Making an analogous assumption for the components of current (3) corresponding to weak magnetism, we obtain:

$$I^{1(3)\,1(2)}_{3(1)\,1(2)} = (1 + a_1[35^8] - a[189^8] + a_1[405^8])\,\bar{B}^{AiCk1(3)\,1(2)}B_{AiCk3(1)\,1(2)}$$

$$I^{1(3)\,1(2)}_{3(1)\,2(1)} = (1 + a_1[35^8])\,\bar{B}^{AiCk1(3)\,1(2)}B_{AiCk3(1)\,2(1)}.$$

[1] M. Ademollo and R. Gatto, Phys. Rev. Lett. 13, 264 (1964).

[2] V. I. Zakharov and I. Yu. Kobzarev, ITEF Preprint No. 298, 1964.

[3] M. A. Beg and V. Singh, Phys. Rev. Lett. 13, 418 (1964).

[4] L. B. Okun', ITEF Preprint No. 287, 1964.

1) For the sake of generality we are considering also the reducible self-conjugate representation $280 + \overline{280}$. It is easy to see that it does not contain the representations (1, 1) and (27, 1) of the group SU(3) ⊗ SU(2).

2) The latter circumstance is connected with the fact that the baryons belong to the representation of the 56 group of SU(6). In the case of a mesic weak vector current, H_{MS} leads to the appearance of D-coupling.

ANALOG OF THE ZEEMAN EFFECT IN THE GRAVITATIONAL FIELD OF A ROTATING STAR

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As is well known, in general relativity theory the gravitational potential is no longer a scalar (as in Newton's theory). The gravitational field of a rotating body differs from that of a body at rest, just as in electrodynamics a rotating charged body produces not only an electrostatic but also a magnetic field. Thirring and Lense have noted that an ideal gyroscope near a rotating body turns slowly relative to the inertial system at infinity, that is, it rotates relative to remote fixed stars. In order of magnitude, the rotary speed Ω of a gyroscope on the surface of the body is equal to

$$\Omega \approx \omega R_g/R$$

where ω is the speed of rotation of the body and R is the radius, while R_g is the gravitational radius. At the earth's pole Ω is equal to 0.1 angular second per year (5×10^{-7} radian/year = $= 1.6 \times 10^{-14}$ rad/sec); observation of this effect would be an important verification of general relativity. The rotation of the plane of polarization of light was considered by Skrotskii [1].

In this note we consider the effect of the variation of the gravitational field due to the rotation on the spectrum emitted by atoms on the surface of the body and observed by a receiver far from the body.

The components of the gravitational field, in analogy with the magnetic field, produce in the spectrum changes similar to the Zeeman effect.

A line emitted by an atom with frequency ω_0 at the pole and received by a remote observer situated above the pole splits into two components with opposite circular polarization and with frequencies $\omega_0 + \Omega$ and $\omega_0 - \Omega$.

Unlike the classical magnetic Zeeman effect, the gravitational effect is universal, the splitting does not depend on the concrete properties of the system emitting the light, being the same for an atom and for a molecule and the same in the optical and in radio bands.

To prove this, let us consider a linear oscillator on the pole. We can imagine it to be secured to an ideal gyroscope [1)] and to oscillate in a central force field continuously in the plane in which the gyroscope axis lies. From the point of view of the observer on the pole, the oscillator emits a plane-polarized wave, which can be regarded as a superposition of two waves circularly polarized in opposite directions with equal frequency.

With respect to a remote observer, the gyroscope axis rotates with velocity Ω. Consequently, the plane of polarization rotates with the same velocity. Linearly polarized light with a rotating plane of polarization is obviously a superposition of two waves circularly polarized but with different frequencies $\omega_0 \pm \Omega$. We have thus proved that the light emitted by a charge oscillating in a central force field on a pole of a rotating body is received by a remote observer like an aggregate of rays with circular polarization, split in frequency. By virtue of the principle of correspondence between quantum theory and classical mechanics, it is obvious that this result remains valid for any atomic or molecular system. The effect can reach in principle an observable magnitude on the surface of a neutron star. In fact, for a mass of the order of that of the sun the radius of the star is of the order of 10 km; the maximum speed ω of rotation of the star, corresponding to parabolic velocity at the equator, is of the order of $\sim 10^4$ sec^{-1}. We then obtain (taking into account the density distribution) as much as $\Omega \sim 10^2$ sec^{-1}. For a 21 cm radio line, $\omega_0 = 10^{10}$ sec^{-1}, such a splitting ($10^{10} \pm 10^2$) could be observed at contemporary accuracy. However, the actual observation is probably a hopeless task, since the surface of a neutron star is negligible and accordingly the radiation power in the long-wave band is negligible. There are other causes for broadening and shifting of the lines; the effect has opposite signs on the pole and at the equator.

Independently of the experiment, principal considerations of the existence of a gravitational Zeeman effect can be of interest from the point of view of deepening the analogy between the magnetic field and the corresponding terms in relativistic theory of gravitation. This analogy was independently pointed out by Smorodinskii, who considered within the framework of general relativity a vector playing the role of a potential. The curl of this vector determines the local rotation of the inertial system.

An alternative description of the phenomenon consists in the fact that the quanta which are left- and right-circularly polarized experience different red shifts in a gravitational field. Thus, we should have here a particular manifestation of the influence of the angular momentum of the particle (quantum) on the motion of the particle in a gravitational field.

It is clear from the symmetry of the problem that this difference is due entirely to the rotation of the body that produces the gravitational field.

The change of Ω in the quantum frequency ω_0 is independent of the latter and occurs essentially over a path of the order of 1/2 or 1/3 of the radius of the body. On earth it amounts to approximately 2.5×10^{-15} cps over $(2 - 3) \times 10^8$ cm, that is, 10^{-23} cps/cm. This change can be compared with the red shifts of all the quanta (right and left polarized) in the main static field of the earth, measured by Pound and Rebka,

$$\frac{1}{\omega}\frac{d\omega}{dx} = \frac{g}{c^2} = 10^{-18}\ \text{cm}^{-1}$$

For quanta with energy 14 keV and frequency 4×10^{18} cps, the change in frequency is 4 cps/cm and the influence of the spin (circular polarization) of hard quanta is immeasurably small. For a proton the influence of the direction of the spin on its weight, due to the earth's rotation, is of the order of 10^{-28} of the weight of the proton.

[1] G. V. Skrotskii, DAN SSSR 114, 73 (1957), Soviet Phys. Doklady 2, 226 (1958).

1) The gyroscope axis lies in the horizontal plane and is perpendicular to the line drawn through the center of the body, the pole, and the observer, i.e., to the beam direction.

ACCELERATION OF PARTICLES BY THE EDGE FIELD OF A MOVING PLASMA POINT THAT INTENSIFIES AN ELECTRIC FIELD

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It is usually assumed that quasistatic electric fields are incapable of accelerating particles to energies above the potentials employed. In this paper is shown that by means of a moving inhomogeneity, which intensifies a quasistatic electric field, it is possible under certain conditions to obtain acceleration equivalent to potentials exceeding by many times the employed potential difference.

Let us consider a very simple example of intensification of an electric field by a specially produced inhomogeneity in the medium. We assume that two plane electrodes, between which a potential difference U_0 is applied, produce a field of intensity E_0. If a conducting projection is placed on one of the electrodes, in the form of half a prolate spheroid directed along the field, then the intensity of the field reaches a maximum value in the region of the maximum curvature in an area of radius $\rho \sim b^2/a$ on the top of the spheroid

$$E_m = E_0 \frac{2e^2}{(1 - e^2)(\ln\frac{1+e}{1-e} - 2e)} = \frac{E_0}{n^{(x)}}$$

where $e = (1 - b^2/a^2)^{1/2}$ is the eccentricity of the spheroid, a and b are the major and minor semiaxes, and $n^{(x)}$ is the depolarization coefficient. In the case of a very prolate ellipsoid ($a \gg b$, $e \to 1$), we have

$$E_m \approx E_0 \frac{a^2}{b^2(\ln\frac{2a}{b} - 1)} \sim \left(\frac{a}{b}\right)^2 E_0$$