Entanglement by Parametric Amplification in a Cold Atomic Cloud

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From an atomic cloud of cold Cs atoms, we use the parametric amplification to produce entangled beams by a four-wave mixing process. The pair of counterpropagating fields are known to generate a strong and narrowband amplification of a seed beam, coupled by recoil induced resonances, leading to extremely high gain [1]. Moreover, cascaded process led to the generation of four fields, coupled by these pump beams. It is expected that this process will operate even in the case that we have vacuum as the input, thus leading to a multiple parametric process to a four-mode entangled state.

Nevertheless, the narrowband and the short operation time of the amplifier, based on an atomic cloud, imposes challenges in the detection of the produced states and their characterization. This limitation is overcome by a combination of optical and electronic heterodyning [2], that we use to observe a pair of entangled fields in the 852 nm. This technique opens the path for a better understanding of the atomic process, as well as the exploration of entanglement over a broader set of modes.

References

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