PhD18-27

Summary
Doctoral School of PHYSICS at University of Debrecen, Hungary

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Table of Contents

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Introduction

The University of Debrecen, Hungary has right for giving PhD degrees in physics in the fields below:

· Atomic and Molecular Physics	(Director: Prof. Á. Vibók)
· Nuclear Physics	(Director: Prof. Zs. Fülöp)
· Solid State Physics and Material Science	(Director: Prof. Z. Erdélyi)
· Physical Methods in Interdisciplinary Researches	(Director: Prof. F. Kun)
· Particle Physics	(Director: Prof. Z. Trócsányi)

If you want to take part in the PhD school - which requires 8 semesters after your M.Sc. degree - you should fill the application form, pay the application fee and take an entrance examination. The examination consists of the following items:

	M. Sc. after 2005	M. Sc. before 2006
· Quality of the Diploma	(max. 20 pts)	-
· Previous scientific activity *(research record, etc)*	(max. 30 pts)	(max. 40 pts)
· Proficiency in Physics	(max. 50 pts).	(max. 60 pts)

It should be mentioned, that proficiency in a world language (usually English) is required.

The successful applicant should reach min. 10 pts. in any of items above. One can mention that in the two preceeding years those applicants were enrolled in the PhD school who collected more than 80 points on the examination. In the application form the applicant should choose the subject(s) of his thesis.

For general information about the application to the University of Debrecen please visit http://www.edu.unideb.hu/

The students of the doctoral program should take part in courses (4-5 hours/week) in the first two years, and at the end of courses they should pass on exams.

At the end of the second year they should take a complex examination related to their own field and research work. By the end of the fourth year students should complete their thesis which should be defended.

The detailed description of the courses and the research topics of the program, and the subjects of the theoretical part of the complex examination can be found in World-Wide-Web (WWW) on page: http://physphd.unideb.hu

For further information, concerning the school please contact the director of the program, or the secretary: Dr. Oláh László, University of Debrecen, Department of Experimental Physics, 4010 Debrecen, P.O.Box 105., Bem tér 18/b, Tel.: +36-52-509-201, fax: +36-52-509-258, email: olah.laszlo@science.unideb.hu .

For information about the conditions of the available scholarships and for getting application forms, and cheques please contact: Ms Éva Bessenyei, Natural Sciences Doctoral Council PhD administrator, email: phd-ttk@science.unideb.hu , Tel.:+36 52 512 900 / 62890, 4032 Debrecen, Egyetem tér 1. Main building, room 15/B.

The Doctoral school of Physics

Physics has reached the highest degree of exactness among all sciences. Both its experimental and theoretical aspects embrace the broad scale of orders of magnitude from the smallest, the elementary particles, to the largest, the Universe. It studies the elementary particles and their interactions as well as the properties of systems of high complexity composed of these particles. Some of its results are of fundamental significance for human cognition, some are of decisive importance for the development of technology, for our everyday life and for our cultural environment.

These are the basic motives in launching a doctoral school in physics at University of Debrecen. The fields covered by this school represent fundamental and modern branches of physics, which altogether, form a school that meets current demands for physics postgraduate training. The Debrecen physics of the last decades is not unworthy of the century old traditions, which are based on a solid experimental foundation and comprise interest in theoretical interpretation and practical applications. The vigour of physics research in Debrecen is shown by the fact that in the past decades hundreds of doctoral theses of physics were passed here. The physics departments of the University and the participating research institute, Institute of Nuclear Research of the Hungarian Academy of Sciences, are equipped sufficiently well to provide the very basis elements of a technical background (experimental instruments and computers) to start training graduate students.

As should be clear from the supplements, the number, the scientific degrees, the level of activity and the international reputation of the teachers and researchers participating in the training courses as well as the prospective project supervisors are high enough to guarantee a decent quality of the postgraduate education.

Atomic and Molecular physics program

The main purpose of the formal courses of the atomic and molecular physics program is to give - during the basic courses - firm and practical knowledge of advanced atomic and molecular physics to students intending to conduct research in this field. Assuming that the students completed their basic atomic and molecular physics courses - either in their undergraduate studies or in this doctoral program - the offered special courses will systematically introduce the students to their chosen research topics. Completing the special course approved by the student's supervisor, the student should know and be capable to apply the most important theoretical or experimental techniques in the chosen special field, and parallel with this he (she) can start the research part of his (her) training. In the further part of the training the students can choose courses from the whole physics PhD school.

The formal courses and lectures offered in the atomic and molecular physics program cover all the offered research topics. The most important fields are:

- calculation of atomic and molecular properties and parameters
- theoretical study of atomic and molecular collisions
- experimental investigation of ion-atom collisions using x-ray and electron spectroscopic techniques

The importance and significance of the atomic and molecular physics does not need justification. The atomic and molecular physics is a lively research subject at nearly every university and it constitutes the most basic knowledge in physics. Furthermore, atomic and molecular physics is the most common and the most convenient testing ground of theories of principal interest and those of theoretical-technical and computational interest. The knowledge of basic atomic processes and parameters is of vital interest in understanding solid materials, chemistry and even biological materials. The detailed knowledge of atomic collisions is very important in studies of materials in extreme circumstances (stellar and laboratory plasmas).

The personal background of the atomic and molecular program is provided by a number of faculty and staff members successfully involved in research for many years. From the point of view of the facilities, the theoretical part of the program is based on the computational power at University of Debrecen (VAX 6000), at Institute of Nuclear Research (Challenge-L, Silicon Graphics) and on the Sun and Silicon Graphics workstations and AT486 PCs. The experimental part of the program is based on the accelerators (cyclotron, Van de Graaff generator) ion sources, detectors, spectrometers and atomic physics laboratories in Institute of Nuclear Research. Through numerous international cooperation the most advanced experimental facilities and computer systems are also accessible for dedicated students.

Nuclear Physics program

The significance of present-day nuclear physics studies is threefold:

- Nuclear physics research explores the structure of and the nucleonic constituents and interactions in atomic nuclei, which are important building blocks of the Universe.
- The theoretically predicted quark-gluon plasma, which is an ensemble of the constituents of the nucleons collected in a single "bag", can be studied by the methods of nuclear physics, namely, by means of ultrahigh-energy heavy-ion collisions.
- The methods of nuclear physics constitute a culture, whose adaptation to other sciences, to economic production, energetics, environment protection and to medicine may directly benefit mankind.

The objective of the curriculum is to introduce the participating students to research on nuclear physics to the degree of attaining valuable scientific results, and thereby to qualify them for research work or high-level application work in this field. The current research projects collected offer a wide selection of subjects of all three categories. The training is made methodical and broad-based by a number of lecture courses, laboratory and computing practical lessons. These are at different levels of generality, but altogether they cover a broad field so that the student will conveniently find the subjects most relevant to his (her) project. The selection offered is rich enough to leave scope for the student's individual taste as well. The curriculum of each course is built up so as to rely only on the knowledge of undergraduate studies. This gives additional freedom in choosing courses and their sequence.

The experimental background of the program is provided by the charged- particle accelerators of Institute of Nuclear Research, by the neutron generators of the Department of Experimental Physics, by the large accelerators accessible through international co-operation and by the additional on-site facilities (detectors systems, spectrographs, data acquisition systems, computers etc). The theoretical computations will be performed on the central computers of the University and of the Sándor Szalay Centre for Physics as well as on the workstations and personal computers of the departments and of the research groups. The intellectual background of the Debrecen school of nuclear physics will stimulate the Ph.D. studies in the new framework as well.

Solid State Physics and Material Science program

In the last decades the materials science has been increasingly integrated the physical, chemical and technical research activities and methods. The understanding of the basic properties of new technological materials especially demands the knowledge and methods of solid state physics. The subject is grounded in the atomic theory of solids which in turn related, through the hierarchy of microstructural scales, to the useful properties of materials whether they be chemical, mechanical, electrical, optical or magnetic. Our aim is the education of specialists who use physical approach to understand the phenomena but are able to solve technical and technological problems as well.

On the basis of the traditions and methods being present at our University (Department of Solid State Physics: metals and alloys, migration of atoms; Department of Theoretical Physics: ion-bombardment of solids, spin glasses; Institute of Nuclear Research: superconductivity, magnetic properties, surface-physics; Technical Research Institute, Laboratory of Electronmicroscopy: physics of thin films, electronmicroscopy) we have applied for the accreditation of PhD postgraduate education in Physics with the program "Solid State Physics and Materials Science". As antecedents of this program we have a postgraduate course entitled "*Materials Science engineer-physicist*" being still currently in progress.

Physical Methods in Interdisciplinary Researches program

It has been demonstrated recently that physics play a very important role in studying and understanding environmental problems of regional as well as those of global nature. The global atmosphere and hydrosphere is rapidly changing their composition with respect to many trace constituents as a result of anthropogenic emissions. These changes may have far-reaching consequences for the global ecosystems in the near future via direct harmful effects on the biosphere including human beings and alteration of the life-supporting system of the earth. Anticipated global warming as a result of rapidly growing concentrations of the so called greenhouse gases may serve as a prominent example of such consequences. During the past forty years particularly nuclear physics has provided quite a number of excellent tools for specifically probing the various environmental systems at any scale on our planet. Very sensitively detectable natural and anthropogenic radionuclides for this purpose have been supplemented more recently by chemical tracers like the halogenated hydrocarbons and other trace constituents to be assessed by mass spectrometry, gas chromatography and nuclear analytical methods like PIXE, PIGE, ESCA, RBS, CPAA, NAA and SSNTD. The doctoral program gives detailed information about the nuclear analytical and mass-spectrometric methods and will show the range of global and local problems where these methods can be applied.

Available facilities are:

- Isotope ratio mass-spectrometer, sample preparation lines
- Low-level counting facility for measuring ^{14}C, ^{85}Kr and ^{3}T
- Noble gas mass-spectrometer, argon extraction line
- Quadrupole mass-spectrometers, membrane inlet system
- Electron spectrometer systems for X-ray photoelectron spectroscopy
- X-ray fluorescent equipment, aerosol sampling unit
- Radon monitors working in field and indoor environment
- Track etch detectors
- Si α–spectrometer
- Van de Graff accelerator, target chambers for PIXE, PIGE and RBS
- proton-beam microprobe
- γ spectrometers
- gross-β counting equipment

Each equipment is coupled to suitable data acquisition and processing system. Software and well trained staff, good infrastructure are available.

Particle Physics program

The particle physics searches for the fundamental building blocks of matter and it investigates the interactions among the particles. At the moment the leptons and the quarks are considered to be the fundamental (or elementary) particles. The interactions among them is mediated by the gauge-bosons (photon, gluons, weak-bosons) and by the scalar-(Higgs-) bosons. All of the fermions of the standard model has been discovered. The gauge-bosons were observed, too. Only the Higgs-scalar-bosons are not yet discovered experimentally. For the theory the greatest challenge it the unification of the fundamental interactions. The unification of these interactions with the theory of gravity is also an important unsolved problem.

The phase transitions of matter in the early Universe is also a question to be solved in the future. The production of quark-gluon plasma in laboratory is an important part of this task.

The particle physics is in the frontier of scientific research. Its requirements against the experimental technics (vacuum-technics, cryogenics, detector-technics, remote control, optoelectronics, signal processing etc.) and against computer science (parallel processing and algorithms) are extremely high, consequently the particle physics has an important role in the development of science and technology.

During the last eight years at the University of Debrecen the necessary conditions of a successful activity both in research and in teaching has been reached. Considering these circumstances the strengthening of the particle physics activity by a PhD program is possible and justified.