**Review on the project**

**“Design and development of the tagged neutron method for determining the elemental structureofmatterand studying nuclear reactions”.**

The project TANGRA has been implemented in JINR since 2014 and is a unique project of its kind aimed at studying nuclear reactions induced by neutrons with one energy – about 14 MeV. Neutrons with such energy are formed in the reaction D(T,n)α, which is considered to be one of the main reactions of the thermonuclear fusion thatin itself can serve as a sufficient basis for studying the interaction of such neutrons with matter. Yet, this reaction has another unique feature – it allows “to tag” neutrons by registering the accompanying alpha-particle. The tagged neutron method provides a number of advantages in experimental studies of neutron-nuclear interactions.Perhaps one of the main advantages isthe multiple suppression of the background due to the analysis of events formed in coincidence with the accompanying alpha-particle. Another important property of the tagged neutron method is the ability of determining exactly the number of neutrons falling on a sample, i.e. actually built-in neutron beam monitor.

During the implementation of the project a fully functioning facility has been designed by the authors, both methodical and scientific results of apparently scientific importancehave been obtained. Information on the angular correlations of gamma-ray emission in inelastic scattering reactions is important both in terms of application – to clarify thegamma-rayyields, required for elemental identification using the tagged neutron method (TNM), andfor understanding the mechanisms of interaction processes of fast neutrons with nuclei from the point of view of fundamental science.

The work plan for the next three years proposed by the authors of the project appears to be reasonable and well thought-out. It includes activities in the field of fundamental physics: further measurements of angular correlations in neutron-nuclear interactions, the (n, 2n) reactionstudyin the interaction of nuclei with the neutrons with an energy of14.1 MeV, development of a complete theory for describing angular correlations both in the gamma-ray emission and secondary scattered neutrons; as well as applied tasks: creation of gamma-transitiondatabaseand an elemental analysis technique development based on it, methodologies of searching for diamonds in kimberlite ores using the tagged neutron method, study of the Martian soil model.

The use of high pure germanium (HPGe) detectors will improve the accuracy and reliability of the results obtained. There is, however, a high probability of radiation damage to theHPGe crystal when it is irradiated with fast neutrons. Since the radiation resistance for a *p-* and *n-*type material differs by more than two orders of magnitude, the authors should pay particular attention to this property when choosing a detector. In addition, such detectors are significantly slower than scintillation detectors which, when carrying out time-of-flight measurements, will cause additional difficulties.

The team of authors of the project is suitably qualified, has high scientific potential andpossesses the necessary equipment, experience in conducting experiments on neutron beams and analyzing experimental data. An important factor both for the successful implementation of the project and the international profileenhancementof the ongoingresearch is the broad international cooperation presented in the project.

I propose to approve the project.

Project evaluation:

А. –Scientific, methodical or technical significance (scale 0-10 points): 8 points;

B. – Competitiveness (scale 5 points): 5 points;

C. –Probability of the Project implementation (scale 0-1): 1 point;

D. –Compliance of resources with the significance of the Project (scale 0-1): 1 point;

E. – Authors’ qualification and staffing (scale 0-5 points): 5 points;

F. – Sum of points (scale 0-20): 18 points.

Head of Sector No. 2, DNSRC (Department of Nuclear Spectroscopy and Radiochemistry)

DLNP, JINR

[Dr. Phys.-Math.Sci.](https://www.multitran.com/m.exe?s=Dr.%20Phys.-Math.Sci.&l1=1&l2=2) V.G. Egorov