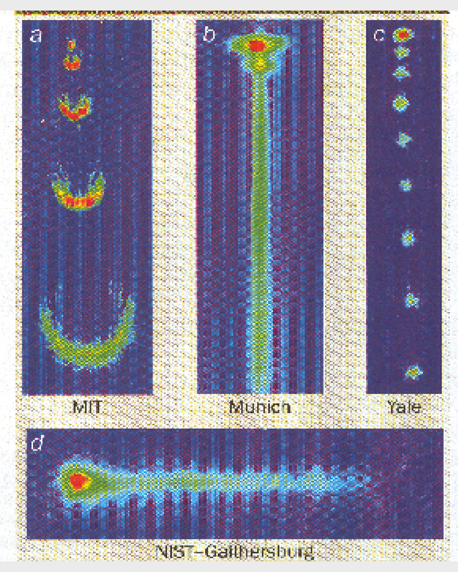
REALIZATION OF A MAGNETICALLY GUIDED BEAM IN THE COLLISIONAL REGIME

T. Lahaye, Z. Wang, J. Dalibard and D. Guéry-Odelin

Laboratoire Kastler Brossel, Ecole Normale Supérieure, 24 rue Lhomond, 75005 Paris (France)

Previous members: J. M. Vogels, K. Günter, C. F. Roos, A. Aclan, P. Cren

MOTIVATION



Atom lasers from BEC

Radiofrequency outcoupler

Low flux < 10^4 atoms/s

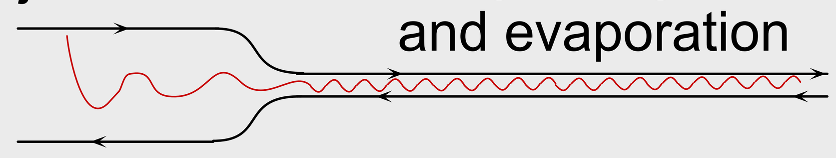
1 monolayer on 1 μm^2 in 3 years

OUR PROJECT

Transpose to an atomic beam the techniques used on atom clouds.

Goal: achievement of a continuous and intense cold atomic beam, magnetically guided, with a low mean velocity.

Apply transverse evaporative cooling [1]. If the initial collision rate is high enough, quantum degeneracy can be reached after a few meters.



EXPERIMENTAL SETUP

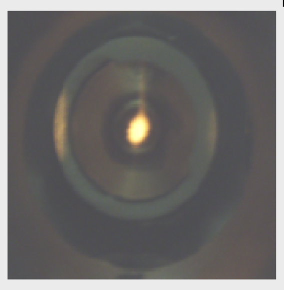
MAGNETO-OPTICAL TRAP

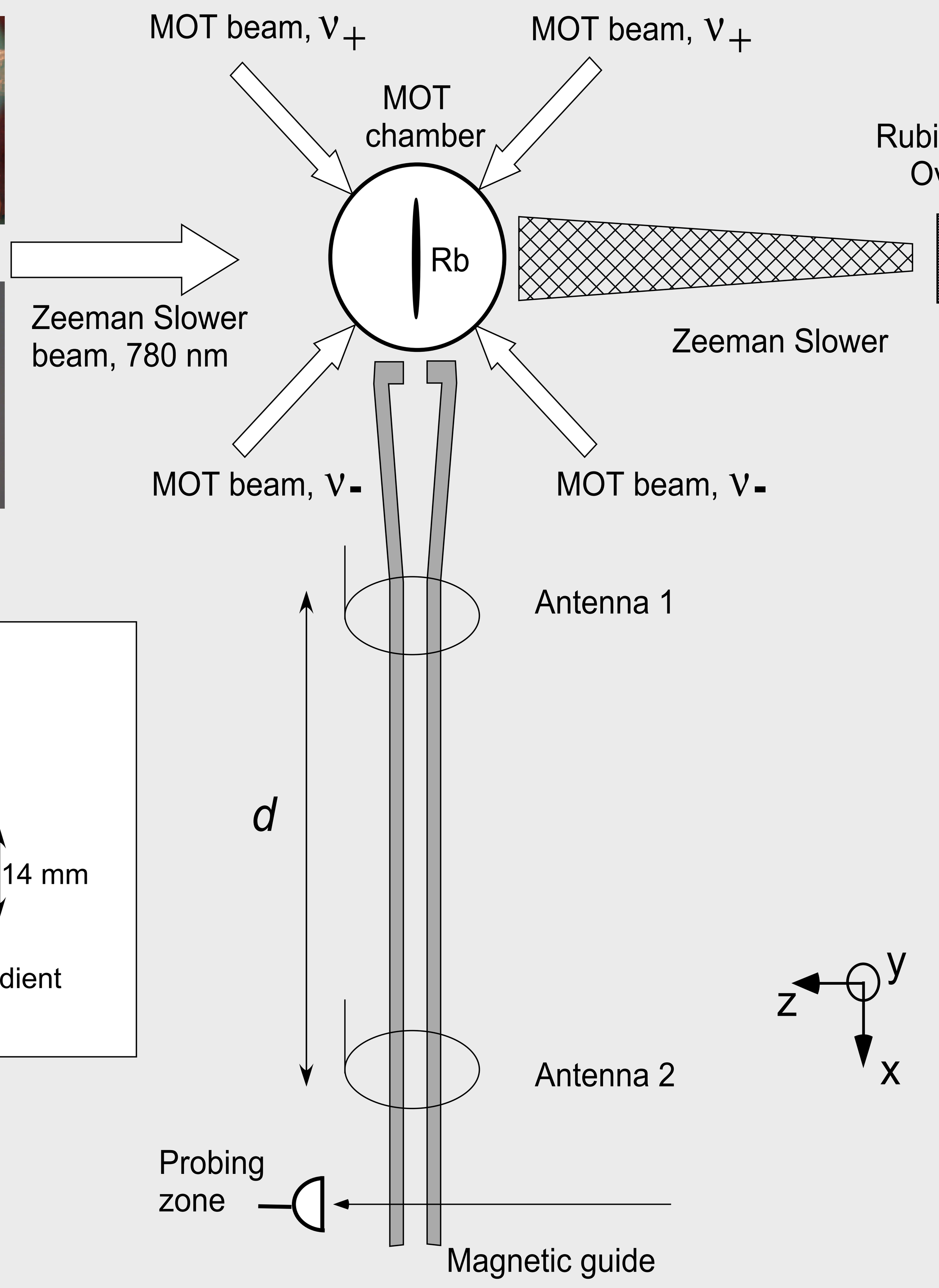
Anisotropic 3D magnetic gradient

Six beams MOT

Capture rate > 2. 10^{10} atoms/s

Adjustable launching velocity from 0.3 m/s to 3 m/s





OVEN AND ZEEMAN SLOWER

Oven T= 140-170 °C

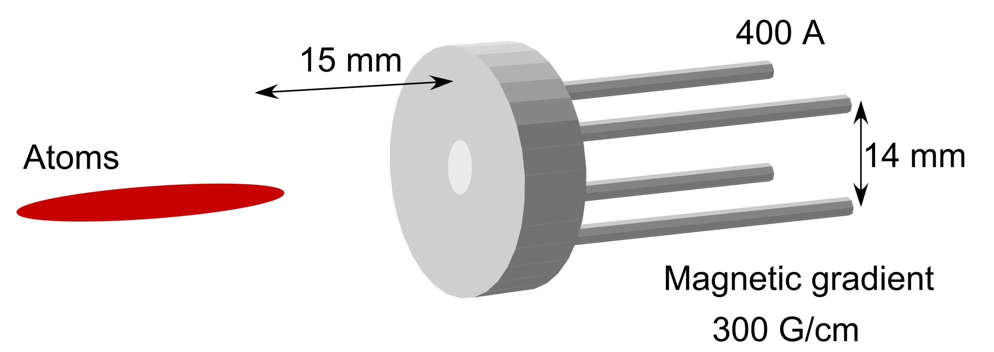
Oven flux = 1.5 10^{12} atoms/s

Flux of slow atoms:

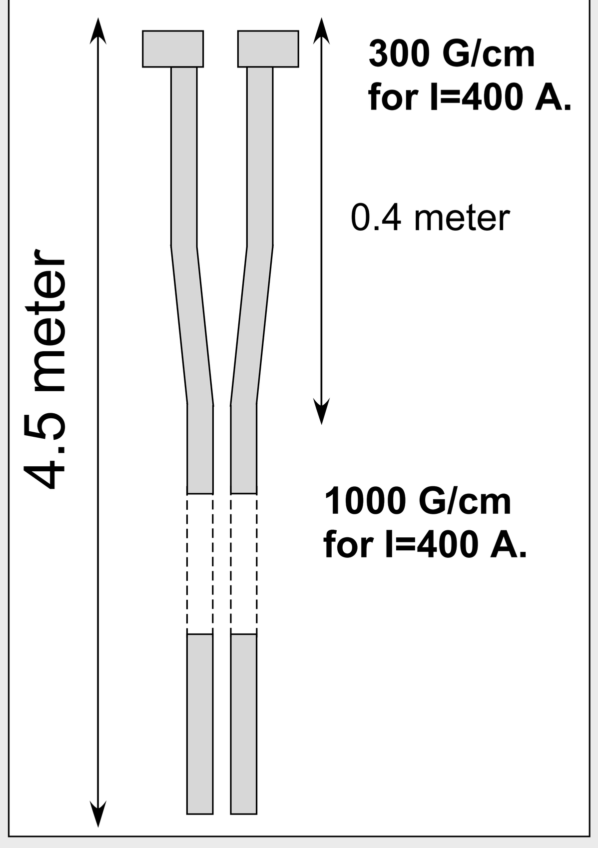
2. 10^{11} atoms/s

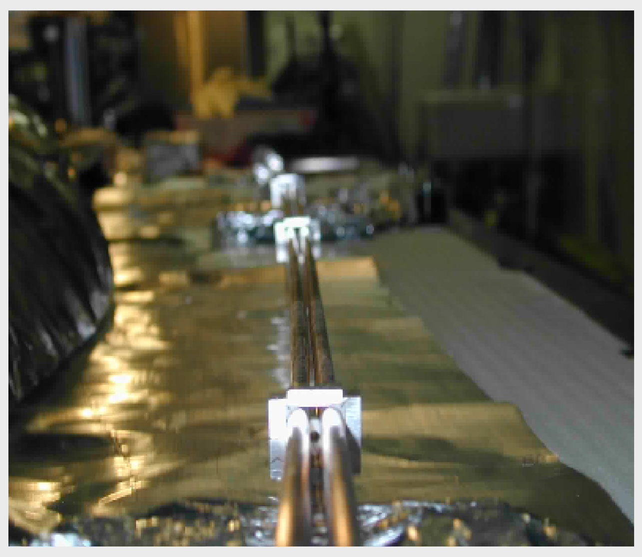
at a mean velocity of the order of 15 m/s.

ENTRANCE OF THE MAGNETIC GUIDE



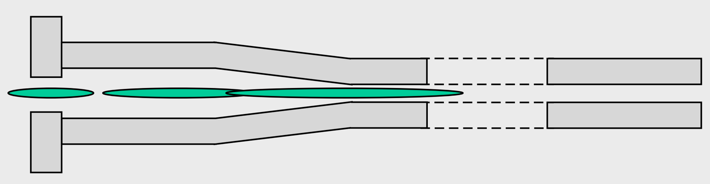
TAPERED SECTION OF THE MAGNETIC GUIDE





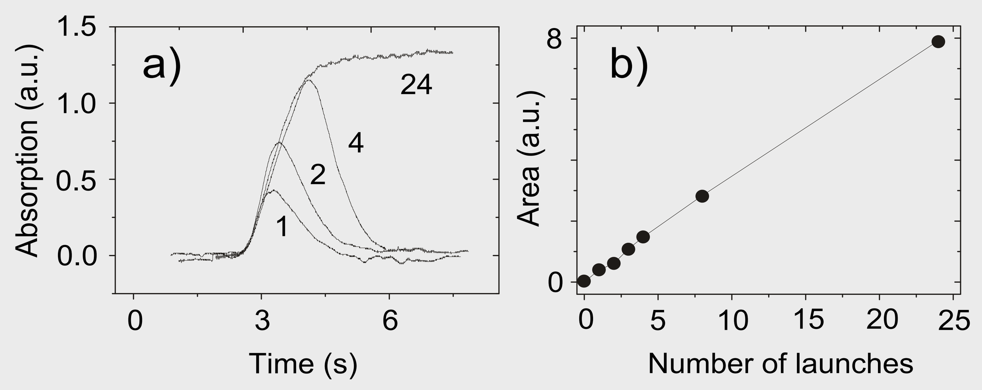
PULSED INJECTION

Pulsed injection in the guide, overlap after 70 cm propagation:

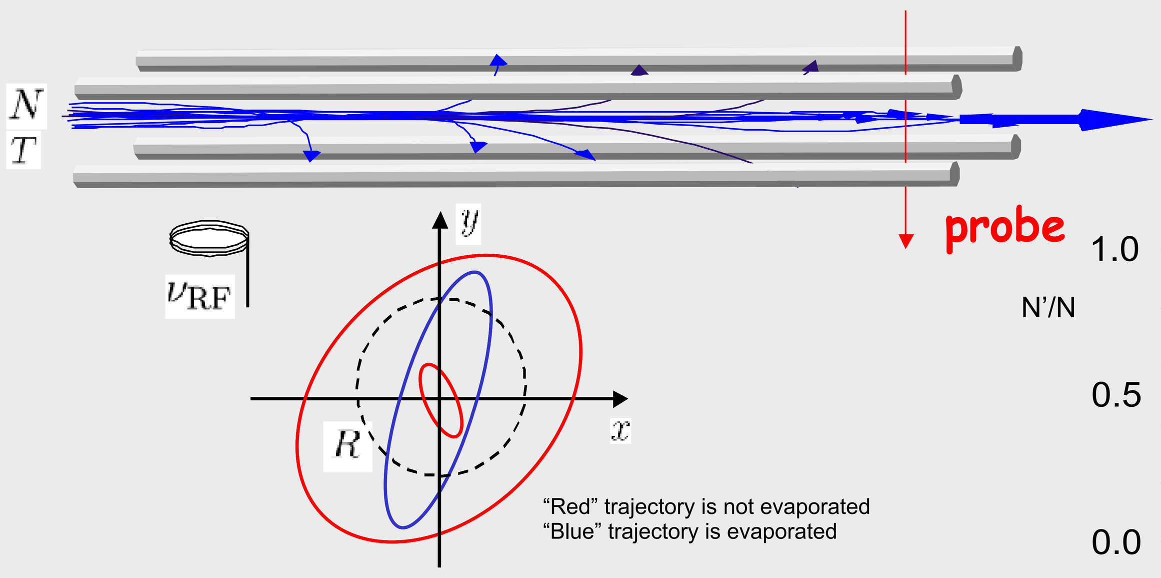


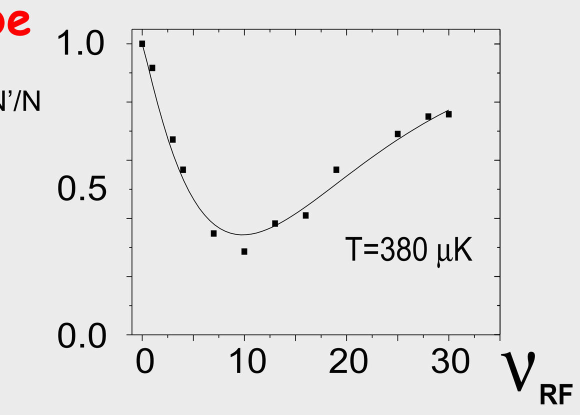
REALIZATION OF A CONTINUOUS BEAM

3 to 4 packets per second: Flux of the order of 7.10^9 atoms/s

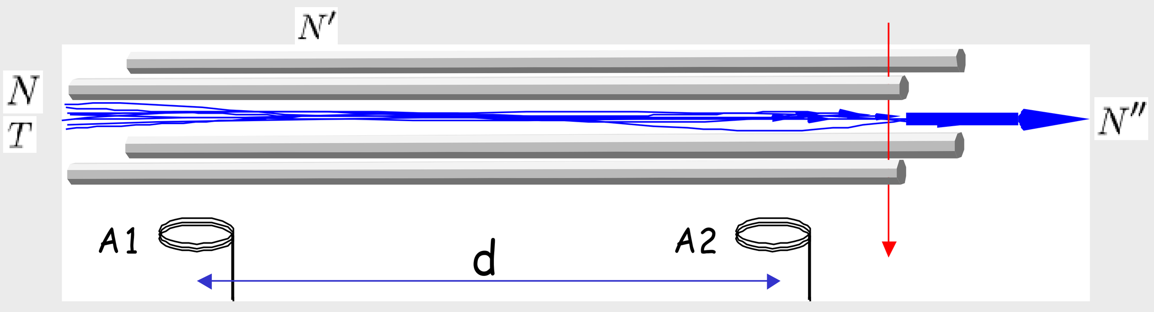


TEMPERATURE MEASUREMENT WITH ONE RF ANTENNA



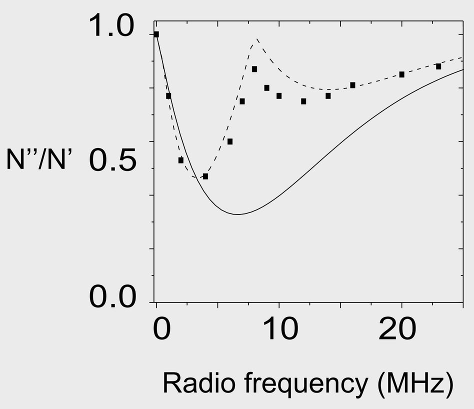


EXPERIMENT WITH TWO ANTENNAS

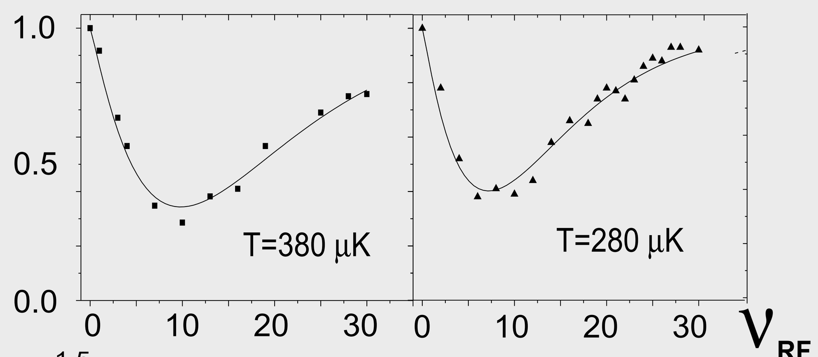


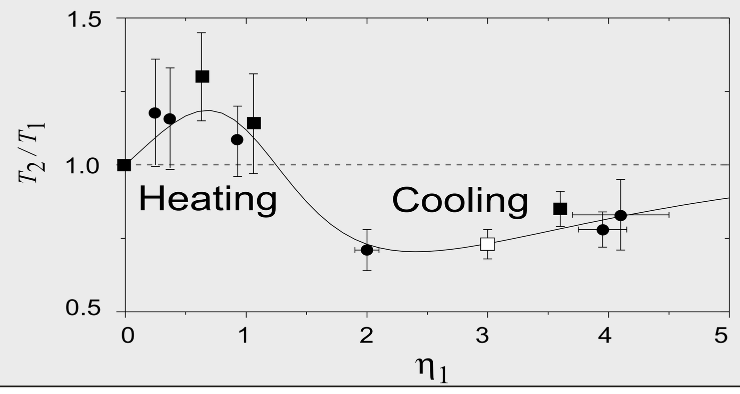
WITHOUT COLLISIONS

ν_1= 8 MHz

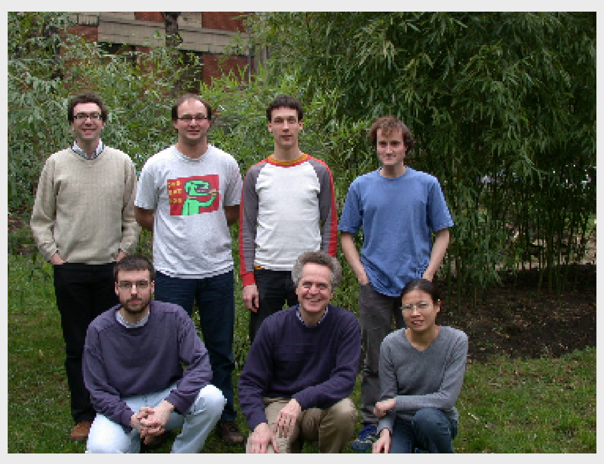


WITH COLLISIONS d=3 m





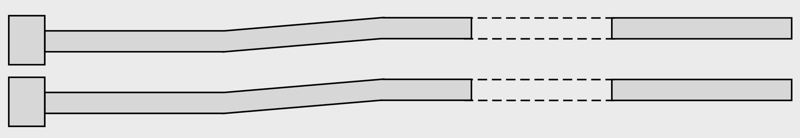
THE TEAM



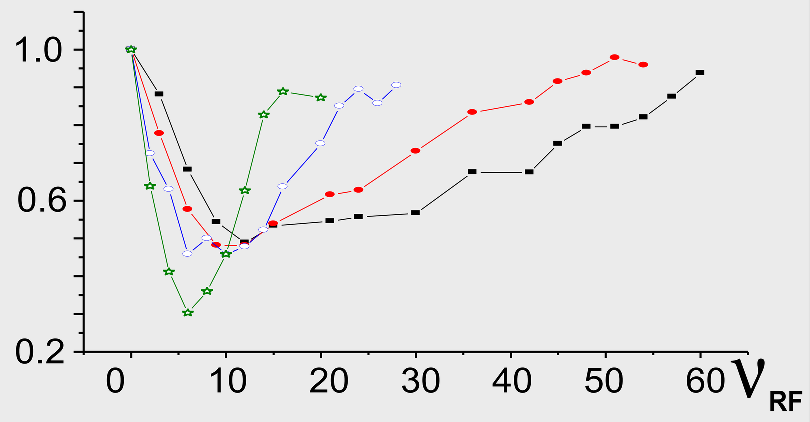
D. Guéry-Odelin, J. M. Vogels, K. Günter, A. Senger, T. Lahaye, J. Dalibard, Z. Wang

OUTLOOK

- Slope to slow down the beam



- Start forced evaporative cooling with many antennas



- Dark line MOT.

REFERENCES

[1] E. Mandonnet A. Minguzzi, R. Dum, I. Carusotto, Y. Castin and J. Dalibard, Eur. Phys. J. D **10**, 9 (2000).
[2] P. Cren, C. F. Roos, A. Aclan, J. Dalibard and D. Guéry-Odelin, Eur. Phys. J. D **20**, 107 (2002).
[3] C. F. Roos, P. Cren, J. Dalibard and D. Guéry-Odelin, Physica Scripta **T105**, 19 (2003) and cond-mat/0212060.
[4] C. F. Roos, P. Cren, T. Lahaye, J. Dalibard and D. Guéry-Odelin, Laser Physics **13**, 605 (2003) and cond-mat/0212147.
[5] T. Lahaye, P. Cren, C.F. Roos and D. Guéry-Odelin, Comm. Nonlin. Sci. Num. Sim., **8**, 315 (2003) and cond-mat/0211661.
[6] C. F. Roos,P. Cren, D. Guéry-Odelin and J. Dalibard, EuroPhys. Lett., **61**, 187 (2003).
[7] J. M. Vogels, T. Lahaye, C. F. Roos, J. Dalibard and D. Guéry-Odelin, cond-mat/0404560.
[8] T. Lahaye, J. M. Vogels, K. Günter, Z. Wang, J. Dalibard and D. Guéry-Odelin, to appear in Physical Review Letters, cond-mat/0405013.