New technique to detect dark matter uses atomic clocks and lasers

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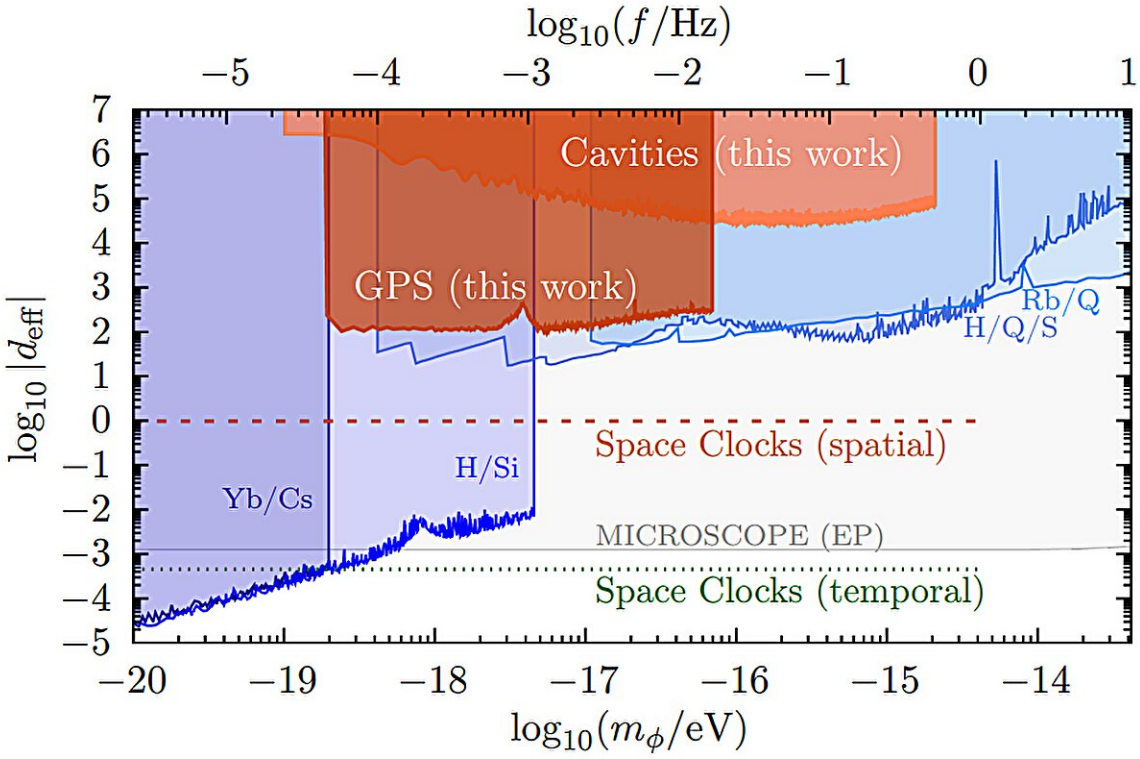

Experimental limits on a coupling strength d_{eff} of dark matter with mass m_φ to normal matter. Credit: *Physical Review Letters* (2025). DOI: 10.1103/PhysRevLett.134.031001

A team of international researchers has developed an innovative approach to uncover the secrets of dark matter. In a collaboration

between the University of Queensland, Australia, and Germany's metrology institute (Physikalisch-Technische Bundesanstalt, PTB), the team used data from atomic clocks and cavity-stabilized lasers located far apart in space and time to search for forms of dark matter that would have been invisible in previous searches.

This technique will allow the researchers to detect signals from dark matter models that interact universally with all atoms, an achievement that has eluded traditional experiments.

The team analyzed data from a European network of ultra-stable lasers connected by fiber optic cables (previously reported in a 2022 article), and from the atomic clocks aboard GPS satellites. By comparing precision measurements across vast distances, the analysis became sensitive to subtle effects of oscillating dark matter fields that would otherwise cancel out in conventional setups.

Published in *Physical Review Letters*, their new study highlights the power of international collaboration and cutting-edge technology. By enabling scientists to investigate a broader range of dark matter scenarios, this method brings us closer to understanding one of the universe's most elusive and fundamental components.

More information: Melina Filzinger et al, Ultralight Dark Matter Search with Space-Time Separated Atomic Clocks and Cavities, *Physical Review Letters* (2025). DOI: 10.1103/PhysRevLett.134.031001

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