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ERRATUM

Erratum to: "On the Possibility of the Dynamic Self-Polarization of Nuclear Spins in a Quantum Dot" [JETP Letters 98, 266 (2013)]

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In [1], Eqs. (10), (11), and (12) should be replaced by Eqs. (2), (3), and (4), respectively, given below.

In [1], for the self-polarization of nuclear spins in a quantum point, it was proposed to use the mechanism of relaxation of an electron spin through the hyperfine interaction, where fluctuations of an electric field serve as a thermal reservoir. However, fluctuations of an electric field in the quantum dot were erroneously related to the voltage at the total capacitance of the considered electric circuit rather than the capacitance of the capacitor $C_{\rm qd}$ creating the quantum dot. Thus, the correct expression for the total resistance of the circuit $Z(\omega)$ at the frequency ω has the form

$$Z(\omega)^{-1} = \left(R + i\omega L + \frac{1}{i\omega C_{\rm v}}\right)^{-1} + i\omega C, \qquad (1)$$

where $C = C_0 + C_{\rm qd}$ is now the sum of the additional capacitance and capacitance of the quantum dot and R, L, and $C_{\rm v}$ are still the active resistance, inductance, and capacitance of a varicap, respectively. In this case, the real part of the total resistance is given by the expression

$$R(\omega) = \frac{R}{(1 + C/C_{\rm v} - \omega^2 LC)^2 + (RC\omega)^2}. \qquad (2)$$

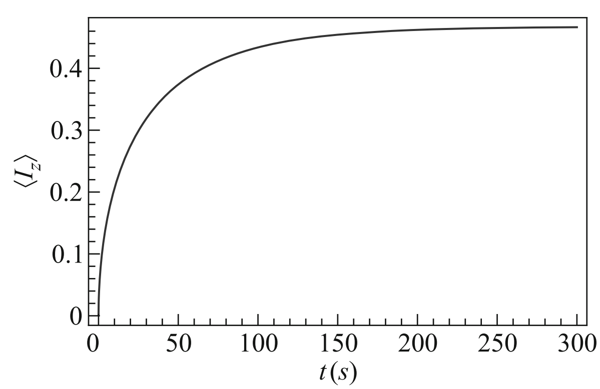
In the limit $C \gg C_{\rm v}$ at a given relaxation energy $\hbar\omega = A\langle I_z\rangle$, which corresponds to the Zeeman splitting energy in the effective magnetic field of nuclei, the presence of resonance is still determined by the condition $\omega^2 = 1/\sqrt{LC_{\rm v}}$. However, the dynamic equation for the average nuclear spin $\langle I_z\rangle$ has a somewhat different form

$$\frac{d\langle I_z\rangle}{dt} = -\frac{\gamma_0}{\langle I_z\rangle}\coth\frac{A\langle I_z\rangle}{2T}\left(\langle I_z\rangle - \frac{1}{2}\tanh\frac{A\langle I_z\rangle}{2T}\right) - \frac{\nu_0\langle I_z\rangle}{1 + (A\langle I_z\rangle/\hbar\Gamma)^2}, \qquad (3)$$

where

$$\gamma_0 = \frac{\pi}{3N^2}\frac{(A/\hbar)}{\Omega_0^2}\frac{1}{RR_QC^2}, \quad \nu_0 = \frac{4}{3N^2}\frac{(A/\hbar)^2}{\Gamma}. \qquad (4)$$

The main difference is in a negative exponent of the power-law dependence of the right-hand side of the equation on $\langle I_z\rangle$, which results in a much sharper increase in $\langle I_z\rangle$ at the initial time if the polarization rate is higher than the depolarization rate.



Time dependence of the nuclear polarization $\langle I_z\rangle$ according to Eq. (3) at the parameters $\gamma_0 = 10^{-2}$ s^{-1} and $\nu_0 = 10^2$ s^{-1}, temperature $T = T_c/2$, and the initial polarization $\langle I_z\rangle_{t=0} = 10^{-3}$.

At the same parameters of the quantum dot and electric circuit as in [1] (i.e., $A \approx 0.1$ meV, $\hbar\Omega_0 \sim$ 1 meV, $\Gamma \sim 10^8$ s^{-1}, $N \sim 10^6$, $L \sim 1$ mH, and, correspondingly, $C_v \approx 1/(L\omega^2) \sim 10^{-7}$–$10^{-1}$ pF), but at a lower resistance $R \sim 10^{-2}$ Ω and a lower capacitance $C \sim 1$ pF, the parameters become $\gamma_0 \sim 10^{-2}$ s^{-1} and $\nu_0 = 10^2$ s^{-1}. The figure shows the time dependence of $\langle I_z \rangle$ (solution of Eq. (3)) obtained with these parameters at the initial value $\langle I_z \rangle_{t=0} = 10^{-3}$, which corresponds to a typical fluctuation of about $1/\sqrt{N}$ of the average nuclear spin.

REFERENCES

1. V. A. Abalmassov, JETP Lett. **98**, 266 (2013).