

Lateral Casimir-Polder force on an excited atom

Frontal Casimir-Polder forces have already been predicted and measured for many different systems with ground-state atoms. Expanding these systems to ones with multiple-state atoms give rise to new effects. One of them is a laterally acting Casimir-Polder force which occurs if the excited atom has a rotating dipole moment. This is due to conservation of momentum as a resulting asymmetric distribution of photons can be proven. And in early 2015 a first measurement had been conducted proving its existence. The observed system contains a dielectric half space and a vacuum one with an excited two-state atom. Using macroscopic QED a term of the lateral force depending only on the dipole moment and the systems' Greens tensor will be derivated, eventually it will be quantified as a function of distance between body and atom. For three different plates it will be observed: A perfect conductor, gold and silica. All of them show an oscillating behaviour. Yet depending on real and imaginary parts of their permittivities they differ. Finally, to show the origin of this force the atoms' directional decay rate will be derivated and from it an asymmetry term. The asymmetry will also be an oscillating term as it should oscillate oppositely to the force. A problem occurring will be the total decay rate for very close distances as it will become negative. There the idea of photon emission won't be applicable anymore. Yet above this boundary the atom would be starting to move laterally while being attracted to the plate due to classical Casimir-Polder force.