# General presentation of the project

**Call:** FET-OPEN (630 proposals, 11 funded ≈ 1,7%)

**Proposal full title:** Hijacking cell signaling pathways with magnetic nanoactuators for remote-controlled stem cell therapies of neurodegenerative disorders

**Proposal acronym: MAGNEURON**

**Type of funding scheme:** Research & Innovation actions (100%)

**Partnership:** 6 partners / 3 countries

**Duration:** 48 months

**Requested subvention:** 3 473 026 €

**Workplan:** 6 S&T WPs and 1 administrative WP

# MAGNEURON consortium

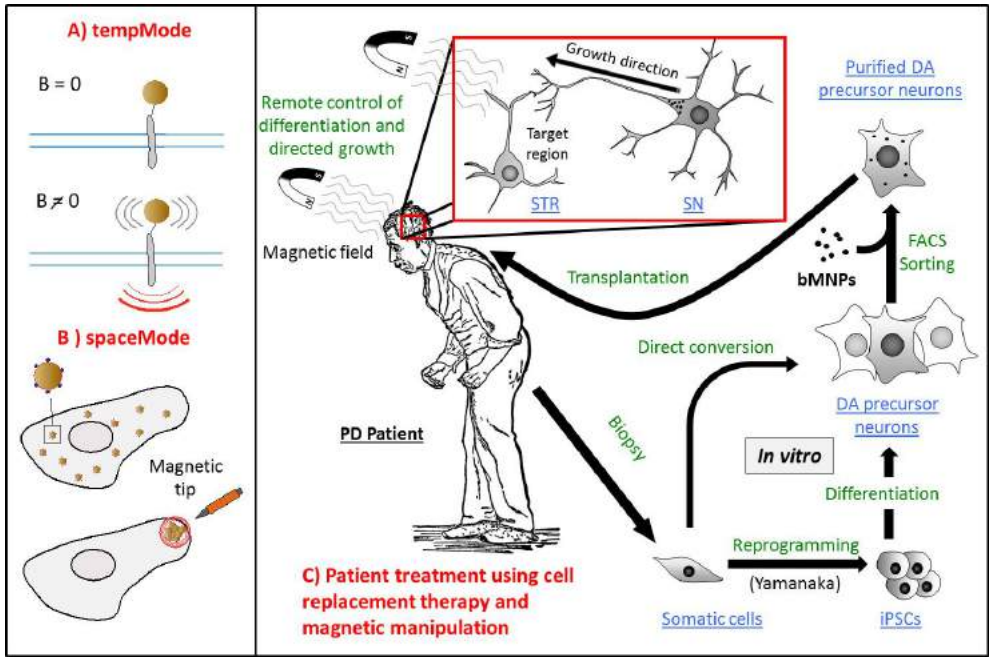
**Type of consortium: 5 universities, 1 SME**

| Participant no. | Participant legal name | Country |
|---|---|---|
| 1 Coordinator | Institut Curie | France |
| 2 | Phenix laboratory | France |
| 3 | Keele University | UK |
| 4 | University of Osnabrück | Germany |
| 5 | Ruhr-University Bochum | Germany |
| 6 | Efficient Innovation | France |

***Introduction of each participant after this presentation***

# MAGNEURON objectives

**The MAGNEURON project aims at a breakthrough in stem cell therapies of neurodegenerative diseases by developing a novel technology for magnetic actuation of cellular functions.**




***Concept of MAGNEURON technology***

*A-B) Magnetic manipulation of signalling is controlled by the mechano-actuation of a signalling protein bound to a MNP using an oscillating field (tempMode) or by the asymmetric membrane accumulation of intracellular MNPs functionalized with signalling proteins (blue dots) due to magnetic gradients (spaceMode).*

*C) Application of magnetic actuation to CT for PD. Somatic cells are reprogrammed to DA precursor neurons. After loading with MNPs and transplantation in the SN, a magnetic field is used to promote proper differentiation towards DA neurons and oriented growth of DA neurons.*

# MAGNEURON objectives

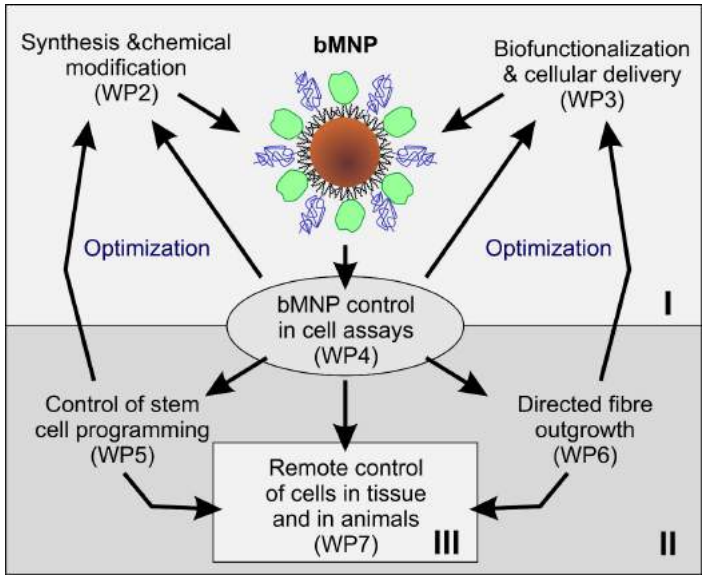
The key objectives of our proposal are:

(i) the development of the chemical, biochemical and physical tools for the magnetic control of signalling in stem cells and neuronal cells

(ii) the demonstration of magnetic actuation of differentiation and oriented growth of DA precursor neurons in single-cell *in vitro* assays

(iii) the application of the technology with cells transplanted into organotypic brain slices and rodents.

# MAGNEURON work programme 1/2




**WP 2 (PHENIX, UOS)**: Preparation of synthetic and recombinant MNPs

**WP 3 (UOS, IC, PHENIX)**: Biofunctionalization and intracellular delivery of MNPs

**WP4 (IC, PHENIX)**: Tools for MNP manipulation in single-cell assays

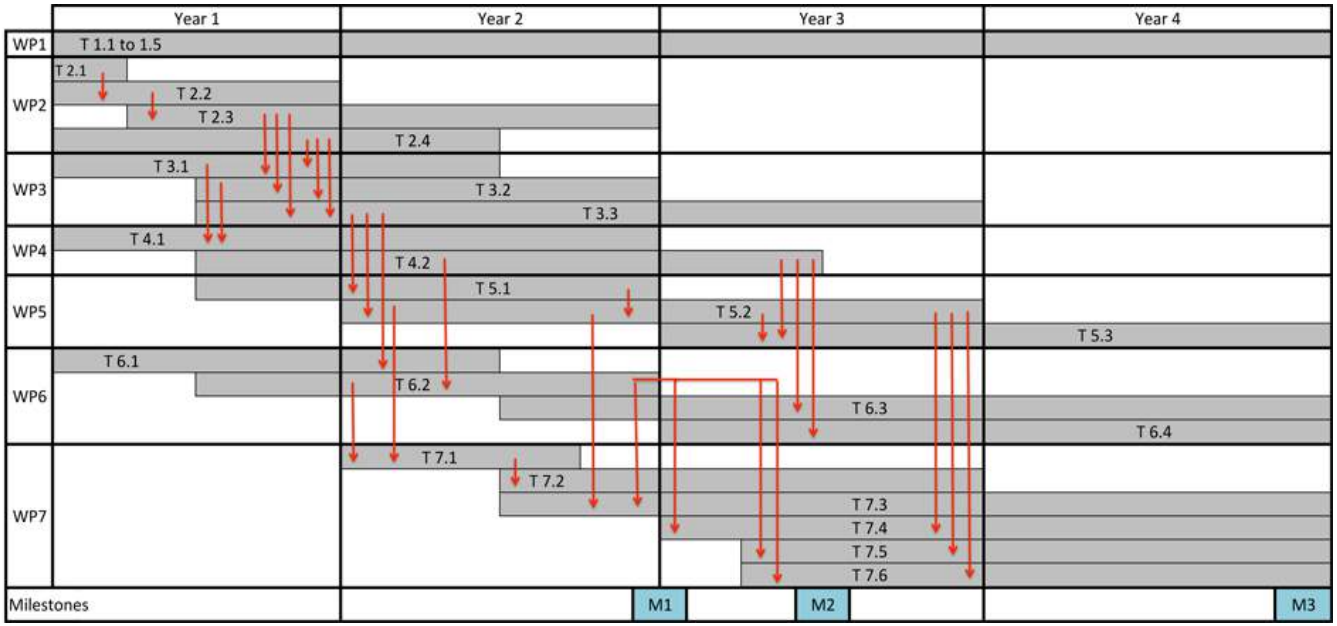
**WP5 (KU, IC)**: Biomagnetic control of stem cell differentiation

**WP6 (UBO, IC)**: Directed fibre outgrowth of neuronal cells

**WP7 (KU, UBO):** Magnetic manipulation of cellular signalling in organotypic brain Sslices and *in vivo* models of Parkinson's disease.

# MAGNEURON work programme 2/2

Official start date: 01/01/2016

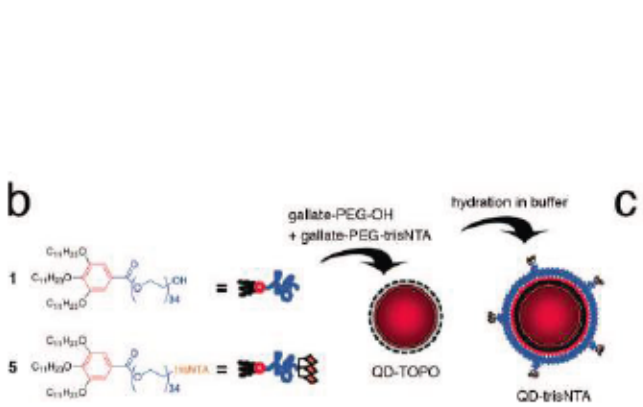


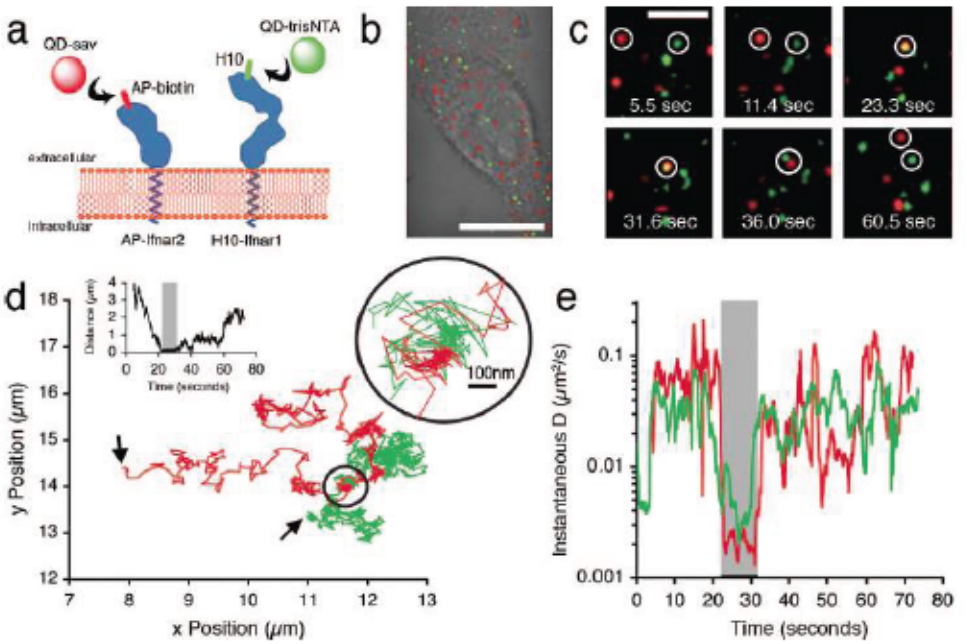
# MAGNEURON budget

| Number | Beneficiary | Personnel costs | Subcontracting | Other direct costs | Indirect costs | Total costs | EU contribution |
|---|---|---|---|---|---|---|---|
| 1 | Institut Curie | 360 000,0 € | | 151 000,0 € | 127 750,0 € | 638 750,0 € | 638 750,0 € |
| 2 | Phenix (CNRS/UPMC) | 325 620,8 € | | 65 000,0 € | 97 655,2 € | 488 276,0 € | 488 276,0 € |
| 3 | Keele University | 530 000,0 € | | 158 100,0 € | 172 025,0 € | 860 125,0 € | 860 125,0 € |
| 4 | University of Osnabrück | 402 800,0 € | | 120 400,0 € | 130 800,0 € | 654 000,0 € | 654 000,0 € |
| 5 | Ruhr-University Bochum | 435 500,0 € | | 110 000,0 € | 136 375,0 € | 681 875,0 € | 681 875,0 € |
| 6 | Efficient Innovation | 105 600,0 € | 3 000,0 € | 12 000,0 € | 29 400,0 € | 150 000,0 € | 150 000,0 € |
| | Total | 2 159 520,8 € | 3 000,0 € | 616 500,0 € | 694 005,2 € | 3 473 026,0 € | 3 473 026,0 € |

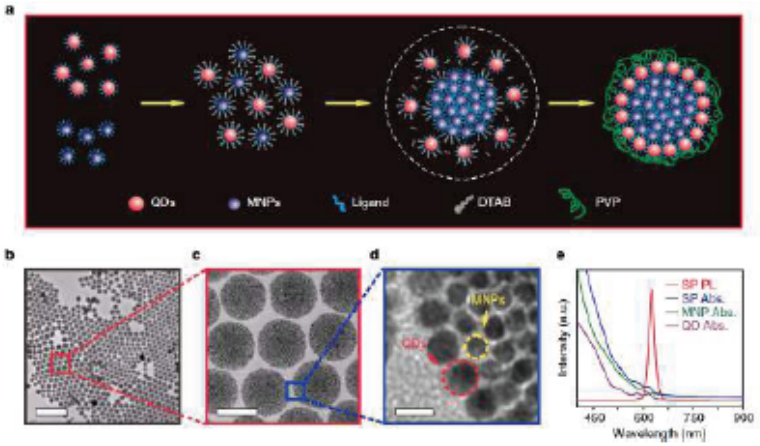
38% of the budget will be distributed to the teams in january 2016

- Collaboration between Institut Curie and Osnabruck started in 2006 with the development of new modalities for (mono)functionalization of quantum dots for single particule tracking applications.

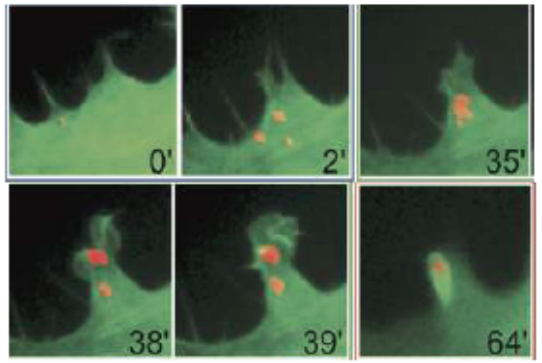


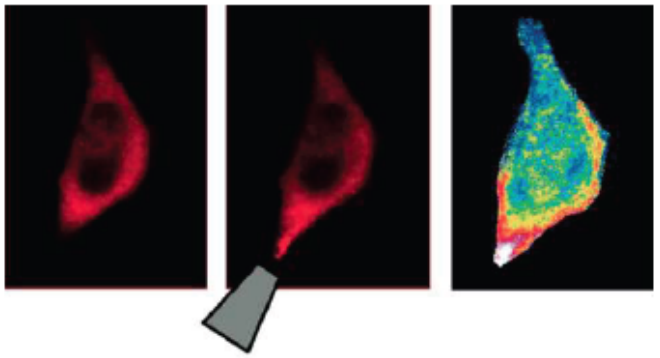
- In 2008, Institut Curie and Osnabruck, together with Y. Bellaiche (Institut Curie) and M. Bawendi (MIT) were awarded a HFSP grant on the study of cell polarity and asymmetric cell division using magnetofluorescent nanoparticles.
- It led to several publications on the development of nanomaterials (Chen et al. Nat. Comm. 2015), on the magnetic manipulation of nanoparticules inside cells (Etoc et al 2013, Etoc et al 2015), and on the magnetic control of signalling at the subcellular scale (Etoc et al. 2013).




Chen et al. Nat. Comm. 2015




Etoc et al. Nat. Nano. 2013



Etoc et al. Nanolett. 2015

# Context

- **There is currently a strong effort to develop tools for remote actuation of cellular activity and cellular functions:**
  - **Chemical control**
  - **Optical control**
    - Optogenetic
    - Photoactivatable synthetic molecules
  - **Magnetic control**
    - Mechanical perturbation
    - Hyperthermia
    - Clustering of proteins
    - …