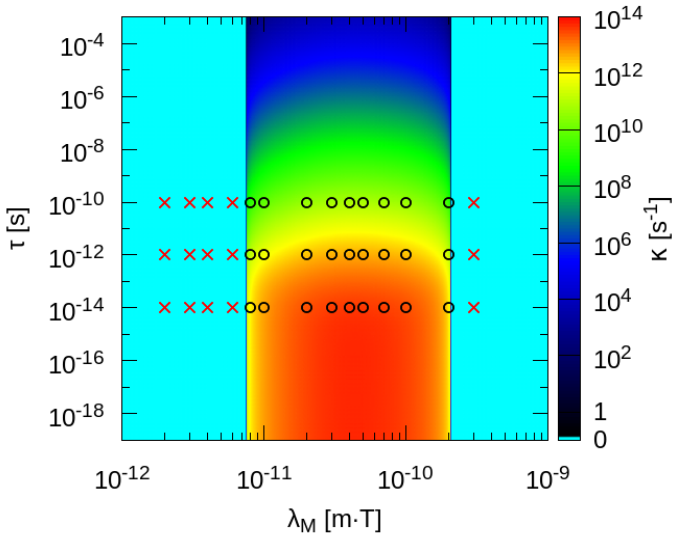
Instability of exciton-polaritons system in semimagnetic semiconductor microcavity

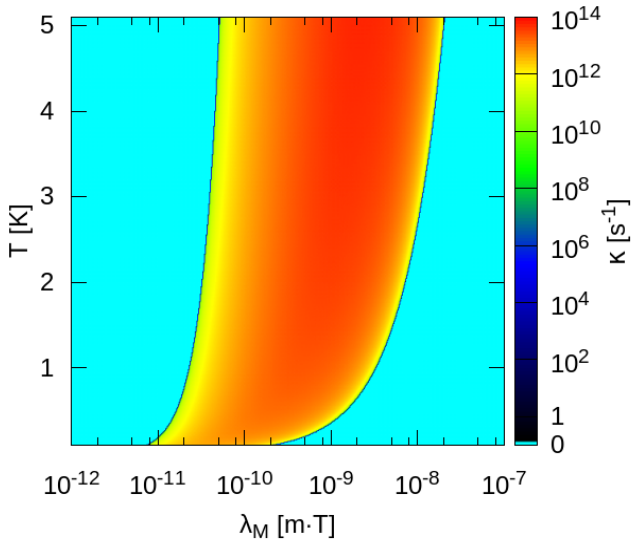
P. Miętki [1] and M. Matuszewki [1]
[1]*Institute of Physics Polish Academy of Sciences,*
Al. Lotników 32/46, 02-668 Warsaw, Poland

We study the system of exciton-polaritons condensate in a semimagnetic semiconductor microcavity [1,2], described by the Complex Ginzburg-Landau equation with additional magnetic spin relaxation equation for magnetic ions. Similar system was considered in [1], and here we extend it by including external pumping and losses.

Circularly polarized condensate can self-localize due to the exchange coupling interaction between polaritons and magnetic ions. We calculate the diagram of stability of magnetic polarons due to various physical parameters, emphasizing the special role of polariton-magnetic ion coupling constant λ_M. The stability was determined both by numerical solution of the Complex Ginzburg-Landau equation and the linear Bogoliubov approximation. Surprisingly, limiting values of λ_M that determine the stability depend strongly on the derivate of the Brillouin function, but not on the magnetic spin relaxation time, see Fig. 1a. The dependence on temperature and coupling constant λ_M is shown in Fig. 1b.



(a) Parameters: temperature: T=0.1K, magnetic field: B=0T



(b) Parameters: spin relaxation time: $\tau=10^{-12}$s, magnetic field: B=0T

Figure 1. Diagrams of instability. Color scale represents the instability rate. Cyan color shows that system is stable (it is symbolically expressed by 0 on logarithmic scale). Crosses and circles in Fig. 1a represents respectively stable and unstable states derived in evolution simulations.

[1] I. A. Shelykh, T. C. H. Liew and A. V. Kavokin, Phys. Rev B **80**, 201306 (2009).
[2] R. Mirek, M. Król, K. Lekenta, J.-G. Rousset, M. Nawrocki, M. Kulczykowski, M. Matuszewski, J. Szczytko, W. Pacuski, and B. Piętka, Phys. Rev. B **95**, 085429 (2017).
[3] P. Miętki, M. Matuszewski, Phys. Rev. B **96**, 115310 (2017).