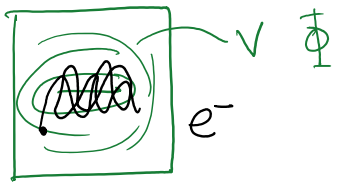
Elektronen Bewegungen

29 April 2019 13:14



$$\underline{F} = m\underline{a}$$

$$\underline{F} = e\left(\underline{E} + \underline{v} \times \underline{B}\right)$$

$$\underline{F} = e\left(-\nabla \Phi\right)$$

Für elektronen gilt:

$$\underline{a} = \left(\frac{e}{m_e}\right)\left(-\nabla \Phi\right)$$

$$\ddot{x} = \left(\frac{e}{m_e}\right)\left(-\frac{\partial \Phi}{\partial x}\right)$$

$$\ddot{y} = \left(\frac{e}{m_e}\right)\left(-\frac{\partial \Phi}{\partial y}\right)$$

$e = 1.60 \times 10^{-19}\ C$

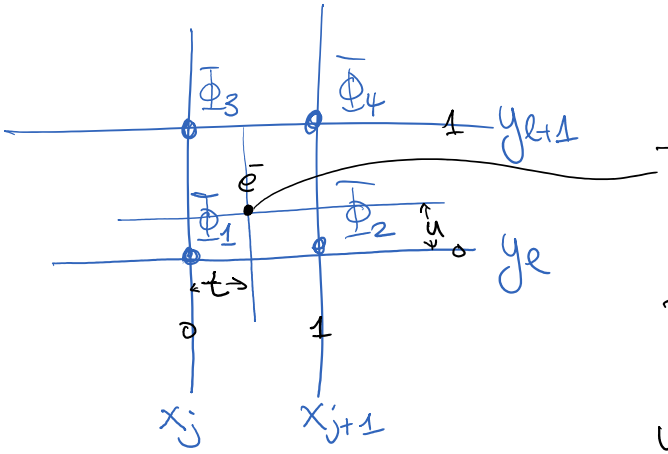
$m_e = 9.11 \times 10^{-31}\ kg$

$\left(\frac{e}{m_e}\right) = 1.756 \times 10^{11}\ \frac{C}{kg}$

$$\Phi = \left[\frac{N\,m}{C}\right] \qquad \nabla\Phi = \left[\frac{N}{C}\right]$$

$$\left(\frac{e}{m_e}\right)\left(-\nabla\Phi\right) = \left[\frac{C}{kg}\right]\cdot\left[\frac{N}{C}\right] = \left[\frac{N}{kg}\right] = \left[\frac{kg\ m/s^2}{kg}\right]$$

$$\ddot{x} = \left[m/s^2\right]$$



$\Phi(x,y)$

$$t = \frac{(x - x_j)}{(x_{j+1} - x_j)} = \frac{1}{\Delta}(x - x_j)$$

$$u = \frac{1}{\Delta}(y - y_e) \qquad \frac{\partial t}{\partial x} = \frac{1}{\Delta}!$$

$$\Phi(x,y_0) = (1-t)\Phi_1 + t\Phi_2$$

$$\Phi(x,y) = (1-u)\Phi_1 + u\Phi_3$$

$$\Phi(x,y_{e+1}) = (1-t)\Phi_3 + t\Phi_4$$

$$\Phi(x,y) = (1-t)(1-u)\Phi_1 + (1-u)t\Phi_2 + u(1-t)\Phi_3 + ut\Phi_4$$

$$\left.\frac{\partial\Phi}{\partial x}\right|_u = \frac{\partial t}{\partial x}\frac{\partial\Phi}{\partial t} = \frac{1}{\Delta}\left[-(1-u)\Phi_1 + (1-u)\Phi_2 - u\Phi_3 + u\Phi_4\right]$$

$$= \frac{1}{\Delta}\left[(1-u)(\Phi_2-\Phi_1) + u(\Phi_4-\Phi_3)\right]$$

$$\left.\frac{\partial\Phi}{\partial y}\right|_t = ?$$ Aufgabe

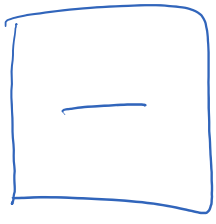
$$\dot{x} = v_x$$

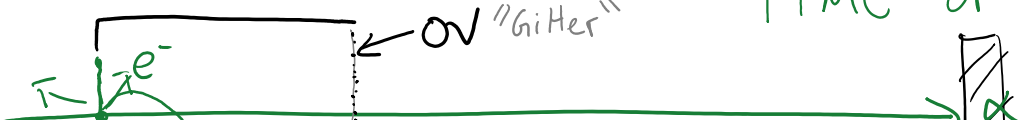
$$\dot{v}_x = \left(\frac{e}{m_e}\right)\left(-\frac{1}{\Delta}\left[(1-u)(\Phi_2-\Phi_1) + u(\Phi_4-\Phi_3)\right]\right)$$

$$\dot{y} = v_y$$

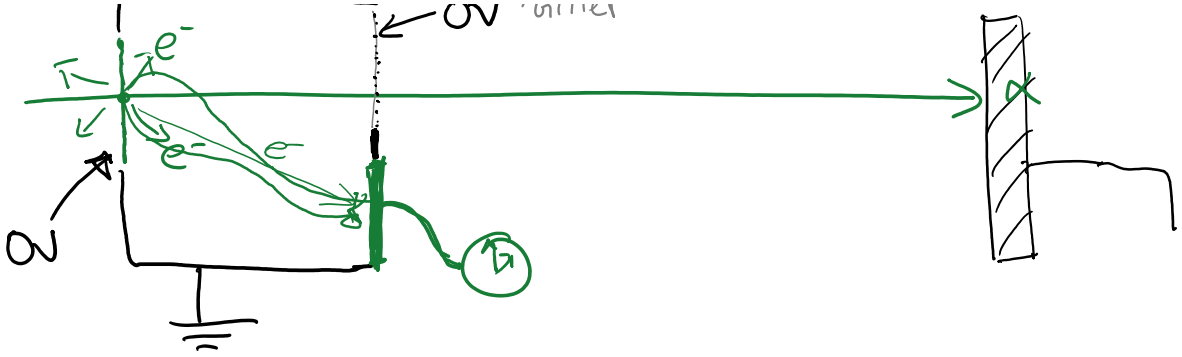
$$\dot{v}_y = \left(\frac{e}{m_e}\right)\left(-\frac{1}{\Delta}[\cdots]\right)$$

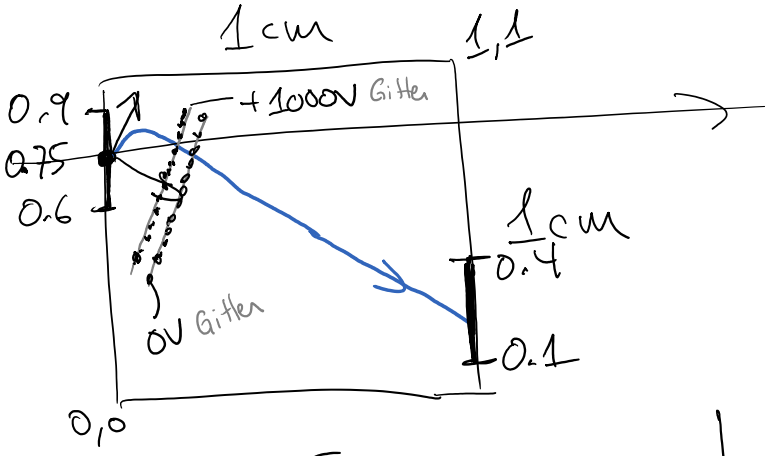
Leapfrog : RK4 ?





TIME OF FLIGHT





$|\underline{v_e}| = 10^6$ m/s

~5 ns