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Certain nonlinear properties of the single crystal $Ba_2NaNb_5O_{15}$

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It has been observed that single-crystal barium-sodium niobate has 90° phase synchronism at 18 °C at a fundamental emission wavelength $\lambda = 10\,270$ Å.

In second-harmonic generation, the most convenient from the energy point of view is a phase synchronism angle 90°. To obtain this angle, however, it is necessary to heat the crystal to high temperatures, which is experimentally inconvenient.

We have observed that the congruent-form barium-sodium niobate single crystal has 90° phase synchronism at room temperature and at the fundamental wavelength $\lambda = 10270$ Å. The radiation source was the second Stokes component of stimulated Raman scattering excited in liquid nitrogen by a ruby laser.

The optical-quality single crystals grown by us had a chemical composition $Ba_{2.085}Na_{0.711}Nb_5O_{14.94}$. They were made single-domain and were oriented with accuracy not worse than 30′. The crystal point group is $mm2$. The components d_{311} and d_{322} of barium-sodium niobate, which are indistinguishable in a twinned crystal (the crystal is in fact uniaxial, i.e., $n_x \approx n_y \neq n_z$) admit of phase synchronism[1,1)]. Here n_x, n_y, and n_z are the respective refractive indices.

The phase synchronism angular half-width was 57′ and was measured with a two-limb goniometer by rotating the crystal about an axis perpendicular to the wave vector and the polarization of the incident wave.

1)The production of materials having 90° phase synchronism at room temperature and at the wavelength of the neodymium laser ($\lambda = 10\,640$ Å) was reported in[2,3].

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Use of the anomalous passage effect to obtain stimulated emission of γ quanta in a crystal

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The possibility of increasing the coherent active region in the generation of the paired Bragg state of γ quanta in a crystal by nuclei is demonstrated. To this end it is necessary that the Borrman effect be realized for one of the polarizations, that the suppression effect be simultaneously absent, and that the state with this polarization be an eigenstate of the crystal.

1. The possibility of observing stimulated emission of γ quanta of nuclei decaying in a crystal under conditions of the Mössbauer effect encounters great difficulties because the problem is critically sensitive to the values of the corresponding physical parameters (see, e.g., [1]). This is connected to a noticeable degree by the limited mean free path of the γ quanta in the medium, owing to absorption (and inelastic scattering) by the electrons. It seems at first glance that this limitation is of principal character and cannot be overcome.

Under conditions of Bragg diffraction in a perfect crystal, however, a coherent superposition of two waves (that differ by the reciprocal-lattice vector **K**) can be realized, and the absorption is greatly reduced for this superposition. This is the so-called Borrman effect (BE), [2] which occurs for waves with σ polarization (the electric field vectors are perpendicular to the scattering plane) and is connected with the fact that the total electric field has nodes at the lattice sites.

However, the vanishing of the electric field at the nucleus makes stimulated decay impossible if an electric dipole transition takes place. It was precisely this

