VEKTORPOTENTSIAAL $\vec{A}$

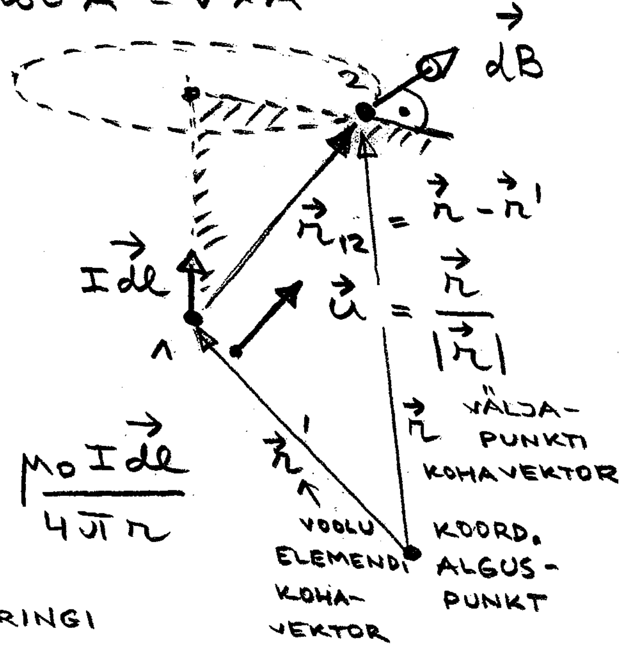
VP ON VEKTOR, MILLE TSIRKULATSIOON = MAGNETVOOGA

$$\oint_{l} A_l \, dl = \int_S B_n \, dS \;\Big|\cdot \frac{d}{dS} \Rightarrow \underbrace{\frac{d}{dS}\oint A_l \, dl}_{\mathrm{rot}\,\vec{A} \,=\, \nabla\times\vec{A}} = \vec{B}$$

l ÜMBRITSEB PINDA S

BIOT'-SAVART': $(\mu = 1)$ eeld.

$$\vec{dB} = \frac{\mu_0}{4\pi}\,\frac{I\vec{dl}\times\vec{u}}{r_{12}^2} \Longrightarrow$$



KUI $\frac{d}{dx}(\;) = \frac{1}{x^2}$ (siin $\frac{1}{r^2}$),

SIIS $(\;) = -\frac{1}{x}$, SEEGA VP

$$\boxed{\vec{dA} = \frac{\mu_0 I\vec{dl}}{4\pi r}}$$

NING $\vec{A} = \oint \frac{\mu_0 I \vec{dl}}{4\pi r}$ ÜLE VOOLURINGI

$$\nabla\times\vec{dA} = \nabla\times\Big[\underbrace{\frac{\mu_0}{4\pi}}_{\text{KONSTANT}}\;\underbrace{I\vec{dl}}_{\text{VEKTOR-FUNKTSIOON}}\cdot\underbrace{\frac{1}{r}}_{\text{SKAALAR-FUNKTSIOON}}\Big] = \frac{\mu_0}{4\pi}\Big[\frac{1}{r}(\nabla\times I\vec{dl}) - I\vec{dl}\times\nabla\Big(\frac{1}{r}\Big)\Big] = \ldots$$

MF II VALEM:

$$\nabla\times\varphi\cdot\underset{\text{SK. VEKT.}}{\vec{A}} = \varphi\cdot\underbrace{\nabla\times\vec{A}}_{\mathrm{rot}\,\vec{A}} - \vec{A}\times\underbrace{\nabla\varphi}_{\mathrm{grad}\,\varphi}$$

$I\vec{dl}$ EI SÕLTU VÄLJAPUNKTI KOORDINAATIDEST (x, y, z),

SEEGA $\nabla\times I\vec{dl} = 0$ JA

$$\ldots = \frac{\mu_0}{4\pi}\Big[(-I\vec{dl})\times\Big(-\frac{1}{r^2}\Big)\vec{u}\Big] = \frac{\mu_0}{4\pi r^2}\, I\vec{dl}\times\vec{u} = \vec{dB}$$

BIOT'-SAVART'

PIDEVUSE VÕRRAND:

$$\nabla\cdot\vec{J} = \mathrm{div}\,\vec{J} = -\frac{\partial\rho}{\partial t}$$

AJAS MUUTUMATU (ALALISE) ρ KORRAL $\nabla\cdot\vec{J} = 0$

$$\vec{A} = \oint_l \frac{\mu_0}{4\pi r}\underbrace{\int_S J_n \overbrace{dS\,dl}^{dV}}_{I} = \frac{\mu_0}{4\pi}\int_{V'}\frac{J_n\,dV}{r_{12}} = \frac{\mu_0}{4\pi}\int_{V'}\frac{J(\vec{r}')\,dV}{\underset{|r_2 - r_1|}{|\vec{r} - \vec{r}'|}}$$

ÜLDINE VALEM

KUI $\nabla\cdot\vec{J}=0$, SIIS KA

$$\nabla\cdot\vec{A}=\frac{\mu_0}{4\pi}\int_{V'}\frac{\nabla\cdot\vec{J}\,dV}{r_{12}}=0$$

KUI $\operatorname{div}\vec{A}=0$, SIIS KA $\operatorname{grad}\operatorname{div}\vec{A}=0$

MF II VALEM: $\operatorname{rot}\operatorname{rot}\vec{A}=\operatorname{grad}\operatorname{div}\vec{A}-\nabla^2\vec{A}$

EHK $\nabla\times(\nabla\times\vec{A})=\nabla(\nabla\cdot\vec{A})-(\nabla\cdot\nabla)\vec{A}$

ANNAB, ET $\operatorname{rot}\operatorname{rot}\vec{A}=\operatorname{rot}\vec{B}=\mu_0\vec{J}=-\nabla^2\vec{A}$

$\vec{B}$ VÕI $\vec{H}$ TSIRKULATSIOONILAUSE PÕHJAL

SAIME POISSON'I VÕRRANDI MAGNETVÄLJA KOHTA: $\boxed{\nabla^2\vec{A}=-\mu_0\vec{J}}$

TSIRKULATSIOONILAUSE DIFERENTSIAALKUJUL:

$$\oint H_l\,dl=\int J_n\,dS \quad \Big|\cdot\frac{d}{dS} \quad \Rightarrow \quad \underbrace{\frac{d}{dS}\oint_l H_l\,dl}_{\overset{\text{DEF.}}{=}\ \operatorname{rot}\vec{H}}=\underbrace{\frac{d}{dS}\int_S J_n\,dS}_{=\ \vec{J}}$$

$l \rightarrow$ PIIRAB PINDA $\rightarrow S$

$\operatorname{rot}\vec{H}=\vec{J}$

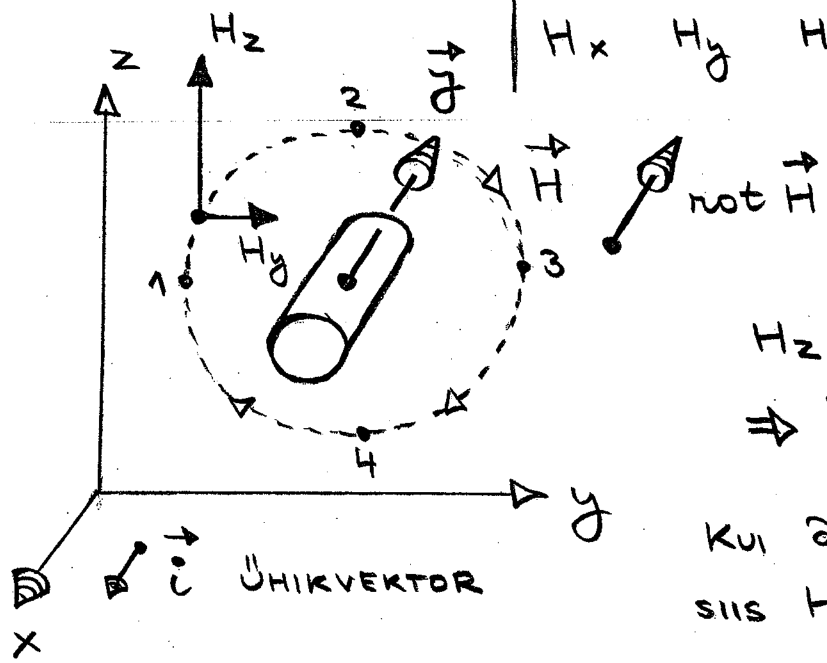
KOMPONENTIDES:

$$\operatorname{rot}\vec{H}=\nabla\times\vec{H}=\begin{vmatrix}\vec{i} & \vec{j} & \vec{k}\\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z}\\ H_x & H_y & H_z\end{vmatrix}$$

SEEGA

$$(\operatorname{rot}\vec{H})_x=\left(\frac{\partial H_z}{\partial y}-\frac{\partial H_y}{\partial z}\right)\vec{i}$$

jne.



MEIE POOLE

KUI $\partial y>0$ EHK y KASVAB (1–2–3), SIIS

H_z KAHANEB (PUNKTIS 2 ON NULL)

$$\Rightarrow \frac{\partial H_z}{\partial y}<0$$

KUI $\partial z>0$ EHK z KASVAB ($4\to1\to2$),

SIIS H_y KA KASVAB $\Rightarrow \dfrac{\partial H_y}{\partial z}>0$

$\Rightarrow$ KOGU $\left(\dfrac{\partial H_z}{\partial y}-\dfrac{\partial H_y}{\partial z}\right)$ ON NEGATIIVNE JA

$\operatorname{rot}\vec{H}$ ON SUUNATUD

MEIST EEMALE (NAGU KA $\vec{J}$)