In addition to the invariant gravitational waves, anomalous effects can arise in collapsing systems. It is perfectly obvious that when a certain gravitating medium contracts, the Riemannian curvature of the gravitational field increases (at least during the Einsteinian stage of contraction) together with the density of matter, and under certain conditions can reach and exceed the critical value $l^2R \sim 1$. In such a case an anomalous collapse arises, the qualitative character of which is determined by the parameters of the medium and by the structure of the function Φ in Eq. (1). A tentative investigation of the simplest relations of the type $\Phi = \Phi(l^2R)$ shows that in the case of anomalous collapse of a homogeneous and isotropic medium the state with infinite density can apparently be entirely nonexistent (it is well known to be unavoidable in the case of ordinary collapse). Under certain conditions, the anomalous collapse of such a medium degenerates into stable undamped pulsations of density between two finite limits. It is not at all excluded that the universe as a whole is just in such a state, whereas individual parts of it collapse in the usual fashion (contracting until nuclear reactions occur). The anomalous gravitation thus leads to the physical possibility of an entirely different cosmology of the universe as a whole and of its individual parts. In Einstein's cosmology (within the limits of the homogeneous and isotropic model) such an alternative is completely excluded.

Detailed results will be published in coming numbers of JETP. I am grateful to Ya. A. Smorodinskii and E. L. Feinberg for interest and stimulating discussions.

PREDICTION OF MASSES IN MESONIC MULTIPLETS IN THE SIMPLE QUARK MODEL

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Submitted 3 November 1965
JETP Pis'ma 2, 554-557 (15 December 1965)

Reference [1] discussed, within the framework of SU(6) symmetry, a model of higher meson resonances, consisting of a quark and antiquark in a state with orbital angular momentum L = 1. The spin-orbit interaction $\alpha(\vec{L}\cdot\vec{S})$, where S is the total spin of the quarks, has split the multiplets with respect to the angular momentum J. The splitting of the mesons inside the multiplets was described qualitatively by an increase of the third quark mass [2]. The recently published experimental data on several meson resonances fit the foregoing model well 1). The experimental data presented below are taken from the proceedings of the Oxford conference (September 1965) and from the reviews [3,4]. The resonances discovered were $K^{**}(1320) \to K^*\pi$ (denoted in [1] as K 1360) and $f'(1510) \to \bar{K}^*K, \bar{K}K$ (denoted in [1] as φ 1600). A study of the quantum numbers of the resonances B 1220 and E 1420 favors $J^P = 1^+$, in agreement with [1], and analysis of the energy distributions in the decay $A_1 \to \rho\pi$ indicates that this resonance can have $J^P = 1^+$ or 2^-. In neither case can the resoance A_1 decay into $\pi\eta$. However, the $\pi\eta$ spectrum contains an appreciable maximum at energies of the order of 1040 MeV [5]. The maximum in the $\pi\eta$ spectrum is apparently connected with the resonance T, $J^{PG} = 1, 0^{+-}$, which according to [1] should have a mass ~1000 MeV.

We see thus that the mass splitting can describe qualitatively the heavier third quark in the nonet 2^+ (A_2(1320), K^* 1405, f 1253, f 1510) just as in the nonet 1^- (ρ 765, K^* 891, etc.) and in the baryon resonances [2]. This circumstance, and also the successful prediction in the simple quark model of quantum numbers of resonances B 1220 and E 1420 and of the masses of resonances K^{**} (1320) and f' (1510) can hardly be a random coincidence. Either the mass splittings inside the multiplets are actually described qualitatively with the aid of a heavier third quark, or else there exists a higher symmetry the unifies all these resonances (including baryonic ones) 2).

In the quark model the higher meson resonances are either quark and antiquark states with $L \neq 0$, or states of two (or more) quarks and two (or more) antiquarks. In multiplets consisting of a large number of quarks and antiquarks, the mass splittings are expressed in a complicated manner in terms of heavier third quark and, of course, are not replicas of the mass splitting in multiplets consisting of a quark and antiquark. The determination of the mass differences inside such multiplets, and their comparison with the predictions of the simple model, can serve as a good criterion for its real existence. The recently discovered resonance M_1 in the K^+K^+ spectrum, with mass 1280 MeV ($S = 2$, $T = 1$, $J^P = 0^+, 2^+$) offers a good possibility of checking whether the splitting in multiplets with a large number of quarks and antiquarks can be qualitatively described by the heavier third quark.

In a system of two quarks and two antiquarks, resonances with $S = 2$ and $T = 1$ are contained in two SU(6) multiplets (189-plet and 405-plet). There is one such resonance with $J^P = 0^+$ in the 189-plet and resonances with $J^P = 0^+$ and with $J^P = 2^+$ in the 405-plet. If the simple model discussed above is valid then, regardless of the multiplet to which the resonance M_1 belongs, the following resonances should exist in the Kπ and ππ spectra: S, T, $J^P = 1, 3/2, 0^+$ or 2^+, and S, T, $J^P = 0, 2, 0^+$ or 2^+ with masses $M_{K\pi} = 1280 - \Delta \simeq 1130 - 1180$ MeV and $M_{\pi\pi} = 1280 - 2\Delta \simeq 980 - 1080$ MeV. The masses of the resonances with other quantum numbers depend on the multiplet to which the resonance M_1 belongs and on the value of its spin. The resonances in the spectra of Kπ and ππ with the masses indicated above have not yet been observed, but the experimental accuracy is apparently insufficient to conclude that they do not exist. If the predicted resonances are observed, this will serve as a serious argument in favor of the simple model. Their absence will indicate the need for searching for a broader symmetry that unifies all the resonances with identical splittings.

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1) The mass predictions in the model with heavier third quark are approximate, owing to the interaction that violates this model. As a result, the values of Δ (the mass difference between the third and one of the first quarks) differ somewhat from one another in the different multiplets (in mesonic multiplets $\Delta \simeq 100 - 150$ MeV), and splittings also appear in resonances which should have identical masses according to the model.

2) The latter possibility was pointed out By M. Gell-Mann, Erevan, Physics Summer School, May 1965.

SURFACE IMPEDANCE OF Bi AT 1 - 10 Mc IN WEAK MAGNETIC FIELDS

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JETP Pis'ma 2, 557-562 (15 December 1965)

It was pointed out for the first time in [1] that the surface impedance Z of a metal can exhibit a complicated nonmonotonic variation with the magnetic field H in the region of weak magnetic fields at helium temperatures. Khaikin's experiments were carried out at a frequency $f \sim 10^{10}$ cps. It was established somewhat later [2] that nonmonotonic variation, albeit of simpler form, is observed also at lower frequencies ($f \sim 10^6$ cps). The behavior of Z(H) near H = 0 was investigated also in [3,4]. It was indicated in [4] that the function Z(H) changes with varying amplitude of the low-frequency field on the surface of the metal. Inasmuch as there is still no convincing explanation of such strong nonmonotonic variations near H = 0, it is in essence unclear whether the results of [1-4] are different manifestations of the same physical mechanism or not. It is therefore highly desirable to accumulate additional experimental facts.

We have carried out experiments on the behavior of bismuth single crystals in weak fields. Bismuth discs 18 mm in diameter containing $\sim 10^{-4} - 10^{-5}\%$ impurities were grown in dismountable quartz molds. The samples were placed in the coil of a radio-frequency tank circuit and were cooled together with the coil to helium temperatures. The experiments consisted of recording $\partial f/\partial H$ as a function of H with an automatic two-coordinate plotter in the magnetic-field range from 0 to 5 Oe. The measuring apparatus is described in [5]. The earth's field was compensated for accurate to 1%.

The electron mean free path in the metal was such that the radio-frequency size effect [5] could be observed without difficulty on the extremal sections of the electronic "ellipsoids" of samples 1 and 1.2 mm thick. The obtained numerical values of the "ellipsoids" in the C_3 and C_2 directions agree very well with the values obtained by other methods. We were unable to measure the major semiaxis because the line began to diffuse and was eventually