On the quantum theory of Fresnel reflection

Veklenko B.A.

Joint Institute for High Temperatures RAS, Moscow, Russia

The paper proposes a method for studying solutions of the equations of quantum electrodynamics of many particles, eliminating the need for forced rupture of quantum correlators in the process of solving.

 This method bridges the gap between the theories of quantum gases and the theories of superconductivity and superfluidity. Correct account of quantum correlation effects shows that there are analogues of Cooper and Josephson effects in gas media [1]. There existe analogues of the phenomena of superfluidity [1] and Andreev reflection in superconductors [2]. The proposed method made it possible to obtain an equation describing the evolution of the photon (Fock) state of the electromagnetic field in thermally excited media. By its physical properties, this equation differs from Maxwell's equations in thermally excited media, is not determined by the standard refractive index, and therefore predicts previously unknown optical effects. As an example, the process of Fresnel reflection from the interface is considered: thermally heated gas-vacuum. It is shown that even outside the scattering layer there are photon States associated with the scattering layer by quantum correlations or General wave functions. Such photons form, in particular, two previously unknown reflected beams. The quantum structure of photons in these rays shows that their correlation with the medium is not interrupted even at points sufficiently far from the scattering layer. The existence of two additionally refracted rays in the radiation transmitted through the scattering layer is indicated. One of these rays has the left-hand refracting properties.

References

1. B.A. Veklenko. Engineering physics No. 1, 31 (2018).
2. A.F. Andreev. ZhETF 46, 1823 (1964).