The inhomogeneity of the field of Faraday isolator (FI) magnetic system is an important characteristic, because it predetermines the isolation ratio of this device. In most cases inhomogeneity is a negative factor so long as it causes depolarization of transient radiation. In this work we showed that inhomogeneity of the magnetic field can be used for compensation of polarization distortions induced by other effects.

When linearly polarized laser beam passes through the magnetooptical element (MOE) situated in inhomogeneous magnetic field the nonuniform cross-sectional distribution of the rotation angle of the polarization plane appears. Similar nonuniformity of the rotation angle causes by the temperature dependence of the Verdet constant and the nonuniform cross-sectional distribution of temperature in the MOE induced by the radiation absorption in magnetoactive media. Magnetization of the MOE leads to additional inhomogeneity of the magnetic field and, as a result, it leads to additional nonuniformity of the rotation angle. The idea of compensation consists in creation of certain magnetic field profile that provides minimal rotation angle nonuniformity when all these effects appear together.

Radiation absorption in magnetoactive media leads to rising of temperature of the central part of MOE in comparison with its peripheral areas. The Verdet constant drops with temperature rise therefore polarization plane rotation angle along the axis of MOE is smaller that near its lateral surface. Magnetization of paramagnetic MOE (such as terbium gallium garnet crystals and magnetooptical glasses) also leads to decrease of rotation angle in the center of MOE. Thus, if we want to compensate these two effects by the external magnetic field, its strength on the axis of the magnetic system should be greater than at its periphery.

Traditional magnetic systems that are composed of one coaxially magnetized ring and two rings with radial magnetization (fig.1.a) usually provide magnetic field with weaker strength on the axis that at its periphery. The value of the magnetic field inhomogeneity depends on the ratio of geometrical sizes of rings. We can diminish it and even reverse its sign (make field strength on the axis greater than at a periphery) by variation of this ratio but value of the field strength would considerably recede. It is unacceptable because it requires the extending of MOE (fig.2, black line) and, as a result, it would cause the growth of radiation absorption in MOE and increase of all negative thermal effects.

Main contribution to the inhomogeneity of the magnetic field in traditional systems brings the central part of coaxially magnetized ring. That is why using the tiny ring with opposite magnetization direction in the center of the magnetic system (fig.1.b) helps in creation of necessary magnetic field inhomogeneity. We can change the value of this inhomogeneity in a wide range without significant decrease of the magnetic field strength (fig.2, red line). Thus, such magnetic systems can be used for compensations of the polarization distortions caused by the temperature dependence of the Verdet constant and by the magnetization of the MOE.