

## Referee report

on the extension of the theme “Modern Trends and Developments in Raman Microspectroscopy and Photoluminescence for Condensed Matter Studies”  
and opening new project “Biophotonics” for the years 2021-2023

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

In recent years the development of modern diagnostic methods and new research techniques in biophysics and soft matter physics is also closely related to achievements in the field of biophotonics. The proposed extension of the topic "Modern trends and development in Raman microspectroscopy and photoluminescence in condensed matter research", as well as the opening of the new project "Biophotonics" perfectly fit in this trend and are also supported by previous achievements obtained using a multimodal optical platform, which is successfully operating at the Frank Laboratory of Neutron Physics. They cover both: Raman microspectroscopy, including CARS, SERS and SECARS enhanced modifications, as well as the photoluminescence in optical phosphors activated with rare earth elements. The submitted project is original, its research assumptions are clearly presented and motivated, as well as the main scientific competitors were identified. In my opinion, very important for the future successful implementation of the evaluated project is also the fact that project goals are based on the results of the previously implemented project.

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

The project proposal is well balanced between basic and applied research, and focuses on biosensing and diagnostics. The goal of basic research proposed in the project is an identification of physical nature of the anomalous intensity ratio of the anti-Stokes and Stokes components in SERS spectrum. This problem has still not been fully resolved, even though research has been going on for over twenty years. The progress in understanding the mechanisms of such anomalies in SERS spectra will allow to approach closer the solution of the problem of the reproducible spectrum registration, which is an crucial criterion for the development of biosensors. Second topic described in the project is related to lipid-protein interactions and assumes application of modern biomembrane mimetic nanosystems – lipodiscs (biceles). These systems, so far, have been successfully used in NMR studies of the structure of membrane proteins or peptides, therefore their application for planned research is justified. Moreover, one of the important goals described in the proposal is also the pioneering work that has been started, as a matter of fact, while looking for early diagnostic Raman markers of netosis.

The described proposal is in my opinion interesting and attractive, and the research plan is realistic and technically feasible. The proposed model of studies and advance of the project will likely resolve the aims of proposal. The scientific and technical impact of this research is on the excellent level. The requested funding is tied realistically to the budget estimated taking into the account the need of acquiring low-frequency Raman spectrometer both for basic and applied research proposed in the project.

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

Following to the report and presentation submitted by the theme leaders, the “CARS” microscope modernized over the years 2015-2016, has a high potential to be considered as a competitive facility at the world level. Optical microscopy overall, has a niche 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. Modern imaging methods based on SECARS and dedicated nanostructures can then open new frontiers in chemical and biological discovery and medical diagnostics as they are minimally destructive allowing deep penetration in tissues and requiring virtually no contact with the sample.

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

### **The availability of human resources within JINR and cooperating institutions:**

It is important to take into account that the FLNP staff members from the Raman spectroscopy team have already gained qualified experience in Raman spectroscopy and photoluminescence studies, and have published a number of research papers in prestigious journals. Nevertheless, the new project of this proposal continues to aspire rather ambitious tasks in the above mentioned field of activities.

The potentials for the innovations versus risk levels are balanced by the team experiences partially gained during the pilot studies and previous works. In my opinion expected results of the project implementation could reach the worldwide levels.

The project management includes a clear overall plan for the activities including a problem-solving mechanism in the event of assignment experiments between partners from JINR and participating institutions from other countries, that have expressed an interest in the joint study within the proposed project. In this regard and with expected results, the “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.
- The planned research schedule is well balance within the time frames and costs, the description of the work plan is clear, benefits for JINR arising from this activity, structure and planned procedures are clearly determined.
- Proposal successfully addresses all relevant scientific criterion and formal aspects.
- The project scientific merit, technical ability and funding are given as a complex of the activity proposed.
- Partners are capable to fulfil tasks from stated periods.

### **WEAKNESSES of the project:**

- No factual errors were identified. I have not any other critical comments.

**Within the evaluation scale (Excellent, Very good, Good, Fair, Poor and Proposal fails), the project is scoring on Excellent level. The proposal successfully addresses all relevant criterion aspects. I suggest the project “Biophotonics” 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.**

  
Prof. dr hab. Maciej Kozak  
PAC member for Condensed Matter Physics of JINR

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