Coherent superflash effect in cold atoms: Revealing forward scattering field in optically dense medium

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The coherent transmission of a wave, through absorbing medium, results of interference between the incident field and the forward scattering field. This basic and well established process was experimentally observed in the case of an electromagnetic wave transmitted through a resonant atomic cold cloud [1]. Since the forward scattering field is build up with the incident field, one may states that the amplitude of the former cannot be larger than the latter. We recently demonstrate that this intuitive picture is incorrect [2]. This result recasts our understanding of coherent wave transport in optically dense medium.

We will discuss in detail how the complex transmitted field can be reconstructed using fast transient phenomena on Strontium intercombination line with cold atoms. An example of such a reconstruction is given in Fig. 1. Moreover, if the probe laser is abruptly switched off, we observe a coherent superflash of light at the output of the optically dense medium. Its intensity can be up to four times the incoming probe intensity. This superflash allows us to measure the coherence properties of the forward scattering field. We finally discuss potential application of optically dense medium for phase discrimination and for narrow pulse generation with high repetition rate.

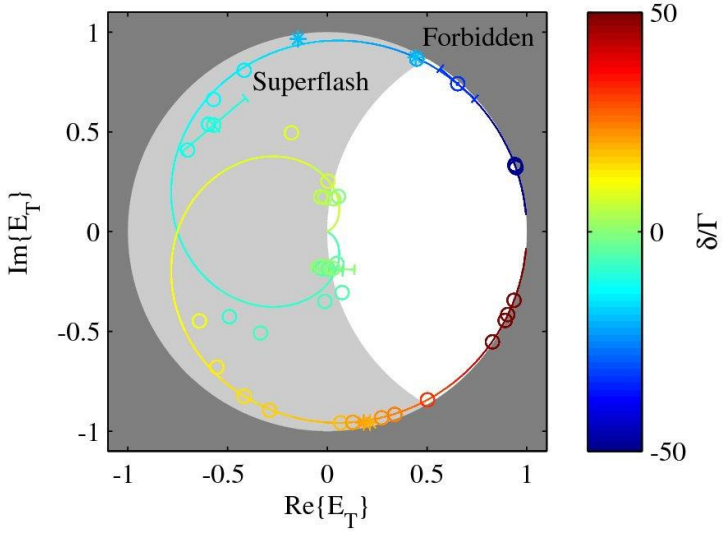

Figure 1: *Reconstruction, as function of the probe frequency detuning, of the transmitted field in a cold cloud with an optical density of* 19*. The open circles are the data points and the plain curve the theoretical prediction.*

References

[1] M. Chalony, R. Pierrat, D. Delande and D. Wilkowski, Phys. Rev. A 84, 011401(R) (2011).
[2] C. C. Kwong, T. Yang, P. Mysore, K. Pandey, D. Delande, R. Pierrat, and D. Wilkowski, *to be issued in 2014.*