Measurements of long-range atom-surface forces

In the late 1960s Nobel Laureate Polykarp Kusch initiated a series of experiments to measure long-range forces between neutral atoms and condensed matter surfaces: Van der Waals/Casimir-Polder forces. The experiments measured the deflection of atoms passing close to surfaces. The most detailed studies were carried out for the interactions of neutral Cs atoms with gold surfaces. This system is especially important because it is one of the few for which the data for both the atom and the condensed matter species are sufficient to allow accurate theoretical predictions. Theory-experiment comparisons were found to differ by ~30% in the values obtained for the strength of the force. This discrepancy is much larger than the identified uncertainties in both the experiment and the theoretical estimates. The discrepancy remains unresolved to this day.

We are carrying out an experimental study of the problem. We use Kusch's original experimental approach but bring to it important advances in relevant technologies: surface science, atomic beams, vacuum science etc. We will report our progress to date towards resolving the discrepancy. We will also briefly outline additional experiments that we have planned to study in detail atom-surface forces for extremely large separations, < 1 micrometer.