Impurity-induced Inverse Faraday Effect

A.S.Mel'nikov [1,2], * A. A. Kopasov [3], A. A. Bespalov [2,1]
[1] Moscow Institute of Physics and Technology, Dolgoprudnyi, Moscow Region 141701, Russia
[2] Institute for Physics of Microstructures, RAS, 603950 Nizhny Novgorod, GSP-105, Russia
[3] National University of Science and Technology "MISIS", Moscow 119049, Russia
*email: asmeln@rambler.ru

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We provide a quantum-mechanical description of the photoinduced dc current states and magnetic fields around nonmagnetic point impurities in a two-dimensional (2D) electron gas irradiated by a circularly polarized electromagnetic wave (see Pic.1). Based on the solution of the corresponding time dependent Schrodinger equation within the second-order perturbation theory in the electromagnetic wave amplitude we find that the resulting dc magnetic field component perpendicular to the plane of the 2D system is distributed like in a set of random magnetic fluxes bound to the positions of impurities. As a result, the spatially averaged dc magnetic field does not vanish far from the sample edges and, thus, our scenario of the inverse Faraday effect in disordered systems differs strongly from the standard one based on the relaxation time approximation within the hydrodynamic or kinetic equation approaches which would give only the photoinduced currents flowing along the sample edges. The internal dc magnetic field can give rise to the photoinduced Hall effect and Faraday rotation for a probing electromagnetic signal.

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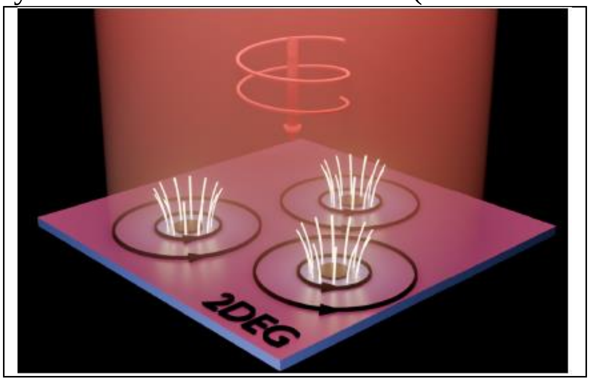

Pic.1. Schematic picture illustrating the suggested mechanism of the inverse Faraday effect. We show the lines of the dc currents flowing around each impurity center and magnetic field generated by a circularly polarized light incident on the two-dimensional electron gas (2DEG).