PHYS 436: Lecture # 35

Cliff Sun

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Lorentz Transformation of E&M Potentials

The retarded E&M potential forms a relativisitic 4-potential,

$$A^\mu = \begin{pmatrix} V/c \\ \mathbf{A} \end{pmatrix} \tag{1}$$

There, they also follow the same Lorentz Transformations. Moreover, since

$$\Box^2 V/c = -\mu_0 \rho c = -\frac{\rho}{\epsilon_0 c} \tag{2}$$

$$\Box^2 A = -\mu_0 J \tag{3}$$

It follows that

$$J^\mu = \begin{pmatrix} \rho c \\ \mathbf{J} \end{pmatrix} = A^\mu \tag{4}$$

The Lorenz gauge can therefore be written as

$$\nabla \cdot A + \frac{1}{c^2}\partial_t V = \partial_\mu A^\mu = 0 \tag{5}$$