exist we must have $v_t > 3D\omega_t$. The value of v_t is determined by precisely those velocity components that ensure the entanglement of the "liquid 'article" trajectory. In a star with $L \sim 10^{11}$ cm, $\omega_t \sim 10^{-5}$ sec^{-1}, and $v_t \sim 10^5$ cm/sec the value of τ is of the order of one year. Such a rapid filed growth can alter radically the character of the heat transfer and can lead by the same token to catastrophic processes such as flares. It is not excluded that outbursts of novas, all of which are binary, are due to this effect.

If the star surface has a well-conducting layer that is ineactive in field generation, then the field produced inside the star need not necessarily break through to the surface. If such a layer exists at the surface of the earth's core ($\sigma \sim 10^{16}$ cgs), then, regardless of the generation mechanism, fields with periods $\lesssim 10^4$ years will not penetrate to the earth's surface.

In binary systems, there should also act an inductive field-generation mechanism comprising typical dynamo enhancement for the case of doubly-connected geometry. Hertzenberg [3] has shown that a stationary field can be produced in a system of two rotating spheres in a conducting medium. From the fundamental point of view, this system does not differ essentially from a binary-star system. We have considered generation of a field in a star surrounded by a disk-like cloud that revolves around the star with its axis inclined to the rotation axis of this star. In first approximation, the conditions for field growth are satisfied for only those magnetic moment components of the star, which are perpendicular to its rotation axis. Since the magnetic moment is connected with the star, the cloud is acted upon by an alternating magnetic field and it must be taken into account that such a field does not penetrate deeply into the mantle. Nonetheless, the growth increment may be large enough to permit a strong field to be generated in a time much shorter than the evolution time. We note that unlike field generation by tidal flows that produce a field in the entire interior of the body, the inductive mechanism generates a field primarily in the surface layers, since the inner layers are screened, and only stochastic flows of various types can carry the field to the interior. Magnetic Ap stars are frequently single. There are data, however, indicating that many are surrounded by shells. The presence of a shell could explain such properties of these stars as the relatively slow rotation, the appreciable magnetic field, and the anomalies of the chemical composition. These anomalies could result from differentiation of the matter in the shell with subsequent accretion onto a star.

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NEUTRAL CURRENTS AND P-ODD EFFECTS IN DEEP INELASTIC MUON SCATTERING

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We discuss the possibility of observing the neutral-current interactions predicted by weak-interaction gauge models, using P-odd effects in deep inelastic scattering of polarized muons

1. There have been many recent discussions of gauge models of weak interactions in which interaction takes place between neutral-vector and axial currents of leptons ℓ_α with the hadron current h_α [1]. The existing experimental limitations on the interaction constants of neutral currents with $\Delta S = 0$ are quite weak, and the best of them, which follows from an analysis of the process $\nu_\mu p \to \nu_\mu p \pi^0$ [2] yields

$$G_n^{(\nu)} \lesssim 0{,}4\, G_F \, . \tag{1}$$

Moreover, in many models (see [1]) the neutral current contains no neutrinos, and in this case the neutrino experiment is generally insensitive to its existence. The experimental limitations on the interaction constants of a neutral current of charged leptons $G_n^{(e)}$ and $G_n^{(\mu)}$ with a hadron current with $\Delta S = 0$ is much worse than the limitation (1). The experimental data on muon scattering and on the test of $-e$ universality yield only a very weak limitation2):

$$G_n^{(\mu)} \lesssim (500 - 1000)\, G_F \, . \tag{2}$$

The weak limitation on $G_n^{(\mu)}$ follows from (g-2) of the muon. In renormalizable gauge models, the correction to (g-2), generally speaking is of the order of $G_n^{(\mu)} m_\mu^2/\sqrt{2}\cdot 8\pi^2$ [5] and at the present experimental accuracy 3×10^{-7} this yields $G_n^{(\mu)} \lesssim 350\, G_F$. A limitation that is weaker by one order of magnitude is obtained for $G_n^{(\mu)}$ from data on mu-mesic atoms [6].

The weakness of the existing limitations on $G_n^{(\mu)}$ is connected with the fact that in the hitherto performed experiments the contribution of the $\ell_\alpha h_\alpha$ interaction appears only as a small correction against the background of the dominant contribution of the electromagnetic interaction. There is only one experiment [4a] in which the single-photon contribution was eliminated (the ratio

$$(\sigma^{e\ell}_{\mu^- p} - \sigma^{e\ell}_{\mu^+ p})/(\sigma^{e\ell}_{\mu^- p} + \sigma^{e\ell}_{\mu^+ p})$$

was measured), but the large experimental errors ($\sim$5% - 50% at $Q^2 \sim (0.1 - 0.9)\ (\mathrm{GeV}/c)^2$) do not make it possible to improve the limitation (2).

2. The purpose of the present note is to emphasize that an appreciable improvment of the limitations on the value of $G_n^{(\mu)}$ can be obtained by directly measuring P-odd effects, such as the dependence of the total cross section for inelastic muon scattering on the longitudinal muon polarization. As noted by A. M. Zaitsev and L. G. Landsberg, a unique possibility of performing such an experiment is afforded by the presence of an intense beam of polarized muons from the accelerator of the Institute of High Energy Physics. Since the neutral lepton current may not contain either the $\nu\nu$ or the ee component[3] and since in a number of models the constant $G_n^{(\mu)}$ can be much larger than G_F, the improvement of the limitations on $G_n^{(\mu)}$ is of very great interest for the verification of gauge models of weak interaction.

We consider a phenomenological interaction of the type

$$L = \frac{G_n^{(\mu)}}{\sqrt{2}}\, \bar{\mu}\, \gamma_\alpha (g_V + g_A \gamma_5)\, \mu\, h_\alpha\,, \tag{3}$$

where h_α is a neutral hadron current with $\Delta S = 0$. Within the framework of Feynman's parton model [7] we obtain for the cross section of the deep inelastic scattering of negative muons, in the standard notation

$$\frac{d^2\sigma}{dQ^2 d\nu} = \frac{d^2\sigma^{em}}{dQ^2 d\nu}\left\{1 - \frac{9\sqrt{2}\, G_n^{(\mu)} Q^2}{20\pi a} g_A G_A \frac{E^2 - E'^2}{E^2 + E'^2} + \frac{9\sqrt{2}\, G_n^{(\mu)} Q^2}{20\pi a} s_\mu \left[g_V G_A \frac{E^2 - E'^2}{E^2 + E'^2} + g_A G_V\right]\right\}. \tag{4}$$

Here s_μ is the degree of longitudinal polarization of the incident muons, E and E' are the energies of the incident and scattered muons in the lab, and G_A and G_V are connected with the axial and vector constants of the parton neutral currents in accordance with

$$G_A = \sum_i Q_i g_{Ai} = \frac{2}{3} g_{Ap} - \frac{1}{3} g_{An};\quad G_V = \sum_i Q_i g_{Vi} = \frac{2}{3} g_{Vp} - \frac{1}{3} g_{Vn}.$$

Formula (4) is valid in the region $x \gtrsim (+0.3 - -0.5)$, which is optimal for searches of the expected effect from the experimental point of view, and where it suffices to include in the nucleon wave function only the contribution of the valent quarks [8]. Equation (4) contains also summation over the protons and neutrons (nuclear target). The constants $g_{A,V}$ and $G_{A,V}$ have values on the order of unity and depend on the concrete model.

In the muon beam of the Institute of High Energy Physics one can get $Q^2 \sim 10 - 20\ (\mathrm{GeV}/c)^2$ (see [9]), and at the attainable accuracies $\sim$1% in the comparison of the total cross sections for right- and left-hand polarized muons, this could lead to a record limitation on the interaction constant of a neutral muon current with a neutral hadron current without change of strangeness:

$$G_n^{(\mu)} \lesssim (3 \div 5) G_F \tag{5}$$

at g_A, $G_V \sim 1$. Further improvement of the limitation (5), up to $G_n^{(\mu)} \lesssim G_F$ would be possible in the muon beam of the NAL accelerator, where values of Q^2 larger by approximately one order of magnitude will be available.

3.We emphasize that experiments on deep inelastic scattering of polarized muons are presently the most critical with respect to observation of the interaction (3). In scattering of unpolarized muons (the SLAC muon beam), separation of the contribution of the interaction (3) is a much more complicated problem, since the separation of the P-odd effects calls for exact measurement of the small longitudinal polarization of the scattered muons. In elastic muon scattering, small violations of the Rosenbluth formula as a result of the interaction (3) can be masked by two-photon exchange. On the other hand in inelastic processes, the separation of the P-even corrections due to interaction (3) is possible only by comparing the μN and eN interactions and using the additional assumption concerning the character of violation of μ-e universality. Similar theoretical uncertainties and the ensuing weakness of the limitations on $G_n^{(\mu)}$ appear also when an attempt is made to estimate $G_n^{(\mu)}$ from data on the photoproduction of muon pairs and on mu-mesic atoms. In addition, a comparison of the electron and muon scattering always encounters normalization problems. This pertains also to the measurements of the difference $\sigma(\mu^+N) - \sigma(\mu^-N)$, which is possible on account of the interaction (3) (the sign of g_A in (4) is reversed on going from μ^- to μ^+). In addition, in this case it is necessary to determine the unknown two-photon contribution to $\sigma(\mu^+N) - \sigma(\mu^-N)$.

4. The interaction of muons with a neutral hadron current without change of strangeness is a general characteristic of weak-interaction gauge models. Measurement of $G_n^{(\mu)}$ at a level $\leq G_F$ would serve as a direct check on models such as Weinberg's, where $G_n^{(\mu)} \simeq G_F$. Even a limitation at the level of (5) would yield important information concerning some of them. Thus, for example in the Lee-Prentki-Zumino model [1c], in which there is no neutral neutrino current, $G_n^{(\mu)}$ can be much larger than G_F and is a free parameter. Its measurement would make it possible to determine the Z-boson mass in this model, and is important as a check on the predictions of the model in other processes.

In addition, a limitation on $G_n^{(\mu)}$ at the level (5) would make it possible to confirm or refute reliably the previously proposed nonrenormalizable Tanikawa-Wanatabe-Shabalin scalar weak-interaction models, which predict $G_n^{(\mu)} \gtrsim 200G_F$ [10].

The possibility of searching for neutral currents produced in the Weinberg model [1a] in deep inelastic scattering of muons on nucleons, by determining the deviation from scaling and by measuring the difference of the scattering cross sections of μ^+ and μ^- for μ^+ with negative helicity and μ^- with positive helicity was discussed also in [11] within the framwork of the Weinberg model. Measurement of this cross-section difference with high accuracy, 1%, is, as mentioned above, a difficult problem because of the normalization difficulties, and it can be easily seen from (4) that the effect is suppressed by the additional kinematic factor $(E^2 - E'^2)/(E^2 + E'^2)$.

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2) The estimate (2) was obtained by recalculating the results of papers dealing with the possible anomalous (i.e., non-electromagnetic) scattering of muons by nucleons (see the review [3] and the papers in [4]).

3) Such a possibility was pointed out, in particular, by Bjorken and Smith [1c].

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ERRATUM

In the article by L. I. Grigor'eva et al., Vol. 17, No. 11, p. 392, Figure 3 should be turned 180°.