

Nonlinear Interaction of Quasi-Particle with Thermostat and the Problem of Second Order Phase Transitions in Cooperative Phenomena of Condense Mater]

**Abstract**

A great deal of attention is currently devoted to the problem of coherence which appears not only between quanta but between groups of quanta too. The generation of non-classical coherent electromagnetic field in multi-photon emission and the interaction of coherent radiation with matter have been the subjects of a number of theoretical and experimental studies in recent years [1]. Examples include the higher-order coherence in multi-photon generation of light, the two-photon micro-maser emission; two-photon lasers the parametric down conversion, four-wave mixing and other effects in optical diapason.

The collective processes in condense matter have many analogical proprieties with cooperative non-linear optics. Examples are superconductivity [2], super-radiance [3], ferromagnetism etc. For example the Cooper-pairs created in the processes of non-linear interaction of electrons with lattice vibration contain the single and two-phonon exchange integrals between electrons. The large nonlinearity occurs, when the single-phonon exchange integral between band electrons is smaller than the multi-phonon exchanges. This is possible in the many-band superconductive materials, in which the nonlinear exchange integral arises through virtual bands of material [4].

The similar effect of nonlinear interaction can be observed and in the super-radiance theory and ferromagnetism if we consider that the exchange integral between the quasi-spins has the nonlinear character like in superconductivity. Considering that multi-quantum scattering process in condensed matter depends on the mean number of thermal phonons, it is possible the increasing of exchange integral between the electrons or spins , due to the dependence of nonlinear cooperative processes on the intensity of the thermal field. This report shown that order parameter of correlated quasi-particle in superconductivity, ferromagnetism or super-radiance firstly increases with temperature achieving the maximal value. After that it decreases as in traditional phase transition effects. In this case the competition between single- and two quanta exchange integrals takes place through nonlinear interaction. The behavior of quantum fluctuation of order parameter as function of temperature and single and two-quantum exchange integrals in condensed matter is discussed. The behavior of quantum

fluctuation of order parameter as function of temperature and single and two-quantum exchange integrals in condensed matter is discussed.

## References

- [1] M. O. Scully and M. S. Zubairy, Quantum Optics (Cambridge 1997), W.P.Schleich, Quantum Optics in Phase Space (Wiley 2001)
- [2] N.A. Enaki N.A.,V. Eremeev , NJP 4, 80.1-80.12 (2002)
- [3] Enaki N.A., Eremeev V. Phys. Lett. A 357, 104 (2006)
- [4] N.A. Enaki, JOLTP, 160, 157 (2010)

[

Nicolae A. Enaki

April 4, 2011