THE PHOTONS BOUND STATES

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All known methods of describing the quantized electromagnetic field in media require of breaking the quantum correlators. In the method of quantum Green's functions the breaking correlators is justified by application of a thermodynamic limit [1]. Such a study is questionable. Evidence of this is the theory of superconductivity. In quantum optics the process of stimulated emission produce photons in strongly correlated states, and the gap between correlators need to break the description of those or other correlation effects. In the works [2,3] one proposed so-called the Г-operator method, which allows in quantum electrodynamics to avoid breaks correlators photon –photon, and pointing to the existence of some new optical correlation effects in the media. One of such effects is the inability to describe the behavior of a single photon in the excited media by a standard refractive index.

In this work we investigate other properties of the polarization operator arising in the Г-operator method. This polarization operator indicates the existence in excited media the bound photon states, formally resembling bound states of electrons in superconductivity theory. For breaking photon pairs one requires some energy that resembles the energy gap in superconductors. The elementary optical excitation that occurs when the inclusion of an external monochromatic perturbation of frequency , along with the occurrence of photon pairs and the external signal frequency contains the signal with a frequency that is formally **r**eminiscent of the Josephson effect. The growth of temperature and concentration of the excited atoms in medium entails an increase in the number of photon pairs and the loss of thermodynamic stability of the system. The formation of photon pairs manifests itself in the angle of refraction of the electromagnetic field on the interface that is available experimental verification.

References

1. Matzubara T. A. Progr. Theor. Phys., 1955, 14, 351-378.
2. Veklenko B. A. News of higher educational institutions. Physics (in Russian), 1978, 5, 77-81.
3. Veklenko B. A. JETP (in Russian), 1998, 114, 492-510.
4. B. A. Veklenko, Y. B. Sherkunov News of higher educational institutions (in Russian). Physics 2000, 6 , 17-21.