

Abstract

Light transport in cold atoms: the fate of coherent backscattering in the weak localization regime

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After a few mean free paths, a wave propagating in a strongly scattering medium rapidly loses the memory of its initial direction. At this scale, propagation can be described by a diffusion process. However this description discards an important phenomenon : interference between multiply scattered waves. It is now known that interference can profoundly alter the wave transport. An extreme situation is that of the Anderson (or strong) localization regime, where diffusion vanishes. In the intermediate regime of weak localization, light diffusion is hampered by interference. A hallmark of interference effects in multiple scattering is provided by the so-called coherent backscattering effect (CBS), an interferential enhancement of diffuse reflection of light off a disordered sample. CBS has been widely studied with classical samples like semi-conductor powders, white paint, teflon, etc. The use of atoms as scatterers gives rise to new possibilities. They indeed exhibit some peculiar light scattering properties (internal structure, optical pumping, saturation effects, resonant scattering, etc) and the now well-established techniques of laser cooling allow one to fully exploit the potentialities of this atomic scattering medium. For example wave effects in the external motion of atoms as well as statistical aspects (BEC condensates) should open new areas in the field. The purpose of this talk is to describe our experiments on coherent backscattering and to present various aspects of quasi-resonant light scattering in optically thick samples of laser cooled atoms. In particular, we shall stress the dramatic impact of the atomic internal structure on weak localization, a role which may be of importance in the search for strong localization of light in cold atoms.

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