On the covariant relativistic equation for particle-antiparticle doublet of arbitrary spin

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Derivation of the Dirac-like equation

$$\left[i\partial_0 - \Gamma^0_{2\mathrm{N}}(\overrightarrow{\Gamma}_{2\mathrm{N}} \cdot \overrightarrow{p} + m)\right] \psi(x) = 0 \qquad (1)$$

for the particle-antiparticle doublet of arbitrary spin is presented. Here

$$\Gamma^0_{2\mathrm{N}} \equiv \sigma^3_{2\mathrm{N}} = \left| \begin{array}{cc} \mathrm{I_N} & 0 \\ 0 & -\mathrm{I_N} \end{array} \right|, \Gamma^j_{2\mathrm{N}} = \left| \begin{array}{cc} 0 & \Sigma^j_{\mathrm{N}} \\ -\Sigma^j_{\mathrm{N}} & 0 \end{array} \right|, j = 1, 2, 3, \quad (2)$$

Σ^j_{N} are the $\mathrm{N} \times \mathrm{N}$ Pauli matrices, $\mathrm{I_N}$ is unit matrix, $\mathrm{N} = 2s + 1$.

The special attention for the case of dimensions, in which the gamma matrices do not exist is given. The general solution of the Eq.(1) is presented. The Poincaré invariance is proved. The way of introducing the interaction with external electromagnetic field is considered on the example of spin $s = 3/2$ particle-antiparticle doublet.

The preliminary consideration of the model can be found in the articles [1, 2].

1. Simulik V. M. Link between the relativistic canonical quantum mechanics of arbitrary spin and the corresponding field theory. Journ. Phys.: Conf. Ser., 2016, 670, 012047(1–16).
2. Simulik V. M. Relativistic wave equations of arbitrary spin in quantum mechanics and field theory, example spin s=2. Journ. Phys.: Conf. Ser., 2017, 804, 012040(1–10).