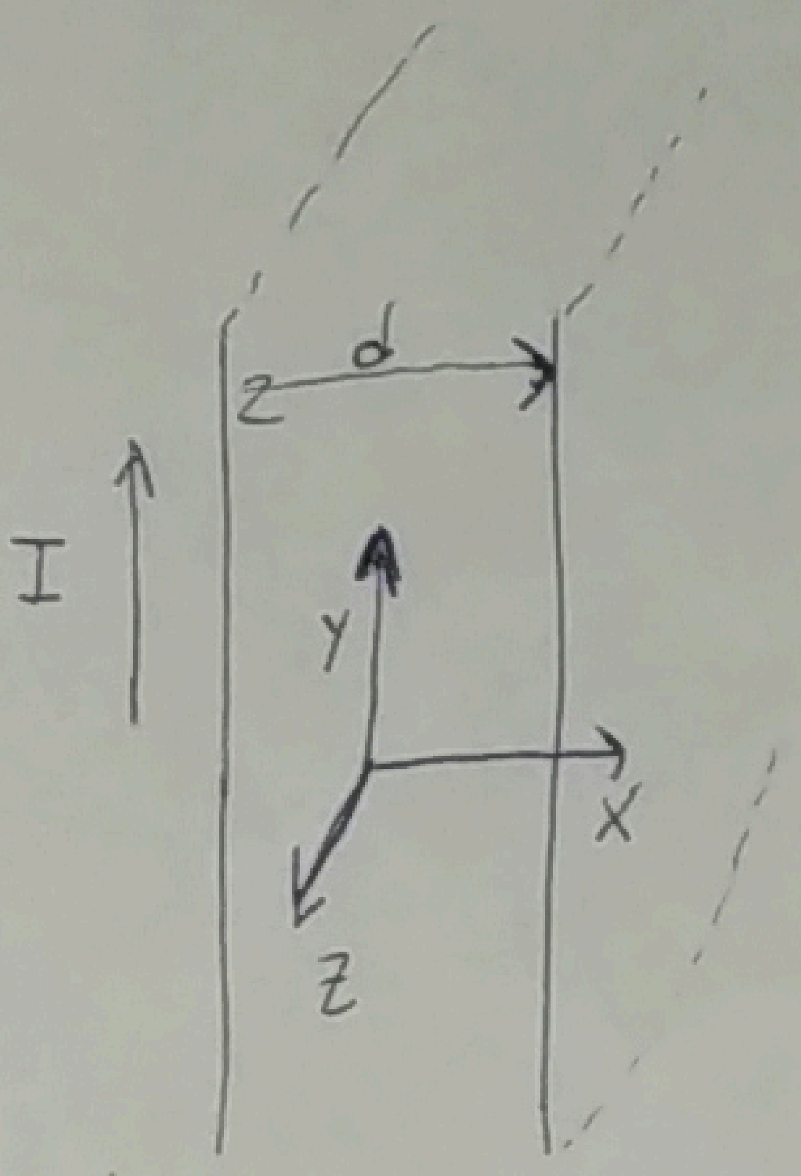
1]

$\bar{B} = (0, 0, B(x))$



$\bar{A} = (0, A(x), 0)$

$\bar{B} = \nabla \times \bar{A}$

$B(x) = \frac{\partial A(x)}{\partial x}$

$\nabla \times \bar{B} = \bar{j}\mu_0$ ← Předpoklad homogeního $\vec{j}$

$\oint \bar{B} \cdot \bar{s} = I \mu_0$

$B_I \cdot 2l = j l d \mu_0$

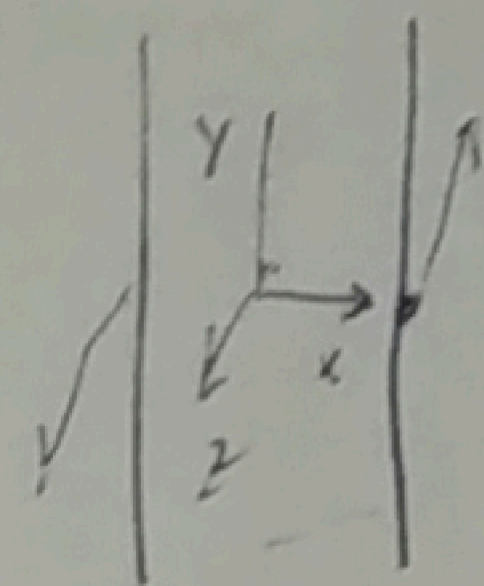
$B_I = \frac{j d \mu_0}{2}$

2

$$\nabla\times\bar B = \frac{1}{\lambda^2}\left[\frac{i\hbar}{4e}(\psi^*\nabla\psi-\psi\nabla\psi^*)-|\psi|^2\bar A\right] \overset{\psi\in\mathbb{R}}{=} -\frac{1}{\lambda}|\psi|^2\bar A$$

$$\nabla\times\nabla\times\bar A = -\frac{1}{\lambda^2}|\psi|^2\bar A \qquad \left(\nabla\times\nabla\times\bar A = \nabla(\underbrace{\nabla\cdot\bar A}_{0})-\nabla^2\bar A\right)$$

$$\frac{\partial^2 A}{\partial x^2} = -\frac{1}{\lambda^2}|\psi|^2 A \rightarrow A = A_1\cdot\sinh\left(\frac{\psi}{\lambda}x\right)+A_2\cdot\cosh\left(\frac{\psi}{\lambda}x\right)$$



$$B = \frac{\partial A}{\partial x} = A_1\frac{\psi}{\lambda}\cosh\left(\frac{\psi}{\lambda}x\right)+A_2\frac{\psi}{\lambda}\sinh\left(\frac{\psi}{\lambda}x\right)$$

$$B\left(x=\frac{d}{2}\right)=B_I = A_1\frac{\psi}{\lambda}\cosh\left(\frac{\psi}{\lambda}\frac{d}{2}\right)+A_2\frac{\psi}{\lambda}\sinh\left(\frac{\psi}{\lambda}\frac{d}{2}\right)$$

$$B\left(x=-\frac{d}{2}\right)=B_I = A_1\frac{\psi}{\lambda}\cosh\left(\frac{\psi}{\lambda}\frac{d}{2}\right)-A_2\frac{\psi}{\lambda}\sinh\left(\frac{\psi}{\lambda}\frac{d}{2}\right)$$

$$\rightarrow 0=2A_1\frac{\psi}{\lambda}\cosh\left(\frac{\psi}{\lambda}\frac{d}{2}\right) \Rightarrow A_1=0$$

$$-B_I\cdot\frac{\lambda}{\psi}\cdot\frac{1}{\sinh\left(\frac{\psi}{\lambda}\frac{d}{2}\right)} = A_2$$

$d \ll \lambda$

$|x| \ll \lambda$

$\psi x \ll \lambda \quad \psi\in[0,1]$

$\frac{\psi x}{\lambda} \ll 1 \Rightarrow \sinh(x)=x \quad \cosh(x)=1$

$$B = -B_I\frac{\sinh\left(\frac{\psi}{\lambda}x\right)}{\sinh\left(\frac{\psi}{\lambda}\frac{d}{2}\right)} = -B_I\cdot\frac{x}{d}\cdot 2 \qquad A = -B_I\frac{\lambda}{\psi}\frac{\cosh\left(\frac{\psi}{\lambda}x\right)}{\sinh\left(\frac{\psi}{\lambda}\frac{d}{2}\right)} = -B_I\frac{\lambda^2}{\psi^2}\frac{2}{d}$$

3

$$\underbrace{-\xi^2\left(\bar\nabla + i\frac{2e}{\hbar}\bar A\right)^2\psi}-\psi+|\psi|^2\psi=0$$

$$-\xi^2\nabla^2\psi+\left(\xi\frac{2e}{\hbar}A\right)^2-\underbrace{\xi^2\bar\nabla i\frac{2e}{\hbar}\bar A\psi}_{0}-\underbrace{\xi^2\frac{2e}{\hbar}\bar A\bar\nabla\psi}_{0}$$

$$\nabla\cdot A=\underset{0}{\partial_x A_x}+\underset{0}{\partial_y A_y}+\underset{0}{\partial_z A_z}$$

$$(0, A_y(x), 0)\left(\frac{\partial\psi}{\partial x}, \underset{0}{\frac{\partial\psi}{\partial y}}, \frac{\partial\psi}{\partial z}\right)$$

$\psi=\psi(x)$

$$-\xi^2\nabla^2\psi+\left(\xi\frac{2e}{\hbar}A\right)^2\psi-\psi+\psi^2\psi=0$$

$$\xi^2\nabla^2\psi=\psi\cdot\left[\left(\xi\frac{2e}{\hbar}A\right)^2-1+\psi^2\right]$$

$\xi>>d$

$$0=\psi\Big[\underbrace{\left(\xi\frac{2e}{\hbar}A\right)^2-1+\psi^2}_{0}\Big]$$

$$A=-B_I\frac{\lambda^2}{\psi^2}\frac{2}{d}$$

$$\left(\xi\frac{4e}{\hbar}B_I\frac{\lambda^2}{\psi^2}\frac{1}{d}\right)^2=1-\psi^2$$

$$B_I^2=(\psi^4-\psi^6)\cdot\left(\frac{\hbar d}{\xi 4e\lambda^2}\right)^2$$

$$\partial(\psi^4-\psi^6)=4\psi_c^3-6\psi_c^5=0$$

$$\psi_c^3(4-6\psi_c^2)=0$$

$$\psi_c^2=\frac{4}{6}=\frac{2}{3}$$

$$B_{Ic}=\underbrace{\sqrt{\frac{4}{9}-\frac{8}{27}}}_{\sqrt{\frac{4}{27}}}\frac{\hbar d}{\xi 4e\lambda^2}=\frac{1}{\sqrt{3}3}\frac{\hbar d}{\xi 2e\lambda^2}=B_I=\frac{j_c d\mu_0}{2}$$

$$j_c=\frac{1}{\sqrt{3}3}\frac{\hbar d}{\xi e\lambda^2\mu_0}=\frac{B_c\cdot 2\sqrt{2}}{\sqrt{3}3\,\lambda\mu_0}$$

$$B_c=\frac{\hbar}{2\sqrt{2}e}\frac{1}{\lambda\xi}$$