

## **Questionnaire**

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

*Period: January 1, 2003 - December 31, 2006*

#### **I. Formal information on the assessed Organisation:**

##### **1. Legal name and address**

Institute of Physics Slovak Academy of Sciences (IP SAS), Dubravská cesta 9, 84511 Bratislava, Slovakia

##### **2. Executive body of the Organisation and its composition**

Directoriat	name	age	years in the position
director	RNDr. Eva Majkova, D.Sc.	57	7
deputy director	RNDr. Stanislav Dubnička, D.Sc.	65	7
scientific secretary	RNDr. Peter Markoš, D.Sc.	49	2

##### **3. Head of the Scientific Board**

Prof. RNDr. Vladimír Bužek, D.Sc.

##### **4. Basic information about the research personnel**

- i. Number of employees with a university degree N (PhD students excluded) engaged in research and development and their full time equivalent work capacity (FTE) in 2003, 2004, 2005, 2006 and average number during the assessment period

	N	FTE
2003	72	68
2004	68	60
2005	68	61
2006	70	63

ii. Organisation units/departments and their FTE employees with the university degree engaged in research and development

Research staff	2003		2004		2005		2006		average	
	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE
organisation in whole	70	68	68	60	68	61	70	63	69	63
Department of Applied Physics	9	9	8	7	8	7	8	7	8,25	7,5
Department of Complex Physical Systems	7	6	7	6	7	6	7	6	7	6
Department of Metal Physics	11	11	11	10	13	12	12	11	11,75	11
Department of Multilayers and Nanostructures	6	6	7	6	7	6	7	6	6,75	6
Department of Nuclear Physics	17	17	13	11	13	12	14	13	14,25	13,25
Department of Solid State Physics	5	5	4	4	4	4	4	4	4,25	4,25
Department of Theoretical Physics	8	7	7	6	6	5	7	6	7	6
Department of Thermophysics	4	4	4	4	4	3	4	4	4	3,75
Research Center for Quantum Information	3	3	7	6	6	6	7	6	5,75	5,25
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5. Basic information on the funding

i. Total salary budget<sup>1</sup> of the Organisation allocated from the institutional resources of the Slovak Academy of Sciences (SAS) in 2003, 2004, 2005, 2006, and average amount for the assessment period

Salary budget	2003	2004	2005	2006	average
total salary budget (millions of SKK)	18,685	19,221	20,915	21,168	19,997

<sup>1</sup> Sum of the brutto salaries without the fund contributions.

## 6. URL of the Organisation's web site

www.fu.sav.sk

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

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

IP SAS is a contributory scientific organization established on October 1<sup>st</sup>, 1955. The mission of the organization is:

- a) experimental and theoretical scientific and research activities in the field of physics of condensed matter, nuclear and subnuclear physics, quantum electronics and optics.
- b) consultations and expertise services in the areas mentioned above for domestic and foreign clients including sale of special equipments and materials developed and produced at IP SAS
- c) IP SAS provides PhD studies in the accredited programmes and guarantees participation of researchers in pedagogical activities at universities.
- d) IP SAS takes care of publishing scientific results via periodic and non - periodic press. IP SAS is the publisher of Acta Physica Slovaca journal.

### **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)**

The Institute of Physics is primarily aimed at experimental and theoretical research in physics. Current research at the Institute focuses on **condensed matter physics** (rapidly quenched materials, multilayers, semiconductors, theory of low dimensional systems), **nuclear physics** (nuclear structure, mechanism of nuclear reactions, positron utilization), **subnuclear physics** (phenomenology of high energy collisions, nonperturbative QCD, properties of hadron spectra) and **quantum information**.

Significant part of our research results is obtained in collaboration with research institutions in Slovakia and abroad. The Institute is also involved in a broad scientific collaboration within European scientific projects and cooperates closely with world most famous research centers (e.g. JINR Dubna, ESRF Grenoble, DESY Hamburg).

The Institute provides scientific education for graduate students to obtain Ph.D. degree and for undergraduate students to prepare their diploma thesis.

Short characteristics about the research group and their results are summarized as follows.

#### **Nuclear Physics** (PI E. Běťák, Š. Gmuca, J. Kliman, J. Krištiak M. Morháč and M. Veselský)

R&D effort of the Department of Nuclear Physics focuses on both the experimental and theoretical low energy nuclear physics and the application of nuclear analytical techniques.

During the period assessed the main attention was put on the **fission of heaviest nuclei** (PI J. Kliman, Ľ. Krupa). It is aimed at systematic investigation of dynamical processes of the production and decay of the heavy and superheavy compound nuclei. Such nuclei are outside the region of macroscopic stability and are stabilized by the microscopic shell effects only. The **mass and energy distributions of superheavy element (SHE)**

**fission fragments** indicate a sharp transition from the predominant compound nucleus fission around  $Z=102-106$  to the quasi-fission mechanism of decay in the case of the  $Z>112$  nuclei. The mass distribution of fission fragments for superheavy compound nuclei with  $Z=112-122$  was found to be asymmetric, in contrast to the symmetric fission of actinides. The nature of the asymmetric fission is determined by the shell structure of the light fragment.

**Neutron and  $\gamma$ -ray multiplicities in the fission of superheavy nuclei** were found to be clear indicator of the fusion-fission vs. quasi-fission competition. The fission neutron multiplicity may be used in the identification of SHE in the experiments on their synthesis.

**Proton induced fission of actinides** (PI J. Kliman, Š. Gmuca) at intermediate energies contribute to our understanding of the fission process with increasing excitation energy of the compound nucleus. The measurements of the average pre-scission and post-scission neutrons and  $\gamma$ -ray multiplicities in coincidence with primary fission fragments and total kinetic energy (TKE) provide access to fission dynamics. The neutron post-scission multiplicity is a measure of the excitation energy distributed to both fragments, whereas the  $\gamma$ -multiplicity is more closely related to the spin and deformation of fission fragments.

The study is a part of the broad research programme conducted under wide international collaboration around FLNR JINR Dubna (Russia). Experimental investigation of the fission of superheavy compound nuclei was performed at JINR Dubna. The proton induced fission was done at JYFL Jyväskylä and INFN Legnaro using their heavy ion facilities. The double arm spectrometer of kinetic energies and masses of fission fragments CORSET was used and the multidetector systems DEMON and HENDES were employed in the multilateral cooperation to measure the multiplicity, energy and angular correlations of the emitted neutrons and gamma-rays. The processing of the data obtained in cooperation with the JINR Dubna, University Messina, and University Libre Brussels.

**Binary and ternary (quaternary) spontaneous fission of  $^{252}\text{Cf}$**  (PI J. Kliman, M. Jandel) was investigated using the US national  $\gamma$ -spectrometer GAMMASPHERE. The project was devoted to the study of nuclear structure of exotic fission fragments and to the assessment of the role of single-particle and collective degrees of freedom on the dynamics of fission. The hot bimodal fission of  $^{252}\text{Cf}$  was observed in both, the binary and ternary fission channels. The experiments were done within the collaboration with Vanderbilt University, LBL Berkeley and JINR Dubna.

Studies of the **dynamics of nucleus-nucleus collisions** (PI M. Veselský) : Production cross sections of the neutron-rich nuclei, a crucial for the next generation of isotope beam facilities, were studied both experimentally and theoretically at projectile energies around the Fermi energy in collaboration with the Texas A&M University. In the peripheral collisions, influence of the isospin asymmetry at the nuclear periphery was observed and described. Isoscaling was observed in the heavy residue data and also in the nuclear fission whereas shell structure of the highly deformed scission configuration was demonstrated. Multifragmentation of the hot nuclei was studied and multiple coincident signals of the isospin asymmetric first order phase transition were observed. Based on the above-mentioned activity, participation in the European 6<sup>th</sup> FP project **Eurisol** was commenced.

The **pre-equilibrium formulation of direct reactions** (PI E. Běták) with participation of clusters was developed. Under the auspices of IAEA Research Contract, the production cross sections of therapeutic radioisotopes in several selected reactions were established, and also were the cross sections of production of diagnostic isotope  $^{111}\text{In}$ . Collaboration with IJS Ljubljana continued in specifying the basic features of the optical model potential used for the description of nuclear reactions at low energies.

An inherent part of departmental research activity is the development of new efficient methods and algorithms needed to analyze experimental multiparameter nuclear data and their implementation in the data acquisition, processing and visualization systems. The new highly sophisticated program **DaqProVis** (PI M. Morháč) was developed in our laboratory, which integrates coincidence multiparameter data collection, processing and great variety of visualization techniques. The software comprises of a large number of tools for background elimination, deconvolution methods, peaks identification and fitting, as well as specific

methods of data storage and compression algorithms. It is well suited to interactive analysis of data from small- and medium-size experiments in nuclear physics. A good portion of the DaqProVis system was adapted for and ported to the CERN based ROOT package.

A systematic study of glass-forming liquids was performed by a nuclear probe to elucidate the dynamics of super-cooled liquids and glassy states. The characteristics of positronium decay on a wide set of compounds consisting from polymers and molecular liquids have been measured.

The best description of all data was achieved by modified defect diffusion model (DDM). It can be used to interpret structural and kinetic changes which occur in super-cooled liquids. **Mobile packets of free volume** (PI J. Krištiak) detected by the positronium behave as interacting defects in liquids and experience an intermittent diffusion throughout the system above glass transition. The results indicate an important role of the free volume in control of the dynamics of super cooled liquids.

New class of experiments to understand dynamics of finite number of molecules confined in nano-pores was started.

### **Investigation of the hadron structure manifestation in their electromagnetic and weak interactions** (PI S. Dubnička)

As hadrons are compounds of quarks, they are non-point like and their structure is manifested in various interactions. One can thus speak about electromagnetic or weak hadron structure. As a result, one cannot write down the matrix element of the corresponding matrix element of the corresponding current explicitly. Therefore it is decomposed into a maximum number of linearly independent covariants constructed by the fourmomenta and spin parameters of hadrons where the coefficients are functions of one variable (photon or W-boson momentum transfer squared) and called electromagnetic or weak form factors of the considered hadron.

We elaborated the most advanced unitary and analytic hadron structure model which was applied: (i) to evaluation of hadronic contributions to the anomalous magnetic moment with the highest precision (ii) to a determination of characteristic parameters of higher excited vector mesons with photon quantum numbers, (iii) at the prediction of the vector and tensor polarizations of final state particles in the process of electron-positron annihilation into proton-antiproton and deuteron-antideuteron pairs (iv) at the investigation of strange quark contributions to the nucleon structure.

International relevance of achieved results is confirmed by the approved international projects in Darmstadt (FAIR-PAX), Frascati (DAPHNE 2) and Peking (BES 3) in the framework of which they are planned to be tested experimentally, in Peking 2007-2010, in Frascati 2010-2012 and in Darmstadt 2014-2016.

### **Nonperturbative aspects of the theory of strong interactions** (PI Š. Olejník):

Two different models of a possible mechanism of quark confinement in quantum chromodynamics were investigated. According to one of them, confinement is due to the condensation of center vortices. The other assumes that the cause of confinement is accumulation of gauge fields (in Coulomb gauge) near a so-called Gribov horizon, where the value of the Faddeev-Popov operator is close to zero. We demonstrated in numerical simulations of lattice QCD that these two seemingly unrelated pictures are in fact closely connected. We also determined a so-called Coulomb string tension which is about three times higher than the asymptotic string tension between the quark and antiquark, and derived interesting analytic results on the role of center vortices and the structure in the Gribov horizon.

Further we pointed out a possible relation between colour confinement and the phenomenon of localization, known from the Anderson theory of the metal-insulator transition.

We applied the nonperturbative discretized-light-cone-quantization (DLCQ) method to determine the spectrum of low-lying states of the 2-dimensional scalar field-theoretical model with quartic self-interaction in the broken-symmetry phase. We determined the mass of quantum solitons (kink and antikink), the number density of elementary bosons in these collective excitations and the kink formfactors. The calculated values of the kink mass, the vacuum energy density and condensate do not differ significantly from their classical values and are mutually consistent for both periodic and boundary conditions. Similar results have not been determined so far by other non-approximative schemes.

Results were obtained within a broad informal cooperations with researchers abroad (SFSU, NYU, ISU, ITP Moscow, Univ. Tübingen, TU Wien, Univ. Montpellier, Saha Inst.).

### **Numerical analysis of left-handed materials** (PI P. Markoš)

In collaboration with Ames Laboratory, Iowa, we have continued in the analysis of electromagnetic properties of artificial structures, which possess, in a certain frequency region, negative refractive index.

### **Electron localization** (PI P. Markoš)

The *metal-insulator transition* in the three dimensional Anderson model was analyzed. Scaling of the conductance distribution was verified numerically. Detailed numerical analysis of the electronic wave functions enabled us to prove the universality of metal-insulator transition and to calculate the critical exponent and the multifractal dimensions of the critical quantum states. Critical regimes in two-dimensional disordered systems were studied numerically. In the *critical quantum Hall regime*, the equivalence of the mean conductivity and the conductance was confirmed. The *universal value of the mean conductance* corresponds to the fractal dimension  $d_2$  of the electron wave function. We have also analyzed the electronic transport in *strongly disordered systems*. Our numerical data verified the validity of the analytical model for the strongly localized insulators, proposed recently by other groups.

In a review article for the Slovak journal, *acta physica slovacica*, we summarized recent numerical results for the electron conductance in disordered systems and discussed critical regime of the metal-insulator transition in various dimensions. The results were obtained in collaboration with Sophia University Tokyo, PTB Braunschweig, UF Gainesville and Univ. Karlsruhe.

### **Quantum fluctuations in two-level electron-phonon models of the Jahn-Teller class** (PI E. Majerníková)

Elements of quantum complexity and symptoms of chaos in the wave patterns associated with atomic energy levels in quantum systems are usually studied in the classical or semiclassical limit. The spin-boson models, e.g., two and more levels coupled to bosons (vibrons, phonons, photons) exhibit chaotic phenomena and do not have a naive classical or semiclassical counterpart. The quantum tunneling and multi-mode nonadiabatic fluctuations lead to complicated wave packet dynamics. A typical representative of such a non-adiabatic system is the two-level molecular system coupled with two vibron modes of different symmetry against the transformation of reflection - the Jahn-Teller (JT) class of models.

We investigated (i) the ground state (ii) enhancement of quantum fluctuations (nonadiabaticities) caused by a strong mixing of electron and phonon degrees of freedom due to the nonlinearity inherent to the reflection symmetry. (iii) statistical properties of excited levels of the  $E_x(b_1+b_2)$  Jahn-Teller model:

## Statistical mechanics (PI L. Šamaj)

The research in the statistical mechanics was oriented to contemporary problems of statistical mechanics of low-dimensional classical systems.

In the field of the **equilibrium thermodynamics of two-dimensional (2D) systems with logarithmic Coulomb interaction**: A two-component plasma model with the charge 1/-2 asymmetry was solved exactly via the equivalent Bullough-Dodd field theory. In the presence of some guest charges in the 2D Coulomb gas, their effective interaction at large distances and the exact formula for the renormalized charge were derived. For the model of the electric double layer with the rectilinear geometry of the confining wall, the behaviour of charge and number density profiles at asymptotically large distances from the wall was obtained. The integrability of the one-component plasma (jellium) was investigated via equivalent 2D Euclidean field theories. The breaking of translation symmetry in quasi-one-dimensional models of the jellium was described qualitatively as well as quantitatively.

In the case of **Coulomb systems in arbitrary dimension**: Using simple thermodynamic principles, the shape-dependent tensor of the dielectric susceptibility was derived for a large class of conducting domains. Based on a revision of the high-temperature evaluation of the Casimir force between neutral conducting plates in a radiation field it was shown that this force is generated exclusively by charge fluctuations inside the conductors. The screening of the long-range Casimir force by the presence of an electrolyte between neutral planes was proved.

In the field of the **diffusion processes**, a systematic method was proposed for mapping 2D and 3D diffusion equation in quasi-one-dimensional domains onto the longitudinal coordinate. The result of mapping is the so-called generalized 1D Fick-Jacobs equation whose variational version was subsequently optimized. In the stationary state, the generalized Fick-Jacobs equation is transformed to the form known in the nonequilibrium thermodynamics with an effective diffusion coefficient which is calculated systematically by using the mapping technique.

## Metal Physics (PI P. Švec and M. Krajčí)

Synergic research effort of the Department of Metal Physics together with partners from Slovakia (IEP SAS Kosice, FEI STU Bratislava) and from abroad through diverse forms of cooperation (joint multinational projects, bilateral projects, cooperations and *ad-hoc* collaborations) has lead to new fundamental knowledge in the field of solid state physics, especially of *amorphous and nanocrystalline alloys* and composites with nanostructure exhibiting unique mechanical and magnetic properties and combinations of properties for potential exploitation in optimised soft magnetic materials, sensors and advanced construction materials.

Combination of *first-principle calculations* and diverse computer simulations within the framework of broader research in the field of computational materials science with intense experimental research has allowed to prepare several real physical systems and to formulate general physical models, tools and approaches linking quantum-mechanical and structural phenomena of nanoworld with macroscale behavior for exploitation in multifunctional materials.

Progress has been achieved in the methods of investigation of these novel materials and in the interpretation and quantification of experimentally obtained results. Active interaction with leading centers and institutions working in the field of basic and applied research has lead to an intense exchange of information, providing the potential for effective future applications of new knowledge and newly developed high-performance and cost-effective material systems. Bi-directional transfer of knowledge and training of students and young researchers as well as dissemination of results via organization of national

(NANOVED2003) and larger international scientific meetings (NATO ARW "Prosize", SMM17) and via participation in EC-based networking schemes (COST 523, COST P17) has been an integral part of the Department's activities.

We have achieved many important specific results in the field of structure and physical properties of complex metallic systems, published in the most prestigious physical journals. In 2003 our work on *quasicrystals* (a set of 42 articles, mainly using *ab-initio* methods) has received the Award of the Slovak Academy of Sciences.

The predictive power of *ab-initio* methods was extended to the studies of the 5-fold surface of the icosahedral AlPdMn quasicrystal investigated experimentally by the STM method [DMP7]. A direct comparison of the experimental image with the image of the same part of the surface obtained by *ab-initio* calculations of the surface charge density distribution and the tunneling current enabled us to identify the positions and the chemical types of individual atoms in the experimental image as well as specific vacancy sites.

We have developed an original method of calculation of the *thermodynamic stability of various phases* and used it for several selected binary, ternary and quaternary systems. We have investigated more than 1500 known and numerous new phases as well. The article by M. Gao, N. Unlu, G. J. Shiflet, M. Mihalkovic and M. Widom „Reassessment of Al-Ce and Al-Nd Binary Systems Supported by Critical Experiments and First-Principles Energy Calculations", Metall. Mater. Trans. A 36A (2005) pp3269-3279, has been awarded "APDIC Best Paper Award" in 2006 for the best published manuscript on alloy phase diagram data in the year 2005. The results of our calculations are published on the internet in a form of a database accessible at <http://alloy.phys.cmu.edu>. We have theoretically predicted the existence of new phases with extraordinary physical properties. One of the most interesting results is our discovery of a quasicrystal with high boron content [DMP8]. The importance of this discovery is obvious from the fact that almost all quasicrystals known so far are aluminium based. Another important result of our *ab-initio* method is a study of the quaternary phase diagram of Fe based bulk amorphous alloys, very promising materials for industrial applications.

#### *Cooperation with Industrial Partners, Applications, Patenting:*

1. Successful development of nanocrystalline systems and algorithms of thermomagneto-mechanical processing in external magnetic field for tailoring magnetic characteristics (B-H loop, coercive field, etc.) – simplification and optimization of processing for technology transfer (joint APVV project, EVPU Nova Dubnica, 2005-2007)
2. Mastering of medium-scale preparation of rapidly quenched precursor ribbons (~kgs) for bulk nanostructured lightweight high-strength compacts based on Al-Fe-V (cooperating partner IMMM SAS & industrial partners, continued in 2007)
3. Submission of patent application (PP 0142-2004: Strain and Deformation Sensor, P. Švec et al., submitted March 11, 2004), based on magnetoelastic effect of soft magnetic amorphous ribbons; set of sensors for harsh environments applied on the Gabčíkovo Dam Watergates.

#### **Defect states and charge transfer in solid and liquid systems on macro- and micro-scale** (PI V. Nadazdy, K. Gmucova, S. Lanyi).

We have studied **electrical and electrochemical properties of hydrogenated amorphous silicon (a-Si:H)**. Experiments were based on both current and charge measurements of thin a-Si:H layers incorporated in metal/SiO<sub>2</sub>/a-Si:H structure, *pin* solar cell, and Pt/a-Si:H electrode immersed in aqueous solution. We have investigated the influence of light exposure on the distribution of defect states and on the amplitude of the limiting current in voltammetry. We have formulated **an improved model of degradation of a-Si:H due to light exposure** (Staebler-Wronski effect) (V. Nádaždy). The model is a contribution to the explanation of the microscopic origin of charge states in a-Si:H and can explain changes in the distribution of defect states caused by light degradation as well as by high-energy



electron irradiation. It allowed us to design experiments which aimed at studying the nature of hydrogen in a-Si:H. The performed measurements showed an important role of the mobile hydrogen in the degradation process. The electrocatalytic properties of Pt/a-Si:H electrode can be programmed by controlled changes of defect distribution, which was demonstrated on the changes of its sensitivity to several kinds of heavy metals, metal complexes and pharmacoterapeutics. **Kinetics studies of redox reactions** taking place on Pt/a-Si:H electrode and carbon fibre microelectrode, modified by thin organic Langmuir-Blodgett films, revealed deviations from the ideal Cottrellian kinetics (K. Gmucová). Both the Pt/a-Si:H electrode and bare carbon fibre microelectrode were shown to be a suitable tool for the study of electronic and **electrochemical properties of nanoparticles** immobilized on their surfaces (K. Gmucová, V. Nádaždy). We also measured and determined **the thermal diffusivity of metal matrix composites (T. Šrámková)**.

The shape of a **scanning capacitance microscope** probe affects the spatial resolution and contrast formation. We have arrived at an unexpected result, namely that for the best results the tip apex radius must not be too small. With a radius as large as 1  $\mu\text{m}$  the resolution of small features is only slightly worse than with a sharp tip with 25 nm radius, whereas the accuracy of the measurement of more extended artefacts is incomparably higher. This is the good news for our **move towards defect analysis on the nanoscale (Š. Lányi)**.

We have developed important components for a new combined **Scanning Capacitance/Tunnelling/Force Microscope**, such as new input stages with input capacitance 15 – 20 fF up to 10 MHz and a stable phase-locked-loop controller for the force sensor. An original input module, which will be used for current and charge transient measurements achieved **resolution of ~600 electrons**. The module was applied to investigation of deep levels in the channel of thin film transistors with the gate size of 6  $\mu\text{m}^2$  (**Š. Lányi, V. Nádaždy**).

#### **Applied Physics (PI E. Pinčík, M. Hartmanová)**

During the last period we have performed research on **electrical, optical and structural properties of amorphous silicon based structures** (PI E. Pinčík).

i) Original results were obtained concerning the microstructure of a-Si:H and micro-crystalline Si prepared by PECVD using different dilutions by  $\text{H}_2$ . In this way, various sets of a-Si:H based layers deposited on c-Si with different hydrogen densities and thicknesses were prepared. We have determined PECVD conditions at which a mixture of amorphous and micro-crystalline phases is created in one deposited layer. Proto-crystalline Si phase resistant against Stabler-Wronski effect has been studied in these phases. It has been found that hydrogen is bound with Si predominantly in the form of hydrides and dihydrides. An increase of hydrogen dilution applied during the PECVD led to an increase of micro-crystalline Si phase, increase of the optical band gap width, and a decrease of spectral refractive index of the layer. The PECVD conditions for formation of proto-crystalline Si (which is considered as the most stable phase in the thin film solar cell production) were determined.

ii) we have developed a method for determination of optical parameters of thin films;

iii) we have successfully performed total passivation of  $D_h$  group of a-Si:H defect states in the interface region of very thin oxide/a-Si:H structure using HCN aqueous solutions;

iv) we have studied physical properties of crystalline  $\text{ZrO}_2$  stabilized by  $\text{Yb}_2\text{O}_3$  and  $\text{Sm}_2\text{O}_3$  (PI M. Hartmanová). It was shown that polymorphous structure can be created for  $\text{Yb}_2\text{O}_3$  concentration 1.5 – 6.4 mol % and monophasic cubic structure for  $\text{Yb}_2\text{O}_3$  content 11.1 - 13.8%. Changes of electrical conductivities of  $\text{Yb}_2\text{O}_3$  containing structures are related to free oxygen vacancies (an increase) and to interaction of oxygen vacancies with  $\text{Yb}^{3+}$  cations (a decrease of conductivity). The systems  $\text{ZrO}_2\text{-Yb}_2\text{O}_3$  and  $\text{ZrO}_2\text{-Sm}_2\text{O}_3$  can be used, depending on their phase composition, as components of solid oxide fuel cells, resistant layers of metals and active optical layers.

v) Oxygen nonstoichiometry in  $\text{CeO}_2$  (PI M. Hartmanová) systems with the fluorite (F) structure and the related lattice defects were studied in the reduced ceria ( $\text{CeO}_{2-x}$ ) crystals doped with high concentrations of yttria ( $\text{Y}_2\text{O}_3$ ) and grown by the directional crystallization. The investigation has shown the importance of relationship between the cooling rate and the oxygen diffusion rate at the exchange of oxygen with the atmosphere, its influence on the structure on Arrhenius conductivity plots and the ordering of oxygen vacancies after the stoichiometry is reached.

The research tasks were solved in collaboration with Delft University of Technology, CNRS Grenoble, Masaryk University, Zaragoza University, and Osaka University and Sharp Corporation, Japan. A bilateral project IP SAS with Osaka University for years 2007-2009 has been accepted by the JSPS of Tokyo, Japan.

### **Thermophysics** (PI Ľ. Kubičár)

Activities of the Department of Thermophysics have been focused on the development and applications of transient methods in materials science and technology. Main areas of interest have been devoted to energy saving – thermal insulation properties, and environment effects – role of water in porous materials. The following investigations were conducted in the period 2003 – 2006 :

*Heat transfer in heterogeneous structures.* Differences in the values of specific heat, thermal diffusivity and thermal conductivity can be found when steady-state (or equilibrium) and transient methods are compared. A statistical model has been worked out that accounts for the difference of heat transport parameters between the steady-state and dynamic regimes for some kinds of heterogeneous materials composed of particles embedded in a matrix. Much attention has been paid to nanocomposites based on carbon nanotubes. Effect of experimental conditions on the consistency of the data obtained by steady state and transient methods was established experimentally and theoretically.

*Porous structures.* A detailed study of a broad range of porous materials has been performed, the pores being filled with water, helium, air and vacuum. In addition to differences in the heat transport characteristics when gas or vacuum fill the pores, freeze-thaw processes have been studied in stones of different porosities with the pores filled with water.

*Development of transient methods.* Much attention has been paid to new versions of transient methods. A sandwich version of the pulse transient method for thin specimens has been worked out. A new type of the transient method based on hot ball has been developed. A new thermal conductivity sensor (patent pending) working on the hot ball principle with a broad application potential in materials science and technology was designed at our Department.

*Construction of instrument.* An instrument for monitoring the thermal conductivity and utilizing the hot ball method has been constructed. The instrument works under environmental load (rain or freeze) from  $-40$  up to  $+60^\circ\text{C}$  in the range of thermal conductivities  $0.04 - 2 \text{ W m}^{-1} \text{ K}^{-1}$  and temperatures  $-50 - +200^\circ\text{C}$ .

*Applications and cooperation.* Department has a broad cooperation with several institutions based on comparative measurements to validate the pulse transient method, especially when a coupled conductive-radiative heat transport plays a role, (PTB Braunschweig, NPL Teddington), monitoring the moisture at Duomo Cathedral at Florence (ICVBC), thermophysical measurements of construction materials (BRO Gaston Watford), development of theoretical models and evaluation methods (Department of Physics FEI STU). The staff of the Department has participated at two EU projects (MCDUR and Thermal Metrology) and organized The 17<sup>th</sup> European Thermophysical Conference in Bratislava. A close cooperation with the SME TransientMS aimed at the production of transient instrumentation and implementation of the transient technique into environment and technology has been established.

**Research Center for Quantum Information** (PI V.Buzek, M.Ziman, P.Stelmachovic, M.Plesch)

During the period 2003-2006 our research interests have been focused on several mutually related topics:

*Quantum information processing*: universal optimal manipulations with quantum information (e.g. universal quantum machines such as quantum cloners or universal NOT gates)

*Quantum state and process reconstruction*: reconstruction of states of quantum systems from incomplete data (e.g. application of maximum entropy principles and Bayesian quantum interference)

*Dynamics of open quantum systems*: stochastic quantization, quantum decoherence, nonclassical effects in quantum optics, reconstruction of Liouvillian superoperators, description of dynamics of open systems from the point of view of quantum information theory.

*Quantum entanglement in multi-partite systems*: generation of entanglement (non-classical correlations) in many body systems,

*Quantum protocols for secure communication*: utilization of multi-partite entanglement for secure multi-user communication (e.g. quantum secret sharing or quantum voting).

We plan to continue in our research effort in collaboration with major European research laboratories.

**Multilayers and Nanostructures** (PI E. Majkova, S. Luby, M. Jergel)

During the period 2003-2006 our research was focused on the following areas:

- X-ray and magnetic multilayers and spin valve structures, development, preparation and analysis;

- studies of the processes at the interfaces of ultrathin film multilayers (layer thickness  $\leq 1$  nm) by X-ray scattering and diffraction methods;

- magnetic nanoparticles – preparation (collaboration with Polymer Institute SAS), properties and spontaneous formation of ordered arrays

- self-assembling of nanoparticles studied by grazing incidence small angle x-ray scattering GISAXS, time resolved GISAXS studies of self assembling.

The research was done within a project of the 5th FP EC, State Order program, Slovak Research and Development Agency project and several international and domestic projects, in collaboration with the Polymer Institute SAS, FEI SUT, ILC and Institute of Infomatics SAS (electron beam lithography). The most important results are listed below:

Magnetic iron-oxide and cobalt-iron oxide monodispersed nanoparticles of 6-10 nm diameter have been prepared and analysed. Formation of 2-dimensional ordered arrays was studied in dependence on external conditions (e.g. magnetic field). Three dimensional ordered arrays of columns composed of cobalt nanoparticles have been prepared and the conditions of their formation were analysed.

The *in situ* time-resolved GISAX was employed to study the self-assembling of magnetic nanoparticles from colloidal solution. The measurement results indicate the vicinity of the three-phase drop contact line as a region of nanoparticle self-assembling

The research of X-ray multilayers was focused on detail analysis of the interface phenomena and growth process of the multilayers and on the properties of patterned multilayer structures.

Magnetic layered systems Fe/W and Co/W were prepared and studied. We have shown that the Fe/W system can be used in GMR applications (GMR at RT  $\sim 3\%$ ). The spin valve structures were investigated with the perspective for current induced magnetization switching. For Co/Au/Co structures the correlation between the interface roughness and Neel ferromagnetic coupling was studied (P. Siffalovic, et al, JAP accepted).

During the period 2003-2006 the null ellipsometer, magneto-optical Kerr effect, and UHV rapid thermal annealing equipments were designed and constructed.

**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**

**Low energy nuclear physics (PI J. Kliman, M. Veselsky, E. Betak, M. Morhac, J. Kristiak)**

Main effort will be devoted to investigation of **fission of heaviest compound nuclei** and **proton induced fission of actinides**. We aim to perform complex correlation measurements of fission fragments and kinetic energy distributions together with neutron and  $\gamma$ -ray multiplicities in the fission of heavy nuclei. The main objectives will be to measure yields at extremely asymmetric mass division, to disentangle the pre-scission and post-scission neutron multiplicity, and to decompose the pre-scission multiplicity into pre-equilibrium and statistical parts.

We plan to perform further theoretical and experimental investigations of the production mechanisms of the exotic very neutron-rich isotopes in the **nucleus-nucleus collisions** at projectile energies 10-100 A MeV. It is also planned to continue studies of the hot exotic nuclei with the emphasis on the signals related to the expected isospin-asymmetric liquid-gas phase transition. The possibilities to produce secondary beams of the very neutron-rich nuclei will be investigated in the framework of the EU 6FP project **EURISOL Design Study**. We also plan to address the phase diagram of the nuclear matter.

We will continue to study the basic principles of underlying **theory for nuclear reactions** at low energies (including heavy-ion collisions) and their consequences for cross sections and other measurable physical quantities. Further development of **data acquisition systems** with implementation of latest technologies and knowledge will continue as well.

We propose to build a new laboratory for low energy nuclear reactions and **nuclear astrophysics**. The proposed new facility should enable the Institute to competitively cooperate in the frame of ERA on the low energy nuclear astrophysics. In addition, it will create a base for various nuclear analytical methods to be used in material research, nanotechnology, environmental research, etc. The EU Structural funds should be exploited for funding this lab.

The positron annihilation group will be oriented to study of new physics that occurs in systems of limited number of molecules confined within nano-meter pores/space. The expected new behaviour of confined matter can be due to interplay of finite-size effects, surface forces and/or reduced dimensionality. The unique ability of the small ortho-positronium (o-Ps) atom (diameter of o-Ps is appr. 0.1 nm) to be localized in a region of lower electron density provides a suitable probe for phase transitions in confined geometry. We also expect that the dynamics of finite number molecules confined in nanopores will be modified. Preliminary experiments on a liquid in pores of silicagel were started.

**Investigation of the hadron structure manifestation in their electromagnetic and weak interactions (PI S. Dubnička)**

Concept of R&D activity of our group for the next four years is mainly determined by the running E821 and approved E962 Brookhaven National Laboratory experiments. These experiments will provide improved measurements of the anomalous magnetic moment  $a_\mu$ , which requires more and more precise theoretical evaluation of the hadronic contributions. If the difference of the experimental value and the theoretical one will be less than the total error, it will mean the Standard Model is able to explain the value of  $a_\mu$ . Moreover, it will be the first indication of the existence of the new physics beyond the Standard Model.

### **Theory of elementary-particle interactions (PI Š. Olejník):**

(i) The situation in the physics of elementary particles in the coming years will be strongly influenced by commencement of experiments on the Linear Hadron Collider (LHC) at CERN in 2007. They will undoubtedly bring new experimental information on particle interactions and open an avenue towards a new level of understanding the structure of matter. From the theoretical point of view they will continue testing predictions of the successful standard model (SM) of particle interactions, but SM physics will represent at LHC just a background to new phenomena of the physics beyond SM.

(ii) Proper understanding of SM phenomena and processes will be a must for discriminating them from the “new physics”. This will be both a challenge and focus of our future activities. The research group dealing with SM problems has been obtaining competitive results in the field, publishes them in respected international scientific journals, and results have had considerable impact on the whole field.

(iii) Our objective will be to continue activities in developing and using nonperturbative methods of quantum field theory, in particular the lattice and light-front formulations, to shed light on some of the unresolved problems of the standard model. The focus will remain on the mechanism of confinement and symmetry breaking, and the structure of the vacuum in gauge theories of particle interactions.

(iv) We will use computer simulations of lattice gauge theories (a large part of which can now be performed on our recently built computer cluster, see below) as well as analytic investigations of field-theory models formulated in light-front variables. Research problems will be solved also within informal international cooperation.

### **Electronic transport in disordered structures (PI P. Markos)**

We plan to continue in the **numerical analysis of the electronic transport in disordered structures**. Our numerical studies will rely on the numerical transfer matrix method and on the statistical analysis of the spectra and wave functions of the disordered single-electron Hamiltonian. We plan also to solve the generalized DMPK equation, proposed recently for the description of the transport in strongly disordered systems. The developed methods will be applied to the analysis of the quantum and classical localization.

### **Quantum fluctuations in two-level electron-phonon models of the Jahn-Teller class (PI E. Majerníková)**

We intend to elaborate the concept of the Calogero-Moser dynamic model for a gas of interacting pseudoparticles for the Exe **Jahn-Teller model** for a set of levels (pseudoparticles) using the method of path integrals for elimination of the background. We intend to investigate statistical distribution of spectral curvatures which is a key characteristic for the identification of the traces of chaotic behaviour in complex systems. The spectral distributions seem to fulfill the Fokker-Planck type of equations in a pseudotime including a term characteristic for the telegraph equation.

### **Statistical mechanics (PI L. Šamaj)**

In the field of the statistical mechanics of particle systems interacting through the Coulomb interaction, we plan to extend the exact results for classical 2D thermodynamics to the quantum regime, e.g. within the semiclassical Wigner-Kirkwood expansion. A special interest will be devoted to an exact treatment of anomalous effects in Coulomb fluids, like an effective change of the sign of a guest charge immersed in an electrolyte or an effective attraction of guest charges of the same sign. These effects have fundamental importance in chemical reactions of biological systems.

As concerns the dynamics of transport processes in quasi-one-dimensional systems, our task for the future is to derive their exact mapping onto the longitudinal dimension. These

dynamical systems describe the transport of molecules through carbon nanotubes, systems of channels (e.g. zeolites), in membranes of cells, etc. Our aim will be to find out relevant macroscopic 1D transport equations, in which the effects of local properties of capillary cross-section, potential) and of the molecules will be treated rigorously.

**Bulk and surface properties and structure of complex metallic alloys (CMA)** (PI M. Krajci, P. Svec)

Modelling of the atomic structure of the complex metallic alloys, particularly quasicrystals. Search for new intermetallic phases on the basis of *ab-initio* calculations. Understanding the structure and stability of existing phases. Experimental verification of the existence and stability of predicted phases – From simple binary to complex many-component phases. Further development of our *ab-initio* method for calculating the phase diagrams. Construction of pair interatomic potentials from the results of *ab-initio* total-energy calculations. Study of the atomic dynamics of selected model structures.

Study of the structure of clean surfaces of complex metallic alloys (icosahedral AlPdMn, pseudodecagonal Al<sub>13</sub>Co<sub>4</sub>). Stabilization of nanostructures on the surfaces of metals, e.g. monolayers on the surface of quasicrystals. Adsorption and dissociation of molecules (e.g. CO) on the surface of complex metallic alloys. Experimental correlations of structures present on the surfaces and in the volume of rapidly-quenched amorphous and nano(quasi)crystalline systems, investigation of origins of eventual differences, assessment of possibilities for obtaining functionally graded materials.

Investigation of the basic binary rapidly quenched amorphous systems as precursors for the corresponding complex amorphous and nanocrystalline systems. Preparation and investigation of binaries with respect to the formation and identification of phases formed and to their local atomic ordering (BCC and FCC phases with large unit cell dimensions) including comparison with *ab-initio* simulations, assessment of the importance of such phases and their local ordering for the formation of multicomponent alloys and for the formation of amorphous bulks.

Nanocrystalline alloys from amorphous precursors: kinetics, thermodynamics, mechanisms controlling transformation processes on the atomic level. Study of local ordering and atomic neighbourhoods. General relationships between structure, properties and possibilities of their controlled tailoring. Study of the microstructure-property relationship in the new Fe-(Ni,Co)-(Nb,Zr)-B -type nanocrystalline alloys systems with emphasis on the magnetic properties and taking into account the BCC-FCC phase transition in the nanograins.

**Defect states and charge transfer in solid and liquid systems on macro- and micro-scale** (PI Š. Lányi, V. Nadazdy, K. Gmucova)

We shall implement several transient techniques developed in our laboratory in the last years into a novel Scanning Probe Microscope. We intend to refine them to attack the limits put by physics and statistics. This will allow us to study thin-film structures on submicron scale. Relying on our expertise in the study of c-Si and a-Si:H, we will perform both electrical and electrochemical investigations of inorganic/organic structures prepared on these materials. Our next activities will contribute particularly to the characterization of novel materials for hybrid electronics, e.g. metal and semiconductor nanoparticles, and organic semiconductors. We expect to acquire knowledge of yet unknown properties of materials on the nanoscale, a better understanding of the capabilities and limitations of inorganic/organic hybrids in the electrocatalysis, sensing, and photovoltaics. In addition, we will contribute to the development of metal matrix composites with high thermal conductivity and low thermal expansion.

**Department of Thermophysics** (PI L. Kubičár)

A new innovative class of multi-parameter testing methods – transient methods for measuring thermophysical properties - started to be implemented in research and technology. The methods give an access to a group of parameters that can be obtained not only in laboratories but under environmental and industrial load, too. Slovakia is one of the pioneers in this research.

Department of Thermophysics has concentrated on the development of various versions of transient methods and the corresponding measurement methodologies, construction of the instruments and implementation of the transient technique into environment and technology. The staff of the Department started this original research in Slovakia and presented it to the Slovak scientific community via organization of the scientific events on national and international levels.

Department will concentrate on keeping up and strengthening its leading role in the development and applications of the above mentioned progressive testing methods. A broader cooperation will be developed between the staff members and the industry and SME's. New research areas in technology and environmental monitoring will be opened with the help of close cooperation with universities and the research centers within ERA.

Strategy in the R&D within the next four years will be focused on the development and construction of new class of thermophysical sensors and on searching new application areas mainly in environment, technology and energy saving. The instruments based on thermophysical sensors are highly effective in monitoring structural changes that accompany variations of thermodynamic and transport properties of materials.

#### **Applied Physics** (PI E. Pinčík)

Physical properties of oxide/semiconductor structures (single layers, interfaces, substrates, multilayers) with an extremely reduced interface state density will be studied. This will be achieved using passivation process in HCN aqueous solutions. Special attention will be paid to theoretical and experimental research of passivation processes of defect states created at ultra-thin oxide/semiconductor interfaces during the oxide formation. Structures based on various types of semiconductors will be passivated in HCN aqueous solutions, the most important being c-Si, poly-Si, GaAs, porous silicon, amorphous hydrogenated silicon and  $\text{Cu}_2\text{O}$ . The results obtained can be applied in development of low-size high efficiency Si based solar cells.

Strategy of the project supposes a strong cooperation with several EU laboratories, e.g. with HMI Berlin, Delft University, CNRS Grenoble, and laboratories in Japan

#### **Research Center for Quantum Information** (PI V.Buzek, M.Ziman, P.Stelmachovic, M.Plesch)

During the period 2007-2011 (next five years) we plan to continue to work on various problems of quantum information processing. Our main research tasks will be focused on following problems:

*Programmable quantum processors;*

*Quantum process reconstruction;*

*Quantum memories: storage and retrieval of quantum information;*

*Quantum protocols for secure communication: utilization of multi-partite entanglement for secure multi-user communication.*

We plan to continue in our research effort in collaboration with major European research laboratories within existing 6FP projects. We plan to submit projects within the 7FP. Our aim is to transform the RCQI into an institute independent of the Institute of Physics.

#### **Department of Multilayers and Nanostructures** (E. Majkova, S. Luby, M. Jergel)

During the period 2007-2011 we plan to continue our research in the field of magnetic nanoparticles and assembling phenomena, development and analysis of layered spintronic nanostructures (patterned spin valve systems, spin valve nanopillars) for current induced magnetization switching CIMS. The GMR and TMR current induced magnetic switching devices are still under development in the world. The important applications include magnetic field sensors, read heads for hard drives, galvanic isolators and MRAMs.

The main goals of our research are:

To clarify the correlation between the GMR nanopillar structure, esp. interface roughness and its lateral and vertical correlations, and magnetic properties, esp. ferromagnetic (Néel) coupling and its scaling with decreasing lateral dimensions of the nanopillar.

To understand the role of magnetic clusters embedded in the insulating layer of the TMR nanopillar increasing the TMR value. Application of ordered monolayer of monosized magnetic nanoparticles in the TMR structure will enable original detailed analysis of this effect.

The formation of ordered clusters of nanoparticles in a colloidal solution and details of the early stage of ordering process will be studied by time resolved GISAXS studies (project DESY, Contract RII3-CT-2004-506008 (IA-SFS), project nr. II-05-083 EC).

Scanning magneto-optical Kerr microscope for studying magnetization changes on nanostructures is developed. Its unique feature is a detection scheme combining an auto-balanced optical difference detection supported by lock-in technique, to our knowledge not yet applied to published MOKE systems.

All these aims are supported by the Slovak Research and Development Agency and other national and international projects.

Further development of infrastructure (UHV ion beam sputtering deposition, AFM and spintronic lab) is planned utilizing the funding from Structural Funds of EU within the project of a Technological Institute mentioned previously.

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

As it follows from the review of the results given above, the research areas of the IP SAS are various. In all presented areas, the results are at least fully comparable with the European and world standards. The status of a particular research team can be estimated from the publication and citation output and the participation at international projects, esp. those of the 5<sup>th</sup> and 6<sup>th</sup> FP EC. Considering these facts, we assume that the proposed research plans will be fulfilled.

Approximately 50% of researchers are active in the field of experimental physics (mostly solid state), applied physics and materials science. Here, the crucial point for successful research is the extent and quality of instrumentation.

Further development of our infrastructure is connected with the funding of EU Structural Funds. This funding should start to the end of this year or later. At present 9 Institutes of SAS agreed to prepare a common project for basic development of the instrumentation for materials research and technology. A new Institute of Technology was proposed to house the new instrumentation and also preliminarily approved by our authorities. The key institutes of this consortium are IP SAS, IEE SAS and IIC SAS.

The researchers from the Department of Nuclear physics are preparing a similar proposal for the instrumentation development.

## **iii. Objectives of the Concept**

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



- Top quality research in the particular areas. All researchers are engaged in at least one project. **The most important goal is a successful participation in multilateral research schemes and large national projects and projects of Structural Funds of EU.**
- To publish in top ranking journals.
- To develop the infrastructure of the Institute as mentioned above.
- To hire more PhD students and post docs.
- To finalize the "vision of the Institute" which we started to prepare in connection with the expected funding from Structural Funds of EU.
- Participation of the research teams at the National Centers of Excellence- this program will be open in 2007 or 2008.

### **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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KEPAPTSOGLU, D.M. – PALUGA, Marek – DEANKO, Marián - MÜLLER, Dušan – CONDE, C.F. - HRISTOFOROU, E. – JANIČKOVIČ, Dušan - ŠVEC, Peter .Peculiarities of nanocrystal formation in rapidly quenched (FeCo)MoCuB amorphous alloys. In *Journal of Microscopy*. Vol. 223 (2006), p. 288-291. ( 2.095 – IF2005 )

KRAJČÍ, Marián – Hafner, J. Ab initio study of quasiperiodic Bi monolayer on a fivefold icosahedral Al-Pd-Mn surface. In *Philosophical Magazine*. Vol. 86, no. 6-8 (2006), p.825-830. ( 1.470-IF2005 )

MAJERNÍKOVÁ, Eva – SHPYRKO, S. Incipience of quantum chaos in the Jahn-Teller model. In *Physical Review E*. Vol. 73 (2006), 066215

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MALAKHOV, A.I. – ANISIMOV, Y.S. – GMUCA, Štefan – KIZKA, V.A. – KLIMAN, Ján – KRASNOV, V.A. – KUREPIN, A.B. – KUZNETSOV, S.N. – LIVANOV, A.E. – MATOUŠEK, Vladislav – MORHÁČ, Miroslav – TURZO, Ivan . The laser-based calibration system of delta spectrometer. In *Nuclear Instruments and Methods in Physics Research Section A*. Vol. 566, no. 2 (2006), p. 413-421. (1.224-IF2005)

PAWLUS, S. – BARTOŠ, J. – ŠAUŠA, Ondrej – KRIŠTIAK, Jozef – PALUCH, M. Positronium annihilation lifetimes and dielectric spectroscopy studies on diethyl phthalate: Phenomenological correlations and microscopic analyses in terms of the extended free volume model by Cohen-Grest. In *Journal of Chemical Physics*. Vol. 124 (2006), 104505. ( 3.138-IF2005)

VESELSKÝ, Martin .Dynamical aspects of isostopic scaling. In *Physical Review C*. Vol. 74 (2006), 054611. ( 3.610-IF2005 )

PINČÍK, Emil – KOBAYASHI, H. – RUSNÁK, Jaroslav - TAKAHASHI, M. – BRUNNER, Róbert – JERGEL, Matej – MORALES-ACEVEDO, A. - ORTEGA, L. – KÁKOŠ, J. Passivation of Si and a-Si: H surfaces by thin oxide and oxy-nitride layers. In *Applied Surface Science*. Vol. 252, no. 21 (2006), p. 7713-77221. ( 1.263-IF2005 )

## ii. List of monographs/books published abroad

[1] M. Fecko, *Differential Geometry and Lie Groups for Physicists*, Cambridge University Press 2006. ISBN 0521845076V.

### Chapters in monographs published abroad

V. Buzek, Quantum tomography from incomplete data via MatEnt principle, In *Quantum Estimations: Theory and Experiment*, Springer Series on Lecture Notes in Physics Vol 20 Eds, G. M. Paris, J. Rehacek, Berlin Springer Verlag 2004, 189-234.

V. Buzek, Optimal manipulations with quantum information: Universal quantum machines, NATO Advanced Study Institute on Quantum Communication and Information Technologies, Dordrecht, Kluwer 2003 p. 47-84.

P. L. Knight, V. Buzek, Squeezed states: basic principles, In: *Quantum Squeezing*, Springer Series on Atomic, Optical and Plasma Physics Vol. 27, Berlin Springer Verlag 2003, p. 3-32.

M. Mihalkovic, Structure of quasicrystals via pair potentials. In: *Quasicrystals, An Introduction to Structure, Physical Properties and Applications*, Berlin Springer 2002, ISSN 0933-033x, p. 167-182.

P. Svec, K. Kristiakova, M. Deanko, Cluster structure of the amorphous state and (nano) crystallization of rapidly quenched iron and cobalt based systems In: *Nanostructures: Synthesis, Functional Properties and Applications*. Crete, Greece, 2001, Dordrecht: Kluwer Academic Publ. 2003, ISBN 1-4020-1752-9, p.271-294.

## iii. List of monographs/books published in Slovakia

[1] M. Fecko, *Diferencialna geometria a Lieove grupy pre fyzikov*, Bratislava, Iris 2004. ISBN 80-89018-10-6 (see above)

## iv. List of other scientific outputs specifically important for the Organisation

### v. 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).

Research outputs	2003			2004			2005			2006			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	averaged number per year	av. No. / FTE	av. No. / salary budget
chapters in monographs, books published abroad	5	0,07	0,27	1	0,02	0,05	0	0,00	0,00	1	0,02	0,05	7	1,8	0,03	0,09
chapters in monographs, books published in Slovakia	0	0,00	0,00	2	0,03	0,10	0	0,00	0,00	0	0,00	0,00	2	0,5	0,01	0,03
CC publications	87	1,28	4,66	104	1,73	5,41	98	1,61	4,69	96	1,52	4,54	385	96,3	1,53	4,81
scientific publications indexed by other databases (specify)	0	0,00	0,00	0	0,00	0,00	0	0,00	0,00		0,00	0,00	0	0,0	0,00	0,00
scientific publications in other journals	8	0,12	0,43	9	0,15	0,47	9	0,15	0,43	7	0,11	0,33	33	8,3	0,13	0,41
publications in proc. of international scientific conferences	33	0,49	1,77	40	0,67	2,08	37	0,61	1,77	21	0,33	0,99	131	32,8	0,52	1,64
publications in proc. of nat. scientific conferences	17	0,25	0,91	25	0,42	1,30	10	0,16	0,48	8	0,13	0,38	60	15,0	0,24	0,75
active participations at international conferences	127	1,87	6,80	140	2,33	7,28	127	2,08	6,07	94	1,49	4,44	488	122,0	1,94	6,10
active participations at national conferences	17	0,25	0,91	10	0,17	0,52	17	0,28	0,81	8	0,13	0,38	52	13,0	0,21	0,65

#### vi. Renormalized publications<sup>2</sup>

*Renormalized publications = number of CC publications in the given year times authorship's portion of the Organisation times the journal impact factor in 2005 divided by the median impact factor in the research field*

<sup>2</sup> This information is required only from the Organisations of the Section 2 of the Slovak Academy of Sciences.

Renormalised publications	2003			2004			2005			2006		
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget
Renormalized publications	0	0,00	0,00	0	0,00	0,00	0	0,00	0,00	0	0,00	0,00

#### vii. Standard manuscript page count<sup>3</sup>

Standard manuscript page count	2003			2004			2005			2006		
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget
page count	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0

#### viii. List of patents and patent applications

**Application model no. 3684:** Measurement chamber of the instrument for measurements of specific heat, thermal and temperature conductivity of materials by pulse transient method, realized by Transient MS Ltd. since 2005, L. Kubicar

**Patent nr. 04474002.5:** Measurement chamber of the instrument for measurements of specific heat, thermal and temperature conductivity of materials by pulse transient method, realized by Transient MS Ltd. since 2005, L. Kubicar

**Patent application PP 0142-2004** Strain sensor for harsh environment, P. Svec et al, owner IP SAS, applied 11.3.2004.

**Patent application PP 0160 – 2006** L. Kubičár, V. Vretenár, V. Štofanič: Method of the measurement of thermal conductivity and sensor for it, owner IP SAS.

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

<sup>3</sup> This information is required only from the Organisations of the Section 3 of the Slovak Academy of Sciences.

## 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 Organisation at the respective year; finally these entries are divided by the total salary budget (from Tab. Salary budget).

Citations	2002			2003			2004			2005			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	averaged number per year	av. No. / FTE	av. No. / salary budget
Web of Science	854	12,6	45,7	848	14,1	44,1	1189	19,5	56,8	1400	22,2	66,1	4291,0	1072,8	17,0	53,6
scopus	47	0,7	2,5	108	1,8	5,6	53	0,9	2,5	1	0,0	0,0	209,0	52,3	0,8	2,6
(specify Database 1)	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0,0	0,0	0,0	0,0
in monographs, conf. proceedings and other publications abroad	46	0,7	2,5	0	0,0	0,0	0	0,0	0,0	204	3,2	9,6	250,0	62,5	1,0	3,1
in monographs, conf. proceedings and other publications in Slovakia	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0,0	0,0	0,0	0,0

### i. List of 10 top-cited publications and number of their citations in the assessment period 2002 - 2005.

**Bužek V**, Hillery M, Quantum copying: Beyond the no-cloning theorem.  
Physical Review A **54** (1996): 1844-1852  
**WOK: 169**  
**Other: 57**

Hillery M, **Bužek V**, Berthiaume A: Quantum secret sharing.  
Physical Review A **59** (1999) 1829-1834  
**WOK: 132**  
**Other: 50**



R. Smith, S. Schultz, **P. Markoš**, C. M. Soukoulis: Determination of Effective Permittivity and Permeability of Metamaterials from Reflection and Transmission Coefficients. Phys. Rev. B **65** (2002) 195104, 1-5

**WOK: 65**

**Other: 14**

Runga P, **Bužek V**, Caves SM, Hillery M, Milburn G: Universal state inversion and concurrence in arbitrary dimensions. Physical Review A **64** (2001)042315

**WOK: 56**

**Other: 4**

Del Debbio L, Faber M, Greensite J, **Olejník Š**: Center dominance and  $Z_2$  vortices in SU(2) lattice gauge theory. Physical Review D **55** (1997) 2298-2306

**WOK: 52**

**Other: 22**

**Bužek V**, Hillery M, Werner RF: Optimal manipulations with qubits: Universal NOT gate. Physical Review A **60** (1999) R2626

**WOK: 52**

**Other: 9**

Kim MS, Son W, **Bužek V**, Knight PL: Entanglement by a beam splitter: Nonclassicality as a prerequisite for entanglement . Physical Review A **65** (2002) 032323

**WOK: 51**

**Other: 10**

**Bužek V**, Braunstein SL, Hillery M, Bruss D: Quantum copying: A network. Physical Review A **56** (1997) 3446-3452

**WOK: 49**

**Other: 7**

**Bužek V**, Knight P.L.: Quantum interference, superposition states of light and non-classical effects. Progress in Optics **34** (1995) 1-151

**WOK: 46**

**Other: 6**

Derka R, **Bužek V**, Ekert AK: Universal algorithm for optimal estimation of quantum states from finite ensembles via realizable generalized measurement. Physical Review Letters **80** (1998) 1571-1575

**WOK: 44**

**Other: 20**

**ii. List of top-cited authors from the Organisation (at most 10 % of the research employees) and their number of citations in the assessment period**

<b>1440</b>	Vladimír Bužek
<b>310</b>	Peter Markoš
<b>223</b>	Štefan Olejník
<b>194</b>	Marián Krajčí
<b>182</b>	Marek Mihalkovič
<b>137</b>	Stanislav Hlaváč
<b>125</b>	Peter Švec
<b>117</b>	Jozef Krištiak

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

In the Table of research outputs of IP SAS the publications of STAR Collaboration are included. Dr Peter Filip is the employee of IP SAS and is a member of the STAR Collaboration. His membership is supported by the Institute of Nuclear Physics AS CR and JINR Dubna.

## 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). Collective membership in the international research organisations, in particular within the European Research Area**

### List of projects of 5<sup>th</sup> and 6<sup>th</sup> Framework programmes of EC, NATO SfP and ESF projects

- |                         |  |
|-------------------------|--|
| 1. Title:               | <b>Quantum entanglement states of trapped particles (Quest)</b>  |
| Principal investigator: | Bužek Vladimír, Prof., RNDr., DrSc.  |
| Chief coordinator:      | Dr. Danny Segal, Imperial College, London, England   |
| No. of contract:        | IHPRN-CT-2000-00121, 5RP   |
| Period:                 | 2000-2003  |
| 2. Title:               | <b>Quantum Properties of Distributed Systems (QUPRODIS)</b>  |
| Principal investigator: | Bužek Vladimír, Prof., RNDr., DrSc.  |
| Chief coordinator:      | Prof. M. Wilkens, Inst. für Physik Uni.v Potsdam, Germany  |
| No. of contract:        | IST-2001-38878   |
| Period:                 | 2003   |
| 3. Title:               | <b>Quantum Gates and Elementary Scalable Processors Using Deterministically Addressed Atoms (QGATES)</b> |
| Principal investigator: | Bužek Vladimír, Prof., RNDr., DrSc.  |
| Chief coordinator:      | Dr. Danny Segal, Imperial College, London, England   |
| No. of contract:        | IST 2001 38875   |
| Period:                 | 2003-2005  |
| 4. Title:               | <b>Magnetostrictive bilayers for multi-functional sensors families</b>                                   |
| Principal investigator: | Duhaj Pavol Ing., DrSc.  |
| Chief coordinator:      | Prof. Helmut Pfitzner, Vienna University of Technology, Vienna   |
| No. of contract:        | G5RD-CT-2002-00690   |
| Period:                 | 1.4.2002-31.3.2005   |
| 5. Title:               | <b>Acoustic and Thermophysical Analysis of Stones</b>  |
| Principal investigator: | Kubičár Ľudovít, Ing., DrSc.   |

- Chief coordinator: Dott. Piero Tiano, CNR – C.S. Firenze, Italy  
 No. of contract: NAS-G6RD-2000-00266  
 Period: 06/2002-06/2005
6. Title: **The European Virtual Institute for Thermal Metrology**  
 Principal investigator: Kubičár Ľudovít, Ing., DrSc.  
 Chief coordinator: Dr. John Redgrove, National Physical Laboratory, Teddington  
 No. of contract: GTCI-2002-73009  
 Period: 2002-2005
7. Title: **Correlation of structure and magnetism in novel nanoscale magnetic particles**  
 Principal investigator: Majková Eva, RNDr., DrSc.  
 Chief coordinator: Prof. M. Farle, Universität Duisburg-Essen, Germany  
 No. of contract: HPRN-CT – 00150-1999  
 Period: 01/2000-07/2004
8. Title: **European Network on Amorphous-Silicon Technology (NAS-aSiNet)**  
 Principal investigator: Vojtech Nádaždy, Ing., CSc.  
 Chief coordinator: Dr. Julio Cárabe, Centro de Investigaciones Energéticas, Medioambientales Tecnológicas, Madrid, Spain  
 No. of contract: - GTC3-2001 - 6300  
 Period: 05/2002-04/2004
9. Title: **Manufacture and characterization of nanostructural Al alloys**  
 Principal investigator: Švec Peter, Ing., DrSc.  
 Chief coordinator: Prof. B. Cantor, Dept of Materials, Uni. of Oxford, UK,  
 No. of contract: 5th Framework Programme No. HPRTN-CT-2000-00038  
 Period: 1.9.2000-30.8.2003
10. Title: **Magnetoelastic Properties of Rapidly Quenched Materials and Their Applications in Civil Engineering.**  
 Principal investigator: Švec Peter, Ing., DrSc.,  
 Chief coordinator: Dr. Massimo Pasquale, IEN „Galileo Ferraris“, Torino, Italy  
 No. of contract: NATO Sfp-973 649  
 Period: 2000/2003
11. Title: **Quantum Information Processing and Communication in Europe (QUROPE)**  
 Project: 6RP – Coordination Action (CA)  
 No. of contract: 033622  
 Principal investigator: Bužek Vladimír, Prof., RNDr., DrSc.  
 Chief coordinator: Prof. E. Polzik, Niels Bohr Institute, Copenhagen, Denmark  
 Period: 09/2006-08/2009
12. Title: **Controlled Quantum Coherence and Entanglement (CONQUEST)**  
 Chief coordinator: Vladimír Bužek, prof. RNDr., DrSc. coordinator  
 No. of contract: MRTN-CT-2003-505089  
 Period: 2004-2008
13. Title: **European Lead-Free Soldering Network – ELFNET**  
 Principal investigator: Švec Peter, Ing., DrSc.  
 No. of contract: NMP2-CT-2003-505504 (6RP)  
 Period: 2004-2007
14. Title: **European Isotope Separation On-Line Radioactive Ion Beam Facility (EURISOL DS)**  
 Principal investigator: Běták Emil, Doc., RNDr., DrSc.  
 Title programm: FP6-2003 Infrastructures 4

- Chief of coordinator Dr. Graziano Fortuna, INFN, Legnaro, Taliansko, Dr. Y. Blumenfeld  
IPN Orsay, France
- No. of contract: 515768  
Period: 2005-2009
15. Title: **EUROpean Nuclear Structure Integrated Infrastructure Initiative (EURONS)**  
Principal investigator: Běták Emil, Doc., RNDr., DrSc.  
Title programm Integrating Activity/Int. Infrastructure Initiative  
Chief of coordinator Dr. A.C. Müller, GSI Darmstadt, Nemecko  
No of contract: 506065  
period: 2005-2008
16. Title: **ERA-PILOT QIST**  
Principal investigator: Vladimír Bužek, prof. RNDr., DrSc.  
Chief of coordinator: Christian Monyk, ARC Seibersdorf research Ges.m.b.H.  
No. of contract: IST-015789  
Period: 2005-2007
17. Title: **Quantum Applications (QAP)**  
Principal investigator: Bužek Vladimír, prof., RNDr., DrSc.  
Chief of coordinator: Prof. Martin Plenio, Imperial College, London  
Prof. Ian A. Walmsley, University of Oxford, Oxford  
No. of contract: 2004-IST-FETPI-15848 (IP)  
Period: 2005-2009
18. Title: **Methods of Integrable Systems, Geometry, Applied Mathematics (MISGAM)**  
Principal investigator: Šamaj Ladislav, RNDr., CSc.,  
Chief coordinator : B. Dubrovin, SISSA, Terst, Italy, European Science Foundation (ESF), Program in physical and Engineering Sciences (PESC)  
Period: 2004-2009

**In addition to large multilateral international projects our research teams collaborate within the framework of NATO collaborative grants, bilateral projects and/or informally, e.g.**

- Title: **Theoretical Studies in Disordered Systems**  
Investigator IP SAS: Markoš Peter, RNDr., CSc.Chief contract  
Principal investigator: C.M. Soukoulis, Ames Lab., USA  
No. of contract: PST.CLG.978088 NATO Collaborative Linkage Grant  
Period: 08/2001-09/2003
- Title: **Electromagnetic properties of left-handed materials**  
Investigator IP SAS.: Markoš Peter, RNDr., DrSc.  
No. of contract: NATO CBP.EAPCLG 981471  
Principal investigator: C.M. Soukoulis, Ames Lab., USA  
Period: 2005-2006
- .Title: **Laser assisted formation of magnetic nanoparticles for information storage**  
Investigator IPSAS: Luby Štefan, Prof.,Ing., DrSc.  
Principal investigator Prof. A.Luches, Univesity of Lecce, Italy  
No. of contract: PST.CLG 978058, 2001-2003  
Period: 2001-2003
- Title: **Gasless combustion and structure formation in multilayer thin films**

Investigator IP SAS: Illeková Emília, RNDr., CSc.  
 Principal investigator: prof. J.C. Gachon z Univ. Henri Poincare, Nancy, France  
 No. of contract: INTAS 03-51-4103  
 Period: 2004-2006

Title: **Quantum information technologies: Quantum cryptography and simulation of quantum many-body systems**

Principal investigator: Bužek Vladimír, Prof., RNDr., DrSc.  
 No. of contract: INTAS 04-77-7289  
 Chief coordinator: Bužek Vladimír, Prof., RNDr., DrSc.  
 Period: 2005-2007

Title: **Properties of glass -forming materials and proton-conducting polymers**

Investigator IP SAS: Krištiak Jozef, Ing., CSc.  
 Principal investigator: J. Fontanella, US, Naval Academy, Annapolis  
 No. of contract: NSF 02 171 29  
 Funding: 2003-2005

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

- [1] ECOVAST: Rural Development in the Knowledge-Based Society, 15.-17. 10 2006 Bratislava
- [2] Solid State Surfaces and Interfaces 2006, 19.-24. 11. 2006 Smolenice
- [3] CEQIP: Central European Quantum Information Processing Workshop, 4.5.-8.5.2006, Znojmo, ČR,
- [4] QUPREST: QAP Focus meeting: Quantum Process Estimations, 29.9.-1.10.2006, Budmerice, SR
- [5] YEP 2006: Young European Physicists meeting, 11.12.-15.12.2006, Budmerice, SR
- [6] Int. workshop „Relativistic Nuclear Physics: From Hundreds MeV to TeV“, 22 – 27. 5. 2006, Modra – Harmónia, SR
- [7] DANF 2006, Dynamical Aspects of Nuclear Fission, 2-6.10.2006, Smolenice
- [8] Young European Physicists meeting 2005, Budmerice,
- [9] RNP2005 – Relativistic Nuclear Physics: from hundreds MeV to TeV, JINR Dubna, May 23-28, 2005
- [10] 17th European Conference on Thermophysical Properties, ECTP, Bratislava 5-8. 9. 2005
- [11] NATO Advanced Research Workshop Left Handed Materials and Photonic Crystals, Heraklion June 19-22, 2005 (director C. M. Soukoulis, P. Markoš)
- [12] SMM 17, Soft Magnetic Materials, Bratislava, Sept. 7-9, 2005,
- [13] . Solar Renewable Energy News - SREN 2005 International Conference“, Florencia, 2.-8.4.2005,
- [14] Silicon - News in Science and Technology SNST 2004, February 29 – March 4, 2004, Grand Hotel Permon, Vysoké Tatry - Podbanské, SR.
- [15] Int. Conf. 4<sup>th</sup> Solid state surfaces and interfaces 4<sup>th</sup> SSSI 2004, November 8-14, 2004, Smolenice Castle, SR.
- [16] Int. Conf. Hadron Structure O4, KC SAV Smolenice, 29.8.-4.9.2004.
- [17] 3-rd aSiNet Workshop on Thin Silicon, 25-27 February, 2004, Bratislava, Slovak Republic,
- [18] MECO29, 29. Middle-European collaboration in statistical physics, 28.3.-1.4.2004, Bratislava, SR.
- [19] 2004 QIPC Review , Bratislava 16.-18.2. 2004,
- [20] NATO ARW “ProSize”, Properties and Applications of Nanocrystalline Alloys from Amorphous Precursors, Budmerice, June 9-16, 2003, SR.
- [21] AI-Mat – Bulk Nanocrystalline high-strength Al-based materials, Bratislava, SR, Sept. 5-6, 2003,.

[22] XIV<sup>th</sup> Symposium on Application of Plasma Processes SAPPXIV, 13.-18. január 2003, Liptovský Mikuláš, SR.

[23] ECOLOGICAL ASPECTS OF DEVELOPMENT OF RURAL REGIONS I – Alternative Energy Sources Utilization in Rural Regions, 11.-13. december 2003, Banská Štiavnica, SR..

[24] FEW QUBITS APPLICATIONS (Budmerice SR 11.-14.12.2003, 4th European QIPC Workshop, Oxford 13.-17.7.2003.

[25] RNP2003 – International Workshop Relativistic Nuclear Physics: From Hundreds MeV to TeV, August 25-30, KC Academia, Stará Lesná.

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

**acta physica slovacca**, a journal for experimental and theoretical physics, established in 1951, Indexed in Current Contents and in Physics Abstracts; recognized by EPS.

Editor up to August 2006, Ass. Prof. RNDr. Emil Betak, DrSc.

Since August 2006 the editorial policy of the *acta physica slovacca* changed, new Editorial board was nominated as follows from the text below:

Editorial Board: Prof. V. Bužek, Prof. J. Fabián (Regensburg), Prof. I. Štich (Bratislava), Prof. I. Horváth (Lexington), Dr. M. Franz (Vancouver).

#### Editorial APS Iss. 5, 2006 (V. Bužek)

Within the last ten years scientific publishing has changed dramatically. Most papers appear in electronic form (e.g. on [www.arxiv.org](http://www.arxiv.org)) and are publicly available. Dissemination of information is fast (some times too fast) and efficient. However, authors are under great stress to publish their work fast in order to survive tough competition. In addition, to be promoted within the academic environment scientists have to have "impressive" (i.e. long) list of publications. Given these factors it frequently happens that in scientific publishing readers are "forgotten".

Therefore we would like to put our journal back in the service of our readers. We want to offer them papers that are accessible, reliable, and informative. In order to meet these goals the publisher of the journal *acta physica slovacca* has decided to change its editorial policy. While each volume will still contain six issues (i.e. the journal will continue to be published bimonthly), starting from the present issue each issue of the journal will contain just a single article - preferably a review with a touch of a tutorial style. We want these articles to be accessible to our most precious readers - students and young researchers.

We hope that you will profit from the upcoming changes and will enjoy reading our journal.

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

12th Internat. Conf. on Thin Films, Bratislava, Sept. 2002, *Thin Solid Films*, 433/1-2, 2003, Guest Ed. S. Luby.

Proceedings of the 3-rd aSiNet Workshop on Thin Silicon, February 25-27, 2004, Bratislava, Slovakia, ed. by M. Schuber, V. Nádaždy, K. Gmucová.

Proceedings of the XIV-th Symposium on Application of Plasma Processes SAPP XIV, January 13-18, 2003, Liptovský Mikuláš, Hotel Jamajka, Slovak Republic, ed.: P. Šutta, J. Müllerová, R. Brunner, ISBN 80-8040-195-0

Materials of Solid State Surfaces and interfaces IV Smolenice (Slovakia), November 2004, ed.: R. Brunner, J. Müllerová, in: *Acta Physica Slovaca* 55, 3,4 (2005)

Proceedings of the SREN 2005, Florence, Italy, April 2-8, 2005, ed.: R. Brunner, ISBN 80-223-2099-4. Properties and Applications of Nanocrystalline Alloys from Amorphous Precursors/, NATO Science Series II: Mathematics, Physics and Chemistry, vol. \*184\*, B. Idzikowski, P. Svec, M. Miglierini (eds.), Kluwer Academic Publishers, Dordrecht, 2005

- **National position of the Organisation**
- i. **List of selected most important national projects (Centres of Excellence, National Reference Laboratories, Agency for the Promotion of Research and Development (APVV/APVT), National Research Programmes, Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA), and others)**

#### Centres of Excellence

##### 1. Center of excellence SAS „NANOSMART“

Principal investigator: Dusza J., Doc., RNDr., Dr.Sc.

Investigator IP SAS: Švec Peter, Ing., DrSc.

##### 2. Center of excellence SAS CE-PI Physics of Information

Principal Investigator Prof. RNDr. V. Bužek, DrSc.

Investigator IP SAS Prof. S. Luby, DSc.

#### 2. Projects of Slovak Research and Development Agency APVT /APVV

- |                         |  |
|-------------------------|--|
| 1. Title:               | <b>Ordered arrays of metallic and magnetic nanoparticles for information technologies – preparation and properties</b> |
| Principal investigator: | Majková Eva, RNDr., DrSc.  |
| No. of contract:        | APVT-51-021702   |
| Period:                 | 2002-2005  |
| 2. Title:               | <b>Strongly correlated and disordered electronic systems</b>   |
| Principal investigator: | Hlubina R., Doc., RNDr., CSc., FMFI UK Bratislava  |
| Investigator IPSAS:     | Markoš Peter, RNDr., CSc   |
| No. of contract:        | APVT-51-021602   |
| Period:                 | 2002-2005  |
| 3. Title:               | <b>Bulk nanostructured metallic materials for structural applications</b>  |
| Principal investigator: | Šimančík F., Ing., CSc., ÚMMS SAV  |
| from Inst. of Phys.SAS: | Švec Peter, Ing., DrSc.  |
| No. of contract:        | APVT-51-021102   |
| Period:                 | 2004   |
| 4. Title:               | <b>Free volume of molecular and polymer systems and their transport and dynamics properties</b>                        |
| Principal investigator: | Ing. J. Krištiak, CSc.   |
| No. of contract:        | APVT-51-045302   |
| Period:                 | 02/2004 -12/2006   |
| 5. Title:               | <b>Novel multiphase nanostructured materials with extraordinary physical properties</b>                                |
| Principal investigator: | Švec Peter, Ing., DrSc.  |
| No. of contract:        | APVT-51-052702   |
| Period:                 | 2003-2005  |
| 6. Title:               | <b>Thin oxide films for advanced MOS structures</b>  |
| Principal investigator: | Ing. K. Frohlich, DrSc., IEE SAS   |
| Investigator IP SAS:    | Jergel Matej, Ing., DrSc.  |

- No. of contract: APVT-51-017004  
 Period: 2005- 2008
7. Title: **Novel Scanning Probe Microscopy and Spectroscopy Techniques for Nanostructure Analysis**  
 Principal investigator: Lányi Štefan, Ing., DrSc..  
 No. of contract: APVT-51-013904  
 Period: 2005 - 2007
8. Title: **Functional supramolecule surface nanostructure based on cyclodextrines**  
 Principal investigator: Ass. Prof. D. Velic, PhD, International Laser Centre  
 Investigator IP SAS.: Majková Eva, RNDr., DrSc.  
 No. of contract: APVT-20-02-029804  
 Period: 2005- 2007
9. Title: **The theory of strong interactions of subnuclear particles and physical phenomena and processes at large distances**  
 Principal investigator: Olejník Štefan, RNDr., DrSc.  
 No. of contract: APVT-51-005704  
 Period: 2005 - 2007
10. Title: **Research and development of selected electrotechnical applications of nanocrystalline and amorphous materials**  
 Principal investigator: EVPÚ, a.s., Nová Dubnica, Ing. J. Kuchta, PhD.  
 Investigator IP SAS.: Švec Peter, Ing., DrSc  
 No. of contract: APVT-99-017904  
 Period: 2005 - 2007
11. Title: **Coherence, decoherence and disorder in metallic and superconducting**  
 Principal investigator: Markoš Peter, RNDr., DrSc.  
 No. of contract: APVV-51-003505  
 Period: 2006-2009
12. Title: **Scanning magneto-optical Kerr microscope for studying magnetization changes on nanostructures**  
 Principal investigator: Majková Eva, RNDr., DrSc.  
 No. of contract: APVV LPP-0080-06  
 Period: 11/2006-11/2009
- APVV projects of bilateral collaboration**
- 13 Title: **Quantum Mechanics of Nucleon Radiative Capture Models Based on Optical Potential**  
 Principal investigator: Běťák Emil, RNDr., DrSc.  
 Partner: Jožef Štefan Institute, Lublana, Slovenia  
 No. of contract: APVV SK-SI-02006  
 Period: 2006-2008
14. Title: **Process, tomography and multi-partite entanglement**  
 Principal investigator: Bužek Vladimír, Prof., RNDr. DrSc.  
 No. of contract: APVV-CHIN-3-08  
 Partner: Lab. of quantum information, Univerzity of Science and technology of China, prof. Guo Guang -Can  
 Period: 2006-2007
15. Title: **Diffusion and interface stability in metallic multilayers**  
 Principal investigator: Majková Eva, RNDr., DrSc.  
 Partner: prof. S. Protsenko, Dept. Appl Phys. Univ Sumy, Ukraine  
 No. of contract: APVV SK-UA-01606



Period: 2006-2007

16. Title: **Magnetic multilayers and effects of induced magnetism**  
 Principal investigator: Majková Eva, RNDr., DrSc.  
 Partner: Dr. A. Rogalev, PhD, ESRF Grenoble, France  
 No. of contract: APVV SK-FR-00706  
 Period: 2006-2007

17. Title: **Investigation of nuclei under extremes of isospin asymmetry**  
 Principal investigator: Veselský Martin, Ing., PhD.  
 Partners: Shanghai Inst.of Applied Physics, ChAS China  
 No. of contract: APVV SK-CN-00706  
 Period: 2006-2007

### 3. National research programs – State order

#### State order New materials and devices in submicron technologies

1. Title: **Part 01 –Mastering of submicron technologies**  
 Principal investigator: RNDr. E. Majková, DrSc.  
 No. of contract: 2003 SO 51/03R 06 00/01  
 Partners: IP SAS, EII SAS, II SAS  
 Period: 2003-2005

2. Title: **Part 02 – Application of new devices based on submicron thin film technologies**  
 Principal investigator: IEE SAS  
 Investigator IP SAS: RNDr. E. Majková, DrSc.  
 No. of contract: 2003 SO 51/03R 06 00/02  
 Partners: IP SAS, EII SAS, II SAS  
 Period: 2003-2005

3. Title: **Part 03: Research and development of ceramic composite materials for civil engineering**  
 Principal investigation: Prof.. RNDr. P. Šajgalík, DrSc., IIC SAS  
 Investigator IP SAS: ŠvecPeter, Ing.,DrSc.,  
 No.contract: 2003 SO 51/03R8 06 00/03R 03-2003  
 Period: 2003/2005

#### Selected projects of Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA)

1. Title: **Programmable Quantum Processors**  
 Principal investigator: Bužek Vladimír., Prof., RNDr., DrSc.  
 No. of contract: 2/3109/23  
 Period: 2003-2005

2. Title: **Study of organic molecular systems responsive to physico-chemical factors for biosensor applications**  
 Principal investigator: Círák L., Doc. Ing.,CSc., KF FEI STU  
 Investigator IP SAS: Gmucová Katarina, RNDr., CSc.  
 No. of contract: 1/0277/03  
 Period : 2003- 2005

3. Title: **Physical properties of nanometer-,subnanometer- and hybrid structures**  
 Principal investigator: Luby Štefan, Prof. Ing., DrSc.  
 No. of contract: 2/3149/23  
 Period: 2003 - 2005

4. Title: **Transport properties of disordered and heterogeneous systems**  
Principal investigator: Markoš Peter, RNDr., DrSc.  
No. of contract: 2/3108/2003  
Period: 2003 - 2005
5. Title: **Topological Structures, Colour Confinement, and Symmetry Breaking in Gauge Theories**  
Principal investigator: Olejník Štefan, RNDr., DrSc.  
No. of contract: 2/3106/23  
Period: 2003 - 2005
- 6 Title: **Statistical Mechanics of low-dimensional Coulomb systems**  
Principal investigator: Šamaj Ladislav RNDr., CSc.  
No. of contract: 2/3107/23  
Period: 2003 - 2005
7. Title: **Reaction products at cyclotron energies**  
Principal investigator: Běták Emil, Doc., RNDr., DrSc.  
No. of contract: 2/4102/24  
Period: 2004 - 2006
8. Title: **Ivestigation of a manifestation of the electromagnetic and weak structure of mesons, baryons and light atomic nuclei in various physical processes)**  
Principal : Dubnička Stanislav RNDr., DrSc.  
No. of contact: 2/4099/24  
Period: 2004 - 2006
9. Title: **The role nuclear shells in formation, decay, and structure of heavy and superheavy nuclei**  
Principal investigator: Gmuca Štefan, Ing., CSc.  
No. of contract: 2/4098/24  
Period: 01/2004 - 12/2006
10. Title: **Electrical and electrochemical studies of hydrogenated amorphous silicon (a-Si:H)**  
Principal investigator: Gmucová Katarína, RNDr., CSc.  
No. of contract: 2/4100/24  
Period: 2004 - 2006
11. Title: **The nanometric free volume and dynamic processes detected by positronium in disordered structures)**  
Principal investigator: Krištiak Jozef Ing., CSc.  
No. of contract: 2/4103/24  
Period: 2004- 2006
12. Title: **Properties of Exotic Nuclei**  
Principal investigator: Gmuca Š., Ing., CSc.  
No. of contract: 2/1132/21  
Period: 2001-2003
13. Title: **Study of the heat transport in porous materials by dynamic methods**  
Principal investigator: Kubičár Ľudovít, Ing., DrSc.  
No. of contract: 2/2036/22  
Period: 2001-2003
14. Title: **Investigation of methods of increasing the resolution scanning capacitance microscopes**  
Principal investigator: Lányi Štefan, Ing., DrSc.

- No. of contract: 2/2037/22  
Period: 01/2001-12/2003
15. Title: **Physics of nanoscale materials**  
Principal investigator: Švec Peter, Ing., DrSc.  
No. of contract: 2/2038/22  
Period: 01/2001-12/2003
16. Title: **Programmable Quantum Processors**  
Principal investigator: Bužek V., Prof., RNDr., DrSc.  
No. of contract: 2/3109/23  
Period: 01/2003-12/2005
17. Title: **Physical Properties of Nanometer-, Subnanometer- and Hybrid Structures**  
Principal investigator: Luby Štefan, Prof. Ing., DrSc.  
No. of contract: 2/3149/23  
Period: 01/2003-12/2005
18. Title: **The nanometric free volume and dynamic processes detected by positronium in disordered structures**  
Principal investigator: Krištiak Jozef Ing., CSc.  
No. of contract: 2/4103/24  
Period: 01/2004-12/2006
19. Title: **New combined sensors based on GMR**  
Principal investigator: Majková Eva, RNDr., DrSc.  
No. of contract: 2/4101/24  
Period: 01/2004-12/2006
20. Title: **Investigation of passivation of defects in silicon polymorphous layers and its interfaces with very and ultrathin dielectrics**  
Principal investigator: Pinčík Emil, RNDr., CSc.  
No. of contract: 2/4105/24  
Period: 01/2004-12/2006
- 21 . Title: **Physical properties of organic two-dimensional systems and formation of nanostructures for molecular electronics**  
Investigator IP SAS  
Principal investigator: Gmucová Katarína, RNDr., CSc.  
No. of contract: Cirák Július, Doc., Ing., CSc., STU  
1/3038/26  
Period: 01/2006-12/2008
22. Title: **Nanoparticle, granular structures and new magnetic films with unique properties**  
Principal investigator: Luby Štefan, Prof., Ing., DrSc.  
No. of contract: 2/6030/26  
Period: 01/2006-12/2008
23. Title: **Chaos in nonlinear electron-phonon systems**  
Principal investigator: Majerníková Eva, Prof., RNDr., DrSc.  
No. of contract: 2/6073/26  
Period: 01/2006-12/2008
24. Title: **Localization**  
Principal investigator: Markoš Peter, RNDr., DrSc.  
No. of contract: 2/6069/26  
Period: 01/2006-12/2008

25. Title: **Nonperturbative aspects of elementary particle interactions**  
 Principal investigator: Olejník Štefan, RNDr., DrSc.  
 No. of contract: 2/6068/26  
 Period: 01/2006-12/2008
26. Title: **Statistical mechanics of low-dimensional classical systems**  
 Principal investigator: Šamaj Ladislav, RNDr., CSc.  
 No. of contract: 2/6071/26  
 Period: 01/2006-12/2008
27. Title: **Quantum information theory of multipartite systems**  
 Principal investigator: Ziman Mário, Mgr., PhD  
 No. of contract: 2/6070/26  
 Period: 01/2006-12/2008

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

**iii. List of national journals published by the Organisation**

non

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

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

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

**2003**

1. V. Bužek: Quantum state reconstruction and optimal manipulations with quantum information, Workshop Quantum Measurements and Quantum Stochastics Aarhus, Denmark, August 6-12, 2003.
2. V. Bužek: Quantum infodynamics: An alternative approach to quantum theory of open systems, Workshop The First QuICT Network Meeting, Abigdon, UK, July 11-13, 2003.
3. V. Bužek: Flipping qubits, Obergurgle Meeting 2003: Quantum Optics, Obergurgle, Austria, February 23-28, 2003.
4. V. Bužek: Quantum Programming, Open Information Workshop: The making of a quantum computer (Bad Nauheim, Germany, March 9-12, 2003.
5. V. Bužek: From Flipping qubits to programmable quantum processors, plenary talk at the VIII-the International Workshop on Squeezed States and Uncertainty Relations Puebla, Mexico, June 9, 2003.
6. V. Bužek : From Flipping Qubits to programmable quantum processors, ERATO Conference on Quantum Information Science 2003 (EQISO3) Kyoto, Japan, September 6, 2003.
7. V. Bužek : Quantum Infodynamics: An attempt to describe dynamics of open quantum systems from a perspective of quantum information theory, workshop Non-locality of Quantum Mechanics and Statistical Inference Kyoto, Japan, September 8, 2003.
8. M. Krajič: Semiconducting Aluminum-Transition-Metal Quasicrystals. Symposium Quasicrystals MRS Fall Meeting 2003 in Boston (Massachusetts, USA). Organising Committee: Esthér Belin-Ferré, Mick Feuerbacher, Yasushi Ishii, Dan Sordelet, 1-5th of December 2003

9. E. Majková, Š. Luby, M. Jergel: Submicrometer Subpicosecond Laser Patterning of Soft X-Ray Mo/Si and W/Si Multilayer Gratings, Working Group Meeting of COST P7 Action, Berlin 21.-22.11.2003.

10. E. Pinčík, M. Jergel, H. Kobayashi, R. Brunner: New Developments in Amorphous Thin Film Silicon Solar Cells and New Approaches How to Investigate and Improve Their Electrical, Optical, and Structural Properties, "Int. Symp. on 21<sup>st</sup> Century COE Program", Osaka 11.-12.3.2003.

11. E. Pinčík: Photoluminescence, Structural and Electrical Properties of Passivated a-Si:H Based Thin Films and Corresponding Solar Cells, "III Int. Seminar on Semiconductor Surface Passivation – SSP 2003", Ustron 14.-17.9.2003

12. P. Švec, I. Škorvánek, D. Janičkovič, M. Deanko, D. Muller: Atomic ordering, nanocrystal nucleation and grain size effects in soft-magnetic rapidly quenched systems. Intl. Conf. Amorphous and Nanocrystalline Magnetic Materials 2003, Iasi, September 17-19, 2003.

13. Peter Švec, Ivan Skorvanek: Cluster structure, thermodynamics of formation and properties of nanocrystalline alloys from amorphous precursors, European Academy of Sciences Annual Congress on Materials Science and Nanotechnology, NANOMAT, 22. – 24. 10. 2003, Brussels, Belgium.

15. M. Deanko, D. Janičkovič, D. Muller, P. Švec: Cluster structure and thermodynamics of formation of nanocrystalline phases. NATO ARW "Properties and applications of nanocrystalline alloys from amorphous precursors", June 9-16, 2003, Budmerice, NATO ARW Series, Kluwer.

16. E. Illeková: Kinetic characterization of nanocrystal formation in metallic glasses. In: Properties and applications of nanocrystalline alloys from amorphous precursors", June 9-16, 2003, Budmerice, NATO ARW Series, Kluwer 2004

## 2004

1. V. Bužek: Entanglement and quantum phase transitions in the Dicke model (Central European Workshop on Quantum Optics, Trieste, 18-20 July 2004, Italy).

2. V. Bužek: Quantum infodynamics (Decoherence, Entanglement and Information Protection in Complex Quantum Systems (DEICS), Les Houches, 24-27 April 2004, France).

3. V. Bužek: Entanglement and quantum phase transitions in Dicke model (Quantum Optics II, Cozumel, Mexico, 6 – 10 December 2004).

4. V. Bužek: Programmable quantum processors (Quantum Optics for Quantum Information Processing, Roma, Italy, 6 – 8 May 2004).

5. V. Bužek: Optimal measurements and quantum state reconstructions (4th School on Modern Optics, INAOE, Tanantzintla, Mexico, 6 – 10 September 2004).

6. V. Bužek: "Creazy idea of Nick Herbert and its consequences" Quantum cloning (4th School on Modern Optics, INAOE, Tanantzintla, Mexico, 6 – 10 September 2004)

7. V. Bužek: From flipping qubits to programmable quantum processors (4th School on Modern Optics, INAOE, Tanantzintla, Mexico, 6 – 10 September 2004).

8. V. Bužek: Quantum infodynamics "Some ideas about dynamics of open systems (4th School on Modern Optics, INAOE, Tanantzintla, Mexico, 6 – 10 September 2004).

9. V. Bužek: Quantum entanglement in multi-qubit systems: Ising model and entangled graphs (4th School on Modern Optics, INAOE, Tanantzintla, Mexico, 6 – 10 September 2004).

10. M. Jergel, M. Ožvold, R. Senderák, E. Majková, Š. Luby : Interference Multilayer mirrors for X-EUV Optics, "Int. Conf. on Solid State Surfaces and Interfaces – SSSI IV", Smolenice, 8.-11.11.2004.

11. M.Hartmanová, M.Jergel, V.Navrátíl, K.Navrátíl, K.Gmucová, F.Cruz-Gandarilla, J.Zemek, Š.Chromík, F.Kundracík, L.Ortega : Effect of Structural Imperfections on the Characteristics of YSZ Dielectric Layers Grown by E-Beam Evaporation from the Crystalline Targets, "Int. Conf. on Solid State Surfaces and Interfaces – SSSI IV", Smolenice, 8.-11.11.2004.
12. M.Jergel, E.Majková, Š.Luby : X-ray Techniques for Characterization of Surfaces and Thin Films for Microelectronics, Int. Conf. "Silicon News in Science and Technology – SNST 2004", Podbanské, 29.2.-3.3.2004.
13. M.Hartmanová, M.Jergel, I.Thurzo, F.Kundracík, Š.Chromík : ZrO<sub>2</sub> Gate Dielectric on Si Substrate, Int. Conf. "Silicon News in Science and Technology – SNST 2004", Podbanské, 29.2.-3.3.2004.
14. Š.Luby, E.Majková, M.Jergel : Role of Interfaces in the Nanometer-Scale Period Multilayers for X-ray Optics, "10th Joint Vacuum Conf., Proc. of Abstracts, Slovenian Soc. Vac. Techn. Ljubljana, ISBN 961-90025-5-5, Portoroz, September 2004, p. 23
15. E.Pinčík, H.Kobayashi, S.Jurečka, M.Jergel, H.Glesková, M.Takahashi, R.Brunner, N.Fujiwara, J.Müllerová : Investigation of Electrical, Structural, and Optical Properties of Very Thin Oxide/a-Si:H/c-Si Interfaces Passivated by Cyanide Treatment, "5th Int. Conf. On Thin Film Physics and Applications", Shanghai, 31.5.-2.6.2004.
16. E.Pinčík, H.Kobayashi, S.Jurečka, M.Jergel, M.Takahashi, J.Rusnák, R.Brunner, N.Fujiwara, J.Müllerová: Very Thin SiO<sub>2</sub>/a-Si:H (c-Si) Interfaces Passivated by Wet Cyanide Treatment and Application of the Cyanidization in Thin Film Device Production, "9-th Scientific and Business Conference on Silicon Technology, Photovoltaic and Infrared Optics SILICON 2004", Rožnov pod Radhoštěm, 2.-5.11.2004.
17. M. Krajčí: Semiconducting Al-transition-metal quasicrystals. The Third ASIA International Workshop on Quasicrystals, April 27-30, 2004, Taipei, Taiwan. Org.: National Cheng Kung University and Tamkang University, Taiwan, R.O.C.
18. Ľ. Kubičár, V Boháč, V Vretenár, U Hammerschmidt: Thermophysical Measurement of PMMA by Pulse Transient Method: Methodology of Intercomparison, The 25th Japan Symposium on Thermophysical Properties, Nagano October 20-22, 2004, Japan – invited lecture.
19. Ľ. Kubičár, V Vretenár, V Boháč, P Tiano: Thermophysical Analysis of Sander Sandstone and marble: Methodology for Pulse Transient Method, 7th Asian Thermophysical Properties Conference, Hefei&Huangshan, China, August 31, 2004.
20. Ľ. Kubičár, V Boháč, V Vretenár: Transient Methods for Measuring Thermophysical Properties: Application in Material Science, Seminar Department of Acoustic and Thermal Physics, Katholik University of Leuven, Belgium, October 28, 2004.
21. Ľ. Kubičár, V Boháč, V Vretenár: Transient methods for measuring thermophysical properties of solids: methodology for pulse transient, Seminar National Metrological Institute. Tsukuba, October 18, 2004
22. Š. Olejník: Relations between the Gribov-horizon and center-vortex confinement scenarios, Quark Confinement and the Hadron Spectrum VI, Villasimius, Sardinia, Italy, September 21-25, 2004.
23. Ľ. Šamaj: The statistical mechanics of the classical two-dimensional Coulomb gas is exactly solved. MECO 29, Bratislava, 30.3. 2003.
24. V. Bužek: Dynamics of open systems from a perspective of quantum information theory (Quantum entanglement in physical and information sciences, Pisa, Italy, 14-18 December).
25. S. Luby, E. Majkova, I. Zergioti, D. Papzoglou, A. Manousaki, C. Fotakis, Patterning of thin films and multilayers by femtosecond laser beam Internat. Workshop on Phys. And Technol. Of Thin Films, Sharif Univ. Of Technol., Teheran, 22. 2. – 6. 3. 2003, Book of Ext. Abstracts 13/1

26 M.Jergel, E.Majková, Š.Luby: X-ray Diagnostics of Thin Films, "3rd Int. Conf. on Physical Engineering", Mexico City, 15.-19.11.2004

## 2005

1. V. Bužek, Quantum information processing with three qubits, QUPON, 26.5.05 Wien,
2. V. Bužek, Optimal manipulations with quantum information: Programmable quantum processors, Science and Art in Europe - meeting of the Max Planck Society, 25.5.05, Dresden,
3. V. Bužek, Physics of qubit applications, QIST meeting, Innsbruck, 14.2.05
4. V. Bužek, Dynamics of open quantum systems: Quantum information theory approach, Obergurgl, Quantum Optics Meeting 2005, 3.3.05, Obergurgl,
5. M. Deanko, M. Paluga, D.M. Kepaptsoglou, D. Muller, P. Mrafko, D. Janickovic, E. Hristoforou, I. Skorvanek, P. Svec, Peculiarities of Electrical Resistivity during Transformations in Amorphous and Nanocrystalline Alloys, inv. lecture, ISMANAM 2005, Paris, 3. – 7. 7. 2005, J. of Alloys and Compounds, in print.
6. Hartmanová M., I. Thurzo, M. Jergel, F. Kundracik: Trends of structural and electrical properties in materials for advanced technologies - New non-traditional energetic sources and environmental problems. Internat. Conference on Solar renewable energy news – Research and applications 2005 (SREN 2005), Florence, Italy, April 2-8, 2005.
7. Jergel M., Majková E., Luby Š. X-ray Diffractometry and Reflectometry of Thin Films and Surfaces, Solar Renewable Energy News – Research and Applications, Florence 2005, , R. Brunner ed., ISBN 80-223-2099-5, p. 33.
8. Krajčí M. and Hafner J.: Semiconducting aluminum-transition-metal alloys, TMS 2005 Annual Meeting and Exhibition in San Francisco, California, USA, February 13-17, 2005. The Science of Complex Alloy Phases, eds. T.B. Massaklski and P. Turchi, A Publication of TMS, Warrendale 2005, pp 251-280.
9. Krupa, D.: High Energy Physics Collaboration Insight on Networking. Scientific Network Conference, 11.6. – 16.6. 2005, Sopron, Hungary
10. Martinovič, L.: Higgs mechanism in a light front formulation. International Light Cone Workshop, Cairns, Austrálie, 7.-17. júl 2005. Vyjde v Nuclear Physics B (Proc. Supplem.).
11. E. Pinčík, H. Kobayashi, J. Rusnák, M. Takahashi, J. Kákoš, R. Brunner.: Passivation of Si and a-Si:H Surfaces by Thin Oxide and Oxy-Nitride Layers. IV International Workshop on Semiconductors Surface Passivation SSP'2005, Polsko.
12. Šamaj L.: The statistical mechanics of the classical two-dimensional Coulomb gas is exactly solved. Conference on Riemann-Hilbert problems, integrability and asymptotics SISSA-Trieste, September 20-25,05.
13. Šiffalovič P.: Ultrashort XUV Pulses for time –Resolved and Non-Linear Applications – XTRA Summer School, Porquerolles Island, France, 25.-28.05.2005., „XUV Applications in solid state physics“
14. Švec P.: Advanced amorphous and nanocrystalline alloys prepared by rapid quenching from the melt – physical properties and applications, plenary lecture, TECHNOLOGY 2005, Bratislava 13. – 14. 9. 2005 (zb. abstraktov).
15. Veselsky M.: Isospin dependence of nucleus-nucleus collisions. Workshop "Isospin physics and liquid-gas phase transition", Peking, 18.8 - 21.8. 2005

16. M. Veselsky: Production of n-rich nuclei in peripheral nucleus-nucleus collisions "Workshop "Future prospects for high-resolution gamma-spectroscopy at GANIL", Caen, France, 3.10.2005 - 7.10.2005
17. M. Veselsky: Production of rare nuclear species with proton and heavy ion beams in different regimes. EURISOL TOWN meeting 2005", Caen, France, 27.11.2005 - 2.12.2005.
18. M. Ziman: Reconstruction of quantum states and processes, RESQ meeting, Budapest, 14.5.05.
19. S. Luby, E. Majkova, Tailoring of multilayer interfaces by pulsed laser irradiation, Int. Conf. On Photo-Excited Processes and Applications 4-ICPEPA, Lecce 2004, Appl. Surf. Sci. 248, 2005, p. 316 – 322.

## 2006

1. S. Dubnička, A.Z. Dubničková: Manifestation of the Jlab proton polarization data on the behaviour of strange nucleon form factors. 3-rd International Workshop „From parity violation to hadron structure and more“, 16-20 May, 2006, Milos Greece.
2. Ľ. Kubičár, P. Dieška, V. Boháč, V. Vretenár: Measurements of PMMA by Pulse Transient Method: Determination of Thermophysical Parameters Including Heat Transfer Coefficient. 16th Symposium on Thermophysical properties Boulder, CO, USA July 30 - August 4, 2006
3. Ľ. Kubičár, V Vretenár, V Štofanič, Ľ. Bagel: Thermophysical sensors: Theory and application of the Hot Ball, Thermophysics 2006, Kočovce, 12 – 13 October, 2006.
4. E. Pinčík, H. Kobayashi, H. Glesková, M. Takahashi, M. Jergel, R. Brunner, L. Ortega, M. Kučera, and J. Rusnák: On interface properties of very-thin and ultra-thin oxide/a-Si:H structures prepared by both oxygen based plasmas and chemical oxidation. 4th International Workshop on Basic Aspects of nonequilibrium Plasmas Interacting with Surfaces;- Negative ions, their function & designability- 4th EU-Japan Joint Symposium on Plasma Processes. January 30 – February 1, 2006, at Hotel Highland Resort, Lake Kawaguchi, Japan.
5. E. Pinčík, R. Brunner, and M. Mikula: On Solar Energy Demand and Si-based Solar Cell Technology. Int. conference SILICON 2006, 7-10 November 2006, Hotel Relax, Rožnov pod Radhoštěm, Czech Republic. Published In: Proc. of int. conference SILICON 2006, 7-10 November 2006, ed. K. Vojtěchovský, 335-341, ISBN 80-239-7781-4.
6. Mario Ziman: Universality and optimality questions of programmable quantum processors CEWQO 2006, Wien, Austria (24.5.2006)
7. Mario Ziman: Quantum Process Estimation Procedures von Neumann workshop, Budapest, Hungary (29.5.2006)
8. Mario Ziman: Entanglement vs. local operations, NATO workshop: Quantum communications and security, Gdansk, Poland (13.9.2006)
9. V. Bužek: Reconstruction of quantum states and processes, Workshop on quantum statistics and information theory, Wien (28.11.2006)
10. M. Paluga, P. Švec, D. Janičkovič, D. Muller, P. Mrafko, M. Miglierini, Nanocrystallization in rapidly quenched Fe-Mo-Cu-B: Surface and volume effects. 3<sup>th</sup> International Symposium on Metastable and Nano Materials (ISMANAM 2006), Warsaw University of Technology, Warsaw, Poland, 26. 8. - 1. 9. 2006 (J. of Alloys and Compounds, submitted).
11. V. Bužek: Towards quantum-based privacy and voting, ICQFT06, Hangzhou, China (27.8.2006)
12. V. Bužek: Quantum state and process reconstruction, Winter schools on optics and quantum information, ICTP, Trieste (6.2.2006)



13. Katarína Gmucová, Ignác Capek, Lívia Chitu, Július Cirák, Rudolf Durný, Martin Kopáni, Eva Majková, Vojtech Nádaždy, Juraj Pavlásek, Alexander Šatka, Martin Weis: Interfaces at nanoscale: Electrochemical properties and perspectives. Konferencia: Solid State Surfaces and Interfaces 2006, Smolenice, 19 – 24 November 2006.

14. M. Hartmanová, F. Kubel, V. Navrátil, V. Buršíková, E. E. Lomonova, F. Kundracik: Effect of changes in composition design on properties and defect structure of crystalline Sm-doped ZrO<sub>2</sub>. The 8th Int... Meeting on „Fundamental problems of solid state ionics“, Chernogolovka, Russia, June 13 – 16, 2006

15. Krajčí M., Hafner J.: Ab initio study of quasiperiodic alkali- monolayers on a fivefold i-Al-Pd-Mn surface. International Conference on Aperiodic Crystals (Aperiodic 2006), September 17-22, 2006, Zao, Miyagi, Japan

16. Majková E., Luby Š., Chitu L., Frait Z., Fraitová D., Majchrak P., Malych, - Carito A.P., Fernandez M., Luches A.: Laser vacuum deposited multicomponent films for fast magnetic sensors. Invited paper, 11th Joint Vacuum Conf. Prague, Sept. 2006, Book of Abstracts, Czech. Vacuum Soc., (ed. Masek), Ref. 19.

17. Eva Majková, M. Jergel, S. Luby, D. Papazoglou, C. Fotakis, I. Zergioti, Sub-ps Laser Patterning of Multilayer Structures for X-Ray Gratings and Sensors, PXRMS 06, Sapporo, Japan, Book of abstracts

18. E. Majková, Y. Halahovets, P. Siffalovic, M. Jergel, S. Luby and I. Kostic: Structure and magnetic properties of nanostructured pseudo-spin valves, Workshop on Properties of ultrathin magnetic films, Białowieża, Poland, 7-9 September 2006.

19. E. Majková, Magnetic nanoparticles: structure and properties, Solid State Surfaces and Interfaces 2006, Smolenice, 19 – 24 November 2006, Book of Abstracts 94.

20. P. Švec, M. Deanko, M. Paluga, D. Janičkovič.: Nanocrystallization from amorphous state: Local characterization of metallic systems. Konferencie MIKROSKOPIE 2006, Hotel SKI, Nové Město na Moravě, 16.- 17. 2. 2006.

21. V. Bužek: Optimal manipulations with q-information and programmable q-processors, Winter schools on optics and quantum information, ICTP, Trieste (6.2.2006)

22. V. Bužek: Dynamics of open q-systems: Perspective of q-information theory, Winter schools on optics and quantum information, ICTP, Trieste (7.2.2006)

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

### **a) organized or co-organized by IP SAS.**

#### **2003**

1. NATO ARW “ProSize”, Properties and Applications of Nanocrystalline Alloys from Amorphous Precursors, Budmerice, 9.-15.6.2003, P. Švec, B. Idzikowski

2. AI-Mat – Bulk Nanocrystalline high-strength Al-based materials, Bratislava, Sept. 5-6, 2003, RTN Nano-Al, P. Švec.

3. XIV<sup>th</sup> Symposium on Application of Plasma Processes SAPPXIV (13.-18. January 2003, Liptovský Mikuláš), E. Pincik.

4. ECOLOGICAL ASPECTS OF DEVELOPMENT OF RURAL REGIONS I – Alternative Energy Sources Utilization in Rural Regions (11.-13. December 2003, Banská Štiavnica). E. Pincik.

5. FEW QUBITS APPLICATIONS (Budmerice 11.-14.12.2003, 4th European QIPC Workshop, Oxford 13.-17.7.2003, V. Buzek).

6. RNP2003 – International Workshop Relativistic Nuclear Physics: From Hundreds MeV to TeV, August 25-30, KC Academia, Stará Lesná, S. Gmuca.

**2004**

7. „Silicon - News in Science and Technology“ SNST 2004, February 29 – March 4, 2004, Grand Hotel Permon, Vysoké Tatry - Podbanské, SR. E. Pinčík:
8. „4<sup>th</sup> Solid state surfaces and interfaces“ 4<sup>th</sup> SSSI 2004, November 8-14, 2004, Smolenice Castle, SR. E. Pinčík; R. Brunner:
9. Hadron Structure O4, KC SAV Smolenice, 29.8.-4.9.2004. RNDr. S. Dubnička, 59410504,
10. 3-rd aSiNet Workshop on Thin Silicon, 25-27 February, 2004, Bratislava, Slovak Republic.: V. Nádaždy, R. Durný, K. Gmucová, T. Šrámková, +421-2-594 10 542,
11. MECO29. 29. Conference on Middle European Collaboration in Statistical Physics 28.3.-1.4.2004, Bratislava, A. Šurda,
12. 2004 QIPC Review , Bratislava 16.-18.2. 2004, V. Buzek

**2005**

13. Young European Physicists meeting 2005, Budmerice, Bužek Vladimír, Prof., DrSc.
14. RNP2005 – Relativistic Nuclear Physics: from hundreds MeV to VeV, JINR Dubna, May 23-28, 2005 (FÚ SAV bol spoluorganizátorom), Gmuca Štefan, Ing., CSc.
15. 17th European Conference on Thermophysical Properties, Bratislava 2005, Kubičár Ľudovít, Ing., DrSc. –
16. NATO Advanced Research Workshop Left Handed Materials and Photonic Crystals, Heraklion June 19-22, 2005 (director C. M. Soukoulis, P. Markoš)
17. SMM 17, Soft Magnetic Materials, Bratislava, Sept. 7-9, 2005, Švec Peter, Ing., DrSc. –
18. Solar Renewable Energy News - SREN 2005 International Conference“, Florence, -21..2005, Emil Pinčík, RNDr., CSc.,

**2006**

19. QAP Process and state tomography workshop, Budmerice, September 2006, Bužek Vladimír.
20. ECOVAST: Rural Development in the Knowledge-Based Society 15.-17. October 2006 Bratislava, Emil Pinčík, Róbert Brunner.
21. Solid State Surfaces and Interfaces, 19.-24. 11. 2006 Smolenice. Emil Pinčík, Róbert Brunner.
22. CEQIP: Central European Quantum Information Processing Workshop, 4.5.-8.5.2006, Znojmo, Czech Republic, Martin Plesch, Mário Ziman
23. QUPREST: QAP Focus meeting: Quantum Process Estimations, 29.9.-1.10.2006, Budmerice, Slovakia, Mário Ziman, Martin Plesch, Vladimír Bužek,
24. YEP 2006: Young European Physicists meeting, 11.12.-15.12.2006, Budmerice, Slovakia, Martin Plesch, Mário Ziman
25. Int. workshop „Relativistic Nuclear Physics: From Hundreds MeV to TeV“, 22 – 27 May 2006, Modra – Harmónia, Slovakia, S. Dubnickar
26. DANF 2006, Dynamical Aspects of Nuclear Fission, 2-6.10.2006, Smolenice, Jan Kliman

**List of employees who were the members of Programme (PC) and Organizing Committees (OC) of international conferences not organized by IP SAS is presented only for the years 2005 and 2006. It was not documented for the whole period.**

**2005**

Béták E., RNDr., DrSc-

ICNRP 05, Almaty (Kazachstan),

Butvin P., RNDr., CSc. Bužek V., Prof., RNDr. DrSc. – Dubnička S., RNDr., DrSc. -	PV Soft –Magnetic Materials 17, Bratislava, Sept. 05 CEQIP 05, YEP Meeting 05 Int. Advisory Committee of Workshop on Nucleon Form Factors in Frascati Roma
Gmuca S., Ing., CSc.	RNP2005 – Relativistic Nuclear Physics: from hundreds MeV to TeV, JINR Dubna, May 23-28, 2005, OC
Jergel M., Ing. DrSc.	Solar Renewable Energy News - SREN 2005, 2-8 April 2005 Florence, Italy, OC
Kliman J., Ing., CSc.	3rd International Summer School on Nuclear Physics Methods and Accelerators in Biology and Medicine 30.6.-11.7.2005, Dubna (Ratmino), OC
Majkova E. RNDr., DrSc, Markoš P., RNDr., DrSc. - Šurda A., RNDr., CSc. Švec Peter, Ing., DrSc. -	Int.Adv.Com. ICTF 13, Stockholm, June, 2005 Co-director NATO Workshop PST.981137 MECO 30, Florence, March 2005, OC Soft Magnetic Materials 17, Bratislava, 6.-9.9. 05 RQ12 – Int. Advisory Committee on Rapid Quenching
<b>2006</b>	
Běták E., RNDr., DrSc- Hartmanová Mária, RNDr., DrSc.	Reaction Models 06, Varenna (Italy) OC, 8th International Meeting Fundamental Problems Of Solid State Ionics“, June 13 – 16, 2006, Chernogolovka, Moscow region, Russian Federation
Krištiak Jozef, Ing.,CSc.	Int. Programme Com., 37 PolishSeminar on Positron Annihilation, September 2007.

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

Doc. RNDr. E. Běták, DrSc.	Institute of Physics (UK) Fellow, member of Fellowship Panel
Prof. RNDr. V. Bužek, DrSc.	Fellow of Institute of Physics (2004) Member of the American Physical Society Member of the American Optical Society Board member of the Quantum Electronics and Optics Division of the European Physical Society Member of the Scientific Board of the ARC Seibersdorf research GmbH , Austria Member of the EPSRC (Engineering and Physical Sciences Research Council) Peer Review College
RNDr. S. Dubnička, DrSc. RNDr. D. Krupa, CSc. D. Phil.	member of National Committee IUPAP. member Ex. Comm.of EPSS Fellow of the Institute of Physics, UK member of National Committee IUPAP honorary position of Assistant Under Secretary, Science and Technology, International Energy Foundation Fellow of the World Innovation Foundation
Prof. Ing. Š. Luby, DrSc.	member Academia Europaea Scientiarum et Artium, Vienna member Central European Academy of Sciences and Arts ... member American Physical Society member World Innovation Foundation member European Security Research Advisory Board, ESRAB member of Senat of the Academia Europaea Scientiarum et Artium, Salzburg.
RNDr. E. Majerníková, DrSc. RNDr. E. Majková, DrSc.	member APS national representative at IUVESTA-Thin Film Division

RNDr. Š. Olejník, DrSc.	member Academia Europaea Scientiarum et Artium, Viedeň
RNDr. A. Šurda, CSc.	delegat of SR at the Priority 3-NMP 6 <sup>th</sup> FP EC Committee
	member of the Committee for the collaboration with CERN
	member of the Middle European Cooperation in statistical
	Physics Committee
Ing. P. Švec, DrSc.	head of the National Committee of IUPAP

#### **Membership in Editorial boards of the international scientific journals**

Doc., RNDr. E. Běťák, DrSc.	Czech J. Phys. Int. Advisory Board
Prof. RNDr V. Bužek, DrSc.	Journal of Modern Optics
	Journal of Optics B
	Acta Physica Hungarica B (honorary editor)
	Physical Review A
	European Journal of Physics D editor
	Journal of Physics B
	Central Eur. Journal (editor)
RNDr. S. Dubnička, DrSc.	Medicus, Medical Faculty, Univ. of Kragujevac, Serbia
Ing. P. Duhaj, DrSc.	Journal of Materials Science and technology,
	Bulgarian Academy of Science
	ER High Temperature Materials and Processes,
	Tohoku University, Japan
Ing. J. Krištiak, CSc.	Ed. board Materials Science Foundations, Swiss
Prof. Ing. Š. Luby, DrSc.	Mediterranean Review, PAV
RNDr. L. Šamaj, CSc.	J. of Statistical Physics (Plenum Publishing)
	J. of Statistical Mechanics: Theory and Experiment
Ing. P. Švec, DrSc.	Ed. Board Metallic Materials
Doc. RNDr. M. Blažek, DrSc.	Czech. J. Phys.- Advisory Board

#### **Other:**

Běťák Emil, Doc., RNDr., DrSc.,	Steering Committee of the EURISOL (6RP) project
Bužek, Vladimír, Prof. RNDr., DrSc	Steering Committee of the QAP, QUROPE, ERA-Pilot QIST projects
Krištiak Jozef, Ing., CSc.	Board of the Center for Basic Research at the Institute of Nuclear Physics AS CR
Majkova Eva RNDr. DrSc.,	Steering Committee MNT-ERANET programme

Researchers of the IPSAS are members of the European Physical Society, Material Research Society, and other organizations according to their field of interest.

#### **iv. List of international scientific awards and distinctions**

Prof. RNDr. V. Buzek, DrSc., Humboldt Research Award 2004

Prof. RNDr. V. Buzek, DrSc et al., Werner von Siemens Award, 2005.

Prof. RNDr. V. Buzek, DrSc, elected Foreign Corresponding member of the Austrian Academy of Sciences, 2006.

Prof. RNDr. V. Buzek, DrSc, Adjunct Honorary Professor, National University of Ireland, Maynooth, Ireland

Dubnička, Stanislav, RNDr., DrSc., Medal for the collaboration of the Government of Polish Republic (2006)

Ing. S. Gmuca, CSc., Ing. J. Kliman, CSc., Ing. V. Matousek, CSc., Ing. M. Morhac, CSc, Ing. I. Turzo, CSc., collective members, prize JINR Dubna (2<sup>nd</sup> place) System for laser calibration of electromagnetic calorimeters for experiments on relativistic nuclear physics on nuclotron  
RNDr. E. Běťák, DrSc., member of the Fellowship Panel Institute of Physics 2005

RNDr. D. Krupa, PhD., Fellow of the Worlds Innovation Foundation

- **National position of the individual researchers**

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

.3-4 invited talks each year at the Conference of Slovak Physicists

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

non registered

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

**Membership:**

Běták Emil, Doc., RNDr., DrSc. -	Editor Acta Physica Slovaca up to 31.7.2006
Bužek Vladimír, Prof., RNDr., DrSc. -	Editor Acta Physica Slovaca since 1.8.2006
Bužek Vladimír, Prof., RNDr., DrSc. -	Member of the Board of Governors of the Slovak Research and Development Agency
Krupa Dalibor, Phil, RNDr.,DrSc.	Ed. board Progress in mathematics, physics and informatics
Luby Štefan, Prof. Ing. DrSc.	Journal of Electrical Engineering, STU/SAV
Švec Peter, Ing., DrSc.	Ed. board Metallic materials

**National, or Czech-Slovak scientific societies**

Krupa D., RNDr., DrSc. – scientific secretary of the Slovak Physical Society

Luby Š., Prof., DrSc. – head of the Slovak Vacuum Society

- iv. **List of national awards and distinctions**

Prof., Ing. Š. Luby, DrSc.	Pribina Cross of the President of SR
Prof., RNDr. V. Bužek, DrSc.	Award of the Minister of Education for the year 2004
RNDr. M. Krajčí, CSc.	SAS award for international scientific collaboration
S. Lanyi, Ing. DrSc.,	Medal of the Slovak Physical Society
P. Markos, RNDr., DrSc.	SAS award for scientific results
Luby Štefan, Prof. Ing. DrSc.	Gold Medal of the SAS
Ziman Mário, Mgr., PhD.	Award of the Minister of Education of SR for personality in science and technology below 35 years
Bartoš Erik, Mgr., PhD. –	3 <sup>rd</sup> place in the Competition of scientific works of young physicists organized by Slovak Physical Society

**Supplementary information and/or comments documenting international and national status of the Organisation**

#### 4. Project structure, research grants and other funding resources

- **International projects and funding**

- i. **List of major projects within the European Research Area – 5th and 6th Framework Programme of the EU, European Science Foundation, NATO, COST, INTAS, CERN, etc. (here and in items below please specify: type of project, title, grant number, duration, funding, responsible person in the Organisation and**

his/her status in the project, e.g. coordinator, principal investigator, investigator)

**5<sup>th</sup> and 6<sup>th</sup> FP EC**

1. Title: **Quantum entanglement states of trapped particles (Quest)**  
Principal investigator: Bužek Vladimír, Prof., RNDr., DrSc.  
Chief coordinator: Dr. Danny Segal, Imperial College, London, England  
No. of contract: IHPRN-CT-2000-00121, 5RP  
Period: 2000-2003  
Funding: 30000 EUR
2. Title: **Quantum Properties of Distributed Systems (QUPRODIS)**  
Principal investigator: Bužek Vladimír, Prof., RNDr., DrSc.  
Chief coordinator: Prof. Martin Wilkens, Inst. für Physik Uni. Potsdam, Germany  
No. of contract: IST-2001-38878  
Period: 2003 -2006  
Funding: 19188 EUR
3. Title: **Quantum Gates and Elementary Scalable Processors Using Deterministically Addressed Atoms (QGATES)**  
Principal investigator: Bužek Vladimír, Prof., RNDr., DrSc.  
Chief coordinator: Dr. Danny Segal, Imperial College, London, England  
No. of contract: - IST 2001 38875  
Period: 2003-2005  
Funding: 84960 EUR
4. Title: **Magnetostrictive bilayers for multi-functional sensors families**  
Principal investigator: Duhaj Pavol Ing., DrSc.  
Chief coordinator: Prof. H. Pftzner, Vienna University of Technology, Vienna  
No. of contract: G5RD-CT-2002-00690  
Period: 2002-2005  
Funding: 69000 EUR
5. Title: **Acoustic and Thermophysical Analysis of Stones**  
Principal investigator: Kubičár Ľudovít, Ing., DrSc.  
Chief coordinator: Dott. Piero Tiano, CNR – C.S. Florence, Italy  
No. of contract: NAS-G6RD-2000-00266  
Period: 2002-2005  
Funding: 87500 EUR
6. Title: **The European Virtual Institute for Thermal Metrology**  
Principal investigator: Kubičár Ľudovít, Ing., DrSc.  
Chief coordinator: Dr. John Redgrove, National Physical Laboratory, Teddington  
No. of contract: GTCI-2002-73009  
Period: 2002-2005  
Funding: 10080 EUR
7. Title: **Correlation of structure and magnetism in novel nanoscale magnetic particles**  
Principal investigator: Majková Eva, RNDr., DrSc.  
Chief coordinator: Prof. M. Farle, Universität Duisburg-Essen, Germany  
No. of contract: HPRN-CT – 00150-1999  
Period: 2000-2004  
Funding: 90000 EUR
8. Title: **Manufacture and characterization of nanostructural Al alloys**  
Principal investigator: Švec Peter, Ing., DrSc.  
Chief coordinator: Prof. B. Cantor, Dept of Materials, Univ. of Oxford, UK,  
No. of contract: HPRTN-CT-2000-00038

Period: 2000-2003  
Funding: 150 000 EUR

9. Title: **European Network on Amorphous-Silicon Technology (NAS-aSiNet)**

Principal investigator: Vojtech Nádaždy, Ing., CSc.  
Chief Coordinator: Dr. J Cárabe, CIEMT, Madrid, Spain  
No. of contract: GTC3-2001-6300  
Period: 2002-2004  
Funding: 21000 EUR

10. Title: **Controlled Quantum Coherence and Entanglement (CONQUEST)**

Chief Coordinator: Vladimír Bužek, prof. RNDr., DrSc.  
No. of contract: MRTN-CT-2003-505089  
Period: 2004-2008  
Funding: 280972 EUR (Slovakia)

11. Title: **European Lead-Free Soldering Network – ELFNET**

Principal investigator: Švec Peter, Ing., DrSc.  
No. of contract: NMP2-CT-2003-505504 (6RP)  
Period: 2004-2007  
Funding: 51150 EUR

12. Title: **European Isotope Separation On-Line Radioactive Ion Beam Facility (EURISOL DS)**

Principal investigator: Běták Emil, Doc., RNDr., DrSc.  
Chief coordinátor: Dr. Graziano Fortuna, INFN, Legnaro, Italy, Y. Blumenfeld, IPN Orsay, France  
No. of contract: FP6-2003 Infrastructures 4 515768  
Period: 2005-2008  
Funding: 50000EUR

13. Title: **EUROpean Nuclear Structure Integrated Infrastructure Initiative (EURONS)**

Principal investigator: Běták Emil, Doc., RNDr., DrSc.  
Chief coordinátor: Dr. A.C. Müller, GSI Darmstadt, Germany  
No of contract: FP6 Integrating Activity/Int. Infrastructure Initiative 506065  
period: 2005-2006  
Funding: 10000 EUR

14. Title: **Quantum Applications (QAP)**

Principal investigator: Bužek Vladimír, prof., RNDr., DrSc.  
Chief coordinator: Prof. Martin Plenio, Imperial College, London  
Prof. Ian A. Walmsley, University of Oxford, Oxford  
No. of contract: 2004-IST-FETPI-15848  
Period: 2005-2009  
Funding: 227700 EUR

15. Title: **Quantum Information Processing and Communication in Europe (QUROPE)**

No. of contract: 6RP – Coordination Action (CA) 033622  
Principal investigator: Bužek Vladimír, Prof., RNDr., DrSc.  
Partners: Prof. Eugene Polzik, Niels Bohr Institute, Copenhagen, Denmark  
Period: 2006-2009  
Funding: 71000 EUR

Title: **ERA-PILOT QIST**

Principal investigator: Vladimír Bužek, prof. RNDr., DrSc.  
Chief of coordinátor: Christian Monyk, ARC Seibersdorf research Ges.m.b.H.

No. of contract: IST-015789  
 Period: 2005-2007  
 Funding: 106 920 EUR

### **COST**

15. Title: **Complex disordered and nanocrystalline metastable metallic systems**

Principal investigator: Švec Peter, Ing., DrSc.  
 No. of contract: COST 523  
 Period: 2001- 2004  
 Funding:

16. Title: **Multilayer Structures for X-ray Optics**

Principal investigator: Jergel Matej, RNDr., CSc.  
 No. of contract: COST P7  
 Period: 2002-2006  
 Funding:

17. Title: **Electromagnetic processing of Materials (EPM)**

Principal investigator: Švec Peter, Ing., DrSc.  
 No. of contract: COST P17  
 Period: 05/2004-09/2006  
 Funding:

### **NATO**

18. Title: **Theoretical Studies in Disordered Systems**

Principal investigator: Markoš Peter, RNDr., CSc.  
 Prof. Costas Soukoulis, Dept. of Physics and Astronomy, Iowa State University, Ames, USA  
 No. of contract: PST.CLG.978088 NATO Collaborative Linkage Grant  
 Period: 08/2001-09/2003

19. Title: **Properties and applications of nanocrystalline alloys from amorphous precursors (PROSIZE)**

Principal investigator: Švec Peter, Ing., DrSc.  
 Chief Coordinator: Prof. Bogdan Idzikowski, Institute of Molecular Physics, PAS, Poznan, Poland  
 No. of contract: NATO PST-ARW  
 Period: 10/ 2002-12/2003

20. Title: **Laser assisted formation of magnetic nanoparticles for information storage**

Principal investigator: Luby Štefan, Prof., Ing., DrSc.  
 Prof. A.Luches, University of Lecce, Italy  
 No. of contract: NATO PST.CLG 978058, 2001-2003  
 Period: 2001-2003

21.. Title: **Electromagnetic properties of left-handed materials**

Investigator from Inst. of Phys.: Markoš Peter, RNDr., DrSc.  
 No. of contract: NATO CBP.EAPCLG 981471  
 Chief contract: C.M. Soukoulis, Ames Lab., USA  
 Period: 2005-2006

22. Title: **Magnetoelastic Properties of Rapidly Quenched Materials and Their Applications in Civil Engineering.**

Principal investigator: Švec Peter, Ing., DrSc.,  
 Chief coordinator: Dr. Massimo Pasquale, Istituto Elettrotecnico



No. of contract: Nazionale „Galileo Ferraris“, Torino, Italy  
 NATO SfP-973 649  
 Period: 2000-2003  
 Funding: 8000000 BEF

Funding of NATO CLG grant covers travel expenses and stays at the partner's institution typically 6-8 000 EUR/project. Additional funding of SAS was between 3500 – 5000 EUR.

### INTAS

23. Title: **Gasless combustion and structure formation in multilayer thin films**

Principal investigator: Illeková Emília, RNDr., CSc.  
 Chief coordinator: prof. J.C. Gachon z Univ. Henri Poincare, Nancy, France  
 No. of contract: INTAS 03-51-4103  
 Period: 2004-2006  
 Funding: 10600 EUR

24. Title: **Quantum information technologies: Quantum cryptography and simulation of quantum many-body systems**

Principal investigator: Bužek Vladimír, Prof., RNDr., DrSc.  
 No. of contract: INTAS 04-77-7289  
 Chief coordinator: Bužek Vladimír, Prof., RNDr., DrSc.  
 Period: 2005-2007  
 Funding: 100 000 EUR/6000,-EUR Slovakia

### OTHERS

25. Title: **Methods of Integrable Systems, Geometry, Applied Mathematics (MISGAM)**

Principal investigator: Šamaj Ladislav, RNDr., CSc.,  
 Chief coordinator: B. Dubrovin, SISSA, Terst, Italy, European Science Foundation (ESF), Program in physical and Engineering Sciences (PESC)  
 Period: 2004-2009

26. Title: **Developement de nouveaux alliages amorphes massifs ou nanostructured precurseurs d, alliages a memoire de forme**

Principal investigator: Švec Peter, Ing., DrSc.  
 No. of contract: ECONET  
 Principal investigator: ESCP Paříž, partneri Ukrajina, Rusko, Azerbajdžan  
 Period: 2004-2006

27. Title: **Ordered arrays of nanoparticles for spintronic devices**

Principal investigator: E. Majkova, RNDr., DrSc.  
 Principal investigator: IA SFS:EU DESY, Hamburg  
 No. of contract: II 05 083 EC,  
 Period: 2006-2008

### ii. List of other international projects incl. funding

Title: **Compositional optimisation of high-performance metastable nanocrystalline alloys for physics and applications**

Principal investigator: ŠvecPeter, Ing., DrSc.  
 Partner: Prof.Evangelous Hristoforou, National Technical University of Athens, Athens, Greece,

No. of contract: 01  
 Period: 1. 1. 2002 – 31.12.2004  
 Funding: travelling, visits

- Title:** **Study of magnetic Co nanoparticles by XRD**  
**Principal investigator:** Majková Eva, RNDr., DrSc.  
 Ing. Buchal Antonín, CSc. OSFA-ÚMI-FSI, VUT Brno,Cz  
**No. of contract:** 018  
**Period:** 1.1.2002-31.12.2003  
**Funding:** travelling, visits
- Title:** **HADES time-of-flight wall**  
**Principal investigator:** Hlaváč Stanislav, RNDr., CSc.  
**Chief coordinator:** GSI Darmstadt, Dr. K. D. Gross  
**No. of contract:** GSI No. 27  
**Period:** 01/2001-03/2003  
**Funding:** 150 000,-Sk
- Title:** **Entagled graphs**  
**Principal investigator:** Bužek Vladimír, Prof., RNDr.,DrSc.  
 Jex Igor., FJFI ČVUT Praha, CR  
**No. of contract:** 134  
**Period:** 2004-2005  
**Funding:** travelling, visits
- Title:** **Production cross sections of the (n,gamma) reactions on Sr-88, Pd-102, Xe-124, Te-130, Sm-152 and Ir-191 leading to therapeutic isotopes**  
**Principal investigator:** Běťák Emil, Doc.RNDr., DrSc.  
 IAEA No.. 12425/R0/RBF  
**Period:** 2002-2005  
**Funding:** 367 000 SK
- Title:** **Optical and electrical properties of oxide ionic and electronic conductors in the form of thin films**  
**Principal investigator:** Hartmanová Mária, RNDr., DrSc.  
**Partner:** J. P. Holgado, PhD ,Institutode ciencia de materiales de Sevilla ,C.S.I.C. –Uni. Sevilla, Sevilla, Spain  
**No. of contract:** No. 2005 SK 0001  
**Funding:** travelling, visits
- Title:** **New Ti-based materials for biomedical applications**  
**Principal investigator:** Švec Peter, Ing., DrSc.  
**Partner:** ENSCP Paris, – Egide/Štefánik.  
**Period:** 2004-2006  
**Funding:** travelling, visits
- Title:** **Potential of Antiprotons for Medical Diagnostics and Therapeutic Applications**  
**Principal investigator:** Dubnička Stanislav, RNDr., DrSc.  
**Partner:** Prof. A. Angelopoulos, University Athens, Athens, Greece  
**Period:** 2005-2006  
**Funding:** travelling, visits
- Title :** **Relativistic nuclear physics in 4pi-geometry**  
**Principal investigator:** Kliman Ján, Ing., CSc.  
**Partners:** LJR, Project SPHERA-HEL JINR Dubna, prof. Malachov  
**No. of contract:** JINR 03-1-0983-92/2007
- Title:** **Study of heavy and superheavy elements**  
**Principal investigator:** Kliman Ján, Ing., CSc.  
**Chief coordinator:** JINR Dubna, LJR, prof. Itkis

No. of contract: 04-5-1004-94/2006

Title: **Low Energy Quark Models of Light Hadrons**

Principal investigator SR: Dubnička Stanislav, RNDr., DrSc.,

No. of contract: 01-3-1028-99/2008

Partner: E.A. Kuraev, DrSc.

Period: 2004 2006

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

1. Title: **Properties of glass -forming materials and proton-conducting polymers**  
Investigator IP SAS: Krištiak Jozef, Ing., CSc.  
Principal investigator: Bartoš, Ing., Úpo SAV  
Coordinator: J. Fontanella, US, Naval Academy, Annapolis  
No. of contract: NSF 02 171 29  
Period: 2003-2005
2. Title: **Setup for, and measurement of Casimir force in the nanometre to micrometre range**  
Investigator IP SAS: Lányi Štefan, Ing., DrSc.  
Partner: Dr. Marco Pisani, CNR-IMGC Torino  
Period: 2004-2006
3. Title: **The effect of the reduced dimensionality on the magnetic properties of soft magnetic nanocrystalline alloys**  
Investigator IP SAS: Švec Peter, Ing., DrSc.  
Partners: IP PAS – Warsaw, Poland  
Period: 2004-2006
4. Title: **Neutrón-rich exotic hypernuclei**  
Investigator IP SAS: Gmuca Štefan, Ing., CSc.  
Partners: INP AS CR, Rez, CR  
Period: 2006-2008
5. Title: **Soft magnetic amorphous and nanocrystalline materials for sensor applications**  
Investigator IP SAS: Švec Peter, Ing., DrSc.  
Partners: IP AS CR, Prague, CR  
Period: 2006-2008
6. Title: **Investigation of quark structure of baryons**  
Investigator IP SAS: Nagy M., RNDr., DrSc.  
Partners: M.I. Haysak, Ukrajina, Institute of Electron Physics, NASU  
Period: 2005-2007
7. Title: **Statistical mechanics of Coulomb systems**  
Principal investigator: Šamaj Ladislav, RNDr., CSc.  
Partner: CNRS (Francúzsko), Laboratoire de Physique Théorique, Université Paris-Sud, 91405 Orsay, France
8. Title: **Structure-crystal size-property relationship in soft magnetic nanocrystalline systems**  
Investigator IP SAS: Švec Peter, Ing., DrSc.  
Partner: PAS IPM –Poznaň, Poland  
Period: 2004-2006
9. Title: **Thermodynamic and High-Res. Characterization of Nanocrystalline Systems with Outstanding Properties from**

- Amorphous Precursors**  
Investigator IP SAS: Švec Peter, Ing., DrSc.  
Partners: CSIC/Univeridad de Sevilla, Spain  
Period: 2004-2006
10. Title: **The study of chosen physical properties of fully – and partially-stabilized ZrO(2)CrO(2)-based single crystals and thin films**  
Investigator IP SAS: Hartmanová Mária, RNDr., DrSc.  
Partner: E.E. Lomonova, DrSc. Institute of General Physics, RAS, Moscow  
Period: 2005-2006
11. Title: **Formation of ordered arrays of magnetic colloidal nanoparticles by self-assembling in magnetic field on patterned substrates**  
Investigator IP SAS: Luby Štefan, Prof.,Ing., DrSc.  
Partner: Dr. G. Leo, ISMN-CNR, Roma, project SAS-CNR.  
Period: 2004-2006
- 12 Title: **Investigation on the electronic states in amorphous silicon and related materials**  
Investigator IP SAS: Nádaždy Vojtech, Ing., CSc.  
Partner: Institute of Solid State Physics, BAV, Bulharsko, Dr. N. Nedev  
Period: 2005-2007

- **National projects and funding**

- i. **List of projects supported by the Agency for the Promotion of Research and Development (APVV/APVT), National Research Programmes, and their funding**

1. Title: **Ordered arrays of metallic and magnetic nanoparticles for information technologies – preparation and properties**  
Principal investigator: Majková Eva, RNDr., DrSc.  
No. of contract: APVT-51-021702  
Period: 2002-2005  
Funding: 2 857 000 Sk
2. Title: **Strongly correlated and disordered electronic systems**  
Principal investigator: Hlubina R., Doc., RNDr., CSc., FMFI UK Bratislava  
Investigator IPSAS: Markoš Peter, RNDr., CSc.  
No. of contract: APVT-51-021602  
Period: 2002-2005  
Funding: 300 000 Sk
3. Title: **Free volume of molecular and polymer systems and their transport and dynamics properties**  
Principal investigator: Ing. J. Krištiak, CSc.  
No. of contract: APVT-51-045302  
Period: 02/2004 -12/2006  
Funding: 600000-Sk
4. Title: **Bulk nanostructured metallic materials for structural applications**  
Principal investigator: Šimančík F., Ing., CSc., ÚMMS SAV  
from Inst. of Phys.SAS: Švec Peter, Ing., DrSc.  
No. of contract: APVT-51-021102  
Period: 2004-2006

- Funding: 1300 000-Sk
5. Title: **Novel multiphase nanostructured materials with extraordinary physical properties**  
Principal investigator: Švec Peter, Ing., DrSc.  
No. of contract: APVT-51-052702  
Period: 01/2003-12/2005  
Funding: 4 916 000,-Sk
6. Title: **Thin oxide films for advanced MOS structures**  
Principal investigator: EII SAS  
from Inst. of Phys. SAS: Jergel Matej, Ing., DrSc.  
No. of contract: APVT-51-017004  
Period: 2005- 2008  
Funding: 240 000-Sk
7. Title: **Novel Scanning Probe Microscopy and Spectroscopy Techniques for Nanostructure Analysis**  
Principal investigator: Lányi Štefan, Ing., DrSc..  
No. of contract: APVT-51-013904  
Period: 2005 - 2007  
Funding: 3 236 000- Sk
8. Title: **Functional supramolecule surface nanostructure based on cyclodextrines**  
Principal investigator: International laser centre  
from Inst. of Phys.: Majková Eva, RNDr., DrSc.  
No. of contract: APVT-20-02-029804  
Period: 2005- 2007  
Funding: 220000,- Sk
9. Title: **The theory of strong interactions of subnuclear particles and physical phenomena and processes at large distances**  
Principal investigator: Olejník Štefan, RNDr., DrSc.  
No. of contract: APVT-51-005704  
Period: 2005 - 2007  
Funding: 1537000Sk
10. Title: **Scanning magneto-optical Kerr microscope for studying magnetization changes on nanostructures**  
Principal investigator: Majková Eva, RNDr., DrSc.  
No. of contract: APVV LPP-0080-06  
Period: 11/2006-11/2009  
Funding: 1 196 000 SK
11. Title: **Research and development of selected electrotechnical applications of nanocrystalline and amorphous materials**  
Principal investigator: EVPÚ, a.s., Nová Dubnica, Ing. J. Kuchta, PhD.  
Investigator IP SAS: Švec Peter, Ing., DrSc  
No. of contract: APVT-99-017904  
Period: 2005 - 2007  
Funding: 450 000 SK
12. Title: **Coherence, decoherence and disorder in metallic and superconducting**  
Principal investigator: Markoš Peter, RNDr., DrSc.  
No. of contract: APVV-51-003505  
Period: 2006-2009  
Funding: 4761000 SK

13 Title: **Quantum Mechanics of Nucleon Radiative Capture Models Based on Optical Potential**  
 Principal investigator: Běták Emil, RNDr., DrSc.  
 Partner: Jožef Štefan Institute, Ljubljana, Slovinsko  
 No. of contract: APVV SK-SI-02006  
 Period: 2006-2008  
 Funding: 160000 SK

14. Title: **Process, tomography and multi-partite entanglement**  
 Principal investigator: Bužek Vladimír, Prof., RNDr. DrSc.  
 No. of contract: APVV-CHIN-3-08  
 Partner: Lab. of quantum information, University of Science and technology of China, prof. Guo Guang -Can  
 Period: 2006-2007  
 Funding: 240 000 SK

15. Title: **Diffusion and interface stability in metallic multilayers**  
 Principal investigator: Majková Eva, RNDr., DrSc.  
 Partner: prof. S. Protsenko, Dept. Appl Phys. Univ Sumy, Ukrajina  
 No. of contract: APVV SK-UA-01606  
 Period: 2006-2007  
 Funding: 160 000 SK

16. Title: **Magnetic multilayers and effects of induced magnetism**  
 Principal investigator: Majková Eva, RNDr., DrSc.  
 Partner: Dr. A. Rogalev, PhD, ESRF Grenoble, France  
 No. of contract: APVV SK-FR-00706  
 Period: 2006-2007  
 Funding: 160 000 SK

17. Title: **Investigation of nuclei under extremes of isospin asymmetry**  
 Principal investigator: Veselský Martin, Ing., PhD.  
 Partners: Shanghai Inst. of Applied Physics, ChAS China  
 No. of contract: APVV SK-CN-00706  
 Period: 2006-2007  
 Funding: 240 000 SK

## **2. State order New materials and devices in submicron technologies**

2.1. Title: **Part 01 –Mastering of submicron technologies**  
 Principal investigator: RNDr. E. Majková, DrSc.  
 No. of contract: 2003 SO 51/03R 06 00/01  
 Partners: IP SAS, EII SAS, II SAS  
 Funding: 8 000 000/850 000 SK  
 Period: 2003-2005

2.2. Title: **Part 02 –Application of new devices based on submicron thin film technologies**  
 Principal investigator: RNDr. E. Majková, DrSc.  
 No. of contract: 2003 SO 51/03R 06 00/02  
 Partners: IP SAS, EII SAS, II SAS  
 Funding: 1500 000 SK  
 Period: 2003-2005

2.3. Title: **Part 03: Research and development of ceramic compoc materials for civil engineering ...**  
 Principal investigation: Prof.. RNDr. P. Šajgalík, DrSc., IIC SAS  
 from IP SAS: ŠvecPeter, Ing., DrSc.,  
 No. contract: 2003 SO 51/03R8 06 00/03R 03-2003  
 Period: 2003/2005

Funding: 1200 000 SK

**ii. 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	2003	2004	2005	2006
number	21	19	18	19
funding (millions of SKK)	1,644	1,796	2,100	2,435

**• Summary of funding from external resources**

External resources	2003	2004	2005	2006	total	average
external resources (millions of SKK)	16,448	47,478	18,427	38,791	121,144	30,286
external resources transferred to cooperating research organisations (millions of SKK)	0,800	28,075	1,300	27,232	57,407	14,352
ratio between external resources and total salary budget	0,880	2,470	0,881	1,833	-	1,516
overall expenditures from external as well as institutional resources(millions of SKK)	48,165	48,524	54,992	87,926	239,607	59,902

External resources together:

**2003 4,980+11,468= 16,448 SK**

**2004 9,453+ 38,025=47,478 SK**

**2005 12,519+ 5,908=18,427 SK**

For the years 2003, 2004 and partially 2005 the payment from external resources was administrated directly from the particular bank accounts of the IP SAS. These transfers are not included in the Annual Report tables. Since 2006 all accounts are concentrated at the bank Statna pokladna.

**Supplementary information and/or comments on research projects and funding resources**

**5. 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)

- 4.1.2. General Physics and Mathematical Physics
- 4.1.3. Physics of Condensed Matter and Acoustics
- 4.1.4. Quantum electronics and Optics
- 4.1.5. Nuclear and Subnuclear Physics
- 5.2.13 Electronics

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	31.12.2003			31.12.2004			31.12.2005			31.12.2006		
number of potential PhD supervisors	44			44			44			44		
PhD students	number	defended thesis	students quitted	number	defended thesis	students quitted	number	defended thesis	students quitted	number	defended thesis	students quitted
internal	14	5	1	13	3	1	15	2	0	15	1	0
external	4	0	0	3	0	0	2	1	0	2	0	0
supervised at external institution by the research employees of the assessed organisation	0	0	0	0	0	0	0	0	0	1	0	0

Typical duration of a PhD study at our Institute is 4 years, for the experimental physics 4.5 year. All our PhD students have at least accepted papers in regular CC journals prior defense.

iii. Postdoctoral positions supported by

a) external funding (specify the source)

projects of the 5<sup>th</sup> and 6<sup>th</sup> Framework programmes of EC, projects of Slovak Research and Development Agency (since 2006)

5

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

6 post-doc applications, all accepted.



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

Teaching	2003	2004	2005	2006
lectures (hours/year)	338	204	255	154
practicum courses (hours/year)	56	24	30	48
supervised diploma works (in total)	11	10	11	11
members in PhD committees (in total)	3	9	14	17
members in DrSc. committees (in total)	2	5	3	2
members in university/faculty councils (in total)	3	3	3	3
members in habilitation/inauguration committees (in total)	2	3	2	3

3 employees are members of 10 faculty and/or university councils

3 employees are members in 6 habilitation committees

**v. List of published university textbooks**

**vi. Number of published academic course books**

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

Joint research laboratory for thin films between University of Zilina and IP SAS.

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

IP SAS is the core member of the ESF project **JPD 3 2004/4-055**, project code **13120200055** Cluster of advanced studies – support of further education in the field of multidisciplinary research and development of progressive materials and nanomaterials with regard to sustainable society development. In addition to IP SAS, FMPI CU, FEI STU MLC, IA SAS and II SAS are other institutions participating at the project. The cluster has 3 modules:

**Module 1. Further education of young scientific workers** with the aim to form creative experts in the given field of science

**Module 2. Targeted education (aimed at PhD students)** to prepare highly qualified young experts

**Module 3. Further education of experts** (university graduates) from application sphere with the aim to facilitate and to support transfer of new technologies and top expertise in the given field of research into practice.

The Cluster provides top quality education within these modules in the form of lectures, trainings and workshops. By joining front-edge internationally recognized institutions in the field of modern technologies (nanotechnology, informatics, laser and environmental technologies) and multidisciplinary research of progressive materials, a high-quality education for PhD students, young scientific workers and experts from application sphere can be provided. At present, there are **15 PhD students and 9 young scientific workers** in the project. **Experts from application sphere** have participated at the project within the module 3 so far.

**7. - 11. 11 2005 School of PhD students**- one week lasting school for PhD students of the Cluster of advanced studies – support of further education in the field of multidisciplinary research and development of progressive materials and nanomaterials with regard to sustainable society development (Majkova E., RNDr., DrSc.)

**21.-24.3.2006 School of young scientific workers**: one week lasting school for PhD students and other interested persons. The event took place within an ESF project entitled Cluster of advanced studies – support of further education in the field of multidisciplinary research and development of progressive materials and nanomaterials with regard to sustainable society development (Majková E., RNDr., DrSc.)

## **6. Direct output to the society**

### **(applications of results, popularisation and outreach activities)**

#### **i. List of the most important results of applied research projects**

Application of the apparatus RTM.01 developed at IP SAS for the monitoring of moisture at the tower of Duomo at Florence, Italy (project of 5<sup>th</sup> FM EC McDU

Faculty of Electrical Engineering CVUT: oven for annealing in magnetic field (design)

LES, Ltd. - magnetocaloric development materials (production)

EVPU Technology Consulting, Co, Ltd., nanocrystalline torroids (design and production), analysis of magnetic properties of magnetic cores, custom designed processing of nanocrystalline materials for applications in high power pulse sources.

Max-Planck-Institute, Stuttgart, the strategy of the improvement of the SWCNT content in the production technology.

Transient MS s.r.o., application of equipments for measurements of thermophysical properties designed and developed at IP SAS on the market

US Steel Košice, thermal conductivity measurements.

SILICON, Ltd., Dobšiná, testing of the technology for fabrication of pure SiO<sub>2</sub> glass.

EMCon, Ltd., Bratislava, developemtn and design of stress sensors for civil engineering

TZUS, Technický a skúšobný ústav stavebný, n. o., developement and application of magnetoelastic tensometers for hydrology

Banské stavby – Carbotech, Banská Bystrica: installation of magnetoelastic tensometers in tunnel Višňové.

Transient MS, Ltd. – application equipments for measurements of thermophysical properties

Malibu, GmbH Co. &KG, Germany, development of an equipment for in situ deposition process monitoring

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

**Membership in advisory bodies of the Government of the SR, National council of the Slovak Republic, ministries of the Slovak Republic, etc.**

Běták Emil, Doc., RNDr., DrSc.	Working group for physics of the Accreditation Commission, advisory body of the Government, up to April 2006) Working group for physics and sciences of Earth and Space. of the Accreditation Commission, advisory body of the Government since May 2006)
Dubnička Stanislav, RNDr., DrSc. –	plenipotentiary of the Government of Slovak Republic at JINR Dubna (RF)
Luby Štefan, Prof., Ing., DrSc.	Board of the Government of Slovak Republic for Sciences and Technology Board of the Ministry of Education of the Slovak Republic for Sciences, Technology and Education
Olejník Štefan, RNDr., DrSc.	member of the Committee for the collaboration of the Slovak Republic with CERN (do 17.10.2006).

**iii. List of the most important popularisation activities**

MAJKOVA, Eva: Neviditeľný poker: Nanotechnológie Invisible poker: Nanotechnologies. In *Visions*, č. 4( 2006), s. 51-53.

Markos P., 4 papers in Quark  
Ziman M. 20 papers in Quark  
5 papers in other journals

IP SAS (E. Majkova) participates in the project APVV LPP 0316 06 Touch of Knowledge, coordinator Dr. P. Maraky, Slovak National Museum, 2 lectures Nanotechnologies – do we need them?

Lecture Contemporary Physics, Research, Applications and Ethical Appeals in Research Súčasná fyzika, výskum a prax morálne výzvy, vo výskume, Conference on Ethics Univ. Constantin Philosopher, Nitra, 21. 6. 06. (S. Luby)

Young Physicists Tournament, IP SAS is organizer of the Tournament (M. Plesch)

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

**v. List of the patents issued in Slovakia, incl. revenues**

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

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

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

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

Thermophysical analysis in dry and saturated condition, Building Research Establishment Garston, Watford, UK, 200 000 SK

**x. Summary of outreach activities**

Outreach activities	2003	2004	2005	2006	total
studies for the decision sphere, government and NGOs, international and foreign organisations	0	0	0	1	1
articles in press media/internet popularising results of science, in particular those achieved by the Organization	2	5	22	17	46
appearances in telecommunication media popularising results of science, in particular those achieved by the Organization	19	5	17	10	51
public popularisation lectures	11	5	3	3	22

#### xi. Supplementary information and/or comments on applications and popularisation activities

Int. Engineering Fair Nitra 2003 (28. – 30. May 2003, Nitra, presentation of 3 types of sensors of deformation, multisensing tensometric system, P. Svec

Conference and exhibition “New Methods in Geotechnical Engineering”, Bratislava, 23. – 24. June 2003, talk P. Svec, P. Balaz, T. Pollak, Magnetoelastic tensometers and strain monitoring in civil engineering, transportation and geotechnics.

Exhibition at the ECTP Int. Conference Bratislava, with developed instruments for themophysical properties measurements, L. Kubičár

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

##### i. Summary table of personnel

Personnel	2003	2004	2005	2006
all personel	94	102	95	97
research employees from Tab. Research staff	70	68	68	70
FTE from Tab. Research staff	68	60	61	63
averaged age of research employees with university degree	51	52	49	49

##### ii. Professional qualification structure

Number of	2003	2004	2005	2006
DrSc.	13	16	18	18
PhD / CSc.	43	51	49	47
Prof.	3	4	4	4
Doc./Assoc. Prof.	1	4	1	2

**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)**

IP SAS is a contributory organization. Almost 50% of researchers of the IPSAS are working in the field of theoretical physics (nuclear, subnuclear and solid state) and quantum informatics. 50% of research staff is active in the field of experimental and applied physics, technology and materials science. According to the foundation charter, IP SAS can create its own resources to buy parts for assembling small- or medium-size equipments. In this way during the last 4 years, some new equipments were designed and constructed (null ellipsometer with picometer sensitivity, longitudinal magneto-optical Kerr effect , UHV  $10^{-8}$  mbar rapid thermal annealing) and some other are under construction. Two PC clusters were built enabling effective computation. Various equipments (ion beam etching for preparation of TEM samples, CCD camera for TEM and various small instruments) were bought. However, it is not possible to buy large instruments in this way. Therefore 5 research Institutes of SAS active in materials research created the consortium MULTIDISC (Consortium for multidisciplinary research of materials). Within this scheme, the X-ray diffractometer (Bruker D8 Discover Super Speed) equipped with Cu rotation anode (wavelength 0.154 nm) and Goebel mirror yielding  $10^9$  photons/s in the primary beam was installed last year.

The researchers of the IP SAS have well developed domestic and international collaboration and various complementary experiments are performed utilizing these collaborations including large facilities like DESY, ESRF, JINR Dubna, GSI Darmstadt etc.

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

The Library of the IPSAS provides standard librarian services, number of books (11083) and periodical journals (34).

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

Institute of Physics SAS was ranked in A category and within this category obtained the best assessment during the previous evaluation procedure. There were no

direct conclusions concerning improvements in this evaluation. During the last 4 years, we tried to increase the number of papers in prestigious journals, to obtain national and international projects, to increase the number of patent applications, to organize international conferences, to develop new technologies, to design and to construct new equipments. For the PhD studies, the Cluster of advanced studies mentioned previously brings considerable benefit for PhD students in the field of solid state physics and materials science. We increased our popularization activities, number of presentations on TV, radio, in the press increased considerably. IP SAS participates in the APVV project Touch of knowledge coordinated by Slovak National Museum. IP SAS is responsible for the nanoscience and nanotechnology area.

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

The organization scheme of the Institute is flexible. The basic units are the research teams grouped on particular projects. The principal investigators of the research teams are members of the Board of Institute and participate at the Institute research and economical policy. The Departments serve as the units covering the safety problems and basic administration.

A relatively large number of scientists with permanent position in comparison to the post docs and PhD students are the result of a different personal policy throughout the period 1955 -1990. The first post-doc and doc positions funded from the projects appeared in the years 1999-2000 in the first projects of EU (5<sup>th</sup> framework programme) and later in the projects of Slovak Research and Development Agency.

Another problem is the low number of PhD students in physics. This is the result of a very low number of university students graduating in physics and physical engineering. We try to get students from abroad but have to face the following problems:

Present legislation does not enable to pay PhD scholarship to the students coming from non-EU countries. The lowest PhD scholarship within EU is hardly attractive for an EU citizen interested in daily study

### **Other information relevant to the assessment**

At present, IP SAS is an internationally recognized institution in more fields. Taking into account publication activities, number of citations, and other international response (invited lectures, invitations, collaborations with renowned institutions in the world, participation at international projects) we can speak about interesting research results in the following fields:

quantum informatics, universal quantum machines - universal quantum entangler, programmable processors

research on mechanism of quark confinement in the theory of strong interactions  
study of models of the field theory in variables of the light front

new summation rules for total cross sections of hadron photoproduction on baryons, mesons, and light atomic nuclei

statistic mechanics of model systems

experimental and theoretical research of atomic nuclei and nucleus matter in the extreme conditions

acquisition, analysis, and visualization of multidimensional nuclear data

materials prepared by rapid quenching of the melt, research of the alloys formed from amorphous precursors

electronic structure of crystalline and quasicrystalline alloys

ultrathin multilayer structures and nanostructures for X-ray optics and spintronics. nanoparticles - properties and self-assembling.

electron transport in disordered systems

creation and annihilation of positronium in disordered molecular systems

DLTS spectroscopy of semiconducting structures and cyclic voltametry of solid and liquid phases based on the development of own device

thermophysical properties of solids, development of instruments utilizing pulse method

**Most representative results:**

**a) basic research**

2003 Electromagnetic properties of left-handed materials, P. Markos

2004 First principle method for calculations of phase diagrams, M. Mihalkovic

2005 Multipartite entanglement in physical models, V. Buzek

2006 Quantum entanglement and interference – fundamental results, V. Buzek

**b) international collaboration**

2003 Cluster emission, transfer and capture in nuclear reactions, E. Betak)

2004 Progress in physics of metastable, metallic systems with nanoscale structure, P. Svec

2005 Physical properties of unusual aluminum alloys investigated by *ab initio* methods, M. Krajci

2006 Dynamics of supercooled liquids as seen by positronium, J. Kristiak

**c) application:**

2003 Magnetoelastic tensometry for harsh environments (P. Svec)

2005 Thermophysical properties of heterogeneous materials L. Kubicar

2006 Thermal conductivity sensor , patent application(L. Kubicar).