



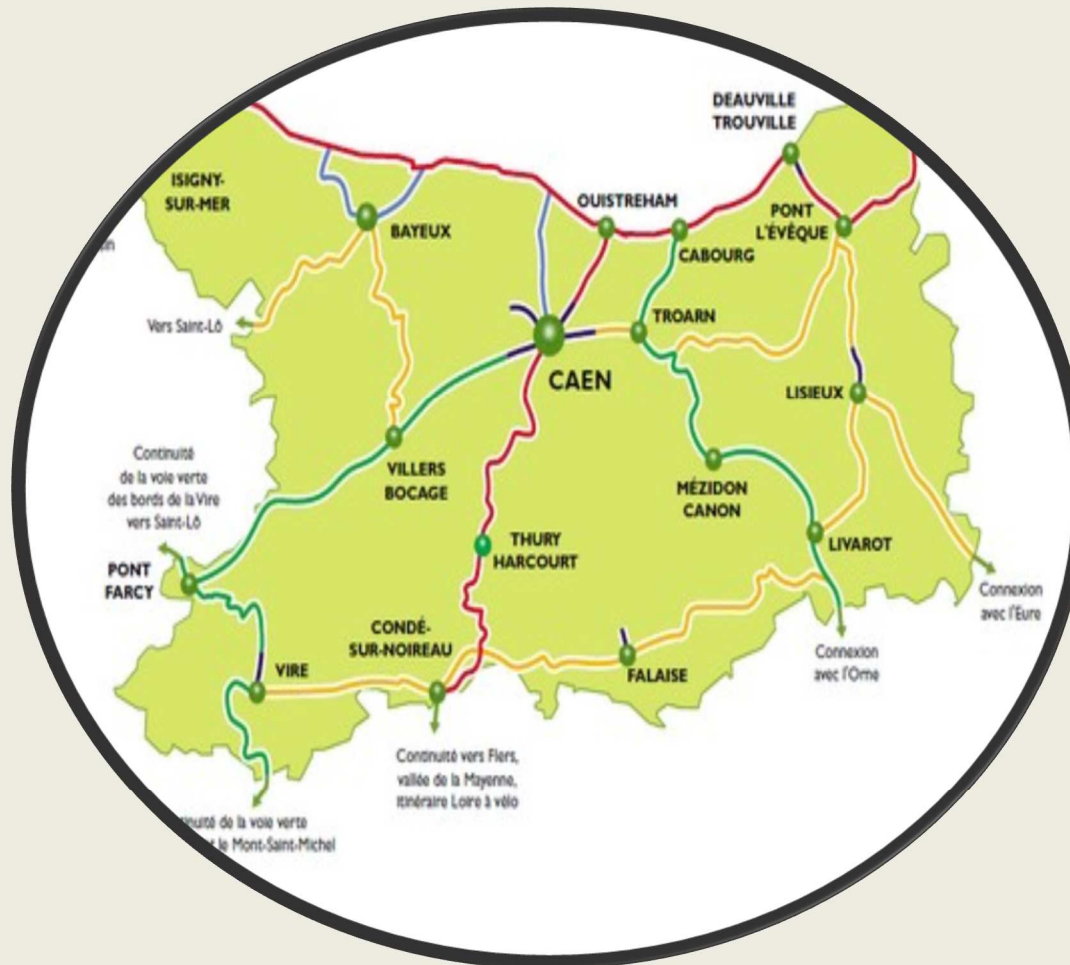
The “ARCHADE” project : *Hadrontherapy in France.*

Technical & clinical programs Overview

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For the ARCHADE group, Caen, Fr

CAEN :

Capital city of lower Normandy



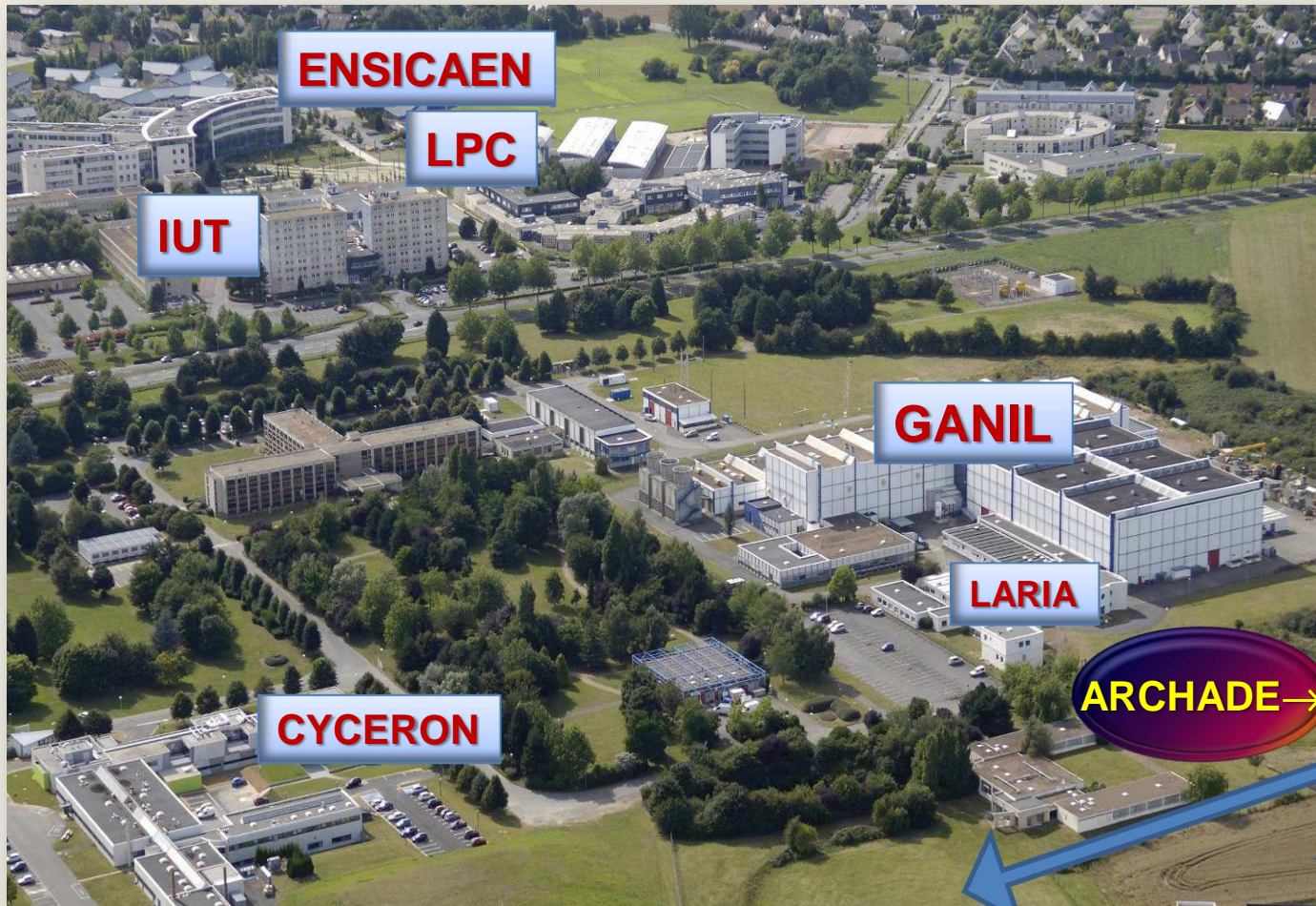
ARCHADE

« *Advanced Resource Centre for HADrontherapy in Europe* »

OBJECTIVES: Develop hadrontherapy under 4 aspects: physical, biological, clinical

- Dealing with protons, carbon ions, and other light ions
- Based on :
 1. Commercially available proton equipment
 2. Innovative technology for different ion species
- Two goals:
 - **Scientific:** *Appraise relative merits of high vs low LET radiations (i.e. light ions vs protons)*
 - **Industrial & commercial:** *implement design of compact & low cost accelerator for wide range of ions species, followed by its commercialisation*

ARCHADE :
⇒ *GANIL CAMPUS (Caen, Normandy)*



GANIL:
« Grand Accélérateur National d'Ions Lourds »

LARIA:
Radiobiology lab

CYCERON:
Multimodal imaging platform

LPC:
Nuclear Physics lab

ENSICAEN:
Superior School of Engineering

IUT:
Technology Institute

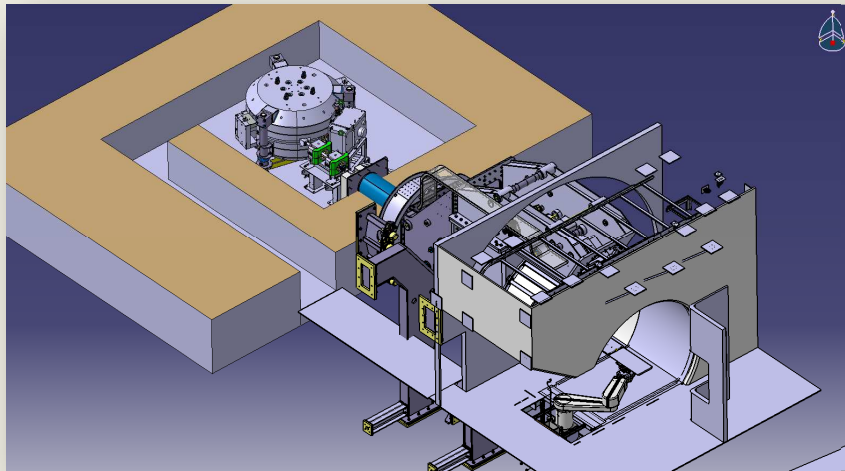
10' ↑ :
U. Hosp.
& F.Baclesse
Cancer Center

5' ↑ : Hôtel Mercure/Côte de Nacre****
& Tram → city center

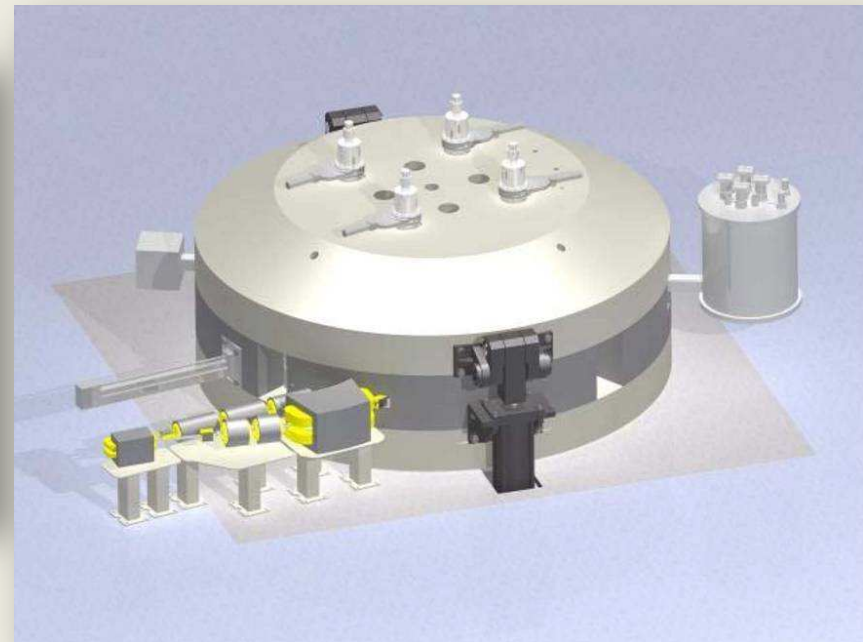
Time table ARCHADE project

- **2012** C400 design (after IBA concept), validated by international panel
- **2014** Financing agreements Normandy Region and banks (Bank of Europe + French banks...). Contract signatures
- **2015** « **Normandy-hadrontherapy (NHA)** » consortium formed
- **2016** Start building construction
- **2017** End building, Proton machine installation (IBA), NHA operational
- **2018** First patients with Proteus one (total 345 pts/ year)
- **2022 onwards** Start Research + Clinical programs with C400 (\cong 175 Pr + 100 ions Pts)

Core-equipments



1/ IBA S2C2 (operational 2018)
superconducting synchrocyclotron



2/ C400 (operational 2022)
IBA design
Realisation:
« Normandy-Hadrontherapy » consortium

ARCHADE building *(artist view)*



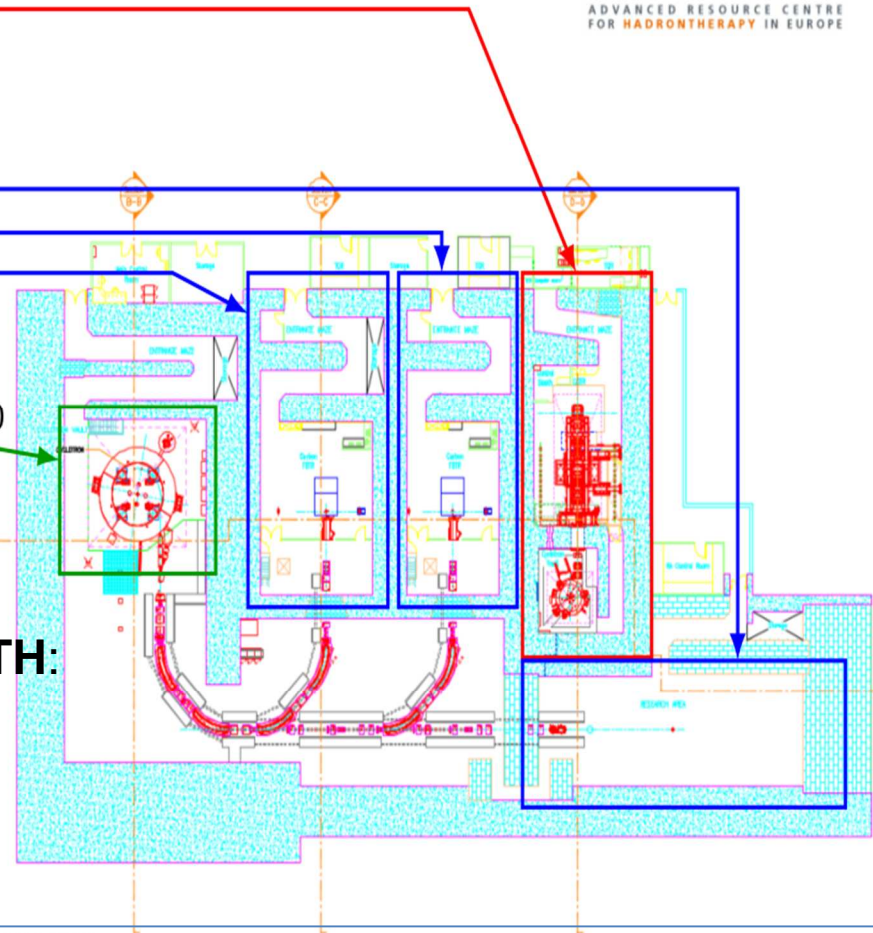
ARCHADE CENTER GROUND FLOOR



- Hadrontherapy (230 MeV)
 - ▶ Protontherapy (230 MeV)
 - Proteus One (S2C2)
 - Protons at 250 MeV
 - ▶ Research in carbon-therapy
 - Physics
 - Biology
 - Clinical testing

- Supraconducting Cyclotron C400
 - ^{12}C at 400 MeV/u
 - Protons at 250 MeV
 - All light nuclei with $A/Z=2$

Nha will deliver SRTH:
C400 + beam lines
+ treatment rooms



ACCELERATORS, Treatment rooms, experimental areas

ARCHADE center (*actual view*)

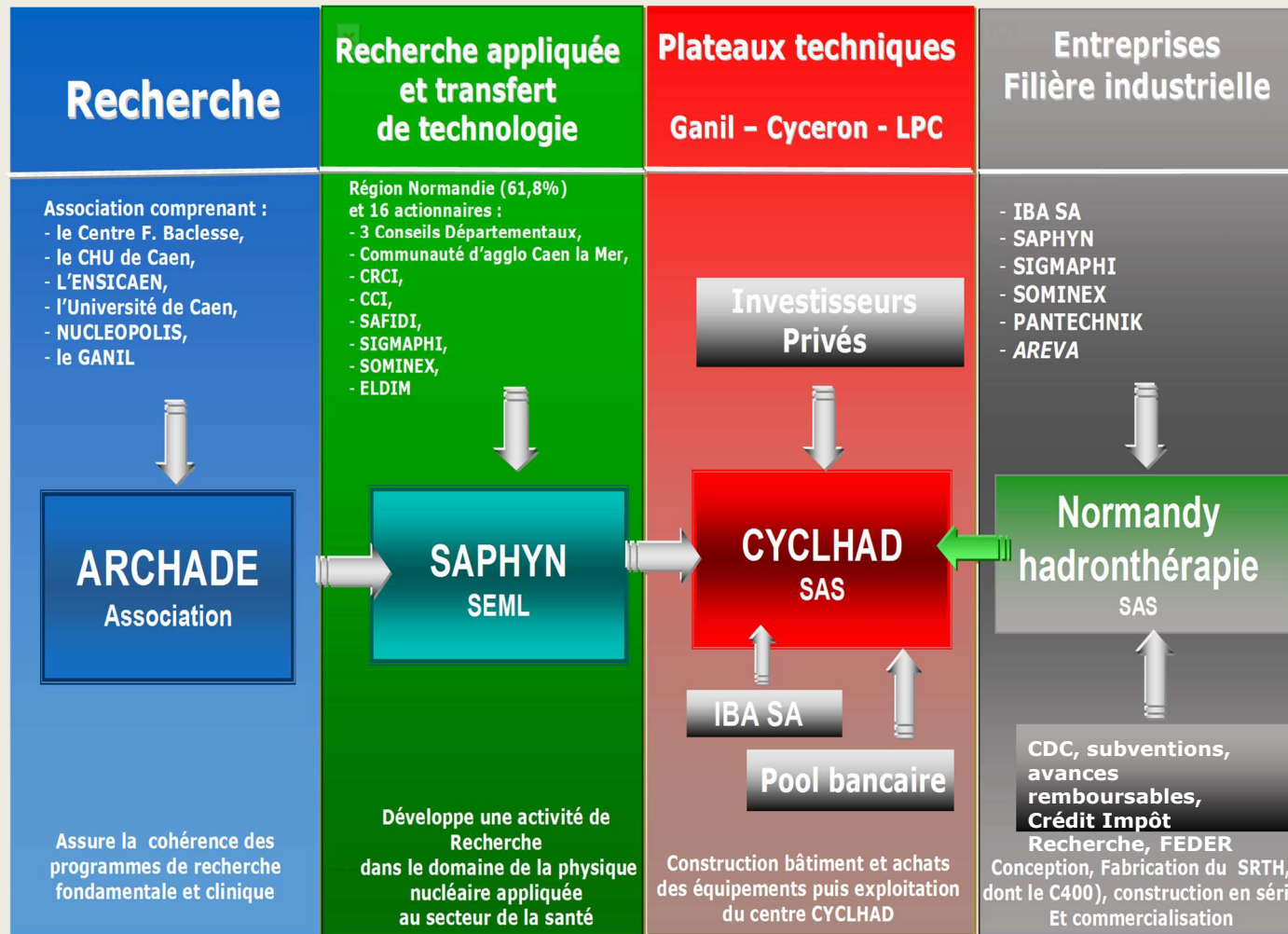
(*April 2017*)



**Completion building + S2C2 compact cyclo
+ compact gantry
installations**

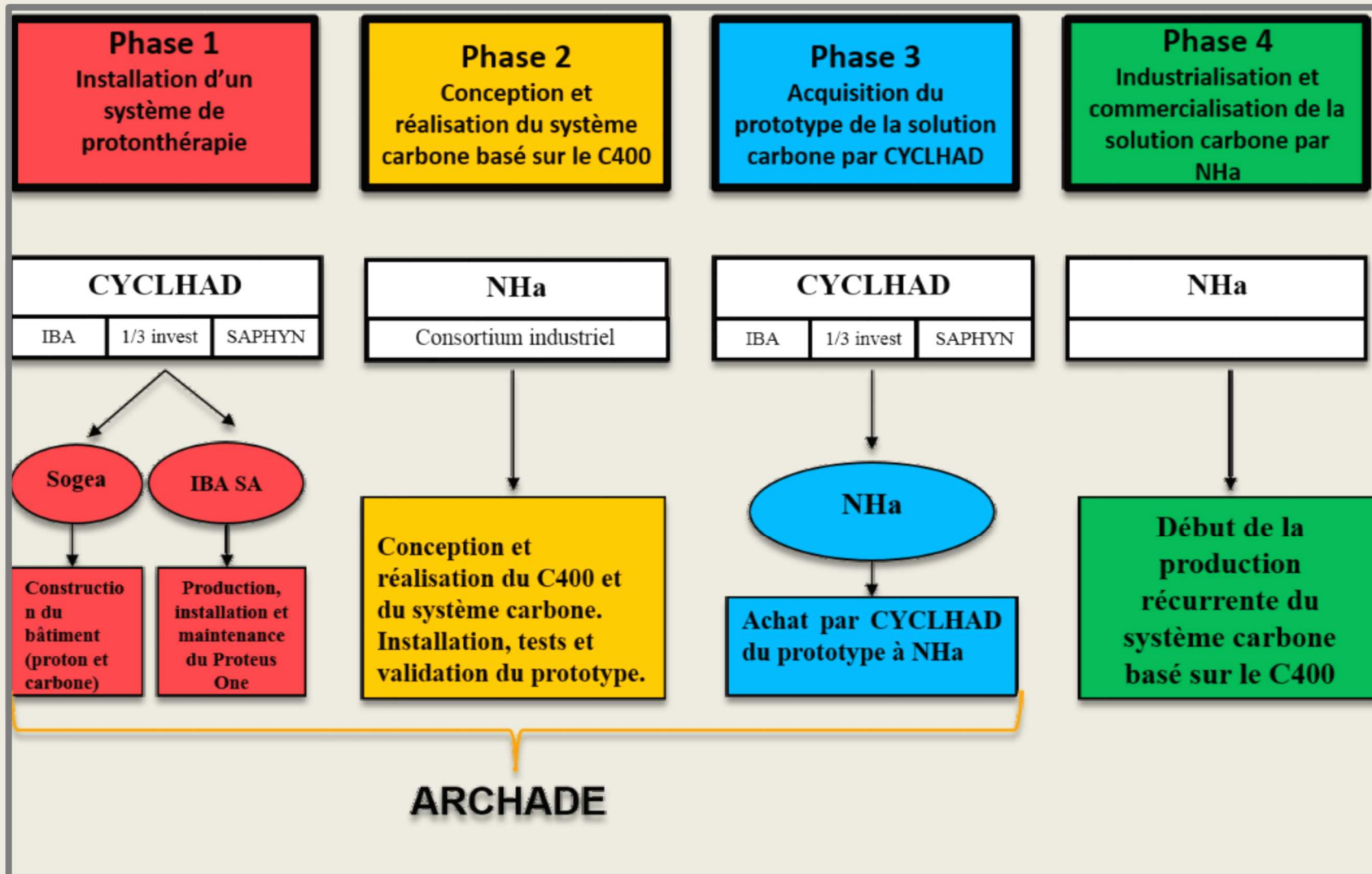
« ARCHADE »

ADMINISTRATIVE & FINANCIAL (PRIVATE/PUBLIC) STRUCTURES



4 interactive companies for Research, Clinical, & Industrial applications

« NHa » consortium: Progress from phase 1 to 4



CLINICAL PROGRAM. (P+&C12)

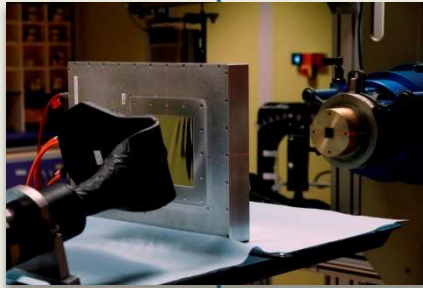
(Ramp-up 2018-2024)

	1	2	3	4	5	6	7
Proteus One							
# patients	150	250	345	345	345	345	345
# fractions	5 000	8 065	10 755	10 755	10 755	10 755	10 755
C400 protons							
# patients	-	-	-	55	110	175	175
# fractions	-	-	-	1 716	3 432	5 460	5 460
Total protons							
# patients	150	250	345	400	455	520	520
# fractions	5 000	8 065	10 755	12 471	14 187	16 215	16 215
C400 carbon ions							
# patients	-	-	-	-	-	50	100
# fractions	-	-	-	-	-	1 000	2 000
TOTAL # FRACTIONS							
	5 000	8 065	10 755	12 471	14 187	17 215	18 215

NUCLEAR PHYSICS PROJECTS SUMMARY

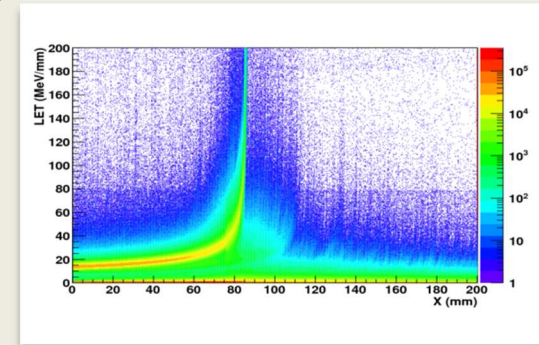
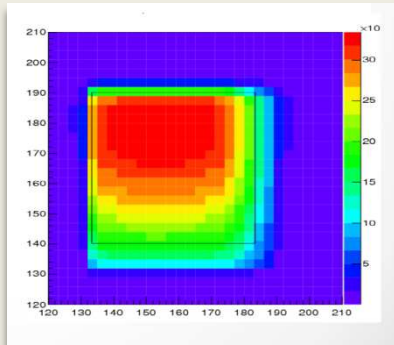
Contrôle de la dose
(Contrôle du traitement)

Cartographie de dose et des
effets biologiques
(optimisation du traitement)

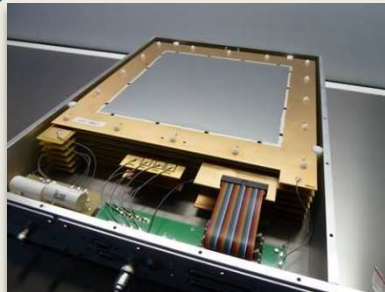


Imagerie des
tissus
(composition chimique)

Données nucléaires
&
Modèles nucléaires
&
Instrumentation nucléaire



Radiobiologie
(Contrôle des conditions
d'irradiation)



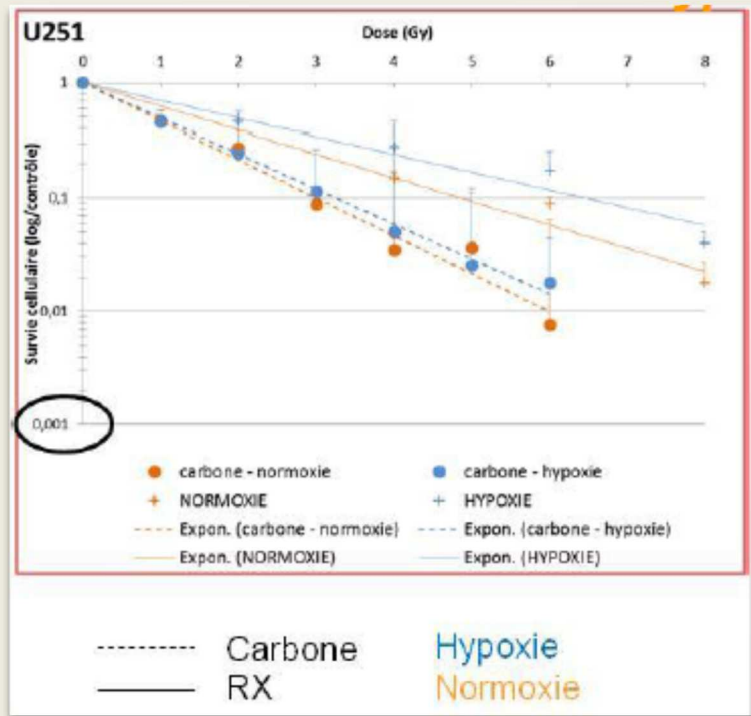
Physique Nucléaire
(maîtrise des processus
d'interaction)

Courtesy D. Cussol

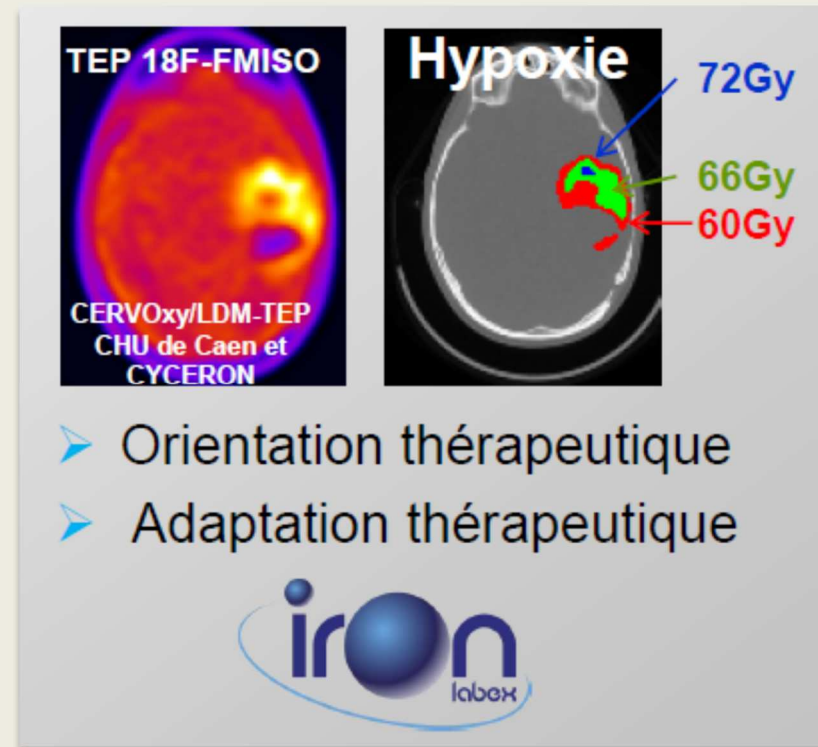
RADIOBIOLOGY PROJECT: GLIOBLASTOMA



Meilleure efficacité sur la cellule tumorale même en conditions d'hypoxie



Imagerie pour guider la radiothérapie (IRM/TEP)



Effets sur le tissu sain cérébral : Cellules (astrocytes, neurones, macrophages...) / Cerveau entier

RADIOBIOLOGY: NaI & Pathol chondrocyte

- Etudier les effets des ions carbone dans des modèles expérimentaux adaptés aux recommandations émises par la Haute Autorité de Santé quant à la définition des tumeurs en première ligne pour l'hadronthérapie carbone
- Etudier les effets des ions carbone sur les tissus sains traversés par les faisceaux (effets secondaires rapportés au NIRS)



Chondrosarcome / Chondrocytes :

Mise au point des modèles de cultures cellulaires tridimensionnelles pour l'hadronbiologie en physioxie

Effets cellulaires directs et indirects des RX et des ions des faisceaux du GANIL de TEL compris entre 30 et 120 keV/ μ m

Perspectives : Transposition in vivo (greffe) des modèles de cultures cellulaires tridimensionnelles, Radiobiologie proton (selon les possibilités : faisceaux médicaux à Orsay, Nice et plateformes à Lyon, Strasbourg), Radiobiologie ^{12}C (selon les possibilités : faisceaux médicaux Heidelberg, Pavia & Chiba et faisceaux GANIL), Xénogreffe des modèles 3D sur l'animal, Radiobiologie in vitro & in vivo en protons et ions carbone avec les faisceaux du cyclotron supra C400 d'Archade



REGION NORMANDIE

This is lower Normandy!



CAEN



HONFLEUR



D. DAY LANDINGS



MONT SAINT MICHEL



SAPHYN



CYCLHAD



On behalf of

SAPHYN



Family Offices



the ARCHADE group



safidi



Thank you!

