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EFFECT OF PULSED MAGNETIC FIELD ON QUADRUPOLE SPIN ECHO

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We investigate the effect of a pulsed magnetic field on quadrupole spin echo. Observing the beats of the spin-echo envelope permits small shifts of the NQR frequencies to be observed against the background of an appreciable inhomogeneous broadening of the spectral line.

The pulsed method of observing NQR signals has made it possible to register small electric-field-induced shifts of the NQR frequency against the back-round of an appreciable inhomogeneous broadening of the spectral line [1, 2].

The effect of a constant magnetic field on quadrupole spin echo is dealt with in [3 - 5]. The beats of the spin-echo envelope (SEE) in a constant magnetic field are determined by the interference effects [6] resulting from mixing of the states $|+1/2\rangle$ and $|-1/2\rangle$, and also of the states $|+m\rangle$ and $|-m\rangle$, if the asymmetry parameter η of the electric field gradient (EFG) is not equal to zero.

If $I \neq 3/2$ and $\eta = 0$, the constant electric field lifts the degeneracy of the states $\pm m$ and leads to an inhomogeneous broadening of the NQR lines. Since the spin-echo amplitude is determined only by homogeneous broadening, no SEE beats are observed for the transitions $\pm m \leftarrow\rightarrow \pm(m + 1)$, where $m \neq 1/2$.

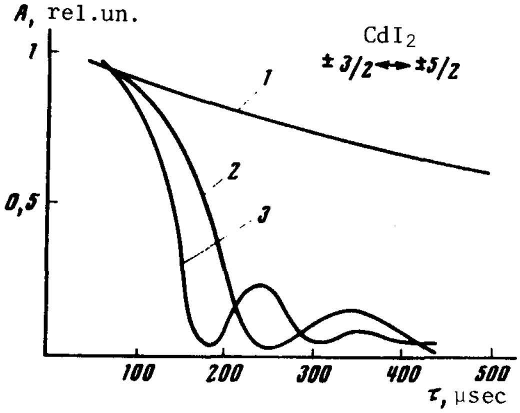
We succeeded in observing the effect of a pulsed magnetic field on the SEE. As follows from the general principle of observing external actions that lead to inhomogeneous broadening of the NQR line [1, 2], the external magnetic field should be applied in one of the two intervals $0 - \tau$ and $\tau - 2\tau$, using a two-pulse program for registering the NQR signal.

In single crystals having bonds that are equivalent with respect to the magnetic field and contain quadrupole atoms, the SEE beats are observed in a pulsed magnetic field and are described by the relation

$$A = A_0 \cos [(2\pi\Delta\nu_L \cos\theta)\tau],$$

where A_0 is the SEE in a zero magnetic field, $\Delta\nu_L$ is the Larmor frequency of the investigated quadrupole nucleus in the field H, and θ is the angle between the $\vec{H}$ direction and the EFG axis.

In polycrystals, the SEE is modulated by the Fourier transform of the function $h_H(\nu)$, which describes the shape acquired in a field of intensity H by an NQR resonance line that is monochromatic in a zero field.



Effect of pulsed magnetic field on the NQR spin-echo envelope: 1 — H_{const} = 3 Oe, 6 Oe; 2 — H_{pulse} = 3 Oe, 3 - H_{pulse} = 6 Oe.

The investigations were performed with an IS-2 NQR spectrometer at liquid-nitrogen temperature. The SEE was registered with a "boxcar" integrator and a special program unit. The magnetic field was produced with Helmholtz coils and pulsed power supply.

The figure shows, with CdI_2 ($I = 5/2$, $\eta = 0$) as an example, the effect of a pulsed magnetic field on the SEE.

If beats due to interference effects are observed in the SEE, then the SEE is additionally modulated in a pulsed magnetic field by the Fourier transform of the function $h_H(\nu)$. This phenomenon was observed by us on the transitions ±1/2 — ±3/2 in CdI_2 and in the transitions ±1/2 - 3/2 and ±3/2 - ±5/2 in $(CO)_{10}Re_2$ ($\eta = 0.88$).

The phenomenon of SEE beats in a pulsed magnetic field is to some extent the dual of the phenomenon of SEE beats of EPR in a pulsed electric field, and is closely connected with the technique of double NQR-NQR resonance [8].

The observed phenomenon will undoubtedly stimulate further studies of the influence of external factors on NQR spectra, and further development of the techniques of double NQR-NQR resonance.

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FEATURES OF EXCITATION OF AUTOIONIZATION STATES OF Ne ATOMS IN SLOW COLLISIONS WITH Na^+ IONS

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The excitation of discrete groups of fast electrons by collision of Na^+ ions with Ne atoms has been investigated at the relative-motion energies W from 80 to 320 eV. Resonant excitation of the autoionization states of neon has been observed at W near 150 eV.

Principal attention in investigations of the energy distributions of electrons released in atomic collisions has been focused on the identification of the discrete electron groups. The conditions for the excitation of the auto-ionization states with which the appearance of such groups is connected have been little investigated. In particular, the excitation functions of the indicated groups in slow ion-atom collisions, insofar as we know, have been directly investigated only in [1, 2].

A systematic investigation of the integral energy distributions of electrons released in collisions of alkali-metal ions (Na^+, K^+, Rb^+, and Cs^+) with atoms of all inert gases [3] has shown that the conditions for the excitation of discrete groups depend strongly on the partner