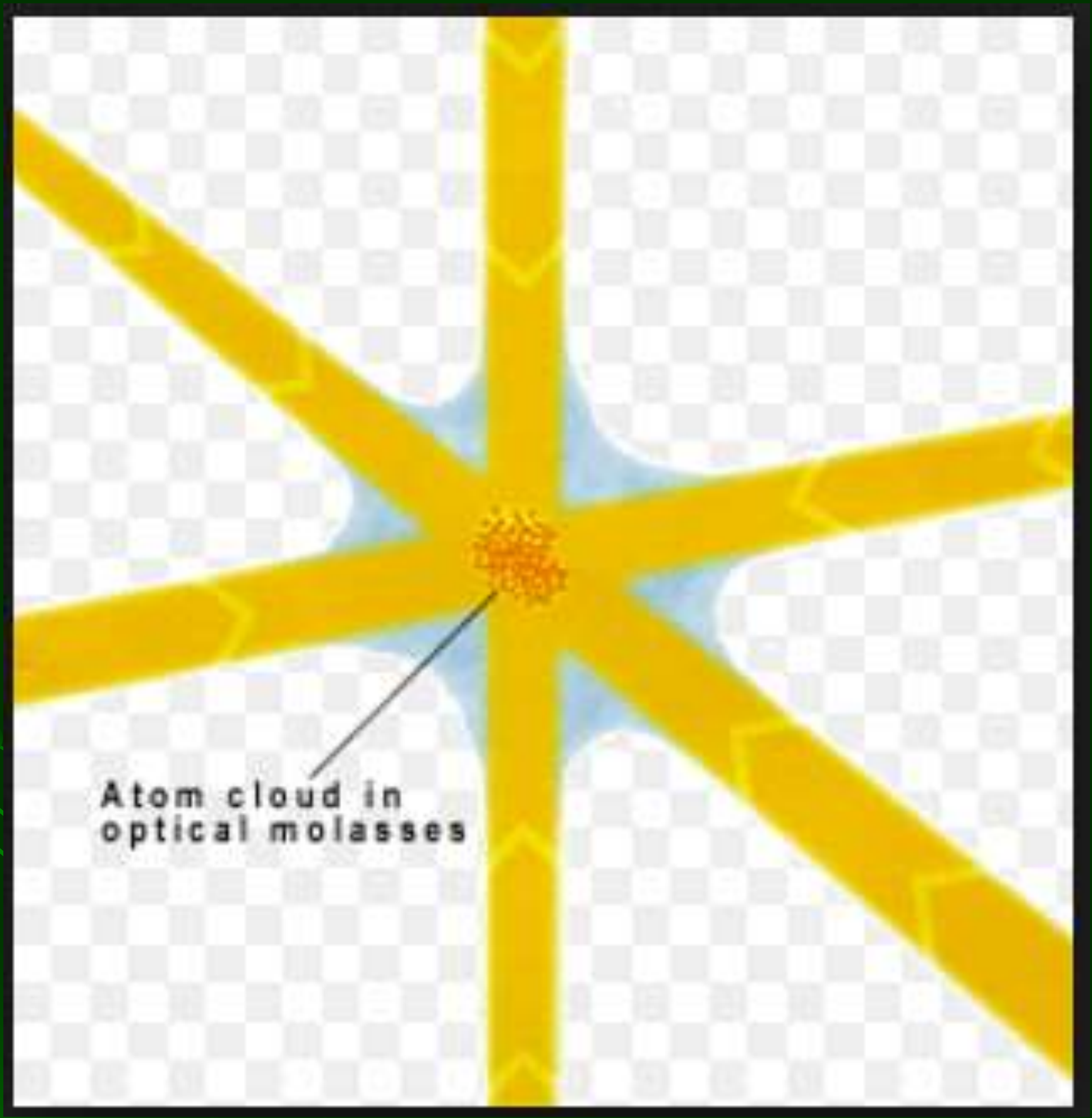
Роль “molasses” в магнитооптических ловушках

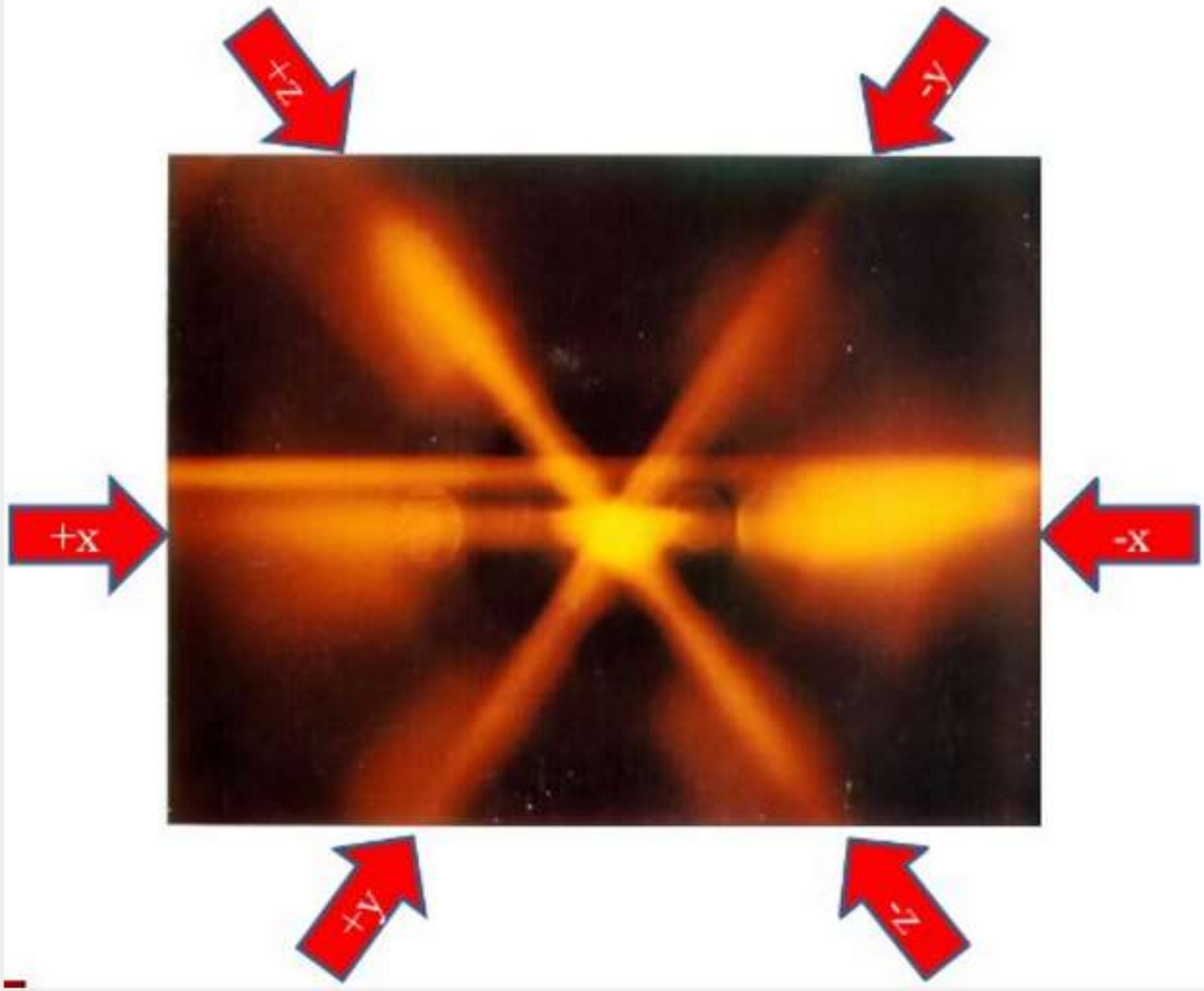
Атутов С.Н.

Институт Автоматики и Элетрометрии

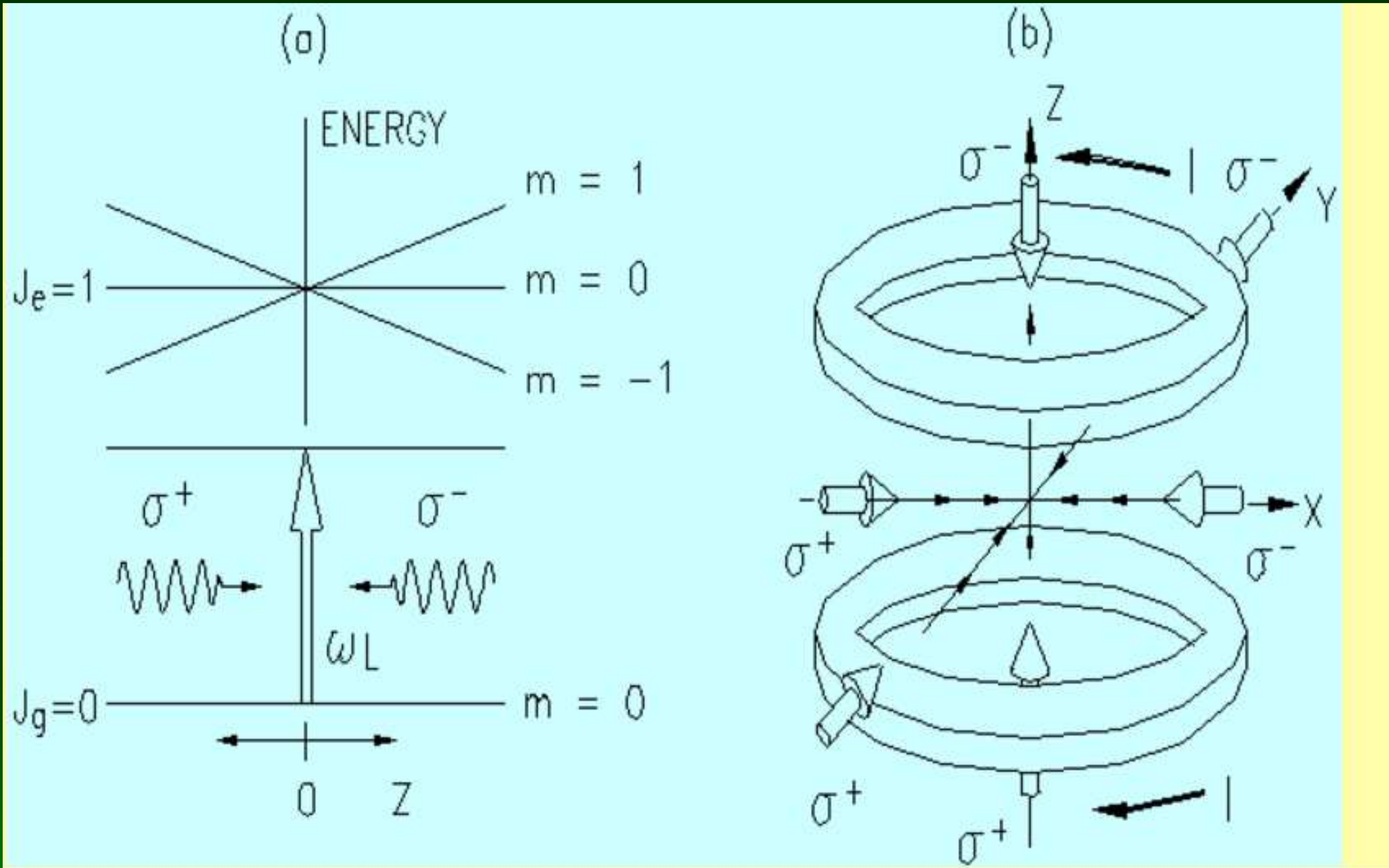
Новосибирск 21. 12. 2016


Atom cloud in
optical molasses


http://www.opl.me



Sodium optical molasses at NIST, showing the three pairs of counter-propagating beams.


(a)
ENERGY
m = 1
$J_e=1$
m = 0
m = −1
σ^+
σ^-
ω_L
$J_g=0$
m = 0
0
Z
(b)
Z
σ^-
I
σ^-
Y
X
σ^+
σ^-
σ^+
I
σ^+

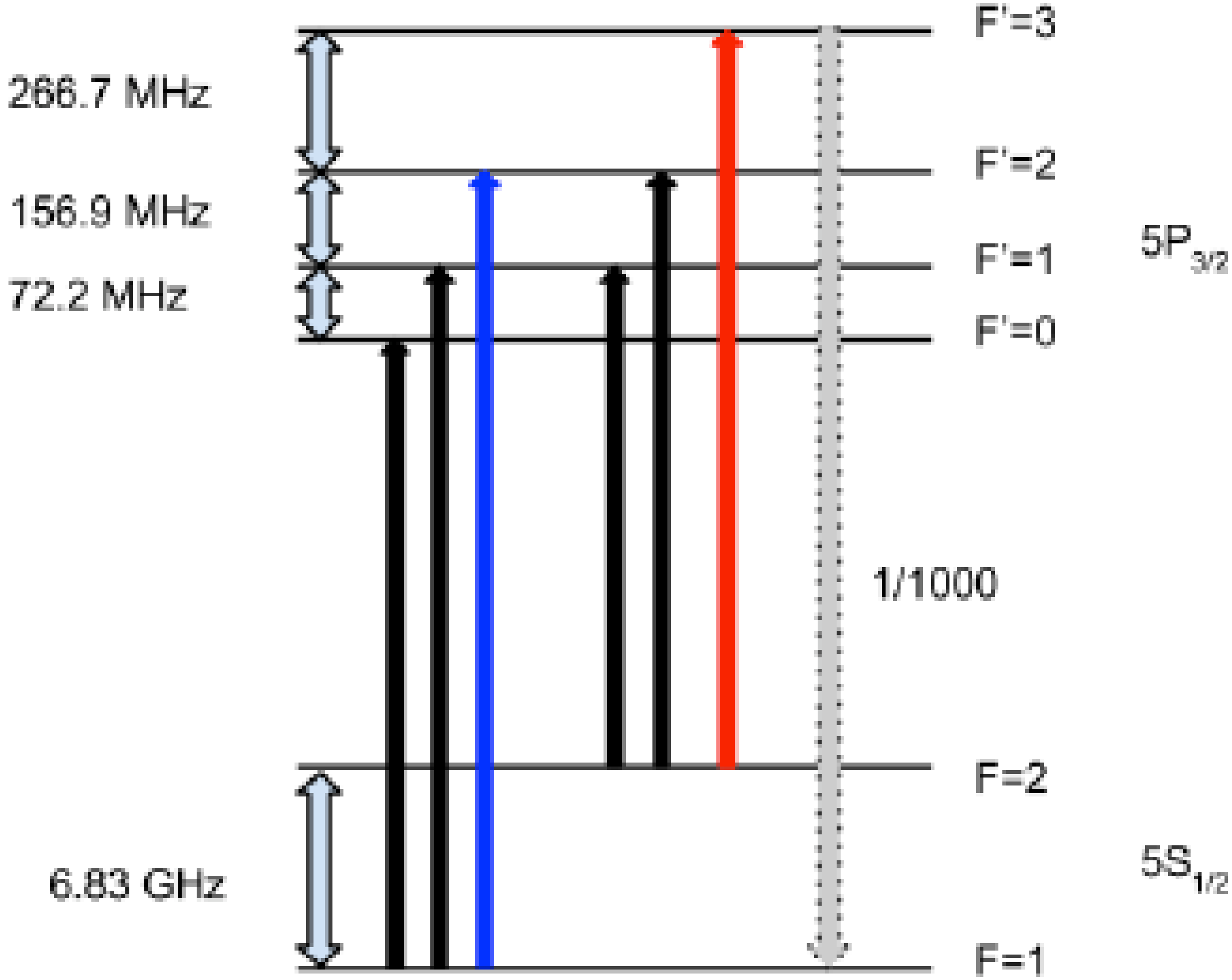


Figure 1. The D_2 transition for ^{87}Rb. The red arrow represents the cooling transition, while the blue arrow represents the repump transitions. The dotted gray arrow represents the fact that the far off resonant cooling laser may also excite atoms to the $F' = 2$ hyperfine level, which can then decay to the $F = 1$ ground state level.

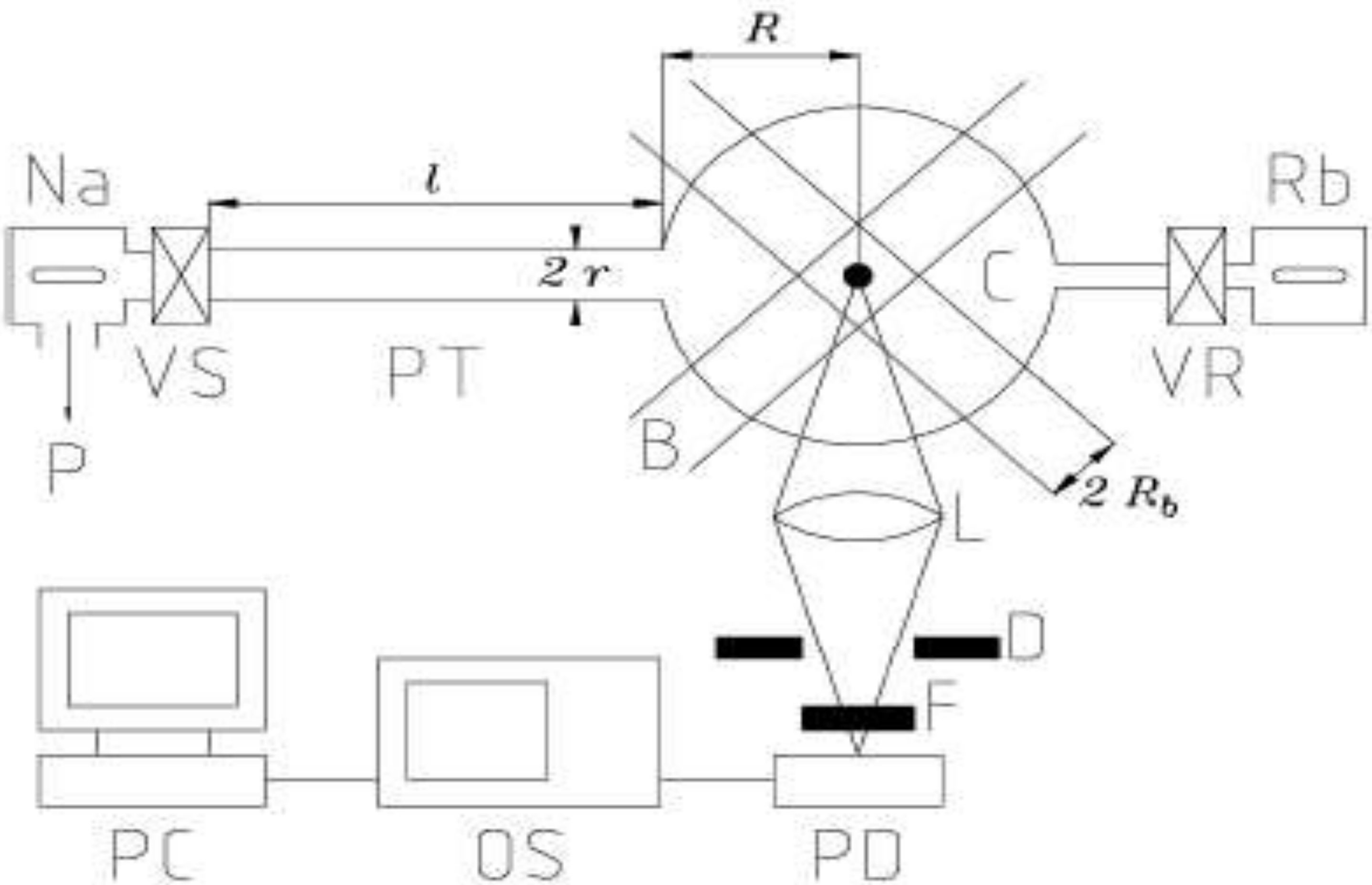


Figure 1. Schematic diagram of the apparatus: atomic sources (Na and Rb); valves (VS and VR); port tube (PT), length l and inner radius r; trapping lasers beams (B), radius R_b; trap cell (C), radius R; collection lenses (L); iris diaphragm (D); interferential filter (F); photodetector (PD); digital oscilloscope with lock-in amplifier (OS); computer (PC); pumping port (P).

A Francium MOT for atomic parity violation measurements

S.N. Atutov[a], R. Calabrese[a], L. Corradi[b], A. Dainelli[b], C. de Mauro[c], A. Khanbekyan[c],
E. Mariotti[*c], P.Minguzzi[d], L. Moi[c], S. Sanguinetti[d], G. Stancari[a] and L.Tomassetti[a]
[a]INFN- Physics Dept. Ferrara University,
[b]INFN – Laboratori Nazionali di Legnaro,
[c]CNISM–Physics Dept. Siena University,
[d]CNISM–Physics Dept. Pisa University

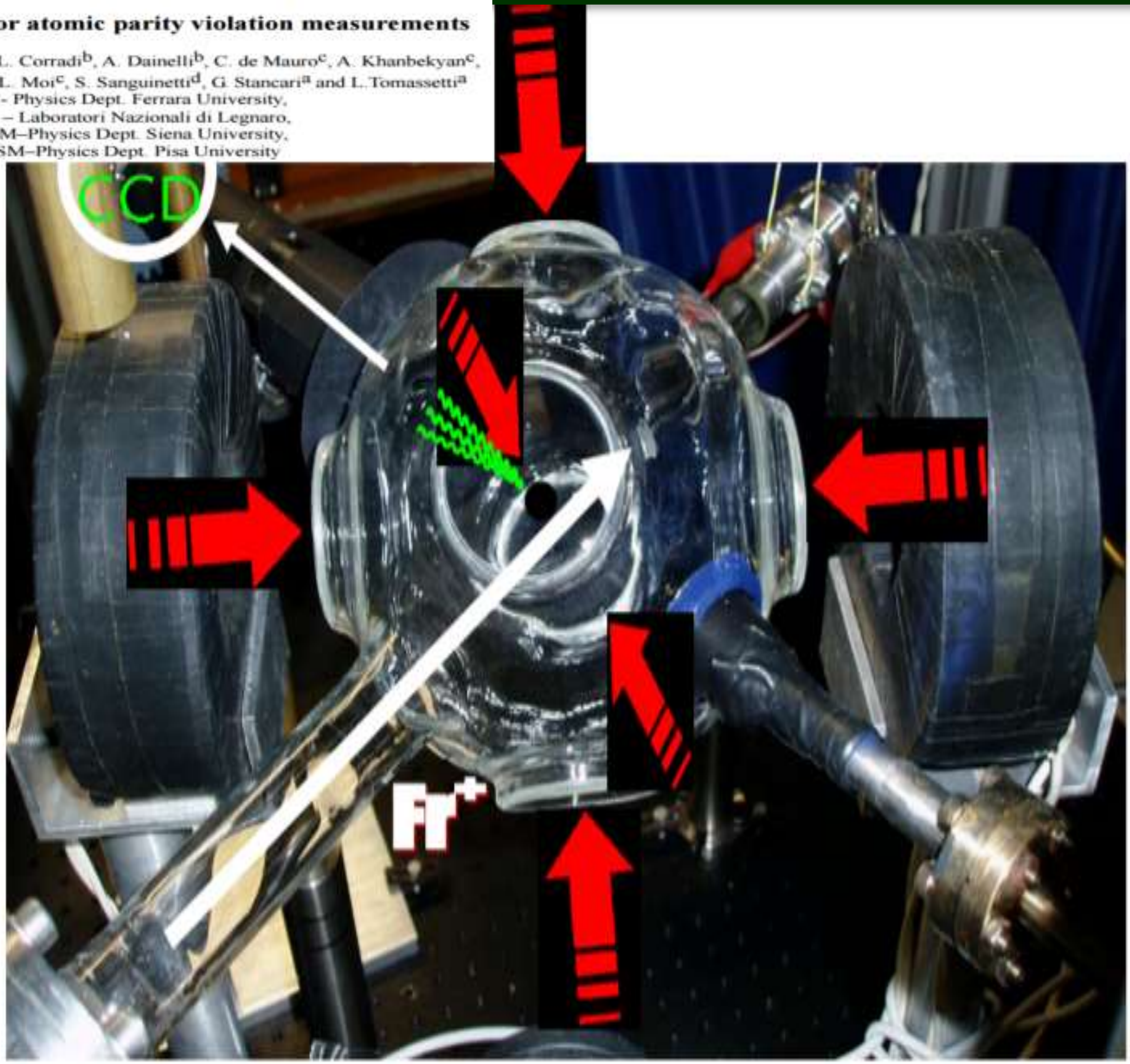
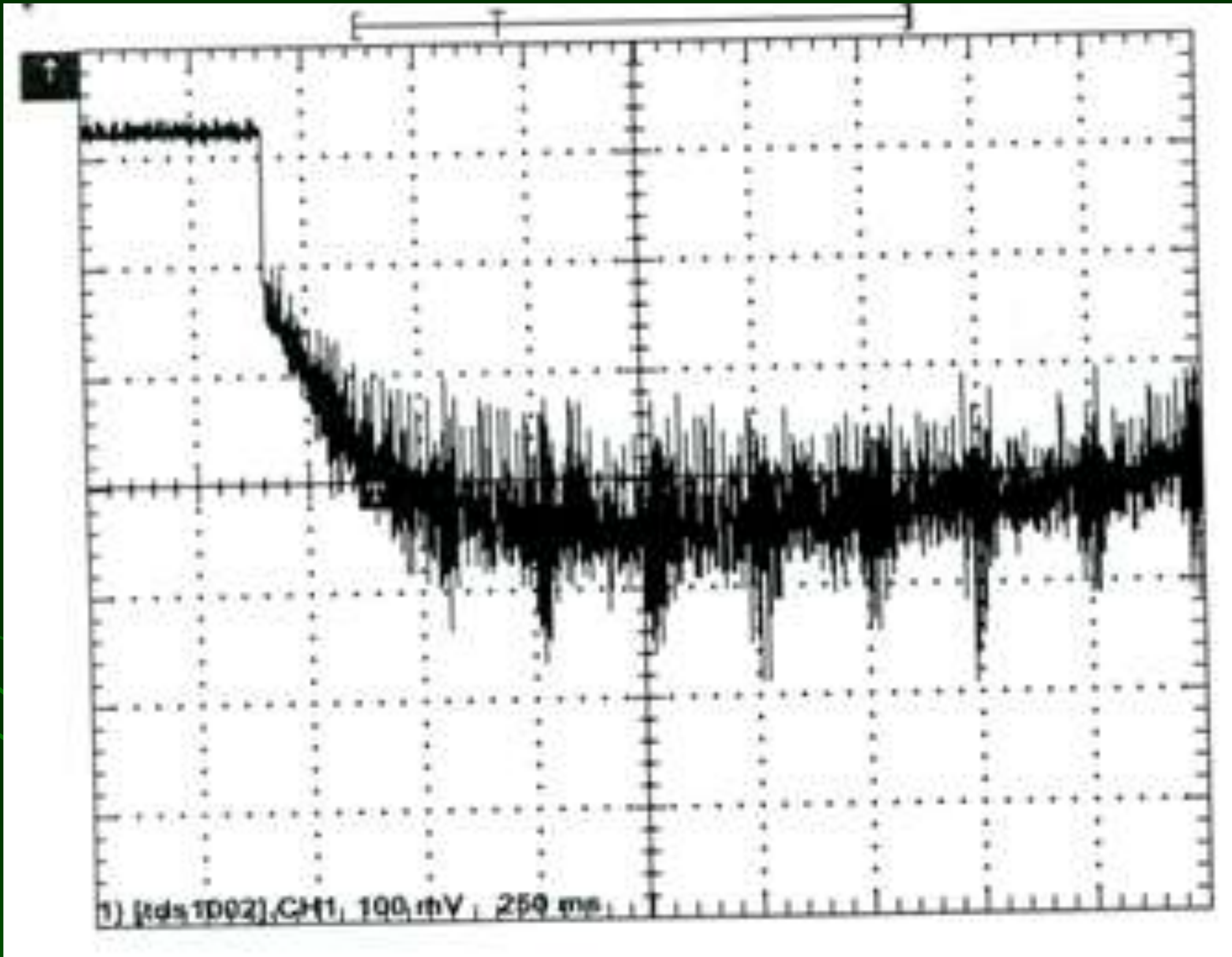
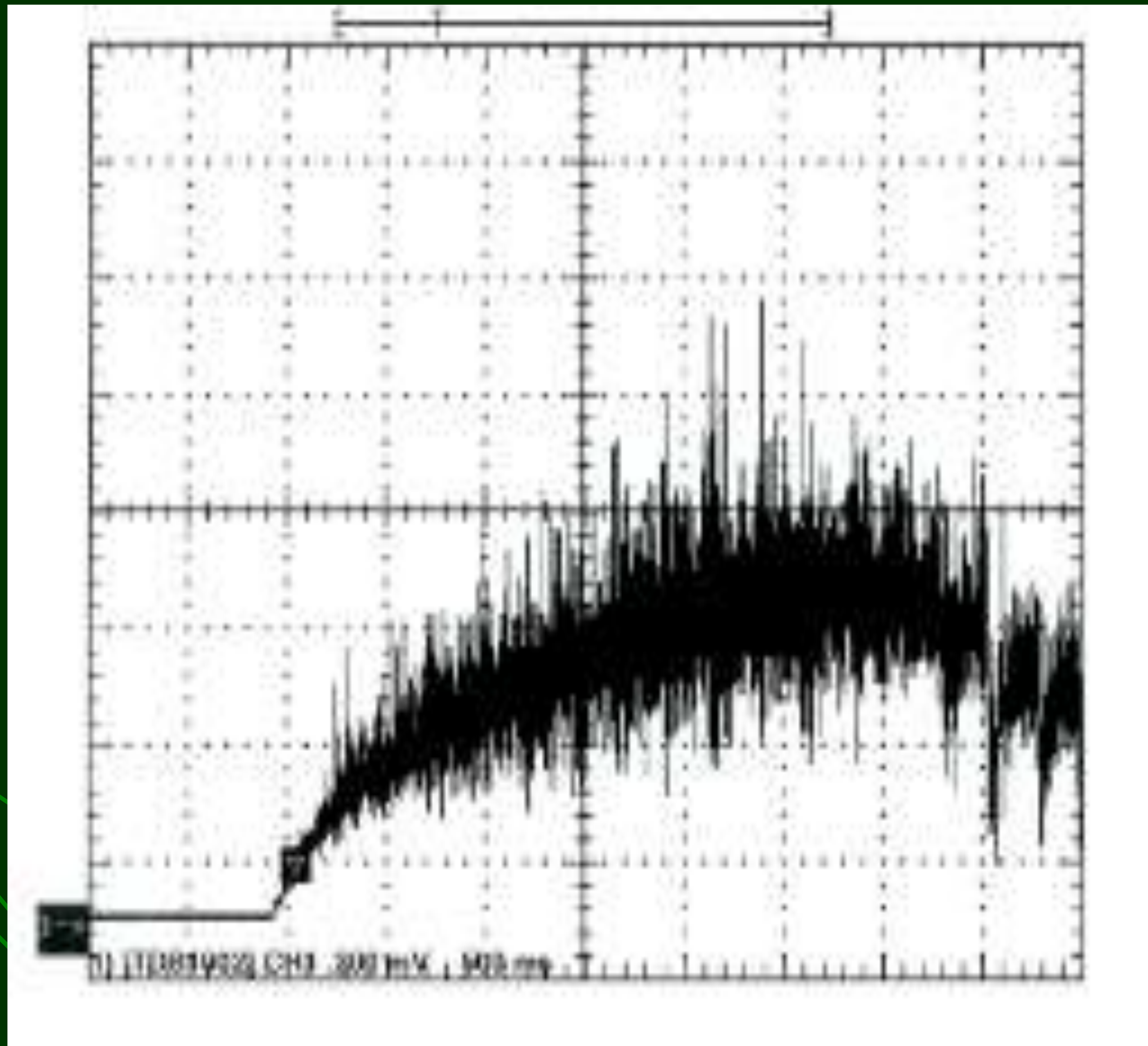
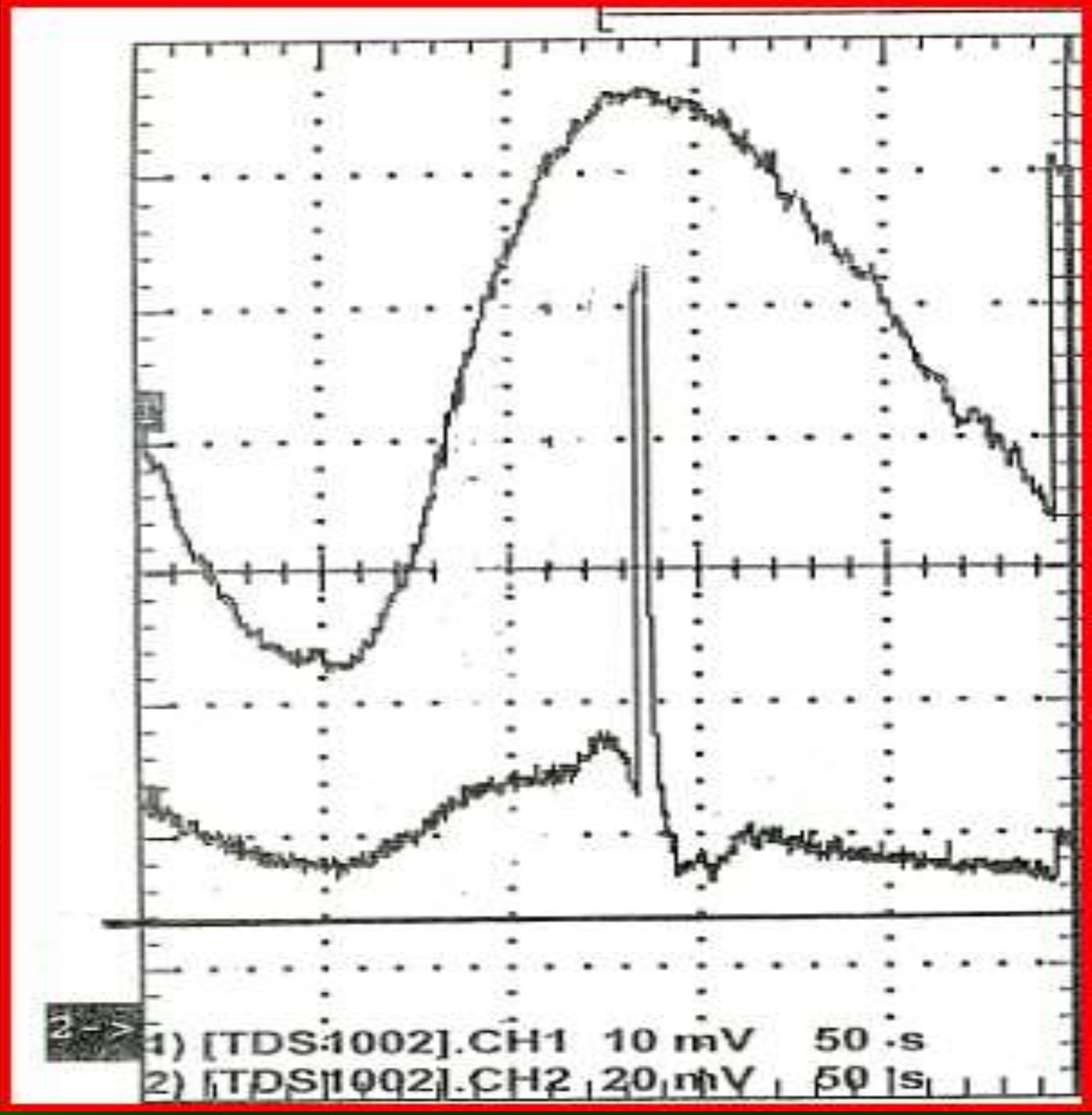


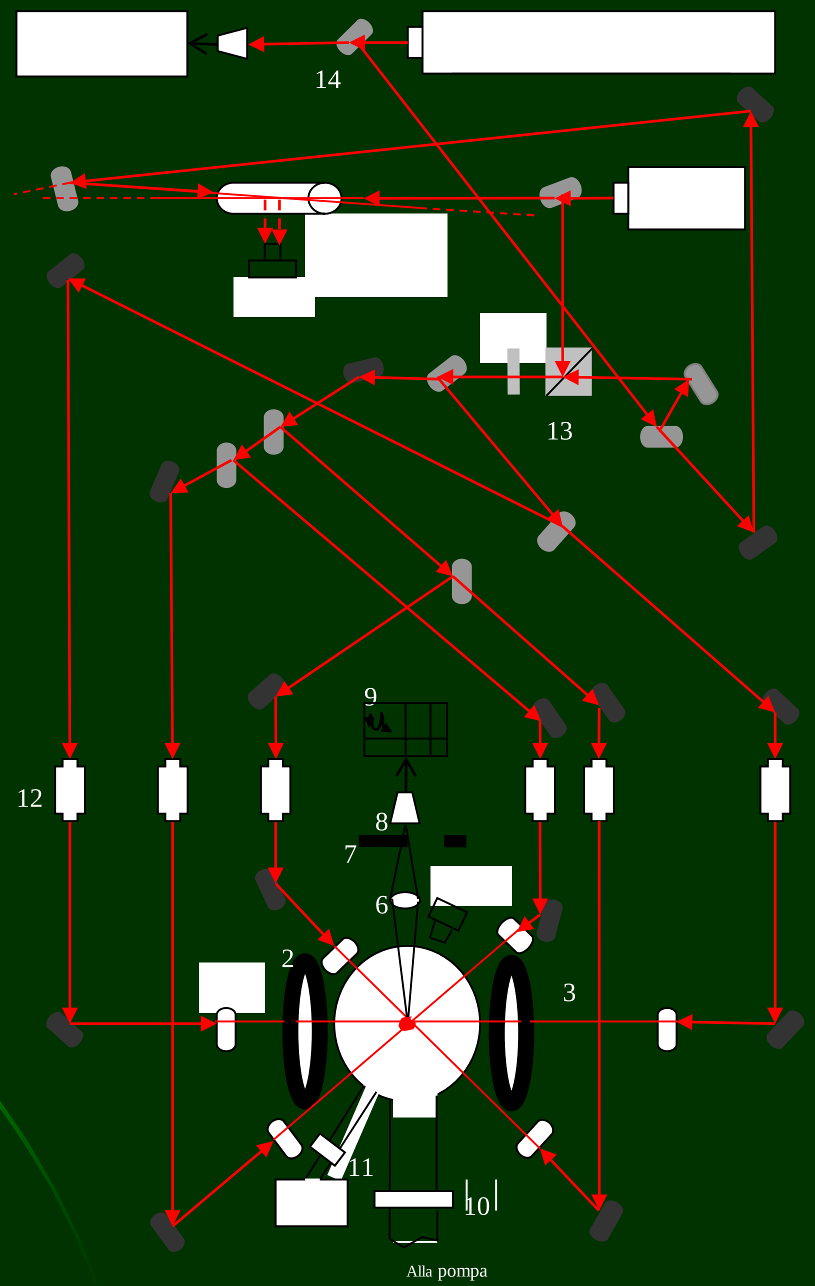
Fig.2. Picture of the MOT cell. Dashed arrows show the laser beams. The direction of the francium ion beam and the position of the CCD camera are also shown.


1) [tds1002] CH1, 100 mV , 250 ms




1) [TDS 1002].CH1 10 mV 50 s
2) [TDS 1002].CH2 20 mV 50 s

Спасибо за внимание


14
13
12
9
8
7
6
2
3
11
10
Alla pompa

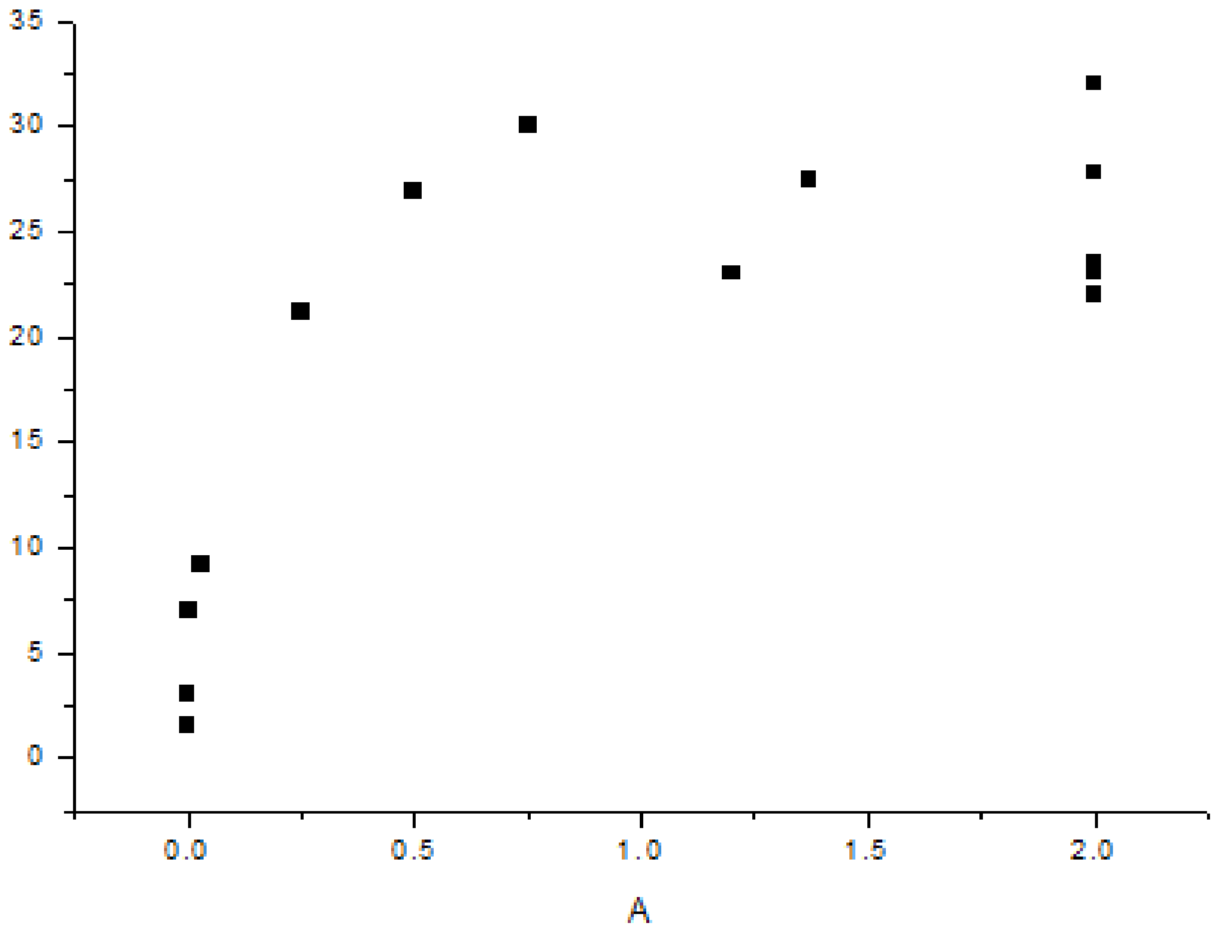


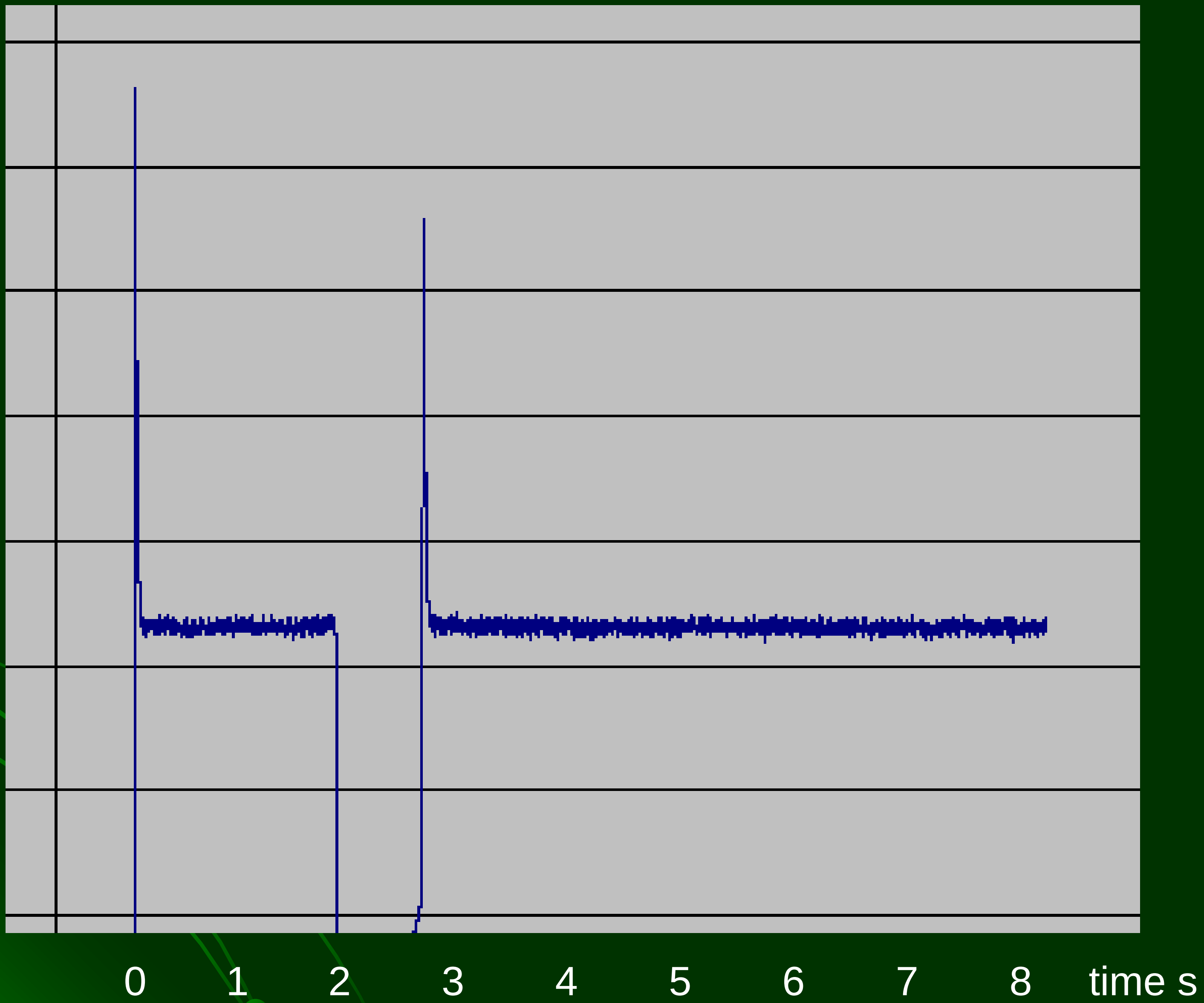
Figure 2. Dependence of the equilibrium density *n* on the film thickness.

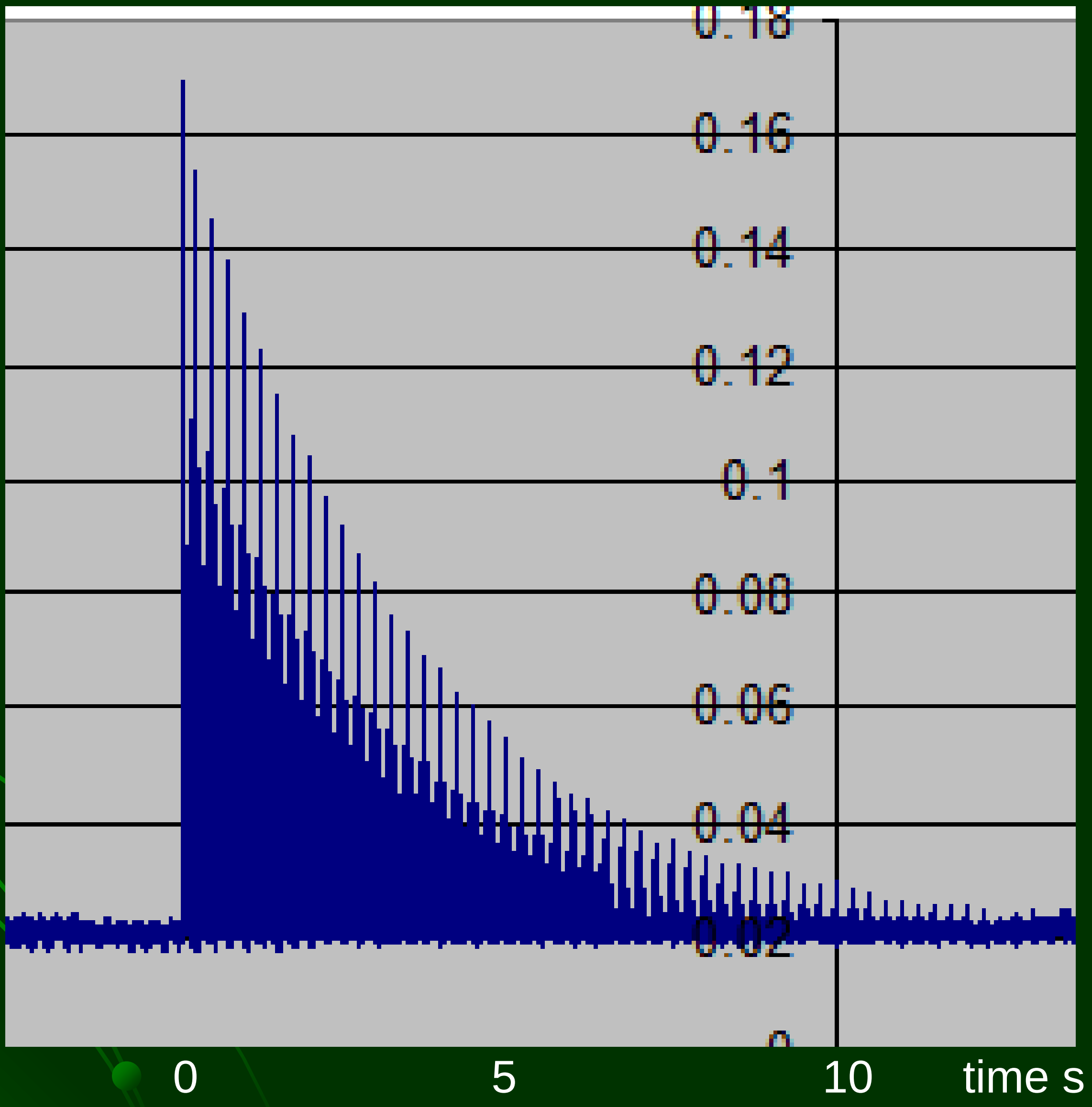
$$P = p \cdot n_{eq} V = \phi_{\mathrm{esc}} + \phi_{\mathrm{relax}} + \phi_{\mathrm{adsorb}} \tag{4}$$

$$P = \frac{2\pi r^3 \bar{\upsilon} n_{pumped}}{3L} + \frac{\pi R^2 \bar{\upsilon} n_{pumped}}{\chi_{relax}} + \frac{\pi R^2 \bar{\upsilon} n_{pumped}}{\chi_{adsorb}} \tag{5}$$

$$N_{pumped} = P\left[\frac{1}{\tau_{esc}} + \frac{1}{\tau_{relax}} + \frac{1}{\tau_{adsorb}}\right]^{-1} = P \cdot \tau_{loss} \tag{6}$$

$$\tau_{esc} = \frac{2L}{\bar{\upsilon}}\left(\frac{R}{r}\right)^3, \quad \tau_{relax} = \frac{\chi_{depolariz} l_{mean.path}}{\bar{\upsilon}}, \quad \tau_{coat} = \frac{\chi_{adsorb} l_{mean.path}}{\bar{\upsilon}} \tag{7}$$


0
1
2
3
4
5
6
7
8
time s


0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
5
10
time s

$$\tau_{loss} = 0,5s$$

$$\tau_{esc} = 2,5\ s$$

$$\tau_{adsorb} = 5\ s$$

$$\tau_{relax} = 0,71s$$

$$\chi = 4 * 10^4$$

Спасибо за внимание