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**Radiopharmacy/radiochemistry: therapy: alpha - beta emitters**

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Room: Poster Exhibition Hall

## P467 Medical radioisotopes activation in the JRC cyclotron-driven INBARCA neutron activator

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A compact, accelerator driven, neutron activator based on a modified version of the Adiabatic Resonance Crossing (ARC) concept has been developed, with the aim of efficiently utilising ion-beam generated neutrons for the production of radioactive nanoparticles for brachytherapy. The facility has been tested under various experimental configurations, and the activation yields of different materials, measured with γ-spectrometry techniques, have been compared with those of our Monte Carlo (MCNPX, FLUKA) simulations. In particular two version of the activator were tested: a lead-graphite and an all-graphite configuration. Experimental results, in agreement with Monte Carlo calculations, showed that higher activation rates (factor 1.7) are obtained for the isotopes of interest (166Ho (T1/2=26.8h), 186Re(T1/2=3.7d) and 188Re (T1/2=0.71d)) as a result of the improved neutron moderation/confinement effects of the all-graphite configuration. Experiments showed that a 166Ho saturation yield of 150 MBq/μA/g can be obtained on 125 μm Ho metal foils (99.9% Ho content, density 8.8 g/cm3) at 36 MeV in the all-graphite configuration. When Ho-oxide 300 nm nanoparticles are irradiated (87.3% Ho content, variable density depending on nanoparticles conglomeration) a saturation yield of 220 MBq/μA/g can be achieved. An extrapolation from 36 to 40 MeV (the maximum energy of the JRC cyclotron) of the experimental results allows estimating a saturation yield of about 350 MBq/μA/g, which can be considered as the present maximum 300 nm Ho-nanoparticles activation potentiality of the JRC INBARCA activator. Animal tests carried out in the framework of the INBARCA project showed that therapeutic effects on MAT3B tumours implanted in rats can be obtained with injected activities of the order of 50 MBq, corresponding to the injection of 20 mg of nanoparticles at 2.5 GBq/g. Such specific activity can be obtained 24h after an irradiation of 12 h with the INBARCA activator at 40 MeV and 50 μA. Much higher therapeutic doses (estimated at a factor 70 by Monte Carlo codes) can be clearly obtained with

higher energies (70 MeV) and currents (~350 μA) currently available in commercial cyclotrons for medical applications. The demonstration of the possibility to obtain a satisfactory distribution and fixation of nanoparticles after intratumoral injection (brachytherapy) in rats was carried out by using Ho and Re loaded nanoparticles activated in the JRC INBARCA activator and visualised/quantified through in-vivo SPECT imaging and ex-vivo g-counting on single organs.