

## **Review on the project “Open information and educational environment for supporting fundamental and applied multidisciplinary research at JINR”**

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The project submitted for review continues the work being carried out at the JINR UC on the creation of multimedia interactive computer-based teaching resources on the subject of fundamental and applied multidisciplinary research at JINR. This work is of great importance for the educational process both in the natural-scientific and information technology areas.

Recently, computer-based educational resources have been actively used in the educational process both for full-time student education, and for correspondence and distance education. Multimedia educational resources make it possible to tell students about the latest breakthroughs of science and technology in an interesting and accessible form, increase their interest in further work in research centers, and help determine the subject of final qualification works. Such resources are especially important when organizing the process of additional training, for example, at the International School of Engineering and at the International School “Big Data Analytics” of Dubna State University.

The solutions proposed by the project authors can significantly help in organizing career guidance activities for school students, in conducting summer schools, practices, open-door days and science fests.

Of particular interest is the section of the project devoted to the creation of a set of virtual, remote and hands-on practicums and research works based on real experimental data, as well as the creation of an open Internet environment for constructing laboratory works to study nuclear physics. It is well known that practicums form the basis for the training of a modern specialist in the field of physics and engineering. However, to organize a wide range of laboratory works at universities, the necessary base of experimental equipment is not always available. Also, there is no opportunity to conduct laboratory works in nuclear physics connected with radioactive sources. Therefore, a set of virtual practicums can be significantly useful. Equally important for the university is the opportunity to hold hands-on practicums and research within the university campus, which will appear during the implementation of project proposals. The opportunity to develop remote practicums on the basis of the open web-based environment for practicum modeling proposed in the project allows to organize a wide range of research and final qualification works of students studying in areas related to physics, electronics and information technology.

### **1. Scientific relevance, elements of novelty, timeliness of research**

Joint educational programs for school- and university students belong to one of the priority directions of activity of all major research centers. Participants in such programs are specialists of research centers, university and school teachers. The Joint Institute for Nuclear Research has always paid attention to educational programs. Therefore, the development of existing and the development of new computer educational resources in the framework of modern trends in the use of information technology in education is of great scientific importance.

The novelty of the project is as follows:

- Leading JINR specialists will create online courses about researches conducted at the institute in the format of open online courses using visualization capabilities based on interactive 3D-graphics and interactive control materials.
- Within the framework of the Virtual Laboratory for the Study of Nuclear Physics, virtual practicums on gamma spectroscopy with various types of detectors will be created; a set of practicums will be developed to study the operation of the detectors and signal processing, including signals from digitizers; a course on the analysis of experimental data in the ROOT environment will be developed.
- A platform for organizing remote practicums on nuclear physics will be developed. This platform will have the opportunity to attach various types of equipment using a single data exchange protocol.

## **2. The group's experience and technical ability to implement the project on time**

The project authors have long-term experience in creating multimedia educational resources for school- and university students, as well as in creating interactive multimedia scientific and educational exhibitions and Internet resources.

In recent years, the project authors have been actively involved in the development of online courses for international and Russian platforms for massive open educational resources (Coursera, edX, National Open Education Platform). The JINR Open Educational Portal was developed. It hosts online courses from JINR specialists on JINR research topics.

The project authors developed the Virtual Laboratory for Studying of Nuclear Physics. On the basis of this software-hardware complex hands-on practicums, workshops for teachers, university- and school students are regularly held, international student practices are organized. Virtual practicums from this complex are already being used at universities in 16 countries.

Earlier, the project authors developed multimedia educational resources that formed the basis of the work of the Educational center named after academician A.N. Sissakian at Dubna State University.

Taking into account the qualifications and previous experience of the project authors, the implementation of the project on time is beyond doubt.

## **3. Relevance of the requested financial resources to the objectives of the project / theme**

The requested financial resources correspond to the objectives of the project.

## **4. Human resources at JINR and in collaborating organizations**

The project is provided with human resources both from the JINR and from the organizations participating in the project.

I want to add that at Dubna State University there is great interest in participating in the project and implementing its results into the educational process. The participation of the university teachers at the stage of design and development of all project components will allow to implement

its results into the educational process, taking into account the specifics of both different universities and different countries. It is very important that the JINR University Centre is the coordinator of this work.

In general, the creation of training courses, practicums and training programs will take place with the participation of university teachers in conjunction with JINR specialists. The work related to the creation of software products is supposed to be carried out on the basis of JINR with the involvement of information technology specialists.

I think that the project "Open information and educational environment for supporting fundamental and applied multidisciplinary research at JINR" is an important activity direction for JINR and the JINR Member States. I propose to support it with first priority and funding allocation in full.

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