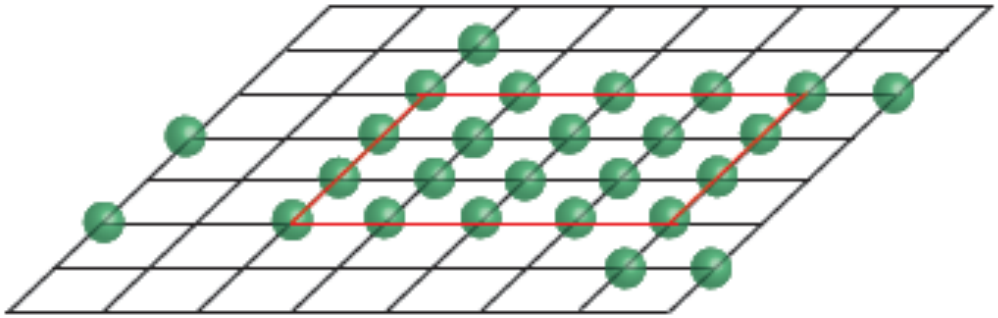
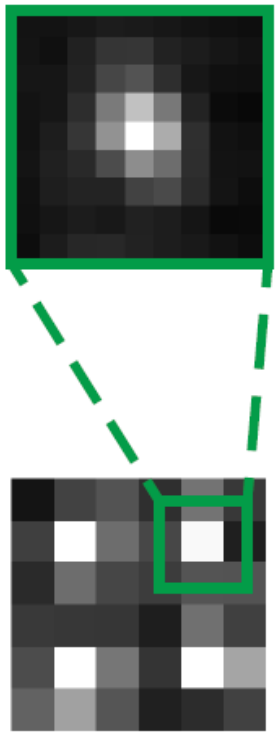
Rapid production of uniformly filled arrays of neutral atoms



황명규

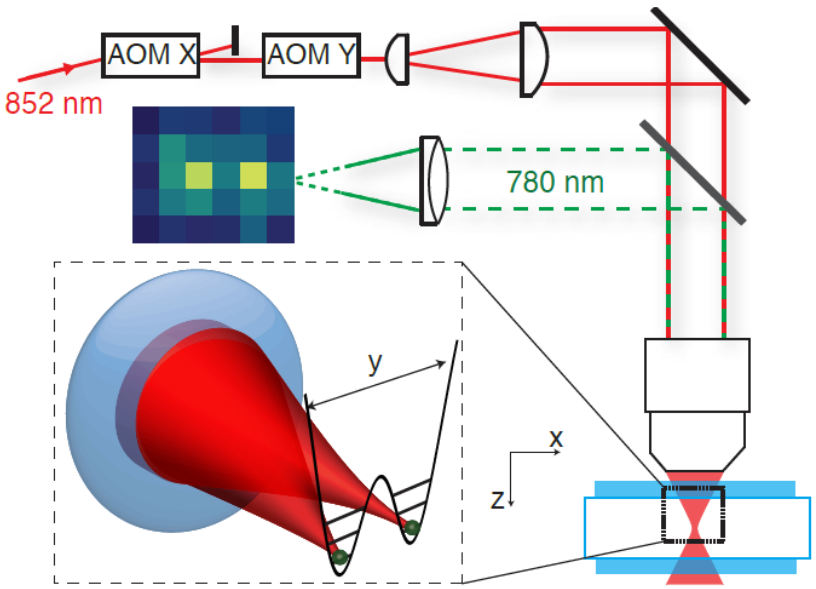
B. J. Lester et al., PRL **115,** 073003 (2015).

Introduction



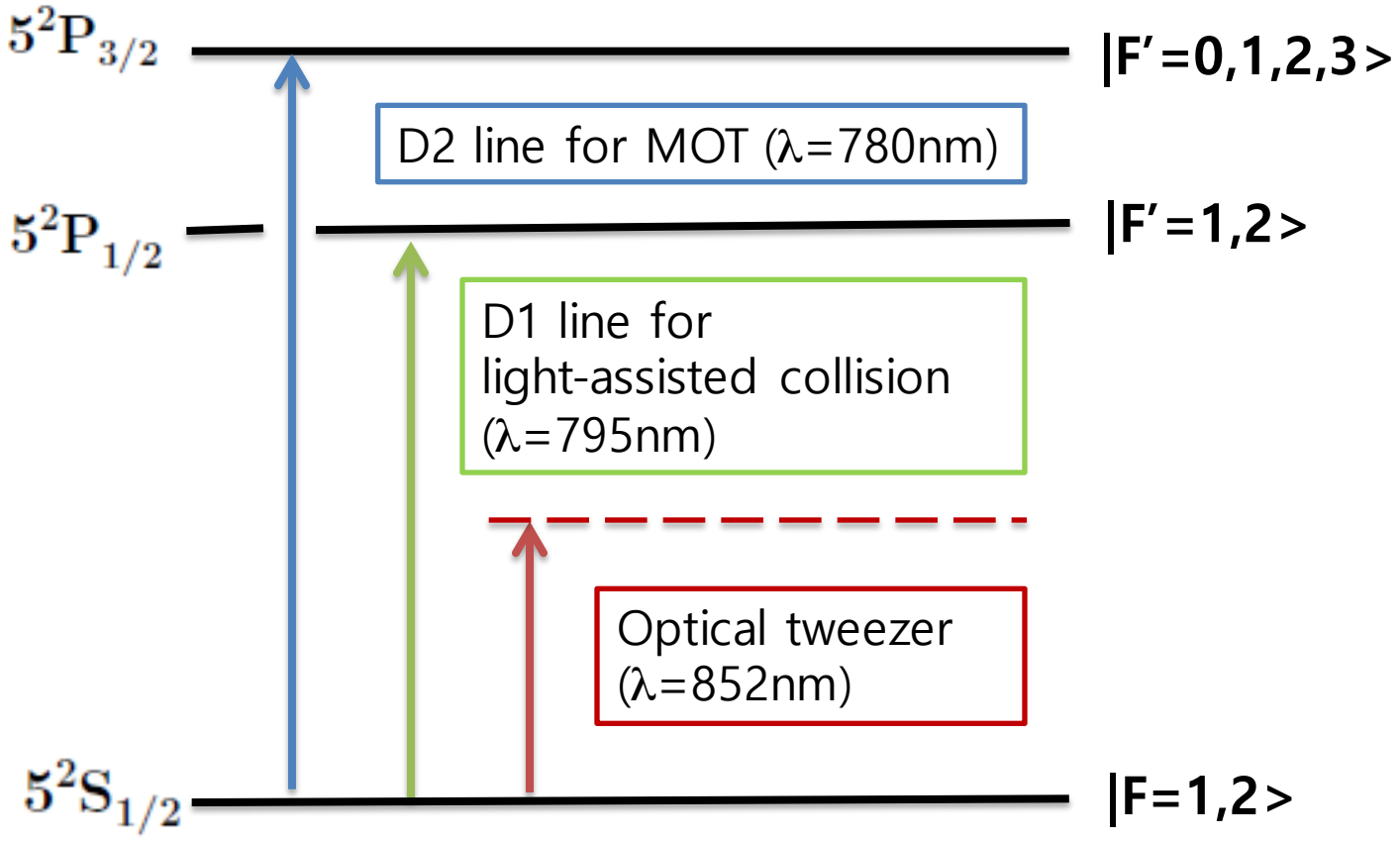
- Near-deterministic loading of single ^{87}Rb atoms in 2x2 array of optical tweezers
- More than 60% rate of success in maximum 4 atoms loading
- Smallest successful well spacing was 1.46μm.

Highly focused tweezer

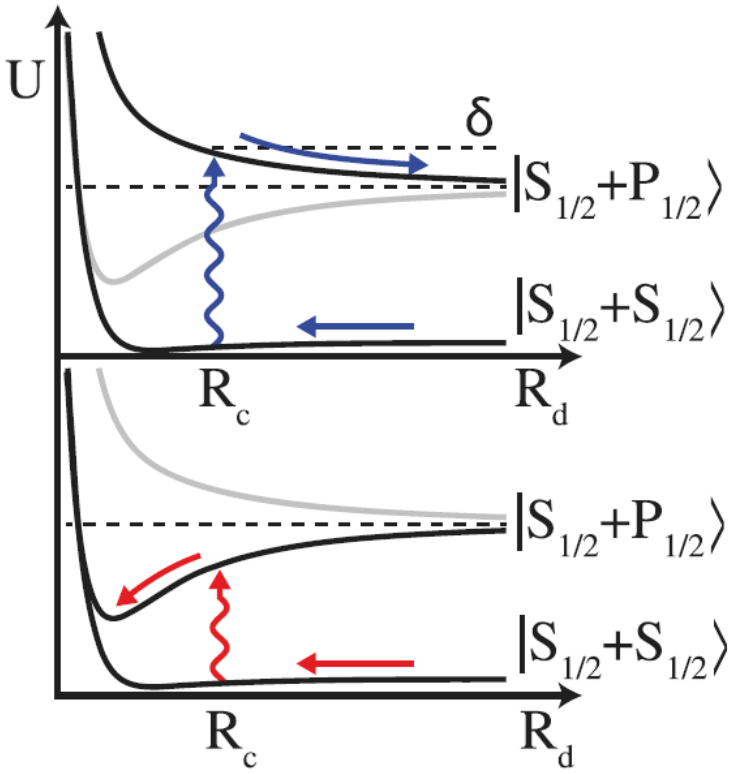


- Loading atoms by putting the array of tweezer in MOT cloud.
- After turning off MOT, only one atom can be loaded in one site with collisional beam.
- (λ= 852 nm, w_0= 0.71 μm)

Level structure of ^{87}Rb

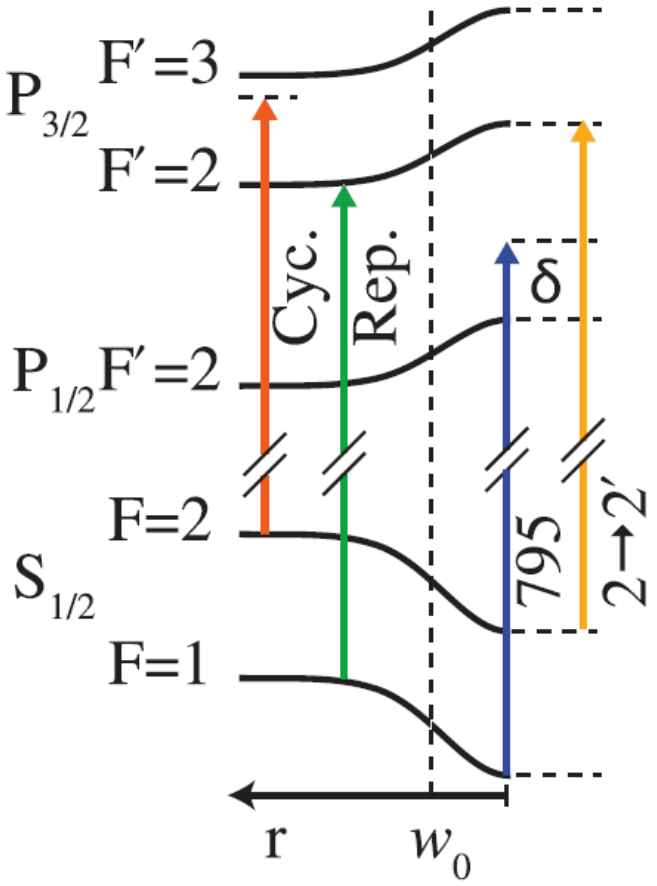


Light-assisted collisions



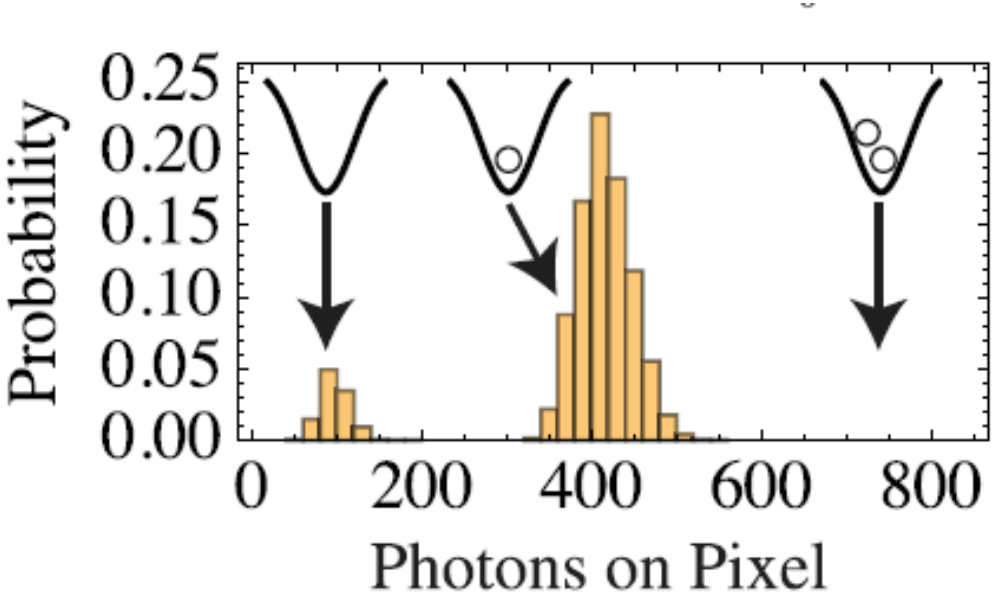
- As atoms approaches each other, D1 line laser is resonant with molecular potential.
- Repulsion or attraction occurs according to the detuning.

Light-assisted collisions



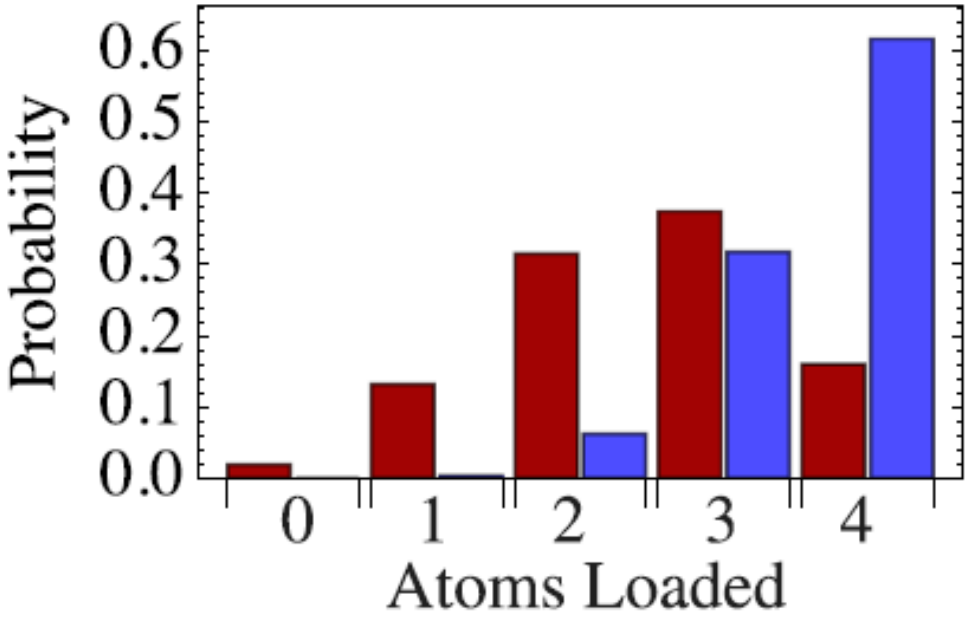
- Trap depth: h·73 MHz
- δ= 115MHz
- 2-2′ beam pumps trapped atoms to the |F=1> state.

Photon number histogram



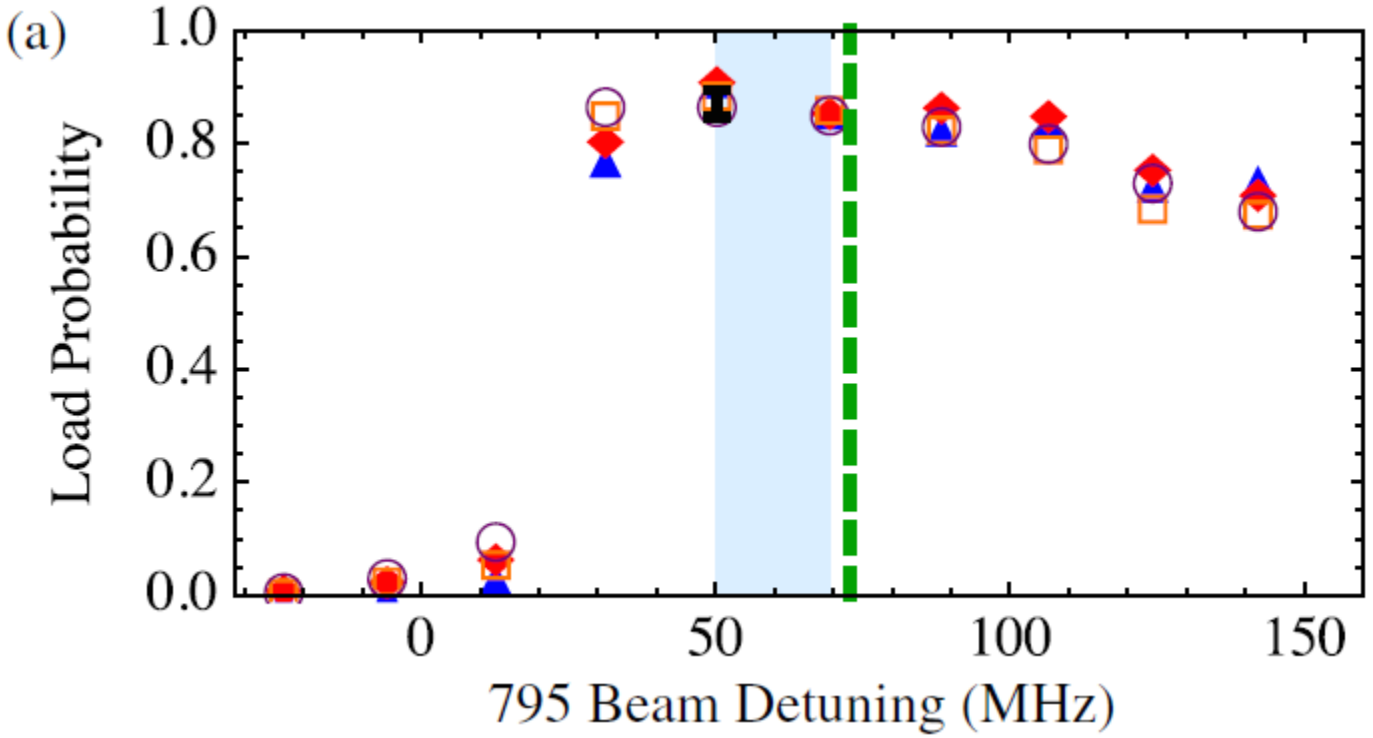
- No single event 2 atoms in one site in 2000 experiments
- One atom prob. is 88.7±0.4)%.

Atom number probability



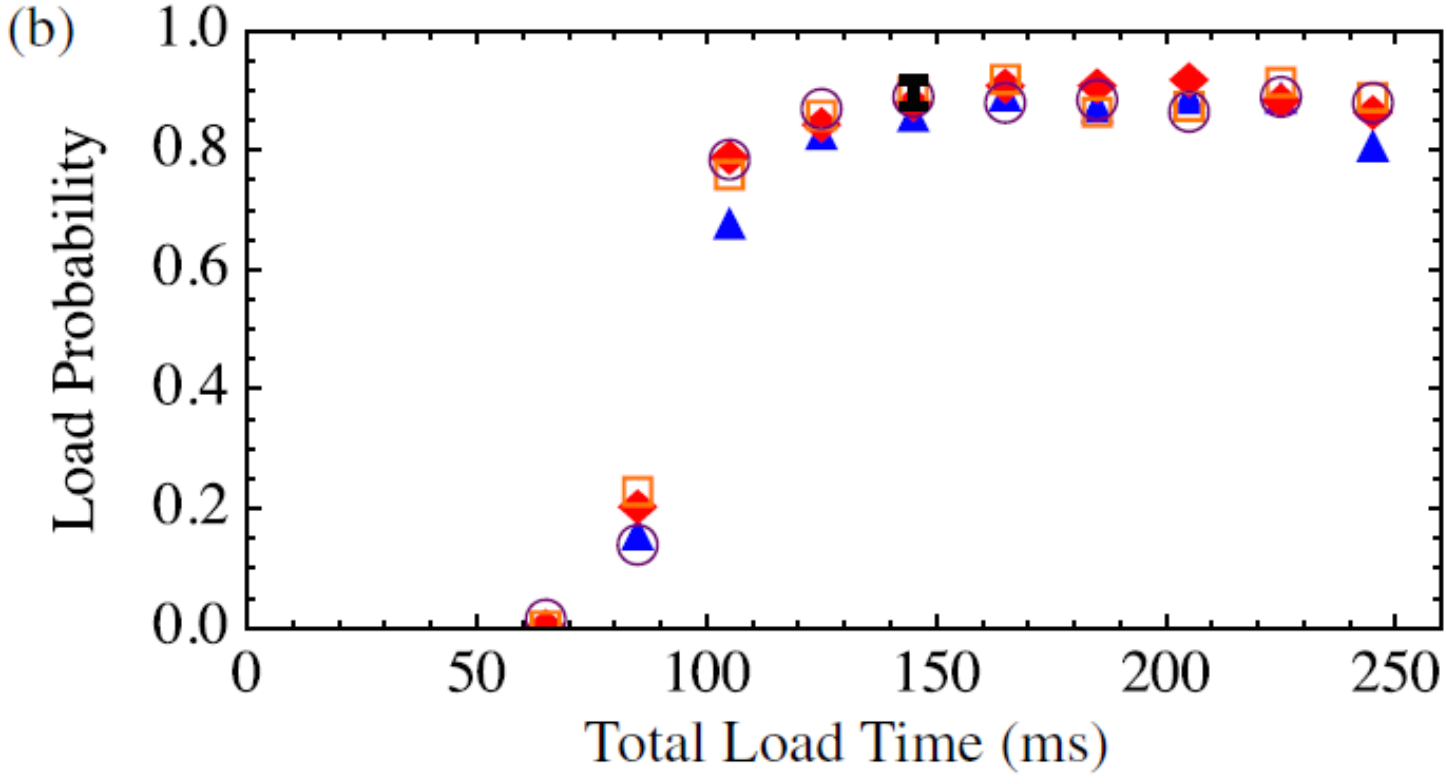
- Maximum loading probability is increased compared to previous expeiriment.

D1 laser detuning vs loading



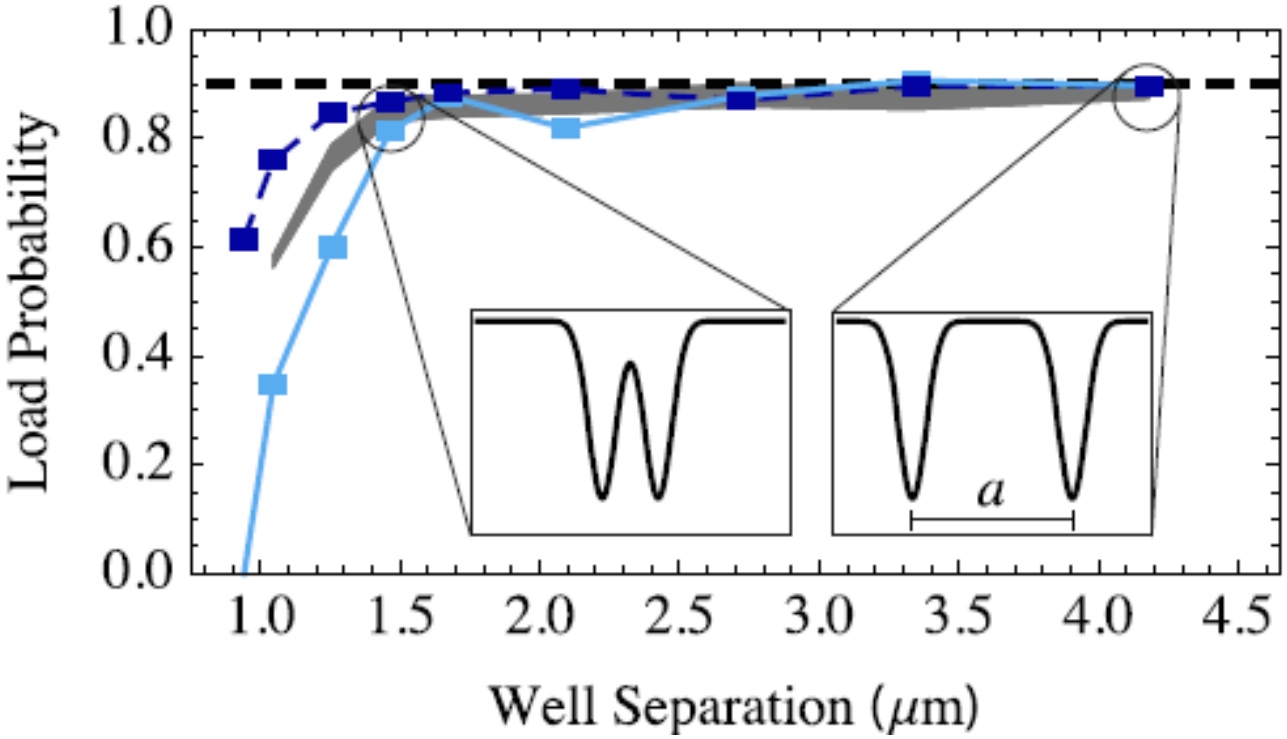
- Green dashed line is trap depth.
- Detuning near trap depth is proper to give one atom energy for leaving the trap.

Loading time vs loading



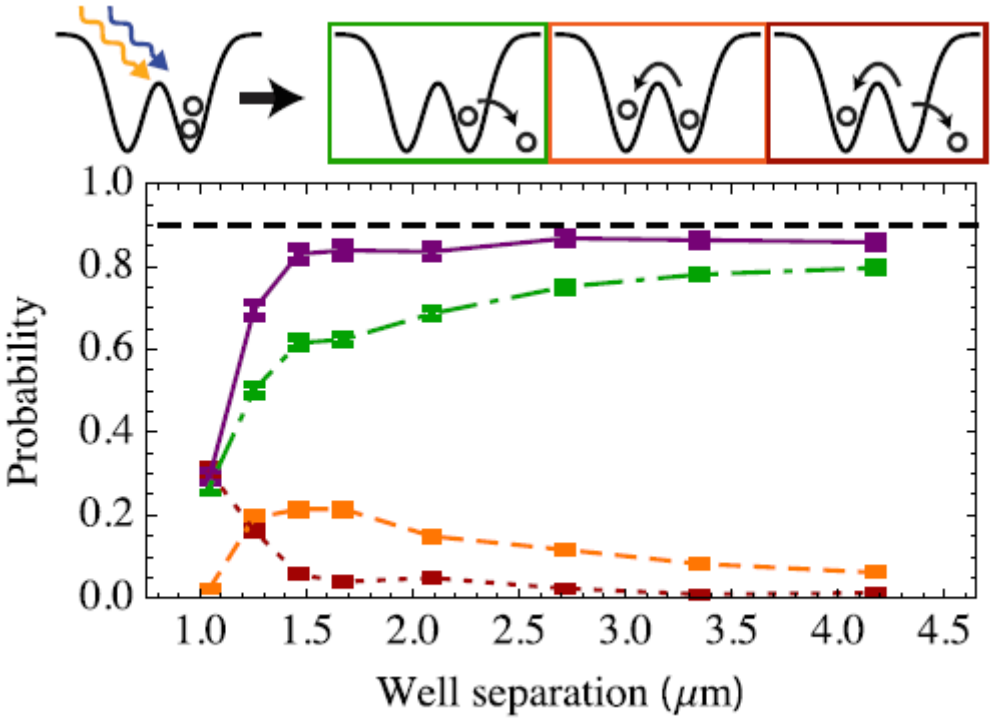
- Rapid increase as MOT density increases.

Tweezer spacing vs. loading



- Loading probability decreases as the barrier between wells is lowered.
- (w_0= 0.71 μm, a= 1.46μm)

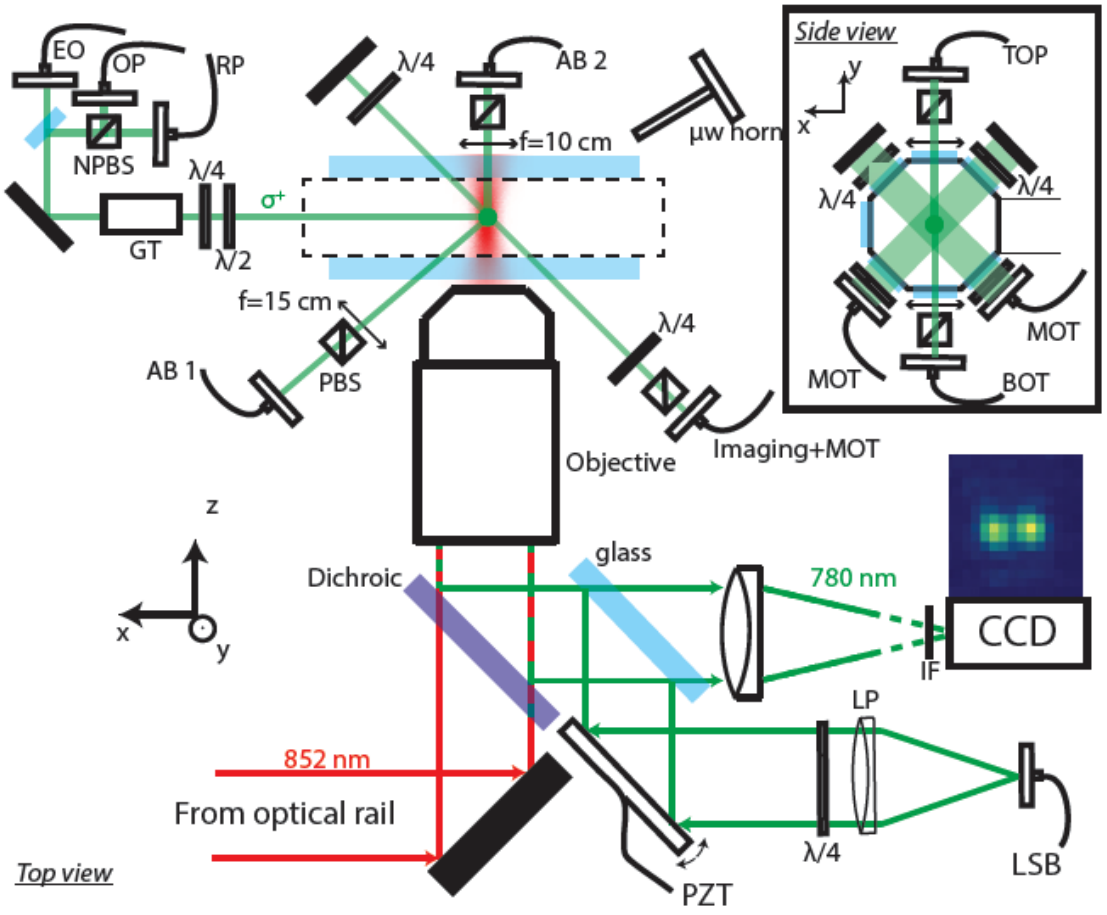
Two trapped atoms



- Prepared Initially 2 atoms in right well.

감사합니다.

Setup


EO
OP
RP
NPBS
λ/4
GT
λ/2
σ+
λ/4
AB 2
f=10 cm
μw horn
f=15 cm
AB 1
PBS
λ/4
Objective
Imaging+MOT
Side view
TOP
y
x
λ/4
λ/4
MOT
MOT
BOT
z
x
y
Dichroic
glass
780 nm
CCD
IF
LP
852 nm
From optical rail
λ/4
LSB
PZT
Top view