It was wrong in electromagnetism to think of the $f_{\mu\nu}$ as fixed on the surface. It appears equally wrong in geometrodynamics to think of the $g^{\mu\nu}$ as fixed on the surface.

In electromagnetism we know the potentials which should be fixed on the surface. In geometrodynamics we do not yet know these potentials.

Therefore, we regard the problem ahead as not to change the variational principle Eq. (16), which is so plausible on physical grounds, but rather to find the right superpotential in terms of which to express the $g^{\mu\nu}$.

In discussions (1) of the quantization of general relativity and (2) of the "true variables" of general relativity, the hope has often been expressed to find these superpotentials. We now have a third and perhaps even stronger motive to construct these quantities: to validate—if possible—a variational principle which, for the first time, summarizes in purely geometrical terms the whole content of classical source-free electromagnetism and general relativity.

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POSSIBLE METHODS FOR THE DETERMINATION OF STRANGE-PARTICLE PARITIES*

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The question of the intrinsic parities of the strange particles has been extensively discussed in the past. The aim of this note is to point out two possible experiments that may shed light on this matter.

We first consider the capture reaction

$$K^- + d \to Y + N. \quad (1)$$

It has been recently suggested that the capture of K^- in liquid hydrogen and deuterium occurs predominantly from bound s states.[1] In this note we shall consider that statement as a working hypothesis and shall derive a theorem that may be used to obtain information regarding the parity of the K meson relative to the YN system. With the assumption that K capture occurs predominantly from s states (bound or from the continuum) relative to the center of mass of the deuteron, the most general form of the transformation matrix in spin space is

$$M = [a + b(\vec{\sigma}_1 \cdot \hat{k})(\vec{\sigma}_2 \cdot \hat{k})]T \text{ for scalar } K, \quad (2a)$$

and

$$M = [c\vec{\sigma}_1 \cdot \hat{k} + d\vec{\sigma}_2 \cdot \hat{k}]T \text{ for pseudoscalar } K, \quad (2b)$$

where $\hat{k}$ is a unit vector along the direction of the relative momentum of the final system and T is the triplet projection operator. The operator T simply describes the spin correlation of the initial state. We also note that the other possible invariants $\vec{\sigma}_1 \cdot \vec{\sigma}_2 T$ and $\vec{\sigma}_1 \cdot (\hat{k} \times \vec{\sigma}_2)T$ can be reduced to the general forms given in Eqs. (2a) and (2b), respectively.

We now evaluate the correlation between the components of the spins of the Y and N along a direction $\hat{n}$, perpendicular to $\hat{k}$:

$$\langle \sigma_{1n}\sigma_{2n} \rangle = \mathrm{Tr}[MM^\dagger \sigma_{1n}\sigma_{2n}]/\mathrm{Tr}[MM^\dagger]. \quad (3)$$

Inserting expressions (2a) and (2b) into (3), we obtain

$$\langle \sigma_{1n}\sigma_{2n} \rangle = |a-b|^2/[|a+b|^2 + 2(|a|^2 + |b|^2)] \geq 0, \quad (4a)$$

and

$$\langle \sigma_{1n}\sigma_{2n} \rangle = -|c-d|^2/[|c+d|^2 + 2(|c|^2 + |d|^2)] \leq 0, \quad (4b)$$

for scalar and pseudoscalar K, respectively.

Thus, the K parity can be determined, in principle, by the measurement of the sign of this correlation.

The determination of $\langle\sigma_{1n}\sigma_{2n}\rangle$ in reaction (1) presents two main practical difficulties: in the first place, reaction (1) occurs only in about 1% of all K^- capture reactions; secondly, if the final system is Λn, this measurement will involve the determination of the spin direction of n, which may present special problems. The spin direction of the Λ may be determined from the angular distribution of the decay products. If the final system is $\Sigma^- p$, the determination of the spin direction of the Σ^- may be difficult because of the apparently small value of the asymmetry parameter in Σ^- decay.

It is perhaps interesting to observe that if, in the more frequent reactions

$$K^- + d \to Y + N + \pi, \tag{5}$$

it turns out to be possible to isolate those events in which the Y and N are produced with sufficiently small relative momentum so that they are predominantly in a relative s state, then a similar theorem would hold for their spin correlation. In that case, in Eqs. (2a) and (2b) the vector $\vec{k}$ would represent the momentum of the pion relative to the YN system and the results of Eqs. (4a) and (4b) would be interchanged because of the pseudoscalar nature of the pion field. Reactions of type (5) have the advantage that they are more frequent than (1) and they would permit the investigation of the spin correlations of the Λp and the $\Sigma^+ n$ systems, which may avoid some of the difficulties mentioned above.

Finally we mention the reaction

$$\Sigma^{\pm} + He^4 \to {}_{\Lambda}He^5 + \pi^{\pm}, \tag{6}$$

as a possible means of determining the relative Λ-Σ parity. (We assume spin $\frac{1}{2}$ for ${}_{\Lambda}He^5$.) When the Σ has a polarization $\vec{P}_0$, the differential cross section for reaction (6) is given by

$$d\sigma/d\Omega = (d\sigma/d\Omega)_0 (1 \pm \vec{P}_0 \cdot \vec{P}_1), \tag{7}$$

where $\vec{P}_1$ is the polarization of the ${}_{\Lambda}He^5$ in the case $\vec{P}_0 = 0$ and $(d\sigma/d\Omega)_0$ is the corresponding differential cross section. The +(-) sign in Eq. (7) applies in the case in which the relative intrinsic parity of the initial and final systems is even (odd). Thus, the relative intrinsic parity of the final and initial systems in (6) can be determined, in principle, by a measurement of $\vec{P}_1$ and the left-right asymmetry for $\vec{P}_0 \neq 0$. The derivation of Eq. (7) follows the same lines as the theorems recently given by Bilenky[2] and Bohr.[3]

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ELECTROMAGNETIC TRANSITIONS BETWEEN μ MESON AND ELECTRON*

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The existence of the ordinary μ decay, $\mu \to e + \nu + \bar{\nu}$, seems to prove that the muon and electron do not differ in any quantum numbers.[1] It follows that weak electromagnetic transitions between muons and electrons could occur, if there is a mechanism to produce them. For example, one such mechanism would exist if the μ decay was not caused by a direct $\bar{\mu}e\bar{\nu}\nu$ Fermi interaction but instead involved a virtual charged boson. This particular possibility seems ruled out, since the predicted[2] rate for $\mu \to e + \gamma$ would be considerably greater than the upper limit set by recent experiments.[3,4] The purpose of this note is to discuss phenomenologically (without