

場の量子論 p205check7.10

谷脇 貞善

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$$D'_\mu \Psi'_{\text{ad}}(x) \tag{1}$$

$$= \partial_\mu \Psi'_{\text{ad}}(x) + ig[A'_\mu(x), \Psi'_{\text{ad}}(x)] \tag{2}$$

$$= \partial_\mu [U(x) \Psi_{\text{ad}}(x) U^{-1}(x)] + ig[U(x) A_\mu(x) U^{-1}(x) + \frac{i}{g} \{\partial_\mu U(x)\} U^{-1}(x), U(x) \Psi_{\text{ad}}(x) U^{-1}(x)] \tag{3}$$

$$= \partial_\mu [U(x) \Psi_{\text{ad}}(x) U^{-1}(x)] + [igU(x) A_\mu(x) U^{-1}(x) - \{\partial_\mu U(x)\} U^{-1}(x), U(x) \Psi_{\text{ad}}(x) U^{-1}(x)] \tag{4}$$

$$\begin{aligned} &= [\partial_\mu U(x)] \Psi_{\text{ad}}(x) U^{-1}(x) + U(x) [\partial_\mu \Psi_{\text{ad}}(x)] U^{-1}(x) + U(x) \Psi_{\text{ad}}(x) [\partial_\mu U^{-1}(x)] \\ &\quad + igU(x) A_\mu(x) U^{-1}(x) U(x) \Psi_{\text{ad}}(x) U^{-1}(x) - igU(x) \Psi_{\text{ad}}(x) U^{-1}(x) U(x) A_\mu(x) U^{-1}(x) \\ &\quad - [\partial_\mu U(x)] U^{-1}(x) U(x) \Psi_{\text{ad}}(x) U^{-1}(x) + U(x) \Psi_{\text{ad}}(x) U^{-1}(x) [\partial_\mu U(x)] U^{-1}(x) \end{aligned} \tag{5}$$

$$\begin{aligned} &= [\partial_\mu U(x)] \Psi_{\text{ad}}(x) U^{-1}(x) + U(x) [\partial_\mu \Psi_{\text{ad}}(x)] U^{-1}(x) + U(x) \Psi_{\text{ad}}(x) [\partial_\mu U^{-1}(x)] U(x) U^{-1}(x) \\ &\quad + igU(x) A_\mu(x) \Psi_{\text{ad}}(x) U^{-1}(x) - igU(x) \Psi_{\text{ad}}(x) A_\mu(x) U^{-1}(x) \\ &\quad - [\partial_\mu U(x)] \Psi_{\text{ad}}(x) U^{-1}(x) + U(x) \Psi_{\text{ad}}(x) U^{-1}(x) [\partial_\mu U(x)] U^{-1}(x) \end{aligned} \tag{6}$$

$$\begin{aligned} &= U(x) [\partial_\mu \Psi_{\text{ad}}(x)] U^{-1}(x) + igU(x) A_\mu(x) \Psi_{\text{ad}}(x) U^{-1}(x) - igU(x) \Psi_{\text{ad}}(x) A_\mu(x) U^{-1}(x) \\ &\quad + U(x) \Psi_{\text{ad}}(x) [\partial_\mu U^{-1}(x)] U(x) U^{-1}(x) + U(x) \Psi_{\text{ad}}(x) U^{-1}(x) [\partial_\mu U(x)] U^{-1}(x) \end{aligned} \tag{7}$$

$$= U(x) \{ \partial_\mu \Psi_{\text{ad}}(x) + ig[A_\mu(x), \Psi_{\text{ad}}(x)] \} U^{-1}(x) + U(x) \Psi_{\text{ad}}(x) [\partial_\mu U^{-1}(x) U(x)] U^{-1}(x) \tag{8}$$

$$= U(x) [D_\mu \Psi_{\text{ad}}(x)] U^{-1}(x) + U(x) \Psi_{\text{ad}}(x) [\partial_\mu U] U^{-1}(x) \tag{9}$$

$$= U(x) [D_\mu \Psi_{\text{ad}}(x)] U^{-1}(x) \tag{10}$$

参考文献

- [1] 坂本眞人著「場の量子論-不変性と自由場を中心にして」(裳華房,2014,ISBN9784785325114)