Tertiary quantization of quantum electrodynamics equations and bound States of photonic pairs [[1]](#footnote-1)\*)

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Veklenko B.A.

Joint Institute for High Temperatures RAS (JIHT RAS), Moscow, Russia. [veklenkoba@yandex.ru](mailto:veklenkoba@yandex.ru)

When solving the equations of quantum electrodynamics by the perturbation theory method, no problems arise. But if we are talking about the behavior of the electromagnetic field in dispersing media, the presence of many particles in the system and numerous interactions between them require the use of a forced procedure for breaking quantum correlators in calculations. This procedure cannot be avoided at present. It seems natural both in the method of chains of N. N. Bogolyubov and in the diagram technique of R. Feynman when replacing the algebraic theorem of Wick [1] with its thermodynamic version [2]. The resulting errors cannot be estimated simply because they can be hundreds of percent. In classical optics, the validity of the breaking of correlators is justified by the consideration of dust media. In quantum theory, such a procedure cannot be justified, since the wave function of two identical photons can never be represented as a product of single-photon wave functions because of their mutual orthogonality. The impossibility of breaking quantum correlators explains the thirty-year history of creation the theory of superconductivity. Standard methods of solutions here were insufficient.

We propose a method for solving the equations of quantum electrodynamics that avoids the forced procedure of breaking quantum correlators and predicts the existence of new correlation optical effects.

The idea of the method is as follows. Let us consider example. The nonrelativistic theory of the hydrogen atom is based on the Schrödinger equation. But we can use the second quantized equations of quantum electrodynamics. In the nonrelativistic approximation, we get the same result. Similarly, solutions of secondarily quantized equations can be found both by directly solving these equations and by solutions of these equations pre-quantized once again. It's a cumbersome path. Attempts at "tertiary" quantization have been made repeatedly [3], but, as far as we know, have not led to noticeable success. Their authors unsuccessfully tried to detect the presence of fundamentally new natural phenomena. We use "tertiary" quantization to the extent that its consequences coincide with the consequences of the secondarily quantized theories. But in the calculations, as will be shown, it is possible to avoid the forced procedure of breaking the quantum correlators. In turn, on this way it is possible to predict a large number of new correlation quantum effects, to build a bridge between the electrodynamics of gases and the theory of superfluidity. One of such effects is the possibility of existence of bound states of photon pairs in thermally excited media [4].

References

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4. Veklenko B. A. Engineering physics No. 1 (2018) 30-40.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Lt/ru/EA-Veklenko.docx) [↑](#footnote-ref-1)