“INNOVATIVE RADIOPHARMACEUTICALS: A realistic application of personalized medicine by Atlantic Biotherapies”
• ABT cluster introduction

• The birth of a mini cluster dedicated to nuclear medicine

• Recent achievements of the mini cluster
  • The “THERENEAN” project
  • The “Alpha-RIT” project

• ABT cluster conclusion…What’s next?
ABT cluster introduction
46 companies
28 research units
2 universities
2 university hospitals
2 cancer centers
1 veterinary school
2 business schools

> A complete value chain

> Development of new human and animal biotherapies and biodiagnostics
4 areas of Excellence

• Cell and Gene Therapy
  – Nantes is #2 most sponsored site in France by Telethon (national charity) for Gene and Cell Therapy
  – 2008 : 14 ongoing Cell and gene Therapy clinical protocols
  – 2009 : Opening of Atlantic Bio GMP – cGMP Viral Vectors Manufacturing
    • Nantes, a “one stop shop” for gene therapy :
      – Gene Identification +
      – Vector construction +
      – Product manufacturing +
      – Preclinical trial +
      – Process development +
      – cGMP manufacturing +
      – Clinical evaluation

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4 areas of Excellence

- **Immunobiotherapies**
  - 400 researchers in 3 research & clinical institutes
  - Immunology of Cancer, Research in Transplantation
  - #1 in Europe for Kidney and pancreas transplantations
  - 7 spinoff companies
    - TcLand, Clean Cells, CyTune Pharma,
    - IDBC, Myelomax, Chelatec, Atlab Pharma
  - 2007: Monoclonal Antibody (CD28at) outlicensed
  - 2008: opening of CIMNA – Comprehensive Immunomonitoring facility

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• Biomaterials combined to biotherapies for bone and joint regeneration
  – new public-private partnerships every year:
    • Hydrogels + therapeutic cells for bone reconstruction at bedside (ATOS project)
    • Injectable bone substitutes + bioactive compounds for post-surgery cancer treatment (Geltop project)
  – 2 company creations under evaluation
4 areas of Excellence

• Radiopharmaceuticals
  − 2007: Arronax still under construction, several ideas of projects
    • a need expressed by Arronax to bridge research to industry
    • a working group from which 3 different projects emerged
    • the starting point for industrial collaborations in the field of nuclear medicine

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The birth of a mini cluster dedicated to nuclear medicine

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Nuclear Medicine in Nantes from 1975 to 2009

- **1975**: creation of a small research group for preclinical studies in tumor-bearing mice using radiolabelled molecules in collaboration with CEA
- **1981**: affiliation with an Inserm research unit devoted to immunology and oncology
- **1981…2009**: development of a multidisciplinary research group in Nuclear Oncology
  - 1981: 1st injection of a radiolabelled antibody in a patient
  - 1996: 1st radioimmunotherapy clinical study
  - 1998: 1st in vitro experiments with an antibody coupled to an alpha particle-emitting radionuclide ($^{213}$Bi)

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Actual Research subgroups in Nuclear Oncology

- **Chemistry-immunochemistry-radiopharmacy**
  - synthesis of original chelating agents for coupling of radionuclides to monoclonal antibodies
  > creation of Chelatec company in 2000

- **Radiophysics-dosimetry**
  - development of innovative methodology for accurate pre-radionuclide therapy dosimetry

- **Biology- radiobiology**
  - preclinical studies in nude mice with radiolabelled antibodies

- **Clinical nuclear oncology**
  - implementation of multiple phase I/II clinical trials with radiolabelled antibodies
  > creation of Atlab-Pharma company in 2008

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The Arronax cyclotron, an accelerator for the nuclear medicine installed in Nantes

Objectives:
- Production of innovative radionuclides for research in TEP imaging and radionuclide therapy

Main characteristics:
- High energy: up to 70 MeV
- High intensity: up to 750 µA (protons)

Will start operating in October 2009

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Radionuclides produced by Arronax

1st priority list

• Positron-emitting radionuclides
  - $^{82}$Sr/$^{82}$Rb (nuclear cardiology)
  - $^{68}$Ge/$^{68}$Ga (oncology, neurology, cardiology)
  - $^{64}$Cu (oncology, neurology, cardiology)

• Electron-emitting radionuclides
  - $^{67}$Cu (radionuclide therapy)
  - $^{47}$Sc (radionuclide therapy)

• Alpha particle-emitting radionuclide
  - $^{211}$At (alpha-radionuclide therapy)

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Recent achievements of the mini cluster

• The “THERENEAN” project
• The “Alpha-RIT” project
THERANEAN project:
Therapy through Neutron Activation using Nanoparticles

L. Maciocco
Project Leader AAA
M. F. Mariani
Head Research and Development AAA

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Theranean Partners
Advanced Accelerator Applications
History of the Theranean Project
Objectives of the Theranean Project
The Theranean methodology
Available data: Proof of concept
<table>
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<th>Partner (type of instit.)</th>
<th>Loc.</th>
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<tr>
<td>AAA (SME)</td>
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<td>Quantitative dosimetry using Monte Carlo simulation</td>
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<td>Development of nanoparticles and brachytherapy techniques, animal testing, SPECT and MRI imaging</td>
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<td>Lyon</td>
<td></td>
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<tr>
<td>Nano-H (SME)</td>
<td>Lyon</td>
<td>Development and production of nanoparticles</td>
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<td>CERMA (SME)</td>
<td>Archamp</td>
<td>Optimization and industrial development of the injection system</td>
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AAA Mission

BRIDGING SCIENCE WITH LIFE

AAA’s business focus on innovative diagnostic (molecular imaging) and therapeutic (personalised medicine) solutions capable of enhancing everybody’s life.

• AAA has today **50 shareholders**, including management, a paid-up capital of about **31M€** and more than **100 employees** in **4 countries** (France, Italy, Switzerland and Spain).

• AAA first commercial product is **Gluscan®** (FluoroDeoxyGlucose or **FDG**), an injectable solution used for **PET** diagnostics (**Positron Emission Tomography**), registered in Belgium, France, Italy, Luxemburg, Germany, Poland, Portugal, Spain, and Switzerland.

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AAA presence and facilities roll out

- **AAA laboratories:**
  - 6 production sites operational.
  - 2 sites under construction.
  - 2 approved (funded) projects, of which 1 is for R&D only.

All AAA sites are designed to produce **Gluscan®** but also **PET Investigational Medical Products** (for human injection) and potentially **new PET commercial tracers**.

- **Commercial partnerships for FDG production and distribution** (first operation: Geneva University Hospital, Switzerland)

- **GLUSCAN® Site training and licensing** (first operations: NTP, South Africa, Casablanca: Morocco).

AAA is the fastest growing player in the PET European market

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From its very beginning (2002) AAA pursues the exploitation of the ARC (Adiabatic Resonance Crossing) patent by C. Rubbia (CERN), a method which would allow the production by neutron activation of isotopes for cancer therapy using medium-sized cyclotrons as an alternative to nuclear reactors.

The method has been experimentally proven at CERN between 1995 and 1997 with the TARC experiment (the 3x3x3 m lead assembly is shown in the figure).

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In 2005 the activity takes the form of an EUREKA project (INBARCA-Innovative Brachytherapy through ARC using Accelerators).

Objective of the projects are
- Design, construction and experimental validation of a prototype of the ARC neutron activator coupled with a cyclotron for medical applications.
- Development of nanoparticles containing the isotope to be activated, to be used for cancer therapy through intra-tumoral injection (brachytherapy) using the high-pressure TMT injector developed by CERMA
- Animal tests of the proposed technique to give the proof of principle of its effectiveness for the treatment of solid cancers
The INBARCA collaboration includes

- 2 French PMEs (AAA and CERMA)
- A spin-off of Lyon university (LAGEP) as subcontractor
- the European Joint Research Centre (JRC) of Ispra (Italy) which make its structures available on the basis of the scientific interest for the project
- CERN as an external support for material and software
- From 2006, another spin-off of Lyon university (Nano-H) and the nuclear medicine department of Edouard Herriot Hospital (HEH) informally join the project, bringing new competences and tools for the success of the project
The INBARCA projects officially ends in March 2009 with the following results:

- A prototype of the neutron activator has been built and validated at JRC, coupled with a 40 MeV-50 μA cyclotron, demonstrating the possibility to produce radioisotopes for cancer therapy using medium sized cyclotrons for medical applications.

- Animal tests carried out at HEH using LAGEP and Nano-H nanoparticles gave clear evidences of the anti-tumoural effect of the proposed brachytherapy technique.

- The general methodology, including animal model, nanoparticles activation, injection, follow-up and analysis was successfully demonstrated.

- It is however clear that a more powerful cyclotron is necessary to realise an efficient industrial production of activated nanoparticles.

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History of the THERANEAN Project (5)

- Contacts are established in 2007 between AAA and ARRONAX, to explore the possibility of realising a high-power activator coupled with the 70 MeV-350 µA ARRONAX cyclotron.

- From the beginning of 2008 Atlantic Biotherapies catalizes the common interests of AAA, ARRONAX and INSERM U892.

- The THERANEAN partnership is finally established in March 2008, including:
  - AAA
  - ARRONAX
  - SUBATECH
  - Nano-H
  - INSERM U892
  - INSA-Lyon
  - CERMA
  - Claude Bernard University-Lyon (UCBL)

- The project is labelled by Atlantic Biotherapies and LyonBiopole.

- A FUI grant (3.5 M€) is obtained in June 2009 (AAA and SUBATECH with the financial support of Pays de la Loire region).

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Objectives of the THERANEAN project

Global aim:
Development of an innovative brachytherapy technique using micro/nanoparticles activated in an accelerator-driven neutron activator

Project objectives:

- Design and construction of a high-power (70 MeV – 350 μA) neutron activator
- Characterisation of Ho/Lu-oxide, non coated/coated nanoparticles of different sizes (100-300 nm)
- Development of a medical device for the safe and effective intra-tumoral/intra arterial injection of activated nanoparticles
- Development of a personalised dosimetric method based on the Monte Carlo-simulation of the dose released in the tissues, starting from SPECT/CT data
- Potential clinical indications: Glioblastoma, Prostate cancer, Liver cancer

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The THERANEAN method

- Synthesis of various types and sizes of nanoparticles with lanthanide-oxide core, containing the stable (non radioactive) isotope to be activated (e.g. $^{165}$Ho)

- Pharmaceutical preparation of sterile injectable nanoparticles suspension

- Insertion of injectable doses in the cyclotron-driven activator for neutron activation (no alteration of pharmaceutical characteristics)

- Intra-tumoral/intra-arterial injection using the TMT injector

- SPECT detection of nanoparticles distribution, CT for morphological data

- Transfer of imaging data to Monte-Carlo dosimetry model for dose distribution calculation

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The THERANEAN method

Activator

Reflector/moderator

Activation samples

neutrons

Target

CYCLOTRON

Rabbit transfer system

NanoThera capsule

Injection samples

Shielded capsule loader

NanoTMT injector

Injector tube (shielded for β radiation)

Compressed air

Personalised dosimetry

SPECT/CT

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Radioisotopes production

β⁻ emitting radioisotopes can be produced through neutron irradiation of the corresponding stable isotopes:

\[ ^{165}\text{Ho}(n,\gamma)^{166}\text{Ho} \]

Currently such isotopes are produced only in research nuclear reactors (by using fission neutrons):

- reactor irradiation induces damages to the nanoparticles (γ heating). It is necessary to irradiate the nanoparticles in dry conditions (then hot manipulation to prepare the injectable suspension)

- very few reactors are available in Europe for medical use, and with tight schedule and ageing problems

AAA has developed and experimentally demonstrated a method for the efficient production of neutron-activated radioisotopes using cyclotrons for medical applications

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The neutron activator: principle of operation

- A proton beam is generated by a cyclotron
- Protons interact with a solid target (Be,Ta)
- Fast (high energy) neutrons are generated

- Neutrons are moderated (water)
- Neutrons are reflected and further moderated (graphite)
- Nanoparticles are activated by moderated neutrons

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The TMT brachytherapy is based on the high-pressure injection of the pharmaceutical solution containing the nanoparticles by using a perforated needle/microtube inserted/implanted inside the tumour.

The injection technique is already being clinically tested by using hot water as active agent (thermoablation).
Quantitative dosimetry (INSERM-U892)

- Monte Carlo modelling of the activity distribution (SPECT data)
- Monte Carlo modelling of the tumour and surrounding organs (CT data)
- Determination of the actual delivered dose
- Personalisation of the treatment

S Chiavassa et al. PMB 51 601-616, 2006

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Nano-H multifunctional nanoparticles

Active targeting of therapeutic effect

Organic molecules grafting

γ emission (SPECT)

β⁻ Emission (therapeutic properties)

Paramagnetic (MRI)

Lanthanides (Ho, Lu)

Optical imaging

Fluorescence

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INBARCA activator at JRC Ispra Cyclotron Facility

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### Results of INBARCA animal tests (1)

- Nanoparticles activated in the INBARCA activator
- Two tumours (~1 cm) grafted on Fischer rat
- One 100µl 20%w nanoparticles TMT injection per tumour (~1 MBq)
- Good intra-tumoral dispersion
- Very good fixation of nanoparticles

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Results of INBARCA animal tests (2)

Tumoral growth

Days following tumor graft

Tumor volume (cm³)

Intra-tumoral particles injection

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ALPHA-RIT project
(Alpha-RadioImmunoTherapy)

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There is a need for an original and efficient therapeutic solution in prostate cancer.

Micro-metastases and disseminated disease are commonly recognized as the best indication for RIT (Radio Immuno Therapy).

Due to specific physical properties, alpha emission could be the ideal solution.

The proposal is to combine the specificity of an antibody targeting prostate cancer cells with an alpha-emitter.

Ways to produce the alpha-emitter in larger (industrial) amounts have to be developed.

Chemistry, biology, toxicology and clinical tests have to be carefully taken in account.

Alpha-emitters for medical use are new and new rules for handling these radionuclides have to be invented, approved and adopted.

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Key points

- Development of radio-pharmaceuticals
- Collaboration between one industrial partner, two smaller companies and one large public institution
- Target: commercialization of two drugs
- Business: Long term competitive advantage in France
- Target market of € 200 M (real potential can be expressed in €Bs)
- Global budget of € 30+ M over 8 years
- OSEO/ISI grant of € 8.1 M
Partners

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Prostate cancer

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Improving the existing therapeutic offer

- Surgery
  (Removing tumor)
  Non-applicable in case of dissemination

- External radiotherapy
  (Destroying cells)
  Non-applicable in case of dissemination

- Chemotherapy
  (Slowing down of proliferation)
  Limited action on resting cells
  Resistance development

- Immunotherapy
  (Stimulating immunity)
  Experimental stage
  Often limited action (resistances)
  Efficient only in certain indications

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Micro metastases need to be destroyed

Primary tumor

- LOCO-REGIONAL
  - Surgery
  - External radiotherapy

Microscopic metastases

- Potential
- Confirmed

DISSEMINATED

- Chemotherapy
- Immunotherapy

Radioimmunotherapy

Macroscopic metastases

- Surgery
- Radiotherapy
- Chemotherapy
- Immunotherapy

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Radio-immunotherapy (RIT)

Radioactive antibody fixed to a tumor cell

Blood vessel

tumoral cells

Radioactive antibody
Radioactivity

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Active agent: β or α radio-isotope

β emitter (electrons)
- <1 MeV dissipated over 1 to 10 mm
- energy deposited outside the target cell
- TARGET: cell macro-clusters, metastases

α emitter (He nucleus)
- 5-6 MeV dissipated over 0.1 mm
- energy deposited within the target cells
- TARGET: isolated cells, micro-clusters

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In summary: from β-RIT to α-RIT

β-RIT

- Validated technology
- Target: mm Ø tumors
- Products (lymphoma) & candidates (solid tumors)
- Stake is market leadership

α-RIT

- 100 times* more powerful
- Target: isolated cells
- No candidates
- No supply-chain for α
- Stake is technology mastering

* Linear energy transfer
Why Astatine-211?

- Few potential candidates
  - $^{211}$At, $^{213}$Bi, $^{223}$Ra, $^{224}$Ra, $^{227}$Th, $^{225}$Ac

- Medical use
  - Half-life of 7.2 h vs. 46 min (Bi) or >10 jours (Ra, Th)
  - No alpha-emitting decay products

- Easier manufacturing
  - Cyclotron rather than reactor (Ra, Th)
  - Stable target rather than radioactive target (Ac/Bi)

- Appropriate chemistry
  - Coupling to antibodies vs. encapsulation (Ra)

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Project overview

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1. Create a long-term expert partnership

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2. A major indication: prostate cancer

- **Primary tumor**
  - 500'000 cases
  - LOCO-REGIONAL
  - ABLATION

- **Microscopic Metastases**
  - 100'000 cases
  - Potential
  - Confirmed (PSA)
  - DISSEMINATED
  - Hormonotherapy
  - Secondary Hormonotherapy
  - α-RIT
  - α-RIT / β-RIT

- **Macroscopic Metastases**
  - 80'000 deaths
  - METASTATIC
  - Chemo (Docetaxel)
  - Bone radiotherapy
  - β-RIT

Sources: NCI, Eurocare, Inca

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3. To bring a β-RIT on the market

- Opportunity of a phase III in Europe
- Commercialization in Europe & US
- Learning phase for "prostate" market penetration

Leadership in the indication

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4. To bring an α-RIT drug on the market

- α GMP supply chain
- Preclinical validation
- Phases I, II, III clinical validation
- Commercialization in Europe & US

α Supply chain  →  Scale-up  →  Labelling  →  Preclinical  →  Clinical  →  Marketing

Technological leadership


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5. Develop an α-RIT pipeline

- Prostate
  - Clinical
  - Market
- Vascularization
  - Clinical
- Other indications
  - Clinical

➢ Commercial leadership

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Public partners are collaborating within the framework of the University of Nantes, which will coordinate with other research organizations (CNRS, Ecole des Mines de Nantes, Inserm)

- GIP Arronax
- CRCNA
- Subatech
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Subatech profile

- Laboratoire de Physique Subatomique et des Technologies associées,
  - CNRS (IN2P3), Ecole des Mines of Nantes, University of Nantes
- Nuclear physics and radiochemistry
  147 agents including
  - 43 Researchers
  - 52 Engineers -Technicians-Administrative

- Director : Jacques Martino

- Competences
  - Astatine chemistry (ANR Jeune Chercheur project)
  - Alpha radiolysis
  - Fundamental nuclear physics (cross section measurements- simulations)
  - Design of devices submitted to high radiations (Target stations ARRONAX)
  - Mechanics laboratory - from design to achievement of prototypes.
  - Electronic laboratory

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Involvement in the project

- Fundamental study of chemical properties of astatine (element not existing in stable form and thus not well known).

- Targetry development (in partnership with ARRONAX)
  - Mechanical and thermic aspects
  - Production optimization (nuclear aspect)

- Participation in the design of a dedicated cyclotron

Contact: Férid Haddad (Associate Professor, University of Nantes)
Profile of CRCNA

- Research Center INSERM and University of Nantes (U892)
  - 15 teams: immunotherapy of cancers, oncogenesis and radiotherapies
  - Director: Marc Bonneville.

- Team "Research in Nuclear Oncology"
  - Radionuclide therapy, especially radioimmunotherapy
  - Multidisciplinary group and translational research

- Project alpha-immunotherapy managed by:
  - Michel Chérel, Associate Professor at the medical school
  - François Davodeau, INSERM research fellow.
Collaboration networks:

- Group « tumor targeting » within the « Canceropole Grand Ouest »
- COST European network on Targeted Radionuclide Therapy
- European project « Targeted Alpha-Radiotherapy to Combat Cancer »
- ANR Project VecRIT
- Arronax, collaboration between CRCNA and Subatech

Clinical trials (detection and treatment of cancers)

- With the Department of Nuclear Medicine at IRCNA (associating the University Hospital and René Gauducheau Cancer Centre) headed by Françoise Kraeber-Bodéré
Involvement in the project
- Biology of antigen and antibody
- Lutetium phase
  - Clinical investigation
  - Quantitative imaging
  - Dosimetry
- Astatine phase
  - Extraction and radiolabelling
  - Efficacy and preclinical toxicology studies
  - Radiobiology
  - Quantitative imaging and dosimetry

Contact: Michel Chérel (responsible for the alpha-immunotherapy project)
Industrial partners

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Chelatec: Profile

- CRO specialized in Customized Radio-Labelling & Preclinical Studies
- Creation: 2000; Staff: 12
- 40 international collaborations with Pharmaceutical Industries
- New labs on the Arronax site

Our Core business includes:

- Biologicals Labelling
- Carbone-14 Radiosynthesis
- R&D in Radiopharmaceuticals: Diagnosis and Therapy
- Pharmacokinetic and ADME in rodents including Autoradiography
Chelatec: Contributions

- Inputs in Alpha-RIT Project
  - Labelling Optimisation
  - Pre-clinical regulatory studies
  - Process Industrialisation
  - Setting up of a Manufacturing Unit
  - Clinical Doses Manufacturing

- Contact: Dr. Anthony Loussouarn (President-CEO)
ATLAB Pharma: Profile

- **Bio-radiopharmaceuticals**
  - Created in Nantes in 2008

- **Mission**
  - To develop innovative therapeutic radio-antibodies

- **Vision**
  - Expand the routine use of radiotherapy to disseminated cancer

- **Business model**
  - Value creation through preclinical & clinical validation
  - Commercialization through partner radio-pharmaceutical companies

- **Pipeline under construction**
  - Lung cancer
  - Myeloma
  - Prostate

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ATLAB Pharma: Contribution

- Pharmaceutical & clinical development

- Preclinical studies
  - Design, Planning & financing
  - Project management
    - Laboratory preclinical (CRCNA)
    - Regulatory preclinical (with Chelatec)
    - IND file

- Clinical studies
  - Design, Planning & Financing
  - Project management
    - Center recruitment
    - Clinical efficacy/toxicity (with CRCNA and hospitals)
    - PK/PD

- Project coordination

- Contact: Jean-Marc Le Doussal, President

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IBA Molecular:
Profile

- IBA Molecular
  one of the Business Units of IBA (Ion Beam Applications) international company of Belgian origin founded in 1986, specialized in the development of tools using radioactivity in the medical field (diagnostic and therapy)
  - Development and manufacturing of cyclotrons
  - Building of proton-therapy and hadron-therapy centers
  - Manufacturing and distribution of radiopharmaceuticals
  - Network for production of $^{18}$F and $^{18}$F labelled molecules

- Acquired recently (June 2008) the French company CIS bio international, radiopharmaceuticals manufacturing leader (Saclay)

- Worldwide activity: 54 FDG manufacturing centers, 4 R&D centers (Sterling VA, USA; Totowa NY, USA; Fleurus, Belgium; Saclay, France)

- IBA: staff 2100 (2009), Revenue 2008: 320M€ (IBA Molecular >50%)

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IBA Molecular: Contribution

- Involvement in the project
  - Project coordination (*chef de file*) including project administration
  - Nuclear safety and Regulatory affairs - MA dossiers filing
  - Final drugs manufacturing, marketing, sales and distribution
  - Dedicated cyclotrons development
  - Building of GMP manufacturing centers
    - Industrial labelling of $^{177}$Lu-mAb
    - Industrial manufacturing of $^{211}$At and labelling of $^{211}$At-mAb

- IBA is in charge of the industrialization of the project
  - by providing the expertise in radiopharmaceuticals
  - by developing the new and dedicated tools

- Contact: Richard Zimmermann (VP Development RP IBA Molecular)
A new world to invent

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Conclusion: A new world to invent

- **Clinical:** demonstrate superior efficacy of α-RIT in a cancer pathology
- **Regulatory:** get alpha-therapy accepted by authorities and hospitals
- **Industrial:** development of a specific manufacturing tool for $^{211}$At and creation of a manufacturing network
- **Commercial:** acceptance by the medical community of this innovative therapy
- **Long term:** open the way for blockbusters « adjuvant » or « vascular endothelium » new indications

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Alpha-RIT Project
(Alpha-RadioImmunoTherapy)

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ABT conclusion…
What’s next?
Concrete results

• 2 out of 3 ideas converted into real projects
• A value chain built up
  – Operational, tested, reusable
  – Strengthened by new stakeholders
    • AAA established in Nantes
    • A major account, IBA, involved in longterm relationships with Nantes
  – Opened to
    • National collaborations (Ex. Theranean: LyonBiopole stakeholders)
    • International collaborations
      (Ex. Belgium, Italy, USA, Switzerland …)
Perspectives

• A tested value chain that is expected to grow
  – External investments under discussion
  – A start up creation under evaluation

• Other collaborative projects waiting for new partners
Next project?  
...about PET imaging using gallium-68

• Context:
  – Most of imaging biomarkers are currently labelled with technetium-99m
  – Technetium-99m shortage
    • Technetium supply requires nuclear reactors that became too old and less and less operational
    • Building new reactors is not a good option considering the high cost (200-300M€ each)
  – Gallium-68, an alternative positron-emitting radionuclide
    • Production in cyclotron (cheaper than reactor)
    • Favorable physical features for PET imaging
      – Short half life (68 min),
      – suitable for peptide or peptide analogue coupling
      – image acquisition few hours after injection

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Next project? ...about PET imaging using gallium-68

• Planned partnership and possible workpages
  – Arronax:
    • competences in nuclear physics (for target irradiation) and radiochemistry (for extraction and purification of radionuclides such as germanium-68)
    > WP1: the Arronax cyclotron will produce germanium-68 for loading of gallium-68 generators
  – Chelatec company:
    • radiolabelling activity
    > WP 2: Chelatec will label any small molecule including peptides with gallium-68 for PET imaging
  – The CRCNA (research center in oncology):
    • all competences in chemistry, immunochemistry, radiopharmacy, dosimetry and preclinical and clinical studies
    > WP3: The CRCNA will perform all preclinical testing especially using a micro-PET machine located at the veterinary school in Nantes and dosimetric studies

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Next project?
...about PET imaging using gallium-68

- Partner search: a supplier of innovative biomarkers suitable for
  - Diagnostic but most of all post treatment monitoring
  - Through apoptosis or angiogenesis follow up
  - 1st priorities of indications: Oncology, cardiology, neurology....
Thanks

- Financial supports
  - Eurobio, Lille, September 25th
  - Oséo ISI team
  - Mr Kitten

- Partners
  - Oséo
  - DGCIS
  - Rhône-Alpes
Contacts at ABT

• Inquiries about collaborations in the field of radiopharmaceuticals
  – Pr Jean-François Chatal - chatal@arronax-nantes.fr
  – Dr Jean-François Gestin, VP radiopharmaceutical of the ABT cluster, cofounder of Chelatec - jfgestin@chelatec.fr

• Inquiries about any collaborations with ABT
  – Dr Réjane Bihan, ABT project coordinator - bihan@atlanpole.fr

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Thank you for your attention!