the polarization operator with contribution of three modes was exploited. We saw how the eigenvectors characteristic of the one-invariant (magnetic in a special frame) background field are linearly combined with the help of dynamics-dependent coefficients to form eigenvectors of the general problem under investigation.

Among the vacuum perturbations special attention was payed to the sourceless excitations that supply poles to the photon propagator and satisfy three different dispersion equations. These may be either massive or massless. In the latter case they are called photons. The massless excitations belong only to two modes, in accordance with two polarization degrees of freedom of a gauge vector particle, the photon. Massive excitations belong to all the three modes, since a massive vector field has three degrees of freedom. These may have unrestricted number of branches in each mode depending on the properties of the corresponding dispersion equation. We described admitted disposition of various dispersion curves (in the appropriate momentum plane) as it is restricted by the causal propagation requirement. The eigenmodes are plane-polarized, and the orientations of their electric and magnetic fields with respect to propagation direction and the direction of the background field are described. We dwelled on the impact the admixture of an electric field to a magnetic background may have on the selection rules for photon splitting. We noted that such admixture results in a larger separation between two different dispersion curves enhancing the birefringence.

Among possible perturbations of the background caused by small sources we especially considered the magnetic (part of the) field produced by a point static electric charge and found its behavior far from the source.

We also established coincidences between eigenvalues of the polarization operator (degeneracies) that, under special relations between momenta, reflect the residual rotational and Lorentz symmetries of the vacuum left after the background field is imposed.

All the results are approximation-independent, except for the statement, based on the one-loop calculations, that the mixing between modes is not resonant in the limit of small electric field at the first threshold of electron-positron pair creation by a photon.