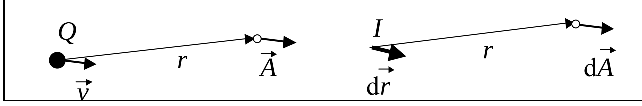
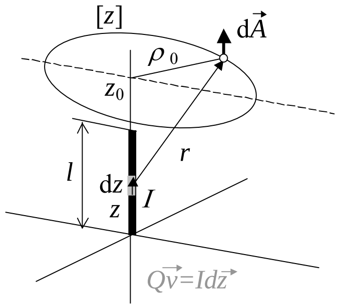


$$\vec{A}(r)=\frac{\mu}{4\pi}\frac{Q\vec{v}}{r},\quad \mathrm{d}\vec{A}(r)=\frac{\mu}{4\pi}\frac{I\mathrm{d}\vec{r}}{r}$$



$$\mathrm{d}A_z(\rho_0,z_0)=\frac{\mu}{4\pi}\frac{I\mathrm{d}z}{r},\quad r=\sqrt{\rho_0^2+(z_0-z)^2}$$

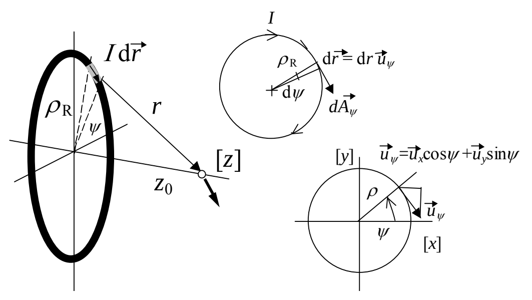
$$A_z(\rho_0,z_0)=\frac{\mu I}{4\pi}\int_0^l\frac{\mathrm{d}z}{\sqrt{\rho_0^2+(z_0-z)^2}}=\frac{\mu I}{4\pi}\int_{z_0-l}^{z_0}\frac{\mathrm{d}\xi}{\sqrt{\rho_0^2+\xi^2}}=$$

$$\frac{\mu I}{4\pi}\ln\frac{z_0+\sqrt{\rho_0^2+z_0^2}}{z_0-l+\sqrt{\rho_0^2+(z_0-l)^2}}$$

Špeciálny prípad, v mieste $z_0=l/2$ (v rovine symetrie) a ak $l\to\infty$ vedie to k výsledku ktorý zodpovedá nekonečne dlhému líniovému zdroju:

$$A_z(\rho)=\frac{\mu I}{4\pi}\ln\frac{\frac{l}{2}+\sqrt{\rho^2+(\frac{l}{2})^2}}{-\frac{l}{2}+\sqrt{\rho^2+(\frac{l}{2})^2}}=\frac{\mu I}{4\pi}\ln\frac{1+\sqrt{1+(\frac{2\rho}{l})^2}}{-1+\sqrt{1+(\frac{2\rho}{l})^2}}\doteq\frac{\mu I}{4\pi}\ln\frac{1+\left(1+\frac{1}{2}(\frac{2\rho}{l})^2\right)}{-1+\left(1+\frac{1}{2}(\frac{2\rho}{l})^2\right)}=$$

$$=\frac{\mu I}{4\pi}\ln\frac{2+\frac{1}{2}(\frac{2\rho}{l})^2}{\frac{1}{2}(\frac{2\rho}{l})^2}=\frac{\mu I}{4\pi}\ln\left((\frac{l}{\rho})^2+1\right)\doteq\frac{\mu I}{4\pi}\ln(\frac{l}{\rho})^2=\underbrace{\frac{\mu I}{2\pi}\ln l}_{\text{konšt.}}-\frac{\mu I}{2\pi}\ln\rho=-\frac{\mu I}{2\pi}\ln\rho$$



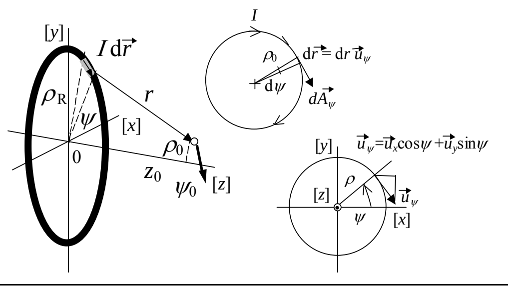
$$\mathrm{d}r=\rho_R\mathrm{d}\alpha,\quad r=\sqrt{\rho_R^2+z_0^2},$$

$$\mathrm{d}\vec{A}_\psi(z_0)=\frac{\mu I}{4\pi}\frac{\vec{u}_\psi\mathrm{d}r}{r},\ A_\rho=0,\ A_z=0$$

$$\vec{A}_\psi(z_0)=\frac{\mu I}{4\pi}\frac{\rho_R}{\sqrt{\rho_R^2+z_0^2}}\int_0^{2\pi}\vec{u}_\psi\,\mathrm{d}\psi=0$$

$$B_z=rotA_\psi=\frac{1}{\rho}\left(\frac{\partial(\rho A_\psi)}{\partial\rho}-\frac{\partial A_\rho}{\partial\psi}\right)=\frac{1}{\rho}\frac{\partial(\rho A_\psi)}{\partial\rho}$$

ak aj: $A_\psi(z_0)\big|_{\rho=0}=0$, môže byť: $\frac{\partial(\rho A_\psi)}{\partial\rho}\Big|_{\rho=0}\neq 0$



$$\mathrm{d}r=\rho_R\mathrm{d}\psi,\quad r=\sqrt{(x-x_0)^2+(y-y_0)^2+z_0^2},$$

$x=\rho_R\cos\psi,\ y=\rho_R\sin\psi,\ z=0,\ x_0=\rho_0\cos\psi_0,\ y_0=\rho_0\sin\psi_0,\ z_0$

$$\mathrm{d}\vec{A}_\psi(z_0,\rho_0,\psi_0)=\frac{\mu I}{4\pi}\frac{\vec{u}_\psi\mathrm{d}r}{r},\ A_\rho=0,\ A_z=0$$

$$\vec{A}_\psi(z_0,\rho_0,\psi_0)=\frac{\mu I}{4\pi}\rho_R\int_0^{2\pi}\frac{(\vec{u}_x\cos\psi+\vec{u}_y\sin\psi)\mathrm{d}\psi}{\sqrt{(\rho_R\cos\psi-x_0)^2+(\rho_R\sin\psi-y_0)^2+z_0^2}}$$

čo je neľahký výpočet ..

Vypočítajte v prvom prípade aj magnetickú indukciu (t.j. hustotu magnetického toku), ako rotáciu vektorového potenciálu.