$$\mathrm{rot}\,\vec{A} = \left(\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z},\ \frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x},\ \frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y}\right) = \vec{\nabla}\times\vec{A}$$

$$\vec{\nabla} = \left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right)$$

その結果

$$\int_S \mathrm{rot}\,\vec{E}(\vec{x},t)\, n(\vec{x})\, ds = -\frac{d}{dt}\int \vec{B}(\vec{x},t)\,\vec{n}(\vec{x})\, ds$$

Sは固定

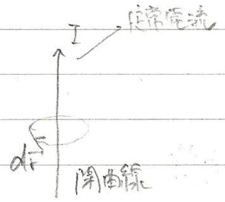
$$= -\int_S \frac{\partial \vec{B}(\vec{x},t)}{\partial t}\cdot\vec{n}(\vec{x})\, ds$$

$$\therefore \int_S \left(\mathrm{rot}\,\vec{E}(\vec{x},t) + \frac{\partial \vec{B}(\vec{x},t)}{\partial t}\right)\vec{n}\cdot ds = 0$$

Sは任意なので、 $\mathrm{rot}\,\vec{E}(\vec{x},t) + \dfrac{\partial \vec{B}(\vec{x},t)}{\partial t} = 0$

微分形式における Farady の誘導法則

§5. Ampére の法則

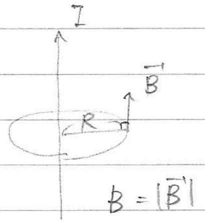


$$\oint \vec{B}(\vec{r})\, d\vec{r} = \mu_0 I \quad [A]$$

$$[Wb/m^2] = [T]$$

真空の透磁率 $\mu_0 = 4\pi\times10^{-7}\,[N/A^2]$ $\left(= \dfrac{1}{c^2\varepsilon_0}\right)$

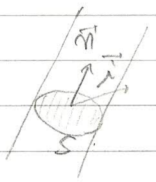
(ex) 直線電流



$$B\cdot 2\pi r = \mu_0 I$$

$$\therefore B = \frac{\mu_0 I}{2\pi r}$$

近接作用



$\vec{i}$: 電流密度 $[A/m^2]$

$$I = \int_S \vec{i}\cdot\vec{n}\cdot ds$$

$$\therefore \oint_C \vec{B}\cdot d\vec{r} = \mu_0\int_S \vec{i}\cdot\vec{n}\, ds$$

$$\int_S \mathrm{rot}\,\vec{B}\cdot\vec{n}\, ds = \mu_0\int_S \vec{i}\,\vec{n}\, ds \quad (\because \text{stokes の定理})$$