Dense and cold atomic beam delivered by a 2DMOT repumped and channelled by a Laguerre-Gaussian laser beam

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Nowadays, 2DMOTs are atomic sources currently used for trap loading, 3DMOTs for example. Indeed, they deliver slow and cold atom beams: typically for rubidium, the transverse temperature is 0.4 mK and the longitudinal velocity in the 10-50 m/s range. Nevertheless, the divergence of the output beam being about 40 mrad leads to a rapid decrease of the atomic density as the beam propagates. It is the reason why the 3DMOTs are installed close to the 2DMOT exit and require cooling-laser beams with a large diameter and a large power. The divergence can be reduced with an additional far-blue-detuned Laguerre-Gaussian (LG) mode set on the 2DMOT axis, which operates as a 2D-dipole trap on exiting atoms [1].

In the present version the LG mode, frequency-locked to the ^{87}Rb $5s_{1/2}$ F=1 $\rightarrow$ $5p_{3/2}$ F'=2 transition, is set along the main axis of a vapor-cell 2D-magneto-optical trap (2DMOT) and, realizes both functions, namely repumping atoms inside the 2DMOT and channelling atoms exiting the cell. It avoids any other repumping light. The output atomic beam properties (flux, density) depend on the LG power (enough to repump and to channel) and order (large enough for minimize atom losses due to residual heating), as shown in the figure. We show that with about 50-100 mW the density gain exceeds 100. As preliminary result we will present a LG2DMOT-loaded 3DMOT realized with millimeter-sized cooling laser beams.

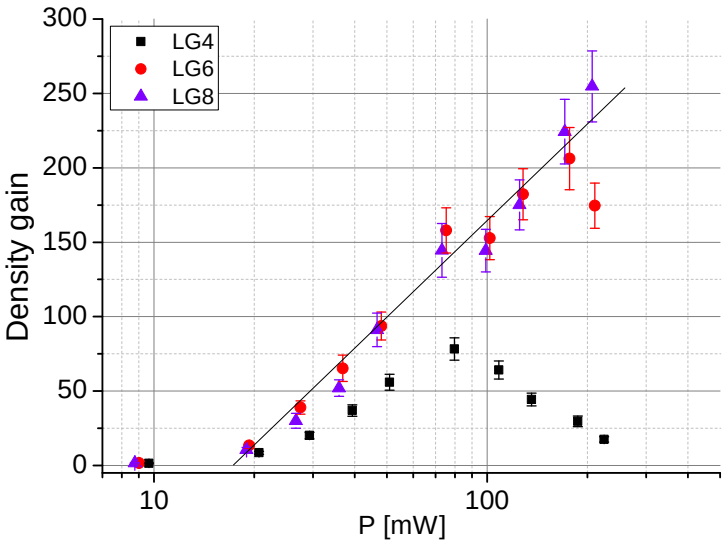

Figure 1: *Density gain of the LG2DMOT observed at 300 mm, versus the LG power, for orders equal to 4, 6 and 8.*

References

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