2016 FNR ANNUAL REPORT

Excellence and quality of research, as well as long-term socio-economic benefits these are the two cardinal ideas that must mark the path of Luxembourg's public research. It is only through them that we can achieve our ambitious goal of establishing Luxembourg as a knowledge-based society focused on science, research and innovation, to contribute to the economic diversity, social well-being and the future prosperity of our country.

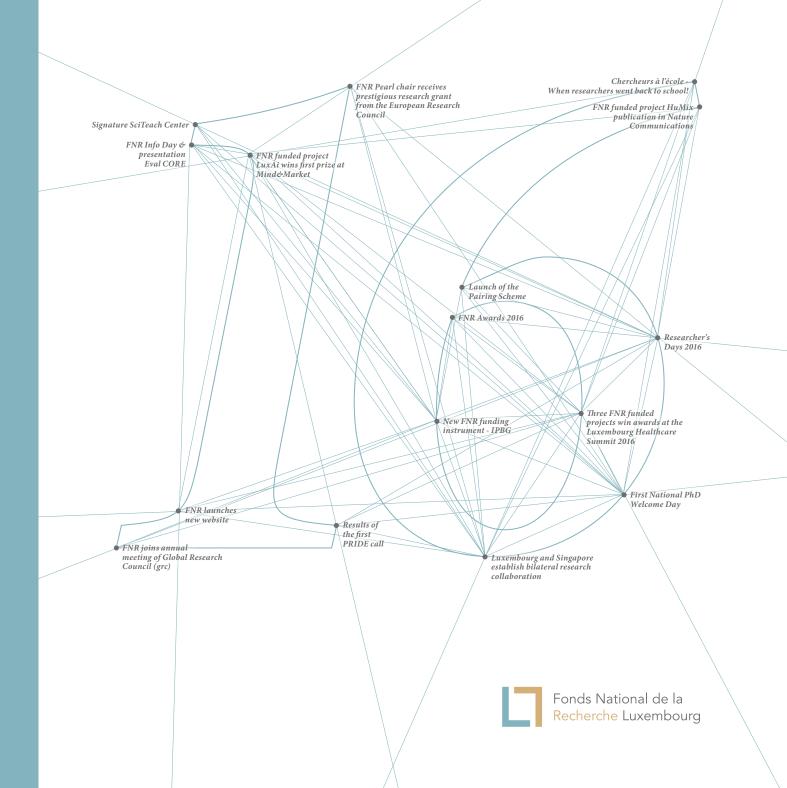
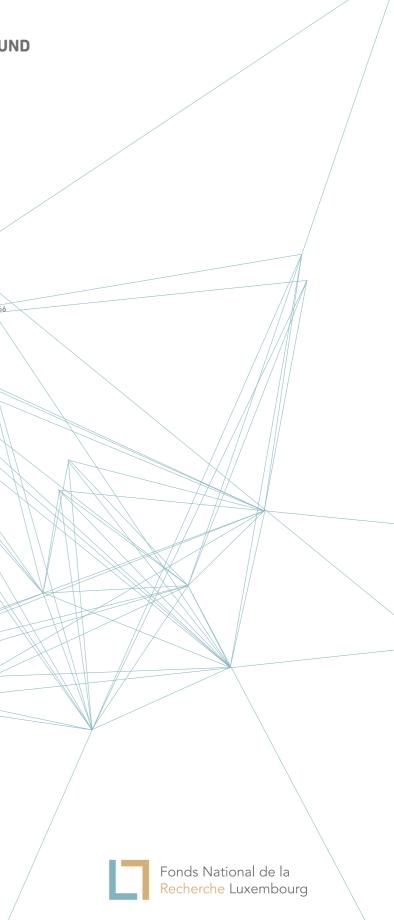


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01 2016 A YEAR OF SIGNIFICANT CHANGE

In 2016, the FNR had a key role in the implementation of important inter-institutional decisions and it strengthened its international visibility.

In July 2016, important and significant changes took place Furthermore, in December 2016, the research at the governance level of the FNR. Yves Elsen was institutions and the FNR created the LARI - Luxembourg appointed Chairman of the Board of Governors of the Agency for Research Integrity. It was set up as an a.s.b.l. University of Luxembourg. Due to legal incompatibility (non-profit organisation) following intense preparations clauses, he immediately stepped down from the Board of and negotiations carried out by the FNR. This agency will the FNR, of which he had been a member since 2005 and become operational in 2017, as soon as a national and Chair since 2010. Véronique Hoffeld, up until then the independent commission has been appointed. Vice-Chair, replaced him as Chair of the Board of the FNR.

During 2016, the FNR worked on the implementation of Recherche took place; the topic under the spotlight was an inter-institutional agreement on doctoral training and the transfer of knowledge and technology. Around 100 the rights governing the supervisory framework of researchers and guests attended this meeting. It was doctoral students in Luxembourg. It was under the organised by the Ministry of Higher Education and leadership of the FNR that an agreement was negotiated Research with the active support of the FNR. between the University of Luxembourg, the Luxembourg Finally, at international level, the FNR signed an Institute of Health (LIH), Luxembourg Institute of important cooperation agreement with Singapore's Socio-Economic Research (LISER) and Luxembourg National Research Foundation. This agreement was Institute of Science and Technology (LIST) research signed in November 2016 during Prime Minister Xavier centres, and the Max Planck Institute (MPI). Under the Bettel's visit to Singapore. In 2017, thematic calls for joint terms of this agreement, qualified researchers from the research projects will be launched in the fields of research centres shall be given the authority to materials, FinTech and stand-alone systems. supervise doctoral students enrolled at the University. This was a long-standing request made by the FNR and one of the commitments made during the first edition of the Assises de la Recherche, at the end of 2014.



On 1 December 2016, the second Assises de la

Véronique Hoffeld, Chair of the Board Thierry Wolter, Vice-Chair of the Board Marc Schiltz, Executive Head

> 1. Véronique Hoffeld 2. Thierry Wolter 3. Marc Schiltz

02 FNR CHAIR OF THE BOARD

Words of thanks to Yves Elsen



For ten years, Yves Elsen was a member of the Board of the Luxembourg National Research Fund, five of which as its Chair (since 2010). In July 2016, he left the FNR to take the Presidency of the Board of Governors of the University of Luxembourg.

Under his impetus, the Luxembourg National Research Fund has become a dynamic organisation, whose central role within the national research and innovation system is unanimously recognised today. Yves Elsen formulated a clear vision for public research, guided by the belief that the significant investments made over the years should generate a benefit for the country in the medium and long term. He has always defended the quest for excellence and quality of research, and he realised that the FNR had an essential role to play in this regard. Under his governance, the FNR has developed the socio-economic valorisation of research results and partnerships between public research and business. Similarly, he has actively supported the international orientation of Luxembourg research and has encouraged the the FNR's Executive Office to push collaborations beyond Europe, particularly in Asia.

Yves Elsen has succeeded in inspiring an unprecedented dynamism at the FNR, at all levels of the organisation, whose state of mind today is exactly the opposite of that of an anonymous administrative entity. The FNR is today often cited as an example of good governance of a public institution. Merit is entirely his credit.

The FNR would like to thank Yves Elsen for his unwavering dedication.

Under his impetus, the Luxembourg National Research Fund has become a dynamic organisation, whose central role within the national research and innovation system is *unanimously recognised today.*

Editorial Véronique Hoffeld

Excellence and quality of research, as well as long-term socio-economic benefits - these are the two cardinal ideas that must mark the path of Luxembourg's public research. It is only through them that we can achieve our ambitious goal of establishing Luxembourg as a knowledge-based society focused on science, research and innovation, to contribute to the economic diversity, social well-being and the future prosperity of our country.

The role of public research is to be the powerhouse of the Luxembourgish research ecosystem. It has the potential to actuate others, but to achieve impact, it also needs the determination and the energy of the private sector. The Luxembourg public research ecosystem has been consolidated and the Belval campus, which embodies both the country's past and the future of research, is its showcase. Abroad, we can now sell the excellence of our ecosystem, because we have an absolutely unique business card.

Within the institution that I have been chairing since July 2016, we have been working in that direction for years now. I intend to continue on the path of my predecessor Yves Elsen and maintain the FNR as a centre of excellence and innovation which implements the research policy of the country. We will continue to implement fair and transparent processes in our decision making and foster an open dialogue with the scientific community. We will continue to invest public funds in research projects and high-quality human capital. We will also continue to promote scientific literacy to a wider audience, to respond to societal expectations and to ensure the sustainability of the ecosystem we have helped to put in place.

Véronique Hoffeld, Chair of the Board

Excellence and quality of research, -- these are the two cardinal ideas that must mark the path of Luxembourg's *public research.*

FNR ANNUAL REPORT 2016 | FNR CHAIR OF THE BOARD | 4 > 5

/éronique Hoffeld Shair of the Board

03 OBJECTIVES, STRATEGY, POLICY

Luxembourg National Research Fund *Research with impact*

WHAT WE DO

The Luxembourg National Research Fund (FNR) is the main funder of research activities in Luxembourg. The FNR invests public funds and private donations into research projects in various branches of science and the humanities, with an emphasis on selected core strategic areas. Furthermore, the FNR supports and coordinates activities to strengthen the link between science and society and to raise public awareness for research. It also advises the Luxembourg government on research policy and strategy.

OUR VISION

To establish Luxembourg as a leading knowledgebased society through science, research and innovation, thereby contributing to the country's economic diversification and future prosperity.

OUR MISSION

To set up a sustainable world-class research system in Luxembourg that will generate societal and economic impact in key strategic areas.

OUR STRATEGIC PRIORITIES

The FNR aims to be a driving force for Luxembourg's innovation capabilities and focuses on the three following strategic objectives to foster research with impact:

 Attaining scientific leadership in key areas By setting the highest quality standards, the FNR contributes to establishing international research

excellence in Luxembourg. By attracting and training the most talented scientists, the FNR helps to build critical mass in key research areas, thereby supporting economic development and societal progress.

• Turning public research into a competitive advantage for Luxembourg

The FNR supports the advancement of Luxembourg's knowledge-based economy by supporting industryinformed research, by reinforcing co-operation between public research and innovative industries and by facilitating the commercial exploitation of research results.

• Anchoring Science and Research in Society The FNR promotes the active involvement of researchers and scientists in addressing current and future societal challenges. To ensure that research is established sustainably in the public consciousness as an important pillar of Luxembourg's knowledge society, the FNR supports an active exchange between scientists and the public at large.

HOW WE WORK

Our most highly valued criteria are excellence and quality in research. In order to identify the most promising and most excellent projects and researchers, we systematically submit funding requests to an assessment by independent international experts. The FNR implements the "Principles of Scientific Merit Review", which embody the highest international standards of expert assessment, transparency, impartiality, confidentiality and integrity.

OUR CORE VALUES

- Towards researchers and research institutions We implements a fair and transparent process in our decision taking and nurture an open dialogue with the scientific community.
- Towards the government, tax-payers and donators We are accountable for the usage of funds that we are entrusted with and we strive for efficiency in our operations.
- Towards the general public We care for the long-term interest of the country and consider engagement with society as a constitutive part of science.
- Towards our collaborators We aim to stimulate talent-development and competence building of our staff, who translate the FNR's vision, mission and core values into action.

04 SELECTION PROCESS

Through a rigorous selection process, the FNR aims to fund the most excellent and promising research. FNR's selection process is therefore based on scientific merit and applies the highest standards of transparency, impartiality and integrity.So how can researchers apply for FNR funding and how are their proposals evaluated?

First, the FNR launches calls for project proposals in its different research programme. Second, a project has to be submitted to the FNR.

Then the FNR identifies the most suitable independent experts for each project and systematically submits funding proposals for evaluation to them. The names of these experts are not disclosed by the FNR so that they can provide their assessment in full confidentiality. These experts provide written reviews on the merits of the proposals, based on the following criteria:

• Scientific or technological innovativeness and excellence - feasibility of the project- expected results

Additional specific criteria might be applicable depending on the target programme.

In a next step, the FNR appoints panels of independent, high-profile scientists and experts to assess and compare the merits of all the proposals that have been submitted within a given programme or research field.



Each panel establishes a ranking for funding the most excellent and promising projects. For some FNR schemes, the panel also conducts interview sessions of candidates in addition to the written reviews. The formal decision to fund a proposal is taken by the FNR, in strict compliance with the funding recommendations issued by the expert panels.

To be transparent, a complete feedback is sent to all the submitting researchers including the reviews and a feedback of the expert panel. This gives the researchers the opportunity to eventually resubmit their an improved proposal in a next call.

The FNR has, on average, a 30% success rate.

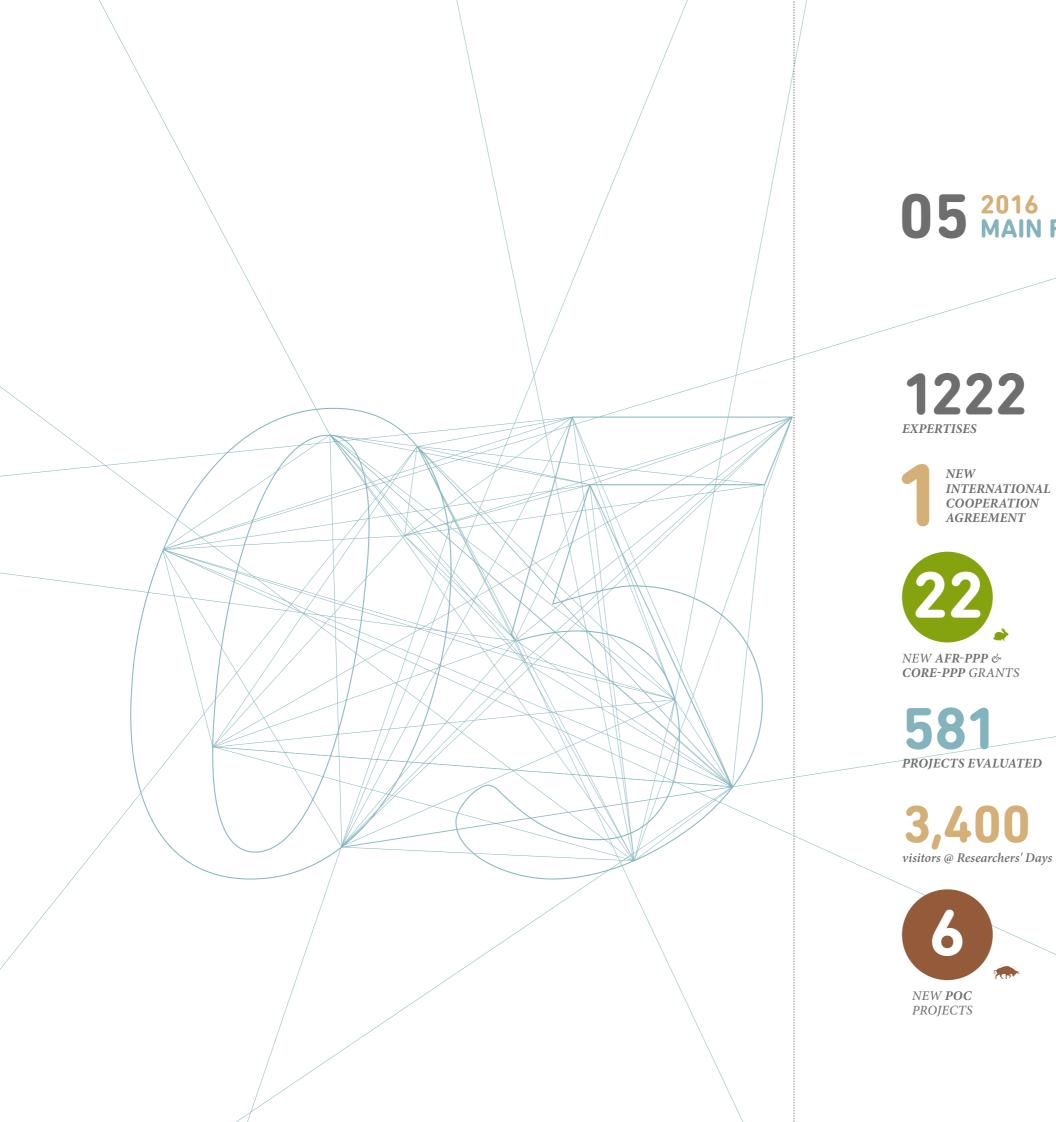
The FNR aims to continuously evaluate and improve its assessment and selection processes to keep up with the highest international standards of transparency, impartiality and integrity. In 2015, an independent assessment of the CORE selection process was undertaken by the Evaluation Center of the University of Michigan. It concluded that "The FNR successfully (implements) what are currently considered 'best practices' in peer-review internationally" also, the FNR has also been delivered the ISO-9001 certificate that attests quality standards of the management system at FNR.

scientific merit

transparency

impartiality

integrity



05 MAIN FIGURES

1222 **EXPERTISES**

NEW

INTERNATIONAL **COOPERATION** AGREEMENT



RESCOM CONFERENCES, WORKSHOPS & LECTURE SERIES FUNDED

195 **FUNDED PROJECTS**



NEW AFR-PPP ఈ **CORE-PPP** GRANTS



NEW PRIDE PROJECTS

> NEW FNR **PEARL** CHAIRS





FNR ANNUAL REPORT 2016 | 2016 MAIN FIGURES | 10 > 11







NEW PSP -PROMOTING SCIENCE TO THE PUBLIC PROJECTS











NEW ATTRACT FELLOWS



06 FNR ACTIVITY REPORT FOR 2016

I. MAJOR PROJECTS

The "Pairing Scheme - Politics meets Research" is a new project which was initiated in 2016 and will be concluded in 2017. It has been carried out in close cooperation with Parliament (Chambre des députés). Following a call for candidates, 17 'couples' were formed - each comprising a researcher and a Member of Parliament. The 'couples' met at least twice in their respective professional environments. The objective is to establish sustainable links between the world of politics and research.

After the first call for proposals for the new PRIDE programme in 2015, the assessment of the proposals took place at the start of 2016. In the end, 15 doctoral training units were approved for financing.

The FNR also managed Luxembourg's participation in the "Teaming" segment of the H2020-Widespread programme initiated by the European Commission. A joint project of the LIH and the LCSB with the University of Southern Denmark (Odense) targeting digital innovation in the medical sector has been submitted. A decision is expected at the start of 2017.

The FNR has been working with the Ministry of the Economy (MECO) to develop an initiative in the area of additive manufacturing. A 'package' of FNR and MECO financing instruments was established to back a national initiative in this area. The LIST and the University of Luxembourg were called upon to develop a joint proposal, with support from Luxinnovation.

Along similar lines, the FNR has implemented a financing programme for a whole series of doctoral and post-doctoral grants with the objective of supporting significant industrial cooperation (IPBG – Industrial Partnership Block Grant). A joint project involving LIST and the Goodyear Innovation Centre was approved for funding.

In collaboration with the University of Luxembourg, the SCRIPT and IFEN, the FNR implemented the "SciTeach Centre" project, a pilot project in the framework of the new PSP-Flagship programme. Its role is to develop introductory science modules as part of the initial and continuing training of primary school teachers. A new teaching and educational resource centre will provide further support for this initiative.

During the year, the FNR commissioned an external study on the impact of the CORE (materials), INTER (materials), PEARL and ATTRACT programmes, which was carried out by the Swiss agency INTERFACE. The survey was completed and presented in early 2017.

Together with Luxinnovation, the FNR continued to develop a brand image for the Belval site as well as a global promotional strategy.

The FNR divided its Promoting Science to the Public (PSP) programme into two strands to provide an optimum solution for all types of PSP projects and further strengthen the exchange between science and society. The goal of the new PSP-Flagship scheme is to help set up long-term science outreach activities with a sustainable and lasting impact on the promotion of science to the public in Luxembourg.

II. FNR GOVERNANCE

Board

The Board of the FNR held five meetings in 2016. In July 2016, Yves Elsen stepped down from the FNR Board following his appointment as Chairman of the Board of Governors of the University of Luxembourg. Véronique Hoffeld, up until then the Vice-Chair of the Board, was appointed as Chair of the Board. Thierry Wolter, up until then a member of the Board, was appointed Vice-Chairman.

In September, Roger Assaker was appointed as a new member of the Board, taking over the position left vacant following the departure of Yves Elsen, a role he will hold until the mandate has expired.



Signature of the Luxembourg Agency for Research Integrity statutes

- The Chairmanship (Yves Elsen, Chairman, and Véronique Hoffeld, Vice-Chair of the Board, and Marc Schiltz, Secretary General) met three times during the first half of 2016. The new Chairmanship (Véronique Hoffeld, Thierry Wolter and Marc Schiltz) met three times during the second half-year of 2016.
- The Audit and Finance Committee of the Board of Directors (comprising Andrée Billon, Hjoerdis Stahl and Thierry Wolter) held five working sessions, three of which by circular procedure.
- The Appointments and Remuneration Committee (CNR) of the Board (comprising Yves Elsen (ex-officio member), Véronique Hoffeld (ex-officio member) and Christiane Hoffmann) met once in April 2016. Following the departure of Yves Elsen, Thierry Wolter joined the CNR. Under this new set-up, the CNR met once in November 2016.

Robert Kerger, in his capacity as Government Commissioner, is allowed to attend committee meetings.

On 13 and 14 July 2016, the Board of the FNR convened at an extraordinary Board of the Executive Office meeting. This was the first meeting with members of the Executive Office in order to establish the future strategic direction of the FNR.

Scientific Council

The FNR's new Scientific Council met for the first time on 27 November 2015. In 2016, it met twice under the chairmanship of Yves Fromes.

III. PROGRAMMES AND PRIORITY ACTIONS

The activities carried out during the year for the three strategic objectives laid down in the FNR's current multi-annual contract with the Government are summarised as follows:

OBJECTIVE 1:

To promote scientific quality and excellence in research

CORE

The FNR received 110 proposals, 108 of which were eligible. After assessment by independent international experts, the FNR selected 32 projects for funding for a total of EUR 18.3 million.

In the CORE Junior programme, 13 of the 32 proposals submitted were accepted. Under bilateral international cooperation projects implemented in CORE, one of the 13 proposals submitted for bilateral projects was selected for funding.

The study conducted by the Western Michigan University on the evaluation procedure of the CORE programme, as well as the selection panels, confirmed that the project selection process has been applied according to the highest international standards.

OPEN

The OPEN programme was revived in 2016, after having been suspended in 2015 as established in the multiannual contract. Two of the six proposals put forward have been accepted and will receive funding to the tune of EUR 1.2 million. The programme will be continued in 2017.

INTER – International Cooperation

The FNR has assessed 165 proposals and granted funding to 12 projects for a total of EUR 4 million.

As part of the EUROSTARS programme, one project has been granted EUR 300,000 in funding.

The FNR also assessed 37 INTER-Mobility (international mobility) proposals, 14 of which were approved for a total budget of EUR 1.1 million.

A cooperation contract was concluded with Singapore's National Research Foundation (NRF) as part of a visit to Singapore in November with the Luxembourg delegation. An initial call for projects will be launched in 2017.

Cooperation contracts with RCUK (UK) and NCBR (Poland) were renewed for a five-year period.

RESCOM – Support for Research Communication

The FNR assessed 19 proposals, 13 of which were selected and received financing totalling EUR400,000.



Chris Corbyn (Evaluation Centre of the Western Michigan University) presenting the results the results of the external evaluation of the CORE selection process

OBJECTIVE 2:

To strengthen research that generates economic and societal impact

Proof of Concept (POC)

The PoC programme was launched in 2014 and, following one year of consolidation, 2016 proved to be a highly successful year with a sharp increase in the quality of the projects submitted. In fact, six projects were assessed and selected, receiving EUR 2 million in financing. As a direct result of the PoC projects, two spin-off companies of the University of Luxembourg were created: LuxAI and BlackSwan.

Knowledge & Innovation Transfer Support (KITS)

Launched in 20/15, the KITS programme is a supplementary and vital component of the PoC programme, enabling the transfer of knowledge to capitalise on research results. A call for KITS projects was again (aunched at the end of 2016, with two deadlines in 2017.

CORE and PhD/PostDoc (AFR) for Public-Private Partnerships

2016 was the first year of activity following the launch of the new CORE-PPP and AFR-PPP programmes in December 2015. In total, eight submitted CORE-PPP projects and 38 submitted AFR-PPP projects were assessed. Six CORE-PPP and 16 AFR-PPP projects were selected following the assessment and granted financing to the tune of EUR 5.4 million.

The Industrial Partnership Block Grant (IPBG) pilot programme, launched in 2016, aims to nurture cooperation between Luxembourg companies active in the field of research and development and public research institutions in Luxembourg, as well as financing positions for doctoral and post-doctoral students. At least 25% of the financing must be provided by the industrial partner. Following the assessment of two IPBG projects, one project was approved, receiving EUR 2.7 million in funding.

Science in Society

In order for research to be permanently anchored in the public consciousness, the FNR promotes an active exchange between scientists and the general public. In 2016, the FNR renewed its existing Mr Science media partnerships with RTL Télé Lëtzebuerg, RTL Radio and Eldoradio, and continued to cooperate with Radio 100.7 as part of the Café Scientifique programme. The science.lu website still attracts and retains visitors, with over 1,000,000 pages read (since 2013), over 450,000 individual visits to the site (since 2013), over 18,000 fans on Facebook and over 170,000 views on YouTube.

In 2016, the FNR also reached out to the general public via a number of events, including the Researchers' Days. This event attracted an increasing number of visitors, with 3,400 people attending over two days. As part of the Chercheurs à l'école initiative, 64 researchers visited 48 classes in 21 secondary schools in Luxembourg. The past year also witnessed the launch of a new exchange platform, the Pairing Scheme – Politics Meets Research, during which 17 parliamentarians and 17 researchers met in their respective working environments in order to promote a better understanding of the two fields.

Finally, the FNR also offered 14 training courses for journalists, researchers, teachers and youth workers on communicating and raising awareness of science.

PSP – Promoting Science to the Public (PSP-Classic + PSP-Flagship)

In 2016, the PSP programme was further strengthened by the additional PSP-Flagship component, enabling funding over a longer period and a more sustainable impact.

As part of the PSP-Classic, the FNR has assessed 48 proposals and granted funding to 39 projects for a total of EUR 420,000. As part of the first call of the PSP-Flagship programme, the FNR has assessed six proposals and granted funding to two projects for a total of EUR 746,000.

FNR AWARDS 2016

On 14 October 2016, the 8th FNR Awards ceremony was held at the Halle des poches à fonte at the Belval site in the presence of Marc Hansen, the Minister for Higher Education and Research. Seven researchers and science communicators were acknowledged by the FNR in the categories 'Outstanding Scientific Publications', 'Outstanding PhD Thesis' and 'Outstanding Promotion of Science to the Public'. In his speech, the Minister for Higher Education and Research underlined the importance of raising awareness of research results in Luxembourg, both among Luxembourg and foreign scientists and the public as a whole.

Promotion of FNR activities

The FNR actively supported the Belval branding project initiated by public research stakeholders to establish a joint brand for Luxembourg public research.

OBJECTIVE 3:

To reinforce the efficiency and sustainability of Luxembourg's public research system. Investing in human capital

PEARL

Six PEARL projects were submitted under the 2016 call for proposals. The strategic value of three projects was judged to be sufficiently important to pass first selection stage. Of these three projects, two were selected and received funding totalling EUR 6.7 million. The first project is led by Professor Dubois (LIST), who aims to establish a research programme in the field of composite materials. The other PEARL project approved was in the form of an open position in the field of neuropathology. Following a competitive recruitment procedure, this position was offered to Professor Jens Mittelbronn at the end of 2016. He started to work as a neuropathologist at the LNS in January 2017 and will have his research group at the LIH and LCSB.

ATTRACT

Nine candidates (four from the University of Luxembourg, four from LIST and one from LISER) applied for the ATTRACT programme in 2016. Given the high level of the applications, the FNR selected three ATTRACT projects, namely Dr Alex Redinger in the Department of Physics of the University, Dr Pedro Cardoso in the ECCS Research Unit in Education Sciences at the University and Dr Stanislas Schymanski in the ERIN department of LIST. A total of EUR 5.7 million has been allocated to these projects.

NCER - PD

The Research Centre of Excellence in Parkinson's Disease (NCER-PD) has been in existence since June 2015, and two steering committee meetings were held in 2016 confirming highly encouraging progress.

AFR - Aides à la Formation-Recherche

Following the introduction of the PRIDE programme, only a small part of doctoral students continues to be financed by the AFR instrument. Consequently, during the AFR 2016 annual call for proposals, 79 proposals were submitted of which 29 were selected and received EUR 4.4 million in funding. A new simplified selection mechanism has been implemented, optimising the selection and interaction process with the panel of experts. Moreover, several AFR grants are reserved for specific international cooperation (Singapore, RIKEN/Japan, NASA-Ames Research Centre); 18 proposals were submitted of which seven were awarded EUR 2.2 million in financing. In addition, the FNR has maintained its efforts to improve training opportunities for PhD students, offering a 'Leadership and Communication' pilot course which was well received by the participants.

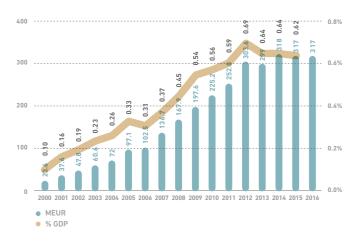
PRIDE – Programme for Research Intensive Doctoral Education

The new PRIDE programme which allocates collective AFR grants to institutions on top of individual AFR grants, was launched in 2015. In 2016, the FNR was able to finalise the selection: from the 26 proposals received from doctoral training units (DTUs) at the University of Luxembourg and three public research centres: LIST, LIH and LISER, 15 were approved during the first selection phase. For these 15 units, on-site assessment panels were set up in February 2016. In the end, 11 doctoral training units were selected and granted EUR 25.2 million in financing, thereby allowing 135 doctoral students to receive funding.

07 ²⁰¹⁶ **STATISTICS**

LUXEMBOURG INVESTMENTS

Luxembourg public investments in public and private R&D (MEUR)



FNR NEW COMMITTED 2016

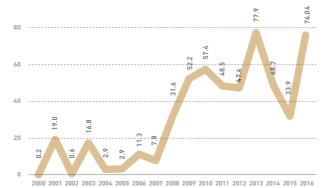
64 FNR-funded projects	43.26 (MEUR)
32 CORE <i>Projects</i>	m 18.29
3 ATTRACT <i>Projects</i>	5.70
2 PEARL <i>Project</i>	.6.65
12 INTER <i>Projects</i>	3.96
6 POC Projects	2.04
2 OPEN Projects	🀙 1.20
6 CORE PPP <i>Projects</i>	2.74
1 IPBG Projects	2.68

41 PSP 14 INTER MOBILITY 13 RESCOM	2.63 (MEUR)
39 PSP Classic	🧺 0.42
2 PSP Flagship	🥳 0.75
14 INTER-MOBILITY	1.12
13 RESCOM	휞 0.34

63 AFR Grants	34.25 (MEUR)
29 AFR <i>PhD Grants</i>	4.21
9 AFR PPP	1.74
7 AFR <i>PDR PPP</i>	0.93
7 AFR <i>Bilateral</i>	2.18
11 PRIDE (= 135 PhD positions)	25.19

FNR FUNDING

FNR: Annual funding commitments (MEUR)



FNR NEW COMMITTED 2014-2016

182 FNR-funded projects	105.75 (MEUR)
93 CORE <i>Projects</i>	53.04
6 ATTRACT <i>Projects</i>	11.04
3 PEARL <i>Projects</i>	F 11.63
51 INTER Projects	17.57
15 POC <i>Projects</i>	4.00
4 OPEN Projects	🀙 2.20
6 CORE PPP <i>Projects</i>	1 2.74
3 KITS Projects	0.85
1 IPBG Projects	2.68

148 PSP 36 INTER MOBILITY 55 RESCOM	6.73 (MEUR)
145 PSP Classic	🧺 1.58
3 PSP Flagship	🧺 1.12
36 INTER-MOBILITY	3.02
55 RESCOM	휞 1.01

183 AFR Grants	61.4 (MEUR)
145 AFR PhD Grants	22.85
18 AFR <i>PPP</i>	3.44
54 AFR Postdoc Grants	6.35
11 AFR <i>PDR PPP</i>	1.39
7 AFR Bilateral	2.18
11 PRIDE (= 135 PhD positions)	25.19

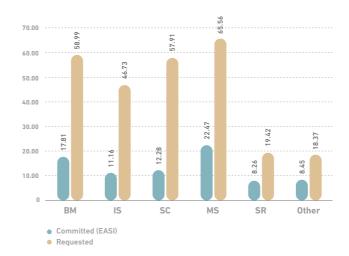
FUNDING AND PROJECTS FIGURES

267 TOTAL AMOUNT REQUESTED, IN MEUR

80.4 NEW COMMITTED BY FNR -TOTAL AMOUNT IN MEUR

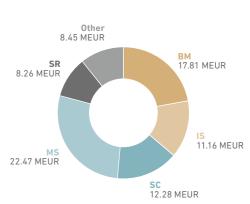
30% OVERALL FUNDING SUCCESS RATE **33,5%** OVERALL PROJECT SUCCESS RATE

2016 REQUESTED AND COMMITTED FUNDS *Applied funds vs. FNR committed 2016 (MEUR)*









FNR committed 2016 per domain

BM Biomedical Sciences/Regulation of Chronic, Degenerative and Infectious Diseases IS Innovation in Services

SC Societal Challenges (LM+ID)

MS New Functional and Intelligent Materials and Surfaces and New Sensing Applications SR Sustainable Resource Management in Luxembourg

PUBLIC-PRIVATE PARTERSHIPS

CORE-PPP	2008	2009	2010	2011	2012	2013	2014	2015	2016	TOTAL
National private partners	5	4	4	3	5	7	2	1	6	37
International private partners	5	4	2	1	2	3	2	2	0	21
TOTAL	10	8			7	10		3		58

AFR-PPP	2008	2009	2010	2011	2012	2013	2014	2015	2016	TOTAL
PhD	1	12	1	10	13	9	7	9	9	71
Postdoc	1	1	0	2	1	1	3	4	7	20
TOTAL		13		12	14		10	13	16	91

FUNDING INSTRUMENTS 2006-2016

(Statistics of ongoing instruments)

Launch date	Programme title	number of submitted proposals	number of FNR funded projets fi	number of inished projets	committed (MEUR)
2006	ATTRACT Opportunities for Outstanding Young Researchers in Luxembourg	58	15	5	23.1
2006	INTER Promotion of International Cooperation	776*	136	57	44.92
2008 🛤	CORE Multi-annual Thematic Research Programme	992	296	143	157.45
2008 À	AFR PhD Grants + BFR-AFR Transitions	1858	82	155	108.73
2008 À	AFR Postdoc Grants	756	346	217	31.49
2009 🥂	PEARL Excellence Programme for Research in Luxembourg	22	9	1	38.9
2012	INTER Mobility Promotion of International Scientific Exchange	133	52	29	2.22
2012 휞	RESCOM Promoting Scientific outcomes	204	101	69	1.68
2012 😿	PSP Promoting Science to the Public	293	234	165	2.9
2012	POC Proof of Concept	25	17	8	5.59
2013 🎘	OPEN ** Multi-annual Research Programme	20	6	0	3.2
2015	KITS Knowledge & Innovation Transfer	4	3	0	0.85
2016	PRIDE Research Intesive Doctoral Education	52	11	0	25.19
2016 À	AFR Bilateral	18	7	0	2.18
2016	IPBG Industrial Partnership Block Grant	2	1	0	2.68
2016 🧺	PSP-Flagship	6	2	0	0.75
2016 👘	CORE PPP***	8	6	0	2.74
2016 À	AFR PhD PPP***	28	9	0	1.74
2016 À	AFR PDR PPP***	11	7	0	0.93

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* Since 2010

** suspended 2015 *** new format since 2016

CORE

Sum of Committed Funding (in MEUR)/Domain

DOMAIN

MS_New Functional and Intelligent Materials and Surfaces and New Sensing Applications

BM_Biomedical Sciences/Regulation of Chronic, Degenerative and Infectious Diseases

SR_Sustainable Resource Management in Luxembourg

IS_Innovation in Services

SC_Societal Challenges (LM+ID)

Projects by Domain

DOMAIN

TOTAL

MS_New Functional and Intelligent Materials and Surfaces and New Sensing Applications

BM_Biomedical Sciences/Regulation of Chronic, Degenerative and Infectious Diseases

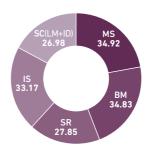
SR_Sustainable Resource Management in Luxembourg

IS_Innovation in Services

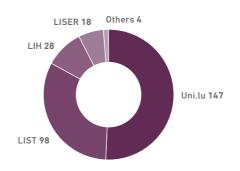
SC_Societal Challenges (LM+ID)

TOTAL

CORE: Funding by domain, between 2008 and 2016



CORE: *Projects by institution, between 2008 and 2016*



2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
3.40	3.40	4.50	2.90	2.00	6.90	3.32	3.92	4.6	34.92
3.20	1.90	5.40	2.80	6.60	3.40	3.42	3.99	4.1	34.83
2.50	4.20	3.00	3.10	4.20	3.50	3.40	2.09	1.9	27.85
2.40	3.30	2.70	3.80	3.80	3.80	3.86	5.69	3.8	33.17
2.60	1.40	3.80	2.90	4.20	3.10	2.98	2.10	3.9	26.98
		19.40	15.50	20.80	20.70				157.75

2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
7	8	8	5	4	10	7	7	8	64
7	3	8	5	9	7	7	6	8	60
6	11	5	5	6	4	4	4	3	48
8	10	6	7	8	6	8	10	6	69
6	4	9	6	9	5	4	4	7	54
					32			32	295

CORE: *Projects by domain, between 2008 and 2016*



DOCTORAL CANDIDATES

Coming from all over the world, the young researchers represent an undeniable force for the future of Luxembourg research, whose presence is reinforced on the international scene.

In 2016, more than 100 new doctoral candidates joined the national public institutions, the majority being affiliated with the University of Luxembourg.

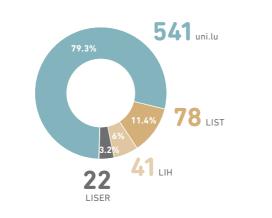
The number of researchers is expected to grow steadily in the coming years, and many job opportunities are regularly offered at the different research institutions. To guarantee a quality doctoral training, the Luxembourg institutions have all agreed on a **"National Quality Framework for Doctoral Training"**.

PHD GRADUATES 2015*

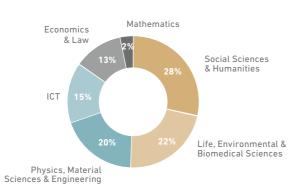


ONGOING & SUCCESSFULLY GRADUATED PHD 2015*

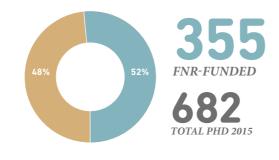
Ongoing by host institution



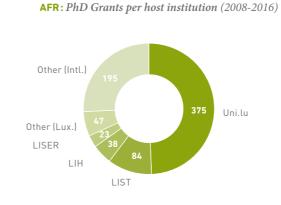
Ongoing by domain



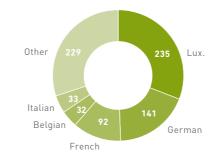
PhDs funded 2015



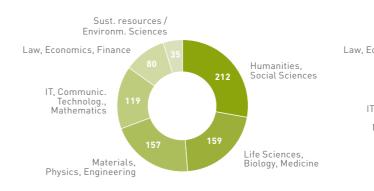
AFR PHD & POSTDOC GRANTS



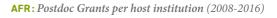
AFR: PhD Grants by nationality (2008-2016)

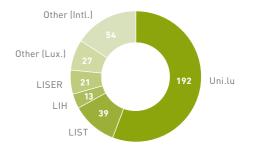


AFR: PhD Grants by domain (2008-2016)

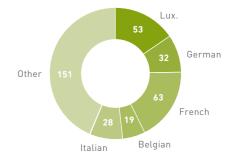


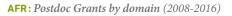
* figures at 01.12.2016

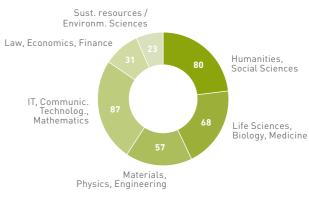




AFR: Postdoc Grants by nationality (2008-2016)









GENDER BALANCE IN RESEARCH: THE VIEW FROM LUXEMBOURG

Gender balance in research is a topic frequently discussed and debated – it is a fact that nearly all countries in Europe have more men than women scientists, and it is also known that the proportion of women generally decreases the higher it goes up the career ladder. We take a look at what the situation is like in Luxembourg – and what the FNR is doing to help change it.

The Luxembourg public research system employs approximately 2,870 researchers (full-time equivalent = FTE)¹, based on the statistics provided for 2015 by the Government. Around one in four researchers are female – putting Luxembourg below the EU average of one in three. These statistics stem from the so-called SHE figures² from 2015 – an EU-wide publication edited every three years with data on female researchers' participation.

¹ based on statistics provided for 2015 by the Luxembourg Government ² SHE Figures 2015

³ 62% of all proposals submitted were from male researchers, 38% of all submitted were from female researchers. 63% of all proposals retained were from male researchers, 37% of all retained proposals were from female researchers.

Male and female success rates almost identical

As for the FNR's funding instruments, statistics show that the success rate for retained proposals is almost identical between male and female applicants (2007 – 2015, main FNR programmes). This shows that the evaluation procedure of the FNR does not have any significant distortions, which was also confirmed in a recent external and independent evaluation of the FNR's CORE selection procedure³.

Also, there is a good gender balance in FNR's governing bodies, with 55% female members in the Board and 62% female members in the Scientific Council. The FNR expert panels are not yet as balanced (34% of 2016 panel members were female), but efforts are being made to increase female participation.

As a member of Science Europe, the FNR is committed to a detailed monitoring of gender statistics across its funding schemes. Science Europe has recently published a "Practical Guide do Improving Gender Equality in Research Organisations" including grant management practices that enhance gender equality, a guide which constitutes a benchmark for further FNR action. In fact, the FNR is doing comparatively well in terms of maternity and parental leave, since researchers funded in the framework of the FNR's various schemes all have employment contracts entitling them to the relatively generous Luxembourg maternity and parental leaves.

Only 16.5% leading researchers in Luxembourg are female

Progressing in the career and moving up the ladder, Luxembourg ranks 2nd last in Europe with only 16.5% of so-called Grade A positions allocated to women (2013), corresponding to full professorships or senior researchers.

It is true that even in countries where support measures to female researchers are strong, there still exists a gender gap for female researchers in higher positions and in engineering and technology domains, but support measures seem to soften this gap, so Luxembourg will need to develop its own measures in the future to address the most severe gender imbalances in the research system.

FNR efforts to increase number of female leading researchers in Luxembourg

In March 2016, the FNR has taken two measures to strengthen female participation within its two recruitment schemes ATTRACT and PEARL, requiring that at least 40% of ATTRACT applicants and at least 30% of PEARL applicants need to be female for the period 2017-2021.

Gender balance in schools

In the 'Lycée classique' the share of young women in the natural science sections (B and C combined) is still nearly balanced (49% female vs 51% male) in Luxembourg.

Drop in female ratio after PhD

At doctoral level, based on FNR statistics 2010-2016 for AFR fellowships, the share of female doctoral candidates is 45%, while the figure is only 34% for the share of female postdoctoral AFR fellows.

Recommendations for improvement

In February 2017, the FNR co-organised the WiSE Colloquium to discuss how to improve the situation and outlook for women in science and engineering in Luxembourg. Recommendations put forward by three panels composed of scientists, engineers and other stakeholders concerned with gender balance will be summarised in a White Paper (to be published in 2017).



Early-career





OF AFR PHD & AFR PHD PPP GRANTS AWARDED TO WOMEN (2008-2016)

OF AFR POSTDOC PPP GRANTS AWARDED TO WOMEN (2008-16)

Established

1 in 3 (2013-16) OF THE PRINCIPAL INVESTIGATORS ON

→ LAW, ECONOMICS & FINANCE The strongest domain

OPEN PROJECTS IS FEMALE

1in3 OF THE **PRIDE** DOCTORAL UNIT COORDINATORS IS FEMALE

1 in 4 (2008-16)

OF THE PRINCIPAL INVESTIGATORS ON CORE PROJECTS IS FEMALE

→ SOCIETAL CHALLENGES The strongest domain

FNR ANNUAL REPORT 2016 | GENDER BALANCE | 26 > 27

→ LIFE SCIENCES, BIOLOGY & MEDICINE

Domain with strongest female representation among early-career researchers funded by FNR. At **55%** this domain has a majority of women

Leading



ARE FEMALE



OF INTER MOBILITY RECIPIENTS ARE FEMALE (2012-2016)



OF RESEARCHERS ON **INTER** PROJECTS ARE FEMALE (2010-2016)

09 ²⁰¹⁶ EVENTS

Signature of the "SciTeach Center" Project

On 21 January, the FNR and partners in the area of research and education signed a cooperation agreement to support the science education of primary school teachers in Luxembourg, in the form of a 'SciTeach Center'. The overall aim of the project is to increase the status of natural sciences across primary schools in Luxembourg.

fnr.lu/sciteach-agreement

Presentation of the external evaluation report

On 27 January, the FNR hosted the FNR Info Day 2016, where attendees had the opportunity to find out about the FNR's funding instruments and activities; the results of an evaluation of the CORE selection procedure; as well as what researchers need to be aware of in the area of data protection. The FNR and CNPD presentations are available for download.

fnr.lu/fnr-info-day-evaluation

FNR Pearl chair receives prestigious research grant from the European Research Council

In March, Professor Lionel Briand, FNR PEARL Chair and Vice Director of the Interdisciplinary Centre for Security, Reliability and Trust (SnT) at the University of Luxembourg, was awarded an "Advanced Grant" by the European Research Council (ERC) for his research in the field of software reliability and security.

fnr.lu/fnr-pearl-briand-erc

New FNR Funding instrument - PSP Flagship

On 3 March, the FNR announced the first ever call for the PSP-Flagship scheme, a new strand in the Promoting Science to the Public (PSP) programme, specifically aimed at supporting long-term science outreach activities with lasting impact.

📼 fnr.lu/flagship

-Chercheurs à l'école – When researchers went back to school!

From 14 March to 18 March, researchers from various institutions went back to secondary schools to present their job: the FNR organised the 6^{th} edition of the campaign "chercheurs à l'école".

One of the main goals of the campaign is to present and promote the profession of researcher, still relatively unknown to the general public. Scientists of all scientific disciplines from public institutions and the private sector go back to school to meet pupils to speak to them about their life as a researcher: the life as a student, their motivation for one or the other scientific discipline, first steps in their professional lives, career challenges and opportunities.

Pupils are given the opportunity to meet researchers "in flesh and bone" and to receive information on the advantages and also the possible disadvantages of being a scientist.

For the sixth time, the initiative was a great success, touching the pupils of 47 classes in 21 secondary schools and gathering 63 researchers ready to take part in the action!

fnr.lu/checole-2016





FNR-funded project HuMiX publication in Nature Communications

On 11 May, the University of Luxembourg announced the publication of a research article in the internationally renowned scientific journal Nature Communications. The article was based on research on the interaction between microorganisms in the gut and the human body through the development of the artificial 'HuMiX' model.

The development of the HuMiX model was achieved through support from the FNR's ATTRACT, CORE, INTER MOBILITY, Accompanying Measures 2c, Proof-of-Concept and AFR funding programmes.

📼 fnr.lu/humix-nature

FNR launches new website

On 22 May, the FNR launched a new, improved website. Features of the new site include improved navigation, filters to narrow down funding instruments, a project finder, as well as a dedicated section for success stories, media, facts and figures.

www.fnr.lu/welcome-new-fnr-website/

The FNR joins annual meeting of Global Research Council

From 25 to 27 May, the FNR joined global research funders to address interdisciplinarity and issues concerning women in research. The FNR debated global approaches to interdisciplinarity and the equality and status of women in research with funding leaders from across the world at the Global Research Council (GRC) 2016 Annual Meeting.

fnr.lu/fnr-annual-meeting-grc

FNR-funded project LuxAI wins first prize at Mind&Market

On 30 June, innovative artificial intelligence spin-off company LuxAI took home the first prize for their socially assistive robot at the second edition of the Mind & Market Forum.

LuxAI is a spin-off from the SnT at the University of Luxembourg, which is specialized in socially assistive robotics. The team, led by Dr Pouyan Ziafati and Dr Aida Nazarikhorram, developed the prototype of the robot with the assistance of an FNR Prrof-of-Concept grant.

LuxAl uses the latest advancements in Artificial Intelligence and robot-therapy in building social robots to assist people. The mission is to make socially assistive robots economical and user-friendly in order to enable all teachers, therapists and care givers to use advanced robots in their everyday work of improving the health and education of people.

www.fnr.lu/luxai-wins-first-prize-mind-market-forum/

New FNR funding instrument – IPBG

On 14 July, the FNR announced the pilot call for its new programme IPBG.

It is a strategic priority of the FNR to turn public research into a competitive advantage for Luxembourg. To this end, the FNR supports the advancement of Luxembourg's knowledge-based economy by supporting industryinformed research, by reinforcing co-operation between public research and innovative industries, as well as by facilitating the commercial exploitation of research results.

www.fnr.lu/new-funding-instrument-ipbg/

Results of the first PRIDE call

In September, the FNR announced the very first results of its PRIDE scheme. It generated 135 FNR-funded PhD positions in Luxembourg, spread over 11 doctoral training units and six of the country's research domains. In addition to the 135 FNR-funded doctoral candidate positions, around 20 further PhD positions are to be funded by the Luxembourg host institutions.

www.fnr.lu/results-first-pride-call/

Three FNR-funded projects win awards at the Luxembourg Healthcare Summit 2016

In October, three FNR-supported projects won awards at the 2016 Healthcare Awards, part of the 2016 Luxembourg Healthcare Summit. University of Luxembourg spin-off LuxAI took home the Healthcare Facilities Award, while the Luxembourg Institute of Health's study on national cardiovascular health (ORISCAV-LUX) won the Healthcare Research Award, and Black Swan won the Start-up of the Year.

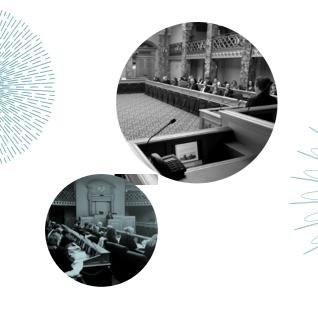
fnr.lu/2016-healthcare-awards/

Launch of the Pairing Scheme -Politics meets Research

Over the past years, Luxembourg established itself as an internationally recognised research and innovation destination. In order to maximise the impact of this scientific knowledge in society – including in politics, the FNR launched on October 11 its initiative Pairing Scheme - Politics meets Research, in collaboration with the Luxembourg Parliament. The Pairing Scheme enabled MPs and researchers to get together in their respective working environments, so that the worlds of politics and research can get to know each other better.

The Pairing Scheme saw 17 MPs – nearly 1/3 of Luxembourg's MPs – paired with 17 researchers.

fnr.lu/pairing-scheme-launch







Luxembourg and Singapore establish bilateral research collaboration

On 15 November, officials from Luxembourg and Singapore have this week signed a Memorandum of Understanding (MOU) on research collaborations. Signed between the FNR and the National Research Foundation, Prime Minister's Office, Singapore (NRF), the MOU sets out the joint-funding of collaborative research projects in areas of mutual interest. This was witnessed by the countries' respective Prime Ministers, Mr Xavier Bettel and Mr Lee Hsien Loong.

fnr.lu/luxembourg-singapore

Reseachers' Days 2016

On 2 and 3 December, the FNR organised the 5th edition of the Researchers' Days at the Rockhal in Esch/Belval together with its partners.

During two days, the Rockhal was transformed into a giant research lab with more than 20 exciting interactive workshops, and 4 Science Cafés, all revolving around the topic of research and science! Held for the first time in Esch/Belval, Luxembourg's research and innovation campus, this new edition had a huge success with more than 3,400 visitors!

fnr.lu/researchers-days-2016



First National PhD Welcome Day

The inaugural edition of the National PhD Welcome Day take place in Luxembourg City at the picturesque Neumünster Abbey on December 7. Doctoral candidates of all disciplines who started their PhD in 2016 in the country were invited.

Organised by Luxembourg's public research actors Luxembourg Institute of Science and Technology (LIST); the Luxembourg Institute of Health (LIH); the Luxembourg Institute of Socio Economic Research (LISER); as well as Euraxess Luxembourg, the national service centre assisting for the mobility of researchers, LuxDoc, the national young researchers' association, and the FNR, the young scientists who have chosen a public institution to begin their scientific careers were welcomed with honours.

fnr.lu/phd-welcome-day-2016











FNR awards 2016: the FNR awards excellence in research and science communication

On Friday, 14 October, the FNR held the 8th edition of the FNR Awards, presenting four awards for excellence in science and research communication. In presence of the Luxembourg research community, awards endowed with a 5,000 EUR prize were presented in the categories "Outstanding Scientific Publication", "Outstanding PhD Thesis" and "Outstanding Promotion of Science to the Public".

The aim of the FNR Awards is to reward outstanding researchers and science communicators along with their individual institutions.

The awards were presented by Marc Hansen, Minister delegate for Higher Education and Research; Véronique Hoffeld, Chairwoman of the Board of the FNR; and Marc Schiltz, Secretary General of the FNR Véronique Hoffeld congratulated the winners in her speech and thanked them for their dedicated efforts.

Minister Marc Hansen in his opening speech emphasised how vital it is to communicate the findings of research in Luxembourg – both to a specialist audience, and to the general public in Luxembourg and abroad.



Winner "Outstanding Scientific Publication"

Jérôme Paggetti and Etienne Moussay

(Luxembourg Institute of Health) for the publication 'Exosomes released by chronic lymphocytic leukemia cells induce the transition of stromal cells into cancerassociated fibroblasts', published in the journal "Blood"

Jérôme Paggetti and Etienne Moussay, have shown how cancer cells in chronic lymphatic leukaemia (CLL) change their surroundings to promote their survival. The jury chose their publication because of the high impact potential the findings have for the field of intercellular communication in general, and particularly CLL.

Winner "Outstanding Scientific Publications"

Matteo Polettini (University of Luxembourg) for the publication *'Efficiency Statistics at All Times: Carnot Limit at Finite Power'*, published in the journal "Physical Review Letters".

Matteo Polettini's work focusses on investigating thermodynamic processes and energy efficiency in nanosystems. The jury found the scientific quality of the publication to be outstanding.



Winner "Outstanding PhD Thesis"

Zhe Liu (University of Luxembourg – Faculty of Science, Technology and Communication) for his PhD thesis 'Lightweight Public-Key Cryptography for Wireless Sensor Nodes. '

The FNR Awards jury praised the quality of Zhe Liu's PhD thesis, emphasising how remarkable it is that he already has 22 publications and 140 citations to his name.

Winner "Outstanding Promotion of Science to the Public"

Astrid Maischak ("Déi kleng Fuerscher"), Gérard Wagener (Lycée de Garçons Esch), Maryse Lallemand (Ecole Fondamentale Dellhéicht) for the experiment theater piece "Die Alchemisten von Dellhéicht".

The jury for one praised the original idea to combine a scientific experiments show with a theater performance. It also praised was the pedagogical rarity of the project: secondary school students worked – largely in their spare time – with primary school students.





U HIGHLIGHTS

COLLOIDAL PHYSICS CONCERNING RESEARCH ON ENERGY LANDSCAPES

Dr. Sven Dorosz is a basic researcher: 'My CORE Junior project has led to basic findings for materials research and generated numerous very good publications', reports Dr. Sven Dorosz. The topic that Dorosz was involved with at the University of Luxemburg is called Colloidal Physics, specifically, the 'statistical mechanics of manyparticle systems out of equilibrium', as Dorosz explains.

What does that mean exactly Mr Dorosz? 'Liquids change, under sufficient pressure, from the liquid into the solid, crystalline phase. At the moment of phase transition – according to the laws of thermodynamics – the degree of chaos within the system, the entropy, must increase. Energy is dissipated during this process.'

The basic assumption here is that the system finds itself in a kind of equilibrium during the crystallisation process. Dorosz explains that 'the process should be perceived in a presumably defined energy landscape.' Within the context of the FNR Core Junior Project, his team sought to investigate the behaviour of simple liquids out of equilibrium during the phase of crystal formation: 'It was our objective to quantify the dissipated energy that is produced out of equilibrium.'



CORE Junior

The main FNR programme for funding of high-quality research projects in five priority domains: Innovation in Services, Sustainable Resources Management, Material Sciences, Biomedical and Health Sciences, Societal Challenges. The programme is dedicated to established and starting Principle Investigators.

FNR CALL: 2012 DOMAIN: MS - NEW FUNCTIONAL AND INTELLIGENT MATERIALS AND SURFACES FNR COMMITTED: 261,881 EUR PERIOD: 01.12.2012 to 31.10.2015

Molecules like billiard balls

In his simulations, the team concentrated on simple liquids. Physicists such as Dorosz interpret this as substances in which the molecules do not influence one another: 'One can imagine them as billiard balls that forcefully collide with one another. Other influences are not taken into consideration in the simulations.'

The physicists had to carry out an extreme quantity of statistics in order to get to the bottom of the interesting processes in the simulated liquids. Dorosz: 'Particularly those processes in the solution that are relatively atypical are interesting for comprehension of the entire system – and these can only be recorded with the aid of statistics and algorithms specially designed by us for this purpose.' With comprehensive analysis of such atypical crystallisation processes, the scientists were then able to put together a detailed picture 'of the locally released energy in the system', Dorosz explains.

Understanding how novel materials can be obtained from a melt

A certain applicability shines through in Dorosz's research: 'Our simulation procedures are interesting when one seeks to find out how novel materials can be obtained from a melt. We have changed many different parameters in our simulations. We learned thereby how to further improve their predictive power.'

And in the end, the research scientists were no longer forced to limit themselves only to rigid, sphere-shaped molecules; rather, they could also properly forecast the behaviour of elliptically-shaped liquid particles. 'This is an outstandingly significant finding for science'. Dorosz is pleased to say: 'This was explicitly confirmed to us once again by the external reviewers during their final evaluation of my FNR Core Junior Project.'

PEARL

Attracting established leading researchers in strategically relevant areas for Luxembourg research.

FNR CALL: 2011

DOMAIN: ID – HUMANITIES AND SOCIAL SCIENCES FNR COMMITTED: 2.367 MEUR R

PERIOD: 1.6.2012 to 31.5.2017

THE MANY SIDES OF SOCIO-ECONOMIC INEQUALITY

Economist Conchita D'Ambrosio and sociologist Louis Chauvel examine the same issue but from different perspectives.

"In a way, we are doctors of society," says Louis Chauvel. "Our mission is to investigate society's health." He explains his view using the example of the USA: "We are particularly interested in the USA because the system there is actually only perfect for the top ten percent. With the situation worsening for two thirds of the population, what we are seeing in the States is a shrinking middle class." He stresses the importance of examining the situation, adding: "It is critical that we understand the relationships so that we can prevent the same happening here."

Each an expert in their own field

Chauvel is a professor at the University of Luxembourg. Together with Professor Conchita D'Ambrosio, he leads the Institute for Research on Socio-Economic Inequality founded in 2013. What is special about this particular joint FNR PEARL chair shared by D'Ambrosio and Chauvel, is their unusual collaboration. Despite their offices being just a few metres apart, they analyse socio-economic inequality from different academic directions: Chauvel is a sociologist while D'Ambrosio is an economist.

D'Ambrosio, who as an economist enjoys explaining relationships in mathematical terms, is excited to be working in the humanities department. "In my line of work, I have to work closely with sociologists, as well as with psychologists, biologists and IT specialists," she says. "This allows us to observe complex relationships from all angles because we are all experts in our own field."

Facts not always indicative of the perception of social inequality

According to D'Ambrosio, individual well-being within society is a very complex system influenced by genetic and psychological processes and their interaction with the socio-economic environment, meaning that perception within society does not necessarily match factual evidence.

"For example, if we take a look at how incomes have changed over the last 25 years, we see that inequality has increased significantly in countries such as Denmark, France, Germany, Japan and the USA. In Belgium, Greece, Ireland, Portugal and the Netherlands on the other hand, levels of inequality have remained stable or even decreased," explains D'Ambrosio. "Yet," she adds, "what has increased in these countries is the perceived inequality." Professor D'Ambrosio explains numerous studies and surveys among EU citizens have shown that many more people consider themselves a victim of social inequality than is actually the case.



Ever stronger correlation between income and wealth

Not everyone has it as bad as they think. Yet it is well known that a large part of society is becoming poorer, while a minority are seeing their situation improve – a fact also confirmed by a study currently being carried out by Chauvel. Using data on the financial situation of American consumers collected over more than 20 years, Chauvel has been studying the relationship between income and distribution of wealth. According to the results of the study, the differences within society in terms of both income and wealth are becoming ever greater, with the correlation between high income and affluence getting stronger and stronger.

"Wealth distribution is always more inequitable than income: wealth is not only more unequal, but also less earned than income," explains Professor Chauvel. "Because when parents earn well but are not well-off by birth, the financing of the children's studies can become a nightmare for them," says the sociologist. And now comes the generation that is both high-earning and well-off. The problem, however, is that this applies only to a small percentage of society: "What we see in the US is basically the development of a new aristocracy. But the problem for progress is less inequality than the lack of competition, investment and effort that creates inequality in general: wealth is often a threat to social stability, but could be an opportunity for socio-economic development.'

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Unlike the USA, wealth in Europe is far more democratically distributed, says the sociologist. "Having to fork out €800,000 for a home in Luxembourg may seem excessive to Germans, but this has long been a relatively normal amount for their western neighbours." Chauvel explains that the situation in Germany, France and Luxembourg is still in no way comparable to the extremes in the States, where middle-class wealth was struck in the core economic meltdown of 2008. However, he adds, this makes it all the more important to analyse developments in the USA to prevent the same happening in Europe – after all, there must be some reasons why Donald Trump was elected.

ATTRACT

Funding to attract outstanding researchers with high potential in strategic research areas in order to set up a research group in Luxembourg.

FNR CALL: 2010 DOMAIN: BM - LIFE SCIENCES, BIOLOGY AND MEDICINE FNR COMMITTED: 1.43 MEUR PERIOD: 15.09.2010 to 15.09.2015

BREAKTHROUGH MADE IN LUXEMBOURG CELLULAR METABOLISM RESEARCH IS HERE TO STAY

Prof Dr Karsten Hiller was awarded an FNR ATTRACT Fellowship in 2010, with which he brought experimental and computational research in cellular metabolism to Luxembourg. The German national set up the Metabolomics Group at the Luxembourg Centre for Systems Biomedicine (LCSB) at the University of Luxembourg and during the 5 years that followed, the group implemented a high-quality mass spectrometrybased profiling platform and applied their expertise to study metabolism in-depth.

The research conducted by Dr Hiller and his team has led to a metabolomics analysis platform at the LCSB, which includes protocols for sample preparation, in addition to mass spectrometry, computational data processing and storage. All of this established knowledge is now open to the Luxembourgish research environment and will, as Dr Hiller points out, undoubtedly support the NCER (National Centre for Excellence in Research) diagnosis initiative in the future.

Scientific breakthrough 'made in Luxembourg'

The biggest achievement of the group during Dr Hiller's ATTRACT Fellowship was the discovery of the metabolite 'itaconic acid' and finding out what role it plays in macrophages, a specific type of immune cells in mammals. This discovery – which Dr Hiller emphasises was very much a discovery 'made in Luxembourg' – was published in the prestigious scientific journal PNAS, and could now help other researchers make further discoveries in this domain.

The work published in this journal was also recognised with an FNR Award for 'Outstanding Scientific Publication', which Dr Hiller won in 2014, together with fellow researchers with Dr Thekla Cordes and Dr Alessandro Michelucci.

International mobility is a keyword in a researchers career, and brings with it a natural cycle of movement. Once a project is complete, you move on to the next challenge. For Dr Hiller, the next challenge was found in Germany. As his ATTRACT Fellowship came to a conclusion in 2016, Dr Hiller was recruited as the successor of Prof Dr Dietmar Schomburg at the University of Braunschweig, where he has taken on the role as Director of the Department of Bioinformatics and Biochemistry.



New challenge accepted

Dr Hiller praises the ATTRACT programme, and also says it played a big part in helping him secure his new prestigious role in Germany:

"Without any doubt, the ATTRACT fellowship was enabling this big step in my career. Due to all the privileges of an ATTRACT fellow, I could develop into an independent research group leader and qualify for the new position. Very important in this regard was the authorization to teach at the University, to supervise master and PhD candidates and the possibility to apply independently for funding.

"Besides that, the ATTRACT programme offered me all the resources to purchase the required instrumentation, to hire personnel and gave me a lot of flexibility on how to spend the budget. This always allowed me to quickly react on specific situations."

Lasting impact

Experimental and computational research in cellular metabolism was brought to Luxembourg with the arrival of Prof Dr Hiller, but it has not left with him. Not only will the work accomplished during his fellowship have a lasting impact on research in the country – Hiller left Luxembourg with a list of Luxembourg collaborations in his pocket, which includes topics such as looking at particular aspects during cancer development, as well as studying the link between melanoma and Parkinson's disease.

It is safe to say Dr Hiller's impact on research in Luxembourg is far from over – and that it will continue to grow as the collaborations flourish. Additionally, Dr Hiller has helped further establish Luxembourg's reputation as a first-class research destination, where scientists can not only benefit from good working conditions, but also make significant contributions to their domains, not only in the Luxembourg context, but also in a global context.

CORE

The main FNR programme for funding of high-quality research projects in five priority domains: ICT, Sustainable Resources Management, Material Sciences, Biomedical and Health Sciences, Societal Challenges. The programme is dedicated to established and starting Principle Investigators.

FNR CALL: 2011

DOMAIN: IS - INFORMATION SECURITY AND TRUST MANAGEMENT FNR COMMITTED: 693,000 EUR PERIOD: 01.01.2012 to 31.12.2014

FAVE

THINK SMART – AND ANALYSE YOUR DATA EFFICIENTLY!

Surveillance cameras have become a permanent feature in our daily routine. In order to improve the resolution of the acquired images and the results from their automatic analysis, complicated and expensive cameras have always been required until now. More affordable cameras are still limited with regards to automatic detection of flexible and dynamic non-rigid movements

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In the Core-Project FAVE – Fusion Approaches for Visual Systems Enhancement-Security Applications – as part of the SigCom group of Prof. Björn Ottersten, a computer vision team led by the scientist Dr. Djamila Aouada at the Interdisciplinary Centre for Security, Reliability and Trust (SnT) at the University of Luxemburg has selected an entirely new approach. In partnership with the sensor specialists at IEE, the researchers have developed an algorithm that prepares the data from simple and inexpensive 3D cameras in real time in such a way that high-definition images are produced. But it is not only the quality of the image that increases; for the first time non-rigid movements – for example, a hand reaching into a handbag – can be automatically reconstructed with high precision.

Going back in time – picture by picture

An important factor in this success is Aouada's scientific background as a specialist in image processing and computer vision: 'Even in the data of simple cameras, there is more quality hidden there than one realises at first. One just has to analyse it efficiently', Aouada says. Her approach: Through the calculation of images that have been produced one after the other, interrelations that are not recognisable in the individual image become visible.



Prof. Björn Ottersten Director of SnT and principal Investigator in the FAVE Project



Dr Djamila Aouada scientist at the Interdisciplinary Centre for Security, Reliability and Trust (SnT) at the University of Luxemburg

An algorithm that provides access to this information was developed by the SnT team in the context of the FAVE Project – the recursive dynamic multi-frame superresolution-algorithm. 'Our algorithm allows to perform a simple local per-pixel tracking where both depth measurements and deformations are dynamically optimised', explains Dr. Kassem Al Ismaeil, whose PhD dissertation forms essential parts of the project. 'This enables us to appreciably increase the resolution and minimise the disruptive effects, i.e. the signal noise.' With the aid of the algorithm, the team has thus far been able to process data from a camera in real time. In the next step, images from several cameras shall then be used as well.

Recognise faces, without the identity of the observed person being known

An important aspect in the project is the topic of privacy. The cryptography specialist Dr. Dalia Khader, who recently moved from SnT as Security Information Analyst to the POST Luxemburg, was involved for this reason. With her support, the team was able to have a pattern recognition algorithm work with encrypted data; it is able to recognise faces, without the identity of the observed person being known. 'Authorized individuals receive a notice – and can then determine who is in the image', says Djamila Aouada.

The new 3D superresolution algorithm created quite a splash among professional circles and led to publications in high-level technical journals. Moreover, a patent has secured future economic exploitation of the knowledge, and formation of a company is foreseen. The director of SnT, Professor Björn Ottersten was the Principal Investigator in the FAVE Project. 'Björn Ottersten was highly committed to our project', says Aouada. 'We were able to engender huge benefits thereby. And I have learned a lot from him regarding how to structure a large-scale project and to manage the team.'

INTER Mobility

Funding researchers based in Luxembourg for a mobility period at leading research institutions abroad, or excellent researchers from abroad to integrate Luxembourg research teams (mobility periods up to 1 year).

FNR CALL: 2016 DOMAIN: BM - LIFE SCIENCES, BIOLOGY AND MEDICINE FNR COMMITTED: 85,000 EUR PERIOD: 01.11.2016 to 31.10.2019

LACK OF FIBRE MAKES INTESTINAL BACTERIA AGGRESSIVE

The globally acknowledged study led by Dr Mahesh Desai shows the potential effects of a lack of fibre on the intestinal flora.

It is common knowledge that people can become rather irritable and even aggressive when they are hungry. Yet it was not known until now that the same goes for intestinal bacteria, which can also become quite aggressive when deprived of nutrients. "We have discovered that intestinal flora becomes angry when given less dietary fibre," explains Dr Desai. And it is the intestinal mucosa that must bear the brunt of this anger.

Dr Desai is the head of the Eco-immunology and Microbiome research group at the Department of Infection and Immunology at the Luxembourg Institute of Health. Together with Dr Eric Martens of the University of Michigan Medical School, he carried out a study in which the functioning of the human digestive tract was simulated. The two researchers investigated the behaviour of certain bacteria in a living organism under controlled conditions using mice that had been born and grown without intestinal microbes before having a transplant put in containing a cocktail of 14 different bacteria.

Basis for developing next-generation prebiotic food

Dr Desai and Dr Martens noted that when deprived of dietary fibre, intestinal bacteria altered their survival strategies and began to eat the intestinal mucosa. They also observed that the bacteria cannot be stopped from doing so even if the host is given additional conventional prebiotic food supplements – a fact also demonstrated in other studies.

Dr Desai considers the results of this study to be crucial because they form the basis for the development of next-generation prebiotic food, as well as to understand disease pathogenesis mechanism. The results may also contribute to the development of successful treatments for irritable bowel disease, intestinal cancers and other digestive tract diseases. The fact that these results were published in the renowned journal *Cell* in 2016 demonstrates the significance of the findings for medicine. Dr Mahesh Desai Head of the Eco-Immunology and Microbiome research group at the Luxembourg Institute of Health



"This is a great honour for us and for Luxembourg," says Dr Desai, currently studying the processes in the intestinal mucosa with scientists at the RIKEN Center for Integrative Medical Sciences in Tokyo. One thing the researchers are aiming to find out is how the destruction of the mucosa together with organic acids and shortchain fatty acids increases sensitivity to certain intestinal germs, such as *Citrobacter rodentium*. This three-year collaboration has been made possible by the FNR's INTER Mobility programme. Dr Desai has also obtained an FNR AFR Bilateral grant with the Japanese institute, where he is one of the principal investigators. This grant involves several researchers from the Luxembourg Institute of Health, the Luxembourg Centre for Systems Biomedicine (LCSB) at the University of Luxembourg, and scientists at the RIKEN institute.

This is not the first time the FNR funding has supported Dr Desai in his research. During his previous work at the LCSB, the research group leader worked on another INTER Mobility programme studying how a dynamic supply of certain carbohydrates (glycans) affected the intestinal flora. As well as the current INTER Mobility grant, his above-mentioned work to develop prebiotic food to prevent intestinal diseases is also being funded as part of the FNR CORE programme.

"Our research is a prime example of what a pilot grant can help achieve," says Desai. "The INTER Mobility programme has made a key contribution to creating a successful, international research network whose highlevel collaborative work is supported by further grants."

PSP Classic

The FNR offers platforms and funding to foster the exchange between science and society. Researchers and science communicators may benefit from training in science communication, take part in events for the general public, and use the FNR media and web channels to communicate communicate their science and research. In addition to these exchange platforms, the PSP programme provides funding for science outreach activities.

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FNR CALL: 2014 FNR COMMITTED: 50,000 EUR PERIOD: 01.04.2015 to 31.12.2015

INDIANA JOS

IN THE FOOTSTEPS OF RESEARCHERS AND EXPLORERS

Educators of day care centres and youth houses gear up: with training courses and experimental workstations in natural sciences and technology!

Children see the world differently. Rather than taking everything for granted as adults often do, they continuously explore and challenge their surroundings through observation, play, trial and error.

To foster this natural behaviour in the context of science and technology, the not-for-profit association Anne a.s.b.l, of elisabeth day care centres (Maison Relais) and youth houses (Jugendhaus) in Luxembourg started in 2014 the pilot project "Indiana Jos – op de Spuere vu Fuerscher an Entdecker", with financial support from the PSP-Classic programme of the FNR.

One goal of the project is to develop training courses in inquiry-based learning of natural sciences and technology for educators. These equip them to incorporate these topics in non-formal educational workshops and the daily care of children. In addition, the participating institutions install experimental workstations, where the educators can research and experiment together with the children and adolescents.

Stimulate interest and reduce inhibitions through play

A central focus of the project is the perspective of the child, who explores the world with curiosity, creativity and a joy for playing and learning. The experimental workstations allow children to be "co-creators", to design their own learning processes and to pursue their research efforts.

Jutta Meyer-Sieren, the project leader from Anne a.s.b.l. explains: "Through the project, inhibitions against science can be avoided at an early stage and the researching and curious attitude of children can be encouraged."



The approach: "Train the trainers"

Pedagogical specialists and facilitators taking care of children between age four and 14 are the main target for the training courses. During the pilot project, 32 educators from 11 day care centres and two youth houses developed workshops in five research domains per age category. They receive technical and thematic advice from external training partners.

The training participants subsequently implement the workshops in their respective institutions with a lot of motivation, fun and exploratory spirit. In addition, they can pass on their newly gained competences to other staff.

During the pilot phase, 11 day care centres and one youth house also installed experimental workstations.

The future of the Indiana Jos project

The pilot project ended after one year but the initiative continues to grow, with additional support through the FNR PSP-programme.

Handbooks were designed to accompany the training and a brochure with observations from the pilot project, conceptual advice and best-practice examples was issued in collaboration with the Service National de la Jeunesse. Additional courses were held with 72 educators and more institutions set up experimental workstations.

Jutta Meyer-Sieren summarises: "Through the Indiana Jos project, elisabeth institutions have strengthened the central focus on science and technology in their pedagogical work."

In 2017, the project will be extended to target audiences outside elisabeth institutions, e.g. by offering training workshops for educators or parents and by cooperating with schools in the framework of the "plan d'encadrement périscolaire (PEP)" on the communal use of experimental workstations.

POC

The Proof of Concept programme is the FNR's facilitation programme for successful commercialisation of research results with the goal to encourage the translation of high-impact research into commercially viable innovations.

FNR FUNDING SCHEMES: ATTRACT, CORE, AFR PHD, POC FNR CALL: 2015 (POC) DOMAIN: BM - LIFE SCIENCES, BIOLOGY AND MEDICINE FNR COMMITTED: 480,500 EUR (POC) PERIOD: 01.01.2016 to 30.04.2017 (POC)

POCKET-SIZED INTESTINES:

THE HUMIX MODEL ENABLES INTESTINAL FLORA TO BE INVESTIGATED UNDER REAL CONDITIONS

Researchers at the University of Luxembourg have developed a model of the human intestines which simplifies the examination of intestinal bacteria and removes the need for animal experiments.

The human gut is up to eight metres long, but Paul Wilmes' and Pranjul Shah's model is only the size of a beer mat. "It may look very simple, but it's packed full of know-how", says Shah pointing to the small orange-white box on the table in front of him. You would never guess by looking at this small device that it has revolutionised intestinal tract research. But that's precisely what it has done.

Pranjul Shah is a scientist at the Luxembourg Centre for Systems Biomedicine (LCSB), which is part of the University of Luxembourg, where this device was developed in the "HuMiX" research group led by FNR ATTRACT Fellow Professor Paul Wilmes. HuMiX stands for Human Microbial Cross-talk, and it is nothing less than the model of a human gut. The HuMiX organ-ona-chip technology enables the complex interactions between human cells and bacteria to be analysed under the same conditions as those found in the human gut.



Finding out about changes that take place in bacteria

The organ-on-a-chip consists of three chambers which lie on top of each other and are separated from each other by a membrane. The human cells are in the middle chamber, and the lowest one is where the bacteria are kept. Liquid nutrient is pumped through the two outer cells, and its contents enter the neighbouring layers through the permeable membrane. This also enables the oxygen levels in HuMiX to be matched to the conditions found in the human gut.

"The cells and the bacteria are less than half a millimetre apart, but there is no physical contact", Pranjul emphasises. And he says that this is extremely important. "After all, we don't want to simulate an infection; we want to find out what changes take place in the bacteria and how that influences the cells", he says.

Completely open system for carrying out investigations at any time

"In many cases we simply don't know whether certain bacteria are the cause of an illness, or perhaps also the result of it", he states. However, the organ-on-a-chip enables us to find that out. "The advantage is that we have a fully accessible system that we can investigate whenever we want to", the researcher explains. "So we don't have to use any test animals for investigations."

According to Pranjul Shah, HuMiX also provides findings which can be translated more precisely to the human gut than tests on mice or piglets. Organs-on-a-chip like HuMiX could also propel research into other diseases, such as skin and lung diseases, as well as research into neurodegenerative diseases like Parkinson's. For instance, the LCSB researchers have established that combined cultures of intestinal cells and certain bacteria lead to the formation of chemical messengers (neurotransmitters) for the nervous system. This result backs up the existing hypothesis that communication takes place between the gut and the brain. Issues like this are now easier to examine in the new, open HuMiX system than in mice.

Major contribution to eliminating animal experiments

HuMiX will therefore remove the need for future animal tests in microbiome research. Admittedly, not right across the board, but in many fields, which is why the LCSB researchers have recently been awarded the Lush Prize. Bestowed every year as the world's most highly endowed prize in this field, it is awarded for test procedures and scientific work that contributes to doing away with animal experiments.

Scientists at the University of Luxembourg have proven that it works. The next step involves persuading the research departments in the pharmaceuticals, cosmetics and food industries to use HuMiX technology. Responsibility for this lies with the LCSB "Innovation Team", which Pranjul Shah is also a member of. The team helps scientists with promising research projects to launch start-up companies and to collaborate with industry.

AFR PhD

TO FOSSILS FUELS

big role in this search.

distinction".

diesel", he explains.

Individual candidates to apply for PhD training in high-quality research environments in Luxembourg and abroad.

FNR CALL: 2013 **DOMAIN:** MS - MATERIALS, PHYSICS AND ENGINEERING PERIOD: 01.10.2013 to 30.09.2016

FROM CYCLE RACING TO THE CHEMISTRY LAB:

PIT LOSCH ON THE QUEST FOR ALTERNATIVES

The finite nature of fossil fuels forces us to look for

He actually wanted to become a professional cyclist.

his Bachelor's degree in Freiburg was followed by his

the young Luxembourger didn't have enough time to

prepare for major cycle racing events while he was

writing his dissertation, he switched to doing triathlons.

Last year, he took part in an Iron Man race for the first

his paces a few weeks later when he had to defend his

doctoral thesis. The panel of eminent examiners spent

no fewer than four hours asking him questions about his

thesis – and they finally awarded him a doctorate "with

In his work, Pit looked into the possible uses of zeolites,

and of the zeolite ZSM-5 in particular. Zeolites are

crystalline aluminosilicates which occur naturally,

for example in parts of the Earth's crust which are

volcanic in origin, but which can also be synthetically

manufactured. "Ever since the 1950s, they have been

synthetically manufactured and used as catalysts in

the petrochemical industry, where they are used, for

example, in the conversion of crude oil into petrol or

time. It was hard, but he was only really put through

Master's in Strasbourg and finally his doctorate. Because

But then chemistry got in the way of that ambition:

alternatives. For researcher Pit Losch, zeolites play a

Dr Pit Losch

researche

Great potential for recycling CO₂

However, heterogeneous catalysts (see info. box), of which over 230 different structural groups have so far been identified, can also be important in relation to the conversion of other materials. Due to their threedimensional porous structure with pore diameters the size of molecules, they enable conversions to be carried out based on shape selection, which is why they are also called molecular sieves. And that makes them especially interesting, particularly in light of the foreseeable end of fossil fuels.

"Zeolites hold great promise for recycling CO₂ via methanol", he states, "and methanol is, for example, a suitable material for storing renewable energy from wind farms." Wind farms produce surplus energy at certain times, but at present very little of this energy is stored due to the lack of available storage options. In a sustainable future, however, methanol could be obtained cheaply from CO₂ by using renewable forms of energy, so it could be used as a liquid, easily transported hydrogen energy storage medium.

Research work is now also being supported by BASF

The specially designed zeolites can be used to convert methanol into light hydrocarbons such as ethylene and propylene. And propylene is in turn used for manufacturing polypropylene (a thermoplastic). Until now, these so-called olefins have almost exclusively been manufactured based on fossil fuels (oil and gas). Pit Losch, whose doctoral thesis focuses on this conversion of methanol into olefins (MTO process) facilitated by zeolites, sees it as an important step towards weaning us off our dependence on fossil fuels. This is true above all for the plastics industry, which is reliant on olefins, and for which this process offers not only a substitute for fossil fuels but also a more environmentally friendly alternative to them.

The industry is well aware of these facts. "Our research work on converting methanol into propylene is now also being supported by BASF", he says. Since the beginning of this year, he has been working at the Max-Planck-Institute for Coal Research in Mülheim an der Ruhr in Germany.

Meanwhile, in Strasbourg, his work is being used as a basis for attempts to prove that these extremely selective and stable catalysts can also be produced on a larger scale, after which the objective is to register a patent. The main problem with the catalysts is that although they enable the chemical reaction to take place, they can't maintain it for long enough. However, Pit Losch has already proven that an operating period of 100 hours or more is possible without deactivating the catalyst.

Conscious decision to undertake public sector research

After he had completed his doctoral thesis, the young researcher could have walked into a well-paid job with one of the world's largest chemical industry conglomerates. And it would have been just a couple of miles from his home town. "I found it really hard to turn down this offer", he says, "but in the end I opted for research work in the public sector."

While he was writing his thesis, he received financial help in the form of a three-year AFR-PhD grant from the FNR. "For me, these three years were really rewarding because my supervisor, Dr Benoît Louis, allowed me a lot of freedom, and I was able to attend conferences all around the world", he states. He took part in events in Hawaii, Rio, Bulgaria and Berlin – and has no regrets whatsoever about being a scientist rather than a professional cyclist.

A catalyst, heterogeneous forms of which are also used in car exhaust systems. is used to reduce the amount of energy needed to activate a chemical conversion process. The catalysts themselves are not consumed during a chemical reaction. The most important properties of a catalyst are reactivity (a little must be able to convert a large quantity of material), selectivity (ideally only the desired product is produced), and stability (they should be as long-acting and as long-lasting as possible). They are used both to convert hazardous substances into harmless products, and to convert cheap starting materials into valuable end-products. The largest chemical, industrial processes in the world are only economically viable thanks to the use of heterogeneous catalysts – one example of such a process is the Haber-Bosch process for obtaining ammonia from atmospheric nitrogen.

1 FUNDING INSTRUMENTS

STRATEGIC OBJECTIVE 1:

To promote scientific quality and excellence in research

CORE

CORE is a traditional programme for the funding of research projects. Proposed projects are submitted by the research institutions (bottom-up approach) and are part of the national research priorities defined by the Government (top-down approach). The projects are selected on the basis of their scientific quality.

INTER

The objective of the INTER programme is to strengthen international cooperation and increase the impact of research activities in Luxembourg by promoting research projects which combine Luxembourg and foreign researchers. The programme is currently in three segments: (1) the international mobility programme, (2) bilateral cooperation, and (3) multilateral cooperation. The projects are selected on the basis of their scientific quality.

RESCOM (Support for Research Communication)

The objective of the RESCOM instrument is to promote communication and exchange between researchers, notably by subsidising scientific events of an international scope.

OPEN

The OPEN programme allows researchers to submit research projects whose themes are not covered by the fields of the CORE programme and therefore make it possible to identify research groups which are competitive at international level outside national priorities. The projects are selected on the basis of their scientific quality.

STRATEGIC OBJECTIVE 2: To strengthen research engendering an economic and societal impact

Valorisation Programme (Proof of Concept, Knowledge & Innovation Transfer Support)

The purpose of the valorisation programme is to encourage the transfer of research results into economically viable innovations. The FNR can support feasibility studies and the realisation of prototypes and pilot systems for the purpose of projects with a high level of potential innovation. The project will be selected on the basis of the economic potential of the innovation and the proposed exploitation plan. The FNR may also support people whose expertise is needed to reflect the transfer of the results of the research into economically exploitable innovative projects.

AFR-PPP (Public Private Partnership)

The PPP segment of the AFR programme quite specifically supports trainee researchers who carry out their research as part of a cooperation between a public research body and an industrial partner.

CORE-PPP (Public Private Partnership)

The PPP segment of the CORE programme supports in particular research projects carried out as part of a cooperation between a public research body and an industrial partner.

IPBG (Industrial Partnership Block Grant)

The aim of the IPBG programme is to foster the cooperation between Luxembourg based companies active in R&D and public research institutions in Luxembourg. The IPBG awards a block allocation of PhD and/or Postdoc grants (AFR-PPP) in which Luxembourgbased industry partner(s) take the lead in arranging a research programme with a Luxembourg-based public research institution of their choice (in research relevant to FNR's strategic priority areas).

FNR-MECO (joint programming)

Establish a partnership between the FNR and the Ministry of Economy with the goal of providing financial support for large, strategically important public-private projects aimed to generate the knowledge meeting future technological challenges for the partners and the country and to establish Luxembourg as an innovation hub.

SIS (Science in Society)

The FNR wants to strengthen the link between sciences and society which is why it promotes scientific culture as one of its priority areas. This promotion aims to create awareness among the whole population, decisionmakers and young people alike who are the citizens and researchers of the future. The objective is to create acceptance and comprehension of the role of sciences and research as creators of knowledge, innovation and to spark enthusiasm among young people about scientific careers. It is for this reason that the FNR offers platforms to assist researchers in promoting their activities, organises its own promotion activities in order to increase the visibility of sciences and research, and also provides financial support to researchers.

PSP (Promoting Science to the Public)

The objective of the PSP-Classic programme is to strengthen the exchange between science and society. The programme co-funds projects that allow lay audiences (general public, school children, educational personnel etc.) to come into contact with science and research in an interactive way.

Projects must communicate research results or general knowledge about science and research (the career of a researcher, scientific methods, the complexity of research etc.). The choice of scientific themes is free and the funding programme is open to all disciplines. The PSP-Flagship programme aims to set up long-term science outreach activities with a sustainable and lasting impact on the promotion of science to the public in Luxembourg. The promotion of science or research needs to be placed at the centre and projects must include the active participation of the audience.

PSP-Flagship is different from PSP-Classic in the sense that it focusses on long-term projects with high impact. Similar to PSP-Classic, it is open to proposals from all scientific disciplines. Both new projects and ongoing projects are eligible for PSP-Flagship co-funding.

STRATEGIC OBJECTIVE 3: To strengthen the efficiency and durability of Luxembourg public research - To invest in human capital

PEARL

The PEARL programme aims to contribute to developing a truly critical mass and international visibility of research priorities in Luxembourg both in quantitative and qualitative terms. The principal aim of PEARL is to offer a flexible and highly attractive tool to institutions so they can attract more experienced and established researchers who are recognised at international level. These parties will transfer and develop their research programmes to Luxembourg and thereby contribute to accelerating the development of national priorities.

ATTRACT

The ATTRACT programme aims to strengthen the excellence of Luxembourg research by attracting researchers of an excellent scientific level who are able to draw upon recognised professional experience in research. The programme offers researchers not yet established in Luxembourg the opportunity to set up their own research in a public research body in Luxembourg which is prepared to accommodate them with a jointly submitted project.

NCER (National Centre of Excellence in Research)

The objective of the NCER programme is to support the development of public research in areas of strategic interest in order to derive a socio-economic return in the medium to long term. It aims to strengthen cooperation between institutions and to concentrate research activities based around a common scientific and socio- economic challenge. The objective of the programme is to increase the critical mass of public research in Luxembourg and to achieve greater visibility at international level.

AFR (Aides à la Formation-Recherche) Individual)

The AFR programme is one of the FNR's longestrunning funding schemes and now serves the specific purpose of providing funding to the best researchers who are studying at doctorate levels. The AFR PhD grant scheme is divided into two sub-categories: AFR PhD in Luxembourg (AFR Incoming) and AFR PhD abroad (AFR Outgoing).

PRIDE

PRIDE is the FNR's new programme for funding doctoral research in Luxembourg. Under this programme, a block of PhD grants is awarded to a consortium of excellent researchers grouped around a coherent research and training programme. PRIDE is open to all domains of research and technological development. PRIDE aims at attracting excellent PhD candidates to Luxembourg and offering them a high quality interdisciplinary research training. Compared to the AFR individual grant scheme for PhDs, PRIDE provides greater advantage to institutions and PhD candidates, as institutions are able to immediately offer a full PhD grant to promising candidates, without having to undergo a separate application and selection procedure at the FNR.

CORE 2016

PROJECT ACRONYM	PROJECT TITLE	PRINCIPAL INVESTIGATOR	HOST INSTITUTION	DOMAIN	FNR CONTRIBUTION
LuxDemo	The origins of democracy in Luxembourg: Mechanisms of democratization at the elite and popular levels	Philippe Poirier	UL	SC	368,000.00
miRMet	Role of miR-371-373 cluster in tumor initiation and metastatic colonization	Elisabeth Letellier	UL	BM	496,000.00
CABERNET	Studying cell wall-associated processes in fibers of nettle	Gea Guerriero	LIST	SR	491,000.00
METASTALIM	Inhibition of breast cancer metastasis by targeting critical cytoskeletal components of invadopodia	Clement Thomas	LIH	BM	252,000.00
• FESS	Functional Encrypted Secure Systems	Vincenzo lovino	UL	IS	586,000.00
ECLECTIC	Energy and Complexity Efficient Millimiter-wave Large-Aray Communications	Christos Tsinos	UL	IS	628,000.00
• ACHE	Age-related Changes in Human pain perception and modulation: Evidence from functional brain imaging	Marian Van der Meulen	UL	BM	526,000.00
ESTIMUM	Ecosystem Service Toolbox developed from multi- scale Integrated Modelling of Urban Metabolism	Benedetto Rugani	LIST	SR	647,000.00
CAROPROT	Bioavailability of Carotenoids – Influence of Co- ingested Proteins	Torsten Bohn	LIH	BM	534,000.00
PARENT	PARENT Evaluation of parental leave in Luxembourg, focus on couples' strategies and the role of workplace characteristics		LISER	SC	540,000.00
TRIOPS	The Training of Complex Problem Solving	Samuel Greiff	UL	SC	744,000.00
ESSTIMS	Enhanced Signal Space optimization for satellite communication Systems	Farbod Kayhan	UL	IS	595,000.00
GutHealth	Identification of genome-based metabolic disease- markers in the human gut microbiome	Dmitry Ravcheev	UL	BM	396,000.00
DynASCEL	Dynamics of Academic Self-Concept in Everyday Life	Christoph Niepel	UL	SC	591,000.00
MiBiPa	Non-invasive microbiome-derived multi-omic biomarkers for the early-stage detection and stratification of Parkinson's disease	Paul Wilmes	UL	ВМ	757,000.00
DAPRECO	DAta Protection REgulation COmpliance	Gabriele Lenzini	UL	IS	689,000.00
Publimape	Public Information Mapped to Environmental Events	Thomas Tamisier	LIST	IS	763,000.00
SWITCH	Subjective Wellbeing and Identity Construal in a Changing World	Elke Murdock	UL	SC	576,000.00
CIRCULAR	CIRCULAR Challenges for the implementation of Circular Economy policies: practices, institutions and hybrid intersections		UL	SR	725,000.00
• COMET	COMET Completing the metabolic map around the oncometabolite D-2-hydroxyglutarate		UL	BM	607,000.00
SURPASS	Surface passivation for thin film photovoltaics	Florian Werner	UL	MS	467,000.00
MetCOEPs	DNA Methylation: Conducting the orchestra from exposure to phenotypes	Jonathan David Turner	LIH	BM	548,000.00
INTEGRIMM	Migration duration and socio-cultural integration	Bertrand Verheyden	LISER	SC	549,000.00

PROJECT ACRONYM	PROJECT TITLE	PRINCIPAL INVESTIGATOR	HOST INSTITUTION	DOMAIN	FNR CONTRIBUTION IN EUR
WorkAgeing	Older workers' employment participation: new evidence from Luxembourg	Thuc Uyen Nguyen-Thi	LISER	SC	542,000.00
BIAFET	BIsmuth-based AntiFErroelectrics as Tunable materials	Mael Guennou	LIST	MS	596,000.00
PSSENS	transparent Piezotronic Strain SENSors	Jerome Polesel	LIST	MS	835,000.00
• eCoBus	Electrified Cooperative Bus System	Francesco Viti	UL	IS	563,000.00
PARTI	Photon Absorption and Relaxation in Topological Insulators	Thomas Schmidt	UL	MS	485,000.00
STHIM	Scanning Transmission Helium Ion Microscopy: from classical to quantum phenomena	Tom Wirtz	LIST	MS	665,000.00
MICROPLAS- COAT	Atmospheric pressure plasma TORCH for microprinting organic/inorganic functional layer	Patrick Choquet	LIST	MS	632,000.00
QUANTION	Quantum Ion Tunneling and Scattering in Layered Nanomaterials	Alexandre Tkatchenko	UL	MS	548,000.00
NANOSOFT	Nanodisk assembly for new soft matter	Giusy Scalia	UL	MS	348,000.00
TOTAL					18,289,000.00

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/core

CORE-PPP 2016

PROJECT ACRONYM	PROJECT TITLE	PRINCIPAL INVESTIGATOR	HOST INSTITUTION	DOMAIN	FNR CONTRIBUTION IN EUR
• ILEP	Interaction with low energy photons	Susanne Siebentritt	UL	MS	324,355.00
MOSIS	Model-Based Simulation of Integrated Software Systems	Lionel Briand	SnT (UL)	IS	485,497.32
 GREENANO- NANO2 	Upscaled fabrication of CNTs/Silica fillers, integration of biphased filler in tire tread compound and prototype of passenger tire technology	Didier Arl	LIST	MS	500,000.00
PROSAT	On-board processing techniques for high throughput satellites	Björn Ottersten	SnT (UL)	IS	499,993.00
METAMARINE	METAllic elements topcoat against corrosion in MARINE environment	Patrick Choquet	LIST	MS	427,480.00
CuCfoils4LSP	Cu-Carbon nanocomposite foils: highly conductive materials with high ampacity for lightening strike protection	Damien Lenoble	LIST	MS	500,000.00

TOTAL

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/core

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 ${\bf BM}$ Biomedical Sciences/Regulation of Chronic, Degenerative and Infectious Diseases ${\bf IS}$ Innovation in Services SC Societal In Jan Yees SC Societal Challenges (LM+ID) MS New Functional and Intelligent Materials and Surfaces and New Sensing Applications SR Sustainable Resource Management in Luxembourg

W INTER 2016

PROJECT ACRONYM	PROJECT TITLE	PRINCIPAL INVESTIGATOR	HOST INSTITUTION	DOMAIN	FNR CONTRIBUTION
• 10591095	0591095 Characterization and formation of Pierre Gratia the Kepler-56 system: can scattering ex- plain the observed orbital properties?		NASA Ames Research Center	MS	133,758.00
LaserSTAMP	Laser and Surface Treatment Assisted Metal Polymer assembly	Peter Plapper	UL	MS	500,000.00
 DIKOMPAS Diagnostische Kompetenz von Lehrkräften: Wie interagieren Aufgaben- und Schülermerkmale im Prozess der Leistungsbeurteilung? 		Sabine Krolak-Schwerdt	UL	SC	189,500.00
ECOTREE	Ecotoxicology of Rare Earth Elements in Aquatic Systems	Arno Gutleb	LIST	SR	650,000.00
• DynGeo Dynamics and geometric structures		Jean-Marc Schlenker	UL	MT	307,000.00
InTopIns	Interacting Topological Insulators	Thomas Schmidt	UL	MS	90,000.00
• 4DCollab	4DCollab Usage and interaction of synchronous 4D simulation for collaborative decision support in Architecture, Engineering and Construction		LIST	IS	513,000.00
• 11244009	Development and benchmarking of a compact mass spectrometer for space applications (MS-SPACE)	Rathaiah Pureti	LIST	MS	132,508.00
ProtectMove	Reduced penetrance in hereditary movement disorders: Elucidating mechanisms of endogenous disease protection	Anne Grünewald	UL	ВМ	368,000.00
• X-SOLVER	Extended Supply Chain Software for complex value networks	Peter Plapper	UL	MS	286,000.00
 FinWebs Stabilising an unstable industry: Sa The role of agency in interconnecting international financial centres 		Sabine Dörry	LISER	SC	524,000.00
2Defect	2D materials beyond graphene	Ludger Wirtz	UL	MS	262,000.00
TOTAL					3,955,766.00

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/inter

INTER-MOBILITY 2016

PROJECT ACRONYM	PROJECT TITLE	PRINCIPAL INVESTIGATOR	HOST INSTITUTION	DOMAIN	FNR CONTRIBUTION
BA4 Smartness	Business Analytics as an enable for Smartness	Henderik Alex Proper	LIST	IS	30,000.00
CBMETRO	The cross-border metropolis hypothesis: Back to the source	Christophe Sohn	LISER	LE	69,900.00
• Sabbeine Research visits of Michel Beine in the context of the sabbatical leave to Australia and the US. 3 institutions visited: Macquarie University at Sydney and University of Western Australia at Perth in Australia; University of California-Davis in the US.		Michel Beine	UL	SC	28,200.00
SOLACE	Solute transport assessment in catch- ments: ecohydrological perspectives	Julian Klaus	LIST	SR	126,400.00
MULTICALOR	Multi-caloric materials	Emmanuel Defay	LIST	MS	136,000.00
SMART	A New Law for FinTECHs? - The Regulatory Sandbox	Andreas Zetzsche	UL	LE	53,000.00
EU- SANCT-PIL	European Union Autonomous Sanctions form the Perspective of Public International Law	Matthew Happold	UL	LE	14,000.00
APO-SLE	From Systemic Lupus Erythematosus to Cancer; role of the Mutator Enzyme APOBEC3A in auto-immunity and tumorigenesis	Danielle Perez Bercoff	LIH	ВМ	63,000.00
MicroMuc	Dietary-fiber mediated gut homeostasis: interaction of the microbiome with the colonic mucus barrier	Mahesh Desai	LIH	ВМ	85,000.00
Serval@ Berkeley	Serval@Berkeley	Yves Le Traon	SnT (UL)	IS	149,000.00
2D-Ferro	Electronic properties of hybrid 2D- ferroelectric structures	Jens Kreisel	LIST	MS	85,000.00
AstroSyn		Université du Luxembourg	UL	BM	48,000.00
ECONSPEZ	Segregation in fileds of specialization: the case of Economics	Eva Sierminska	LISER	LE	98,000.00
SMMIP Split band assisted Muli-dimensional and Multi-zonal InSAR time series Processor		Nicolas d'Oreye	European Center for Geodynamics and Seismology (ECGS)	SR	135,000.00
TOTAL					1 120 500 00

TOTAL

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/inter

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 ${\rm BM}$ Biomedical Sciences/Regulation of Chronic, Degenerative and Infectious Diseases ${\rm IS}$ Innovation in Services SC Societal In Jan Yees SC Societal Challenges (LM+ID) MS New Functional and Intelligent Materials and Surfaces and New Sensing Applications SR Sustainable Resource Management in Luxembourg

ATTRACT 2016

PROJECT ACRONYM	PROJECT TITLE	PROJECT LEADER	HOST INSTITUTION	DOMAIN	FNR CONTRIBUTION IN EUR
DIGILEARN	Scientifically validated digital learning environments	Pedro Cardoso-Leite	UL	SC	2,000,000.00
SUNSPOT	Surface and interface science on photovoltaic materials	Alex Redinger	UL	MS	2,000,000.00
• WAVE	Water and vegetation in a changing environment	Stanislaus Schymanski	LIST	SR	1,700,000.00
TOTAL					5,700,000.00

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/attract

PRIDE 2016

PROJECT ACRONYM	PROJECT TITLE	PROJECT LEADER	HOST INSTITUTION	DOMAIN	FNR CONTRIBUTION
• CANBIO	Training in Cancer Biology: Focus on Tumour Escape Mechanisms	Simone Niclou	LIH	BM	2,689,951.60
• NEXTIMMUNE	NEXT GENERATION IMMUNOSCIENCE: Advanced Concepts for Deciphering Acute and Chronic Inflammation	Markus Ollert	LIH	BM	2,417,394.20
• CriTICS	Critical transitions in complex systems: from theory to applications	Jorge Goncalves	UL	BM	1,859,534.00
• CALIDIE	Capitalising on Linguistic Diversity in Education	Adelheid Hu	UL	SC	1,673,580.60
• DHH	Digital History and Hermeneutics	Andreas Fickers	UL	SC	2,045,487.40
MASSENA	MAterials for SenSing and ENergy hArvesting	Emmanuel Defay	LIST	MS	3,719,068.00
HYDRO-CSI	Towards a holistic understanding of river systems: Innovative methodologies for unraveling hydrological, chemical and biological interactions across multiple scales	Laurent Pfister	LIST	SR	2,603,347.60
SPsquared	Security and Privacy for System Protection	Sjouke Mauw	UL	IS	2,045,487.60
• GSM	Geometric and Stochastic Methods in Mathematics and Applications	Gabor Wiese	UL	MT	1,673,581.00
• REMS	Enforcement in multi-level regulatory systems	Katalin Ligeti	UL	LE	2,231,441.00
MINLAB	Migration, Inequalities and Labour Markets	Michel Beine	UL	LE	2,231,441.00
TOTAL					25,190,314.00

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/pride

AFR PPP 2016

TYPE	NAME	PROJECT TITLE	PROJECT DOMAIN	HOST INSTITUTION	COLLABORATING INST.	FNR CONTRIBUTION
PDR	Gilles Adam	Treatment Of BIogas digestate and for accrued Agricultural Sustainability	SR	LIST	Ama Mundu Technologies ENOVOS Luxembourg	133,288.00
PDR	Alvoaro Antonio Estupinan Donoso	Multi-scale and Multi-physics Mod- elling of Grain Growth Mechanisms During the Industrial-scale Reduc- tion of Tungsten Oxides	MS	CERATIZIT Luxembourg S.à.r.l.	UL	133,288.00
PDR	Jeroen Karl P. Joly	Improving Social and Political Data (Collection, Analysis & Dissemination) in Luxembourg	ID	UL	TNS ILRES	133,288.00
PDR	Marcin Seredynski	Dynamic Zero Emission Bus Corridor Management	IS	E-Bus Compen- tence Center S.à.r.l.	UL	133,288.00
PDR	Vesselin Velichkov	Smart Contracts: Security and Analytics	IS	Deloitte	UL	133,288.00
PDR	Carlos Couto	Development of an innovative design method for structural stability verification of tapered steel members with variable class 4 sections	MS	ASTRON BUILDINGS S.A.	University of Aveiro	134,038.00
PDR	Thomas Schaubroeck	PVC flooring recycling: a sustain- ability assessment of different circular business models	SR	LIST	Tarkett	133,288.00
PhD	Markus Maleska	Impact of the water film thickness of a non-free rolling passenger car tire on its hydroplaning performance	MS	Goodyear S.A.	TU Kaiserslautern	193,654.00
PhD	Christian Hammes	Enhancing Angular Resolution in Radar Through Dynamic Beam Steering and MIMO	IS	SnT (UL)	IEE S.A.	193,654.00
PhD	Manxing Du	Self-learning predictive algorithms: from design to scalable implementation	IS	SnT (UL)	OLAmobile	193,654.00
PhD	Raghavan Lakshmanan	Exploration of Combustion and Injection Systems for High Load Low NOx in RDE	MS	Delphi Automotive Systems Luxembourg S.A.	RWTH Aachen University	193,654.00
PhD	Maciej Piotr Chrzanowski	Structural Behaviour of Heavy Composite Columns with Multiple Encased Steel Profiles for High Rise Buildings	MS	UL	ArcelorMittal Esch-sur-Alzette R&D Centre	193,654.00
PhD	Bruno Coutty	Development and implementation of fan aeroacoustic simulation tool integrated in vehicle engine cooling application	MS	Mahle Behr Luxembourg S.à.r.l.	Université de Sherbrooke	193,654.00
PhD	Mariem Jobrane	Optimization of a solar evaporation/ condensation desalination system for drinking water production	SR	LIST	University of Gabès (ISSTEG) Myriado Cleantech	194,404.00
PhD	Jevgenij Krivochiza	End-to-end Signal Processing Algorithms for Precoded Satellite Communications	IS	SnT (UL)	SES S.A.	193,654.00
PhD	Patrick Oliver Glauner	Spatio-Temporal Processes for Electricity Theft Detection	IS	SnT (UL)	CHOICE Technologies	193,654.00
TOTAL						2,667,402.00

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/afr

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IS Innovation in Services

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SC Societal In Jan Yees SC Societal Challenges (LM+ID) MS New Functional and Intelligent Materials and Surfaces and New Sensing Applications SR Sustainable Resource Management in Luxembourg

AFR PhD 2016

FIRST NAME	LAST NAME	HOST INSTITUTION	DOMAIN	TITLE OF PROJECT	FNR CONTRIBUTION
Elisa Eykta	Meyer	Universität Wien	SC	Identitatskonzepte im "Mann ohne Eigenschaften" von Robert Musil.	26,000.00
Thiemo	Kunze	UL	SC	Time As Relevant, Dynamic and Integral part of complex problem Solving	170,908.00
Ana	Bezirgani	Ana Bezirgani	SC	Psychosocial determinants in the voluntary use of sustainable transportation	72,000.00
Nina	Hentzen	ETH Zürich	MS	Cross-Linked Collagen Peptides for Self-Assembly Into Higher-Ordered Structures	170,908.00
Hugues	Meyer	UL	MS	Coarse-grained description of entropy production in crystallization processes	170,908.00
Cedric	Oms	Universitat Politecnica de Catalunya	MT	Global Hamiltonian Dynamics of singular symplectic manifolds	170,908.00
Teresa	Quintel	UL	LE	"Data Protection For Asylum Seekers In The European Union?" Harmonization prospects under the EU Data Protection Reform	170,908.00
Francois Noel Marcel Josepha	Fays	LIH	BM	Novel Strategies for the assessment of exposure to fast elimination endocrine disruptors with non-invasive biological sampling	170,908.00
Noemi Helena	Deitz	Noemi Helena Deitz	SC	Helen Buchholtz - Leben und Werk	72,000.00
Christine	Faber	Christine Faber	SC	Literature in Times of Crisis: the Shifting Idea of Home in Contemporary Fiction	64,500.00
Paula	Hild	UL	SC	Implementing a circular economy in Luxembourg - Motivations and barriers of companies for shifting towards circularity	170,908.00
Max Henri	Zacharias	Max Henri Zacharias	SR	On the ecology of tree and bush dynamics in African savannahs	72,000.00
Tim	Herpich	UL	MS	Improving Energy Conversion by Synchronization	170,908.00
Joe	Weber	University of Zurich	ВМ	Proteomics of alternative homolog conjunction in Drosophila male meiosis	170,908.00
Nathalie	Kerschen	Nathalie Kerschen	SC	CTRL + Z: The limits of computational design in regard to the complexity of the human mind	72,000.00
Shervin	Vencatachellum	UL	SC	Perceptual Inference as a Core Mechanism of Mindfulness: Implications for Pain Regulation	170,908.00
Max Marc Roger	Meyrath	LIH	BM	Molecular and functional characterization of CXCR7 and its unconventional ligands MIF and ADM and their roles in virus-associated tumorigenesis.	170,908.00
Martin	Stohr	UL	MS	Coupling nuclear dynamics to electronic correlation in molecular materials	170,908.00
Francois	Thilmany	Regents of the University of California, UCSD	MT	What does covolume tell us about the structure of a lattice?	170,908.00
Sandy Kathy	Artuso	UL	SC	A narratological analysis of the German autobiographies by transgender people collected in the Lili-Elbe-Archive and published between 1980 and 2016	170,908.00
Bernadette	Borkam	UL	SC	Aesthetic Education as a Programme of Intercultural Empowerment in German Literary Texts	170,908.00
Titcheu Chekam	Thierry	SnT (UL)	IS	Tailoring Automated Software Techniques for Real World and Large Scale Software Applications	170,908.00
Fulvio	Paleari	UL	MS	Phonon-assisted optical absorption in layered materials	170,908.00
Aleksandr	Pilgun	SnT (UL)	IS	Systematically Exploring Semantic App Models for Android	170,908.00
Weber	Fabienne	UL	LE	Banks and Money Markets	170,908.00
Sebastien	Depaifve	LIST	MS	Thermal conductivity enhancement of polymer-based composites	170,908.00
Oyebade	Oyedotun	SnT (UL)	IS	Automatic Feature Selection for Visual Recognition	170,908.00
Jan	Dorendahl	UL	SC	Assessment of Fundamental Motives	170,908.00
Anna	Schleimer	Anna Schleimer	ВМ	Combination of genetics and demographics to study the population structure and future trends of a far-ranging vertebrate: the fin whale.	72,000.00

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/afr

POC 2016

PROJECT ACRONYM	PROJECT TITLE	PROJECT LEADER	HOST INSTITUTION	DOMAIN	FNR CONTRIBUTION
BrainChip	Brain-on-a-Chip technology for advanced screening for drugs against neurodegenerative disorders	Jens Schwamborn	UL	ВМ	499,000.00
ProCRob2	Programming Cognitive Robots	Leon Van der Torre	SnT (UL)	IS	196,000.00
SimCoTest	Simulink Controller Tester	Reza Matinnejad	SnT (UL)	IS	223,000.00
SERENADE	Satellite Precoding Hardware Demonstrator	Symeon Chatzinotas	SnT (UL)	IS	248,000.00
microGUT	A microfluidics-based platform emulating the gastrointestinal tract on a chip	Pranjul Shah	UL	BM	500,000.00
IMOTEP	Immobilized enzymes for the treatment of pharmaceutical residues in water	Henry-Michel Cauchie	LIST	BM	374,000.00
TOTAL					2,040,000.00

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/poc

PEARL 2016

PROJECT ACRONYM	PROJECT TITLE	PROJECT LEADER	HOST INSTITUTION	DOMAIN	FNR CONTRIBUTION
SUSMAT	Sustainable Multifunctional Polymeric and Composite Materials	Philippe Dubois	LIST	MS	4,000,000.00
NPath	Chair in Neuropathology	Michel Mittelbronn	Laboratoire National de Santé	BM	2,650,000.00
TOTAL					2,650,000.00

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/pearl

🗯 OPEN 2016

PROJECT ACRONYM	PROJECT TITLE	PROJECT LEADER	HOST INSTITUTION	DOMAIN	FNR CONTRIBUTION IN EUR
OptSys	High-performance optimization for molecular systems biology	Ronan Fleming	UL	BM	523,000.00
 AGoLoM 	Analysis and Geometry of Low-dimensional Manifolds	Jean-Marc Schlenker	UL	MT	677,000.00
TOTAL					1,200,000.00

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/open

IPBG 2016

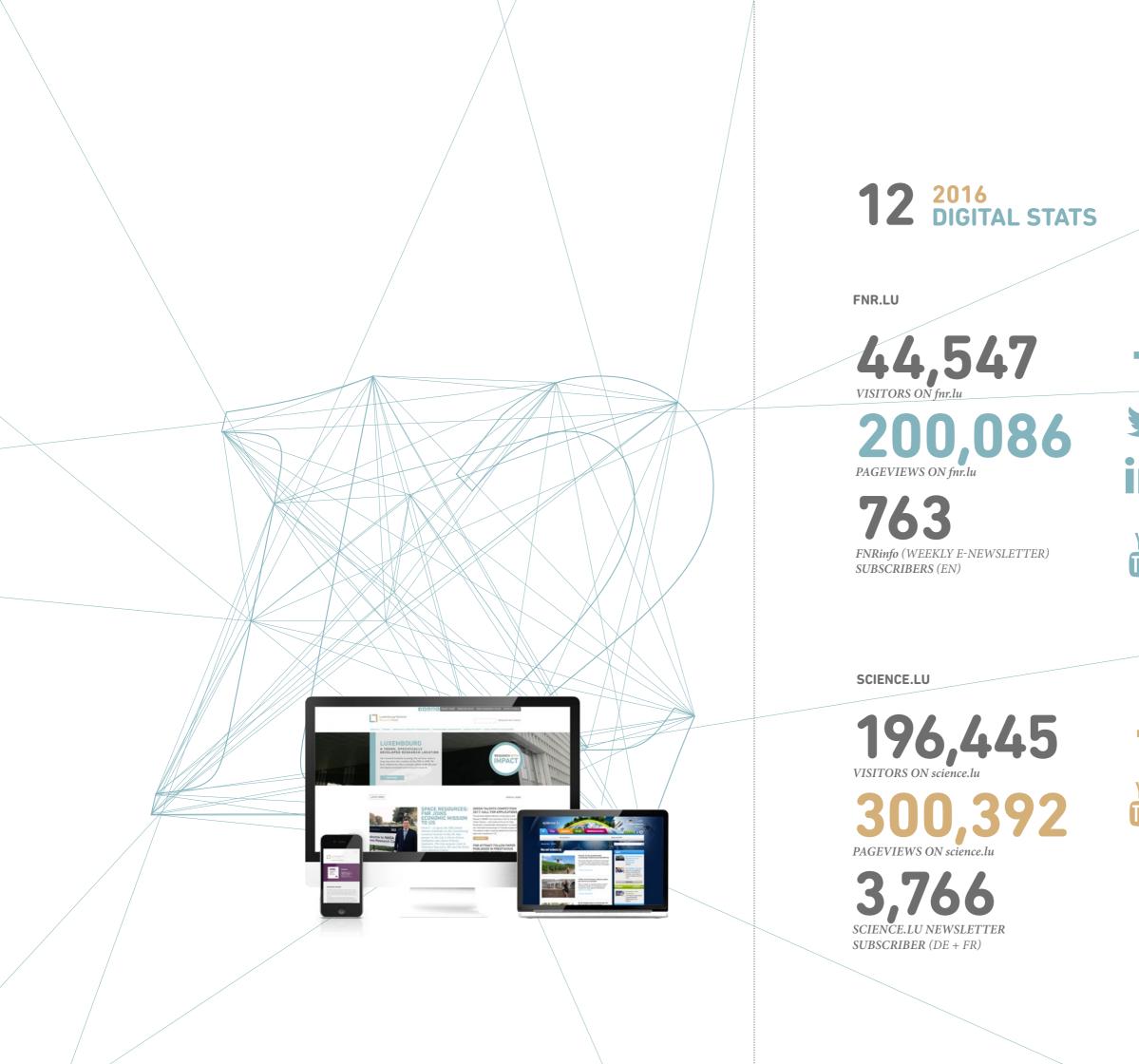
PROJECT ACRONYM	PROJECT TITLE	PRINCIPAL INVESTIGATOR	HOST INSTITUTION	DOMAIN	FNR CONTRIBUTION
TireMat-Tech	Materials Research for the Tire Technology of Tomorrow	Philippe Dubois	LIST	MS	2,684,000.00
TOTAL					2,684,000.00

For a detailed summary of each project as well as other information, please refer to www.fnr.lu/ipbg

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 ${\bf BM}$ Biomedical Sciences/Regulation of Chronic, Degenerative and Infectious Diseases



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700 TWITTER FOLLOWERS

in 432 LINKEDIN CONNECTIONS



You **14,043** *views on youtube* 30,458 MINUTES OF VIDEOS VIEWED ON YOUTUBEON YOUTUBE









274,702 MINUTES OF VIDEOS VIEWED ON YOUTUBE

ORGANISATION

The FNR is a public institution created by statute (Law of 31 May, 1999) and enjoys legal capacity and full administrative and financial autonomy. Our overall strategy is laid down in a four-year contract with the Luxembourg Government, which also defines our budget appropriation.

THE BOARD

Our Board supervises the organisation and approves the overall policies and strategic priorities of the FNR. It is appointed by the government and is composed of nine independent directors active in industry, business and the civil society. The members of the Board act in full autonomy.

Chair

Yves ELSEN, Managing Partner & CEO at HITEC Luxembourg SA Chair of the Board until 7/16

Véronique HOFFELD, Attorney-at-law, Member of the Executive Committee and partner at Loyens & Loeff Chair of the Board since 7/16

Vice-Chair

Véronique HOFFELD, Attorney-at-law, Member of the Executive Committee and partner at Loyens & Loeff Vice-Chair of the Board until 7/16

Thierry WOLTER, Member of the Executive Board and the Supervisory Board of CERATIZIT (Luxembourg) Vice-Chairman of the Board since 7/16

Members

Andrée BILLON, Executive Director of "Commission de Surveillance du Secteur Financier" (Luxembourg) from 2009-2016

Edmond DIFFERDING, Managing Director of Differding Consulting (Louvain-la-Neuve, Belgium)

Christiane HOFFMANN, Manager of Lilith Project (Luxembourg)

Anouk HILGER, Head of Project Development Renewable Energies at Enovos Luxembourg S.A.

Richard SEDRANI, Executive Director at the Novartis Institutes for BioMedical Research (Basel, Switzerland)

Hjoerdis STAHL, Director and Deputy Member of the Management Board at "Entreprise des Postes et Télécommunications Luxembourg"

Thierry WOLTER, Member of the Executive Board and the Supervisory Board of CERATIZIT (Luxembourg) Member until 7/16

Roger ASSAKER, Co-founder and CEO of e-Xtream engineering Member since 11/16

Ex-officio (non-voting) members

Marc SCHILTZ, Secretary General of the FNR

Robert KERGER, Government Commissioner

Yves FROMES, Chair of the Scientific Council of the FNR



BOARD

from left to right: Richard Sedrani, Roger Assaker, Robert Kerger (Government Commissioner), Marc Schiltz (Secretary General), Thierry Wolter (Vice-Chairman of the Board), Véronique Hoffeld (Chair of the Board), Hjoerdis Stahl, Christine Hoffmann, Edmond Differding, Andrée Billon, Yves Fromes (ex-officio member)

THE SCIENTIFIC COUNCIL

Our Scientific Council acts as an advisory body to the FNR. Appointed by the Government, it is composed of international experts. The current Scientific Council was appointed by ministerial decree in June 2015.

Chair

Prof. Dr Yves FROMES, Institut de Myologie, Paris (France)

Vice-Chair

Prof. Dr Ursula LEHMKUHL, Universität Trier (Germany)

Members

Prof. Dr Yves COCARD, Pädagogische Hochschule Bern (Switzerland)

Mrs Gabriele DOBENECKER, Empa, Dübendorf (Switzerland)

Dr Pierre LAGODA, FAO/IAEA, Vienna (Austria) Until 6/16

Prof. Dr Claudine MANGEN,

Université Concordia, Montréal (Canada)

Prof. Dr Moira NORRIE, ETH Zurich (Switzerland)

Ass.-Prof. Dr Patrycja PARUCH, Université de Genève (Switzerland)

M. Aloyse SCHOOS, IEE, Contern (Luxembourg)



SCIENTIFIC COUNCIL

from left to right: Aloyse Schoos, Dr Patrycja Paruch, Dr Marc Schiltz (Secretary General of the FNR), Prof. Dr Ursula Lehmkuhl (Vice-Chair), Prof. Dr Yves Fromes (Chair), Prof. Dr Moira Norrie, Prof. Dr Yves Cocard, Gabriele Dobenecker. Not in the picture: Prof. Claudine Mangen; Dr Pierre Lagoda

EXECUTIVE OFFICE

The Secretary General of the FNR is the chief executive of the organisation. He heads the Executive Office, implements the strategy, oversees programme development and manages all running activities. He is appointed by the Board of the FNR, subject to approval from the Government. The Executive Office is composed of more than 26 committed collaborators, who are experienced and highly-qualified professionals with a strong track record in science and research management or in the field of science communication.

- (1) *Dr Marc SCHILTZ*, Secretary General, Executive Head of the FNR
- (2) Jean-Paul BERTEMES, Science Communicator
- (3) *Karine BRIAND*, Event Manager / Communication Manager (until 03/16)
- (4) Dr Helena BURG, Head of International Relations
- (5) Angelina CLEMENS, Administrative Assistant
- (6) Dr Carlo DUPREL, Head of Unit Programme Development; Head of International Relations (until 01/16)
- (7) Frank GLOD, PhD, Head of Unit Strategic Research Programmes Dr Alicja GNIEWEK, Programme Manager (since 05/16)
- (8) *Didier GOOSSENS*, Head of Corporate Communication
- (9) Emily IVERSEN, Web and Social Media Communication Manager
- (10) Tom JAKOBS, Administrative Assistant
- (11) Christiane KAELL, Head of Unit Thematic Research Programmes
- (12) *Ulrike KOHL*, Head of Unit Talent Attraction & Capacity Building
- (13) Sylvie KRIER, Senior Administrative Assistant
- (14) Marie-Claude MARX, PhD, Programme Manager
- (15) Dr Andreea MONNAT, Head of Unit Innovation Programmes
- (16) Jill MOUSEL, Administrative Assistant
- (17) Sandra NITTEL, Administrative Assistant
- (18) Ionut PERES, IT Manager
- (19) Susana PINTO, Finance & Quality Assistant
- (20) Sonia RAMOS, Communication Manager
- (21) Susanne RICK, Programme Manager
- (22) *Marc ROCK*, Head of Finance
- (23) Joseph RODESCH, Science Communicator
- (24) Asaël ROUBY, Programme Manager; Legal Advisor & Research Integrity Officer
- (25) Anne SCHROEDER-VAN DEN BULCKE, Head of Unit Science in Society
- (26) Josiane STAUS, Administrative Assistant
- (27) Michèle WEBER, PhD, Science Communicator & Programme Manager



14 BALANCE SHEET AND PROFIT AND LOSS ACCOUNT

The accounts have been audited by KPMG Luxembourg, Société coopérative, Cabinet de révision agréé, and approved by the Board of Directors on 17 March 2017. Only the original French version of the annual accounts and the audit opion is binding. For the complete annual report (in French), please refer to www.fnr.lu/annualreports

BALANCE SHEET

As at 31 December 2016 (keur)

ASSETS	2016	2015
FIXED ASSETS		
Intangible fixed assets	0.38	16.55
Tangible fixed assets	120.18	117.40
CURRENT ASSETS		
Budgetary allocations to be received	99,156.59	76,265.35
with a maturity less than 1 year	64,802.00	63,732.26
Other receivables	13.71	346.53
Cash at bank	82,710.78	71,729.38
DEFERRED CHARGES	17.85	10.12
TOTAL ASSETS	182,019.49	148,485.33

LIABILITIES	2016	2015
CAPITAL AND RESERVES		
Reserves	5,016.12	4,457.82
Result for the financial year	154.20	558.30
CREDITORS		
Trade payables	644.44	547.91
 Tax and social security debts 	80.56	83.21
Amounts owed to beneficiaries	155,891.03	128,453.99
with a maturity less than 1 year	70,418.89	62,919.88
Other debts	198.23	161.37
DEFERRED INCOME	20,034.91	14,222.73
TOTAL LIABILITIES	182,019.49	148,485.33

PROFIT AND LOSS ACCOUNT

As at 31 December 2016 (keur)

INCOME

Budgetary allocation

• Other operating income

Commitments made

• Operating costs (including staff costs)

Value adjustments on fixed assets

Interest receivable and similar income

Interest payable and similar charges

PROFIT FOR THE FINANCIAL YEAR

201	6 2015
80,798.9	39,232.24
63.2	412.15
(76,045.9	3) (33,916.39)
(4,681.8	8) (5,074.86)
(71.1	3) (240.94)
90.9	26 146.15
(0.0	5) (0.05)
154.2	20 558.30

Highlights:

Fonds National de la Recherche (ATTRACT ; PSP) Uwe Hentschel (AFR-PhD ; INTER Mobility; PEARL; POC) scienceRELATIONS (CORE; CORE Junior)

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