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The Earth as a transducer for dark-photon dark-matter detection

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In this talk, I will propose the use of the Earth as a transducer for ultralight dark-matter detection. In particular I will point out a novel signal of kinetically mixed dark-photon dark matter: a monochromatic oscillating magnetic field generated at the surface of the Earth. Similar to the signal in a laboratory experiment in a shielded box (or cavity), this signal arises because the lower atmosphere is a low-conductivity air gap sandwiched between the highly conductive interior of the Earth below and ionosphere or interplanetary medium above. At low masses (frequencies) the signal in a laboratory detector is usually suppressed by the size of the detector multiplied by the dark-matter mass. Crucially, in our case the suppression is by the radius of the Earth, and not by the (much smaller) height of the atmosphere. The magnetic field signal exhibits a global vectorial pattern that is spatially coherent across the Earth, which enables sensitive searches for this signal using unshielded magnetometers dispersed over the surface of the Earth. I will summarize the results of such a search using a publicly available dataset from the SuperMAG collaboration. The constraints from this search are complementary to existing astrophysical bounds. Future searches for this signal may improve the sensitivity over a wide range of ultralight dark-matter candidates and masses.

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