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Guided atom lasers

In this seminar, I will report on our work on the generation of guided atom lasers.

The first part will be devoted to the production of a guided atom laser from a Bose Einstein condensate (BEC), produced in an all-optical manner, either in a given Zeeman sublevel m=-1,0,+1, or in an incoherent mixture of those levels. The first method we used for outcoupling was relying on magnetic fields (using the first and second order Zeeman effects) and enabled us to reach an unprecedented control of the transverse degrees of freedom in the guide and this for any spin state, the mean excitation number being less that one. We are currently using other outcoupling techniques to investigate the role played by interactions, both in the outcoupling process and on the quality of the transverse mode. This permits one to control the generation of a guided atom laser in a mixture of spin states.

Such guided atom lasers are pulsed since they consist in depleting a BEC. I will summarize our efforts to produce a continuous guided beam in the degenerate regime. I will first present an optimization procedure that we have used for the generation of guided thermal beam, and show that it is reminiscent of Maxwell's demon thought experiment. Secondly I will present the recent results we have obtained on the transport of ultracold atoms with optical tweezers in the non-adiabatic regime, i.e. on a time scale on the order of the oscillation period. This work, combined with the technique of production of guided atom lasers from BEC, opens new prospects for the generation of a continuous guided atom laser.

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