QUADRUPOLE MOMENT OF THE ^{114}Cd NUCLEUS IN THE FIRST EXCITED STATE

D.S. Andreev, G.M. Gusinskii, K.I. Krokhina, M.S. Kudoyarov, I.Kh. Lemberg, and I.N. Chugunov
A.F.Ioffe Physico-technical Institute, USSR Academy of Sciences
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There is a great disparity in the values of the quadrupole moment Q_{2+} of the first excited state of ^{114}Cd, measured in investigations of the effect of reorientation in Coulomb excitation. According to [1 - 3], the value of Q_{2+} lies in the range -(0.42 - 0.90) b, but a later investigation yielded a value close to zero.

In the present investigation we have used, for the first time, a cyclotron for the determination of the value of Q_{2+} of the first excited state of ^{114}Cd. To exclude the influence of the instability of the intensity and the energy of the accelerated ions on the measurement results, we used in our experiments simultaneous acceleration of singly-charged α particles and triply charted carbon ions with energies 8 and 24 MeV, respectively. In this case the values of the Coulomb parameter ξ for both types of particles is practically the same, and the errors arising in the comparison are minimal. Separate experiments have shown that in the case of simultaneous acceleration the ratio of the energies of the light and heavy particles remains the same with accuracy not worse than 0.1%, and the ensuing error in the determination of Q_{2+} does not exceed 10%.

Unlike other investigations, in which γ-ray spectra were registered in coincidence with ions of selected energy, we have measured the spectra of the back-scattered ions in coincidence with γ quanta of selected energy. The ions were detected with a silicon annular detector, and the γ quanta with four NaI(Tl) crystals. The peaks corresponding to the actual and random coincidences of the α particles were fully separated, and the number of actual (S_α) and random (S_α^r) coincidences can be determined with high accuracy. The ratio k of the random coincidences of the γ quanta and α particles to the number of coincidences of the γ quanta with the carbon ions was determined in separate experiments. Knowing the counting rates N_α and N_C of the α particles and the carbon ions in the coincidence circuit, it is possible to determine the contribution of the random coincidences to the total number of coincidences with the carbon ions, $S_C^r = S^r(N_C/N_\alpha)k$, and to calculate the ratio of the Coulomb excitation probabilities $P_\alpha/P_C = S_\alpha N_C/S_C N_\alpha$.

To eliminate the influence exerted on the reorientation effect by the attenuation of the angular correlation of the γ quanta emitted by the recoil nuclei emitted from a thin target in vacuum following bombardment by heavy ions we used a special γ-counter geometry, described in detail in [5].

The following corrections were introduced in the experimental ratio: a) for the loss of the bombarding-particle energy in the target material (the target thickness was 440 ± 30 μg); b) for the missed counts and pileup of pulses in the recording channel; c) for the presence of other isotopes in the target; d) for the aberration of the γ quanta and the change of the γ-detector efficiency due to the Doppler shift of the energy. The ratio P_α/P_C was compared with the theoretical value obtained with a BESM-4 computer. In accord with the conclusions of [6], it was assumed in the calculation that the sign of the product

$$\langle 0 \| M(E2) \| 2 \rangle \langle 0 \| M(E2) \| 2' \rangle \langle 2 \| M(E2) \| 2' \rangle$$

is positive. It follows from a comparison of P_α/P_C with its theoretical value that $Q_{2+} = -(0.53 \pm 0.17)$ b.

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OBTAINING A GIANT PULSE IN A SOLID-STATE LASER WITH THE AID OF ORGANIC SOLVENTS

S.V. Gaponov, A.G. Goncharov, G.A. Kraftmakher, and Ya.I. Khanin
Radiophysics Research Institute, Gor'kii

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A giant pulse is generated, as is well known, in those cases when the loss in the resonator can be sharply reduced by the instant when the maximum population inversion of the active medium is reached. This can be attained, in particular, by placing a medium with nonlinear optical properties in the resonator. The most widely used are passive shutters based on the absorption-saturation effect [1, 2]. A number of workers have produced shutters based on stimulated Mandel'shtam-Brillouin scattered [3 - 5]. In principle, other nonlinear effects can also be used for this purpose.

In our experiment, the giant pulses were obtained with the aid of an organic solvent having no saturable absorption. A cell filled with this solvent was placed inside the misaligned laser resonator. A block diagram of the laser is shown in Fig. 1. The active element was a neodymium-glass rod measuring 130 × 10 mm. One of the resonator mirrors comprised a stack of three plane-parallel plates (M_1), and the other mirror was either a total-internal-reflection prism (M_2). The resonator length was 500 mm.

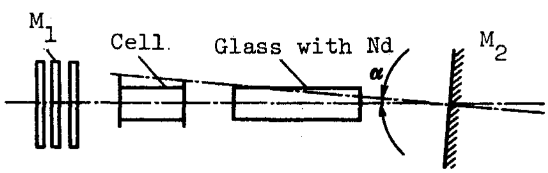

Fig. 1. Block diagram of experimental setup.

Insertion of a cell with acetone into the resonator has practically no influence on the threshold pump, but changes noticeably the generation kinetics. So long as the alignment is not disturbed, the presence of the solvent is manifest in a shortening of the spikes with simultaneous increase of the intensity and of the interval between them; this agrees with the results of [6]. The more M_2 is inclined, the more the spike amplitudes increase and the shorter their durations. It is easy to choose conditions such that only one giant pulse is emitted per flash. Figure 2 shows an oscillogram of a giant pulse with a half-power duration 10 - 15 nsec and energy of the order of 1 - 2 J. It corresponds to an inclination of the mirror M_2 by an angle $\alpha \approx 6 - 8'$ and a pump energy exceeding the threshold value (for the resonator before misalignment) by approximately four times. It should be noted that the effect is not very sensitive to the change of the resonator parameters.

The distribution of the field in the near zone is shown in Fig. 3. The spectrum of the giant pulse contains 3 - 6 components, the distance between which corresponds to the Stokes shift in stimulated Mandel'shtam-Brillouin