tion of media with noticeable absorption, we used low powers and thin layers of the medium). The radius of the intense beam was several times larger than the dimensions of the particle. The profile of the sounding coloring beam could be chosen arbitrarily.

The display was on a screen located 1.5 m from the layer of the medium. Observation was with the aid of IR binoculars, and motion pictures were taken in the red light of the auxiliary laser.

A growth of the overlap area, by up to 30 times and more, was registered. The strongest effects were observed in Plexiglas, which has a large derivative n'_T of the refractive index.

We observed[6] a new type of self-focusing in the region of perturbations of the medium with $n'_T > 0$ near the absorbing particle. A smooth rapid transition from the shadow region to the bright point at the center was observed.

These experiments demonstrated the process of aureole refraction from centers giving thermal aureoles with dimensions exceeding the wavelength of the light. The case of aureoles with dimensions that are small compared with the wavelength also admits of a simple description.

The great abundance of natural and artificial media with inhomogeneities (impregnations, sols, dislocations) make the foregoing effects promising in practice. Cases are possible when the transparency and the scattering ability can depend so strongly on the intensity that even a barely noticeable haze or a slightly scattering cloud may turn out to be opaque to light of high intensity. The pulsed character of the processes makes it possible to use them to produce modulators with variable transmission or reflection. These effects can be the cause of power or energy limitation, for example in such working elements as neodymium glass with small platinum particles or other technological impurities.

This effect can be observed also in intense flashes of incoherent light.

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B. B. Kadomtsev, Matter in a Superstrong Magnetic Field

In fields of 10^{12}–10^{24} Oe, which according to present notions can exist in neutron stars, there should occur a noticeable change of the physical properties of matter. Namely, a complete realignment of the electron shells takes place in an atom with atomic number Z at $B > Z \times 10^9$ Oe. All the electrons are then at the lower Landau levels, their magnetic moments are oriented along the field, and the electrons move in thin crylindrical shells with symmetry axis passing through the nucleus and directed along the field. In the field interval $10^9 Z \ll B \ll 10^9 Z^3$ Oe the ground state of the heavy atom can be described within the framework of the modified Thomas-Fermi approximation, which shows that the atom retains its spherical symmetry, and its volume decreases like $B^{-6/5}$. In a field $B \gg 10^9 Z^3$ Oe the atoms are stretched out along the magnetic field, and since they have a large quadrupole moment they can form molecules with high binding energies.

In a sufficiently strong magnetic field, the ionization energy of the atoms and the dissociation energies of the molecules can be so large that the neutral atoms and molecules can exist even at very high temperatures. If the temperatures are not very high, then the atoms and molecules in the superstrong field can become condensed into a solid phase. A preliminary analysis shows that the solid should apparently be a polymer.

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I. I. Gurevich, Investigation of the Condensed State of Matter with the Aid of Positive Muons

A new method for studying the properties of method and the kinetics of chemical reactions with the aid of muons has been developed recently at the Atomic Energy Institute, the Nuclear Problems Laboratory of the Joint Institute for Nuclear Research, and the Institute of Theoretical and Experimental Physics. The muon method of investigating the properties of matter is based on the fact that muons stopped in matter are "tagged" particles, the polarization and spin direction of which can be traced by means of the asymmetry of the angular distributions of the $\mu \rightarrow$ e-decay electrons. It uncovers additional possibilities for studying the kinetics of chemical reactions, local magnetic fields in matter, interactions of muonium atoms with matter, etc.

This paper does not consider interactions of negative muons with matter, which are being intensively studied by V. S. Evseev's group at the Nuclear Problems Laboratory of the Joint Institute for Nuclear Research.

All the experiments considered below on muon interaction with matter were performed with the polarized μ^+-meson beam of the same laboratory.

A consistent theory of interaction of positive muons with matter was developed at the Atomic Energy Institute (V. G. Nosov and I. V. Yakovleva, I. G. Ivanter, and V. P. Smilga). According to this theory, when the μ^+ meson slows down in matter to the velocities of the atomic electrons, it captures an electron and forms a muonium atom. The muonium then enters into chemical reaction with the molecules of the medium or penetrates into the lattice. The experimentally measured polarization of the μ^+ mesons is determined in this theory by two parameters: the lifetime τ of the muonium and the frequency ν of the depolarization of the muonium electron upon interaction with the medium. The values of τ and ν can be determined from experiments on the dependence of the residual polarization of the μ^+ mesons (polarization after the muonium enters in the chemical reaction) on the values of the longitudinal and transverse magnetic fields. Much work was done in this area at the Institute of Theoretical and Experimental Physics (V. G. Firsov's group). In these experiments they measured the time τ at which the muon enters in the chemical reaction. Calculation shows that it is possible to determine in this manner the time τ to within $\approx 10^{-11}$ sec. This group observed for the first time the free muonium atom following the stopping of μ^+ mesons in condensed media. Great interest attaches to work on the interaction of the electron shell of the free muonium atom with matter. This work led to the discovery, at the Atomic Energy Institute, of a new phenomenon—two-frequency spin precession of the μ^+ meson in muonium in a transverse magnetic field. The two-particle precession result from the quadratic Zeeman effect on the levels of the ground state of muonium and makes it possible to determine the "dimensions" of the muonium atom in matter. Thus, for quartz and ice the "dimensions" of the muonium atom turned to be equal to the vacuum values, which agrees with measurements of the dimensions of the free hydrogen atom in this substances by the EPR method. The dimensions of muonium in germanium turned to be larger than the vacuum values, i.e., the muonium atom in germanium is "inflated." Another area of the research at the Atomic Energy Institute is the study of dipole-dipole interactions of the μ^+-meson and muonium magnetic moment with the magnetic moments of the nuclei of the medium. The dipole-dipole interactions cause relaxation of the μ^+-meson spin in matter. This relaxation usually takes place only at low temperatures, since the rate of diffusion of the μ^+ meson over the crystal increases with increasing temperature, the nuclear magnetic fields at the μ^+ meson become variable in time, and the relaxation of the μ^+-meson spin decreases. Positive muons can also be used to study local magnetic fields in matter. Theoretical calculations show that this method can be used, for example, the structure of hard superconductors.

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