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Global Positioning System as a dark matter detector[1]

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Cosmological observations indicate that dark matter (DM) constitutes 85% of all matter in the Universe, yet conclusive evidence for DM in terrestrial experiments remains elusive. One of the possibilities is that DM can be composed from ultralight quantum fields whose self-interactions lead to the formation of DM objects in the form of stable topological defects. Such DM "clumps", depending on the masses of underlying fields, can be spatially large on the laboratory scale. As the Earth moves through the halo of DM objects, interactions with such DM clumps could lead to measurable variations in GPS signals which propagate through the satellite constellation at galactic velocities of ~ 300 km/s. Here we use the network of atomic clocks onboard GPS satellites as a $\sim 50,000$ km aperture DM detector. By mining 16 years of archival GPS data, we find no evidence for topological defects in the form of domain walls at our current sensitivity. As a result, we improve the present limits on certain DM-ordinary matter coupling strengths by up to six orders of magnitude. *Details: Roberts, et al. Search for domain wall dark matter with atomic clocks on board global positioning system satellites. Nature Commun. 8, 1195 (2017).*

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