DISCUSSION

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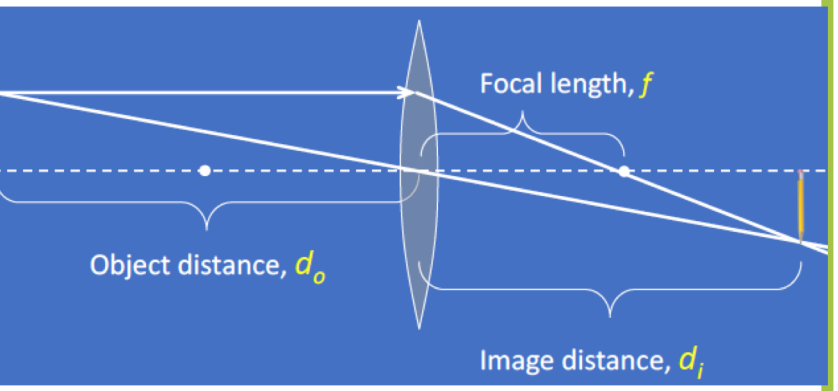
REVIEW OF THE LABS

Converging Lens



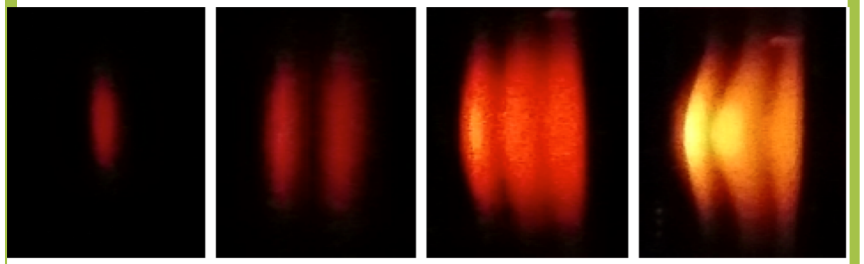
Focal length(f):

$$\frac{1}{d_i}+\frac{1}{d_o}=\frac{1}{f}\Rightarrow f=\frac{d_i\times d_o}{d_i+d_o}$$

determine the focal length using different methods

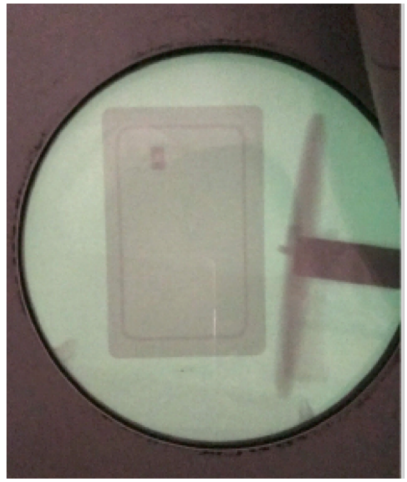
Frank Hertz Exp.

Observe Light emission.
Quantized excitation/deexcitation of Neon atoms



Determine the first excitation potential

X-ray Experiment



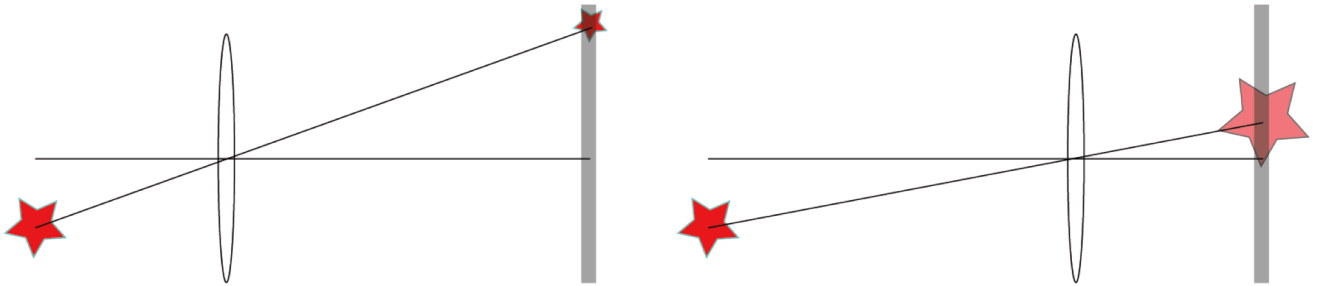
X-ray diffraction on single crystal

DISCUSSION 1.1 OPTICAL ALIGNMENT

- What parameters do you adjust to reach the optical alignment?

- How can you do optical alignment? (roughly, precisely) In what order do you adjust the optical elements?

Bessel approach



1.2 FOCAL LENGTH BY USING LENS EQUATION:

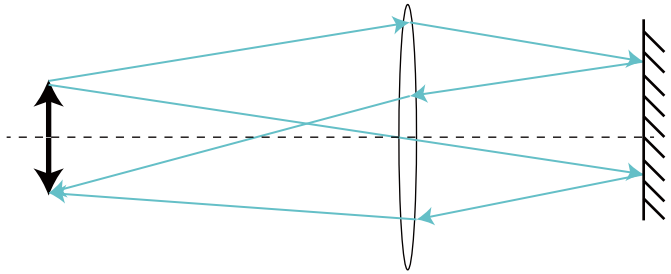
- How does your measured focal length change with decreasing d_o? Why?

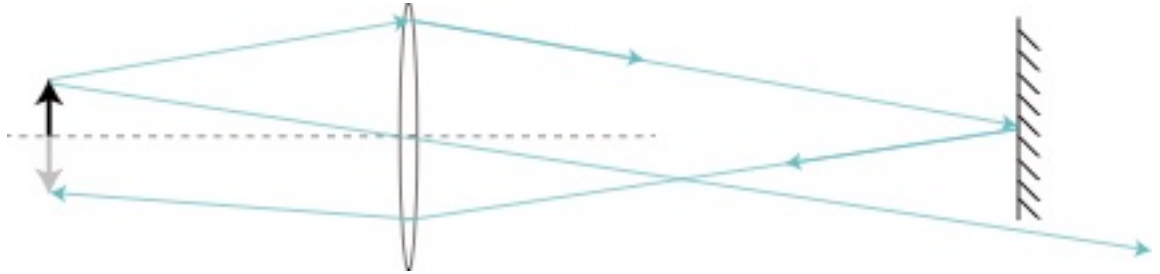
$$\frac{1}{d_i}+\frac{1}{d_o}=\frac{1}{f}\Rightarrow f=\frac{d_i\times d_o}{d_i+d_o}$$

f is the inherent property of the converging lens. It does not change with do.

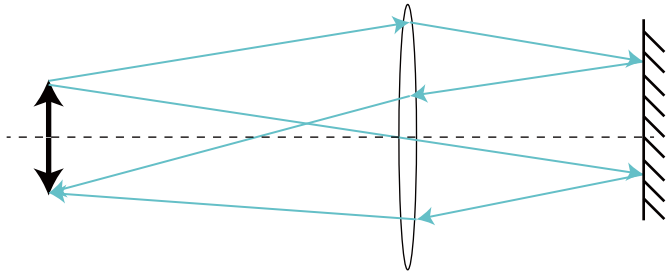
1.3 AUTOCOLLIMATION APPROACH:

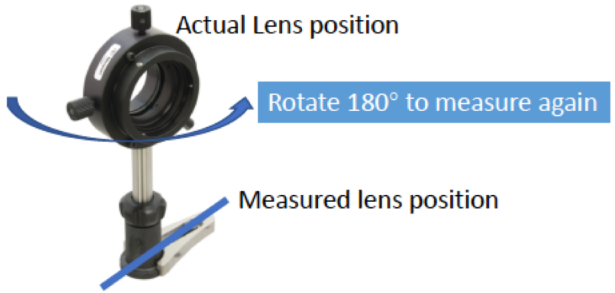
- How does the result affected by the distance between the lens and the mirror?

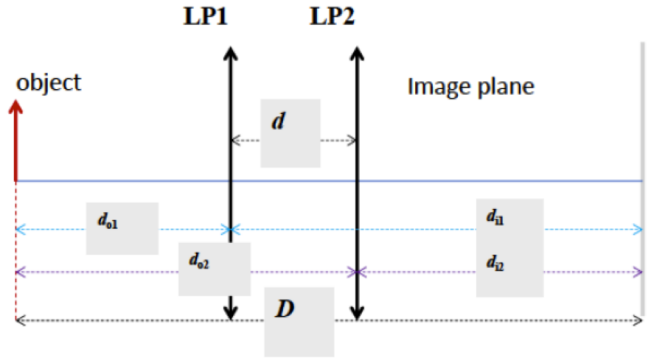




- Why we need to rotate the lens by 180 degrees? Is it required in the Bessel approach? Why?

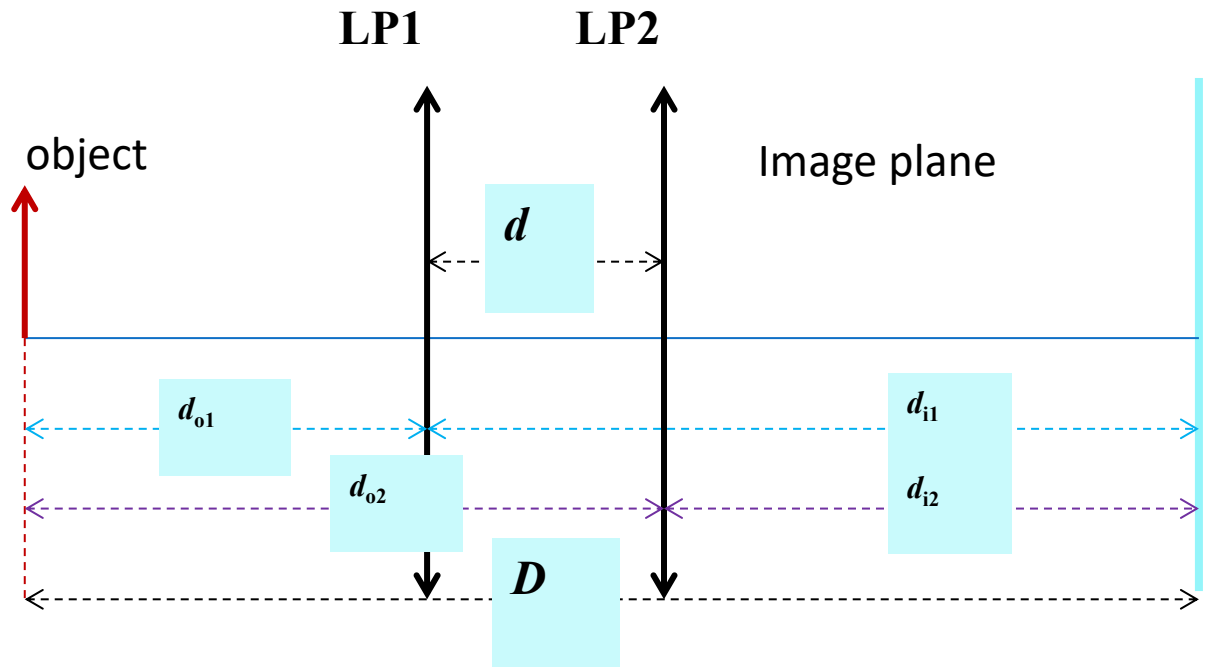






1.4 BESSEL APPROACH:

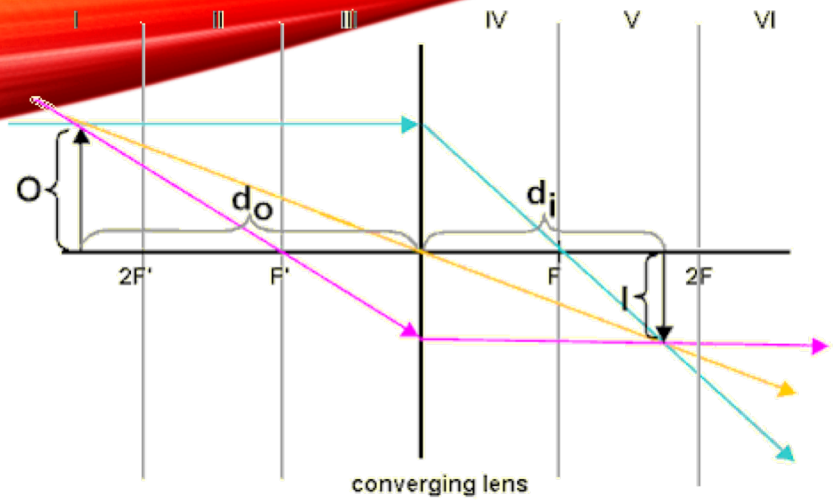
- Why we need the distance between the object and the image plane larger than 4f?



$$f = \frac{D^2 - d^2}{4D}$$

D>4f, why?

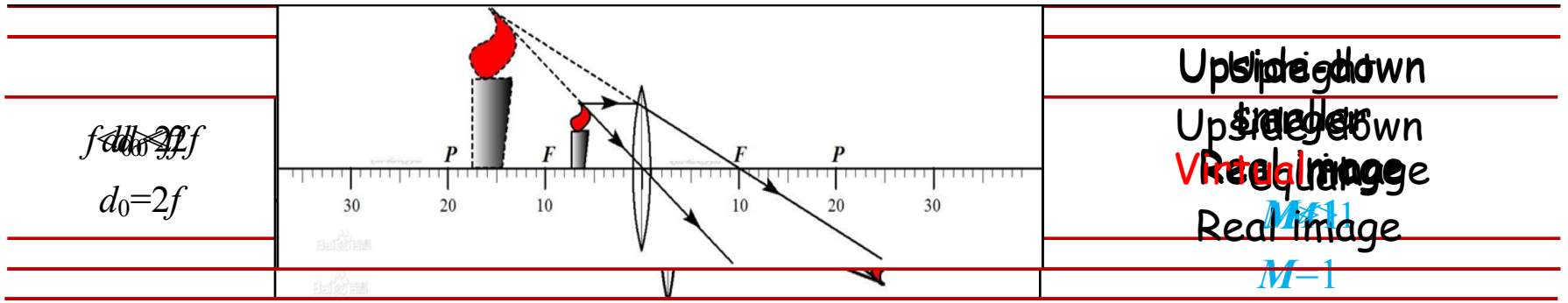
Image properties of Converging Lens



Region I is greater than two focal lengths in front of the lens.
Region II is between one and two focal lengths in front of the lens.
Region III is within one focal length in front of the lens.
Region IV is within one focal length behind the lens.
Region V is between one and two focal lengths behind the lens.
Region VI is beyond two focal lengths behind the lens.

Region III

$f=10\text{cm}$

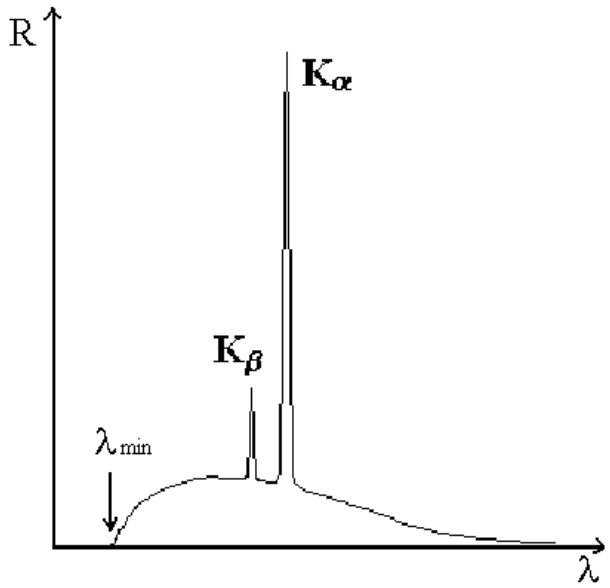


$$f=\frac{D^2-d^2}{4D}$$

$d^2=D^2-4Df=D(D-4f)\geq 0$

2.1: X-RAY EXPERIMENT

- 1. In this experiment, how does the I of the X ray tube affect the lineshape of the characteristic X-ray (bremsstruhlung X ray)?
- 2. In this experiment, how does the U of the X ray tube affect the lineshape of the characteristic X-ray (bremsstruhlung X ray)?



Hint：What is the X-ray energy for Mo Kα and kβ radition?

Anode: Mo

Kα: λ1=0.0711nm

Kβ: λ2=0.0632nm

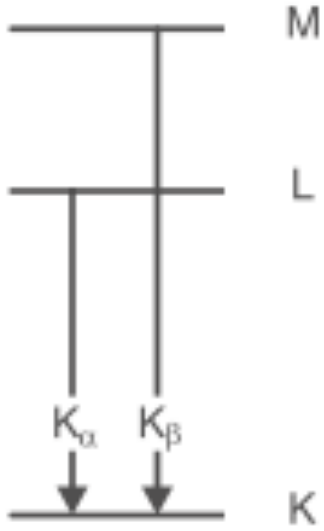
$E=hc/\lambda$

1eV= 1.60217662e-19 J

（$e=1.6\times10^{-19}C$,

$h=6.62\times10^{-34}J\cdot S$

$c=3.0\times10^{8}m/s$）



2. HOW TO CALCULATE THE LATTICE CONSTANT OF THE NACL CRYSTAL?

Tips:

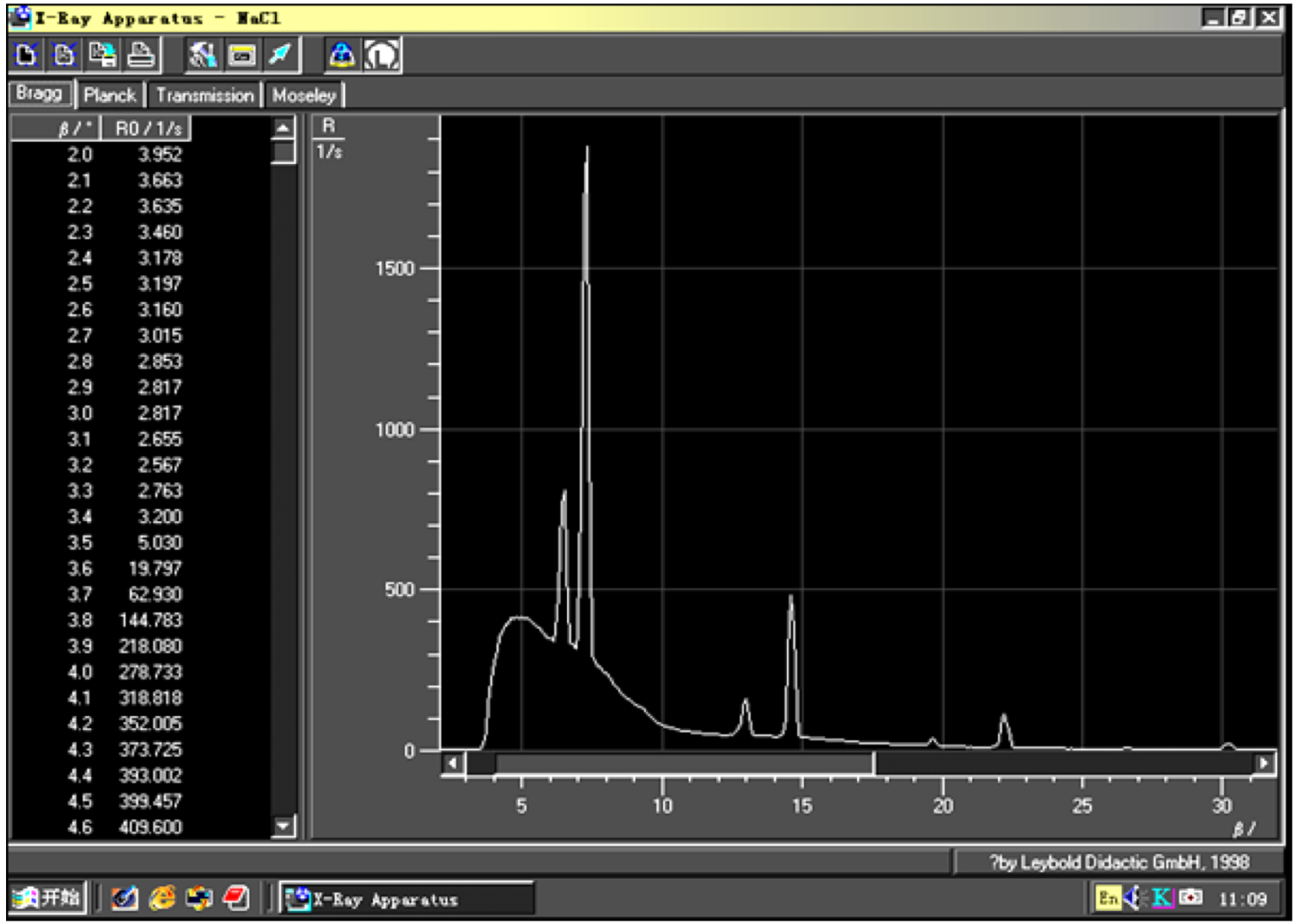
Bragg law:

$2d \sin\beta = k\lambda,\ k=1,2,3,\ldots$

Can you draw the schematic view of our experiment?

What is the beta angle?

3. How to calculate the λmin based on your Intensity-β curve



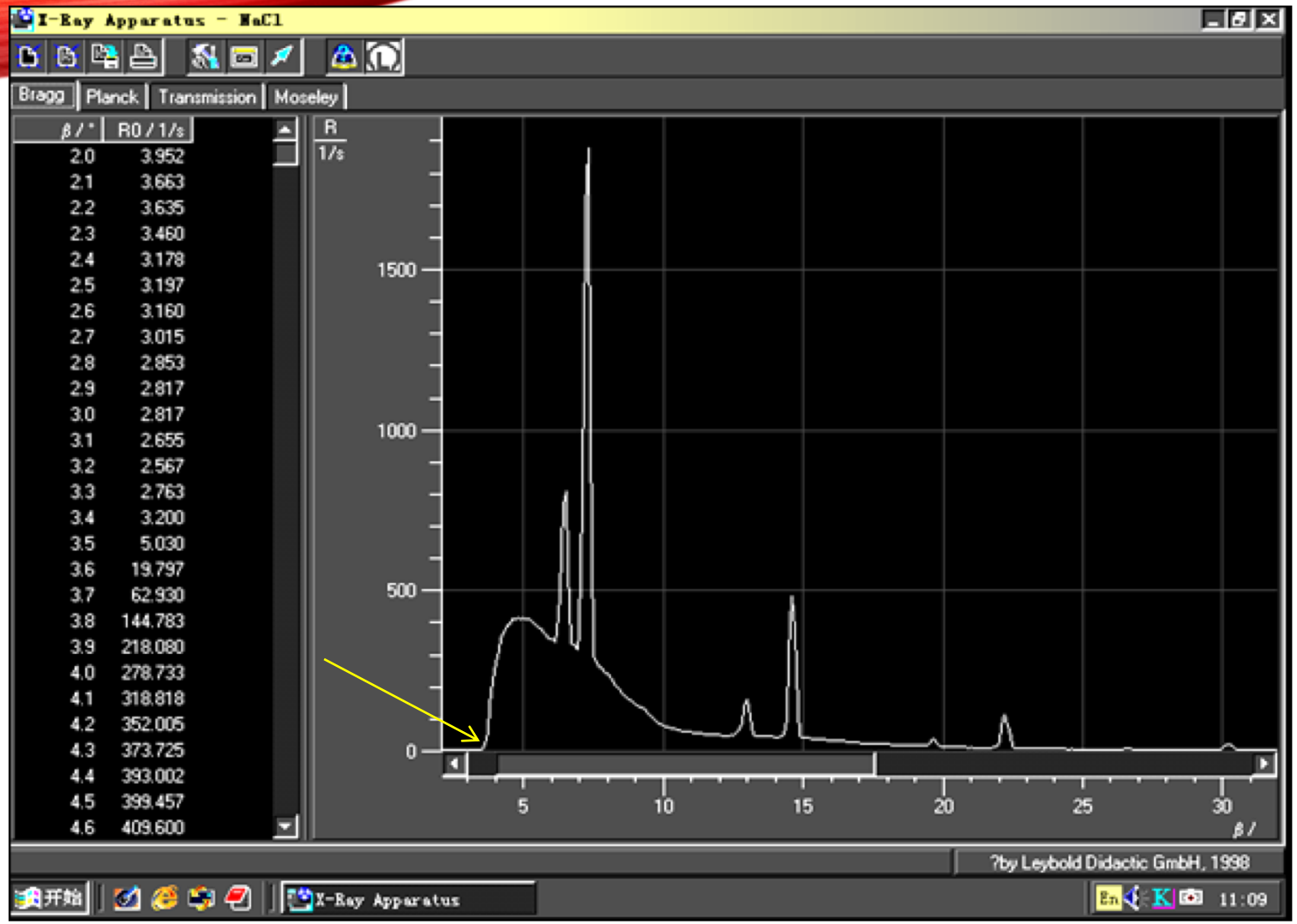
$2d \sin\beta = k\lambda$, $k=1,2,3,\ldots$

d~0.283nm

βmin=3.5 degrees

λmin=?

Why do we have such a λmin?



$2d \sin\beta = k\lambda,\ k=1,2,3,\ldots$

$d \sim 0.283\text{nm}$

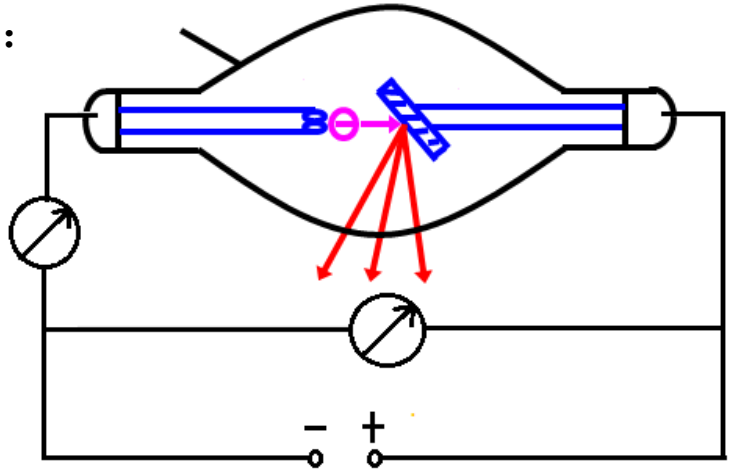
$\beta_{min} = 3.5$ degrees

$\lambda_{min} = 0.0346\text{nm}$

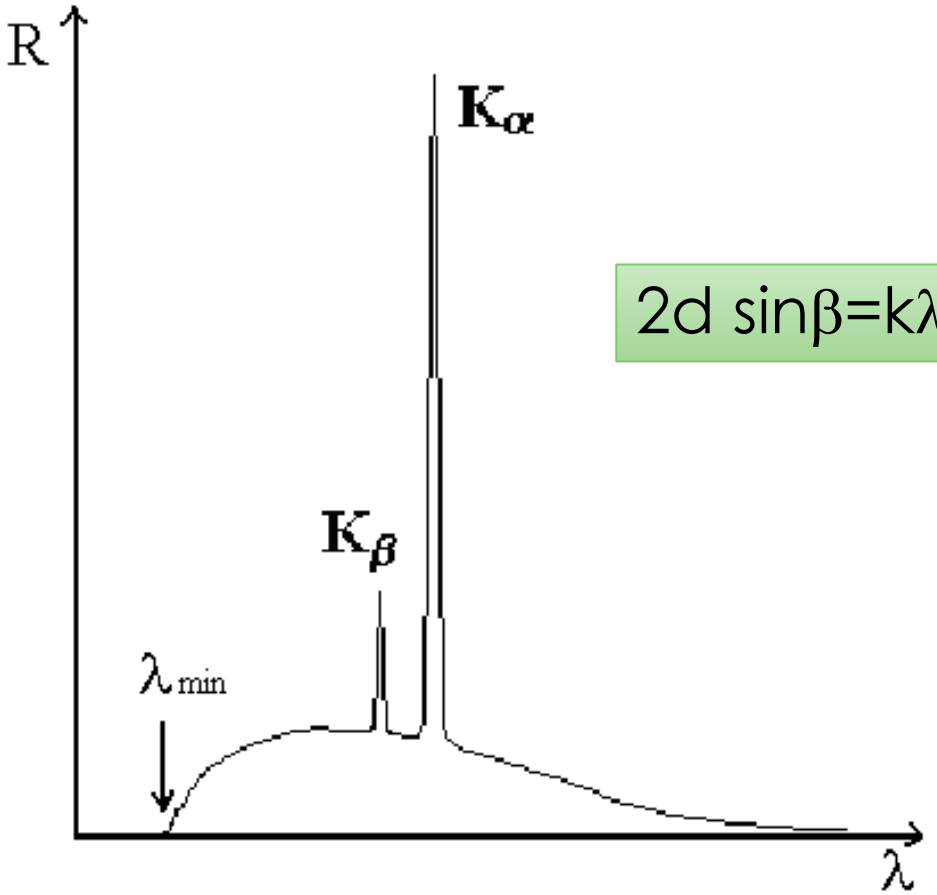
$E = hc/\lambda \sim 35\text{keV}$

3. How to calculate the λmin based on your Intensity-β curve

Tips:



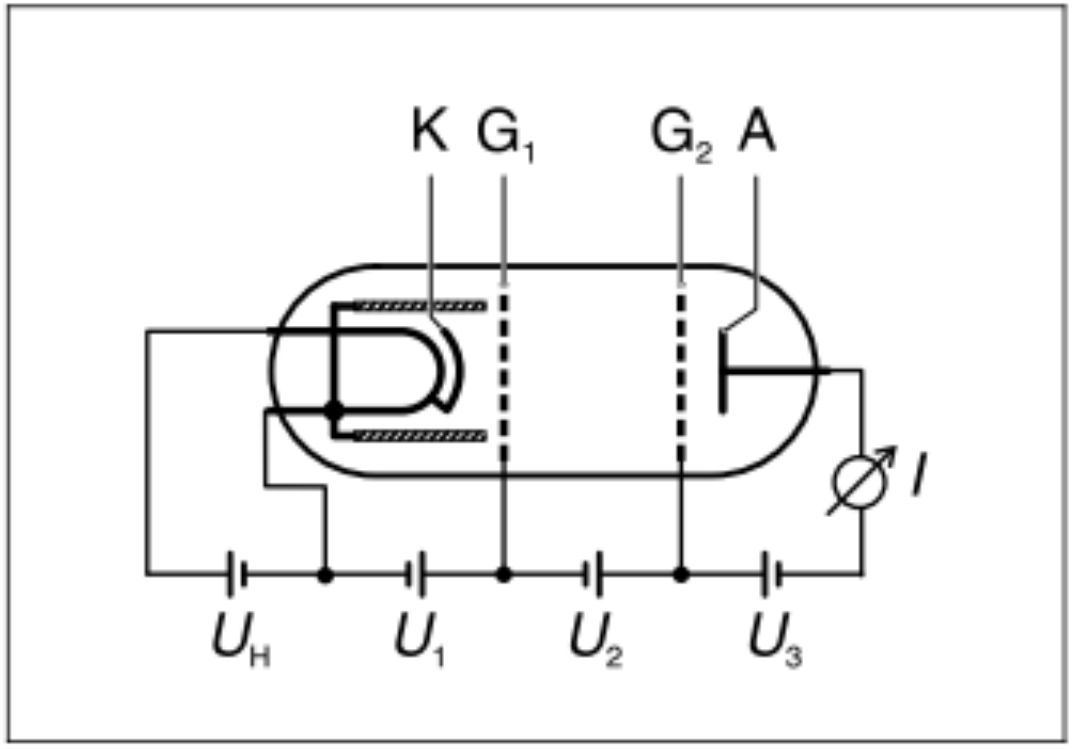
Energy conservation:
$hc/\lambda=\Delta E$
Limit wavelength
$hc/\lambda_{min}=E-0$



$2d \sin\beta=k\lambda$, k=1,2,3,…

FRANK-HERTZ

How do luminance layers look like as U1(U2,U3) is changed independently? Why?



How can you change the number of electrons between G1 and G2?
How can you change electron energy?

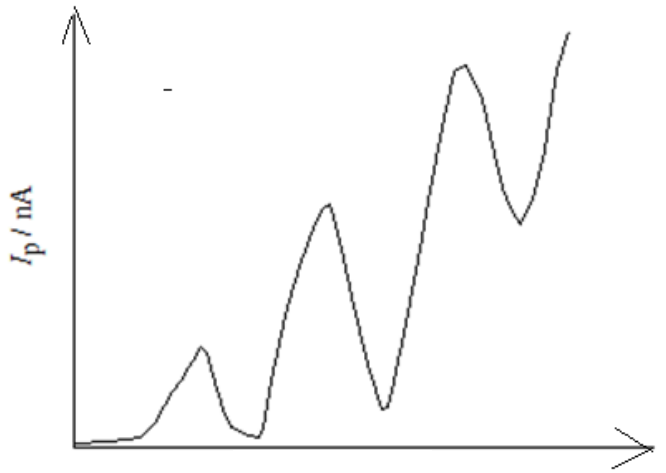
2. WHY THE CURRENT OF THE PEAKS AND THE TROUGHS OF THE CURVE INCREASE WHEN U2 IS INCREASED?

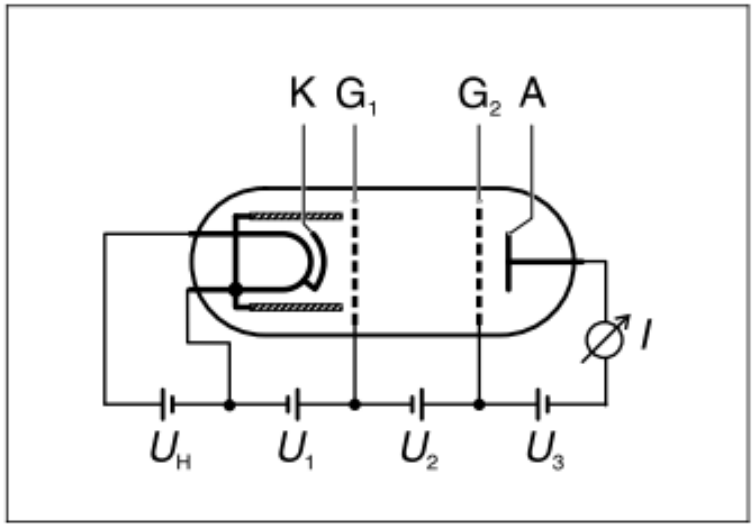
Absorbs more energy and
more electrons can reach the collector.

$$I = nAvQ$$

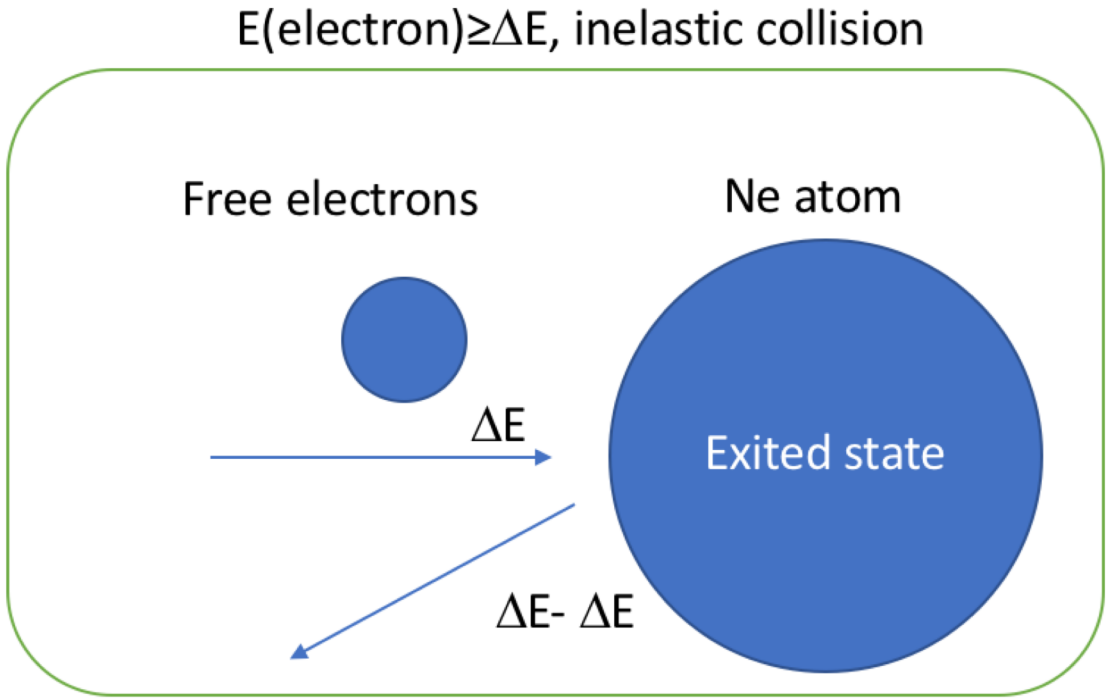
U1 is not changed.

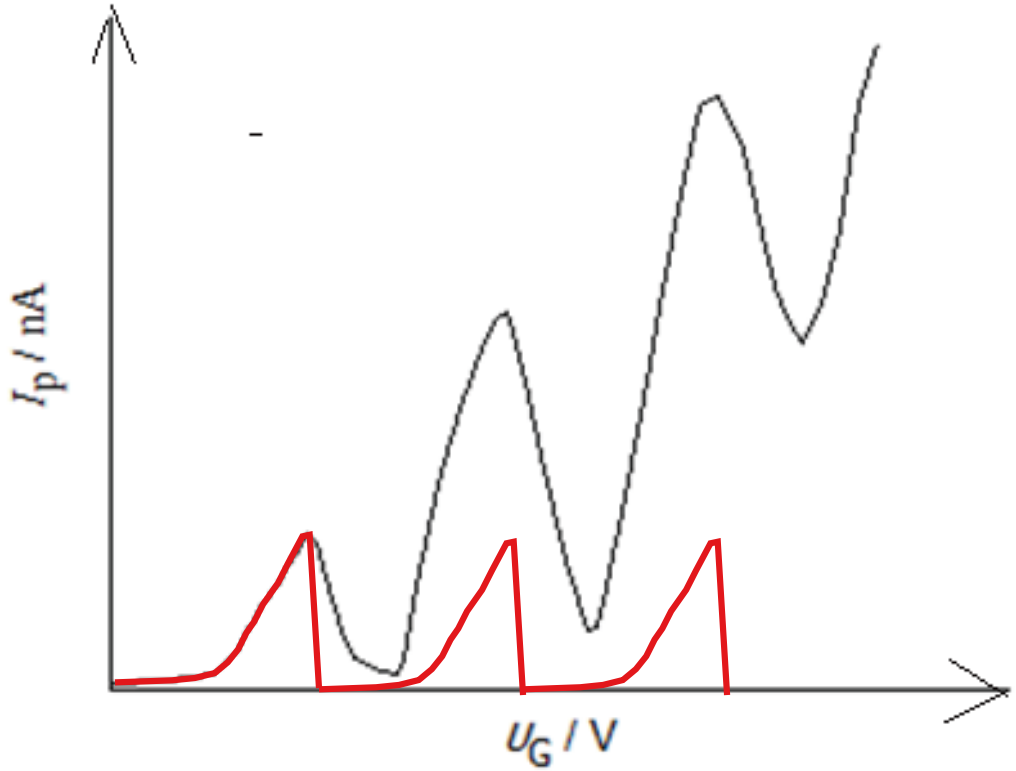
If all the electrons collide with Ne atoms, what would happen? Will the the current of the peaks and the troughs of the curve increase?





IF ALL THE ELECTRONS COLLIDE WITH THE NEON ATOMS

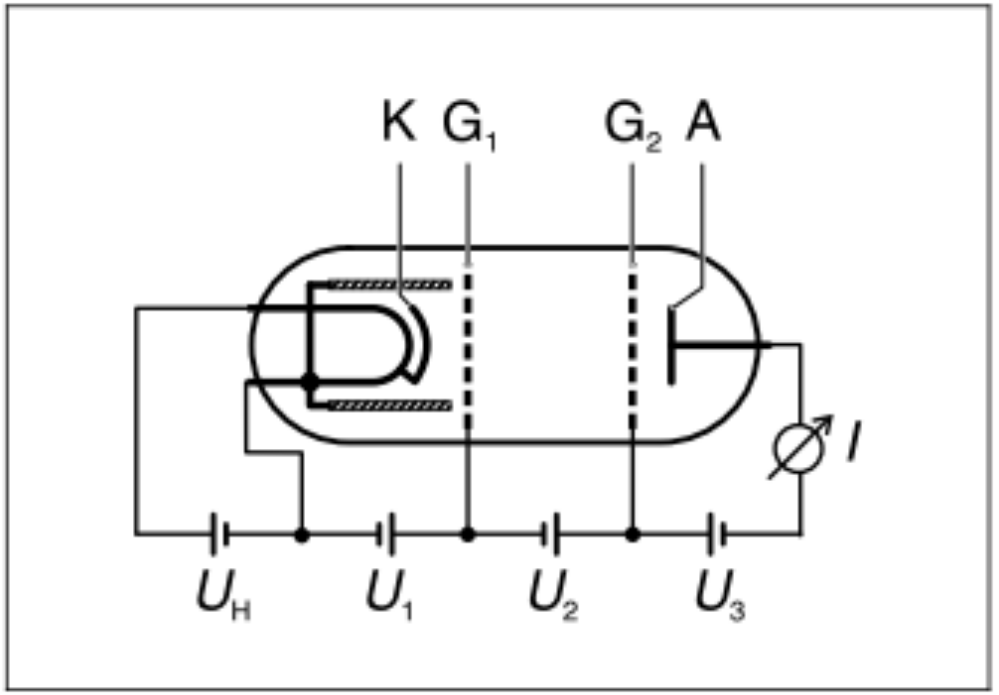




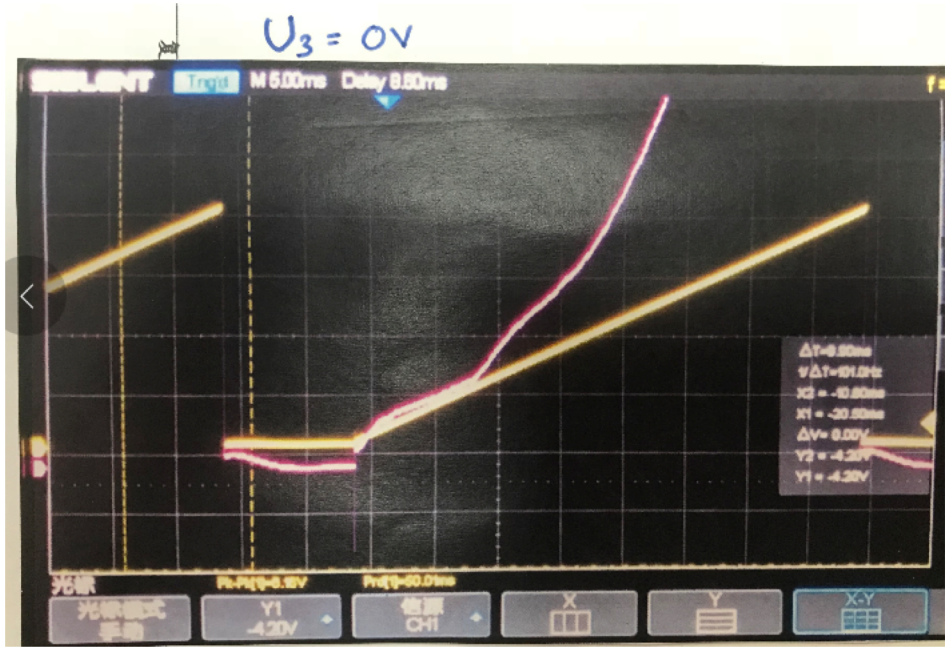
There is a chance of collision. Not all electron collides with the Neon atoms. For the electrons not collide with Neon atom, its v will increase with increasing U2.

$$I = nAvQ$$

3. WHY DO WE NEED A DECELERATION VOLTAGE U3?



It is necessary to apply a deceleration voltage so that a reading of current can be read.



4. WHAT IS THE WAVELENGTH CORRESPONDING TO THE FIRST EXCITATION POTENTIAL? IS IT RELATED WITH THE LUMINANCE LAYER?

$E=hc/\lambda \sim 16.7eV$

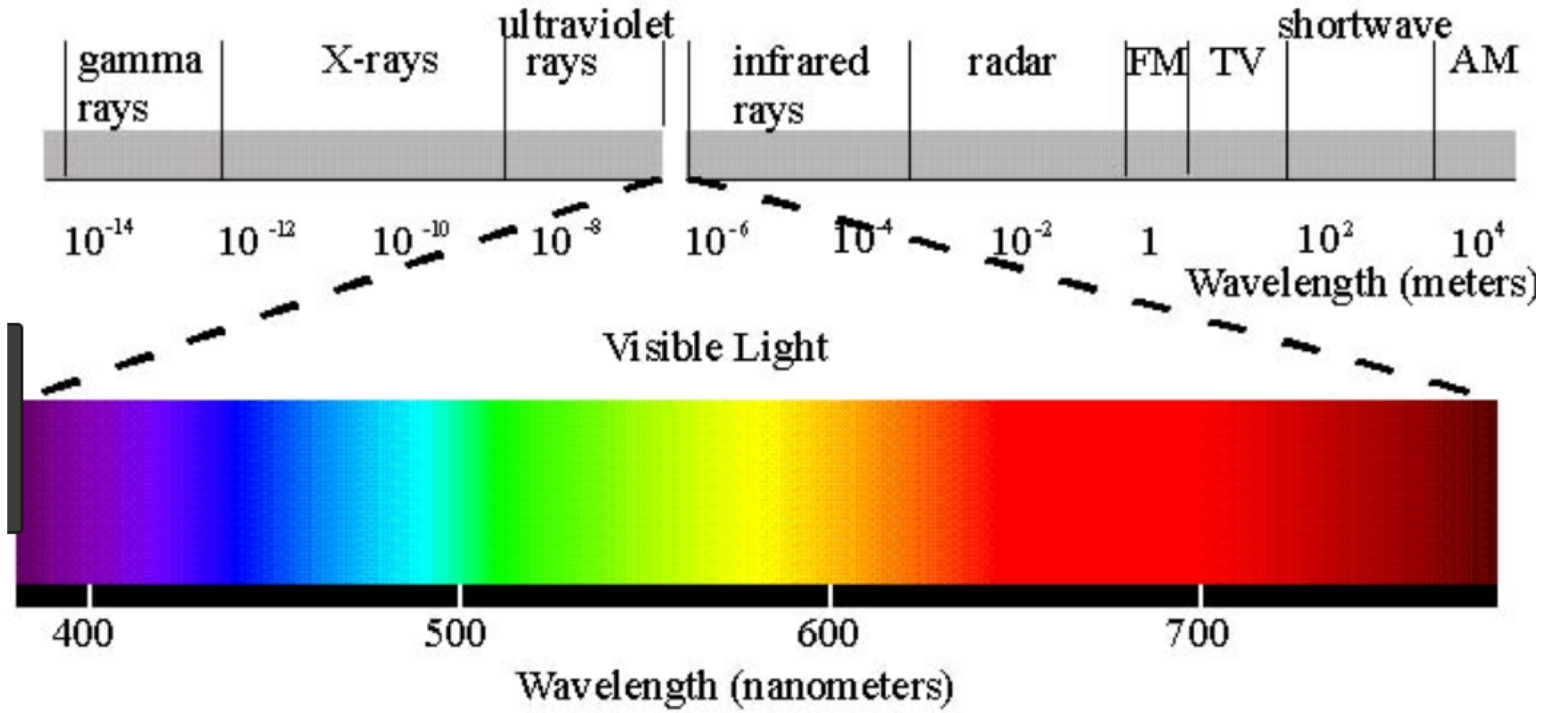
1eV= 1.60217662e-19 J

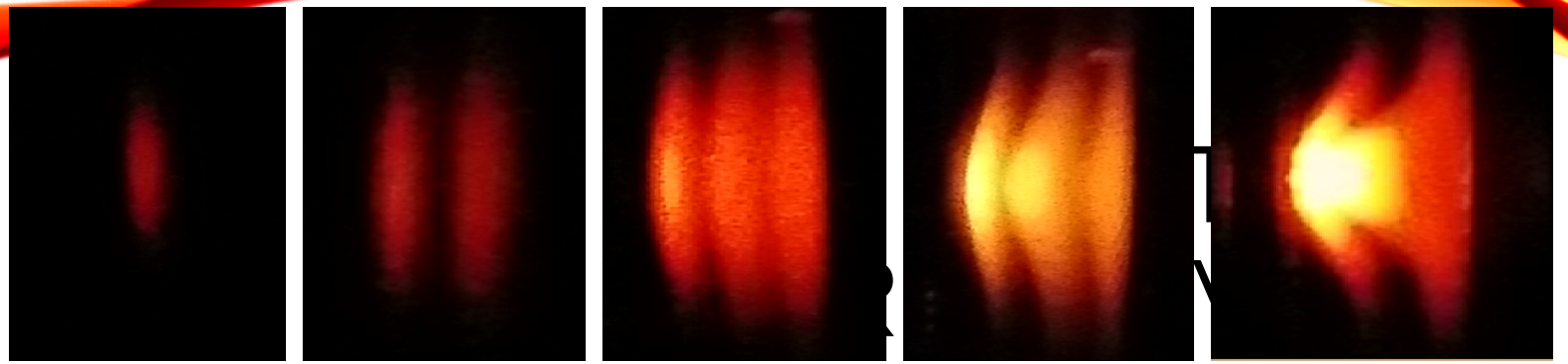
（$e=1.6\times10^{-19}C$,

$h=6.62\times10^{-34}J\cdot S$

$c=3.0\times10^{8}m/s$）

λ =? **74.2nm**





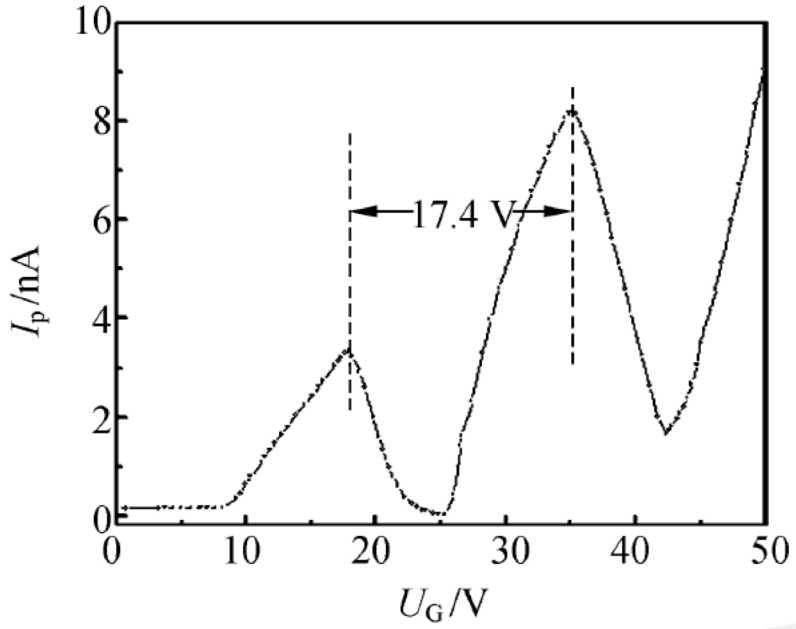
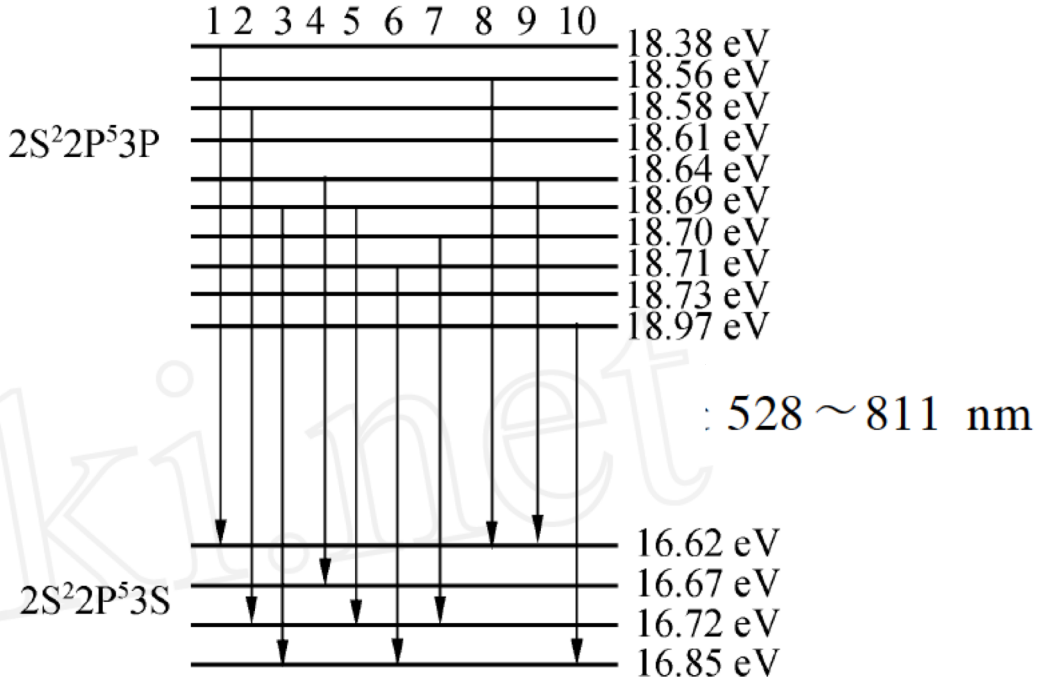

10
8
6
4
2
0
0
10
20
30
40
50
17.4 V
I_p/nA
U_G/V

图 2　*I-U* 曲线


1 2 3 4 5 6 7 8 9 10
18.38 eV
18.56 eV
18.58 eV
18.61 eV
18.64 eV
18.69 eV
18.70 eV
18.71 eV
18.73 eV
18.97 eV
$2S^22P^53P$
528～811 nm
16.62 eV
16.67 eV
16.72 eV
16.85 eV
$2S^22P^53S$