France HADRON

A national Infrastructure

To enable the consolidation of all medical, scientific and technical aspects of hadrontherapy in France, the actors in this field, mainly federated by universities and major national research agencies (CNRS, INSERM, CEA, IRSN) have joined their forces with clinical centers (Orsay and Nice protontherapy centers) to present a project in response to the call for projects "National Infrastructure for Biology and Health", it is called ***France HADRON***. The National Agency for Research, funder of the French research, gave 15M€ divided between investments and running costs.
This project federates 5 nodes and 19 research teams.

The scientific project

- **Clinical research** will be structured as a national hadrontherapy collaborative group. One of the main projects is to create a platform and a data base for data exchange and dosimetric advice (see ProtonShare). Next problematic will be to involve more deeply *France HADRON* in medical trials.

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WP1

- Measurement of cross sections was an important part of experiments done in *France HADRON*, data are analyzed to implement nuclear collision models and finally **improve TPS**. Reference biological data are acquired with X-ray, proton and carbon to supply biological models currently under development.

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WP2

- **Radiobiological** studies are performed to validate the reduction risk of metastasis and relapse with carbontherapy using different cell lines, migration properties of stem cells are also investigated. These studies are done on combined or sequential hadrontherapy with chemotherapy or targeted therapy. A part of the research concerns the consequence of hypoxia and the bystander effects.

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WP3

- **R&D on instrumentation** is probably the most fruitful work-package of *France HADRON*. Developments are various and concern: Prompt-gamma imaging, Beta+ detectors, proton radiography, study of neutron contamination… A large project, ProtoBeamLine, is about to start.

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WP4

Experimentations with France HADRON

Infrastructure Nationale en Biologie et Santé

Four platforms are presently available to welcome experiments in the network:

GANIL (Caen):
- A tandem cyclotron accelerating Carbons from 156 to 1140 MeV with fluency from 0,5 to 100 Gy/min. CIRIL and LARIA are two teams dedicated to the hosting of experiments including radiobiology.

Centre de Protonthérapie d'Orsay (Paris area):
- With a C230 cyclotron, 230 MeV protons, up to 40 Gy/min. CPO makes available for experimentalists a full biological model capability.

Centre Antoine Lacassagne (Nice):
- The Medicyc cyclotron, accelerating protons at 62 MeV with 10 to 25 µA,
- The first S2C2 cyclotron with 230 MeV protons, reaching 150 nA,

Equipment of a full biology lab is under consideration.

Institut de Physique Nucléaire de Lyon:
- 3 MeV and lower, protons from a Van de Graaff accelerator (max 10Gy/min). A full biology lab is on site.

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Archade
ADVANCED RESOURCE CENTRE FOR HADRONTHERAPY IN EUROPE

In addition to be a protontherapy clinic facility, this complex will be a national and international host structure for the researchers working on carbontherapy thematics. The buildings construction has started in December 2015.
This project is a confirmation of the need of an efficient and dedicated carbontherapy center in France able to offer recurrent beam time for R&D. A part of the funding will be used for the building of the rest FRACAS detector used for fragmentation experiences and to study secondary products production. These data will be very interesting to have a better evaluation of treatment effect in tissue and to improve TPS simulations.

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ProtoBeamLine

The decision to support the ProtoBeamLine project follows a general tendency in France which shows a gain in importance of the protontherapy. ProtoBeamLine federates all the actors involved in R&D and aims to develop the next generation of detectors and to aggregate them in synergy around a S2C2 cyclotron. The creation of a complete environment of detectors and software surrounding an accelerator acquired by several protontherapy centers is a very relevant opportunity for *France HADRON* to collaborate with industrial partners.

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ProtonShare

The protagonists, involved in French protontherapy, gathered and worked to create a collaborative internet-based tool: ProtonShare. In this project, it will be possible

- for a radiotherapy service to address a patient medical file and ask for a comparison between protontherapy and standard-RT dosimetry,
- to collegially develop new software modules for comparison tools (TCP/NTCP/QALY),
- to store the dosimetric- and patient follow-up data and possibly to query existing databases for future studies on toxicity and secondary effects.

This will increase the ease of access of the French radiation oncologists to protontherapy for the benefit of their patients; it will increase communication between centers for the benefit of the patient repartition. This national collaborative project will enhance links and discussions with health authorities about hadrontherapy importance in health landscape.

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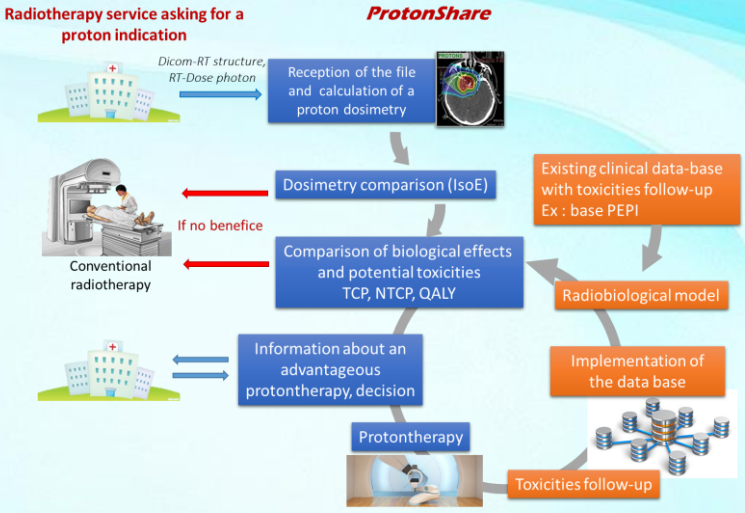

France HADRON

A National Infrastructure for Biology and Heath

Resume

France HADRON is a French infrastructure aiming to federate all the hadrontherapy national workforces. To do this, *France HADRON* contributed to the setup of new research beam lines on existing clinical facilities (Orsay and Nice) in order to increase beam access for researchers.
Making easier the ion-beam access enhances results obtained in the scientific program composed by 4 working packages : i) clinical research, ii) simulation and TPS improvement, iii) radiobiology and iv) R&D on instrumentation.
France HADRON coordinates several large-scale projects in the frame of data management and sharing in clinical research (ProtonShare) or in instrumentation for hadrontherapy (ARCHADE equipment, ProtoBeamLine).

PROJET FINANCÉ PAR L'ANR - PROJECT FUNDED BY THE ANR
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