# Generation of polarization squeezed light in PPNC

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**Abstract**

Theoretical analysis is presented on quantum state evolution of polarization light waves at frequencies $\omega_o$ and $\omega_e$ in a periodically poled nonlinear crystal (PPNC). It is shown that the variances of all the four Stokes parameters can be squeezed.

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## Summary

During the last decade much attention has been paid to the realization of quantum information protocols [1] such as quantum teleportation, quantum cryptography. These protocols are based on the methods of nonlinear quantum optics. Nonlinear optical sources [2] play an important role in the generation of nonclassical states of light [3] and realization of optical quantum information protocols. The nonlinear optical processes such as degenerate parametric down conversion (type I and II processes) [2,3] and the Kerr effect [2,3] are used to create nonclassical states of light (squeezed states, polarization squeezed states and entangled states). The variance of one of the four Stokes parameters of polarization squeezed light is less than the corresponding value for the coherent state. Traditionally the degenerate parametric process (type II) and the Kerr effect are responsible for the generation of polarization squeezed states or polarization entangled states in ordinary nonlinear crystals. One can achieve suppression of variances of three Stokes parameters [5-9] ($\hat{S}_0, \hat{S}_2, \hat{S}_3$) in the type II process by using ordinary nonlinear crystal. Most of the quantum information protocols are based on type II process [1] and Kerr effect, which are used to generate entangled states. The entangled states are used in the realization of quantum teleporation and quantum cryptography protocols. Experiments on quantum teleportation and quantum cryptography are performed by using ordinary nonlinear optical crystals with second and third order nonlinear susceptibilities. In the past few years, some experiments in the creation and realization of nonclassical and entangled states are performed by using PPNCs with second order nonlinear susceptibilities. The PPNCs [10,11], which have many interesting advantages as compared to ordinary nonlinear crystals were proposed by Bloembergen and co-authors in 1962. The main advantages of PPNCs against ordinary nonlinear crystals are: the quasi-phase-matching condition between the interacting waves; the highest nonlinear susceptibility coefficient can be used; multi-mode interaction of optical waves.

Recent experiments on quantum noise reduction [12,13] and the generation of entangled states [14] promising the applications of PPNCs in the realization of optical quantum information protocols. These experiments were based on type I and II processes. It should be noted that the parametric down conversion (type I) and frequency sum generation processes have been studied theoretically [see for instance, [4] and the references therein] and experimentally [12-15] very well. In a PPNC, the type II process is much more complicated as compared to ordinary nonlinear crystals. The type II process in PPNC can be accompanied by three other nonlinear processes [4]. All these nonlinear processes can be quasi-phase-matched at certain coherent lengths [4]. Here we will study the generation of polarization squeezed states based on type II processes in PPNC with second order nonlinear susceptibility.

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