PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Máté Csanád
e-mail address	csanad@elte.hu
topic	**Quantum statistical correlations in high energy heavy ion physics**
description (5-8 lines)	The goal of high energy heavy ion physics is to experimentally investigate the phase diagram of strongly interacting matter; a research area at the frontiers of our understanding of strong interaction, one of the four fundamental interactions in our Universe. Quantum statistical correlations provide a unique tool to study the space-time structure of particle creation in the extreme temperature fireball created high energy heavy ion collisions. This PhD topic covers the measurement of such correlations at RHIC (PHENIX experiment) and at the LHC (CMS experiment).
maximum number of students for this topic	2
place of research	ELTE, Department of Atomic Physics
knowledge of English required	excellent English communication skills required (C1)
professional requirements	programming skills in C++, good knowledge in particle physics (quantum field theory basics, strong interaction, Standard Model), interest in experimental physics

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	István Scheuring
e-mail address	istvanscheuring@gmail.com
topic	**Microbiome dynamics**
description (5-8 lines)	Microbiome, the complex microbial community living on the surface of hosts is the result of complex interaction among genotypes. Recently we worked out a simple dynamical model to study the succession of antibiotics produced microbes on the surface of host [1]. We started to expand this model to study this process in the presence of numerous different bacteria including the possibility of high mutation rate and the effect of spatial constraints. The central questions are the following: What are the key mechanisms maintain high diversity communities? How can the host modify the microbiome community to be helpful or less harmful for the host? These questions will be studied by the PhD student with the tools of mathematical modelling. [1] Scheuring and Yu (2012) How to assemble a beneficial microbiome in three easy steps Ecology Letters 15: 1300-1307
maximum number of students for this topic	1
place of research	Eötvös University, Biological Institute, Department of Ecology, Plant Systematics and Theoretical Biology
knowledge of English required	fluent
professional requirements	Basics of ecology and evolutionary biology Special fields of mathematics: analysis, dynamical systems, differential equations Some practice in one of the programming language: C, C++, phyton, etc.

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Prof. Tamás Vicsek
e-mail address	vicsek@hal.elte.hu
topic	**Distributed control of aerial robots (drones)**
description (5-8 lines)	Our research is aimed at further developing the autonomous quadrocopter flock which we first created 3 years ago. This drone flock is capable of flying outdoor and carry out a number of global tasks on its own Collective behavior is achieved by a bio-inspired flocking algorithms, inherited from statistical physical models of animal swarms. The model allows for stable flight even when flock size exceeds communication range and is also robust against delays present in the system. We successfully deployed swarms of up to 30 units, being able to fly safely in a tight flock without collisions, arrange themselves into basic shapes (grid, ring, line), switch between shapes dynamically, follow an arbitrary target or split the group to follow multiple targets. The potential further eciting directions are numerous. for more info see **http://hal.elte.hu/~vicsek/**
maximum number of students for this topic	1
place of research	ELTE University, Budapest
knowledge of English required	fluent
professional requirements	C++, Python, Linux, possibly skills in electronics

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Prof. Vicsek Tamás
e-mail address	vicsek@hal.elte.hu
topic	**Complex networks**
description (5-8 lines)	The last decade has witnessed an explosive growth of interest in the descriptive analysis of complex natural (e.g., biological or societal) and technological systems that permeate many aspects of everyday life. there are several reasons to assume that most of the networks in nature and society are optimal from the point of their actual function. The objective of this research is the studying of the design, structure and origin of optimal complex networks and investigating its dynamics as well as finding the characteristic features of the associated robust and adaptive behaviours. One of the main potential applications is the study of the processes on networks which later could be useful for locating the various misuse (e.g. terrorism) of the internet.
maximum number of students for this topic	1
place of research	ELTE University, Budapest
knowledge of English required	fluent
professional requirements	c++, Python, statistical mechanincs,

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Géza Ódor
e-mail address	odor@mfa.kfki.hu
topic	**Investigation of disorder effects in network models**
description (5-8 lines)	Network inhomogeneities can strongly affect the critical dynamics of spreading models if the graph dimension is finite, causing large fluctuations and nonuniversal power-laws in extended control parameter spaces. This provides an alternative or an extension of self-organized criticality, observed in nature very frequently. These Griffiths Effects (GE) are generated by rare-regions and can be observed even in finite scale-free graphs. Real networks are very often modular, that may enhance GE-s. Participation in the research of GE-s in various network models with large scale simulations or by other methods would be the target of this topic. Besides spreading models we plan to study synchronisation transitions from this point of view with a special emphasis on brain and power-grid models.
maximum number of students for this topic	2
place of research	Center for Energy Research, Institute of Technical Physics and Materials Science, Budapest, Konkoly Thege str. 29-33
knowledge of English required	Fluent in English
professional requirements	C or C++ langauge programming experience required, Linux and parallel processing is appreciated

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	László Oroszlány
e-mail address	oroszl@elte.hu
co-supervisor (if any)	János Koltai
e-mail address	Koltai@elte.hu
topic	**Novel topological aspects of hybrid, layered heterostructures**
description (5-8 lines)	In recent years low dimensional heterostructures such as graphene and its analogues have enjoyed a considerable attention. These systems exhibit not only theoretically intriguing properties but also have promising properties for technological applications, from biologically active electronic sensors to components in a quantum logic circuits. One key challenge arising in these systems is the tunability of the spin-orbit coupling. Control of the spin degree of freedom through spin-orbit effects is an essential milestone in achieving efficient and powerful quantum computation capable architectures. The prospective student will have the task to devise effective models based on state of the art ab-initio calculations. Using the derived model the student shall predict spectroscopic and transport properties of future architectural elements of quantum computers.
maximum number of students for this topic	1
place of research	Department of Physics of Complex Systems, Lorand Eötvös University, Budapest, Hungary
knowledge of English required	excellent
professional requirements	MSc in physics or chemistry, user level linux/unix required, basic programing skill (in any language) is preferred

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	György Szabó
e-mail address	szabo@mfa.kfki.hu
co-supervisor (if any)	Imre Derényi
e-mail address	derenyi@elte.hu
topic	**Evolutionary ordinal potential games**
description (5-8 lines)	In spatial evolutionary games players are located at the sites of a network and they collect income by playing games with their neighbors when using one of their possible strategies. The macroscopic behavior of these systems is studied when the players are allowed to modify their own strategy by following a dynamical rule. The pair interactions of these models are characterized by matrices that can be decomposed into the sum of a potential game and rock-paper-scissors type cyclic components. For the ordinal potential games the cyclic components are weak and cannot modify the thermodynamic behavior at low noise levels while drastic changes are caused at high noises. The main goals of our research are to identify the validity region of ordinal potential games and to explore the possible behaviors at high noises.
maximum number of students for this topic	1
place of research	Centre for Energy Research, Hungarian Academy of Sciences, 1121 Budapest, Konkoly Thege út 29-33, Building 26.
knowledge of English required	C1
professional requirements	Knowledge of statistical physics

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Peter Domokos
e-mail address	domokos.peter@wigner.mta.hu
co-supervisor (if any)	András Vukics
e-mail address	vukics.andras@wigner.mta.hu
topic	**Quantum Light-Matter Interface**
description (5-8 lines)	The research activity of our group focuses on ultracold atoms and cavity quantum electrodynamics. In 2016, the group has begun setting up a laboratory for optical experiments with Rubidium atoms, which will be developed to realize a multi-purpose quantum light-matter interface during the period of the PhD scholarship. The quantum field of an optical cavity will be strongly coupled to electric dipole transitions of Rubidium atoms, for which the atoms need to be trapped in the cavity volume. We will realize two kinds of atomic medium: (i) cold atom gas in a magneto-optical trap and (ii) degenerate quantum gas of ultracold atoms, the so-called Bose-Einstein condensate. The successful applicant will be given the opportunity to learn the current experimental techniques of quantum optics while becoming proficient in the fundamental processes of light-matter interaction.
maximum number of students for this topic	1
place of research	Quantum Optics Group, Institute for Solid State Physics and Optics, Wigner Research Centre for Physics of the Hungarian Academy of Sciences
place of research (in brief)	Wigner Atomlaser Laboratory
knowledge of English required	full professional proficiency
professional requirements	(appreciated:) quantum physics, atomic physics, fundamentals of optics, experimental techniques of quantum optics, electronics, programming in Python/C++

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Balázs G. Madas
e-mail address	balazs.madas@energia.mta.hu
Topic	**Mathematical modelling of low dose hypersensitivity and induced radioresistance**
description (5-8 lines)	Low-dose hyper-radiosensitivity (HRS) and increased radioresistance (IRR) have been observed in many different cell lines. It means that cell survival does not decrease monotonically as the function of radiation dose, but there is a local minimum in survival. However, the underlying mechanisms of these phenomena are quite unclear. There is evidence suggesting that low dose hypersensitivity is caused by biological regulation. Therefore the objective of this research to find out whether there are any advantages of this phenomenon at the tissue level.
maximum number of students for this topic	1
place of research	Radiation Biophysics Group, MTA Centre for Energy Research
knowledge of English required	Excellent command of English
professional requirements	Master degree in a quantitative field, strong interest in biology

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Zoltán Bajnok
e-mail address	bajnok@elte.hu
co-supervisor (if any)	László Palla
e-mail address	palla@caesar.elte.hu
Topic	**On solving the maximally supersymmetric gauge theory**
description (5-8 lines)	All fundamental interactions are formulated as gauge theories, but there is no exactly solved interacting 4 dimensional gauge theory yet. The holographic duality relates the maximally supersymmetric 4D gauge theory to an integrable 2D string theory. The project of the applicant is to use the duality to determine the 3 point functions of the gauge theory.
maximum number of students for this topic	2
place of research	Eötvös University
knowledge of English required	Advanced English
professional requirements	knowledge of Quantum Field Theory

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Dr. Ágnes Kóspál
e-mail address	kospal@konkoly.hu
topic	**Circumstellar structure and variable accretion in young stars**
description (5-8 lines)	The "Structured Accretion Disks" ERC-funded research group invites applicants to a PhD position at Konkoly Observatory (Budapest, Hungary), on the topic of circumstellar structure around young eruptive stars. The PhD student will participate in a large systematic study of the accretion-driven eruptions of newborn stars. In order to explore the relationship between the inhomogeneous disk structure and time-variable accretion, observed light curves of young stars and synthetic light curves based on hydrodynamic simulations will be produced and analyzed. Databases from new multi-epoch all-sky photometric surveys (Gaia, Pan-STARRS, Fly's Eye) will be analyzed to search for transient phenomena in young stars. Statistical analysis of the results will outline the general significance of the eruptive phenomenon during star formation. A follow-up study of the individual newly discovered young eruptive stars is also expected.
maximum number of students for this topic	1
place of research	Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences
place of research (in brief)	Konkoly Observatory
knowledge of English required	excellent command of English
professional requirements	Good knowledge of the physics of star formation, experience with photometric data processing and large databases

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Dr. Gergely J Szöllősi
e-mail address	ssolo@elte.hu
topic	**Evolutionary Genomics: dating the tree of life using complete genomes**
description (5-8 lines)	A 4-year PhD position is available to join the Evolutionary Genomics Research Group with full funding from the ERC "GENECLOCKS" project. The research group is lead by Dr. Gergely Szollosi (http://bit.ly/2c1JqfR) and actively collaborates with the research groups of Vincent Daubin, Nicolas Lartillot and Bastien Boussau (Evolutionary Genomics and Phylogeny, CNRS, Lyon France) as well as Eric Tannier (Bioinformatics, Computer Science, INRIA Lyon France), Tom Williams (Molecular evolution, phylogenetics , University of Bristol), Carolin Kosiol (Bioinformatics, Vetmeduni Vienna) and Jens Lagergren (KTH, Stockholm). The successful candidate will have the opportunity to work with and visit for periods of up to several months the collaborating parties. Research Topic: With the advent of genome-scale sequencing, molecular phylogeny, which reconstructs gene trees from homologous sequences, has reached an impasse. Instead of answering open questions, new genomes have reignited old debates. The problem is clear, gene trees are not species trees, each is the unique result of series of evolutionary events. If, however, we model these differences in the context of a common species tree, we can access a wealth of information on genome evolution and the diversification of species that is not available to traditional methods. For example, as horizontal gene transfer (HGT) can only occur between coexisting species, HGTs provide information on the order of speciations. When HGT is rare, lineage sorting can generate incongruence between gene trees and the dating problem can be formulated in terms of biologically meaningful parameters (such as population size), that are informative on the rate of evolution and hence invaluable to molecular dating. The first goal of ERC "GENECLOCKS" research group is to develop methods that systematically extract information on the pattern and timing of genomic evolution by explaining differences between gene trees. This will allow us to, for the first time, reconstruct a dated tree of life from genome-scale data. We will use parallel programming to maximise the number of genomes analysed. Our second goal is to apply these methods to open problems, e.g.: i) to resolve the timing of microbial evolution and its relationship to Earth history, where the extreme paucity of fossils limits the use of molecular dating methods, by using HGT events as "molecular fossils"; ii) to reconstruct rooted phylogenies from complete genomes and harness phylogenetic incongruence to answer long standing questions, such as the of diversification of animals or the position of eukaryotes among archaea; and iii) for eukaryotic groups such as Fungi, where evidence of significant amounts of HGT is emerging our methods will also allow the quantification of the extent of HGT.
maximum number of students for this topic	1
place of research	Evolutionary Genomics Research Group, Dept. of Biological Physics, Institute of Physics, Eötvös University

place of research (in brief)	The recently established Evolutionary Genomics Research Group is funded under a highly competitive 5 year grant from the Hungarian Academy of Sciences' "Momentum" program as well as an ERC Starting Grant starting in 2017. The Institute of Physics has been included in the Excellence Group of European Universities, and has achieved top placement in the number of citations, the number of ERC grants, the time available for PhD research and the gender balance of masters students in the CHE Excellence Ranking. The research group is associated to the Depts. of Biological Physics and Complex Systems composed of several interdisciplinary research groups including those of Prof. Imre Derenyi, Prof. Tamas Vicsek, and Prof. Istvan Csabai.
knowledge of English required	excellent
professional requirements	

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Dr. Gergely J Szöllősi
e-mail address	ssolo@elte.hu
co-supervisor (if any)	Dr. Imre Derényi
e-mail address	derenyi@elte.hu
topic	**Physics of Cancer**
description (5-8 lines)	Cancer is a genetic disease fueled by somatic evolution. Despite advances in the molecular biology of cancer associated genes and the recent surge in genomics data available, our understanding of the evolutionary mechanisms that lead to cancer is limited and cancer mortality rates have changed little in the last few decades. Until we unravel cancer's basic principles, the battle against it can only progress in inches, rather than in miles. To address the problems quantitatively, a new field called the "physics of cancer" has emerged. In the context of this emerging field the Evolutionary Genomics Research Group aims to understand the evolutionary process that leads to the breakdown of the hierarchical organization of healthy tissues and the emergence of tumors, using evolutionary models, computer simulations, and sequence analysis. The PhD candidate will work with us to develop mathematical models of tumor evolution and develop methods that can predict how cancers respond to treatment depending on their functional and genetic diversity and guide us toward developing novel treatment strategies and improving existing ones. References: Derenyi, I & Szollosi, GJ Hierarchical tissue organization as a general mechanism to limit the accumulation of somatic mutations Nature Communications in press (2017) https://doi.org/10.1101/098129 https://doi.org/10.1038/ncomms14545
maximum number of students for this topic	1
place of research	Evolutionary Genomics Research Group, Dept. of Biological Physics, Institute of Physics, Eötvös University
place of research (in brief)	The recently established Evolutionary Genomics Research Group is funded under a highly competitive 5 year grant from the Hungarian Academy of Sciences' "Momentum" program as well as an ERC Starting Grant starting in 2017. The Institute of Physics

	has been included in the Excellence Group of European Universities, and has achieved top placement in the number of citations, the number of ERC grants, the time available for PhD research and the gender balance of masters students in the CHE Excellence Ranking. The research group is associated to the Depts. of Biological Physics and Complex Systems composed of several interdisciplinary research groups including those of Prof. Imre Derenyi, Prof. Tamas Vicsek, and Prof. Istvan Csabai.
knowledge of English required	excellent
professional requirements	

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Prof. György Radnóczi
e-mail address	radnoczi.gyorgy@energia.mta.hu
co-supervisor (if any)	dr. Viktoria Kovács-Kis,
e-mail address	kis.viktoria@energia.mta.hu
topic	**Structural characterization of multicomponent alloys and compounds in bulk and thin film form**
description (5-8 lines)	The research is directed to reveal structural details of multicomponent alloys and compounds, where the number of composing elements is 4-6 and they are present in nearly the same quantity. Structure formation processes, homogeneity of the structures will be investigated mainly by electron microscopy and electron diffraction techniques, as well as by surface analytical tools (AES and XPS). Though the research is directed to provide basic research results, application possibilities of the investigated structures will be also considered, mainly in the fields of biological applications, hard and anticorrosion coatings, as well as in the form of nanoparticles.
maximum number of students for this topic	2
place of research	Centre for Energy Research, 1121 Budapest, Konkoly-Thege Miklós u. 29-33
place of research (in brief)	The place of research is the Thin Film Physics laboratory, equipped with modern electron microscopes, vacuum equipment for thin film growth. Cooperation with other departments is also supported. More at http://www.thinfilms.hu/index.html
knowledge of English required	A good command of English is essential. The applicant must be capable to present her/his results as an oral scientific presentation.
professional requirements	Master-level degree in Physics, Materials Science or related fields.

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Lajos Varga
e-mail address	varga@szfki.hu
topic	**High entropy alloy foam for high temperature thermopower generator**
description (5-8 lines)	The actual Pb-Se-Te-based thermoelectric materials are not resistent to high temperature and to corrosion. We propose to prepare a multielement metallic composition with several 10 microvolt/K Seebeck coefficient based on electronic stucture calculations. The nominator of the figure of merit, -the thermal conductivity-, will be diminished by the foam structure of the alloy which will be prepared by the usual "yeast" technology. In this way the value of the figure of merit will be increased to the acceptable values for applications.
maximum number of students for this topic	2
place of research	Hungarian Academy of Sciences, Wigner Research Center for Physics, Solid State Physics Institute
place of research (in brief)	MTA, Wigner RCP
knowledge of English required	excellent
professional requirements	experience in metallurgy, experience in computer applications, basic knowledge's in solid state physics, specially in electron transport theory and measurements

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Ádám Gali
e-mail address	gali.adam@wigner.mta.hu
topic	**Point defects, diamond, semiconductors, density functional theory, optically detected magnetic resonance**
description (5-8 lines)	The candidate will study point defects acting as quantum bits in diamond and related materials. The point defects will be characterized by either advanced density functional theory calculations or experimental techniques based on optically detected magnetic resonance. Local computer facilities with scientific program packages and laboratory equipments are available to conduct this research. By exploring the magneto-optical properties of point defects in solids, one can utilize them for single photon sources, single quantum bits for quantum information processing applications, or nanometer spatial resolution ultrasensitive sensors for biology, space industry or materials science.
maximum number of students for this topic	2
place of research	Wigner Research Centre for Physics, Hungarian Academy of Sciences
knowledge of English required	excellent command of English
professional requirements	solid background in quantum mechanics and solid state physics; either computational skills in programming or experience in magnetic resonance and/or optical spectroscopies

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Zsolt Kovács
e-mail address	kovacszs@metal.elte.hu
topic	**Plastic deformation of metallic glasses**
description (5-8 lines)	Metallic glasses are special metallic materials with amorphous structure lacking of long range order. Plastic deformation takes place in metallic glasses in few atom wide shear bands at ambient temperature. In absence of periodicity, shear bands form from shear transformation zones (i. e. the formation of local atomic redistributions) by acting strong internal stresses. Details of this process is unknown, yet. But recent advances have been achieved by the scientific community in the plasticity of metallic glasses.
maximum number of students for this topic	1
place of research	Department of Materials Physics, ELTE University
knowledge of English required	Excellent command of English
professional requirements	Good knowledge of materials science. Research experience in mechanics of solid materials and/or thermodynamics.

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Agnes Buka
e-mail address	buka.agnes@wigner.mta.hu
topic	**Dynamics of topological defects in soft matter**
description (5-8 lines)	A new experimental technique, a unique polarimetric microscopy should be applied to anisotropic soft matter like polymers, suspensions, liquid crystals etc, in order to study the distribution of the orientational order and its dynamics in those systems. The method can be applied either in reflection or transmission mode, to study phenomena on the surface or in the bulk of the matter, with a considerably higher time resolution than before. The aim is to investigate one of the actual hot topics like the alignment dynamics at the free surface of liquid crystals, the intrinsic structure of optical vortices induced by pattern forming instabilities, formation of topological defects e.g. Skyrmion-like structures and flow properties of anisotropic fluids in microfluidic channels.
maximum number of students for this topic	2
place of research	Wigner Research Center for Physics of the Hungarian Academy of Sciences
knowledge of English required	excellent command of English
professional requirements	Statistical physics, solid state physics, optics

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Robert Szabo
e-mail address	rszabo@konkoly.hu
topic	**Numerical modeling of stellar pulsations in 2D and 3D**
description (5-8 lines)	The only way to understand the dynamical phenomena of classical pulsating variable stars, such as the Blazhko effect, resonances, excitation of nonradial modes, and period doubling is the application of multidimensional hydrodynamical codes. The task is to learn how to use existing hydrodynamical codes, how to modify them, then apply them to model and investigate dynamical phenomena that have been discovered in space photometric and ground based data bases. The candidate will benefit from the expertise accumulated in the Institute during the past decades.
maximum number of students for this topic	2
place of research	MTA Csillagászati és Földtudományi Kutatóközpont, Csillagászati Intézet
place of research (in brief)	MTA CSFK CSI, Konkoly Observatory
knowledge of English required	Excellent command of English, C1
professional requirements	Excellent programming skills, ability to solve physical problems numerically, ability to work in a team, as well as individually.

PhD School	**Doctoral School of Physics at Eötvös Loránd University (ELTE)**
supervisor	Quang Chinh NGUYEN
e-mail address	chinh@metal.elte.hu
topic	**Studying plastic instabilities by Depth Sensing Indentation (DSI) tests**
description (5-8 lines)	In this research work we plan to study plastic instabilities occurring in stable solid solutions and age-hardenable alloys by using the combination of novel depth-sensing indentation (DSI) and other microstructural tests. The main scopes are planned as following investigations: -The effect of solute atoms on mechanisms of plastic instabilities in stable solid solutions. -The decomposition of supersaturated solid solution (age-hardenable) alloys, the effect of the precipitation on plastic instabilities. -The effect of grain boundary (GB) on plastic instabilities. -Statistical description of plastic instabilities occurring in different conditions. *Investigation methods*: DSI, scanning electron microscopy (SEM), focused ion beam (FIB), atomic force microscopy (AFM), differential scanning calorimetry (DSC), compression of micro-pillars.
maximum number of students for this topic	1
place of research	Deparment of Materials Physics, Eötvös Loránd University, Budapest
knowledge of English required	C1, excellent command of English
professional requirements	Basic knowledges about solid-state physics and/or materials sciences

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Istvan Csabai
e-mail address	csabai@elte.hu
topic	**Machine learning in astronomy**
description (5-8 lines)	Astronomy is one of the first and leading field where large amount of data is produced by the large observing instruments. Th e large amount of data, and the complexity of questions require the use of advanced computational techniques. Several machine learning methods has been already used to analyse astronomical observational data, like random forests or support vector machines. Neural networks, especially deep learning seems to be very efficient with the use of multi-core architectures, like GPUs. During the PhD research, the candidate will learn to use these methods and analyse various astronomical (mainly extragalactic) datasets. Depending on the background and interest of the candidate, (s)he can investigate questions like evolution of galaxies or determine the large scale structure of the Universe with these tools, or dive deeper into the theoretical understanding and development of machine learning algorithms.
maximum number of students for this topic	2
place of research	Eotvos Lorand University, Department of Physics of Complex Systems
knowledge of English required	Reading articles, take part in discussions, write scientific papers, present at conferences
knowledge of other language appreciated	Knowledge of some Hungarian, makes life much easier in Budapest.
professional requirements	Backgrouns in physics, astronomy, computer science

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Istvan Csabai
e-mail address	csabai@elte.hu
topic	**Expansion of an inhomogeneous Universe**
description (5-8 lines)	Einstein equations are famously complex and hard to find analytic solutions that satisfy them. Thiy may be reason that current cosmological models asuume the Universe to be homogeneous and isotropic. This may be tru on extremely large scales, but up to the limits we can observe, the distribution of matter is inhomogeneous, galaxies are clumped into large clusters, filaments and walls and there are huge voids between them. During the PhD we will continue our exploration if the inhomogeneity of matter distribution has a significant effect on the evolution history of the Universe (see: https://arxiv.org/abs/1607.08797). Depending on the background and interest of the candidate, (s)he can work on theoretical aspects, develop numerical simulations and/or conforont the model with cosmological observations.
maximum number of students for this topic	1
place of research	Eotvos Lorand University, Department of Physics of Complex Systems
knowledge of English required	Reading articles, take part in discussions, write scientific papers, present at conferences
knowledge of other language	Knowledge of some Hungarian, makes life much easier in Budapest.
professional requirements	Backgrouns in physics, astronomy, computer science

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Péter Ábrahám
e-mail address	abraham.peter@csfk.mta.hu
co-supervisor (if any)	Attila Moór
e-mail address	moor@konkoly.hu
topic	**Observation and modeling of young debris disks**
description (5-8 lines)	During the birth of young planetary systems, collisions between planetesimals produce dust particles, leading to the formation of a debris dust disk. Traditionally, these disks were considered to be gas poor, but recent results, including research at the Konkoly Observatory of the Hungarian Academy of Sciences, demonstrated the presence of observable amount of gas in some of these disks. The PhD student will participate in the reduction, analysis and modeling of our millimeter wave observations of gas in debris disks, obtained with the Atacama Large (Sub)Millimetre Array (ALMA), as well as contribute to the preparation of new ALMA proposals. She/he will also work on finding and studying debris systems where recent giant collisions has produced a large amount of transient dust. The warm dust will be characterized mainly via infrared observations and radiative transfer modeling.
maximum number of students for this topic	1
place of research	Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences
place of research (in brief)	Konkoly Observatory
knowledge of English required	excellent command of English
professional requirements	good knowledge of the physics of star formation, experience with photometric data processing and astronomical databases

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Péter Ábrahám
e-mail address	abraham.peter@csfk.mta.hu
topic	**Star formation studies based on the new results of ESA's Gaia mission**
description (5-8 lines)	Gaia, the currently operational space telescope of the European Space Agency, regularly releases astrometric, photometric and spectroscopic results of more than a billion stars. In parallel, Gaia also publishes photometric alerts of unexpected flux variations. The PhD student will contribute, in collaboration with the Gaia Science Alerts Group at Cambridge University, to improve the alert detection algorithms for young stellar objects. The PhD project will aslo include the follow up of published alerts for pre-main sequence stars, by obtaining new observations of the variable source, then analysing, modeling, and publishing the results.
maximum number of students for this topic	1
place of research	Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences
place of research (in brief)	Konkoly Observatory
knowledge of English required	excellent command of English
professional requirements	Good knowledge of the physics of star formation, experience with astronomical databases

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Péter Ábrahám
e-mail address	abraham.peter@csfk.mta.hu
co-supervisor (if any)	József Varga
e-mail address	varga.jozsef@csfk.mta.hu
topic	**Studying the initial conditions for planet formation using infrared interferometry**
description (5-8 lines)	Terrestrial, rocky planets are thought to form in the inner zone of the protoplanetary disks surrounding young, pre-main sequence stars. The exceptional angular resolution offered by the Very Large Telescope Interferometer (European Southern Observatory, Paranal, Chile) makes possible the detailed observational exploration of these inner disks. The PhD student's work will start with the scientific analysis of archival data of the mid-infrared MIDI interferometer. Next, from 2018, new data with the MATISSE interferometer will be available on circumstellar disks. A speciality of our interferometry program is the study of time variability in the planet forming zone.
maximum number of students for this topic	1
place of research	Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences
place of research (in brief)	Konkoly Observatory
knowledge of English required	excellent command of English
professional requirements	Good knowledge of the physics of star formation

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Prof. Károly Szegő
e-mail address	szego.karoly@wigner.mta.hu
co-supervisor	Dr. Andrea Opitz
e-mail address	opitz.andrea@wigner.mta.hu
topic	**Solar wind structures throughout the heliosphere by multi-spacecraft observations**
description (5-8 lines)	The Sun is the primary energy source of the plasma physical processes in our Solar System, its permanent outflow of charged particles (solar wind) and fields interact with the plasma environment of the planets. Disturbances in the solar wind such as solar eruptions (CMEs) and stream interaction regions (CIRs) can be studied through multi-spacecraft observations. The aim of this topic is to characterize these solar wind structures based on observations and modelling. Additionally, we will study their interaction with the induced magnetospheres of unmagnetized planets. Our Space Physics and Technology team at Wigner has expertise and international collaboration in solar and heliospheric physics, planetary plasma physics, space instrumentation, etc.
maximum number of students for this topic	1
place of research	Wigner RCP, Budapest (Hungary)
place of research (in brief)	http://wigner.mta.hu/en/
knowledge of English required	advanced
professional requirements	MSc in Physics or related science

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Gabriella Pásztor
e-mail address	Gabriella.Pasztor@cern.ch
topic	**Search for New Physics with the CMS detector at the LHC**
description (5-8 lines)	The Standard Model (SM) of particle physics leaves open several theoretical and observational problems – such as the existence of dark matter - that suggest the existence of a more fundamental theory hidden behind it. Search for new phenomena such as the appearance of new heavy particles at the TeV energy scale predicted by extensions of the SM - for example by adding supersymmetry or extra spatial dimensions to the model – are thus in the focus of the proposed research. The student will use the proton-proton collision data collected by the CMS experiment at the Large Hadron Collider (LHC), the most powerful particle accelerator ever built.
maximum number of students for this topic	2
place of research	ELTE Institute of Physics (with visits to CERN, Geneva, Switzerland)
place of research (in brief)	The student will join the MTA-ELTE Lendület Particle and Nuclear Physics Group at the Department of Atomic Physics at the ELTE Lágymányos Campus in Budapest and will travel regularly to the CMS experiment at the CERN LHC in Geneva, Switzerland.
knowledge of English required	Fluent
professional requirements	Computer programming (preferably C++, python), basic knowledge of particle physics

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Gabriella Pásztor
e-mail address	Gabriella.Pasztor@cern.ch
topic	**Study of diboson production with the CMS detector at the LHC**
description (5-8 lines)	The Standard Model (SM) of particle physics describes well the phenomena observed in high energy particle collisions. Precision measurements provide an excellent tool to test the limits of the model's validity. The study of gauge interactions in the electroweak sector is very sensitive to the mechanism of electroweak symmetry breaking as well as new phenomena potenyially appearing at high energies. The measurements of electroweak diboson prodution processes and of anomalous triple and quartic guage couplings are in the focus of the proposed research. The student will use the proton-proton collision data collected by the CMS experiment at the Large Hadron Collider (LHC), the most powerful particle accelerator ever built.
maximum number of students for this topic	2
place of research	ELTE Institute of Physics (with visits to CERN, Geneva, Switzerland)
place of research (in brief)	The student will join the MTA-ELTE Lendület Particle and Nuclear Physics Group at the Department of Atomic Physics at the ELTE Lágymányos Campus in Budapest and will travel regularly to the CMS experiment at the CERN LHC in Geneva, Switzerland.
knowledge of English required	Fluent
professional requirements	Computer programming (preferably C++, python), basic knowledge of particle physics

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Dezső Varga
e-mail address	Varga.dezso@wigner.mta.hu dezso.varga@cern.ch
topic	**Micro-Pattern Gaseous Detectors for CERN experiments**
description (5-8 lines)	Gaseous detectors were invented in the 1970-ies, with multi-wire proportional chambers initiating the „electronic detector” era of particle physics, replacing bubble and streamer chambers. In the last decades, a new class of gaseous tracking detectors, generally known as „micro-pattern gaseous detectors”, open new technological possibilities. Leading high energy physics instrumentation apply these, including GEM foils. The aim of the project is to understand the fundamental physics principles of detection and signal formation, and evaluating their properties from the point of view of applying in high speed, high volume tracking detector systems.
maximum number of students for this topic	1
place of research	Wigner Research Centre for Physics, Hungarian Academy of Sciences
knowledge of English required	Proficient
professional requirements	Experimental high energy physics (particle or nuclear physics), basic electronics, basic computing

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Dezső Varga
e-mail address	Varga.dezso@wigner.mta.hu dezso.varga@cern.ch
topic	**Gaseous tracking detectors for Muography Instrumentation**
description (5-8 lines)	Muography, short for „Muon Radiography", is an emerging field for imaging large objects using cosmic muons. Though most physics principles are understood, efficient instrumentation is lacking to realize most measurements by this approach. Gaseous detectors provide a viable option for most of the relevant muography applications both above- and underground, whereas full exploitation of the technological possibilities needs considerable steps forward from the laboratory-bound developments in HEP instrumentation. The project aims at understanding the key physics effects which limit the signal-to-noise ratio of open sky muography measurements (including volcano imaging) and optimizing the structure of future large size detectors for resolution and cost.
maximum number of students for this topic	2
place of research	Wigner Research Centre for Physics, Hungarian Academy of Sciences
knowledge of English required	Proficient
professional requirements	Experimental high energy physics (particle or nuclear physics), basic electronics, basic computing

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Gábor Vásárhelyi
e-mail address	vasarhelyi@hal.elte.hu
topic	**Collective intelligence of drones in real-life applications**
description (5-8 lines)	Our department is world leading in collective aerial robotics research with a professional electronic and mechanical lab, decades of knowledge in collective phenomena and a large fleet of self-organizing aerial robots. We open a doctoral position for investigating the advantages of collective behavior in various drone applications. The research starts with the theoretical background of multi-robot control, contains agent-based realistic simulations and ends with actual real-life challenges to be solved with a flock of drones, such as self-organized drone traffic, multi-drone surveillance or distributed adaptive aerial measurements with a heterogeneous fleet.
maximum number of students for this topic	1
place of research	ELTE Department of Biological Physics
knowledge of English required	good english skills are required
professional requirements	- MSc in physics/informatics/engineering/mathematics - abstract thinking, creative problem solving - enthusiasm for robotics / drones - linux knowledge, at least basic programming skills (preferred: C/C++, Python)

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Tamás Tél
e-mail address	tel@general.elte.hu
topic	**Understanding dynamics with drifts: a snapshot attractor view**
description (5-8 lines)	Complex dynamics in driven systems with nonperiodic forcing cannot be understood by means of the traditional theory of chaos. The concept of snapshot attractors offers a new view for dissipative cases. The aim is to understand this approach and to apply it in numerical simulations. Potential applications range from mechanical systems in which the forcing is dying away up to the dynamics of climate change.
maximum number of students for this topic	1
place of research	Institute for Theoretical Physics, Eötvös Loránd University
knowledge of English required	native English
professional requirements	Preliminary knowledge:Ott: Chaos in Dynamcal Systems (Cambridge 1993) Experience with the numerical solution of ordinary differential equation, with the use of Latex, Gnuplot, etc. Basics of statistical mechanics

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Sandor Katz
e-mail address	katz@bodri.elte.hu
topic	**The QCD phase diagram from lattice calculations**
description (5-8 lines)	The goal of the research project is to study the QCD phase diagram at non-vanishing chemical potentials towards the continuum limit. Results obtained with multiparameter reweighting on coarse lattices will be extended to finer lattices. New methods, such as the density of states method will be applied.
maximum number of students for this topic	1
place of research	Institute for Theoretical Physics, Eotvos University
knowledge of English required	a good command of English is required
professional requirements	quantum field theory

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Istvan Groma
e-mail address	groma@metal.elte.hu
topic	**High resolution electron backscatter diffraction**
description (5-8 lines)	High resolution electron backscatter diffraction (HR-EBSD) is a recently developed new method to determine the local stress state developing in plastically deformed crystalline materials. Among other microstructural parameter with HR-EBSD one can determine the statistically stored, and geometrically necessary dislocation densities, and the correlation properties of the stress map obtained. Since the method is new, there are several open problems that have to be resolved before the technique can be applied in a routine way. One of the aim of the PhD project proposed is to further develop the method. Measurements will be carried out on different deformed single crystals and pillars with micron size (micropillar).
maximum number of students for this topic	2
place of research	Eötvös University Budapest, Pázmány P. sétany 1/A
place of research (in brief)	The SEM laboratory of the Faculty of Sciences
knowledge of English required	Basic knowledge in scanning electron microscopy
professional requirements	MSc in physics or materials science

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Zsolt KIS
e-mail address	kis.zsolt@wigner.mta.hu
topic	**Atom-photon interaction nearby plasmonic waveguides**
description (5-8 lines)	Recently, plasmonic structures attract more and more interest. The peculiarity of these structures is that light confinement much smaller than the diffraction limit of ordinary optical elements can be achieved. Moreover, interfacing them with existing optical networks can be readily done. The main drawback of light guiding with plasmonic waveguide is the large loss. However, there are techniques to avoid the population of strongly decaying states in a compound waveguide -- atom system, yet realizing excitation transfer between coupled atomic systems. Hence the plasmonic waveguide and cavities could be used to mediate the interaction between far located atomic qubits. The goal of the proposed thesis project is to work out the description of atom-field interaction nearby a plasmonic waveguide. Find ways for the tuning of the interaction parameters. Finally, to work out the controlled interaction between a plasmonic waveguide and several atomic qubits.
maximum number of students for this topic	1
place of research	Hungarian Academy of Sciences, Wigner Research Center for Physics
knowledge of English required	native English, C1, excellent command of English
professional requirements	strong background in theoretical physics, interest in light-matter interaction, some computer simulation knowledge is an adventage (some numerics cannot be avoided)

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Prof. Kristof Petrovay
e-mail address	K.Petrovay@astro.elte.hu
topic	**Solar and astrophysical magnetohydrodynamics**
description (5-8 lines)	Research in mean field theory: MHD modeling of solar activity phenomena; Theoretical study of turbulent astrophysical dynamos; Modelling of turbulent transport processes in diffuse astrophysical media. Statistical analysis of relevant observational data. Study of large scale / long time scale regularities in solar activity.
maximum number of students for this topic	2
place of research	ELTE Department of Astronomy, Budapest
knowledge of English required	excellent command of English
professional requirements	MSc in Physics / Astronomy / Astrophysics / Geophysics or a related field

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	L. Diosi
e-mail address	Diosi.lajos@wigner.mta.hu
topic	**Newton-Schrödinger equation**
description (5-8 lines)	Newton-Schrödinger was proposed independently by the supervisor and R. Penrose to model certain modifications of quantum theory in massive gravitating macroscopic objects. Thesis investigations concern interpretations, solutions, and possible experimental verifications of Newton-Schrödinger equation.
maximum number of students for this topic	1
place of research	Wigner Research Centre for Physics of Hungarian Academy of Sciences
knowledge of English required	excellent command of English
professional requirements	Excellence in theoretical physics and quantum theory, plus one further theory or experimental discipline

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	L. Diosi
e-mail address	Diosi.lajos@wigner.mta.hu
topics	**Open Quantum Systems**
description (5-8 lines)	A quantum system under the influence of its environment is called an open quantum system. Its dynamics is irreversible, including fluctuations and dissipation. Dynamical equations are understood well when Markovian approximation applies. When, however, the memory of the environment is significant the dynamical equations become less tractable and open interesting perspectives for the Thesis research.
maximum number of students for this topic	1
place of research	Wigner Research Centre for Physics of Hungarian Academy of Sciences
knowledge of English required	excellent command of English
professional requirements	Excellence in theoretical physics and quantum theory, plus one further theory or experimental discipline

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Prof Robertus Erdelyi
e-mail address	robertus@sheffield.ac.uk
topic	**Magnetodydrodynamic waves in the solar atmosphere**
description (5-8 lines)	High-resolution ground- and spaced-base magnetohydrodynamic (MHD) waves are ubiqutously observed in the solar atmosphere. They are very important as they may have dominant contribution to the plasma heating present in the solar atmosphere, that is one of the key puzzles of moder astrophysics. Another key aspect of solar atmospheric MHD wave research is that these waves may be used to diagnose the magnetised solar plasma where they propagate. This project is to further the currently available MHD wave theory in inhomogeneous waveguides. The theory will be applied to a number of solar structures from pores, magnetic bright points to solar jets, called spicuules. The study will involve mathematical modelling complemented with observational data analysis using high spatial, temporal and spectral resolution solar telescopes. The developed MHD wave theory will be justified by validating the obtained analytical results with observational data.
maximum number of students for this topic	1
place of research	Dept of Astronomy, Eotvos University
knowledge of English required	Excellent command of English
professional requirements	This project requires excellent skills in mathematical modelling complemented with interest in taking observations by either ground- or space-based telescope. Further, the project also likely requires collaboration with colleagues from Solar Physics and Space Plasma Research Centre (SP2RC), University of Sheffield (UK). Therefore it is anticipated the student to spend some more extensive time at SP2RC within the framework of Erasmus+ or otherwise.

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Prof Robertus Erdelyi
e-mail address	robertus@sheffield.ac.uk
topic	**Developing state-of-the-art Space Weather forecast tools**
description (5-8 lines)	The production of flares and Coronal Mass Ejections (CMEs) from solar active regions (ARs) is still not well understood in spite of their huge importance to Sun-Earth connections, in particular, to protect mankind and our sophisticated technological systems that might be at considerable risk from high-speed charged particles blowing often abruptly off the Sun. These most energetic eruptions of the entire Solar System follow the 11-year solar cycle. At the peak of the cycle, several dangerously high-intensity class flares and CMEs may occur (i.e. around monthly 2-3). Most solar flares and CMEs originate from magnetically active regions around sunspot groups. . To make a leap forward in Space Weather prediction, the student will generalise our forecast method, by applying it to the Interface Region and low corona in 3D, in order to identify the optimum height for flare/CME lift-off prediction in the solar atmosphere. Here, we expect to considerably increase the current forecast capability, with having massive practical implications in our high-tech-driven world. In particular, the student will aim (i) to investigate the pre-flare/CME dynamics and the related physical processes in the 3D solar atmosphere by constructing the magnetic topology above ARs, and (ii) to track their temporal evolution by applying WGM. These aims aims will be realized by the objectives of (i) acquiring knowledge to implement potential and non-linear field exploration techniques; (ii) create a data catalogue of 3D magnetic mapping of AR(s). The student will also (iii) employ the next-generation high spatial- and temporal-resolution sunspot data, provided by a combination of ground- and space-based magnetogram, white light and EUV observations, in particular with the complementary use of the solar observations of the novel Gyula Solar Telescope.
maximum number of students for this topic	2
place of research	Dept of Astronomy, Eotvos University
knowledge of English required	Excellent command of English
professional requirements	This project requires interest in taking observations by either ground- or space-based telescope. Therefore it is expected that the student may undertake such work with ground-based solar observatories. Further, the project also likely requires collaboration with colleagues from Solar Physics and Space Plasma Research Centre (SP2RC), University of Sheffield (UK). Therefore it is anticipated the student to spend some more extensive time at SP2RC within the framework of Erasmus+ or otherwise.

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Prof Robertus Erdelyi
e-mail address	robertus@sheffield.ac.uk
topic	**Modelling (macro)spicules and their effect on solar atmospheric dynamics**
description (5-8 lines)	(Macro)spicules are one of the longest studied yet unsolved phenomena of small-scale solar atmospheric dynamics. Since the discovery of spicules a number of theories have been developed to model the generation, propagation and energy transport capability of spicules. The key question is whether these highly collimated magnetised plasma jets are indeed able to supply the measured mass flux of solar wind. Their big cousins, macrospicules, were discovered more recently. They are less ubiquitous when compared to spicues, however, their extent is often an order of magnitude larger. Therefore, their role may be also key in solar wind flows. This project is about to study the properties of (macro)spicules and model their generation and propagation by means of magnetohydrodynamic wave physics. The study will involve observational data analysis using high spatial, temporal and spectral resolution telescopes and numerical simulations by means of our state-of-the-art numerical code.
maximum number of students for this topic	2
place of research	Dept of Astronomy, Eotvos University
knowledge of English required	Excellent command of English
professional requirements	This project requires interest in taking observations by either ground- or space-based telescope. Therefore it is expected that the student may undertake such work with ground-based solar observatories. Further, the project also likely requires collaboration with colleagues from Solar Physics and Space Plasma Research Centre (SP2RC), University of Sheffield (UK). Therefore it is anticipated the student to spend some more extensive time at SP2RC within the framework of Erasmus+ or otherwise.

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	László Négyessy
e-mail address	negyessy.laszlo@wigner.mta.hu
topic	**Modeling interactions of the cerebral cortical areas by graph theoretic tools**
description (5-8 lines)	Goal: Understanding the the role of the areas of the cerebral cortex, regions with specific cortical functions, which form complex network, by examining the importance of interactons formed via the areas.
maximum number of students for this topic	1
place of research	Hu.Acad.Sci. Wigner RCP
knowledge of English required	Excellent command of English
professional requirements	programming, network analyses softwares

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Imre BAKONYI
e-mail address	bakonyi.imre@wigner.mta.hu
topic	**Preparation of nanowires and study of their magnetic and transport properties**
description (5-8 lines)	Our research group has been engaged for the last two decades in the electrochemical preparation and experimental study of metallic magnetic/non-magnetic multilayer films which exhibit the phanomenon of giant-magnetoresistance (GMR) based on spin-dependent electron transport in ferromagnets. The electrochemical technique provides a unique opportunity to electrodeposit materials into the nanoscale pores of some special non-metallic membranes and this offers the possibility to fabricate nanowires with a diamter of typically 100 nm. Similarly to the preparation of mulitlyer films, the electrochemical deposition method enables the modulation of the chemical composition also along the nanowire length and in such multilayered nanowires the GMR effect can also be observed. By specific element combinations, one can achieve various specific properties of such nanowires (e.g., magnetically hard and soft materials, magnetic metals and semimetals or superconductors). The PhD work includes the electrochemcial preparation of nanowires, their structural characterization by electronmicroscopy and X-ray diffraction, as well as studying their magnetic and transport properties. The research will be caried in collaboration with a group in Dresden, Germany with the topic focusing on the fabrication of magnonic crystals by electrochemical routes.
maximum number of students for this topic	1
place of research	Wigner Research Centre for Phyics, Hungarian Academy of Sciences, Budapest
knowledge of English required	medium level conversation, ability to read scientific literature
professional requirements	MSc in Physics/Engineering Physics, basic knowledge of measurement techniques, data acquisition and evaluation; programming expertise is advantageous

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Viktor Tóth L.
e-mail address	lvtoth@astro.elte.hu
topic	**Clouds in a violent environment - Multi-wavelength studies of galatic cold interstellar clouds**
description (5-8 lines)	The all-sky catalogue of Planck Galactic Cold Clumps (PGCC) allows an almost unbiased study of the early phases of star-formation in our Galaxy. The Herschel Key Program „Galactic Cold Cores" explored about 350 PGCCs, sampling those with a broad range of physical parameters and environments. These and hundreds of other PGCCs were further investigated by radio-spectroscopic surveys. The planned research should reveal the rich structure of both star forming and starless PGCCs. It should compare clumps, which are embedded in large complexes, or even close to OB associations to those, which are isolated and lay far from UV luminous objects. The PhD project includes astronomical measurements of the radiation of the interstellar medium with world-class telescopes. The applicant will need to use and also develop software tools for the data processing and analysis, as well as to model the observed clouds. This research is part of the international "Galactic Cold Cores" project.
maximum number of students for this topic	1
place of research	Eötvös Loránd University, Institute of Geography and Earth Sciences, Depertment of Astronomy, Budapest
knowledge of English required	at least B2
professional requirements	MSc in physics and/or astronomy

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Viktor Tóth L.
e-mail address	lvtoth@astro.elte.hu
topic	**Star formation and active galactic nuclei**
description (5-8 lines)	The planned research will uncover parameters of infrared bright galaxies using infrared and high-resolution radio interferometry measurements. A statistical sample of galaxies should be investigated sampling all evolutionary phases and a range of galaxy masses. Dedicated measurements will be planned and carried out using European and American array systems, besides an intensive data mining in existing archives. The analysis of the obtained data set should include modeling. Star formation and AGN activity will be determined. This research is to be carried out in an international collaboration.
maximum number of students for this topic	2
place of research	Eötvös Loránd University, Institute of Geography and Earth Sciences, Depertment of Astronomy, Budapest
knowledge of English required	Proficient user
professional requirements	MSc in Physics, or Astronomy

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	András Vukics
e-mail address	vukics.andras@wigner.mta.hu
topic	**C++QED – a framework for simulating open quantum dynamics**
description (5-8 lines)	C++QED – a generic framework for simulating open quantum dynamics – is an ambitious project that has been developed since 2006 (cf. http://cppqed.sf.net). C++QED uses a unique heuristic Monte Carlo wave-function (MCWF) trajectory driver with adaptive step-size, which method has not yet been published. The convergence of the method should be established depending on the physical system and driver parameters. The adaptive step-size heuristic should be extended to higher order MCWF steppers. Besides working with quantum trajectory methods, the candidate has the opportunity of learning best practices in C++ scientific computing, using state-of-the-art programming techniques, such as C++ template metaprogramming and high-quality libraries.
maximum number of students for this topic	1
place of research	Wigner Research Centre for Physics of the Hungarian Academy of Sciences, Institute for Solid State Physics and Optics, Department of Quantum Optics and Quantum Information
knowledge of English required	at least B2
professional requirements	Sound foundations in quantum (statistical) mechanics Sound knowledge of Python and/or C++

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	András Vukics
e-mail address	vukics.andras@wigner.mta.hu
topic	**The multipolar gauge of quantum electrodynamics in the ultra-strong light–matter coupling regime**
description (5-8 lines)	Recently, the interest in the multipolar gauge of quantum electrodynamics has been revived following a revisit of the problem of the feasibility of the Dicke phase transition with atoms in the electromagnetic field (cf. e.g. Phys.Rev.Lett.112:073601[2014]). The multipolar gauge has been worked out for arbitrary topology of the domain of the electromagnetic field. Regarding this fundamental work, several open questions remain, such as the role of cohomological fields and the nature of the Lamb shift in this gauge. The behaviour of the system of atoms and field as a many-body system can further be studied including atom-atom interaction by many-body methods, such as the renormalization group treatment. The developed formalism can then be used to study other candidate systems for ultra-strong coupling, such as a two-dimensional electron gas trapped in semiconductor heterostructures and circuit QED. Besides learning the sound quantum electrodynamical foundations of the interaction of matter with light, the candidate has the opportunity to join the quest for achieving ultra-strong coupling between light and matter on the quantum scale.
maximum number of students for this topic	1
place of research	Wigner Research Centre for Physics of the Hungarian Academy of Sciences, Institute for Solid State Physics and Optics, Department of Quantum Optics and Quantum Information
place of research (in brief)	MTA
knowledge of English required	at least B2
professional requirements	Sound foundations in electrodynamics and quantum mechanics, and some understanding of quantum electrodynamics and the canonical formalism of fields

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	Zsolt Kovács
e-mail address	kovacszs@metal.elte.hu
topic	**Controlling the Properties of Bioactive Glasses and Glass-Ceramics**
description (5-8 lines)	Bioactive glasses and their devitrification products in the SiO_2-P_2O_5-CaO-Na_2O system are able to degrade in the body and form a hydroxyapatite surface layer. This mechanism helps bonding to bone and assist bone regeneration. Additional atomic substitutions provide therapeutic flexibility with ion release and control over the properties (crystallization tendency, ion release, elastic moduli or strength) by tailoring packing of the glass network. Suitable thermal treatments inducing internal stresses or forming glass ceramics by the nucleation and growth of crystalline phases can improve mechanical properties of bioactive glasses. In this doctoral project, an experimental study is proposed to modify bioactive glass properties by various atomic substitutions, thermal and thermo-mechanical treatments complemented by structural investigation of the glass state.
maximum number of students for this topic	1
place of research	Department of Materials Physics, Eötvös University
knowledge of English required	Excellent command of English
professional requirements	-

PhD School	**Doctoral School of Physics at ELTE University**
supervisor	István Bányász
e-mail address	banyasz.istvan@wigner.mta.hu
topic	**Design, fabrication and characterization of integrated optical elements and circuits for telecommunication and optical biosensors using ion beam techniques**
description (5-8 lines)	Photonics technology is in the process of entering many traditional electronics markets. It started in telecommunications and data centres. More recently it has been spreading to sectors like precision instrumentation, sensing, aerospace, automotive, health-care and defence. Photonic integration has been revolutionizing optics in the latest two decades in a similar way as integrated circuits revolutionized electronics in some over 50 years ago. Optical industry has been concentrated on the improvement of the properties of single components for a long time, investing a lot in finding the best materials, and refining techniques to obtain various devices. Currently photonics companies produce optical chips using standard fabrication processes and materials to make all kinds of devices. The successful candidate will join a multinational *ad-hoc* team, performing research work to develop a novel technology for photonic integrated circuit fabrication using only ion beam implantation and irradiation techniques. Intensive researches in this field began in 2004. Some of th emost important results obtained so far are: Fabrication of channel waveguides [1] and planar waveguides [2] in Er:TeO_2-Ge_2O_3 optical glass, using MeV energy nitrogen ion implantation. The Ph.D. student will have the possibility to participate in the implantation/irradiation of the new samples at the new ion nanobeam line of the MTA Atomki Research Centre (Debrecen, Hungary), as well as in the Tandetron Laboratory of the Řež Nuclear Research Institute (Czech Republic). His or her main research tasks will be the design and the optical and functional characterizations of the integrated optical elements and circuits, using the following techniques: Classical microscopy (interference, phase contrast, INTERPHAKO, DIC) M-line spectroscopy (using a METRICON 2010M Prism Coupler) Spectroscopic ellipsometry Micro Raman spectroscopy Ionoluminescence
maximum number of students for this topic	1
place of research	MTA Wigner Research Centre for Physics, Budapest, Hungary
knowledge of English required	The ideal candidate must have a good command of everyday and scientific English
professional requirements	Candidate has to be familiar with computer codes for the control and evaluation of experiments, must be willing to continue learning, be labourious, must have his or her own ideas concerning research.