Chapter 3

Siongduix-lun leghak

3.1 *Metric tensor*

Di de-ji ciafng laixdea, larn zaiviar six-do ee *Minkowski* siqofng laixdea ee uixdix hiorngliong (ct, x, y, z) pitsuiaux zunsiuo *Lorentz* zoafnvoa. Di siongduix-lu lai, larn ka (ct, x, y, z) ie huhoi x^μ laai piawsi:

$$\begin{aligned} x^0 = ct, &\quad x^1 = x, \\ x^2 = y, &\quad x^3 = z. \end{aligned} \tag{3.1}$$

Lorentz zoafnvoa exdaxng ka siar zoix

$$x'^\mu = \Lambda^\mu_\nu x^\nu, \tag{3.2}$$

ciaf Λ daixpiao *Lorentz* zoafnvoa, $\mu.\nu = 0, 1, 2, 3$. Di Siongduix-lun laixdea, sofu zunsiuo Eq.(3.2) citee zoafnvoa kongseg ee hiorngliong, larn lorng ka kioix zoix *four-vector*. Sofie jukoir A si *four vector*, afnnef A itdeng zunsiuo $A'^\mu = \Lambda^\mu_\nu A^\nu$. Suxsit siong, A^μ di Siongduix-lun lai si siogii *contravariant vector*. Lexnggoa cit hongbin, larn ma exsae dexnggi *covariant vector* A_μ

$$A_\mu \equiv g_{\mu\nu} A^\nu = (A^0, -A^1, -A^2, -A^3), \tag{3.3}$$

di ciaf $g_{\mu\nu}$ doixsi *metric tensor*.

$$g_{\mu\nu} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix} = g^{\mu\nu}. \tag{3.4}$$