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INVITED LECTURE - ARRONAX: on the way to the production of radio-isotopes with high-power targets

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ARRONAX, acronym for "Accelerator for Research in Radiochemistry and Oncology at Nantes Atlantique", is a high energy (70 MeV) and high intensity multi-particle cyclotron located in Nantes (France). It is designed to be able to extract two proton beams simultaneously (dual beam mode) up to 2*375µA. Beams can be delivered into 6 experimental vaults: Four are devoted to radionuclide production and equipped with an irradiation station connected to our hot cells via a pneumatic system; one contains a neutron activator developed in collaboration with the AAA company whereas the last one is used for basic research with low intensity beam (alpha radiolysis, radiobiology and physics).
ARRONAX main activity is non-conventional radioisotope production for nuclear medicine for both therapeutic use (67Cu, 47Sc and 211At) and imaging (82Sr/82Rb and 68Ge/68Ga generators and 64Cu, 44Sc).

As a first step, our work has been focused on the production of strontium-82, copper-64 and astatine-211. For that purpose, we have developed our own targets and modified the irradiation stations, purchased from IBA, to meet our requirements and lower the beam power density on target. With these changes, it is possible to irradiated deposit (Copper-64 or Astatitne-211) as well as encapsulated targets. These changes have allowed producing strontium-82 from RbCl target using 2*95 µA proton beams making ARRONAX one of the few places in the world able to produce this isotope for commercial use. These changes will also allow a scale up of our Copper-64 production. In the case of Astatine-211, an additional beam energy degrader has been designed and mounted on one of the beam line and is presently under testing.

In order to further increase the beam intensity on our targets, we plan to play with all the available parameters. In the case of Strontium-82, we are planning to change the target material in collaboration with INR Troitsk (Russia). Indeed, Rb metal is offering higher production yield and better thermal conductivity than RbCl. We may also try the wobbling of the beam. Finally we are thinking on a design of a new target station able to handle larger beam spot on target (we are currently limited to 20 mm in diameter).
All these changes will help us to take advantage of the high intensity available on our cyclotron.

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