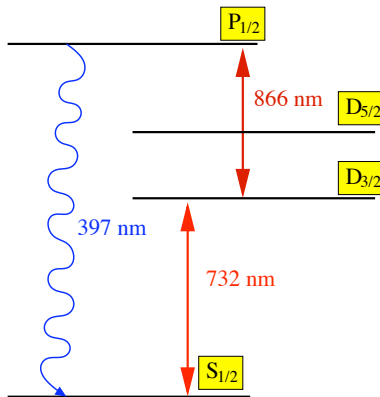


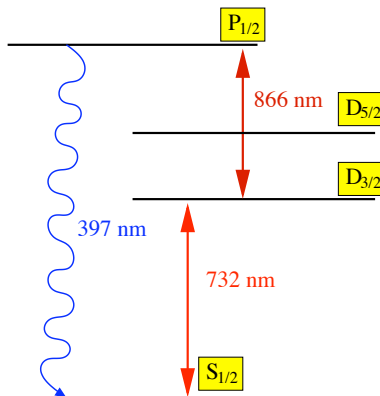
Cooling beyond the Doppler limit without resolving the motional side-bands

- idea : using the quadrupolar transition $S \rightarrow D$
- detection with no background
- laser sources only in the red and infra-red domain
- no need to resolve the motional side-bands
- the limit temperature is controlled by the coupling on the dipolar transition

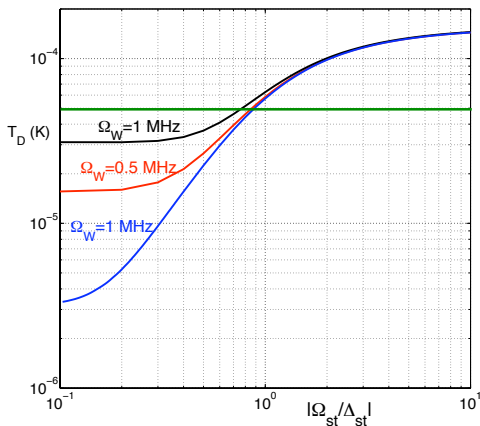


Optimizing the number of scattered photons

- the limiting factor is the strength of the laser coupling on the weak transition
- the detuning of the 732 nm laser has to adapt to the light-shift induced by the laser coupling on the dipolar transition



Limit Doppler temperature



Ω_W is the Rabi frequency on the 732 nm transition

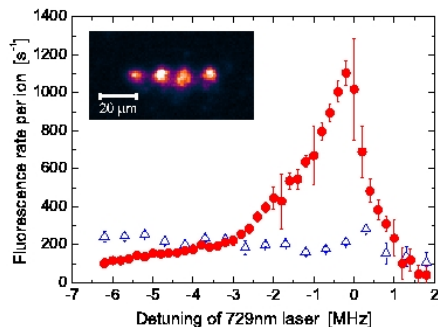
10 times less scattered photons than for $S \rightarrow P$ Doppler cooling

Champenois *et al.* Phys. Rev. A **77**, 033411 (2008)

Experiment done in M. Drewsen' group (Århus)

two co-propagating lasers :
efficient cooling

two counter-propagating lasers
: the two induced recoils
compensates : no cooling



Hendricks *et al.* Phys. Rev. A **77**, 021401(R) (2008)