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FET OPEN IN 2014-2017: STATE OF PLAY

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Directorate A – Excellent Science
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EUROPEAN COMMISSION

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2018

Research Executive Agency

FOREWORD

In 2018, the highly successful FET-Open programme became part of the European Innovation Council (EIC) pilot, which in the next three years will support top-class scientists, researchers, innovators, entrepreneurs and small companies with bright ideas. FET Open will be the EIC pilot's exploratory engine for research on future and emerging technologies. It will continue to mobilise Europe's most creative and forward thinking researchers and innovators from all disciplines to work together and discover what may become the disruptive technologies of the future.

FET Open supports early-stage high-risk research around new ideas for radically new future technologies. It explores an open range of new and disruptive technological possibilities in all areas of Science & Technology, inspired by cutting-edge science, unconventional collaborations and thus pioneering new ways to create the optimum conditions for serendipity to occur.

FET Open is extremely popular in the research community. An impressive amount of 3.408 proposals have been submitted to the different calls during the first four years of Horizon 2020, covering a wide range of disciplines: from physical, chemical and biological sciences and biotechnology, to medicine and medical engineering and to humanities and social sciences. Needless to say that interdisciplinarity is a key characteristic of the 122 running FET-Open projects. In fact, FET Open is the only part of Horizon 2020 that is addressing bottom-up interdisciplinary research on emerging technologies - this, together with its simple proposal submission process, makes it one of the most popular parts of Horizon 2020. And there is more good news: during the period 2018-2020, the EU will invest another 650 Mio € in more than 200 ambitious high-risk / high-impact interdisciplinary FET-Open projects as part of the EIC pilot. The reinforced budget allocated to FET Open will also help increasing the success rate for applicants, which, according to preliminary results, seems to be around 10% in 2018.

This booklet provides analysis and information on tendencies of FET-Open Research and Innovation Actions in terms of country and organization participations, scientific fields covered, interdisciplinarity of research topics, proposal resubmissions as well as innovation-related aspects. Enjoy the reading!

Alessandra LUCHETTI, Head of the Excellent Science Department, REA

CONTENT

This booklet has been realised thanks to the members of unit REA.A.5 ‘Fostering Novel Ideas: FET Open’ who contributed in the collection, analysis and presentation of the information, and in the authoring and editing of the text. The authors are grateful to the REA communication team for the layout of the booklet.

1. FET Open: What is it?

The European Union's Future and Emerging Technologies (FET) programme supports early-stages of collaborative scientific and technological research and innovation. FET projects are based on radically new, high-risk ideas that could open promising paths towards new technological opportunities. In the past, FET has been instrumental in identifying emerging scientific disciplines and supporting the relevant communities in developing new technologies and moving them closer to industrial realization. Over the previous EU Research Framework Programmes, FET has contributed to the European lead position in ICT-related areas such as nano-electronics, microsystems, new computing paradigms, dependable embedded systems, photonics, and new materials.

In FP7, FET Open has been one of the most successful programmes. According to the "Analysis of publications and patents of ICT research in FP7" published on the Digital Single Market website, FET Open is, compared to the EU funding invested, the most productive programme in generating patents and publications (together with "Micro-Nanosystems").
In Horizon 2020, the scope of FET Open has been extended beyond ICT-related areas, aiming at building up a diverse portfolio of targeted projects by means of a bottom-up process that is open to any scientific discipline. Early detection and support of promising new scientific developments and trends, along with the empowerment of new and high-potential research and innovation actors such as researchers at the early stage of their career and high-tech SMEs, are the key factors of the FET-Open programme.

FET Open is highly competitive and aims to fund only the most excellent proposals addressing the so-called FET-Open gatekeepers:

- Radical vision
- Breakthrough technological target
- Ambitious interdisciplinary research

2. General statistics on the proposal submissions and projects funded

From 2014 to 2017, 3408 eligible RIA proposals have been submitted and evaluated in the H2020-FETOPEN-2014-2015-RIA and the FETOPEN-01-2016-2017 calls, which included 6 cut-offs: 30/09/2014 (Sep-14), 31/03/2015 (Mar-15), 30/09/2015 (Sep-15), 11/05/2016 (May-16), 17/01/2017 (Jan-17) and 27/09/2017 (Sep-17) . In the first four years, the number of submitted proposals has initially increased with more than 1465 proposals evaluated in 2015. In 2017, 760 proposals have been submitted to the two cut-off dates. In total 122 projects have been selected for funding for a budget of 415 M€ (Table 1).

Year	Total # of eligible proposals	Number of grants	Total Budget (M€)
2014	639	24	78.1
2015	1465	22	78.8
2016	544	23	87.8
2017	760	53	170.1
Total	3408	122	414.8

Table 1. FET-Open RIA: eligible proposals, funded projects and budget per year.

2.1. Statistics on SME participation and gender

The relative participation of SMEs in FET-Open proposals significantly increased since the start of Horizon 2020 (see figure 1).

While in 2014 only 10% of all applicants were SMEs, their participation grew to 15% in 2017. The presence of SMEs in the consortia of funded projects lies around 14% on the average and slightly varies for each cut-off. Although participation of SMEs is not obligatory in FET Open, it is remarkable that 70% of all funded projects have one or more SMEs in the consortium. Counting all partners from the private sector (SME or large industry, e.g. IBM, Airbus etc.), this number even amounts to 83%.
When submitting proposals, each applicant has to indicate the gender of its main scientific contact person. The participation of female main contact persons in proposals has seen a steady growth from about 16% to currently 22%. In the last two cut-offs, proposals with female main scientific contact persons have been more successful, resulting in 27% of female main contacts at the Sep-17 cut-off.

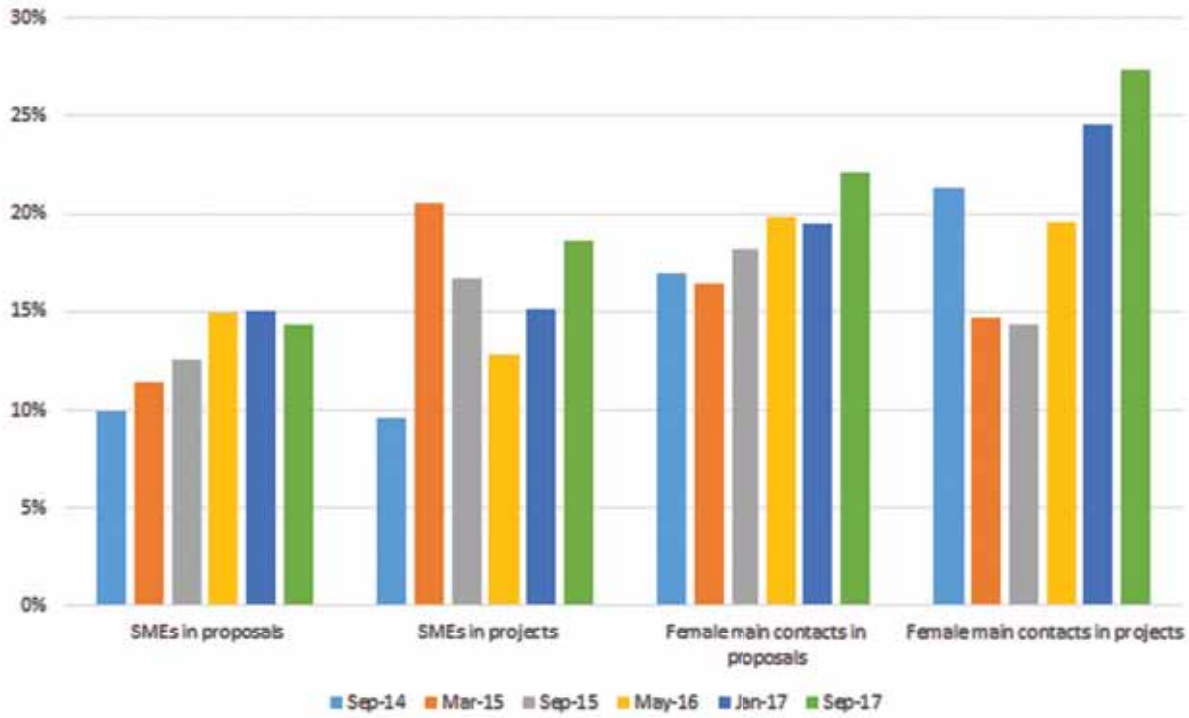


Figure 1. Trends in SME participation and gender of main contact persons.

2.2. Geographical distribution of funded projects and submitted proposals

Fig. 2 and 3 show the geographical distribution of the funded participants and applicants, respectively, in the EU member states and in the countries associated to Horizon 2020.
The highest number of funded participants is located in the UK, followed by Germany, France, Italy and Spain.
The number of applicants by country is shown in Fig. 3. Most applicants are located in Germany, followed by UK, Italy, France and Spain.

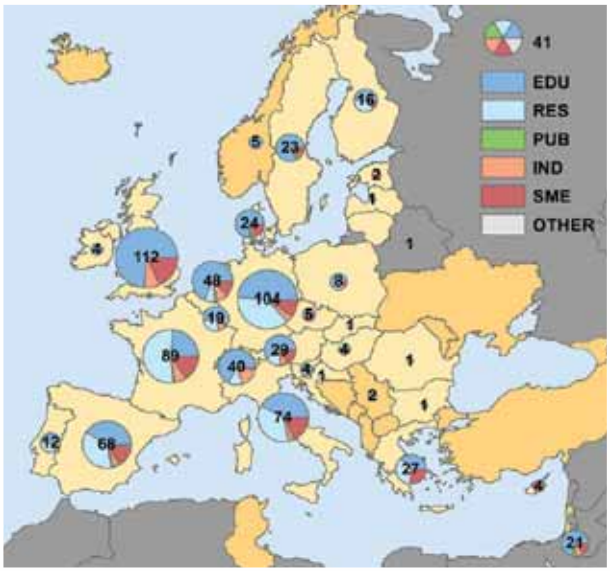


Figure 2. Number of FET-Open funded participants by country.

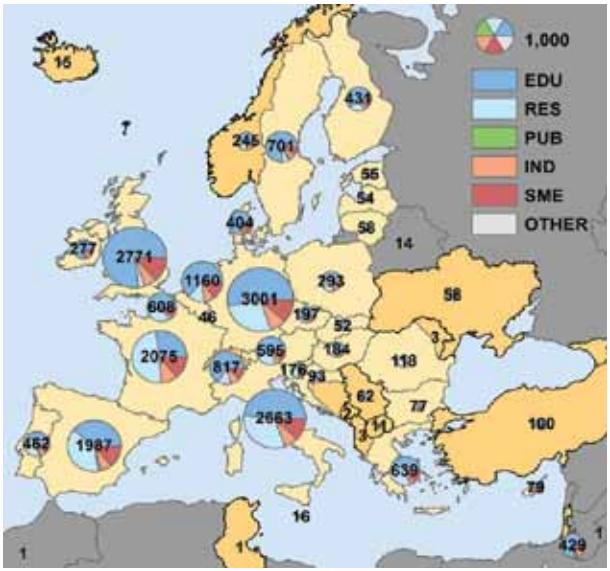


Figure 3. Number of applicants by country.

Countries other than EU Member States and associated countries also participated in all calls as consortium members (Figure 4). The most common applicants in the submitted proposals are organisations from the Unites States, followed by Japan, Australia, Canada, Russia and Belarus.

A few organisations from non-EU and non-associated countries have succeeded in obtaining funding from FET Open: two from the United States, one from Belarus and one from Brazil. In addition, a Russian and an Australian organisation are participating in FET-Open projects with their own funding.

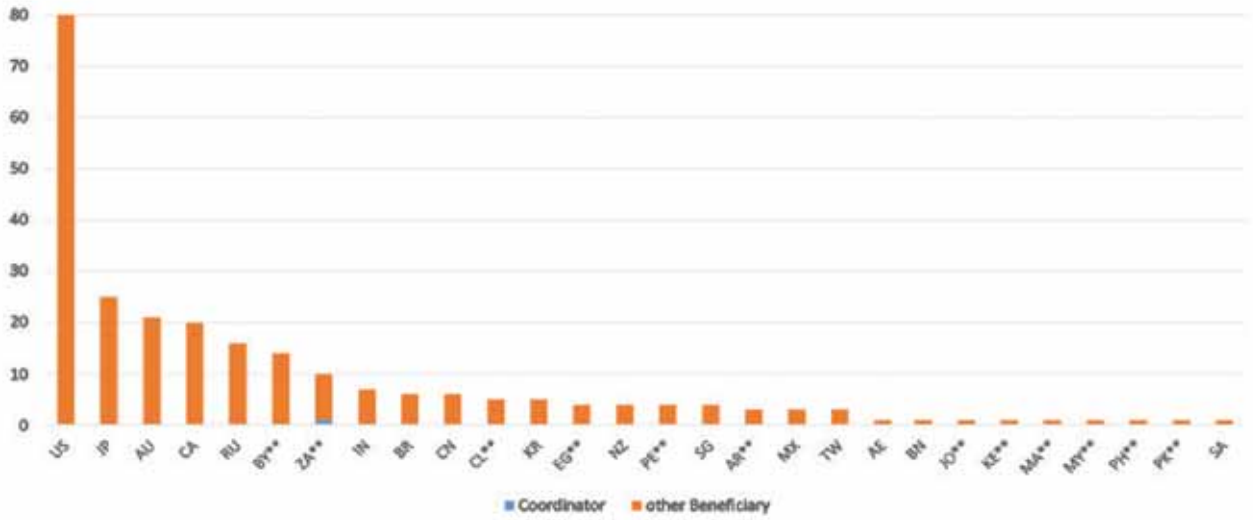


Figure 4. Number of applicants from non-EU, non-associated countries in eligible proposals. (indicate countries that are automatically eligible for funding)**

3. Participation of organisations in the projects funded

More than 450 participant organisations are involved in at least one of the 122 FET-Open projects, 29% of them being in the consortium of at least two projects. The list of the top-15 organisations with the highest participation in projects is presented in Table 2. The French National Centre for Scientific Research (CNRS) and the Italian National Research Council (CNR) are among the top ranked. These national research organisations are typically affiliated with various smaller universities or research centres. For that reason, they significantly contribute to broadening the effective number of participants in the FET-Open programme.

Participant Legal Name	Country	Number of projects' coordinator	Total number of projects
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	FR	6	52
CONSIGLIO NAZIONALE DELLE RICERCHE	IT	7	16
AGENCIA ESTATAL CONSEJO SUPERIOR DEINVESTIGACIONES CIENTIFICAS	ES	3	11
MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV	DE	1	11
AARHUS UNIVERSITET	DK	2	10
COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	FR	2	10
EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH	CH	1	10
THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD	UK	1	8
UNIVERSITY OF GLASGOW	UK	1	8
FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS	EL	4	7
FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	DE	0	7
ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE	CH	1	6
UNIVERSITE PARIS-SUD	FR	1	6
UNIVERSITY COLLEGE LONDON	UK	0	6
IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE	UK	0	6

Table 2. Top-15 research organisations in FET-Open funded projects.

4. Analysis of the scientific disciplines and interdisciplinarity

4.1. Applied methodology

The data analysis of the scientific landscape presented here is based on the 3408 eligible proposals submitted to the six H2020 FET-Open RIA cut-offs and on 122 funded projects. The analysis has been carried out using the keywords provided by the applicants at the proposal submission, covering the scientific disciplines of the proposal.

4.2. Disciplines covered in the FET-Open funded projects.

Figure 5 presents the outcome of the analysis of disciplines covered by the 122 FET-Open projects selected for funding during 2014-2017. The projects are grouped into 10 different categories, whereby almost all projects belong to more than one category due to their interdisciplinary character.

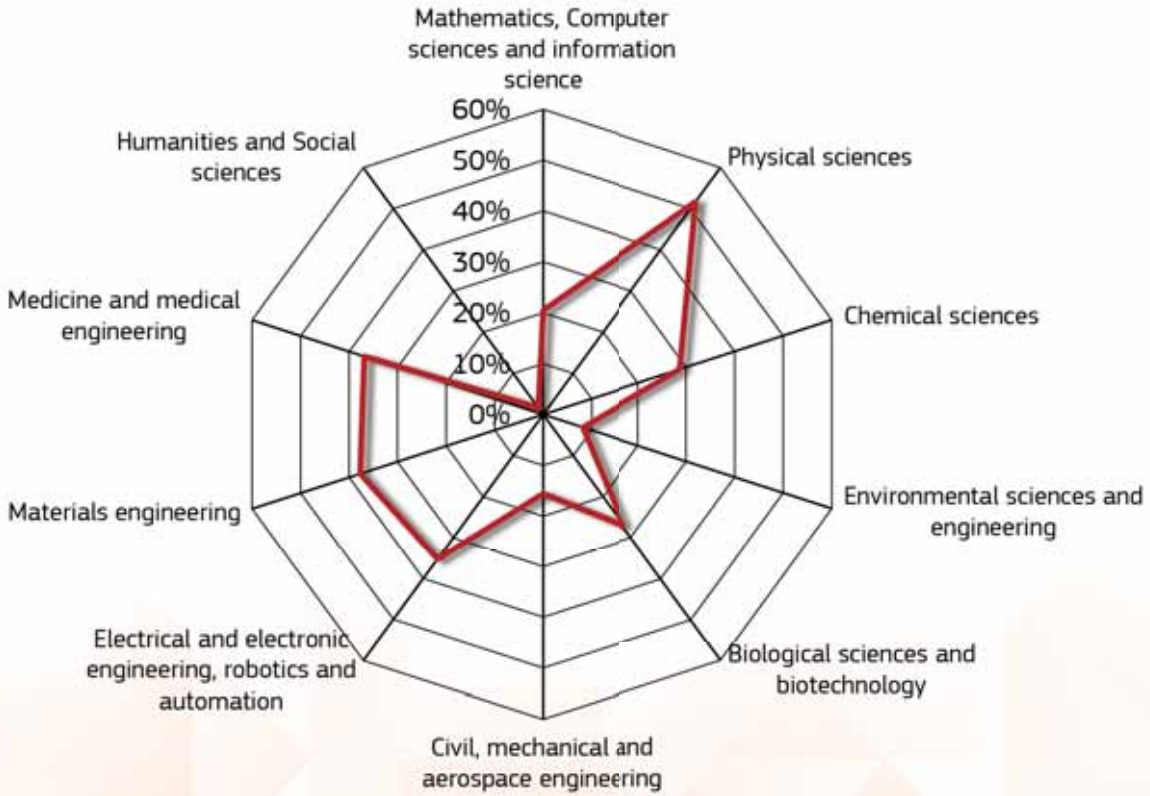


Figure 5. Discipline coverage of the funded projects.

Physical sciences is the area that is most prominently represented with about half of all projects. Other disciplines that are widely covered (30-40% of all projects) are medicine and medical engineering, materials engineering as well as electrical and electronic engineering, robotics and automation. Between 20% and 30% of the funded projects can be attributed to chemical sciences, biological sciences and biotechnology, and mathematics, computer sciences and information sciences. Civil, mechanical and aerospace engineering, environmental sciences and engineering as well as humanities and social sciences are less prominently present in the portfolio of FET-Open projects (<20%).

4.3. Disciplines covered in the FET-Open submitted proposals

Comparing Figure 6 with Figure 5 shows that in general, proposals and projects have approximately the same share in scientific disciplines, with only a few exceptions. Physical and chemical sciences are better represented in funded projects than in submitted proposals, while mathematics, computer sciences and information sciences as well as humanities and social sciences are less represented.

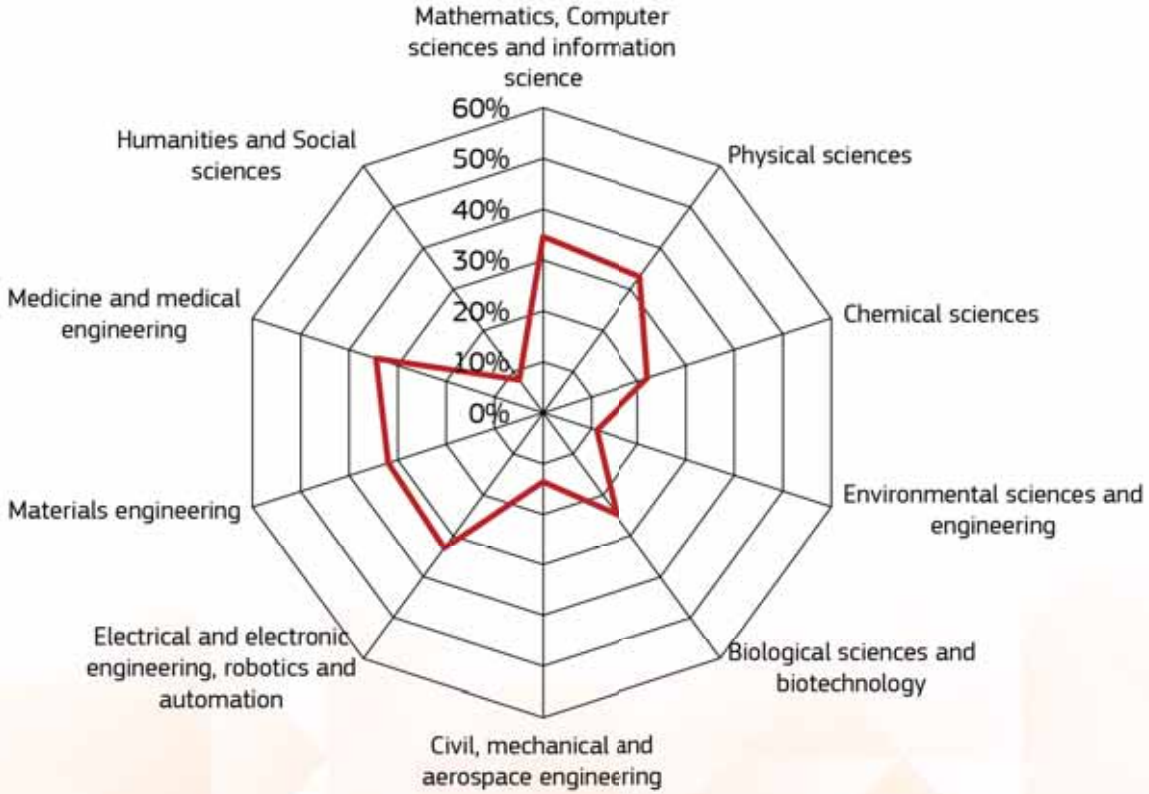


Figure 6. Discipline coverage of the submitted proposals.

4.4. Interdisciplinarity and supported areas of emerging technologies

	Mathematics Computer sciences and information science	Physical sciences	Chemical sciences	Environmental sciences and engineering	Biological sciences and biotechnology	Civil, mechanical and aerospace engineering
Mathematics Computer sciences and information science	Phoenix, Levitate, H-Reality	IIBSEN, RECORD-IT, Microflusa, InnoSMART, DEDALE, MAGicSky, CellViewer, VISORSURF, HiTIMe, EVO-NANO, PROCHIP	RECORD-IT, HELENIC-REF	HELENIC-REF	VOXEL, CellViewer, COSY-BIO, Pan3DP, CyGenTiG, MyoChip	Microflusa, InnoSMART, MAGicSky, VOXEL, ComplInnova, HELENIC-REF, ICARUS, BioWings, PIEDMONS
Physical sciences		PHENOMEN, MaQSens, FEMTOTERABYTE, ASPIN,TEQ, Q-SORT, ErBeStA, NEWTON-g	nuClock, RECORD-IT, 2D-INK, DIACAT, CONQUER, PROSEQO, LiRichFCC, LMCat, LLR, INDEX, COPAC, COSMICS, MEMO, PEGASUS, CARBAT, QuIET, PETER, NANOPHLOW, EFINED, MS SPIDOC	LLR, NEWTON-g	CellViewer, SENSITIVE, Q-MIC, MS SPIDOC	Microflusa, InnoSMART, MAGicSky
Chemical sciences			One-Flow	HELENIC-REF, GOTSolar, LLR, SALBAGE	AMECRYS, FLIPT, TISuMR, ULTRACHIRAL, SUMCASTEC, MADONNA, MS SPIDOC, evFOUNDRY	Symbiotic, HELENIC-REF
Environmental sciences and engineering					LIAR, MagnaPharm	HELENIC-REF, LIAR, MagnaPharm, AMADEUS, DISCOVERER, HARMoNIC
Biological sciences and biotechnology					MRG-Grammar, FutureAgriculture, PRe-ART	VOXEL, LIAR, NEURAM, MagnaPharm
Civil, mechanical and aerospace engineering						
Electrical and electronic engineering, robotics and automation						
Materials engineering						
Medicine and medical engineering						
Humanities and Social sciences						

Figure 7. Discipline coverage and interdisciplinarity of all 122 FET-Open projects (their acronyms and numbers can be found in Annex II).

Electrical and electronic engineering, robotics and automation	Materials engineering	Medicine and medical engineering	Humanities and Social sciences
RECORD-IT, Microflusa, InnoSMART, DEDALE, MAGicSky, VOXEL, CompInnova, GOAL-Robots, VISORSURF, HiTIMe, COSY-BIO, BioWings, PIEDMONS	RECORD-IT, Microflusa, InnoSMART, MAGicSky, CompInnova, HELENIC-REF, ICARUS, BioWings,	IBSEN, DEDALE, VOXEL, Pan3DP, EVO-NANO, CyGenTiG, PROCHIP, BioWings, MyoChip	IBSEN, GOAL-Robots
RECORD-IT, Microflusa, InnoSMART, DEDALE, DIACAT, MAGicSky, Zoterac, QCUMbER, ULTRAQCL, SUPERTWIN, LiRichFCC, SPICE, SiLAS, VISORSURF, MIR-BOSE, TRANSPIRE, OCULUS, PHASE-CHANGE SWITCH, HiTIMe, FLASH, microSPIRE, NanoStencil, EFINED, CHIRON, SUPERTED, Q-MIC, LEAF-2D	RECORD-IT, Microflusa, InnoSMART, DIACAT, MAGicSky, LiRichFCC, NanOQTech, OCULUS, PHASE-CHANGE, SWITCH, INDEX, COPAC, FLASH, PEGASUS, CARBAT, QuIET, microSPIRE, NanoStencil, PETER, NANOPHLOW, CHIRON, NanoTBTech, LEAF-2D	IBSEN, DEDALE, CONQUER, PROSEQO, MESO_BRAIN, M-CUBE, OCULUS, ByAxon, HISTO-MRI, AMPHORA, RNDEX, EVO-NANO, NanoTBTech, PROCHIP, SENSITIVE	IBSEN
RECORD-IT, DIACAT, LiRichFCC, SUMCASTEC, EFINED, MAGNIFY	RECORD-IT, Symbiotic, DIACAT, HELENIC-REF, GOTSolar, LiRichFCC, AMECRYS, FLIPT, TISuMR, SUMCASTEC, INDEX, COPAC, PEGASUS, CARBAT, QuIET, SALBAGE, PETER, NANOPHLOW, MAGNIFY, evFOUNDRY	VOXEL, MARA, MAGNEURON, NEURAM, FLIPT, MagnaPharm, TISuMR, SUMCASTEC, ArrestAD, CURE, STARDUST, SilkFUSION, Pan3DP, CyGenTiG, SENSITIVE, Ves4US, NICI, MyoChip	
	HELENIC-REF, GOTSolar, MagnaPharm, AMADEUS, SALBAGE, HARMoNIC	MagnaPharm	
VOXEL, LiNaBioFluid, NEURAM, SUMCASTEC, COSY-BIO, HyPhOE, Q-MIC	MAGNEURON, AMECRYS, FLIPT, MagnaPharm, TISuMR, SUMCASTEC, SilkFUSION, HyPhOE, Ves4US, evFOUNDRY, SPRINT	VOXEL, MAGNEURON, MARA, Magnapharm, FLIPT, ArrestAD, TISuMR, NEURAM, SUMCASTEC	
Microflusa, NEMF21, InnoSMART, MAGicSky, VOXEL, CHROMAVISION, CompInnova, NEURAM, BioWings, PIEDMONS	Microflusa, InnoSMART, Symbiotic, MAGicSky, CompInnova, HELENIC-REF, ABIOMATER, ICARUS, MagnaPharm, AMADEUS, BioWings, HARMoNIC	Symbiotic, VOXEL, ABIOMATER, NEURAM, MagnaPharm, BioWings	
	RECORD-IT, Microflusa, InnoSMART, DIACAT, MAGicSky, CompInnova, LiRichFCC, OCULUS, PHASE-CHANGE SWITCH, SUMCASTEC, FLASH, microSPIRE, NanoStencil, HyPhOE, CHIRON, BioWings, MAGNIFY, LEAF-2D	DEDALE, VOXEL, BREAKBEN, NEURAM, OCULUS, SUMCASTEC, HybridHeart, BionicVEST, BioWings, MAGNIFY	GOAL-Robots
		NanoSmell, Symbiotic, ABIOMATER, MAGNEURON, FLIPT, MagnaPharm, TISuMR, OCULUS, SUMCASTEC, INDEX, SilkFUSION, NanoTBTech, BioWings, EDIT, MAGNIFY, Ves4US	
		LUMINOUS, B2B	IBSEN

The first H2020 FET-Open projects started mid-2015. With an average duration of 3-4 years, some of them will end already in the course of 2018. The initial output of many of these projects is very promising, both in terms of potential innovations and scientific advances, while playing a catalytic role in fostering new collaborations and stimulating new thinking. Already by June 2018, H2020 FET-Open projects had published 144 peer-reviewed publications, out of which 95 in high-impact journals. Examples of future emerging technology areas addressed by running FET-Open projects are:

- Artificial Intelligence, algorithms mimicking "cognitive" functions for learning and problem solving (DEDALE, GOAL-Robots)
- Revolutionary future battery technologies (SALBAGE, CARBAT, LiRichFCC)
- 3D Bioprinting and tissue engineering for Health applications (Pan3DP, MyoChip,B2B,Silk Fusion, Meso-Brain)
- Disruptive energy harvesting, conversion and storage technologies employing solar and/or water resources (AMADEUS, GOTSolar, HARMonic, NANOPHLOW, LIAR, DIACAT)
- Novel ideas for curing cancer (SUMCASTEC, EVO-NANO, Lumiblast) and neuro-diseases such as Parkinson and Alzheimer (STARDUST, MAGNEURON)
- New methodologies in (Bio)pharmaceuticals production (MagnaPharm, AMECRYS, One-Flow)
- Novel environmental approaches towards CO2 or waste conversion and increased energy efficiency (DIACAT, MADONNA, FutureAgriculture, LIAR, HYphoe, E-SPECTR, EFINED, FLIPT)
- Using quantum phenomena for the development of new technologies (MaQSens, TEQ, Q-SORT, QCUMbER, SUPERTWIN).
- In vivo nano- and cell-therapeutic platforms (ByAXON, EDIT, Magneuron, CURE, Ves4US, EVO-NANO)
- Spintronics, exploiting the spin of electrons for information storage and processing (FEMTOTERABYTE, ASPIN, COSMICS, SPICE, MAGicSky)
- Diagnostic tools for early disease detection (PROCHIP, Symbiotic, SENSITIVE, CATCH-U-DNA, M-CUBE, INDEX, MARA)
- Enhancing or replacing state-of-the-art complementary metal oxide semiconductors (CMOS) in circuit technology (PHASE-CHANGE SWITCH, CHIRON, PHENOMEN)
- Closing the "terahertz gap" by developing the basic components for future Terahertz technology (FLASH, PETER, Zoterac, ULTRAQCL, TRANSPIRE, SUPERTED, MIR-BOSE)
- Advanced approaches for the manufacturing of two-dimensional materials (LMCat, LEAF-2D, 2D-INK)
- Novel imaging technologies with potential applications in Health (VOXEL, M-CUBE, TISuMR, ChipScope, HISTO-MRI, NICI, EDIT, NanoTBTech, PROCHIP, BREAKBEN, CellViewer)
- Bio-robotics (MAGNIFY, HybridHeart)
- Personalised medicine (B2B)

5. Innovation in FET Open: The Innovation Radar

All FET-Open projects participate in the European Commission's Innovation Radar initiative[1], which focuses on the identification of high potential innovations and the key innovators behind them. The Innovation Radar supports innovators by suggesting a range of targeted actions to assist them in fulfilling their potential in the market, including the possible submission of proposals to the FET Innovation Launchpad (see also Section 7 below). The European Commission also organizes 'Innovation Radar Award' contests to give visibility to nominees and awardees, or issues targeted invitations for relevant events, exhibitions or offers opportunities of pitching to investors.

With the help of the Innovation Radar, 119 innovations have been identified in the currently running FET-Open RIA projects (status June 2018). For each of these projects, innovation experts fill in a questionnaire during project review meetings. The thorough use of the Innovation Radar Methodology allows the early identification and support of the most promising innovations in FET Open, and analysing them in terms of their market readiness by assigning them to one of the four categories[2] :

- Exploration: Innovations actively exploring value creation opportunities.
- Commitment: Putting concrete market-oriented ideas together (e.g. market studies, business plans).
- Creation: Progressing on technology development process (e.g. pilots, prototypes, demonstration).
- Optimisation: Outperforming in innovation management and innovation readiness. Considered "Ready for market"

Figure 9 shows the distribution of the 119 identified FET-Open innovations amongst these categories. In line with the exploratory nature of FET Open, 80% of these innovation fall into the "exploration" category. These innovations are in the early phases of technological readiness, but already show high commitment levels from the organisations developing them.

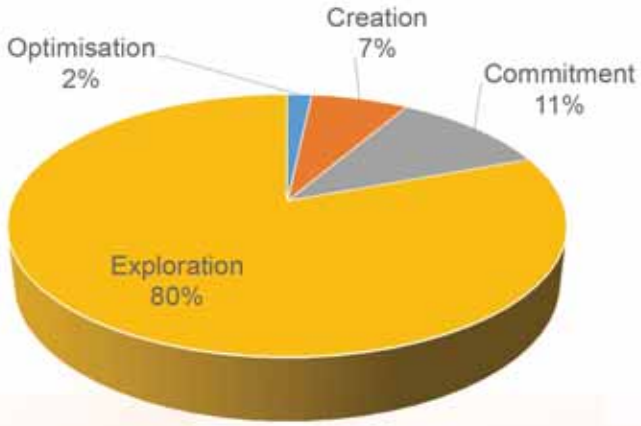


Figure 8. Maturity level of FET-Open RIA innovations identified by means of the Innovation Radar methodology.

[1] More information about the Innovation Radar can be found on www.innoradar.eu
[2] https://ec.europa.eu/jrc/sites/jrcsh/files/booklet-a4_innovation_radar.pdf

6. Innovation in FET Open: The FET Innovation Launchpad

Introduced in 2016, the FET Innovation Launchpad scheme is a new initiative that aims at boosting economic growth stemming from FET research by supporting unexplored innovation opportunities from FET-funded projects, such as the ones identified with the help of the Innovation Radar. The FET Innovation Launchpad is helping innovators, entrepreneurs and researchers in taking further steps towards the market by funding, among others, the definition of a commercialisation process, market and competitiveness analysis, technology assessments, verification of innovation potential, consolidation of intellectual property rights or advancing business cases.

For the first two years of the Launchpad, 138 eligible applications have been submitted to the two cut-offs. Out of these applications, 35 received a funding of €100.000 for projects with a typical duration of 18 months. These projects are mainly in the ICT domain, 20 being based on ongoing or recently finished FP7 FET projects and 15 on Horizon 2020 projects. Under the EIC pilot, SMEs participating in FET Open are also eligible for 12 days of business coaching, which gives them additional feedback on several areas of possible improvement, such as technology patenting, the definition of a more structured market approach strategy or the design of a new organization model to advance their Innovation Management Capacity.

Calls	Total # of eligible proposals	Number of grants	Success rate	Total Budget (M€)
Sep-16	88	16	18%	1,6
Sep-17	50	19	38%	1,9
Total	138	35		3,5

Table 3. FET Innovation Launchpad: proposals, projects and budget.

7. Conclusions

During the first four years of Horizon 2020, 122 interdisciplinary FET-Open projects have been launched, already now delivering world-class science and laying the foundations for radically new future technologies. The methodical application of the Innovation Radar guarantees a systematic identification of innovations generated by these projects. Future uptake and exploitation of results will be facilitated by the presence of SMEs or large industry in consortia, as well as some follow-up funding possibilities under the EIC pilot (2018-2020) such as the FET Innovation Launchpad, Fast Track to Innovation or the SME Instrument.

The presented statistics show that under Horizon 2020, the FET-Open programme has successfully expanded beyond ICT, in particular to Health & Life Sciences, as well as to Energy-related areas.

Annex I: Examples of promising projects and success stories

LIAR

From smart homes to living buildings – the next step in human habitats

Life happens inside your four walls, right? But what if those walls are actually alive themselves? The vision of FET-Open project LIAR is to turn our habitats into sustainable 'living' buildings.

LIAR stands for Living Architecture and refers to a programmable bioreactor that the FET-Open project plans to develop. Project partners are working on inserting bacteria into bricks and concrete in order to generate heat, circulate air or produce biomass.

By using innovative microbial fuel cell technology and synthetic 'consortia' of microbes, LIAR plans to develop a modular bioreactor wall. Bioreactor building blocks will become part of common building construction methods. Homes, offices or large public buildings such as schools could benefit from the envisaged customizable and programmable bioreactor, which will extract valuable resources from waste water and air, generate oxygen or produce proteins and fibre.

Living architecture is one answer to the steady urbanisation trend worldwide. The LIAR project aims at providing a sustainable solution for a growing number of people in limited space with limited resources.

The project is coordinated by the University of Newcastle upon Tyne (United Kingdom) and has 6 partners.

http://livingarchitecture-h2020.eu/

Microflusa

Frontier research for new materials

Project Microflusa wants to revolutionize the fabrication of colloidal materials. While present production of innovative colloidal materials remains time consuming and limited to small scale, Microflusa proposes novel ways to break this bottleneck.

The project proposes to design and assemble colloidal molecules by using microfluidic technology. This technology has demonstrated its capacity to produce and handle micrometric droplets under excellent control. It could advance the production of colloidal molecules to unprecedented speed. Whereas now one millimeter cube of colloidal material would take years to produce, Microflusa envisages producing one million of building blocks in a second. This acceleration would enable the creation of colloidal materials with innovative functionalities for industrial purposes.

What for?

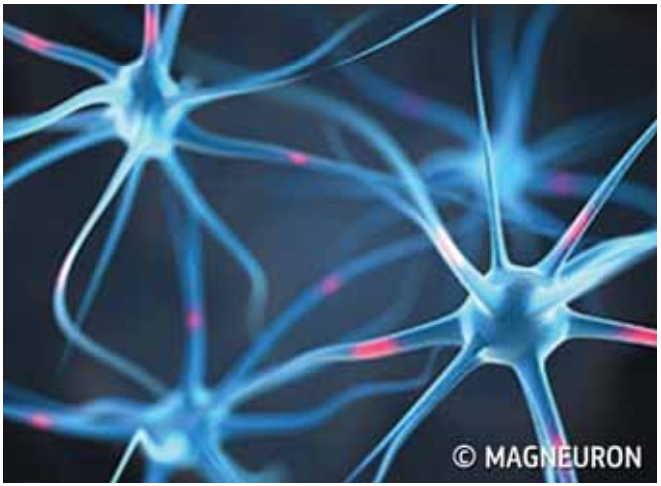
Microflusa's vision is to use colloidal building blocks for creating photonic materials with complete band gap. Such materials enable the control of the generation and flow of light. They would allow for much more and much faster transportation of information than what is currently possible on a computer chip. Being able to produce 3D photonic material based on colloids would certainly be a major breakthrough in the field of optoelectronics.

The project is coordinated by the ESPCI ParisTech (France) and has 5 partners.

http://www.microflusa-project.eu/

MAGNEURON

Hijacking cell signalling pathways with magnetic nanoactuators for remote-controlled stem cell therapies of neurodegenerative disorders



A fundamentally new concept for remote control of cellular functions by means of magnetic manipulation for treatment of neurodegenerative disorders will be introduced by the FET-Open project MAGNEURON.

Neurodegenerative diseases, such as Parkinson's disease, are a major public health issue given the aging population in Europe and beyond. While curative pharmacological treatment of these diseases is not in sight, cell replacement therapies (CTs) are considered very promising. However, a fundamental challenge in the medical application of CTs in the brain of patients lies in the lack of control of cell behaviour at the site of transplantation, and particularly their differentiation and oriented growth. This challenge will be tackled by the MAGNEURON project.

The aim of MAGNEURON is to introduce a fundamentally new concept for remote control of cellular functions by means of magnetic manipulation. The technology is based on magnetic nanoparticles (MNPs) functionalized with proteins involved in cellular signalling cascades. These bio-functionalized MNPs will be delivered into target cells, where they act as intracellular signalling platforms activatable in a spatially and temporally controlled manner by external magnetic fields.

By the end of the project, MAGNEURON will have reached a conceptual and practical expertise for the magnetic control of signalling activity in cells, with a demonstrated proof-of-concept for the differentiation and growth of stem cell derived neuronal cells in cultures, tissues and animals.

The project is coordinated by the Institute Curie (France) and has 6 partners.

http://magneuron.eu/

GOTSolar

New technological advances for the third generation of solar cells

Achieving energy efficient, cost effective and versatile solar cells has always been a challenge for the scientific community. The emerging perovskite sensitized solar cells (PSCs) are very attractive candidates to fulfil these requirements. In only three years, organic/inorganic lead halides PSCs have leapt from around 10 % in 2013 to a certified value of 23.35 % of power conversion efficiency in 2018. This fast rise in performance attracted intense attention from the scientific community and in particular from the GOTSolar consortium. The manufacture of PSCs is substantially simpler when compared with crystalline and polycrystalline silicon cells, allowing a deconcentrated production, favourable to the European producers.

GOTSolar proposes disruptive approaches for the development of highly efficient PSCs, aiming to face the challenge of bringing this new and promising technology to the commercial level for the first time ever. The projected innovations, going substantially beyond the state-of-the-art, are developments of new advanced materials that would target highly efficient and stable PSCs, as well as addressing PSC durability issues, and more specifically the development of a unique hermetic glass frit-based encapsulation. These and other anticipated developments address the main challenges towards the industrialization of PSCs.

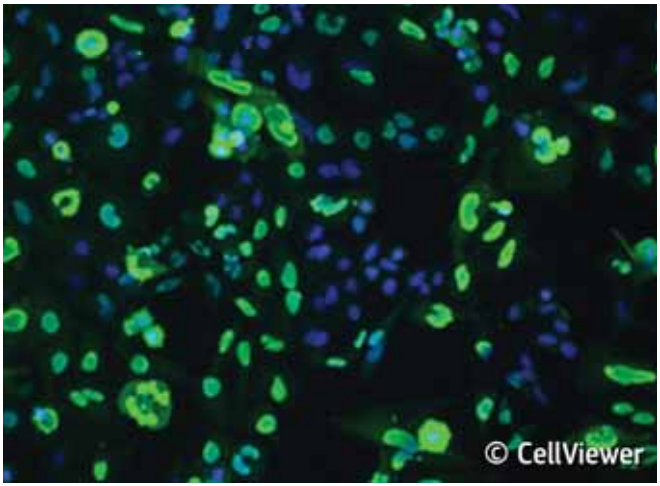
The project is already achieving exciting results, as for instance, polymer-coated cells that maintained 95% of their initial performance at 85°C for 500 hours under full solar illumination and maximum power point tracking. Also, in low-temperature laser-assisted sealing, a process for sealing conductive glasses at temperatures of 120ºC has been fully optimized to a size of 100 cm2; its hermeticity and long-term stability have been successfully tested against MIL-STD-883 and IEC-61646 standards respectively.

The project is coordinated by the University of Porto (Portugal) and has 7 partners.

http://www.gotsolar.eu/

CellViewer

radically revolutionary way to determine the state of a cell



A FET-Open project works on developing new technologies that will allow for visualization in single cells - in parallel and at the systems' level, DNA, mRNAs and proteins with nanoscale resolution: technologies collectively referred to by the consortium as the CellViewer.

The CellViewer consortium will develop methods for high-throughput rapid sequential imaging of DNA, mRNA and proteins of many coding genes in single cells. On the long run this will generate a novel technique to analyse cellular state at high resolution thanks to the integration of different technologies into one microscopy device. The ultimate goal of the project is to be able to analyse the state of a population of cells with single cell sensitivity and high resolution using the CellViewer system.

In addition to its high impact on stem cell characterization, tissue engineering and regeneration, CellViewer will contribute further to the optimization of personalized medicine as it can be adapted to characterize a group of genes and gene products in a wild type or tumour biopsy cells from patients.

The project is coordinated by the Centre for Genomic Regulation (Spain) and has 6 partners.

http://www.cellviewer.eu/

ChipScope

and the new tiny microscopes

ChipScope aims to develop a completely new and extremely small optical microscope capable of observing the interior of living cells in real time. The project will tackle this issue with very ambitious objectives during a four-year research program.

Today, optical microscopes are limited in resolution by physical laws related to the wavelength of light, around half a thousandth of a millimetre. Single proteins, DNA molecules or the interior of living cells are much smaller and cannot be directly observed with conventional optical microscopes. The objective of the ChipScope project is to develop a new kind of optical microscope allowing to see the infinitely small.

To demonstrate the usefulness of this new scientific tool, at the end of the project, the developed chip-sized microscope will be used to observe in real-time the interior of cells present in a disease called Idiopathic Pulmonary Fibrosis (IPF), a chronic age-related lung disease killing 0.5 Million people each year worldwide.

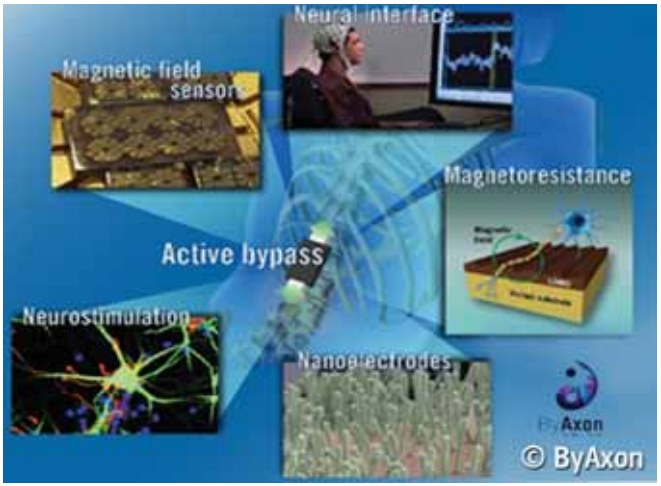
The new microscope will be affordable and ubiquitously available. In science, it is expected to lead to fundamental breakthroughs in virtually every field of research that currently makes use of optical microscopes – particularly in the medical field. Making microscopic images will be easy and accessible to researchers who operate out in the field, away from scientific infrastructures and they will be affordable to researchers in developing countries. In the future, these microscopes-in-a-chip could also be integrated into consumer electronic products, being as common as a camera is in a smartphone today.

The project is coordinated by the University of Barcelona (Spain) and has 8 partners.

http://www.chipscope.eu/

ByAxon

Towards an active bypass for neural reconnection



ByAxon is developing a new generation of sensors and electrodes for neural interfacing, bringing together both nano- and neuro- science. The aim of the project is to design and build a prototype of an active implant that works directly at the spinal cord level, focusing on the restoration of the transmission of signals in the injured spinal cord. The device will combine high-resolution sensing of magnetic fields produced by the neuron's activity plus functional stimulation electrodes with enhanced adhesion. The final prototype will act as a bi-directional bypass working at room temperature, something not possible using current technology. The research on magnetoresistive materials will enable the detection of ultra-small magnetic fields. This when combined with the investigation on biocompatibility of the materials will produce the necessary knowledge to make a technological leap.

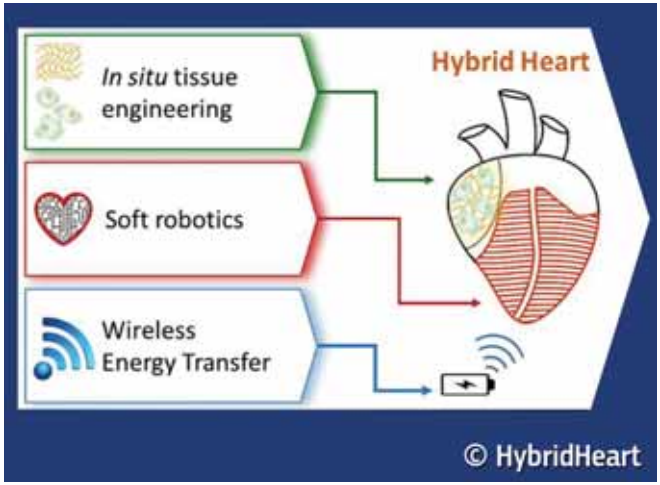
Although in its early stages, the project has already delivered a first prototype of an artificial neuron that allows the generation of magnetic fields similar to those generated by neural tissue. The first generation of the magnetic sensors and nanostructured electrodes have been designed and are ready to be implanted in in-vitro neuronal cultures. Next the biocompatibility tests will be followed by the optimization of the design, then implantation in a pair of spinal explants, enabling the final model of the bypass prototype.

The project is coordinated by the IMDEA Nanociencia (Spain) and has 6 partners.

http://www.byaxon-project.eu/

HybridHeart

Development of the first fully biocompatible, soft actuated heart: combining in situ tissue engineering and soft robotics



The HybridHeart consortium envisions to develop and bring to the clinic a soft biocompatible artificial heart, which can completely replace a patient's heart in a procedure similar to a heart transplant. HybridHeart will provide a cure for heart failure, which affects ~23 million people worldwide. Hybrid Heart will consist of a soft robotics shell with actuators ('artificial muscles') and sensors, enabling completely natural motion. The inner lining and structures will be made by in situ tissue engineering (TE), ensuring biocompatibility of blood-contacting surfaces.

To achieve the ambitious goal the participants will, in parallel, develop the components of the HybridHeart: 1) a soft elastomeric robotics shell containing actuators and sensors, 2) scaffolds for in situ TE of inner lining, valves and vessels and 3) a wireless energy transfer system. These components together will form the full HybridHeart, which will be soft, adaptable, wireless and fully bio- and hemocompatible. Both functionality as well as biocompatibility of the HybridHeart will be shown in a Proof-of-Principle study in the chronic sheep model at the end of the project.

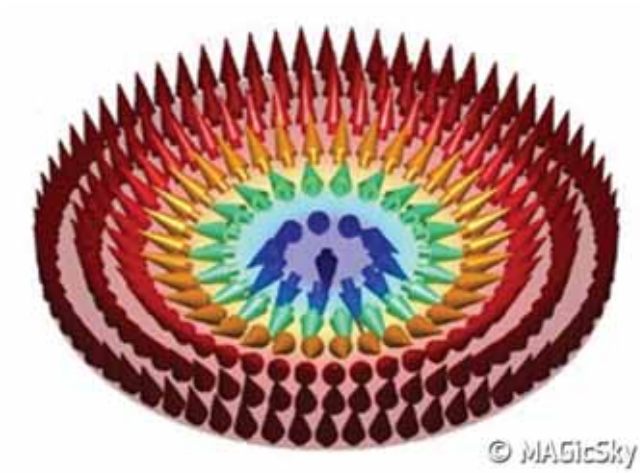
The technology underlying the HybridHeart is applicable to a range of soft robotics-based artificial organs, including the bowel, lung, or muscle structures (limbs). Replacing an entire organ with bioinspired robotic elements, TE biocompatible surfaces, artificial sensors, and an external power source allows for an off-the-shelf therapy for patients with organ failure.

The project is coordinated by the Academic Medical Center Amsterdam (The Netherlands) and has 6 partners.

https://www.hybridheart.eu/

MAGicSky

A new horizon for information storage



There is nothing magic about FET-Open project MAGicSky, nor does it look to the stars. MAGicSky stands for MAGnetic Skyrmions for future nano-spintronic devices. Its very down-to-earth objective is to significantly improve information storage capacity and speed of information processing. In other words, MAGicSky research aims at developing extremely small and powerful memory elements. Current data storage devices use the charge of electrons to store and transfer information.

Besides the charge though, electrons also have a spin, and this is exploited in the field of spintronics, the combination of spin and electronics. Skyrmions are named after British mathematician Tony Skyrme who first described them theoretically in 1962. Magnetic skyrmions are nano-size spin configurations with stable topological properties. They can be moved by magnetization induced by extremely small electrical currents which makes them very promising for highly efficient memory storage.
Until recently, skyrmion structures have been experimentally demonstrated only under external strong magnetic fields or at low temperature in bulk materials and in ultrathin films. Nowadays it is possible to create and manipulate skyrmions with magnetic field, electric field or temperature in a controlled environment.

The MAGicSky research partners explore new materials and techniques, with which skyrmions can be stabilised and manipulated. The ultimate goal is to manipulate skyrmions individually in devices at room-temperature. The resulting stable, nano-scale skyrmions will go far beyond current technology for information storage. The next generation of storage devices based on skyrmions will contain bits of a few nanometers only. Speed and efficiency of the writing and reading of information will be significantly improved compared to current devices. And finally, energy consumption will drop due to the low-density current necessary for skyrmion-based devices.

The project is coordinated by the CNRS (France) and has 7 partners.

http://magicsky-fet.prod.lamp.cnrs.fr/

Annex II: List of projects, alphabetically sorted according to their acronym

Project Acronym	Project Number	Project Title
2D-INK	664878	Redesigning 2D Materials for the Formulation of Semiconducting Inks
ABIOMATER	665440	Magnetically actuated bio-inspired metamaterials
AMADEUS	737054	Next GenerAtion MateriAls and Solid State DevicEs for Ultra High Temperature Energy Storage and Conversion
AMECRYS	712965	Revolutionising Downstream Processing of Monoclonal Antibodies by Continuous Template-Assisted Membrane Crystallization
AMPHORA	766456	ACOUSTIC MARKERS FOR ENHANCED REMOTE SENSING OF RADIATION DOSES
ArrestAD	737390	3-O-sulfated heparan sulfate translocation in altered membrane biology: A new strategy for early population screening and halting Alzheimer's neurodegeneration
ASPIN	766566	Antiferromagntic spintronics
B2B	801159	Modeling spontaneous Breast cancer metastasis TO the Bone with a first-of-its-kind 3D device that recapitulates physiological tissue-level complexity.
BionicVEST	801127	EUROPEAN DEVELOPMENT OF BIONICS VESTIBULAR IMPLANT FOR BILATERAL VESTIBULAR DYSFUNCTION
BioWings	801267	Bio-compatible electrostrictive smart materials for future generation of medical micro-electro- mechanical systems
BREAKBEN	686865	Breaking the Nonuniqueness Barrier in Electromagnetic Neuroimaging
ByAxon	737116	Towards an active bypass for neural reconnection
CARBAT	766617	CAlcium Rechargeable BAttery Technology
CATCH-U-DNA	737212	Capturing non-Amplified Tumor Circulating DNA with Ultrasound Hydrodynamics
CellViewer	686637	CellViewer: super-resolution systems microscopy to assess pluripotency and differentiation of stem cells at single cell level
ChipScope	737089	Overcoming the Limits of Diffraction with Superresolution Lighting on a Chip
CHIRON	801055	Spin Wave Computing for Ultimately-Scaled Hybrid Low-Power Electronics
CHROMAVISION	665233	Super-resolution visualisation and manipulation of metaphase chromosomes

Project Acronym	Project Number	Project Title
CompInnova	665238	An Advanced Methodology for the Inspection and Quantification of Damage on Aerospace Composites and Metals using an Innovative Approach
CONQUER	665172	Contrast by Quadrupole Enhanced Relaxation
COPAC	766563	Coherent Optical Parallel Computing
COSMICS	766726	Concepts and tools in molecular spintronics
COSY-BIO	766840	Control Engineering of Biological Systems for Reliable Synthetic Biology Applications
CURE	767015	Constructing a 'Eubiosis Reinstatement Therapy' for Asthma
CyGenTiG	801041	Cypergenetic Tissue Engineering
DEDALE	665044	Data Learning on Manifolds and Future Challenges
DIACAT	665085	Diamond materials for the photocatalytic conversion of CO2 to fine chemicals and fuels using visible light
DISCOVERER	737183	DISCOVERER – DISruptive teChnOlogies for VERy low Earth oRbit platforms
EDIT	801126	Novel precision technological platforms to promote non-invasive early diagnosis, eradication and prevention of cancer relapse: proof of concept in the bladder carcinoma.
EFINED	766853	Energy Filtering Non-Equilibrium Devices
ErBeStA	800942	Error-Proof Optical Bell-State Analyzer
evFOUNDRY	801367	The Extracellular Vesicle Foundry
EVO-NANO	800983	Evolvable platform for programmable nanoparticle-based cancer therapies
FEMTOTERABYTE	737093	Spinoptical nanoantenna-assisted magnetic storage at few nanometers on femtosecond timescale
FLASH	766719	Far-infrared Lasers Assembled using Silicon Heterostructures
FLIPT	713475	FLow Induced Phase Transitions, A new low energy paradigm for polymer processing
FutureAgriculture	686330	Transforming the future of agriculture through synthetic photorespiration
GOAL-Robots	713010	Goal-based Open-ended Autonomous Learning Robots
GOTSolar	687008	New technological advances for the third generation of Solar cells
HARMoNIC	801229	HierARchical Multiscale NanoInterfaces for enhanced Condensation processes

Project Acronym	Project Number	Project Title
HELENIC-REF	665318	Hybrid Electric Energy Integrated Cluster concerning Renewable Fuels
HISTO-MRI	737180	IN SITU IMAGING OF LIVING TISSUES WITH CELLULAR SPATIAL RESOLUTION
HiTIMe	766714	High Frequency Topological Insulator devices for Metrology
H-Reality	801413	Mixed Haptic Feedback for Mid-Air Interactions in Virtual and Augmented Realities
HybridHeart	767195	Development of the first fully biocompatible, soft actuated heart: combining in situ tissue engineering and soft robotics
HyPhOE	800926	Hybrid Electronics based on Photosynthetic Organisms
IBSEN	662725	Bridging the gap: from Individual Behaviour to the Socio-tEchnical MaN
ICARUS	713514	Innovative Coarsening-resistant Alloys with enhanced Radiation tolerance and Ultra-fine -grainedStructure for aerospace application
INDEX	766466	Integrated nanoparticle isolation and detection system for complete on-chip analysis of exosomes
InnoSMART	664892	An Innovative Method for Improving the Structural Integrity using SMA Revolutionary Technology
LEAF-2D	801389	Laser EnAbled TransFer of 2D Materials
Levitate	737087	Levitation with localised tactile and audio feedback for mid-air interactions
LIAR	686585	Living Architecture
LiNaBioFluid	665337	Laser-induced Nanostructures as Biomimetic Model of Fluid Transport in the Integument of Animals
LiRichFCC	711792	A new class of powerful materials for electrochemical energy storage: Lithium-rich oxyfluorides with cubic dense packing
LLR	737033	Laser Lightning Rod
LMCat	736299	Development of continuous two-dimensional defect-free materials by liquid-metal catalytic routes
Lumiblast	712921	A paradigm shift in cancer therapy – using mitochondria-powered chemiluminescence to non-invasively treat inaccessible tumours
LUMINOUS	686764	Studying, Measuring and Altering Consciousness through information theory in the electrical brain
MADONNA	766975	Microbial deployment of new-to-nature chemistries for refactoring the barriers between living and non-living matter
MAGicSky	665095	Magnetic Skyrmions for Future Nanospintronic Devices

Project Acronym	Project Number	Project Title
MagnaPharm	736899	Magnetic Control of Polymorphism in Pharmaceutical Compounds
MAGNEURON	686841	Hijacking cell signalling pathways with magnetic nanoactuators for remote-controlled stemcell therapies of neurodegenerative disorders
MAGNIFY	801378	From nano to macro: a groundbreakIng actuation technology for robotic systems
MaQSens	736943	Magnetomechanical Platforms for Quantum Experiments and Quantum Enabled Sensing Technologies
MARA	686647	Molecular Analytical Robotics Assays
M-CUBE	736937	MetaMaterials antenna for ultra-high field MRI
MEMO	766864	Mechanics with Molecules
MESO_BRAIN	713140	Custom architecturally defined 3D stem cell derived functional human neural networks fortransformative progress in neuroscience and medicine
Microflusa	664823	Fabricating colloidal materials with microfluidics
microSPIRE	766955	micro-crystals Single Photon InfraREd detectors
MIR-BOSE	737017	Mid- and far-IR optoelectronic devices based on Bose-Einstein condensation
MRG-GRammar	664918	Massive Reverse Genomics to Decipher Gene Regulatory Grammar
MS SPIDOC	801406	Mass spectrometric technology for next generation proteomics in systems medicine
MSmed	686547	Mass Spectrometry for Single Particle Imaging of Dipole Oriented protein Complexes
MyoChip	801423	Building a 3D innervated and irrigated muscle on a chip.
NANOPHLOW	766972	TOWARDS NOVEL NANO-SCALE TECHNOLOGIES BASED ON PHORETIC FLOW EFFECTS
NanOQTech	712721	Nanoscale Systems for Optical Quantum Technologies
NanoSmell	662629	NanoSmells: Artificial remote-controlled odorants
NanoStencil	767285	Nanoscale self-assembled epitaxial nucleation controlled by interference lithography
NanoTBTech	801305	Nanoparticles-based 2D thermal bioimaging technologies
NEMF21	664828	Noisy Electromagnetic Fields - A Technological Platform for Chip-to-Chip Communication in the 21st Century

Project Acronym	Project Number	Project Title
NEURAM	712821	Visual genetics: establishment of a new discipline to visualize neuronal nuclear functions in real-time in intact nervous system by 4D Raman spectroscopy
NEWTON-g	801221	New Tools for Terrain Gravimetry
NICI	801075	Non-Invasive Chemistry Imaging in the whole human body
nuClock	664732	Towards a nuclear clock with Thorium-229
One-Flow	737266	Catalyst Cascade Reactions in 'One-Flow' within a Compartmentalized, Green-Solvent 'Digital Synthesis Machinery' – End-to-End Green Process Design for Pharmaceuticals
Pan3DP	800981	3D bioprinting of pancreatic tissue for biomedical research
PEGASUS	766894	Plasma Enabled and Graphene Allowed Synthesis of Unique nano Structures
PETER	767227	Plasmon Enhanced Terahertz Electron Paramagnetic Resonance
PHASE-CHANGE SWITCH	737109	Phase-Change Materials and Switches for Enabling Beyond-CMOS Energy Efficient Applications
PHENOMEN	713450	All-Phononic circuits Enabled by Opto-mechanics
Phoenix	665347	Exploring the Unknown through Reincarnation and Co-evolution
PIEDMONS	801285	Portable Ion Devices for Mobile-Oriented Next-generation semiconductor Technologies
PRe-ART	764434	Predictive Reagent Antibody Replacement Technology
PROCHIP	801336	Chromatin organization PROfiling with high-throughput super-resolution microscopy on a CHIP
PROSEQO	687089	PROtein SEQuencing using Optical single molecule real-time detection
QCUMbER	665148	Quantum Controlled Ultrafast Multimode Entanglement and Measurement
Q-MIC	801060	Quantum-enhanced on-chip interference microscopy
Q-SORT	766970	QUANTUM SORTER
QuIET	767187	Quantum Interference Enhanced Thermoelectricity
RECORD-IT	664786	Reservoir Computing with Real-time Data for future IT
SALBAGE	766581	Sulfur-Aluminium Battery with Advanced Polymeric Gel Electrolytes
SENSITIVE	801347	Early Detection of cancer onset based on sensing field cancerization at the organ level
SiLAS	735008	SiliconLaser

Project Acronym	Project Number	Project Title
SilkFUSION	767309	Genetically engineered human pluripotent stem cells, functionalized silk-fibroin platforms and bio-inks: a novel solution for large-scale ex-vivo platelet production, transfusion and drug research
SPICE	713481	Spintronic-Photonic Integrated Circuit platform for novel Electronics
SPRINT	801464	Ultra-versatile Structural PRINTing of amorphous and tuned crystalline matter on multiple substrates
STARDUST	767092	in vivo optogeneticS, elecTrophysiology and phArmacology with an ultRasonically-powered DUST for Parkinson's Disease
SUMCASTEC	737164	Semiconductor-based Ultrawideband Micromanipulation of CAncer STEm Cells
SUPERTED	800923	Thermoelectric detector based on superconductor-ferromagnet heterostructures
SUPERTWIN	686731	All Solid-State Super-Twinning Photon Microscope
Symbiotic	665046	INNOVATIVE AUTONOMOUS ELECTRICAL BIOSENSOR SYNERGISTICALLY ASSEMBLED INSIDE A PASSIVE DIRECT METHANOL FUEL CELL FOR SCREENING CANCER BIOMARKERS
TEQ	766900	Testing the Large-Scale Limit of Quantum Mechanics
TISuMR	737043	Integrated Tissue Slice Culture and NMR Metabolomics – A Novel Approach Towards Systemic Understanding of Liver Function And Disease
TRANSPIRE	737038	Terahertz RAdio communication using high ANistropy SPIn torque REsonators
ULTRACHIRAL	737071	Ultrasensitive chiral detection by signal-reversing cavity polarimetry: applications to in-situ proteomics, single-molecule chirality, HPLC analysis, medical diagnostics, and atmospheric studies
ULTRAQCL	665158	Ultrashort Pulse Generation from Terahertz Quantum Cascade Lasers
Ves4US	801338	Extracellular vesicles from a natural source for tailor-made nanomaterials
VISORSURF	736876	VisorSurf - A Hardware Platform for Software-driven Functional Metasurfaces
VOXEL	665207	volumetric medical x-ray imaging at extremely low dose
Zoterac	665107	Zinc Oxide For TeraHertz Cascade Devices

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