

## **Referee report**

on the opening of new theme Modern Trends and Developments in Raman Microspectroscopy and Photoluminescence for Condensed Matter Studies

and project Ultrasensitive SECARS microspectroscopy and luminescence biolabeling with core-shell nanostructures

(2018-2020)

**Leaders: *G. Arzumanyan and N. Kučerka***

The proposed new theme and project are definitely based on the previous achievements accumulated so far on the multimodal optical platform which is successfully operating at Frank Laboratory of Neutron Physics. They concern both: Raman microspectroscopy, including CARS and SERS enhanced modifications, and photoluminescence in optical phosphors activated with rare earth elements as well. The project is original and the overview of state of the project is adequately presented. The essential goals are consistent with results from the previous scientific work, this project builds their aims on previous experiences from research results, which were completed successfully.

### Appropriateness of the requested funding and problems to solve:

The proposal of project which comprises two advanced aims are addressed to the modern trends in Raman spectroscopy, and first of all to the implementation of ultrasensitive and highly contrast surface-enhanced CARS (or SECARS) modality based on four-wave mixing at plasmonic materials, and core-shell structures in photo-and upconversion luminescence studies.

Its seems to be an attractive and realistic proposal. Showing model of investigation and advance of the project will resolve the aims of proposal. The scientific and technical impact of this research is on the very good level and the measures maximizing the impact of the project will be required future independent researches based on using these JINR's facilities. The requested funding is realistic for estimated budget.

### Technical ability to implement the project within the stated periods:

Following to the report and presentation submitted by the theme leader, the "CARS" microscope, after its modernization in 2015-2016 years, has a high potential to be considered as a competitive facility at the world level. Optical microscopy is unique among current imaging modalities in its ability to probe bio-specimens with subcellular resolution, enabling the visualization of morphological details in tissue and cells on the scale of a few hundred nanometers. Novel optical imaging methods based on SECARS and core-shell nanostructures can open new frontiers in chemical and biological discovery and medical diagnostics as they are minimally destructive allowing deep penetration in tissues, requiring virtually no contact with the sample.

The current report demonstrated certain background already achieved in this group for the successful implementation of the new theme in the coming three years. The management plan and stated periods are adequate and practicable.

### Availability of the human resources of JINR and cooperating institutions:

Previously, the staff members of the Sector of Raman spectroscopy at FLNP have already gained qualified experience in Raman spectroscopy and photoluminescence studies and have published a number of articles in high-ranking journals.

The new theme of this proposal comprises two really modern trends in the above mentioned field of activities.

The potential for the innovations versus risk levels are correlated on the team experiences, partially on the pilot studies and also of the continuation of the previous works. These research results from JINR will be also making the better use of application therapeutic facilities to the Russia and expected results could reach the worldwide levels.

The management include clear overall responsibility for the activities including a problem-solving mechanism in the event of assignment experiments between partners from JINR and participating institutions from other countries, which expressed an interest of the joint study within the proposed project. The data collection strategy, potential sources of information and accessibility of data are clear. In this regard and with expected results the policy “user-friendly” facility could be enlarged around the “CARS” microscope by engaging more users from the JINR Member-States and other potential stakeholders of this facility.

STRENGTHS of the project:

- The Project Proposal Application for Funding Form is specific enough to clearly show its innovative and original aspects
- Proposal successfully addresses all relevant criterion aspects - shortcomings were not found.
- The resources in scientific merit, technical ability and funding are given as a complex of the activity proposed.
- Planned timetable, balance between the time frames and costs, description of the work plan, benefits for JINR arising from this activity, structure and planned procedures are clearly determined.
- Partners are capable to fulfil tasks from stated periods.

WEAKNESSES of the project:

- No factual errors were found, without discriminatory comments.

**Within the five usually limits (Excellent, Very good, Good, Fair, Poor and Proposal fails) the evaluation of the project is in scoring scale - Excellent level. Proposal successfully addresses all relevant criterion aspects. Take into account, the project under the theme “Modern Trends and Developments in Raman Microspectroscopy and Photoluminescence for Condensed Matter Studies”, to be recommended for opening and funding, in coming three years.**

Assoc. prof. Martina Dubnickova, PhD.  
PAC member for Condensed Matter Physics member, JINR

In Bratislava, Slovak Republic: May 29, 2017