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Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Anton Baranikov

PhD Program: Physics

Title of Thesis: Dynamic polariton condensation in organic microcavities

Supervisor: Prof. Pavlos Lagoudakis

Date of Thesis Defense: 8 November 2019

Name of the Reviewer: Nikolay A. Gippius

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Signature:**  **Date: 08-10-2019**

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

This thesis is focused on experimental investigation of dynamic polariton condensation in organic microcavities. Throughout the work, the author elucidates the physical mechanisms of the condensation using advanced experimental techniques. He also expands the research with the room-temperature polariton amplifier demonstration. Finally, the author presents experimental evidence of the light-light interaction that is interpreted in terms of "room-temperature polariton transistor".

The organic strongly-coupled microcavities attract a lot of scientific interest. So far, this area is not well-explored. This work has several important achievements, that previously has not been reported:

- First demonstration of dynamic polariton condensation in an organic microcavity at room temperature by means of pump-probe technique
- First demonstration of organic polariton amplifier at room temperature
- Exhibition of switching behavior, experimental testing of cascadability and demonstration of the concept for OR, AND and NOR optical gates functionality

The results have been published in Nature Photonics.

Furthermore, the author explores the influence of intracavity nonlinear refractive index change on the polariton blueshift. The energy shift is not well-understood in organic strongly-coupled microcavities. Performed experiments are described in Chapter 2. Author utilizes well-known Z-scan technique, which he successfully tests in the publication [Reference 2 for the author's list of publications].

Overall, the work is convincing and has high-quality. A minor weak points communicated to the author at early stages have been properly taken into.

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*