Elektrizität

Prüfungen

~~7.12.2017~~

09.02.2018

09.03.2018

Elektrostatik

q_i

$$\vec{E}(\vec{r}) = \sum_{i=1}^{N} \frac{q_i(\vec{r}-\vec{r}_i)}{4\pi\varepsilon_0 \left|\vec{r}-\vec{r}_i\right|^3}$$

$$\varphi(\vec{r}) = \sum_i \frac{q_i}{4\pi\varepsilon_0 \left|\vec{r}-\vec{r}_i\right|}$$

$\vec{E}$

$$\varphi = -\int \vec{E}\cdot d\vec{r} + \varphi_0$$

$$\vec{E} = -\nabla\varphi$$

φ

Ladungsdichte

für viele elektrische Ladungen

$$\sum_i q_i \quad \Rightarrow \quad \rho(\vec{r})$$

$$\vec{E}(\vec{r}) = \sum_{i=1}^{N} \frac{q_i(\vec{r}-\vec{r}_i)}{4\pi\varepsilon_0 \left|\vec{r}-\vec{r}_i\right|^3}$$

$$\vec{E}(\vec{r}) = \frac{1}{4\pi\varepsilon_0} \iiint_{vol} \frac{\rho(\vec{r}\,')}{\left|\vec{r}-\vec{r}\,'\right|^3} (\vec{r}-\vec{r}\,')\,dx'dy'dz'$$

Elektrostatik

$$\rho$$

$$\vec{E}(\vec{r}) = \frac{1}{4\pi\varepsilon_0} \int \frac{\rho(\vec{r}')}{\left|\vec{r}-\vec{r}'\right|^3}(\vec{r}-\vec{r}')d^3r'$$

$$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$$

$$\vec{E}$$

$$\varphi = -\int \vec{E} \cdot d\vec{r} + \varphi_0$$

$$\vec{E} = -\nabla \varphi$$

$$\varphi$$

Gaußsches Gesetz

$$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$$

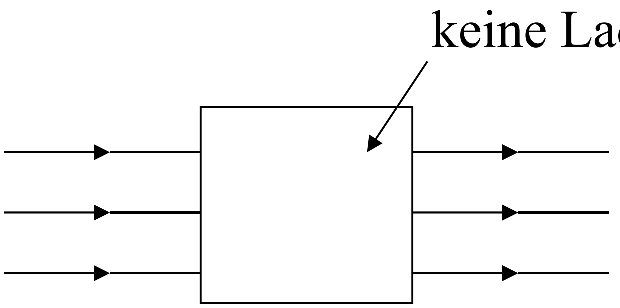
Divergenz

elektrische Feldkonstante

$$8.854187817 \times 10^{-12} \ \frac{\mathrm{A\,s^4}}{\mathrm{kg\,m^3}}$$

$$\nabla \cdot \vec{E} = \mathrm{div}\,\vec{E} = \frac{\partial E_x}{\partial x} + \frac{\partial E_y}{\partial y} + \frac{\partial E_z}{\partial z}$$

Divergenz

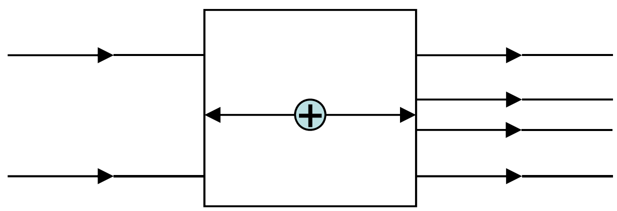


$$\nabla \cdot \vec{E} = \frac{\partial E_x}{\partial x} + \frac{\partial E_y}{\partial y} + \frac{\partial E_z}{\partial z}$$

$$\frac{dE_x}{dx} = 0$$

$$\nabla \cdot \vec{E} = 0 \quad \Longrightarrow \quad \iint_A \vec{E} \cdot d\vec{A} = 0$$

Divergenz



$$\nabla \cdot \vec{E} = \frac{\partial E_x}{\partial x} + \frac{\partial E_y}{\partial y} + \frac{\partial E_z}{\partial z}$$

$$\frac{dE_x}{dx} \neq 0$$

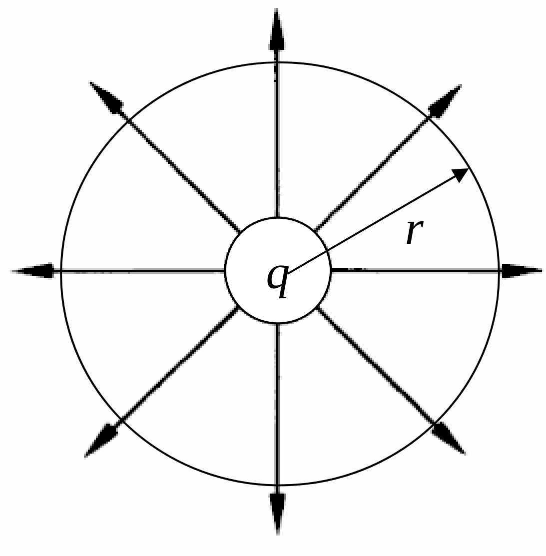
$$\iint_A \vec{E} \cdot d\vec{A} \neq 0$$

$$\iiint_{vol} \nabla \cdot \vec{E}\ dxdydz = \iint_A \vec{E} \cdot d\vec{A} = \frac{q}{\varepsilon_0}$$

← Gaußsches Gesetz

Gaußsches Gesetz

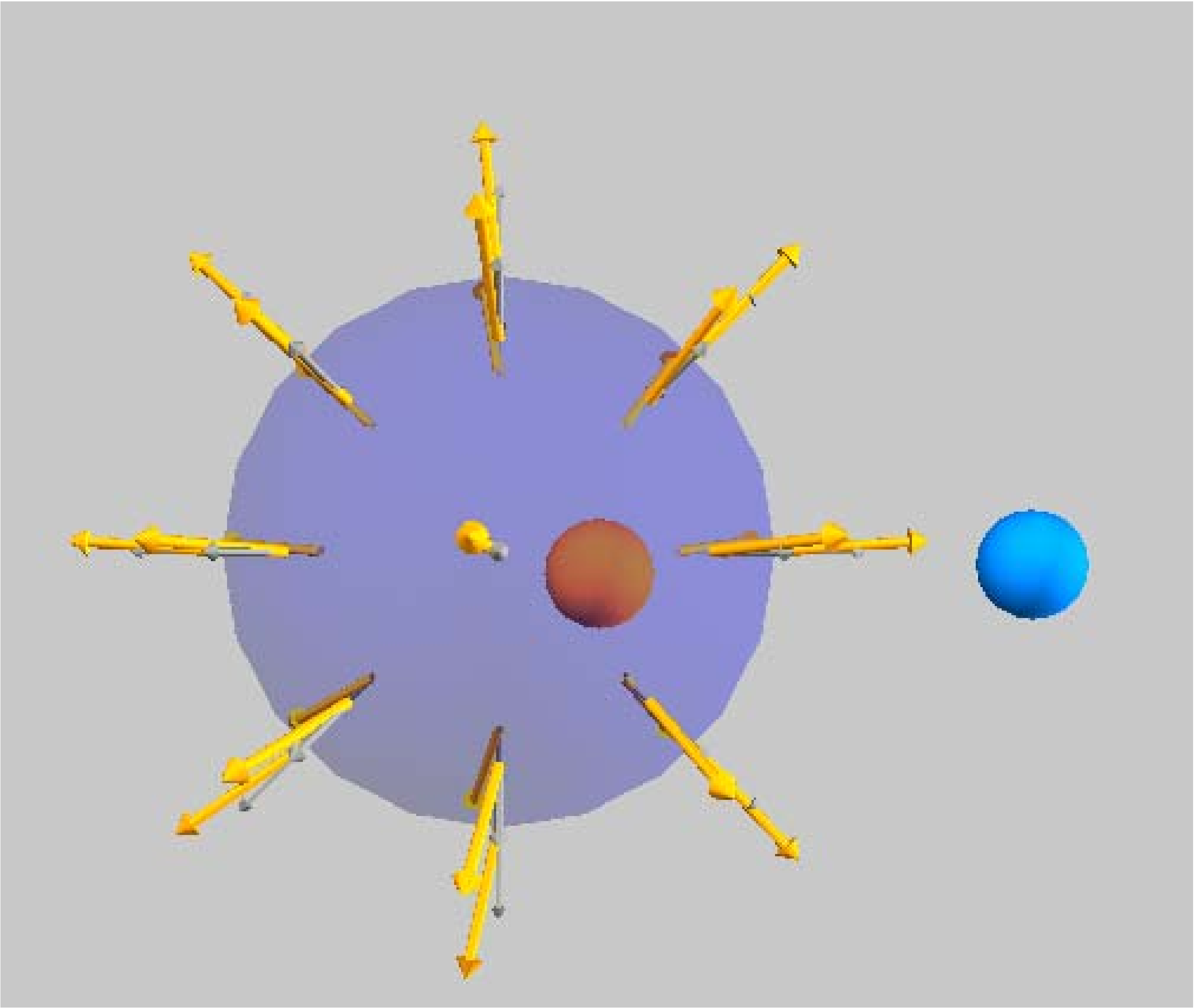
$$\vec{E}(\vec{r}) = \frac{q}{4\pi\varepsilon_0 r^2}\hat{r}$$



Elektrisches Feld × Oberfläche = $\frac{q}{4\pi\varepsilon_0 r^2} \times 4\pi r^2 = \frac{q}{\varepsilon_0}$

$$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$$

Gaußsches Gesetz



http://public.mitx.mit.edu/gwt-teal/GaussLawFlux.html

Elektrostatik

$$\rho$$

$$\vec{E}(\vec{r}) = \frac{1}{4\pi\varepsilon_0}\int \frac{\rho(\vec{r}\,')}{\left|\vec{r}-\vec{r}\,'\right|^3}(\vec{r}-\vec{r}\,')d^3r'$$

$$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$$

$$\vec{E}$$

$$\varphi = -\int \vec{E}\cdot d\vec{r} + \varphi_0$$

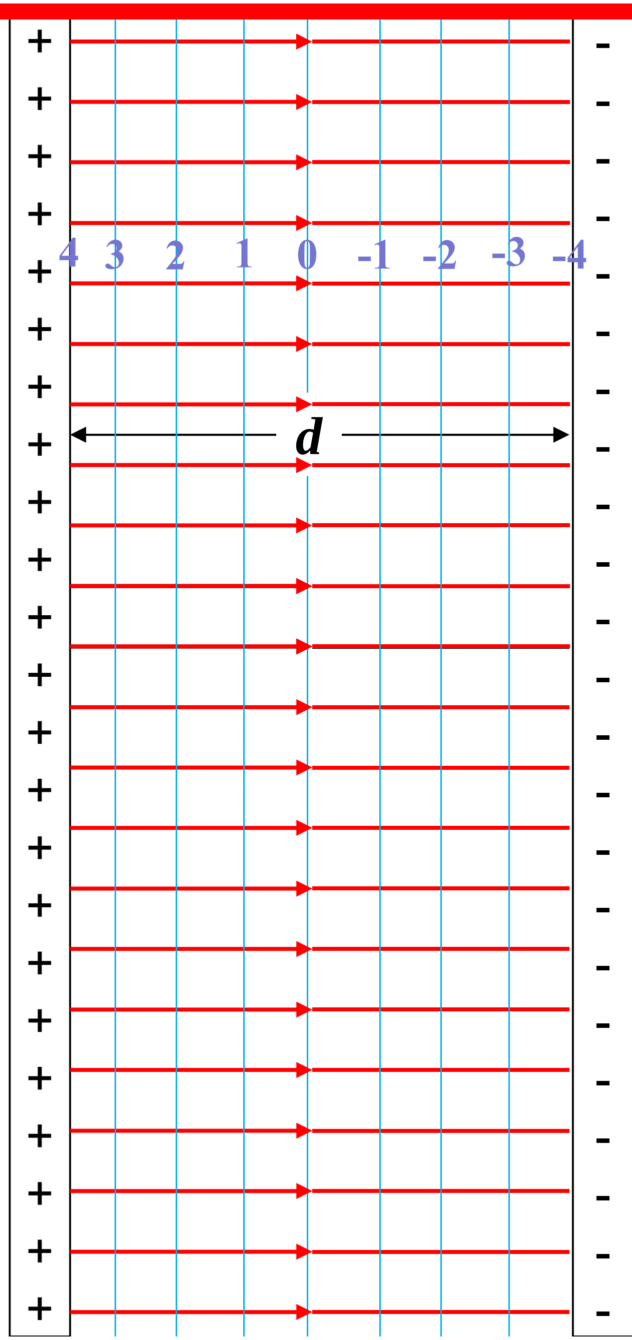
$$\vec{E} = -\nabla\varphi$$

$$\varphi$$

parallen Platten

$$\varphi_{links} = 4\ [\text{V}]$$

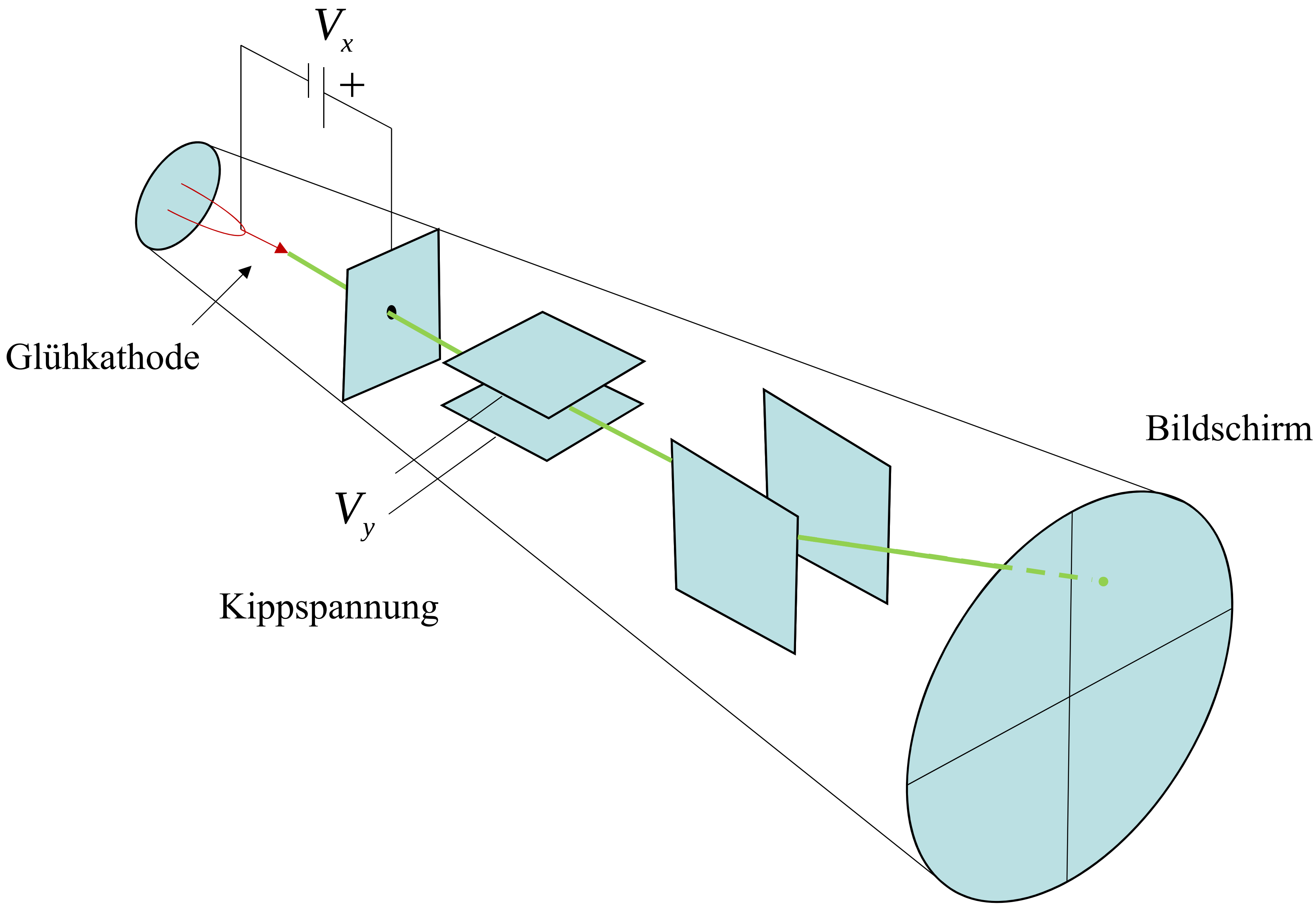
$$V = \varphi_{links} - \varphi_{rechts}$$
$$= 8\ [\text{V}]$$

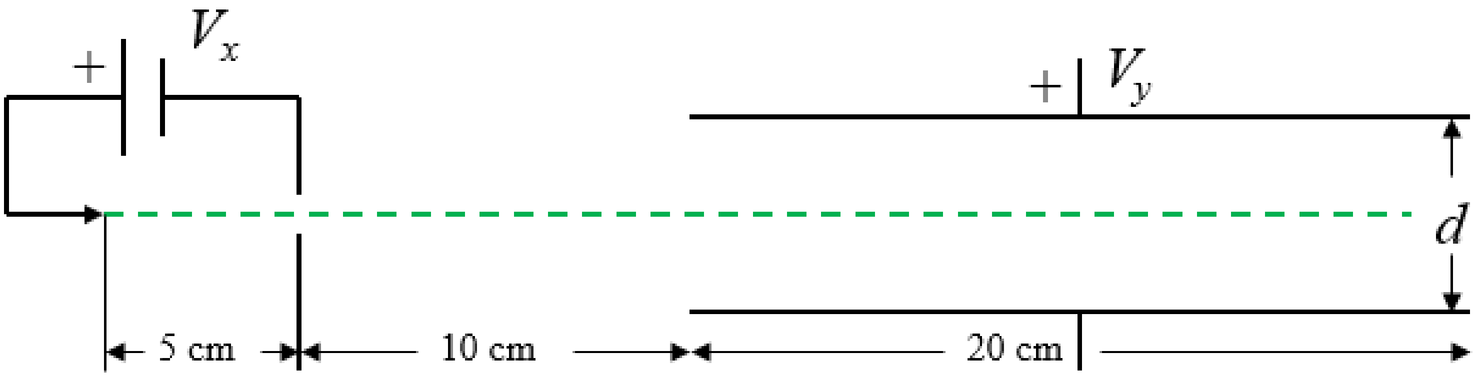


$$\varphi_{rechts} = -4\ [\text{V}]$$

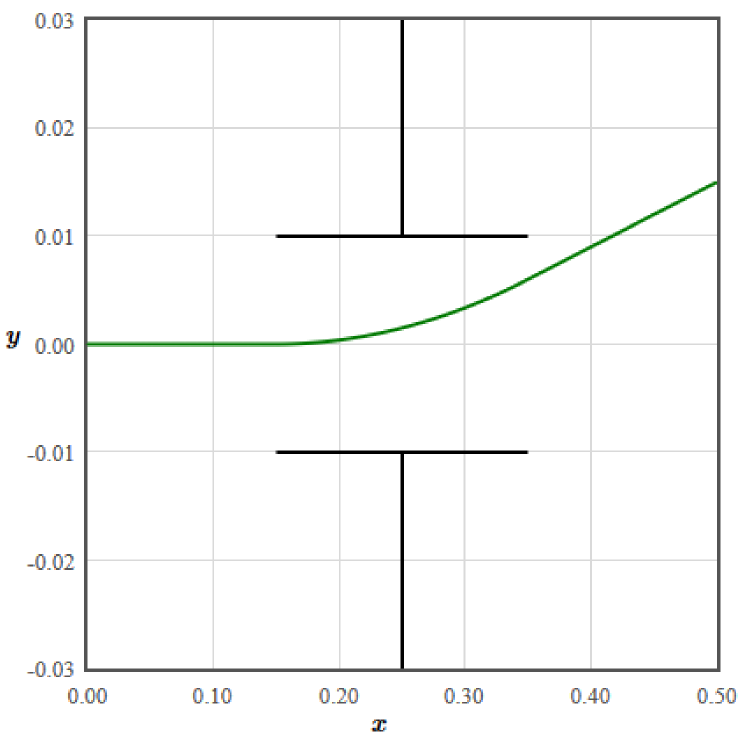
$$\vec{E} = -\nabla\varphi$$
$$= -\frac{\partial\varphi}{\partial x}\hat{x}$$
$$= \frac{V}{d}\ \hat{\text{x}}\ [\text{V/m}]$$

Elektronenstrahl

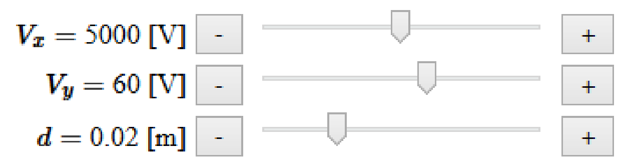




+
V_x
+
V_y
d
5 cm
10 cm
20 cm



0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
y
0.00
0.10
0.20
0.30
0.40
0.50
x



V_x = 5000 [V]
V_y = 60 [V]
d = 0.02 [m]