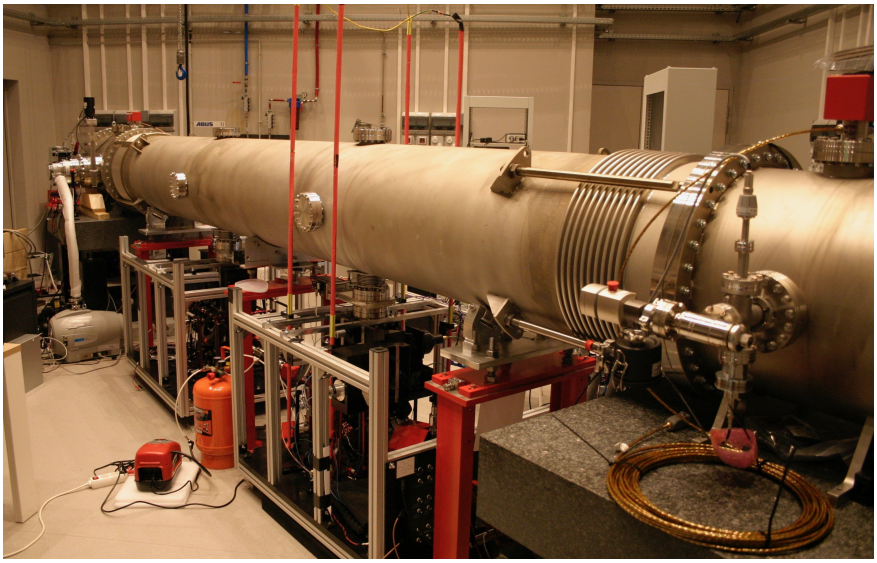

FIG. 1. Standard Tube Prototype at LP2N undergoing vacuum generation.

[1] B. Canuel, A. Bertoldi, L. Amand, E. P. di Borgo, T. Chantrait, C. Danquigny, M. D. Álvarez, B. Fang, A. Freise, R. Geiger, J. Gillot, S. Henry, J. Hinderer, D. Holleville, J. Junca, G. Lefèvre, M. Merzougui, N. Mielec, T. Monfret, S. Pelisson, M. Prevedelli, S. Reynaud, I. Riou, Y. Rogister, S. Rosat, E. Cormier, A. Landragin, W. Chaibi, S. Gaffet, and P. Bouyer, Exploring gravity with the MIGA large scale atom interferometer, Sci. Rep. **8**, 14064 (2018).