Measurement of the Casimir interaction from 0.2 to 8 microns: what we know and what we don't

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The measurement of the Casimir interaction between a R = 150 m Au-coated sphere mounted on a mechanical torsional oscillator (MTO) and a Au-coated Si sample will be presented. The Si sample is engineered such that deep trenches (from 75 to 150 microns deep) are made by Deep Reactive Ion Etching (DRIE) and subsequently coated with Au. Trenches and regions without them alternate in a periodic fashion, each Au-covered region and trench subtending the same angle. On a given sample different angular regions have been used, which facilitate detecting systematic effects. By rotating the Au-covered Si sample, there is a time dependent Casimir force felt by the sphere-MTO assembly, it alternatively seeing a Au surface or vacuum (because the contribution of the Casimir interaction over the trench is negligible). By judicious frequency and phase discrimination the Casimir interaction has been obtained. Due to the high sensitivity of the MTO, a signal to noise ratio of one can be observed for separations in excess of 10 microns. A quantitative analysis of the interaction can be achieved for separations of up to 6 microns. In the talk the sample preparation, experimental setup (including modifications to an existing system), systematic signals detection and how they are dealt with, and a comparison of the experimental results with theory will be presented. Future directions of experimental research in Casimir physics using this and other approaches will also be briefly discussed.