Title: Noncollinear phase matching in nonlinear optics

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Abstract: Luminescence in semiconductors can have very fast decay (in terms of picoseconds). Measuring the time evolution of the process requires resolution in terms of hundreds of femtoseconds ($\sim 10^{-13}$ s). This high resolution can be reached using optical upconversion method.

In the theoretical section of this report, we discussed the necessary theoretical background which was afterward used to solve a particular problem. We paid extra attention to collinear and noncollinear phase matching, optical upconversion, luminescence and nonlinear uniaxial BBO crystal (*beta-Bariumborat crystal*, $\beta - BaB_2O_4$).

In the practical section, we determined the tuning curve (dependence of the optimal orientation of the crystal on the luminescence wavelength) of the non-linear BBO crystal. The crystal was exposed to luminescence radiation and to switching laser beam. Both waves in the crystal propagate like ordinary rays and the sum frequency wave as extraordinary ray (phase matching of the o-o→e kind).

The tuning curve was at first determined in the case of collinear phase matching, when it is possible to neglect the angle between entering rays, and then in more general noncollinear phase matching case. Calculations were made for wavelengths of the laser beam 810nm and 760nm.

Obtained data will be used for measuring the time-resolved luminescence in laboratories of KCHFO. The more accurate tuning curve obtained by inclusion of the more general noncollinear phase matching will allow higher accuracy of experiments.

Keywords: Nonlinear Optics, Collinear and Noncollinear Phase Matching, Upconversion, Luminescence