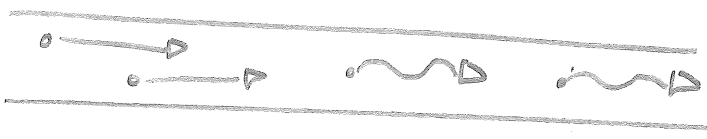
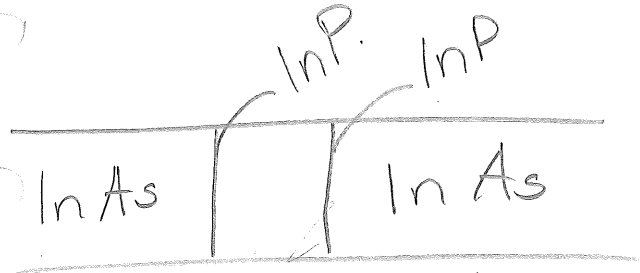
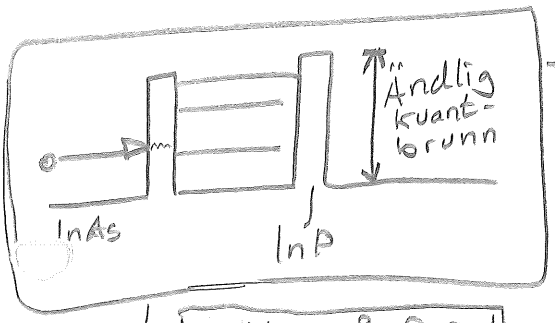
Föreläsning 10

Bundna tillstånd: **KVANTISERING**

(Tråd → )



Elektronerna "trivs" bättre i InAs.

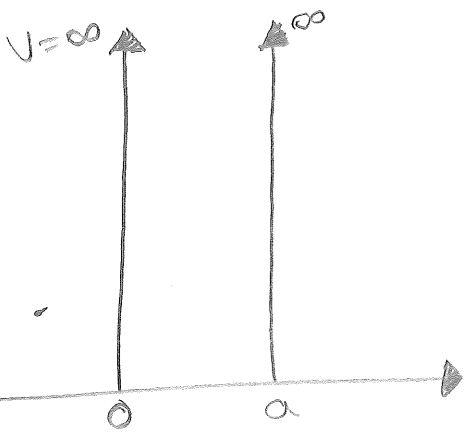


Allt e i 2D!

I lådan kan elektronerna endast anta vissa kvantiserade energier

Oändlig kvantbrunn

Vilka energinivåer kan elektronerna anta?



S.E. $-\frac{\hbar^2}{2m}\cdot\phi''(x)+V(x)\phi(x)=E\phi(x)$

$\phi''(x)+k^2\phi(x)=0,\quad k=\frac{\sqrt{2mE}}{\hbar}$

FORTS...

$$\phi(x) = A\sin(kx) + B\cos(kx)$$

Test: Är $A\sin(kx)+B\cos(kx)$ verkligen en lösn.?

sätt in

JAPP, det funkar.

$$\phi(x) = \begin{cases} 0 & x<0 \\ A\sin(kx)+B\cos(kx) & 0<x<a \\ 0 & a<x \end{cases}, \quad k = \sqrt{\frac{2mE}{\hbar^2}}$$

PASSNINGSVILLKOR:

① $\phi(x=0)=0 \Leftrightarrow A\sin(k0)+B\cos(k0)=0 \Rightarrow \boxed{B=0}$

② $\phi(x=a)=0 \Leftrightarrow \boxed{A\sin(ka)=0}$

$\hookrightarrow k_n a = n\cdot\pi, \quad n\in\mathbb{N}$

så:

$\phi(x) = A\sin(k_n x), \quad k_n a = n\cdot\pi$

- $k_n a = n\pi \Leftrightarrow \frac{2\pi}{\lambda_n} a = n\pi$

$\Leftrightarrow \lambda_n = a\frac{2}{n} \Leftrightarrow \boxed{a = n\frac{\lambda_n}{2}}$

- $k_n = \frac{\sqrt{2mE_n}}{\hbar}$

FORTS.→

KOMMA IHÅG

$$E_n = \frac{\hbar^2 k_n^2}{2m} \quad , \; k_n = \frac{n\pi}{a} \quad , \; n \in \mathbb{N}_{*0}$$

katt

$$\frac{\hbar^2 \cdot n^2 \cdot \pi^2}{2ma^2} = \frac{h^2 \cdot n^2}{8ma^2}$$ — concepts

Fixa A:

- **Normering**

$$P = \int_{-\infty}^{\infty} |\psi(x)|^2 dx = \int_0^a |\psi_n(x)|^2 dx = 1$$ — ETT

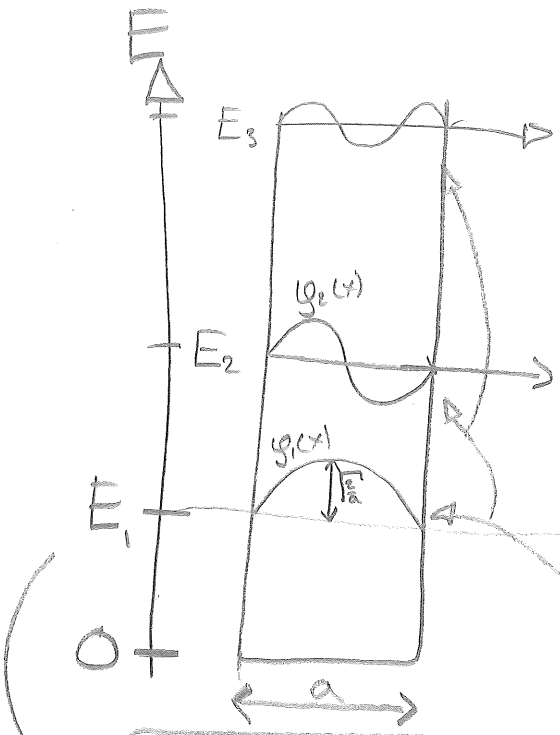
$$\int_0^a |A \sin(k_n x)|^2 dx = 1 \Leftrightarrow |A|^2 \int_0^a |\sin(k_n x)|^2 = 1$$

TABELLMAGI! — $\int (\sin^2 bx)\, dx = -\frac{x}{2} - \frac{1}{4b} \sin 2bx$

$$|A|^2 \cdot \left[-\frac{1}{2}x - \frac{a}{4n\pi} \cdot \sin\left(2\frac{n\pi}{a}x\right) \right]_0^a = 1$$

$$\Leftrightarrow |A|^2 = \frac{2}{a} \Leftrightarrow A = \pm\sqrt{\frac{2}{a}} \qquad [A] = \frac{1}{\sqrt{m}}$$

TOLKNING av $\varphi_n(x) = \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi}{a} x\right)$, $n = 1, 2, 3 \ldots$



⇒ 1:a exiterade tillståndet

⇒ x (grundtillstånd)

$$E_1 = \frac{h^2}{8ma} \cdot 1^2$$

Amplituden är $\sqrt{\frac{2}{a}}$

Det går inte att vara i brunnen utan E_1-energi.