Figure 2 shows a plot of $\alpha(T)$ at constant pressure. The data on the equation of state of Cs for these conditions were taken from [7]. The maximum of the thermal emf is due to the fact that when T increases at constant pressure the main term in α, which is proportional to $I(p, T)/T$, first increases, since I increases as a result of the decrease in density, but then decreases when I becomes equal to the ionization potential I_0 of the atom. At lower temperatures α is small, since the electrons are degenerate in this case. Figure 2 (solid curves) shows calculations of the potentials

$$U = -\int_{T_{cold}}^{T_{hot}} \alpha dT$$

with $\alpha(T)$ taken from Fig. 1. The results of the calculations agree in order of magnitude with the measurement data.

In conclusion, the authors thank senior mechanics I. Puolokainen and N.P. Kostin for taking part in performing the experiment, and the seminar of the Laboratory for useful discussions.

[1] H. Lewis and J. Reitz, J. Appl. Phys. 30, 1439 (1959).
[2] B.Ya. Moizhes and P.E. Pikus, Fiz. Tverd. Tela 2, 756 (1960) [Sov. Phys.-Solid State 2, 697 (1960)].
[3] A.F. Ioffe, Poluprovodnikovye termoelementy (Semiconductor Thermocouples), AN SSSR, 1960.
[4] A.A. Vedenov, Paper at the Conference on the Physics of Queiescent Plasma, Frascati, Italy, 1966; A.A. Vedenov add V.A. Alekseev, Usp, Fiz. Nauk 102, 665 (1970) [Sov. Phys.-Usp. 13, No. 6 (1971)].
[5] V.A. Alekseev, TVT (High Temp. Physics) 6, 961 (1968).
[6] H. Renkert, F. Hensel, and F. Frank, Phys. Lett. 30A, 494 (1969).
[7] V.A. Alekseev, V.G. Ovcharenko, Yu.F. Ryzhkov, and A.P. Senchenkov, ZhETF Pis. Red. 12, 306 (1970) [JETP Lett. 12, 207 (1970)].

SPONTANEOUS PARAMETRIC EMISSION OF THE α-HIO_3 CRYSTAL

G.F. Dobrzhanskii, V.F. Kitaeva, L.A. Kuleskii, Yu.N. Polivanov, S.N. Poluektov, A.M. Prokhorov, and N.N. Sobolev
P.N. Lebedev Physics Institute, USSR Academy of Sciences
Submitted 19 October 1970
ZhETF Pis. Red. 12, No. 11, 505 - 508 (5 December 1970)

This paper is devoted to the first observation of spontaneous parametric radiation in a biaxial α-HIO_3 crystal belonging to class 222 of rhombic syngony.

It is known that when a crystal with quadratic nonlinearity is illuminated with a laser beam there is probability that the photon from the laser (henceforth referred to as the pump) with frequency ω_p will decay spontaneously into two photons, one with the signal frequency ω_1 and the other with the supplementary frequency ω_2 [1]:

$$\omega_p = \omega_1 + \omega_2. \quad (1)$$

The frequencies ω_1 and ω_2 of the parametric radiation are determined primarily by the dispersion characteristics of the crystal, since the process proceeds effectively when the following condition is satisfied:

$$\mathbf{k}_p = \mathbf{k}_1 + \mathbf{k}_2, \quad (2)$$

where $\vec{k}_p$, $\vec{k}_1$, and $\vec{k}_2$ are the wave vectors of the pump, signal, and supplementary waves.

The foregoing phenomenon is quite interesting, since it is observed even at pump powers too small to excite parametric generation, and also in the absence of a resonator; it can be used also to obtain the angle, temperature, and electro-optical tuning curves of active media suitable for the use in parametric generators of light.

The α-HIO_3 crystal is transparent in the 0.4 - 1.4 μ band and has high nonlinear constants $[(d_{14}^2(\alpha\text{-}HIO_3) = (1.5 \pm 0.5)d_{31}^2\ (LiNbO_3)$ for $\lambda = 1.065\ \mu)]$ [2, 3]. Unlike in $LiNbO_3$, no optical inhomogeneities appear in the refractive index of α-HIO_3 under the influence of optical radiation with high power density [2, 3]. This is of great importance for the development of parametric light generators.

In our experiments, the pump used was a CW argon laser with wavelengths λ_{p1} = 4880 Å and λ_{p2} = 5145 Å, and with output power up to 1 W at each of the wavelengths. The crystals measured 1 - 2 cm and were cut in such a way that the pump wave vector was in the principal plane (XZ) of the crystal and made an angle θ with the crystallographic axis X (the crystallographic axes of the crystals are designated in accordance with the IRE standards [4]). When the pump propagates in the XZ plane of the α-HIO_3 crystal, conditions (1) and (2) are satisfied simultaneously if the pump polarization vector and the polarization vector of one of the parametric frequencies lie in the XZ plane, and the polarization vector of the second parametric frequencies is parallel to the Y axis. The parametric radiation produced in the crystal and polarized

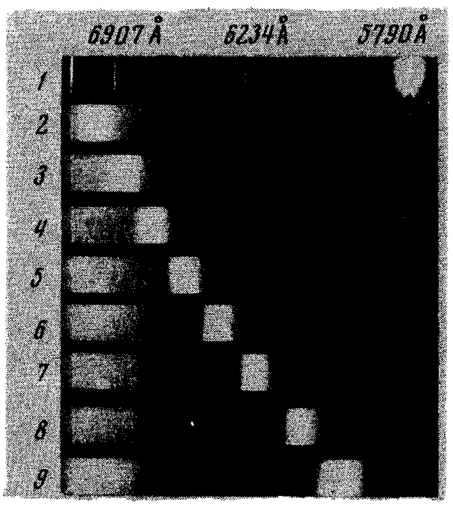

Fig. 1

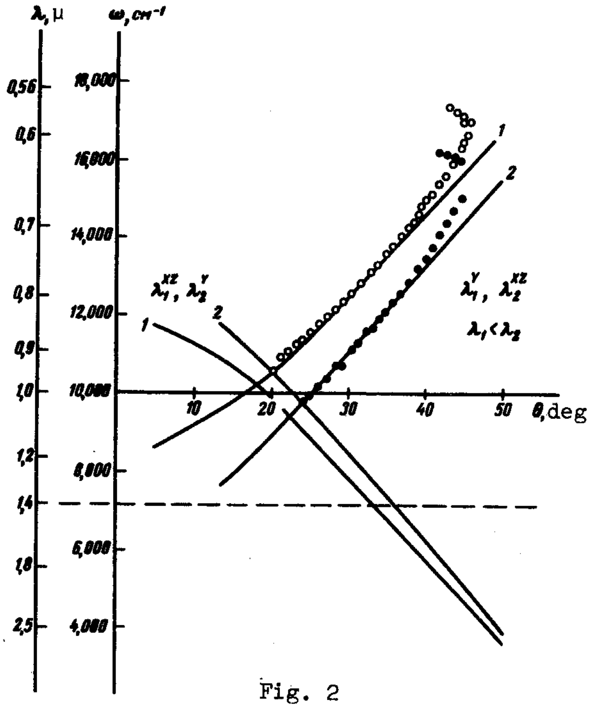

Fig. 2

Fig. 1. Spectrogram of spontaneous parametric radiation signal at λ_p = 4880 Å; 1 - mercury spectrum, 2 - 9 - signal spectrograms for angles θ = 38, 39, 40, 41, 42, 43, 44, and 45°, respectively.

Fig. 2. Tuning curves for the α-HIO_3 crystal at pump wavelengths λ_{p1} = 4880 Å (curves 1) and λ_{p2} = 5145 Å (curves 2). λ^{XZ} denotes that the wave is polarized in the XZ plane and λ^{Y} denotes polarization parallel to the Y axis.

along the Y axis was registered in the pump-propagation direction on photographic film with the ISP-51 spectrograph.

Figure 1 shows typical spectrograms of the spontaneous parametric radiation signal. These spectrograms illustrate the dependence of the signal frequency ω_1 on the direction of pump propagation in the crystal. The direction of propagation of the pump in the crystal (the angle θ) was varied by rotating the crystal about the Y axis.

Figure 2 shows the tuning curves of the α-HIO_3 crystal pumped at wavelengths λ_{p1} = 4880 Å (curves 1) and λ_{p2} = 5145 Å (curves 2). The solid curves are the results of calculation for the case of one-dimensional parametric interaction. The calculation was based on the refractive-index dispersion data for the α-HIO_3 crystal, measured up to λ = 1.2 μ in [3]. The dispersion of the refractive indices for λ > 1.2 μ was approximated with the Cauchy formulas. The experimental results are shown by circles for λ_{p1} = 4880 Å and by dots for λ_{p2} = 5145 Å. The dotted line shows arbitrarily the start of noticeable absorption of α-HIO_3 in the long-wave region of the spectrum. It is seen from Fig. 2 that anomalies are observed in the experimental tuning curves near ω_1 = 16000 cm^{-1}. We attribute these anomalies to the anomalous dispersion in the region of absorption of the supplementary frequency ω_2, where the Cauchy formulas no longer hold. Similar anomalies in the tuning curves near the absorption of the supplementary radiation were observed earlier in ADP crystals [5]. It follows from the experimental curves that $d\omega/d\theta \simeq 230$ cm^{-1}/deg for λ_{p1} = 4880 Å and $d\omega/d\theta \simeq 250$ cm^{-1}/deg for λ_{p2} = 5145 Å.

It should be noted in conclusion that the α-HIO_3 crystal can be used to produce both pulsed and continuous parametric light generators tunable in the range from ~0.6 to ~1.3 μ.

[1] S.A. Akhmanov and R.V. Khokhlov, Usp. Fiz. Nauk 88, 439 (1966) [Sov. Phys.-Usp. 9, 210 (1966)]; see also S.H. Harris, Proc. IEEE 57, 2098 (1969).

[2] S.K. Kurtz and T.T. Perry, J. Appl. Phys. 39, 3798 (1968).

[3] S.K. Kurtz, T.T. Perry, and J.G. Bergman, Jr., Appl. Phys. Lett. 12, 186 (1968).

[4] Standards on Piezoelectric Crystals, Proc. IRE 37, 1378 (1949).

[5] D. Magde and H. Mahr, Phys. Rev. 171, 393 (1968).

INDUCTION OF MAGNETIC FIELD AT THE NUCLEI OF DIAMAGNETIC TIN ATOMS IN YTTRIUM AND GADOLINIUM ORTHOFERRITES

I.S. Lyubutin and Yu.S. Vishnyakov
Crystallography Institute, USSR Academy of Sciences

Submitted 21 October 1970
ZhETF Pis. Red. 12, No. 11, 508 - 511 (5 December 1970)

We report here observation, with the aid of the Mossbauer effect, of strong effective magnetic fields at the nuclei of diamagnetic tin ions in the crystal lattice of yttrium and gadolinium orthoferrites ($YFeO_3$ and $GdFeO_3$).

The discovery of strong magnetic field at the nuclei of diamagnetic tin and antimony ions introduced in iron-garnet [1 - 5] and iron-spinel [6, 7] structures has aroused great interest. We assume that the special interest in this phenomenon is due to two causes: (1) these compounds are as a rule dielectrics, and therefore the transfer of the magnetic hyperfine interaction from a ferromagnetic atom to a diamagnetic one with the aid of conduction electrons is completely excluded here; (2) in these compounds the diamagnetic