the order of 10^{-2} (the frequency of the ion collisions is $\tau^{-1} \sim 10^{10}$ sec^{-1}, corresponding to collisions with neutral particles whose density is $n \sim 0.01n_0$).

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RELAXATION OF μ^+-MESON SPIN IN SUBSTANCES WITH SATURATED BONDS

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According to the presently accepted theory [1 - 3], the depolarization of a μ^+ meson in matter is due to the formation of a hydrogenlike muonium atom. The produced muonium can have a spin I = 0 and I = 1. In the case of polarized μ^+ mesons, both these states are produced with equal probability. The production of muonium with I = 0 leads to depolarization of the μ^+ meson within a time $t = 1/\omega_0 \approx 3.6 \times 10^{-11}$ sec, where ω_0 is the frequency of the hyperfine splitting of the ground state of the muonium. When muonium with I = 1 is produced, the μ^+ meson is not depolarized. Owing to the interaction with the medium, the muonium electron can charge the spin direction, which leads to transitions $I = 1 \rightleftarrows I = 0$, which lead to further depolarization of the μ^+ meson. The muonium process of depolarization terminates when muonium enters into a chemical bond with the molecules of the medium. The two parameters not calculated in the theory, namely the lifetime τ of the muonium and the frequency ν of the depolarization of the muonium electrons, determine the residual polarization P_{res} of the μ^+ meson in the substance at the instant of termination of the muonium stage. It is obvious, that P_{res} increases with decreasing τ. The dependence of P_{res} on ν has a more complicated form. At $\nu = 0$, the polarization P(t) decreases rapidly within a time t_0 to $P_{res} = 1/2$, and subsequently remains constant. With increasing ν at a given τ, the polarization P_{res} first decreases, reaches a minimum at $\nu \approx \omega_0$, and then begins to increase and tends to unity at $\nu >> \omega_0$ [3].

We have investigated the depolarization of the μ^+ meson in saturated hydrocarbons (hexane, heptane, octane) and in methyl alcohol - substances with saturated bonds. It can be assumed that the time τ that muonium enters into a chemical reaction with the molecules of these substances is relatively long. The large lifetime of the muonium, $\tau > 1/\omega_0$, at low frequencies $\nu << \omega_0$ should lead to a complete depolarization of the μ^+ meson in the state with I = 0, i.e., to $P_{res} < 1/2$. The values $\tau < 1/\omega_0$ and $\nu << \omega_0$ should lead, in addition, to an appreciable dependence of the residual polarization P_{res} of the μ^+ meson on the transverse magnetic field $H_\perp$ [3]. The $P_{res}(H_\perp)$ dependence is due to the fast "muonium" precession of the spin of the μ^+ meson during the lifetime τ of the muonium. The spins of the individual μ^+ mesons "turn" in this case through different angles, leading to a decrease of the residual polarization P_{res}.

Experiment did not confirm these assumptions (see the table). It was found that the residual polarization of the μ^+ meson in the investigated substances exceeds the value $P_{res} = 1/2$ and does not depend on $H_\perp$. Such a result does not agree with the muonium theory of depolarization of the μ^+ meson either at $\tau < 1/\omega_0 = 3.6 \times 10^{-11}$ sec or at high frequencies $\nu > \omega_0$ [3].

It is seen from the table that the residual polarization P_{res} in all the investigated substances is larger than 1/2. It can be assumed that the values $P_{res} > 1/2$ are due to the fact that some of the muonium atoms enter into a chemical bond without having time to slow down to thermal velocities and retain thereby the initial polarization of the μ^+ meson (reactions of "hot" chemistry). If in addition $\tau > 1/\omega_0$ and $\nu \ll \omega_0$ for the remaining (thermalized) muonium atoms, then in spite of the summary value $P_{res} > 1/2$, one should observe for the given substance a decrease of P_{res} with increasing $H_\perp$. From the data of the table it follows that no such $P(H_\perp)$ dependence is observed. Nor is a $P_{res}(H_\perp)$ dependence observed also when the temperature is lowered to -78°C. Thus, the dependence of the residual polarization of the μ^+ meson on the transverse magnetic field, $P_{res}(H_\perp)$, obeys in the investigated substances with saturated bonds the same laws as for many other substances considered in [4].

It is seen from the table, furthermore, that for all the investigaged substances a lowering of the temperature to -78°C does not lead to a change of P_{res}.

Residual polarization P_{res} of μ^+ mesons in methyl alcohol and in saturated hydrocarbons (hexane, heptane, octane)

Substance	H, Oe	T, °C	P_{res}
Methyl alcohol (spectrally pure)	50	20	0.60 ± 0.02
	90	20	0.61 ± 0.03
	3400	20	0.62 ± 0.05
Hexane (spectrally pure)	50	20	0.62 ± 0.03
	100	20	0.57 ± 0.06
	3400	20	0.67 ± 0.08
	7	-78	0.62 ± 0.03
	100	-78	0.60 ± 0.05
	200	-78	0.57 ± 0.03
Heptane (chemically pure)	100	20	0.57 ± 0.06
	100	-78	0.56 ± 0.05
	1400	-78	0.60 ± 0.04
Octane (chemically pure)	100	-78	0.52 ± 0.05

The work was performed with the beam of polarized μ^+ mesons of the JINR synchrocyclotron. The residual polarization P_{res} of the μ^+ meson in matter was measured by the method of precession in a transverse magnetic field [4].

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FAST PARTICLES IN A PARAMETRICALLY UNSTABLE PLASMA

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The theory of parametric action of radiation of high intensity on a plasma has made it possible to reveal the conditions under which parametric instabilities occur [1, 2], to predict the phenomenon of anomalously rapid transfer from the field to the plasma [1, 3], and to determine in a number of cases the anomalous high-frequency conductivity of the plasma [3, 4]. The predictions of the theory were confirmed by experiment and the physical picture of the development of the parametric instabilities came into extensive use for the interpretation of the experimental data. In this communication we wish to touch upon the question of the formation of rapid particles in a parametrically unstable plasma, bearing in mind the fact that the experimental study of the reaction of high-power radiation on the plasma has come to be accompanied frequently with measurement of the particle velocity distribution. The corresponding capabilities of the theory were revealed in [1, 3, 5]. However, the concrete results of the theory have so far been limited in fact to the approximation of a Maxwellian distribution, in which the cause of the temperature rise was the development of parametric instabilities [3, 6].

We wish to call attention below to such a cause of the appearance of fast particles in experiments with powerful electromagnetic fields, such as Cerenkov interaction of waves with particles. It is precisely such an interaction which is taken into account by the main equation of the quasilinear approximation of the theory of parametrically unstable plasma [3]. Bearing in mind the inertia of the ions, we shall assume their distribution to be Maxwellian and constant in time. To consider the evolution of the electron distribution $F_e(\vec{v}, t)$ and of the field $\vec{E}(\vec{k}, t)$, we use the system of equations (e and m are the charge and mass of the electron):

$$\frac{\partial F_e}{\partial t} = \frac{\partial}{\partial v_i} D_{ij}(v, t) \frac{\partial F_e}{\partial v_j}; \tag{1}$$

$$\frac{\partial}{\partial t} |\mathbf{E}(\mathbf{k}, t)|^2 = 2\gamma(\mathbf{k}, t) |\mathbf{E}(\mathbf{k}, t)|^2 . \tag{2}$$

To illustrate the consequences ensuing from this system of equations, we assume the parametric-instability increment in the form (see [2]):

$$\gamma = \frac{1}{4} (k r_E)^2 \frac{\omega_{Li}^2 \omega_0 \Delta\omega_0 \tilde{\gamma}}{[(\Delta\omega_0)^2 + \tilde{\gamma}^2]^2} .$$

Here $r_E \equiv (\vec{e}\cdot\vec{E}_0/m\omega_0^2)$ is the amplitude of the oscillations of the electrons in the field of the pump wave $\vec{E}_0 \sin\omega_0 t$, $\Delta\omega_0$ is the difference between the frequencies of the external pump field and the high-frequency plasma wave ($\Delta\omega_0 > 0$), $\tilde{\gamma}$ is the damping decrement of the high-frequency plasma wave, and