

$$4b) \quad m\ddot{\vec{r}} + e(\vec{E} + \dot{\vec{r}} \times \vec{B}) = 0, \quad \dot{\vec{r}}(0) = 0, \quad \vec{r}(0) = v_0 \vec{e}_z$$

$$\vec{E} = E_0 \vec{e}_z, \quad \vec{B} = B_0 \vec{e}_z$$

$$\Rightarrow m\ddot{x} + e\dot{y}B_0 = 0$$

$$m\ddot{y} - e\dot{x}B_0 = 0$$

$$m\ddot{z} + eE_0 = 0$$

$$\Rightarrow \ddot{z} = -\frac{eE_0}{m} \Rightarrow z = -\frac{eE_0}{2m}t^2 + c_1t + c_2$$

= 0 wegen Anfangsbedingungen

$$\Rightarrow \ddot{x} + \frac{eB_0}{m}\dot{y} = 0 \quad \left\{ \begin{array}{l} \ddot{x} + \omega\dot{y} = 0 \\ \ddot{y} - \omega\dot{x} = 0 \end{array} \right. \quad \text{mit } v = \dot{x} \text{ und } u = \dot{y}$$

$$\Rightarrow \dot{v} + \omega u = 0 \quad \left\{ \begin{array}{l} \dot{v} = -\omega u \\ \dot{u} = \omega v \end{array} \right. \quad \left\{ \begin{array}{l} \dot{u} = -\frac{\dot{v}}{\omega} \\ \dot{v} = \omega \dot{u} \end{array} \right.$$

$$\Rightarrow \ddot{v} + \omega^2 v = 0 \quad \left\{ \begin{array}{l} v = A e^{i\omega t} + B e^{-i\omega t} \\ u = C e^{i\omega t} + D e^{-i\omega t} \end{array} \right. \quad \left\{ \begin{array}{l} x = A e^{i\omega t} + B e^{-i\omega t} + k_1 \\ y = C e^{i\omega t} + D e^{-i\omega t} + k_2 \end{array} \right.$$

$$\Rightarrow x(0) = A + B + k_1 = 0, \quad \dot{x}(0) = i\omega A - i\omega B = v_0 \quad \left\{ \begin{array}{l} A = \frac{v_0}{2\omega} + B \\ B = -\frac{v_0}{2\omega} - k_1 \end{array} \right.$$

$$y(0) = C + D + k_2 = 0, \quad \dot{y}(0) = i\omega C - i\omega D = 0 \quad \left\{ \begin{array}{l} C = D \\ C = -\frac{k_2}{2} \end{array} \right.$$

$$\Rightarrow x = -\frac{k_1}{2} \left(e^{i\omega t} + e^{-i\omega t} \right) + \frac{v_0}{2\omega} \left(e^{i\omega t} - e^{-i\omega t} \right) + k_1 = -k_1 \cos(\omega t) + \frac{v_0}{\omega} \sin(\omega t) + k_1$$

$$y = -\frac{k_2}{2} \left(e^{i\omega t} + e^{-i\omega t} \right) + k_2 = -k_2 \cos(\omega t) + k_2$$

$$\vec{r} = \begin{pmatrix} -k_1 \cos(\omega t) + \frac{v_0}{\omega} \sin(\omega t) + k_1 \\ -k_2 \cos(\omega t) + k_2 \\ -\frac{eE_0}{2m}t^2 \end{pmatrix}$$

Anfangswerte: $k_1 = 0$
 $k_2 = v_0/\omega$

z-Koordinate wie Freier Fall mit $\frac{eE_0}{m}$ statt g

x- und y-Koordinate schwingen

Schöner: Es ergibt sich als Trajektorie eine Spirale, etc.

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gute Idee :)