Dipolar interactions in hot vapor cells

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Light induced dipolar interactions at densities higher than 1 atom per cubic wavelength, give rise to density shifts and broadenings. If the atoms are confined to less then a wavelength this dipolar interaction can give rise to collective blockade phenomena, which mostly have been studied using strongly interacting Rydberg states [1]. Here we study this effect for low lying excited states and confined atoms in two and one dimension. The first approach uses pulsed LIAD (Light induced atomic desorption) to generate a thin layer of free atoms close to a surface. For a few nanoseconds the light induced dipolar interaction on the D1 and D2 line of Rubidium leads to shifts and broadenings, the socalled Lorentz-Lorenz shifts. In a second approach we use hot atoms in slot waveguides [2], where Purcell enhanced interaction also leads to shifts. The latter experiments are done at telecom wavelengths and bare the promise to observe and integrate collective quantum effects like the blockade induced single photon absorber [3]. Finally in the outlook we present the concept of an optical single atom detector based on a freestanding photonic crystal cavity that enhances the atom light coupling to the strong coupling regime [4].

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