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**Operator gauge symmetry in QED.** (English) Zbl 1093.81063

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**Summary:** In this paper, operator gauge transformation, first introduced by Kobe, is applied to Maxwell's equations and continuity equation in QED. The gauge invariance is satisfied after quantization of electromagnetic fields. Inherent nonlinearity in Maxwell's equations is obtained as a direct result due to the nonlinearity of the operator gauge transformations. The operator gauge invariant Maxwell's equations and corresponding charge conservation are obtained by defining the generalized derivatives of the first and second kinds. Conservation laws for the real and virtual charges are obtained too. The additional terms in the field strength tensor are interpreted as electric and magnetic polarization of the vacuum.

**MSC:**

- 81V10** Electromagnetic interaction; quantum electrodynamics
- 35A30** Geometric theory, characteristics, transformations in context of PDEs
- 35Q60** PDEs in connection with optics and electromagnetic theory
- 78A25** Electromagnetic theory (general)

**Keywords:**

gauge transformation; Maxwell's equations; electromagnetic fields

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