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SKALÁR $c \in \mathbb{R}$ $\quad c$

VEKTOR $x \in M$ $\quad \xi_u(x) := (\underbrace{\tau(x)}_{t}, \underbrace{\pi_u(x) := x - t(x)u}_{q_u})$ $\quad x = tu + q$

KOVEKTOR $k \in M^*$ $\quad \eta_u(k) := (\underbrace{ku}_{e_u}, \underbrace{k|_S =: i^* k}_{p})$ $\quad k = e_u\tau + p\pi_u$

ANTISZIMM. TENZOR $G \in M \wedge M$ $\quad \begin{pmatrix} 0 & \tau G \\ \underbrace{-\tau G}_{H_u} & \underbrace{}_{D_u} \end{pmatrix}$ $\quad G - u \wedge (\tau G)$ $\quad$ ~~$G = \pi_u B \pi_u - \tau^* \wedge (\pi_u^* E_u)$~~ $\quad G = H_u - u \wedge D$

ANTISZIMM. KOTENZOR $F \in M^* \wedge M^*$ $\quad \begin{pmatrix} 0 & i^* F u \\ \underbrace{i^* F u}_{E_u} & \underbrace{i^* F i}_{B} \end{pmatrix}$ $\quad F = \pi_u^* B \pi_u - \tau^* \wedge (\pi_u^* E_u)$

DIVERGENCIA $D \cdot J$ $\quad \mathcal{D}_u \varrho + \nabla \cdot j_u$ $\quad J \sim (\varrho, j_u)$

KÜLSŐ DERIV. $D \wedge K$ $\quad \begin{pmatrix} 0 & \nabla V_u + \mathcal{D}_u A \\ -\nabla V_u - \mathcal{D}_u A & \nabla \wedge A \end{pmatrix}$ $\quad K \sim (V_u, A)$

DIVERGENCIA $D \cdot G$ $\quad (\nabla \cdot D, -\mathcal{D}_u D + \nabla \cdot H_u)$ $\quad G \sim ((D, H_u))$

KÜLSŐ DERIV. $D \wedge F$ $\quad ((\nabla \wedge E_u + \mathcal{D}_u B, \nabla \wedge B))$ $\quad F \sim ((E_u, B))$

CamScannerrel szkennelve

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$(u, S, \underset{\circ}{\ })$
$$\begin{tikzcd}
M \arrow[r] & \mathbb{R} \arrow[d, "id"] \\
T \times S \arrow[u] \arrow[r, dotted] & \mathbb{R}
\end{tikzcd}$$

$$J: \begin{tikzcd}
M \arrow[r] & M \arrow[d, "\xi_u"] \\
T \times S \arrow[u, dotted] \arrow[r, dashed] & T \times S
\end{tikzcd}$$

$$K: \begin{tikzcd}
\underset{\circ}{M} \arrow[r] & M^* \arrow[d, "\eta_u"] \\
T \times S \arrow[u] \arrow[r, dashed] & T^* \times S^*
\end{tikzcd}$$

$J: \underset{\circ}{M} \to M$

$DJ: \underset{\circ}{M} \to M \otimes M^*$

$\mathrm{Tr}(DJ) =: \mathrm{Div}\, J = D \cdot J$

$f: \underset{\circ}{M} \to \mathbb{R}$

$f(\underset{\circ}{y}) = f(\underset{\circ}{x}) + Df(\underset{\circ}{x})(\underset{\circ}{y} - \underset{\circ}{x}) + \text{hiba}(\underset{\circ}{y} - \underset{\circ}{x})$

$Df[x_0] \in \mathrm{Lin}(M, \mathbb{R}) = M^*$

$Df: \underset{\circ}{M} \to M^*$

$\big(\underbrace{Df[\underset{\circ}{x}]u}_{[D_u f](x_0)},\ \underbrace{Df(x_0)|_S}_{(\nabla f)[x_0]}\big)$

$(\partial_t f)[t\,q] = (D_u f)(\underset{\circ}{o} + tu + q)$

$(\nabla f)(t\,q] = (\nabla f)[\underset{\circ}{o} + tu + q]$

~~S29~~ S31

$\underset{\circ}{M} \xrightarrow{J} M$

$J \sim (\rho, j_u)$

$\downarrow$

$D \cdot J \sim \partial_u \rho + \nabla \cdot j_u$

$G : \underset{\circ}{M} \longrightarrow M \wedge M$

$DG : \underset{\circ}{M} \longrightarrow (M \wedge M) \otimes M^*$

$D \cdot G : \underset{\circ}{M} \longrightarrow M$

$G \sim ((H_u, D))$ $\quad D \cdot G \sim (\nabla \cdot D, -\partial_u D + \nabla \cdot H_u)$

$\underset{\circ}{M} \xrightarrow{K} M^*$

$K \sim (-V_u, A)$

$D \wedge K \sim (-\nabla V_u - \partial_u A, \nabla \wedge A)$

$DK[\underset{\circ}{x}] \in M^* \otimes M^*$

$F : \underset{\circ}{M} \longrightarrow M^* \wedge M^*$ $\quad F \sim ((E_u, B))$

$DF : \underset{\circ}{M} \longrightarrow (M^* \wedge M^*) \otimes M^*$

$D \wedge F \sim (((\nabla \wedge E_u + \partial_u B, D \wedge B)))$

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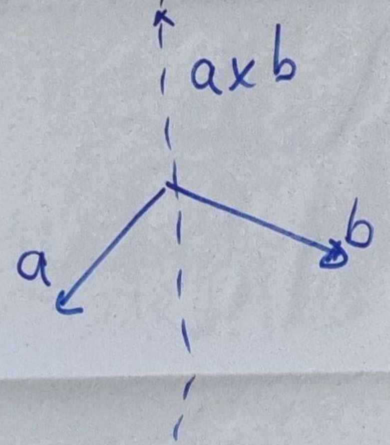
Biot-Savart-tv.

$$\underline{B}(\underline{r}) = \frac{\mu_0}{4\pi}\int \frac{\underline{I}\,d\ell \times (\underline{r}-\ell)}{|r-\ell|^3}$$



$-B\times v$

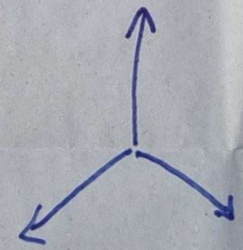
$\hat{B} \in \mathrm{Lin}(S,S) \equiv S^{*} \otimes S^{*}$

Hodge-dualis

$$\underline{e} \qquad \hat{B} = \underbrace{\begin{pmatrix} 0 & \cdot & B_2 \\ B_3 & 0 & \cdot \\ \cdot & B_1 & 0 \end{pmatrix}}^{C}$$

$B \to (a\times b)_i \to \varepsilon_{ijk} a_j b_k$

$\mathrm{div}\,\underline{B} \cancel{= \nabla\cdot\underline{B}} = \underline{\nabla \wedge B}$



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$$\begin{cases} \mathrm{div}\, \underline{B} = 0 & \dfrac{\partial B}{\partial t} + \mathrm{rot}\, \underline{E} = 0 \\ \mathrm{div}\, D = \rho & -\dfrac{\partial D}{\partial t} + \mathrm{rot}\, \underline{H} = j \end{cases}$$

$$\begin{cases} \nabla \cdot \underline{B} = 0 & \dfrac{\partial B}{\partial t} + \nabla \wedge E = 0 \\ \nabla \cdot D = \rho & -\dfrac{\partial D}{\partial t} + \nabla \wedge H = j \end{cases}$$

$$\begin{cases} \nabla \cdot B = 0 & D_u B + \nabla \wedge E_u = 0 \\ \nabla \cdot D = \rho & -D_u D + \nabla \wedge H = j_u \end{cases}$$

$$\begin{cases} D \wedge F = 0 \\ D \cdot G = J \end{cases}$$

$F : \underset{o}{M} \longrightarrow M^* \wedge M^*$ Faraday-mező!!

$G : \underset{o}{M} \longrightarrow \dfrac{M \wedge M}{T \otimes \mathbb{I}^{(3)}}$ Garyaday

$*J : \underset{o}{M} \longrightarrow \dfrac{M}{T \otimes \mathbb{I}^{(3)}}$ elektromágneses gyorsulás

$i^*\left(F[\underset{o}{x}]u\right) \overset{*}{=} \begin{pmatrix} 0 & -E_u \\ E_u & B \end{pmatrix} \begin{pmatrix} 1 \\ v_{u'u} \end{pmatrix} \overset{o}{=} E_u + B v_{u'u}$

$\boxed{S34}$

$$\begin{cases} D \wedge F = 0 \\ D \cdot G = J \end{cases}$$

Közeg $F = \Gamma(G)$

$D = \varepsilon E_u$

$H_u = \frac{1}{\mu} B$

u vákuum éter