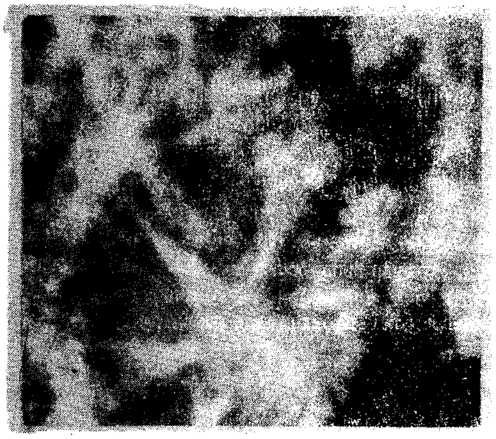

Fig. 2. Needle-like tungsten crystal after a microdeformation jump, σ = 1500 kg/mm^2, T ≈ 80°K.

lattice, and α_i is the polarizability of the free ions.

A calculation based on formula (1) shows that the energy of an interstitial atom emerging to the surface during the course of plastic deformation does not exceed 0.5 eV. This value is smaller by two orders of magnitude than the minimum energy characteristic of the propagation of dynamic crowdions [6]. At lower energies, conversion of the dynamic crowdions into focusons takes place, and the emergence of the latter to the surface would be accompanied by removal of surface atoms. Thus, the displacement of crowdions in low-temperature deformation of tungsten has a diffusion rather than dynamic character.

In many cases one observes, at loads up to 1500 kg/mm^2, a jump-like change in the shape of the sample; in this case the field-emission images do not reveal the microsteps characteristic of dislocation deformation. A crystal formed initially by evaporation in the field, loses its initial crystallographic faceting and a large number of displaced atoms are observed on the surface. The flux of atoms necessary to realize the observed deformation (Fig. 2) should be 10^{15} - 10^{16} atoms/cm^2.

It can be concluded on the basis of the presented experimental data that at low temperatures it is possible to have plastic deformation connected with migration of crowdions. This deformation can be regarded as a particular case of diffusion creep described by the Herring-Nabaro-Lifshitz model in the high-temperature region [7 - 9].

[1] V.N. Razhanskii, M.P. Nazarowa, I.Z. Svetlov, and L.K. Kalashnikova, Phys. Stat. Sol. 41, 579 (1970).

[2] R.I. Garber, Zh.I. Dranova, and I.M. Mikhailovskii, Dokl. Akad. Nauk SSSR 174, 1044 (1967) [Sov. Phys.-Dokl. 12, 585 (1967)].

[3] R.I. Garber, Zh.I. Dranova, I.M. Mikhailovskii, and V.A. Stryatienko, Zh. Eksp. Teor. Fiz. 54, 1025 (1968) [Sov. Phys.-JETP 27, 545 (1968)].

[4] A. Seeger, Phys. Stat. Sol. 38, 235 (1970).

[5] T.T. Tsong and E.W. Muller, Phys. Stat. Sol. (a) 1, 513 (1970).

[6] A. Seeger, Radiation Damage in Solids, I, Vienna, 1962, p. 101.

[7] C. Herring, J. Appl. Phys. 21, 437 (1950).

[8] F.R.N. Nabaro, Conference of the Strength of Solids, Phys. Soc., London, 1948, p. 75.

[9] I.M. Lifshitz, Zh. Eksp. Teor. Fiz. 44, 1349 (1963) [Sov. Phys.-JETP 17, 909 (1963)].

OBSERVATION OF γ QUANTA WITH ENERGY LARGER THAN 100 MeV FROM THE RADIO SOURCE 3C120

S.A. Volobuev, A.M. Gal'per, V.G. Kirillov-Ugryumov, B.I. Luchkov, and Yu.V. Ozerov

Moscow Engineering Physics Institute

Submitted 23 November 1970

ZhETF Pis. Red. 13, No. 1, 43 - 46 (5 January 1971)

The satellites "Kosmos-251" and "Kosmos-264" were equipped with an instrument recording γ quanta with energy $E_\gamma \geq 100$ MeV. The instrument constituted a γ telescope of two scintillation counters and one directional Cerenkov counter, with a lead converter with thickness of 1 radiative unit of length. The instrument was calibrated with cosmic-ray muons at sea level and with electrons of energy 100 - 1500 MeV in electron accelerators. The differential area of the instrument was ~90 cm^2 and the "viewing" angle was $2\theta \simeq 35°$. The calculated geometrical factor for an isotropic flux is 22 cm^2-sr. Two instruments of the same type were used in the flights. The table lists data on the satellites on which the γ telescopes were mounted.

No.	Satellite	Launching date	Orbit inclination, deg	Period T, min	Altitude, km	
					max	min
1	Kosmos-251	31 Oct. 1968	65	89.1	270	200
2	Kosmos-264	23 Jan. 1969	70	89.7	330	220

The instrument on each satellite was installed in the same manner: the angle between the axis of the instrument and the zenith was 57°. Secondary atmospheric γ quanta did not fall in the solid angle of the instrument. However, owing to the large amount of matter above the γ telescope (~10 g/cm^2), the instrument registered mainly secondary γ quanta generated by the cosmic rays in the material.

The counts from the instrument were registered only during selected orbits around the earth, were recorded in a memory device mounted on the satellite, and were transmitted to the earth by telemetry. The obtained data pertain to the time of operation of the instrument on each satellite from 1 to 200 orbits, and constitute mainly geomagnetic plots of N_1 and N_2 with two maxima (in the northern and southern hemispheres) and two minima (in the equatorial regions).

During one orbit of the satellite around the earth, the axis of the instrument described on the celestial sphere a circle of radius equal to the angle of inclination of the axis to the plane of the horizon. The instrument scanned effectively a region of space in a belt $\pm\theta$ relative to this circle. In the case of satellite No. 1, the "viewing" angle of the instrument included the galactic plane in the region of the anticenter.

Owing to the constant drift of the orbits, the routes scanned on the sky by the telescope were subject to a gradual shift (~3.5° daily in the case of satellite No. 1).

To extract from the obtained data information concerning the flux of the primary γ quanta from the region of the anticenter, we subtracted from the averaged geomagnetic plot of N_1 the average

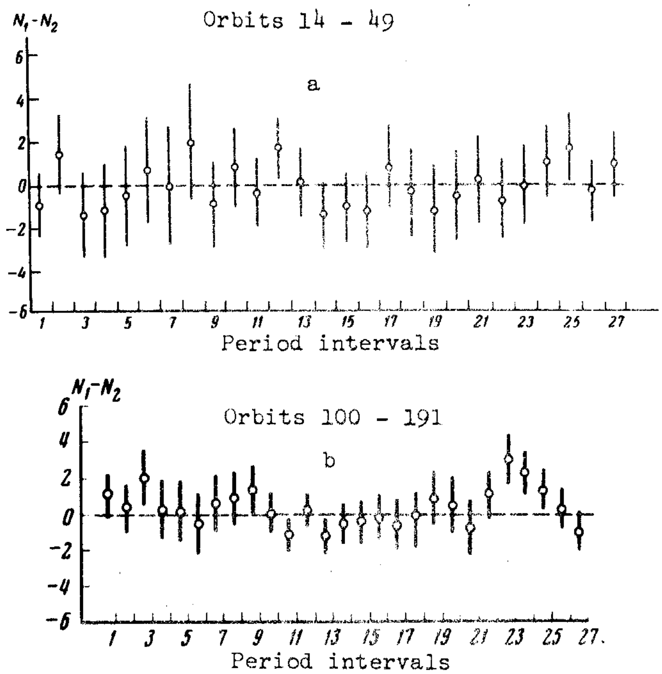

Fig. 1. Excess count of the instrument on satellite No. 1 as compared with No. 2: a - for the initial orbit (14 - 49), b - for the final orbits (100 - 191).

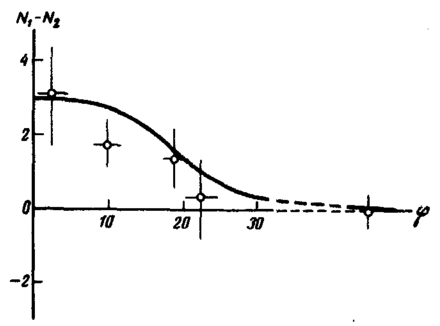

Fig. 2. Dependence of the excess $N_1 - N_2$ on the angle between the telescope axis and the 3C120 source.

geomagnetic plot of N_2. Since N_1 and N_2 were obtained at different times and on orbits with different inclinations, the counting rates of the instrument differed somewhat both in absolute magnitude and in the ratio of the count at the maximum to that at the minimum. Therefore, before carrying out the subtraction, the geomagnetic relations were reduced to a common form. This was done by equating to each other the points of N_1 and N_2 in the northern hemisphere and by modifying the N_2 plot in the southern hemisphere in accordance with the obtained "reconciliation" coefficients. The differences $N_1 - N_2$ for the initial (14 - 49) and final (100 - 191) orbits of satellite No. 1 are shown in Figs. 1a and 1b. Whereas there are no singularities whatever on the initial orbits, on the final orbits one can see quite clearly an increased count in the intervals 22 - 25 (the duration of the interval was 3.27 min for satellite No. 1).

Such a gradual appearance of an excess flux of γ quanta indicates more readily that it comes from a discrete source. The possible location of the source on the celestial map, determined from the scanning of the sky and the data of Fig. 1b, is limited to a region with the following coordinates: direct ascension $\alpha = (3.6 - 5.0)$ h, inclination $\delta = 4 - 9°$; this region includes the radio sources 3C120 (N-galaxy with coordinates $\alpha \simeq 4.5$ h and $\delta = 5°$) and the quasar 3C93 ($\alpha \simeq 3.7$ h, $\delta \simeq 5°$). It is most probable that the source of the registered excess flux of γ quanta is 3C120. This conclusion is based on the following considerations:

1) 3C120 occupies a central place in the region of the probable location of sources, and agrees best with the observed data. Figure 2 shows the excess $N_1 - N_2$ for different orbits, as a function of the angle between the axis of the γ telescope and the direction to the 3C120 source. The solid line shows the apparatus function obtained when calibrating the instrument in a beam of electrons of energy $E \geq 100$ MeV. Figure 2 demonstrates the good agreement between the change of the excess and the apparatus function.

2) It was observed that 3C120 has a variable radio emission in the wavelength interval 2 - 6 cm, with a period 0.7 - 1.5 years, and with a maximum occurring in October - November 1968 [1, 2]; this agrees with the time of the measurements with satellite No. 1.

3) For 3C120, the theory developed in [3] predicts a flash of γ radiation with intensity $\sim 10^{-4}(\mathrm{cm}^2\text{-sec})^{-1}$ for $E_\gamma \geq 100$ MeV, occurring during the time of increased activity in the radio band.

The rate of γ-quantum counting by the instrument, averaged over the intervals in which the excess flux was observed (Fig. 1b), is 2 ± 0.6 in a time interval of 3.27 min. The "zero" level, determined from the initial orbits of the satellite No. 1 (Fig. 1a) is -0.1 ± 0.5. The intensity of the 3C120 source calculated from these quantities is $(6.0 \pm 2.3) \times 10^{-4}$ $(\mathrm{cm}^2\mathrm{sec})^{-1}$ for $E_\gamma \geq 100$ MeV. The registered flux exceeds by more than one order of magnitude the flux from the only γ source observed to date Sgr γ-1 [4], and is sufficiently large not to be noted in the preceding investigations of the region of the anticenter (see, e.g., [5 - 7]). It can be assumed that we have registered an alternating γ-quantum source, having a duration not less than 5×10^5 sec, during the period of its increased activity.

The radiation power of the 3C120 source, the distance to which is 100 mps, amounts to $\sim 2 \times 10^{47}$ erg/sec during the time of the flash, for γ quanta with energy $E_\gamma \geq 100$ MeV.

The authors are deeply grateful to Prof. N.L. Grigorov and to Prof. I.L. Rozental' for a discussion of the work and for useful remarks.

[1] K.I. Kellerman and I. Paclini Toth. Astrophys. J. Lett. 152, 169 (1968).
[2] I. Locke, B.H. Andrew, and W.I. Medd. Astrophys. J. Lett. 157, 81 (1969).
[3] I.S. Shklovskii, Preprint IKI, Pr-30, 1970; Astron. zh. 47, 742 (1970) [Sov. Astron. AJ 14, No. 4 (1971)].
[4] G.M. Frye, Jr., J.A. Staib, A.D. Zich, V.D. Hopper, W.R. Rawlinson, and J.A. Thomas, Nature, 223, 1320 (1969).
[5] C.E. Fichtel, D.A. Kniffen, and H.B. Ogelman, Astrophys. J. 158, 193 (1969).
[6] G.M. Frye, Jr. and C.P. Wang, Astrophys. J. 158, 925 (1969).
[7] G.G. Fazio, Nature 225, 905 (1970).

Q SWITCHING OF A RUBY LASER BY DYE VAPORS

V.P. Klochkov, V.L. Bogdanov, and B.S. Neporent
S.I. Vavilov State Optical Institute
Submitted 23 November 1970
ZhETF Pis. Red. 13, No. 1, 47 - 48 (5 January 1971)

The appreciable differences between the processes occurring after the absorption of a quantum of light in free molecules of complex organic compounds, compared with dissolved ones, differences established earlier by us in various investigations of the absorption and luminescence of vapors of organic substances [1], have induced us to experiment with the use of such vapors for Q-switching of a ruby laser.

Q-switching with vapor of phthalocyanine (H_2Pc) and phthalocyanine of copper (CuPc) was observed at vapor optical densities $D < 0.6$ in a cell 6 cm long at a temperature close to 500°C. At $D > 0.6$, the generation stops. The data presented below pertain to CuPc. An increase of the peak power and narrowing of the pulses are observed already at $D \sim 0.06$, and the comparatively narrow pulse is accompanied by spike-like generation that begins approximately 10 μsec later. With increasing D, the pulse power increases and its width decreases, reaching at $D \sim 0.2 - 0.4$ the values obtained usually when the Q-switching is produced by solutions ($\Delta t \sim 20$ nsec). Further increase of D leads to an appreciable change in the pulse shape. A narrow peak (Fig. a) with duration $\Delta t < 5$ nsec (the resolution limit of the apparatus) appears against the background of a "broad" pulse. When the optimal value of D is approached, the slope of the leading front increases and a pulse of the type shown in Fig. b is produced. At the optimal optical density, which is close to the critical $D \sim 0.6$, a narrow pulse is observed, without the broad pedestal (Fig. c). The subsequent spike-like generation is either missing or weak (1 - 3 spikes are observed). The energy of the obtained pulses amounted to 1 - 3 J and was approximately equal to the energy of the free generation. The power developed in the pulse was $\sim 10^{18} - 10^{19}$ W,