

ESF Exploratory Workshop on
**Physics and Technology of Iron
Pnictide Thin Films**

Bad Schandau (Germany), May 23 – 25, 2011

Convened by:
Silvia Haindl, Bernhard Holzapfel

SCIENTIFIC REPORT

1. Executive summary

The ESF Exploratory Workshop “Physics and Technology of Iron Pnictide Thin Films“ was held in Bad Schandau, Germany from Monday, May 23rd to Wednesday, May 25th 2011. The workshop venue was hotel Elbresidenz, located at the Elbe and easily accessible by public train and ferry either from Dresden or from Prague, where all participants have been full-board accommodated. All presentations (oral and poster) were given in the “Canaletto hall” of the hotel equipped with classroom seating arrangement.

Bad Schandau is a small spa town located in Saxony near the Czech border. The region known as “Saxon-Bohemian Switzerland” is famous for its national park and the Sandstone mountains along the Elbe valley. The Elbe Sandstone formations are also well known from romantic fine art landscapes. Bad Schandau became a summer health resort in the 18th century offering mineral waters and is a tourist region until today. The hotel location and the hospitality of the hotel staff are reasons that made hotel Elbresidenz an ideal choice for the organization of the ESF exploratory workshop.

In total 29 invited participants from 17 different nations (15 European countries, Japan and United States of America) took part in the workshop. All invited participants are experts in the fields represented by the topics addressed in the workshop sessions and currently involved and interested in the research of new iron-based superconductors. In addition, the workshop was accompanied by one ESF representative, Professor Maria Kaminska, from the University of Warsaw, Poland. Unfortunately, Frank Krüger from the University of St. Andrews was not able to attend the workshop because his flight on May 23rd 2011 was cancelled.

After the welcome by the convenor and a presentation by the ESF representative the workshop program was organized into an evening talk, 6 topical sessions of oral contributions, 1 poster session and a “round table” discussion before the closing remarks by the co-convenor. The evening talk in the evening of the first day of the workshop was selected for giving a fresh and stimulating opening. The topical sessions were organized in 18 oral contributions in total, each restricted to 20 minutes followed by 5 minutes of discussion time. The poster session (10 posters) was scheduled for 2 hours in the evening of the second day of the workshop with vivid discussion still after the 2 hours. The “round table” discussion offered the opportunity to shape possible strategies for future projects. Participation in the discussion was widely accepted. Unfortunately, some of the participants had to leave before the discussion. Despite the tight scientific schedule all participants used the time during the extended coffee breaks, lunch and dinner for stimulating interdisciplinary discussions. The general atmosphere was extremely enthusiastic.

Discovered in 2008, iron-based superconductors (iron pnictides, iron chalcogenides) are one of the recent hot topics in solid state physics and a rapidly growing field of research. Yet, there are only a few people worldwide who fabricate thin films of these novel superconducting phases by means of pulsed laser deposition (PLD) or molecular beam epitaxy (MBE). However, thin films offer a broad spectrum of scientific and technical opportunities which cover finally two major directions: thin films, heterostructures and junctions support fundamental experiments and supply the essential functional parts in technical devices. Thus, it is suggested to ask: “Fundamental or functional?” The aim of the workshop is to define future scientific and/or technical routes for iron-based superconducting thin films. Therefore, the two main scientific objectives of the workshop were to elucidate (1) future trends in the physics of iron-based superconducting thin films and heterostructures, and (2) future applications of iron-based superconducting thin films and heterostructures. In order to address both objectives, the topics of the oral sessions included: (I) theory of iron

based superconductors, (II) thin film fabrication, (III) surface sensitive probes and vortex physics, (IV) optics and pinning capabilities, (V) strain and dimensional effects, and, (VI) future applications like junctions or terahertz wave emitters.

All workshop participants received copies of talks and posters on a USB stick. Besides the European Science Foundation (ESF) IFW Dresden and Crystec Kristalltechnologie GmbH are acknowledged financial support, and Omicron is acknowledged for donation of stationery.

2. Scientific content of the event

Presentations and contributions were organized in topical sessions (see final program) which cover the main topics in the field of iron-based superconducting thin films. In addition, the schedule allowed time for discussion and networking despite the tight cycle of talks and a final round table discussion at the end of the workshop.

- May, 23rd 2011

Welcome

The workshop was opened by convenor, Silvia Haindl, from IFW Dresden (DE). The welcome was dedicated to introduce the aim of the workshop, its schedule as well as important organisational details of the workshop flow.

Presentation of the European Science Foundation

The ESF representative, Maria Kaminska, from University of Warsaw (PL) gave a short overview of the ESF science policy in general and ESF instruments in more detail. She addressed the actual situation of cuts in the offer of different supporting instruments. Best opportunities are (i) a follow-up workshop, (ii) a research conference, and (iii) the COST program.

Evening talk: "What Do We Expect From the 2nd Century of Superconductivity?"

Davor Pavuna from EPFL (CH) entertained with a stimulating talk about the history and future of superconductivity. The recently discovered iron-based superconductors were embedded into the hunt for higher superconducting transition temperatures. He summarized with his own recent work on superconductor-insulator transitions.

- May, 24th 2011

Session 1, first talk: "Multiband Eliashberg Model for Superconductivity in Iron Pnictides"

Alexander A. Golubov from University of Twente (NL) started the morning session on theory of iron-based superconductors. After a short introduction into firm results of the band structure and the Fermi surface of these novel materials, he discussed different pairing mechanisms and symmetries of the order parameter. The main parts of his talk were dedicated to multiband features of (i) tunneling, Andreev spectra, and subgap bound states and of (ii) transport properties in the normal state. He also reviewed the possibility for strong coupling multiband superconductivity as interpretation of specific heat experiments. He finished with a note on magnetic and non-magnetic impurities and possible transitions between s⁺⁻ and s⁺⁺ order parameter symmetry.

Session 1, second talk: "A Dynamical Mean Field View on Iron Pnictides"

Silke Biermann from École Polytechnique Palaiseau (FR) first motivated dynamical mean field theory (DMFT) by opposing one-particle approaches with many-body pictures in the treatment of electronic correlations. As most prominent example, the Hubbard model was shortly revisited. Then, the role of the interaction U in the oxypnictide LaFeAsO and in FeSe was discussed concerning different correlation strengths. Finally, recent results on a similar system, BiOCuS , were presented.

Session 1, third talk: "Dichotomy Between Small and Large Magnetic Moments in Fe-Based Superconductors"

After a detailed explanation of the title of his talk Karsten Held from Vienna University of Technology (AT) raised again the question of the strength of electronic correlations in iron pnictide compounds. He reviewed neutron experimental results on the magnetic moments of different iron pnictide compounds. Local-density approximation (LDA) and DMFT calculations result in large/small magnet moments for short/long timescales which may explain the differences in the magnetic moment between local-spin-density approximation (LSDA) and neutron scattering experiments.

Session 2, first talk: "Growth of Superconducting 1111 and 122 Thin Films by Molecular Beam Epitaxy"

Hiroshi Ikuta from Nagoya University (JP) presented his recent results on pnictide thin film fabrication by MBE. The growth of epitaxial F-doped NdFeAsO films is extremely challenging. F-doping was first achieved by an NdOF cap layer on top of the NdFeAsO film. Optimization of the growth parameters lead to transition temperatures of 56 K. Finally, in order to better control F-doping Ikuta proposed annealing of the films in F-atmosphere (instead of the NdOF cap layer). His group also started with the growth of the first Co-doped and P-doped BaFe_2As_2 films by MBE.

Session 2, second talk: "New Routes for Epitaxial Thin Films of Fe-Based Superconductors"

The second talk of the session devoted to thin film fabrication was given by the convenor, Silvia Haindl from IFW Dresden (DE). She summarized the growth of Co-doped Ba-122 films by PLD at IFW Dresden. A detailed analysis of the film/substrate interface by transmission electron microscopy (TEM) revealed an iron rich interlayer formation. The findings resulted in the use of epitaxially grown Fe on MgO as an ideal template for BaFe_2As_2 films. Currently, Josephson junctions and films grown on technical substrates for high current applications are under investigation.

Session 2, third talk: "Growth, Structure, Morphology and Strain Evolution in Fe(Te,Se) Thin Films"

Emilio Bellingeri from CNR SPIN at Genova (IT) presented his studies of iron-chalcogenide films fabricated by PLD. Especially the higher transition temperature of the thin films compared to bulk material lead to the conclusion that film strain plays a crucial role. He is currently studying different influences on the film growth mode and, therefore, is planning to implement more experimental techniques like TEM or STM.

Session 3, first talk: "Vortex Matter in Type 1.5 Superconductivity"

This talk presented by Victor V. Moshchalkov from the Katholieke Universitet of Leuven (BE) was dedicated to the phenomenon of the simultaneous appearance of a type I and a type II superconducting state, which may appear in natural two-band superconductors like MgB_2 as well as in artificially created type I/type II structures. On the basis of the Ginzburg-Landau theory, a formalism to treat the so-called 1.5 type superconductivity was developed. Interestingly, vortices in 1.5 type superconductors show clustering upon the application of a

magnetic field, as shown by scanning Hall-probe and scanning SQUID microscopy. The observation of the 1.5 type superconducting state, however, requires clean samples.

Session 3, second talk: "Modulated Superfluid Density in Iron Pnictide Superconductors"

Another demonstration of powerful scanning SQUID microscopy was given by Beena Kalisky from Stanford University (US). The key challenge is to find a correlation between local structure and magnetism (spin density wave) in iron pnictides. Beena investigated twin boundaries in Co-doped BaFe_2As_2 superconductors which show an enhanced superfluid density. Twin boundaries appear in undoped or under-doped iron pnictides upon distortion when the material undergoes a structural transition from tetragonal to orthorhombic. First experiments on the vortex motion in underdoped BaFe_2As_2 suggest that twin boundaries are barriers for vortices which may explain the higher critical current densities measured in underdoped samples.

Session 3, third talk: "A Nanoscale View of Surfaces, Scattering and Superconductivity in 122 Pnictides"

Freek Masee from the University of Amsterdam (NL) shared his STM/STS results on iron pnictides. He found a Ba terminated surface structure of Co-doped BaFe_2As_2 which consists of half a Ba layer. There is no indication for a pseudogap in this compound for various Co doping levels, however, a significant gap size variation was detected.

Session 3, fourth talk: "Disorder Effects in Pnictides: A Tunneling Spectroscopy Study"

The topic of multiband superconductivity was again stressed by Yves Noat from University Pierre et Marie Curie Paris 6 (FR) in his scanning tunnelling spectroscopy (STS) experiments. Two gaps were identified in F-doped SmFeAsO polycrystals, whereas only one gap was found in $\text{Fe}(\text{Se},\text{Te})$. He discussed Suhl's model of a two-gap superconductor and its extension including quasiparticle scattering as found in the spectra for MgB_2 . Calculations of the tunnelling conductance of the two most prominent gap symmetry scenarios for iron-based superconductors, the s_{++} and the s_{+-} , were compared.

Session 4, first talk: "Optical Investigations of Superconducting 122-Iron Pnictide Thin Films"

After an introduction to the electrodynamics of superconductors, Martin Dressel from the University of Stuttgart (DE) presented recent results on Co-doped BaFe_2As_2 thin films. A small gap with $2\Delta/k_B T = 2.1$ was detected. However, a large absorption for energies below 2Δ is a hint for a finite density of states within the gap or, eventually, nodes in the gap. Similar findings were made in single crystals. Most recently, a Fabry-Perot resonator of Co-doped BaFe_2As_2 thin films was utilized in transmission to extract the temperature dependence of the penetration depth.

Session 4, second talk: "Magneto-Optical Visualization of Flux Distribution in Superconducting Pnictide Films"

Magneto-optics is a powerful tool in order to investigate critical current distributions in superconducting films. The principles of this method were presented by Vitaliy Yurchenko from University of Oslo (NO). Local perturbations of the current flow or thermo-magnetic effects of the trapped magnetic flux are studied. First experiments on $\text{Fe}/\text{Ba}(\text{Fe},\text{Co})_2\text{As}_2$ bilayers indicate a strong interaction between the Fe and the superconducting film.

Session 4, third talk: "Modelling Flux Pinning By Columnar Defects in High-Kappa Superconductors"

This talk given by Petriina Paturi from University of Turku (FI) comprises her work on flux pinning modelling including columnar defects. Columnar (or c-axis oriented) defects were extensively studied in $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ thin films and coated conductors containing BaZrO_3 in the last decade. However, columnar oxygen impurity phases have been recently reported in PLD

grown $\text{Ba}(\text{Fe},\text{Co})_2\text{As}_2$ films. The presented model is capable to explain the magnetic field as well as the angular dependence of the critical current density in superconducting thin films containing columnar defects.

Session 4, fourth talk: "Interplay Between Doping and Vortex Pinning In Iron-Based Superconductors"

Kees Van der Beek from École Polytechnique Palaiseau (FR) reviewed weak collective and strong pinning in Fe-based superconductors. He discussed his findings for PrFeAsO_{1-y} that point like defects of oxygen vacancies are responsible for weak pinning. Disorder and inhomogeneities on the nanoscale which result in a variation of the superfluid density or critical temperature are responsible for strong pinning in the oxypnictides.

Poster Session

The poster session took place in the evening of May 24th. There were 10 poster presentations in total on physical or technological aspects of Fe-based superconductors, and possible technical applications for thin films of these new materials, such as THz wave emission. Because of their layered structure, the oxypnictides are prospective candidates for THz wave emitters, but would have to compete with the cuprate high temperature superconductors such as $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$.

- May, 25th 2011

Session 5, first talk: "Transport Properties of Micro- and Submicrometer Patterned Thin $\text{Ba}(\text{Fe},\text{Co})_2\text{As}_2$ Films"

There is strong interest in the fabrication of superconducting detectors based on the novel iron pnictide compounds. Konstantin Il'in from KIT, Karlsruhe (DE), reported on preliminary results on lithographically patterned, Co-doped BaFe_2As_2 thin films. Micro- and submicrometer small bridges were used for the determination of the depinning current. Yet, device fabrication is technologically challenging and optimization is needed; especially self heating effects have to be avoided.

Session 5, second talk: "Superconducting Properties of $\text{Fe}(\text{Te},\text{Se})$ Thin Films With Critical Temperatures Enhanced by Strain"

Carlo Ferdeghini from CNR SPIN Genova (IT) discussed in more detail the effect of strain in $\text{Fe}(\text{Te},\text{Se})$ thin films. According to the Ginzburg parameter, "11" materials show significant thermal fluctuations despite their low critical temperature. In addition, the investigation of high upper critical fields at low temperatures may reveal a Fulde-Ferrell-Larkin-Ovchinnikov state (FFLO).

Session 6, first talk: "Josephson Junctions with Iron Based Superconductors"

The last session is fully devoted to technological applications based on the new superconductors. First Josephson junctions on the basis of Co-doped BaFe_2As_2 thin films were fabricated by Paul Seidel's group at University of Jena (DE). He gave a brief introduction in the different types of junctions and the Josephson effect. There are a couple of junctions realized on iron pnictides. Especially oxypnictides are favored candidates for intrinsic junctions.

Session 6, second talk: "C-Axis Transport of Pnictide Superconductors"

Oxypnictides or artificially layered structures are optimal candidates for THz wave emitters. Paul Müller from University of Erlangen-Nürnberg (DE) reported on reversible shifts in the transition temperature by carrier injection. He reviewed examples for $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$ and showed first results on oxypnictide thin films and single crystals.

Round Table Final Discussion

In the final discussion possible routes for iron-based superconducting thin films were vividly discussed. First, high current applications like coated conductors were addressed. A final status of iron pnictide coated conductors is unclear yet, but there are possible advantages especially at low temperatures (4.2K) to compete with conventional superconductors. In addition, the magnetic field performance has to be investigated in more detail. However, the major challenge will be grain boundary control and the suppression of weak links. Most of the participants agreed.

Microwave devices are another possibility for the application of iron based superconducting films. The main goal is here to deposit films on substrates with low dielectric constant such as MgO to avoid high frequency losses. Similarly, junction devices are favored since technical difficulties are estimated to be less severe compared to coated conductor processing. There was also the suggestion to construct a demonstration example device within future project collaborations.

From the viewpoint of fundamental investigations, analysis of strain effects was mentioned. Iron pnictide and iron chalcogenide compounds possess an electronic phase diagram rich of interesting features of fundamental interest. Important questions, as addressed already by oral presentations in the workshop, center on the correlation between magnetism, structure and superconductivity.

Finally, heterostructures including iron pnictide compounds were mentioned to be attractive for both, fundamental investigations and functional devices. Especially, Fe/iron pnictide bilayers constitute a nice example of a ferromagnetic/superconducting heterostructure. In total, the final discussion offered an excellent opportunity to shape possible future collaborations and to share ideas for the development track of iron pnictide thin films.

3. Assessment of the results, contribution to the future direction of the field, outcome

The ESF workshop on Physics and Technology of Iron Pnictide Thin Films offered a European platform for scientists active in this rapidly developing field of research. The accepted participation in the workshop showed the huge interest in this topic within leading European research groups and experts.

Further common actions have to be planned accurately. Unfortunately, the cut in ESF instruments limit further networking possibilities. However, the COST action as well as a common proposal within the EU 7th framework programme is a prospective strategy. Also bilateral cooperation projects were discussed. Definitely, a strong collaborative network will be needed in order to progress and compete with research groups from USA and Japan.

In terms of technological application development, a demonstration example device will be an important point. Agreement was achieved for the exploitation of iron-based superconductors in electronic applications operated at low temperatures. Following possible applications were considered: (i) microwave detectors, bolometers; (ii) Josephson junction devices, SQUIDS; (iii) high current applications like coated conductors; (iv) multifunctional heterostructures/multilayers. The competition with established commercially used materials will be challenging. At present, the performance of applications based on the new superconductors cannot be judged since still important knowledge is missing and optimization in thin film growth is not yet attained.

Most interesting fundamental questions concerning iron-based superconductors are related to (i) electronic correlations and the electronic phase diagram; (ii) the multiband nature of these compounds; (iii) the origin of the Cooper pairing and the order parameter symmetry and (iv) the high upper magnetic field and possible FFLO state.

4. Final programme

Monday, 23rd of May 2011

- Afternoon *Arrival*
- 17.00 **Registration** – *distribution of workshop material*
- 18.00 *Dinner*
- 20.00 **Welcome by Convenor**
Silvia Haindl (IFW, Dresden, Germany)
- Presentation of the European Science Foundation (ESF)**
Maria Kaminska (ESF Standing Committee for Physical and Engineering Sciences (PESC))
- 20.20-21.00 Evening Talk**
- “What Do We Expect From the 2nd Century of Superconductivity?”**
Davor Pavuna (EPFL, Lausanne, Switzerland)
- 21.00 *Get-together, informal (Hotel Elbresidenz)*

Tuesday, 24th of May 2011

- 09.00-10.40 Session I: Theory of Iron Pnictide Superconductors**
- 09.00-09.25 **Presentation 1: “Multiband Eliashberg Model for Superconductivity in Iron Pnictides”**
Alexander A. Golubov (University of Twente, Enschede, The Netherlands)
- 09.25-09.50 **Presentation 2: “A Dynamical Mean Field View on Iron Pnictides”**
Silke Biermann (École Polytechnique, Palaiseau, France)
- 09.50-10.15 ~~**Presentation 3: “Signatures Of Orbital Ordering in Iron Pnictides”**~~
~~**Frank Krüger** (University of St. Andrews, Scotland, United Kingdom)~~
- 10.15-10.40 **Presentation 4: “Dichotomy Between Small and Large Magnetic Moments in Fe-Based Superconductors”**
Karsten Held (University of Technology, Vienna, Austria)
- 10.40-11.15 *Coffee / Tea Break*
- 11.15-12.30 Session II: Thin Film Fabrication of Iron Pnictide Superconductors**
- 11.15-11.40 **Presentation 1: “Growth of Superconducting 1111 and 122 Thin Films by Molecular Beam Epitaxy”**
Hiroshi Ikuta (Nagoya University, Nagoya, Japan)
- 11.40-12.05 **Presentation 2: “New Routes for Epitaxial Thin Films of Fe-Based Superconductors”**
Silvia Haindl (IFW, Dresden, Germany)
- 12.05-12.30 **Presentation 3: “Growth, Structure, Morphology and Strain Evolution in Fe(Te,Se) Thin Films”**
Emilio Bellingeri (CNR SPIN, Genova, Italy)
- 12.30-14.00 *Lunch*
- 14.00-15.40 Session III: Surface Sensitive Probes & Vortex Physics**
- 14.00-14.25 **Presentation 1: “Vortex Matter in Type 1.5 Superconductivity”**
Victor V. Moshchalkov (Katholieke Universiteit, Leuven, Belgium)
- 14.25-14.50 **Presentation 2: “Modulated Superfluid Density in Iron Pnictide Superconductors”**
Beena Kalisky (Stanford University, Stanford, United States)

- 14.50-15.15 **Presentation 3: "A Nanoscale View of Surfaces, Scattering and Superconductivity in 122 Pnictides"**
Freek Masee (University of Amsterdam, Amsterdam, The Netherlands)
- 15.15-15.40 **Presentation 4: "Disorder Effects in Pnictides: A Tunneling Spectroscopy Study"**
Yves Noat (Université Pierre et Marie Curie Paris 6, Paris, France)
- 15.40-16.20 *Coffee / tea break*
- 16.20-17.55** **Session IV: Optics & Pinning Capabilities**
- 16.20-16.40 **Presentation 1: "Optical Investigations of Superconducting 122-Iron Pnictide Films"**
Martin Dressel (Universität Stuttgart, Stuttgart, Germany)
- 16.45-17.10 **Presentation 2: "Magneto-Optical Visualization of Flux Distribution in Superconducting Pnictide Films"**
Vitaliy Yurchenko (University of Oslo, Oslo, Norway)
- 17.10-17.35 **Presentation 3: "Modelling Flux Pinning By Columnar Defects in High-Kappa Superconductors"**
Petriina Paturi (University of Turku, Turku, Finland)
- 17.35-18.00 **Presentation 4: "Interplay Between Doping and Vortex Pinning In Iron-Based Superconductors"**
Kees van der Beek (École Polytechnique, Palaiseau, France)
- 18.00-18.30** **Time for Discussion & Networking**
- 18.30 *Dinner*
- 20.00-22.00** **Poster Session**
- Poster 1: "Magnetic State in the Fe-Based Superconductors: Phase Diagram and Anisotropies"**
María José Calderón (CSIC, Madrid, Spain)
- Poster 2: "Spectroscopy and Transport Measurements of Fe Superconductors"**
Lesley Cohen (Imperial College, London, United Kingdom)
- Poster 3: "Retention of the tetragonal to orthorhombic structural transition in F-substituted SmFeAsO: a new phase diagram for SmFeAsO_{1-x}F_x"**
Carlo Ferdeghini (CNR SPIN Genova, Italy)
- Poster 4: "Hall-Array, Gradiometric Measurements of Field and Temperature Variations of Critical Current and Its Anisotropy in Iron-Based Superconductors"**
Marcin Konczykowski (École Polytechnique, Palaiseau, France)
- Poster 5: "Superconductivity and Spin Fluctuations in Iron Pnictides: FLEX Study"**
Jan Kuneš (Academy of Sciences, Prague, Czech Republic)
- Poster 6: "Pinning Energy in Iron Based Superconductors"**
Angela Nigro (University of Salerno, Italy)
- Poster 7: "Atomic Resolution Imaging And Spectroscopy of Thin Film Interfaces"**
Eva Olsson (Chalmers University of Technology, Gothenburg, Sweden)
- Poster 8: "Terahertz Wave Emission of Intrinsic Josephson Junctions in Layered Superconductors"**
Lütfi Özyüzer (İzmir Institute of Technology, İzmir, Turkey)
- Poster 9: "Models for THz Emission From BSCCO Single Crystals"**
Nils Falsig Pedersen (Danmarks Tekniske Universitet, Lyngby, Denmark)

Poster 10: "Strain Driven Model Vortex Pinning Mechanism Induced By Incoherent Interfaces in Superconducting Nanocomposites"

Anna Palau (ICMAB-CSIC Barcelona, Bellaterra, Spain)

Wednesday, 25th of May 2011

09.30-10.20	Session V: Strain & Dimensional Effects
09.30-09.55	Presentation 1: "Transport Properties Of Micro- and Sub-Micrometer Patterned Thin Ba(Fe,Co)₂As₂ Films" Konstantin Il'in (Karlsruher Institut für Technologie, Karlsruhe, Germany)
09.55-10.20	Presentation 2: "Superconducting Properties of Fe(Te,Se) Thin Films With Critical Temperature Enhanced By Strain" Carlo Ferdeghini (CNR SPIN Genova, Italy)
10.20-11.10	Session VI: Junctions & Future Applications
10.20-10.45	Presentation 1: "Josephson Junctions with Iron Based Superconductors" Paul Seidel (Friedrich Schiller Universität Jena, Jena, Germany)
10.45-11.10	Presentation 2: "C-Axis Transport of Pnictide Superconductors" Paul Müller (Universität Erlangen-Nürnberg, Erlangen, Germany)
11.10-12.00	<i>Coffee/Tea Break & Time for Discussion & Networking</i>
12.00-13.15	Round Table: Future Trends in Physics and Technology of Iron Pnictide Thin Films – Discussion on Follow-Up Activities
13.15-13.30	Closing Remarks Bernhard Holzapfel (IFW, Dresden, Germany)
13.30-15.00	<i>Lunch</i>
15.00	<i>End of Workshop and departure</i>

5. Final list of participants

Bellingeri, Emilio	CNR SPIN Genova	IT
Biermann, Silke	École Polytechnique Palaiseau	FR
Calderón, María José	CSIC Madrid	ES
Cohen, Lesley	Imperial College London	UK
Dressel, Martin	University of Stuttgart	DE
Ferdeghini, Carlo	CNR SPIN Genova	IT
Golubov, Alexander A.	University of Twente	NL
Haindl, Silvia	IFW Dresden	DE
Held, Karsten	Vienna University of Technology	AT
Holzappel, Bernhard	IFW Dresden	DE
Ikuta, Hiroshi	Nagoya University	JP
Il'in, Konstantin	Karlsruher Institut für Technologie	DE
Kalisky, Beena	Stanford University	US
Konczykowski, Marcin	École Polytechnique Palaiseau	FR
Kuneš, Jan	Academy of Sciences Prague	CZ
Massee, Freek	University of Amsterdam	NL
Moshchalkov, Victor V.	Katholieke Universitet Leuven	BE
Müller, Paul	University of Erlangen-Nürnberg	DE
Nigro, Angela	University of Salerno	IT
Noat, Yves	University Pierre et Marie Curie Paris 6	FR
Olsson, Eva	Chalmers University of Technology	SE
Özyüzer, Lütfi	İzmir Institute of Technology	TR
Palau, Anna	ICMAB CSIC Barcelona	ES
Paturi, Petriina	University of Turku	FI
Pavuna, Davor	EPFL, Lausanne	CH
Pedersen, Niels Falsig	Technical University of Denmark	DK
Seidel, Paul	University of Jena	DE
Van der Beek, Kees	École Polytechnique Palaiseau	FR
Yurchenko, Vitaliy	University of Oslo	NO
ESF Representative		
Kaminska, Maria	University of Warsaw	PL

6. Statistical information on participants

As shown in figures 1a)-c) from 29 participants from 17 nations (15 European countries, USA and Japan) in total there were 9 female participants (31%) and 11 participants of age below 40 (38%).



