OPTIMIZATION OF PRODUCTION YIELDS, DOSE RATE CONSTANTS AND SHIELDING OF MEDICAL RADIONUCLIDES PRODUCED IN 30 MEV CYCLOTRON – PART Ga-67

R. Adam-Rebeles, P. Van den Winkel, L. De Vis

Vrije Universiteit Brussel – VUB Cyclotron Laboratory
Laarbeeklaan 103, 1090 Brussels, Belgium

Abstract

Optimization of the production parameters - incident and exit proton energy, thickness of the ^{68}Zn target layer, decay time to start chemical processing of an irradiated highly enriched (> 98%) target after the end of bombardment - and of the thickness of the lead shield of the processing hotcell for the cyclotron production of ^{67}Ga by the ^{68}Zn(p,2n) threshold reaction are accomplished by powerful divide et impera and binary search algorithms included in Visual Basic macro's of an Excel worksheet (*Yield&Shield*) with the Pharmacopoeia radionuclidic purity (^{66}Ga and ^{68}Ga contents) of the ^{67}Ga-citrate radiopharmaceutical at the start of distribution and the locally accepted dose rate level for the controlled area as boundary conditions. The algorithms imply that fundamental data are approximated by appropriate continuous functions: cross sections by a (set of) polynomial(s), stopping power of the target material by a sum of exponential decay terms, thick target saturation yields by Gompertz functions and Taylor build-up coefficients and attenuation coefficient of lead by power equations and polynomials. Repetitive application of the optimization procedures allows the derivation of two sets of equations (one associated with the maximum production rate, the other with the use of a minimum target layer thickness) that express the optimized production parameters as a function of the needed activity at the start of distribution and of the maximum allowable beam current on target.