Long-distance channeling of cold atoms exiting a 2D magneto-optical trap by a Laguerre-Gaussian laser beam

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Using a blue-detuned laser, shaped into a Laguerre-Gaussian (LG) donut mode we channel atoms exiting a 2–dimensional magneto-optical trap (2D-MOT) over a 30 cm distance. Compared to a freely-propagating beam, the atomic flux (about 10^{10}at/s) is conserved whereas the divergence is reduced from 40 to 3 mrad. So, 30 cm far the 2D-MOT exit, the atomic beam has a 1 mm diameter and the atomic density is increased by a factor of 200 [1].

Such a LG-channeled-2D-MOT with a high density flux is a promising device to efficiently load a 3D-MOT reducing the capture volume and thus the required dimensions of the 3D-MOT trapping beams. The LG-channeled-2D-MOT is suitable for experiments on chips or for collision experiments.

The LG-channeled-2D-MOT has been studied versus the order of the LG mode (from 2 to 10) and versus the laser-atom frequency detuning (from 2 to 120 GHz). A clever version in which the LG mode frequency is locked to the repumping transition allows us to run the setup with two lasers instead of three.

References

[1] V. Carrat, C. Cabrera-Gutiérrez, M. Jacquey, J. W. Tabosa, B. Viaris de Lesegno, and L. Pruvost Opt. Lett., **39**, 719-722 (2014)