The University of New Mexico Student Chapter of the Optical Society of America
and the Center for High Technology Materials present

Theory of Nonlinear Sagnac effect in Semiconductor Lasers

A 70th Birthday Seminar

Prof. Peter G. Eliseev

Center for High Technology Materials, University of New Mexico and
P. N. Lebedev Physics Institute, Moscow, Russia

Friday, February 3rd, at 10:00 am

Center for High Technology Materials, Room 101

In laser gyros, the Sagnac effect in a ring cavity is used to get a sensitivity to the rotation rate. Semiconductor ring lasers (SRL) are not yet gyro devices, and one reason for this is low sensitivity due to small size. The *scale factor* $K = \Delta\nu/\Omega$ in the active ring laser is known to be proportional to ratio A/L, where A is ring area, L is its perimeter. A problem with this is to increase response at a limited ring size. We consider here if the nonlinear optics of semiconductors can be used for this purpose.

First, we analyze an influence of the dispersive medium on the Sagnac effect and find that K is in reverse proportion to the group index $n^* = n + \nu dn/d\nu$. This is not good (typically n^* is between 3.5 and 4.5 in semiconductors like GaAs). However the involvement of the dispersion gives a way to influence the scale factor dynamically. The nonlinear interaction of electromagnetic waves leads to a perturbation of optical parameters of the medium in vicinity of strong wave frequency. It is characterized with a steep variation of index providing ranges of *slow* and *fast* light. The dynamic *anomalous* dispersion ($dn/d\nu < 0$) is suitable to reduce n^* and increase the rotation sensitivity (~100 times). We consider the concept of fast-light Sagnac effect in vicinity of points of *critically anomalous* dispersion (where group velocity goes to infinity).

Prof. Peter G. Eliseev is a Research Professor at the Center for High Technology Materials, University of New Mexico. His scientific activity is in the field of optoelectronics and laser physics with a focus on semiconductor lasers. He is author and coauthor of more than 500 publications and presentations, several books and numerous review papers. Recent results relate to nonlinear mode interaction, semiconductor ring lasers, analysis of the mode beating spectra, the electrical diagnostics of laser diodes, and the characteristics of group-III nitride lasers. He was awarded the State Prize of the USSR in Science and Technology (1984) and the N. Holonyak OSA Award (2004).