# FULLY AUTOMATED PRODUCTION OF Zr-89 USING IBA NIRTA AND PINCTADA SYSTEMS

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## Background

$^{89}Zr$

$^{89}$Zr (t½ = 3.3d) has a near ideal half-life for antibody-based imaging, and the low energy of its positron (395.5keV) results in PET images with high spatial resolution. The most popular reaction to produce $^{89}$Zr is the $^{89}$Y(p,n)$^{89}$Zr nuclear reaction. Yttrium targets could be either a foil, sputtered onto a support or $Y_2O_3$ pellets.

The motivation of the present work was the fully automated production of $^{89}$Zr using commercially available automated systems. We also describe a newly designed and tested platinum cradle, capable of holding a metallic foil and being directly transferable/compatible between the IBA NIRTA target and IBA Pinctada Metal dissolution/purification module.

## Materials & Method

The commercially available Nirta Solid Target from IBA was coupled to our 18/9 IBA cyclotron using a 2-meter external beam line. A fully automated pneumatic solid target transfer system (STTS) designed by TEMA Sinergie was used to deliver the irradiated targets to a dedicated hotcell. The newly designed platinum cradle holding the yttrium foil (8mm ∅ foils and 0.1mm to 0.250mm possible thickness) is shown in image 1.

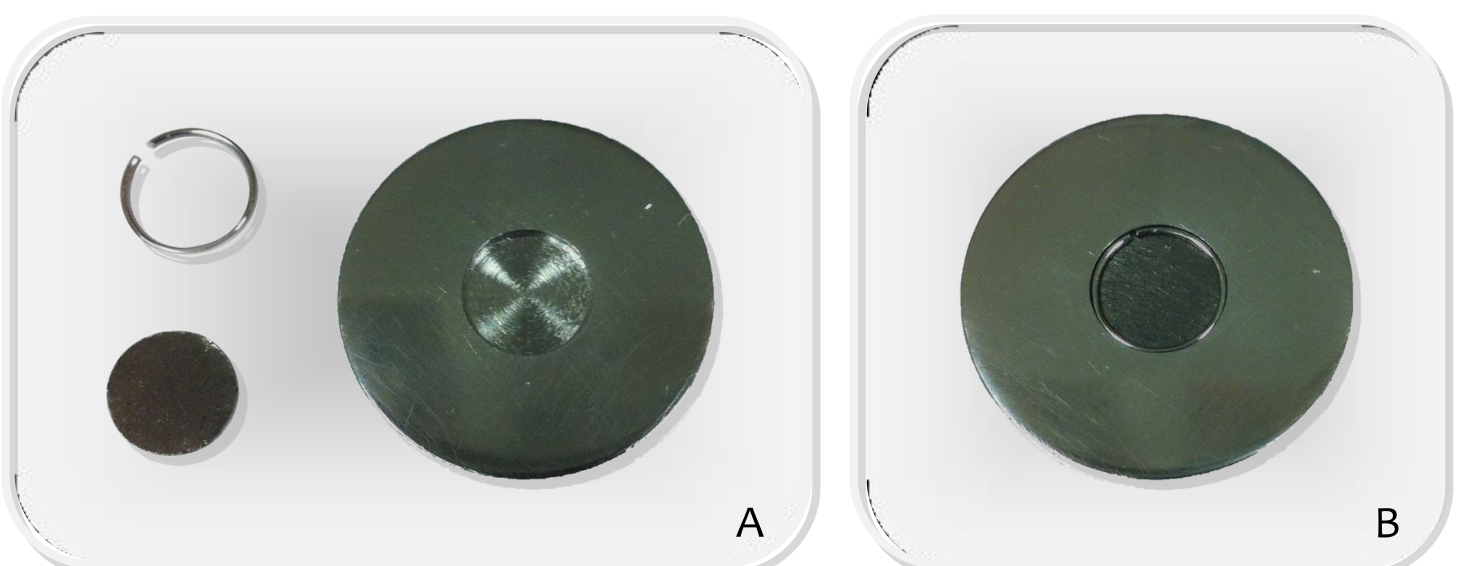


*Image 1: (A) Disassembled Pt target foil cradle, Y-foil and Pt containment ring. (B) Assembled target ready for irradiation.*

Typical irradiation parameters were 14.9MeV at 20-30 μA for 1.5-3.0 hours (90° angle of incidence). No visible damage or deformation of the Y-foil was observed at these beam intensities. The irradiated

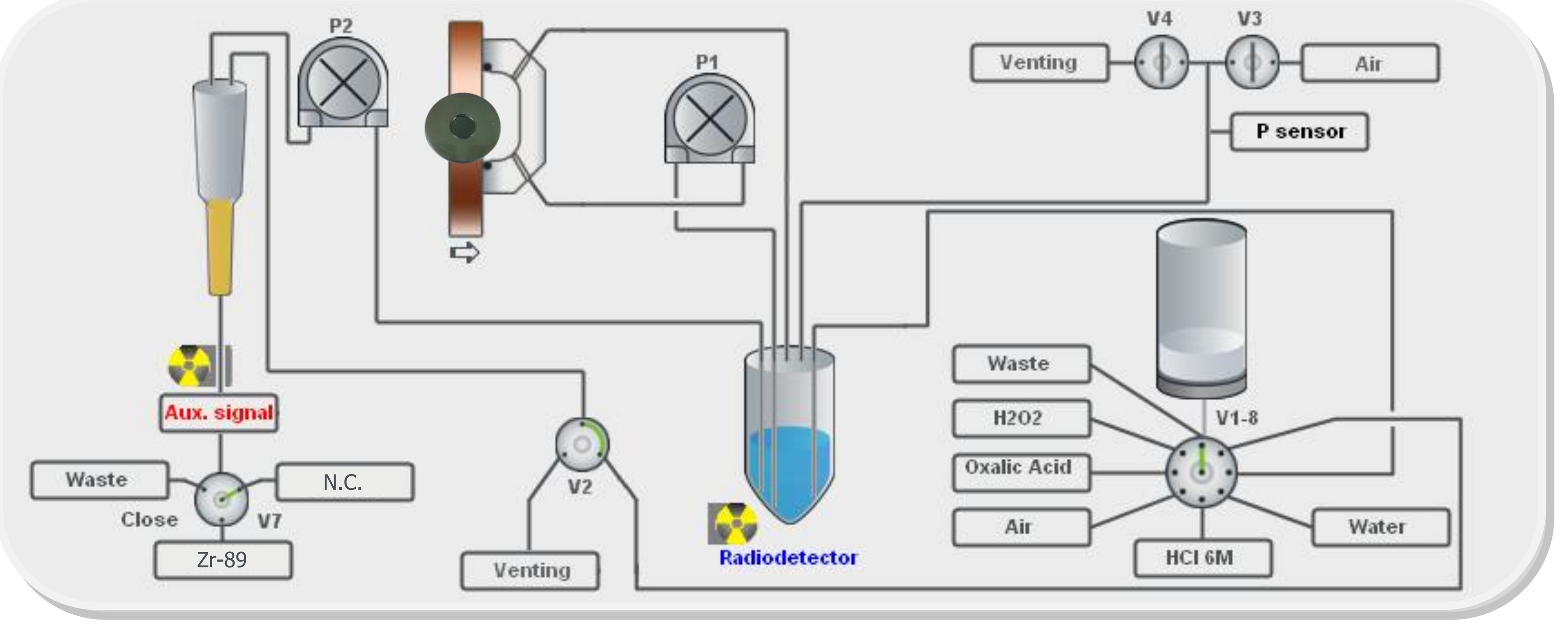


*Image 2: Schematic of IBA Pinctada Metal dissolution/purification module setup for $^{89}$Zr production.*

cradle, containing the $^{89}$Zr target was then loaded directly into the IBA Pinctada Metal module (1st Gen., see image 2) for dissolution/purification without disassembly (foil dissolved on Pt cradle).

We used the dissolution/purification method described by Holland et al. 2009 without modification.

*Image 3: Bio-Rad 10mL column filled with 100mg hydroximate resin (insoluble black material visible on top of resin after use).*

## Results

Image 4 shows the radioactive elution profile from the hydroximate resin column. $^{89}$Zr was eluted from the resin and collected in 1.0-1.2mL 1.0M oxalic acid at a flow rate of 0.7mL/min (start and duration of $^{89}$Zr collection determined by radioactive profile rather than fixed elution volumes).

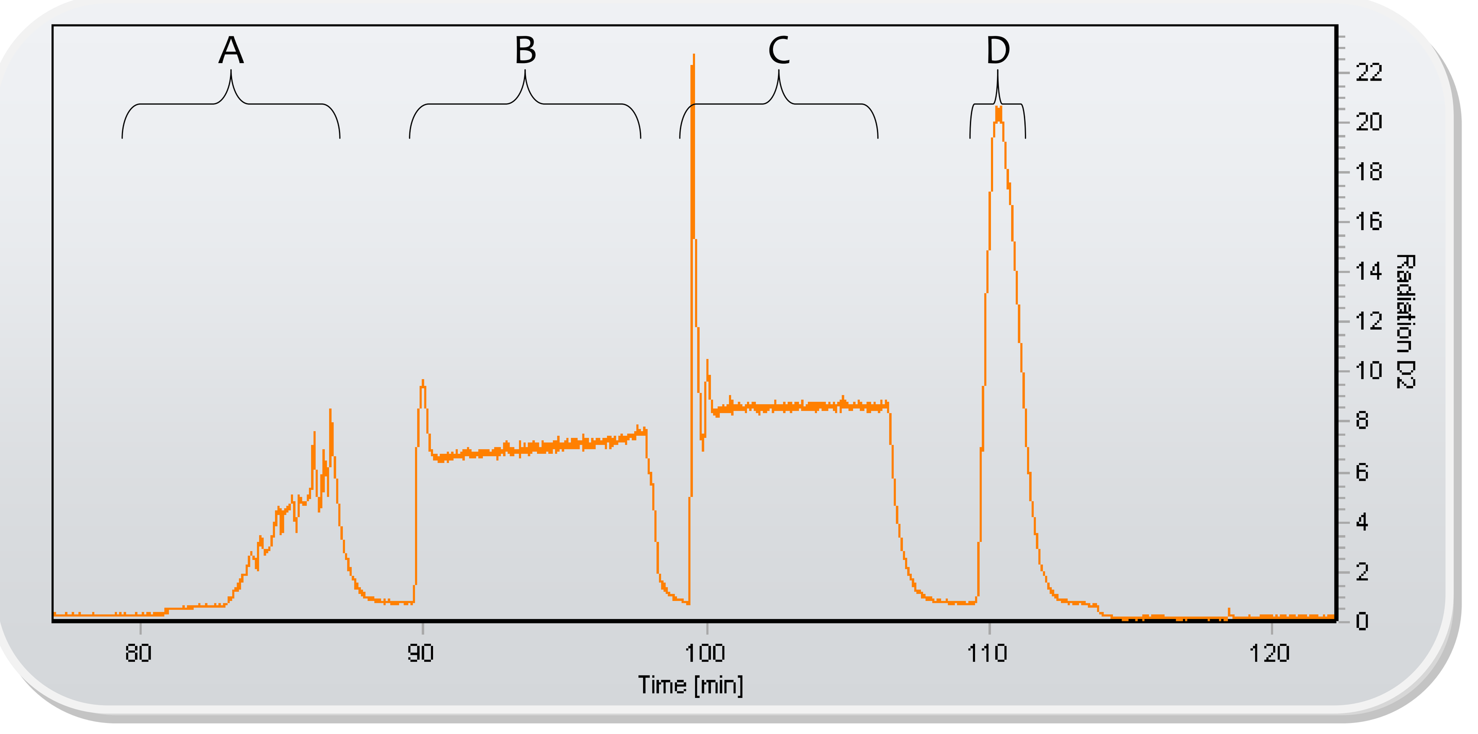


*Image 4: Radioactive elution profile from hydroximate resin column. A. Loading dissolved foil (in 2mL 6M HCl + 5mL H2O) onto resin, B. Washing resin with 10mL 2M HCl, C. Washing resin with 10mL $H_2O$, D. Elution of $^{89}$Zr with 1.0M oxalic acid in 1.0-1.2mL final volume.*

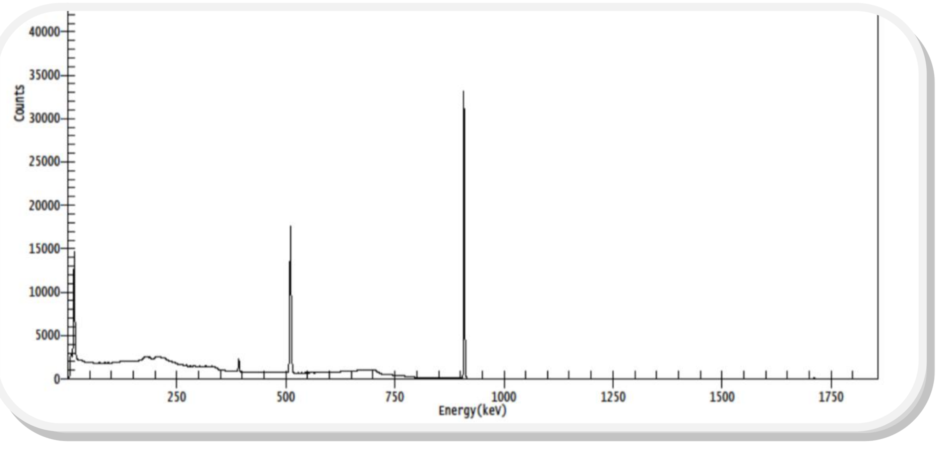

*Image 5: Spectrum of γ-ray emissions from a purified $^{89}$Zr sample 2hrs after EOB*

Since yttrium has one stable isotope only, relatively pure $^{89}$Zr is produced at low energy (14.9MeV).

Table 1 lists current production yields with various Y-foil thicknesses used.

| Y-foil thickness 8mm ∅ | Irradiation | Zr-89 Product EOS MBq (mCi) | D.C. EOB Yield MBq (mCi) / uAh |
|---|---|---|---|
| 0.127mm | 20μA 1.5h | 381 (10.3) | 13.0 (0.35) |
| 0.254mm (2x0.127) | 25μA 2.0h | 1110 (30.0) | 22.6 (0.61) |
| 0.127mm | 28μA 1.4h | 451 (12.2) | 11.5 (0.31) |
| 0.250mm | 30μA 3.0h | 1980 (53.5) | 22.6 (0.61) |

*Table 1: Production summary*

## Conclusion

In these preliminary productions, average purified $^{89}$Zr yield for 0.127mm thick Y-foils was 12.2MBq(0.33mCi)/μAh and 22.6MBq (0.61mCi)/μAh for 0.250mm thickness was achieved, in comparison to an average of 52.7MBq(1.43mCi)/μAh reported by Holland et al. 2009 (at 10° angle of incidence, 0.1mm thick foil).

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