The European Spallation Source ERIC (ESS) - Partner Day in Riga

Potential of Latvian Contribution

Anatoli Popov

Institute of Solid State Physics, University of Latvia, Riga, Latvia

14.40, 2 June 2016 Anatoli POPOV at Academic Center for Natural Sciences, University of Latvia

Current realities for Latvian Scientific and Industrial Community:

1. Do we have enough interest in the construction phase?

2. Do we have enough researchers to use the ESS facility?

3 Are we doing enough research in the field that ESS will provide its unique powerfull instruments?

Current realities for Latvian Scientific and Industrial Community:

What should we do to get the best outcome of the expected deal between Latvia and ESS ?

At what stage of ESS,
the Latvian Research Community should get involve?

A) At the construction phase?

B) At the User side?

ESS –Partner Day in Riga // Potential of Latvian Contribution

Construction Phase

LT **0.45 %**

EST **0.25 %**

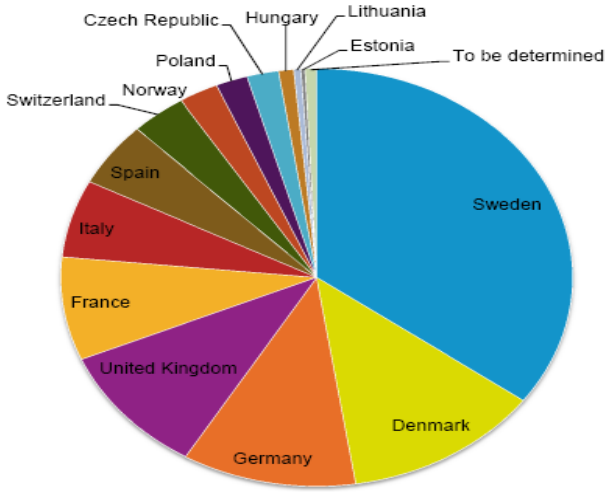
LV ***tbd***

Construction investment

Already committed	
Sweden (member)	35.0 %
Denmark (member) *	12.5 %
Germany (member) *	11.0 %
United Kingdom (observer)	10.0 %
France (member)	8.0 %
Italy (member)	6.0 %
Spain (observer) *	5.0 %
Switzerland (member)	3.5 %
Norway (member)	2.5 %
Poland (member)	2.0 %
Czech Republic (member)	2.0 %
Hungary (member)	0.95 %
Lithuania (future member)	0.45%
Estonia (member)	0.25 %
Total	99.15 %
Belgium (observer)	*tbd*
Netherlands (observer)	*tbd*
Greece (future observer)	*tbd*
Iceland	*tbd*
Latvia	*tbd*

Discussions: Portugal, Turkey, Finland

* *Includes Pre-construction Costs*



Key Decision: Not only from IZM (Ministry of Education and Science), but also EM (Ministry of Economics)

Why Large Scale Facilities?

Synchrotron &Neutron radiation beamlines are high-performance instruments that allow to obtain multi-scale and multi-task researches on materials of industrial as well as fundamental interest.

- **ILL Grenoble, France**
- **LLB Saclay, France**
- **ESRF Grenoble, France**
- **FRM II Munich, Germany**
- **PSI Villigen, Switzerland**
- **DESY Hamburg, Germany**
- **XFEL Hamburg, Germany**
- **ELETTRA Trieste, Italy**
- **DAFNE Frascati, Italy**

etc .....

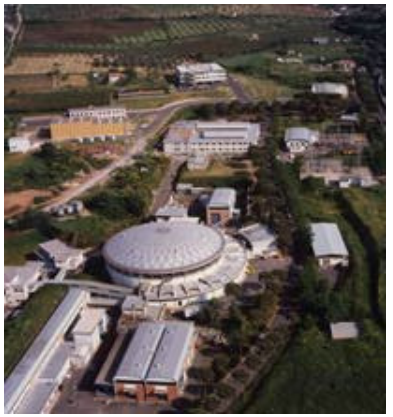
Great opportunities for small countries

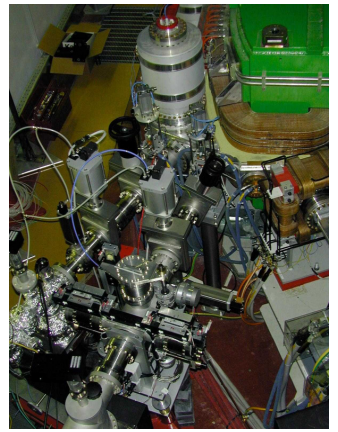
Material	Large Scale Facility	Year	Type of experiment
ZnO	ESRF	2004	XEOL
ReO3	ESRF	2005	EXAFS
Ge (isotopes)	ESRF	2006	EXAFS
ZnO nano	ESRF	2006	XANES, XEOL
ZnWO4 nano	ESRF	2007	XANES, XEOL
ZnNiWO4	HASYLAB/DESY	2009	EXAFS
NiO	HASYLAB/DESY	2010	EXAFS
ReRAM	HASYLAB/DESY	2010	EXAFS
MnWO4	HASYLAB/DESY	2011	EXAFS
ReRAM	HASYLAB/DESY	2011	EXAFS
CuWO4	HASYLAB/DESY	2011	EXAFS
ReRAM	ESRF	2011	EXAFS/XANES
ScF3	ELETTRA	2011	EXAFS
SrTiO3	HASYLAB/DESY	2012	EXAFS
Cu3N	HASYLAB/DESY	2012	EXAFS
ReRAM	HASYLAB/DESY	2012	EXAFS
SrTiO3 (isotopes)	ESRF	2012	EXAFS
NiWO4	SOLEIL	2012	FTIR
ZnNiWO4	SOLEIL	2012	FTIR
SnWO4, CoCuWO4	SOLEIL	2013	FTIR
ODS steels	ELETTRA	2013	EXAFS/XANES
ODS steels	ELETTRA	2014	EXAFS/XANES
CuMoO4	ELETTRA	2015	EXAFS/XANES
SnWO4 HP	SOLEIL	2014	FTIR
SnWO4 HP	SOLEIL	2014	EXAFS/XANES
Cu3N HP	SOLEIL	2014	XANES
CuO HP	SOLEIL	2015	XANES
ODS steels	SOLEIL	2015	EXAFS/XANES
ODS steels	ESRF	2015	EXAFS/XANES
EuTiO3, CH3NH3PbX3	CLAES-ALBA	2015	EXAFS/XANES
CuO nano	HASYLAB/DESY	2016	EXAFS/XANES

Number of projects before 2010: 6
Number of projects starting from 2010: 24

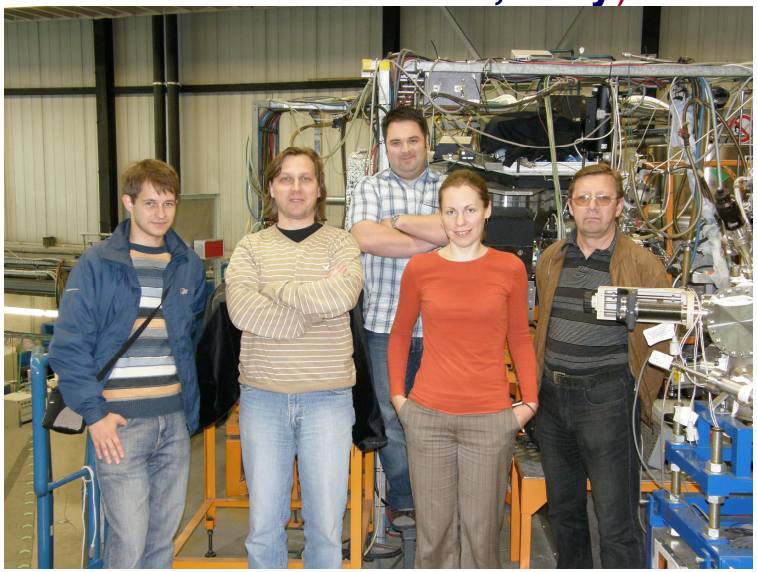
Special thanks to A. Kuzmin

Material	Large Scale Facility	Year	Type of experiment
AlN	LNF Frascati	2005	FTIR, XANES
AlN nano	LNF Frascati	2006	FTIR
AlN nano	ILL Grenoble	2006	INS, PD
CdI2	LNF Frascati	2007	FTIR
CsPbCl nano	LNF Frascati	2008	FTIR
SiC nano	LNF Frascati	2009	FTIR
Ag2CdI4	LNF Frascati	2009	FTIR
CdCoS	LNF Frascati	2010	FTIR, XANES
LaPO4 nano	HASYLAB/DESY	2010	VUV
NiWO4	HASYLAB/DESY	2010	VUV
LaCl3:Eu3+	HASYLAB/DESY	2010	VUV
SrI2:Eu	HASYLAB/DESY	2010	VUV
YVO4	HASYLAB/DESY	2011	VUV
PLZT	HASYLAB/DESY	2011	VUV
SrTiO3	HASYLAB/DESY	2011	VUV
ScF3	HASYLAB/DESY	2011	VUV
SrTiO3	HASYLAB/DESY	2012	VUV
CsBr	HASYLAB/DESY	2012	VUV
BaZrO3-Y	HASYLAB/DESY	2012	VUV
HAP	HASYLAB/DESY	2012	VUV
BaZrO3-Y	LNF Frascati	2015	FTIR
Ge_GaS_glasses	LNF Frascati	2015	FTIR





SINBAD facility (the synchrotron radiation IR beamline at DAFNE, **Frascati, Italy**)



VUV Superlumi beamline (DESY), Hamburg

First Baltic School on Application of Neutron and Synchrotron Radiation in Solid State Physics and Material Science

(BSANS-2012)

Riga, Latvia, 1-4, October, 2012

ILL and ESRF, Grenoble, France

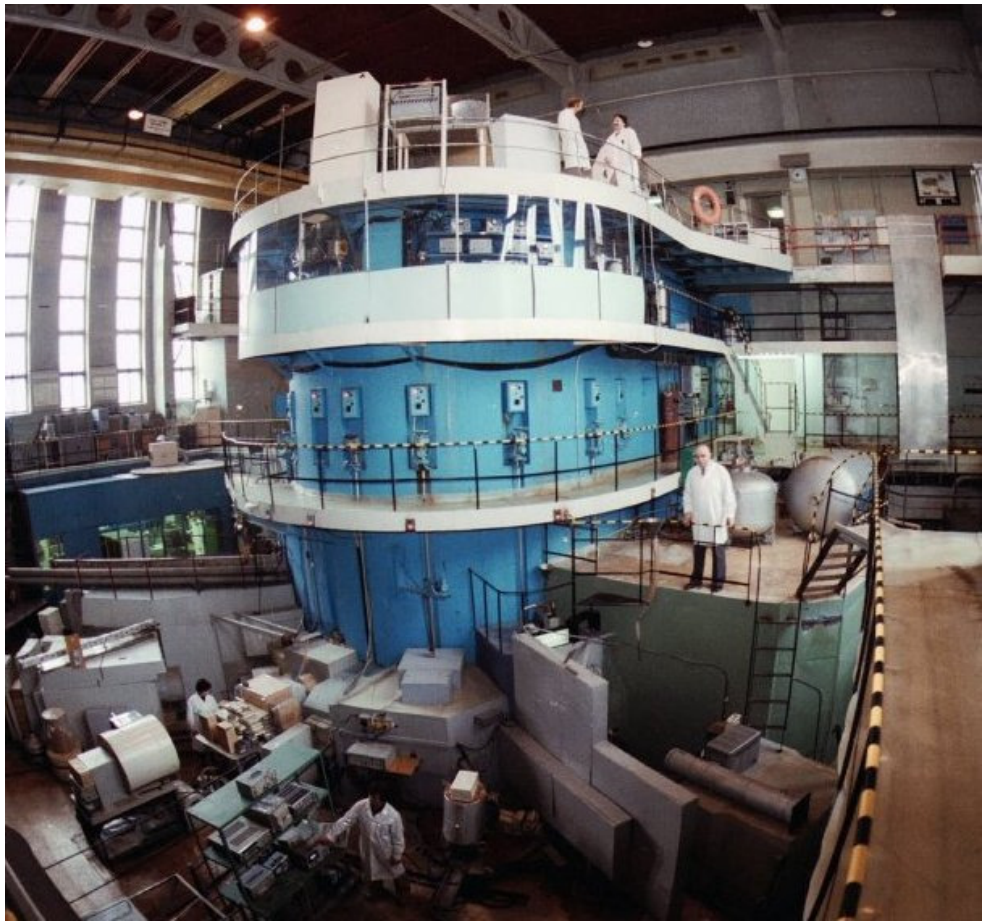
Institute of Laue-Langevin:
ILL is funded and managed by France, Germany
and the United Kingdom, in partnership with 11 other countries.

ESRF (Europen Synchrotron Radiation Facility)

ESRF owes its success to the international cooperation of 21 partner nations, of which 13 are Members and 8 are Scientific Associates.

Note that we have quite limited number of experiments at ILL and ESRF because Latvia is not a member and officially we are not eligible

Nuclear research reactor of Institute of Physics Latvian SSR Academy of Science



The reactor was started up on September 26, 1961. Since 1979 thermal power was 5 MW.

10 horizontal and 17 vertical channels were employed in experimental research with using of neutron fluxes. Until, 1998.

Main fields of investigations:

- Nuclear spectroscopy;
- Solid state physics;
- Radiation materials science;
- Neutron-activation analysis.

Latvian neutron user community

1. Institute of Solid State physics, University of Latvia
2. Institute of Physical Energetics, Riga, Latvia
3. Riga Technical University, Institute of Materials and Structures
4. Institute of Physics of University of Latvia, (Salaspils-team)
5 Laboratory for Mathematical Modelling of Environmental and Technological Processes, University of Latvia (Zeļļu-team)

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5 Laboratory for Mathematical Modelling of Environmental and Technological Processes, University of Latvia (Zeļļu-team)

If neutron-induced radiation damage phenomena as a topic is also included:

6. Institute of Chemical Physics, University of Latvia (Gunta Kizane team)

May be: **It is the basis for the future**

National Large Scale Facility (neutron+synhrotron) research program(s)

???

Latvian neutron user community

1. Institute of Solid State physics, University of Latvia

a) Magnetic Structure

Wiley Online Library Early View publication on www.wileyonlinelibrary.com (issue and page numbers not yet assigned; citable using Digital Object Identifier – DOI)

Phys. Status Solidi B, 1–8 (2016) / DOI 10.1002/pssb.201552680

physica status solidi b www.pss-b.com basic solid state physics

Neutron diffraction study of microstructural and magnetic effects in fine particle NiO powders

A. M. Balagurov[1], I. A. Bobrikov[*,1], S. V. Sumnikov[1], V. Yu. Yushankhai[2], J. Grabis[3], A. Kuzmin[4], N. Mironova-Ulmane[4], and I. Sildos[5]

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Published online 21 March 2016

Keywords core–shell model, crystal structure, magnetic structure, neutron diffraction, NiO, submicron particles

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Nickel oxide powders with grain sizes ranging from 100 to 1500 nm have been studied by high-resolution neutron diffraction. We have found that the atomic structure, the antiferromagnetic ordering, and the value of the nickel magnetic moments inherent in the bulk material of NiO are still preserved and are nearly independent of the average size of the grains. The sizes of the coherently scattering atomic and magnetic domains were estimated independently owing to a complete separation of the nuclear and magnetic peaks in the neutron diffraction patterns. It is shown that the finite-size and surface disorder effects in particles at the submicron scale have a more pronounced influence on the magnetism than on their structural properties. We conclude that the core–shell model suggested earlier for nanosized particles can be successfully extended to particles whose sizes are in the submicron range.

The neutron diffraction measurements at high resolution Fourier diffractometer (HRFD), at the IBR-2 pulsed reactor in JINR (Dubna).

Latvian neutron user community

1. Institute of Solid State physics, University of Latvia

b) Combined neutron and synchrotron studies

Journal of Physics and Chemistry of Solids 69 (2008) 2187–2190

Contents lists available at ScienceDirect

Journal of Physics and Chemistry of Solids

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

Short- and long-range order in $La_{1-x}Sr_xCoO_3$ and $La_{1-x}Ba_xCoO_3$

E. Efimova [a], V. Efimov [a,b,*], D. Karpinsky [c], A. Kuzmin [d], J. Purans [d], V. Sikolenko [a,e], S. Tiutiunnikov [a], I. Troyanchuk [c], E. Welter [f], D. Zajac [f,g], V. Simkin [a], A. Sazonov [c,h]

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ARTICLE INFO

Keywords:
Local structure
Atomic correlations
Cobaltates
EXAFS and XANES
Neutron diffraction

ABSTRACT

The short- and long-range order correlations of the crystal structure in the distorted perovskites $La_{1-x}Sr_xCoO_3$ and $La_{1-x}Ba_xCoO_3$ ($0.0 \leqslant x \leqslant 0.5$) have been studied by the neutron powder diffraction (NPD) and the Co K-edge X-ray absorption spectroscopy (XAS) measurements. The results of XAS and NPD indicate a local distortion around the Co^{3+} ions in $LaCoO_3$ at room temperature. The substitution of the La^{3+} ions by the Sr^{2+}(Ba^{2+}) ions leads to a gradual increase of the Co–O–Co angle and is accompanied by an increase of the mean square relative displacement (MSRD) of the Co–O bond. These results correlate with an increase of the oxygen amplitude vibration in the direction perpendicular to the Co–O bond. The possible explanation of the observed changes of the crystal and electronic structures in the above-mentioned cobaltites is discussed.

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Available online at www.sciencedirect.com
ScienceDirect

Nuclear Instruments and Methods in Physics Research A 575 (2007) 176–179

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

www.elsevier.com/locate/nima

XAFS and neutron diffraction study of $La_{1-x}Sr_xCo_{1-y}Nb_yO_3$

V.V. Efimov[a,*], E. Efimova[a], D. Karpinsky[b], D.I. Kochubey[c], V. Kriventsov[c], A. Kuzmin[d], S. Molodtsov[e], V. Sikolenko[a,f], J. Purans[g], S. Tiutiunnikov[a], I.O. Troyanchuk[b], A.N. Shmakov[c], D. Vyalikh[e]

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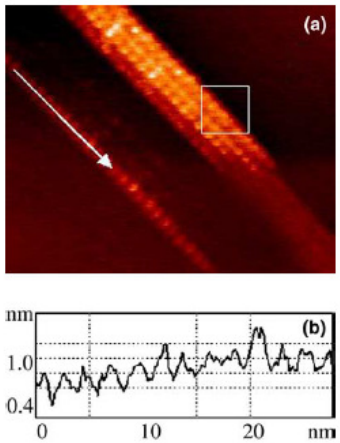
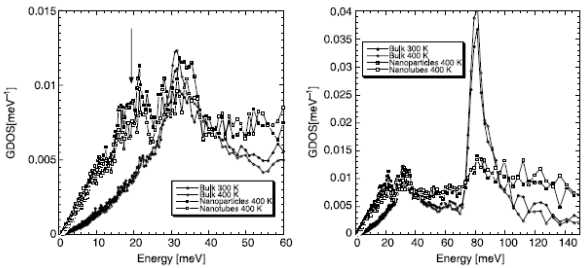
The neutron powder diffraction experiments were carried out using the fine resolution neutron diffractometer E9 at the BER-II reactor in Hahn Meitner Institute (Berlin)
XAS measurements were performed on the Russian–German beamline at the BESSY II (Berlin)

Latvian neutron user community

1. Institute of Solid State physics, University of Latvia



c) nanomaterials



Inelastic neutron scattering at ILL
IN4, IN6 and D20 at ILL

Neutron characterization of aluminium nitride nanotubes

S. BELLUCCI†*, C. BALASUBRAMANIAN†, A. IVANOV‡, A. POPOV‡ and H. SCHOBER‡

Journal of Neutron Research, Vol. 14, No. 4, December 2006, 287–291

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d) nuclear science

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Nuclear Physics A 947 (2016) 76–126

NUCLEAR PHYSICS A

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Levels of ^{188}Re nucleus populated in thermal neutron capture reaction

J. Bērziņš [a], T. Krasta [a,*], L. Simonova [a], M. Balodis [a], V. Bondarenko [a], M. Jentschel [b], W. Urban [c], I. Tomandl [d]

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Available online 29 December 2015

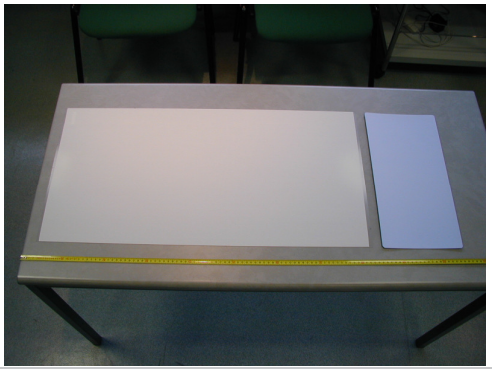
Abstract

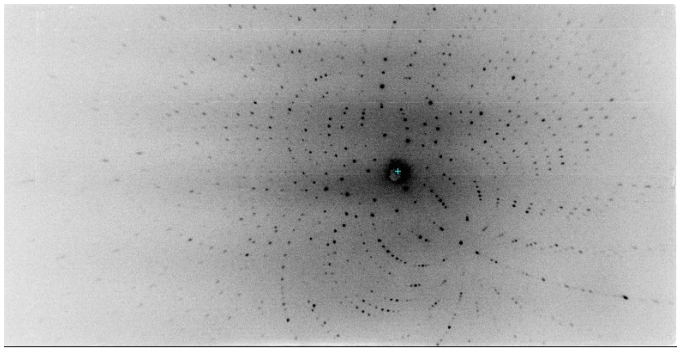
Levels of ^{188}Re populated in thermal neutron capture reaction with enriched ^{187}Re targets have been studied. Single γ-ray spectrum of ^{188}Re, measured with the high-resolution crystal diffraction spectrometer GAMS5, as well as $\gamma\gamma$-coincidence experiments performed with high efficiency Ge detectors, allowed to develop model-independent level scheme of the doubly-odd ^{188}Re nucleus up to ~1.5 MeV excitation energy. Analysis of the established ^{188}Re level scheme in terms of the quasiparticle-plus-rotor model indicates coexistence of axially-deformed and triaxial structures in the energy range above 400 keV.

Latvian neutron user community

1. Institute of Solid State physics, University of Latvia

e) detector physics and development





ARTICLE IN PRESS

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Contents lists available at ScienceDirect

Optical Materials

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

Photostimulated luminescence properties of neutron image plates

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Latvian neutron user community

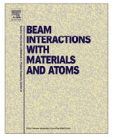
2. Institute of Physical Energetics, Riga, Latvia

Nuclear Instruments and Methods in Physics Research B 268 (2010) 3411–3414

Contents lists available at ScienceDirect

Nuclear Instruments and Methods in Physics Research B

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



Neutron Bragg diffraction on a thick Ge single crystal excited by ultrasound

E. Raitman [a,*], V. Gavrilov [a], D. Mjasischev [a], A. Hoser [b], N. Stüßer [b], A. Arulraj [b]

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Eur. Phys. J. E (2013) **36**: 80
DOI 10.1140/epje/i2013-13080-5

THE EUROPEAN PHYSICAL JOURNAL E

Regular Article

Perspectives in biological physics: The nDDB project for a neutron Dynamics Data Bank for biological macromolecules*

Leonid Rusevich[1,8], Victoria García Sakai[2], Bruno Franzetti[3,4,5], Mark Johnson[1], Francesca Natali[1,6], Eric Pellegrini[1], Judith Peters[1,3,4,5], Jörg Pieper[7], Martin Weik[3,4,5], and Giuseppe Zaccai[1,3,4,5,a]

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More details from
Leonid Rusevich in 20 -25 min !!!

Latvian neutron user community

3. Riga Technical University, Institute of Materials and Structures
4. Institute of Physics of University of Latvia, (Salaspils-team)
5 Laboratory for Mathematical Modelling of Environmental and Technological Processes, University of Latvia (Zeļļu-team)

They are presented here by:

Mihails Ščepanskis (LU -University of Latvia)

Nikolajs Toropovs (Riga Technical University, Inst of Materials and Structures)

They work in close collaboration with PSI (Paul Scherrer Institute), is the largest research institute for natural and engineering sciences in Switzerland.

Dr. Knud Thomsen from Paul Scherrer Institut

Conclusion

1. We have enough research groups, working with neutrons.

2. Our interests are wide enough.

3 It will be good if Latvia will get ESS membership ASAP.

4. It would be even better if the neutron-related research would have some priority for national funding

5. It would be absolutely perfect if all scientific research related to European research large scale facilities, would have proper priority, too……

(not only because LV is small country, but also because of professional project evaluation etc)