Romanovskii, and A. M. Andrianov for the opportunity to perform the work and for continuous interest. The authors thank N. V. Fedorenko, V. V. Afrosimov, and R. N. Il'in for a discussion of the method.

[1] S. M. Trujillo, R. H. Neynaber, Lawrence L. Marino, and E. W. Rothe, IV Internat. Conf. on the Physics of Electronic and Atomic Collisions, Quebec, 1965.

[2] W. L. Fite, A. C. H. Smith, and R. F. Stebbing, Proc. Roy. Soc. A268, 527 (1962).

BARIUM STANNATE - A SOURCE FOR THE MEASUREMENT OF THE MOSSBAUER EFFECT ON Sn^{119}

M. V. Plotnikova, K. P. Mitrofanov, and V. S. Shpinel'
Nuclear Physics Institute, Moscow State University
Submitted 25 February 1966
ZhETF Pis'ma 3, No. 8, 323-326, 15 April 1966

The features of resonance absorption of 23.8-keV γ quanta from Sn^{119} make possible extensive use of the Mossbauer effect on tin for scientific research and technical purposes. The most frequently used sources of recoilless γ quanta are tin oxide SnO_2 or magnesium stannide Mg_2Sn.

An emitter based on SnO_2 is characterized by a high probability of resonance emission of γ quanta even at high temperatures ($f_{293°K} \cong 0.55$, $f_{600°K} \cong 0.42$ [1]). However, the SnO_2 emission line is not a singlet, but a doublet with splitting $\Delta \cong 0.5$ mm/sec [2].

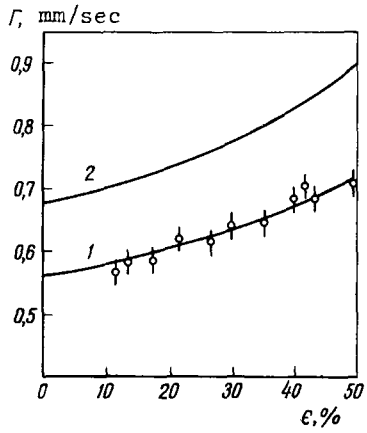
The spectrum of the Mg_2Sn source has the form of a Lorentz unbroadened curve [3]. Its resonance emission probability displays a strong temperature dependence. The low value $f = 0.28$ at room temperature [3] makes it necessary to cool the source to low temperatures during the measurements, thus making the experiment more difficult.

It would be very convenient to use for many scientific and technical purposes an emitter which possesses simultaneously a high probability of the effect at room temperature and a singlet unbroadened resonance-emission line.

Interest attaches in this respect to the stannates of barium, strontium, and calcium. Owing to the high symmetry of the crystal lattices of these substances (perovskite structure), the influence of the quadrupole interaction on the width of their spectral lines should be small.

The gamma resonance in these compounds was investigated earlier [4], where it was noted that the probability f of the effect has a weak temperature dependence and is large at room temperature. The observed absorption spectra of these stannates constitute single lines with width almost double the natural width.

Since no account was taken of the doublet character of the tin-dioxide spectrum in the reduction of the data of [4], where an SnO_2 source was used, we have repeated the measurements of the γ resonance with these stannates. The use of an Mg_2Sn source in conjunction with a resonance counter [5] has made it possible for us to determine with great accuracy the form of the spectra of $BaSnO_3$, $SrSnO_3$, and $CaSnO_3$. Since the use of a resonance counter reduces the



Dependence of the absorption-spectrum line width on the measured effect (after subtracting the nonresonant background). 1 - $BaSnO_3$ absorber, measured by the resonance method; 2 - Mg_2Sn absorber, measured by the usual method with an Mg_2Sn source [3].

width of the observed spectrum, the effective width of the source emission line was approximately 0.18 mm/sec. The measurements have shown that the width of the absorption spectra of the stannates are lower than those reported in [4], and in $BaSnO_3$ there was observed a single line of nearly natural width. Thus, barium stannate combines the favorable properties of the magnesium stannide and tin oxide emitters.

The $BaSnO_3$ source was prepared in accordance with the usual ceramic technology. A compressed and thoroughly ground mixture of stoichiometric amounts of $BaCO_3$ and tin dioxide containing radioactive Sn^{119} was annealed in air at 1300 - 1400°C for one hour. The material obtained was ground again, pressed, and annealed under analogous conditions. The barium stannate was then again ground and deposited on a substrate from a suspension in alcohol. The thickness of the obtained source, in terms of Sn^{119}, was approximately 0.1 mg/cm^2.

To estimate the parameters of the new $BaSnO_3$ source we compared it with the investigated Mg_2Sn source, the transmission spectrum of which was 0.36 mm/sec wide. To this end we plotted with both sources the absorption spectra of Mg_2Sn and $BaSnO_3$ absorbers of known thickness. These measurements have shown that the $BaSnO_3$ source has at room temperature (293°K) approximately the same probability of emission of resonance γ quanta and the same emission-line width as the Mg_2Sn source at liquid-nitrogen temperature.

To carry out further measurements with the $BaSnO_3$ source, a resonance counter [5] based on the same compound was prepared. Since the probability of the effect is larger for barium stannate than for Mg_2Sn at room temperature, the $BaSnO_3$ resonance counter has a higher efficiency for recording recoilless radiation (~15%). This resonance procedure makes it possible to reduce the width of the observed line by ~0.15 mm/sec, as can be seen from the plot of the barium-stannate absorption line width vs. the magnitude of the effect (see the figure).

The results of the measurement of the probability of γ resonance with $BaSnO_3$ ($f = 0.6$ at 293°K and $f = 0.46$ at 690°K) are in good agreement with the data of [4].

Thus, an absorber based on barium stannate has simultaneously a large probability of the effect and a near-natural spectrum width.

[1] Pham Zuy Hien and V. S. Shpinel', JETP 44, 393 (1963), Soviet Phys JETP 17, 268 (1963).

[2] K. P. Mitrofanov, M. V. Plotnikova, and V. S. Shpinel', JETP 48, 791 (1965), Soviet Phys. JETP 21, 524 (1965).

[3] V. A. Bryukhanov, N. N. Delyagin, and R. N. Kuz'min, JETP 46, 137 (1964), Soviet Phys. JETP 19, 98 (1964).

[4] Pham Zuy Hien, V. S. Shpinel', A. S. Viskov, and Yu. N. Venevtsev, JETP 44, 1889 (1963),

Soviet Phys. JETP 17, 1271 (1963).

[5] K. P. Mitrofanov, M. V. Plotnikova, and N. I. Rokhlov, PTE No. 4, 55 (1965).

PARAMETRIC INTERACTION OF INFRARED WAVES IN A MEDIUM IN WHICH INTENSE MOLECULAR OSCILLATIONS ARE EXCITED

B. A. Akanaev and Ya. Petselt
Physics Department, Moscow State University
Submitted March 1, 1966
ZhETF Pis'ma 3, No. 8, 327-329, 15 April 1966

Parametric interactions of light waves in a nonlinear medium are of great interest in connection with the problem of producing light generators that can be tuned in frequency; these interactions have been observed until now in the frequency regions near 1 and 0.7 μ [1 - 3]. There is undisputed interest in the observation of similar effects in the more remote infrared region. The present communication is devoted to a report of the preliminary results of an experiment carried out in this direction. The pumping was, as proposed in [4], with intense molecular oscillations (which can be excited by using stimulated Raman scattering (SRS), for example, in the visible part of the spectrum). Thus, in such a system the energy of the visible light (say from a ruby laser) can be transferred via the molecular oscillations to infrared waves whose frequencies satisfy the relation

$$\Omega_M = \omega_1 + \omega_2, \tag{1}$$

where Ω_M is the frequency of the molecular oscillations, provided the wave vectors satisfy the synchronization condition

$$\vec{k}_M = \vec{k}_1 + \vec{k}_2 \tag{2}$$

We present below the results of experiments, in which we observed parametric interaction of this type in gaseous hydrogen. Hydrogen was chosen on the basis of the following considerations:

1) weak dispersion (hence possibility of satisfying condition (2)),

2) absence of absorption at the frequencies of the ruby laser, SRS, and the interacting infrared waves.

A block diagram of the experimental setup is shown in the figure. M_1 and M_2 -- resonator mirrors, P_1 -- plane-parallel glass plate, L_1 -- quartz lens, L_2 -- fluorite lens, PC -- chamber with hydrogen, PD -- photodiode, ISP-28 -- quartz spectrograph, P_2 -- plane-parallel germanium plate, ZMR-2 -- mirror monochromator with LiF prism, PR -- photoresistor of germanium doped with gold, SI-II -- high-speed oscilloscope. The coherent molecular oscillations were excited in the