High repetition rate pulse trains emitted by optically thick scattering media

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The coherent transmission through a scattering medium results from the interference between the incident field and the field scattered in the forward direction. In previous studies, it was shown that a high intensity flash, the so-called superflash, can be emitted in the forward direction just after an abrupt switch-off of a near resonant incident probe [1-2]. Similar flashes can also be generated by abruptly changing the phase of the incident field. Since it is a cooperative effect, the duration of the flash, in an optically thick medium, can much shorter than the lifetime of a single atom excited state. More precisely, the flash decay time depends inversely on the optical thickness at resonance and zero temperature. When a phase change of π is applied periodically, a train of flashes will be emitted cooperatively with a repetition time that can be much shorter than the single atom excited state lifetime.

Recently, we experimentally demonstrated this phenomenon, using the narrow intercombination line of strontium [3]. An example of the pulse train generated in our experiment is shown in Fig. 1. Surprisingly, it is possible to suppress single atom fluorescence and transfer almost all the power in the incident probe to the pulse train. Remarkably, this is achievable while having a high intensity contrast in the pulse.

In this talk, we will review the underlying mechanism of the (super)flash effect with a particular emphasis on its temporal properties. Then, we will describe the experiment to observe the pulse trains. We will discuss the performance and potential applications of this pulse generating method.

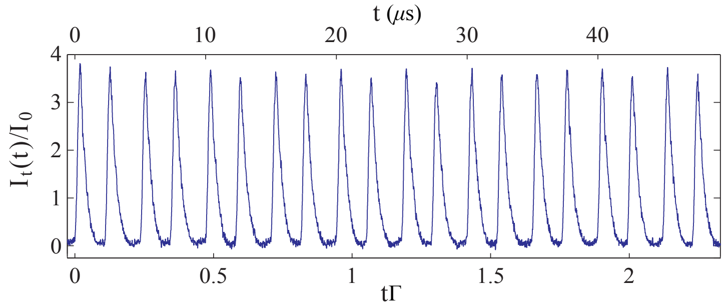

Figure 1: *An example of a pulse train generated in our experiment. The repetition time of this pulse train is* $0.12\Gamma^{-1}$*, which is shorter than the lifetime of the transition, showing that cooperative effect are at play.*

References

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