



SAITAMA, 09.02.2020

**EXTERNAL REPORT ON THE THESIS**

by

**NASSURLLA MAULEN**

entitled

*Effects of cluster structure of stable boron and lithium isotopes to form the outputs of nuclear reaction in the interaction with deuterium and helium isotopes*

**ANNOTATION**

to the thesis Nassurlla Maulen for the degree Doctor of Philosophy (PhD) in. 6D060500-Nuclear Physics

Maulen Nassurlla is a member of the research team of Prof. N. Burtebayev and a collaborator of Prof. Stanislav Sakuta group from the Kurchatov Institute. Over the next few years, he as part of these groups participated in scientific experiments at the Warsaw heavy ion accelerator, where he was responsible for the preparation of experimental facilities for measuring the cross sections of nuclear reactions in light nuclei.

Maulen Nassurlla has visited Saitama University, Department of Physics, Faculty of Science and Heavy Ion Medical Accelerator in Chiba. Also he participated experiment at Riken's RIBF in November 2016 as a visitor.

His first visit was from 17.06.2017-10.08.2017. The main reason of the internship was to participate in the experiment, also get consultation about his thesis.

His second visit to the Saitama University, Department of Physics, Faculty of Science and Heavy Ion Medical Accelerator in Chiba was 02.06.2018-09.08.2018. The main highlight of his visit was participation in experiment and in international conference:

4.06-8.06 2018 - DREB2018 - 10th International Conference on Direct Reactions with Exotic Beams, Matsue, Japan

During his stay at HIMAC Chiba and after experiment he committed most of his time to perfecting the use of data handling and analysis tools and in particular to the ROOT and ANAROOT environment. As a foreign supervisor of Maulen Nassurlla I was in Almaty (Kazakhstan) at Institute of Nuclear Physics, Republic of Kazakhstan at International Scientific Forum "Nuclear Science and Technology" from 12.09.2017-15.09.2017. The purpose of my visit was to consult and to discuss the results obtained in joint experiments for the writing of the PhD dissertation.

As a part of the joint collaboration (Japan and Kazakhstan) we perform joint experiment at U-150M accelerator in Institute of Nuclear Physics in Almaty (Kazakhstan) from 11.10.2017-1.11.2017. Maulen Nassurlla also participated in this experiments which devoted to "Study Of

The  ${}^7\text{Li}(d, t){}^6\text{Li}$  Reaction At The Energy Of 14.5 MeV ". As the result of this experiment the article were published in Acta Physica Polonica B in 2019.

The thesis by Maulen Nassurlla has four aims:

1. To obtain experimental data and angular distribution on the differential cross sections of nuclear processes  ${}^7\text{Li}(d,d){}^7\text{Li}$ ,  ${}^7\text{Li}(d,t){}^6\text{Li}$ ,  ${}^{11}\text{B}(d,t){}^{12}\text{C}$  and  ${}^{11}\text{B}(\alpha,t){}^{12}\text{C}$  at energies of 7-10 MeV/nucleon.

2. To obtain and refind optimal values of the parameters of the optical and folding interaction potentials for the systems " $d+{}^7\text{Li}$ ", " $d+{}^{11}\text{B}$ " and " $\alpha+{}^{11}\text{B}$ " in a wide energy range eliminated the discrete ambiguity of the real part of the potential.

3. To estimate established parameters of the quadrupole deformation of  ${}^7\text{Li}$  and  ${}^{11}\text{B}$  nuclei (with a negative sign) specify the channel relationship between the ground and excited states of the studied nuclei.

4. To obtain adjusted values of the spectroscopic factors of the cluster configurations  ${}^7\text{Li} \rightarrow \alpha + t$  and  ${}^{11}\text{B} \rightarrow 2\alpha + t$  correctly reproduce the rise of the reaction cross sections (d,t) and ( $\alpha,t$ ) at opposite angles on the studied nuclei and substantiate their cluster structure.

The experiential data for the thesis were performed in collaboration with University of Warsaw, Heavy Ion Laboratory, Warsaw, Poland at accelerator U150M in Institute of Nuclear Physics, Almaty, Kazakhstan.

As it is clearly presented in the thesis, the experimental part of this thesis is very successful in terms of experimental setup and data analysis.  $\Delta E$ -E method for registration and identification of nuclear interactions products was used in the experiments. Specific energy loss of nuclear reactions products (dE/dx) and their total kinetic energy (E) were measured simultaneously.

In the second part of the Thesis, the effort has been to explain the measured experimental data theoretically. In the theoretical part, the analysis was made within optical model, folding model, distorted wave method and coupled reactions channels method.

All in all, the two-part internship of Maulen Nassurlla at Saitama University of made an important contribution to his development as a scientist and helped in the completion of his thesis

**"Effects of cluster structure of stable boron and lithium isotopes to form the outputs of nuclear reaction in the interaction with deuterium and helium isotopes".**

In conclusion, I confirm that the thesis of Maulen Nassurlla fully complies with the highest international standards for a Ph.D. degree.

**I strongly recommend the thesis to be awarded as the degree Doctor of Philosophy.**

Best regards,  
Professor, T. Suzuki

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