and signs of the energy and pressure in three axes and with consideration of the reciprocal influence of the newly produced matter on the metric. Finally, we take note of problems that constitute parts of the general problem but require new ideas: 1) general covariant formulation of the theory; 2) consideration of the direct, nongravitational interaction of the particles with one another; 3) the most difficult and important problem: the cosmological problem of emergence from the singularity, of the formulation of initial data in the singular state. It is possible that this last problem will be inseparable from the general problem of quantization of the metric.

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A. B. Migdal. Vacuum Stability and Limiting Fields.

In studies of the polarization of vacuum, the field, in which there are deep bound particle states, is usually left out of consideration. In this paper, we discuss the phenomena that arise when a strong external field leads in the single-particle problem to the appearance of a bound state with energy approaching the energy of formation of particles from the vacuum.

The best-known examples of the appearance of such critical levels are the point nucleus with charge $Z_c = 137$ and the finite nucleus of radius $R = r_0A^{1/3}$ with charge $Z_c = 170$. It can be shown that when $Z > Z_c$, the state with the lowest energy corresponds to an energy with a charge. This charge is situated in the region $\hbar/mc$. Owing to the Pauli principle, which forbids accumulation of particles in a dangerous state, a weak screening field appears. A more important reconstruction of the vacuum occurs in the fields in which production of Bose particles is possible. Consideration of the interaction between particles guarantees stability of the vacuum. Owing to the existence of the Bose particles, the effective field cannot exceed the value at which the critical particle-energy value is reached.

A particularly interesting effect appears in the field realized in nuclear matter. The field acting on mesons in nuclear matter is determined by the formula $V = 4\pi nf$, where n is the nucleon density and f is the amplitude of zero-angle scattering of the π-meson. At a sufficiently high density n (when $V > \mu^2c^4$), the meson vacuum is reconstructed and a phase transition occurs in which the equation of state of the nuclear matter changes. This phase transition can apparently be accomplished in neutron stars, in the region of high neutron density. In ordinary nuclei, the dense phase is separated from the ordinary phase by an enormous potential barrier. Attempts might be made to find such superdense nuclei in cosmic rays. The charge-to-mass ratios of such nuclei are substantially higher than the ordinary.

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