Introduction

Numerous studies made it possible to establish a close relation between the elastic coherent zero-angle scattering amplitude $f(0)$ and the refractive index n (see, for example, [Goldberger and Watson (1984); Gurevich and Tarasov (1968); Fermi (1950); Hughes (1954); Frank (1982); Abov *et al.* (1966)]) and to develop experimental methods for investigating refraction of polarized particles in matter. It turned out that in the case when matter is composed of randomly located scatterers and the condition $|n-1| \leq 1$ is fulfilled, the refractive index has the form

$$n = 1 + \frac{2\pi\rho}{k^2} f(0)\,, \tag{0.1}$$

where ρ is the density of scatterers (the number of scatterers per cubic centimeter of matter); k is the wave number of the incident wave.

It was also found out that the possibility to introduce the refractive index is not associated with the ratio of the radiation wavelength to the distance between scatterers. Equation (0.1) also describes the refraction of short–wave radiation with a wavelength much shorter than the distance between the scatterers. This can be explained by the fact that the refractive index appears due to the interference between an incident wave and secondary rescattered waves, which always occurs in elastic coherent forward scattering. Moreover, Eq. (0.1) describes not only scattering of photons but also scattering of particles of different nature (neutrons, electrons and others).

It is well known that an optically anisotropic medium is characterized by the presence of several refractive indices. For instance, in the case of the Faraday effect, the refractive indices n_+ and n_- are different for light with right-hand and left-hand circular polarizations. In view of Eq. (0.1), from this follows that the amplitude f_+ of elastic coherent forward scattering of a right-hand polarized photon differs from a similar amplitude f_- for a left-hand polarized photon.

Thus, for the effect of light polarization plane rotation in a medium to occur, the elastic coherent zero–angle scattering amplitude should be dependent on the photon polarization state, or, which is the same, on its spin state.

As spin dependence of the scattering process is typical of particle collisions for all particles with nonzero spin, it should be supposed that the phenomena analogous to the Faraday effect (birefringence) will occur for all such particles and various interactions.