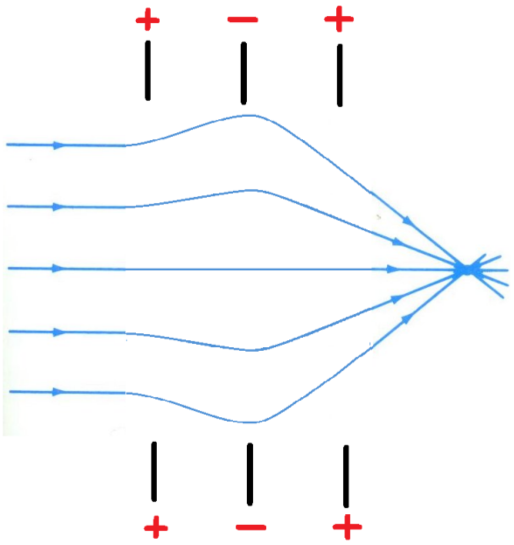
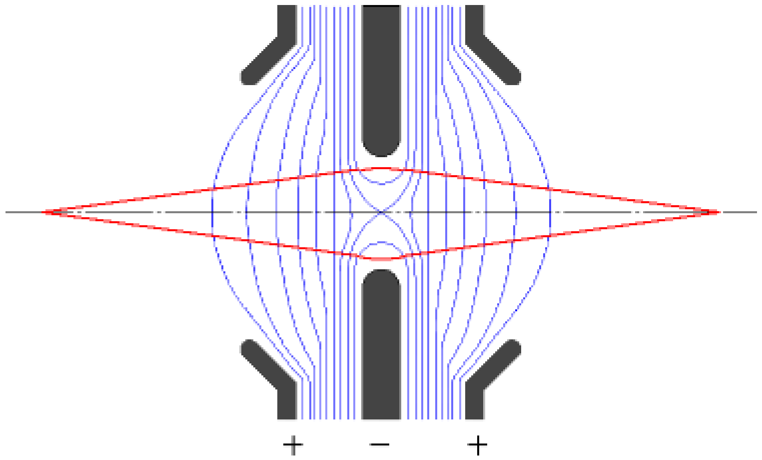
PARAXIÁLNA APROXIMÁCIA PRE ELEKTROSTATICKÚ ŠOŠOVKU

Attila Farkas

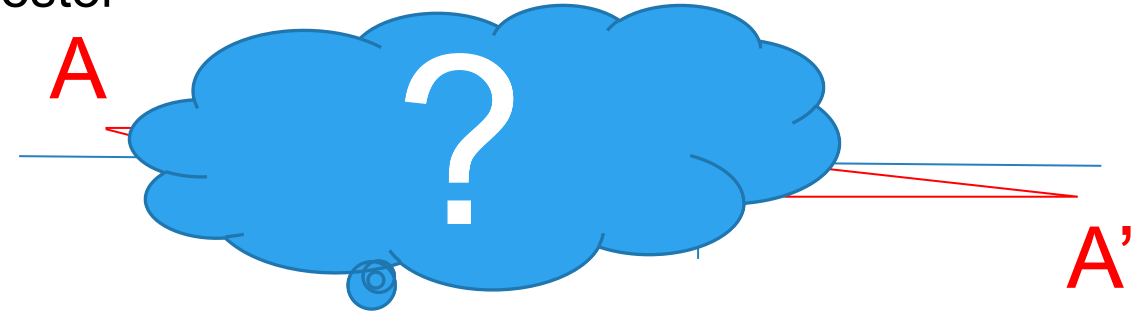
ELEKTROSTATICKÁ ŠOŠOVKA

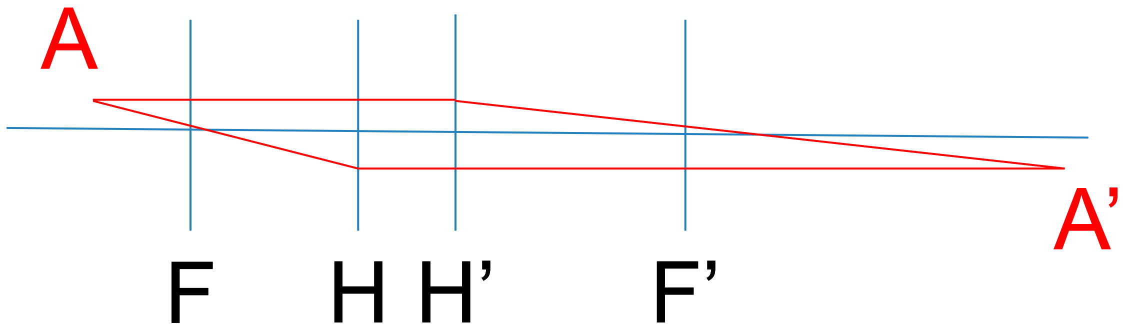




PARAXIÁLNA OBLASŤ

- Predmetový priestor -> Obrazový priestor
- Zobrazenie blízko optickej osi
- Dochádza k ideálnemu zobrazeniu
- Lineárne zobrazenie





VLASTNOSTI ŠOŠOVIEK

KLASICKÁ ŠOŠOVKA

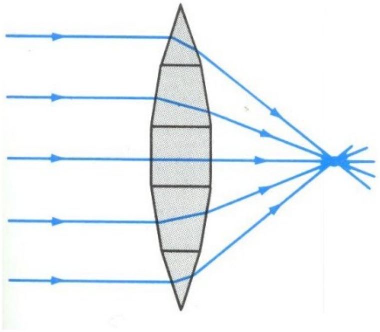
- Lom na rozhraní
- Spojka, rozptylka
- Materiály s rôznym indexom lomu
- $\sin\theta_1 n_1 = \sin\theta_2 n_2$
- $\lambda = \frac{hc}{E}$

ELEKTROSTATICKÁ ŠOŠOVKA

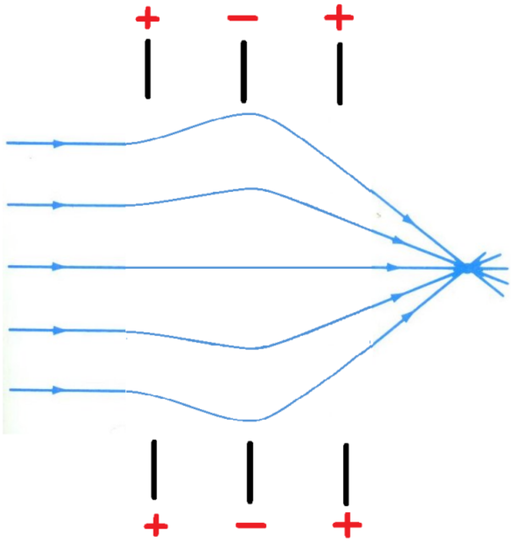
- Spojitý index lomu
- Spojka
- Sústava anód a katód
- $\Delta \varphi = 0$
- $\lambda = \frac{hc}{E_{kin}}$

VLASTNOSTI ŠOŠOVIEK

KLASICKÁ ŠOŠOVKA



ELEKTROSTATICKÁ ŠOŠOVKA



PARAXIÁLNA OBLASŤ

$$\Delta\,\varphi = \mathrm{div}\,\mathrm{grad}\,\varphi = 0$$

$$\oint_S \vec{E}\,d\vec{S} = \int_V \mathrm{div}\,\vec{E}\,dV$$

$$\vec{\mathrm{E}} = -\mathrm{grad}\,\varphi$$

PARAXIÁLNA OBLASŤ

$$\Delta \varphi = \mathrm{div}\,\mathrm{grad}\,\varphi = 0$$

$$\oint_S \vec{E} d\vec{S} = \int_V \mathrm{div}\,\vec{E} dV$$

$$\vec{\mathrm{E}} = -\mathrm{grad}\,\varphi$$

- $$\oint_S \vec{E} d\vec{S} = 0$$

$$\oint_S \vec{E} d\vec{S} = E_z \pi r^2 - E_z \pi r^2 + 2E_r \pi \mathrm{d}l + \frac{\mathrm{d}E_z}{\mathrm{d}r} \pi r^2 \mathrm{d}l = 0$$

PARAXIÁLNA OBLASŤ

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$$\oint_S \vec{E}\,d\vec{S} = \int_V \mathrm{div}\,\vec{E}\,dV$$

$$\vec{\mathrm{E}} = -\mathrm{grad}\,\varphi$$

-

$$\oint_S \vec{E}\,d\vec{S} = 0$$

$$\oint_S \vec{E}\,d\vec{S} = E_z\pi r^2 - E_z\pi r^2 + 2E_r\pi\mathrm{d}l + \frac{\mathrm{d}E_z}{\mathrm{d}r}\pi r^2\mathrm{d}l = 0$$

$$E_r = -\frac{r}{2}\frac{\mathrm{d}E_z}{\mathrm{dz}}$$

PARAXIÁLNA ROVNICA

$$\ddot{r} = \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}r}{\mathrm{d}t}\right) = \frac{\mathrm{d}}{\mathrm{dz}}\frac{\mathrm{dz}}{\mathrm{d}t}\left(\frac{\mathrm{d}r}{\mathrm{dz}}\frac{\mathrm{dz}}{\mathrm{d}t}\right) = \frac{\mathrm{d}}{\mathrm{dz}}v_z\left(v_z\frac{\mathrm{d}r}{\mathrm{dz}}\right)$$

$$ma = eE$$

$$\ddot{r} = \frac{e}{m}E_r$$

$$\ddot{r} = -\frac{e}{m}\frac{r}{2}\frac{\mathrm{d}E_\mathrm{z}}{\mathrm{dz}}$$

PARAXIÁLNA ROVNICA

$$\ddot{r} = \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}r}{\mathrm{d}t}\right) = \frac{\mathrm{d}}{\mathrm{dz}}\frac{\mathrm{dz}}{\mathrm{d}t}\left(\frac{\mathrm{d}r}{\mathrm{dz}}\frac{\mathrm{dz}}{\mathrm{d}t}\right) = \frac{\mathrm{d}}{\mathrm{dz}}v_z\left(v_z\frac{\mathrm{d}r}{\mathrm{dz}}\right)$$

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$$\frac{\mathrm{d}}{\mathrm{dz}}v_z\left(v_z\frac{\mathrm{d}r}{\mathrm{dz}}\right) + \frac{e}{m}\frac{r}{2}\frac{\mathrm{d}E_\mathrm{z}}{\mathrm{dz}} = 0$$

$$E_p + E_k = 0$$

$$\frac{1}{2}mv^2 = -\varphi e$$

$$v = \sqrt{-\frac{2e}{m}\varphi}$$

PARAXIÁLNA ROVNICA

- $$v_z\left(\frac{dv_z}{dz}r' + v_z r''\right) + \frac{e}{m}\frac{r}{2}\varphi(r) = 0$$

$$\sqrt{-\frac{2e}{m}\varphi}\left(\frac{1}{2}\sqrt{-\frac{2e}{m\varphi}}\varphi' r' + \sqrt{-\frac{2e}{m}}\varphi r''\right) + \frac{e}{m}\frac{r}{2}\varphi'' = 0$$

- $$\varphi r'' + \frac{1}{2}\varphi' r' + \frac{1}{4}\varphi'' r = 0$$

REDUKOVANÁ LÚČOVÁ ROVNICA

Substitúcia:

$$R = r\varphi^{1/4}$$

$$R'' = -\frac{3}{16}\left(\frac{\varphi'}{\varphi}\right)^2 R$$

KONIEC