Institute of Experimental Physics
Slovak Academy of Sciences

Watsonova 47, 040 01 Košice, Slovakia

phone: +421 55 7922201, fax: +421 55 6336292, e-mail: sekr@saske.sk

Summary of main results and activities

January 1, 2012 - December 31, 2015

Institute Management 2012 - 2015

2011 – 4.2015

director:	K. Flachbart since 5.2015 Kopčanský
deputy:	A. Juríková
scientific secretary:	P. Szabó
head of scientific board:	Z. Gažová/P.Kopčanský/P.Farkašovský

Established: January 1969

http://uef.saske.sk

Three physical branches:

- **Cosmic rays**
- **High energy physics**
- **Magnetism**

Mission

-space physics
- subnuclear physics
- physics of condensed matter
- biophysics
- theoretical physics

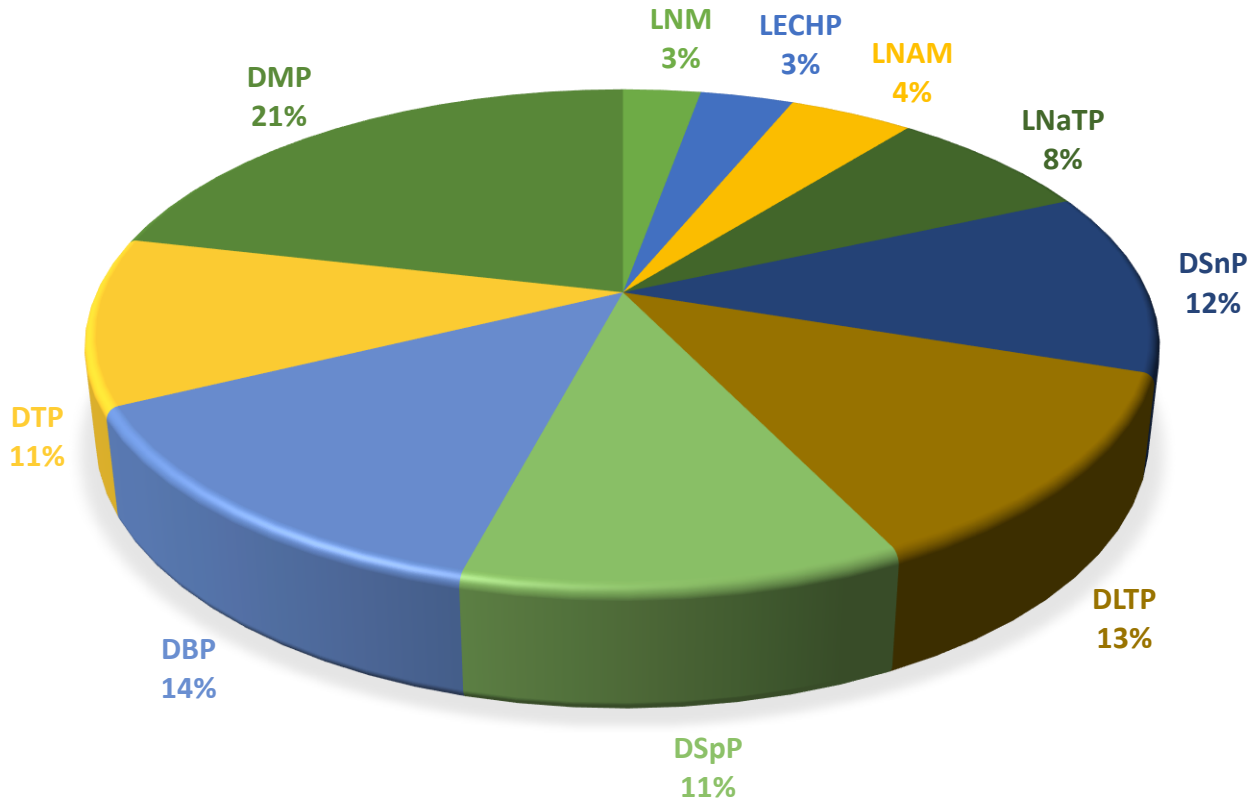
- application oriented research
- services for other institutions (Internet, production and distribution of cryogenic liquids)

- covers distances from sub-proton ones up to interstellar ones
- covers temperatures / energies from values close to 0 K (superfluid ^{3}He) up to highest temperatures accelerators energies or cosmic rays.

Research structure of IEP SAS

- Department of Subnuclear Physics (DSnP)
- Department of Magnetism (DM)
- Department of Space Physics (DSpP)
- Department of Low Temperature Physics (DLTP)
- Department of Metal Physics (DMP)
- Department of Biophysics (DBP)
- Department of Theoretical Physics (DTP)

- Laboratory of Experimental Chemical Physics (LECHP)
- Laboratory of Nanomaterials and Applied Magnetism (LNAM)
- Laboratory of Materials Physics (LMP)

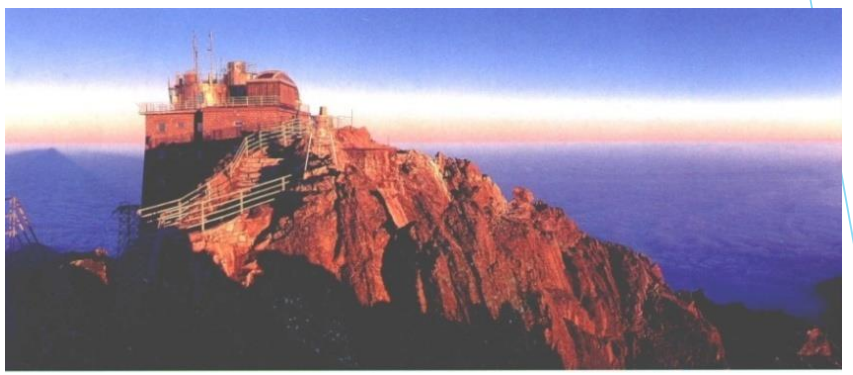


IEP SAS Košice

Main Institute building
Watsonova st. 47

- Management
- Subnucl.phys.
- Theor. phys.
- Metal physics
- Magnetism
- Library

Department of Space physics
Laboratory at Lomnický štít



Park Angelinum / Jesenná st

Bulharská st. 2-6

- Biophysics
- Space phys.
- Mechanical workshop

- Low temperature physics
- Magnetism (partially)

Outline

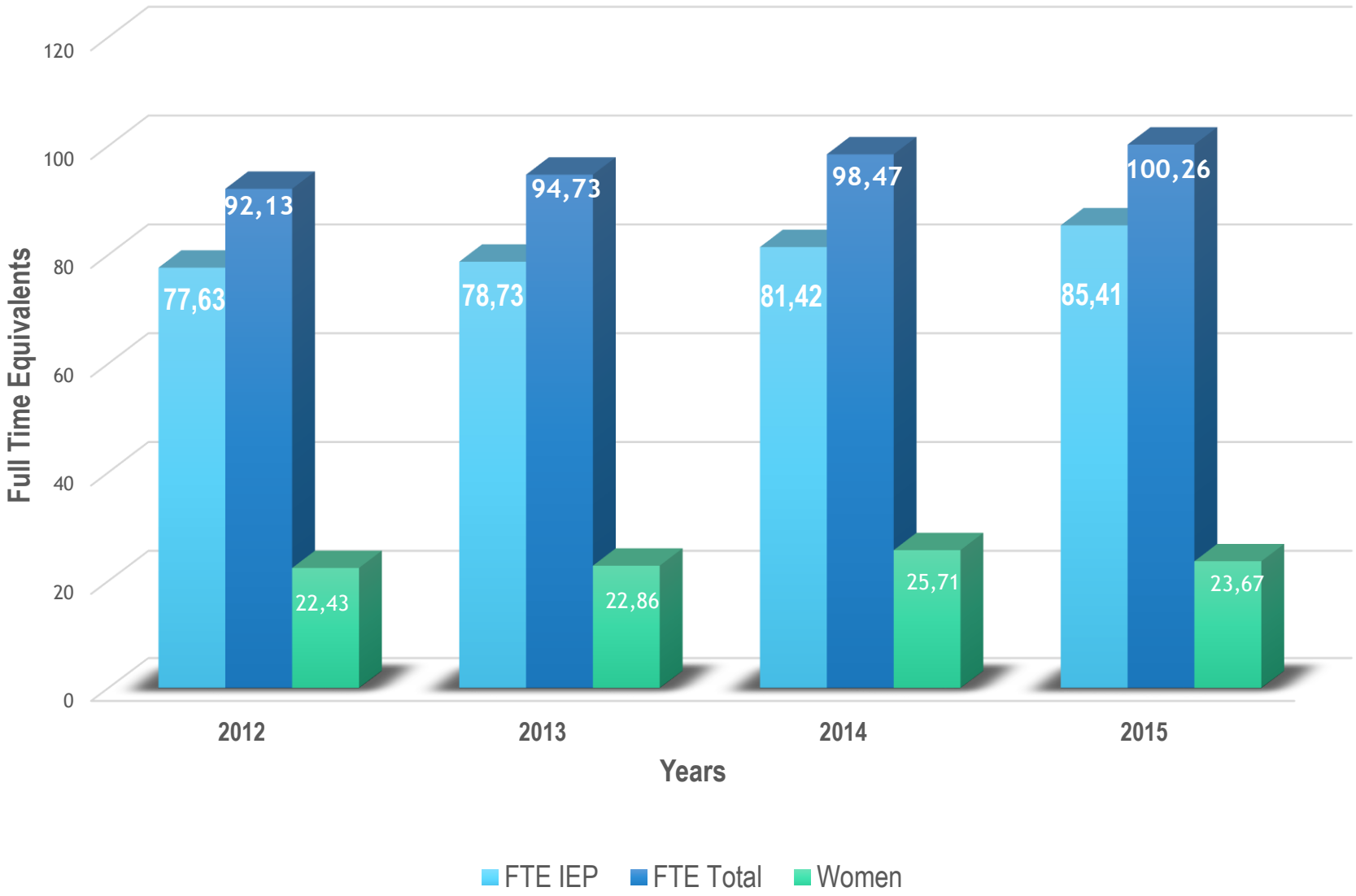
I. Statistics

II. Research activities

III. Societal, cultural, and/or economic impact

IV. Vision of IEP SAS

V. Conclusion



Total number employees including PhD. 165

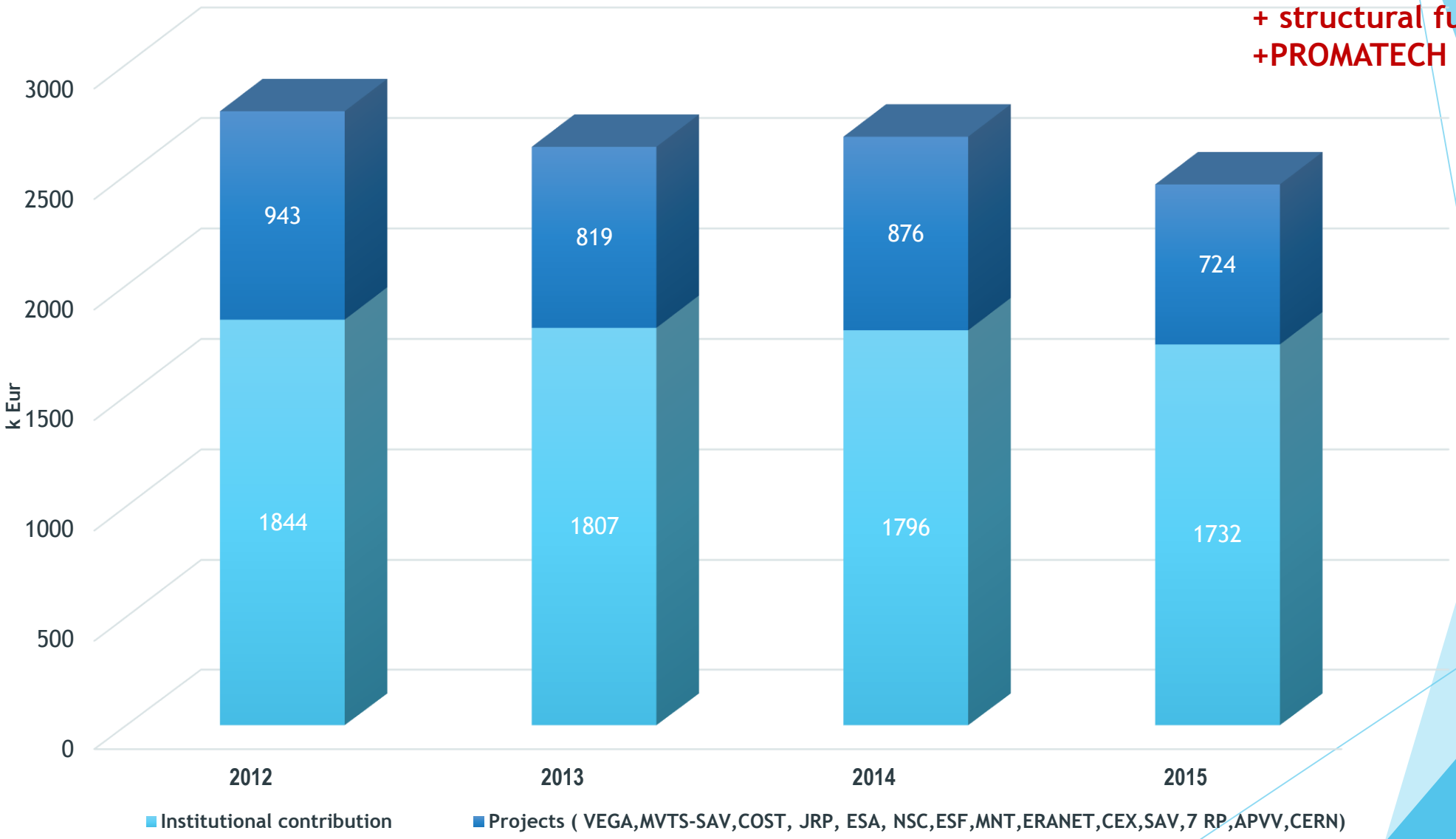
Av.FTE incl. PhD 96,39

Av.FTE researchers 80,79

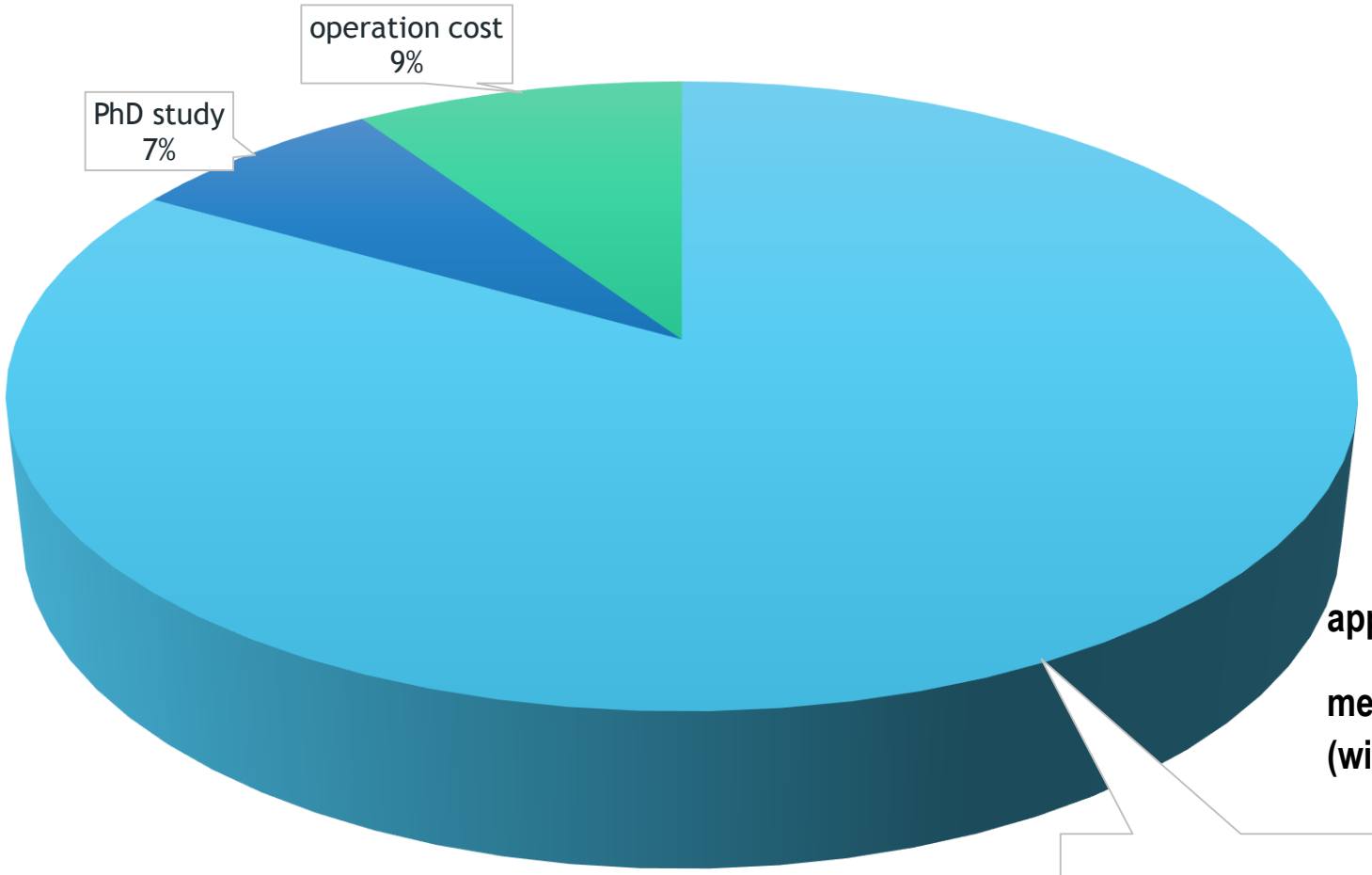
Average age of researchers 46.4 years

Money of IEP SAS

+ structural funds cca.11 mil eur
+PROMATECH (SAS)

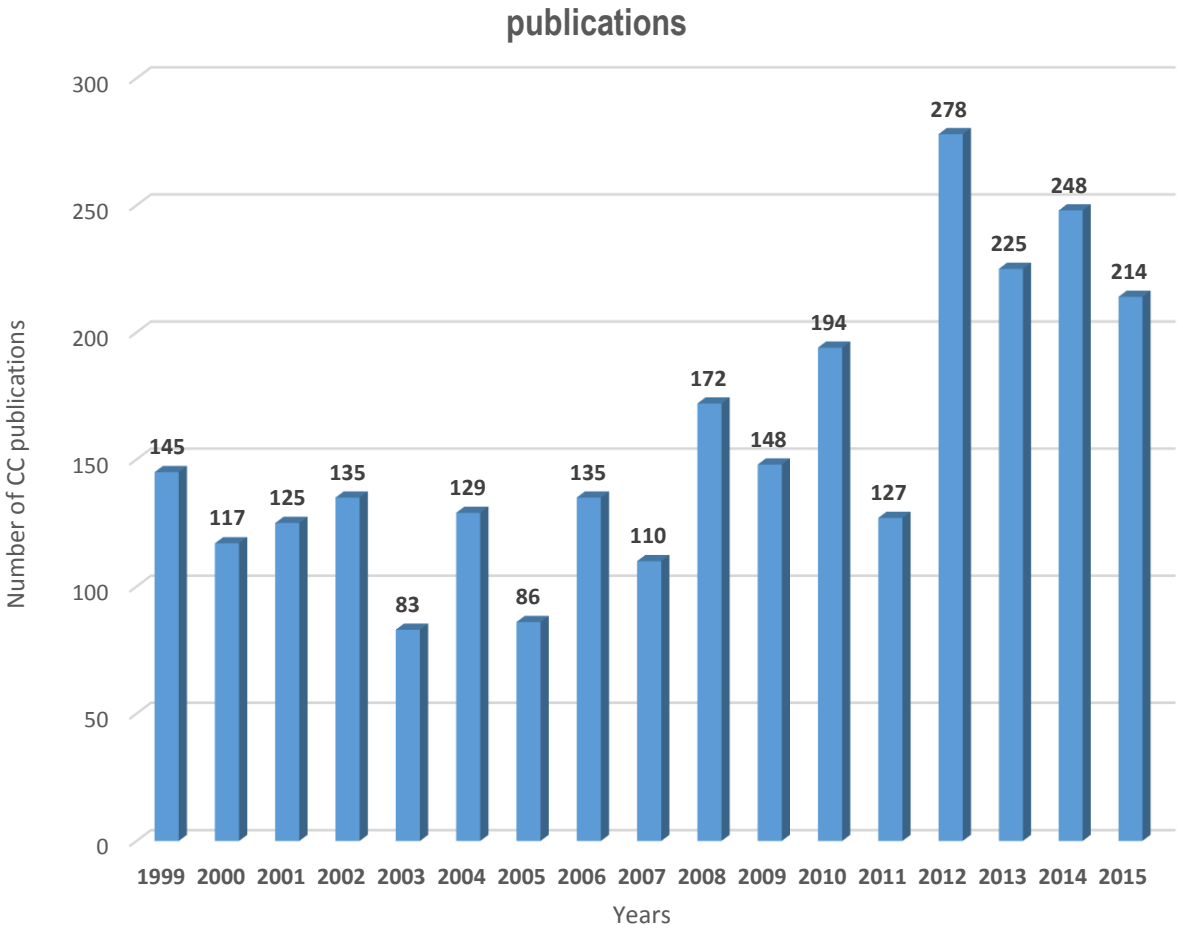


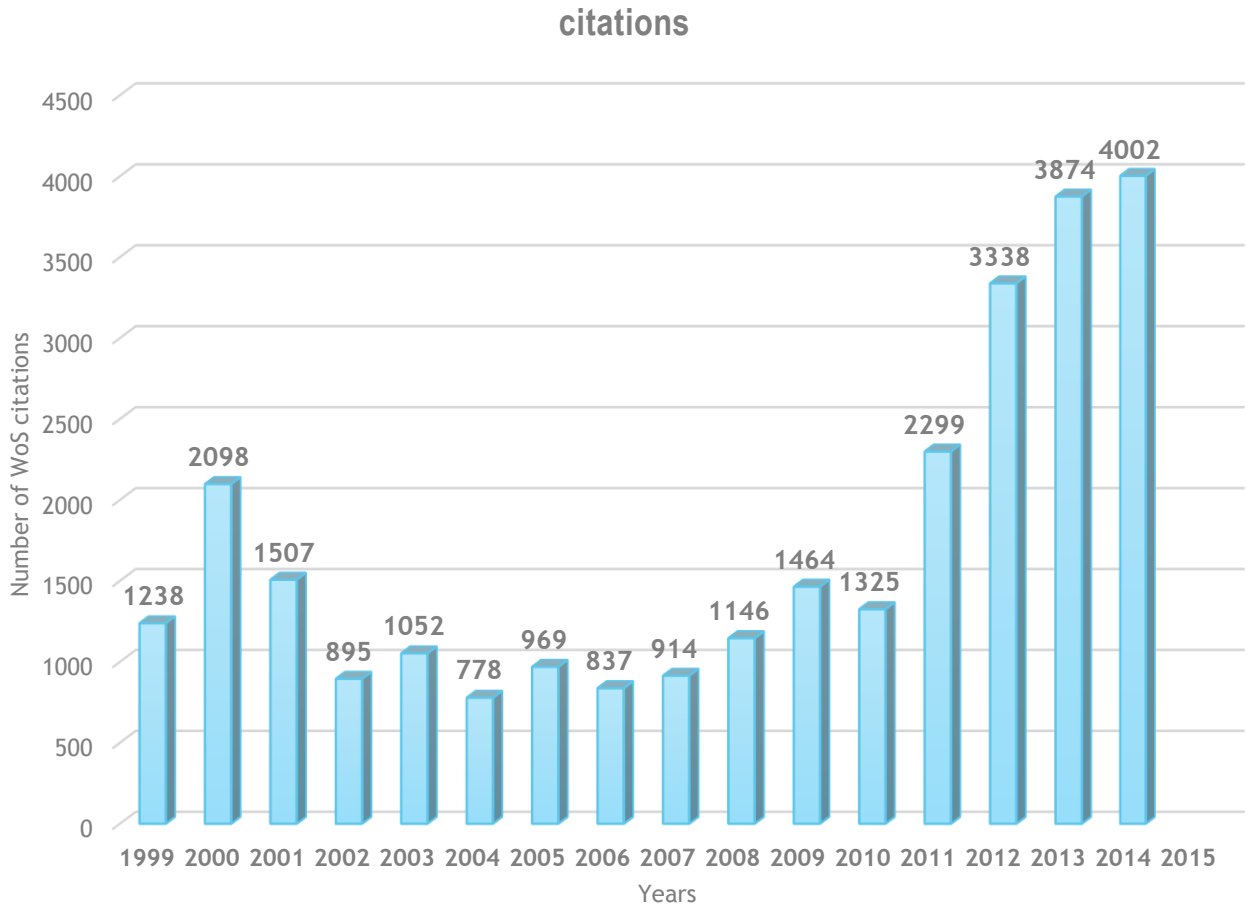
Institutional contribution per year

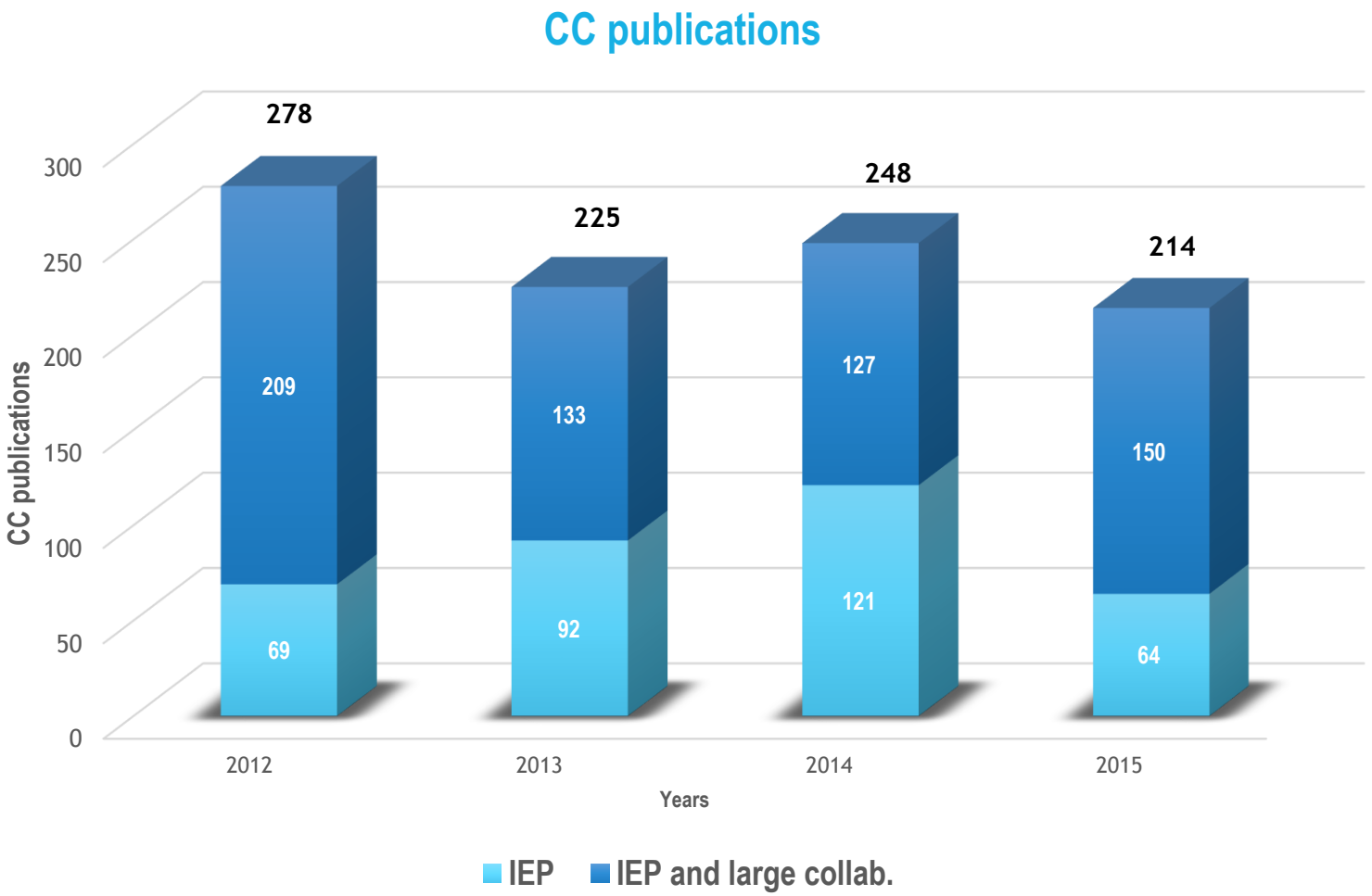


approx. 1.8 mill. eur

mean salary 820eur
(without insurance)


publications
Number of CC publications
300
250
200
150
100
50
0
145
117
125
135
83
129
86
135
110
172
148
194
127
278
225
248
214
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Years


citations
Number of WoS citations
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1238
2098
1507
895
1052
778
969
837
914
1146
1464
1325
2299
3338
3874
4002
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Years

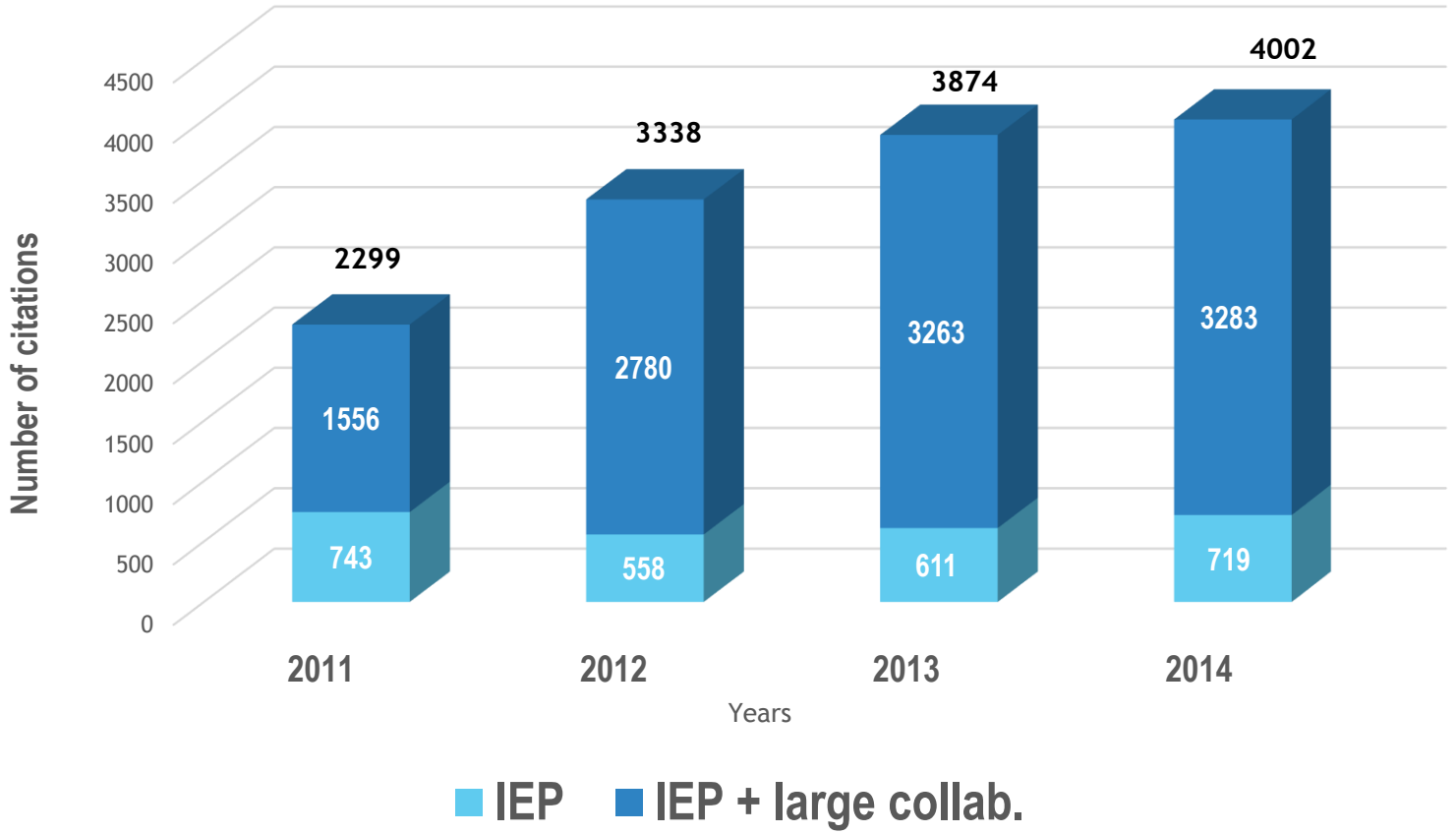


All institute: 241.25 papers/year
96.398 FTE/year
241.25/96.398 = 2.5 papers/yearFTE

Excluding LC's: 86.5 papers/year
96.398 – 9.1 = 87.3 FTE/year
86.5/87.3 = 0.991 papers/yearFTE

Science, Nature, PRL, Adv. Materials, EPL C, Astrophys. J.,Biomacromol.,...

Number of citations



All institute: **3360 cit./year**

96.398 FTE/year

3360/96.398 = 34.9 cit./yearFTE

Excluding LC's: **657 cit./year**

9.1 FTE-LC/year

96.398 – 9.1 = 87.3 FTE/year

657/87.3 = 7.5 cit./yearFTE

List of top-cited authors 2012-2015:

KAREL KUDELA	400
PETER KOPČANSKÝ	378
MILAN TIMKO	360
MARTINA KONERACKÁ	342
MARIAN ANTALÍK	253
PETER SAMUELY	252
MARIAN SEDLÁK	246
JOZEF KAČMARČÍK	236
PAVOL SZABÓ	219
NATÁLIA TOMAŠOVIČOVÁ	202

Collaborations:

DUŠAN BRUNCKO	6744
JAROSLAV ANTOŠ	2386
IVAN KRÁLIK, LADISLAV ŠÁNDOR	1752

Invited presentations at international conferences

2012-2015: 74 invited presentations in 27 countries

II. Research activities / results

Selected activities / results

of structure units / research groups

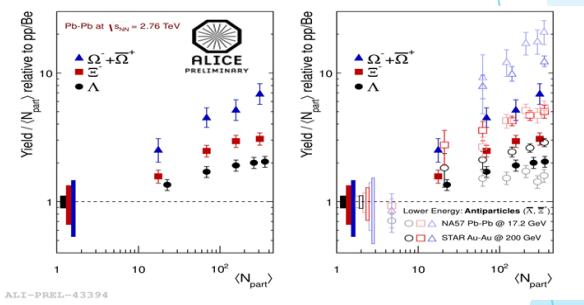
Department of Subnuclear Physics

CERN Experiments at LHC

- **ALICE Experiment**

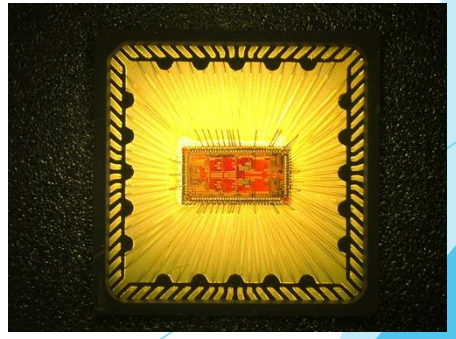
  Heavy ion physics: strange particle and φ(1020) production in p-p, Pb-Pb and p-Pb collisions at LHCenergies

- Responsibility LHC Interface, luminosity monitoring, normalization cross section measurement,



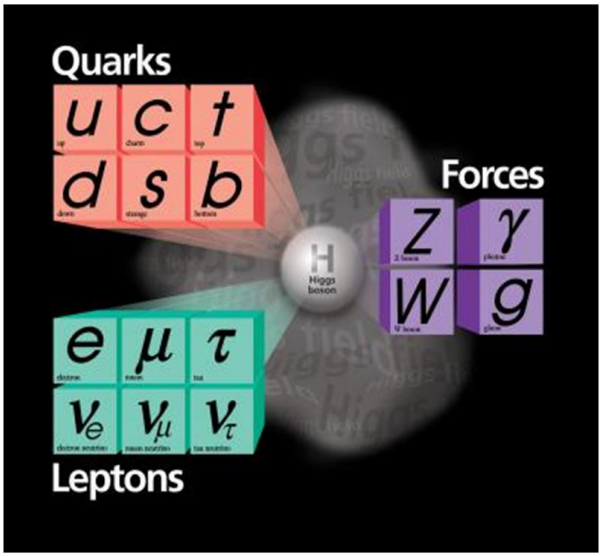
- **ATLAS Experiment – search of Higgs boson**
- Responsibility Liquid Argon (Lar) Calorimetry

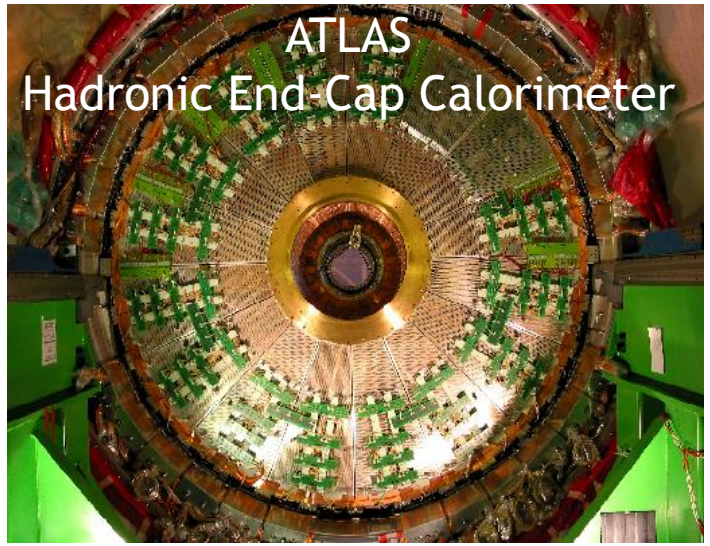
- Development of 4 channels 12bit Analog Digital Converter
  (radiation hardened, fast response, for High Luminosity LHC experiments)

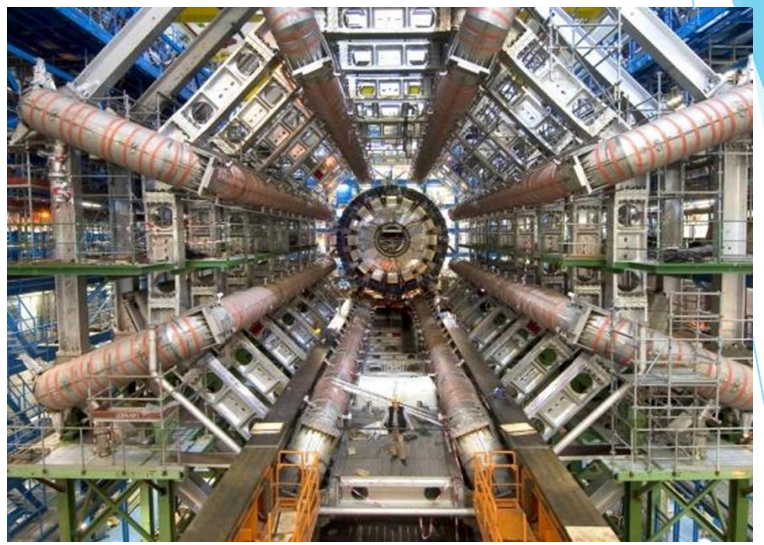


Department of Subnuclear Physics

The best result







- **Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC,**
  J. Antoš, D. Bruncko, E.Kladiva, P Stríženec, ***Phys. Lett. B 716 (2012), 1-29***
  (**more then 6000 citation currently**)
  - deeply involved in the **Liquid Argon** (LAr) **calorimetry -** detector, software, performance
  - **precise photon/electron measurement**, used in many analyses
  - most prominent the Higgs boson discovery

Department of Subnuclear Physics
Research strategy and future development

- **Near future (5-10 years) is determined by the experimental programmes at CERN LHC Collider**

  - **ALICE** experiment :
    - major upgrade already started
    - responsibility: Detector Control System for the new inner tracker
  - **ATLAS** experiment:
    - major upgrade planned at the later stage
    - development of the radiation hard ADC chip

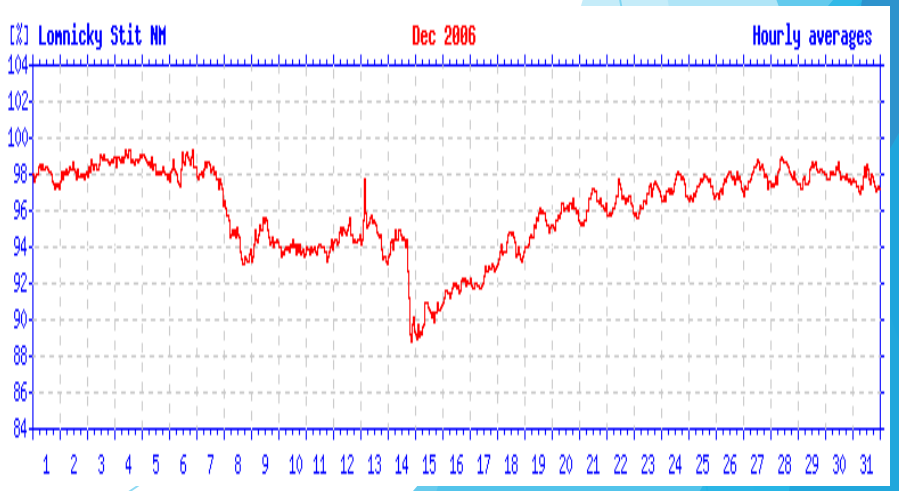
Department of Space Physics:

Detached Laboratory at Lomnický štít (LS)

Long term measurement of cosmic rays (CR) by neutron monitor (NM)

- describe variations of CR intensity in wide frequency range
- obtain relations between CR decreases (FDs),
- dosimetric measurements, space weather

LS (2634 m above sea) - suitable location for CR observations. Measurements by NM, in real time http://neutronmonitor.ta3.sk, in network: http://nmdb.eu, and by SEVAN, in network: http://crd.yerphi.am/Lomnicky_stit_SEVAN_Data



References

1. Parnahaj I., Kudela K., Astrophys. Space Sci., 359, 1, 35-35, 2015
2. Kudela K., Langer R., Rad. Protect. Dosim., 164, 4, 471-476, 2015
3. Kancírová M., Kudela K., Atmos. Res., 149, 166-173, 2014
4. Kubančák J. et al. J. Instrumentation, 9, 7018-7018, 2014
5. Zigman V., Kudela K., Grubor D. Adv. Space Res., 53, 5, 763-775, 2014

Department of Space Physics: JEM-EUSO

- **E**xtreme **U**niverse **S**pace **O**bservatory (EUSO) on the **J**apanese **E**xperiment **M**odule (JEM) on the International Space Station (>2020)

- 16 Countries, 93 Institutes
- IEP / Slovakia member since 2008

Astrophysics for Energies > 5×10^{19} eV

Main Science Objectives:

- identification of UHECR sources

- measurement of the energy spectra of individual sources

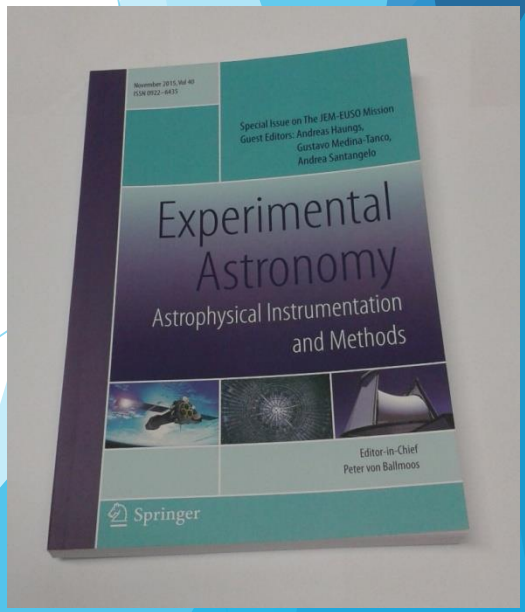
- measurement of the trans-GZK spectrum

Responsibility:

-UV background measurements and data analysis

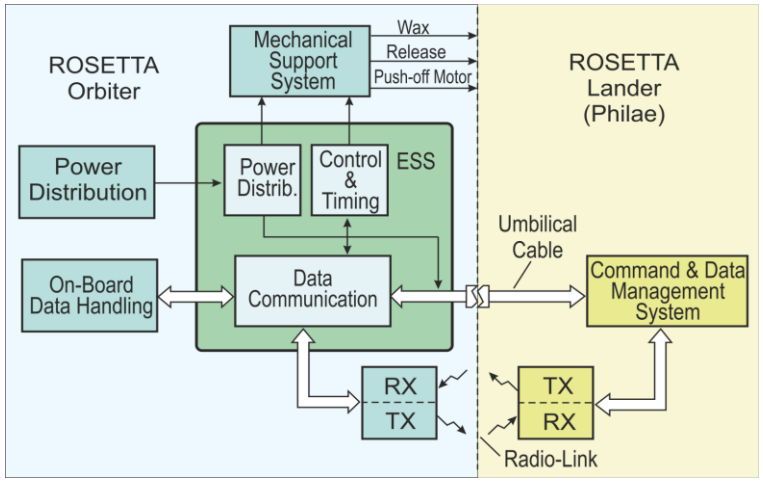
Selected JEM-EUSO result from 2012 - 2015

- **15 papers** in special issue about JEM-EUSO experiment in journal *Experimental Astronomy, Volume 40, Issue 1, 2015 (IF 1,99)*



Department of Space Physics: Rosetta

Department of Space Physics contributed to construction of ESS-processor unit of Rosetta spacecraft that provided communication between Orbiter and lander Philae. The unit performed flawlessly during whole mission.



Reference

McKenna-Lawlor, S.,…,Balaz, J., et al. Performance of the mission critical Electrical Support System (ESS) which handled communications and data transfer between the Rosetta Orbiter and its Lander Philae while en route to and at comet 67P/Churyumov-Gerasimenko. Acta Astronautica **125** (2016).

Department of Space Physics: Vision

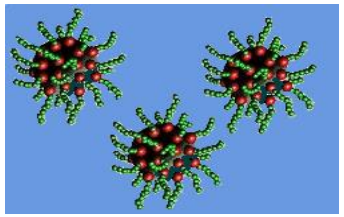
- Within the space physics (at IEP), the strategy is divided into two main research directions.
- The first is the particles of low and medium energy research
- The second is participation in the JEM-EUSO experiment

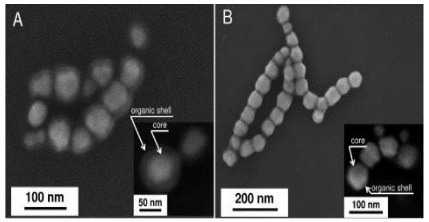
Department of Magnetism

Subjects of study

1. Systems with magnetic nanoparticles – Centre of NANOFLUIDS

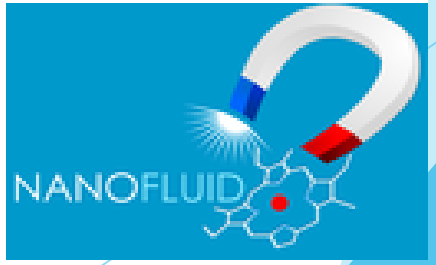
   - NP and MF for biomedical application
   - Oil based MF
   - magnetoferritin
   - ferronematics
   - magnetosome





2. Electrical transport and tunnelling phenomena - valence fluctuating semiconductors

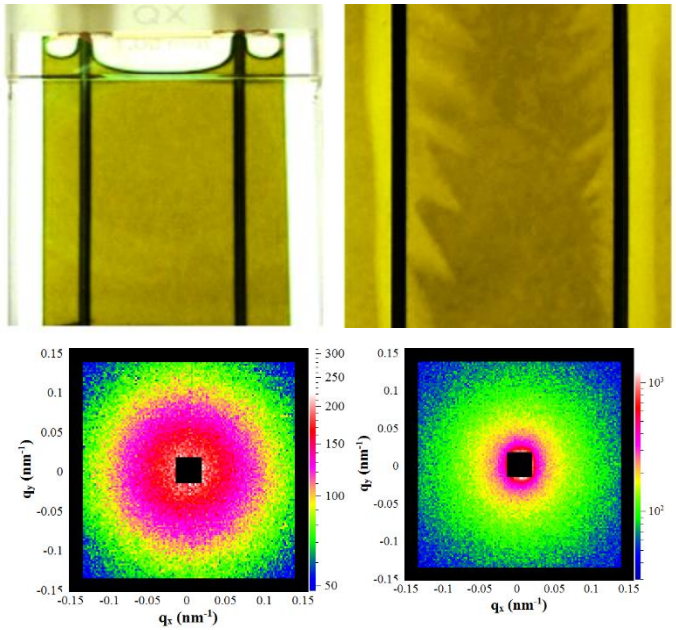
3. Multiferoics-manganites-ferrites



Ferrofluids based on transformer oil – energy applications

Electric field induced structural changes in magnetically controllable fluids

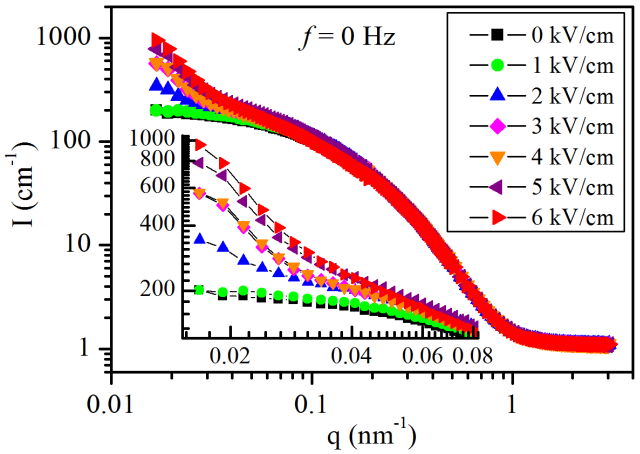
Macroscopic visual pattern formation



E = 0 kV/cm *E* = 5 kV/cm (DC)

RAJŇÁK, Michal et al - Direct observation of electric field induced pattern formation and particle aggregation in ferrofluids. In *Applied Physics Letters*, 2015, vol. 107, no. 7, art. no. 073108

Submicron aggregates formation (SANS)



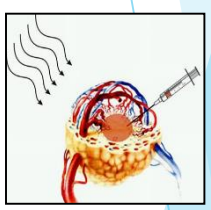
Vision:

Magnetic fluids

- biomedical applications (magnetic drug targeting, hyperthermia, MRI) based of COST Radiomag and APVV projects
- energy applications (cooling and dielectric isolation in power transformer technology) based on COST Nanouptake and APVV projects)
- liquid crystals and magnetic fluids to prepare to prepare liquid magnetic sensors

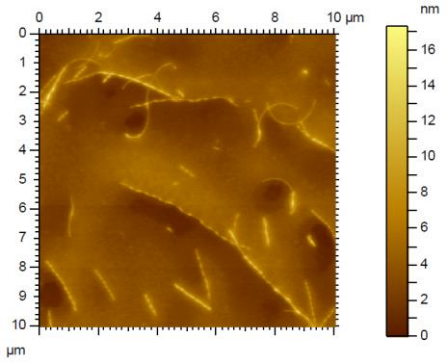
Valence fluctuating semiconductors

- the class of valence fluctuating semiconductors
- understanding the nature of electronic transport in valence fluctuating semiconductors



Multiferoics

- to study of the substitution effect in order to construct magnetic phase diagrams in whole concentration range from manganite to ferrite side.



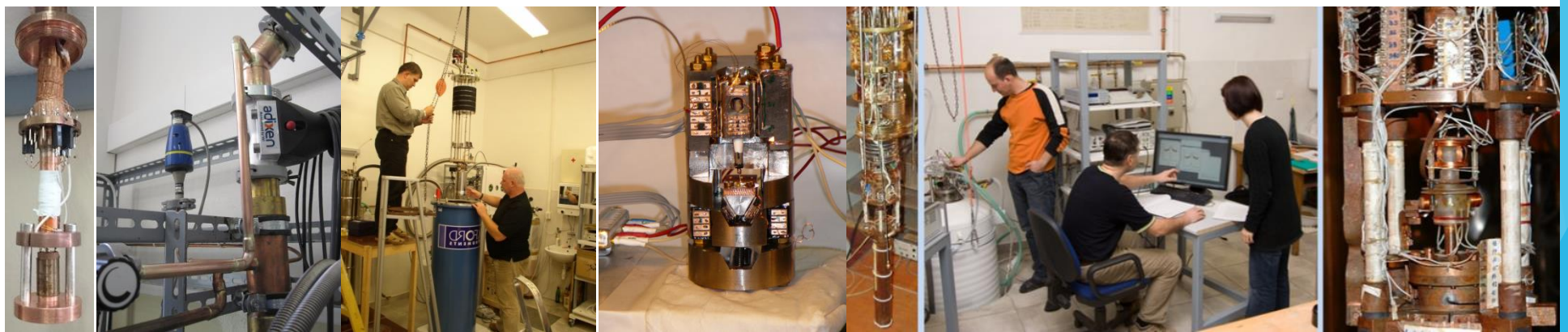
Centre of Ultra Low Temperature Physics

member of the European Microkelvin Platform

3 interconnected subjects

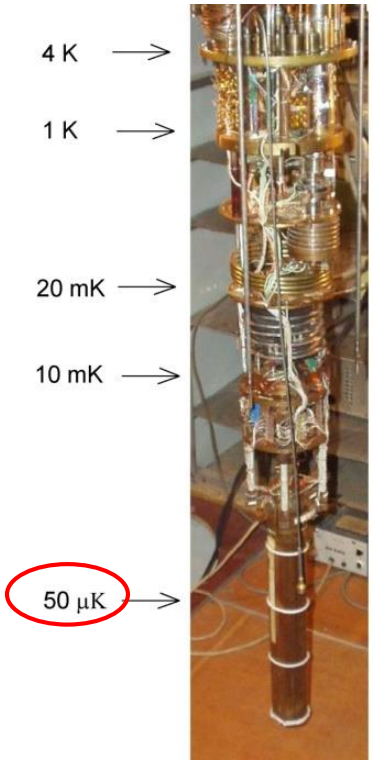
1. ***superconductivity***
2. ***supefluid helium-3 & LT bolometers***
3. ***magnetism in strongly correlated systems***

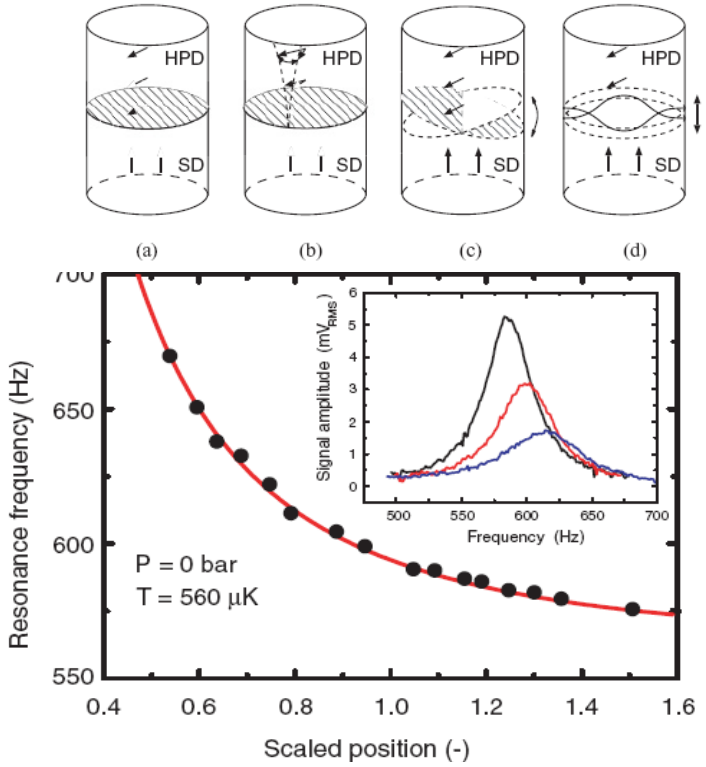
+ helium liquifier & cryogenic infrastructure (*supplying others, too*)
+ in house developed equipment (*dilution fridge, ULT STM, ac calorimetry, high pressure cells*)
+ open access (*guests from many countries*)



Physics of superfluid helum-3 @ microkelvin *T*-range

homogeneously precessing domain represent
Bose-Einstein condensate of magnons.





$$\omega^2 = \frac{3\Omega_B^2}{8\Omega_B^2 + 3\omega_{\rm rf}^2}\left[\frac{4}{\sqrt{15}}\omega_{\rm rf} g B_{\rm rf} + \frac{1}{3}(5c_L^2 + 3c_T^2)\left(\frac{\xi_{m,i}}{R}\right)^2 + \frac{2}{3}(5c_T^2 - c_L^2)\left[\frac{(2n+1)\frac{\pi}{2}}{L}\right]^2\right].$$

Result : massless Goldstone modes acquire energy/mass due to symmetry breaking fields

P. Skyba et al. 2 x Phys. Rev. B 2012

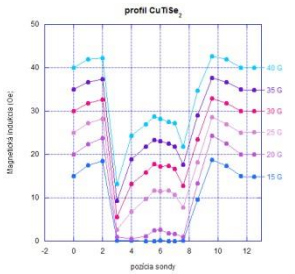
CULTP 2016+ / vision

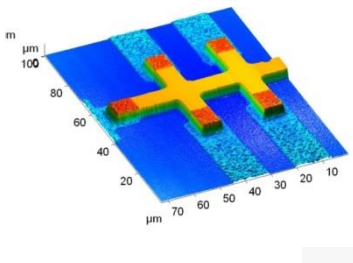
From standard subjects to nanoscience for Quantum Technology Flagship

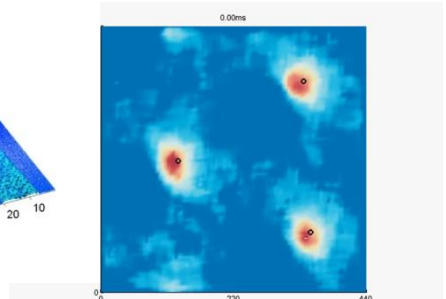
- **topological insulators**/superconductors, atomic monolayer materials, 1D, 0D objects
- **skyrmions**, geometrically frustrated magnetic systems,
- **superfluid helium-3** as a model system for Majorana particles @ $T = 0$
- **nanoresonators** in quantum limit

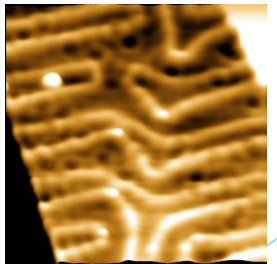
Home made, cutting edge instrumentation in next years

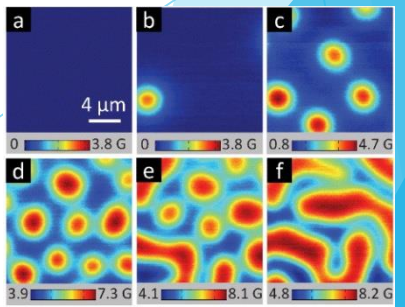
- **calorimetry**: resistive ac-calorimetry, nano-calorimetry, high-field calorimetry
- **scanning probe microscopes**: spin polarized STM, SHPM studies on nanoscale
- **resonance**: magnetic and mechanical resonance up to THz











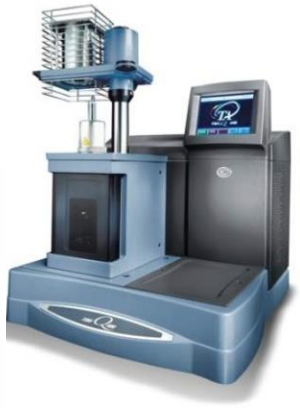
Department of Metal Physics

Research activities:

- plastic deformation and failure of amorphous and nanocrystalline alloys
- thermal stability of systems with magnetite nanoparticles

Vision:

- Extension of study to the deformation behaviour of **high entropy alloys**
- establishing of the **dynamic DSC methods** of thermal analysis of nanoparticles systems

Department of Metal Physics

Deformation and failure of nanocrystalline alloys

International Journal of Plasticity 60 (2014), pp. 40 – 57, IF=5,971

Contents lists available at ScienceDirect

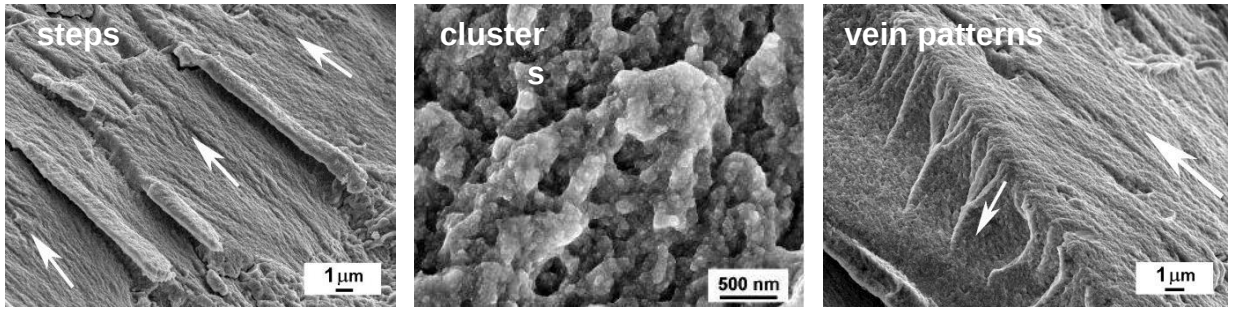
International Journal of Plasticity

journal homepage: www.elsevier.com/locate/ijplas

Variation of the deformation mechanisms in a nanocrystalline Pd–10 at.% Au alloy at room and cryogenic temperatures

Yu. Ivanisenko [a,*], E.D. Tabachnikova [b], I.A. Psaruk [b], S.N. Smirnov [b], A. Kilmametov [a], A. Kobler [a], C. Kübel [a,c], L. Kurmanaeva [a,d], K. Csach [e], Y. Mishkuf [e], T. Scherer [a,c], Y.A. Semerenko [b], H. Hahn [a]

Specific features of fracture surfaces in nc Pd10Au:



Result: Failure of nanocrystalline PdAu alloy at low temperatures is ductile

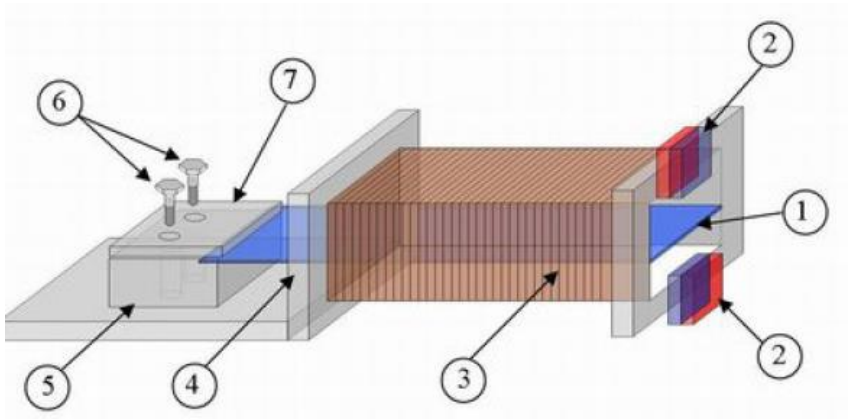
Laboratory of Nanomaterials and Applied Magnetism

Energy harvesting device (EHD) based on soft magnetic nanocrystalline ribbons that converts mechanical vibrations to electricity

Targeted goal - development of EHD prototype with sufficient conversion efficiency and power density for applications in wireless sensor systems

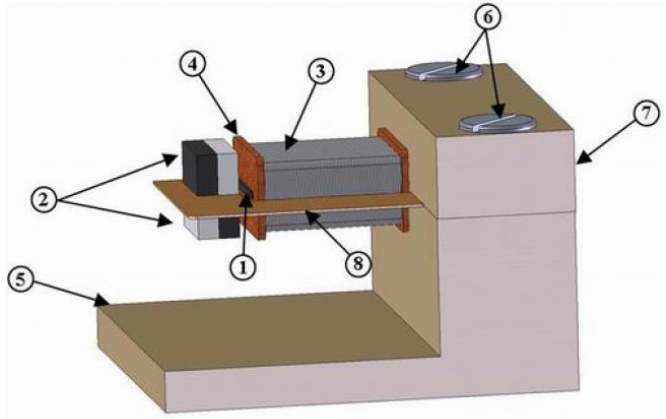
EHD prototype with moving nc-ribbons beam and fixed permanent magnets

Power density 6.56 mW/cm^3



EHD prototype with moving permanent magnets and fixed multilayer nanocrystalline ribbons core

Power density 45.3 mW/cm^3



Project: MNT-ERA.NET II STREAM (2012-2014)

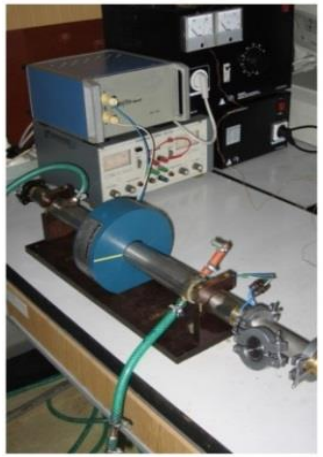
Chiriac, H., Ţibu, M.,, Lupu, N., Škorvánek I., Ovári, T.-A., Nanocrystalline ribbons for energy harvesting applications, Journal of Applied Physics. 115, (2014) p. 17A320 (1-3)

I. Škorvánek, J.Marcin, J. Kováč, P. Švec, N. Lupu, H. Chiriac, Tuning of soft magnetic properties in FeCo- and FeNi-based amorphous and nanocrystalline alloys by thermal processing in external magnetic field, Mat. Sci. Forum, 783 (2014) 1937, (invited talk at THERMEC 2013, Las Vegas, USA)

Research strategy of LNAM

Development of novel materials for highly sensitive magnetic sensors (flux-gate, GMI)

- focus will be given on amorphous and nanocrystalline ribbons and microwires with high permeallility
- tuning of their magnetic response (processing in external magnetic field)
- testing of sensors with ultra-high sensitivity in magnetically shielded room



Experimental facilities for thermal processing of materials in high magnetic fields (up to 14 T)

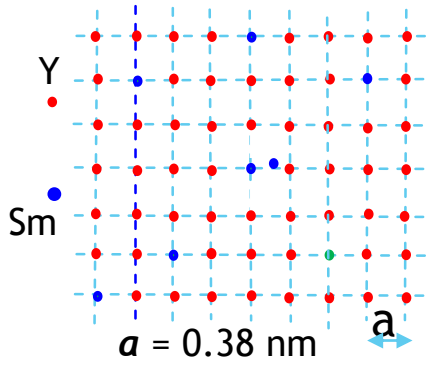
New magnetically shielded room at IEP SAS

Laboratory of Materials Physics

Preparation of magnet with highest value of trapped magnetic field

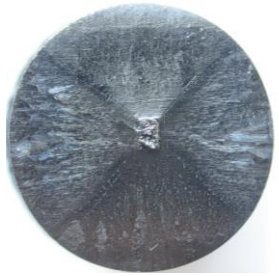
YBCO bulk single-grain superconductor (BSS) - with chemical pining

Nanosize flux line pinning centers induced by low concentration doping



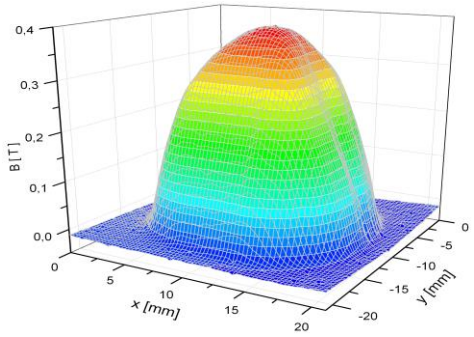
$(Y_{1-x}Sm_x)Ba_2Cu_3O_7$

D = 16 mm

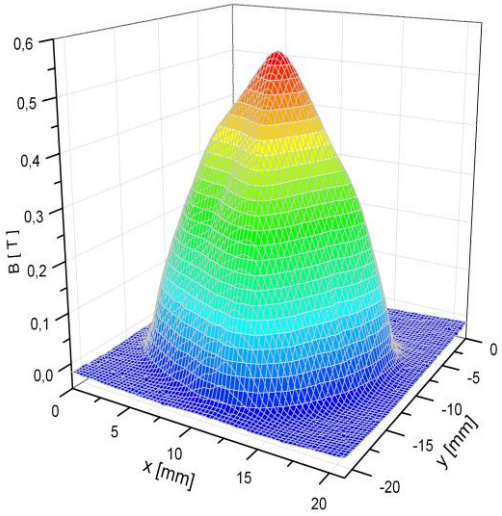


$(Y_{1-x}Sm_x)Ba_2Cu_3O_7$

0 wt. % Sm, B_{max}=395mT



0.11 wt. % Sm, B_{max}=564mT



2 patent applications: PP 00105-2013, PP 00089-2015

Future perspectives

Basic research formation of effective nanosize pining centres in REBCO superconductors to obtain permanet magnets with desired magnetic map

Applications :

- cell separation
- magnetic drug targeting

Roadmapping Workshop: Bulk Superconductivity, Jun 7. 2016, University of Cambridge

Laboratory of Experimental Chemical Physics

I. A new original (bottom-up) approach to the preparation of polymeric nanoparticles

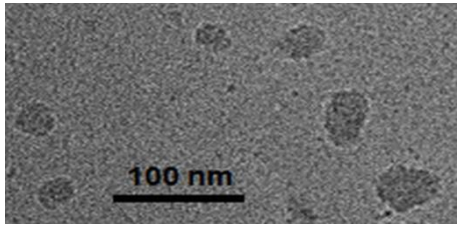
Controled self-assembly via thermoresponsive homopolymers with programable size of resulting nanoparticles.

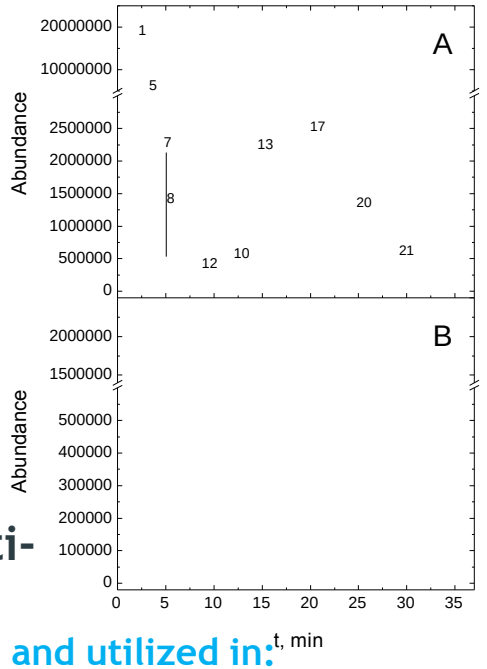
Stability of particles (irreversibility of the self-assembly) reached by hydrogen bonding.

Two patents - Slovak Republic

Key paper:

- M. Sedlák: A Novel Approach to Controlled Self-Assembly of pH-Responsive Thermosensitive Homopolymer Polyelectrolytes into Stable Nanoparticles. Advances in Colloid and Interface Science 2015, http://dx.doi.org/10.1016/j.cis.2015.12.005, (5-year IF = 10.42)



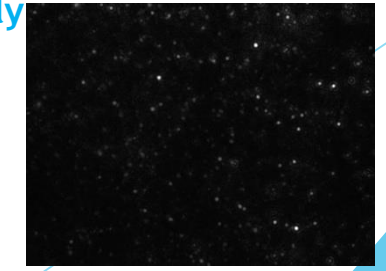


1	tert-Butyl alcohol
2	2-Butanol
3	Di-tert-butyl ether
4	Butanol
5	tert-Butyl-2-butyl ether
6	Butyl acetate
7	1-(1,1-Dimethylethoxy)-2,2-dimethylpropane
8	Methylhexanol
9	1-Chlor-2-methylbenzene
10	Dimethylhexanone
11	Decanal
12	Decane
13	Dodecane
14	Tridecane
15	Dimethyldodecane
16	Methyltridecane
17	Tetradecane
18	Dimethyltetradecane
19	Methylpentadecane
20	Hexadecane
21	Octadecane

II. Mesoscale segregation in ternary and multi-component liquid mixtures

.... explored in detail as a physico-chemical phenomenon and utilized in:

- ❑ Sensitive and low-cost monitoring of contaminants in industrially important liquids
- ❑ Purification of industrially important liquids



Two Slovak patent applications.

One international PCT application

(World Intellectual Property Organization)

Laboratory of Experimental Chemical Physics

Vision (research strategy and further development):

- **Basic research** on spontaneously occurring and induced target-oriented self-assembly of polymeric and nonpolymeric materials in liquid state with a **rapid transfer** of ideas from basic research to **applied research**, the traditional time scheme being to patent first, and then to publish.

- **Implementation of our patents in real life:**
  - Monitoring of contaminants in liquids used mainly in food and pharmaceitical industry
  - Purification of industrially important liquids

- **Creative development of experimental methods**, especially laser light scattering methods, and methodical work in this field.

Department of Theoretical Physics: The best results

The basic scientific investigation covers mainly three areas:

1) Condensed matter physics; 2) Non-linear stochastic dynamics; 3) Physics of elementary particles.

Condensed matter physics

Numerical proof of the Bose-Einstein condensation of preformed excitons in the system of strongly interacting f and d electrons **[P. FARKASOVSKY, Europhysics Letters, 110 (2015) 47007]**.

Investigation of the electronic properties of the graphene curved structures (wormhole, perturbed nanocylinder and nanocones) **R. PINCAK, J. SMOTLACHA, European Physical Journal B86 (2013) 480].**

Non-linear stochastic dynamics

Influence of hydrodynamic fluctuations on the scaling regimes of the models of stochastic dynamics using quantum field theory methods **[M. HNATICH, J. HONKONEN, T. LUCIVJANSKY, European Physical Journal B86 (2013) 214].**

Influence of compressibility on anomalous scaling of correlation functions of a passive weak magnetic field in the Kazantsev-Kraichnan model **[E. JURCISINOVA, M. JURCISIN, Physical Review E88 (2013) 011004(R)].**

Phenomenology of elementary particles.

Study of various effects in nuclear targets. Importance of attenuation of the produced colorless dipole in the dense medium **[B.Z. KOPELIOVICH, J. NEMCHIK, I. K. POTASHNIKOVA, I. SCHMIDT, Physical Review C86 (2012) 054904].**

Department of Theoretical Physics : Future plans and objectives

CONDENSED MATTER PHYSICS

Strongly correlated electron systems: coexistence of charge and spin ordering, ferroelectric and ferromagnetic state, and finally, charge/spin ordering and superconductivity

Graphene: expectation - superconductor.

Superfluid phases of He3 and its excitations: as a model system for the quantum field theory

NON-LINEAR STOCHASTIC DYNAMICS

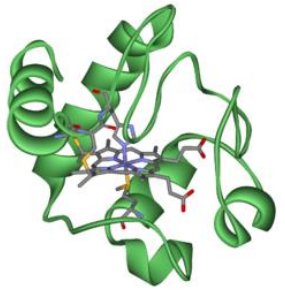
Turbulence: the influence of the breaking of various turbulent environment symmetries on the behavior of correlation functions of passively advected fields.

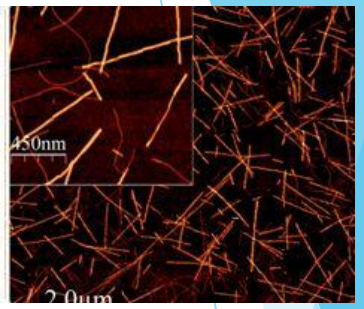
PHENOMENOLOGY OF ELEMENTARY PARTICLES

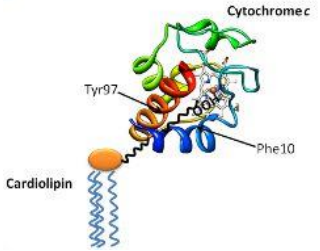
Theoretical investigation of the onset of various effects occuring in interactions with nuclear targets.

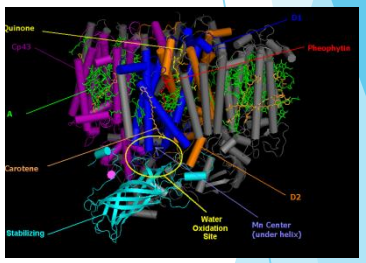
Department of Biophysics

interdisciplinary research
broad international collaboration









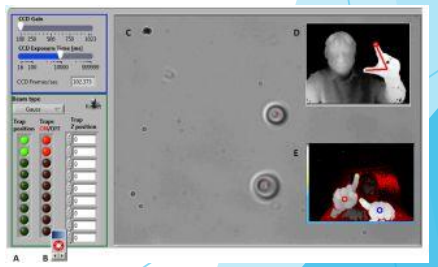
Protein stability - characterization of the structure and stability of various biomacromolecules (proteins, polynucleic acids, polysaccharides) in the presence of denaturants, salts and polyanions.

Protein amyloid structures - study of the mechanism of amyloid aggregation of proteins and treatment of the amyloid-related diseases

Mitochondrial Oxidative Stress - to elucidate mechanisms by which ROS damage individual components of electron-transfer complexes.

Electron Transport in Photosynthetic Reaction Centers - developing of the general master equations which describe the electron transfer in photosynthetic reaction centers

Biomedical image analysis - utilization of the specific NUI devices to control the "state of the art" of experimental devices (optical tweezers and scalpel)



EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

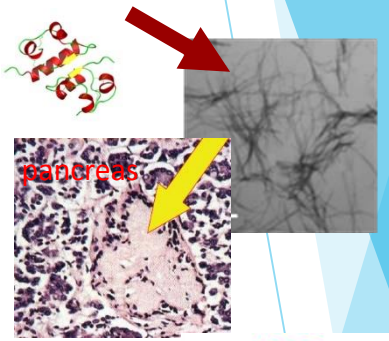
Home | COST Actions | Biomedicine and Molecular Biosciences (BMBS) | BM1405

BMBS COST Action BM1405

Non-globular proteins - from sequence to structure, function and application in molecular physiopathology (NGP-NET)

Amyloid self-assemblies of poly/peptides

polypeptid lysozyme



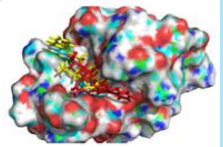
patology of more than 30 amyloid - related diseases – Alzheimer, Parkinson's

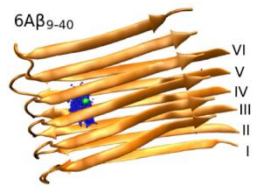
REASONS FOR STUDY

- important for understanding of the nature and treatment of these disease

RESULTS

- cytotoxicity - morphology
- small molecules, short peptides, nanoparticles, fullerenol able to significantly inhibit amyloid aggregation
- Inhibitors - potential to be used for treatment of amyloid related diseases





Van Vuong Q., **Siposová K.** Truc Nguyen T. ,**Antosova A.,** Balogova L., Drajna L.,Imrich J. - Suan L., Mai, **Gazova, Z.** *Binding of Glyco-Acridine Derivatives to Lysozyme Leads to Inhibition of Amyloid Fibrillization*, Biomacromol., 2013, 14, 1035 (IF 5.371).

BioMACROMOLECULES

Mocanu M.M., Ganea C., **Siposova K.**, Filippi A., **Demjen E., Marek J., Bednarikova Z., Antosova A.,** Baran I., **Gazova Z.**, *Polymorphism of hen egg white lysozyme amyloid fibrils influences the cytotoxicity in LLC-PK1 epithelial kidney cells,* Int. J. Biol. Macromol*., 2014, 65, 176 (* IF 3.096)

Vision:

- **New era– amyloidomic**
  - to find the hypothesis for general mechanism of amyloid formation.
  - identification of a new amyloid inhibitors - solving problems connected to amyloid-related diseases
  - formation of the „smart“ hybrid nanostructures on the base of amyloid aggregates

- elucidation of the mechanisms by which the **oxidative stress damages** individual components of the electron-transfer complexes and verification of the participation of these complexes in antioxidant defence.

- **visualization of novel supramolecular complexes** and creation of novel materials structured in the micro- or nanometer scale **using optical tweezers** and two-photon polymerization reaction. Particles image analysis will be transformed into more advanced forms leading to micro/nanorobotics.

III. Societal, cultural, and/or economic impact

International position

- activitities*:*

- 7FP projects 1
- COST projects 3
- SVK- Taiwan 1
- others (JEM-EUSO, GAMAS) 1
- CERN, CDF, JINR 3

National position:

APVV (Slovak and Development Agency) projects: 36

- General calls- projects 17
- LPP (human potentials): 3
- Bilateral (collaboration): 16

Projects of SAS Centres of Excellence: 2

- Centre excelence of SAS- Nanofluids, P. Kopčanský, 2009-2013
- Centre of Low Temperature Physics and Material Research at Extreme Conditions, P. Samuely, 2011-2015

VEGA (Scientific Grant Agency) projects: 47

The scientists of IEP SAS are:

- referees of the most scientific journals- Science, Phys. Rev. Letters, Phys. Review B, Phys. Review E, Biomacromolecules, etc.
- referees, repaorteurs and panelists of FP7 and H2020 projects, foreign grant agencies, etc.
- members of the Selection Committees for beamtime experiments in ILL Grenoble and JINR Dubna

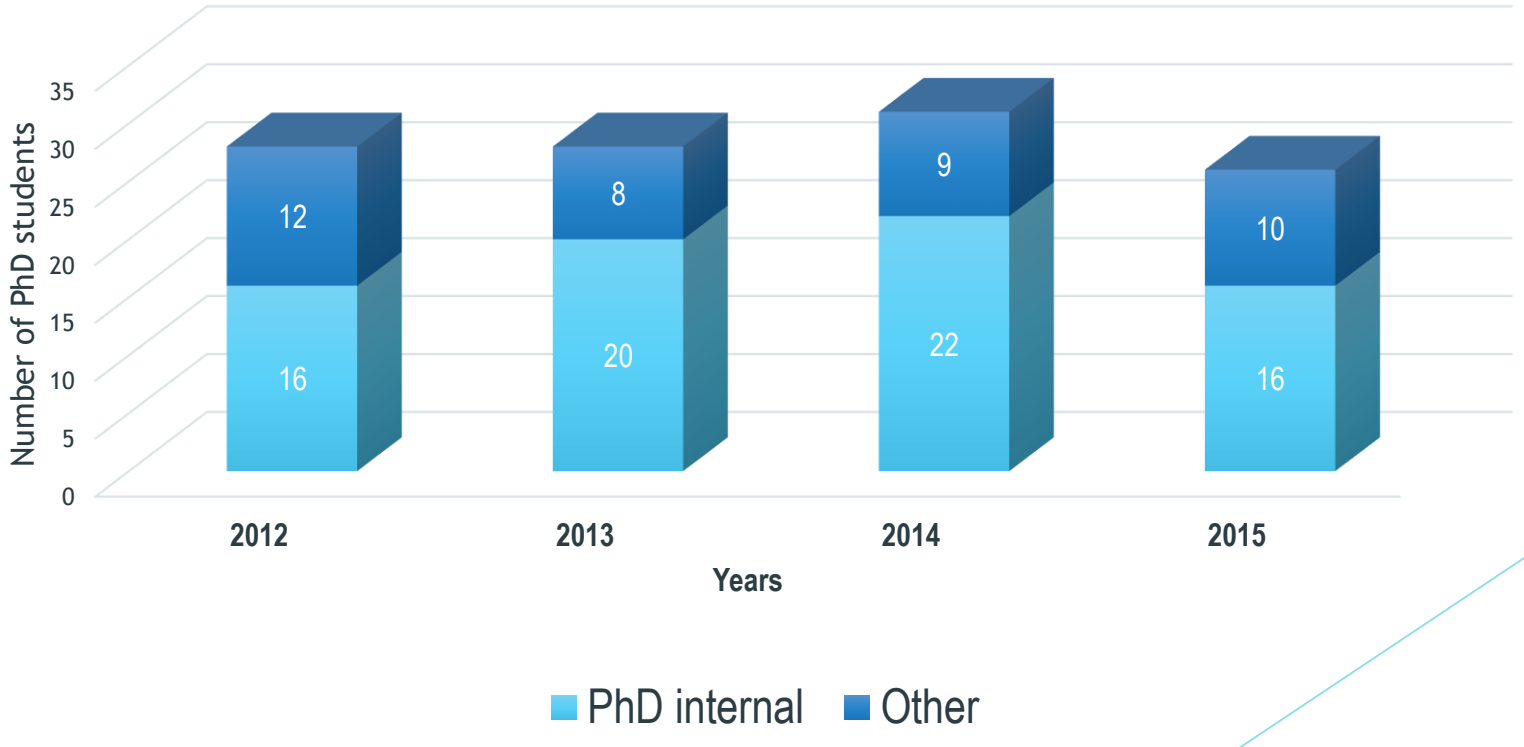
International conferences (co-) organized: 28 (~ 7/ year)

- Microkelvin 2012, 19.-24.3.2012, 90 participants, Smolenice, Slovakia
- Physics in Collision 2012, 12.-15.9.2012, 110 participants, Strbské Pleso, Slovakia
- **CSMAG 13, Czech and Slovak Conference on Magnetism, 17.-24.6.2013, 320 participants, Kosice, Slovakia**
- Structure and Stability of Biomacromolecules, 30.6.-3.7.2015, 60 participants, Kosice, Slovakia
- Mathematical modeling and computational physics 2015, 13.-17.7.2015, 80 participants, Stara Lesna, Slovakia

PhD. study

List of accredited programmes of doctoral studies, period of validity

- **2.4.1 General physics and mathematical physics** – with Faculty of Sciences, Pavol Jozef Safarik University, Košice (FS UPJŠ) - since 2004
- **4.1.3 Physics of condensed matter and acoustics** - with FS UPJS since 2004
- **4.1.5 Nuclear and subnuclear physics** – with FS UPJS since 2004
- **5.2.26 Materials – with Faculty of Metallurgy**, Technical University, Košice - since 2009



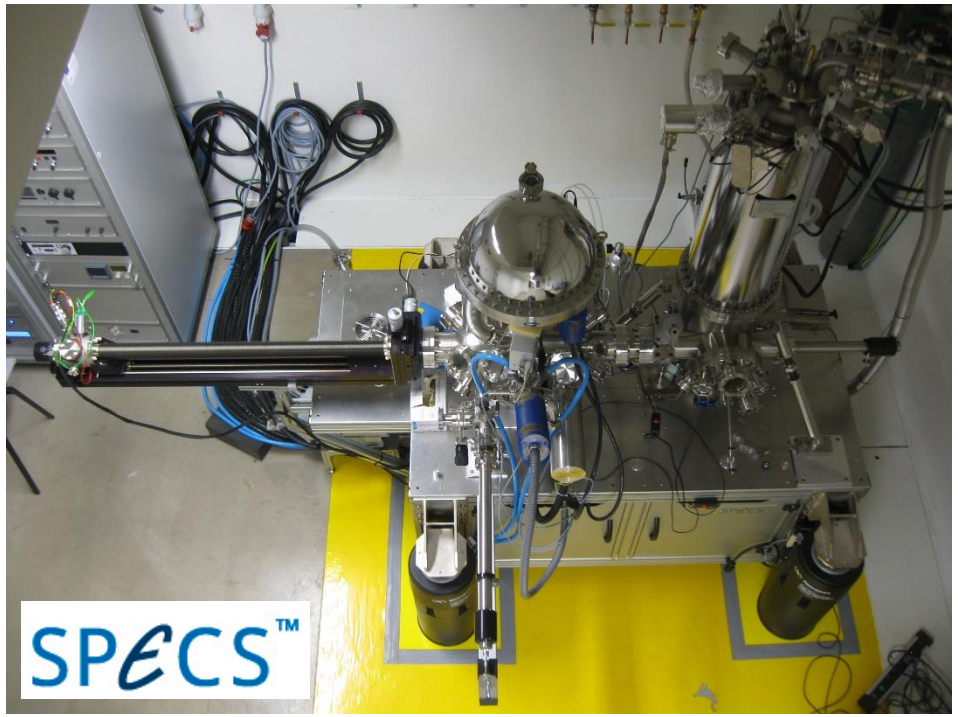
Postdoctoral positions supported by national and international resources:

Projects: provide new PhD and Post-doc positions

- Edufyce 2011-2012
- PhysNet 2013-2015
- Nanokop 2012-2013

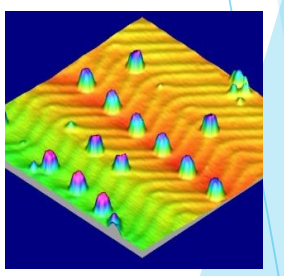
- Positions for young Slovak researchers supported from EU Structural Funds and APVV projects: 7
- New post-doc positions supported by Slovak Academic Informational Agency (SAIA) and Videgrad Fund: 3
- The Slovak Academy of Sciences Supporting Fund of Stefan Schwarz- 15

New infrastructure – UHV LT STM



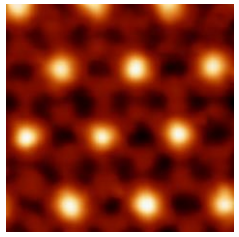
- Base pressure 10^{-10} mbar
- Joule-Thomson STM with base temperature 1K & magnetic field 3T
- 6 e-beam evaporators
- Ar^+ sputtering & annealing of samples
- Quartz crystal microbalance
- Mass spectrometer, RHEED, XPS

SP STM (other authors): magnetic molecules

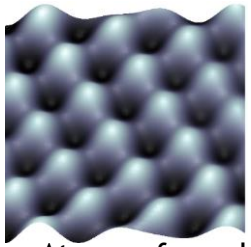


✓ STM under control

our study:



SC vortices in $NbSe_2$



Atoms of graphite

In-house developed equipment :
We will introduce Spin Polarized STM to study magnetic atoms, skyrmions…

Applied research

Registered abroad

Registered patents:

- Kopčanský Peter, Timko Milan, Závišová Vlasta, Tomašovičová Natália, I.P. Studenjak, O.V.Kovalcuk . UA 99100 U

  Method for increasing of ion conductivity of the liquid crystal based composite. Owner/co-owner: Uzhhorod NationalUniversity, Užhorod, Ukraine

- Kopčanský Peter, Timko Milan, Gažová Zuzana, Šipošová Katarína, Šipošová Katarína, I.P. Studenjak, O.V.Kovalcuk . UA 99099 U

  Method for the optimal lysozyme concentration determination to form a lyotropic magnetic liquid crystal

  Owner/co-owner: Uzhhorod National Univerzity, Užhorod, Ukraine

Patent applications:

- Sedlák Marián, Rak Dmytro. PCT/SK2015/050002

  A Method for Determination of Content of Hydrophobic Compounds in Water-Miscible Organic Liquids

  Owner/co-owner: IEP SAS, Košice

  Country: World

Applied research

Registered in Slovakia

Registered patents:

- Sedlák Marián, Koňák Čestmír. 287951

  Preparation method of polymeric nanoparticles on the basis of poly(ethylacrylic acid) homopolymers. Owner/co-owner: IEP SAS, Košice

- Sedlák Marián, Koňák Čestmír. 288071

  Polymeric nanoparticles on the basis of poly(propylacrylic acid) homopolymers and their preparation method.

  Owner/co-owner: IEP SAS, Košice

- Kováč František, Petryshynets Ivan, Stoyka Vladimír, Škorvánek Ivan, Tibor Kvačkaj. 288322

  Method of producing the non-oriented electrical FeSi steels having low watt losses. Owner/ co-owner: IMR SAS, Košice

Applied research

Registered in Slovakia

Patent applications:

- Sedlák Marián, Rak Dmytro. PP50002-2014

  Measurement of the alkane content in alcohols by the method of nanoseggregation in aqueous solutions. Owner/co-owner: IEP SAS, Košice

- Sedlák Marián, Rak Dmytro. PP50001-2015

  A Method for Determination of Content of Hydrophobic Compounds in Water-Miscible Organic Liquids. Owner/co-owner: IEP SAS, Košice

- Diko Pavel, Volochová Daniela, Antal Vitaliy, Piovarči Samuel. PP 00089-2015

  YBCO superconductor doped with samarium and its fabrication. Owner: IEP SAS

- Diko Pavel, Piovarči Samuel, Antal Vitaliy. PP 00067-2014

  YBCO superconductor treated by high pressure oxygenation. Owner: IEP SAS

- Diko Pavel, Volochová Daniela. PP 00105-2013

  Binary doped YBCO superconductor. Owner: IEP SAS

Popularisation of Science

Vedecký brloh (Science nest), **Slovakia at CERN, Rosetta**

Films– two 20 min popularization films: Mrazivý magnet (Freezing magnet) and Vidieť neviditeľné (See the invisible) for the serial Spectrum vedy (Spectrum of science).

Outreach activities	2012	2013	2014	2015	total
Articles in press media/internet popularising results of science, in particular those achieved by the Organization	15	10	7	7	39
Appearances in telecommunication media popularising results of science, in particular those achieved by the Organization	15	10	17	13	55
Public popularisation lectures	25	40	31	22	118

Steel PARK
kreatívna fabrika

Steel Park – the entertainment and technical center of Košice was officially opened in 2013 as one of the main activities of the Košice – European Capital of Culture 2013 project. It is a result of cooperation between the city, the steelmaking company U. S. Steel Košice and three academic institutions – the Technical University of Košice, Pavol Jozef Šafárik University and Slovak Academy of Sciences.

Researchers night – is the biggest scientific popularization action in EU and Slovakia since 2006. The festival in Košice is organized in a Shopping Centre Optima, where the average number of visitors is above 15 000.

Research strategy and future development of the Institute for the next five years (2016-2020)

„current state of knowledge from international and national perspective“

FUTURE VISION

- to enhance the Institute's scientific impact
- to become one of the leading Central European centers for physics research

THE WAYS TO ACHIEVE THE GOALS:

- **support** of the research activities under the European flagship projects;
- **support** of international collaborations;
- **support** of inter- and multidisciplinary research teams/projects;
- **expand** the expertise of the research personnel;
- **support** the education of diverse student body with goals to raise excellent scientists;
- **support** research activities with a potential of rapid transfer of knowledge from basic research into innovative products and technologies;

Research strategy and future development of the institute for the next five years (2016-2020)

„current state of knowledge from international and national perspective“

OTHER WAYS TO ACHIEVE THE GOALS:

- **open** the majority of the Institute’s scientific infrastructure to all academic and research entities in Slovakia;
- **restructure** the departments in order to motivate formation of new dynamic research teams/units;
- **improve** the administrative support for research programs by developing a clear and effective computerized system for administrative procedures;
- **support** of scientific popularization at the regional and national level by raising awareness of the importance of knowledge and scientific research for the development of the entire society.

Why we are here?

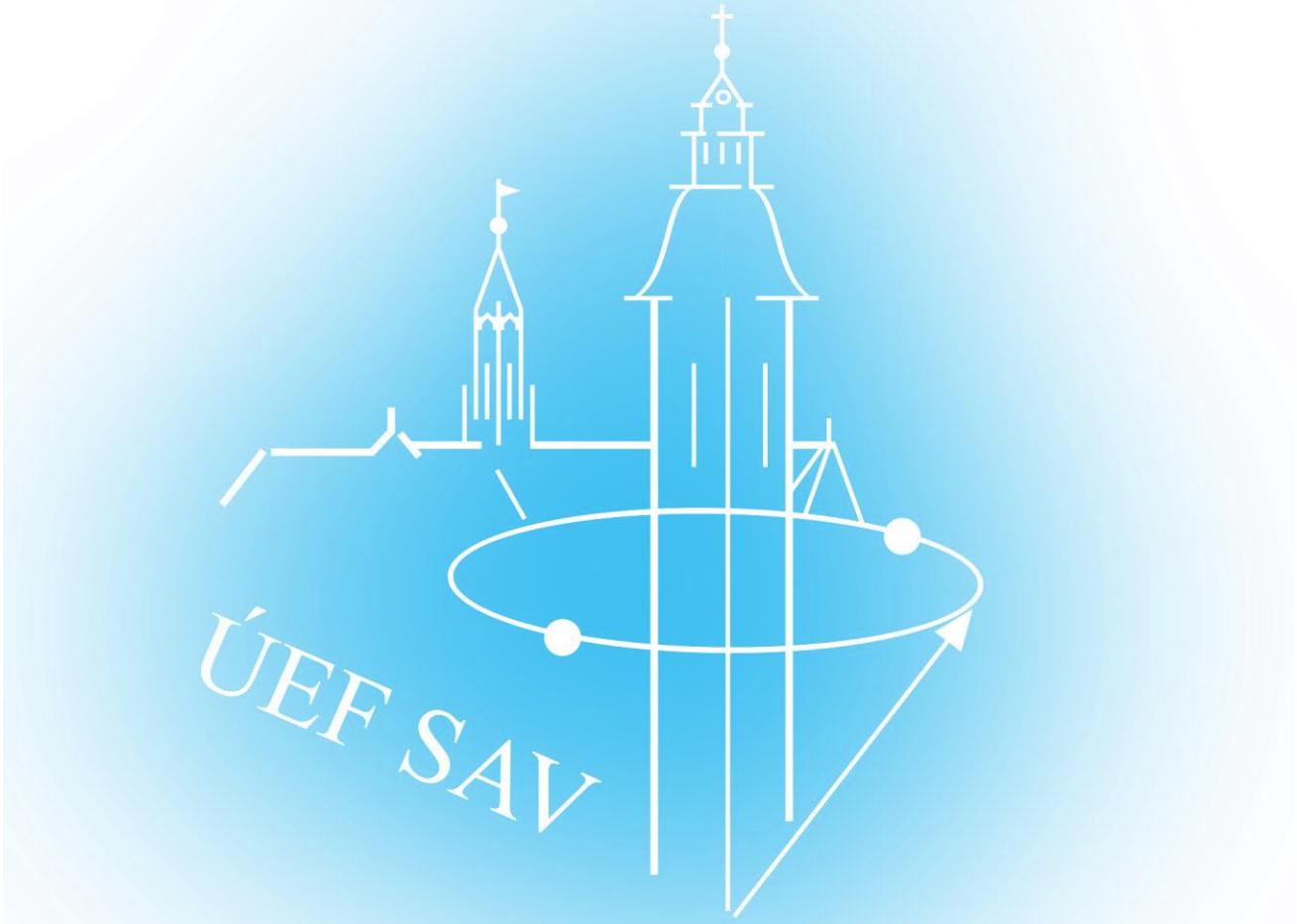
basic research

- Slovakia(Czechoslovakia) is a member state of CERN,
- member of JINR DUBNA(theoretical physics quantum field theory of turbulence, neutron study of matter)
- laboratory at Lomnicky peak, world network of cosmic ray study in connection to space wheater too EMSO projects , Rosseta
- ultra low temperature laboratory
- Magnetism
- complex study of superconductivity
- biophysics study of protein aggregation in frame of neurovegetative diseases research

new movement to applications

- magnetic fluids(MDT, energy industry)
- nanocrystaline materials
- superconductive materials
- polymer science

outreach activities



This was a period of structural funds
Big effort for public procurements – 11 million Euros

Many thanks to all people of the Institute