# INBARCA PROJECT

## Development of a target system for the production of β⁻ emitting radioisotopes with small-size cyclotrons

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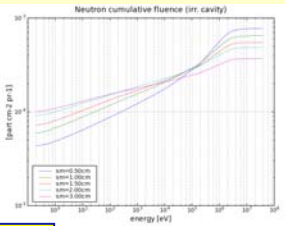
## Activator Design

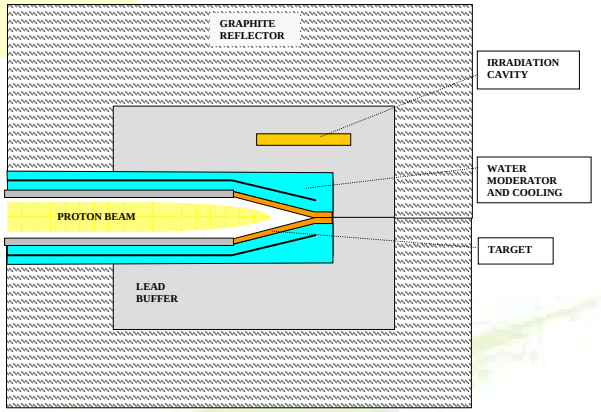
**Objective** Activation of β⁻ emitting radioisotopes for brachytherapy (like $^{166}$Ho, $^{186}$Re and $^{188}$Re) by using an accelerator-driven neutron source as an alternative to nuclear reactors

**Method**
- ⇨ Exploitation of the neutron-capture resonance peaks of the isotopes to be activated (Adiabatic Resonance Crossing CERN patent)
- ⇨ Efficient (low absorption) moderation of the high-energy spectrum of generated neutrons down to thermal energy
- ⇨ Confinement of the neutrons in the activation region

### ARC Activator Prototype

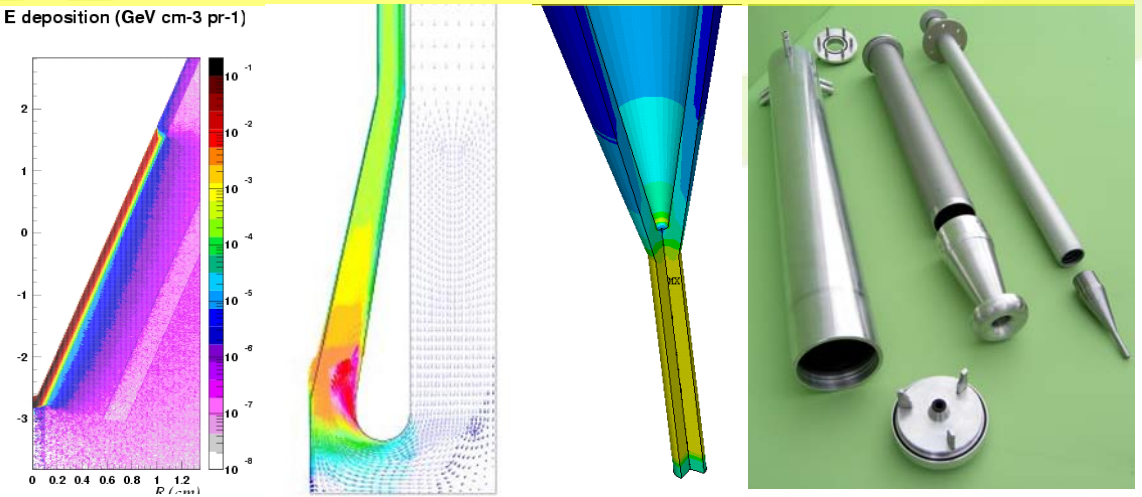
The ARC activator prototype has been designed by using Montecarlo codes (FLUKA, MCNPX). It is being realized at the Joint Research Centre of Ispra (Italy). It is coupled with a variable energy (max 40 MeV) Scanditronix cyclotron with a max current of about 50 μA. Its purpose is to demonstrate the possibility to produce enough activity for therapeutic purposes by using accelerators, to study its performances at different energies (for extension to higher currents) and to validate Montecarlo codes.




## Proton Target Design

The objective of the proton target design is the maximization of the produced neutron flux while keeping temperatures and stresses below acceptable limits. This has been done by coupling Montecarlo codes (energy deposition) with CFD codes (thermal-hydraulic analysis, StarCD) and with structural codes (thermal-stress analysis, ANSYS).
Two options have been considered for the target material: Beryllium and Tantalum. All the target cooling components are in Al to minimize activation.
At these powers, the main constraint from the thermal point of view is to keep cooling water temperature below the boiling point.




## Micro and Nano particles (H. Fessi, M. Hamoudeh)

PLA micro and nano particles loaded with $^{165}$Ho, $^{185}$Re and $^{187}$Re are being developed and tested. They must have good penetration efficiency and stability inside the treated part

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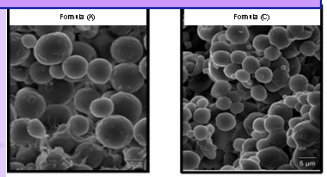

## TMT Brachytherapy Technique (H. Mehier, S. Humbert)

The TMT brachytherapy is based on the high-pressure (~3000 bar) injection of the pharmaceutical solution containing the nano-particles by using a perforated microtube implanted inside the tumor

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