Building Bridges 2018

AE-Barcelona Knowledge Hub

28-29 NOVEMBER 2018

ERC Funding in Physics and Engineering

Andrzej Jajszczyk

ERC Scientific Council

European Commission

Outline

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- ERC Basics
- ERC Funded Projects in PE Domain
- Scientific Highlights of ERC-funded Projects in PE Domain
- My Own Research

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What is the ERC?

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The ERC supports **excellence** in **frontier research** through **bottom-up**, **individual-based**, **pan-European competition**

Strategy

- Support for the **individual scientists** – no networks!
- **Global peer-review**
- No predetermined subjects (**bottom-up**)
- Supports **frontier research in all fields** of science and humanities

Legislation

- Scientific governance: **independent Scientific Council**
- **Full authority** over funding strategy and evaluation
- Finance: EC framework programme; support: **ERC Executive Agency**
- **Scientific excellence** as the sole criterion (no programmatic priorities)

ERC Budget

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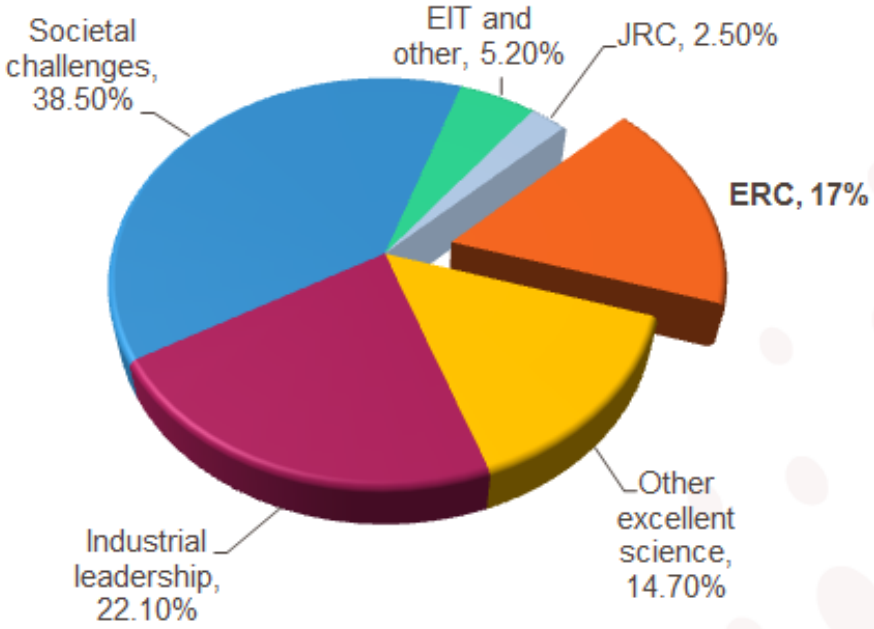
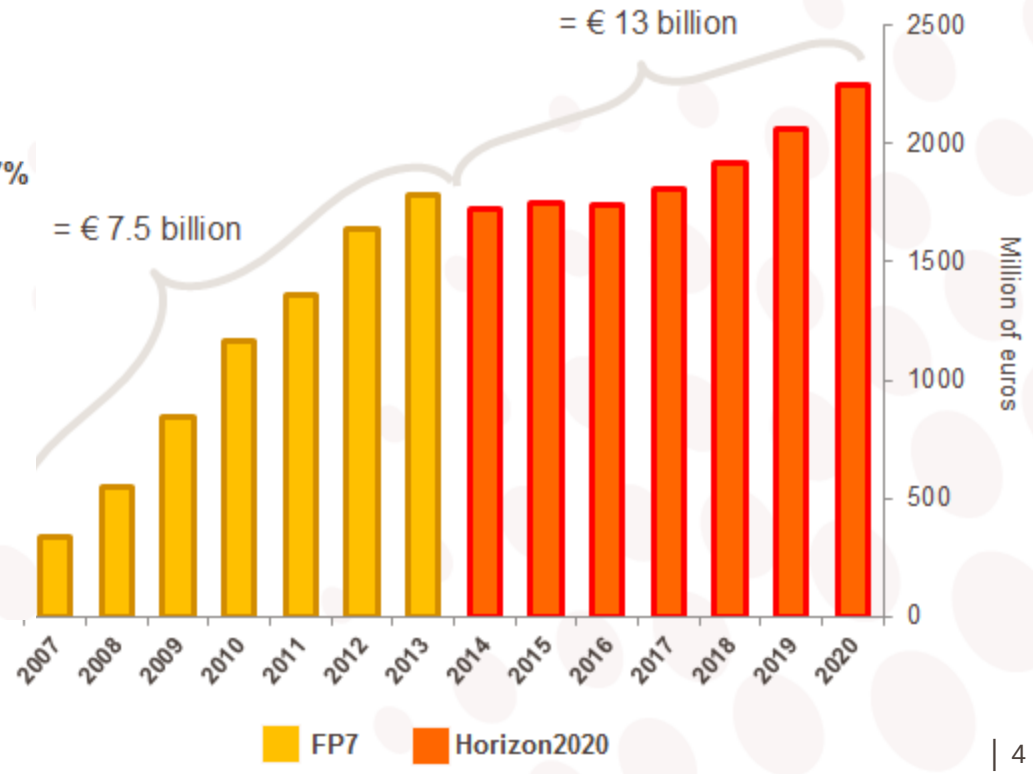
Horizon2020 budget distribution



ERC budget per year



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ERC Grant Schemes

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Starting Grants

starters
(2-7 years after PhD)
up to € 1.5 M
for 5 years

Consolidator Grants

consolidators
(7-12 years after PhD)
up to € 2 M
for 5 years

Advanced Grants

track-record of significant research achievements in the last 10 years
up to € 2.5 M
for 5 years

Proof-of-Concept

bridging gap between research – earliest stage of marketable innovation up to €150 k
for ERC grant holders

Synergy Grants

2 – 4 Principal Investigators
up to € 10.0 M for 6 years

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Evaluation Panel Structure in PE

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- **PE1** Mathematics
- **PE2** Fundamental Constituents of Matter
- **PE3** Condensed Matter Physics
- **PE4** Physical and Analytical Chemical Sciences
- **PE5** Synthetic Chemistry and Materials
- **PE6** Computer Science and Informatics
- **PE7** Systems and Communication Engineering
- **PE8** Products and Process Engineering
- **PE9** Universe Sciences
- **PE10** Earth System Science

ERC-funded Projects (2007 – Oct 2018)

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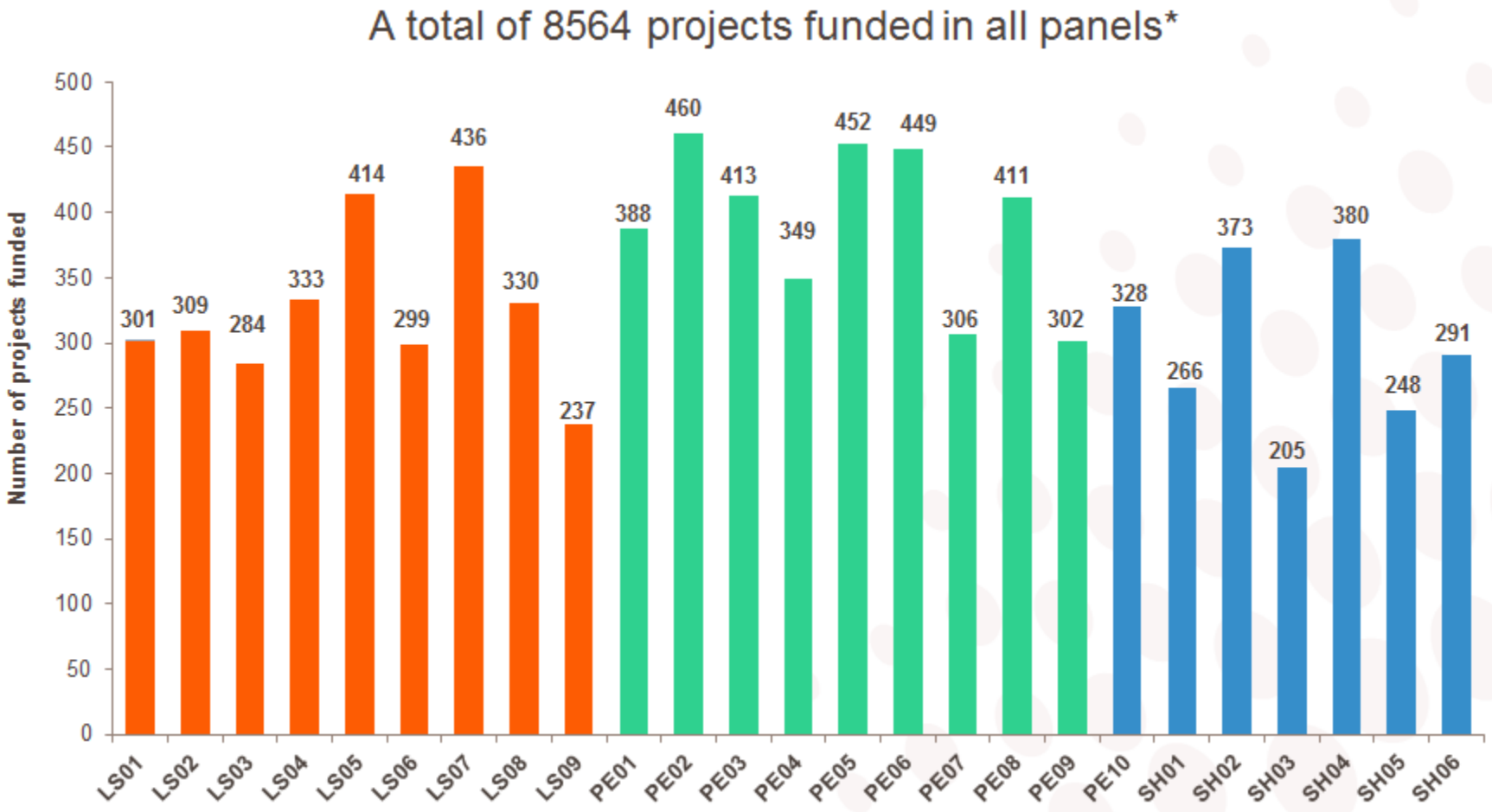

*excluding the PoC and SyG

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ERC-funded projects in PE Domain

2007 – Oct 2018

Funded Projects in PE Domain

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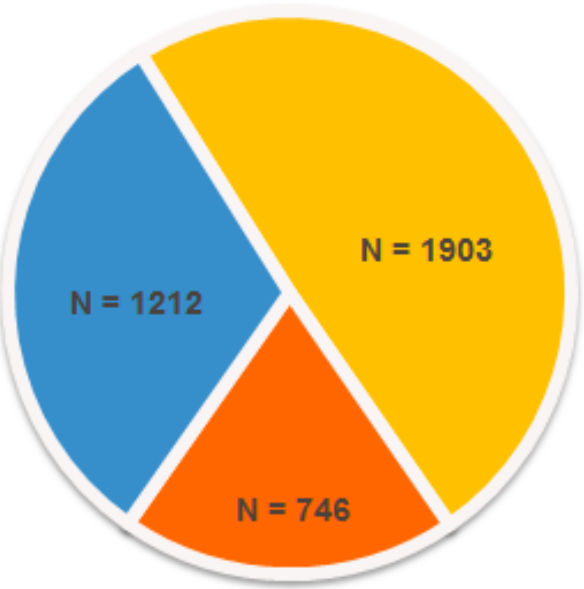
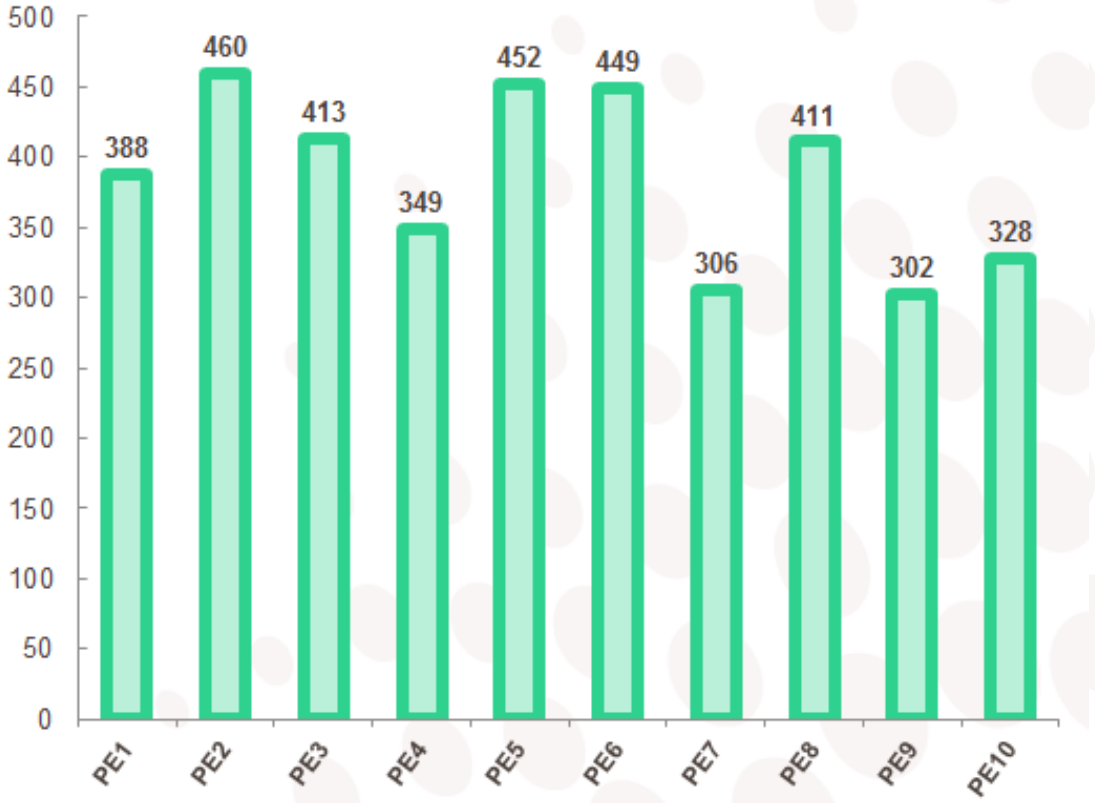
Funded proposals per scheme



Funded proposals per panel



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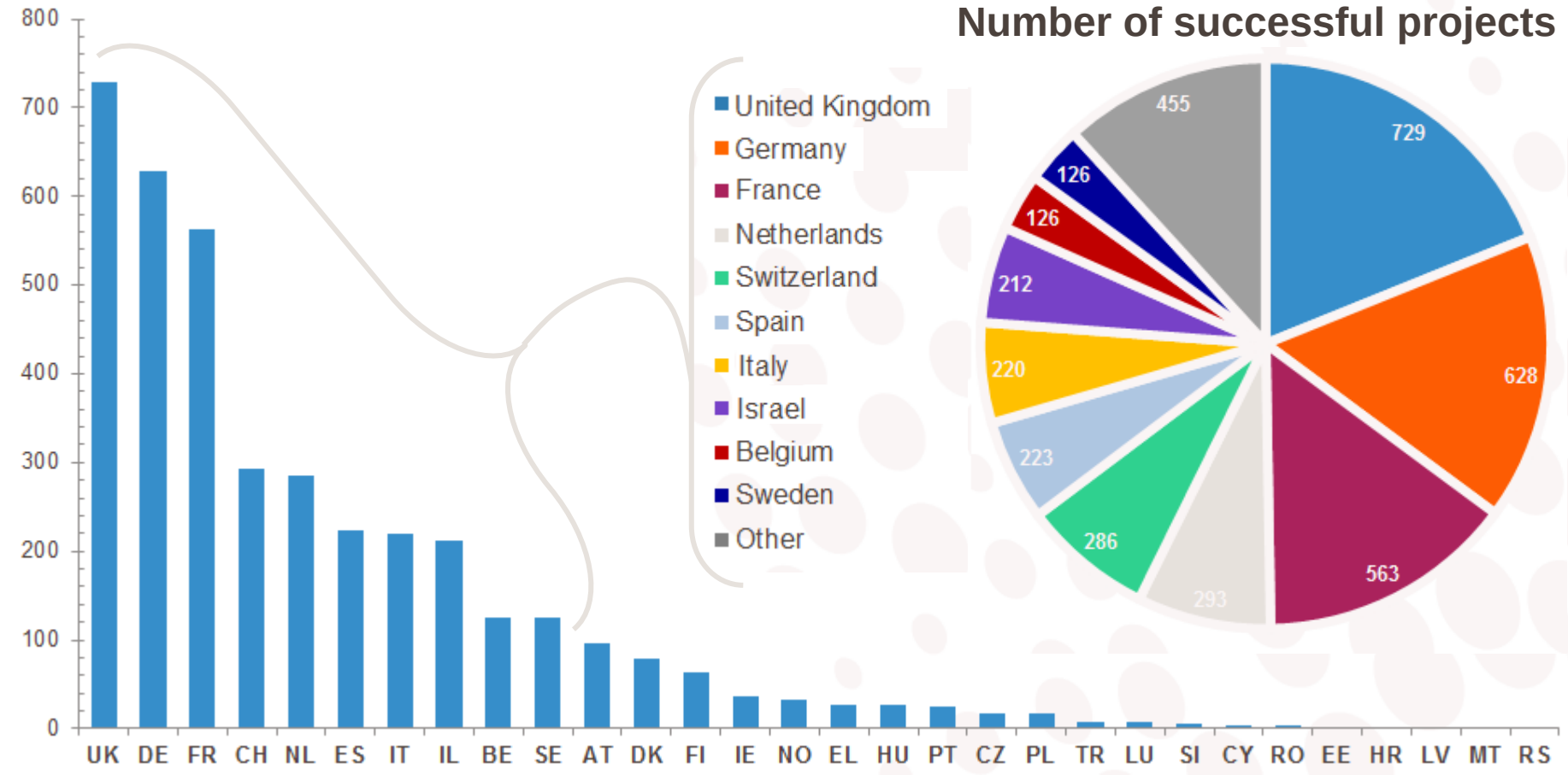
Number of PE Grants per Country of Host Institution



Number of successful projects

Most Successful Host Institutions

Institution	Funded
National Centre for Scientific Research (CNRS)	**265**
University of Cambridge	**109**
Swiss Federal Institute of Technology Lausanne (EPFL)	**98**
Swiss Federal Institute of Technology Zurich (ETH Zurich)	**96**
Max Planck Society	**93**
University of Oxford	**92**
Imperial College	**65**
Weizmann Institute	**57**
Delft University of Technology	**56**
French Alternative Energies and Atomic Energy Commission	**55**
National Institute for Research in Computer Science and Automatic Control (INRIA)	**53**
Hebrew University of Jerusalem	**50**
University College London	**49**
Technical University of Munich	**44**
Technion - Israel Institute of Technology	**42**
University of Leuven	**42**
Spanish National Research Council (CSIC)	**41**
University of Edinburgh	**40**
Tel Aviv University	**39**
University of Bristol	**39**

Nobel Prizes to ERC Grantees

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In Chemistry, *"for the design and synthesis of molecular machines"*.

Bernard Feringa
Nobel 2016

In Economic Sciences, *"for his analysis of market power and regulation"*.

Jean Tirole
Nobel 2014

In **Physics**, ***"for groundbreaking experiments regarding the two-dimensional material graphene"***

Serge Haroche
Nobel 2012

Konstantin Novoselov
Nobel 2010

In **Physics**, ***"for ground-breaking experimental methods that enable measuring and manipulation of individual quantum systems"***

May-Britt Moser
Nobel 2014

Edvard Moser
Nobel 2014

In Physiology or Medicine, *"for their discoveries of cells that constitute a positioning system in the brain"*.

*…and other **7** ERC grantees were already Nobel laureates at the moment they received the ERC grant.*

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Scientific Highlights of ERC-funded Projects in PE Domain

Panel “Systems and Communication Engineering”

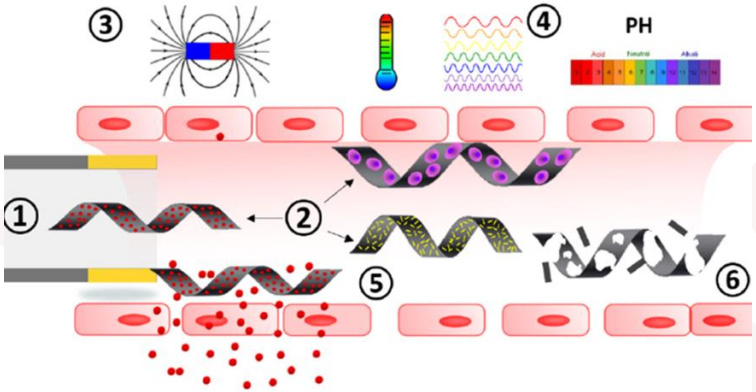
SOMBOT project - Soft Micro Robotics
Researcher - Bradley J. Nelson
Host Institution – ETH Zurich
Advanced Grant 2017 – 2.5 MEuro

Vision: Soft micro robots capable of shape modification induced by environmental conditions and other “smart” behaviours for in-vivo and pre-clinical trials

Concept: develop biocompatible/bioerodable materials that are mechanically deformable and sensitive to environmental changes e.g. light, magnetic fields, pH or temperature

Research challenges:

- smart biodegradable/resorbable/absorbable polymer materials for soft microrobots
- advanced magnetic manipulation system for guiding microrobots
- pursuit of specific therapies for eventual clinical application



① Soft microrobots delivered or collected with a catheter
② Soft microrobots are loaded with drug, nano structures, or cells
③ Soft microrobots are actuated by magnetic fields
④ Stimuli-responsive soft microrobots change shape when stimulated
⑤ Therapeutics release
⑥ Biodegradation of soft microrobots

Panel “Systems and Communication Engineering”

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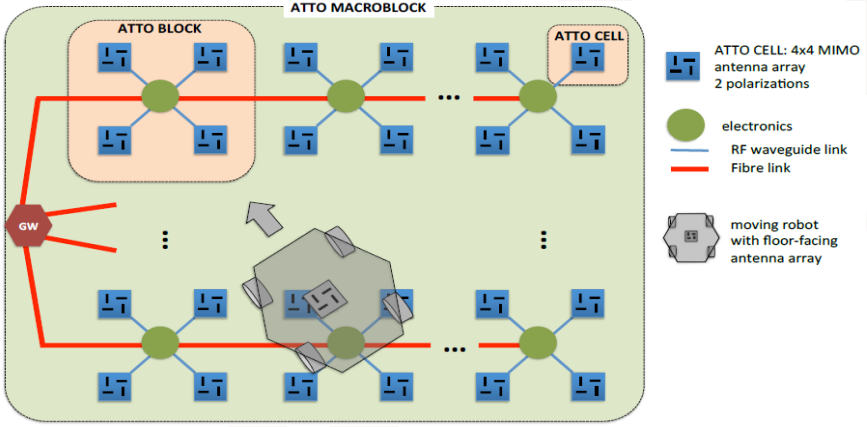
ATTO project - A new concept for ultra-high capacity wireless networks
Researcher – Piet Demeester
Host Institution – Ghent University
Advanced Grant 2015 – ≈2.5 MEuro

Vision: Massively increase the performance (e.g. bitrate density, latency) in dense wireless communication networks for ground moving objects (robot, human) by bringing the fibre as close as possible to the end user

Concept: integration of ATTO-cells in floors that are wirelessly connected through close proximity antennas integrated in the moving objects

Research challenges:

- wireless subsystem (ATTO-block)
- optical interconnection network between gateway and the ATTO-blocks
- overall control of one (or multiple) macroblocks.



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Panel “Systems and Communication Engineering”

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MICRONEX project - Microbioreactor platforms as in vivo-like systems to probe the role of Neuroblastoma-derived Exosomes in cancer dissemination

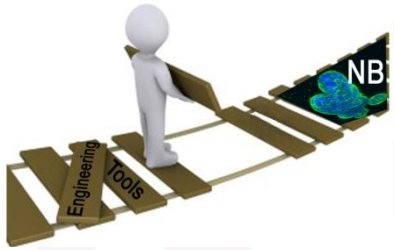
Researcher - Elisa Cimetta

Host Institution –Universita Degli Studi Di Padova

Starting Grant 2017 – ≈1.5 MEuro

Vision: Development of microbioreactors (µBRs) reconstructing biologically sound niches can revolutionize medical research

Approach: Development of platforms and testing their edge over classical approaches in decoding the role of exosomes and microenvironment in cancer research - neuroblastoma (NB). The µBRs will generate time and space-resolved concentration gradients, support fast dynamic changes and reconstruct complex interactions between cells and tissues while performing multifactorial and parallelized experiments.



Research challenges and impact:

- Cross disciplinary research
- Secreted exosomes are means by which NBs reshape their microenvironment and induce local and long-range changes in cells, regulating progression and prognosis. But the mechanisms involved are yet not completely understood. A major limitation is the difficulty to model in vitro the local in vivo dynamic microenvironment.
- The new technologies will bridge the gap between in vitro techniques and in vivo biological phenomena to improve human health.

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Panel “Fundamental Constituents of Matter”

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MaGRaTh project - Matter and strong-field gravity: New frontiers in Einstein’s theory

Researcher – Vitor Cardoso

Host Institution – Instituto Superior Técnico (PT)

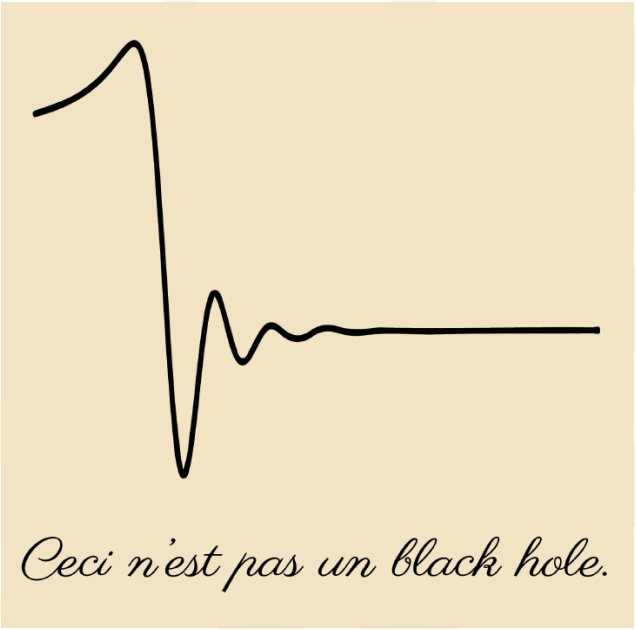
Consolidator Grant 2014 – 1.6 MEuro

Vision: Understanding black hole physics

Approach: Numerical solution of field equations on a dedicated computing cluster

Application fields and impact:

- Interpretation of experiments: Detection of gravitational waves is no in itself a proof of the existence of black holes
- Strategies for future gravitational wave experiments
- New insights into dark matter



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Panel “Fundamental Constituents of Matter”

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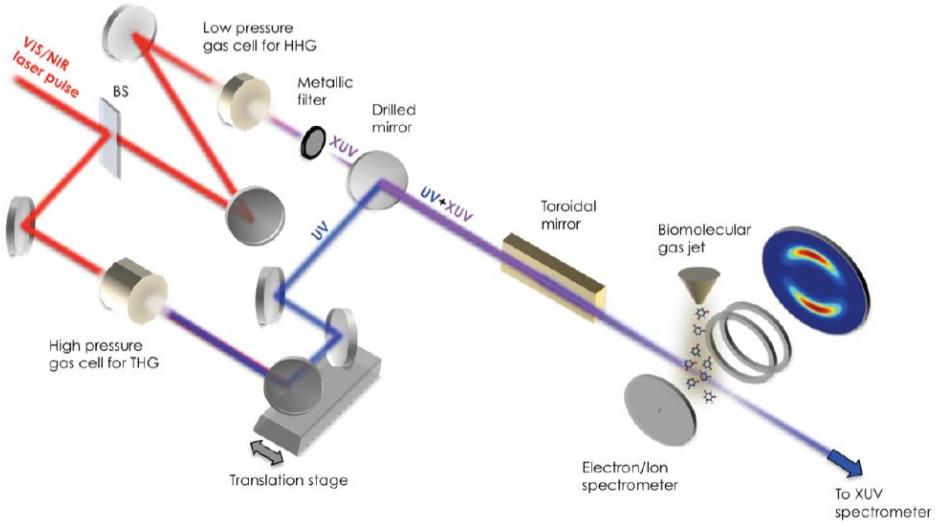
STARLIGHT project – Steering attosecond electron dynamics in biomolecules
Researcher – Francesca Calegari
Host Institution – DESY (DE)
Starting Grant 2014 – 1.5 MEuro

Vision: Understanding the chemical origin of DNA damage-induced mutations

Approach: Resonant activation of electron dynamics in biomolecules by UV pump pulses

Challenges:

- Development of a source of ultra-short UV pulses
- Probing of electron dynamics using a UV-pump XUV-probe approach
- Control of electron dynamics in cyclic biomolecules and more complex systems



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Panel “Condensed matter physics”

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SeSaMe project – Sustainable routes for Smart photonic Materials
Researcher – Silvia Vignolini
Host Institution – University of Cambridge (UK)
Starting Grant 2014 – €1.5 M **Proof of Concept Grant 2017 –** €150k

Vision: Create new sustainable bio-mimetic materials for optical devices and pigments

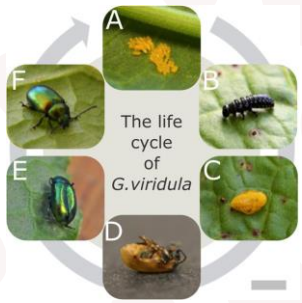
Approach: Study natural materials such as cellulose and chitin that have photonic properties in order to fabricate bio-inspired and bio-mimetic structures for applications in everyday life.

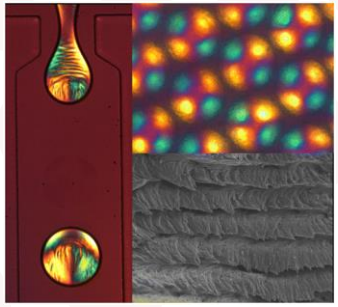
Challenges:

- Control the self-assembly of cellulose to form coloured photonic structures
- Control of the colour formation in bacterial colonies and algae
- Applications in photonic devices and materials

Results:

- Patent for bio-compatible and edible pigments
- Proof of concept grant for large-scale production





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My Own Research

- Theory of connecting networks
  - reformulation of Benes's theory
  - introducing a new class of repackable networks
  - proving nonblocking properties
  - testing of connecting networks
- New structures of photonic switching networks and networks composed of DSMs
- Network survivability
  - new metrics and proving some important network properties
- New architectures and protocols for FANs

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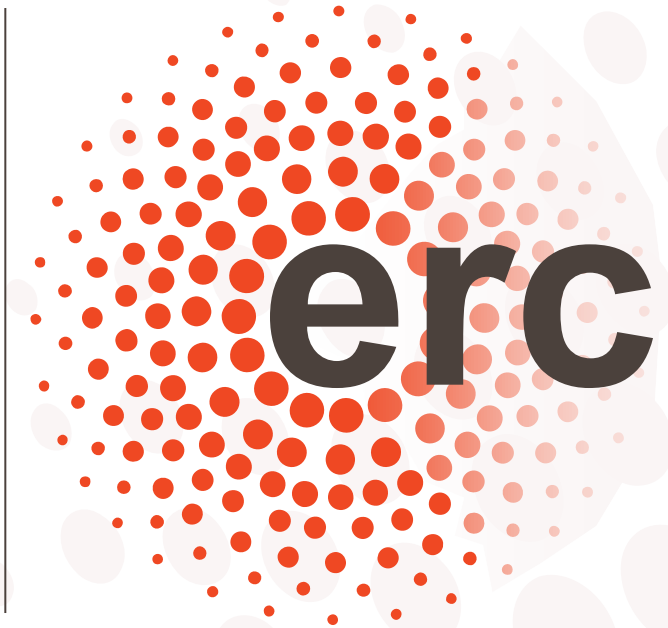
Thank you very much for your attention!



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