

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Ivan Gnusov

PhD Program: Physics

Title of Thesis: Spinor and vorticity control in polariton condensates

Supervisor: Professor Pavlos Lagoudakis

Co-supervisor: Assistant Professor Sergey Alyatkin

Name of the Reviewer: Assistant Professor Yuriy Gladush

I confirm the absence of any conflict of interest

Date: 10-09-2023

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

Thesis work by Ivan Gnusov is devoted to investigation of various aspects of macroscopic spin dynamics of polariton condensates in semiconductor microcavities. The name of the thesis reflects well its actual content. Thesis work consists of six chapters, two of which provide theoretical background for polariton condensates and description of experimental methods used. Author implements diverse experimental methods for condensate spin and phase retrieval for which detailed explanation is given in thesis text. All the methods are relevant to the cases where they are used.

Main results are presented in four chapters. All the results represent significant advancement in the physics of coherent polariton gas. I would like to emphasize the rotating bucked experiment with vortex formation. It is classical experiment in liquid helium physics, but it is the first time it is realized with polaritons which required ingenious experimental approach. High quality and importance of obtained results is evident from publication list – Phys. Rev. B, Phys. Rev. Applied and Science advances. One more paper is on the ArXiv, which has very high potential. All the experimental results are compared with numerical simulations. Worth noting the simulations are performed not by Ivan, but it greatly supports the experiment interpretations.

Overall thesis work is written on a high level and has all it needs for formal thesis defense. Some minor comments are below.

- 1) On the sample sketch (Figure 3-6), several pairs of quantum wells are located in antinodes with distance of λ between each other. In this situation it is important to discuss if the beam is focused only on one pair or integral signal from several pairs is measured. What focus length was used and does PL from other out of focus QWs contribute to the signal measured.
- 2) The rotating potential experiment relies on beating of two independent lasers, thus their mutual coherence is required. I would appreciate the discussion of their mutual coherence time and its influence on the measurement results especially in case of slow rotation.

Provisional Recommendation

I recommend that the candidate should defend the thesis by means of a formal thesis defense

I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report

The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense