

Questionnaire

Summary of the main activities of a scientific Organisation of the Slovak Academy of Sciences

Period: January 1, 2007 - December 31, 2011

I. Formal information on the assessed Organisation:

1. Legal name and address

Institute of Experimental Physics
Slovak Academy of Sciences
Watsonova 47
040 01 Košice
Slovak Republic

2. Executive body of the Organisation and its composition

Directoriat	name	age	years in the position
director	Karol Flachbart	60	since 2007
deputy director	Alena Juríková	46	since 2011
scientific secretary	Pavol Szabó	44	since 2011

3. Head of the Scientific Board

Zuzana Gažová

4. Basic information about the research personnel

- i. Number of employees with a university degree (PhD students excluded) engaged in research and development and their full time equivalent work capacity (FTE) in 2007, 2008, 2009, 2010, 2011 and average number during the assessment period
- ii. Organisation units/departments and their FTE employees with the university degree engaged in research and development

Research staff	2007		2008		2009		2010		2011		average	
	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE
organisation in whole	69,0	61,46	68,0	58,81	91,0	73,82	96,0	78,11	100,0	79,04	84,8	70,2
Department of Magnetism	16,0	14,50	9,0	8,35	11,0	8,83	13,0	9,76	13,0	10,36	12,4	10,4
Department of Low Temperature Physics	9,0	8,90	10,0	9,37	13,0	10,08	12,0	10,90	12,0	10,54	11,2	10,0
Department of Metal Physics	4,0	4,00	4,0	4,00	4,0	4,00	4,0	4,00	3,0	3,00	3,8	3,8
Department of Subnuclear Physics	11,0	9,51	11,0	9,44	13,0	10,56	13,0	11,01	12,0	9,01	12,0	9,9
Department of Space Physics	5,0	5,00	5,0	3,33	11,0	8,66	12,0	8,50	14,0	9,30	9,4	7,0
Department of Biophysics	14,0	12,55	9,0	7,55	13,0	11,55	14,0	11,05	13,0	10,93	12,6	10,7
Department of Theoretical Physics	10,0	7,00	10,0	7,85	12,0	8,55	12,0	9,13	17,0	10,63	12,2	8,6
CITKE	0,0	0,00	0,0	0,00	2,0	2,00	2,0	2,00	2,0	2,00	2,0	2,0
Laboratory of Experimental Chemical Physics	0,0	0,00	3,0	3,00	4,0	2,17	4,0	2,57	3,0	2,60	3,5	2,6
Laboratory of Materials Physics	0,0	0,00	4,0	2,92	4,0	3,42	5,0	4,58	6,0	6,00	4,8	4,2
Laboratory of Nanomaterials and Applied Magnetism	0,0	0,00	3,0	3,00	4,0	4,00	5,0	4,61	5,0	4,67	4,3	4,1

5. Basic information on the funding

- i. Total salary budget¹ of the Organisation allocated from the institutional resources of the Slovak Academy of Sciences (SAS) in 2007, 2008, 2009, 2010, 2011 and average amount for the assessment period - vt

Salary budget	2007	2008	2009	2010	2011	average
total salary budget (millions of EUR)	1,017	1,086	1,167	1,210	1,146	1,125

6. URL of the Organisation's web site

<http://uef.saske.sk>

¹ Objem mzdových prostriedkov bez odvodov do poisťovni so započítaním sumy miezd pracovníkov THS, ktorú organizácii poskytne ETO Úradu SAV. Rozpočet v Sk prepočítajte na eurá podľa konverzného kurzu 1€ = 30,126. (Podobne aj v ďalších tabuľkách.)

II. General information on the research and development activity of the Organisation:

1. Mission Statement of the Organisation as presented in its Foundation Charter

The Institute of Experimental Physics is oriented on basic research in following directions of physics: condensed matter physics, sub-nuclear physics, space physics and biophysics.

In condensed matter physics the Institute carries out studies of transport, optical, thermal, mechanical and magnetic properties of condensed matter (metallic materials, superconductors, quantum liquids, magnetic fluids, molecule-based magnets) down to very low temperatures.

In the direction of sub-nuclear physics the Institute is involved in active participation on experimental projects realized in leading particle physics laboratories (CERN Geneva, CDF).

In the field of space physics the Institute performs studies of the energy distribution of space particles and space radiation using measurements carried out at space satellites and land observatories (especially at Lomnický štít, High Tatras Mountains).

Biophysical research is oriented on the study of conformations, conformational changes, shape, dynamics of transport phenomena and inter-molecular interactions of biological macromolecules, their multi-molecular structures and models.

The theoretical research is focused mainly on non-linear stochastic dynamics and selected problems listed above.

The Institute accomplishes production, storage and distribution of liquid helium for requirements of institutes of the Slovak Academy of Sciences as well as for other national customers.

The Institute provides advisory service, expertise and guards Internet services for institutes of SAS resident in Košice

The Institute carries out scientific research following generally valid legal rules, and releases the results of its scientific-research activities by publications in periodic and non-periodic journals.

2. Summary of R&D activity pursued by the Organisation during the assessed period, from both national and international aspects and its incorporation in the European Research Area (max. 10 pages)

Results achieved by the Institute during the assessment period 2007 - 2011 are in fact represented by research activities of its units - departments and laboratories (Department of Magnetism, Department of Low Temperature Physics, Department of Metal Physics, Department of Subnuclear Physics, Department of Space Physics,

Department of Biophysics, Department of Theoretical Physics, Laboratory of Experimental Chemical Physics, Laboratory of Nanomaterials and Applied Magnetism and Laboratory of Materials Physics). These results are presented in corresponding parts of this document. Taking into account the fact that the majority of achieved results were published in well established international scientific journals, we believe that the research in the Institute (in its relevant fields) corresponds to current / up to date trends, and fulfils all domestic and international criteria for relevance, exactness and quality / excellence of scientific work.

Department of Subnuclear Physics - during the last five years the department actively participated in following experiments: NA57 experiment at the SPS accelerator (CERN Geneva, Switzerland), CDF experiment at the Tevatron collider (Fermilab, Batavia, USA), ALICE experiment at the LHC collider (CERN), and ATLAS experiment at the LHC collider (CERN). October 2009 marks the beginning of the physics at the LHC collider at CERN.

The ALICE experiment, concentrating mainly on nonperturbative QCD physics, succeeded in registering the very first p-p collisions at $\sqrt{s}=900$ GeV and measuring the charged particle multiplicities [1]. Our responsibilities have been centred around the design and development of electronic modules for the pixel detector, maintenance and development of hardware and software for the central trigger, and development of GRID based interactive computing facilities. The physics analysis was/is oriented towards strange particle production, with results on particle spectra in p-p and Pb-Pb collision published e.g. in [2-3].

The ATLAS experiment is optimized for studying the strong and electroweak processes at very short distances, search for new heavy particles and discovering new building blocks of matter. Among our responsibilities were/are cold tests of the calibration electronics for calorimetry, development and maintenance of the calibration software, verifications of hadronic processes in the Geant4 simulation package and development of radiation hardened electronic components. Physical analysis is oriented towards studies of dilepton decays of top quarks. From a plethora of published results we can mention the quenching of high energy jets in quark-gluon plasma observed in Pb-Pb collisions at $\sqrt{s_{NN}}=2.76$ TeV [4], precise tests of the perturbative QCD in p-p collisions at $\sqrt{s}=7$ TeV [5] and a measurement of the top quark pair cross section [6].

The CDF experiment at the Tevatron accelerator complex at Fermilab finished taking data in September 2011. A large accumulated number of events allowed to perform precise measurements of the top quark properties as well as precise measurement of helicities of the W bosons from top quark decays. The latter may serve as a test of the Standard Model. Although the Higgs boson searches [7-8] did not yield any discovery, they provided valuable information about excluded mass intervals.

The NA57 experiment at the CERN SPS accelerator was designed for the study of strange baryon and antibaryon production in Pb-Pb collisions at energies 158 and 40 AGeV/c. Our group made a significant contribution to the physics data analysis. Although the project has finished its main activities in 2006, the analysis of 40 AGeV/c data continued and confirmed the effect of strange hyperon production enhancement in central Pb-Pb collisions, observed by the WA97 and NA57 experiments at 158 AGeV/c, thus giving indication that the onset of a new phase of matter - quark-gluon plasma - takes place at energies below 40 AGeV/c [9-10].

Department of Space Physics - during the last five years the department was focusing on five main fields. On (a) physical processes in the near-Earth's space where energetic charged particles are modulated by the heliosphere and by the Earth's magnetosphere, (b) description of variability of low energy cosmic rays (CR), (c) relations between CR intensity to space weather as well as to atmospheric

processes, (d) solar wind interactions in interplanetary space, and on (e) origin of the ultra-high energy cosmic rays.

Methodological works done in the department have been used in cleaning the magnetic field data from the Venus-Express mission (MAG-VEX experiment, main institute - IWF Graz, Austria). This contributed to first detailed description of the magnetic field environment of Venus [11]. No clear evidence for correlation between the ionization (by CR) of the atmosphere and cloudiness, the absence of correlations in the short-term low cloud cover and the CR variations, have been indicated in [12]. An outstanding flare on 20 January 2005 accompanied by a coronal mass ejection produced a strong compression-pressure pulse at the magnetopause. Enhanced magnetospheric activity has been stimulated. The associated development of a ring current disturbance in the energetic neutral atom (ENA) data, recorded aboard both the Double Star (instrument developed mainly in the department) and the IMAGE (Imager for Magnetopause-to-Aurora Global Exploration) spacecraft as well, was analyzed in [13]. Physical processes affecting the dynamics of the Earth's particle radiation environment were reviewed [14] along with scientific and engineering models developed for its description. Three components of the radiation environment, i.e., galactic cosmic rays (GCRs), solar energetic particles (SEPs) and trapped radiation were considered separately. Models of the effects of particle radiation on the atmosphere were also reviewed. In the article [15] we illustrated that computations based on different available models of geomagnetic field during selected strong geomagnetic disturbances in 2003 and 2004 imply different profiles of cut-off rigidities in time, different transmissivity functions and different asymptotic directions. Using of CR records by neutron monitors at middle and low latitudes during geomagnetically active periods, in addition to study of CR anisotropy in interplanetary space, may be used also for checking the validity of geomagnetic field models. Along with the results mentioned above, the department run continuously the neutron monitor at Lomnický štít (data from the measurements are accessible in real time at <http://neutronmonitor.ta3.sk>), and used regularly for space weather monitoring abroad (e.g. at http://www.spacewx.com/Space_Weather_Now.html). Large part of the work has been devoted to the design and development of the new instruments for measuring energetic particles on the satellites and space probes (SPEKTR-R launched in July 2011 providing first data on energetic protons and electrons; plasma device for BepiColumbo mission to Mercury; energetic particle devices for Lunar Globe and Resonance projects – under development). Extensive information about the Department and its activities are available at <http://space.saske.sk>.

Department of Biophysics - the research interest areas encompass experimental and theoretical studies of biomacromolecules and their models, namely the protein aggregation and stability, electronic properties of carbon composition, image processing methods and molecular dynamics simulations of large systems of biological interest.

Protein aggregation into specific amyloid structures plays an important role in pathogenesis of many diseases such as Alzheimer's and diabetes type II. As the reduction of amyloid aggregates is beneficial for living systems we have searched for inhibitors of amyloid aggregation. We have found that magnetic fluids (MFs) significantly reduce lysozyme or insulin amyloid aggregation *in vitro*, while the extent of anti-amyloid activities was strongly determined by composition of MF [16]. MF in cerebrospinal fluid of the patients with Alzheimer's disease helps to detect protein changes related to determination of early stages of this disease [17].

We have studied structurally distinct acridine derivatives for their potential to inhibit *in vitro* lysozyme amyloid aggregation with the aim to investigate the structure-activity relationship. It was found that loss of acridine core planarity and transformation of the reactive nucleophilic thiosemicarbazide into more stable heterocycles leads to significant decrease of the acridine inhibiting ability [18]. The present findings

represent a starting point for the application of the identified inhibitors as therapeutic agents targeting amyloid-related diseases.

Our interest has been devoted to the characterization of the structure and stability of various biomacromolecules (proteins, polynucleic acids, polysaccharides) in the presence of denaturants, salts and polyanions [19]. A novel, non-native six-coordinated high-spin myoglobin species were detected in the presence of urea or acetic acid at acidic pH conditions.

We have also studied the stability of four dissimilar basic proteins in the complex with four polyanions with different charge density and hydrophobicity. We have found that the stability of proteins in the complex with polyanions negatively correlate with charge-related properties of the proteins (isoelectric point and surface charge density) and hydrophobicity of the polyanions [20].

In addition, we developed brand new method for preparing the metal nanoparticles (Au, Ag, ZnO, Fe₃O₄ covered by various organic compounds, particularly peptides. We utilized electrophoretic methods to gain nanoparticles with exact atomic and structural composition. Those pure fractions of nanoparticles have been recognized to form supramolecular structures with proteins [21]. Some results were obtained in collaborations with other world laboratories of excellence (e.g. Dipartimento di Chimica, Universita di Firenze, Italy, etc.).

The recent support from EU funding for infrastructure and development helped to reshape the research facilities of the Biophysical department. Thanks to this funding, we were able to enter into new research areas supported by the “state of the art” instrumental and computational technologies. Modern computational methodologies allowed carrying out detailed conformational and intermolecular interaction studies, especially for protein-ligand complexes. Conformations of complex glycans were simulated. The MD simulations provided evidence for a shift in conformational equilibrium between linear extension or backfolding of the glycan antennae [22]. Our interest for glycan interactions further extended towards microarray technologies where we discussed the “in silico” screening methodologies [23].

Modern microscopy is based on advanced image processing methods allowing quantitative analysis of micro and nanoparticles. The most important part of image processing is segmentation which separates the microscopic objects from the background. Advanced segmentation methods are often based on the energy minimization principle exploiting mathematical models. Stereological methods estimating the geometric properties in 3D from a series of 2D slices play also significant role. We developed a software tool for interactive segmentation and stereological analysis of neurons in a given volume. In practice, these methods are often correlated with the macroscopic measurements (e.g. biomechanical ones). We designed and constructed devices measuring spasticity (rigidity) [24]. We proposed the computerized acquisition of microscopic images with pre-processing which offers suitable data for subsequent stereological analysis. A new interface for the communication with the apparatus has been tested [25].

While the electronic properties of carbon composition were studied, it was shown that these properties depend on the curvature of carbon nanoparticles and also on the type of the boundary. If we join the carbon nanoparticles with different radius, the electron is transferring from the nanoparticles of bigger radius to the nanoparticles with smaller radius. In such way we can create a nanodipole which could be used in the nanoelectronic. The influence of magnetic field on the electronic spectra of carbon nanoparticles has also been investigated. It was shown that the magnetic field can change the gap in the carbon single and multiwall nanotubes and we can change the optical characteristic of these carbon compositions [26].

The unrelaxed phonon modes were taken into account in the generalized master equation for electron transfer in the open system. It was shown that this part of the generalized master equation could be very important in the systems similar to photosynthetic reaction centers [27].

Department of Theoretical Physics - the basic scientific investigation is focused on three areas: 1) Physics of condensed matter, 2) Non-linear stochastic dynamics, 3) Phenomenology of elementary particles.

We have studied theoretically the cooperative phenomena in strongly correlated systems within various generalizations of the Falicov-Kimball and Hubbard model. The most important results are the following: (i) The numerical proof of existence of electronic ferroelectricity in the two and three dimensional Falicov-Kimball model with f-f hopping for all interaction limits (weak, intermediate and strong) [28]. (ii) The microscopic description of spin ordering and magnetization processes in rare-earth tetraborides [29]. (iii) The numerical proof of the coexistence of metallic and insulating phases in ultracold atomic mixtures with strong mass imbalance in optical lattices [30].

Within non-linear stochastic dynamics (NLSD) the theoretical investigation was focused on the study of developed turbulence, diffuse and transport phenomena in stochastic environments. The influence of various symmetry breaking (anisotropy, helicity, etc.) on turbulent processes has been studied in [31]. One of the most important results is the theoretical calculation of the turbulent magnetic Prandtl number [32], which characterizes diffusion processes of the magnetic field in conductive turbulent environment.

Other activities in the framework of NLSD were/are related with the study of time-behaviour of chemical reactions like annihilation process of two identical active species and their coagulation in the background of random hydrodynamical fluctuations. By application of quantum-field methods we derived improved equations describing space-time behaviour of mean density of interacted particles, found its scaling solution corrected by renormalization group approach, and calculated anomalous exponents [33]. In addition we calculated the representative parameters for hydrodynamic (turbulent, thermal) fluctuations – famous Kolmogorov constant and skewness factor – which are important for definition of the statistics of developed turbulence [34].

The physical investigation in elementary particle physics has been focused on studies of the current status of modelling of high-pT processes in nuclei [35]. Several topics have been analysed including coherence phenomena, in particular gluon shadowing and CGC [36]; nuclear effects related to restrictions imposed by energy conservation at large xL and xT [35]; space-time development of hadronization of highly virtual light and heavy partons, and the related time scales; and the role of early production and subsequent attenuation of pre-hadrons in a dense medium [35].

Under conditions of pulsed nuclear magnetic resonance (NMR), a state of coherently precessing magnetization in $^3\text{He-B}$ is degenerated with respect to the phase of precession. Vibrations around this state represent gapless Goldstone's modes. We have shown that under conditions of continuous wave NMR this degeneracy was lifted by applied radio-frequency field and the vibrations acquired a gap – they became non-Goldstone modes [37].

Department of Low Temperature Physics (Centre of Very Low Temperature Physics, Centre of Excellence of the Slovak Academy of Sciences). Since 2001 the Department of Low Temperature Physics has been intensively involved in studies of two-gap superconductivity - a novel phenomenon found in magnesium diboride. Two of our papers related with this subject have been indexed among "Highly cited papers in 10 years" by ISI Thomson. During this assessed period experimental studies on two-gap superconductivity in MgB_2 , MgCNi and NbS_2 samples [39-43] have continued and were focused on several aspects as peculiarities of the vortex matter in such a system where the order parameter represents a 2×2 matrix. For example in [39] the anisotropy of the Sommerfeld coefficient in Magnesium Diboride single crystals was shown to be strongly affected by the interplay of σ & π bands with different energy gaps. Aluminium and carbon doping and their distinct effect on two

gaps of MgB_2 in a broad doping range were studied. Also the development of inter and intraband scattering was analyzed [40].

The year 2008 brought an important breakthrough since after more than 20 years new high- T_c superconductors were discovered in the form of iron pnictides and selenides. [Y. Kamihara *et al.*, J. Am. Chem. Soc. 130, 3296 (2008)]. A significant part of the debate on these enormously studied materials revolves around similarities and differences between Fe-pnictides and the twentyfive years old *cuprate high-temperature* superconductors, still arguably the deepest mystery of condensed matter physics. Our group has been very active in this field from the beginning of superconducting studies on iron pnictides as documented by following papers with a rather high citation rate. Our systematic studies on the $\text{NdFeAsO}_{0.9}\text{F}_{0.1}$ superconductor showed evidence of two-gap superconductivity with gap values indicating very weak coupling in the band with the small gap and strong coupling for the second band. Also, indication of a reduced DOS in the normal state or pseudogap persisting well above the bulk transition temperature was found in this system [44]. In 122 systems, in hole-doped $\text{Ba}_{1-x}\text{K}_x\text{Fe}_2\text{As}_2$ single crystals, two s-wave gaps were found. Here the smaller gap has a size below the BCS value, while the large gap reveals much higher coupling strength [45]. In the optimally electron doped $\text{Ba}(\text{Fe}_{1-x}\text{Co}_x)_2\text{As}_2$ our measurements indicate that if there are two gaps present, they are very close to each other, both having a strong coupling [46]. Using specific heat and Hall-probe magnetization experiments we studied the extent of the vortex-liquid state in underdoped single crystals of the oxypnictide superconductors $\text{NdFeAs}(\text{O},\text{F})$ and $(\text{Ba},\text{K})\text{Fe}_2\text{As}_2$ [47]. These measurements strongly suggest that a vortex-liquid phase occupies a large portion of the mixed-state phase diagram of $\text{NdFeAs}(\text{O},\text{F})$, but not in $(\text{Ba},\text{K})\text{Fe}_2\text{As}_2$. This difference can be attributed to different Ginzburg numbers G_i , the latter being about 100 times larger in $\text{NdFeAs}(\text{O},\text{F})$ than in $(\text{Ba},\text{K})\text{Fe}_2\text{As}_2$. The upper and lower critical fields have been deduced from specific heat and Hall-probe magnetization measurements in non-optimally doped NdOFFeAs single crystals with $T_c=32-35$ K [48]. Our results suggest the presence of rather large thermal fluctuations and the existence of a vortex liquid phase over a broad temperature range, 5 K large at 2 Tesla.

During recent years we have continued our research using the superfluid phases of ^3He as a model system to study various fundamental physical phenomena [37,38]. On behalf of all, we mention only one of them: we studied the Goldstone modes – collective oscillations of the Bose-Einstein condensate of magnons being created as a state of coherently precessing spins. The experiment showed that the presence of high frequency excitation field B_{rf} removes the degeneracy of precessing state with respect to the phase of precession, that is, it violates the symmetry of the magnon condensate and former Goldstone collective excitation modes become non-Goldstone, as they acquire an energy gap in their spectrum [37].

We have investigated the phase diagram of metallic antiferromagnet TmB_4 , an excellent realization of Ising magnet on a frustrated Shastry-Sutherland lattice (SSL), by neutron diffraction (first time) and magnetization experiments. At low temperatures we found Néel order at low field and ferrimagnetic order at high field. An intermediate phase with magnetization plateaus at fractional values $M/M_{\text{sat}} = 1/7, 1/8, 1/9, \dots$, strikingly similar to the case of isolating antiferromagnet $\text{SrCu}_2(\text{BO}_3)_2$ (first example of a SSL) and spatial stripe structures were observed. Using an effective $S = 1/2$ model and its equivalent two-dimensional fermion gas we suggest that the magnetic properties of TmB_4 are related to the fractional quantum Hall effect of a 2D electron gas [49].

For the first time we studied the influence of dimension on non Fermi liquid systems [50], by using point-contact (PC) spectroscopy principles. On $\text{YbCu}_5\text{-xAl}_x$ compounds in high magnetic fields we observed a new kind of asymmetry of PC spectra connected with NFL behaviour in the proximity of quantum critical point.

Pressure-induced transition from unconventional insulating behavior towards conventional magnetism in intermediate-valence compound SmB_6 was studied by resistivity [51] and NMR. A nuclear spin-lattice relaxation rate increase studied by ^{11}B -NMR in this Kondo insulator under hydrostatic pressure up to 26 kbar was investigated the first time.

Laboratory of Materials Physics (LMF) - the high quality of research at LMF (4 research fellows) can be illustrated by 18 publications in international journals registered by CC database and 9 publications registered by WOS database, one invited plenary talk at International Symposium on Superconductivity, Tsukuba, Japan 2009, and 4 invited talks at the most important international conferences on bulk superconductors. Further by participation in the EU 6 RP project NanoEngineered Superconductors for Power Applications and international cooperation with Cambridge University, ATI Vienna, CNRS Grenoble, ICMAB Barcelona, IFW Dresden, SIT Tokyo, participation in SAS center of excellence NANOSMART and Centre of Low Temperature Physics and Material Research at Extreme Conditions. Important results were obtained in studies of nanosize chemical pinning centers in single grain YBCO bulk superconductors prepared by Top-Seeded Melt-Growth Process, partially in the redistribution of dopants in the Y123 crystal lattice by thermochemical postgrowth treatments in the atmosphere with different partial pressure of oxygen [52]. Mainly the influence of Cu dopants like Al, Mn, Li and Ag were studied [52-53]. A significant result was also obtained at elimination of weak links in the form of cracks. Controlled high pressure oxygenation (in cooperation with CRETA CNRS Grenoble) leads to an increase of critical current density of small YBCO single-grain sample up to 3 times at 77 K [54]. This improvement was caused by full elimination of cracks formed at standard oxygenation process, which reduces the sample effective cross section.

Other results on twin [55] and secondary particle refinement [56], welding [57] and oxygen diffusion [58] are important for the optimization of microstructural design of REBCO bulk superconductors. The experimental infrastructure was essentially improved by successful participation in the projects supported by EU structural funds - LMF coordinates 2 projects and participates in 5 projects.

Department of Metal Physics - the scientific interest was focused on homogeneous and inhomogeneous plastic deformation of amorphous metals, and on creep and creep recovery processes in these materials. Thermal analysis was used to study of the thermal stability of complex nanoparticle systems.

Detailed studies of creep behavior of amorphous $\text{Pd}_{40}\text{Cu}_{30}\text{Ni}_{10}\text{P}_{20}$ metallic glasses have shown that short-term pre-annealing in the glass transition region can significantly compensate the viscosity increase effect caused by structural relaxation. This technique provides a unique possibility to recover the viscoelastic properties of metallic glasses after these have deteriorated greatly via structural relaxation [59].

Fractographic features of failure surfaces were studied in the temperature range 300 K to 4.2 K. Observed traces of melting on these surfaces at temperatures below 300 K indicate the intense heating in catastrophic shear band of the alloy in the moment of failure. Causes of low-temperature decohesion along grain boundaries were discussed in terms of the sulfur segregation influence [60].

The crystal structure of compounds $\text{La}_{0.67}\text{Pb}_{0.33}(\text{Mn}_{1-x}\text{Co}_x)\text{O}_{3-\delta}$ was analyzed by the Rietveld refinement procedure. It was found that the average bond-valence sum for the Mn/Co site decreases, and the average bond-valence sum for the La/Pb site increases with increasing Co content. The strain induced by the substitution is compensated by the rotation of Mn/Co-O₆ octahedra. Partial substitution of octahedrally coordinated Mn^{3+} by Co^{3+} ions decreases the effect of the Jahn-Teller distortion.

The thermal analysis of magnetic nanoparticles modified with PEG polymer showed that added PEG replaces to some extent the surfactant on the accessible surface and modifies the shell around the magnetite. The higher PEG content in modified sample then determines the higher rate of the observed aggregate exchange [62].

The activities of the **Department of Magnetism** have been oriented to studies of magnetic nanoparticles of various shape (spherical, nanorod, biogenic, single wall nanotubes), magnetic fluids based on water and transformer oils, and on magnetoferritin and low-carrier ferromagnets.

Coating of nanoparticles is one of the most important factors responsible for their compatibility in organisms. For our purposes poly(ethylene glycol) (PEG), bovine serum albumine (BSA) and dextran were chosen because they are non-immunogenic, non-toxic, non-antigenic and biocompatible. Magnetic fluids containing magnetite nanoparticles were stabilized electrostatically or sterically, and functionalized by bovine serum albumine (BSA), polyethylene glycol (PEG) or dextran to prepare a new carrier for of magnetically active anticancer drug for magnetic drug targeting [61] as well as to investigate the effect on amyloid aggregation of lysozyme and insulin. It was shown that surface composition, size and structure as well as surface charge of nanoparticles can markedly influence propensity of protein to form amyloid structures [16]. It was discovered that the aggregation processes in magnetic fluid samples modified by PEG (MFPEG) occur from homogeneous distribution of magnetic nanoparticles to fractal like structures in dependence on the PEG amount in magnetic fluid [62]. These results made us to evaluate the cytotoxicity of MFPEG in which no fractals were observed. In vitro cytotoxicity experiments revealed that MFPEG inhibited the growth of mouse B16 melanoma cells at the highest tested dose to ca. 50%, what is promising for the use of MFPEG in field of biomedicine [63].

For the first time magnetic birefringence of magnetoferritin was studied and compared with similar results for horse spleen ferritin and nanoscale magnetite aqueous suspension. Magnetic birefringence of magnetoferritin shows non-Langevin behavior in contrast to that of the nanoscale magnetite suspension. Cotton–Mouton (C–M) constants are roughly four orders of magnitude different for natural and synthetic ferritins. The results show that magnetic birefringence measurements can be a useful method in identification of magnetic core structure of biogenic ferritin [64].

The obtained results from magneto-dielectric studies demonstrated the effect of size and shape of magnetic nanoparticles on the critical magnetic field of liquid crystals doped with magnetic particles (ferronematics) [65]. It was demonstrated that the application of external magnetic field on ferronematic samples, where the isotropic-nematic transition is via droplet state, i.e. coexistence of nematic and isotropic phase, shifts the transition to higher temperature [66]. The obtained results have proven that ferronematics composed of calamitic liquid crystals and rod-like magnetic nanoparticles can be effective in demonstrating the magnetic field induced isotropic-nematic phase transition. This was the first observation a magnetic field induced isotropic-nematic phase transition in such systems. Due to doping, the magnetic field induced shift of the phase transition from isotropic to nematic phase decreases from $100 \sim T$ to $10 \sim T$.

Biogenic magnetic nanoparticles (magnetosomes) were synthesized by biomineralization process of magnetotactic bacteria *Magnetotacticum Spirillum* AMB-1, followed by steps of isolation and purification in order to obtain stable suspensions. Structural analysis confirmed that the cores of magnetosomes are of a good-quality crystallite and magnetic in all their volume. Magneto-induced linear and circular anisotropy [67] confirms the important role played by chains in the orientation mechanism of such magnetic dipoles. Numerical adjustments of the linear anisotropy curves using a classical Langevin orientation model give an average number of magnetosomes per chain, about 12. Hyperthermic measurements showed that the

specific absorption rate (SAR) for magnetosomes is 10 times higher than for chemically prepared samples [68].

The evaluation of the experimental data obtained from small-angle X-ray scattering and ultrasonic attenuation indicates the formation of chain-like aggregates composed of magnetite particles in transformer oil based magnetic fluids. It is assumed that a dimer is the main building block of a B-field-induced chain-like structure, thus the estimation of the nematic order parameter does not depend on the actual length of structure [69].

Results of electric, magnetic, and thermal properties of the low-carrier ferromagnet $\text{EuB}_{5.99}\text{C}_{0.01}$ revealed that the observed anomalously large negative magneto-resistance is attributed to the effect of fluctuations in carbon concentration. It has been proposed that carbon-rich regions act as “spacers” preventing link and percolation of magnetic polarons, and may be responsible for an additional (magneto) resistivity increase [70]. Such proposition has been supported by additional studies of the influence of external pressure on electrical resistivity of $\text{EuB}_{5.99}\text{C}_{0.01}$ [71], and was in good qualitative agreement with our studies of $\text{Eu}_{1-x}\text{Ca}_x\text{B}_6$ system.

Research activities in the field of molecular magnets were focused mostly on studies of pressure effect on magnetic properties of selected hexacyanometallates. It was found that applied pressure in selected hexacyanometallates increases the overlap between magnetic orbitals and these results in an increase of critical temperature of the transition to magnetically ordered state T_C for compounds with dominant antiferromagnetic interaction. For compounds with dominant ferromagnetic interaction no effect or a small decrease of T_C related to pressure induced change in exchange path way was observed [72].

It was shown that in mixed-valence perovskite manganites with general formula $\text{A}_{1-x}\text{A}'_x\text{MnO}_3$ (A-rare earth, A'-alkali earth cation) applied pressure diminishes the magnetism of the sample i.e., it reduces both magnetic transition temperatures as well as saturation magnetization. Such behavior can be compared with the suppression of T_C in bulk manganites with the increase in cation size disorder i.e., with the effects of internal pressure. External pressure applied on nanoparticle manganite with a high degree of disorder further stabilizes the Jahn Teller distortion [73].

The research activities of **Laboratory of Nanomaterials and Applied Magnetism** (LNAM) were closely connected with its participation in two ERA networks: European Research Network GDRE GAMAS “Group for Applied Magnetosciences (2008-2011) and COST P17 “Electromagnetic Processing of Materials” (2006-2009), as well as in other national and bilateral projects with domestic and international partners

Substantial effort was focused on the improvement of functional properties of soft magnetic amorphous and nanocrystalline alloys by thermal processing under the presence of external magnetic field, called also „magnetic annealing“. Special attention was devoted to the study of the effect of induced uniaxial anisotropy in a series of HITPERM-type Fe-Co-(Nb,Mo)-B [74,75] and Fe-Co-B-Cu [76] amorphous and nanocrystalline alloys with different ratios of Fe/Co atoms. It was shown that the specimens annealed without the presence of external magnetic field exhibit an appreciable increase of coercivity, and corresponding hysteresis loops often exhibit a presence of steps due to the depinning of domain walls from the positions stabilized during annealing. After annealing in transverse magnetic field one can obtain sheared loops with a tunable slope and good field linearity. Heat treatment under the presence of longitudinal magnetic field resulted in squared hysteresis loops characterized by very low coercive field values in the range of 2 - 6 A/m. These values are a record

mark for HITPERM-type alloys and they remain fairly stable also at higher temperatures. The development of induced anisotropy in field-annealed alloys was discussed in the frame of the magnetic atoms pair ordering theory. The tailoring of soft magnetic properties by field-annealing was used for optimisation of the FeCo-based amorphous and nanocrystalline materials for their utilization in magnetic sensor systems.

The study of the magnetocaloric effect in amorphous and nanocrystalline FeCrNbB-based alloys was motivated by a search for new magnetic refrigerants capable of operation at room temperature [77,78]. The magnetic entropy changes, ΔS_m , were determined from the set of the $M(H)$ curves taken in the vicinity of the ferromagnetic-paramagnetic phase transition. An addition of Cr to the ternary FeNbB alloy results in a shift of the maximum magnetic entropy change, ΔS_m , from temperatures above 350 K to the desired temperature range slightly below room temperature. The relatively low price of Fe-based amorphous and nanocrystalline materials together with their good chemical stability and possibility to tailor the values of Curie temperature make these alloys an interesting material for potential magnetic refrigeration applications.

We have prepared also exchange-spring type nanocrystalline FePtNbB permanent magnets with excellent coupling between hard and soft magnetic grains, which exhibit coercivities $H_C > 800$ kA/m and are highly corrosion resistant [79] .

Laboratory of Experimental Chemical Physics (LEChF) – A breakthrough achievement was made during the assessed five years period. For the first time in the history of the Institute of Experimental Physics, a successful patent application [see patent1] was realized (submitted and accepted). Another patent application is pending [see patent2]. It concerns a new approach to polymer self-assembly into stable polymeric nanoparticles. In parallel, this research is also significant from the point of view of fundamental science and was published in top international journals devoted to polymer research [81,82]. Polymeric nanoparticles are of interest due to numerous existing or foreseen applications. There are several approaches to their formation, which can be divided into chemical (chemical reactions leading to covalent bonds) and physical (self-assembly by physical forces). In the latter case, several types of interactions were utilized, but always two types of polymers had to be combined, either two types of homopolymers or block copolymers (where two different chemical species are contained in the same macromolecule). Stable polymeric nanoparticles were prepared in our work from homopolymers (i.e. not copolymers), of one type only, and without any assembly-triggering additives. Potential applications for targeted drug delivery were discussed [83]. Different types of polymeric nanoparticles were prepared [83] such that these are responsive to external stimuli and are named as responsive nanoparticles or “intelligent”. The aim of this research is to formulate intelligent nanoparticles which can react to external environment in a desired manner, for instance by releasing drug in a proper place in the human body recognized by pH, temperature, or so. Another related field of research that we focus on is devoted to understanding of spontaneous self-assembly processes in mixtures of low molecular weight (not polymeric) compounds. There, interestingly, increasing evidence on mesoscale structure and dynamics (in addition to conventional molecular scale and macroscopic scale) is obtained. Invited lectures at prestigious international symposia were given in this field. The experimental infrastructure traditionally oriented to laser scattering techniques in our laboratory was

essentially improved by successful participation in the projects supported by EU structural funds. We have also succeeded in a proposal leading to access to a large-scale EU facility (neutron scattering at Institute Laue Langevin, Grenoble).

3. Concept of R&D activity of the Organisation for the next four years (max. 5 pages)

i. Present state of knowledge and status of ongoing research related to the subject of the Concept, from both international and national perspective

All scientific results achieved by the Institute and mentioned in the "Summary of R&D activity..." were obtained predominantly in a vivid international collaboration, many of them with funding from international resources. As the future research of the Institute will mostly maintain this tendency, the ongoing research in related (above-mentioned) directions will present the current state of knowledge from both the international and national perspective also in next four years.

ii. Organisation's role or significance in the overall research effort within the field of the Concept on both the national and international scales

The significance (quality) of the IEP SAS on the national level can be documented by results of annual evaluation of Slovak Academy of Sciences (SAS) institutes, being organized yearly by the Presidium of SAS. According to these evaluation criteria our Institute appears usually to be among the best three within the Section I of Non-living Nature.

The significance on international scale can be documented / underlined by the fact that the majority of research activities was / is carried out in international collaboration with established scientific institutes and research centres in Europe, USA and all over the world, by published papers, and by many bi-lateral agreements between the Institute and foreign institutes.

iii. Objectives of the Concept

The future development of the **Department of Subnuclear Physics** will be mainly determined by scientific programmes of the CERN organization. With several projects that were the backbone of our scientific activities completed, all our effort will be placed on the LHC programme, i.e. experiments ATLAS and ALICE. Although the building of detectors was completed and a long data taking period began, discussions about the upgrade of the LHC accelerator and the related experimental facilities has already started. Both ALICE and ATLAS teams of the Institute have plans to participate in this upgrade making good use of the already gained expertise: design and development of the electronics for pixel detectors and the central trigger, providing control and monitoring software for ALICE, and in calorimetry and design of radiation resistant electronic components for ATLAS. These activities may complement the main effort placed on the physical analysis of fresh LHC data, which will define our research interests for many years. For all LHC activities we will continue to upgrade and maintain our computing facilities: the LHC Grid structure and the interactive analysis facility SKAF.

Research activities of the **Department of Space Physics** will cover studies of low and medium energy cosmic rays (CR) in the Earth's magnetosphere and in interplanetary space. Space weather effects studies connected to CR particles transport in interplanetary space, magnetosphere and Earth's atmosphere will continue. Ultra-high energy CR will be studied as part of JEM-EUSO collaboration activities with estimated start of apparatus measurements at International Space Station from 2017. More specifically, the following topics will be studied: (a)

transmissivity of Earth's variable magnetosphere for solar and galactic CR; (b) variability of galactic and solar CR at neutron monitor energies and above all in relation to space weather effects; (c) transport and loss processes of medium energy charged particles within the Earth's magnetosphere; (d) solar and galactic CR transport and modulation in the Heliosphere during a 11 year solar cycle; (e) ultraviolet light sources intensity and distribution on the Earth's night side; (f) identification of particle and energy sources of ultra-high-energy cosmic rays ($7 \cdot 10^{19} \text{eV} < E < 10^{21} \text{eV}$) using the arrival direction, and studies of acceleration mechanisms with observed events; (g) physical processes in the vicinity of other planets; h) running the continuous cosmic ray measurements at Lomnický štít.

The research at the **Department of Biophysics** will include studies of protein amyloid aggregation and active search for inhibitors of protein amyloid self-assembly. The overall aim is to characterize structure-activity relationship of small molecules. The effect of nanoparticles on the extent of protein aggregation by controlling characteristics of magnetic fluid (size, polarity, surface charge and structure, presence of magnetic field) will be assessed. Additionally, effects of amyloid assemblies on cell cycle and apoptotic processes by biochemical methods will be examined. Based on the importance of the protein-ligand interaction studies, screening of more protein targets will be carried out. The inhibitor design studies will be expanded to include protein complexes and aggregates in addition to single proteins. MD simulations including solvent will be performed on the most stable complexes selected from virtual screening. More elaborate calculations on metal-core nanoparticles will be carried out using quantum chemical (QC) protocols. Combined QC/MM protocols will be used for studies of enzyme kinetics of biomolecular systems of interest. In addition, development of new unique materials, such as liquid crystalline metamaterials, microlasers based on cholesteric liquid crystals, bio-battery using carbon nanotubes for a functionalization with redox enzymes or new micro- and nano-objects (metal nanoparticles), will be carried out. Our newly acquired optical tweezers designed for fluorescence or Raman microscopy of individual nano-objects will provide an invaluable asset. As will the femtosecond laser microfabrication technology, ensuring the micro- or nanometer scale structured materials due to two-photon polymerization reaction. In the near future, many areas of the microscopy field will be dominated by image processing methods. Robot microscopes will automatically search for the region of interest using motorized stage, focus and zoom. Modern methods of pattern recognition based on machine learning algorithms are geared toward particle recognition. The newly acquired microscope supplied with optical tweezers for automatic search and manipulation with microscopic particles will be exploited in these progressive areas. Communication with such equipments can be based on natural user interface instead of joystick and mouse. Last but not least, research will be carried out in the area of the functionality of photosynthetic reaction centres. The electronic properties of carbon nanoparticles in addition to the effect of the boundary on these nanoparticles will be investigated. This will contribute to better understanding of the conversion of solar energy to chemical energy.

The plans of the **Department of Theoretical Physics** can be summarized as follows: Study of cooperative phenomena in strongly correlated electron systems including valence and metal-insulator transitions, itinerant ferromagnetism, superconductivity, phase separation electronic ferroelectricity, formation of inhomogeneous charge and spin ordering. We will be interested in surface states at the interface between the $^3\text{He-B}$ and a solid body, and in the effect of these states on the motion of a body through liquid helium. Continuation of the study of open problems in theory of developed turbulence, e.g., investigation of intermittency and anomalous scaling in diffusion processes in fully developed turbulence with symmetry breaking (spatial parity violation, compressibility, small scale anisotropy, etc.). We will continue with studies of kinetic reactions, investigation of diffusion and

transport of particles in random background. Develop robust analytical numerical algorithm for calculations of statistical quantities in higher order approximation and for solutions of specific integro-differential non-linear equations describing space-time dynamics of chemically active molecules. Investigate dynamical aspects of phase transitions for E and F models of critical dynamics. Theoretical investigation of nuclear effects and azimuthal asymmetry for production of hadrons, photons, heavy quarks and mesons in heavy-ion collisions; comparison of model calculations for the pT- dependence of nuclear suppression and elliptic flow at different energies, centralities and rapidities with SPS, RHIC and LHC data.

Centre of Low Temperature Physics represents a concept of cutting-edge experimental research unit focused on low temperature physics and material research under extreme conditions. The Centre belongs to a dozen world laboratories able to perform experiments in the microkelvin range, but it disposes also other unique techniques for processing and characterization of materials in high magnetic fields, and at high pressures and temperatures. In the near future we will continue in developing the Laboratory of nanotechnologies and thin films, the Laboratory of Hall probe measurements, Laboratory of low temperature scanning probe microscopes/STM, AFM, MFM, SHPM. Beside this unique characterization technique we will focus on the in house technologies for preparation of samples including thin films and nanostructures. Physics and material-science research programme: we will focus on systems with competing orders which can lead to materials with very unexpected properties. In the near future we will focus on three classes of those materials: 1/ superconductors - pnictides, covalent metals/heavily doped semiconductors and dichalcogenides; 2/ superfluid helium-3; and 3/ frustrated magnetic systems. In case of superconductors the fundamental studies of relevant order parameters as the superconducting gap, SDW and CDW controlled by stoichiometry, pressure, magnetic and electrostatic fields will be addressed by different techniques as STM and ac-calorimetry. In superfluid helium-3 we will study the Bose-Einstein condensates of magnons in the B-phase as well as the mutual interactions within the condensates near the absolute zero. We will exploit ultra low temperatures for studies of qubits based on weakly coupled superconducting junctions (collaboration with prof. Grajcar, UK Bratislava). Further we will test nanoresonators made in the Centre which can be later used in nanoelectronics.

The research activities of the **Laboratory of Materials Physics** will be oriented to ceramic materials with progressive physical properties. Mainly the growth and microstructural design of REBCO bulk single-grain superconductors will be investigated from the point of crystallization mode, formation of effective pinning centers, elimination of weak links and microscopic and macroscopic properties. Besides new basic knowledge, we expect that developed bulk superconductors will be suitable for their fabrication in a small company (Cryosoft Ltd.), as well as for a design of new equipments in this company (e.g. permanent magnet for medicine transport). Recently, we started preparation of magnetocaloric materials based on manganites with perovskite structure similar to studied superconductors. The influence of synthesis, thermal treatment, alloying on structure and magnetocaloric effect will be the main objectives of this research. The experimental base of LMF will be used also for preparation and characterization of other materials for basic research at IEP SAS. From the methodological point of view, we will concentrate on methods for preparation and characterization of progressive materials based on new equipments purchased within the framework of our projects: X – ray diffraction analyses of material structure, phase transformations, and reactions in a broad temperature range for materials in the form of single-crystals, polycrystals, thin films, powders and liquid emulsions; microscopical methods of microstructural analyses such as optical microscopy, scanning electron microscopy (SEM) with energy dispersive x – ray analysis (EDAX), wave dispersive x – ray analysis (WDX) and electron backscattered diffraction (EBSD), high resolution transmission electron

microscopy (HREM); thermal treatments of materials in controlled atmosphere under ambient and high pressure; refinement of powder materials to the nanometer size by intensive milling; characterization of particle size and shape distribution by laser granulometry and image processing; thermal analysis oriented on phase transformations and solid state reactions; preparation of thick films by “screen printing” method; reparation of materials by high – frequency inductive melting.

The research activities in **Department of Metal Physics** will be oriented to the study of processes of homogeneous and inhomogeneous plastic deformation and failure mechanisms of micro and nanograined materials. The main interests will be focused on the structural relaxation processes and conditions of thermal stability of metallic glasses. Simultaneously with new experimental facilities of the thermo analytical laboratory and the participation in CEX NANOFLUID project the research interests will extend to investigations of the thermal stability of nanoparticle – polymer complexes.

The future development of the **Department of magnetism** is planned in several directions. R&D activities in preparation of magnetic nanoparticles (NPs) with spherical shape of different size coated with different surfactants and consequently modified with biocompatible material - with the aim to prepare stable colloidal system with rare properties suitable for their application in nanomedicine and for technical use. The next objective will be to develop and evaluate new magnetic targeted nanoparticles localized in a certain region of the body (e.g. kidney) by applying external magnetic field. Renin inhibitor-Aliskiren and biodegradable magnetic nanoparticles based on commercially available polymers loaded with selected Aliskiren will be prepared and characterized with the purpose to enhance the amount of drug reaching the target site. Prolong the circulation time, decrease degradation and increase bioavailability as well as to maximalize the effect of aliskiren on kidney function and structure. R&D activities in field of the study of ferronematics will be a complex study of the mixture of bent-core and rod-shape liquid crystals doped with magnetic nanoparticles. We will construct the phase diagram for different ratios of bent-core and rod-shape liquid crystals doped with magnetic particles. We expect a better understanding of the physics of liquid crystal-nanoparticle colloid systems, which represent the first necessary step for designing liquid crystalline materials with improved magnetic properties and helps to establish the knowledge base necessary to utilize them in related future technologies.

We plan to start preparation and systematic studies of thin films of hexaboride materials. Special attention is going to be paid to Eu-based hexaborides exhibiting colossal magnetoresistance, where studies of the relationship between local structural inhomogenities and electric and magnetic properties (with the aim to understand phenomena governing magnetoresistance) will represent a main task.

Molecular magnetic materials: - study of possibilities to tune magnetic interactions of 3d and low dimensional molecular magnetic materials with magnetic interaction mediated through cyanide bridges by applying external pressure.

Manganese Oxides Based Multiferroics: - study manganese oxides, nanoparticles and single crystals by magnetoresistivity and magnetoelectricity measurements, investigate the magnetic phases, exchange bias phenomena at high pressure, and by Mössbauer spectroscopy. Multiferroics, materials where spontaneous long-range magnetic and dipolar orders coexist, represent an attractive class of compounds, which combine rich and fascinating fundamental physics with a technologically appealing potential for applications in the general area of spintronics. We will study their crystal structure, transport and magnetic properties of prepared nanoparticles and single crystals.

The research activities in the **Laboratory of Nanomaterials and Applied Magnetism** will be focused on development and characterization of novel soft magnetic materials with improved properties for energy applications such as magnetostrictive small energy harvesting devices, electric motors and transformers

with higher efficiency. Here of particular interest will be Fe(Co)-based amorphous and nanocrystalline alloys with reduced content of non-magnetic atoms having high magnetic induction where the better understanding of correlations between the microstructure and the soft magnetic behaviour is required. Our attention will be devoted also to studies of new alloy systems based on rare earths and 3-d transition metal elements showing large magnetocaloric effect for potential application in magnetic cooling at room temperature. Here we plan to employ composites containing two or more magnetic phases with suitable magnetic entropy characteristics and different Curie temperatures in order to enhance the refrigeration capacity of such magnetic refrigeration media. We plan further develop the existing technology for thermal processing of materials in high magnetic fields. This unique tool for tailoring properties and microstructure of materials will be upgraded by utilization of a new cryo-free 14 T magnet system. The optimisation of material composition and thermomagnetic processing will be used in order to enhance the application potential of field-annealed materials especially in the area of magnetic sensors.

In the next period the **Laboratory of Experimental Chemical Physics** will focus on utilizing the improved infrastructure in our laboratory by successful participation in the projects supported by EU structural funds, achieved access to large-scale EU facilities (neutron scattering, synchrotron scattering, high-resolution electron microscopy facilities) as well as maintaining high standard of research outputs, including traditionally high citation standard. Our aim is also to continue in already started patent activities, which have been so far completely missing in our institute. Our research will be focused on understanding key physical interactions in soft matter, subdivided to (i) polymer substances and (ii) low molar mass soft matter systems such as solutions, liquid mixtures, melts, etc. The keyword of our research activities will be "self-assembly". Since collective molecular interactions in soft matter systems cannot be measured directly, we can measure them by monitoring spontaneous self-assembly processes. Custom-tailored self-assembly processes, especially in the case of polymers, can be then utilized for fabrication of nanoobjects with application potentials. Among these will be intelligent polymeric nanoparticles and capsules. We have established active cooperation on the level of joint projects with key players in polymer research in Czech and Slovak Republic (Institute of macromolecular chemistry Prague and Polymer Institute Bratislava) as well as in European research area via COST scheme freshly launched four year Action „Colloidal Aspects of Nanoscience for Innovative Processes and Materials“. Under accepted project of APVV Agency we will work on polymer microcapsules for immunoprotection of transplanted pancreatic islets in diabetes treatment, which is a tremendous challenge given the global character of this disease. From the methodological point of view we will focus on scattering techniques where we have long-term experience and had been publishing in the past methodologically-oriented invited chapters in monographs by prestigious publishers such as Clarendon Oxford. Given the new infrastructure obtained recently from EU structural funds, we have also ambition in this direction.

iv. Proposed strategies and methods to be applied, and time schedule

The general strategy, common to all units of the IEP SAS, can be described / summarized as follows:

- a) Reliance on well established domestic and international collaborations. Search for new possibilities which would/will enable to receive more international funding and to tackle the studied problems in a complex way.

- b) Prepare/submit research proposals which will allow to acquire further up to date infrastructure and to cover the necessary running costs.
- c) In research with application potential look for ways to real applications.
- d) Seek new possibilities to attract students for PhD studies. Gain more support for post-docs. Use EU educational projects to increase the quality of PhD studies and to extend the field of PhD studies.
- e) Continue to publish research results in well established journals and present achieved results at international conferences, workshops and meetings.
- f) Increase the staff involvement in pedagogical/educational process at universities.
- g) Continue to organize well established regional conferences with high international participation.

III. Partial indicators of the main activities:

1. Research output

- i. **List of the selected publications documenting the most important results of basic research. Total number of publications in the whole assessed period should not exceed the average number of the research employees**

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ii. **List of the selected publications documenting the most important results of applied research**

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- [6] **P. SKYBA**: Notes on Measurement Methods of Mechanical Resonators Used in Low Temperature Physics, *JLTP* 160, Num.5-6, 219-239 (2010).
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- [8] **To this list belong also patents stated separately in Part iv.**

iii. List of monographs/books published abroad

- [1] The CERN Large Hadron Collider: Accelerator and Experiments, vol 1, 2. Edited by A. Breskin and R. Voss. Vol. 1: LHC Machine, ALICE and ATLAS. Geneva 2009. (**J. BÁN, D. BRUNCKO, J. FERENCEI, E. KLADIVA, I. KRÁLIK, B. PASTIRČÁK, M. SEMAN, P. STRÍŽENEC, L. ŠÁNDOR, F. TOMASZ.**) ISBN: 978-92-9083-336-9 (vol. 1 and 2), ISBN: 978-92-9083-337-6 (vol. 1), ISBN: 978-92-9083-338-3 (vol. 2).
- [2] Expected Performance of the ATLAS Experiment: Detector, Trigger and Physics. Geneva 2009. ATLAS Collaboration: G. Aad et al., (**D. BRUNCKO, J. FERENCEI, E. KLADIVA, M. SEMAN, P. STRÍŽENEC, F. TOMASZ.**) ISBN: 978-92-9083-321-5
- [3] The Performance of the ATLAS Detector. Springer Heidelberg Dordrecht London New York, 2010. ATLAS Collaboration: G. Aad et al. (**D. BRUNCKO, J. FERENCEI, E. KLADIVA, M. SEMAN, P. STRÍŽENEC, F. TOMASZ.**) ISBN 978-3-642-22115-6, e-ISBN: 978-3-642-22116-3 DOI 10.1007/978-3-642-22116-3
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iv. List of monographs/books published in Slovakia

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- [3] **ČERŇANSKÝ P., ČERVENĚ I., DILLINGER J., HOLÁ O., HORYLOVÁ R., CHRAPAN J., KRUPA D., OŽVOLDOVÁ M., PAVLICOVÁ V., REIFFERS M., ŠUTTA A.** *Fyzikálny slovník slovensko-anglický, anglicko-slovenský (Physics dictionary,*

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- [4] Editor **K. KUDELA**, J. FERANEC, L. MACHO. *Space Research in Slovakia 2006 - 2007: COSPAR, Slovak National Committee*. Košice : Slovak Academy of Sciences, 2008. 78 s. ISBN 978-80-968060-3-4; *Space Research in Slovakia 2008 - 2009: COSPAR, Slovak National Committee*. Košice : Slovak Academy of Sciences, 2010.
- [5] FERANEC J., BUCHA T., CSAPLÁR J., HEFTY J., JURAŠEK M., KAŇÁK J., **KUDELA K.**, MACHKOVÁ N., SVIČEK M., VOJTKO R., SCHOLTZ P., NOVÁKOVÁ M., SZÖCSOVÁ I., RAŠI R., VLADOVIČ J., REICHWALDER P., ZEMAN M., FINĎO S. *Slovensko očami satelitov (Slovakia with eyes of satellites)*. Bratislava : Veda, 2010. 263 s. Svet vedy, 14. ISBN 978-80-224-1105-9.

v. List of other scientific outputs specifically important for the Organisation (normalization, standardization, maps, etc.) -

Chapters in monographs, some of them having a volume of monographs

- [1] **P. SAMUELY, P. SZABÓ, Z. PRIBULOVÁ, J. KAČMARČÍK**: Point Contact Spectroscopy of Multigap Superconductors, in *Nanoscience and Engineering in Superconductivity*, editors: Victor V. Moshchalkov, Roger Wördenweber and Wolfgang Lang, *Springer series*, Berlin, Springer, 2010, chapter 7, s. 187-210. ISBN 978-3-642-15136-1. ISSN 1434-4904.
- [2] **P. SKYBA**: Superfluid ^3He as a model system for cosmology - Experimental point of view, Chapter in *Quantum Analogues: From Phase Transitions to Black Holes and Cosmology*, edited by R. Schutzhold and W. Unruh, *Lecture Notes in Physics Springer* (2007).
- [3] R.H.T. WILKE, **P. SAMUELY, P. SZABÓ, Z. HOLANOVÁ**, S. BUD'KO, P. C. CANFIELD, D.K. FINNEMORE: Superconducting and normal state properties of carbon doped and irradiated MgB_2 . Invited chapter in *Recent Advances in MgB_2 Research*, edited by S. Tajima, I. Mazin, D. van der Marel and H. Kumakura, *Physica C* 456, 108-116 (2007).
- [4] **P. SAMUELY, Z. PRIBULOVÁ, P. SZABÓ, G. PRISTÁŠ**, S.L. BUD'KO, P.C. CANFIELD, Point contact Andreev reflection spectroscopy of superconducting energy gaps in 122-type family of iron pnictides. Invited chapter in *Superconductivity of Iron Pnictides*, Alexei Koshelev, Wai Kwok, Igor Mazin, Ulrich Welp, Hai-Hu Wen, Guest Editors, *Physica C* 469 (2009), 507-511.
- [5] **PINČÁK R., PUDLÁK M.** Electronic structure of spheroidal fullerenes – chapter in book: *Progress in Fullerene Research*. Nova Science Publishers, New York, ISBN: 1-60021-841-5 (2007).
- [6] **T. KOŽÁR, S. ANDRE J., ULICNY H., J. GABIUS**: Three-dimensional Aspects of the Sugar Code, in: H.-J. Gabius (Ed.) *The Sugar Code. Fundamentals of Glycosciences*, Wiley-VCH, Weinheim, Germany, 2009, pp. 15-29, ISBN-10: 3-527-32089-X.

- [7] **K. FLACHBART** et al.: Rare earth dodecaborides - magnetism, superconductivity and other properties. In: *Rare Earths: Research and Application*, Ed. Delfrey K.N. (New York: Nova Science Publishers 2008), 79-125.
- [8] **K. KUDELA** and Leonid Lazutin: Selected Solar Influences on the Magnetosphere: Information from Cosmic Rays, p. 199 - 209, Chapter 18 in *The Sun, the Solar Wind, and the Heliosphere*, IAGA Special Sopron Book Series 4, Ed. Mari Paz Miralles, Jorge Sanchez Almeida, Springer, 2011.

vi. Table of research outputs

Table **Research outputs** shows research outputs in number of specified entries; these entries are then divided by FTE employees with a university degree (from Tab. Research staff) for all Organisation at the respective year; finally these entries are divided by the total salary budget (from Tab. Salary budget).

(and the name of research organisations appears in the list of author)

Research outputs	2007			2008			2009			2010			2011			total			
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
chapters in monographs, books published abroad	5	0,081	4,91	6	0,102	5,52	0	0,000	0,00	3	0,038	2,48	4	0,051	3,49	18	3,6	0,051	3,20
chapters in monographs, books published in Slovakia	1	0,016	0,98	1	0,017	0,92	0	0,000	0,00	1	0,013	0,83	13	0,164	11,35	16	3,2	0,046	2,84
CC publications	110	1,790	108,13	172	2,925	158,34	148	2,005	126,78	194	2,484	160,38	127	1,607	110,85	751	150,2	2,138	133,48
scientific publications indexed by other databases (WOS, SCOPUS, SPIRES, CHEM., ABSTR.)	7	0,114	6,88	114	1,939	104,95	59	0,799	50,54	58	0,743	47,95	25	0,316	21,82	263	52,6	0,749	46,74
scientific publications in other journals	19	0,309	18,68	15	0,255	13,81	9	0,122	7,71	20	0,256	16,53	10	0,127	8,73	73	14,6	0,208	12,97
publications in proc. of international scientific conferences	36	0,586	35,39	31	0,527	28,54	96	1,300	82,24	25	0,320	20,67	72	0,911	62,84	260	52,0	0,740	46,21
publications in proc. of nat. scientific conferences	24	0,390	23,59	14	0,238	12,89	42	0,569	35,98	14	0,179	11,57	56	0,709	48,88	150	30,0	0,427	26,66
active participations at international conferences	47	0,765	46,20	102	1,735	93,90	66	0,894	56,54	151	1,933	124,83	14	0,177	12,22	380	76,0	1,082	67,54
active participations at national conferences	12	0,195	11,80	4	0,068	3,68	22	0,298	18,85	37	0,474	30,59	1	0,013	0,87	76	15,2	0,216	13,51

vii. List of registered patents

- [1] F. KOVÁČ, I. PETRYSHYNETS, V. STOYKA, I. ŠKORVÁNEK, T. KVAČKAJ Slovak Patent Application: no. PV-00009-2011: submitted. Title: Method of production of non-oriented electrical steels with low watt losses.
- [2] M. SEDLÁK, Č. KOŇÁK: Preparation method of polymeric nanoparticles on the basis of poly(ethylacrylic acid) homopolymers. Industrial Property Office of the Slovak Republic, patent application PP5007-2008: accepted.
- [3] M. SEDLÁK, Č. KOŇÁK: Polymeric nanoparticles on the basis of poly(propylacrylic acid) homopolymers and their preparation method. Industrial Property Office of the Slovak Republic, patent application PP 5003-2009: submitted.

viii. Supplementary information and/or comments on the scientific output of the Organisation

None

2. Responses to the scientific output

Table Citations shows specified responses to the scientific outputs; these entries are then divided by the FTE employees with a university degree (from Tab. Research staff) for all Organisations at the respective year; finally these entries are divided by the total salary budget (from Tab. Salary budget).

Citations	2006			2007			2008			2009			2010			total			
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
Web of Science	837	13,6	822,8	914	15,5	841,4	1146	15,5	981,7	1464	18,7	1210,3	1325	16,8	1156,5	5686	1137,2	16,2	1010,6
SCOPUS	90	1,5	88,5	60	1,0	55,2	24	0,3	20,6	20	0,3	16,5	10	0,1	8,7	204	40,8	0,6	36,3
Spires	62	1,0	60,9	76	1,3	70,0	40	0,5	34,3	0	0,0	0,0	0	0,0	0,0	178	35,6	0,5	31,6
NASA ADS	0	0,0	0,0	6	0,1	5,5	4	0,1	3,4	5	0,1	4,1	0	0,0	0,0	15	3,0	0,0	2,7
in monographs, conf. proceedings and other publications abroad	8	0,1	7,9	5	0,1	4,6	17	0,2	14,6	48	0,6	39,7	13	0,2	11,3	91	18,2	0,3	16,2
in monographs, conf. proceedings and other publications in Slovakia	0	0,0	0,0	1	0,0	0,9	1	0,0	0,9	11	0,1	9,1	3	0,0	2,6	16	3,2	0,0	2,8

i. List of 10 top-cited publications from staff members since the establishment of the Organisation up to 2010 and number of their citations in the period 2006 – 2010.

- [1] **SZABÓ, P. - SAMUELY, P. - KAČMARČÍK, J. - KLEIN, T. - MARCUS, J. - FRUCHAR, D. - MIRAGLIA, S. - MARCENAT, C. - JANSEN, A.G.M.** Evidence for Two Superconducting Energy Gaps in MgB₂ by Point-Contact Spectroscopy. In *Physical Review Letters*. Vol. 87, no.13 (2001), p.137005-1-4.
WOS: 117, SCOPUS: 3, Monogr., books: 4
- [2] **BUSTARRET, E. - KAČMARČÍK, J. - MARCENAT, C. - GHEERAERT, E. - CYTERMANN, C. - MARCUS, J. - KLEIN, T.** Dependence of the Superconducting Transition Temperature on the Doping Level in Single-Crystalline Diamond Films. In *Physical Review Letters*. Vol. 93, no.23 (2004), p. 237005-1-4. (7.218 - IF2004)
WOS: 89
- [3] **BUSTARETT, E. – MARCENAT, C. – ACHATZ, P. – KAČMARČÍK, J. – LÉVY, F. – HUXLEY, A. – ORTÉGA, L. – BOURGEOIS, E. – BLASE, X. – DÉBARRE, D. – BOULMER, J.** Superconductivity in doped cubic silicon. In *Nature*. Vol. 444, no. 7118 (2006), p. 465-468.
WOS: 60
- [4] **KONERACKÁ, M. - KOPČANSKÝ, P. - ANTALÍK, M. - TIMKO, M. - RAMCHAND, C.N. - LOBO, D. - MEHTA, R.V. - UPADHYAY, R.V.** Immobilization of proteins and enzymes to fine magnetic particles. In *Journal of Magnetism and Magnetic Materials*. Vol. 201, no. 1-3 (1999), p. 427-430.
WOS: 42, SCOPUS: 7
- [5] **KOPELIOVICH, B.Z. - NEMCHIK, J. - POTASHNIKOVA, I.K. - JOHNSON, M.B. - SCHMIDT, I.** Breakdown of QCD factorization at large Feynman x. In *Physical Review C*. Vol. 72, no. 5 (2005), p. 054606-1-11.
WOS: 36
- [6] **LYARD, L. - SZABÓ, P. - KLEIN, T. - MARCUS, J. - MARCENAT, C. - KIM, K.H. - KANG, B.W. - LEE, H.S. - LEE, S.I.** Anisotropies of the lower and upper critical fields in MgB₂ single crystals. In *Physical Review Letters*. Vol. 92, no. 5 (2004), p. 057001-1-4.
WOS: 35
- [7] **LYARD, L. - SAMUELY, P. - SZABÓ, P. - - KLEIN, T. - MARCENAT, C. - PAULIUS, L. - KIM, K.H.P. - JUNG, C.U. - LEE, H.S. - KANG, B. - CHOI, S. - LEE, S.I. - MARCUS, J. - BLANCHARD, S. - JANSEN, A.G.M. - WELP, U. - KARAPETROV, G. - KWOK, W.K.** Anisotropy of the Upper Critical Field and Critical Current in Single Crystal MgB₂. In *Physical Review B*. Vol. 66, no.18 (2002), p.R180502-1-4.
WOS: 32, SCOPUS: 2
- [8] **SZABÓ, Pavol - PRIBULOVÁ, Zuzana - PRISTÁŠ, Gabriel - BUĎKO, S.L. - CANFIELD, P.C. - SAMUELY, Peter.** Evidence for two-gap superconductivity in Ba_{0.55}K_{0.45}Fe₂As₂ from directional point-contact Andreev-reflection

spectroscopy. In *Physical Review B*. ISSN 1098-0121, 2009, vol. 79, no. 1, Art.no. 012503 (3.322 - IF2008).

WOS: 31

- [9] KLEIN, T. – ACHATZ, P. – **KAČMARČÍK, J.** – MARCENAT, C. – GUSTAFSSON, F. – MARCUS, J. – BUSTARRET, E. – PERNOT, J. – OMNES, F. – SERNELIUS, B.E. – PERSSON, C. – FERREIRA da SILVA, A. – CYTERMANN, C. Metal-insulator transition and superconductivity in boron-doped diamond. In *Physical Review B*. ISSN 1098-0121. Vol. 75, no. 16 (2007), p. 165313-1-7.

WOS: 28

- [10] **KONERACKÁ, M. - KOPČANSKÝ, P. - TIMKO, M. - RAMCHAND, C.N. - DE SEQUEIRA, A. - TREVAN, M.** Direct binding procedure of proteins and enzymes to fine magnetic particles. In *Journal of Molecular Catalysis B: Enzymatic*. Vol. 18, no. 1-3 (2002), p. 13-18.

WOS: 27, SCOPUS: 2

List of 5 top-cited publications from large collaborations since establishment of the Organisation and number of their citations in the period 2006 – 2010

- [1] **H1 Collaboration** (ADLOFF, C. -...- **BRUNCKO, D.** -...- **FERENCEI, J.** -...- **KURČA, T.** -...- **MURÍN, P.** -...-) Deep-inelastic inclusive ep scattering at low x and a determination α_s . Preprint DESY-00-181. In *European Physical Journal C*. Vol. 21, no. 1 (2001), p. 33-61. hep-ex/0012053

WOS: 115, SCOPUS:7, SLAC SPIRES HEP Database:15

- [2] **CDF Collaboration** (AALTONEN, T. -...- **ANTOŠ, J.** -...- **LYSÁK, R.** -...-) Search for $B_s \rightarrow \mu^+\mu^-$ and $B_d \rightarrow \mu^+\mu^-$ Decays with 2fb^{-1} of ppbar Collisions. Preprint FERMILAB-PUB-07-649-E. arXiv:0712.1708. In *Physical Review Letters*. ISSN 0031-9007, 2008, vol. 100, no. 10, p. 101802-1-7. (6.944 - IF2007). ADCA 080155

WOS: 90

- [3] **H1 Collaboration** (AKTAS, A. -...- **BRUNCKO, D.** -...- **FERENCEI, J.** -...- **MURÍN, P.** -...- **TOMASZ, F.** -...-) Measurement and QCD Analysis of the Diffractive Deep-Inelastic Scattering Cross Section at HERA. Preprint DESY-06-049. In *European Physical Journal C*. Vol. 48, no. 3 (2006), p. 715-748. hep-ex/0606004. (3.209 - IF2005) *AKTAS A HEPEX0606004 **AKTAS A HEPEX0606004 HI COLL

WOS: 51, SLAC SPIRES HEP Database:10

- [4] **H1 Collaboration** (ADLOFF, C. -...- **BRUNCKO, D.** -...- **FERENCEI, J.** -...- **MURÍN, P.** -...-) Measurement and QCD Analysis of Neutral and Charged Current Cross Sections at HERA. Preprint DESY-03-038. In *European Physical Journal C*. Vol. 30, no. 1 (2003), p. 1-32. hep-ex/0304003

WOS: 46, SCOPUS:5, SLAC SPIRES HEP Database:6

- [5] **CDF Collaboration** (AALTONEN, T. -...- **ANTOŠ, Jaroslav** -...- **LYSÁK, Roman** -...-). First Flavor-Tagged Determination of Bounds on Mixing-Induced CP Violation in $B_0 \rightarrow s\bar{j}$ Decays. arXiv:0712.2397. In *Physical Review Letters*, 2008, vol. 100, no. 16, art. no. 161802. (6.944 - IF2007). ADCA 119473

WOS: 47

ii. List of 10 top-cited publications from staff members published 2000 - 2010 and number of their citations in the period 2006 – 2010

- [1] **SZABÓ, P. - SAMUELY, P. - KAČMARČÍK, J.** - KLEIN, T. - MARCUS, J. - FRUCHART, D. - MIRAGLIA, S. - MARCENAT, C. - JANSEN, A.G.M. Evidence for Two Superconducting Energy Gaps in MgB₂ by Point-Contact Spectroscopy. In *Physical Review Letters*. Vol.87, no. 13 (2001), p.137005-1-4. **WOS: 117, SCOPUS: 3, Monogr., books: 4**
- [2] BUSTARRET, E. - KAČMARČÍK, J. - MARCENAT, C. - GHEERAERT, E. - CYTERMANN, C. - MARCUS, J. - KLEIN, T. Dependence of the Superconducting Transition Temperature on the Doping Level in Single-Crystalline Diamond Films. In *Physical Review Letters*. Vol. 93, no.23 (2004), p. 237005-1-4. (7.218 - IF2004) **WOS: 89**
- [3] BUSTARETT, E. – MARCENAT, C. – ACHATZ, P. – **KAČMARČÍK, J.** – LÉVY, F. – HUXLEY, A. – ORTÉGA, L. – BOURGEOIS, E. – BLASE, X. – DÉBARRE, D. – BOULMER, J. Superconductivity in doped cubic silicon. In *Nature*. Vol. 444, no. 7118 (2006), p. 465-468. **WOS: 60**
- [4] KOPELIOVICH, B.Z. - **NEMCHIK, J.** - POTASHNIKOVA, I.K. - JOHNSON, M.B. - SCHMIDT, I. Breakdown of QCD factorization at large Feynman x. In *Physical Review C*. Vol. 72, no. 5 (2005), p. 054606-1-11. **WOS: 36**
- [5] LYARD, L. - **SZABÓ, P.** - KLEIN, T. - MARCUS, J. - MARCENAT, C. - KIM, K.H. - KANG, B.W. - LEE, H.S. - LEE, S.I. Anisotropies of the lower and upper critical fields in MgB₂ single crystals. In *Physical Review Letters*. Vol. 92, no. 5 (2004), p. 057001-1-4. **WOS: 35**
- [6] LYARD, L. - **SAMUELY, P. - SZABÓ, P.** - - KLEIN, T. - MARCENAT, C. - PAULIUS, L. - KIM, K.H.P. - JUNG, C.U. - LEE, H.S. - KANG, B. - CHOI, S. - LEE, S.I. - MARCUS, J. - BLANCHARD, S. - JANSEN, A.G.M. - WELP, U. - KARAPETROV, G. - KWOK, W.K. Anisotropy of the Upper Critical Field and Critical Current in Single Crystal MgB₂. In *Physical Review B*. Vol. 66, no.18 (2002), p.R180502-1-4. **WOS: 32, SCOPUS: 2**
- [7] **SZABÓ, Pavol - PRIBULOVÁ, Zuzana - PRISTÁŠ, Gabriel** - BUĎKO, S.L. - CANFIELD, P.C. - **SAMUELY, Peter**. Evidence for two-gap superconductivity in Ba_{0.55}K_{0.45}Fe₂As₂ from directional point-contact Andreev-reflection spectroscopy. In *Physical Review B*. ISSN 1098-0121, 2009, vol. 79, no. 1, Art.no. 012503 (3.322 - IF2008). **WOS: 31**
- [8] KLEIN, T. – ACHATZ, P. – **KAČMARČÍK, J.** – MARCENAT, C. – GUSTAFSSON, F. – MARCUS, J. – BUSTARRET, E. – PERNOT, J. – OMNES, F. – SERNELIUS, B.E. – PERSSON, C. – FERREIRA da SILVA, A. – CYTERMANN, C. Metal-insulator transition and superconductivity in boron-doped

diamond. *In Physical Review B*. ISSN 1098-0121. Vol. 75, no. 16 (2007), p. 165313-1-7.

WOS: 28

- [9] **KONERACKÁ, M. - KOPČANSKÝ, P. - TIMKO, M. - RAMCHAND, C.N. - DE SEQUEIRA, A. - TREVAN, M.** Direct binding procedure of proteins and enzymes to fine magnetic particles. In *Journal of Molecular Catalysis B: Enzymatic*. Vol. 18, no. 1-3 (2002), p. 13-18.

WOS: 27, SCOPUS: 2

- [10] VESELOVSKY, I.S. - ... - **KUDELA, K.**... - YANKE, V.G. Solar and Heliospheric Phenomena in October-November 2003: Causes and Effects. In *Cosmic Research*. Vol. 42, no. 5 (2004), p. 435-488 (Kosmičeskije issledovanija. Vol. 42, no. 5 (2004), p. 453-508.)

WOS: 26, SCOPUS: 2, Monogr., books: 1

iii. List of top-cited authors of the Organisation (at most 10 % of the research employees) and their number of citations in the period 2006 – 2010

H1 Collaboration ...- **D. BRUNCKO, J. FERENCI** -...

WOS 508, Scopus 56, SPIRES (9) 115

PAVOL SZABÓ

WOS 445, Scopus 12

PETER SAMUELY

WOS 421, Scopus 12

KAREL KUDELA

WOS 420, Scopus: 31, (3) 75, (4) 13, (6) 2, NASA (9) 14

JOZEF KAČMARČÍK

WOS 393, Scopus 6

MARIAN SEDLÁK

WOS 227, Scopus 2

MARIAN ANTALÍK

WOS 220, Scopus 8

MILAN TIMKO

WOS 216, Scopus: 21, (4) 1

ZUZANA PRIBULOVÁ

WOS 208, Scopus 6

PETER KOPČANSKÝ

WOS 207, Scopus: 22, (4) 1

MARTINA KONERACKÁ
WOS 194, Scopus: 22, (4) 1

JOZEF KOVÁČ
WOS 187, Scopus 20

JÁN NEMČÍK
WOS 182, Scopus 6, SPIRES 8

iv. Supplementary information and/or comments on responses to the scientific output of the Organisation

None

3. Research status of the Organisation in the international and national context

- **International/European position of the Organisation**
 - i. **List of the most important research activities documenting international importance of the research performed by the Organisation, incl. major projects (details of projects should be supplied under Indicator 4). Provide arguments why the selected projects are particularly important and represent the international position of the Organisation).**

In the assessed period the Institute was involved in following international projects (6FP, 7FP, ESF, COST, INTAS). Details are described under Indicator 4.

6FP, 7FP:

- [1] **SWEETS 6FP EU.** Space Weather and Europe – Educational Tool with the Sun. Duration: 2007. K. Kudela, investigator - project for the outreach of european citizens about the importance of space wether studies and forecasts in the forthcoming period,
<http://www.physik.uni-greifswald.de/sweets2007/>
- [2] **NMDB 7FP EU.** Neutron Monitor Data Base, Duration 2008-2009, K. Kudela, investigator (R. Langer, I. Strhárský) - joining the effort of several european and non-european cosmic ray stations to build, enhance and update the data base of neutron monitor measurements. It included also outreach activities. The project despite its official finishing, is continuing and data from new neutron monitors are implemented in 2010 and 2011, <http://www.nmdb.eu>
- [3] **FP6 EU: MTKD-CT-2005-030002 ExtreM** Condensed matter at extreme experimental conditions. Duration: 2006-2009. P. Samuely, main coordinator. The ExtreM has been a very successful project where unique instruments as the subkelvin STM, ac calorimetry for the milikevin temperature range, a

versatile dilution refrigerator with milikelvin calorimetry as well as the diamond cell for 150 kbar pressure measurement were created in collaboration with the world leading laboratories.

- [4] **FP7 EU: Microkelvin**, Duration: 2009-2013. P. Skyba investigator. Within the programme Capacities of FP7. The project covers the leading European microkelvin and nanotechnology laboratories.
- [5] **FP6 035619-2 NanoEngineered Superconductors for Power Applications** (NESPA), Duration 2006-2010. P. Diko, investigator - Laboratory of Materials Physics participated in Marie Currie Training Network (*6-th Framework Program*) in the frame of the project "*NanoEngineered Superconductors for Power Applications*" (NESPA) with 12 EU participating institutions is an evidence of international importance and high level of the research of REBCO bulk single-grain superconductors, which is performed at the IEP SAS. This EU cooperation supported fully one PhD student (V. Antal defended his PhD thesis in 2010), partially another PhD student (D. Volochova), participation of LMF members at regular NESPA meetings, schools, international conferences as well as research at IEP SAS (consumables). Outcomes of this cooperation are also 21 papers published in international journals.
- [6] **FP7 MNT-ERA-NET, Engineering in Superconductivity**, 2010-2012, Principal investigator Peter Samuely. The project is dealing with two technological problems of applied superconductivity: increase of the critical current density in the high-temperature superconductors of YBCO and REBCO type through nanoscopic pinning centers and development of superconducting and hybrid superconducting-magnetic nanostructures fabricated by the AFM, electron and optical lithography. Both tasks are coordinated at IEP SAS, Kosice.
- [8] **FP7 MNT-ERA-NET Transnational Cooperation MAFINCO -Magnetic fluid-new insulated and cooling medium for power transformers**, Duration: 2009-2011, Coordinator M. Timko - this project enabled to manage the processes of preparation and characterization of inhibited hydrocarbon transformer oil based magnetic nanofluids with properties suitable for their application in power transformers. The better thermal and dielectric characteristics of magnetic nanofluids, compared with pure transformer oils, were tested in commercially produced transformer and the obtained results confirmed the improved operation conditions of power transformer and the increase its resistance against electric discharge too. The interdisciplinarity of the international participating groups allowed a unique combination of expertise in synthesis, characterization and application of magnetic soft matter.
- [9] **INTAS 05-103-7555** A proposal for R&D to establish the limitations on the operation of the ATLAS end-cap calorimeters at high LHC luminosities. Duration 2006-2008. Responsible person: Dušan Bruncko.
- [10] **INTAS 05-1000008-8050** Solar wind: A new glance at high resolution. Duration 2007-2008. Responsible person: Karel Kudela. - the Project was aimed to increase understanding of formation and dynamics of mid and small-scale solar wind (SW) structures and their interaction with magnetosphere, basing on the available data and via the development of a new experiment. It was used in development phase of MEP device for SPECTR-R satellite.

ESF:

- [1] **Nanoscience and Engineering in Superconductivity** was the European Science Foundation research network of the European leading laboratories in the field of the superconducting nanophysics, vortex matter, fluxtronics, plasmonics and spintronics. Duration 2008-2012. P. Samuely member of the steering committee.

COST:

- [1] **COST 724** Developing the scientific basis for monitoring, modelling and predicting Space Weather, Duration: 2003-2007. K. Kudela, investigator. Project joining the effort of many European institutes and universities in space weather research and applications.
http://www.cost.eu/domains_actions/essem/Actions/724
- [2] **COST 803** Developing space weather products and services in Europe, Duration: 2008 – 2012. K. Kudela, investigator (J. Baláž, P. Bobík, M. Slivka, I. Strhárský, R. Langer) This COST Action has the primary goal to form an interdisciplinary network between European scientists dealing with different issues of Geospace, as well as warning system developers and operators to progress in the space weather actions for Europe.
<http://www.costes0803.noa.gr/>
- [3] **COST ECOM P16** Emergent behaviour of correlated matter. Duration: 2005 – 2008. M. Reiffers, investigator. Project joining leading EU institutes for the study of strongly correlated systems.
- [4] **COST D43** Colloid and Interface Chemistry for Nanotechnology, Duration: 2006-2011. Dr. M. Sedlák, investigator - this COST action and our participation is devoted to the development and understanding of soft matter nanotechnological objects.
- [5] **COST P17** Electromagnetic processing of materials. Duration: 2006-2009. Ivan Škorvánek - principal investigator - the group of LNAM joined the COST P17 consortium in 2006 with the project "Improvement of functional properties of Fe and Co-based nanocrystalline magnetic materials by heat treatment in external magnetic field". The consortium was composed of more than 30 laboratories from 18 EU countries and its activities were focused on various aspects of utilization of electromagnetic fields during the processing of materials.

ANOTHERS:

- [1] **JEM-EUSO** - Extreme Universe Space Observatory onboard Japanese Experiment Module. Duration: 2008 – 2017. K. Kudela, investigator (P. Bobík, B. Pastirčák) – the project on International Space Station will study the origin of the highest energy particles in Universe. Collaboration of 75 institutions from 13 countries is led by JAXA and ESA space agencies.
<http://jemeuso.riken.jp/en/index.html>**JEM-EUSO**
- [2] Project in frame of **EEA GRANTS, Financial mechanism of EEA**, SAV-FM-EHP-2008-01-01. Duration: 2009-2011, Investigator M. Timko - magnetic

nanoparticles and nanoparticle membranes for application in sensors. In frame of this project were obtained original results concerning to the role of surfactants in nanoparticle assembly and new theoretical knowledges regarding to thermal, photo and mechanical excitations in surfactant molecules. Applicable membranes which are sensitive to magnetic field were prepared.

- [3] **Network GDRE** – Group FOR THE APPLIED MAGNETOSCIENCES GAMAS
Duration: 2008-2011. Ivan Škorvánek - principal investigator in SR, deputy coordinator of GDRE GAMAS and member of management committee.
GDRE - Groupement de Recherche Européen is a European Research Network created in January 2008 and coordinated by CNRS France. This cooperative structure connects 15 laboratories from 7 EU countries involved in applied magneto-sciences, i.e. the application of magnetic field to control various processes. The objective of GAMAS is to facilitate and to encourage contacts and exchanges between researchers, to develop training actions and to encourage the development of cooperation within the EU scientific community focused on the applications of magnetic field in various domains (biology, medicine, energy, materials), at various scales (nano and macro technology).

CERN, CDF, JINR DUBNA

The participation of Slovakia in scientific programmes of the CERN organisation is supported at governmental level. Besides finances coming to the Institute of Experimental Physics, an additional support of about 150 000 Euro per year is provided to cover experimental costs at CERN (maintenance, operation, collaboration funds, etc...). The participation in the CERN experimental programme has been a backbone of our research activities in the field of high energy and elementary particle physics for about two decades. The research of the Department of Subnuclear physics has been mainly supported by CERN / ME SR projects:

CERN ALICE KE: Duration: 1998 - 2015. Principal investigator: L. Šándor.

CERN ATLAS KE: Duration: 1998 - 2015. Principal investigator: D. Bruncko.

CERN NA57 KE: Study of possible quark-gluon plasma production in heavy ion collisions at CERN SPS. Duration: 1998-2007.
Principal investigator: I. Králik.

After many years of participation of individual researchers in the **CDF experiment** at the Fermilab, Batavia, USA, which lead to such discoveries as the top quark, the role of our Institute was put on a more formal basis. During the evaluated period the IEP SAS has been an official participant in the CDF collaboration up to the end of Tevatron collider operation. This research activity was supported by an MVTS project.

The year 2008 marked an end of very fruitful participation in the H1 experiment at **DESY, Hamburg**, Germany, which started at the end of Nineteen Eighties.

JINR Dubna: - The Department of Theoretical Physics has a very fruitful collaboration with the Laboratory of Theoretical Physics in Dubna focused on application of quantum field theory in stochastic dynamics.

ii. List of international conferences (co-) organised by the Organisation

- [1] **11-th International Conference on Magnetic liquids - ICMF 11**, 23.7.-27.7.2007, Košice, Slovakia
- [2] **21. European Cosmic Ray Symposium**, 09.09.-12.09.2008, Košice, Slovakia
- [3] **Microkelvin 2011**, Congress Centre of SAS, 14.03.-18.03.2011 Smolenice, Slovakia
- [4] **Cryokonferenc 2010**, 09.09.-15.09.2010, Mýto pod Ďumbierom, Slovakia
- [5] **'Strangeness in Quark Matter' - SQM 2007**, 24.6.-29.6.2007, Levoča, Slovakia
- [6] **13-th Czech and Slovak Conference on Magnetism**, 9.7.-12.7.2007, Košice, Slovakia
- [7] **Structure and Stability of Biomacromolecules SSB07**, 5.9.-8.9.2007, Košice, Slovakia
- [8] **Hadron Structure 2007**, 3.-7.9.2007, Congress center Modra-Harmónia, Slovakia
- [9] **9. Small triangle meeting on theoretical physics**, 9.9.-12.9.2007, Medzilaborce, Eurohotel Laborec
- [10] **XVIth RPKD – Regional powder diffraction conference**, 19.-21. 9. 2007, Tatranská Štrba, Slovakia
- [11] **Autumn school on neutron scattering**, 15.-18.9.2007, Tatranská Štrba
- [12] **H1 Workshop**, 22.05.-24.05.2008, Danišovce, Slovakia
- [13] **XVII. – Regional powder diffraction conference**, 18.06.-20.06.2008, Valtice, Czech Republic
- [14] **10. Small triangle meeting on theoretical physics**, 21.09.-24.09.2008, Medzilaborce, Slovakia
- [15] **ILL-Slovakia – new possibilities of neutron studies**, 23.01.-23.01.2009, Košice, Slovakia
- [16] **Structure and Stability of Biomacromolecules SSB09**, 09.09.-11.09.2009, ÚEF SAV Košice, Slovakia
- [17] **11. Small triangle meeting on theoretical physics**, 20.09.-23.09.2009, Kysak, Slovakia
- [18] **14-th Czech and Slovak Conference on Magnetism**, 06.07.-09.07.2010, Košice, Slovakia
- [19] **STM2010 - Small triangle meeting**, 19.09.-22.09.2010, Stakčín, Czech Republic
- [20] **Kosice-Prague-Bratislava Collider workshop**, 23.09.-24.09.2010, Kysak, Slovakia
- [21] **8th School on the Physics and Chemistry of the Actinides**, 07.04.-09.04.2011, Stará Lesná, Slovakia
- [22] **41 emes Journées des Actinides**, 09.04.-12.04.2011, Stará Lesná, Slovakia

- [23] **Mathematical Modeling and Computational Physics 2011**, 04.07.-08.07.2011, Stará Lesná, Slovakia
- [24] **17. Conference of Slovak and Czech physicists**, 05.09.-08.09.2011, Žilinská Univerzita, Žilina, Slovakia
- [25] **Structure and Stability of Biomacromolecules SSB11**, 06.09.-09.09.2011, Košice, Slovakia
- [26] **13 Small Triangle meeting on Theoretical Physics**, 13.11.-16.11.2011, Stará Lesná, Slovakia
- [27] **JEM-EUSO simulation meeting in Košice**, 02.11.-04.11.2011, Košice, Slovakia

iii. List of international journals edited/published by the Organisation

The Institute does not edit or publish international journals.

iv. List of edited proceedings from international scientific conferences and other proceedings

- [1] *SSB 2007: 5th Conference Structure and Stability of Biomacromolecules and satellite conference Modern Trends in Biomacromolecular Research, September 5-8, 2007, Košice : book of contributions*. Eds.: **M. ANTALÍK, D. FEDUNOVÁ, Z. GAŽOVÁ**. Košice : Prírodovedecká fakulta UPJŠ, 2007. 148 s. ISBN 978-80-7097-693-7.
- [2] *SQM 2007 : international Conference on Strangeness in Quark Matter, Levoča, Slovakia, 24-29 June 2007, sp. iss. Journal of Physics G: Nuclear and Particle Physics, Vol. 35, no. 4 (2008)*. Eds. **K. ŠAFAŘÍK, L. ŠÁNDOR, B. TOMÁŠIK**. Bristol : IOP Publishing, 2008. ISSN 0954-3899.
- [3] *9th Small Triangle Meeting on Theoretical Physics, September 9-12, 2007, Medzilaborce*. Ed. **M. STEHLÍK**. Košice : ÚEF SAV, 2007. 54 s.
- [4] *ICMF 2007 : 11th International Conference on Magnetic Fluids, Košice, Slovakia, 23.-27.7. 2007, sp. iss. Magnetohydrodynamics, Vol. 44, no. 2 (2008), p. 97-201*. Eds. **P. KOPČANSKÝ, M. TIMKO, M. VACLAVÍKOVÁ**. University of Latvia, Inst. of Physics.
- [5] *ECRS 2008: 21st European Cosmic Ray Symposium in Košice, Slovakia, 9 - 12 September 2008 : Programme and Abstracts*. Zostav. **K. KUDELA**. Košice : ÚEF SAV, 2008. 147 s. ISBN 978-80-968060-4-1.

- [6] *ICMF 2007 : Proceedings of the 11th International Conference on Magnetic Fluids, Košice, Slovakia, 23-27 July 2007, sp. iss. Journal of Physics: Condensed Matter, Vol. 20, no. 20 (2008)*. Eds. **P. KOPČANSKÝ, M. TIMKO, J. KOVÁČ, M. VÁCLAVÍKOVÁ, S. ODENBACH**. ISSN 0953-8984.
- [7] *Proceedings of the 13th Czech and Slovak Conference on Magnetism, Košice, July 9 - 12, 2007 (CSMAG '07), sp. iss. Acta Physica Polonica A, Vol. 113, no. 1 (2008), p. 1-638*. Eds. **M. ZENTKOVÁ, M. MIHALIK**.
- [8] *SQM 2007 : international Conference on Strangeness in Quark Matter, Levoča, Slovakia, 24-29 June 2007, sp. iss. Journal of Physics G: Nuclear and Particle Physics, Vol. 35, no. 4 (2008)*. Eds. **K. ŠAFAŘÍK, L. ŠÁNDOR, B. TOMÁŠIK**. Bristol : IOP Publishing, 2008. ISSN 0954-3899.
- [9] *Proceedings of 21st European Cosmic Ray Symposium, 9 - 12 September 2008, Košice, Slovakia*. Edited by **P. KIRÁLY, K. KUDELA, M. STEHLÍK**, A.W. Wolfendale. Košice : Institute of Experimental Physics Slovak Academy of Sciences, 2009. 633 s. ISBN 978-80-968060-5-8.
- [10] *SSB 2009: 6th International Conference Structure and Stability of Biomacromolecules, September 9 - 11, 2009, Košice, Slovakia : book of Contributions*. Editor **Z. GAŽOVÁ**. Košice: ÚEF SAV, 2009. 152 s. ISBN 978-80-968060-6-5.
- [11] *STM 10 : 10th Small Triangle Meeting on Theoretical Physics, September 21-24, 2008, Medzilaborce*. Eds. **M. JURČIŠIN, M. HNATÍČ**. Košice: Institute of Experimental Physics SAS, 2009. 29 s.
- [12] *CSMAG '10 : 14th Czech and Slovak Conference on Magnetism, July 6.-9., 2010, Košice, Slovakia. Programme and Abstracts*. Editors: **P. SOVÁK, I. ŠKORVÁNEK, P. KOLLÁR, J. MARCIN, G. PAVLÍK**. Košice: UPJŠ, 2010. 280 s. ISBN 978-80-7097-804-7.
- [13] *Space Research in Slovakia 2006-2007 : COSPAR, Slovak National Committee*. Editors **KAREL KUDELA, Ján Feranec and Ladislav Macho**. Košice: Slovak Academy of Sciences, 2008.
- [14] *Space Research in Slovakia 2008-2009 : COSPAR, Slovak National Committee*. Editors **KAREL KUDELA, Ján Feranec and Ladislav Macho**. Košice: Slovak Academy of Sciences, 2010. 62 s. ISBN 978-80-968060-7-2.
- [15] *STM 11 : 11th Small Triangle Meeting on Theoretical Physics, September 20-23, 2009, Kysak*. Eds. **J. BUŠA, M. HNATÍČ, P. KOPČANSKÝ**. Košice: Institute of Experimental Physics SAS, 2010. 120 s. ISBN 978-80-968060-8-9.
- [16] *CSMAG '10 : proceedings of the 14th czech and Slovak Conference on Magnetism, Košice, Slovakia, July 6-9, 2010 : Acta Physica Polonica A, Vol. 118, no. 5 (2010), p. 713-1078*. Editors **J. KOVÁČ, R. VARGA**.

- [17] *41èmes Journées des Actinides together with the 8th School on Physics and Chemistry of the Actinides, Stará Lesná, Slovakia, 7.-12.4. 2011: programme and proceedings*. Editors **M. ZENTKOVÁ, M. MIHALIK, M. REIFFERS**. Bratislava : SFS, 2011. 108 s. ISBN 978-80-970625-1-4.
- [18] *SSB 2011: 7th International Conference Structure and Stability of Biomacromolecules, September 6-9, 2011, Košice, Slovakia: book of contributions*. Editors **D. FEDUNOVÁ, Z. GAŽOVÁ, J. BÁGELOVÁ**. Košice: ÚEF SAV, 2011. 158 s. ISBN 978-80-970779-0-7.
- [19] *Material Research under Extreme Conditions : proceedings*. Editors **I. BAŤKO, M. BAŤKOVÁ, M. ORENDÁČ, A. ORENDÁČOVÁ**. Košice: UPJŠ, 2011. 133 s. ISBN 978-80-7097-867-2.
- [20] *STM 12 : 12th Small Triangle Meeting on Theoretical Physics, September 19-22, 2010, Stakčín*. Edited by J. BUŠA, **M. HNATICĚ, P. KOPČANSKÝ**. Košice: ÚEF SAV, 2011. 99 s. ISBN 978-80-89284-88-7.

- **National position of the Organisation**
 - i. **List of selected most important national projects (provide the arguments why the selected projects are particularly important and represent the international position of the Organisation)**

In the assessment period 2007-2011 the Institute was very successful in obtaining projects/grants of EU structural funds (ASFEU). Alltogether the Institute received 18 grants (see Chapter 4) which enabled to invest up to now about 6.5 million EUR into the infrastructure of various units (departments / laboratories). The success of the Institute in the national research area was confirmed also by receiving a rather high number of APVV grants and projects related with Slovak Academy of Sciences Centers of Excellence (see Chapter 4, parts ii, iv).

Centers of Excellence of SAS

1. **CEx SAS “Centre of Low Temperature Physics”**, Duration: 2007 – 2010, head P. Samuely Further development of the common laboratories of IEP SAS and the Šafárik University has been the main task of the project. Several unique equipments were built in house. Some examples are thermometry for microkelvins, subkelvin STM, ac calorimetry, and so on.
2. **CEx SAS “Centre of Low Temperature Physics and Material Research at Extreme Conditions”**, Duration 2011-2014, head P. Samuely. One of the major goals of the project has been the development of common infrastructure incl. unique experimental techniques in physics and material science. Examples of such a development in 2011 reckon in mastering of the magnetron sputtering

of thin films and AFM LAO nanolithography, EPR spectrometry on the Bruker equipment, TEM with high resolution in the common laboratory, etc.

3. **Centre of Excellence: NANOFLUIDS.** Duration: 2009 – 2013. Responsible person: P. Kopcansky, head of the Centre. Centre of NANOFLUIDS is oriented to development of technology of nanoparticles, as are magnetic nanoparticles, colloid gold, nanotubes and their complex characterisation with aspect to their magnetic and morphologic properties. The prepared nanoparticles are functionalised for applications in biomedicine, biotechnology and electrotechnical industry. In case of biomedical applications the interaction of nanoparticles with biomacromolecules are investigated, mostly with aspect of the nanohazard, drug targeting delivery, hyperthermia and treatment of many human diseases as e.g. Alzheimer's diseases, etc. For technical applications the centre investigates opportunities of application in LCD's, sensors of magnetic field, as an insulated and cooling medium in high power transformers and converters, exploitation of multilayered nanotubes and fullerenes as electrodes in device that could convert sun energy into electricity.
4. **CEx APVV "Centre of Cryophysics and Cryonanoelectronics",** Duration: 2008-2011, head P. Samuely. The centre joined 4 Slovak research institutions: IEP, the Safarik University of Kosice, the Comenius university in Bratislava and the Institute of Electrical Engineering SAS in Bratislava.
5. **CEx SAS, NANOSMART,** Duration: 2003-2010, (Head: prof. RNDr. Ján Dusza, DrSc., IMR SAS) Head of WP „Nanostructured YBCO bulk superconductors“: Pavel Diko – the research was focused on formation of nanosize pinning centers by doping. Results were published in 12 papers. Head of WP „Nanostructured magnetic materials“: Ivan Škorvánek.
6. **Centre of Excellence SAS: Nanostructured Materials NANOSMART II.** The centre joined 8 research groups working in the area of nanostructured materials from 7 Institutes of Slovak Academy of Sciences. Duration: 2006 – 2010. Responsible person: Ivan Škorvánek, Pavel Diko

ii. List of national scientific conferences (co)-organised by the Organisation

Yearly the Conference of Slovak Physicists has been co-organized by Institute employees.

iii. List of national journals published by the Organisation

None

iv. List of edited proceedings of national scientific conferences/events

- [1] *17th Conference of Slovak Physicists, Bratislava, 16.-19.9. 2009 : proceedings* Ed. **M. REIFFERS**. Bratislava : Slovak Physical Society, 2009. 1 CD-ROM (204 s.). CD-ROM, <http://neon.dpp.fmph.uniba.sk/ksf17/prispevky/17ksf.pdf> ISBN 978-80-969124-7-.
- [2] *Space Research in Slovakia 2008-2009: COSPAR, Slovak National Committee*. Editors **K. KUDELA**, Ján Feranec and Ladislav Macho. Košice : Slovak Academy of Sciences, 2010. 62 s. ISBN 978-80-968060-7-2.
- [3] *18th Conference of Slovak Physicists, 6.-9.9. 2010, Matej Bel University, Banská Bystrica : proceedings*. Editor **M. REIFFERS**. Košice : SFS, 2011. 148 s. ISBN 978-80-970625-0-7.

- **International/European position of the individual researchers**

- i. **List of invited/keynote presentations at international conferences, documented by an invitation letter or programme**

- [1] **DIKO P.** Microstructural design of YBCO bulk superconductors. In *ISS 2009: 22nd International Symposium on Superconductivity*, Nov. 02 - Nov. 04. 2009, Tsukuba, Japan. - Tsukuba, 2009, *invited plenary lecture* PL-2-INV, highlights of the ISS09. AFE 115216.
- [2] **BRADLEY D.I., ČLOVEČKO M., FISHER S.N., GAŽO E., GUÉNAULT A.M., HALEY R.P., KUPKA M., PICKETT G.R., SKYBA M., SKYBA P., SURAMLISHVILI N., TSEPELIN V.** Anomalous spin relaxation and quasiparticle damping in superfluid ³He-B at very low temperatures. In *LT26: 26th International Conference on Low Temperature Physics*, August 10-17, 2011, Beijing, China, invited lecture.
- [3] **SEDLÁK M.** Aqueous solutions: unusual features. In *The Sixth Annual Conference on the Physics, Chemistry and Biology of Water 2011*, West Dover, Vermont, USA, 20.10.-23.10. 2011, invited lecture.
- [4] **KUDELA K.** Cosmic Rays and Space Weather: Direct and Indirect Relations. In *ICRC 2007: 30th International Cosmic Ray Conference*, July 3 – 11, 2007, Mérida, Yucatan, Mexico. Session: Plenaries 3. Invited talk 1313. Highlight talk.
- [5] **ŠKORVÁNEK I., MARCIN J., ŠVEC P.** Field-Annealed Fe-Co Based Amorphous and Nanocrystalline Alloys with Improved Magnetic Softness. In *TMS 2011: 140th Annual Meeting and Exhibition*, February 27-March 3, 2011, San Diego, California, USA, invited lecture.
- [6] **SAMUELY P.** Scanning Tunneling Spectroscopy of Superconducting Energy Gap in SrPd₂Ge₂ Single Crystal, Isostructural with 122 Iron Pnictides. In

Stripes 11: 8th International Conference on Stripes and High Tc Superconductivity: Quantum Phenomena in Complex Matter and Quantum Physics of Living Matter, Rome, Italy, 10 July - 16 July 2011. - Roma: Superstripes Press, 2011, p. 57. ISBN 978-88-904818-4-0, invited lecture.

- [7] **KOPČANSKÝ P.**, KONERACKÁ M., TIMKO M., TOMAŠOVIČOVÁ N., ZÁVIŠOVÁ V., MITRÓOVÁ Z. Nematic isotropic transition in ferronematics induced by magnetic field. In *MISM 2011: Moscow International Symposium on Magnetism*, August 21-25, 2011, Moscow Russia, invited lecture.
- [8] **SKYBA P.** Bose-Einstein condensates of magnons in superfluid $^3\text{He-B}$ and symmetry breaking fields. In *QFS 2010: international symposium on quantum fluids and solids*, August 1-7, 2010, Grenoble, France, invited talk, s. 119. AFE 133581.
- [9] **ŠKORVÁNEK I.**, ŠVEC P., MARCIN J., TURČANOVÁ J., **KOVÁČ J.**, JANIČKOVIČ D. Nanocrystalline Fe(Co,Ni)-based alloys with tailorable soft magnetic properties. In *ANMM'07: 4th International Workshop on Amorphous and Nanostructured Magnetic Materials*, 29 – 31 August 2007, Iasi, Romania. Programme and Abstracts. Iasi: National Institute of Research and Development for Technical Physics, 2007.
- [10] **DIKO P.**, KAŇUCHOVÁ M., ŠEFČÍKOVÁ M., ZMORAYOVÁ K. On the mechanism of 211 particle refinement by CeO₂ addition. In *PASREG 2007: 6th International Workshop on the Processing and Applications of Superconducting (RE)BCO Large Grain Materials*, Corpus Christi College and the Department of Engineering, Cambridge, UK, 13 – 15 September 2007. Invited contribution PIV-1. Sent to J. Mat. Sci. Engn. B.
- [11] EISTERER M., HÖRHAGER N., ZEHETMAYER M., HENGSTBERGER F., WEBER H.W., ŠEFČÍKOVÁ M., **DIKO P.** Influence of a/c microcracks on the trapped field of bulk superconductors. In *PASREG 2007: 6th International Workshop on the Processing and Applications of Superconducting (RE)BCO Large Grain Materials*, Corpus Christi College and the Department of Engineering, Cambridge, UK, 13 – 15 September 2007. Invited contribution CIV-3. Sent to J. Mat. Sci. Engn. B.
- [12] **ŠKORVÁNEK I.**, MARCIN J., TURČANOVÁ J., KOVÁČ J., ŠVEC P., JANIČKOVIČ D. Recent advances on soft magnetic nanocrystalline alloys. In *NANOVED 2007: 4th International Conference on Nanosciences and Nanotechnologies*, Bratislava, Slovakia, November 11 – 14, 2007. Eds. F. Šimančík, P. Švec, I. Vávra. Program and Abstracts. Brno: Tribun EU, 2007. Invited contributions L09.
- [13] KAČMARČÍK J., SZABÓ P., **SAMUELY P.**, RODRIGO J.G., SUDEROW H., VIEIRA S., LAFOND A., MEERSCHAUT A. Intrinsic Josephson junction behavior of the low T_c (LaSe)_{1.14}(NbSe₂) superconductor. In *VORTEX V: Joint ESF and JSPS Conference on Vortex Matter in Nanostructured Superconductors*, 8-14 September 2007, Rhodes, Greece. Abstract Book. SUN.13. Invited talk. Proc. Physica C.

- [14] **KUDELA K.** Solar particle phenomena into magnetosphere. In Institute for Nuclear Research and Nuclear Energy, BEO Centre of Excellence, BEOBAL FP6 project, Solar particle phenomena training seminar, 20 Februar 2007, Sofia, Bulgaria. Invited talk.
- [15] **KUDELA K.** Transmissivity of low energy cosmic rays in variable magnetosphere. In *VIII COLAGE: Proceedings of the VIII Latin American Conference on Space Geophysics*, Mérida, Mexico, July 11 – 17, 2007. Invited talk.
- [16] **KUDELA K.**, L. Lazutin, Selected Solar Influences on the Magnetosphere: Information from Cosmic Rays, IAGA 2009 Scientific Assembly, Sopron, Hungary, August 23 - 30, 2009, invited talk
- [17] **GAŽOVÁ Z.** Amyloid Assembly. In EU Project STRP-032652 BIODOT Meeting, Budapest, Hungary, 7-8 May, 2007. Invited lecture.
- [18] **KOŽÁR T.** Clusters, Grids & Molecules: Virtual Screening. In *Grid for Pharmaceutical & Biomedical Challenges*. EGEE Industry Day Bratislava, Slovakia, 19 September 2007. Invited lecture.
- [19] **KOŽÁR T.** High-throughput computing in molecular modeling and design. In *GCCP 2007: 3rd International Workshop on Grid Computing for Complex Problems*, Bratislava, Slovakia, October 22-23, 2007. Invited lecture.
- [20] **REIFFERS M.**, PRISTÁŠ G., ILKOVIČ S. Point contact spectroscopy of ground state of non-Fermi liquid compounds in system $\text{YbCu}_5\text{-xAl}_x$ ($x = 1.3 - 1.75$), *Exotic States in Materials with Strongly Correlated Electrons 2007 - ESM 07* - Sinaia, Rumania - 09/2007.
- [21] **SAMUELY P.** et al., Intrinsic Josephson junction behavior of the low T_c $(\text{LaSe})_{1.14}(\text{NbSe}_2)$ superconductor, VORTEX V, Crete, Greece.
- [22] **TIMKO M.**, Magnetic fluids-Preparation, properties and applications, in *European Summer School, Magnetic nanoparticles, composite materials and optical applications*, 3-8 September, 2007, St Etienne, France.
- [23] **STRÍŽENEC P.** Geant4 validation with test beam data from LHC calorimetry. In *12th Geant4 Collaboration Workshop*, 13-19 September 2007, The Birchcliffe Centre, England. Plenary Session 1. Invited talk.
- [24] **ANTOŠ J.**, Top Charge Measurement, invited talk at CDF in *Paris meeting*, Paris, May 28-th - July 2-nd, 2007.
- [25] **ANTOŠ J.**, Top Charge Determination, *Triangle Meeting*, Medzilaborce, 9.9-12.9. 2007.
- [26] **LYSÁK R.**, The mass of the top quark, *Triangle Meeting*, Medzilaborce, 9.9-12.9.2007.
- [27] **FLACHBART, K.** Magnetic Rare Earth Compounds. In *MANA-EU Workshop on Atomic Network Compounds for New Energy Applications*, September 14-16, 2008, Tsukuba, Japan. Invited talk.

- [28] **HNATIC M.** Improved e-expansion in theory of turbulence: inclusion of an infrared irrelevant operator as a way of summation of nearest singularities. In *7th International Conference on Renormalization Group and Related Topics*, Dubna, September 1-5, 2008.
- [29] **HNATIC M.** Influence of parity violation to scalling regimes in Kraichnan model. *2nd Int. Conf. Models of Quantum Field Theory*, Sankt Peterburg State University, 5. - 7. November 2008.
- [30] **KONERACKÁ M., ZÁVIŠOVÁ V., MUCKOVÁ M. JURÍKOVÁ A., TOMAŠOVIČOVÁ N., LANCZ G., KOPČANSKÝ P., TIMKO M., FABIÁN M.** Anti-cancer drug taxol loaded by magnetic polymer nanospheres for biomedical applications. In *Proceedings of the 7th International PAMIR Conference Fundamental and Applied MHD and COST P17 Annual Workshop 2008, Presqu'île de Giens, France, September 8 - 12, 2008: Volume 1/2, invited lecture*, S. 29-34.
- [31] **KOPČANSKÝ P., KONERACKÁ M., TIMKO M., TOMAŠOVIČOVÁ N., ZÁVIŠOVÁ V., TOMČO L., DŽAROVÁ A., ŠPRINCOVÁ A., ÉBER N., FODOR-CSORBA K., TÓTH-KATONA T., VAJDA A., JADZYN J.** Nematic liquid crystal doped by fine magnetic particles of different shape. In *MISM 2008: Moscow International Symposium on Magnetism*, June 20-25, 2008. Book of abstracts. - Moscow: M.V. Lomonosov MSU, 2008. ISBN 978-5-8279-0072-6, invited lecture 23RP-F-10, s. 407-408.
- [32] **KUDELA K.** Cosmic ray transmissivity in variable magnetosphere on various time scales. In *FORGES 2008: Forecasting of the Radiation and Geomagnetic Storms by networks of particle detectors*, September 29-October 3, 2008, International Conference Center, Nor Amberd, Armenia. Invited talk.
- [33] **NEMČÍK Ján - POTASHNIKOVA I.K.** Forward Physics in Proton -Nucleus and Nucleus-Nucleus. *Sixth International Conference on Perspectives in Hadronic Physics*, Trieste, Italy, 12 - 16 May, 2008. In AIP Conference Proceedings. ISSN 0094-243X, 2008, vol. 1056, p. 207-214. Invited talk.
- [34] **NEMČÍK J.** Nuclear Suppression at Large χF . In *ECT Workshop Nuclear medium effects on the quark and gluon structure of hadrons*, Trento, Italia, June 3-7, 2008. Invited talk.
- [35] **MITO T., WADA S., IDZIKOWSKI B., REIFFERS M., KOTEGAWA H., KOBARASHI T.C., SARRAO J.L.** High pressure studies on Yb based strongly correlated electron systems. In *The European Conference Physics of Magnetism 2008*, June 24-27, 2008, Poznan, Poland, invited lecture
- [36] **REIFFERS M., IDZIKOWSKI B., ILKOVIČ S., ŠEBEK J., ŠANTAVÁ E.** Heat capacity of the melt-spun cubic RECu₅ compounds (RE - heavy rare earths). In *The European Conference Physics of Magnetism 2008*, June 24-27, 2008, Poznan, Poland, invited lecture
- [37] **ŠKORVÁNEK I., MARCIN J., TURČANOVÁ J., KOVÁČ J., ŠVEC P., JANIČKOVIČ D.** Recent advances in soft magnetic nanocrystalline Fe-Co and

Fe-Ni based alloys. In *IWNCS 2008: Ninth International Workshop on Non-Crystalline Solids*, Porto, 27-30 April 2008, abstr. I-16, p. 28.

- [38] **ŠPRINCOVÁ A.**, KONERACKÁ M., ZÁVIŠOVÁ V., DŽAROVÁ A., TIMKO M., KOPČANSKÝ P., DUBNIČKOVÁ M. Effects of Differently Shaped Fine Magnetite Nanoparticles on Human Leukocyte Activity. In *NANORISK 2008 Conference: Seventh Framework Programme EU*, 21. - 23. oktobra 2008, Paris, France, invited talk.
- [39] **TIMKO M.**, DŽAROVÁ A., KONERACKÁ M., KOPČANSKÝ P., TOMAŠOVIČOVÁ N. Magnetic nanoparticles and their application in biomedicine. In *16th Conference of Czech and Slovak Physicists*, September 8-11, 2008, Hradec Králové: proceedings of abstracts. - Hradec Králové: CPS and SPS, 2008, plenary lectures, S. 7.
- [40] **KONERACKÁ M.** Polymer magnetic nanoparticles for magnetic drug targeting. In *Workshop Smart Fluids and Complex Flows*, 5-6 June, 2009, Timisoara, Romania.
- [41] **KOPČANSKÝ P.**, KONERACKÁ M., TIMKO M., TOMAŠOVIČOVÁ N., HNATIČ M., BEAUGNON E., CHAUD X. The structural transitions in liquid crystals doped with magnetic particles. In *Ukrainian-Hungarian Days for the Extending of the Bilateral Cooperation*, 3rd - 4th November, 2009, Uzhorod, Ukraine: book of abstracts and papers. - Uzhorod: GRAŽDA, 2009. ISBN 978-966-176-037-9, Invited lecture, s. 13. AFE 112920.
- [42] **KOPČANSKÝ P.** How magnetic nanoparticles can influence the sensitivity of liquid crystals to external magnetic fields. In *Workshop Smart Fluids and Complex Flows*, 5-6 June, 2009, Timisoara, Romania.
- [43] **KUDELA K.**, LAZUTIN L. Solar Influence on the Magnetosphere: Information by Cosmic Rays. In *IGA 2009: abstract book of the IAGA 11th scientific assembly*, Sopron, Hungary, 24-29 August, 2009, invited talk. AFE 111275.
- [44] **NEMČÍK J.**, ŠUMBERA M. Nuclear suppression at large x. In *4th International Workshop on high-pt Physics at LHC 09*, Prague, Czech Republic, 04 Feb - 07 Feb 2009: proceedings of science. - Prague, 2009. ISSN 1824-8039, invited talk, PoS 042. AFA 115292.
- [45] **NEMČÍK J.**, ŠUMBERA M. Suppression of high-pT particles produced in interactions of high energy protons and deuterons with nuclear targets. In *N-N 2009: 10th International Conference on Nucleus-Nucleus collisions*, August 16-21, 2009, Beijing, China, invited talk. Nucl. Phys. A. AFE 115313.
- [46] CEPILA J., **NEMČÍK J.** Nuclear Suppression of Dileptons at Large-xF. In *HADRON STRUCTURE '09 : 3rd joint International Conference*, August 30 - September 4, 2009, Tatranská Štrba, Slovakia, invited talk, AFE 115264.
- [47] **SAMUELY P.**, PRIBULOVÁ Z., SZABÓ P., PRISTÁŠ G., BUĐKO S.L., CANFIELD P.C. Superconducting energy gaps in 122-type family of iron pnictides. In *Nanoscience and Engineering in Superconductivity, Hybrid and Josephson Structures*, Anacapri, 3-6 June 2009: abstract book. - Anacapri: European Science Foundation, 2009, invited talk, s.48.

- [48] **SAMUELY P.** High Temperature superconductors. In *EU - Japanese Expert´s Workshop on Novel Superconducting Materials*, 10-11 November 2009, Brussels, Belgicko.
- [49] **SKYBA P.** Measurement Methods of Vibrating Mechanical Objects Used for Generation and Detection of Quantum Turbulence. In *Workshop on Topics in Quantum Turbulence*, 16 March - 20 March 2009, ICTP, Trieste, Italy.
- [50] **ŠKORVÁNEK I.** Tailoring of functional properties of magnetic materials by thermal processing in static magnetic field. In *COST P17: training school on magneto sciences*, Riga, Latvia, May 18-22, 2009. Volume 2. - Riga, 2009, invited talk, s. 345-388. AFA 114589.
- [51] **ŠKORVÁNEK I., MARCIN J., TURČANOVÁ J., HANKO J., ŠVEC P.** FeCo-based nanocrystalline alloys with tailorable soft magnetic properties. In *ICCE-17: seventeenth International Conference on Composites or Nano Engineering*, July 26 - August 1, 2009 - Honolulu: International Comunity for Composites or Nano Engineering, 2009, invited talk. AFA 114502.
- [52] **TIMKO M.** Dielectric properties of transformer oil based magnetic fluids. In *Workshop Smart Fluids and Complex Flows*, 5-6 June, 2009, Timisoara, Romania.
- [53] **TIMKO M., KOPČANSKÝ P., KONERACKÁ M., TOMČO L., MARTON K.** Magnetic fluids for transformers. In *Ukrainian-Hungarian Days for the Extending of the Bilateral Cooperation*, 3rd - 4th November, 2009, Uzhorod, Ukraine: book of abstracts and papers. - Uzhorod: GRAŽDA, 2009. ISBN 978-966-176-037-9, s. 14. AFE 112919.
- [54] **HNATICĀ M.,** The workshop on tools of theoretical physics and the problem of turbulence 16.-20. february, 2009 (pedagogic workshop), S.N.Bose National Centre for Basic Sciences, Kolkata, Cycle of 6 invited talks about: Application of the quantum-field theory methods in the theory of developed turbulence.
- [55] **DIKO P.** New possibilities in microstructrural design of REBCO bulk superconductors. In *ICSM 2010: international Conference on Superconductivity and magnetism*, 25-30 April 2010, Antalya, Turkey. Abstract Book, invited talk S-I-006, s. 20. AFE 125176.
- [56] **KAČMARČÍK J., PRIBULOVÁ Z., MARCENAT C., KLEIN T., RODIÉRE P., CARIO L., SAMUELY P.** NbS₂ and NbSe₂ - new family of two-gap superconductors?. In *International Workshop on Superconductivity in Reduced Dimensions*, Salzburg, Austria, May 4 - 8, 2010: scientific programme and abstracts, invited talk, s. 63. AFE 133369.
- [57] **DIKO P., ZMORAYOVÁ K., ŠEFČÍKOVÁ M., ANTAL V., KAVEČANSKÝ V., CHAUD X., EISTERER M., WEBER H.** Influence of Post-growth Thermal Treatments on Critical Current Density of TSMG YBCO Bulk Superconductors. In *PASREG 2010: International Workshop on Processing and Applications of Superconducting (RE)BCO Large Grain Materials*, July 29-31, 2010, Washington. Program and abstracts, invited talk, s. 15. AFE 133372.

- [58] **ANTOŠOVÁ A.**, ŠIPOŠOVÁ K., KONERACKÁ M., ZÁVIŠOVÁ V., DAXNEROVÁ Z., VÁVRA I., FEDUNOVÁ D., BÁGELOVÁ J., KOPČANSKÝ P., GAŽOVÁ Z. Magnetic fluid - a novel approach to treat amyloid-related diseases. In *ICMF 12: 12th International Conference on Magnetic Fluids*, August 1 - 5, 2010, Sendai, Japan. Abstract Book. - 2010, abstract invited talk OS7-1099, s. 61-62. AFE 129606.
- [59] ČURLIK I., **REIFFERS M.**, GIOVANNINI M. The heat, transport and magnetic properties of a novel Yb-Pd-Sn and YbCu₄Ni compounds. In *JEMS 2010: joint European Magnetic Symposia*, 23 - 28 August 2010, Kraków, Poland. Programme. Abstracts. - Kraków, Poland: Institute of Physics, Jagiellonian University, 2010, abstract invited talk 112, s. 78. AFE 130343.
- [60] **SAMUELY P.** Point contact spectroscopy of superconducting energy gap. The case of MgB₂ and pnictides. In *Cryoconference 2010 - Young Research*, Mýto pod Ďumbierom, Nízke Tatry, 9 - 15 September 2010, abstract invited talk. AFFA 131411.
- [61] **SKYBA P.** Superfluid phases of helium-3 and BEC of magnons. In *Cryoconference 2010 - Young Research*, Mýto pod Ďumbierom, Nízke Tatry, 9 - 15 September 2010, abstract invited talk. AFFA 131412.
- [62] **ŠKORVÁNEK I.**, MARCIN J., CAPIK M., VARGA M., TURČANOVÁ J., KOVÁČ J., ŠVEC P., JANIČKOVIČ D., KOVÁČ F., STOYKA V. Tailoring of functional properties in Fe-based soft magnetic alloys by thermal processing under magnetic field. In *Fundamental and applied MHD: 8th international pamir conference*. Borgo, Corsica, 5.-9.9.2011. - B.V., 2011, vol. 2, P. 903-908, invited lecture.
- [63] **ŠKORVÁNEK I.**, MARCIN J., KOVÁČ J., ŠVEC P. Recent Progress in FeCo-Based Soft Magnetic Nanocrystalline Alloys. In *PM 2011: European Conference Physics of Magnetism*, June 27 - July 1, 2011, Poznan, Poland. Abstracts. - Poznan: IMP PAS, 2011, p. 28. ISBN 83-922407-6-6, invited lecture.
- [64] **ŠKORVÁNEK I.**, MARCIN J., KOVÁČ J., IDZIKOWSKI B., ŠVEC P. Amorphous and nanocrystalline FeCo- and GdFeCo-based alloys with improved application-oriented properties. In *ANMM 2011: 5th International Workshop on Amorphous and Nanostructured Magnetic Materials*, 5-7 September 2011, Iasi, Romania. - Iasi: National Institute of Research and Development for Technical Physics, 2011, I.3, p. 19, invited lecture.
- [65] **ŠKORVÁNEK I.** Magneto-static applications. In *GAMAS Summer School*, September 5 - 9, 2011, Borgo, Corsica, France, invited lecture.
- [66] **KUDELA K.** Energetic particles in space and cosmic rays in relation to selected problems of Space Weather. In *IsraSWAPS 2011: Space Weather and Plasma in Space*, Qazrin, Israel, May 1-5, 2011, invited lecture.
- [67] **KUDELA K.** Principal Investigator of Lomnický štít Neutron Monitor. In *Athens Cosmic Ray Station "10 years of operation" 2000-2010: Energetic particles in*

Space, Cosmic Rays and Space Weather: selected results and tasks, Athens, Greece, March 10, 2011, invited lecture.

- [68] **KUDELA K.** Cosmic rays and relations to Space Weather. In *ISWI 2011: Europe Summer School in Space Science*, August 21-27, 2011, Tatranská Lomnica, Slovakia, invited lecture.
- [69] **KOPČANSKÝ P.**, ŠIPOŠOVÁ K., KUBOVČÍKOVÁ M., BEDNÁRIKOVÁ Z., KONERACKÁ M., ZÁVIŠOVÁ V., ANTOŠOVÁ A., DAXNEROVÁ Z., GAŽOVÁ Z. Interaction of magnetic fluids with amyloid structures. In *Workshop Structural aspects of biocompatible ferrocolloids: stabilization, properties control and application*, 19-20 August 2011, Dubna, Russia, invited lecture
- [70] **KOPČANSKÝ P.** The Induced Structural Changes in Liquid Crystals Doped by Magnetic. In *NCTS April Workshop on Critical Phenomena and Complex Systems*, April 29-30, 2011, Taipei, Republic of China, invited lecture.
- [71] SAMUELY T., SZABÓ P., RODRIGO J.G., INOSOV D.S., PARK, J.T., SUNG N.H., CHO, B.K., **SAMUELY P.** Scanning Tunneling Spectroscopy of Superconducting Energy Gap in SrPd₂Ge₂ Single Crystal, Isostructural with 122 Iron Pnictides. In *International Workshop on Mesoscopic Superconductivity and Vortex Imaging*, Bath, U.K., 3-7 May, 2011, invited lecture.
- [72] SAMUELY T., SZABÓ P., RODRIGO J.G., **SAMUELY P.** Superconducting density of states and vortex studies on SrPd₂Ge₂. In *Seventh International Conference on Vortex Matter in Nanostructured Superconductors*, Rhodes, Greece, 10-17 September, 2011, invited lecture
- [73] SAMUELY T., **SZABÓ P.**, RODRIGO J.G., INOSOV D.S., PARK J.T., SUNG N.H., CHO B.K., SAMUELY P. Scanning Tunneling Spectroscopy of SrPd₂Ge₂ Single Crystal, Isostructural with 122 Iron Pnictides. In *E-MRS 2011 Fall Meeting*, Warsaw, Poland, September 19 - 23, 2011, invited lecture.
- [74] **KOŽÁR T.** Clusters, Grids and Molecules: HTC and HPC Computing. In *NCTS April Workshop on Critical Phenomena and Complex Systems*, April 29-30, 2011, Taipei, Republic of China, invited lecture.
- [75] **KOŽÁR T.** New trends in simulation of biomacromolecules and nanostructures. In *Spring School - a Week of Doctoral Studies*, May 16-20, 2011, Nový Smokovec: proceedings, invited lecture.
- [76] **GAŽOVÁ Z.** Inhibitors of protein amyloid aggregation. In *NCTS April Workshop on Critical Phenomena and Complex Systems*, April 29-30, 2011, Taipei, Republic of China, invited lecture.

ii. **List of employees who served as members of the organising and/or programme committees for international conferences**

M. MIHÁLIK, Chairman of the 13th Czech and Slovak Conference on Magnetism CSMAG'07, 9.-12. July 2007, Košice, Slovakia.

I. ŠKORVÁNEK, Program Chairman of 13th Czech and Slovak Conference on Magnetism CSMAG'07, 9.-12. July 2007, Košice, Slovakia.

J. KOVÁČ, Publication Chairman of 13th Czech and Slovak Conference on Magnetism CSMAG'07, 9.-12. July 2007, Košice, Slovakia.

P. SAMUELY, 13th Czech and Slovak Conference on Magnetism CSMAG'07, 9.-12. July 2007, Košice, Slovakia.

M. TIMKO, European Summer School, Magnetic nanoparticles, composite materials and optical applications, 3-8 September, 2007 St Etienne, France.

K. KUDELA, co-organiser of the workshop "50 years from the beginning of continuous cosmic ray registration" organizovaného v Merida, Mexico, <http://www.icrc2007.unam.mx/workshops>

D. BRUNCKO, member of the organising committee of the international conference Hadron Structure 2007.

P. STRÍŽENEC, member of the organising committee of the international conference Hadron Structure 2007.

M. REIFFERS, member of the organising committee of the Annual general workshop COST ECOM.

P. SAMUELY, Member of International Advisory Board VORTEX V, Crete, Greece.

P. DIKO, International Advisory Committee, PASREG 29–31 July 2010, Washington DC, USA.

P. DIKO, Member of International Scientific Committee, 13th International Symposium on Metallography, METALLOGRAPHY '07, 07, 02- 04.06.2007, ACADEMIA Congress Centre, Stará Lesná, High Tatra Mountains, Slovak Republic.

P. DIKO, Member of International Advisory Board, NANOVED 2007, 4th International Conference on Nanosciences and Nanotechnologies Bratislava, Slovakia, November 11 – 14, 2007.

I. ŠKORVÁNEK, Member of International Advisory Committee, Soft Magnetic Materials Conference SMM-18, Cardiff, Great Britain, September 2.–5., 2007.

I. ŠKORVÁNEK, Member of International Advisory Board, NANOVED 2007, 4th International Conference on Nanosciences and Nanotechnologies, Bratislava, Slovakia, November 11 – 14, 2007.

L. ŠÁNDOR, I. KRÁLIK, Members of the organizing committee of the SQM 2007 Strangeness in Quark Matter, Levoča, Slovakia, June 24 - 29, 2007.

L. ŠÁNDOR, Member of the International Advisory Committee, XXXVII International Symposium on Multiparticle Dynamics ISMD 2007, Berkeley, USA, August 4 - 9, 2007.

D. BRUNCKO, Member of International Advisory Board, XVI Int. Workshop on Deep Inelastic Scattering and Related Subjects, London, UK, 7.-11. 4. 2008

K. KUDELA, Member of International Advisory Board FORGES 2008: Forecasting of Radiation and Geomagnetic Storms by networks of particle detectors, September 29 – October 3, 2008, Nor Amberd, Armenia; member international advisory committee ICRC Merida, Mexico, 2007; ICRC Lodz, Poland, 2009; ECRS Turku, Finland, 2010.

K. KUDELA, Member of International Advisory Board - International Workshop on Advances in Cosmic Ray Science, March 17 – 19, 2008, Waseda University, Shinjuku, Tokyo, Japan

K. KUDELA, Member of International Advisory Committee and Session Organizer of 10th, 11th, 12th and 13th ICATPP Conference on Astroparticle, Particle, Space Physics, Detectors and Medical Physics Applications organized in 2007, 2009, 2010, 2011 - Villa Olmo, Como, Italy

M. REIFFERS, Member of International Advisory Board 2008 General Workshop of the COST P16 - ECOM Action, 16.-19.7.2008, Santander, Spain.

M. TIMKO, member of the organising committee Conference of Czech and Slovak Physicists, 8. - 11.9.2008, Hradec Králové, Czech Republic

M. ZENTKOVÁ, Member of International Advisory Board Magnetic Measurements 2008, September 21 – 24, 2008, Budapest, Hungary.

J. BALÁŽ, member of the organising committee 21st European Cosmic Ray Symposium, 9 - 12 September 2008, Košice, Slovakia.

P. BOBÍK, member of the organising committee 21st European Cosmic Ray Symposium, 9 - 12 September 2008, Košice.

D. BRUNCKO, member of the organising committee, HSQCD 2008 Hadron Structure and QCD, 30. jún – 4. júl. 2008, Gatčina, Rusko.

K. KUDELA, chairman 21st European Cosmic Ray Symposium, 9 - 12 September 2008, Košice, Slovakia.

M. REIFFERS, member of the organising committee 16. Konference českých a slovenských fyziku, 8.-11.9.2008, Hradec Králové, Czech Republic.

M. SLIVKA, member of the organising committee 21st European Cosmic Ray Symposium, 9 - 12 September 2008, Košice, Slovakia

P. SAMUELY, Member of International Advisory Board Probing superconductivity at nanoscale, Alicante, Španielsko.

I. ŠKORVÁNEK, co-organizer of workshop „Utilization of Electromagnetic Processing of Materials (EPM) to Control the Properties and Microstructure of Solids”, 27. 5. - 29. 5. 2009 Prague, Czech Republic.

I. ŠKORVÁNEK, Member of International Committee, Soft Magnetic Materials Conference SMM-19, Torino, Italy, September 6. – 9., 2009.

I. ŠKORVÁNEK, Chairman of 14th Czech and Slovak Conference on Magnetism, July 6.-9., 2010, Košice, Slovakia, CSMAG-10.

I. ŠKORVÁNEK, member of organizing committee of Nanoved & Nanotech &

Techtransfer 2010: International conference on nanosciences, nanotechnologies, nanomaterials, nanomedicine and technology transfer, Bratislava, Slovakia, May 16 - 19, 2010.

J. MARCIN, Program Chairman of 14th Czech and Slovak Conference on Magnetism, July 6.-9., 2010, Košice, Slovakia, CSMAG-10.

J. KOVÁČ, Publication Chairman of 14th Czech and Slovak Conference on Magnetism, July 6.-9., 2010, Košice, Slovakia, CSMAG-10.

I. ŠKORVÁNEK, Member of International Committee, Soft Magnetic Materials Conference SMM-20, Kos, Greece, September 18 – 22, 2011.

I. ŠKORVÁNEK, Member of International Scientific Committee, „Fundamental and Applied Magnetohydrodynamics (PAMIR) Conference“Borgo, Corsica, France, September 5-9, 2011.

I. ŠKORVÁNEK, Member of International Program Committee, International Workshop on Amorphous and Nanostructured Magnetic Materials, Iasi, Romania, September 4-7, 2011.

L. ŠÁNDOR, Member of the International Advisory Committee and a convenor of the Heavy Flavours section, XXXIX. International Symposium on Multiparticle Dynamics ISMD 2009, Gomel, Belarus, September 4 - 9, 2009.

L. ŠÁNDOR, Member of the International Advisory Committee, XL International Symposium on Multiparticle Dynamics ISMD 2010, Antwerp, Belgium, September 21 - 25, 2010.

M. ANTALÍK, J. BÁGEL'OVÁ, D. FEDUNOVÁ, Z. GAŽOVÁ, T. KOŽÁR, Z. TOMORI, E. DEMJÉN – members of scientific committee 5th - 7th International Conferences "Structure and Stability of Biomacromolecules, 5.9.-8.9.2007, 09.09.-11.09.2009, 06.09.-09.09.2011, Kosice Slovakia.

T. KOŽÁR, Member of program committee: 4th International Workshop on Grid Computing for Complex Problems, Bratislava, 2008, 5th International Workshop on Grid Computing for Complex Problems, Bratislava, 2009, 6th International Workshop on Grid Computing for Complex Problems, Bratislava, 2009, 7th International Workshop on Grid Computing for Complex Problems, Bratislava, 2010, 8th International Workshop on Grid Computing for Complex Problems, Bratislava, 2011.

M. HNATIČ, *Member of organizing committees:* Renormalization group and related topics 2008, September 2008, Dubna, Russia; „Hadron Structure 2009, (HS09), August 2009, Tatranská Štrba, Slovakia; „Hadron Structure 2011, (HS11), June 2011, Tatranská Štrba, Slovakia; Models of Quantum field theory 2010, (MQFT 2010) , Oct. 2010, Sankt Peterburg, Russia; European Committee for Future Accelerators, May 2011, Košice, Slovakia.

Member of program committees: Mathematical methods and Computational Physics 2009, (MMCP2009) , júl 2009, Dubna, Russia; Models of Quantum field theory 2010, (MQFT 2010) , Oct. 2010, Sankt Peterburg, Russia.

Chairman of conferences: Mathematical methods and Computational Physics 2011, July 2011, Stará Lesná-Hotel Akadémia, Slovakia; Small Triangle Meeting on Theoretical Physics“ 2008, 2010.

iii. List of employees who served as members of important international scientific bodies (e.g. boards, committees, editorial boards of scientific journals)

I. ŠKORVÁNEK - member of the International Committee of Soft Magnetic Materials (SMM), member of the International Scientific Committee of the Applied MHD (PAMIR), member of the Magnetism Committee of the Minerals, Metals & Materials Society (TMS), vice president of Humboldt club in Slovak Republic, leader of the professional group "Magnetism" of the Slovak Physical Society, deputy chairman of national IUPAP committee, member of Editorial board of scientific journal ISRN Nanotechnology.

M. REIFFERS - individual member of EPS, secretary of national committee IUPAP, member of IOP.

P. SAMUELY - member of American Physical Society (APS), member of Academia Europaea Scientiarum et Artium, Salzburg.

P. SZABÓ - member of APS.

K. KUDELA - member of IUPAP C4 (Cosmic Rays), chairman of NK COSPAR, member of NK URSI, member of American Geophysical Union, member of the advisory Board of Acta Universitatis Carolinae, member of Editorial Advisory Board of the Open Aerospace Engineering Journal, Elected as Corresponding member of IAA in 2007, member of the Editorial Advisory Board of Acta Electrotechnica et Informatica, member of Editorial Advisory Board of Indian Journal of Radio and Space Physics.

P. KOPČANSKÝ - member of International Advisory Committee for Magnetic Fluids

K. FLACHBART - member of German Physical Society DPG, member of American Physical Society, member of Editorial Advisory Board of Acta Electrotechnica et Informatica.

M. SEDLÁK - member of American Chemical Society, member of American Physical Society.

Z. TOMORI - member of IEEE Computer Society, USA.

D. BRUNCKO - member of the Council of the Center of elementary physics LC527, Praha CzR, member of the collaboration of the Council for experiment ALICE in CERN.

V. KAVEČANSKÝ - member of the Crystallographic society

L. ŠÁNDOR - member of the Council of the Centre for physics of relativistic atomic collisions (CFRJS), member of collaboration Council for experiment ALICE in CERN, member of working group CERN for scientific and geographic extension CERN.

J. NEMČÍK - scientific referee of the Council of the Centre for Physics of Relativistic Atomic Collisions (CFRJS).

Z. TOMORI - member of IEEE Computer Society, USA.

M. ANTALÍK - member of the Editorial Advisory Board of Chemical papers.

P. DIKO - member of Editorial board of ISRN Condensed Matter Physics.

iv. List of international scientific awards and distinctions

None

• National position of the individual researchers

i. List of invited/keynote presentations at national conferences documented by an invitation letter or programme

- [1] **BAŤKO I.** From STM tunnelling to calorimetric tunnelling experiments. In *16. Conference of Slovak Physicists, 10.-13. September 2007, Žilina, Slovakia*. Invited plenary talk.
- [2] **FLACHBART K.** Frustrated magnetic systems and dodecaborides. In *16. Conference of Slovak Physicists, 10.-13. September 2007, Žilina, Slovenská republika*. Invited plenary talk.
- [3] **KUDELA K.** Cosmic weather and cosmic radiation. In *16. Conference of Slovak Physicists, 10.-13. September 2007, Žilina, Slovakia*. Invited plenary talk.
- [4] **BRUNCKO D.** The physics of LHC, School of high energy physics, Svit, Slovakia, 10.9.2007, Invited talk.
- [5] **BRUNCKO D.** LHC and ATLAS in these days. In *KOLOS 2008: International meeting on variable stars observing, Humenné, Slovakia, December 4 – 6, 2008*. Invited talk.
- [6] **KUDELA K.** IHY 2007 in Slovakia: some activities of IEP SAS in Košice: review talk. In *19. National Sun Seminary, Papradno, 12.-16. May 2008: - Hurbanovo: SUH, 2008*, Invited review talk.
- [7] **ŠÁNDOR L.** The recent physics and the first seconds of the Universe. In *40. Conference of Slovak Mathematics, 27. - 30. November 2008, Jasná pod Chopkom, s. 39-40*. Invited talk.
- [8] **ZENTKOVÁ M.** Adventure of knowledge. In *Creative teacher of physics: Festival of Physics 2008, Smolenice, 22.-25. June 2008*. ISBN 978-80-969124-6-9. Invited talk.
- [9] **ANTALÍK M., FEDUNOVÁ D., BÁGEĽOVÁ J.** Conformational transition of cytochrome c. In *Proceedings of the Scientific Conference Physics of Materials ´09 organised on occasion of the 40th anniversary of the foundation of Faculty of Electrical Engineering and Informatics Technical University of Košice, 14-16 October 2009, Košice, Slovakia*. Editors Vladimír Lisý, Dušan Olčák. - Košice: Faculty of Electrical Engineering and Informatics Technical University. ISBN 978-80-8086-122-3, invited lectures, s. 66-67. AFBB 111900.

- [10] **KOPČANSKÝ P.**, TOMAŠOVIČOVÁ N., KONERACKÁ M., TIMKO M., ZÁVIŠOVÁ V., TOMČO L. Magnetic nanoparticles in magnetic fluids. In Proceedings of the Scientific Conference Physics of Materials '09 organised on occasion of the 40th anniversary of the foundation of Faculty of Electrical Engineering and Informatics Technical University of Košice, 14-16 October 2009, Košice, Slovakia. Editors Vladimír Lisý, Dušan Olčák. - Košice: Faculty of Electrical Engineering and Informatics Technical University. ISBN 978-80-8086-122-3, invited lectures, s. 30-33. AFBB 111890.
- [11] **KOPČANSKÝ P.**, TIMKO M., TOMAŠOVIČOVÁ N., KONERACKÁ M., ZÁVIŠOVÁ V., DŽAROVÁ A., MITRÓOVÁ Z., TOMČO L., ÉBER N., FODOR-CSORBA K., TÓTH-KATONA T., VAJDA A., JADZYN J. How magnetic nanoparticles affect the influence of applied magnetic field for liquid crystals for. In *17. Conference of Slovak Physicists*, Bratislava, 16. - 19. September 2009: invited plenary talk, PP 4, s. 7. AFFB 102727.
- [12] **SAMUELY P.** Iron pnictides – New High Temperature superconductors. In *17. Conference of Slovak Physicists*, Bratislava, 16. - 19. September 2009: zborník abstraktov. - Bratislava: FMFI UK Bratislava, SFS, 2009, Invited plenary talk PP 13, s. 12. AFFB 102731.
- [13] **SAMUELY P.**, PRIBULOVÁ Z., SZABÓ P., PRISTÁŠ G., BUŽKO S.L., CANFIELD P.C. Iron Pnictides - New High Temperature superconductors. Point Contact Andreev Reflection Spectroscopy Studies. In *Proceedings of the scientific Conference Physics of Materials '09 organised on occasion of the 40th anniversary of the foundation of Faculty of Electrical Engineering and Informatics Technical University of Košice*, 14-16 October 2009, Košice, Slovakia. Editors Vladimír Lisý, Dušan Olčák. - Košice: Faculty of Electrical Engineering and Informatics Technical University. ISBN 978-80-8086-122-3, invited lectures, s. 1-5. AFBB 111821.
- [14] **ŠKORVÁNEK I.** Nanocrystalline materials with improved magnetic properties. In *17. Conference of Slovak Physicists*. Hotel Družba, Bratislava, 16. - 19. September 2009: Invited plenary talk PP 7, s. 9. AFHB 102729.
- [15] **ŠKORVÁNEK I.**, MARCIN J., TURČANOVÁ J., KOVÁČ J., ŠVEC P. FeCo-based soft magnetic nanocrystalline alloys. In Proceedings of the Scientific Conference Physics of Materials '09 organised on occasion of the 40th anniversary of the foundation of Faculty of Electrical Engineering and Informatics Technical University of Košice, 14-16 October 2009, Košice, Slovakia. Editors Vladimír Lisý, Dušan Olčák. - Košice: Faculty of Electrical Engineering and Informatics Technical University. ISBN 978-80-8086-122-3, invited lectures, s. 22-25. AFBB 111887.
- [16] **SKYBA P.**, ČLOVEČKO M., GAŽO E., KUPKA M. Bose-Einstein condensation of magnons in superfluid ^3He . In *18. Conference of Slovak Physicists, Banská Bystrica, 6 - 9 September 2010*, Invited plenary talk PP5. <<http://sfs.sav.sk/>>. AFFB 133829
- [17] **KOŽÁR, Tibor.** New trends in simulation of biomacromolecules and nanostructures. In Spring School - a Week of Doctoral Studies. Spring School - a Week of Doctoral Studies, May 16-20, 2011, Nový Smokovec: proceedings, invited lecture.
- [18] **ANTALÍK, Marián.** Protein Conformational Stability In Spring School - a Week of Doctoral Studies. Spring School - a Week of Doctoral Studies, May 16-20, 2011, Nový Smokovec : proceedings, invited lecture.

ii. **List of employees who served as members of organising and programme committees of national conferences**

M. REIFFERS, yearly chairman of the Conference of Slovak Physicists.

M. TIMKO, yearly member of the organization committee of the Conference of Slovak Physicists.

iii. **List of employees serving in important national scientific bodies (e.g. boards, committees, editorial boards of scientific journals)**

Organs of SAS

K. KUDELA - member of the assembly of SAS, Scientific Committee of Astron. Institute of SAS.

P. SAMUELY – member of the presidium of SAS, member of the scientific council of SAS, chairman of the Accreditation commission of SAS, Scientific committee of IMR SAS, member of the Learned Society of SAS.

P. DIKO – member of the collegium of SAS for Electronics, Material Research and Technologies.

P. KOPČANSKÝ – Collegium of Slovak Academy of Sciences for Mathematics, Physics and Informatics.

L. ŠÁNDOR - Collegium of Slovak Academy of Sciences for Mathematics, Physics and Informatics.

K. KUDELA – Collegium of SAS for Earth and Space Sciences, Collegium of SAS for Mathematics, Physics and Informatics.

M. SEDLÁK – Collegium of SAS for Chemical Sciences.

M. REIFFERS – chairman of the Dislocation commission of SAS, member of commission of SAS for international contacts.

P. SZABÓ – commission of SAS for propagation.

Z. GAŽOVÁ - Collegium of Slovak Academy of Sciences for Mathematics, Physics and Informatics.

K. FLACHBART - Collegium of Slovak Academy of Sciences for Mathematics, Physics and Informatics, member of commission of SAS for international contacts.

V. KOČAN - Commission of SAS for IT Technologies.

I. ŠKORVÁNEK – Commission of SAS for international projects.

M. ANTALÍK - Collegium of SAS for Chemical Sciences.

Organs of VEGA grant agency

M. ANTALÍK – Commission nr. 8 for Molecular and Cellular Biology, Slovak VEGA grant agency.

P. DIKO – Commission nr. 5 for Mechanical Engineering, Metallurgy and Material Engineering, Slovak VEGA grant agency.

K. CSACH - Commission nr. 5 for Mechanical Engineering, Metallurgy and Material Engineering

K. FLACHBART – Commission nr. 2 for Physics, Slovak VEGA grant agency.

M. HNATIČ – Commission nr. 2 for Physics, Slovak VEGA grant agency.

I. ŠKORVÁNEK – Commission nr. 2 for Physics, Slovak VEGA grant agency.

M. JURČIŠIN – Commission nr. 1, Slovak VEGA grant agency.

P. KOPČANSKÝ - Commission nr. 1, Slovak VEGA grant agency.

P. STRÍŽENEC - Commission nr. 1, Slovak VEGA grant agency.

Organs of APVV grant agency

K. FLACHBART, M. HNATIČ, P. SKYBA, L. ŠÁNDOR - members of the evaluation committee.

P. SAMUELY – member of the council of VVCE.

Organs of Slovak Physical Society

M. REIFFERS – chairman of the Slovak Physical Society.

M. TIMKO – member of the Committee of Solva Physical Society.

iv. List of national awards and distinctions

P. KOPČANSKÝ, M. TIMKO, M. ANTALÍK, M. BÁNÓ, J. BÁGEĽOVÁ M. KONERACKÁ I. POTOČOVÁ, K. PAULOVIČOVÁ, N. TOMAŠOVIČOVÁ, V. ZÁVIŠOVÁ – SAS Award 2007 - International R&D collaboration.

J. KAČMARČIK – “Scientist of the year 2006” in Slovakia in the category “international R&D collaboration awarded in 2007 by the Journalist Studio and the Club of Scientific and Technological Journalists of the Slovak Journalist Syndicate.

Z. PRIBULOVÁ - 1. place in Competition of SPS 2007 – The best scientific publication of young scientists.

FLACHBART K., GABÁNI S., GAŽO E., KAČMARČÍK J., KOVÁČ J., PAVLÍK V., PRISTÁŠ G., REIFFERS M., SAMUELY P., SKYBA P., SZABÓ P. – SAS Award 2008 - New Scientific Infrastructure.

A. CHOMIČOVÁ – SAS Award for technicians 2008.

S. ŠTEFÁNIK - SAS Award for technicians 2008.

R. LYSÁK - 3. place in “Competition of young researchers of SAS 2008”.

DIKO P. - Honourable mention in the competition “Scientist of the year 2008” in the category “Scientific achievement in Slovakia 2008”, awarded in 2008 by the Journalist Studio and the Club of Scientific and Technological Journalists of the Slovak Journalist Syndicate.

L. ŠÁNDOR – Bronze Medal of UPJŠ 2008.

ZENTKO A. - Silver Medal of UPJŠ 2008.

J. BALÁŽ - Memorial Plaquette of SAS 2009.

Z. PRIBULOVÁ - 1. place in “Competition of young researchers of SAS 2009”.

M. ČLOVEČKO - 1. place in Competition of SPS – The best scientific publication of young scientists 2009.

DŽAROVÁ A. - 1. place in Competition of SPS – The best scientific publication of young scientists.

G. PRISTÁŠ - 1. place in Competition of SPS – The best scientific publication of young scientists 2009.

M. ČLOVEČKO - 3. place in “Competition of young researchers of SAS 2010”.

R. REMECKÝ - 2. place in Competition of SPS – The best scientific publication of young scientists 2010.

L. ŠÁNDOR - Highest Slovak (Ľ. Štúr) award handed over by the President of Slovak Republic.

D. BRUNCKO, E. GAŽO, J. KAČMARČÍK, E. KLADIVA, I. KRÁLIK, M. MIHÁLIK, Z. PRIBULOVÁ, P. SAMUELY, P. SZABÓ, L. ŠÁNDOR, M. ZENTKOVÁ – SAS Award for popularization 2011.

K. KUDELA – Gold Medal of SAS 2011.

L. ŠÁNDOR – Gold Medal of SAS 2011.

H. ČENČARIKOVÁ - 2. place in “Competition of young researchers of SAS 11”.

K. KUDELA - The Slovak Physical Society (SPS) Award 2011.

G. PRISTÁŠ – The Award of the President of SR for Young Scientists 2011.

- v. **Supplementary information and/or comments documenting international and national status of the Organisation**
None

IV. Project structure, research grants and other funding resources

- **International projects and funding**
- i. **List of major projects within the European Research Area – 6th and 7th Framework Programme of the EU, European Science Foundation, NATO, COST, INTAS, CERN, ESA etc. (here and in items below please specify: type of project, title, grant number, duration, total funding and funding for the Organisation, responsible person in the Organisation and his/her status in the project, e.g. coordinator, work package leader, investigator)**

6th Framework Programme of EU projects (FP6)

- [1] **FP6 EU: SWEETS** Space Weather and Europe – Educational Tool with the Sun. Duration 2007. 2007-01-01/2007-12-31, K. Kudela, investigator.
Total project funding
IEP SAS funding from EU 6 806,75 EUR
Cofunding from SAS (2007) 2 224,99 EUR
- [2] **FP6 EU: MTKD-CT-2005-030002 ExtreM** Condensed matter at extreme experimental conditions. Duration: 2006 – 2009. 2006-03-01/2009-02-28, P. Samuely, coordinator.
Total project funding
IEP SAS funding from EU 141 937,85 EUR
Cofunding from SAS (2007-2009) 34 721,22 EUR
- [3] **NESPA NanoEngineered Superconductors for Power Applications**
01.10.2006/30.09.2010, Pr. No. 035619-2, Principal investigator Pavel Diko.
Total project funding
IEP SAS funding form EU 173 683,83 EUR
Cofunding from SAS (2007-2010) 24 552,59 EUR

- [4] **European Commission 6th FP “Transnational Access – Specific Support Action” contract No. RITA-CT-2003-505474** – accepted for experiments in High Magnetic Fields in GHMFL Grenoble, France
 Total project funding
 IEP SAS funding from EU
 Cofunding from SAS (2007-2009)

7th Framework Programme of EU projects (FP7)

- [5] **FP7 EU: NMDB**. Neutron Monitor Data Base, Duration 2008-2009, K. Kudela, investigator (and R. Langer, I. Strhárský)
Total project funding 500 000,00 EUR
IEP SAS funding from EU 16 800,00 EUR
Cofunding from SAS (2008-2009) 3 253,08 EUR

- [6] **FP7 EU: Microkelvin**, Within the programme Capacities of FP7. The project covers the leading European microkelvin and nanotechnology laboratories. Principal Investigator. P. Skyba
Total project funding 4 200 000,00 EUR
IEP SAS funding from EU 46 000,00 EUR
Cofunding from SAS (2009-2011) 4 686,00 EUR

- [7] **FP7 EU: MNT ERA.Net, Engineering in Superconductivity (ESO)** 2010-2012,
 Principal investigator: Peter Samuely
 Total project funding
 IEP SAS funding from EU
Cofunding from SAS (2007-2010) 100 000,00 EUR

- [8] **FP7 EU: MNTERA-NET Transnational Cooperation MAFINCO** -Magnetic fluid-new insulated and cooling medium for power transformers, Duration: 2009-2011, Coordinator M. Timko
 Total project funding
 IEP SAS funding from EU
Cofunding from SAS (2009-2011) 149 373,00 EUR

CERN

The participation of Slovakia in scientific programmes of the CERN organisation is supported at the governmental level. Besides the finances coming to the Institute of

Experimental Physics, an additional support of about 150 000 Eur per year is provided to cover experimental costs at CERN.

- [9] **CERN ALICE KE:** ALICE experiment at the CERN LHC: a study of strong interacting matter properties at high energy densities. Duration: 1998 - 2015. 1998-01-01/2007-12-31,
Principal investigator: L. Šándor.
Funding for IEP SAS (2007-2011) **277 360,12 EUR**
- [10] **CERN ATLAS KE:** The ATLAS experiment CERN LHC. Deep inelastic events and new physics at TeV energies. Duration: 1998 - 2015. 1998-01-01/2007-12-31
Principal investigator: D. Bruncko.
Funding for IEP SAS (2007-2011) **270 011,94 EUR**
- [11] **CERN NA57 KE:** Study of possible quark-gluon plasma production in heavy ion collisions at CERN SPS. Duration: 1998-2007. 1998-01-01/2007-12-31
Principal investigator: I. Králik.
Funding for IEP SAS (2007-2011) **4 979,09 EUR**

INTAS, COST, ESF

- [12] **EFFORT** - The European Forum for Processors of Large Grain (RE)BCO 2006-2007 Duration 24 months.
Responsible person: Pavel Diko,
Cofunding from SAS (2007) **1 394,14 EUR**
- [13] **INTAS 05-103-7555** A proposal for R&D to establish the limitations on the operation of the ATLAS end-cap calorimeters at high LHC luminosities. 2006-01-01/2008-12-31 Duration 24 months. Responsible person: Dušan Bruncko.,
Cofunding from SAS (2007-2008) **5 742,55 EUR**
- [14] **INTAS 05-1000008-8050** Solar wind: A new glance at high resolution. Duration 24 months. 2007-01-01/2008-12-31, Responsible person: Karel Kudela.
Funding for IEP SAS: (2007-2008) **3 987,00 EUR**
Cofunding from SAS: (2007-2009) **1 327,16 EUR**
- [15] **COST 724** Developing the scientific basis for monitoring, modelling and predicting Space Weather, Duration: 2003-2007.. 2003-01-01/2007-12-31, K. Kudela, investigator
Cofunding from SAS (2007) **3 053,84 EUR**

- [16] **COST P16 ECOM** - Emergent behaviour of correlated matter.
Duration: 2005-01-01/2008-12-31, M. Reiffers, investigator
Cofunding from SAS (2007-2009) 9 128,78 EUR
- [17] **COST P17 EMP** Improvement of functional properties of Fe- and Co-based nanocrystalline magnetic materials by heat treatment in magnetic field.
Duration 30 months. 2006-03/2009-06, Responsible person: Ivan Škorvánek.
Cofunding from SAS (2007-2009) 9 957,78 EUR
- [18] **COST Action D43** Colloid and Interface Chemistry for Nanotechnology,
4.10.2006 – 9.11.2011, Dr. M. Sedlák - Slovak Republic delegate, member of
the management committee,
Cofunding from SAS (2007-2011) 16 164,25 EUR
- [19] **TOP KVARK- CDF** Study of the top quark properties, 2007-2011
Jaroslav Antoš
Cofunding from SAS (2007-2011) 17 957,78 EUR
- [20] **COST 803** Developing space weather products and services in Europe,
Duration: 1.8.2008 / 30.11.2012. K. Kudela, investigator (J. Baláž, P. Bobík,
M. Slivka, I. Strhárský, R. Langer)
Cofunding from SAS (2008-2011) 10 914,00 EUR
- [21] **ESF-NES Nanoscience and Engineering in Superconductivity** was the
European Science Foundation research network of the European leading
laboratories in the field of the superconducting nanophysics, vortex matter,
fluxtronics, plasmonics and spintronics. (2008 -2012)
P. Samuely member of the steering committee
Cofunding from SAS (2008-2011) 13 970,39 EUR

ii. List of other international projects incl. total funding and funding for the Organisation

The list of bilateral projects with direct funding is shown in Chapter 4 between APVV projects.

iii. List of other important projects and collaborations without direct funding

- [1] Rocket measurements at Andoya Rocket Range (ARR) in Norway on January 31, 2008 (HotPay-2, PEEL instrument); ESA Project BepiColombo (participation in plasma instrument); participation in ESA-China project Double Star (NUADU experiment), participation in SPEKTR-R project (MEP-2 instrument), invitation to participate in the projects Luna Globe and

Resonance (more at <http://nccospar.saske.sk/> within reports covering period since 2007 until 2011).

- [2] Participation in Norwegian project HotPay with design, development, construction of detector of energetic electrons PEEL, launched on board of HotPay-2 sounding rocket on January 31, 2008 from Andoya Rocket Range ARR, Norway. Currently - Data analysis.
- [3] Participation in ESA space exploration project ESA-BepiColombo (mission to planet Mercury) with design, development, construction of planetary ion camera PICAM.
- [4] Participation in ESA-China space exploration project Double Star - NUADU (Neutral atom imager), currently data analysis.
- [5] Participation in Russian space exploration project Spectrum-Radioastron with design, development and construction of energetic particle spectrometer MEP-2 (launched on July 18, 2011), currently data analysis.
- [6] Participation in Russian space exploration project RESONANCE with design, development and construction of energetic particle spectrometer DOK-M.
- [7] Participation in Russian space exploration project LUNA-GLOBE with design, development and construction of energetic particle spectrometer ASPECT-L
- [8] Participation in Chinese space exploration project MIT (Mesosphere-Ionosphere-Thermosphere) with design, development and construction of Neutral Atom Imaging System (NAIS).
- [9] More details at <http://nccospar.saske.sk/> within reports covering period since 2007 until 2011).

Bilateral agreement projects (MAD)

- [10] Study of free radicals and paramagnetic metallic complexes in model biological systems. Duration 24 months. Responsible person: Marián Antalík, principal investigator. 2006-01-01/2008-12-31.
- [11] Interaction of L-glutamic acid N-mer and selected peptides on cytochrome c conformation. Duration 24 months. Responsible person: Marián Antalík, principal investigator. 2006-01-01/2008-12-31.
- [12] DAAD Magnetische Eigenschaften von Borreichen Verbindungen mit seltenen Erden unterhalb und oberhalb der Ordnungstemperatur. Duration 12 months. Responsible person: Karol Flachbart, principal investigator. 2006-01-01/2007-12-31.
- [13] SK-PL Physics of magnetic materials. Duration 36 months. Responsible person: Milan Timko, principal investigator. 2007-01-01/2009-12-31.
- [14] Study of physical properties of nanostructured magnetic materials. Duration 36 months. Responsible person: Milan Timko. 2007-01-01/2009-12-31.

- [15] Experimental investigation of influence of atomic melt structure peculiarities due to their temperature-time treatments on structure and physical-mechanical properties of amorphous and nanocrystalline alloys. Duration 36 months. Responsible person: Kornel Csach. 31.12.2010.
- [16] Slovak-Polish project No. 26 in framework of MAD - Properties of molecule-based magnetic materials. Duration 23 months. Responsible person: Marián Mihalik, principal investigator. 1.1.2007 / 31.12.2009.
- [17] Chemical nanosize pinning centers in YBCO superconductors. Duration 24 months. Responsible person: Pavel Diko, principal investigator. 31.12.2011
- [18] Properties of new magnetic materials. Duration 24 months. Responsible person: Marián Mihalik. / 31.12.2012
- [19] Energetic particle transport in the turbulent heliosphere. Duration 24 months. Responsible person: Milan Stehlík.
- [20] Mechanical properties of bulk nanocrystalline and amorphous materials at cryogenic temperatures. Duration 12 months. Responsible person: Kornel Csach, principal investigator. 1.1.2011 / 31.12.2013
- [21] Study of the amyloid aggregation in vitro and in cerebrospinal fluid. Duration 15 months. Responsible person: Zuzana Gažová, principal investigator. 1.10.2010 / 31.12.2014

- **National projects and funding**

- i. **List of projects supported by the European Social Funds (ESF) and Structural Funds of EU and the role of the Organisation**

Structural Funds of EU:

Call OPVaV 2008/2.1/01-SORO:

- 1) **ITMS 26220120021** Cooperative phenomena and phase transitions in nanosystems with perspective applications in nano- and biotechnology. 24.4.2009 / 31.3.2011, duration 23 months. **Funding 1.159.770,63 EUR.** Responsible person: Peter Kopčanský, principal investigator.
- 2) **ITMS 26220220019** Centre of Excellence of progressive materials with nano and submicron structure. 20.5.2009 / 30.4.2011, duration 23 months. **Funding 411 055,13 EUR.** Responsible person: Ivan Škorvánek. Coordinator: Institute of Materials Research, principal investigator Dusza Ján.
- 3) **ITMS 26220120009** Center of Space Research: influence of space weather. 24.4.2009 / 31.8.2012, duration 40 months. **Funding 515.234,69 EUR (2010-2011 spendings 404.633,25 EUR)** Responsible person: Karel Kudela. Coordinator: Astronomical Institute SAS, Svoreň Ján.

- 4) **ITMS 26220120005** Extrem - Center of advanced physical studies for materials in extreme conditions. 19.5.2009 / 30.4.2011, duration 22 months. **Funding 502 862,79 EUR**. Responsible person: Peter Skyba. Coordinator: Pavol Jozef Šafárik University, Košice, Alexander Feher.
- 5) **ITMS 26220120003** Center of excellence for power electronics and their material components. 25.5.2009 / 24.5.2011, duration 24 months. **Funding 97.733,57 EUR**. Responsible person: Milan Timko. Coordinator: University of Žilina.
- 6) **ITMS 2622012001** Center of Excellence for Research on Physiology of the Digestive Tract – CEFTA. 1.9.2009 / 30.4.2011, duration 20 months. **Funding 55 603,52 EUR**. Responsible person: Marián Antalík. Coordinator: Institute of Animal Physiology, SAS, principal investigator Koppel Juraj.

Call OPVaV 2009/2.1/02-SORO:

- 7) **ITMS 26220120033** Cooperative phenomena and phase transitions in nanosystems with perspective applications in nano- and biotechnology. (Dobudovanie centra pre kooperatívne javy a fázové prechody v nanosystémoch s pespektívou využitia v nano- a biotechnológiách). 1.4.2010 / 31.3.2013, duration 21 months. **Funding 2.532.369 EUR, (2010-2011 spendings 1 907 499 EUR)** . Responsible person: Peter Kopčanský, principal investigator.
- 8) **ITMS 26220120035** Infrastructure Improving of Centre of Excellence of Advanced Materials with Nano- and Submicron- Structure. 1.5.2010 / 30.4.2013, duration 20 months. **Funding 664.653 EUR (2010-2011 spendings 314.464,01 EUR)**. Responsible person: Ivan Škorvánek, Pavel Diko. Coordinator: Institute of Materials Research, principal investigator Dusza Ján.
- 9) **ITMS 26220120029** Center of Space Research: influence of space weather - second phase 1.3.2010 / 28.2.2013, duration 22 months. **Funding 612 597,80 EUR. (2010-2011 spendings 183.164 EUR)** Responsible person: Karel Kudela. Coordinator: Astronomical Institute SAS, Svoreň Ján.
- 10) **ITMS26220120047** Extrem II - Center of advanced physical studies for materials in extreme conditions. 28.8.2010 / 31.7.2013, duration 16 months. **Funding 1 210 462,80 EUR. (2010-2011 – spendings cca 937.815 EUR)** Responsible person: Peter Skyba. Coordinator: Pavol Jozef Šafárik University, Košice, Alexander Feher.
- 11) **ITMS 26220120046** Center of excellence for power electronics and their material components II. 30.9.2010 / 31.8.2013, duration 16 months. Funding **57.490 EUR (2010-2011 – spendings 0,00 EUR)**. Responsible person: Milan Timko. Coordinator: University of Žilina.
- 12) **ITMS 26220120043** Center of Excellence for Research on Physiology of the Digestive Tract –CEFT II. 1.11.2010 / 1.2.2013, duration 14 months. **Funding 214.425,58 EUR. (2010-2011 spendings 151.690 EUR)** Responsible person: Marián Antalík. Coordinator: Institute of Animal Physiology, SAS, principal investigator Koppel Juraj.

Call OPVaV 2008/2.2/01 – SORO:

13) ITMS 26220220061 New materials and technologies for energetics. 1.5.2010 / 30.4.2013, duration 20 months. **Funding 3.218.062 EUR (2010-2011 spendings 715.142 EUR)** Responsible person: Pavel Diko, principal investigator.

ITMS 26220220037 Technology of the fabrication of electrical steels for the electric motors with higher efficiency. 1.11.2010 / 31.12.2012, duration 14 months. **Funding 102.554 EUR. (2010-2011 spendings 3.730 EUR)** Responsible person: Ivan Škorvánek. Coordinator: Institute of Materials Research, principal investigator František Kováč.

14) ITMS: 26220220005 Development of the technological processes of magnetic fluids for biomedical applications. 1.1.2010 / 30.6.2012, duration 24 months. **Funding 497.015 EUR. (2010-2011 spendings 450.540 EUR)** Responsible person: Peter Kopčanský, principal investigator.

15) ITMS 26220220041 Research and Development of the Second Generation of YBCO Bulk Superconductors. 1.1.2010 / 31.5.2012, duration 24 months. **Funding 260.384 EUR. (2010-2011 spendings 139.022 EUR)** Responsible person: Pavel Diko, principal investigator.

16) ITMS 26220220037 Technology of the fabrication of electrical steels for the electric motors with higher efficiency. 1.11.2010 / 31.12.2012, duration 14 months. **Funding 102.554 EUR. (2010-2011 spendings 3.730,00 EUR)** Responsible person: Ivan Škorvánek. Coordinator: Institute of Materials Research SAS, František Kováč.

Program education - call OPV-2009/1.2/01 – SORO:

17) ITMS 26110230034 Educational Centre of Physics IEP SAS. 1.9.2010 / 30.6.2013, duration 16 months. **Funding 624.210,06 EUR. (2010-2011 spendings – 316.140 EUR)** Responsible person: Mária Zentková, principal investigator.

National project – call OPVaV/K/RKZ/NP/2009-1:

18) ITMS: 26210120002 SIVVP - The Slovak Infrastructure for High Performance Computing. 15.1.2010 / 31.12.2014, duration 24 months. **Funding 1.616.837 EUR. (2010-2011 spendings – 50.512 EUR)**, Responsible person: Tibor Kožár. Coordinator: Computing Centre of SAS, Tomáš Lacko.

ii. List of projects supported by APVV and the role of the Organisation

APVT projects 2005/2007 – max. 1 year in assessed period:

APVT – general call 2005/2007 – 1 year in the assessed period:

1. **APVT-20-005204** Magnetostructural correlations in unconventional magnetic materials. 2005-01-01/2007-12-31 duration 12 months. **Funding (2007) 6.970,72 EUR.** (210.00 Sk) Responsible person: Marián Mihalik.
2. **APVT 20-008404** Study of structural and magnetic properties of nanophase and amorphous systems based on 3-d transition metals Fe, Co, Ni. 2005-2007 - duration 12 months. **Funding (2007) 2.755,10 EUR** (83 000 Sk). Responsible person: Jozef Kováč, principal investigator.
3. **APVT-51-016604** Superconductors for future technologies. 2005-01-01/2007-12-31 - duration 12 months. **Funding (2007) 96.926,24 EUR** (2 920 000 Sk). Responsible person: Peter Samuely, principal investigator.
4. **APVT-51-031704** Magnetic properties and electron structure of d- and f- metal compounds. 2005-01/2007-12 - duration 12 months. **Funding (2007) 17.592,78 EUR** 530 000 Sk. Responsible person: Marián Reiffers, principal investigator.
5. **APVT-51-027904** Study of phase transitions, cooperative phenomena and structural changes in nanomaterials, critical and stochastic Dynamics. 2005-01/2007-12 - duration 12 months. **Funding (2007) 20.447,45 EUR** (616.000 Sk). Responsible person: Michal Hnatič, principal investigator.

APVT projects 2006/2009 – 2 - 3 years in assessed period:

APVT – general call 2005/2007 – 1 year in the assessed period:

6. **APVT-51-061505** Microstructural design of YBCO bulk superconductors. 2006-05-01/2009-04-30 - duration 23 months. **Funding (2007-2009) 57.226,31 EUR.** Responsible person: Pavel Diko, principal investigator.
7. **APVT-51-037905** Water soluble polymers: from the fundamentals of interactions, structure and dynamics in solution to controlled polymer synthesis and self-assembly. 1.3.2006 / 1.3.2009 - duration 26 months. **Funding (2007-2009) 128.925,18 EUR** Responsible person: Marián Sedlák, principal investigator.
8. **APVT-51-053805** Monitoring of energetic particles in space for selected problems of space weather. 2006-05-01/2009-04-30 - duration 28 months. **Funding (2007-2009) 89.358,03 EUR** Responsible person: Karel Kudela, principal investigator.
9. **APVT-20-057305** The advanced top quark physics studies. 2006-01-01/2008-12-31 - duration 24 months. **Funding (2007-2009) 34.322,52 EUR** Responsible person: Jaroslav Antoš. Coordinator: FMFI UK BA Stanislav Tokár.

10. **APVT 99-026505** Targeted transport of anticancer drugs in magnetically labelled nanoparticles. 2006 - duration 12 months. **Funding (2007-2009) 38.770,50 EUR**
Responsible person: Martina Koneracká, principal investigator.

APVV – LPP projects 2006/2009 – 2 - 3 years in assessed period:

11. **APVV LPP-0030-06** Scientific incubator for pupils and students. 2006-11-01/2010-10-30 - duration 46 months. **Funding (2007-2009) 61.342,67 EUR.**
Responsible person: Mária Zentková, principal investigator.
12. **APVV LPP-0047-06** Study of strongly correlated electron systems beyond standard approximations. 2006/2008 - duration 24 months. **Funding (2007-2009) 23.333,67 EUR.** Responsible person: Pavol Farkašovský, principal investigator.
13. **APVV LPP-0101-06** Perspective superconductors. 1.10.2006 / 30.9.2009 - duration 33 months. **Funding (2007-2009) 36.711,01 EUR.** Responsible person: Peter Samuely, principal investigator.
14. **APVV LPP-0334-06** Single-grain composite YBCO superconductors. 2006-10-01/2010-09-30 - duration 45 months. Funding(2007-2009) **67.330,55 EUR.**
Responsible person: Pavel Diko, principal investigator.

APVV – MVTS bilateral projects 2006/2007 – 1 year in assessed period:

15. **SK CZ 11306** Bistable molekular magnetic materials with utilitarian physical properties. 2006-07-01 -2007-12-31 duration 18 months. **Funding (2007) 1.194,98 EUR** Responsible person: Mária Zentková, principal investigator.
16. **SK CZ-05506** Association of weak polyanions by hydrogen bonds – new candidates for targeted drug delivery. 2006-07-01 -2007-12-31 duration 18 months **Funding (2007) 775,68 EUR.** Responsible person: Marian Sedlák, principal investigator.
17. **SK FR-023-06** Controlled formation of oxygenation cracks in YBCO bulk superconductors 2006-07-01 -2007-12-31 duration 18 months. **Funding (2007) 5.311,03 EUR.** Responsible person: Pavel Diko, principal investigator.

APVV projects 2007:

APVT –general call 2007/2009 – 3 years in the assessed period:

18. **APVV 0173-06** Hybrid Spintronic Nanostructures Controlled by Spin-Polarized Current. 1.2.2007 / 31.12.2009 - duration 35 months. **Funding 16.097,89 EUR.**
Responsible person: Milan Timko. Coordinator: Phys. Institute SAS, Majková E.
19. **APVV - 0413-06 (2/7192)** Complex Metallic Alloys. 2007-01-01/2009-12-31 - duration 36 months. **Funding 27.086,23 EUR.** Responsible person: Ivan Škorvánek, Coordinator: Physical Institute SAS, Bratislava, M. Krajčí.
20. **APVV-0514-06** 1-Methoxyindole phytoalexins and their analogues as a new type of compounds with antitumour activity. 1.2.2007 / 30.6.2010 - duration 41 months. **Funding 26.720,75 EUR** Responsible person: Tibor Kožár. Coordinator: P.JŠ University Košice, Faculty of Science, P. Kutschy.

APVV – MVTs bilateral projects 2007/2008 – 1,2 years in assessed period:

21. **APVV SK MAD 01306** Development of a Virtual Laboratory for high-throughput ligand and receptor-based molecular screening. 2007/2008 duration 12 month **Funding 2.257,19 EUR**. Responsible person: Tibor Kožár, principal investigator.
22. **APVV SK-MAD 02606 Structural phase transition in liquid crystals doped by magnetic nanoparticles.** 2007/2008 duration 12 month. **Funding 2.987,45 EUR**. Responsible person: Natália Tomašovičová, principal investigator.

APVV projects 2008/2011:APVT – general call 2008/2011 – 3 years in the assessed period:

23. **APVV VVCE-0058-07** Centre of Cryophysics and Cryonanoelectronics. 1.7.2008 / 30.6.2011- duration 36 months. **Funding 660.918 EUR (for IEP SAS: 182.765 EUR)**. Responsible person: Peter Samuely, principal investigator.
24. **APVV-0346-07** Superconductors and Strongly Correlated Systems at Extreme Conditions. 1.6.2008 / 31.12.2011 - duration 43 months. **Funding 215.893,24 EUR**. Responsible person: Peter Samuely, principal investigator.
25. **APVV-0432-07** Macroscopic quantum phenomena and detectors. 1.6.2008 / 31.12.2010 - duration 31 months. **Funding 58.155,74 EUR**. Responsible person: Peter Skyba. Coordinator: FMI UK Bratislava, M. Grajcar.
26. **APVV-0454-07** Research and development of magnetic sensor systems for search and indication of ferromagnetic and conductive substances. 1.9.2008 / 31.12.2010 - duration 28 months. **Funding 61.175,58 EUR**. Responsible person: Ivan Škorvánek. Coordinator: LF TUKE Košice.
27. **APVV-0509-07 MAGNOLIC** The structural transitions in liquid crystals doped by nanoparticles. 1.2.2008 / 31.12.2010 - duration 35 months. **Funding 109.938,26 EUR (for IEP SAS: 95.166,96 EUR)** Responsible person: Peter Kopčanský, principal investigator.
28. **APVV-0682-07** Fluorescent image analysis of irregularly shaped cells for purposes of non destructive DNA contents quantitation. 1.6.2008 / 31.12.2010 - duration 31 months. **Funding 174.931,99 EUR (for IEP SAS: 54.674.95 EUR)** Responsible person: Zoltán Tomori.

APVV – LPP projects 2008/2011 – 3 years in assessed period:

29. **APVV - LPP-0181-07** Through microcosmos to understanding of macrocosmos. 1.4.2008 / 31.3.2011 - duration 44 months. **Funding 98.718,72 EUR (for IEP SAS: 28.546.77 EUR)**. Responsible person: Eduard Kládva, principal investigator.
30. **APVV LPP-0200-07** The hour of Sciences 1.7.2008 / 31.12.2010 - duration 30 months. **Funding 79.665,14 EUR (for IEP SAS: 58.753.24. EUR)**. Responsible person, coordinator: Pavol Szabó.

APVV – MVTS bilateral projects 2008/2009 – 2 years in assessed period:

31. **APVV SK- CN-0035-07** Study of Re-Ba-Cu-O single crystals. Coexistence of superconductivity and magnetism. 2008-2009 - duration 23 month. **Funding 7.417,21 EUR.** Responsible person: Pavol Szabo, principal investigator.
32. **APVV SK-CZ-0030-07** Identification, visualization and measurement of fibrous structures in 3D space. 1.2.2008 / 31.12.2009 - duration 23 months. **Funding 2.354,65 EUR.** Responsible person: Zoltán Tomori, principal investigator.
33. **APVV SK-FR-0007-07** New hard magnetic FePt based alloys prepared from amorphous precursors 1.2.2008 / 31.12.2009 - duration 23 months. **Funding 4.473,01 EUR.** Responsible person: Ivan Škorvánek, principal investigator.
34. **APVV SK-FR-0022-07** Magnetic nanoparticles for magneto-optical thin films. 1.2.2008 / 31.12.2009 - duration 23 months. **Funding 4.485,60 EUR.** Responsible person: Milan Timko, principal investigator.
35. **APVV SK-SRB-002-07** Magnetic nanomaterials: synthesis and physical properties. 1.2.2008 / 31.12.2009 - duration 23 months. **Funding 4.290,05 EUR.** Responsible person: Marián Mihalik, principal investigator.
36. **APVV SK- ZA- 0009-07** Physical properties of strongly correlated electron systems. 1.1.2008 / 31.12.2010 - duration 36 months. **Funding 9.544,63 EUR.** Responsible person: Marián Reiffers, principal investigator.

APVV projects 2009/2011:

APVV – LPP projects 2009/2012 – 3 years in assessed period:

37. **APVV LPP 0093-09** Nanomaterials for applications: future is in the students hands 1.9.2009 / 31.8.2012 - duration 30 months. **Funding (2009-2011) 2.000 EUR.** Responsible person: Mária Zentková. Coordinator: UPJŠ – V. Zeleňák.
38. **APVV LPP-0124-09** Interactive activities to make physics attractive for basic school, their teachers and general public. 1.9.2009 / 31.8.2012 - duration 28 months. **Funding (2009-2011) 7.116 EUR.** Responsible person: Marián Mihalik. Coordinator: UPJŠ – Ludmila Onderová.
39. **APVV LPP-0270-09** Science - user friendly. 1.9.2009 / 31.8.2012 - duration 30 months. **Funding (2009-2011) 46.505 EUR €.** Responsible person: Mária Zentková, principal investigator.

APVV – MVTS bilateral projects 2009/2010 – 2-3 years in assessed period:

40. **APVV SK-HU-0008-08** Magnetically active anisotropic fluids 1.2.2009 / 31.12.2010 - duration 24 months. **Funding 2.905,85 EUR.** Responsible person: Natália Tomašovičová, principal investigator.
41. **APVV SK - IT -0023-08** Effect of chemical composition on ground state of Yb and Ce based strongly correlated compounds. 1.1.2009 / 31.3.2011 - duration 36 months. **Funding 4.447,93 EUR.** Responsible person: Marián Reiffers, principal investigator.

42. **APVV SK-SI-0032-08** Magnetic nanoparticles: synthesis and physical properties. 1.1.2009 / 31.12.2010 - duration 24 months. **Funding 3.195,01 EUR**. Responsible person: Mária Zentková, principal investigator.

APVV projects 2010:

APVV – MVTS bilateral projects 2010/2011 – 2 years in assessed period:

43. **APVV SK-CZ 0137-09** Processing and analysis of three-dimensional biomedical images. 1.1.2010 / 31.12.2011 - duration 24 months. **Funding 3.172,00 EUR**. Responsible person: Zoltán Tomori, principal investigator.
44. **APVV SK-FR-0024-09** Exceptional superconductors. 1.1.2010 / 31.12.2011 - duration 24 months. **Funding 4.234,75 EUR**. Responsible person: Peter Samuely, principal investigator.
45. **APVV SK-PL-0047-09** Vplyv chemického zloženia a spôsobu prípravy na magnetické a magnetokalorické vlastnosti LaFeCo(SiAlGa) zliatin)1.1.2010 / 31.12.2011 - duration 24 months. **Funding 2.292,99 EUR**. Responsible person: Ivan Škorvánek, principal investigator.
46. **APVV SK-PL-0069-2009** Accoustic and hyperthermic properties of biocompatible magnetic fluids. 1.1.2010 / 31.12.2011 - duration 24 months. **Funding 3.828,04 EUR**. Responsible person: Milan Timko, principal investigator.
47. **SK-SRB-0033-09** Magnetic and transport properties of manganite based nanoparticles with 3d substituents. 1.1.2010 / 31.12.2011 - duration 24 months. **Funding 3.828,04 EUR**. Responsible person: Marián Mihalik, principal investigator.

APVV projects 2011:

APVV – general call 2011/2014 – 1 year in assessed period:

48. **APVV-0171-10** Structuralization phenomena in systems with nanoparticles. 1.5.2011 / 31.10.2014 - duration 8 months. **Funding (2011) 42.650 EUR**. Responsible person: Peter Kopčanský, principal investigator.
49. **APVV-0266-10 SEMAMID** Sensors based on magnetic microwires. 1.5.2011 / 30.12.2014 - duration 8 months. **Funding (2011) 6.835 EUR**. Responsible person: Ivan Škorvánek.
50. **APVV-0486-10 DIASOLVE** Advanced polymer technologies in biomedicine: Polymer microcapsules for immunoprotection of transplanted pancreatic islets in diabetes treatment. 1.5.2011 / 31.10.2014 - duration 8 months. **Funding (2011) 10.320 EUR**. Responsible person: Marián Sedlák. Coordinator: Igor Lacík.
51. **APVV-0515-10 HEFAISTOS** Quantum electrodynamics of artificial nanostructures. 1.5.2011 / 31.10.2014 - duration 8 months. **Funding (2011) 18.975 EUR**. Responsible person: Martin Kupka. Coordinator: Grajcar Miroslav.

- 52. APVV 0742-10 NANOALIS** Effect of aliskiren loaded nanoparticles in experimental hypertension. 1.5.2011 / 31.10.2014 - duration 8 months. **Funding (2011) 9.336 EUR.** Responsible person: Martina Koneracká. Coordinator: Oľga Pecháňová.

APVV – MVTS bilateral projects 2011/2012 – 1 year in assessed period:

- 53. SK-RO-0012-10** Investigation of the lysozyme amyloid aggregation usinf in vitro assay and analysin its effects on cell viability and proliferation. 1.1.2011 / 31.12.2012 - duration 12 months. **Funding (2011) 1.540,27 EUR.** Responsible person: Zuzana Gažová, principal investigator.
- 54. SK-RO-0027-10** Multifunctional nanostructured magnetic materials for sensor applications. 1.1.2011 / 31.12.2012 - duration 12 months. **Funding (2011) 2.071,35 EUR .** Responsible person: Ivan Škorvánek, principal investigator.

iii. Number of projects supported by the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA) for each year, and their funding

VEGA	2007	2008	2009	2010	2011
number	22	24	23	25	23
funding in the year (EUR)	111 233	130 054	109 676	209 835	172 493

• **Summary of funding from external resources (based on annual financial report of the Organisation)**

External resources	2007	2008	2009	2010	2011	total	average
external resources (millions of EUR)	0,775	1,030	1,137	3,559	3,729	10,230	2,046
external resources transfered to cooperating research organisations (millions of EUR)	0,115	0,285	0,313	0,198	0,182	1,093	0,219
ratio between external resources and total salary budget	0,762	0,948	0,974	2,942	3,255	8,881	1,776
overall expenditures from external as well as institutional resources (millions of EUR)	2,535	2,894	3,082	5,577	5,731	19,819	3,964

iv. Supplementary information and/or comments on research projects and funding resources

Centre of Excellence of SAS :

- 1) **Centre of Ultra Low Temperature Physics.** 1.1.2007 / 31.12.2010, duration 48 months. **Funding 142.469,34 EUR.** Responsible person: Peter Samuely, principal investigator.
- 2) **Centre of excellence of SAS for nanostructural materials - NANOSMART I.** 1.1.2007 / 31.12.2010, duration 48 months. **Funding (2007-2010) 17.148,74 EUR.** Responsible person: Pavel Diko. Coordinator: Institute of Materials Science SAS.
- 3) **Centre of excellence of SAS for nanostructural materials - NANOSMART II.** 1.1.2007 / 31.12.2010, duration 48 months. **Funding (2007-2010) 17.148,74 EUR.** Responsible person: Ivan Škorvánek. Coordinator: Institute of Materials Science SAS.
- 4) **Centre excellence of SAS – Nanofluids.** 1.2.2009 / 31.1.2013, duration 35 months. **Funding (2009-2011) 120.032,00 EUR.** Responsible person: Peter Kopčanský, principal investigator.
- 5) **Centre of Low Temperature Physics and Material Research at Extreme Conditions.** 1.7.2011 / 30.6.2014, duration 6 months. **Funding (2011) 15.300,00 EUR.** Responsible person: Peter Samuely, principal investigator.

V. Organisation of PhD studies, other pedagogical activities

- i. List of accredited programmes of doctoral studies (as stipulated in the previously effective legislation as well as in the recently amended Act on the Universities)

Programmes of doctoral studies during the assessed period:

- [1] 2.4.1 General physics and mathematical physics
- [2] 4.1.3 Physics of condensed matter and acoustics
- [3] 4.1.5 Nuclear and subnuclear physics

- ii. Summary table on doctoral studies (number of internal/external PhD students; number of students who completed their study by a successful thesis defence; number of PhD students who quitted the programme)

PhD study	31.12.2007			31.12.2008			31.12.2009			31.12.2010			31.12.2011		
number of potential PhD supervisors															
PhD students	number	defended thesis	students quitted	number	defended thesis	students quitted	number	defended thesis	students quitted	number	defended thesis	students quitted	number	defended thesis	students quitted
internal	13	4	0	14	5	1	15	3	0	16	3	1	18	2	1
external	2	0	0	2	0	0	2	0	1	2	1	0	2	0	0
supervised at external institution by the research employees of the assessed organisation	0	0	0	1	0	0	2	0	0	4	0	0	10	1	0

iii. Postdoctoral positions supported by

a) external funding (specify the source)

Dr. Zuzana Pribulová, supported by the APVV LPP project 2006-2009.

Dr. Gabriel Pristáš, supported by the APVV project, No. 6 months in 2008/9.

Dr. Vladimír Komanický, supported by the FP6 EU project Extrem, 6 months.

Dr. Jana Turčanová, supported by SF EU projects, 18 months, 2010 -2011.

Dr. Marek Varga, supported by APVV and SF EU projects, 20 months, 2010-2011.

Dr. Ján Hanko, supported by APVV project, 12 months, 2009.

Dr. Hana Čenčariková, supported by APVV LPP project 2006-2009

b) internal funding - the Slovak Academy of Sciences Supporting Fund of Stefan Schwarz

Dr. F. Tomasz, 2007 - 2008 (left the Institute in 2008)

Dr. R. Lysák, 2009 - 2010 (left the Institute in 2010)

Dr. Z. Pribulova, 2005 - 2009

Dr. Z. Mitóová, 2005 - 2008

Dr. H. Čenčariková, 2006 - 2010

Dr. R. Pinčák, 2006 - 2010

Dr. V. Závishová, 2010 - 2013

Dr. M. Baťková, 2008 - 2012
 Dr. M. Šefčíkova, 2008 - 2012
 Dr. V. Antal, 2010 - 2014
 Dr. M. Človečko, 2010 - 2014
 Dr. A. Džarová - Hashim, 2010 - 2013
 Dr. G. Pristáš, 2011 - 2015

iv. Summary table on pedagogical activities in undergraduate programmes for each year

Teaching	2007	2008	2009	2010	2011
lectures (hours/year)	541	533	689	677	564
practicum courses (hours/year)	583	290	214	222	206
supervised diploma works (in total)	5	11	17	19	21
members in PhD committees (in total)	2	4	6	6	5
members in DrSc. committees (in total)	4	2	3	4	2
members in university/faculty councils (in total)	5	4	4	4	8
members in habilitation/inauguration committees (in total)	5	2	2	3	4

v. List of published university textbooks

- [1] KOPÁČOVÁ J., ZENTKOVÁ M., ZENTKO J. *Inovácia predprimárneho prírodovedného vzdelávania: úvod do pastelkovej fyziky*. Ružomberok : VERBUM, 2011. 89 s. ISBN 978-80-8084-814-9.
- [2] ORENDÁČOVÁ A. *Úvod do elektrónovej paramagnetickej rezonancie: Jesenná škola ÚEF SAV, Košice, 17.-21.10. 2011*. Editori M. Mihalik, M. Zentková. Košice : ÚEF SAV, 2011. 92 s. ISBN 978-80-970779-2-1.
- [3] ANTALÍK M., GAŽOVÁ Z. *Nové trendy v biofyzike: jesenná škola ÚEF SAV, 7. - 11.2. 2011, Košice*. Editori M. Mihalik, M. Zentková. Košice : ÚEF SAV, 2011. 106 s. ISBN 978-80-970779-3-8.

vi. Number of published academic course books

- [1] SAMUELY P. *Základy supravodivosti*. In BRAUNER, Tomáš et al. *Fyzika nízkých teplot: II. část*. - Praha: Matfyzpress, 2011, s. 325-372. ISBN 978-80-7378-162-2.

- [2] **SAMUELY P.**, JANŮ Z. Supravodivé materiály. In BRAUNER, Tomáš et al. Fyzika nízkých teplot: II. část. - Praha: Matfyzpress, 2011, s. 373-397. ISBN 978-80-7378-162-2.
- [3] **SAMUELY P.** (Editor). Kryofyzika a nanoelektromika. - Košice: Ústav experimentálnej fyziky, 2011, kapitola 5, s. 157-178. ISBN 978-80-968060-9-6:
Chapters:
1. **FARKAŠOVSKÝ P., ČENČARIKOVÁ H.** Kvantové javy na optických mriežkach. In CAMBEL, Vladimír et al. Kryofyzika a nanoelektromika. - Košice Ústav experimentálnej fyziky, 2011, kapitola 5, s. 157-178. ISBN 978-80-968060-9-6.
 2. **FLACHBART K., REIFFERS M., SKYBA P.** Základy kryogénnej techniky. In CAMBEL, Vladimír et al. Kryofyzika a nanoelektromika. - Košice: Ústav experimentálnej fyziky, 2011, kapitola 8, s. 220-268. ISBN 978-80-968060-9-6.
 3. **SAMUELY P.** Supravodivé materiály. In CAMBEL, Vladimír et al. Kryofyzika a nanoelektromika. - Košice: Ústav experimentálnej fyziky, 2011, kapitola 3, s. 79-96. ISBN 978-80-968060-9-6.
 4. **SZABÓ P., SAMUELY P.** Mikrokontaktová spektroskopia. In CAMBEL, Vladimír et al. Kryofyzika a nanoelektromika. - Košice: Ústav experimentálnej fyziky, 2011, kapitola 11, s.324-337. ISBN 978-80-968060-96

vii. List of joint research laboratories/facilities with the universities

1. Laboratory of magnetism - Department of magnetism with the Faculty of Science, P. J. Šafárik University, Košice.
2. Centre of Low Temperature Physics – Centre of Excellence, joint laboratory with the Faculty of Science, P. J. Šafárik University, Košice.
3. Faculty of Electronics and Informatics TU KE - joint laboratory.
4. Faculty of Metallurgy TU KE - joint laboratory.
5. Centre of Cryophysics and Cryonanoelectronics - joint centre with the Institute of Electrical Engineering SAS.
6. Faculty of Electrotechnics, University of Žilina - joint laboratory.
7. Centre of Low Temperature Physics and Material Research at Extreme Conditions - joint centre with IMR SAS and IGT SAS.
8. With Faculty of Aeronautics TU KE - joint laboratory.

viii. Supplementary information and/or comments on doctoral studies and pedagogical activities

Defence of doctoral degree (DrSc.), 2007 - **M. Hnatič.**

Defence of doctoral degree (DrSc.), 2009 - **M, Stehlík.**

VI. Applied research

i. List of the most important results of applied research projects and their socio-economic impact

[1] A new generation of industrial magnetic sensor systems for search and indication of unwanted ferromagnetic objects on belt conveyors has been developed in close collaboration with Faculty of Aviation, Technical University, Košice and EDIS v.d. company within the common project of applied research APVV-0454-07. The core part of these sensors is composed of soft magnetic FeCoBCu-based alloys with special magnetic characteristics. The tuning of these characteristic for sensor applications was obtained by thermal processing of materials in external magnetic fields at LNAM, IEP SAS, Košice. The operational field range of new developed sensor cores was markedly extended. It was doubled as compared to that of currently used cores based on the currently used commercial VITROVAC material while keeping the similar sensitivity $2V/100\mu T$. Hence, the new sensors can be utilized in markedly higher magnetic fields. The industrial sensor system based the innovated sensor cores fabricated by Edis v.d. company in Košice was put in 2010 into pilot operation in Třinec Steel Work, Czech Republic. The two other systems have been utilized in new excavator KK 1300 designed for the North Bohemia Braun Coal Mines in the Czech Republic.

ii. List of the most important studies commissioned for the decision-making authorities, the government and NGOs, international and foreign organisations

P. Samuely, member of the governmental committees, Ministry of Education:

- Slovak road map for the research infrastructure 2008, 2009.
- Committee for the preparation of the common assessment of the Slovak research organizations incl. SAS and universities 2011.
- Committee for R&D policy 2011.
- Committee for the assessment of the research organizations in Slovakia 2009, 2010, 2011.
- Panel for preparation of FP7 call for EU-Japan projects 2009.

I. **Škorvánek** - committee for preparation of innovation strategy of Košice self governing region (2007 - 2008).

iii. **List of patents issued abroad, incl. revenues**

None

iv. **List of the patents issued in Slovakia, incl. Revenues**

1. **M. SEDLÁK, Č. KOŇÁK**: Preparation method of polymeric nanoparticles on the basis of poly(ethylacrylic acid) homopolymers. Industrial Property Office of the Slovak Republic, patent application PP5007-2008: accepted.

v. **List of licences sold abroad, incl. revenues**

None

vi. **List of licences sold in Slovakia, incl. revenues**

None

vii. **List of contracts with industrial partners, incl. revenues**

U.S. Steel Kosice sponsorship in 2007-2011: **83 000 EUR** in total.

viii. **List of research projects with industrial partners, incl. revenues**

The Project FP7-MNT-ERA-NET Transnational Cooperation **MAFINCO** - Magnetic fluid-new insulated and cooling medium for power transformers, Duration: 2009-2011, Coordinator M. Timko. In frame of this project we have tested the possibility of using transformer oil based magnetic fluid as a isolative and cooling medium medium in commercially transformer produced by **Electrotechnical Research and Design Institute Inc. (EVPU) Nová Dubnica** at full loading condition.

ix.

Outreach activities	2007	2008	2009	2010	2011	total
studies for the decision sphere, government and NGOs, international and foreign organisations	1	2	3	1	3	10

VII. Popularisation of Science

i. List of the most important popularisation activities

The main popularization activities have been realized within the framework of three LPP APVV projects and the EU project “Researcher Night”. It is worth to note that the organizers of these projects (19 persons) were awarded by the Price of Slovak Academy of Sciences for popularization in 2011.

1. The main activity of the project „Through microcosmos to understanding of macrocosmos“ (E.Kladiva, in years 2008 - 2011) was the popularization of subnuclear physics and promotion of Slovak scientific research on LHC accelerator in CERN. A mobile exhibition set was designed and complemented with demonstration of experiments, interactive exhibits, video projections and lectures. 16 exhibitions were organized in 5 Slovak academic cities, about 22 thousand visitors came. We trained and managed 92 students to guides and assistants of educational activities. For secondary education, a distance learning course of subnuclear physics was created, also local forms of regional Masterclasses were organized as well as 3 Physics Summer Schools for secondary youth. This non-formal education attended 526 young people. In order to attract, we hold 7 competitions for students of secondary and primary schools and 56 popularizing lectures for students and the public. We published over 70 articles, interviews, messages in printed and electronic media (TV, radio, blog, facebook) and 11 scholarly papers.
2. Dr. Pavol Szabó, Dr. J. Kačmarčík, Dr. Z. Pribulová and Prof. P. Samuely coordinated the project „The Hour of Science“ dedicated to popularization of science and scientific profession among young students and the public in general. The concept of the project has become well-known not only in Kosice but also in the rest of Slovakia. During three years 38 popularization lectures for public and 94 lectures for students of different elementary and high-schools in 10 different towns of Slovakia were presented all with a high visit rate. The project participated at organization of different events for popularization of science (Science fairs, Researchers night etc.). It is worth to note that together with other two projects of the Institute of Experimental Physics it was awarded by the price of Slovak Academy of Sciences for popularization in 2011.
3. The Crayon physics - a special physics course for kids of preschool age and pupils up to 4th grade was tested within the APVV LPP project Scientific incubator for pupils and students (2006-2009). Simple hands on experiments from mechanics, electricity and magnetism were followed by physical paintings. The new methodology of physics for small kids will be regularly implemented as a part of curriculum for future kindergarten teachers at Catholic University Ruzomberok. In the following APVV LPP project Science-user friendly (2009-2012) the Crayon physics course was modified to serve also as an alternative way of physics teaching for gifted pupils with

learning disabilities. For students of secondary schools a possibility to work on their scientific projects in laboratories of our institute under supervision of tutors was given within the frame of both LPP projects. Realized projects of many of them were successful in various national and international competitions (for example European young scientist contest, Intel competition and others).

4. Researcher's night is a series of science popularization events and activities supported under the 7th Framework Programme of the European Union. Staff of Institute (E. Kládva, P. Szabo, M. Zentkova, Z. Pribulova) organized science show in Kosice for the schools and the public. For the year 2010 were engaged 115 scientists from 6 institutes of SAS, students and volunteers of 2 youth centers, 15 thousand visited the show. In year 2011, there participated 192 scientists, PhD students, staff and MB students from 6 institutes of SAS, 9 faculties of four universities, 6 other organizations of state and government, two non-governmental organizations and one private company. 3 foreign institutes were connected in videoconference broadcast. Over 20 thousands visited the show.

ii. Summary of outreach activities

Popularisation of science	2007	2008	2009	2010	2011	total
articles in press media/internet popularising results of science, in particular those achieved by the Organization	21	6	3	3	15	48
appearances in telecommunication media popularising results of science, in particular those achieved by the Organization	13	1	2	13	5	34
public popularisation lectures	5	17	37	76	15	150

iii. Supplementary information and/or comments on popularisation activities

The Department of Low Temperature Physics in collaboration with Media Agency Monarch prepared a scientific-popularization documentary film/movie (20 min) for Slovak Television:

The world near absolute zero – P. Samuely, P. Szabó

VIII. Background and management. Staffing policy and implementation of findings from previous assessments

i. Summary table of personnel

Personnel	2007	2008	2009	2010	2011
all personnel	136	147	138	142	137
research employees from Tab. Research staff	69	67	89	93	99
FTE from Tab. Research staff	61,46	57,805	72,71	76,54	78,44
average age of research employees with university degree	46,6	46,6	47,2	47,2	47,9

ii. Professional qualification structure

Number of	2007	2008	2009	2010	2011
vedúci vedecký pracovník DrSc./ research professor DrSc.	8	10	10	10	11
Vedúci vedecký pracovník CSc., PhD/research professor CSc., PhD	20	21	21	21	21
samostatný vedecký pracovník/ senior scientist	29	23	27	29	32
vedecký pracovník/research scientist	46	58	61	64	67
profesor/professor	2	2	3	3	4
docent/assoc. prof.	6	7	6	6	7

Vyplňte podľa prílohy A, správy o činnosti organizácie.

iii. Status and development of research infrastructure incl. experimental, computing and technical base (description of the present infrastructure, premises, and material and technical resources. Infrastructure, instrumentation and major technical equipment necessary for the achievement of the objectives specified in the research Concept)

Department of Subnuclear Physics

The experimental infrastructure for the department research activities are located in international research centers, due to size and complexity of experimental facilities in elementary particle physics. We have contributed to the development, building, maintenance and running of the ALICE and ATLAS experiments at CERN regularly for several years and similar contributions are planned also in the near future.

An integral part of such large experiments are computing resources needed for processing huge amounts of data. A GRID computer farm built at the IEP SAS has been regularly upgraded and enlarged. As of today, it has 260 processor cores and 60 TB of data storage (compared to 16 CPU cores and 6 TB in 2006) and for the ALICE experiment it represents about 4% of resources provided by CERN. From the start of the LHC operation 737 000 batch jobs have been processed till the end of 2011.

We actively contribute also to the development of the AAF - ALICE Analysis Facilities dedicated for fast interactive data processing during preparation of publications. SKAF - Slovak Kosice Analysis Facility with 60 CPU cores and 60 TB of data storage started as an improvement of the CERN Analysis Facility and showed a new direction in further development of AAF.

Department of Space Physics

Experimental infrastructure of the department consists of the Mountain observatory at Lomnický štít equipped with neutron monitor and Laboratory of space technology in Košice, where spaceborne devices for various space missions are developed, constructed and tested.

The Laboratory includes electronic workshop, mechanical workshop and testing facilities for thermal-vacuum testing, vibration-acceleration testing, magnetostatic and electromagnetic compatibility (EMC) testing of spaceborne devices. In years 2007-2011 the Laboratory acquired space environment simulator SPACEVAC for thermal-vacuum testing, Bruel&Kjaer/LDS vibration system V780-HPAK with LASER Analyzer, and NARDA equipment for EMC testing. From "home made" scientific devices

The MEP-2 particle spectrometer it is notable as its development was finished in 2007-11 period and was also launched on board of Radioastron satellite on 18-JUL-2011. The Laboratory also contributed to development of PICAM planetary ion camera for ESA-BepiColombo mission to planet Mercury. The particle spectrometer DOK-M for mission RESONANCE is currently under development (DOK-M/STM, structural thermal model was already delivered) and under development is also the particle spectrometer ASPECT-L for Luna-Glob / Orbiter mission.

Center of Space Research: Space Weather Influences (for details look at http://ckv.astro.sk/docs/prezentacia_projektu_EN_c.pdf).

Department of Biophysics

Infrastructure of the Laboratory of image analysis and stereology consists at present of:

- Stereomicroscope Leica M165 with motorized XYZ positioning system and a sensitive EMCCD camera Andor with software development kit.
- Several PC computers with MS Visual Studio for software development applications.
- School optical microscope Leica with camera attachment for simple experiments.

Software applications developed in this laboratory should cover also the much wider range of experimental devices of neighbouring laboratories like e.g. optical fluorescence microscopes with optical tweezers, gel scanner, AFM microscope.

Laboratory of protein aggregates and nanostructures – the laboratory allows studies of the protein stability, structure changes and aggregate propensity and searching for amyloid aggregation inhibitors by different experimental methods allowing

- determination of the secondary and tertiary structure of proteins, protein aggregates by spectroscopic methods – UV-VIS absorbance, fluorescence, luminescence, CD and IR spectroscopy,

- study of the stability of biomacromolecules by DSC calorimeter,
- visualization of morphology and size of amyloid aggregates by atomic force microscopy,
- determination of surface properties of protein solutions (surface tension, surface pressure),
- preparation of protein amyloid aggregates (various types of centrifuges (max 600 000g, termomixers, etc.).

A Laboratory for molecular modelling and design was built. The hardware resources comprise newest GPGPU technologies allowing us to complete molecular dynamics simulations of large systems of biological interest. At first we were implementing and testing selected software tools for such simulations (programs NAMD, AMBER, GROMCAS, etc.). Beside this software tools for virtual screening were also implemented and extensively used. Sound results were obtained from studies of protein-ligand interaction studies, especially for lectin-ligand complexes. Recently, based on the computational speedup gained from GPGPU we were able to expand out interest even to larger systems such as amyloid aggregates of protein and other nanoparticles.

Laboratory of supramolecular biophysics – enables studies of structure and stability of biomacromolecules, supramolecular complexes, nanoparticles and development of new materials and includes:

- UVVISNIR spectrophotometer,
- CD and MCD, vibrational CD spectrometers,
- Spectrofluorimeter,
- Impedance spectrometer,
- UV-VIS multi-mode microplate reader,
- FT Raman spectrometer and two FT IR spectrometers,
- Stopped-flow spectrometer,
- DSC calorimeter,
- Multifunctional fluorescence microscope coupled with the single optical tweezers and laser scalpel,
- Advanced optical tweezers device based on the special laser approaches for 3D measurements coupled with Raman spectrometer. Methodology for preparation of new nanoparticles composed from gold, silver, ZnO, iron Fe⁰ alloys, graphene, covered by various organic compounds,
- Viscometry of supramolecular biomacromolecules arrangement.

Department of Theoretical Physics

We have built a PC cluster consisting of 200 cores running under Linux. Distribution and processing of tasks is managed by the Condor-HTC system. The cluster is used for high performance computations in the area of quantum phase transitions on lattices.

Centre of Low Temperature Physics

The Centre covers all basic physical measurements of transport, magnetic and thermal properties of condensed matter starting from microkelvin temperatures to ambient, or to even higher temperatures (400 K), in magnetic fields up to 10 Tesla (a purchase of 14 T magnet is planned in the near future) and under pressure up to 100 kbar. The Centre accommodates numerous excellent devices - two from Quantum Design – PPMS/Physical Properties Measuring System for measurement of basic physical properties down to 300 mK and MPMS/Magnetic Properties Measuring System with SQUID magnetometer, four ³He-⁴He dilution refrigerators, three ³He refrigerators, several ⁴He refrigerators, all of them equipped with superconducting solenoids and implemented techniques like specific heat

measurements, heat and electrical conductance measurements, NMR, EPR, point-contact spectroscopy, etc.

We have developed and mastered several unique techniques as the subkelvin STM, ac calorimetry, high pressure measurements with different pressure cells, incl the diamond anvil cell for pressure up to 150 kbars immersed in the home made versatile dilution fridge working down to 50 mK and fields up to 8 Tesla.

The Centre has its own cryogenic base – helium liquefier with the production on the order of 40 000 liters per year. If need be, it would be capable to supply the liquid helium to whole Slovakia. The laboratory provides consulting services and technical support for companies working in the field of cryogenics and vacuum technology.

The Centre has been successful in applications for the infrastructure with the Agency EU structural funds. By those means we have started among others a development of the nanotechnology and nanophysics laboratories. At the moment there are two commercial experimental systems: atomic force microscope (AFM) and equipment for deposition of thin films via magnetron sputtering. The microscope is already being routinely used for characterization of the surfaces. Recently a local anodic oxidation (LAO) method for preparation of nanostructures was implemented in AFM. LNT will shortly be extended by optical lithography, an electron beam lithography, reactive ion plasma etching and by a system for ultrapure de-ionized water. Thus the laboratory will represent a complex infrastructure for preparation and characterization of nanostructures and nanocomponents.

Laboratory of Materials Physics

The infrastructure of LMF for preparation and characterisation of ceramic materials consists of following instrument: Planetary mill *FRITSCH "pulverisette 6"* for intensive milling of materials (powders) in air, protective liquid or inert atmosphere up to nanometer scale. Fraction mill *FRITSCH "pulverisette 2"* for homogeneous blending and milling of powders in liquids or air. Atritor mill *NETZSCH R41-25/4* for blending and milling materials which have high tendency to agglomerate. Vibratory mill *FRITZSCH Micro mill "pulverisette 0"* to mill soft or very hard materials at liquid nitrogen temperature. Vibratory sieve – shaker *FRITSCH Laboratory Mortar – Grinder "pulverisette 2"* for sieving and homogenization of powders with the size from 3 mm up to 1 μm . Chamber furnace *LAC L06V* with double-sided heating elements up to 1300 °C. Chamber furnace *ThermConcept KC 16/13/6Z* with six-sided heating elements with effect temperature homogeneity or temperature gradients inside the furnace. The absence of temperature gradients allows multi-growth of several bulk single-grain superconductors up to 1300 °C. Tube furnace *Adamel Lhomargy TR-50* and Tube furnace *MTI GSL – 1600X80* for thermal treatments in pure non aggressive gases (e.g. argon, nitrogen, oxygen) or defined mixtures of these gases up to 1600 °C. Thermal analyser *NETZSCH STA 449 F1 Jupiter* for Differential thermal analysis (DTA), Differential scanning calorimetry (DSC) a Thermogravimetric analysis (TGA) or by simultaneous measurements of mass change (TG) and DTA or DSC signal. Working temperature range 30 °C - 1650 °C, atmosphere pure non aggressive gases (e.g. argon, nitrogen, oxygen) or defined mixtures of these gases. Glovebox *Jacomex* a special chamber with very pure inert atmosphere inside. Glovebox is used for keeping chemicals which can change (or degrade) in air and for preparation of materials, which cannot be prepared in air. Optical microscope *Nikon Eclipse LV100* with maximum magnification of 2000 in white light and polarized light for microstructural investigation of anisotropic materials equipped with image processing software. Precise wheel cutting machine *Buehler ISOMET 5000* with diamond discs and possibility of multi cutting. Ultrasonic disc cutting machine *Ultrasonic Cutter Model 380 SBT* for very hard and fragile materials for Transmission Electron Microscopy

or magnetization measurements. Portable High Frequency Induction Heating Machine HX – 15 KW for heat treatment and melting of conductive materials in inert atmosphere with maximum weight up to 5 grams. Automatic Mounting Press *Buehler SimpliMet 1000* for non conductive substance for optical microscopy or to the special conductive substance for Scanning Electron Microscopy. Analytical balances *Mettler Toledo XS105 and DualRange* Analytical balances *RADWAG WAX 110* with precision of weighing up to 10^{-5} gram.

We will further concentrate on methods for preparation and characterization of progressive materials based on new equipments purchased in the framework of our new projects: X – ray diffraction analyses of material structure, phase transformations, and reactions in a broad temperature range for materials in the form of single-crystals, polycrystals, thin films, powders and liquid emulsions; microscopical methods of microstructural analyses such as optical microscopy, scanning electron microscopy (SEM) with energy dispersive x – ray analysis (EDAX), wave dispersive x – ray analysis (WDX) and electron backscattered diffraction (EBSD), high resolution transmission electron microscopy (HREM); thermal treatments of materials in controlled atmosphere under ambient and high pressure; refinement of powder materials to the nanometer size by intensive milling; characterization of particle size and shape distribution by laser granulometry and image processing; thermal analysis oriented on phase transformations and solid state reactions; preparation of thick films by “screen printing” method; preparation of materials by high – frequency inductive melting.

Department of Metal Physics is equipped with new excellent techniques for a complex study of thermal properties and stability of bulk metallic and nonmetallic materials. The thermal properties are studied using Differential Scanning Calorimetry (DSC8000 - Perkin Elmer), thermogravimetric and differential thermal analysis (TGDTA – Setsys16 - Setaram), complex thermomechanic and dynamic mechanical analysis (TMA, DMA - Q400EM, Q800 – TA Instruments).

Department of magnetism

The infrastructure of the department consists of following instruments:

Cryogen free automatized Measurement System for measurements of magnetic, electric and thermal properties. This system contains magnetic field up to 18 Tesla, temperature range 1.6 K – 600 K, VSM magnetometer (sensitivity 10^{-6} emu) AC susceptibility (sensitivity 10^{-7} emu), resistivity (10^{-7} - 10^9 Ohms) and Hall effect (sensitivity 10^{-7} Volts).

Portable AC Susceptometer *DYNOMAG* - frequency range is from 1 Hz up to 200 kHz with a resolution in magnetic moment of $3 \cdot 10^{-11}$ Am² or in volume susceptibility $4 \cdot 10^{-7}$ (SI-units) at 1 kHz and excitation amplitude of 0.5 mT.

For characterization of prepared samples we can use FT-IR FTLA2000-100 laboratory spectrometers (IR region $6500\text{-}350\text{ cm}^{-1}$), Laser Scattering Particle Size Distribution Analyser, LONG-RANGE microscope, ICP-AES spectrometer, UV/VIS spectrometer SPECORD 40 and Zeta and Size Analyzer.

For the preparation and microstructural characterization of samples we have a fully equipped chemical laboratory for preparing and the first characterization of magnetic fluids, magnetic nanoparticles and molecular based magnets equipped by Ultracentrifuge Thermo Scientific Discovery M120/150 SE, Centrifuge - UNIVERSAL 32, Flow UV air decontaminator, Freeze-drier IISHIN Europe TFD5503 and rotation evaporator. An automatic system for purification, incubation and isolation of biogenic magnetite nanoparticles from biomineralization process of magnetotactic bacteria is disposal too.

Laboratory of Nanomaterials and Applied Magnetism

The experimental facilities of Laboratory of Nanomaterials and Applied Magnetism at IEP SAS allow obtain a detailed information on magnetic parameters of materials measured at wide range of temperature and applied fields. They include:

- SQUID magnetometer, Quantum Design type MPMS-XL-5, temperature range 2 – 800 K, fields up to 5 T, with low field ac-susceptibility option.
- Two VSM magnetometers:
 - i) low temperature option, temperature range 4.2 -300 K, fields up to 6 T,
 - ii) high temperature option, temperature range 300 –1100 K, fields up to 0.7 T.
- Home made hysteresis loop tracer for soft magnetic materials based on flux-gate sensors, temperature range 300 – 800 K.
- Impedance analyzer for measurements of magnetic permeability and magnetoimpedance characteristics of soft magnetic materials in the frequency range from 40 Hz to 110 MHz.
- Magneto optic Kerr microscope for observation of domain structure and measurements of surface hysteresis loops in temperature range 10 K to 900 K in the fields up to 800 kA/m.
- Furnaces for heat treatment of samples under high vacuum and different protecting gas atmosphere with the possibility to apply the external magnetic field (max. 0.8 T) during annealing.
- Support infrastructure for determination of density and weight of measured magnetic materials (Helium gas pycnometer, precise ultramicrobalance).

Laboratory of Experimental Chemical Physics

The laboratory is fully equipped for planned research:

- Static light scattering. Custom-made goniometer with argon ion laser (Spectra Physics, USA) and 50mW He-Ne laser (CVI Melles Griot, USA). Precise temperature control (Lakeshore, USA)
- Dynamic light scattering. ALV-7004 correlator with the fast board option (ALV).
- Electrophoretic light scattering (Malvern Instruments, UK). Method of M3 P.A.L.S. (Phase Analysis Light Scattering) enabling to determine not only mean value, but also distributions of electrophoretic mobilities.
- Asymmetric-Flow Field-Flow Fractionation coupled with multiangle light scattering instrument (Wyatt Instruments, USA, Eclipse AF4 unit, 18 angles LS detector Dawn Heleos, and Agilent isocratic pump).
- Differential refractometry (WGE, Germany).
- Vapor pressure osmometry (Knauer, Germany). For low molecular weight compounds, oligomers, and low molecular weight polymers.
- Membrane osmometry (Knauer, Germany). For polymers (medium and high molecular weights).
- FTIR (Fourier Transform Infra Red) spectroscopy (Thermo Scientific Nicolet 6700, USA). Temperature control, liquid samples, ATR and transmission.
- Fluorescence spectroscopy (Shimadzu RF-5301, Japan). Including polarization measurements and temperature control.
- UV Vis absorption spectrometer (Thermo Scientific, USA).
- Light scattering integrating sphere (Thermo Scientific, USA).
- Programmable preparative and analytical separation of particles. Centrifuge KR22i (Jouan, France).
- Capillary viscosimetry (Cannon, USA).
- Further small standard lab instruments for chemical analysis and preparation.
- Access to large-scale EU facilities (neutron scattering at Institute Laue Langevin, Grenoble, France, synchrotron SAXS at European Molecular Biology Laboratory Grenoble, advanced electron microscopy techniques at Euro-Biolmaging Center, Helsinki, Finland).

iv. Status and development of bibliographic resources, activities of the Organisation's library and/or information centre

The institutional library services are handled by two qualified librarians, one with a university degree, one with a fully secondary school qualification. Both work on full time contract.

Services provided by the library are:

- Scientometric database (WOS, SCI, SCOPUS, etc.) searches and scientometric analysis for the Institute (annual reports, accreditation reports, ...) as well as for individual researchers.
- Copying of documents, acquisitions of photocopies of documents from otherwise inaccessible sources – databases.
- Performing revisions of the existing library collection, excluding obsolete materials and acquisitions of new modern books.
- Performing "traditional" library functions – book loans, obtaining literature for loan from other libraries etc...

v. Describe how the results and suggestions of the previous assessment were taken into account

Research output

The amount as well as the quality of research outputs within this evaluation period (2007-2011) increased when compared with the previous period (2003-2006). In addition, many publications appeared also as chapters in monographs or books. This is a very positive result, as we have to take in to account also the parallel, relatively large amount of administrative work related with EU structural funds.

Responses to the scientific output

The number of responses to the scientific output (in comparison with the former evaluation period) increased. One can see it directly when looking e.g. at WOK or SCOPUS web-sides.

Research status of the Organisation

The Institute, as in the previous evaluation period, had an extensive international and national collaboration. High in the assessed period was also the number of invited talks at international conferences (workshops, seminars), as well as the number of referee activities for various scientific journals including *Physical Review Letters* and *Physical Review*.

Project structure, research grants and other funding resources

The Institute was in recent years very successful in receiving grants of EU structural funds (**more than 12 million EUR**), as well as in obtaining APVV and VEGA grants, and Slovak Academy of Sciences projects for Centres of Excellence.

Organisation of PhD studies, other pedagogical activities

The pedagogical activities were on a high level also in this evaluation period. In this period we increased the number of PhD students. A lot was done for the quality of education of PhD students, above all within the framework of the EU structural funds educational project EDUFYCE, which enabled to invite experts from abroad (to have special lectures) and secondments of PhD students. To

support these activities in the next future, another EU educational project (NANOKOP) was started and a new one (PHYS-NET) prepared and submitted.

Applied research and Popularisation of Science

In this evaluation period first applied research products were achieved, and some other results of our research have received a rather high application potential (patents). Moreover, we continued (as in the former period) to supply other places in the region (e.g. MRI tomographs, NMR spectrometers) with cryogenic liquids. In the field of popularization, as mentioned elsewhere, many very valuable results were achieved.

Background and management

In recent years the most of departments / laboratories of the Institute were almost completely equipped with new facilities / devices, which were purchased via EU structural funds or with homemade facilities (constructed e.g. within Transfer of knowledge EU projects). These, we hope, will give the Institute good research perspectives for the next years. On the other hand, there was also a strong tendency to involve into the staff of the Institute young talented people. This concerns as well the management of the Institute, where into positions of deputy director and scientific secretary people with ages far below fifty were selected.

Suggestions for further activities of the organisation:

1. *Carry out evaluation of Institute units with the aim to look for the optimal research structure* – in this evaluation period (since 2008) also smaller units (so called Laboratories) were created - to enable to unfold research activities in special directions. However, after EU structural funds appeared, new structure units based on received grants, seem to develop and create.
2. *Enhance the activities within ERA and the 7FP* – shortly after the last assessment (after 2007) possibilities to obtain larger resources (money) within the framework of EU structural funds appeared. As the chance / probability to receive this kind of resources was for the Institute relatively high, efforts were made above all in this direction. However, also attempts within ERA and the 7FP were made. Nevertheless, as the chance to be successful here was (is) lower, we had only a few new successful applications. But, we hope that with newly acquired infrastructure of the Institute, chances to be successful also within international projects (ERA funding) will increase.
3. *Continue in the effort to gain young talented people for PhD studies* – In this field a lot of effort, especially through activities within projects of EU - structural funds (which were devoted to education), as well as via APVV popularization grants, was made. Details are described elsewhere.
4. *Utilize the popularization potential of the Institute* – this was very well done, above all within the activities of 3 APVV popularization projects which were finally awarded by the Price of the Slovak Academy of Sciences. Among the activities in this field one can/should mention above all many lectures for secondary school and university students, and many public exhibitions with life experiments.

vi. Supplementary information and/or comments on management, research infrastructure, and trends in personnel development

None

IX. Supplementary information and/or comments important for the assessment of organisation which are not explicitly mentioned in the questionnaire (concerning each previously mentioned evaluation criteria, facts not included, evaluation of research teams by ARRA, etc.)

In 2011 the Presidium of SAS invited the **Academic Ranking and Rating Agency** (ARRA - an independent Slovak civil association) to prepare an independent rating report about the quality of research teams at SAS Institutes. The resulting rating list of 22 excellent research teams published in Oct. 2011 (look e.g. at <http://www.urad.sav.sk/downloads/arra/>) contains 3 groups from our Institute:

Team „Samuely“ - the team of researchers **P. Samuely, P. Szabó, J. Kačmarčík** and **Z. Pribulová** of the Department of Low Temperature Physics dealing with the experimental study of unconventional superconductors (see. R&D activities of the Dept. Low Temp. Phys. in Chapter 2).
Team leaders: **P. Samuely, P. Szabó.**

Team „Bruncko“ - the team of researchers **D. Bruncko D, J. Ferencei, J. Antoš, E. Kladiva, P. Strizenec** and **J. Bán** of the Department of Subnuclear Physics participating in ATLAS collaboration CERN (see. R&D activities of Dept. Subn. Phys. in Chapter 2). Team leaders: **Dušan Bruncko, J. Antoš.**

Team „Králik“ - the team of researchers **I. Králik, L. Šándor, J. Bán, M. Straka, J. Špálek, P. Kaliňák, M. Krivda** and **M. Vaľa** of the Department of Subnuclear Physics participating in ALICE collaboration CERN (see. R&D activities of Dept. SP in Chapter 2). Team leaders: **Ivan Králik, L. Šándor.**

Other information relevant to the assessment

None