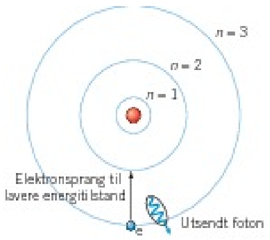
Overganger mellom energinvåer

Hvordan får vi atomer opp i energinivåer over grunntilstanden?

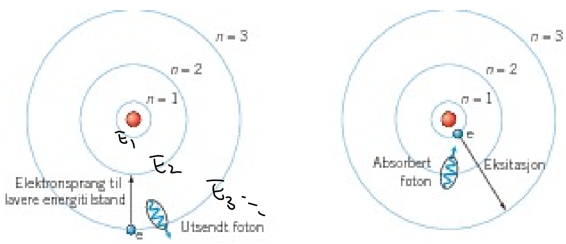
1. Varm opp atomene
2. Send strøm gjennom gass
3. Send lys gjennom gass



Apr 11-10:34 AM

Bohrs postulater:

- Et atome kan eksistere i noen bestemte tilstander uten å miste energi så lenge det er i den tilstanden
- Hvis et atom går fra en energitilstand til en annen med lavere energi, blir hele energiforskjellen sendt ut som ett enkelt foton



$E_{foton} = h f$ (f: frekvens)

$c = f \lambda$

$f = \frac{c}{\lambda}$

$h = 6{,}63 \cdot 10^{-34}$ Js

Plancks konstant

$E_{foton} = E_3 - E_2$

H: $E_1 = -2{,}18 \cdot 10^{-18}$ J

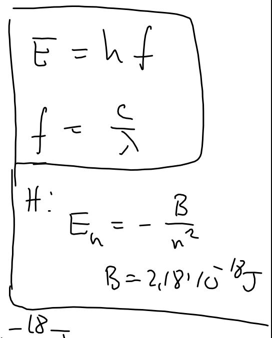
$\lambda \sim 500$ nm

$f = \frac{c}{\lambda} = \frac{3 \cdot 10^8 \text{ m/s}}{5 \cdot 10^{-7} \text{ m}} \approx 10^{15}$ Hz

$E_{foton} = 6 \cdot 10^{-34} \cdot 10^{15}$ J $\approx 10^{-18}$ J

Feb 23-1:47 PM

- Et atom har energinivåene E_1, E_2 og E_3. Ved overgangen $E_3 \rightarrow E_1$ blir det sendt ut lys med bølgelengden 400 nm. Ved overgangen $E_3 \rightarrow E_2$ blir det sendt ut lys med bølgelengden 1200 nm. Hva blir bølgelengden når atomet går fra E_2 til E_1?

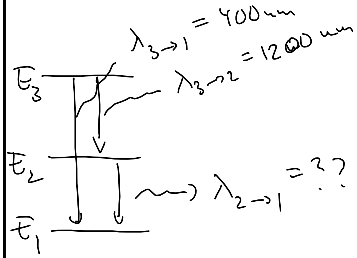


$$E = hf$$

$$f = \frac{c}{\lambda}$$

H: $E_n = -\frac{B}{n^2}$

$B = 2{,}18 \cdot 10^{-18}\,\mathrm{J}$



$$E_3 - E_1 = h f_{3\to1} = \frac{hc}{\lambda_{3\to1}} = 0{,}5 \cdot 10^{-18}\,\mathrm{J}$$

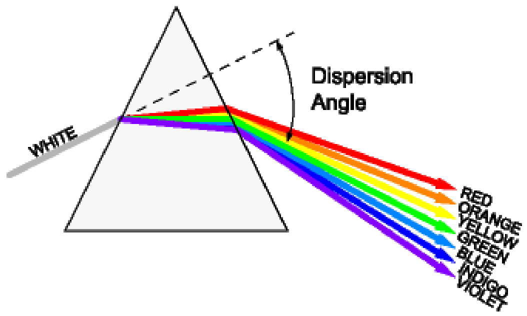
$$E_3 - E_2 = \frac{hc}{\lambda_{3\to2}} = 0{,}166 \cdot 10^{-18}\,\mathrm{J}$$

$$E_2 - E_1 = 0{,}5 \cdot 10^{-18}\,\mathrm{J} - 0{,}166 \cdot 10^{-18}\,\mathrm{J} = 0{,}33 \cdot 10^{-18}\,\mathrm{J}$$

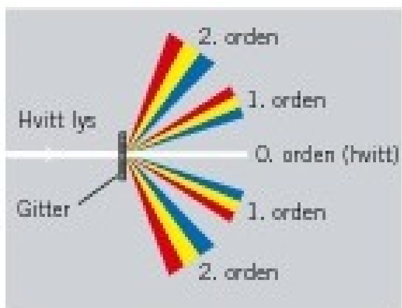
$$\lambda_{2\to1} = \frac{hc}{E_2 - E_1} = 600\,\mathrm{nm}$$

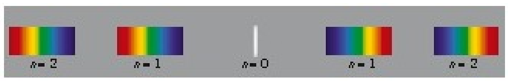
Apr 11-11:54 AM

Spektroskopi



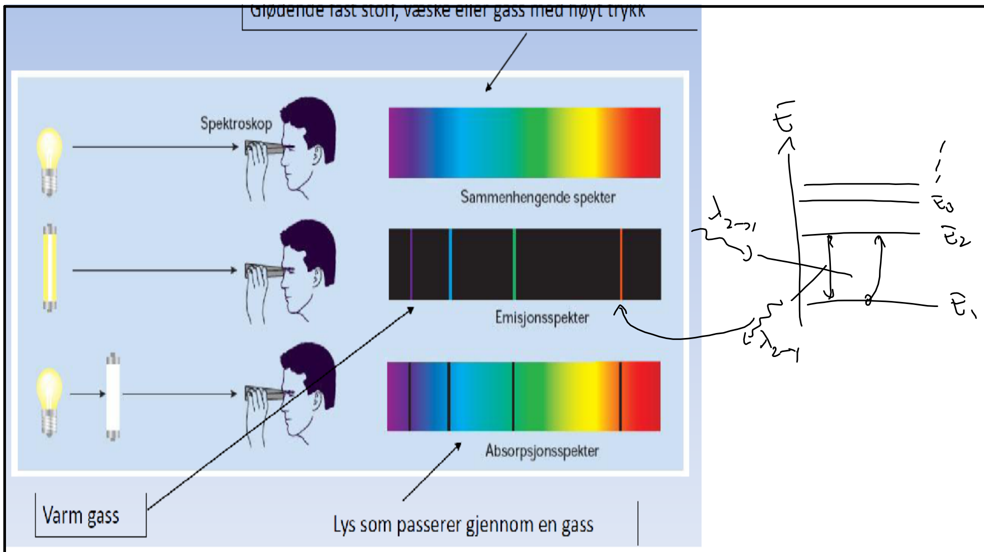
Prisme (brytning)





Gitter (interferens)

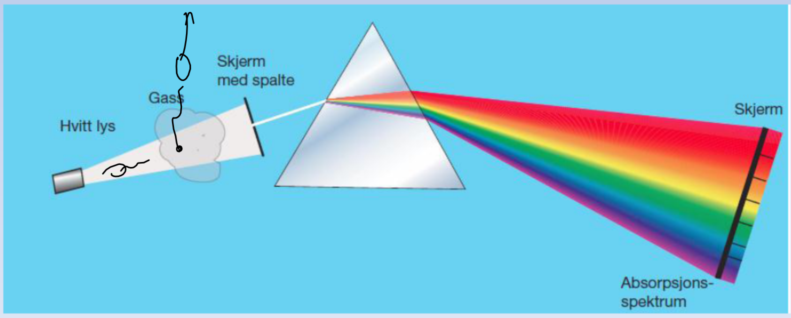
Apr 11-11:43 AM



Apr 11-11:40 AM

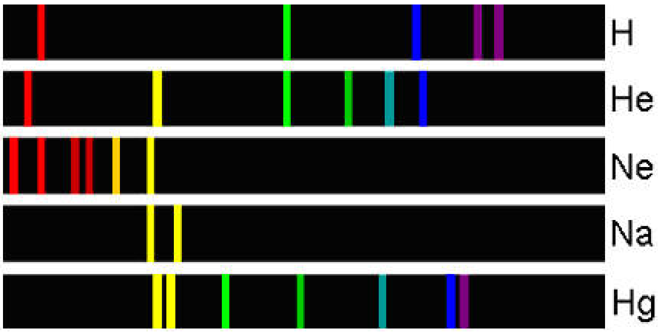
Stopp en halv...

Hvorfor blir det svarte linjer når fotonet de-eksiterer med en gang og sender lys ut igjen?



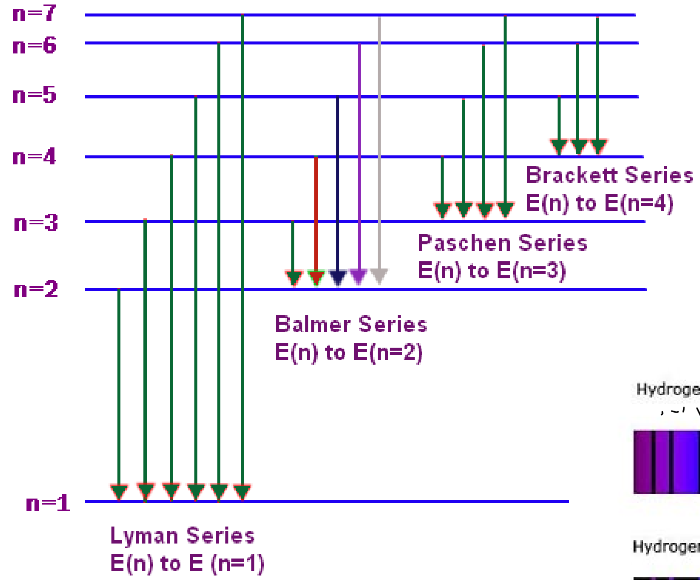
Apr 11-1:22 PM

Emissjonsspekteret er karakteristisk for hver gass, og forteller hvilke mulige energiforskjeller det er mellom energinivåene.



Apr 1-10:52 AM

Hydrogen



$E_n = -\frac{B}{n^2}$

$E_{2\to1} = E_2 - E_1 = -\frac{B}{2^2} - \left(-\frac{B}{1^2}\right) = 1{,}635 \text{ aJ}$

$E = hf = \frac{hc}{\lambda}$

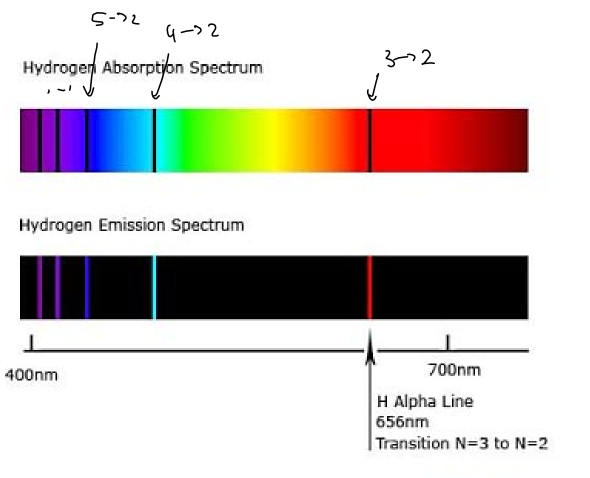
$\lambda_{2\to1} = \frac{hc}{E_{2\to1}} = 122 \text{ nm}$ (UV)

$E_{\infty\to3} = E_\infty - E_3 = 0 - \left(-\frac{B}{3^2}\right) = 0{,}242 \text{ aJ}$

$\lambda_{\infty\to3} = \frac{hc}{E_{\infty\to3}} = 821 \text{ nm}$ (IR)

$E_{3\to2} = E_3 - E_2 = 0{,}303 \text{ aJ}$

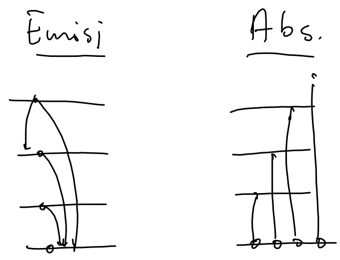
$\lambda_{3\to2} = 656 \text{ nm}$



Apr 11-11:10 AM

An emission spectrum for hydrogen can be obtained by analyzing the light from hydrogen gas that has been heated to very high temperatures (the heating populates many of the excited states of hydrogen). An absorption spectrum can be obtained by passing light from a broadband incandescent source through hydrogen gas. If the absorption spectrum is obtained at room temperature, when all atoms are in the ground state, the absorption spectrum will

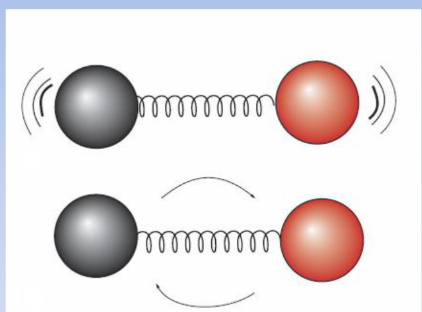
1. be identical to the emission spectrum.
2. contain some, but not all, of the lines appearing in the emission spectrum.
3. contain all the lines seen in the emission spectrum, plus additional lines.
4. ~~look nothing like the emission spectrum~~.

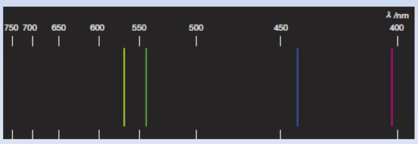


Apr 11-1:34 PM

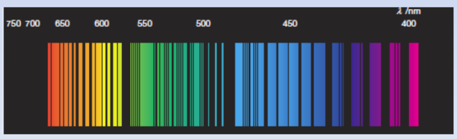
Spektre fra molekyler

- Molekylbindinger gir flere mulige energinivåer
- Vibrasjonsenergi
- Rotasjonsenergi
- Båndspektre





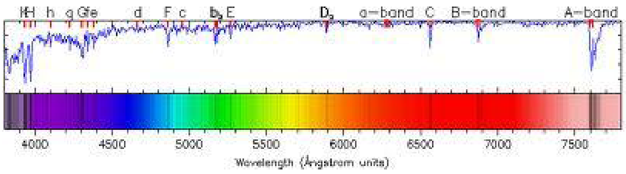
Linjespektrum fra kvikksølvgass (Hg)

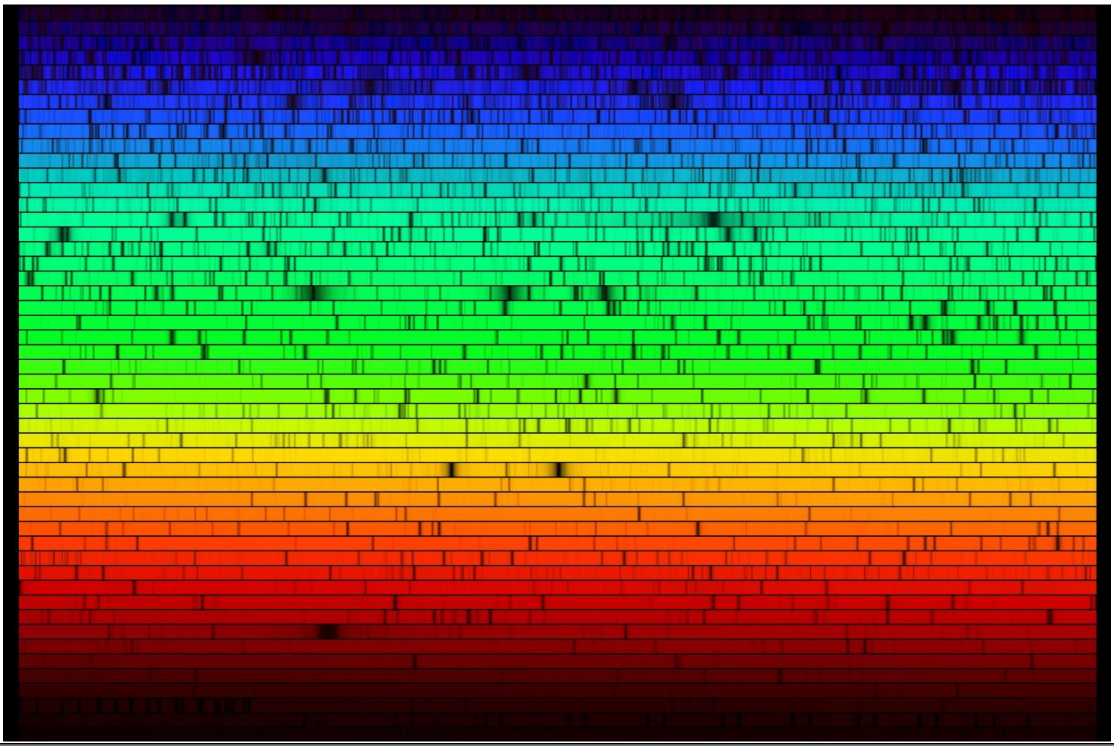


Båndspektrum fra nitrogengass (N_2)

Apr 11-1:40 PM

Solspekteret





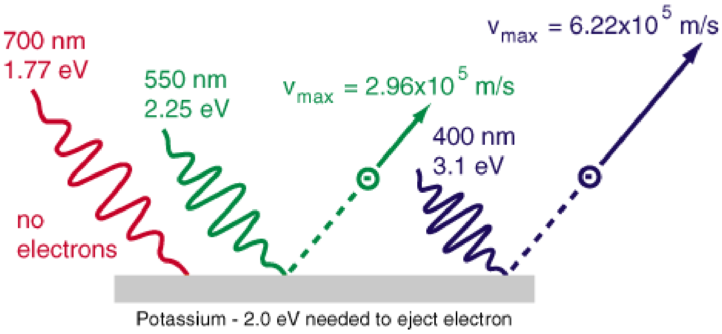
Apr 11-1:41 PM

Eksempler på prosesser med absorpsjon og emisjon av stråling

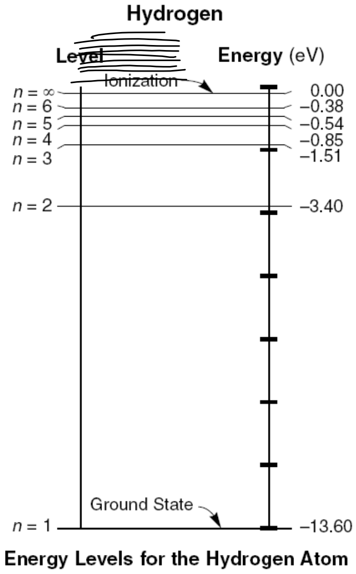
Feb 23-10:39 AM

Fotoelektrisk effekt

$E_{photon} = h\nu$



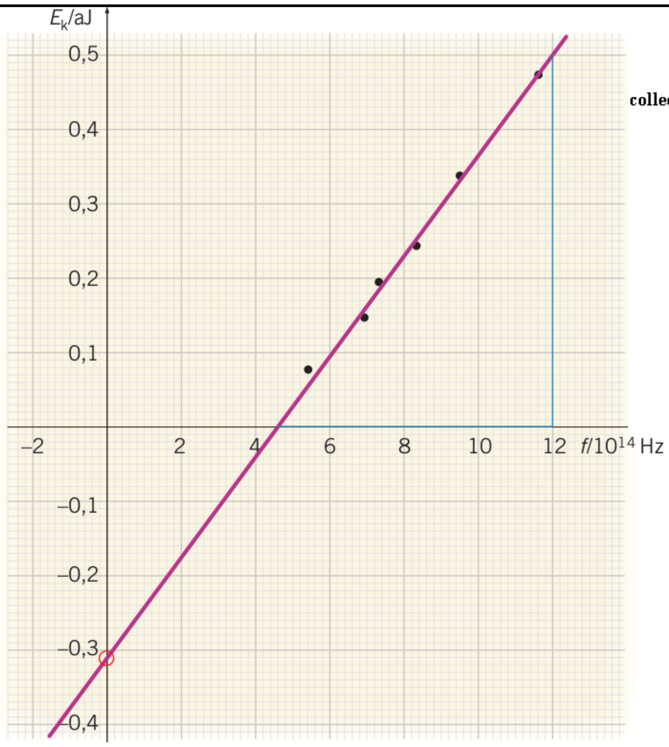
Photoelectric effect

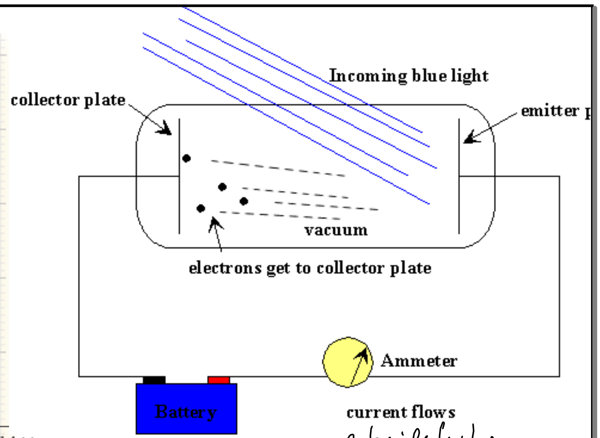


Eksperimentelle fakta:

- $f<f_g$: Ingen elektroner uansett hvor stor intesitet
- $f>f_g$: Elektroner uansett hvor liten intesitet.

Apr 4-10:20 AM





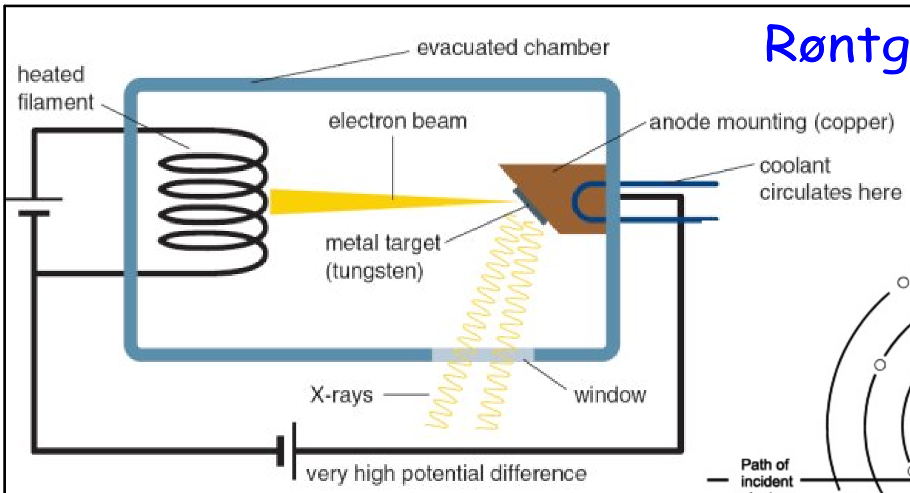
arbeidsfunksjon

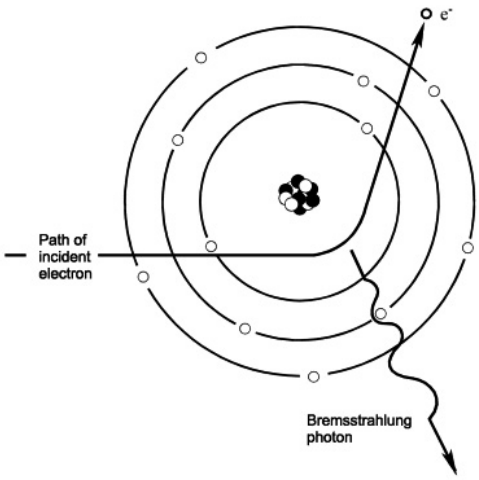
$E_{foton} = hf = W + E_k$

$E_k = hf - W$

Apr 4-10:40 AM

Røntgenstråling

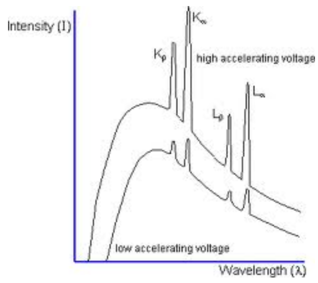


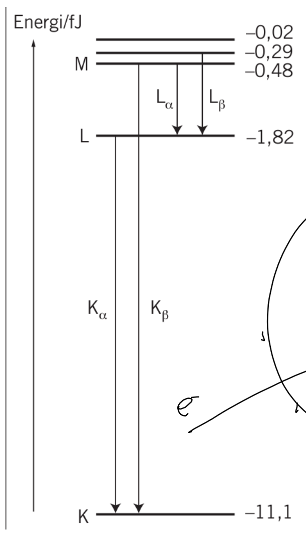


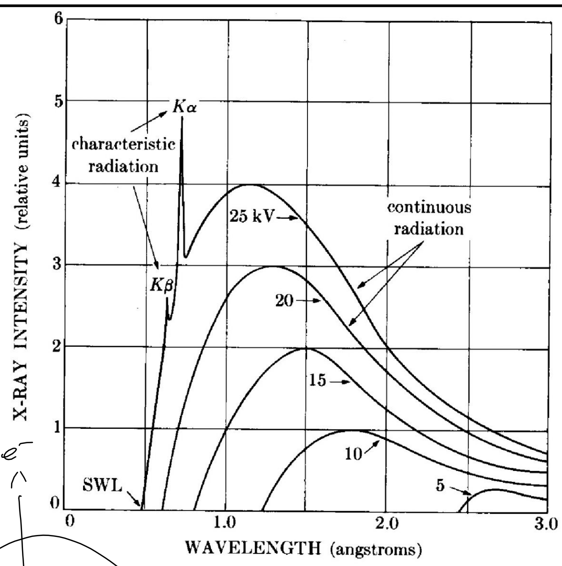
Bremsestråling

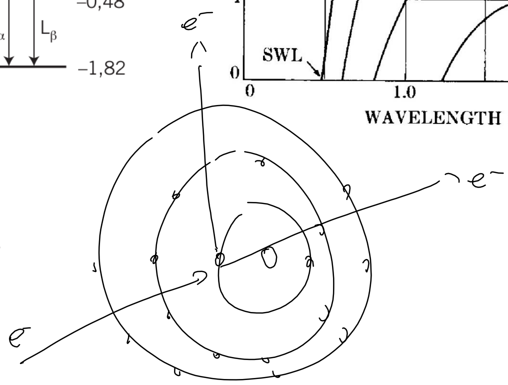
Apr 4-10:45 AM

Røntgenspekteret



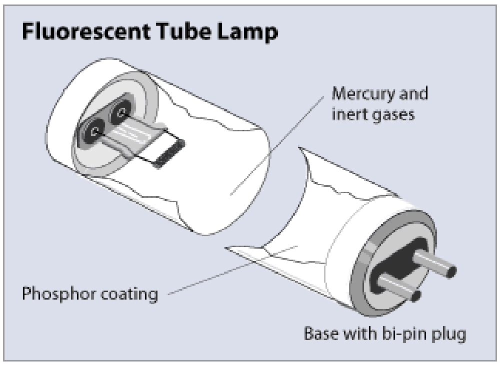


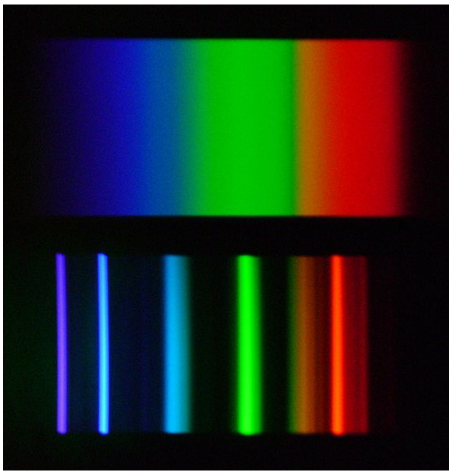


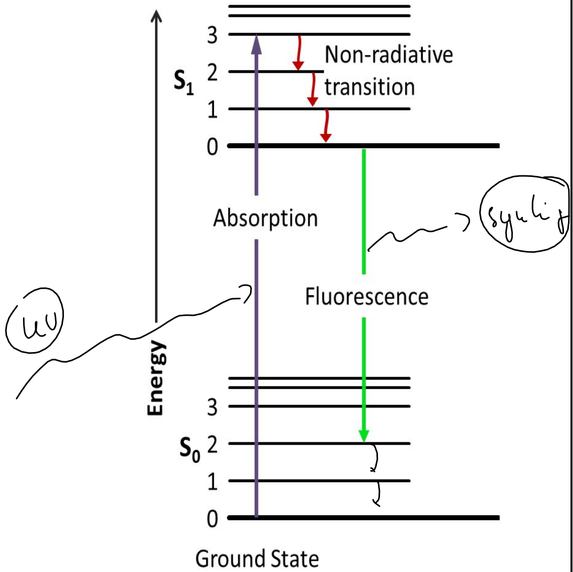


Apr 4-11:16 AM

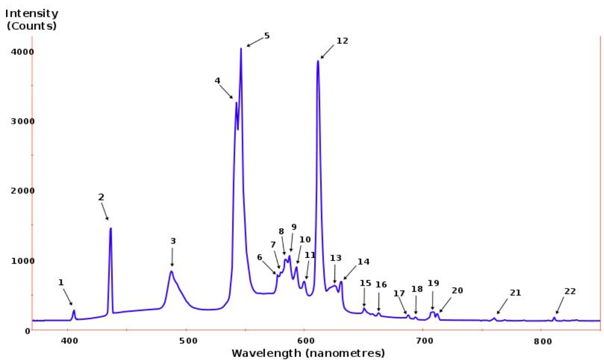
Lysrør: fluorescens







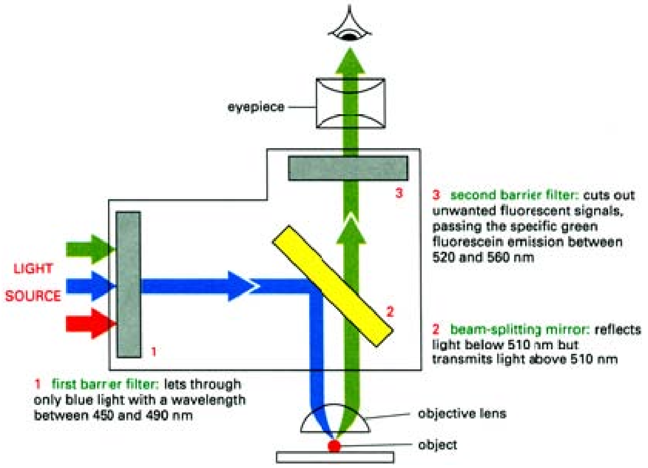
Apr 11-1:46 PM



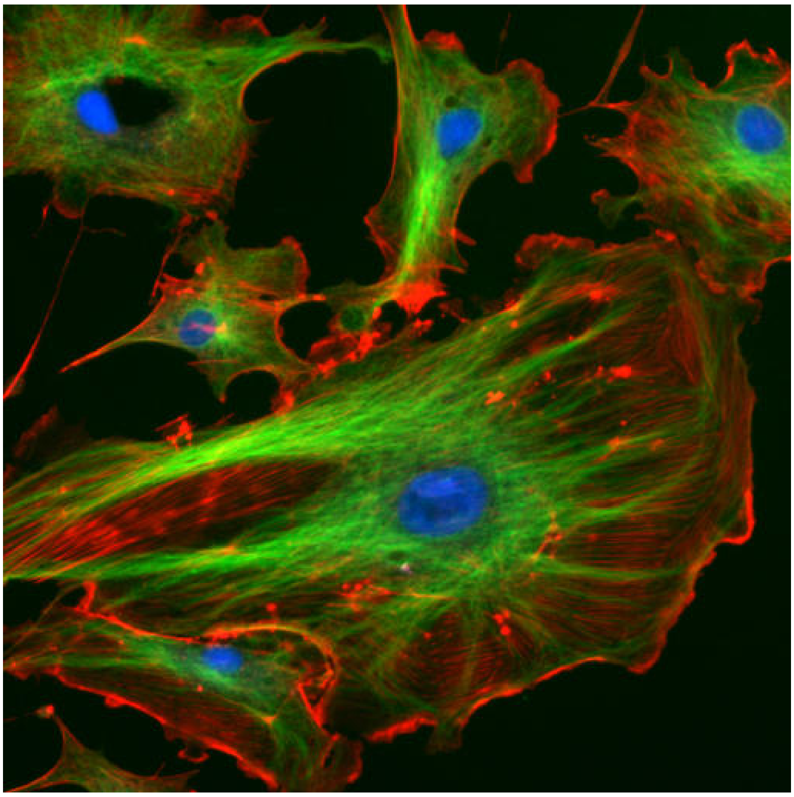
1	405.4	mercury	404.656
2	436.6	mercury	435.833
3	487.7	terbium from Tb3+	~485 to 490
4	542.4	terbium from Tb3+	~543 to 544
5	546.5	mercury	546.074
6	577.7	likely terbium from Tb3+ or mercury	576.960 for Hg or ~578 for Tb
7	580.2	mercury or terbium from Tb3+	579.066 for Hg or ~580 for Tb
8	584.0	possibly terbium from Tb3+ or europium in Eu+3:Y2O3	~580
9	587.6	likely europium in Eu+3:Y2O3	~587
10	593.4	likely europium in Eu+3:Y2O3	~593
11	599.7	likely europium in Eu+3:Y2O3	~598
12	611.6	europium in Eu+3:Y2O3	~611
13	625.7	likely terbium from Tb3+	~625
14	631.1	likely europium in Eu+3:Y2O3	~630
15	650.8	likely europium in Eu+3:Y2O3	~650
16	662.6	likely europium in Eu+3:Y2O3	~661
17	687.7	likely europium in Eu+3:Y2O3	~687-688
18	693.7	likely europium in Eu+3:Y2O3	~693
19	707 and 709	likely europium in Eu+3:Y2O3	~707 and ~709
20	712.3	likely europium in Eu+3:Y2O3	~712
21	760.0	likely argon	758.9315 or 763.5106 (??)
22	811.0	likely argon	811.531

Apr 11-4:38 PM

Fluorescensmikroskopi



Apr 11-4:52 PM

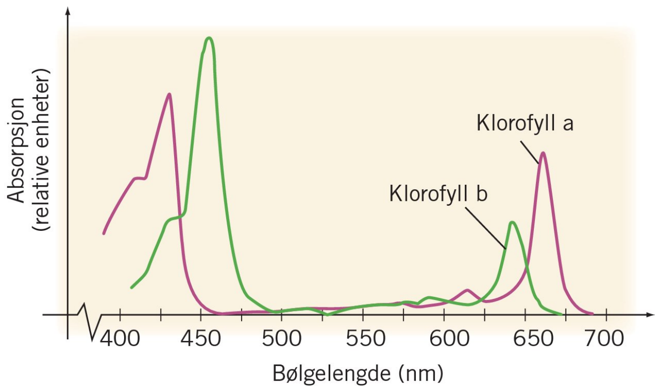


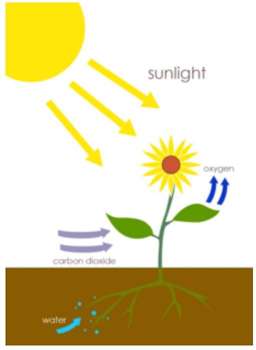
Endothelial cells under the microscope. Nuclei are stained blue with DAPI, microtubules are marked green by an antibody bound to FITC and actin filaments are labelled red with phalloidin bound to TRITC. Bovine pulmonary artery endothelial cells

Apr 11-2:03 PM

Fotokjemiske reaksjoner: Fotosyntese

$2\ H_2O + 2\ NADP^+ + 3\ ADP + 3\ P_i$ + light $2\ NADPH + 2\ H^+ + 3\ ATP + O_2$





Apr 15-12:55 PM

Fotoreseptorer i øyet

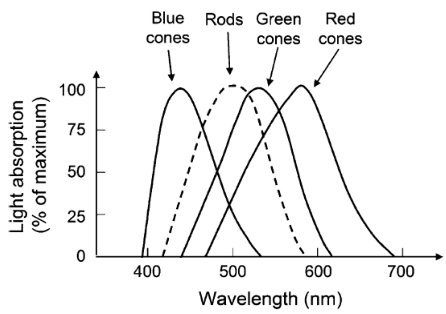


Fig. 11.6. Relative spectral sensitivity of rods and cones. The absolute sensitivity of rods is 1,000× larger those of the cones. (Based on [515], [526], and [540])

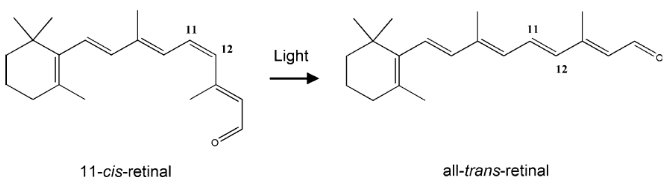
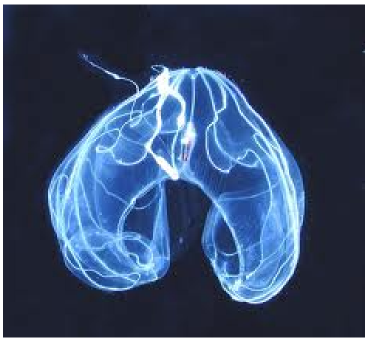
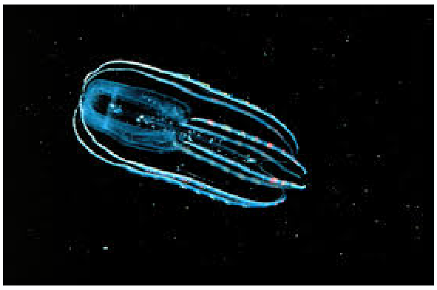


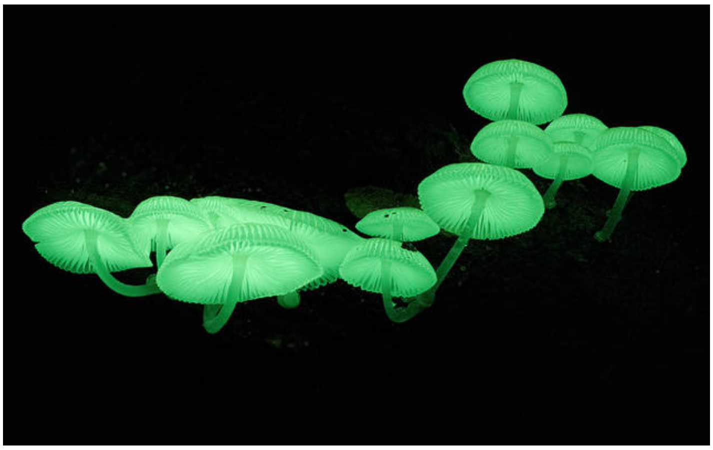
Fig. 11.7. The chromophore 11-*cis* retinal is photoisomerized by light to all-*trans* retinal (11-*trans* retinal)

Apr 11-2:05 PM

Bioluminescens

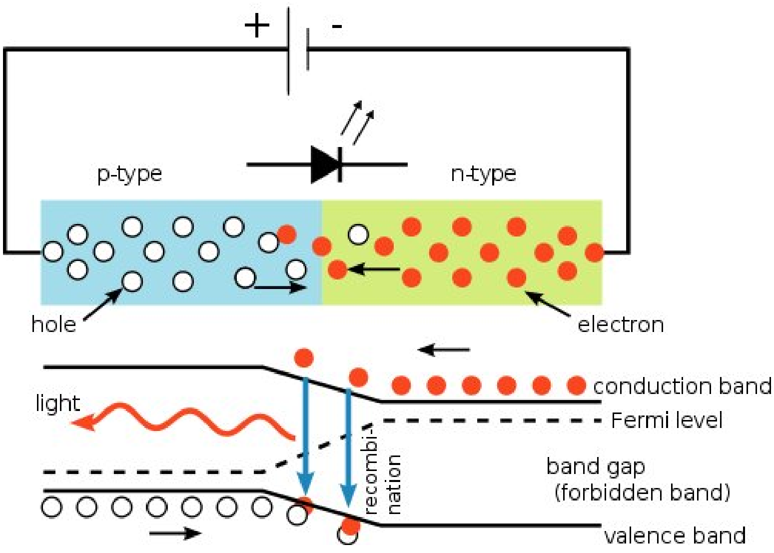






Apr 11-2:05 PM

Lysdioder



Apr 11-2:07 PM

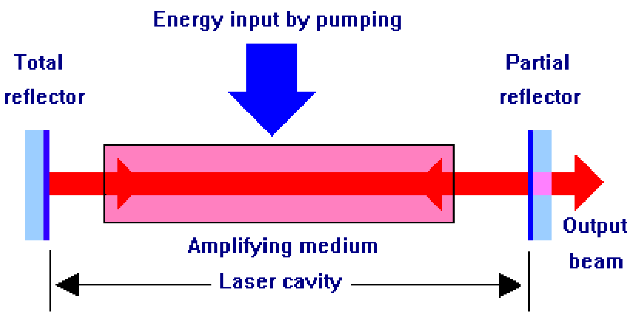
Laser

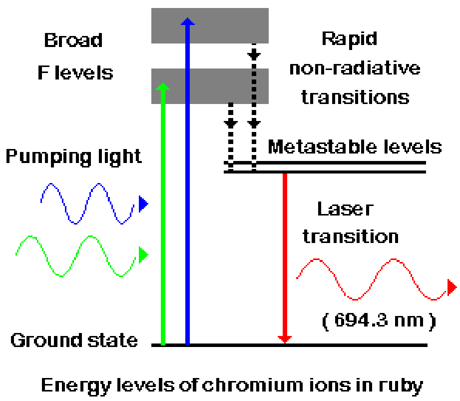
Spontan emissjon

Stimulert emissjon

Apr 11-2:06 PM

Laser





Apr 11-2:06 PM

Apr 11-3:46 PM