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Hunts for dark matter with the global network of synchronized optical magnetometers[1]

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Despite enormous progress of modern science, Nature still holds several great secrets that slip our understanding. Observations such as Non-Newtonian rotation of galaxies, gravitational microlensing in seemingly empty space, accelerating expansion of the Universe, baryogensis, etc. motivate searches beyond the Standard Model. This is addressed by the development of theoretical models, which often introduce new interactions and particles. While the hypothetical particles couples to the ordinary matter mostly through gravity (dark-matter casus), some model predicts that they reveal different coupling affecting internal/quantum state of atoms or molecules. This motivates atomic-physics-based searches for physics beyond the Standard Model [**?**]). To date all dark-matter searches have returned null results. This not only triggered development of more sensitive experiments and different theoretical models, but also lead to rethinking of methodology of such searches. For example, any transient effects that may induced modification in system's state would be washed out by long averaging of the signals. To address this problem, the Global Network of Optical Magnetometers for Exotic physics (GNOME) has been proposed [**?**] and implemented [**?**]. The network consists of several sensitive optical magnetometers, operating in distant (1,000-10,000 km) locations. Via correlations measurements of the readouts of the magnetometers local noise can be suppressed and global (potentially) nonmagnetic disturbances of magnetometers' operation can be identified. This opens possibility for searches for transient exotic spin couplings. Such transient signals may be induced by interaction with topological defects of specific dark-matter constituents (axion-like particles) or "collisions" with the so-called Q-stars. During the presentation, the first scientific run of the GNOME will be discussed. The preliminary results of the network, achieved with 9 stations, will be presented and their implications for various theoretical models will be discussed.

References

[1] M. S. Safronova, D. Budker, D. DeMille, D. F. Jackson Kimball, A. Derivianko, and C. W. Clark, *arXiv* 1710:01833.

[2] S. Pustelny *et al.*, *Ann. Phys. (Berl.)* **525**, 659 (2013).

[3] https://budker.uni-mainz.de/gnome/

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