



Iranian Journal of Physics Research, Vol. 23, No. 1, 2023  
DOI: 10.47176/ijpr.23.1.81540

## Study of charge-conjugation invariance in quantum electrodynamics with SIM(2) symmetry

M Ghasemkhani and Z Haghgouyan

Department of Physics, Shahid Beheshti University, 1983969411, Tehran, Iran

E-mail: m\_ghasemkhani@sbu.ac.ir

(Received 2 August 2022 ; in final form 20 January 2023)

---

### Abstract

In this paper, we consider the four-dimensional electrodynamics with SIM(2) symmetry in a very special relativity framework. First, we examine the charge-conjugation symmetry of the action at the tree (classical) level and show that the action in this framework is charge-conjugation invariant. Then, to investigate perturbatively the preservation of charge-conjugation symmetry at the loop (quantum) level, we shall focus on one-loop graphs with an odd number of photon external lines. To this end, we use the effective action approach to obtain the general form of the photon odd-point function and study the behavior of the one and three-point function of the photon under the charge-conjugation transformation. Our analysis shows that the total amplitude of the one and three-point function vanishes and hence the charge-conjugation symmetry is preserved at the quantum level. Next, we use a non-perturbative method to show that this symmetry exists at the quantum level (to all orders) and the total amplitude of all photon's odd-point functions vanishes.

**Keywords:** SIM(2) symmetry, very special relativity, charge-conjugation symmetry, photon's odd-point functions

---

For full article, refer to the Persian section