ARCHADE-CYCLHAD

Advances Research Center for HADrontherapy in Europe
CYCLotron for HADrontherapy

an introduction

Jacques Balosso, CFB/CHUGA

Some history

after

- EULIMA in 1990 (Nice and EEC) and
  - ETOILE in 1998 (Lyon)

    ARCHADE,

    - ✓ after two metamorphosis (2008 and 2013) is the only French project of ions beam medical center to succeed so far.
    - ✓ It is basically a private joint venture between Normandy Region and IBA to developpe a new cyclotron: the C400
    - ✓ The C400 is an isochron superconductive cyclotron able to reach 400 MeV/u

The ARCHADE project has 5 objectives…

1. **To open new possibilities to treat resistant cancers by hadrontherapy**

2. **To promote cutting edge scientific activities in Normandy**

3. **To develop a new industrial sector in medical accelerators: Normandy Hadrontherapy (NHa)**

4. **To welcome as external users researchers from France, Europe and outside of Europe to perform their experiences at Caen**

4. **To contribute to training and teaching in hadrontherapy**

RÉGION NORMANDIE

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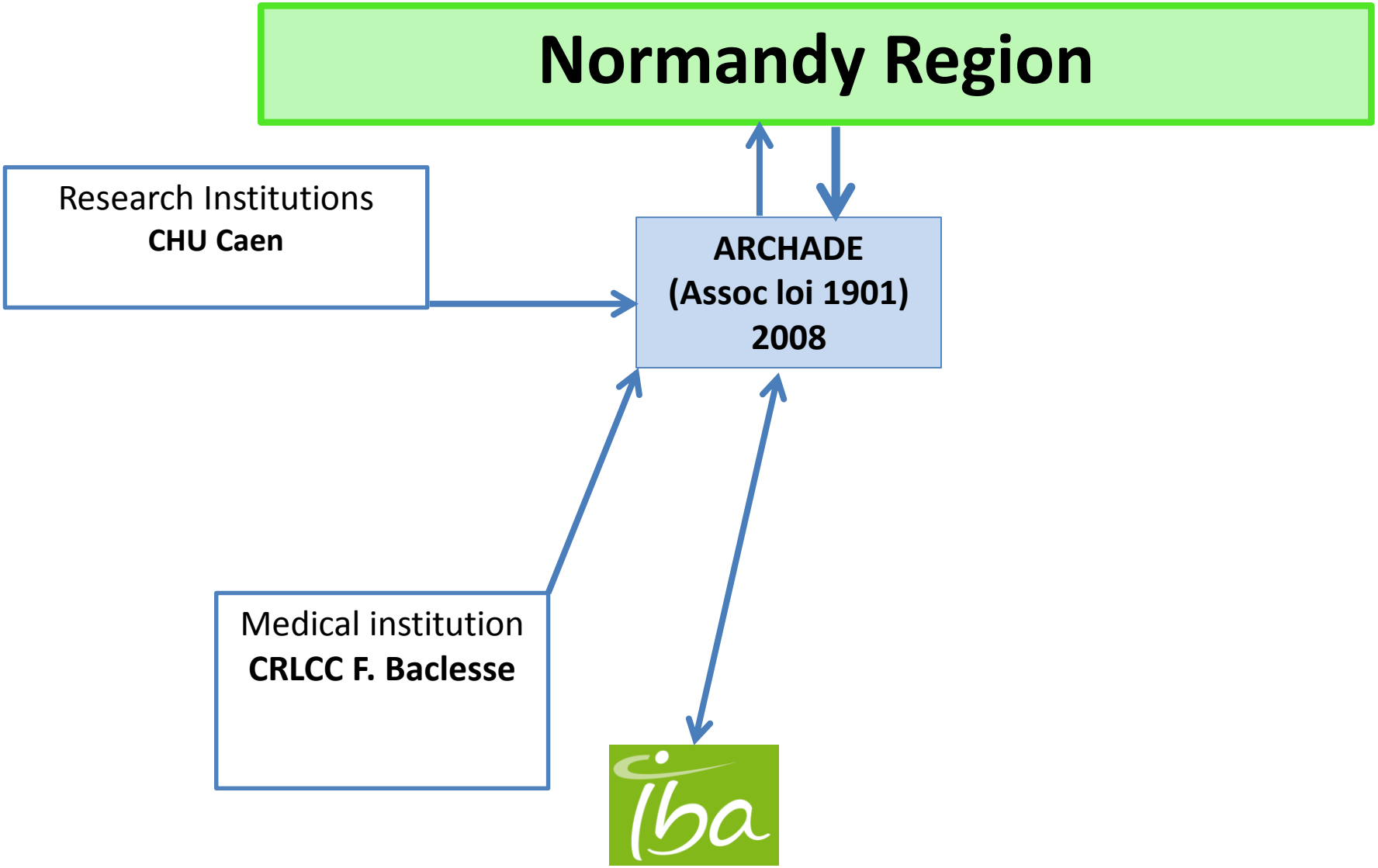
The ARCHADE project in Caen



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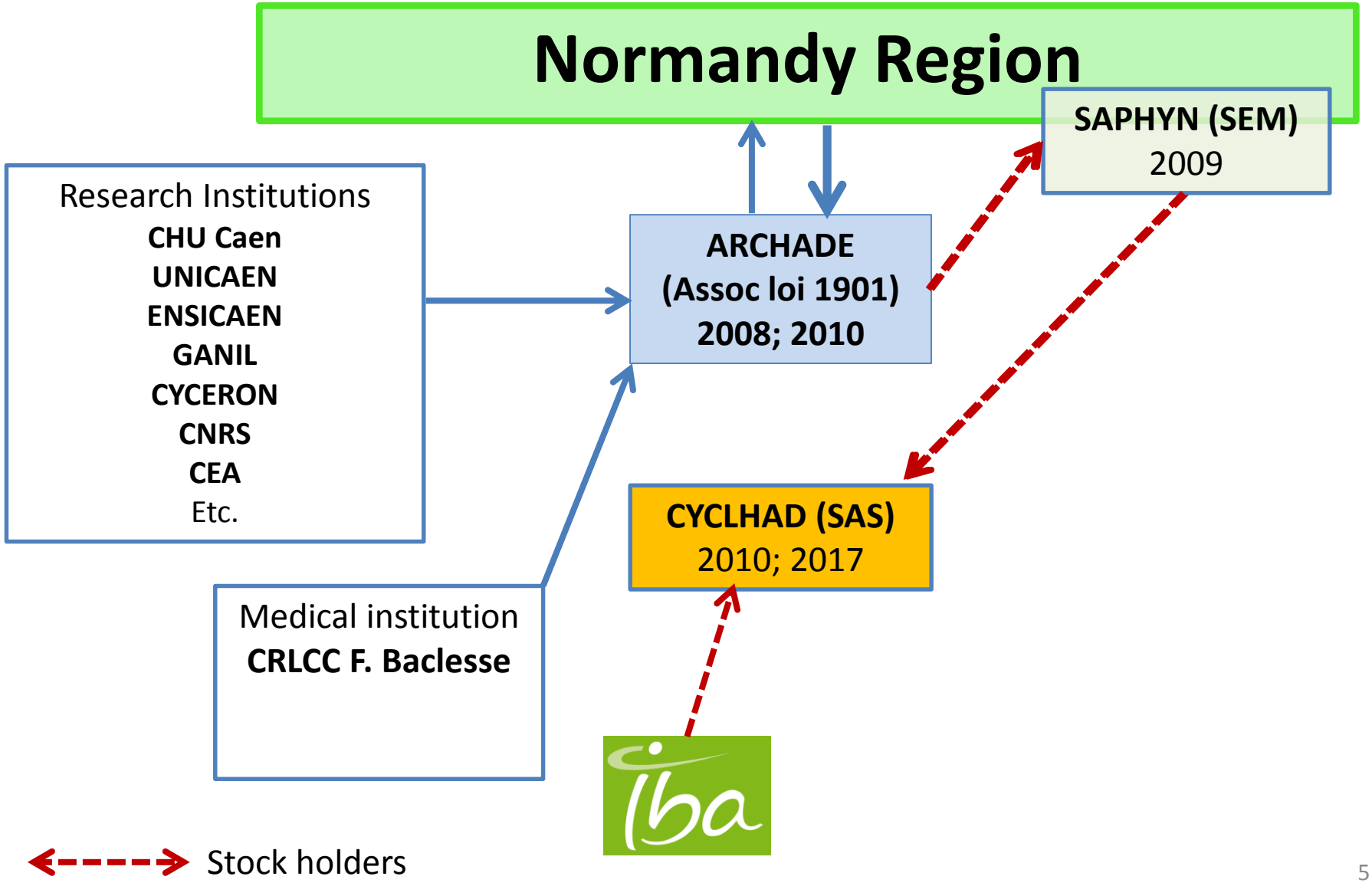

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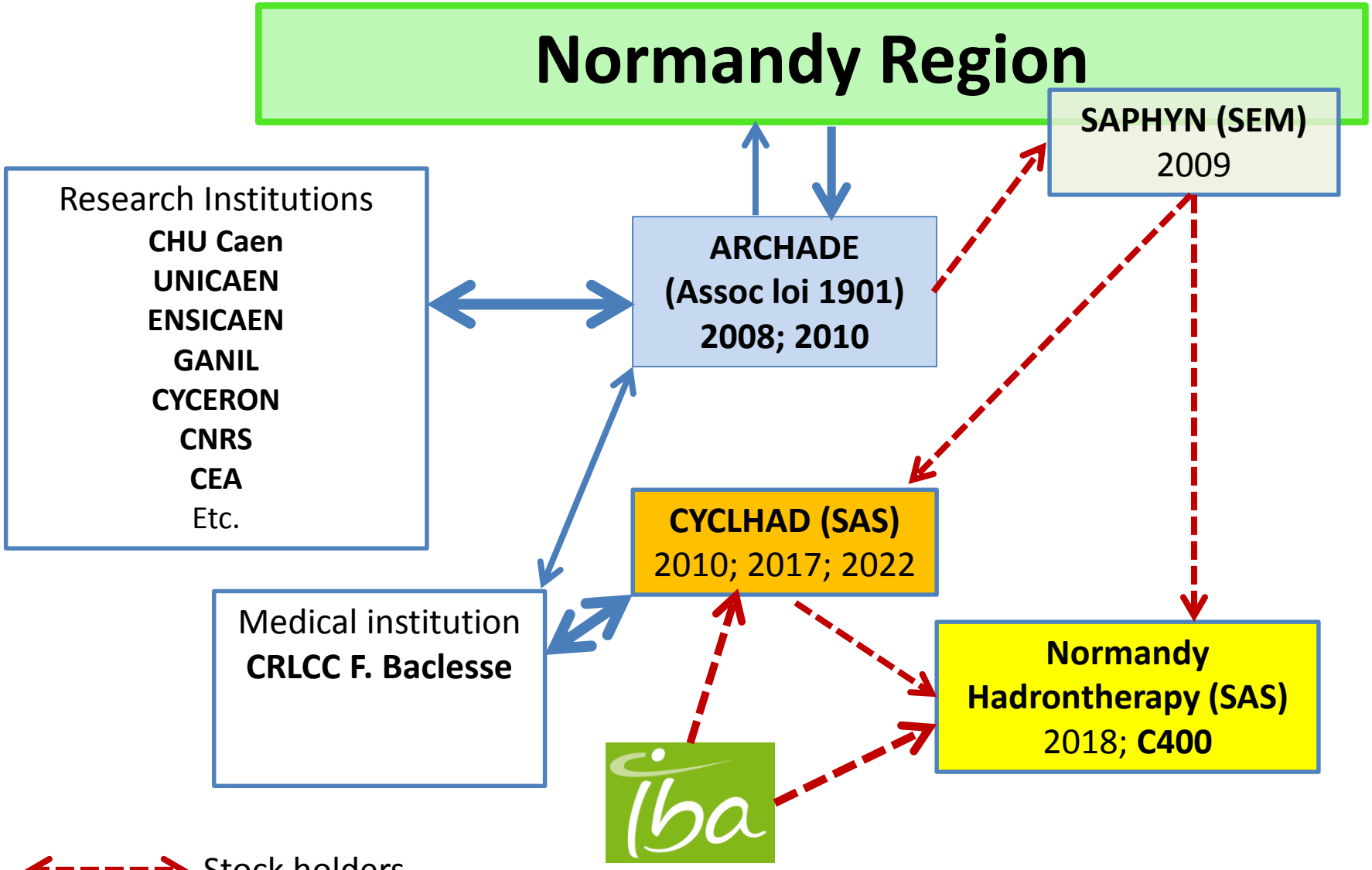

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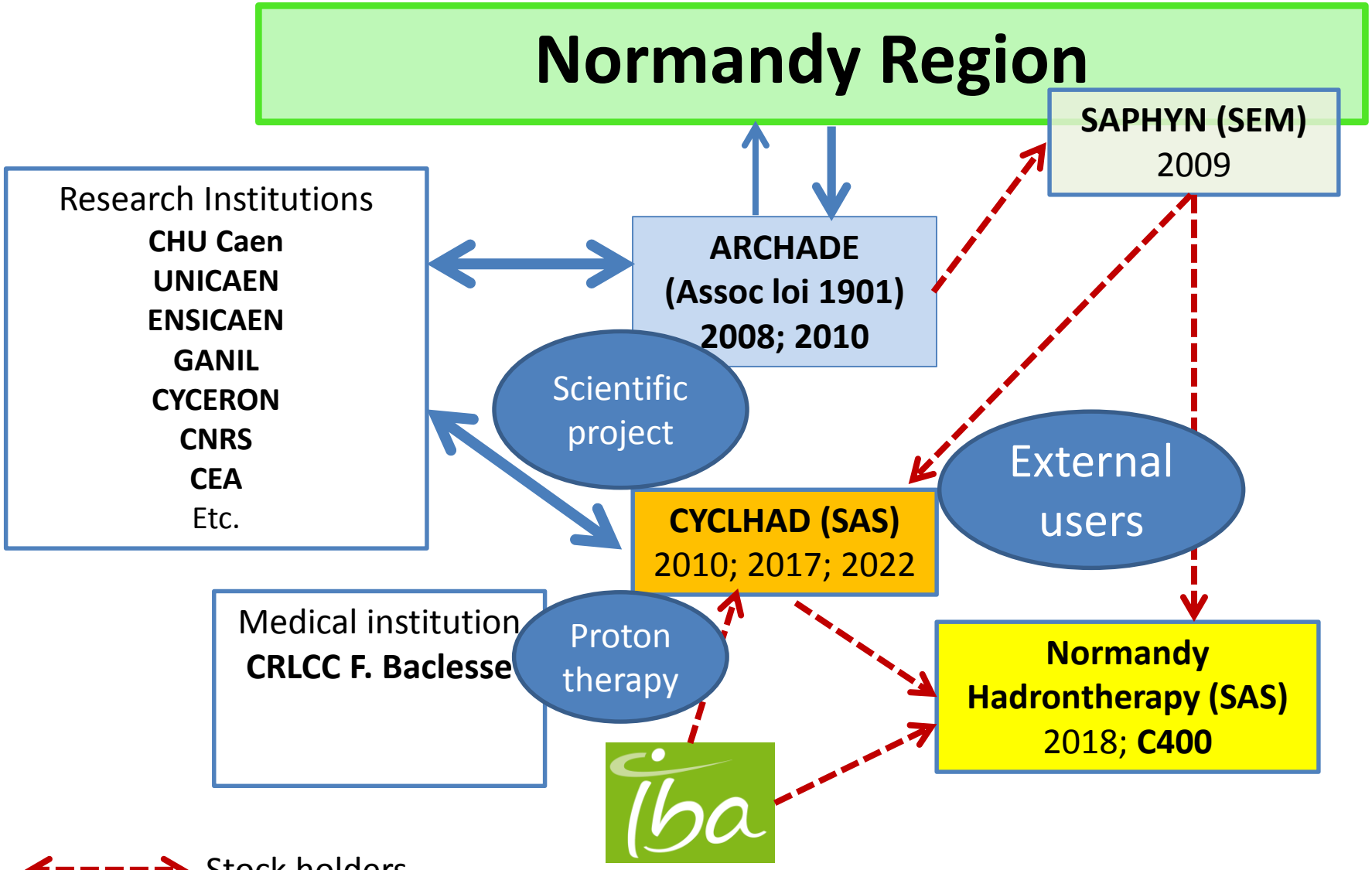
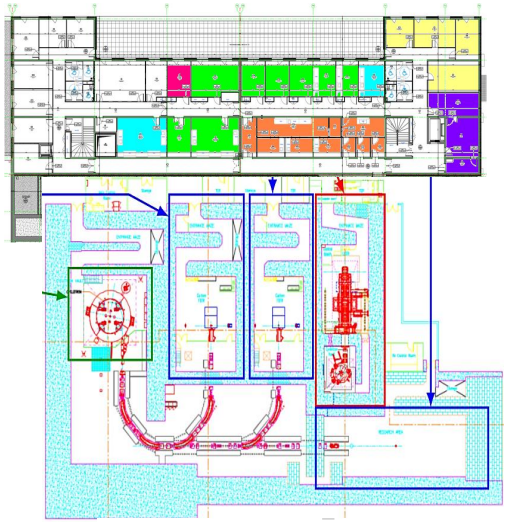


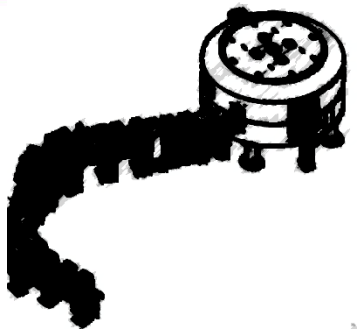
Time table of ARCHADE

- **2002 …**
- **2008** the idea of the **ARCHADE project**
- **2010** EquipEx **REC-HADRON** (1,13 M€)
- **2012** stabilisation of the project : a dual concept: medical activities ***and*** scientific research
- **2013** onset of the national cooperation ***France HADRON*** (PIA 2011; ≈ 7 M€)
- **2017** finalization of the building **CYCLHAD** (67M€)
- **2018** start of protontherapy (31-7-17) and capitalization of **Normandy Hadrontherapy** (about 60 M€)
- **2019** 3y agreement Baclesse-CYCLHAD (12/6/2019) Agreement for buying the first C400 by CYCLHAD (24/6/2019); project of a scientific **consortium** ARCHADE
- **2020 à 2022** quipement and opening of the **laboratories** ARCHADE in CYCLHAD (CPIER 3,8 M€)
- **2023-25 or …** starting of the **C400 operation**

Vacum chamber for FRACAS

PXi XRAD 225 Cx

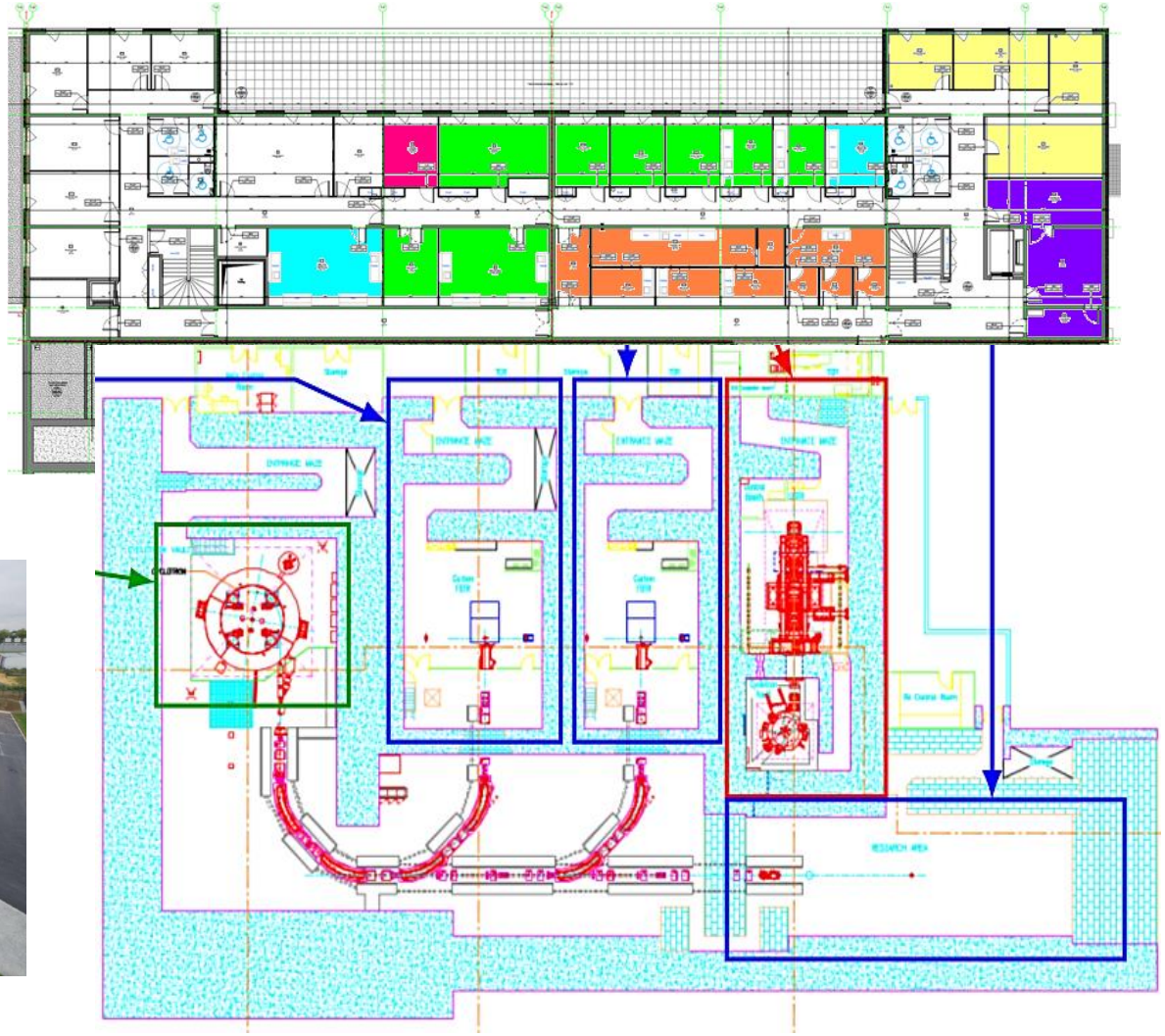




The CYCLHAD building for the installation of two different accelerators and 500 m² of laboratories

The treatment room of ProteusOne during building

The CYCLHAD premise with its 2 cyclotrons and its laboratories



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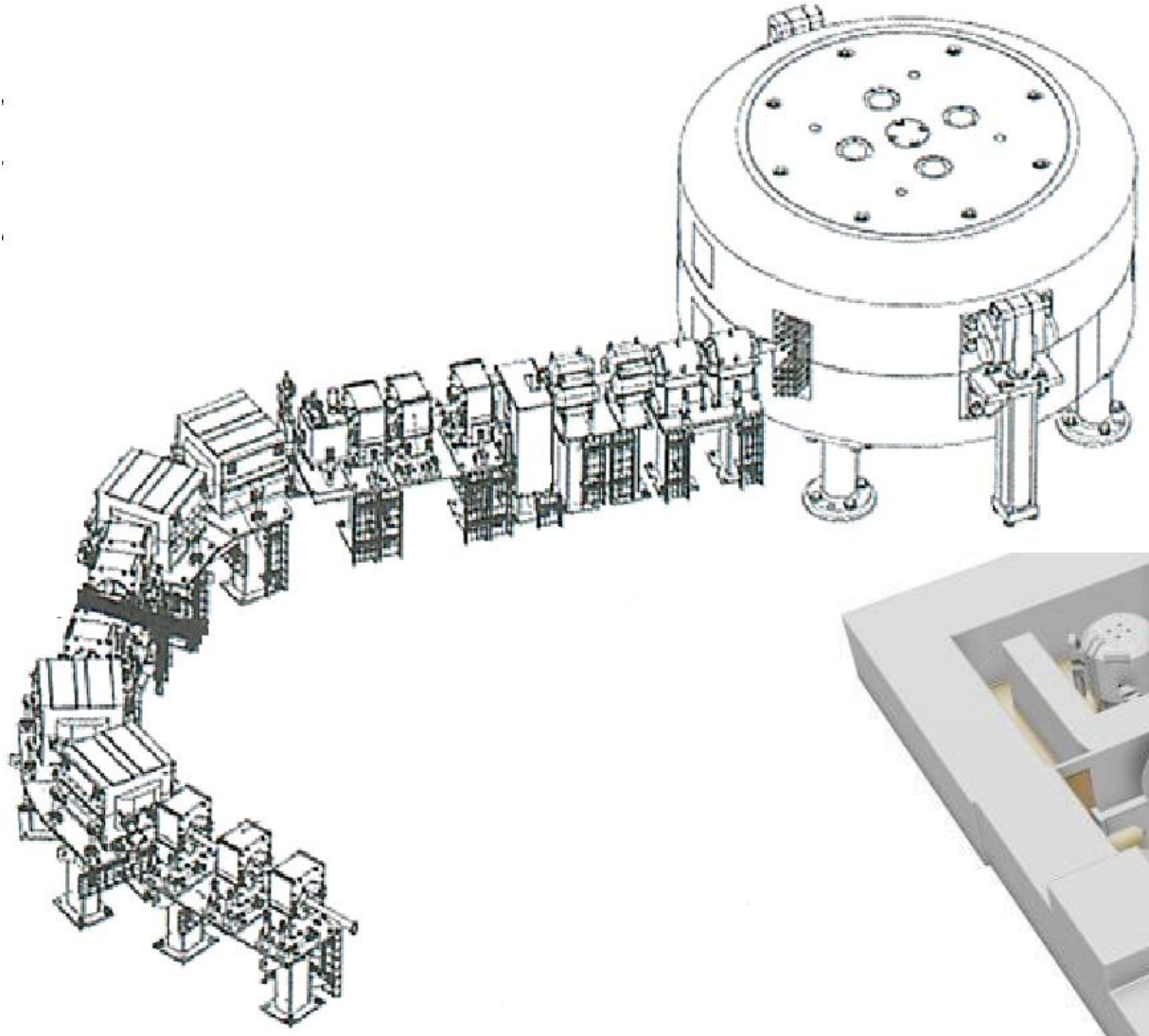
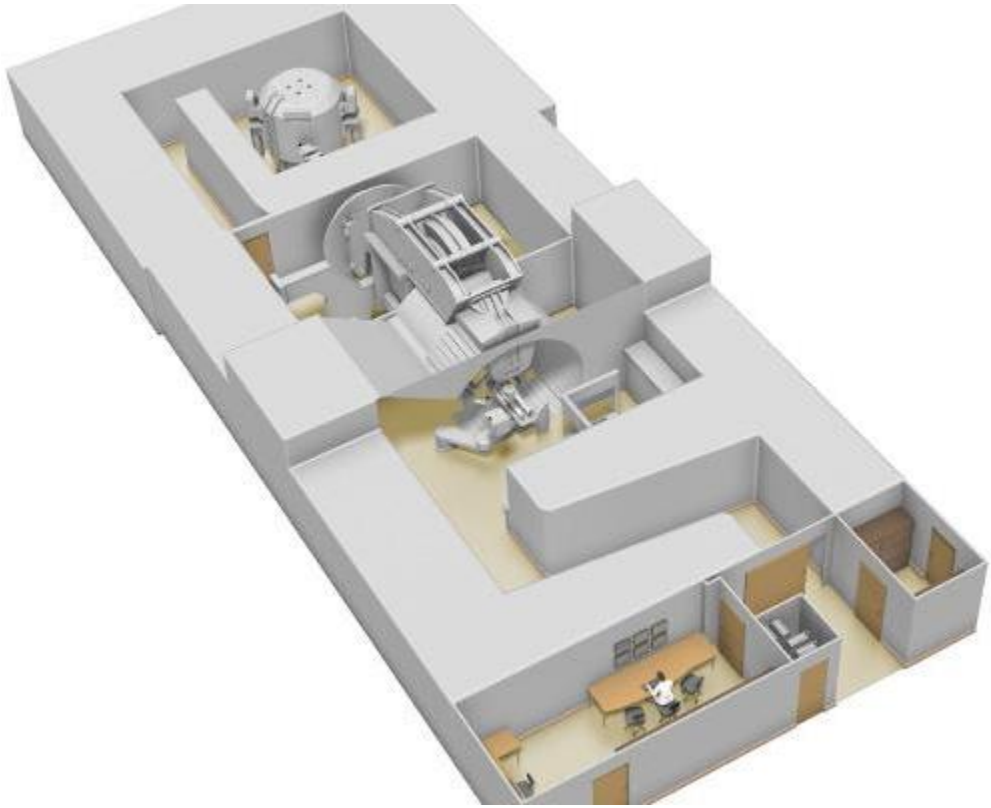
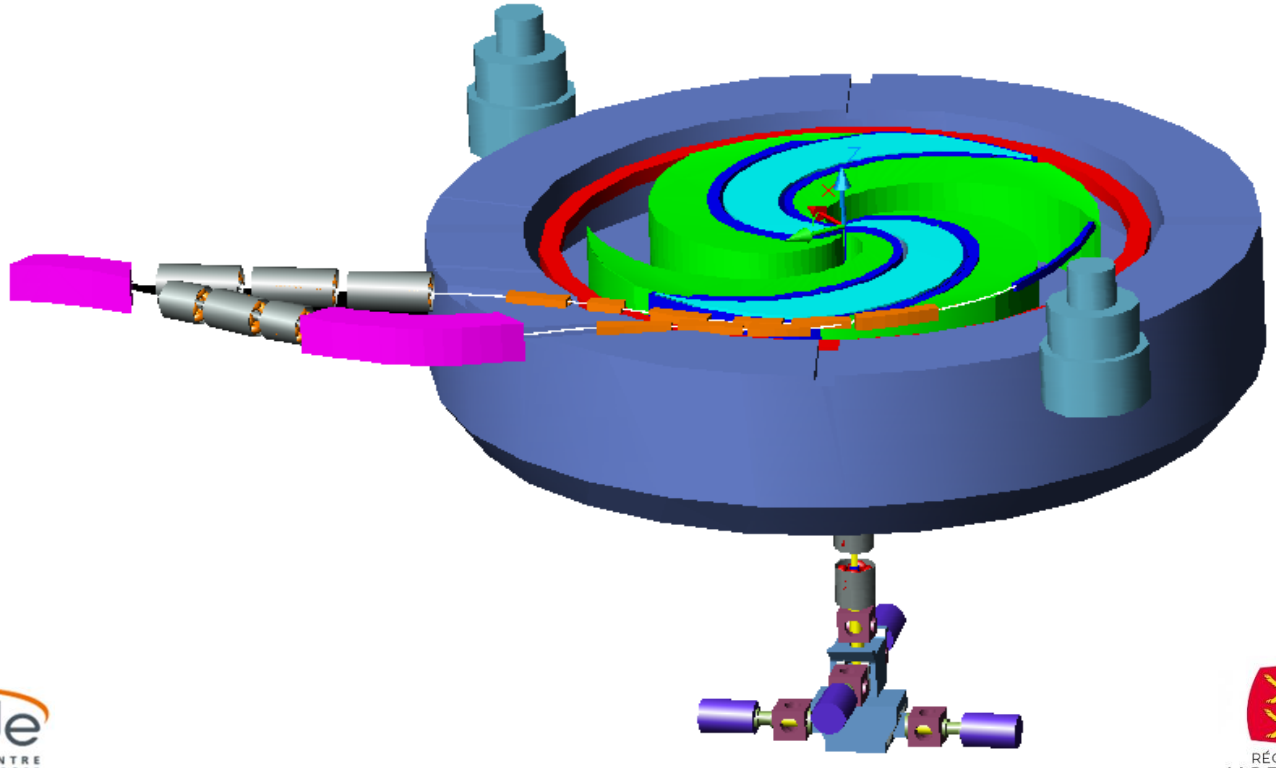


The ProteusOne
(IBA)
And
the future C400
(Nha)



The production of C400 by NHa SAS

- The C400 has been designed by Russian teams of Doubna between 2006-2009 for IBA under the direction of Yves Jongen
- The PI is presently owned by the ARCHADE organization
- It will by an isochrone super conducting **cyclotron** able to accelerate **Protons**, **He**, Li, B, **C**, N, O, Ne



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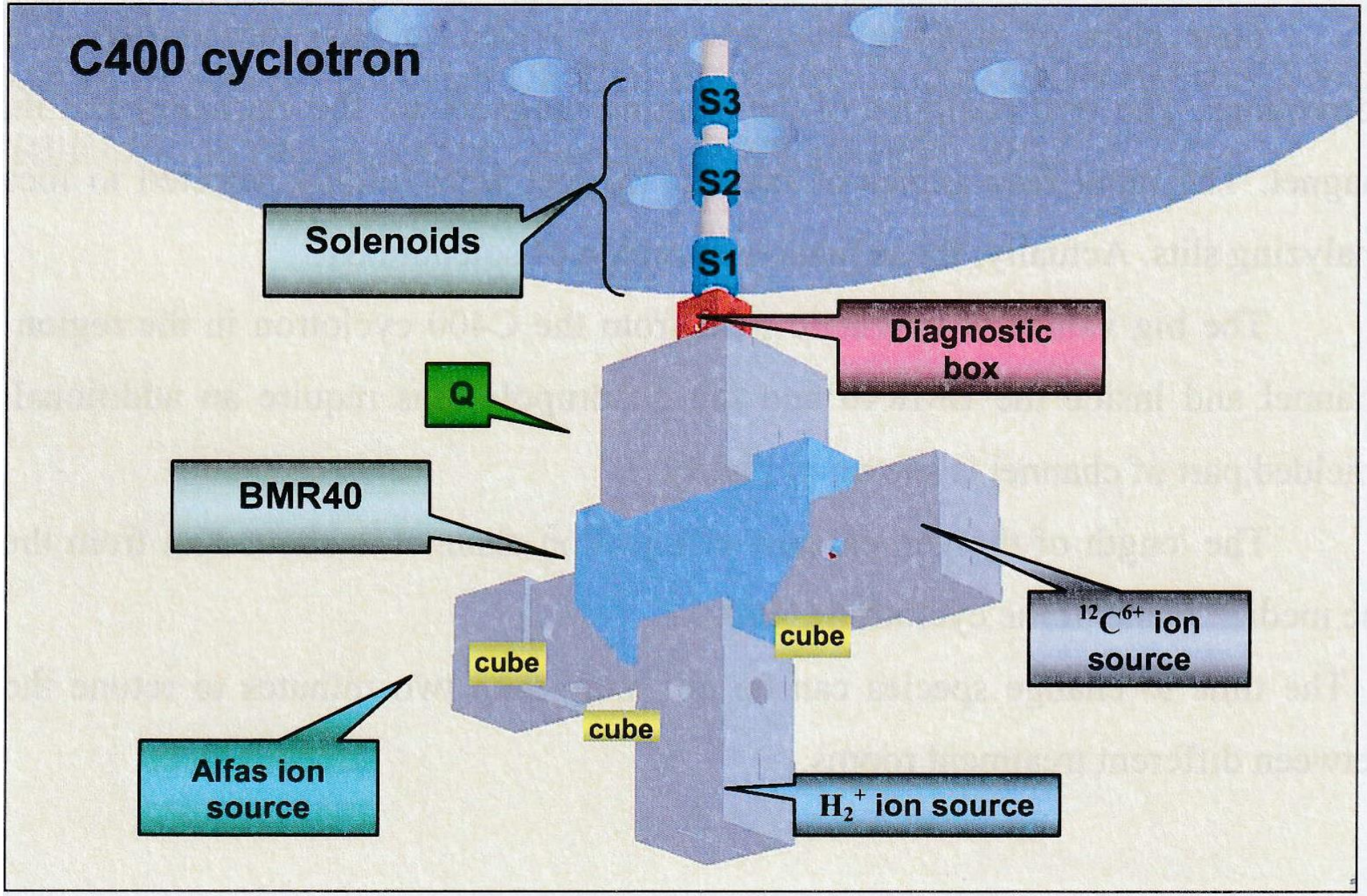
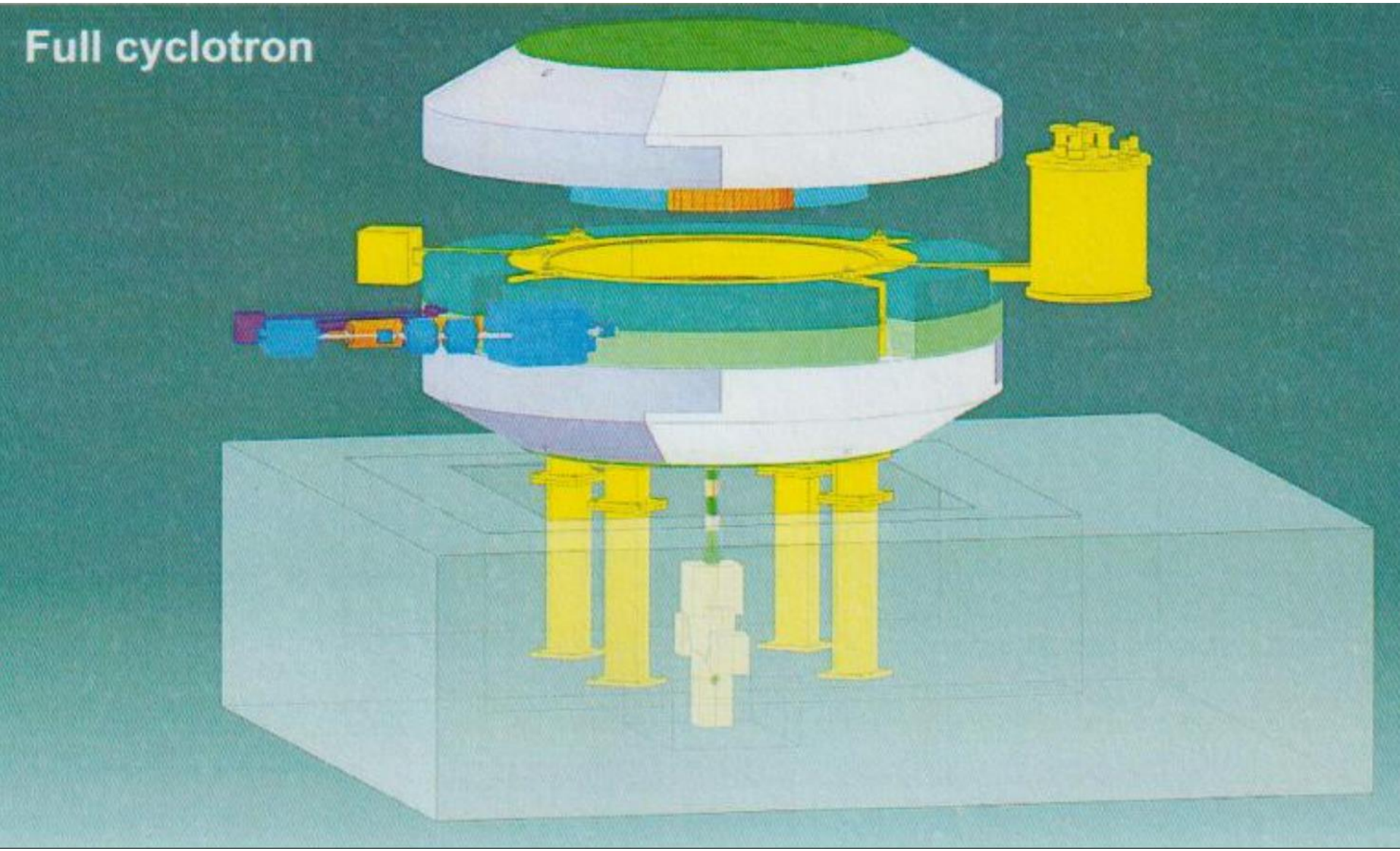


Fig. 5.1.1. General view of main elements of axial injection channel


Full cyclotron

The production of C400 by NHa SAS

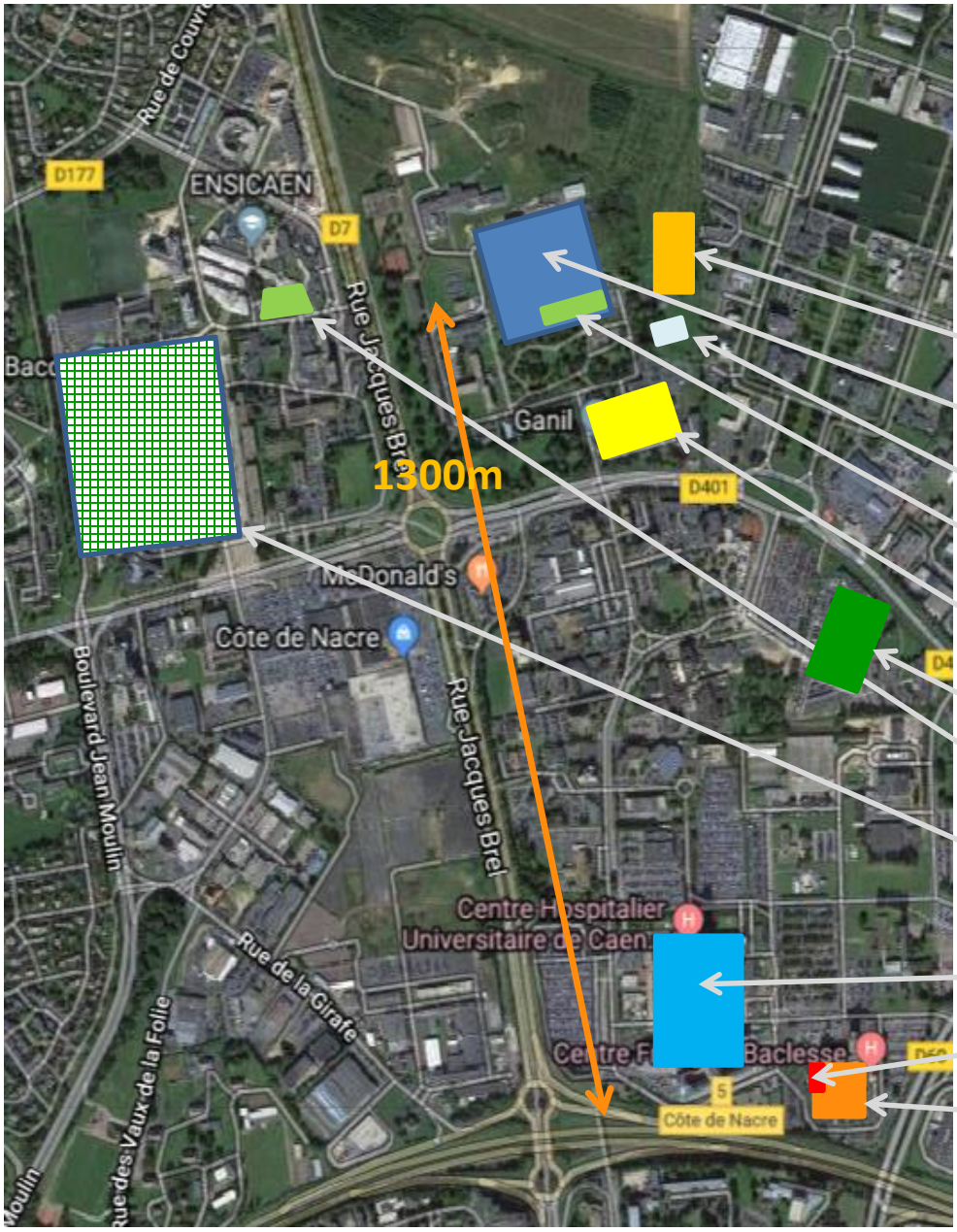
Table 1.3.1. Main parameters of C400 magnetic system

Outer diameter (m)	6.636
Height (m)	3.4
Total iron weight (t)	694
Pole radius (m)	1.87
Valley depth (cm)	60
Sectors gap (cm)	12/0.6
Sector angular width (max) (deg)	45
Sector spiral angle (max) (deg)	74
Bending limit	K=1600
Hill field (T)	4.5
Valley field (T)	2.45
A*turn (1 coil)	1 291777
Current density (A/mm^2)	28

The CYCLHAD building

At the 2nd floor, 28 rooms devoted to science (researcher offices, laboratories, animal house, and logistic spaces) totalizing 500 m ²

The partners in ARCHADE



All labs are located on the “Plateau Nord”

CYCLHAD

GANIL

Guesthouse for researchers

CIMAP-LARIA

CYCERON-ISTCT-CERVOxy

Medical School

ENSICAEN-LPCCaen-GREYC

Sciences university

Caen University Hospital

ABTE-TOXEmac

Centre Fr Baclesse

ARCHADE is a full partner of the French scientific program of *FrHA*

WP1: Clinical research in hadrontherapy

WP2: Basic physicochemical data for hadrontherapy

WP3: Radiobiology data for hadrontherapy

WP4: Operational developments for improving the quality of treatments

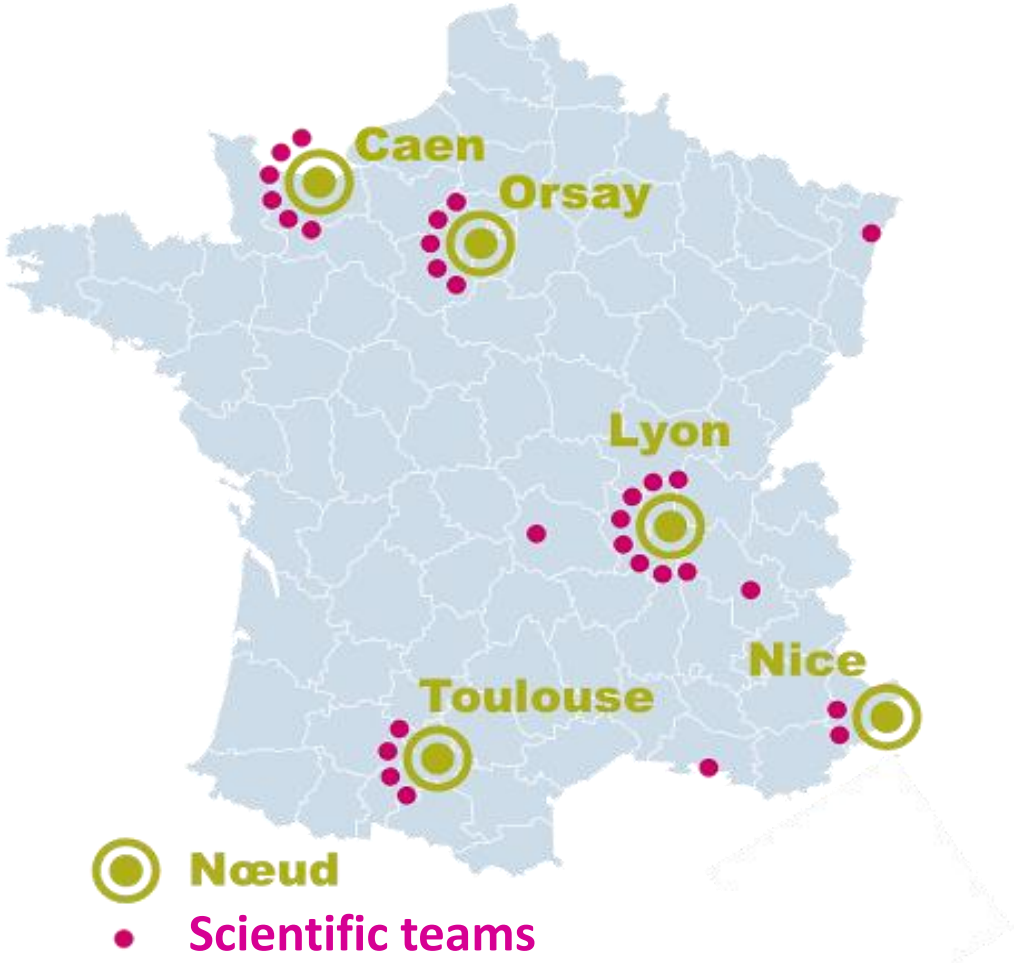
WP5: Gouvernance

WP6: Comm and Web site

WP7: Coll and external users

WP8: Training and teaching

The ARCHADE project in Caen : position in France …



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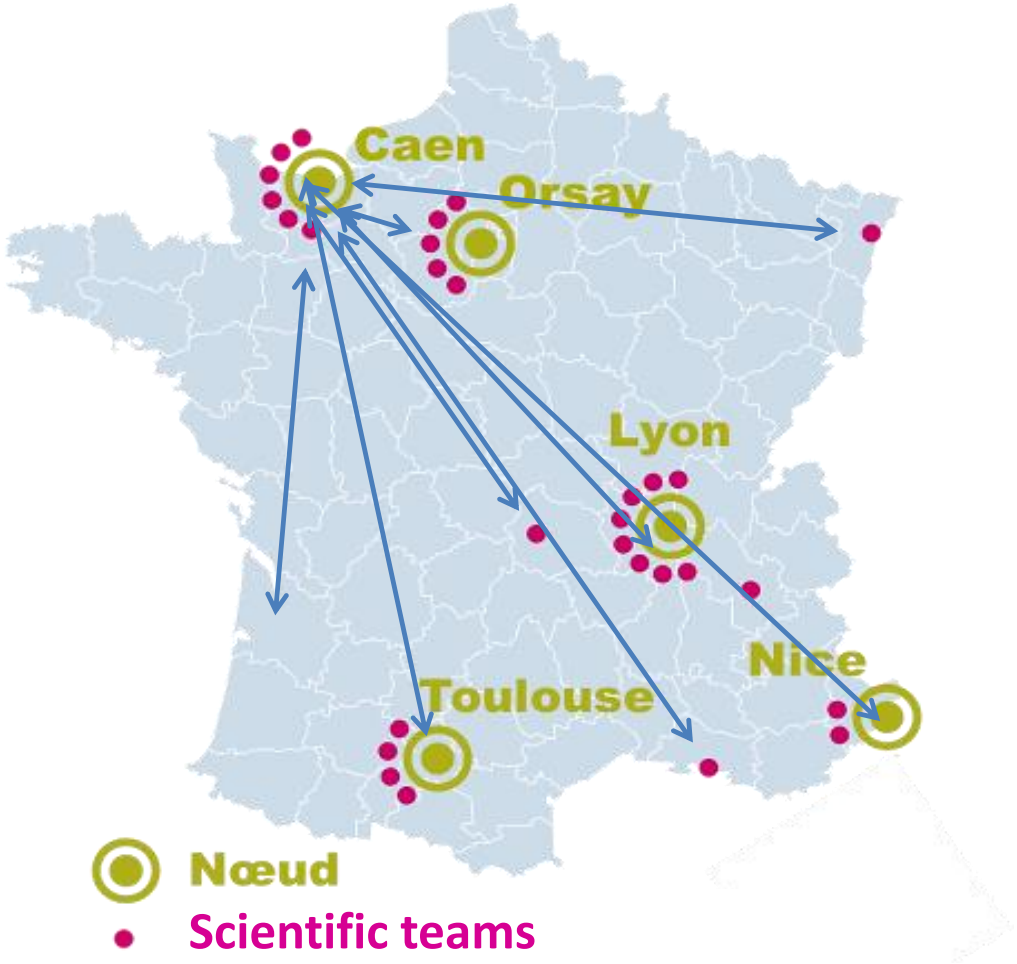
France HADRON

The ARCHADE project in Caen : position in France …



+ **RADIOTRANSNET**

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France HADRON

ARCHADE is commited to contribute in very specific domains to this national programme

UMR 6534, AMI, JM Fontbonne and D Cussol, Pr J Colin, Pr Juliette Thariat
Advanced dosimetry. Fragmentation, PMRT…

CFB, CLIP INCa, Pr Juliette Thariat
Clinical research in particle therapy…

EA 4651 ToxEMAC, C Laurent, Pr JL Habrand
Radiobiology (RBE, radioresistance, radiosensitization

UMR 6252, CIMAP/LARIA, A Cassimi, S Chevillard, Pr S Haghdoost
Molecular targets of radioresistance… Toxicology of fragmented macromolecules…

UMR 6030, ISTCT, Myriam Bernaudin, S Valable
Integrative imaging to target hypoxia and radioresistance Brain toxicity…

Pr J Balosso, Pr K Meflah

European perspectives for ARCHADE

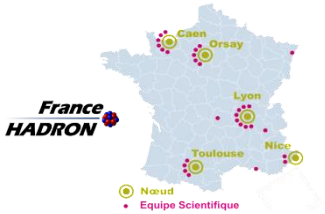
To become a scientific resource contributing to welcome European teams involved in hadrontherapy research

To have a strong organization for welcoming external users

This has to be offered at certain cost since CYCLHAD is not a public funded facility

*Considering the **critical lack of such facility for ions**, European programs to sustain transnational exchanges and research mobility are still needed*

RÉGION NORMANDIE



ENLIGHT

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ADVANCED RESOURCE CENTRE FOR HADRONTHERAPY IN EUROPE

To conclude… ARCHADE project is three folds

HEALTH

Starting July 2018, as a first step of the medical outcome of the **ARCHADE project,** protontherapy treatments will be available in Normandy at the **Centre François Baclesse** for cancer treatment. Protontherapy is a major progress in radiation oncology, especially for children and young adults since it is dramatically decreasing the normal tissue irradiation.
Adults and children will be treated for the following types of tumors:

ADULTS

- Meningioma
- Ependymoma
- Medulloblastoma
- Pituitary adenoma
- Skull base / paraspinal sarcomas
- Nasopharyngeal and HN Tumor
- Re-irradiation
- Orbital tumors
- and more…

CHILDREN

- Brain tumors (PNET)
- Medulloblastoma
- Craniopharyngioma
- Ependymoma
- Optic pathways glioma
- Neuro / Retinoblastoma
- Ewing sarcoma, other sarcoma

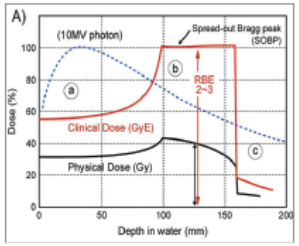
A treatment courses will last several weeks with daily treatment sessions, thus adapted housing will be available. Treatment sessions will be carried out in a devoted building called Cyclhad.

MEDICAL CONTACTS

For adults: Professor **Juliette THARIAT**
For children: Professor **Jean-Louis HABRAND**
Email: protonther.caen@baclesse.unicancer.fr

www.baclesse.fr

SCIENCE



Normandy is developing world class research in nuclear physics since decades at GANIL facility. More recently a comprehensive program of scientific research on hadrontherapy (the use of light ions beams for cancer treatment) has been initiated: the **ARCHADE project**. Several institutions are participating: Caen University, the National Center for Scientific Research (CNRS), the National Atomic Energy Commission (CEA), the François Baclesse Center for cancer treatment, etc.

Different types and scale of collaborations are possible in the frame of bilateral cooperation agreements:

- Short discovery training of 4 to 6 month in the frame of master degree in sciences
- Complete PhD program of 3 years
- Six months or longer medical training in protontherapy for junior or senior radiation oncologists
- Short stay for scientific teams for intensive experimental periods
- Faculty exchanges.

The different research domains are:

- Dosimetry, radiation-protection
- Particle fragmentation, radio-chemistry
- Treatment modelization;
- Beam control, on line quality assurance
- Tumor and normal tissues radiobiology
- Advanced molecular diagnosis
- Nuclear medicine
- Cancer epidemiology
- Clinical research in oncology

SCIENTIFIC CONTACT

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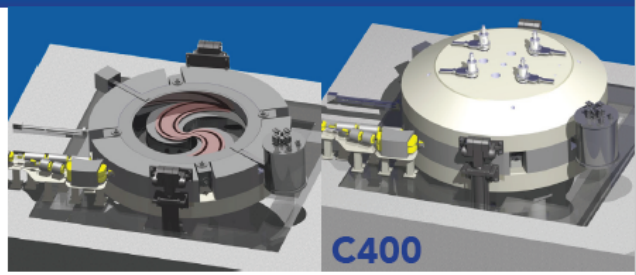
TECHNOLOGY



Hadrontherapy is a presently well-defined radiotherapy technology able to cure efficiently very radioresistant tumors.

However, important technological progresses are needed to make it more straightforward, less expensive and tedious to perform. These conditions are critical for its future development. In the frame of the **ARCHADE project**, Normandy backed by the world leader Co in protontherapy, is investing for technology development either for instrumentation development and breakthrough accelerator technology. For developing new accelerator technology, investments are needed and the devoted corporation backed by Normandy Region – **Normandy Hadrontherapy (NHa)** – is still looking for participation of new investors.

The immediate prospect is the development of a multi-ions superconducting cyclotron, as the entrance item of a new type of hadrontherapy system. Such equipment should be the next generation of accelerator for the future hadrontherapy centers making possible to offer several different types of light ions beams for the best adaptation of the tumor to treat.

Investments are warranted by the Normandy Region in case of failure.

A specific Society of Mixt Economy (SEM) has been set up to organize and manage these investments, the SAPHYN.

BUSINESS CONTACT

For more detailed information :
Mr Christophe LE FOLL
c.lefoll@baclesse.unicancer.fr

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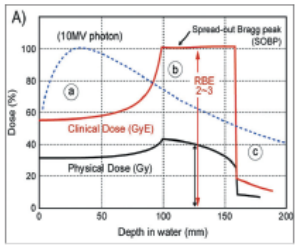

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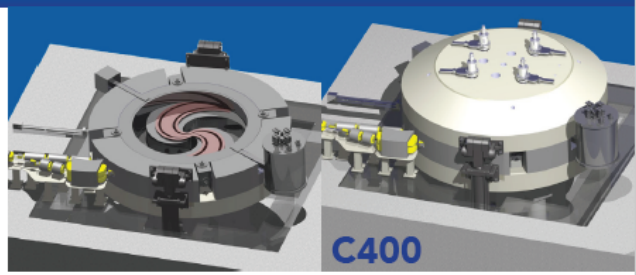

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BUSINESS CONTACT

For more detailed information :
Mr Christophe LE FOLL
c.lefoll@baclesse.unicancer.fr

Organisation for CYCLHAD visit

2 July 2019

First : to constitute 3 groups rather equal

- The Group nbr 1 is from Verity **A**hern to Manjit **DO**sanjh
  - You will take the bus nbr1 at 17:15 in Baclesse parking

- The Group nbr 2 is from Florent **DU**rantel to Gérard **MO**ntarou
  - You will take the bus nbr2 at 17:45 in Baclesse parking

- The Group nbr 3 is from Ahmet S **MU**tluer to Ye **ZH**ang
  - You will take the bus nbr 1 second round at 18:15 in Baclesse parking

Second : at CYCLHAD each group will be split in two sub-groups

to make two simultaneous opposite round visits of the first floor of the building

Third : to transit from CYCLHAD to the townhall

- The Group nbr 1 will wait until the visit of the Group 2 is finished
  - Then you will fill out the bus nbr2 and go to downtown as wangard

- The Group nbr 3 and the remaining persons of the previous groups will take the bus nbr1 at the end of the visit to go downtown.

Fourth : this night for the return we will try to drop you at your hotels We will organize that during the diner.

Last : for those who want to go to the townhall not going through CYCLHAD… it is possible

- Take the Bus A at the front of the Blood Transfusion Center near the CHU building
- Get out at QUATRAN continue along the same way for 100 m until the entrance of the very large and car free rue Saint-Pierre
- Follow Saint-Pierre street until its end in West direction you will reach the townhall it is the “Abbaye aux Hommes”.
- Rendez-vous for 19h15

So First : please constitute 3 groups rather equal

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