Light-Induced Atomic Desorption (LIAD)

presented by Etsuko Mieda

Outline

- How was LIAD found ??
- What is LIAD ??
- Experiments and Results
  - Cell
  - Coatings
  - Time Dependence
  - Light Intensity
  - Light Frequency
- Applications

How was LIAD found??

- By an Italian physicist A. Gozzini in 1993
- It was totally an **ACCIDENT**
- He could not find any reference to this effect
- So he decided to do some experiments and publish paper!!

How was LIAD found ??

What is LIAD ??

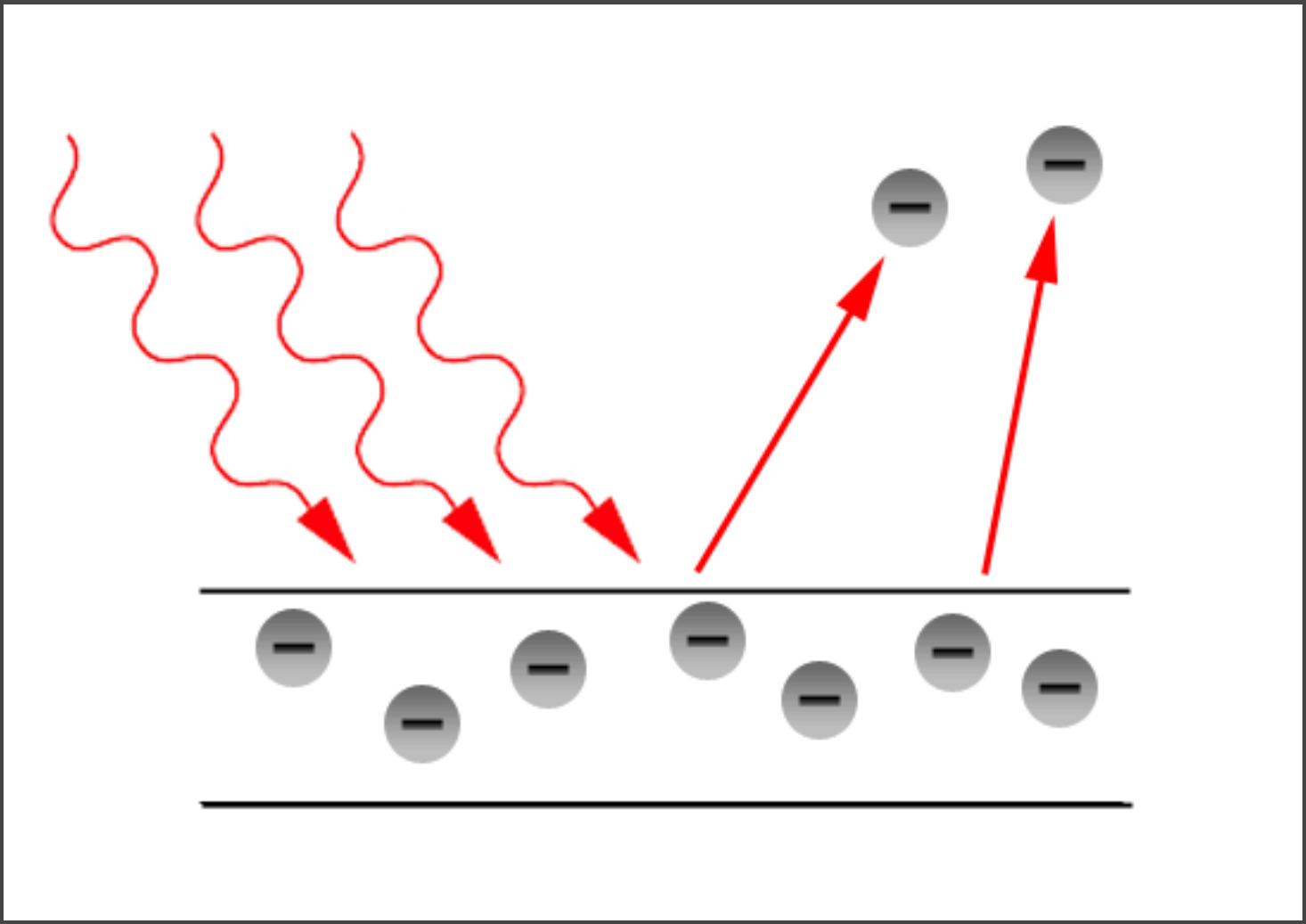
- Shine a beam of light on a coated wall in vapor cell

- alkali-metal are desorbed from the wall

- the atomic vapor density in the cell increase

Photoelectric Effect

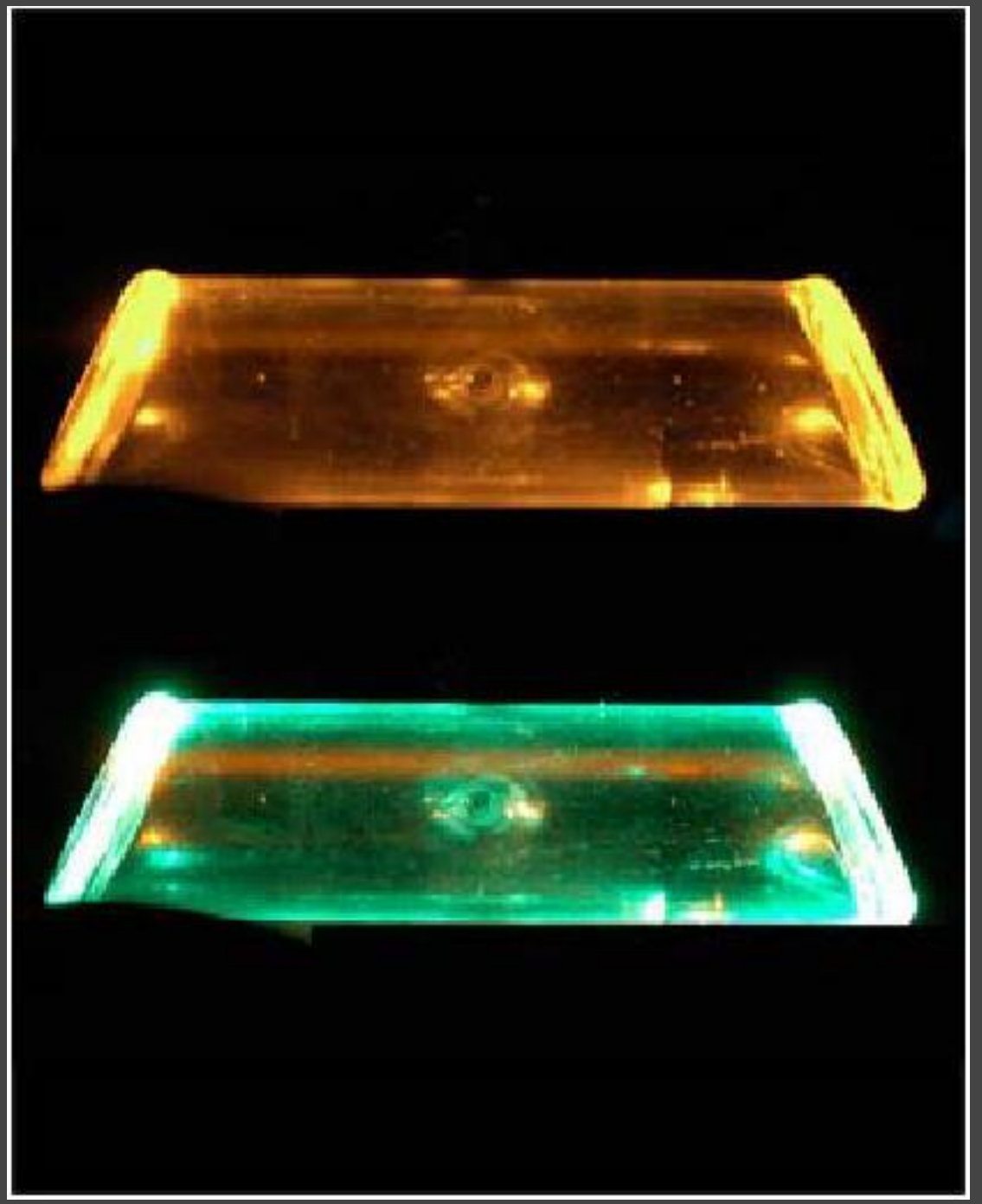
- the absorption of energy from electromagnetic radiation such as X-rays or visible light
- electrons are emitted from matter



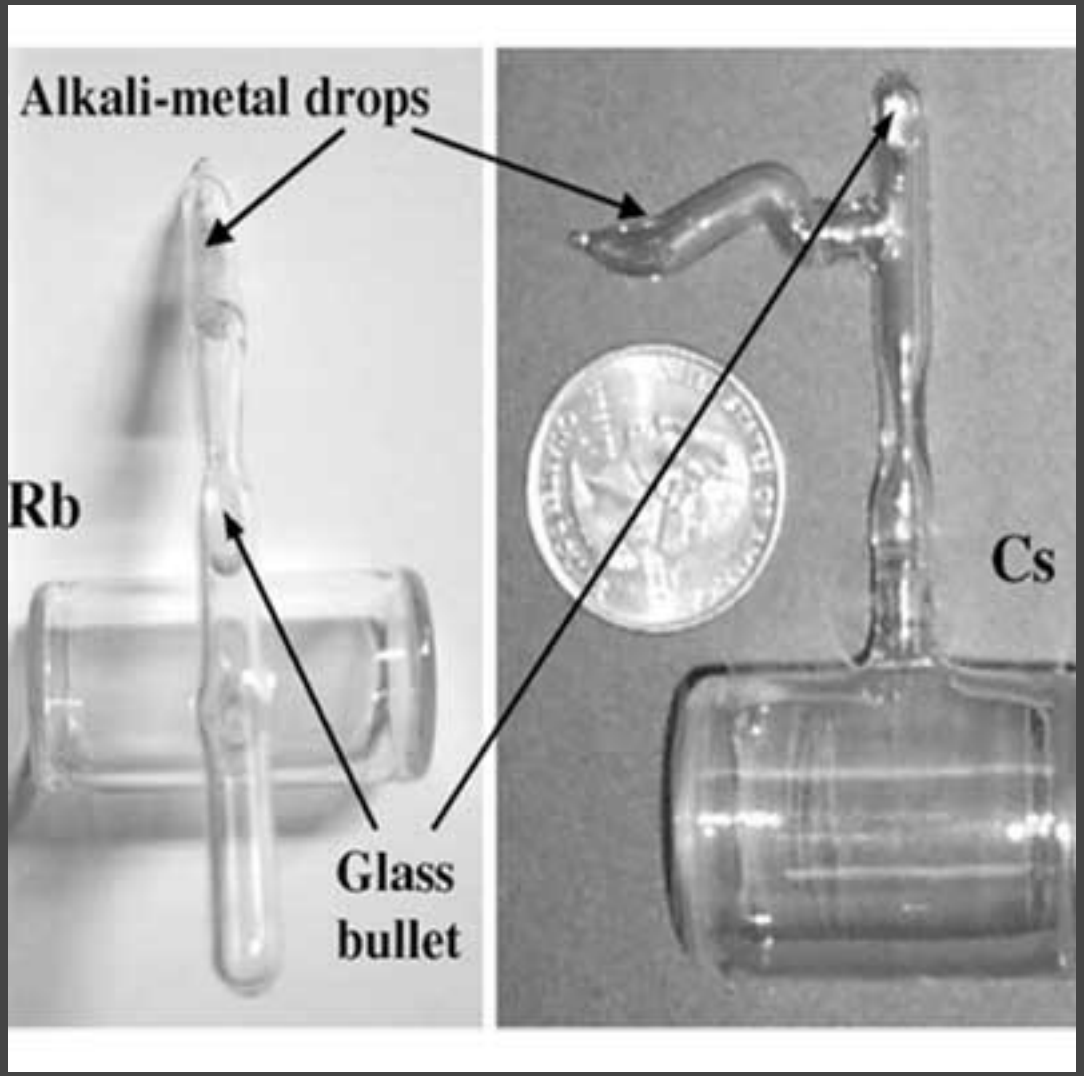
What is LIAD ??

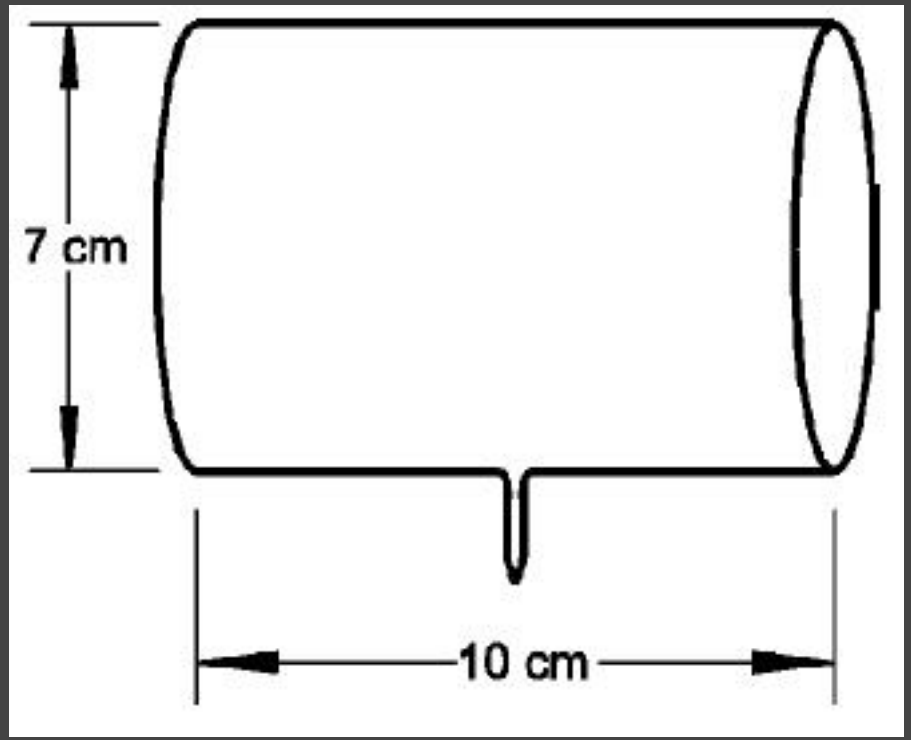
fluorescence observed in presence of the dye laser only (P=100mW) -->

fluorescence observed by adding Ar+ laser illumination (P=500mW) -->

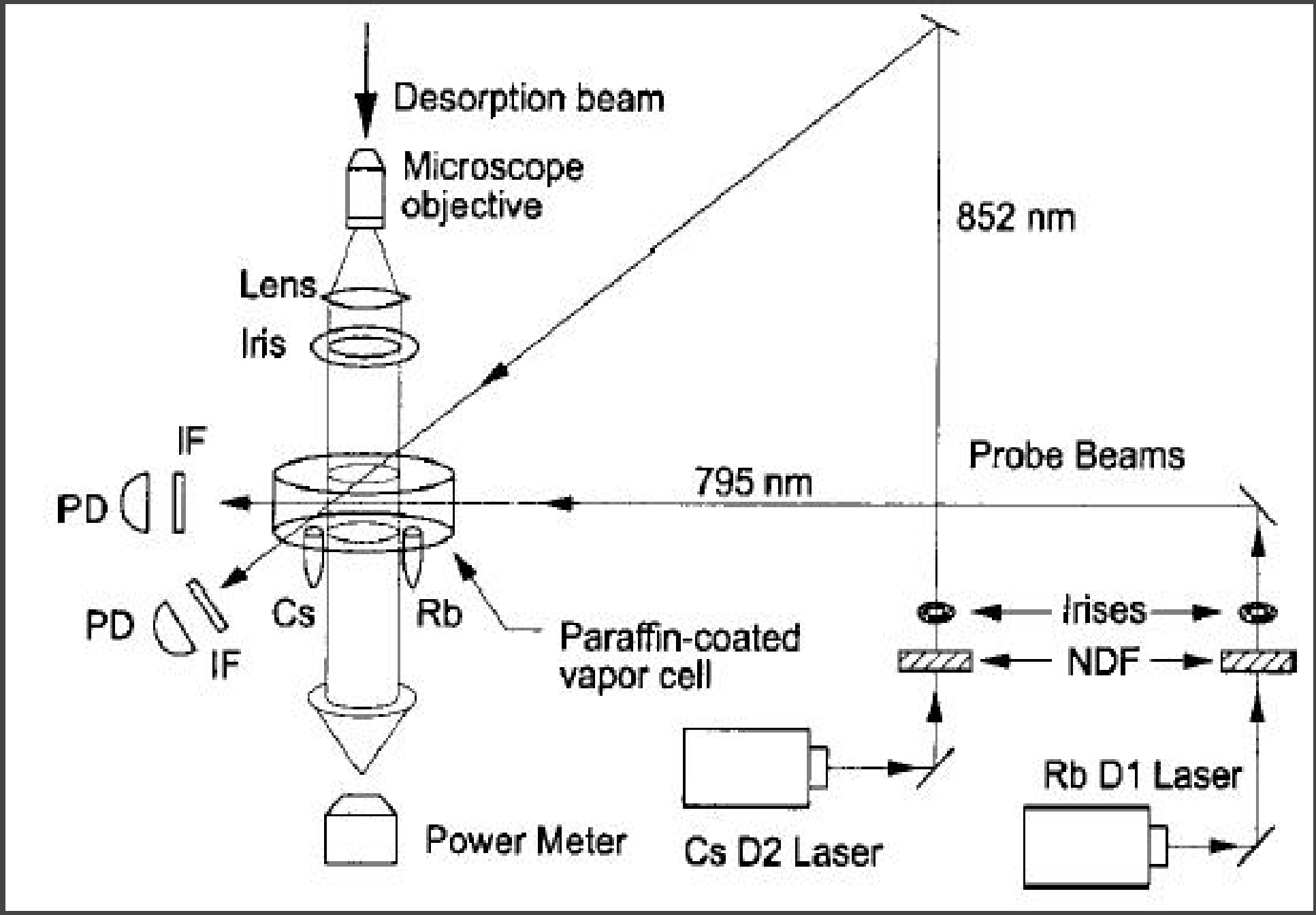


Vapor Cells





Setup for LIAD Measurement



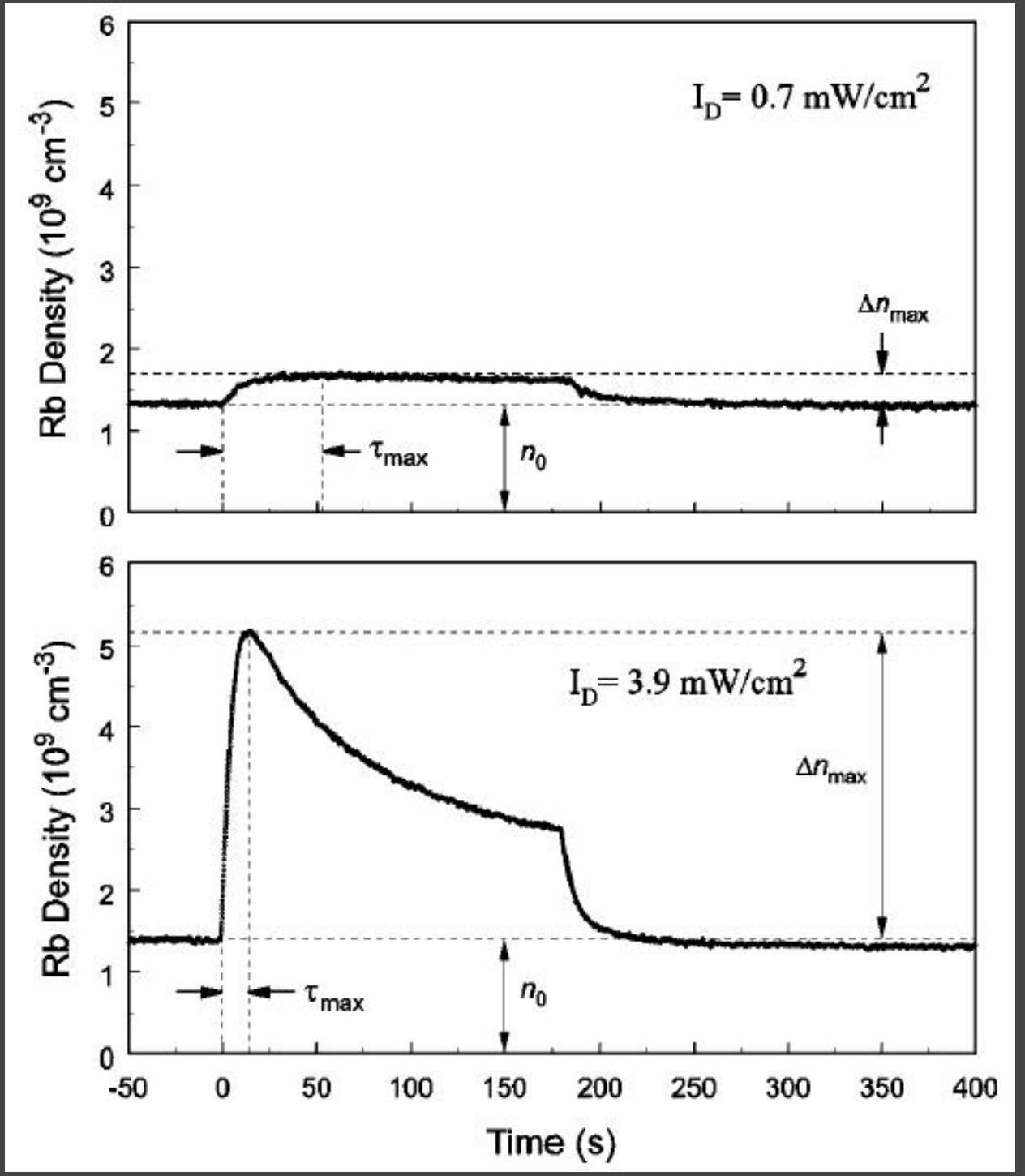
Coatings

- Coatings absorb/adsorb alkali-metal atoms in the vapor cell
- Suppress the vapor densities

- There are different kinds of coatings
- For example: pareffin, silane (polydimethylsiloxane, polysiloxane, etc)

Time Dependence

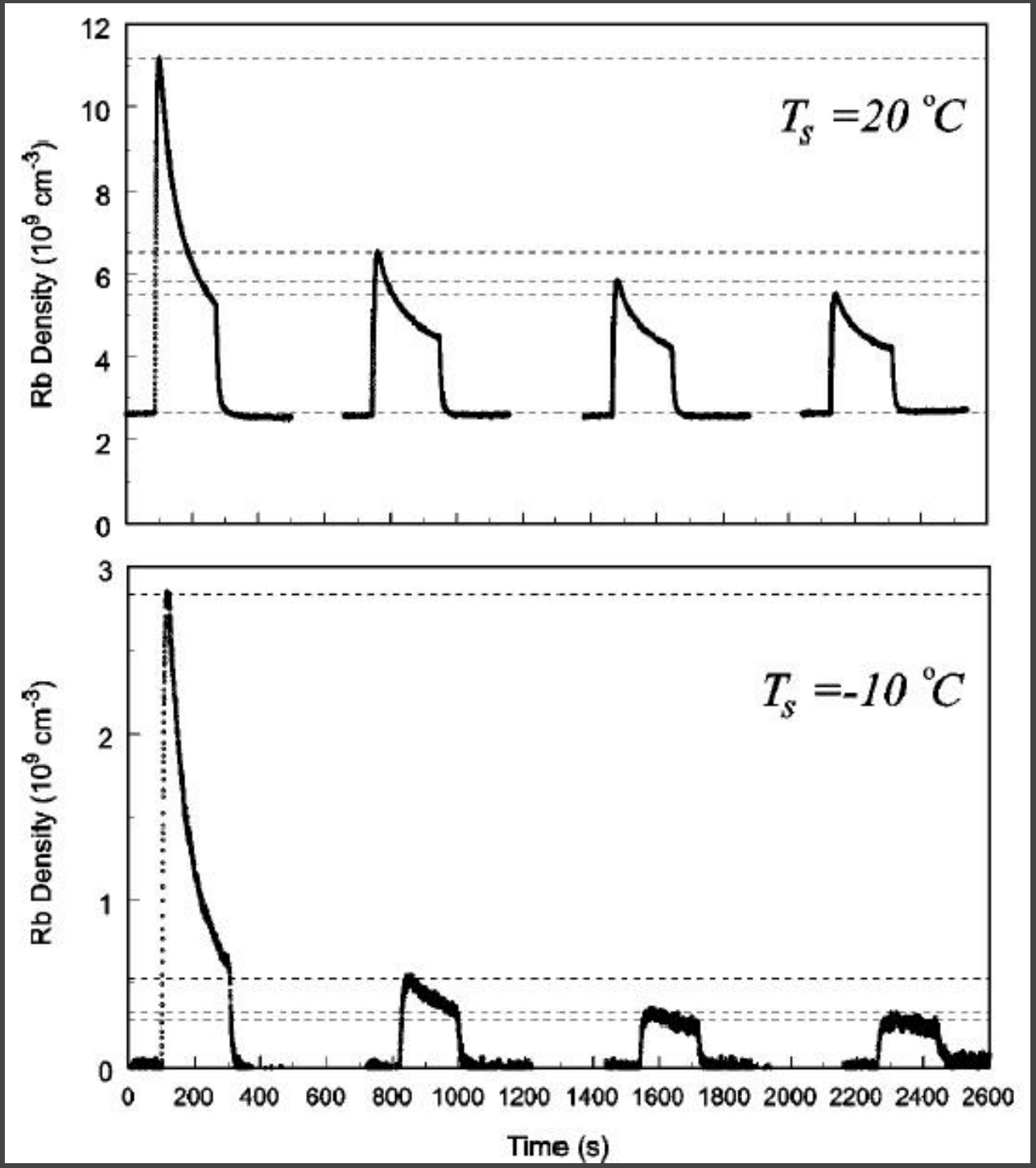
- exposed to 514-nm desorbing light
- at room temperature (~20℃)
- density increase!!
- but decrease as it continues to be exposed!!



Repeated Exposures to Desorbing Light

- ~10 min interval

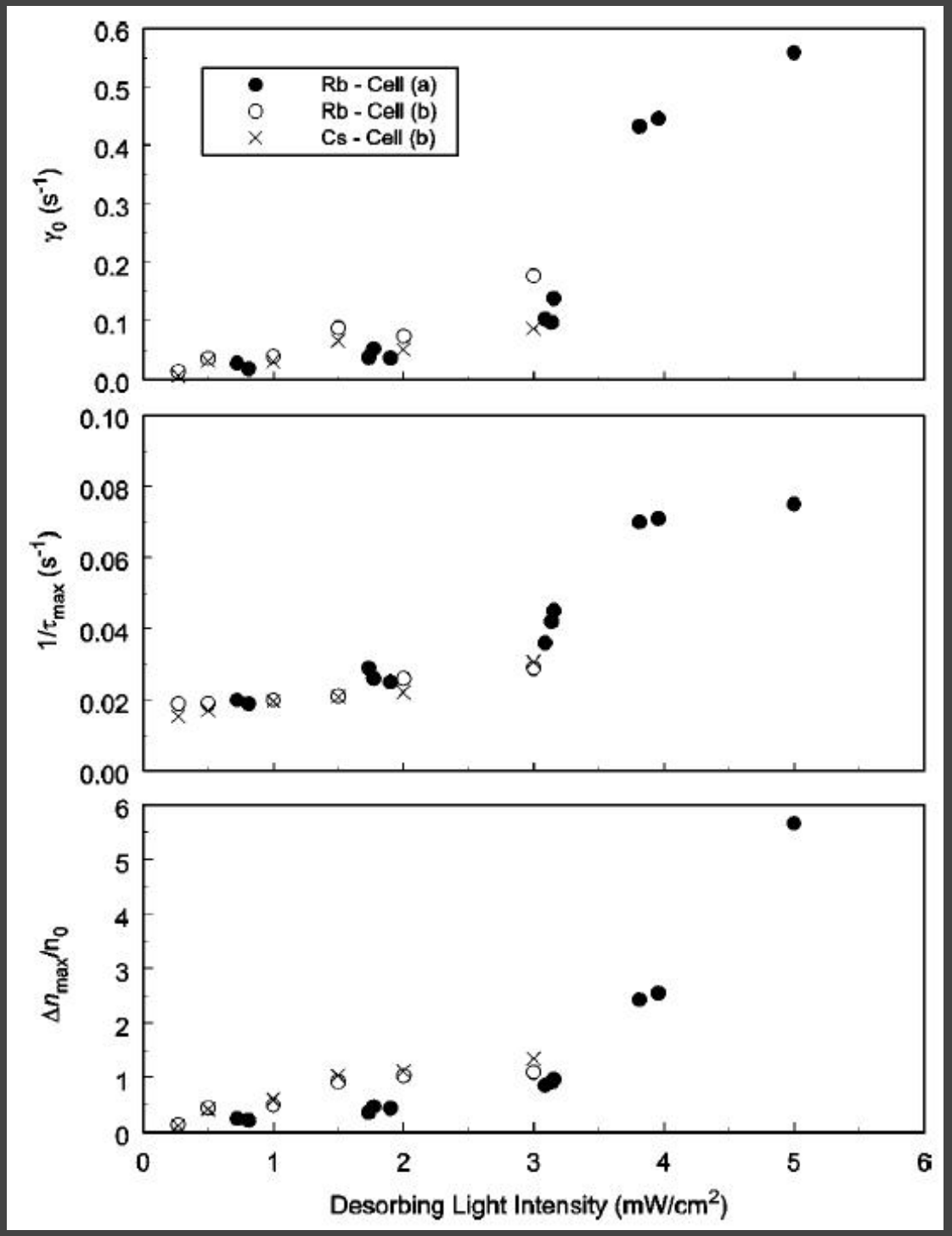
- exceed the saturated vapor density at room temperature!!
- even at very low temperature shows increase in density!!
- coating is replenished



Light Intensity

- γ0=relative rate of increase of the vapor density in the cell
- τ(max)=the time for the density to reach its maximum value
- Δn(max)=the maximum increase in density
- n0=the initial density

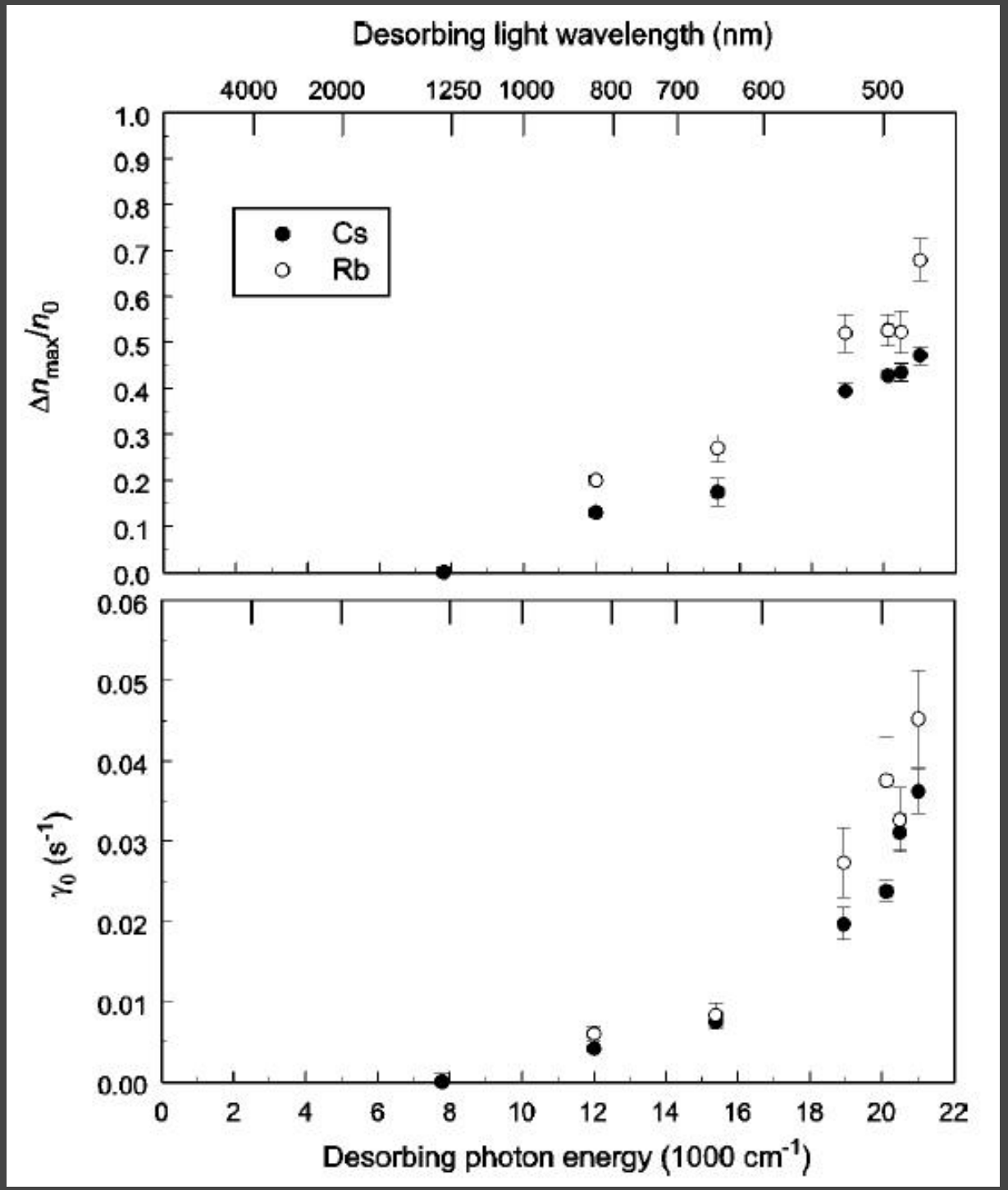
- more intense higher density!!



Light Friquency

- Low light power (0.56mW/cm^2)
- There is a threshold in photon energy for the desorbing light

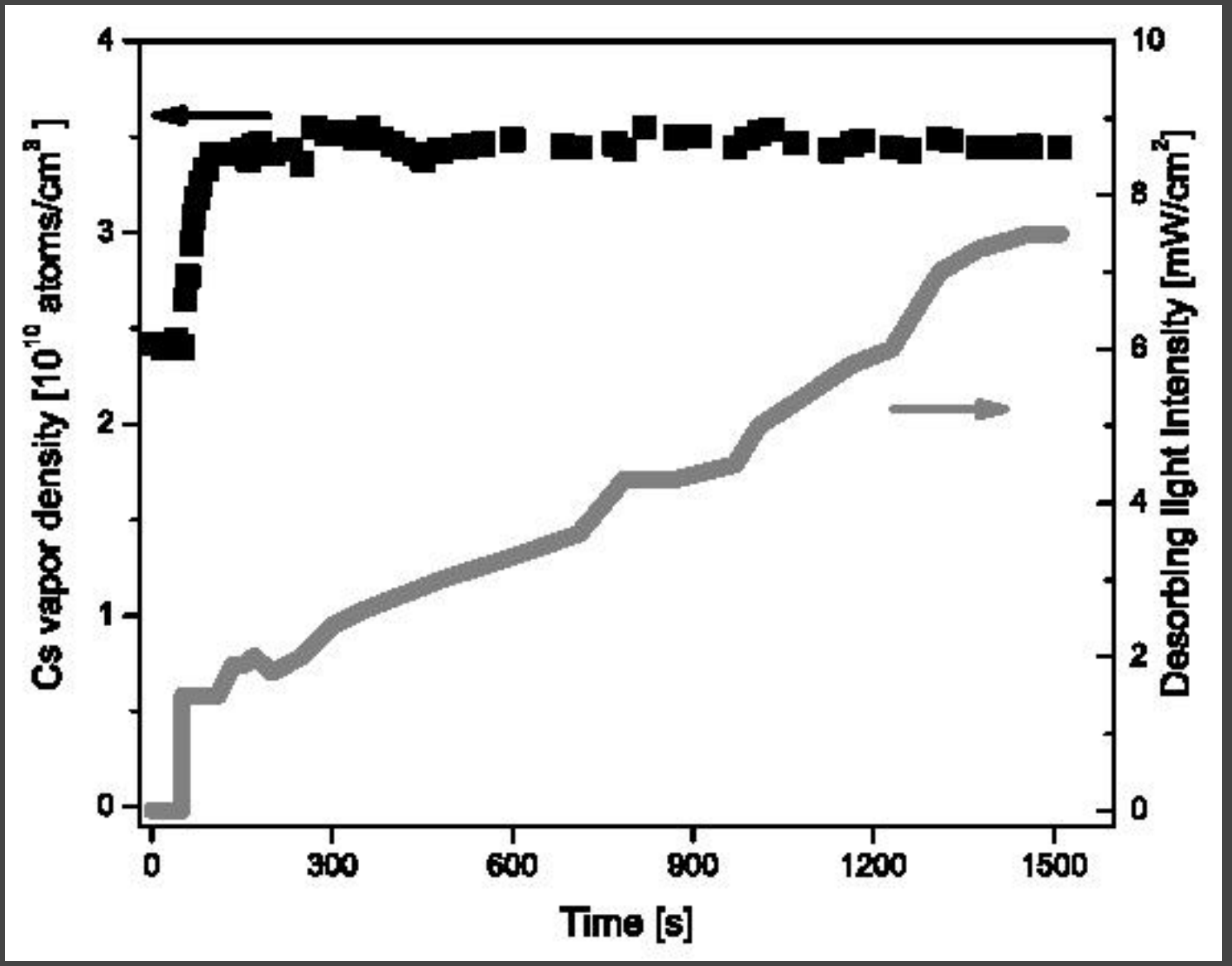
- higher frequency, higher density!!
- there is a threshold!!



Applications

- Controll atomic density without changing temperature

  Bose-Einstein condensation or more EXPERIMENTS



References

- E. B. Alexandrov, M. V. Balabas, D. Budker, D. English, D. F. Kimball, C.-H. Li, and V. V. Yashchuk, Phys. Rev. A 66, 042903 (2002)
- T. Karaulanov, M. T. Graf, D. English, S. M. Rochester, Y. J. Rosen, K. Tsigutkin, D. Budker, E. B. Alexandrov, M. V. Malabas, D. F. Jackson Kimaball, F. A. Narducci, S. Pustelny, and V. V. Yashchuk, Phys Rev. A 79 012902 (2009)
- S. Gozzini, A. Lucchesini, L. Marmugi, and G. Postorino, Phys. J. D 47, 1-5 (2008)
- A. Gozzini, F. Mango, J. H. Xu, G. Alzetta, F. Maccarrone, and R. A. Bernheim, IL Nuovo Cimento Vol. 15 D, N. 5 (1993)
- Wikipedia--Photoelectric effect