European Commission

7th meeting of the Board of Funders

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# HBP and Graphene Flagships
## State of Play

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European Commission

# Graphene: State of Play

GRAPHENE FLAGSHIP

- Horizon 2020 → Operational phase (APR 2016 to 2023):
  - 1st Core project: Apr 2016 to Mar 2018, 89 M€ (WP 2014-15)

    Year one review – Blogpost T. Skordas (Sept 2017)
  - 2nd Core project: Apr 2018 to Mar 2020, 88 M€ (WP 2016-17)

    Positive evaluation – Grant preparation on-going
  - 3rd Core project: Apr 2020 to Mar 2023, 150 M€ (WP 2018-20)

    WP adopted: invitation to submit by May-June 2019
- Key events
  - Graphene week, 25-29 September, Athens
  - Tallinn Digital Summit, 29 September
  - EU-US workshop, 23-25 October, Arlington, VA
  - Medica/Compamed tradefair, 13-16 November, Düsseldorf

# Graphene SGA1

## Review Year 1

"*the Graphene Flagship continues to deliver exceptional results, and keeps showing good promise for major impact.*"

- Progressing towards industrial applications
- Focusing on innovation
- Exceeding performance targets
- Putting Graphene on the map

European Commission

GRAPHENE FLAGSHIP REVIEW (2016-2017)

*September 2017*

**The European Commission held a review of the project to check on the progress of the past year. The overall conclusion of the experts is that the Graphene Flagship continues to deliver exceptional results, and keeps showing good promise for major impact.**

Fourteen high-level experts, selected for their recognised knowledge and scientific expertise in the field, worked for two months to assess the progress of the Flagship. It was also an opportunity to look at the preparations for a next phase that will start in April 2018. Next challenges will be the integration of the new partners that were successful at the call for expression of interest earlier this year and the preparations for the next phase of the project starting next year.

Progressing towards industrial applications

The experts concluded that during the evaluated period (April 2016 – March 2017), the Graphene Flagship has made excellent progress towards its overall goal of taking graphene and related materials (GRM) from the research in laboratories stage to industrial exploitation. The activities encompass nearly all Key Enabling Technologies, in particular micro- and nanoelectronics, nanotechnology, advanced materials, photonics, and advanced manufacturing technologies, and to some extent biotechnology. Several scientific and/or technological achievements beyond state of the art have been highlighted.
These include the integration of GRM with current technologies or devices, with prominent examples such as a CMOS[1] integrated photodetector for/with application for consumer electronics, spintronic device for data processing and storage or enhanced stability of perovskite photovoltaic cells.

Focusing on innovation

High innovation potential results have been also achieved through the development of new devices, material and composites such as:

- graphene based magnetic, gas and bio-sensors for automobiles to medical applications
- a tuneable sieve using a graphene oxide membrane for water desalination
- a graphene-polymer sensor material that could be used for blood pressure monitoring
- a graphene-based composite to be used as permeation barrier in an Airbus winglet
- a graphene-based electrode material for energy devices such as batteries and supercapacitors.

[1] CMOS: complementary metal-oxide semiconductors

Collaborations

- 158 partners in 23 countries, 1252 people involved
- 73 associated members
- 18 partnering projects
- Academia 39%, RTOs 22%, industry 39%

Outputs (FP7+ SGA1/Year 1)

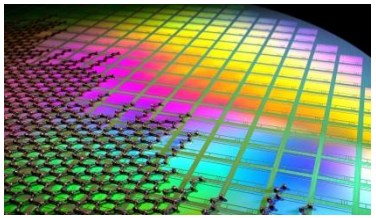
- 1400 scientific publications, 23000 citations
- 6 spin-offs, 37 patents applications, 39 prototypes, 17 products

https://ec.europa.eu/digital-single-market/en/blogposts/graphene-flagship-towards-successful-research-and-innovation-model

# Graphene SGA1
# First success stories in applications

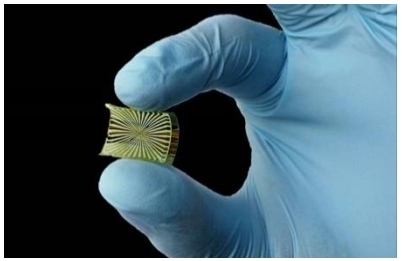
## Graphene CMOS device

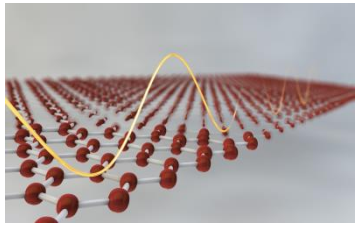
Flagship Partners ICFO and Graphenea made a graphene-CMOS is able to sense UV, visible and infrared light at the same time.



## Artificial Retina

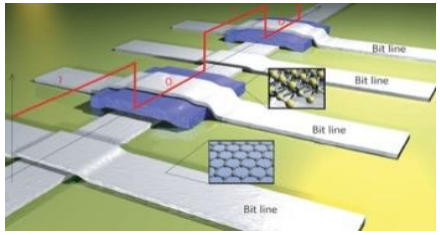
Physicists at Technische Universität München are using the special properties of graphene to produce key elements of an artificial retina.





## Ink-Jet Printable Electronics

Researchers from Manchester and Pisa have demonstrated fully ink-jet printed programmable memory devices, using biocompatible water-based inks

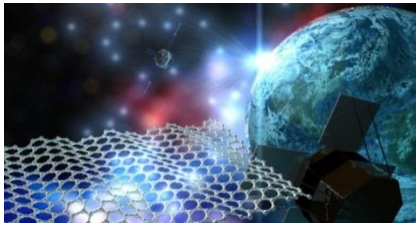



## Graphene helmet

A graphene coating that allows better distribution of impact force makes the helmet less susceptible to damage compared to helmets without graphene, even in high temperature conditions thanks to a collaboration between IIT and Italian design company Momodesign

## Graphene based Terahertz Absorbers

A terahertz absorber – a critical component in optical communication - with an order of magnitude higher performance than other devices produced to date



## Using graphene in zero gravity

In collaboration with ESA, Flagship researchers are carrying out experiments for using graphene in thermal management (heat dissipation) and light propulsion (solar sails)

# Graphene SGA2

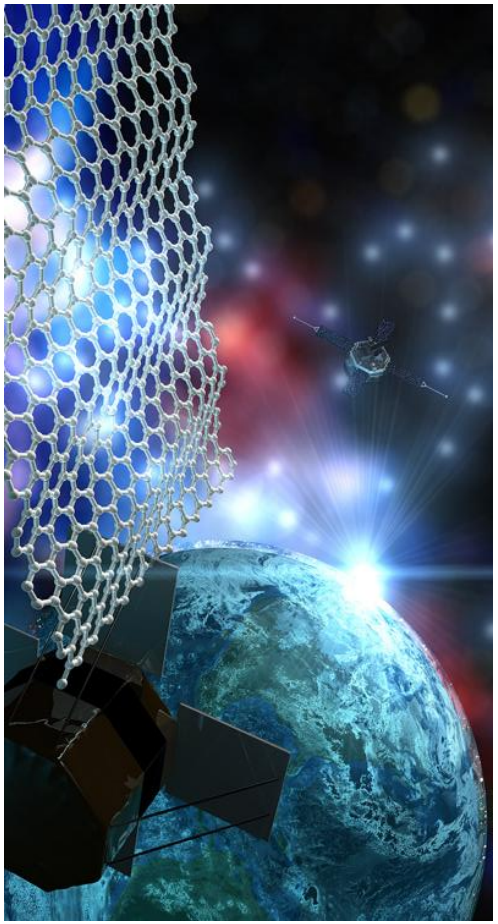
## Increased focus on most promising technologies and more applied research

- **Science and Technology Work Packages continuing with an increasing focus on pushing to higher TRLs**

- **6 new cross-cutting "spearhead projects" to drive concrete innovation opportunities**
  - Graphene-Photonics Integrated Circuits for the 5G Era
  - Printable Sensors Integrated with RFID Antenna
  - Graphene-Perovskite Solar Farm
  - Multifunctional Plaster Sensor for Human Skin, Based in Functionalized Graphene
  - Technology of Silicon Graphene Lithium-Ion Batteries for Large Scale Production
  - Self-Powered Graphene-Based Textile for Wearable Electronics

# Graphene SGA2

| Type of organisation | Number | EC Contribution |
|---|---|---|
| Academic / higher education | 60+1 (42%) | 47,0 M€ (53%) |
| Research Organisation | 25+1 (18%) | 24,6 M€ (28%) |
| Industry | 23+2 (17%) | 8,5 M€ (10%) |
| SME | 17+11 (19%) | 6,3 M€ (7%) |
| Other | 5 (3%) | 1,7 M€ (2%) |
| TOTAL | 130+15 | 88 M€ |



- 28 partners leaving the CP (a majority from academia and higher education)
- 15 new partners added through call for Expression of Interest (a large majority of them are from SME & Industry)
- Consortium: 27% change; 8% reduction

www.graphene-flagship.eu

# HBP: State of Play

Human Brain Project

- Horizon 2020 → Operational phase (APR 2016 to 2023):
  - 1st Core project: Apr 2016 to Mar 2018, 89 M€ (WP 2014-15)

    Year one review completed

    Additional sub-projects reviews: SP8 (July), SP1 and SP10 (Oct.)
  - 2nd Core project: Apr 2018 to Mar 2020, 88 M€ (WP 2016-17)

    Positive evaluation – Grant preparations on-going
  - e-INFRA project: 25 M€ (WP 2016-17)

    Positive evaluation – Grant preparations on-going
  - 3rd Core project: Apr 2020 to Mar 2023, 150 M€ (WP 2018-20)

    Invitation to submit by May-June 2019
- Key events
  - Tallinn Digital Summit, 29 September
  - 5th Annual Human Brain Project Summit, 17-20 October
  - SfN annual conference "Neuroscience 2017", 11-15 Nov., Washington, DC

# HBP SGA1

- Overall good progress
  - Year 1 project review, June
    - HBP has passed most of its milestones for the first year of the SGA1 grant, delivering on HBP roadmap regarding both science and the RI development. New HBP organisation well in place.
    - Reorganisation of the central NIP platform work and teams was successfully completed
    - Further focus is required on activities integration and on provision of facilities crucial for empowering neuroscience, brain medicine and brain-inspired computing
  - Additional sub-projects reviews, July, October:
    - SP8: Focus on demonstrating MIP local & proof of concept for MIP federation for end of SGA1 and review future activities (SGA2) to reinforce medical impact of HBP
    - SP1 and SP10: good technical progress but more connection with theory & simulation required

<u>Collaborations</u>

- 116 partners in 19 countries, 856 FTEs
- 9 associated members
- 7 partnering projects + 6 in prep.
- 87 universities, 26 research institutes, 2 companies

<u>Outputs</u> (FP7 & SGA1 Year 1)

- 700 scientific publications,
- 2 patents
- Platform users: 2.335 (1.412 external)

# HBP SGA1 - Success stories

**Successful combination of physical & virtual experiments for studying cellular information**

Use of two-photon imaging, optogenetics, dual-colour uncaging of glutamate and GABA, and simulation. **SP6**

**First organisation of several long-term collections of functional EEG data**

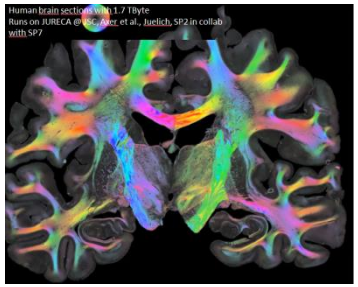
Successful study of face recognition in healthy and diseased patients, using data uploaded by the international community. **SP2**

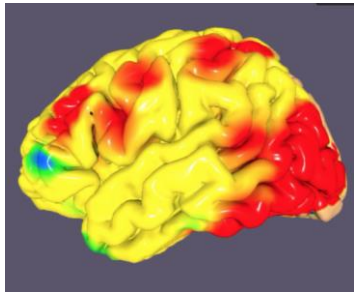
**Prototype of the 2nd generation of HBP neuromorphic chips**

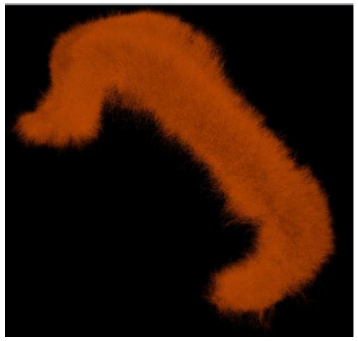
SpiNNaker: 160 ARM cores and 80 GIPS/W per chip. BrainScaleS: Local learning, active dendrites. **SP9**

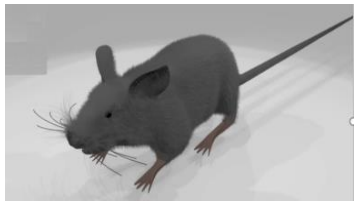
**Successful combination of virtual robotics and experimental neuroscience**

Rehabilitation of mice after stroke. **SP1 and 10**







**A new theory of perception at cellular level explaining the influence of top-down signals**

Dendritic calcium activity correlates to the "moment of perception" and manipulating dendritic excitability shifted the perceptual threshold. **SP3**

**Successful combination of theoretical and empirical neuroscience experiments and clinical practice**

New understanding of consciousness and different level of awareness in healthy and diseased patients. **SP3**

**First mouse hippocampus Calcium functional model with a resolution of 1'000 compartments/neuron**

4TB of output data,.**SP6**

**Opinion on Data Protection and Privacy.** From experts and public consultation. **SP12**

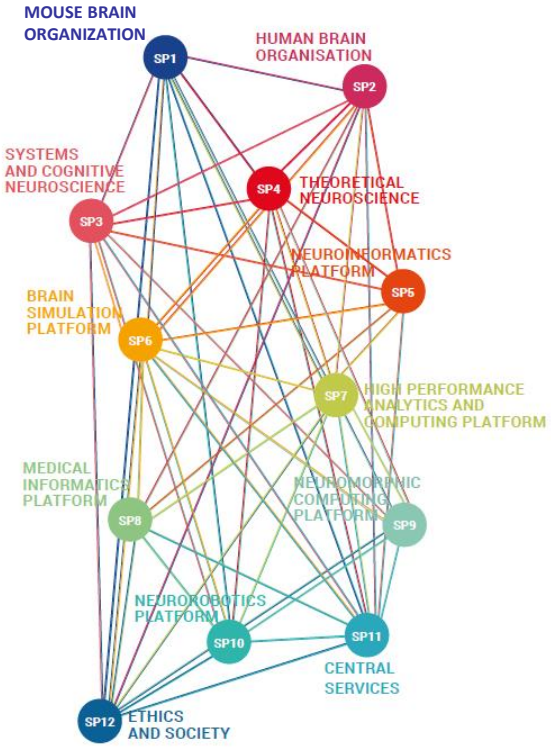
# HBP SGA2
# Joint Platform and Neuroscience

## A more unified and users-driven approach

- Building a Joint Platform Infrastructure addressing the research communities needs and based on the 6 ICT platforms
  - High Level Support Team (HSLT) to provide S&T support to users, coordinate communities demands and infrastructure development.
  - Foster external access and use of the HBP infrastructure (vouchers)
  - More cross-cutting and co-design activities will be initiated via open calls
  - New generation of neuromorphic chips (production of electronic masks)
- Accelerating Neuroscience knowledge
  - Move modeling and simulation from structural to multi-level organization and function of the brain: detailed and molecular/cellular level simulation of hippocampus, basal ganglia and cortex
  - Advance knowledge in learning and memory, in multisensory perception & integration and object recognition, and in brain states: linking neural correlates with behavioral and cognitive data. Verify the new hypotheses with simulations including using robots.
  - Consolidation of open-access brain atlases and models

# HBP SGA2

| Type of organisation | Number | EC Contribution |
|---|---|---|
| Academic / higher education | 88 (75%) | 63,8 M€ (73%) |
| Research Organisation | 27 (24%) | 20,9 M€ (24%) |
| Incl. SME | 1 (1%) | 0,2 M€ (0%) |
| Public body (hospital) | 1 (1%) | 2,7 M€ (3%) |
| Other | 1 (1%) | 0,4 M€ (0%) |
| TOTAL | 118 | 88 M€ |




- New partners to be selected through Calls for Expression of Interest (EoI): on-going.
  Selected partners will join SGA2.
- New activities to be launched to reinforce medical impact: Call for EoI to be launched in January 2018.
- Towards the creation of the HBP Legal Entity

www. humanbrainproject.eu

# HBP e-Infra: ICEI

Human Brain Project

## FENIX: Federated Engine for Information eXchange

### Infrastructure as a Service (IaaS)

**BSC** (SP), **CEA** (FR), **CINECA** (IT), **CSCS** (CH), **JSC** (DE)

***HBP Research Infrastructure for Brain Data Analytics & Simulation***

25%

***Other Communities via PRACE:***

- *Material science,*
- *Physical sci. experiments,*
- *Genomics*
- *…*

15%

**Coordinated and distributed infrastructure:**

- **50 PFlop/s, 10 PB**
- **Scalable Compute services**
- **Interactive Compute services**
- **Active & Archival Data repositiories**
- **Information/catalogue services**
- **AAI and user/resource management**
- **Data transfer services**

# HBP e-Infra: ICEI

| Beneficiaries | Total costs | EC Contribution |
|---|---|---|
| EPFL (administrative coord.) | 50 M€ | 25 M€ |
| FZ Juelich – JSC (tech. coord.) | | |
| BSC | | |
| CEA - TGCC | | |
| CINECA | | |
| ETHZ - CSCS | | |

**ICEI**

**I**nteractive

**C**omputing

**E**-

**I**nfrastructure

## ICEI project in support to FENIX

- **Coordinated procurements of Equipment + R&D services and exploiting the specifications developed during the HBP HPC PCP (FP7 ramp-up phase)**
- **Staged deployment and operation, including a fast-track at CSCS operational for SGA2 start (April 2018)**
- **EC funding plus equivalent amount of in-kind contributions by the HPC centers**
- **ICEI Technical and Executive Boards + Fenix Council**

European Commission


# THANK YOU!