Masstless fermion-antifermion pair

For masstless fermion and antifermion obeying Dirac equation $\gamma^\mu \phi = 0$, the wave function can be separated as $\Psi(p) = \Psi(p_0, \vec{p})$. under the simplest direction $p = (1, 0, 0)$, the spinors $\Psi(p)$ and $\Psi(p')$ are:

$$\Psi(p) = \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \quad \Psi(p') = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}.$$

Transverse component:

Within formula $A^\alpha = \gamma^\alpha \Psi(p')$, two independent unit transverse vector can be formed by:

$$\vec{\epsilon}^T(p) = \frac{1}{\sqrt{2}} \left( \begin{array}{c} 1 \\ i \end{array} \right), \quad \vec{\epsilon}^T(p') = \frac{1}{\sqrt{2}} \left( \begin{array}{c} 1 \\ -i \end{array} \right).$$

Nowadays, we still quantize electromagnetic field by its transverse component, to which:

$$A^\alpha_T = \int d^3p \sum_{n=0}^\infty \epsilon^T_n(p) \epsilon^{T*}_n(p') \gamma^\alpha p^n.$$