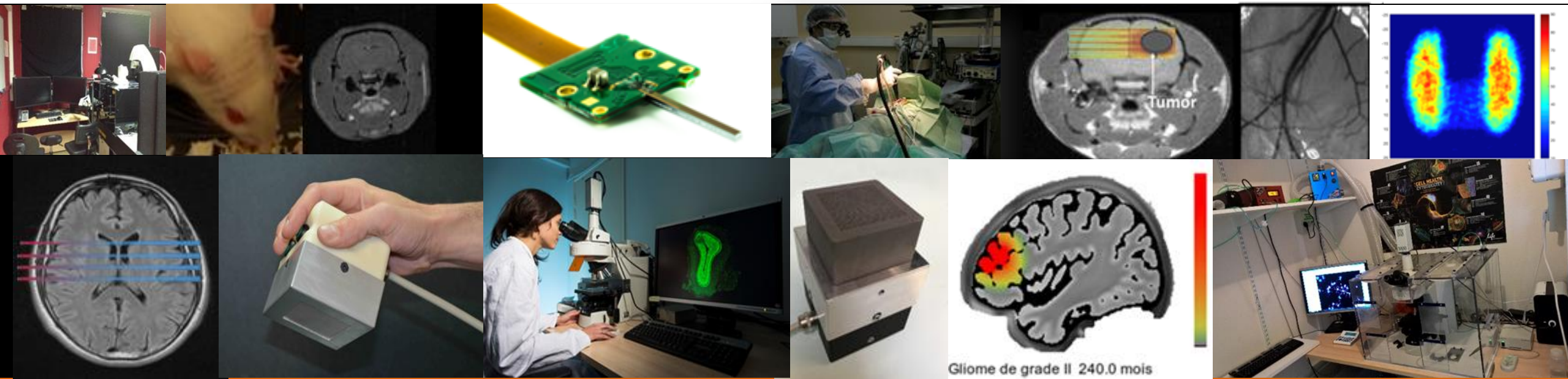


HCERES evaluation of Laboratoires de la vallée d'Orsay

-  CSNSM
-  IMNC
-  IPNO
-  LAL
-  LPT



IMNC UMR 8165

Imagerie et Modélisation en Neurobiologie et Cancérologie

Director: Philippe Laniece

14-17 January 2019

Plan

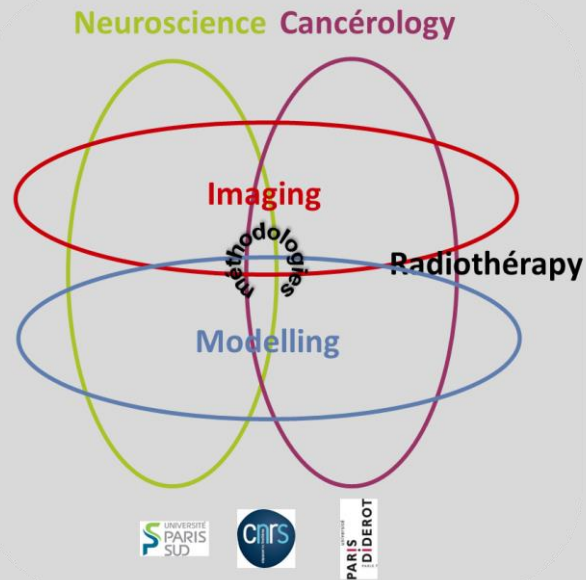
- I. Global view of the laboratory and main data
- II. Structure and scientific policy
- III. Technical infrastructures
- IV. Highlights of the last contract (2015-2019)
- V. International, national and local environment
- VI. Conclusions

Overall presentation of the laboratory

Main themes :

An interdisciplinary lab

First IN2P3 laboratory with research activities fully dedicated to biomedical domains



Creation : January 2006

Merging of two research groups: GMPIB (Paris Diderot University) and IPB group (IPN Orsay)

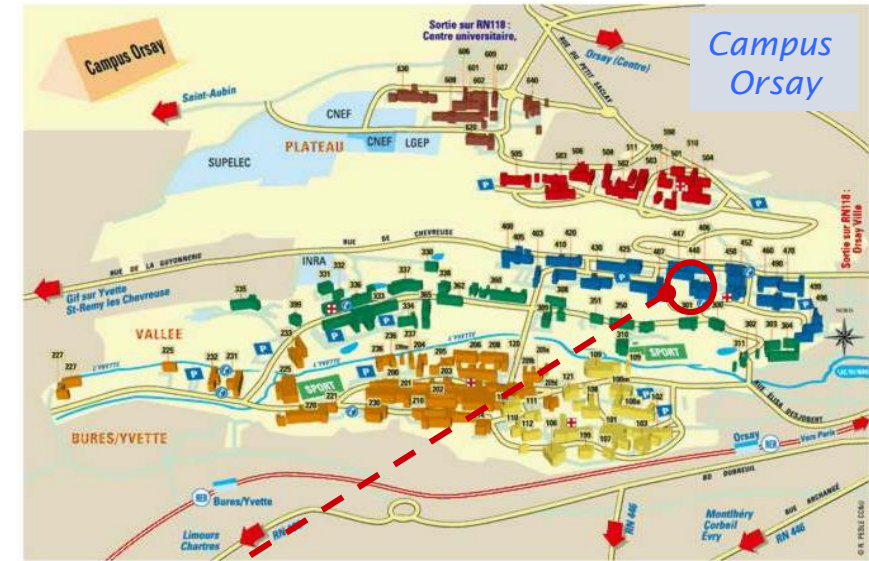
Supporting Institutions :

- Paris Sud, Paris Diderot, CNRS (IN2P3, INSB)

location

- Orsay Campus (IBAIC/bat 440 1220 m²)
- PRG Paris Diderot Campus (bat Condorcet 20 m²)

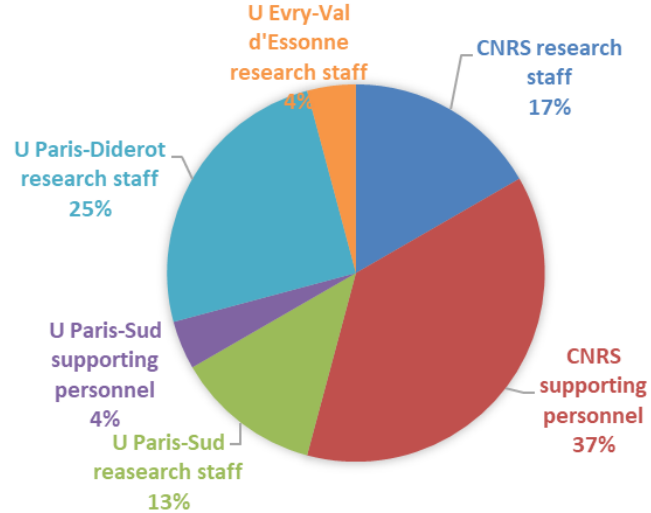
IMNC location



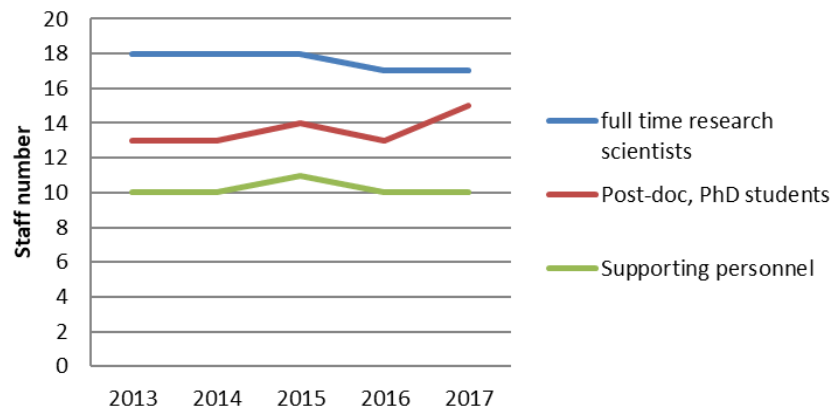
Campus PRG

Main data : Human resources

PERMANENT STAFF DISTRIBUTION



Evolution of IMNC staff from 2013 to 2018

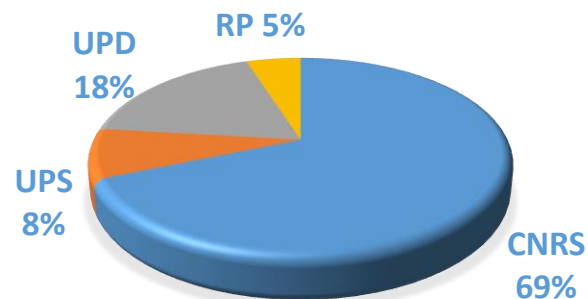


Active staff 30/06/18	CNRS	Univ	Total
Full professors		1	1
Assistant professors		11	11
Full time research directors	1		1
Full time research associate	3		3
Other scientists		1	1
High school teachers			
Supporting personnel (ITAs, BIATSS...)	9	1	10
Permanent staff	13	14	27
Non-permanent professors			
Non-permanent full time scientists		16	16
out of which PhD Students		10	10
non-permanent supporting personnel (4)			
Non permanent staff		16	16
Total		43	43

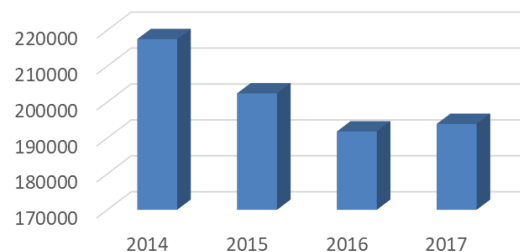
Main data : Budget

IMNC budget = basic funds (tutelles) + contracts

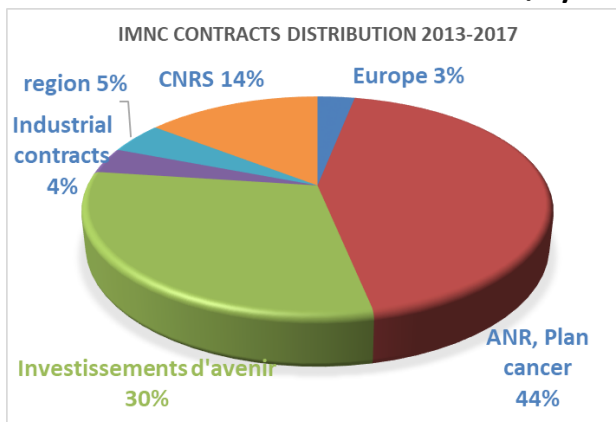
Basic funds: around 200 k€ / year
(except calls and infra)



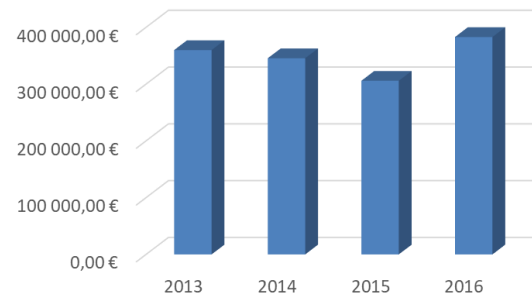
IMNC basic funds per year



Contracts: around 360 k€ / year



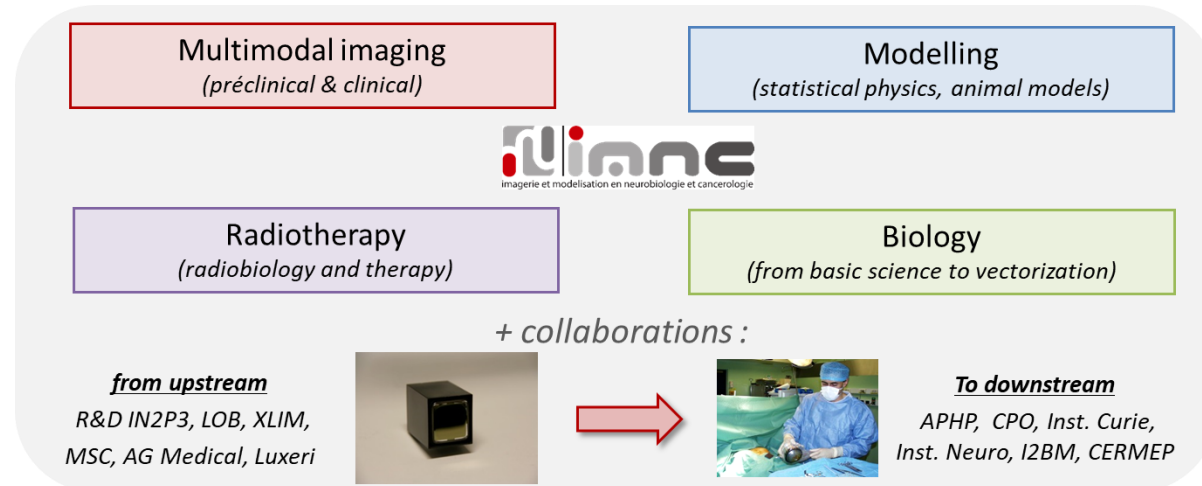
IMNC contracts per year



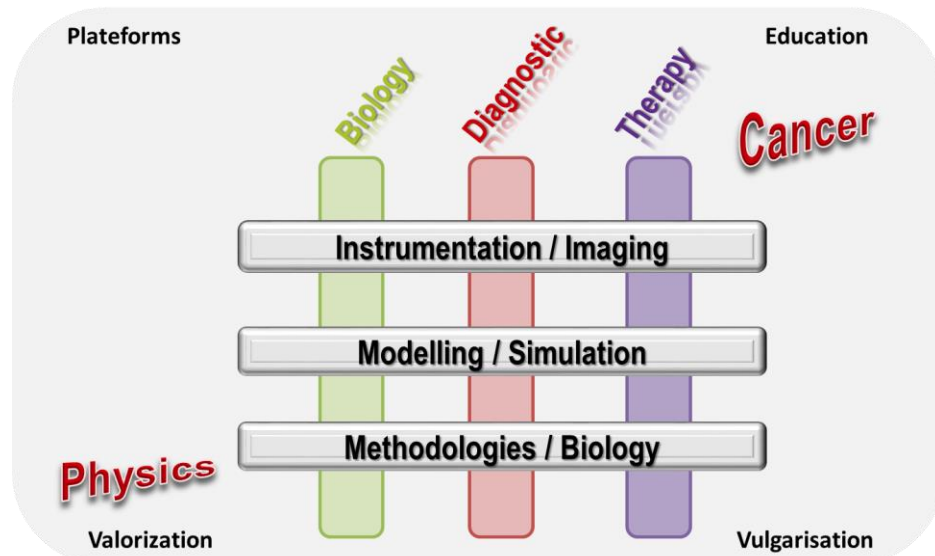
Tutelles	2017
Basic funds	193900
Specific funds	
Calls	42300
Infrastructure	66000
Total tutelles	302200

Contracts	2017
International funds	
European programs	56000
ERC	
European structural funds	
ANR (not PIA)	39100
PIA	200260
Other public funds on calls	
CPER	
Foundations, charities	14400
Industrial contracts	39620
Consulting	1500
Institut Carnot	
Innovation (SATT, BPI, ...)	
Patents	3000
Other funds	
Total contracts	382780

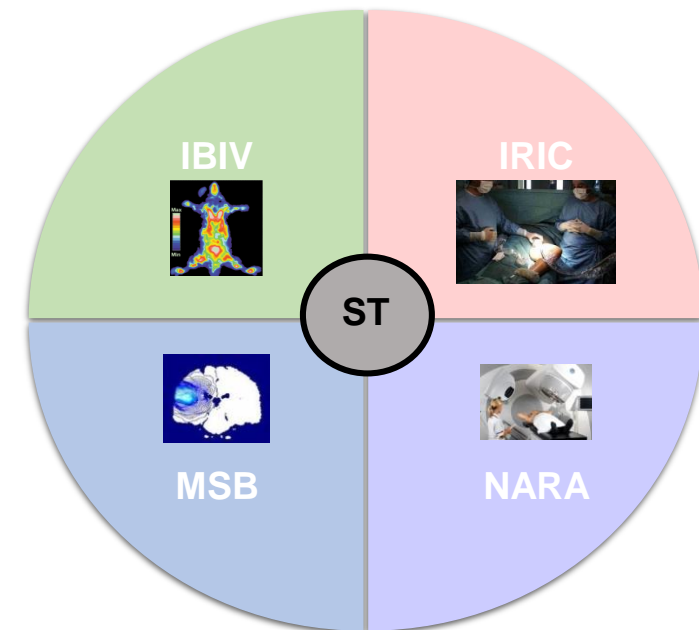
Structure : Main themes and groups (1)



IMNC 2015-2019: Toward an integrated project in oncology with a specific focus on brain tumors



Perimeter centered on physics and cancer interfaces

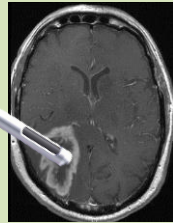


Structure : Main themes and groups (2)

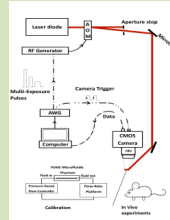
• In vivo Biophotonic imaging (IBIV)

Objectives: To develop new instrumental and methodological linear and non linear optical approaches for clinical research in oncology and neurobiology

- **Clinical imaging:** endomicroscopy and spectroscopy at cell scale to guide biopsy and resection surgery
- **Preclinical imaging:** Large field multimodal imaging; SHG microscopy of collagen; biological magnetic nanoparticles for medical applications
- **Dedicated tissue characterization:** optical properties of healthy and pathological tissues



Development of an endomicroscope for the biopsy control and tumor marging resection in gliomas (project OPTipen)



Large field multimodal neuroimaging performed on small animal models

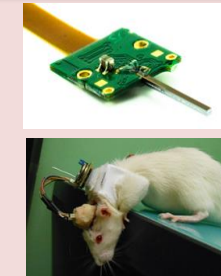
• Clinical and preclinical nuclear Instrumentation et imaging (IRIC)

Objectives: To develop new instrumental and methodological radioisotopic approaches for clinical research in oncology and neurobiology

- **Clinical imaging:** intraoperative imaging to guide resection surgery and ambulatory imaging for therapeutic follow up in oncology
- **Preclinical imaging:** freely moving small animal imaging
- **Dedicated instrumentation:** new instrumental approaches for miniaturization



Per-operative positron probes for the control of tumor margins resection (projects TRIOP et SONIM)

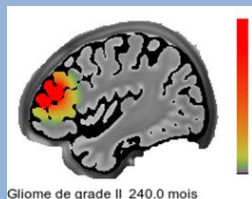


Development of a beta sensitive intracerebral pixelated probe for studies performed on awake small animal

• Modelling of biological system (MSB)

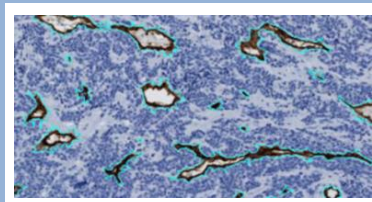
Objectives: To develop non linear physics models from clinical and biological data and to exploit them for prediction and treatment of cancer pathology

- **Clinical modelling:** modeling of low grade glioma growth on biopsy, modeling of treatments effects
- **Biological modeling:** modeling of biological systems: tumor growth ...
- **Dedicated theoretical physics:** dynamical systems study



Gliome de grade II 240.0 mois

Quantitative cell density of a virtual tumor obtained from simulation

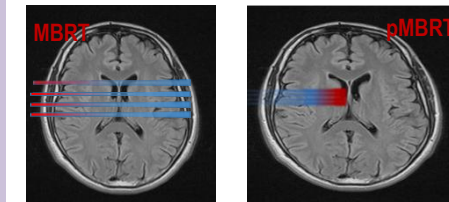


Automatic Detection of blood vessels (light blue) in a glioma tissue

• New approaches in radiotherapy (NARA)

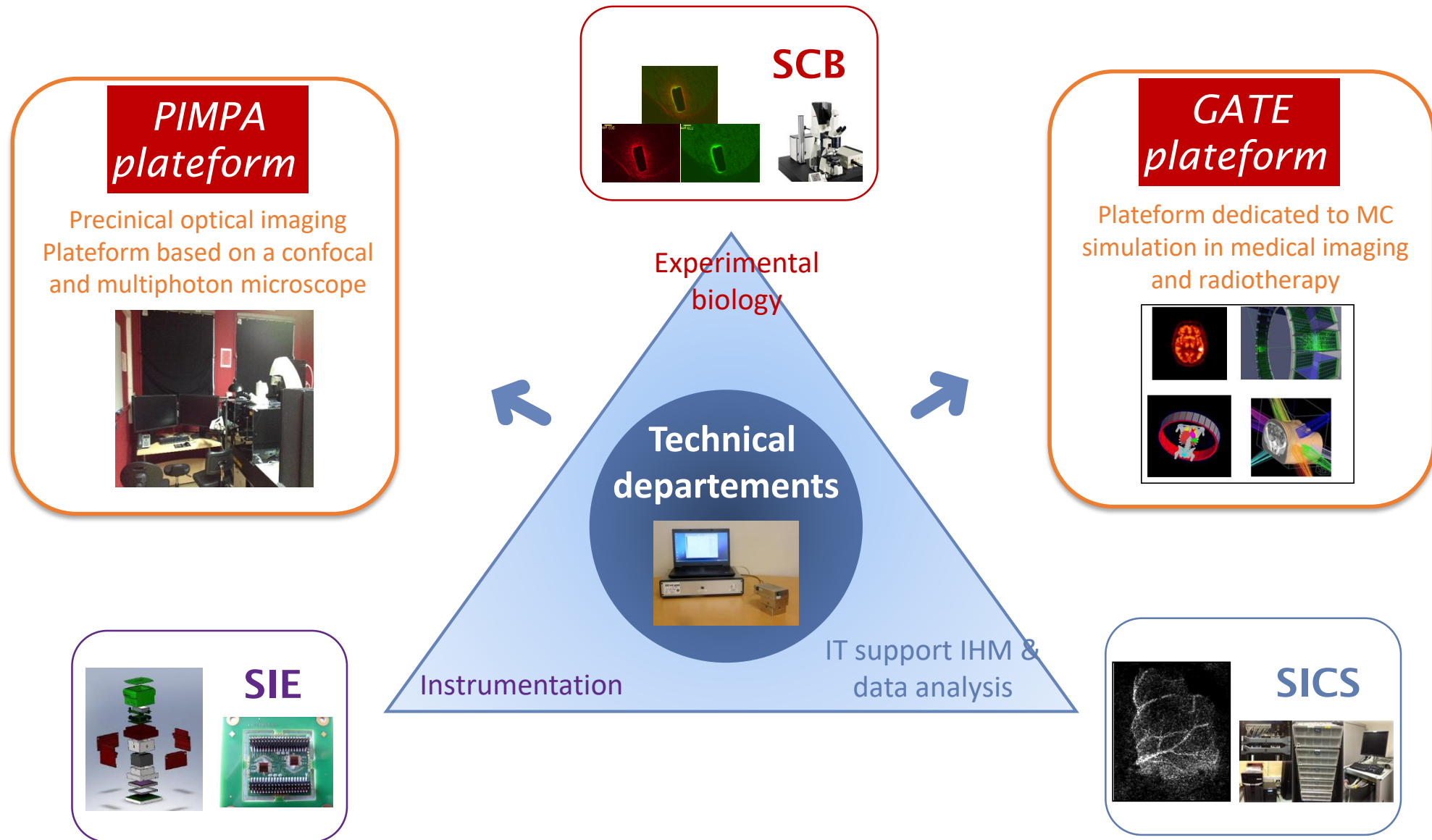
Objectives: to develop new approches in radiotherapy for the treatment of specific radioresistant tumor by improving the therapeutic index

- **Clinical RT:** new modes of deposit on space time fractionation of the dose (mini-beams)
- **Biological RT:** radiobioly (experiments and modelling)
- **Dedicated instrumentation:** specific dosimetry simulation and instrumentation

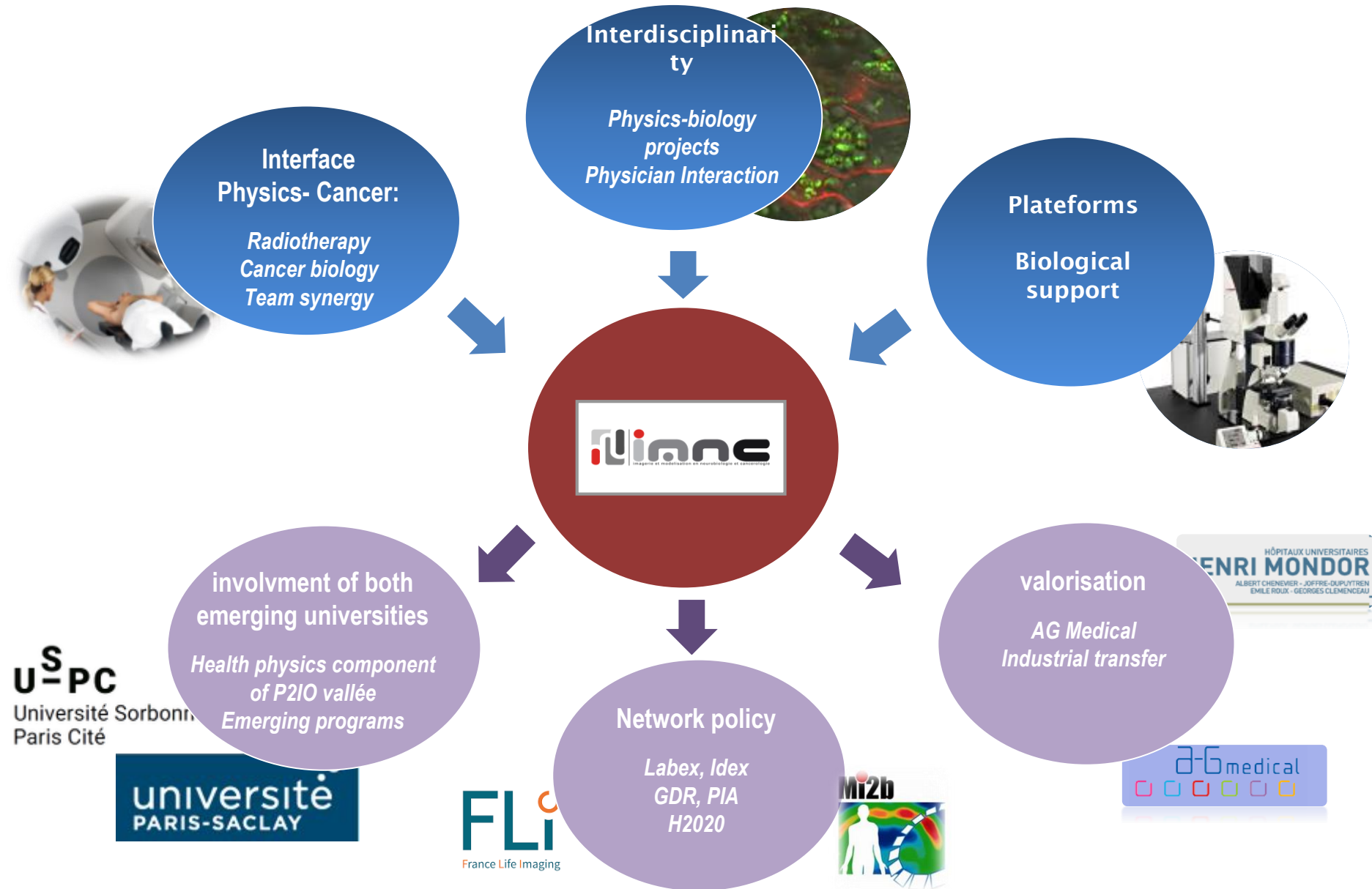


The combining of submillimetric size field (<1 mm) and dose spatial fractionation gives access to a more resistive tolerance of healthy tissue and allows thus to an increase the dose delivered to the tumor tissue (pMBRT project)

Structure : technical infrastructures



Structure : scientific policy

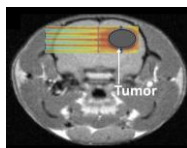


Highlights 1

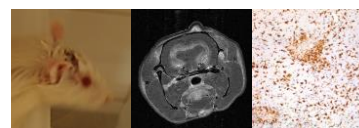
Emergence of the radiotherapy axis

➤ ***Proof of concept of the use of mini-beams as a real alternative in RT treatment***

Standard PT (25 Gy) vs pMBRT (58 Gy):
Follow-up during 7 months



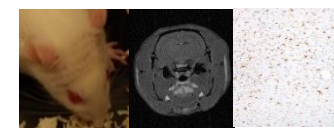
Standard PT
skin and brain
serious damages



versus

pMBRT

No damages



pMBRT increases the tolerance of healthy tissue (Prezado et al, Nature Scientific Reports 2017)

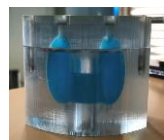
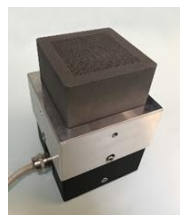
➤ ***Development of the VHEE: PRAE project (IPN, LAL, IMNC)***

➤ ***Strengthening of the NARA team:***

- Recruitment of a full time research associate (R. Delorme)
- Momentum grant (C. Guardiola) and ERC grant (Y. Prezado)

➤ ***Emergence of an axis in radio-biology (minibeam projects)***

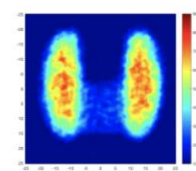
➤ ***Emergence of a new axis focused on vectorized therapy (IRIC)***



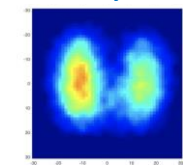
3D-printing thyroid
phantom filled with
¹³¹I (IRSN)



MoTi camera



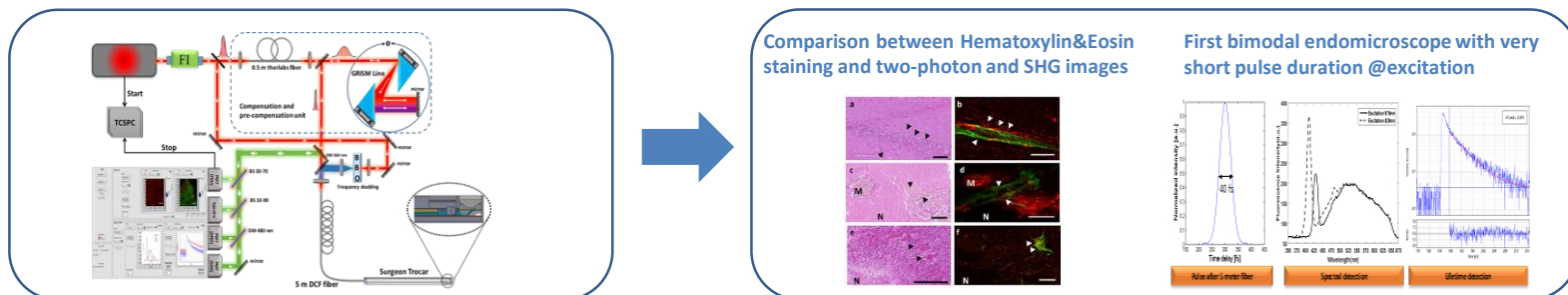
Standard camera
(Siemens Symbia T2)



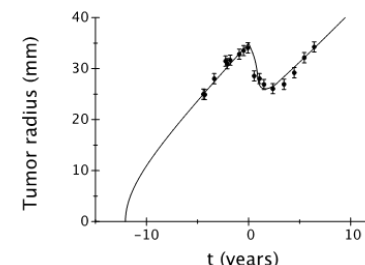
Highlights 2

Reinforcement of the imaging and modeling and of the physics biology and medicine interaction

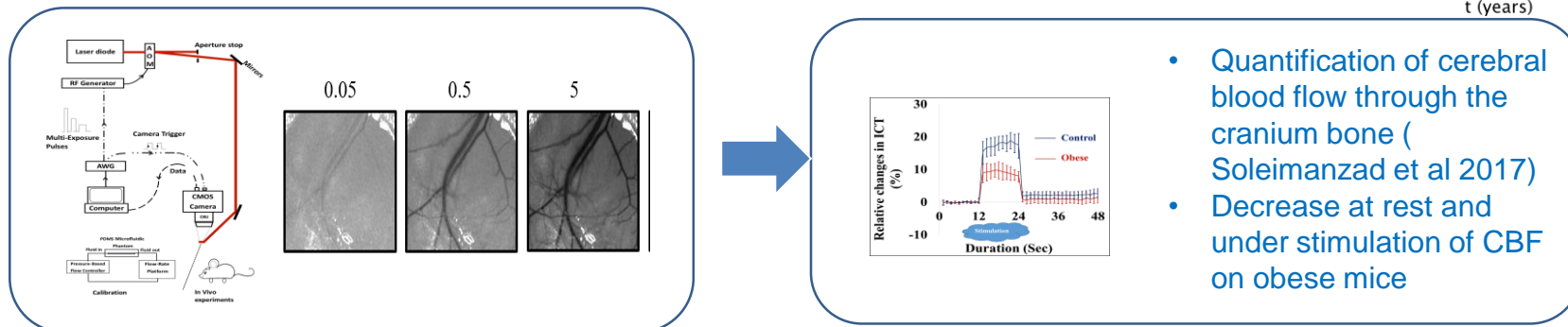
➤ Prevalidation of a new clinical multimodal non-linear endomicroscope for gliomas surgery



➤ Development of a model of the effect of radiotherapy on diffuse low-grade gliomas which has been confronted to clinical data



➤ Interface physics biology: Large field multimodal imaging (IMNC – BFA Lab)



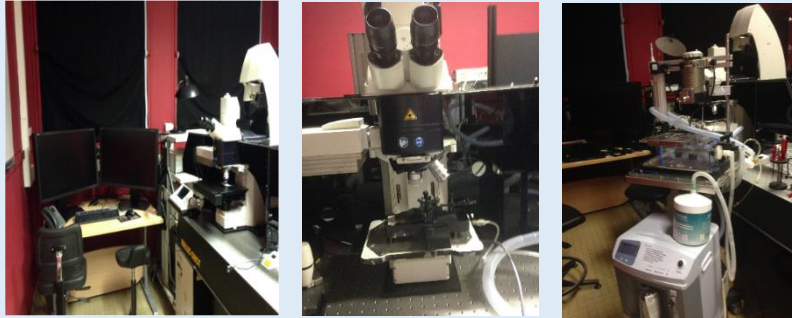
➤ Strengthening of the collaboration with Hôpital Ste Anne and H. Mondor

➤ Development of 3 thesis performed by physicians

Highlights 3

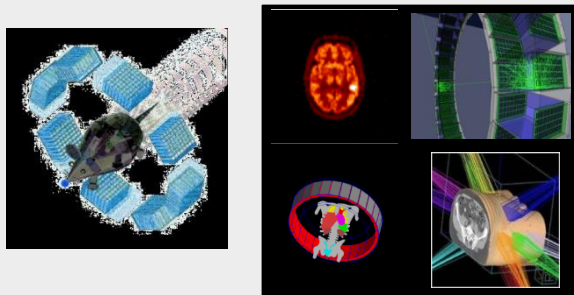
PIMPA platform opening

Collective agreement (CNRS, UPSud, INSERM), user convention, room compliance, prices, training, website, platform advisory board.



GATE platform integration

IMNC Reinforcement inside the collaboration: technical support (A. Dubois), steering committee integration (MA Verdier), project development (optical modelling), project follow-up (radiotherapy, imaging)



Development of the biological department

recruitment of two agents; implementation of specific rooms (cellular biology, microscopy, histology, animal experimentation)



Local environment

PARIS-SACLAY

Links with other labs:

✓ *Radiotherapy (LAL, I. Curie, ISMO)*

➡ *PRAE (Labex P2IO), nanotherad (Idex)*

✓ *Imaging (LAL, IPN, NeuroPSI, CEA/SHFJ)*

➡ *SONIM (Labex P2IO), BME et Bioprobe (Idex)*

✓ *Modélisation santé (LPT, I. Curie)*

➡ *Modélisation et ingénierie des systèmes vivants (Idex)*

Active contribution to the emergence of Idex departments: P2I, SDV (health), EOE (engineering)



Follow up of the physics, biology (P7), and health components (P5, P7):

✓ *Imagerie (BFA, hop. Lariboisière and Jean Verdier)*



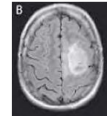
Thesis supervision by IMNC-BFA



Imagerie du Vivant



✓ *Biomedical modeling (Lariboisière, St Louis, Ste Anne, Necker)*



Project supported by INCA (PACRI)

Active contribution to the 'pole' constitution 'SET and 'sciences de la vie'

National and international environment

National:

Main collaborations:

- IRIC: CPPM, IPHC (IN2P3)
- IBIV: CREATIS (Lyon)
- NARA: LPSC (Grenoble), CENBG (Bordeaux), Pasteur Institute (Paris)
- MSB: Hosp. Necker (Paris)

FLI: active members of WP2 and 4 and Paris Sud node

ITS (aviesan): member of the strategic committee

Scientific committees: GDR MI2B, IPN Lyon, LAL Orsay, CENBG Bordeaux

International:

Main collaborations:

- IBIV: U. Florida (USA), National Tsing Hua U. (Taiwan)
- IRIC: Hosp. Royal Marsden
- NARA: micro-electronic center (Barcelona, Spain)
- MSB: U. Virginia (USA), U. of Tokyo (Japan), U. Castilla de la Mancha (Spain)

LIA: France-Ukraine (with LAL and IPN)

RT Facility Users: HIT (Germany), HIMAC (Japan), synchrotron center (Jordania), (Australia)

European fellowships: Marie Curie pos-doc (C. Guardiola) and ERC (Y. Prezado)

Scientific committees: European organization of Medical Physics (Y. Prezado, Vice chair SC)

Conclusions

❖ *IMNC 2.0 (2015-2019) results in accordance with the initial roadmap*

- unifying project focused on cancerology (and neuro) involving biology et medicine 😊
- broad spectrum of skills, scientific cohesion, interdisciplinary maturity 😊
- broad collaborative network including physics and biology labs and hospitals 😊
- 4 teams with coherent themes and good interaction 😊

❖ *An open and rich 5-year cycle: good scientific dynamics and lab life!*

- good level of indicators:
 - Up to 120 published articles (balance between physics, biology and medicine)
 - 10 articles in Nature Scientific Reports in 2017-201
- emergence of the experimental biology department
- site management: animal facilities, new location (bat 104) project
- active involvement with the local site development (emergence of U. PSaclay and U. Paris)

❖ *How to preserve the dynamic ... 😊*

- over-worked staff (research activities, coordination, management, teaching)
- difficulties in fundings accessibility and decreasing basic funds
- uncertain about the CNRS and 'big universities' future
 - ➡ Toward a new lab project (stenghtening of the scientific and technical policy, attractivity, valorisation and strategical positionning)

Thank you