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Axion and hidden photon dark matter detection with multilayer optical haloscopes

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A well-motivated class of dark matter candidates, including axion-like particles and dark photons, takes the form of coherent oscillations of a light bosonic field. If the dark matter couples to Standard Model states, it may be possible to detect it via absorptions in a laboratory target. Current experiments of this kind include cavity-based resonators that convert bosonic dark matter to electromagnetic fields, operating at microwave frequencies. We propose a new class of detectors at higher frequencies, from the infrared through the ultraviolet, based on the dielectric haloscope concept. In periodic photonic materials, bosonic dark matter can efficiently convert to detectable single photons. With feasible experimental techniques, these detectors can probe significant new parameter space for axion and dark photon dark matter in the 0.1 – 10 eV mass range.

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