CANNEX - A parallel plate approach to physics

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Since the discovery of accelerated cosmic expansion dark energy has evolved from a niche subject of cosmology to a focus topic of several related fields. Motivation is given by the cosmological constant problem, originating from the 120 order-of-magnitude discrepancy between actual measurements and the QED prediction for the cosmic vacuum energy density. Among the numerous theories aiming to explain dark energy, effective field theories implementing some kind of screening mechanism have become popular recently. The so-called 'chameleon' model introduces a scalar field whose interactions with ordinary matter depend on the local energy density. This variability allows the theory to be in agreement with all present observations but experimental tests have failed to completely exclude or find evidence for chameleon interactions. In 2010 it has been suggested that a precision measurement of the modulation of the force between macroscopic parallel plates with the pressure of an ambient gas could finally achieve this goal. Another problem related to vacuum energy is the Casimir effect. In MEMS, being widely used in industry and mobile devices, this effect is a major blocker of miniaturization. New geometric structures to overcome the problem are being developed but accurate measurements in geometries involving parallelism are required to verify design methods. A more fundamental problem in Casimir physics, being discussed already for two decades, is centered around the deep question if real and virtual photons behave in the same way. While experimental data clearly state that for virtual photons, dissipation at zero frequency has to be disregarded, for 'real' (thermal) photons, the situation is unclear. If real photons interact dissipatively while virtual ones don't this would be an indication for physics beyond the standard model at low energy. An unambiguous answer could be given by accurate force measurements at large separation - only possible using the parallel plate geometry. After a six-year construction phase the Casimir and Non-Newtonian force EXperiment (CANNEX), devised to detect sub-pN forces between macroscopic plane parallel plates, is starting to give first data. While the experiment is still in the prototype stage, its unique configuration could yield a wealth of metrological force data, answering long-standing questions in two different fields of physics. The present talk focuses on some of the physical questions that can hopefully be solved with CANNEX, the status of the experiment, and results of the very first force measurements between truly parallel macroscopic plates, obtained with the prototype.