Physics hour 04

1) Dielektrikum im Kondensator

$$E_2 = \frac{E_1}{\varepsilon_r} = \frac{90\ V/m}{1{,}5} = 60\ V/m$$

2) Polarisation im Kondensator

$$D = \varepsilon_0 E + P \rightarrow P = D - \varepsilon_0 E = \varepsilon_0 \varepsilon_r E - \varepsilon_0 E = \varepsilon_0 E(\varepsilon_r - 1)$$

$$D = \varepsilon_0 \varepsilon_r E \quad (= C)$$

$$\Rightarrow P = 8{,}85 \cdot 10^{-12} \frac{\tilde{A}s}{\cancel{V}m} \cdot 60 \frac{\cancel{V}}{m} \cdot \frac{1}{2} = 2{,}655 \cdot 10^{-12} \frac{C}{m^2}$$

3) Lorentzkraft I

$$\vec{F}_L = q \cdot \vec{v} \times \vec{B} \quad , \text{ falls } \vec{v} \perp \vec{B}$$

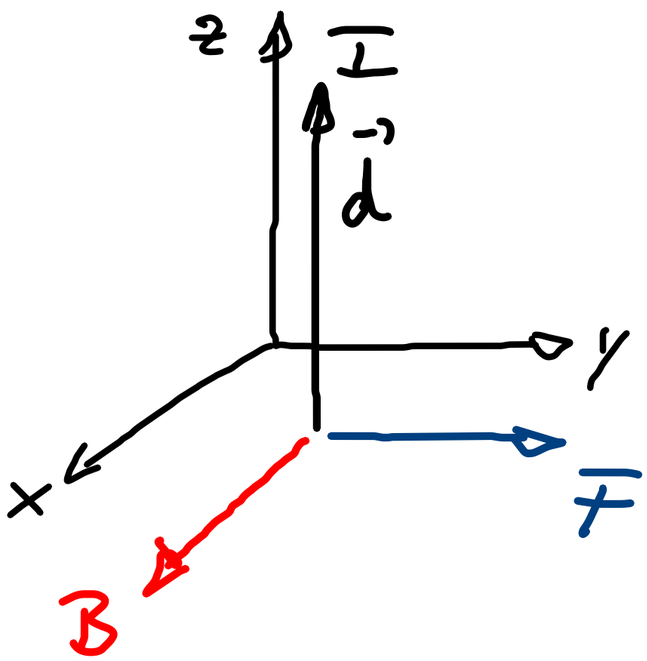
$$\Rightarrow F_L = q \cdot v \cdot B = 1{,}6 \cdot 10^{-19} C \cdot 10^7 \frac{m}{s} \cdot 0{,}15\ T = 2{,}4 \cdot 10^{-13} N$$

4) Lorentzkraft II

$$r = \frac{m_e}{e} \cdot \frac{v}{B} = \frac{9{,}1 \cdot 10^{-31}\,kg}{1{,}6 \cdot 10^{-19}\,C} \cdot \frac{10^7\,m/s}{0{,}15\,T} = 0{,}3\ mm$$

5) Lorentzkraft III

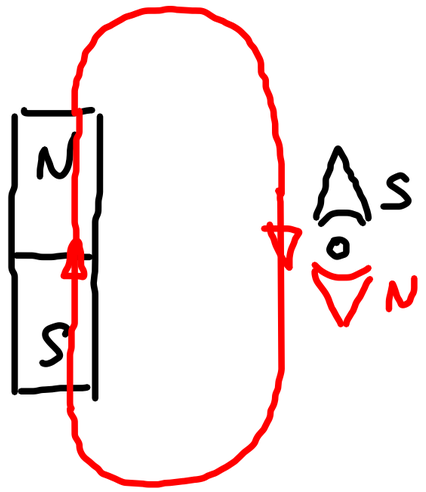
$$\vec{F}_L = I \cdot \vec{d} \times \vec{B}$$



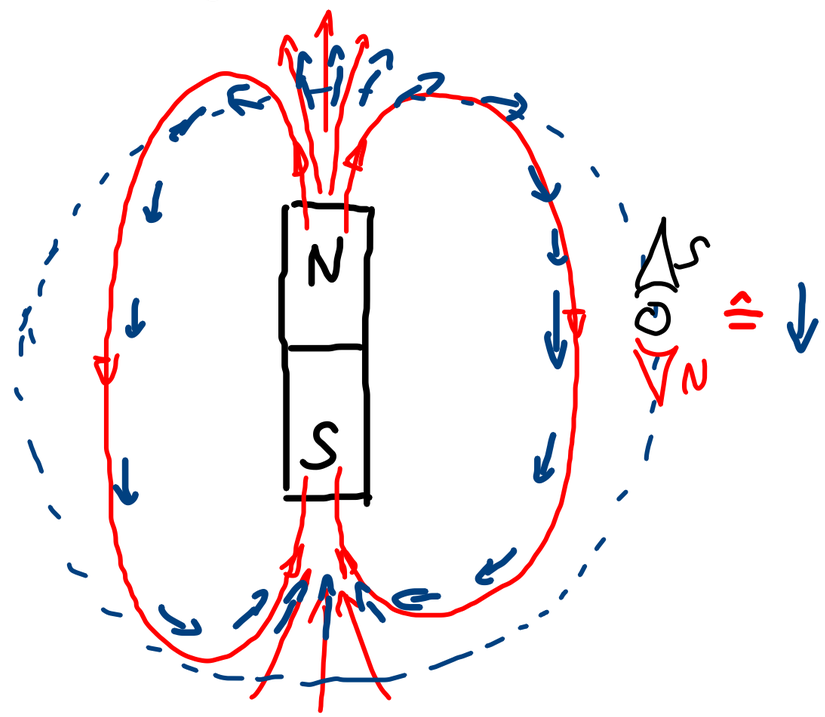
6) Hall-Spannung

$$U_H = \frac{B \cdot I}{e \cdot n \cdot d} = \frac{0{,}1\,T \cdot 5\,A}{1{,}6 \cdot 10^{-19}\,C \cdot 8{,}5 \cdot 10^{28}/m^3 \cdot 10^{-3}\,m} = 37\ nV$$

7) Kompassnadel I



8) Kompassnadel II



Die Kompassnadel dreht sich 2x um sich selbst

9) Atomares magnetischer Dipolmoment I

$$\vec{\mu} = I \cdot \vec{A} \quad ; \quad \mu = I \cdot A = I \pi r^2$$

$$\rightarrow I = \frac{\mu}{\pi r^2} = \frac{9{,}27 \cdot 10^{-24}\ A m^2}{\pi \cdot (5 \cdot 10^{-11}\ m)^2} = 1{,}2\ mA$$

10) Atomares magnetischer Dipolmoment II

$$I = \frac{Q}{t} = \frac{e}{T}$$

T ↖ Umlaufzeit des e^- um Kern

$$v = \frac{2\pi r}{T} \rightarrow T = \frac{2\pi r}{v}$$

$$I = \frac{e}{T} = \frac{e \cdot v}{2\pi r}$$

$$\Rightarrow v = \frac{2\pi r I}{e} = \frac{2\pi \cdot 5 \cdot 10^{-11}\ m \cdot 1{,}2 \cdot 10^{-3}\ A}{1{,}6 \cdot 10^{-19}\ C} = 2{,}3 \cdot 10^6\ \frac{m}{s}$$