Co-funded by the Erasmus+ Programme of the European Union

1st Activities Report on implementation of the project

(BSU team)

The period 15.10.15 – 14.05.16

Physics (Erasmus + programme) Improvement of master-level education in the field of physical sciences in Belarusian universities

DECLARATION

Name of the co-ordinator (institution):

Name of the contact person : ....

Position: .....

Place: .....

Date: .....

REPORT ON IMPLEMENTATION OF THE PROJECT

Please provide an overview on **implementation of the project**, by following the instructions below.

Overall achievements

Please provide a description of the activities carried out since the start of the project and describe to what extent, the results achieved since the beginning of the project, are contributing to the project objectives.

WP 1: Preparation

1.1 The study of compatibilities of educational regulations

Now we finished the study of compatibilities between educational regulations of Belarus and Erasmus+ programme rules using information get from Education, Audivisual and Culture Executive Agency of the European Commission during Project Representatives meeting held on 27-28 January 2016 in Brussels (Belgium) and also studying the Guidelines for the use of the grant CBHE.

1.2 Ex-Ante reports

Ex-ante report was written and directed to RTU in time. It describes curricula presented in BSU before the transition fron 5+1 system to 4+2 system.

1.3 Studies to define specific needs of the labour market

In order to bring the system of higher education in line with the principles of the Bologna process, the Ministry of Education of the Republic of Belarus has set the task for universities of Belarus to reform the curricula in connection with the transition from the existing study system "5 + 1" to the system "4 + 2". Reducing the period of students study in the 1st stage of higher education (specialists) from 5 to 4 years in the field of physics and High-Tech engineering leads to certain risks in the quality of trained personnel for scientific research institutes (SRI), design engineering bure (DEB), high-tech enterprises (HTE) and also Universities. The following risks arise:

• graduates within 4-year programs will have the lower actual qualifications than the graduates at previous 5-year programs.

• low portion of master-level graduates in relation to graduates at the 1st stage of education (in Belarus prevails relation 10 % and 90 % respectively), which previously satisfied the needs of the job market in science, education and high-tech industries.

Currently, professional qualification of graduates within a 5-year education, to a greater extent, meets the requirements of the industry whereas graduates within a 6-year training cycle are basically required for universities, DEBs and SRIs.

Taking into account the EU experience, we predicted that in the coming years, the portion of specialists with a 6-year training cycle for "4 + 2" system, should grow significantly, both for Universities and other employers (like HTE, DEB and SRI). Thus, it becomes relevant the question to develop practice-oriented 2-year master-level studentships on the 2nd stage of higher education.

To study the specific needs of the labour market in Belarus and tune future curricula to these needs, BSU team has organized the survey of professional associations, research institutes and universities as employers of master graduates. The purpose of this survey was to:

- Pooling ideas how to form the 2-year practice-oriented master-level education in Belarusian universities with in-depth training;
- Finding (interpretation of) what think representatives of job market (HTE, DEB, SRI, Uuniversities, etc.) about qualification requirements for graduates of practice-oriented masterships;
- Identifying training requirements of the process-consumers to graduates of masterships for the "4 + 2" system;
- Identification of the needs and requirements for the organization of practical training for master students.

This survey was planned to be used in the preparation of the model curricula and study programs for two-year master-level education in the field of physics, including such specialties as "Functional Nanomaterials" and "Photonics". The survey involved 8 teams from 4 universities (BSU, GrSU, GSU and BSTU), and also Belarusian Physical Society (BPO), SRI for Nuclear Problems of BSU and Republitian Association of Nano-Industry (RANI). Half of respondents belonged to the age group 40-50 years, 25 % were older than 50, 15% were 30-40 years. 65 % responding groups were teachers, 25 % - employees of research institutions.

The copies of the filled questionaires are presented in Appendix 3. The results of survey analysis are presented in Appendix4.

Summarizing results of respondents answers in Appendix 3, we can draw the following conclusion:

1. It is advisable to reduce the time to study the non-core and social-humanitarian disciplines, because knowledge on

these subjects, mainly to be obtained at the secondary level schools.
2. The proportion of theoretical and practical training for master-level students is recommended from 1/3 to 2/3 (i.e., the number of laboratory and practical training must exceed the number of lectures).
3. It is advisable to strengthen the training of master-students in the field of programming and specialized disciplines.
4. It is advisable to enter the education programs extra disciplines such as physics of low-dimensional systems and nano- and biotechnology.
5. The majority of respondents noted the importance of the mastering by the students principles of modern high-tech equipment and computer data processing (model fitting).

1.4 Report on studies
The results of survey analysis are presented in Appendix4.

1.5 WS1 in Minsk
Kick-off meeting was organized in BSU (Minsk) in 17.12.2015, see Minutes of Meeting.

WP 2: Development and modernizing of curricula
2.1.2 Development of 5 courses books in English: Applied Physics, Functional nanomaterials, Photonics, Applied Informatics and Research towards master thesis.
After consultations with GrSU, GSU and BSTU teams, BSU team developed the Content of e-Books "Functional nanomaterials" and "Photonics" (see, below).

WP 5: Dissemination & exploitation
Information by the project was saved on web site of the Chair of Energy Physics (BSU) (see, Appendix 1 and web site http://www.physics.bsu.by/ru/departments/energy-physics/energy) in page http://physics.bsu.by/ru/departments/energy-physics/int_projects .

5.4 Information sessions
BSU team participated in the III International Seminar of Experts on Renewable Energy "Renewable energy: potential, achievements and prospects", which was held from 25 to 27 May 2016 in Minsk at the National Academy of Sciences of Belarus. Professor A. Fedotov as a member of Program Committee of the Seminar (see, and Appendix2 and http://seminar.ipe.by/en/), informed the members of Committee and other participants of Seminar about the goals and tasks of the project PHYSICS.

WP 6: Management
6.1 Accepting Project Schedule, Quality Plan (at Kick-off meeting)
Fully done

6.2 MC meetings (MC1, MC2)
BSU team participated in Management meeting N1 in BSTU (Minsk), which was held in 10.03.2016, see Minutes of Meeting.

6.3 Partner Agreements signing
Now BSU finished the checking of the RTU proposal with the RTU-BSU agreement template on the subject of its compatibility with Belarusian legislation. Unfortunately, now partners from Belarus can not sign officially double-sided agreements for cooperation with other partners before finalization of the official validation procedures which are required in accordance with Belarusian legislation. Now we conform form of double-sided agreements with BSU University authorities.

6.6 Purchasing of Equipment, hardware, software for physical and virtual labs
Purchase of equipment is delayed due to long procedure of the project validation by Governmental Bodies of Belarus. Now we study equipment market to prepare specification list and tender procedure.

Coherence with the workplan and comments on deviations and modifications

Please write in this section the main changes which have occurred compared with the original project proposal. (More detailed information is requested in the relevant sections below).

Tender announcement for purchase of equipment is delayed due to long procedure of the project validation by Governmental Bodies of Belarus. Now we study equipment market to prepare specification list and tender

procedure.
Double-side agreement between RTU and BSU is ready to signing.

Obstacles and shortcomings

Please describe any obstacles and/or shortcomings experienced during the period covered by the report and the measures taken by the project team to address them.

Main obstacles and/or shortcomings experienced during the period covered by the report are connected with the difference of Belarusian and European legislations that resulted in the delay in purchasing of equipment, payment of money for the work and signing of double-sided agreements.

Development of programmes and courses

Please provide a description of the teaching/training programme(s) (undergraduate/postgraduate programmes, intensive courses, training modules to academic or non-academic staff, etc.) that the beneficiaries are developing or of the introduction of the new programme(s) and the state-of-play of these developments at the time of submitting the report. If unforeseen changes in the original plans occurred, please describe the type of changes and the measures taken to address them. Please also indicate the activities you plan to carry out before the end of the project. If this section is not relevant for your project, please write 'Not Applicable'.

Short report about the development of e-Books with responsibility of BSU team

BSU team is responsible for the development of two e-course books: Functional nanomaterials and Photonics. Now the development of their Content and abstracts of Chapters (Papers) are finished.

Content of e-Book "Functional nanomaterials"

Chapters/Papers	Univer-sity	Contributors
Executive summary	BSU	A. Fedotov, V. Odzhaev
Introduction	BSU	A. Fedotov, V. Odzhaev
Chapter 1: Concepts of Low-Dimensional Effects	BSU	A. Fedotov
Chapter 2: Introduction to Physics of Surface/Interface	BSU	A. Fedotov
Chapter 3: Thermal Properties of Nanomaterials	BSU	M. Tivanov
Chapter 4: Chemistry of Nanomaterials	BSU	A. Mazanik
Chapter 5: Physics of Carbon Low-dimensional Systems and Device Structures	BSU	N. Poklonski
Chapter 6: Arrays of carbon nanostructures: fabrication, properties and applications	BSU	V. Ksenevich
Chapter 7: Conductive Polymers	BSU	V. Odzhaev (V.Odjaev)
Chapter 8: Electrically conductive nanocomposites	BSU	N. Gorbachuk, A. Fedotov
Chapter 9: Magnetotransport and Magnetism in Nanocomposite and Multilayered Materials	BSU	J. Fedotova, J. Kasiuk
Chapter 10: Nanoscale Materials and Structures for Spintronics	BSU	M. Lukashevich
Chapter 11: Nanomaterials for Power Engineering	BSU	A. Mazanik
Chapter 12: Nanobiomaterials	BSU	P. Bulay
Chapter 13: Fluorescent quantum dots for bioimaging	GrSU	N. Strekal
Chapter 14: Plasmonic nanomaterials for photonics, biochemistry and quantum technology	GrSU	N. Strekal

Chapter 15: Nanofibers: synthesis, properties and applications	BSTU	N.R. Prokopchuk, Zh.S. Shashok
Chapter 16: Elastomeric compositions with carbon nanomaterials	BSTU	K.V. Vishnevskii, Zh.S. Shashok
Chapter 17: Paints and coatings, modified carbon nanomaterials	BSTU	N.R. Prokopchuk, A.L. Shutova, E.N. Sabadakha
Chapter 18: Plasma-chemical synthesis of nanocomposite polymer coatings	GSU	A.V. Rogachev, A.A. Rogachev, M. Yarmolenko
Chapter 19: Carbon coatings doped with metals	GSU	A.V. Rogachev, D.Pilipcov, N. Fedosenko
Chapter 20: Sol-gel synthesis of functional materials	GSU	D. Kovalenko, V. Gaishun, A. Semchenko

Content of e-Book "Photonics"

Chapters	University	Contributor
Executive summary	BSU	A.Tolstik
Introduction	BSU	A.Tolstik
Chapter 1: Laser physics	BSU	A.Tolstik
1.1. Principles of lasers operation and characteristics of laser radiation. Methods of the active medium pumping. Optical resonators.	BSU	A.Tolstik
1.2. Continuous mode of laser operation. Power generation. The lasing threshold. Free-running mode	BSU	A.Tolstik
1.3. Active and passive Q-switched modes. Power, energy and duration of the laser pulse. Methods of solid-state lasers resonators quality factor modulating.	BSU, GSU	A.Tolstik, V. Myshkovets
1.4. Generation of Mode-locked picosecond pulses	BSU	A.Tolstik
1.5. Methods of radiation frequency tuning	BSU	I. Agishev
1.6. The types of lasers and their applications	BSU	D. Gorbach
1.7. Industrial lasers.	BSU, GSU	D. Gorbach, V. Myshkovets, A.Maksimenko
1.8. Laser processing of materials	BSU, GSU	D. Gorbach, V.Myshkovets, E.Baevich
References	BSU	A.Tolstik
Chapter 2: Laser physics and nonlinear optics	BSU	A.Tolstik
2.1. Nonlinear medium and mechanisms of nonlinearity	BSU	A.Tolstik
2.2. Self-focusing and beam autocollimation	BSU	A.Tolstik
2.3. Second harmonic generation. Phase-matching conditions.	BSU	A.Tolstik
2.4. Parametric amplification and generation.	BSU	A.Tolstik
2.5. Stimulated Raman scattering. Stimulated Brillouin scattering.	BSU	A.Tolstik
References	BSU	A.Tolstik
Chapter 3: Coherent Optics and Holography	BSU	A. Melnikova
3.1. Spatial and temporal coherence.	BSU	A. Melnikova
3.2. Types of holograms: thin and volume, amplitude and phase, reflective and transmissive.	BSU	A. Melnikova
3.3. Diffraction efficiency.	BSU	A. Melnikova

3.4. Spectral and angular selectivity.	BSU	A. Melnikova
3.5. Denisyuk holograms, Fourier hologram, rainbow hologram.	BSU	A. Melnikova
3.6. Dynamic holography.	BSU	A.Tolstik
3.7. Holographic interferometry.	GrSU	A. Ljalikov
References	BSU	A. Melnikova
Chapter 4: Optoelectronics		
4.1. Semiconductor optical detectors	KU Loven	Joan Peuteman
4.2. Solar cells	BSU	M. Tivanov
4.3. Applications of photovoltaic systems	KU Loven	Joan Peuteman
References		
Chapter 5: Nanophotonics	GrSU	N. Strekal
5.1. Quantun and classical confainment effect	GrSU	N. Strekal
5.2. Density of states and modified density of states in system of low dimensionality	GrSU	N. Strekal
5.3. Breaking through the difraction limit and near-field optics	GrSU	N. Strekal
5.4. Quantum dots and basic ideas of nanophotonic devices	GrSU	N. Strekal
5.5 Metamaterials	GSU	I. Semchenko
References	GrSU	N. Strekal

Short report about the development of Curricula with responsibility of BSU team

Preliminary Curricula for 2-year masterships by specialty 1-31 81 03 Functional materials and 1-31 81 02 Photonics include the Lists of courses (see, below). The Preliminary lists of courses are divided on 3 parts (components): State (mandatory) component, University component and Courses at students` option. The final Curricula will include short contents of courses, values of hours and some other information (names of lecturers, type of reporting, etc.).

Specialty 1-31 81 03 Functional materials

Preliminary list of courses (State component)

Year	*Semester*	*Title of special course*
1	*2*	Nanostructured materials and their testing methods

Preliminary list of courses (University component)

Year	*Semester*	*Title of special course*
1	*1*	Contemporary presentation of matter structure
1	*1*	Additional chapters of quantum mechanics
1	*1*	Physics of condensed matter
1	*1*	Group theory
1	*2*	Problemes of applied physics
1	*2*	Wave processes physics
1	*2*	Non-linear physics
1	*2*	Physics and chemistry of surface
1	*2*	Low dimensional systems (LDS)
1	*2*	Optics of nanostructures
2	3	Theory of transfer

Preliminary list of courses at students` option

Year	*Semester*	*Title of special course*
1-2	*1-3*	Materials and electronic structures in energetics

2	*3*	Nanomaterials and nanostructures in electronics
2	*3*	Sinthesys of nanomaterials
2	*4*	Nanotechnology in electronics
2	*4*	Special chapters of LDS
2	*4*	Bionanomaterials/Physics of liquid crystals
2	*4*	Spectra and structure of molculas
2	*4*	Technique of microcontroller systems
2	*4*	Laser physics
2	*4*	Polymer physics

Specialty 1-31 81 02 Photonics

Preliminary list of courses (State component)

Year	*Semester*	*Title of special course*
1	*2*	Nanophotonics

Preliminary list of courses (University component)

Year	*Semester*	*Title of special course*
1	*1*	Contemporary presentation of matter structure
1	*1*	Additional chapters of quantum mechanics
1	*1*	Physics of condensed matter
1	*1*	Group theory
1	*2*	Problemes of applied physics
1	*2*	Wave processes physics
1	*2*	Non-linear physics
1	*2*	Physics of lasers
1	*2*	Non-linear optics
1	*2*	Lasers and laser systems
2	3	Quantum optics

Preliminary list of courses at students` option

Year	*Semester*	*Title of special course*
1-2	*1-3*	Nanophotonic materials
2	*3*	Laser technologies
2	*3*	Laser spectroscopy
2	*4*	Optics of anisotropic media
2	*4*	Coherent optics and holography
2	*4*	Optic processing of information
2	*4*	Optics of polymers and liquid crystals
2	*4*	Photonic crystals

Testing of programmes and courses

Please provide a description of the testing of new developed courses and programs (non-EU partners only).

When testing has been started, which subjects, how many students/ groups. When do you plan to start testing for another groups?

Testing procedure is targeted in 2018.

Restructuring: university management and governance

Please provide information on the institutional changes that the project is introducing in the Partner Country beneficiaries (institutions), the state-of-play of project activities and any changes which occurred compared with the original plans. Please also indicate the activities you plan to carry out before the end of the project. Examples: establishment of new units/faculties,

establishment/upgrading of libraries, establishment/restructuring of international relation offices, introduction of reforms to university governance (i.e. decision process, autonomy, accountability). If this section is not relevant for your project, please write 'Not Applicable'.

Not Applicable

Staff (re-)training

Please provide a description of the activities carried out in order to train the staff of the partner country participating institutions. Please also provide an outline of the selection criteria for the different groups of people who have participated in the implementation of these activities. Please describe any change in comparison with the original proposal and indicate the activities that you plan to carry out before the end of the project. Please, indicate the number males and females.

Some informational sessions and internal management meetings for BSU team and for members of Belarusian consortium were organized.

Staff mobility

Please provide an outline of the staff mobility scheme and the selection criteria used for the different groups of people that participate in mobility. Please describe the activities carried out so far, how mobility activities have been organised by home institutions and how mobility helped and/or will help achieve the project's objectives. Information about how the home institutions recognise the mobility should also be provided. If unforeseen changes in your original plan occurred, indicate the type of changes and the measures taken to address them. Please also indicate the activities that you plan to carry out before the end of the project. Please, indicate the number males and females.

Kick-off meeting was organized in BSU (Minsk) in 17.12.2015, see Minutes of Meeting. Some informational sessions and internal management meetings for BSU team and for members of Belarusian consortium were organized.

Student mobility

Please provide an outline of the student mobility scheme and the selection criteria for the different groups of students that participate in mobility. Please describe the activities carried out so far, how mobility activities have been organised by home institutions and how mobility helped and/or will help achieve the project's objectives. Information about how the home institutions recognise the mobility (credit transfer, double diploma, diploma supplement, etc.) should also be provided. If unforeseen changes in your original plan occurred, indicate the type of changes and the measures taken to address them. Please also indicate the activities that you plan to carry out before the end of the project. If this section is not relevant for your project, please write 'Not Applicable'. Please, indicate the number males and females.

Not applicable

Academic co-ordination and administrative management

Please describe how the division of labour is managed between the various beneficiaries, for both academic co-ordination and administrative management. Particular attention should be paid to the description of how this division of labour is managed in areas such as communication and the decision-making process used. Please also describe how day-to-day project activities are managed, indicating what kind of administrative support or other support you have received from the beneficiaries (institutions). If you encountered difficulties related to the management of the project, please indicate the type of problems and the solutions found to address them.

Not Applicable

Equipment

Please outline the equipment purchased, explain where the equipment has been installed, who will benefit from it and have access to it and plans for future maintenance. Please also describe the activities that you plan to carry out before the end of the project, in relation to the equipment purchased/installed. If unforeseen changes in your original plan occurred, indicate the type of changes and the measures taken to address them. If this entry is not relevant for your project, please write 'Not Applicable'.

Tender announcement for purchase of equipment is delayed due to long procedure of the project validation by Governmental Bodies of Belarus. Now we study equipment market to prepare specification list and tender procedure

Dissemination

Please describe what has been done to disseminate the results of the activities carried out to date, both within the framework of the project and outside the project. In particular, you should refer to the definition of tasks and the dissemination channels used to make the project results available to larger beneficiary groups. If a web site for the project has been created, please provide the address. If there have been any unexpected positive secondary effects from project activities, please describe them in this section. Please indicate any change which occurred in comparison with the original plans for dissemination and the activities you plan to carry out before the end of the project, to disseminate the project results.

5.4 Information sessions

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Information by the project is dowloaded on web site of the Chair of Energy Physics (BSU) (see, Appendix 1 and web site http://www.physics.bsu.by/ru/departments/energy-physics/energy) in page http://physics.bsu.by/ru/departments/energy-physics/int_projects

Project information – conferences

BSU team participated in the III International Seminar of Experts on Renewable Energy "Renewable energy: potential, achievements and prospects", which was held from 25 to 27 May 2016 in Minsk at the National Academy of Sciences of Belarus. Professor A. Fedotov as a member of Program Committee of the Seminar (see, and Appendix 2 and http://seminar.ipe.by/en/), informed the members of Committee and other participants of Seminar about the goals and tasks of the project PHYSICS

Project information – articles

The article "Second-stage education for High-Tech job market needs in Belarus: The study in framework of Erasmus+ project PHYSICS" is prepared for its presentation on 57th International Scientific Conference on Power and Electrical Engineering of Riga Technical University (RTUCON**)** which will be held in Riga & Cesis (Latvia) on October 13-14, 2016

Sustainability

A project is 'sustainable' when it continues to deliver benefits to the project beneficiaries and/or other target groups for an extended period after the EU's financial assistance has ended. Sustainability may not be relevant for all aspects of a project; in each project some activities or results may be continued, while it may not be necessary to continue others. Sustainability is relevant for issues such as: academic/socio-economic/institutional support (describe the measures undertaken to formalise or institutionalise any links with local non-university partners, to obtain official accreditation of new curricula, etc.), involvement of members from the beneficiaries (institutions)(ownership/motivation), effective management and leadership, active participation of the target group, forecast of needs, availability of resources to continue, making

the most of results achieved and a measurable medium/long term impact (long-lasting effects of project cooperation, as well as impact on the beneficiaries (institutions) and target groups). Please explain which of your planned activities and results must be maintained to make your project sustainable. Describe which measures have been taken so far to realistically ensure the continuity of those activities and results beyond the original life- cycle of the project (even when the project is no longer financed by Tempus). Please indicate any changes which occurred in comparison with the original plans and the activities you plan to carry out before the end of the project in order to ensure sustainability.

Quality control and monitoring

Please describe what monitoring activities the beneficiaries carry out, in order to assess whether the project proceeds according to the workplan. Please describe the strategy for internal and external evaluation of project results and include measurable quality indicators for progress. In addition to the project results (courses, publications, new institutional structures, etc), you should also pay attention to the project management strategy. In particular, explain what instruments you use to ensure effective quality control (i.e. the Logframe approach, feedback questionnaires for evaluations or surveys, swot analysis, etc.) and who is involved in evaluation (i.e. committee(s), validation commission(s), accreditation board(s), etc.). For external evaluation, please mention the role of independent experts or peer reviewers providing a summary of their evaluation plan and report(s). Please indicate the activities carried out to date, any change which occurred in comparison with the original plans and the activities you plan to carry out before the end of the project.

Gender balance

Please explain to what extent the principle of equal opportunities has been taken into account in the project implementation (i.e. gender analysis carried out, presence of women in decision-making bodies, balanced percentage share of women among the teachers or the enrolled students, etc.). Describe how the project helped to promote gender balance and to identify and address factors influencing gender discrimination.

Among the BSU team teachers woman present about 20 %.

Any other comment

Please provide in this entry, any relevant information you think might be useful for the assessment of your project's implementation (i.e. synergies with other projects, any support from external environment, networking with professional bodies, etc.).

The head of BSU team
Professor A.L. Tolstik

The manager of BSU team
Professor A.K. Fedotov