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Parallel plate force metrology as a tool to probe the dark sector

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Ever since the discovery of accelerated expansion, the cosmological standard model Lambda-CDM has been our best description of the universe on large scales. In recent years, however, significant tensions have appeared that cast doubt on the validity of dark matter being a cold non-interacting fluid, and the cosmological constant being a global parameter. Moreover, searches for weakly interacting massive particles at accelerators have so-far not been successful. Therefore, light particles, such as the QCD axion have moved into the spotlight. While there is a vast theoretical landscape of effective models at low energies, there exist general frameworks to classify them. The Wilczek-Moody formalism classifies all possible tree-level interactions between fermions, while Kostelecky's standard model extension provides a comprehensive framework for terms breaking the Lorentz invariance.

Using these frameworks, precision force metrology at low energies can be used to search for the manifestations of hypothetical fifth forces. While traditional torsion balances have long set the standards in this area, the Casimir And Non-Newtonian force EXperiment CANNEX is the world's only force metrology setup operating in the geometry of macroscopic plane parallel plates. In this talk, I will review the technique, status, and prospects of this unique setup in the context of dark matter and dark energy detection.

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