

Abstract:

Our research at the University of Southampton is focused on matter wave interferometry of large molecules complementary to the Vienna efforts. We aim to perform interference of molecules in the range of up to 10,000 amu (atomic mass unit) within a near-field Talbot-Lau interferometer consisting of three material gratings. Interestingly, the quantum interference contrast and phase is depending on the dispersion interaction of the electrically neutral molecules with the material diffraction grating. The interaction can be tuned (depending on the grating dimensions) between the Casimir-Polder (CP) and van der Waals interaction regime. Although no systematic study of the Casimir-Polder force between molecules and surfaces has been done so far and we plan to investigate CP interactions and phenomena in this setup. Currently we are using nanofabricated SiN_x gratings, but a variation of materials - especially to meta-materials - is planned. We are interested in the implementation of novel matter-wave optical elements such as mirrors, beam splitters and lenses basing on the interaction of our neutral massive particles with material structures. Very interesting materials here are negative index materials, where repulsive dispersion intersections are promised. We locally collaborate at Southampton with nanofabrication and meta-material experts to realize the experiments. We are interested in collaborations with theoretical and experimental groups within the Casimir network.