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The discovery of a new state of matter, the Bose-Einstein condensate and superfluidity, started one of the most dynamic fields in physics, the study of quantum phenomena in a weakly interacting gas of bosons. For a long time this rich physics was reserved only for ultra-cold atoms. **Exciton polaritons recently emerged as a new class of bosonic quasi-particles in condensed matter physics, which demonstrated the possibility to achieve Bose-Einstein condensate and superfluidity even at room temperature, in a small piece of semiconductor material.**

Exciton polaritons are quasi-particles arising from the coupling of matter excitations and photons. Matter part comes from the excitation of the semiconductor in the form of an exciton localized in a quantum well, photonic part – the photonic mode in semiconductor microcavities. Under strong-coupling conditions these two entities are mixed together to form quasi-particles, exciton polaritons, of dual light – matter nature. From photonic component polaritons gain a little weight, from the exciton - the ability to interact. Their bosonic character is manifested under high concentrations, where quantum degeneracy and the phase transition to a non-equilibrium condensate is observed. Observation of a polariton superfluid state with zero viscosity and the ability to build optoelectronics devices based on polaritons gives in recent years this field of semiconductor physics an exceptional importance.

Within the project we propose to extend the rich physics of non-equilibrium polariton condensates towards magnetic interactions. We plan to create **semimagnetic exciton polaritons**, polaritons dressed in interaction with the magnetic moments of atoms in the crystal lattice. Introduction of an additional internal magnetic interaction will allow for modification of the polariton – polariton interaction strength by the external magnetic field and we expect to observe a new class of quantum phenomena. So far, the polariton – polariton interactions, which are responsible for the observed quantum phase transitions, could be modified only to a limited extent. We expect that the introduction of magnetic ions will change the properties of the non-equilibrium polariton condensates from paramagnetic to ferromagnetic and diamagnetic.

The concept of semimagnetic exciton polaritons is new. It is based on exceptional quality of semi-magnetic semiconductor materials whose growth technology was developed at the University of Warsaw. The results of our preliminary research shows that it is possible to create polaritons demonstrating a giant magnetic Zeeman splitting and the characteristics of nonlinear interactions. **Within the project we propose research on the quantum nature of these entities, the demonstration of the spin Meissner effect, creation of a spin-polarized semimagnetic non-equilibrium polariton condensate of one spin component and the mixed condensate of two spin components.**

The magnetism of exciton polaritons was not explored up to now. Compared to the magnetism of semiconductors and spintronics based on semimagnetic materials, physics of magnetic exciton polaritons opens up new possibilities in optoelectronic. By admixture of a photon in a magnetic exciton, polaritons have much more extended wave function and can propagate at long distances paving the way for new magneto-optical devices (polariton spin transistors, polariton logic gates, spin switches).