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Torsion-balance experiments and ultra-low-mass fields

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Many of the solutions to outstanding problems in modern cosmology posit new, ultra-light fields. Unifying General Relativity and Quantum Mechanics appears to require new ultra-light fields at some level. Such fields are also invoked to drive inflation and dark energy. Ultra-light fields may also make up much or all of the dark matter density of the universe. Torsion pendulums, a technology that dates to the 18th century, remain one of the most sensitive experimental techniques to search for ultra-light, weakly interacting fields. I will explain how torsion balance experiments can search for beyond-the-standard-model fields using laboratory-based as well as galactic sources, and the important cosmological implications of these measurements. I will also describe a new experimental signature for which certain torsion balance geometries make very sensitive direct dark matter detectors over a broad range of interesting dark matter parameter space.