(A, φ) をローレンツゲージとして

$$\frac{d\varphi}{dt} + \operatorname{div} \mathbb{A} = 0$$ 電磁場とベクトル解析 Lemma 3.55

□

$$\Rightarrow \quad \frac{\partial A_1}{\partial x^1} + \frac{\partial A_2}{\partial x^2} + \frac{\partial A_3}{\partial x^3} + \frac{\partial \varphi}{\partial t} = 0 \quad (!!)$$

$$
\begin{aligned}
* = & \left(\qquad \right) A_1 dx^1 + \frac{\partial}{\partial x^1}\left(-\frac{\partial}{\partial x^1} A_1 \right) dx^1 \\
& + \left(\qquad \right) A_2 dx^2 + \frac{\partial}{\partial x^2}\left(-\frac{\partial}{\partial x^2} A_2 \right) dx^2 \\
& + \left(\qquad \right) A_3 dx^3 + \frac{\partial}{\partial x^3}\left(-\frac{\partial}{\partial x^3} A_3 \right) dx^3 \\
& + \left(\qquad \right) \varphi \, dt + \frac{\partial}{\partial t}\left(\frac{\partial}{\partial t} \varphi \right) dt^2 \\
= & \ \square \, \mathcal{V}
\end{aligned}
$$