Concerning the article "Anomalies of the electronic magnetic susceptibility of plates"

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ZhETF Pis. Red. 20, 139–139 (July 20, 1974)

In our earlier paper[1] we predicted quasiperiodic oscillations of the electronic magnetic susceptibility of plates in a magnetic field parallel to the boundaries; these oscillations are due to electrons whose quasiclassical orbits are tangent to both boundaries of the plate. When the orbit is tangent, indeed, a relatively abrupt restructuring of the energy spectrum of the electrons takes place, and this could lead (in our opinion) to the appearance of the periodic term with an amplitude that depends in power-loss action on the quasiclassical parameter $\kappa = 1/n$ (n is the number of magnetic-field-flux quanta passing through the external orbit tangent to the two plate boundaries). The calculation was carried out with the aid of the Poisson formula. An analysis shows that an error has crept into the calculation. The transition from one section of the spectrum (reflected electrons) to another (electrons that do not collide with the plate boundaries) is not abrupt enough ($\Delta\epsilon \sim n^{-2/3}$), as the result the amplitude is (formally) $\sim \exp(-1/\kappa^{1/3})$. However, a calculation of exponentially small terms cannot be carried out with the quasiclassical spectrum used in[1].

Thus, at present there are no grounds for stating that an oscillatory dependence on the magnetic field should be observed in the diamagnetic susceptibility of dielectric plates.

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[1] M. I. Kaganov and S. S. Nedorezov, ZhETF Pis. Red. 18, 330 (1973) [JETP Lett. 18, 193 (1973)].

Investigation of the mechanism of broadening of resonance lines in ruby by the photon echo method

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(Submitted May 12, 1974; resubmitted June 20, 1974)
ZhETF Pis. Red. 20, 139–144 (July 20, 1974)

From an analysis of the experimental dependence of the photon echo on the polarization, contour, and propagation directions of the exciting pulses, on the intensity of the constant magnetic field, and on the time τ between the pulses, it is found that the decisive contribution to the damping of the echo in the ruby, at a Cr^{3+} ion concentration ~ 0.1 at.%, is made by magnetic dipole-dipole interactions. It is established that this damping is determined by the exponential $-\exp(-A\sqrt{\tau})$, where A is a damping constant corresponding to the magnetic dipole-dipole interactions.

The photon echo method[1,2] is effective both in investigations of the nature of the broadening of the resonance line and the characteristic relaxation time,[3–5] in the analysis of the dynamics of generation of optical pulses, and in the study of their waveform and spectral composition. This is made possible by the fact that the optical quantum system consists of a set of quasi-independent "spin packets," which interact in different manners with each of the exciting pulses. Therefore the anomalies in the waveform and in the instants of the appearance of the coherent responses are connected to a large degree with the extent to which the sequence of exciting pulses recombines these elementary acts of ion-photon interaction. Calculation shows that in the case of nonresonant and multifrequency excitation of coherent responses, time shifts should be observed, together with waveform distortions and changes in the characteristics of the photon echo. When the pulse duration is decreased (and consequently their spectra are broadened), these phenomena become more and more manifest, as is confirmed by our experiments.

The photon-echo signal is a coherent spontaneous optical response of a resonant medium to a two-pulse laser excitation. The duration Δt of the exciting pulses and the time τ between them should be shorter than all the irreversible relaxation times. Figure 1 shows the oscillograms of the signals in ruby, which were obtained by us experimentally. As seen from Fig. 1a, the maximum of the photon-echo signal takes place at the instant of time 2τ. The direction of the wave vector $\mathbf{k}_e$ of this signal satisfies the spatial-synchronism condition $\mathbf{k}_e = 2\mathbf{k}_2 - \mathbf{k}_1$, where $\mathbf{k}_\eta$ ($\eta = 1, 2$) are the wave vectors of the exciting pulses. In a number of cases, however, the instant of the appearance of the maximum of the echo was shifted from the instant 2τ by 4–5 nsec. In addition, a correlation was observed between the waveform of the echo and the contours of the exciting pulses. The oscillograms of such signals (we shall call them "anomalous") are shown in Fig. 2.

The working sample, in the form of a plate (with sides 1×1 cm and thickness 0.07 cm) of Al_2O_3 crystal