INFO SHEET	PROJECT PROPOSAL	22
Project title	*Black holes and holographic symmetries*	
Scientific Disciplines	Physics	
Applying Institution in Austria	Technical University of Vienna	
Applying Institution in Iran	Institute for Research in Fundamental Sciences (IPM), Tehran	

Abstract (as provided by the applicant)

Black holes constitute an important class of solutions to Einstein's General Relativity (GR) and have their own very peculiar features and experimental signatures. In this project, we will be studying theoretical questions regarding black holes, especially about the quantum nature of black holes. However, with the rapid and spectacular advances in observational astronomy in recent years, including the discovery of gravitational waves through black hole mergers, black hole physics has emerged as a window to test GR and hopefully provide a venue to beyond GR. The main research goal of the project "Black holes and holographic symmetries" is to understand the physics of black holes in a specific setting based on the notion of symmetries in holographic theories.

The main objective besides the research goal is to generate strong ties and engender research exchanges and visits, particularly for junior scientists, between IPM, Tehran and ITP, TUW (Vienna) by jointly pursing the research goal above.

The project Black holes and holographic symmetries is intended to be in areas of physics which have already active and established groups in both institutions, in school of physics of IPM in Tehran and in ITP at the TUW in Vienna. The group at IPM includes two faculty members (full prof. Level), nine postdoctoral fellows, five PhD students and some short-term research assistants and visitors. At IPM we also have part time members from faculty members around Iran.

The Institute for Theoretical Physics (ITP) at TUW in Vienna is the main center for theoretical research in the field of fundamental interactions and string theory within Austria.

The gravity group at ITP is led by Daniel Grumiller and together with Anton Rebhan's group currently has two long-term visiting researchers, eight postdoctoral researchers, ten PhD students and a couple of undergraduate students.

Our ambitious research project is planned for two years. If the funding can be continued even longer the project can be extended afterwards, as we have numerous questions of common interest that we would like to investigate. The very fact that in both institutions there is already an established and active group on the areas related to the topic shows intentions of IPM, Tehran and ITP and TUW in Vienna for investing in this topic, which is of course one of the very well noted and hot topics in the area of theoretical high energy physics.

As mentioned this project fits very well with the existing scientific plans of the two parties at IPM and ITP and would provide the setup to have closer connections and exchanges between the two groups and would certainly bear remarkable scientific fruits. We envisage to have several mutual visits especially by younger members of the groups, the PhD students and postdocs, common scientific workshops and joint papers will result from this project.

INFO SHEET	PROJECT PROPOSAL	16
Project title	*The emergence and spread of tin bronze alloying in prehistoric Iran – an interdisciplinary approach*	
Scientific Disciplines	Prehistoric Archaeology, Archaeometallurgy, Experimental Archaeology	
Applying Institution in Austria	University Vienna	
Applying Institution in Iran	Art University of Isfahan	

Abstract (as provided by the applicant)

The development of metallurgy in the Iran has been a topic of interest for archaeologists and natural scientists for many years. Its rich and old history and huge metallurgical and metal working remnants have been an important source for archaeological studies over the last decades. Ancient artefacts made of copper and its alloys found from the 7th mill. BC onwards provide evidence that the Iran is one of the core regions for the development of metallurgical techniques.

One of the important changes during the prehistoric period was the introduction of tin bronze alloy in Iranian metallurgy. The alloying of copper with tin enhances its mechanical properties, gives it superior material quality and makes it remarkably harder than e.g. arsenical copper. The emergence of this technology goes back to the early 3rd mill. BC in western Iran and became evident later in other parts of the country. Nevertheless, there is little scientific data about the alloying process and the tin bronze technology applied by ancient Iranian metalworkers.

The analyses of some Iranian Bronze Age artefacts showed that there is **no correlation** between the object's type and the tin concentration suggesting **an uncontrolled (or uncontrollable) alloying process** for the production of binary copper - tin alloys. This could be interpreted in the way that there is no recognizable relationship between the ancient Mesopotamian recipes presented in cuneiform texts and the observable tin bronze technology in neighbouring Iran. This observation stands in clear contrast to the fact that the Iranian region had close economical, artistical and technological relations with Mesopotemia during the Bronze Age, as e.g. observable at the important archaeological site of *Susa*.

This demonstrates that the technological traditions of Iranian metalworkers to produce bronze by alloying are to date not fully described or examinated. It is also caused by the fact, that despite of many archaeological excavations at Iranian sites, there is **no systematic examination of** the metallurgy of tin bronze alloying during the Bronze Age.

The aim of this **interdisciplinary research project** is to examinate the ocurrance and spread of the tin bronze technology in Iran during the Bronze Age (3rd – 2nd mill. BC)**.** This will be conducted by using archaeological, chemical and microstructural analyses as well as experimental archaeology. It is planned to analyse 70 samples from bronze artefacts, slags, crucibles and ores. They will be collected at the important archaeological sites and mines of Deh Dumen (southwestern Iran), Bazgir Tappeh (northern Iran), Gowhar Tappeh (northern Iran), Tappeh Shahdad (southcentral Iran), Tappeh Hisar (northwestern Iran), Sialk (central Iran), Chelo (northeastern Iran), Sheikh Aali mine (southcentral Iran) and the Taknar mine (northern Iran).

This common research project will form the framework for **training measures** for the involved researchers. Two courses in March and September 2018 for 15 days, one in Isfahan and one in Vienna will be conducted to exchange knowledge between the researchers in the specific fields of material analyses, archaeology, geology and archaeometry.

INFO SHEET	PROJECT PROPOSAL	19
Project title	*Mathematics in Motion*	
Scientific Disciplines	Computaional Mathemaics, Scieniic Compuing, High Performance Compuing	
Applying Institution in Austria	University of Graz	
Applying Institution in Iran	Isfahan University of Technology	

Abstract (as provided by the applicant)

We will establish a cooperation between the University of Graz (KFU) and the Isfahan University of Technology (IUT) in terms of summer schools on Scientific Computing for Ph.D. students and in terms of a joint degree program in Scientific Computing.

We will establish a joint Ph.D. degree in the research area of computational mathematics in combination with scientific computing that combines the strengths of the two involved institutions. This requires to define courses in a joint Ph.D. program that are of interest with respect to the interdisciplinary profile of the degree according to the local available competences. We plan two summer schools (first in Isfahan, second in Graz) with lecturers from both universities.

The application area behind the mathematics will be biomedical and biophysiological modelling and simulation. The involved mathematical topics are analysis and numerics of partial differential equations (PDEs) and of ordinary differential equations (ODEs), mathematical modelling in the application areas, optimization and parameter estimation. Additionally programming skills are needed in Python and C/C++/FORTRAN in order to use and adapt available software also in the context of parallel programming.

The IUT has excellent researchers/lecturers in analytical and in numerical mathematics together with many motivated Ph.D. students from Iran. The Ph.D. students have a very good theoretical background but lack the implementation issues of mathematical problems to real world applications. There are lecture halls as well as computer pools available at the IUT.

The KFU has its expertise in scientific computing for biomedical and biophysiological applications, mathematical image processing, optimization, computational mathematics and high performance computing (HPC). The Ph.D. students are internationally recruited and receive a very good education in applied mathematics. These students would benefit from a mathematical view that is less applied. There are enough lecture halls and computer pools available during the summer break (July-Sept.) and several local parallel computers of different kind (CPU, GPU, Xeon Phi KNL) can be used for lectures.

Excluding some large and very well financed universities, most mathematical departments cannot cover all mathematical areas even in applied mathematics. Therefore, joint summer schools and a joint degree gives both institutions the opportunity to extend its local expertise – and that is what we want to achieve with this project. The summer schools will be the initial point for research cooperations between Ph.D. students from different institutions as well as research cooperations between their supervisors.

INFO SHEET	PROJECT PROPOSAL	59
Project title	*Fundamental law and its underlying concept of the human being – a comparison between European Union and the Islamic Republic of Iran*	
Scientific Disciplines	Philosophy, Legal Studies, Theology, Sociology, Religious Studies	
Applying Institution in Austria	University of Salzburg	
Applying Institution in Iran	Kharazmi University	

Abstract (as provided by the applicant)

As Gustav Radbruch, the founder of the German jurisprudential research on the law's concepts of the human being, and many after him claim, every legal system is – be it explicitly, be it implicitly – built upon basic anthropological assumptions about the human being. These assumptions are the very fundament of the law. The concept of the human being that underlies the legal system thus is, as Radbruch put it, what actually is "epoch making" in the legal history. This also means that for really understanding a legal system you have to be acquainted with the concept of the human being the legal system is based upon, otherwise the legal systems does not make sense to you.

If this is true, many differences between legal systems and many intercultural misunderstandings can be traced back to the different concepts of the human being. By conversion, knowing and understanding the concept of the human being of the cultural others' legal system will enhance mutual understanding and foster mutual respect and tolerance.

In this research project, we will explore and compare the concepts of the human being that underlie European and Iranian fundamental law. To do this, we will look at the following "hard" material:

Europe:

- Main Treaties of the European Union
- Charter of Fundamental Rights of the European Union
- European Convention of Human Rights

Iran:

- Constitution of the Islamic Republic of Iran
- Iranian sharia law

This philosophical research project aims at exploring the concepts of the human being (in German: "Menschenbilder", i.e. bundles of basic anthropological convictions) that underlie European and Iranian fundamental law. Its overall goal is to deepen the mutual understanding of the two culturally and philosophically diverse concepts and of the differences between them. The project's objectives are

- to identify the concepts of the human being that underlie European and Iranian fundamental law,
- to thoroughly analyse and compare the two concepts of the human being, and to identify and analyse the main differences between them, and
- to prepare a research proposal to be submitted at a national or European funding scheme (e.g. FWF or ERC).

INFO SHEET	PROJECT PROPOSAL	26
Project title	*Evaluation of low-cycle fatigue properties in piston aluminum alloys reinforced by nano-particles*	
Scientific Disciplines	Mechanical Engineering, Solid Mechanics, Fatigue	
Applying Institution in Austria	University of Leoben	
Applying Institution in Iran	Semnan University	

Abstract (as provided by the applicant)

Researchers have recently investigated thermal and mechanical properties of aluminium alloys, reinforced by different nano-particles. To study mechanical properties of such materials, a high number of articles has been published. However, studies on the reinforcement of aluminium alloys (especially the piston aluminium alloy) by nano-articles and also thermal properties or combined thermo-mechanical properties of aluminium alloy nano-composites are still rare. This lack of sciences is more when cyclic loadings have been considered in comparison to ones under monotonic loadings. Investigating such fatigue behaviours could be categorized in two regimes, including low-cycle and high-cycle zones. For the LCF study, no articles have been found, which the topic of this project is.

Aluminium alloys have been widely used in engine components, such as pistons. Such materials are under thermal and mechanical loads in the engine. During start-stop cycles and engine working, components are exposed to different cyclic loadings, where fatigue phenomena would be occurred, including high-cycle, low-cycle and thermo-mechanical (HCF/LCF/TMF) fatigue behaviours. For engineers and designers during a new engine development, to know the material behaviour, besides to strengthen the material (since the engine power has been recently increased more and more) and lowering the piston weight, is an important rule to have a higher service lifetime of components. One way to reinforce the material, in addition to the heat treatment process, is to add nano-particles to the material, to manufacture the metal-based matrix composite (MMC).

In this project, piston aluminium alloys would be strengthened by nano-particles and then; LCF properties would be evaluated to find the material behaviour under cyclic loadings. For this objective, both experimental and simulation works should be done. Experiments include LCF testing at different temperatures and TMF testing under different conditions, both on standard specimens, made of piston aluminium alloys, with and without nano-particles. Before testing, initial cylindrical specimens should be casted and machined.

As an example of local needs and demands for such topics, Motorsazi Pooya Neyestanak (MPN) Company (a piston manufacturer located in Isfahan, Iran) has requested for the knowledge of material behaviours in pistons for developing new engines. Therefore, they tend to support this project. Therefore, they would provide the initial material and the casting process would be performed in the mentioned company. In return, they could use obtained results (in the case of published articles) of this project to model and simulate the material behaviour in engine pistons by finite element softwares, for a better design or a higher lifetime service. Then also, equipments for high-temperature fatigue testing are high technological, high costly, and time consuming tests and could not find in Iran, such project could be defined for transferring the knowledge of the material behaviour to Iran and Iranian companies. However, it should be noted that the casting process (especially for adding nano-particles to the piston aluminium alloy, as its experience existed) and finite element simulations (for calibrating material constants based on experimental data) would be done in Iran.

INFO SHEET	PROJECT PROPOSAL	30
Project title	*Investigations of microwave irradiation effects on microfracturing in Darrehzar copper ore samples of Iran*	
Scientific Disciplines	Engineering (Mining, mineral processing, rock fragmentation, alternative rock fragmentation, comminution), Geology, Physics	
Applying Institution in Austria	University of Leoben	
Applying Institution in Iran	Shahid Bahonar University of Kerman	

Abstract (as provided by the applicant)

Comminution of ores and rocks is often the most energy consuming processes worldwide. It responsible for approx. 2% of the total energy consumption in major mining countries.

Respective figures for Iran are unfortunately not available. However, it is a highly inefficient process with most of the energy being dissipated to heat instead of going to the generation of new mineral surfaces. New and innovative approaches are therefore needed to overcome these mechanical restrictions.

In this context, research on microwave irradiation of ores for increasing their fragmentation behaviour is dating back at least 20 years now. Up to now, tests have been performed with various ores and at different power levels. It can generally be stated that the technology has huge potential, although no industrial solution has yet been presented. The goal mostly is, to increase selective fragmentation (due to selective electromagnetic heating) and thus increase the degree of liberation of valuable metals at much coarser grain sizes, compared to the conventional process. This will ultimately reduce the need for fine-grinding which is identified as the major energy consumer. This method is especially interesting for copper mines, which have a comparably low grade (in the range of 0.5%) and a wide variety of different copper-bearing minerals. Here, potential energy savings are at approx. 8% according to different literature sources.

The proposed study will demonstrate the application of the microwave (MW) irradiation to enhance mineral processing for Darrehzar copper ores. The process steps are proposed in order to conduct this task.

Montanuniversitaet Leoben has a strong focus on mineral processing with a distinct background in alternative fragmentation concepts, especially the application of microwaves in this context. The Shahid Bahonar University of Kerman, on the other hand, has huge experience in Iranian copper mining and insights into their processes from mine to mill and product. Combining these different skills will ensure the success of this project. The collaboration of these universities will, therefore, be highly beneficial for Iranian mining industry and will open up opportunities for future collaborations and exchange of skills.

INFO SHEET	PROJECT PROPOSAL	38
Project title	*Modelling and Experimental investigation of inhomogeneous locally Nano-Structured materials*	
Scientific Disciplines	Mechanical & Manufacturing Engineering	
Applying Institution in Austria	Technical University of Graz	
Applying Institution in Iran	Iran University of Science and Technology	

Abstract (as provided by the applicant)

Ultra-fine grain materials have attracted the attention of many researchers due to their unique mechanical properties. Control of grain size and texture are known as one of the most effective ways to achieve desired material properties. Severe plastic deformation (SPD) processes are commonly used methods for grain refinement of metallic materials, although they have not been well received by industry. The most important limitations of introduced methods are the small size of the product and the large number of steps needed to reach the desired texture. In recent years, various SPD methods for improving texture and grain size of bars with small diameters are provided. However, imposing large plastic strains to small diameter wires is a complex process and technically challenging.

Traditionally, wires are made by drawing; imposing sever plastic deformation to wires with small diameter is a complex process. Enhancing mechanical properties of wires during fabrication is highly desirable for the production of high strength, durable, and ductile wires. Several methods have been proposed over the years for the improvement of the mechanical properties of wires. For example, severe plastic deformation (SPD) methods for fabricating nano-structured materials have been used with positive results. However, metal wires fabricated from such methods suffer from low ductility due to lack of work hardening.

In order to overcome the aforementioned limits such as small length of the produced materials, discontinuous processing, and numerous passes required to achieve desirable mechanical properties, some novel severe plastic deformation methods have to be developed. Recently a novel method called “Equal Channel Angular Drawing (ECATD)” was introduced by the authors through a work collaboration between Iran University of Science and Technology (IUST) and Graz University of Technology (TU Graz). The method has been preliminary studied through basic experiments and simulations. Results were published in some ISI papers and conferences. In addition, two national Iranian patents have been submitted relating to the project and one U.S. Patent was submitted and is already published. For commercialization of the process and deep investigation of microstructural evolution of the processed materials, further studies are required experimentally and theoretically. In parallel, another method with some improvement compared to the ECATD method was established at TU Graz and it is at the initial check stage. Based on the description provided, the main objectives of the project are as follows:

• Deep analysis of processed materials using some advanced laboratory tools such as EBSD or 3D-EBSD, hardness mapping machine, …
• Modelling and multi-scale simulation of the processes using real material properties achieved by a Gleeble machine.
• Investigating the thermal stability of the developed microstructure using Gleeble machine.
• Theoretical and numerical investigation of grain refinement of the processed martials.
• Investigation the electrical properties of the produced wires.
• Studying the surface properties of the SPD processed materials.

INFO SHEET	PROJECT PROPOSAL	33
Project title	*Optimization of High-harmonic generation from Atomic to Solid sources (OHAS)*	
Scientific Disciplines	Theoretical Physics, Laser Physics, Photonics	
Applying Institution in Austria	Technical University of Vienna	
Applying Institution in Iran	Tarbiat Modares University	

Abstract (as provided by the applicant)

Attosecond pulses based on high-harmonic generation (HHG) have been used for the past two decades for different applications in ultrafast spectroscopy and high resolution imaging of atoms, molecules, and nano-structures. Unfortunately, the low flux of current attosecond sources still severely limits applications to a small subset of potential technical and scientific probes envisioned by this novel approach. To unravel the full potential of attosecond pulses, strategies for the development of sources with higher efficiency are being sought. Indeed, a broad variety of investigations has been performed to overcome this central obstacle. The goal of the OHAS project is to improve our current understanding and the ensuing control of the underlying electronic dynamics with the goal to optimize and tailor the HHG output exploring a variety of systems ranging from atoms and molecules to bulk solids and nano-structured materials.

Research of the interaction of strong and ultrashort laser pulses with matter has become a rapidly developing field since the advent of table-top laser sources able to deliver pulses from optical to IR frequencies at intensities up to some 10^{15} W/cm^2.

On a fundamental level such laser systems enable the study of structural and dynamical information of matter. Non-linear interaction of strong few-cycle pulses creates pulses as short as ~100 attoseconds allowing for observation of the electronic and molecular dynamics on their natural time scale. The key to this rapid progress and workhorse of the rapidly developing field of attosecond science is the generation of coherent temporally and spatially well-defined XUV or X-ray attosecond pulses by high-harmonic generation (HHG). Further development and optimization of HHG is one of the most important goals of current ultrafast science. Many fundamental aspects of the non-linear interaction with matter are still poorly understood. The present partnership OHAS between the Institute for Theoretical Physics of Vienna University of Technology (TUW) and the Institute for Theoretical Chemistry of the University of Vienna (UW) on the Austrian side and the Physics Departments of Tarbiat Modares University (TMU) and Sharif University of Technology (SUT) on the Iranian side plans to jointly address the non-linear response and HHG in matter ranging from atoms, molecules to solids and two-dimensional materials. The primary focus of the partnership will be on new theoretical developments while collaborations with experimental groups within partner institutions within this consortium and beyond are envisioned. Central elements of this partnership will be the development of collaborative research with exchange visits of Iranian and Austrian PhD students starting during the first 6 months of the project. This will also open the opportunity to implement joint training of graduate students on the PhD level by teaching visits by senior academic personnel from the partner universities. On longer terms, joint research projects extending over the period of the OHAS project will help to institutionalize the collaboration between the partners of the consortium.

INFO SHEET	PROJECT PROPOSAL	56
Project title	*Prediction of residual stress in mechanical fasten joints by measurement of dislocation density*	
Scientific Disciplines	Mechanical/Material Science Engineering	
Applying Institution in Austria	Technical University of Graz	
Applying Institution in Iran	Islamic Azad University of Najafabad	

Abstract (as provided by the applicant)

In the recent years, mechanical press joining has rapidly developed into new branches of joining technology such as automobile industry and considerable research activities have taken place in this area. The self-piercing riveting technique was developed about half a century ago and was used by the appliance and packaging industry. This technology were used in the early 1990s by Audi to join structural panels Audi A8. The first patent for clinching was granted in Germany in 1879. Examples for new applications of clinching in automobile industry are clinch spot- positions on the body in white Daimler S- class (W221) model and joining the inner part of front and hatchback (Aluminum- Steel) for the Audi A8 model. The clinching process is developed in recent years and it requires much more research to achieve the point where accuracy, high quality, and optimal strength of the joints become comparable to industry standard.

Mechanical joining technologies are used more and more in various types of industrial manufacturing processes. There are many types of mechanical joining processes used for different applications. The ability to predict the residual stress in mechanical joints can help to solve a number of problems associated with static and fatigue behaviours of joints. This work focuses on measurement of residual stress in clinching and self piercing riveted joints. The investigated material is TL091- aluminium sheet. The experimental joining tests (clinching, self-piercing riveted) will be carried out. The dislocation density in joints will be measured by X- ray diffraction method. The results will be used to predict the residual stresses in joints.

Finally numerical methods are applied to predict the residual stress and static strength of joints. The results of this project should present:

- A new approach to predict the residual stress in mechanical joints
- Better understanding of plastic behavior of material in joining and quasi static loading processes
- Predition of residual stresses in joints by using numerical and theoretical methods
- Prediction of static strength of joints without destractive tests

INFO SHEET	PROJECT PROPOSAL	64
Project title	*Potential of transformative learning theory for teachers' professional development*	
Scientific Disciplines	Education, Teacher Education	
Applying Institution in Austria	University of Vienna	
Applying Institution in Iran	Tarbiat Modares University (TMU)	

Abstract (as provided by the applicant)

The leading question of this research is why teacher professional development and in-service training programs do not often make an effective change on current situation of teachers' actions in classrooms. Studying different teacher education programs (Darling-Hammond & Rothman, 2011, Clandinin, 2010, Connelly, 1994, Fullan, 2007), it could be said that prescriptive perspectives of these programs, partly, make them ineffective for teachers. Therefore, the next question is which methods for teachers' professional development could be effective to make a sustainable improvement. In these regards, professional development literature declares that top-down approaches (traditional CPDs, reading material, consultation of experts etc.) have the least impact on improvement of teaching. In addition, this literature informs us that change and improvement of teaching happen gradually and in stages, it is not an ad-hoc event. Since this is an international problem among different educational systems, various models of teacher development have been constructed in the past ten, fifteen years. Most of them point to some constant factors influencing teaching practices, such as the role of prior beliefs (e.g. Fang, 2006), the relevance of perceptions of self-efficacy (e.g. Gibbs, 1997), the impact of reflective experiences (e.g. Schon, 1996), approaches that rely on collaborative learning of teachers as well as focusing on teachers' knowledge, beliefs and values (Ben-Peretz, 2011) have been proved to be effective according to a number of studies (e.g. Korthagen, 2010). For an overview of studies dealing with the professional development of teachers see Avalos (2010).

In short, this research intends to understand what teachers know (access to assumptions, presupposition and perspectives) and how this knowing affects their actions. Then, applying Transformational Learning Theory, we are looking to see the potential of this theory to change these beliefs and perspectives in order to improve their actions (transformation of beliefs and perspectives). By this, one can reflect on their learning foundations and recognize and evaluate assumptions and presuppositions in their learning and practice. This leads us to a more accurate understanding about the reasons of teachers' performance. The findings have significant and pragmatic implications for teacher professional development programs and initiatives.

INFO SHEET	PROJECT PROPOSAL	8
Project title	*Geochemistry and isotopic studies of REE-bearing Sangan Fe-Skarn, NE Iran*	
Scientific Disciplines	Geology, Geochemistry	
Applying Institution in Austria	Paris Lodron University of Salzburg	
Applying Institution in Iran	Kharazmi University	

Abstract (as provided by the applicant)

In recent years, the rare earth elements (REEs) have quickly become one of the more increasingly sought-after natural resources in the world. The rare earth elements have long been recognized as useful because of their unusual chemical and physical properties. Their natural occurrence is strongly dependent on geological circumstances, and only in a few locations, they are found in sufficient quantity and concentration, and in a suitable form and setting, to make their extraction and exploitation economically viable. The rare earth elements have also been of long-standing interest to geologists as tools for furthering scientific research on the origin of rocks and ores and into the chemical behavior of ocean waters.

The REEs comprise a group of elements in the periodic table known as the lanthanides. Additionally, yttrium and sometimes scandium are added to the group due to their chemical similarities. These elements are extensively used in a number of different applications in the industry including the booming “high tech” and “green tech” sectors, leading to an increasing demand for these commodities.

There are series of questions that deal with the properties, occurrence, extraction, supply and uses of the rare earth elements among scientists, policy-makers, potential investors and other industry players. Rare earth elements will continue to be of considerable interest for the foreseeable future, with demand likely to grow. Geological and mineralogical research should continue to play an important role in the search for rare earth ore deposits and their extraction, ensuring that as little damage is done to the environment as possible.

In Iran, recent interest in REE and other strategic metals resulted in exploration and planned mining for REE deposit as well as increasing research on other types of potential ore deposits. One of the highly promising region of Iran for REE mineralization is REE associated with Fe mineralization. Two districts in Iran have noticeable potentials for REE mineralization:

1) REE mineralization associated with magnetite-apatite (IAO ore type) in central Iran, and

2) Fe skarn mineralization in Sangan mining region.

This project is focused on Sangan mining region with a special emphasis on REE-bearing phases. REE-Fe-deposits in Sangan mining region are found along the E-W trending, only in some explored anomalies in the region. They essentially comprise REE silicate-bearing magnetite skarn mineralizations with variable contents of other metals.

The main purpose of this project is investigation of REEs mineralization, and a joint proposal by Kharazmi and Salzburg Universities is prepared for complementary studies on the skarn and comprehensive studies on REEs mainly focused on their geochemistry and petrography of REEbearing phases.

INFO SHEET	PROJECT PROPOSAL	27
Project title	*Economic assessment of genetic variation in V. arctostaphylos*	
Scientific Disciplines	Life Science	
Applying Institution in Austria	University of Natural Resources and Life Sciences Vienna	
Applying Institution in Iran	University of Guilan	

Abstract (as provided by the applicant)

Deciphering the variation among different phenotypes of wild plants is of significant relevance. The knowledge of rare and particularly valuable variants will entail rapid and accurate determination of genetic variants. Further, knowledge of the rare variants underlying traits of interest can also lead to insight about the more complex phenotypes that involve the combined effect of multiple loci and pathways.

In general, most of the functional variation resides in the coding regions of the genome. Thus it is logical to begin with coding region to discover the causative genetic variants of traits of interest. Further, this approach also has cost advantages over whole genome approaches, since protein coding sequences only constitute a small fraction of the entire genome (Cosart et al. 2011, Bamshad et al. 2011).

While medical research has had great success recently in correlating phenotypes (e.g. disease) with rare defective alleles (premature or abolished stop codons, altered start codons, alternative splice sites in genes), there has been no systematic exploration of such connection in wild forest crops yet. Currently, access to such rare mutations is facilitated by next-generation sequencing (NGS) of coding regions, which has been especially effective for identifying Single Nucleotide Polymorphisms (SNPs) and small insertions or deletions that may cause variations in interesting functional phenotypes.

Wild Iranian *Vaccinum arctostaphylos* stands are mixtures of genotypes, which differ markedly in their abilities to produce valuable compounds, which also affected by environmental factors such as light, temperature, drought and UV as well as the degree of mycorrhization. Therefore, the identification of variation among *Vaccinium* accessions using next generation sequencing provides an excellent starting point to discover novel genes responsible for stress in the light of changing climate conditions and environments.

In addition, identification of genetic variants that alter the metabolic profiles and their interactions with environmental factors may help to understand the susceptibility of certain *Vaccinium* phenotypes. So far, no systematic breeding of *V. arctostaphylos* has been attempted.

Therefore, the proposed method will facilitate a fast and reliable way to identify accessions useful to achieve higher genetic gains for traits of considerable value to the pharmaceutical industry. The knowledge of the genetic variability in wild species regarding pharmaceutically interesting traits opens totally novel economic perspectives. The proposed research will increase our knowledge about the genomics of this wild crop on the verge of domestication. The specific objectives of the proposed project are:

• Assess the genetic diversity and metabolite profiles in *V. arctostaphylos* accessions to make an inventory and characterize functional traits in *V. arctostaphylos*.

• Calculate networks using the generated systems biology data (genetic variation and environment) to identify the most important gene variant controlling specific traits.

• Determine the production and economics values of the fruits of *V. arctostaphylos.*

• Identify particularly interesting genotypes for cultivation.

INFO SHEET	PROJECT PROPOSAL	51
Project title	*Study of Performance of Perovskite Catalysts in Simultaneous Reduction of NO, CO and VOC – Exhaust Catalyst Approach*	
Scientific Disciplines	Katalyse, Umweltchemie, Festkörperchemie, Materialchemie	
Applying Institution in Austria	University of Innsbruck	
Applying Institution in Iran	University of Tabriz	

Abstract (as provided by the applicant)

Nowadays, there are some serious environmental problems in human societies around emission of pollutants. One of the most important producers of environmental pollutants is combustion engines and power plants. Nitrogen oxides (NOx) and carbon monoxide (CO) are the major pollutant gases in the exhaust gases of motors. Nitrogen oxide plays a very important role in the photochemical processes of the production and degradation of ozone in the lower and upper layers of the atmosphere. Other environmental effects of nitrogen oxides are acid rain and photochemical fog that is harmful for the ecosystem, the biological death of lakes and swamps and damage to the nervous and respiratory system of animals, especially humans.

Several laws have been passed to prevent the release of these pollutants in the environment. In order to adapt to the emission levels applied in environmental laws, these pollutants must be removed from the exhaust gases prior to emission into the atmosphere.

For this purpose, combustion engines are equipped with TWC catalyst. The reason for this naming is the specific function of these catalysts. These catalysts are able to simultaneously remove NOx, CO and unburned hydrocarbons. The technology in the TWC catalysts uses noble metals. Palladium (Pd), platinum (Pt) and rhodium (Rh) are the most common metals in these catalysts [3-5]. To increase the efficiency of noble metals, they distribute them on supports with high surface area. The commercial support is of alumina type and is based on a mechanical foundation of ceramic monolith.

One of the goals of this project is to study systematically the formulation of perovskite catalysts and the effects of different metals and doping levels on the structure, stability and catalytic performance of the catalysts. The final goal is evaluating and optimizing the perovskite catalysts activity in the simultaneous removal of NOx and CO. Another important aim of the study is introducing noble metals to the structure of the perovskites. There are a few studies around showing the effect of noble metals on the perovskite structure in the literature, but no systematic studies have been done in this field so far. Especially, reversible exsolution and dissolution phenomena of (noble) metals from/into the perovskite lattice have recently been described and may be important for keeping up a high degree of metal dispersion for long term use. Nevertheless, the effect of increasing some of these metals on the activity of perovskite catalysts in the simultaneous removal of NOx and CO, has not been studied yet. One of the other goals is to introduce noble metals in the catalyst structure at the lowest level that catalyst activity could be maintained at an acceptable level. The use of hybrid and intelligent methods to optimize

INFO SHEET	PROJECT PROPOSAL	41
Project title	*Lossless Compaction of Model Execution Trace*	
Scientific Disciplines	Software Engineering, Business Informatics	
Applying Institution in Austria	Technical University of Vienna	
Applying Institution in Iran	University of Isfahan	

Abstract (as provided by the applicant)

In Model-Driven Engineering (MDE), models are the key artefacts in the software development process. The success of the development process is mainly related to the quality of models. IN order to ensure that a model is correct with regard to its intended behaviour, early dynamic verification and validation (V&V) techniques are required. These techniques require models to be executable. Furthermore, many dynamic V&V techniques require an analysis of behaviours over time, which in turn requires capturing execution traces. Execution traces can be generated during the execution of a model and provide information to help reason about the model's execution behaviour. The capability to capture large-sized information in traces and subsequently explore the content of such large traces is missing in existing model tracing approaches; in particular, no efficient techniques are applied to reduce the impact of this scalability problem.
The main objective of our research is to investigate how to apply compaction techniques to execution traces generated form executable models. Indeed, the goal is to define a scalable trace metamodel that enables the construction of model execution traces for any executable modelling languages, and provides traces in a compact scalable form with good scalability in both in-memory and disk space.
This project will be conducted in a collaboration of the Business Informatics Group at TU Wien and Model Driven Software Engineering Group at the University of Isfahan. The Design Science methodology will be applied as methodological approach for conducting the project. For reaching the objectives of this project, focused research activities will be carried out through the period of one year.

INFO SHEET	PROJECT PROPOSAL	63
Project title	*ZeoChar – The potential of Zeolite and biochar for wastewater treatment and soil amelioration in crops*	
Scientific Disciplines	Agriculture, Nutrients	
Applying Institution in Austria	University of Natural Resources and Life Sciences Vienna	
Applying Institution in Iran	Shahrood University of Technology	

Abstract (as provided by the applicant)

Soil is the foundation of all life and human civilisation. Overexploitation and inadequate management as a result of rapid global change put pressure on natural soil resources and have already led to irreversible degradation. Austrian universities and research institutes are investigating basic soil processes and their interactions with plants (rhizosphere) and microorganisms. The results will be used to develop sustainable strategies and processes for soil management, protection and restoration (remediation). Also, water resources is of great importance due to the high volumes that are necessary. Irrigated agriculture will play a dominant role in the sustainability of crop production in years to come. On the other hand the world water deficit is a recent phenomenon. In many arid and semi-arid regions (such as Iran) of the world water has become a limiting factor, particularly for agricultural and industrial development. Iran, a country of 70 million people, is facing an acute shortage of water. Beside water saving methods, finding new water resources or renewable resources are ineluctable. Wastewater is a renewable resource within the hydrological cycle. On a world-wide basis wastewater is the most widely used low-quality water, particularly for agriculture. Application of wastewater in agricultural field may cause some environmental and health problems. Use of some soil amendments like biochar and zeolite will decrease the unfavourable effects of wastewater in soil and crops on one have, and on the other hand they could be used to improve plant growth-promoting bacteria community, and prevent fertilizer leaching as “slow fertilizer releaser”. It is generally acknowledged that biochar additions can increase the soil's sorption and retention capacity for nutrients and water. Biochar possibly also has a high potential for use in water purification, replacing the coal-based activated carbon as a sorbent for contaminants and pathogens (Gwenzi et al. 2017). Also, it is shown that zeolites can flocculate followed by adsorption of organic pollutants in wastewater (Metes et al. 2004).

Natural zeolites have been recognized as valuable soil conditioners that can positively affect the soil-plant system. These aluminosilicates are characterized by a high and selective cation exchange capacity (CEC), reversible dehydration and molecular sieving that can strongly influence soil physico-chemical characteristics. Zeolite has been applied in agriculture for the controlled release of standard pesticides and in biotechnology for immobilization of microorganisms. It may also function as a cation-exchanger in soil, providing plants with nutrients such as calcium and potassium and increasing water binding capacity. Briefly, benefits from using these amendments in agriculture would be:

- Higher crop yields because of better plant growth
- Saving of fertilisers
- Increase water sorption and retention capacity
- More nutrients available to the plants
- Avoiding overdosage of fertilisers
- Revitalising the ground
- No residue in agricultural products

INFO SHEET	PROJECT PROPOSAL	10
Project title	*Investigating dynamic-mechanical and structure-property relationships of Thermoplastic PU-formulated-nanocomposites for shape memory polymer (SMP) applications*	
Scientific Disciplines	Engineering and Polymer Science	
Applying Institution in Austria	Johannes Kepler University Linz	
Applying Institution in Iran	University of Tehran	

Abstract (as provided by the applicant)

Shape-memory polymers (SMP) are active polymers that have dual-shape capabilities triggered by external physical as well as chemical stimuli. Their properties can be advantageous for medical devices, implants and actuators, among others. Here, we want to **gain deep insights** in the **dynamic-mechanical** as well as **structure property relationships** of **thermo-plastic polyurethane** (TPU) and especially its **shape-memory effect** stimulated upon **temperature change**. The ultimate objective is to formulate shape-memory TPUs **compatible for additive manufacturing.**

Additive manufacturing of our synthesized bio-compatible TPU will enable the **production of 3D curved shapes** for medical applications with perfect fit to the human body (sensors, medical pads, insulin pumps, etc.). Heat stimulated shape-memory behaviour will help to adjust the medical products to temperature changes accordingly for the benefit of patients.

We are intending to prepare TPU based SMPs and so we would like to create segments in the system to entail some kind of crystallinity. The microstructure will comprise a hard seg-ment to control the elasticity of the material and a transitional segment, which melts, strains, cools down, and again heats up to restore the initial shape of the system. Here, for the 1st segment, a hard and regular phase, physical and chemical crosslinked polymer will be used and the 2nd, a soft, semi-crystalline network, will be made of polyol/PCL groups, which can form crystals and supports the main shape of the nanomaterial. These crystals are melted at T_{tran} and a stress/strain is applied to fix any deformation. While the stress is maintained the temperature is lowered to fix the deformation. This temperature could be 20°C below T_g or T_m. Once the shape is fixed, the temperature is augmented and the initial deformation is restored.

Here in this project, it is intended to change the hard segment fraction to study its effect on the SMP behaviour. Number of cycles, either mechanical cycle or thermal cycle will be changed to examine the SMP behaviour of system. We should increase the number of OH groups on canola oil to increase the performance of soft segments in terms of creation of more hydrogen bonds. The application of new and modified graphene nanoparticle to be incorporated in the hard segment to increase its capability of forming a better SMP.

In this two year project, a complete synthesis and designing a system comprising of a di-isocyanate such as iso-phoron-di-isocyanate (IPDI) or Hexa-methylene-di-isocyanate (HDI) will be used along with a vegetable oil such as Canola oil and polycaprolacton (PCL). Can-ola is used as a natural, bio-based entity to boost production of biodegradable bio-based plastics. PCL is also a biodegradable polymer.

We will be focusing on making several mechanical and thermal cycles to characterize the shape memory properties of such systems. The temperature could start from 30°C to -50°C and again get back to 30°C. The stress could start to go from zero to 2MPa and from 2MPa to zero after a given time. We also will work on various nano-graphene nanoparticles which are either modified or unmodified to check for their effects on the SMP properties of the system. As the polyurethane (PU) systems contain both soft and hard segments. The nano-influence can boost the kinetics of phase separation. As the polymer resulted from polymer-ization is not dissolved in THF, the normal GPC molecular weight determination cannot be implemented; instead an Ubbelhode capillary viscometer will be used to determine the mo-lecular weight of the resulting polymer. This is because GPC (gel permeation Chromatog-raphy) of our lab operates only with THF.

For a sustainable, environmental friendly development we will dedicate also our research to formulate non-poisonous, bio-compatible materials. Application of some natural polyols such as Castrol or Canola oils, application of nano-graphene to improve the properties of SMP and the selection of an appropriate di-isocyanate and chain extender would also be the hard-core of this project.

The material synthesis will be in close coordination with the molecular dynamical simulation for the study of the structure-property relation which will be done at JKU Linz-IPPE (Austria). Therefore, the first objective is to investigate the dependency of mechanical properties on the crosslink distribution and optimize the crosslinking rate. Specifically, JOCTA software under COGNAC engine will be used to create the molecular models of the polymer with varying levels of overall crosslink density. The flow chart of the crosslinking simulation pro-cedure is shown in Figure 2. The second

approach is to investigate phase separation process for soft and hard interfaces in the proposed polymer. In JOCTA system, there are several simulation engines (see Figure 2(b)) and SUSHI engine is specified for this purpose. On the other hand, with the dynamic calculation, one can reproduce the time-dependent phase transition behaviour such as phase separation, the adsorption and the order-order transi-tion between micro-phase separated structures.
JOCTA can be used as a knowledge discovery tool to understand complicated properties and phenomena that could not be fully grasped through experimental results alone. We are confident that, using these combined approaches, we could successfully describe the phe-nomena with high accuracy and achieve the objective of the project.

INFO SHEET	PROJECT PROPOSAL	6
Project title	*Effect of mesenchymal stem cells on hippocampus neural cells via investigation of genes promoter methylation status of Wnt/β-catenin pathway in Alzheimer's animal model*	
Scientific Disciplines	Regenerative Medicine, Cell Therapy, Cellular Signalling Pathway, Molecular Biology, Cell Biology, Veterinary Clinical Pathology (Clinical Biochemistry, Clinical Hamatology)	
Applying Institution in Austria	Medical University Innsbruck	
Applying Institution in Iran	University of Tabriz	

Abstract (as provided by the applicant)

Neurodegenerative diseases became a landmark in the history of stem cell therapy back in the 1980s when patients suffering from Parkinson's disease in Mexico were treated with this form of therapy with variable outcome. Today, stem cell therapy offers promising hope for almost all forms of neurodegenerative diseases including Parkinson's disease, Huntington's disease, amyotrophic lateral sclerosis and Alzheimer's disease (AD).

Identifying novel, effective therapies for Alzheimer's patients (AD) is one of the major unmet medical needs for the coming decade. Although stem cell-based replacement strategies carried out in animal models have shown promising results, there are still many hurdles to overcome before these approaches can be translated into the AD patients. One major challenge is the development of a safe method to deliver stem cells to the injury region. In addition, the stage of differentiation of those cells needs careful consideration: fully differentiated cells are associated with a smaller efficiency due to poor viability, while undifferentiated cells present a higher risk of undirected differentiation and uncontrolled proliferation. Finding solutions such as identifying and using specific factors and cytokines secreted from mesenchymal stem cells and the molecular mechanisms of the effect of mesenchymal stem cells and secreted cytokines on Alzheimer's patients could help to alleviate these barriers and enables uses these cells for Alzheimer's patients. Also, it is a clear horizon in the treatment of Alzheimer's disease and medical regeneration.

Main goals

1. Alzheimer's disease induction in the rat animal model by intravenous injection of amyloid beta peptide.
2. Extraction of hippocampal neuronal cells from both control (healthy) and Alzheimer's (patients) groups and extraction of rat bone marrow-derived mesenchymal stem cells.
3. The co-culture of bone marrow-derived mesenchymal stem cells with hippocampal neuronal cells.
4. Investigation of the type of effective secretion factors of mesenchymal stem cells on neural hippocampus cells with antibody cytokine array.
5. Approaches to the effect of bone marrow-derived mesenchymal stem cells on DNA methylation of GSK3β gene promoter as an effective factor in molecular and epigenetic pathways involved in cell therapy and regenerative medicine.

Expected results

1. The co-culture of hippocampal neuronal cells in the group of Alzheimer's rats with bone marrow mesenchymal stem cells inhibits GSK3β gene expression compared to control group.
2. The co-culture of hippocampal neuronal cells in the group of Alzheimer's rats with bone marrow mesenchymal stem cells cause to hypermethylation of GSK3β gene promoter compared to control group.
3. The effect of mesenchymal stem cells on hippocampal neuronal cells in Alzheimer's animal model through its effect on the Wnt signaling pathway.
4. Mesenchymal stem cells are used as an effective strategy to treatment of Alzheimer's disease through secretion of different types of cytokines and growth factors.
5. Direct implantation of secreted cytokines and growth factors from mesenchymal stem cell for the treatment of Alzheimer's disease.