virtue of (3) the same expression as if the nucleon were not to participate in the strong interaction, i.e., a diagram similar to that of Fig. 2, and the terms proportional to $\ln(\Lambda^2/\mu^2)$ turn out to be the same in Figs. 3 and 2, and thus cancel out in the ratio G_μ/G_β.

As a result, we obtain (see [1]) for the ratio of the constants G_μ/G_β

$$\frac{G_\mu}{G_\beta} = \left[1 + \frac{3}{16}\frac{e^2}{\pi}\ln\frac{\Lambda^2}{\mu^2} - \frac{3e^2}{4\pi}\ln\frac{\Lambda_\beta}{2E} + \frac{3}{10}\frac{m_\mu^2}{\mu^2}\right]\frac{G_\mu^0}{G_\beta^0}, \tag{4}$$

where $\Lambda_\beta \sim M$ is the cutoff parameter due to the strong interaction, E the energy released in the β decay, G_μ^0 and G_β^0 the bare constants of the μ and β decay, connected in accord with the Cabibbo theory by the relation $G_\beta^0 = G_\mu^0\cos\theta$. Substituting in (4) the values $\Lambda^2/\mu^2 \sim 10^3$, $\Lambda_\beta = M$, E = 2.3 MeV (the β-transition energy in O^{14}), $\mu \geq 3$ BeV, and $\sin\theta = 0.22$, we get $(G_\mu/G_\beta)_{theor} = 1.022$. This value should be compared with the experimental [4] $(G_\mu/G_\beta)_{exp} = 1.011 \pm 0.005$. It must be borne in mind in this comparison that terms of the order of e^2, which do not contain the large logarithms $\ln(\Lambda^2/\mu^2)$ or $\ln(\Lambda_\beta/2E)$, have been neglected in [4]. In addition, as shown in [1], the corrections due to weak interactions lead to a decrease in the ratio G_μ/G_β and are of the order of 10^{-3} $(\mu/M)^2$.

The presence of relation (3) leads to entirely different conclusions than in [1] with regard to the magnitude of the radiative corrections to the ratio G_μ/G_β, including the case when the W boson has a nonvanishing magnetic moment which is not small. Namely, the radiative corrections turn out in this case to be of the order of $e^2\ln(\Lambda^2/\mu^2)$ and not $\sqrt{e^2}$ as found in [1].

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STRUCTURE OF ISOBARIC ANALOG STATES IN HEAVY NUCLEI

D. F. Zaretskii and M. G. Urin
Moscow Engineering-physics Institute

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Isobaric analog states have been recently observed systematically in various nuclear reactions for practically all nuclei with $N \neq Z$, thus pointing to a common microscopic nature of these states. Since analog states appear in particular as narrow resonances in the neutron spectrum in the direct (pn) reaction, it is natural to assume that these states constitute, with respect to the target nucleus, collective excitations of the proton-neutron hole type.

It will be shown below that such a description, at least for heavy nuclei, makes it possible to determine the energy of the analog states and the excitation cross section in the simplest nuclear reactions.

To investigate the collective excitations of the particle-hole type with small total angular momentum, we can use the methods of the theory of finite Fermi systems [1]. Let $\epsilon_\nu^{p(n)}$ and $\varphi_\nu^{p(n)}(\vec{r})$ be the energies reckoned from the corresponding Fermi boundary $\epsilon_0^{p(n)}$ and the wave functions of the single-particle states of the protons (neutrons) in the shell model, and let F be the amplitude for the scattering of quasiparticles near the Fermi surface in the particle-hole channel. With accuracy $\sim(N - Z)/2A$ we can represent this amplitude in the form [1]

$$F = \tfrac{1}{2}V\rho_0^{-1}(f + f'\vec{\tau}_1\vec{\tau}_2)\delta(\vec{r}_1 - \vec{r}_2), \tag{1}$$

where V is the volume of the nucleus, ρ_0 coincides with the density of the single-particle levels at the Fermi surface for a potential square well, and $1 + f' = 3\beta\epsilon_0^{-1}$ (β is the coefficient in the symmetry energy, $E_{symm} = \beta(N - Z)^2A^{-1}$). Then the equation defining the density matrix ρ^s and the energy ω_s of the collective state of the proton-neutron-hole type takes the form

$$(\epsilon_1^p - \epsilon_2^n - \omega_s)\rho_{12}^s = (n_1^p - n_2^n)f'V\rho_0^{-1}\sum_{3,4}\rho_{34}^s\int\varphi_1^*\varphi_2\varphi_3^*\varphi_4 d\vec{r}\ , \tag{2}$$

where $n_\nu^{n(p)}$ are the occupation numbers for the neutrons (protons). It is natural to set in correspondence with the analog state the excitation that results from the replacement of a neutron by a proton without a change in the shell quantum number and with a total angular momentum equal to zero. For sufficiently heavy nuclei ($N - Z \gg A^{1/3}$) the solution of Eq. (2) corresponding to the analog state is

$$\rho_{12}^a = \delta_{12}(n_1^p - n_2^n)(N - Z)^{-1/2};\quad \omega_a = (1 + f')\Delta\epsilon_0 = 4\beta(N - Z)A^{-1}, \tag{3}$$

where

$$\Delta\epsilon_0 = \epsilon_0^n - \epsilon_0^p = (4/3)\epsilon_0(N - Z)A^{-1}.$$

From (3) we see readily that for nuclei with approximately equal proton and neutron binding energies we have

$$\omega_a = \partial E_C/\partial Z \equiv \Delta E_C, \tag{4}$$

where ΔE_C is the Coulomb energy per proton.

With the aid of the density matrix (3) and the scattering amplitude (1) we can easily calculate the matrix element that determine the cross sections of the simplest nuclear reactions with excitation of the analog states. For the direct (pn) reaction the corresponding matrix element is

$$F_{k'\to k} = f'V\rho_0^{-1}\sum_{1,2}\rho_{12}^a\int\varphi_k^*\varphi_{k'}\varphi_1^*\varphi_2 d\vec{r} = f'V\rho_0^{-1}(N - Z)^{-1/2}\int\varphi_k^*\varphi_{k'}n(r)d\vec{r}, \tag{5}$$

where $\varphi_{k'}$ and φ_k are the wave functions of the continuous spectrum calculated with the aid of the optical model, for the proton and the neutron respectively, and $n(r) = \sum_1 (n_1^p - n_1^n)|\varphi_1|^2$. In this case the cross section integrated in the resonance region over the neutron spectrum connected with the excitation of the analog state ("sum rule") is equal to

$$\frac{d\sigma}{d\Omega_k} = \frac{1}{(2\pi)^2} \frac{(Mf'V)^2}{(N - Z)\rho_0^2} \frac{k}{k'} \left| \int \varphi_k^* \varphi_{k'} n(r) d\vec{r} \right|^2, \tag{6}$$

where M is the nucleon mass and $\epsilon_k = \epsilon_{k'} - \omega_a$.

Let φ_{λ_0} be the wave function of the odd neutron on the Fermi surface in the nucleus (N + 1, Z). Then the matrix element corresponding to absroption of a proton by a nucleus (N, Z) with excitation of a state analogous to the ground state of the nucleus (N + 1, Z) is obtained from (7) by replacing φ_k with φ_{λ_0}. The "sum rule" for this reaction is

$$\int \sigma_{k'} d\epsilon_{k'} = 2\pi \frac{(f'V)^2}{(N - z)\rho_0^2} \frac{M}{k'} \left| \int \varphi_{k'}^* \varphi_{\lambda_0} n(r) d\vec{r} \right|^2, \tag{7}$$

where $\epsilon_{k'} = \omega_a - E_b^p$, and E_b^p is the binding energy of the proton in the nucleus (Z + 1, N).

From the point of view of the microscopic description, other collective excitations, of the proton-neutron-hole type, can exist besides the analog state. Interest attaches to states with energy lower than ΔE_C. The state 2^+, and also a 0^+ excitation with another density matrix that does not reduce to a constant, may be observed in this energy region.

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DENIAL OF SU(3) SYMMETRY IN STRONG INTERACTIONS

Ya. B. Zel'dovich
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The philosophy underlying the modern application of group theory to strongly-interacting particles can be formulated as follows: The Lagrangian (or some other unknown formulation of dynamics) has a definite symmetry. A complete dynamic claculation is beyond the limits of modern theory. However, divergences or similar difficulties which hinder exact calculation do not break the symmetry, all of the consequences of which should be satisfied in real physical processes. Violations of symmetry are small and can be regarded essentially as first-order perturbations estimated from the eigenstates of the symmetrical theory.

In this note we formulate most positively a contrary point of view: Quarks exist, but there is no similarity or symmetry whatever between the strange λ quark and the p and n quarks [1)].

The basis for this point of view is an analysis of the masses of the mesons and baryons [1], which leads to the conclusion that the spin-spin interaction between λ and p or n is