Laser spectroscopy and magnetic resonance atomic magnetomerty in search for dark mater: New bounds on Axion like dark matter from GNOME network of OPM's

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Abstract. In this work we present newest results from the science Run 5 of Global Network of Optical Magnetometers for Exotic physics (GNOME) presented in. Long uninterrupted time series and novel pre-processing methods provide more stringent bounds that are used to estimate exclusion domain of mass and interaction strength of hypothetical axionic or axion like dark matter in form of topological defects. Hypothetical axions or Axion Like Particles (ALP's) are form of ultralight bosonic matter that are postulated in order to solve strong CP problem and matter-antimatter imbalance in the Universe [1] [2]. This type od Dark Matter (DM) has a number of detectable signatures, one being in form of axionic field coupling to fermions that results in formation of pseudo-magnetic fields during passage through topological defect. The GNOME experiment described in [5] and [6] is designed as GPS referenced worldwide distributed network of quantum cross-correlated sensors that increases its sensitivity reach and excludes false positives. Science Run 5 lasted from 24. August to 26. October of 2022 and included, at the highest extent, 11 stations and is characterized by lowest amount of noise, optimal station placement and highest quality of data compare to previous Science Runs [3]. Novel scheme for measuring bandwidth of each station and its frequency response was devised along with pulse sequences that made possible re-scaling in order of site-specific coupling of Optically pumped magnetometers (OPM) to magnetic perturbation as presented (Fig. 1). We present various sensors in the GNOME network and will give other potential uses of data collected by the network.

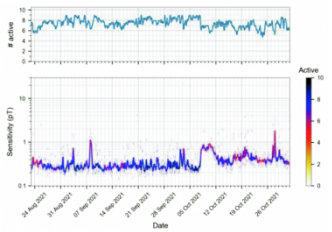

Figure 1: Representation of number of active sensore over time (upper frame); representation of rescaled magnetic field sensitivity of entire network (lower frame).

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