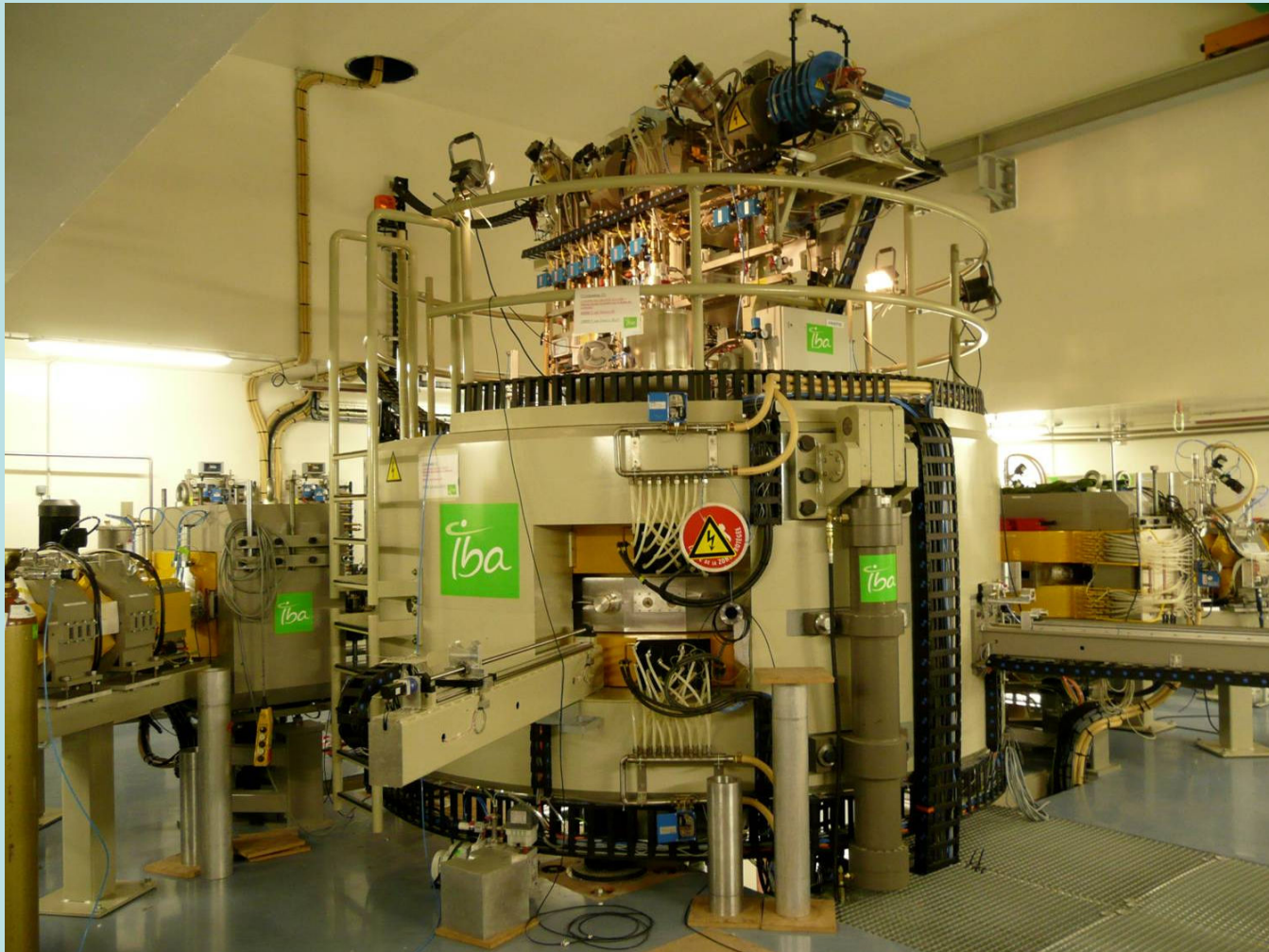
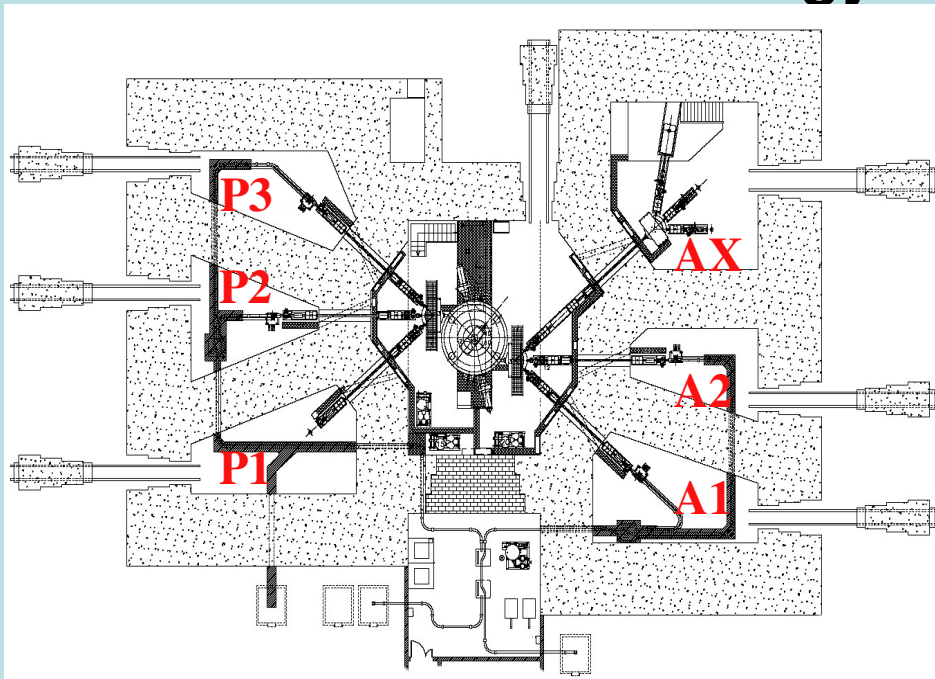


Production of innovative radionuclides at ARRONAX and ^{211}At RIT

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GIP ARRONAX



ARRONAX: an Accelerator for Research in Radiochemistry and Oncology at Nantes Atlantique



Vaults connected to *hot cells* through a **pneumatic system**

Sterile rooms for radiopharmaceutical production

Surrounding labs for radiochemistry, biochemistry, nuclear metrology, quality control,...

Beam characteristics: High energy - High intensity

Beam	Accelerated particles	Energy range (MeV)	Intensity (μAe)	Dual beam
Proton	H-	30- 70	< 375	Yes
	HH+	17.5	<50	No
Deuteron	D-	15-35	<50	Yes
Alpha	He ⁺⁺	68	<70	No

ARRONAX priority list

Targeted radionuclide therapy: $^{211}\text{At}(\alpha)$ - $^{67}\text{Cu}(\beta)$ - $^{47}\text{Sc}(\beta)$

PET imaging:

$^{82}\text{Sr}/^{82}\text{Rb}$ and $^{68}\text{Ge}/^{68}\text{Ga}$ generators

^{64}Cu and ^{44}Sc : *PET dosimetry* before injection of ^{67}Cu and ^{47}Sc

^{44}Sc : β^+ γ emitter (3 γ imaging)

Final Acceptance Tests are in progress

Protons:

Beam transport validated at 375 μA - 70 MeV

Dual beam 2x200 μA -70 MeV extracted

1x500 μA - 30 MeV extracted

Alpha particles: 25 μAe – 68 MeV extracted

Still to be done:

Protons:

Dual beam 2x375 μA -70MeV

Alpha particles:

70 μAe – 68 MeV

First irradiation starting March 2010

Short-term ARRONAX capabilities

- ^{64}Cu : $^{64}\text{Ni}(\text{p},\text{n})$ Activity to perform a TEP exam: ~ 10 mCi
12-10 MeV- expected yield: $4,1$ mCi/ $\mu\text{A}\cdot\text{h}$
- ^{211}At : $^{209}\text{Bi}(\alpha,2\text{n})$ Maximum expected dose to patient: 10-20 mCi (?)
28.3 - 21 MeV- 4h – $70\mu\text{Ae}$: ~ 150 mCi (EOB)
- ^{82}Sr : $^{\text{nat}}\text{Rb}(\text{p},4\text{n})$ Activity to fill a Sr/Rb generator: ~ 120 mCi
70 – 40 MeV – ~ 0.2 mCi/ $\mu\text{A}/\text{h}$
gradual increase up to 60 Ci/year (2012)
- ^{68}Ge : $^{\text{nat}}\text{Ga}(\text{p},2\text{n})$ *Simultaneous production with Sr using dual target*
35-20 MeV - $\sim 0,05$ mCi/ $\mu\text{a}/\text{h}$
gradual increase up to 15 Ci/year

Alpha-RIT

A consortium to work on:

- **Radio Immuno-Therapy** using ^{211}At
- major indication: *prostate cancer*

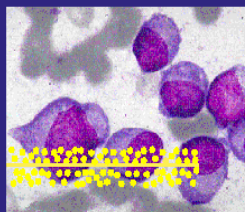
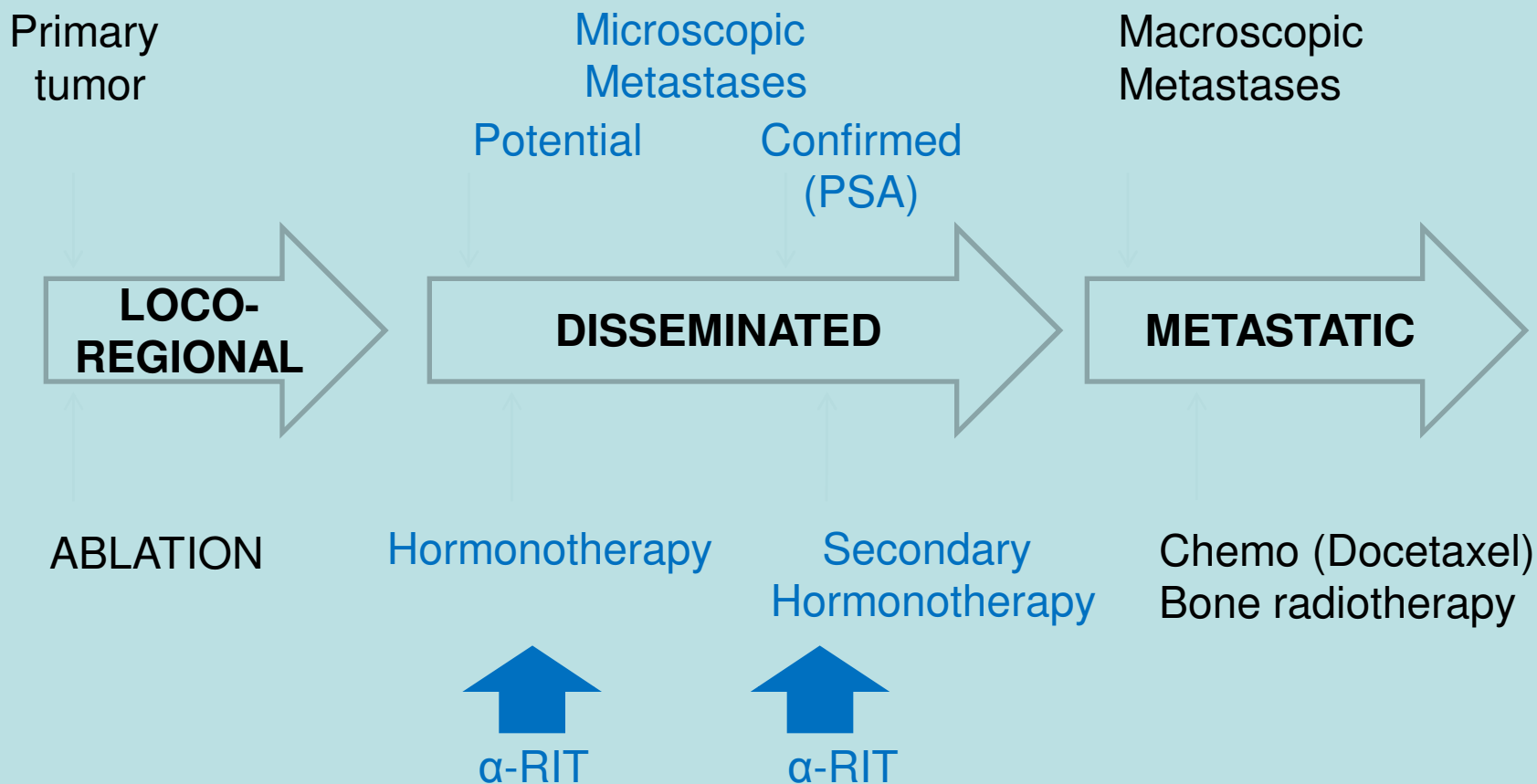


Partners



Coordination

Alpha-RIT in prostate cancer



- 5-6 MeV dissipated over 0.1 mm
- energy deposited within the target cells

Alpha-RIT: Why Astatine-211 ?

➤ Few potential candidates

- ^{211}At , ^{149}Tb , ^{213}Bi , ^{223}Ra , ^{224}Ra , ^{227}Th , ^{225}Ac

➤ Medical use

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

➤ Easier manufacturing

- Cyclotron (α -beam) rather than reactor
- Stable target (Bi) rather than radioactive target

➤ Appropriate chemistry

- Validated coupling method to antibodies

Alpha-RIT: The issues

- To combine the specificity of an **antibody** targeting prostate cancer cells with an alpha-emitter
- **To produce the alpha-emitter** in larger (industrial) amounts (planned design of dedicated cyclotron according to clinical feasibility)
- Chemistry, biology, toxicology and clinical **tests (phase I and II)**
- Alpha-emitters for medical use are innovative and **new rules** for handling these radionuclide have to be invented, approved and adopted

Conclusions

ARRONAX will be operating starting march 2010

ARRONAX priority lists covers both **isotopes for therapy** (^{211}At , ^{67}Cu , ^{47}Sc) and **imaging** (^{82}Sr , ^{68}Ge , ^{64}Cu , ^{44}Sc)

Alpha-RIT, a consortium for the use of ^{211}At in **radio-immunotherapy**, has been set and will start work in 2010

In **Nantes**, a **chain value** going from nuclear physics to nuclear medicine will allow to go **from radionuclide production to radiopharmaceuticals**

Thank you for your attention

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the **Regional Council of Pays de la Loire**
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the **European Union**.