



Radiochemical separations for Pb-203/Pb-212 radiopharmaceuticals

Mengshi Li PhD

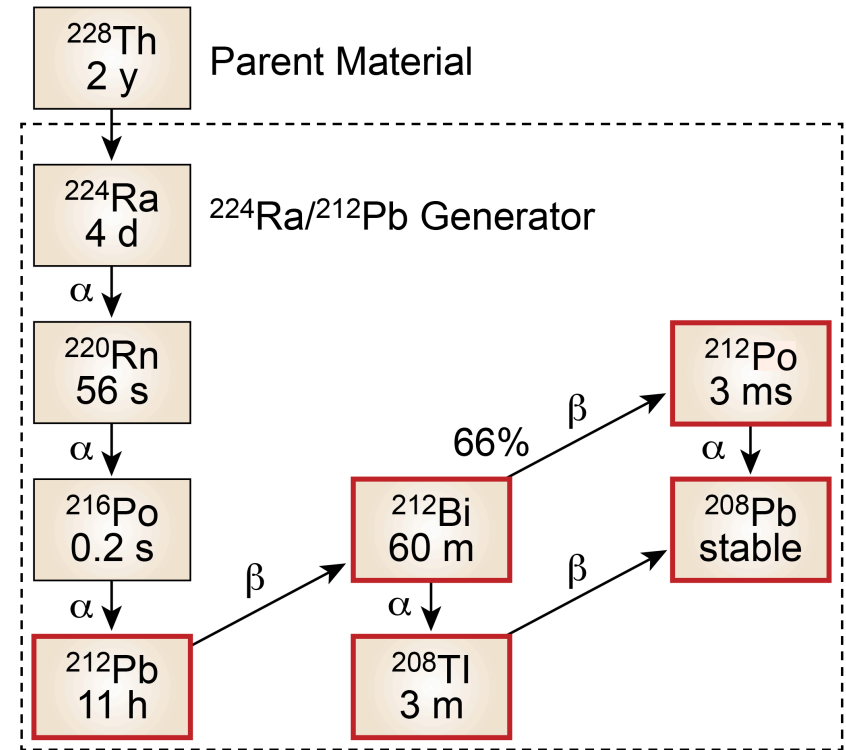
Principal Scientist, Viewpoint Molecular Targeting, Inc.

April 30th 2021

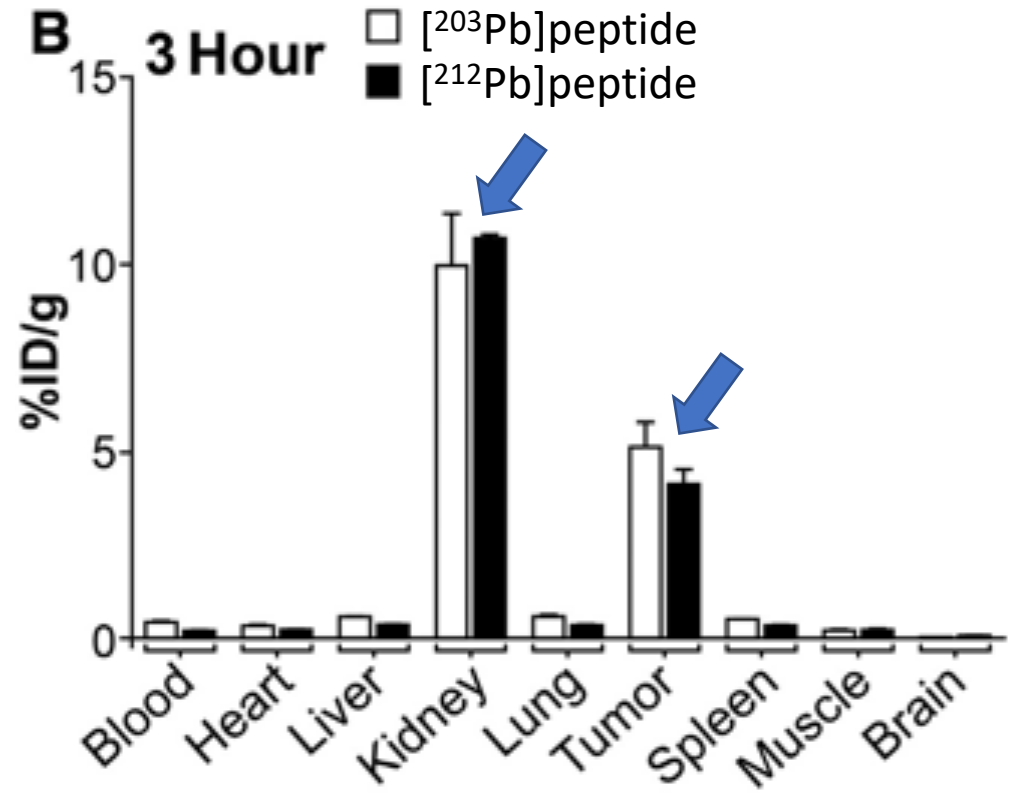
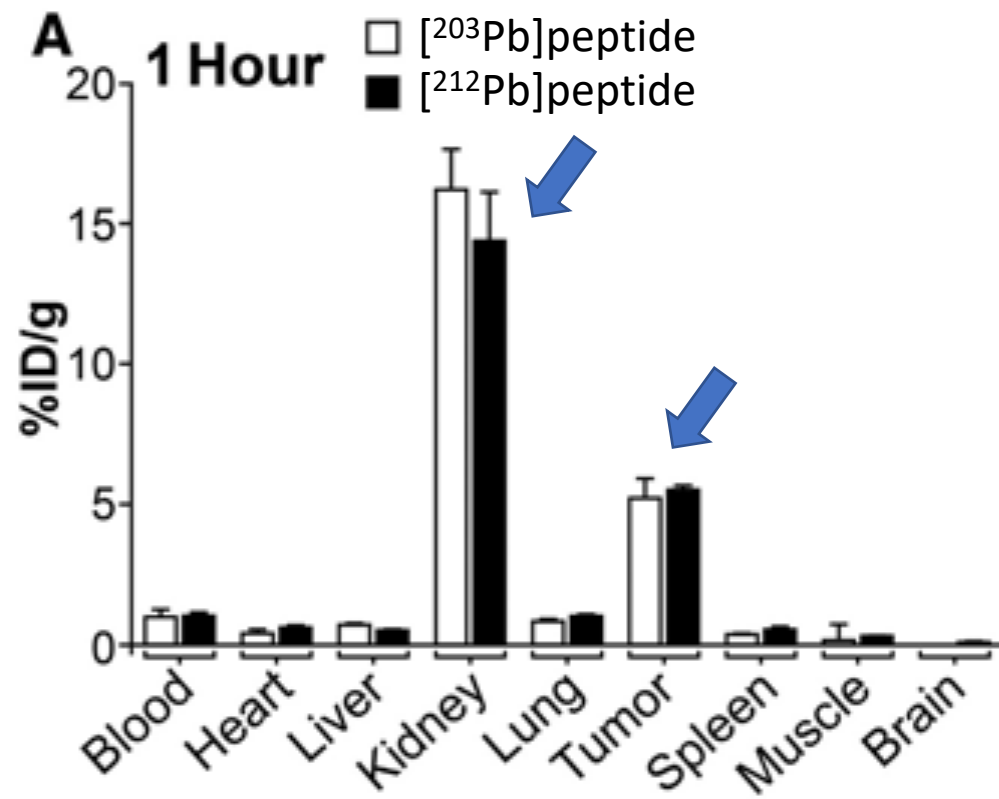
Pb-203 and Pb-212 as Elementally Matched Radioisotopes

Parent Nucleus	Parent E(level)	Parent J π	Parent T _{1/2}	Decay Mode	GS-GS Q-value (keV)	Daughter Nucleus	Decay Scheme	ENSDF file
²⁰³ ₈₂ Pb	0	5/2-	51.92 h 3	ϵ : 100 %	975 6	²⁰³ ₈₁ Tl		

	Energy (keV)	Intensity (%)	Dose (MeV/Bq-s)
XR 1	10.3	36.4 % 15	0.00375 15
XR k α 2	70.832	26.4 % 6	0.0187 4
XR k α 1	72.873	44.2 % 9	0.0322 6
XR k β 3	82.115	5.34 % 11	0.00438 9
XR k β 1	82.574	10.22 % 21	0.00844 17
XR k β 2	84.865	3.73 % 8	0.00316 7
	279.1952 10	80.9 %	0.226
	401.320 3	3.35 % 10	0.0134 4
	680.515 3	0.75 % 3	0.00513 17

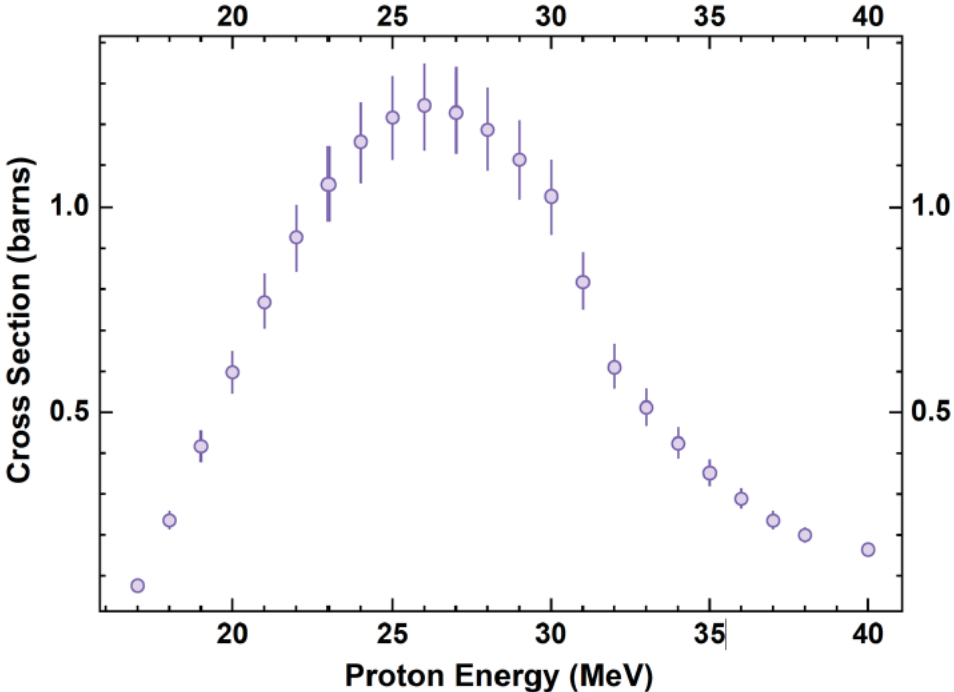


Pb-203 and Pb-212 as Elementally Matched Radioisotopes

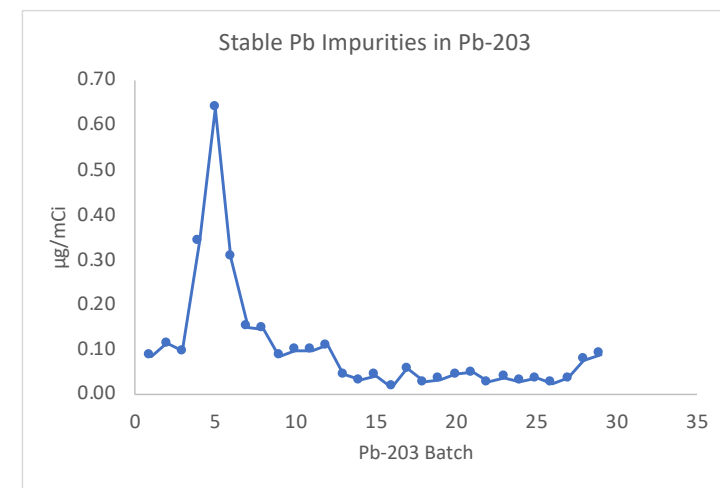
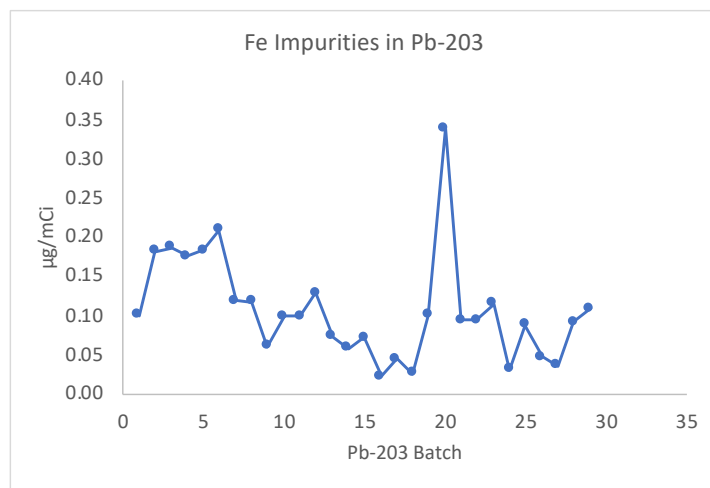
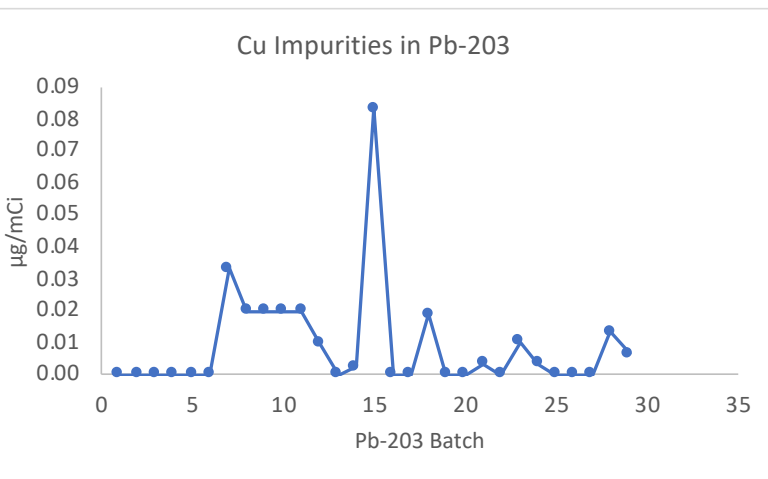
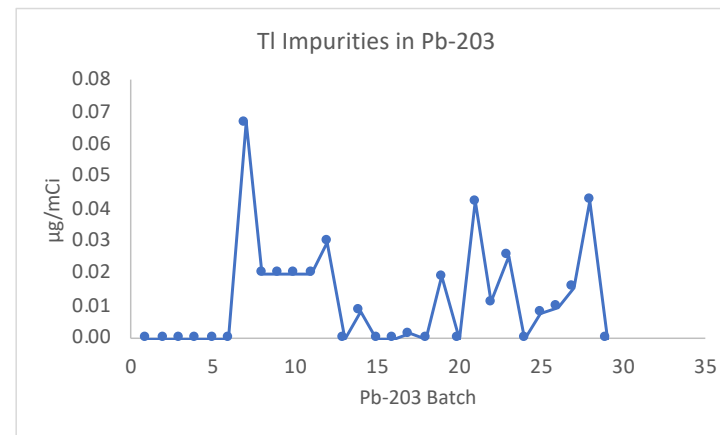
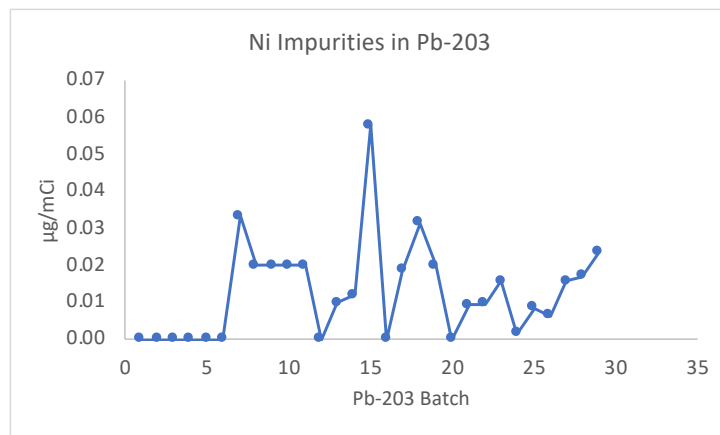
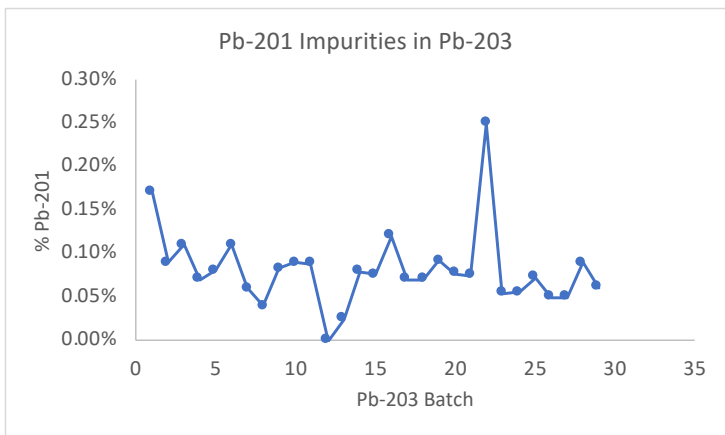


Nuclear reactions and daughter products from ^{203}Tl and ^{205}Tl , as provided by Lantheus Medical Imaging

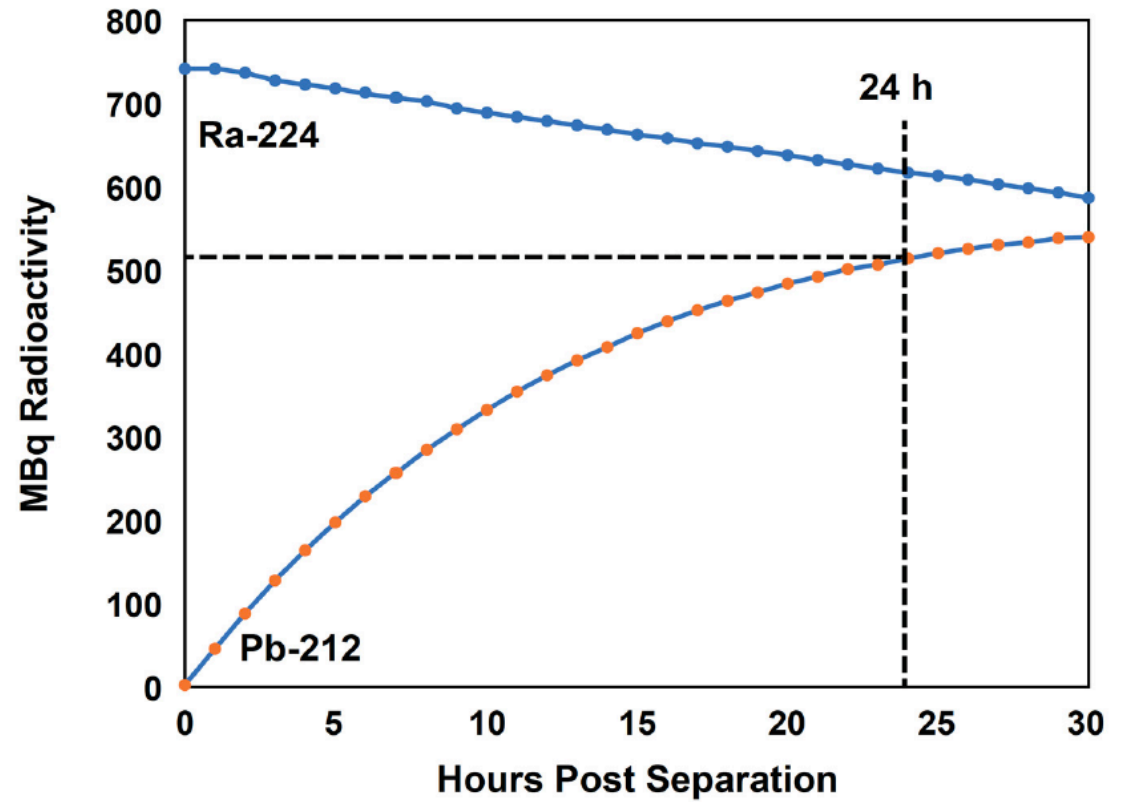
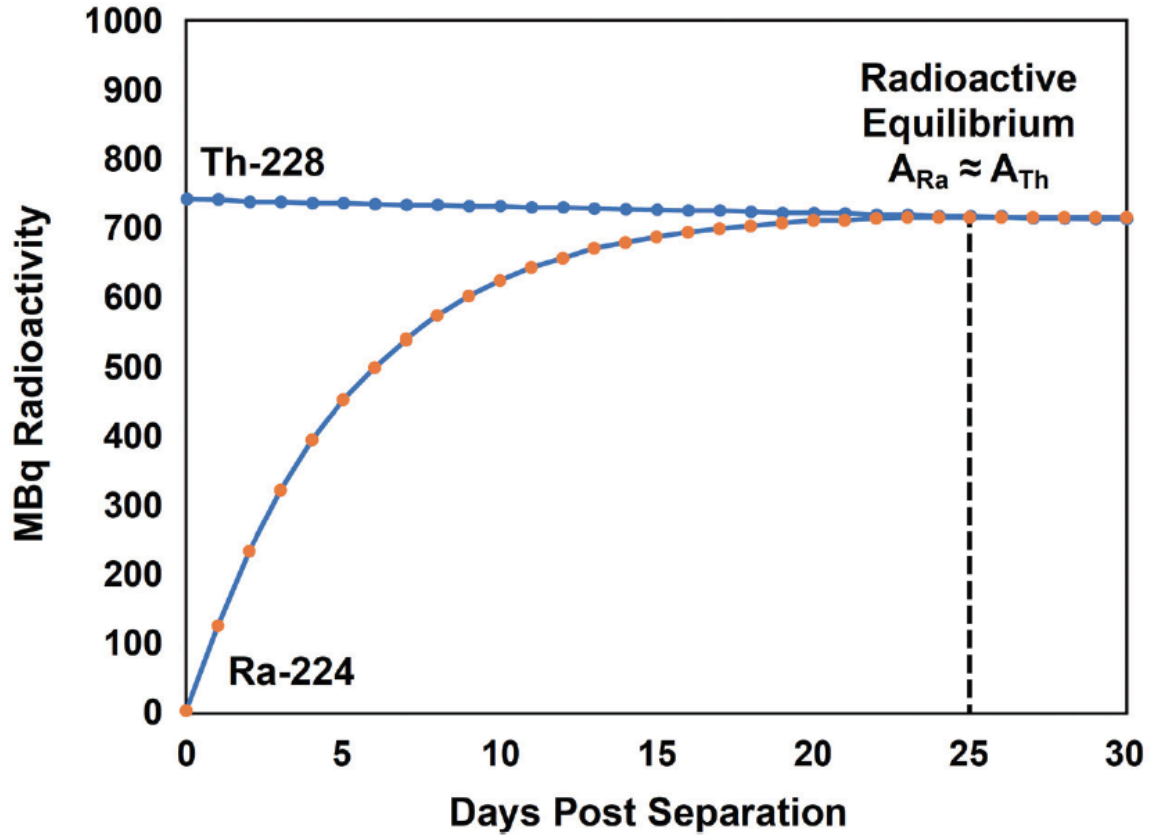
Nuclear Reactions	
$^{205}\text{Tl}(p,3n)^{203}\text{Pb}$	$t_{1/2} = 52 \text{ h}$
$^{203}\text{Tl}(p,3n)^{201}\text{Pb}$	$t_{1/2} = 9 \text{ h}$
$^{205}\text{Tl}(p,2n)^{204m}\text{Pb}$	$t_{1/2} = 1 \text{ h}$ ←
Daughter Products	
$^{203}\text{Pb} \rightarrow ^{203}\text{Tl}$	Stable
$^{201}\text{Pb} \rightarrow ^{201}\text{Tl}$	$t_{1/2} = 73 \text{ h}$
$^{204m}\text{Pb} \rightarrow ^{204}\text{Pb}$	Stable ←



CoA records for ^{203}Pb batches



$^{224}\text{Ra}/^{212}\text{Pb}$ Progeny





203/212 ²¹²Pb Theranostic Radiopharmaceuticals for Image-guided Radionuclide Therapy for Cancer



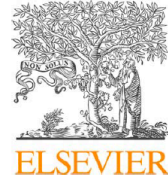
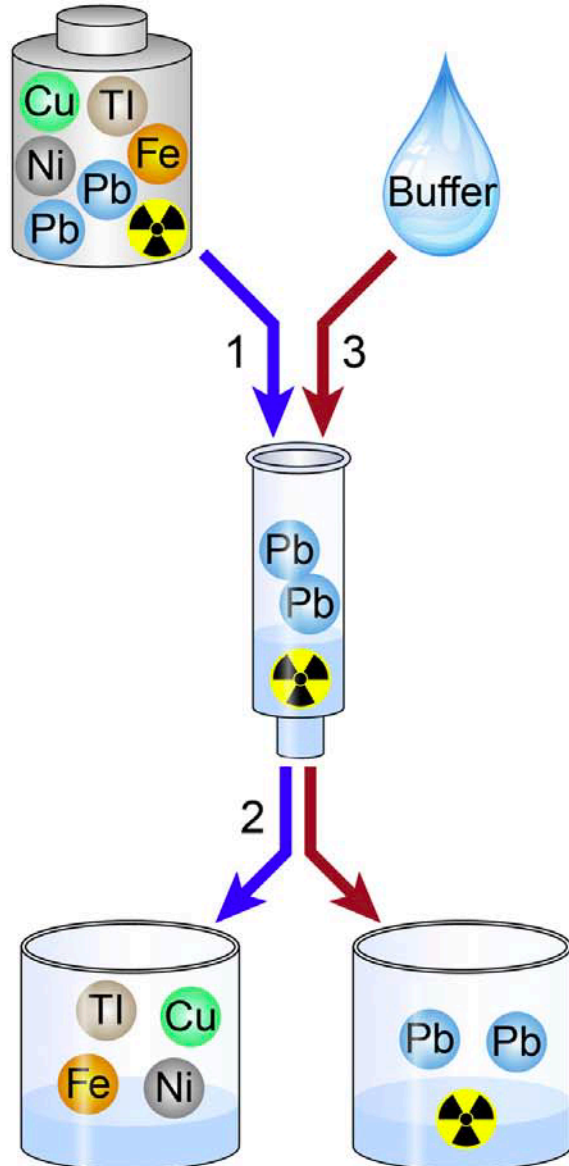
Mengshi Li^{1,2}, Edwin A. Sagastume², Dongyoul Lee³, Daniel McAlister⁴, Anthony J. DeGraffenreid⁵, Keith R. Olewine⁵, Stephen Graves¹, Roy Copping⁶, Saed Mirzadeh⁶, Brian E. Zimmerman⁷, Roy H. Larsen⁸, Frances L. Johnson^{2,9} and Michael K. Schultz^{1,2,3,10,*}

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111

Purification of $^{203/212}\text{Pb}$ Radioisotopes

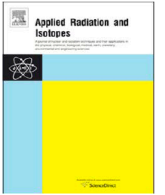
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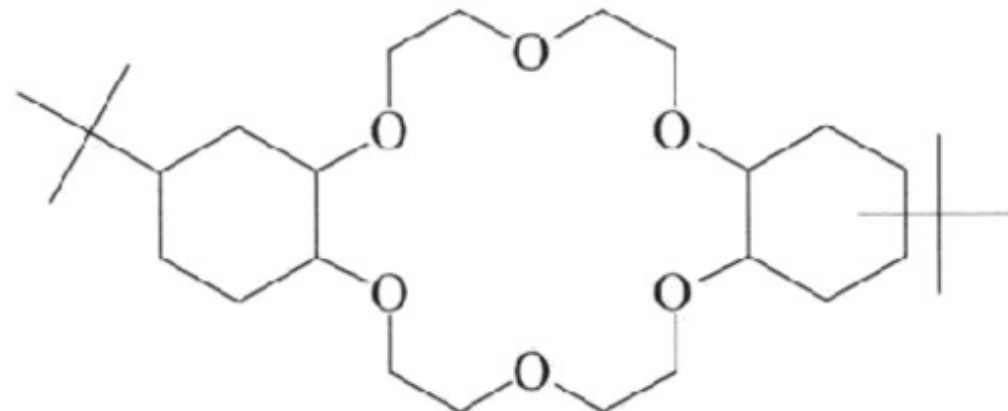


Automated cassette-based production of high specific activity [$^{203/212}\text{Pb}$] peptide-based theranostic radiopharmaceuticals for image-guided radionuclide therapy for cancer

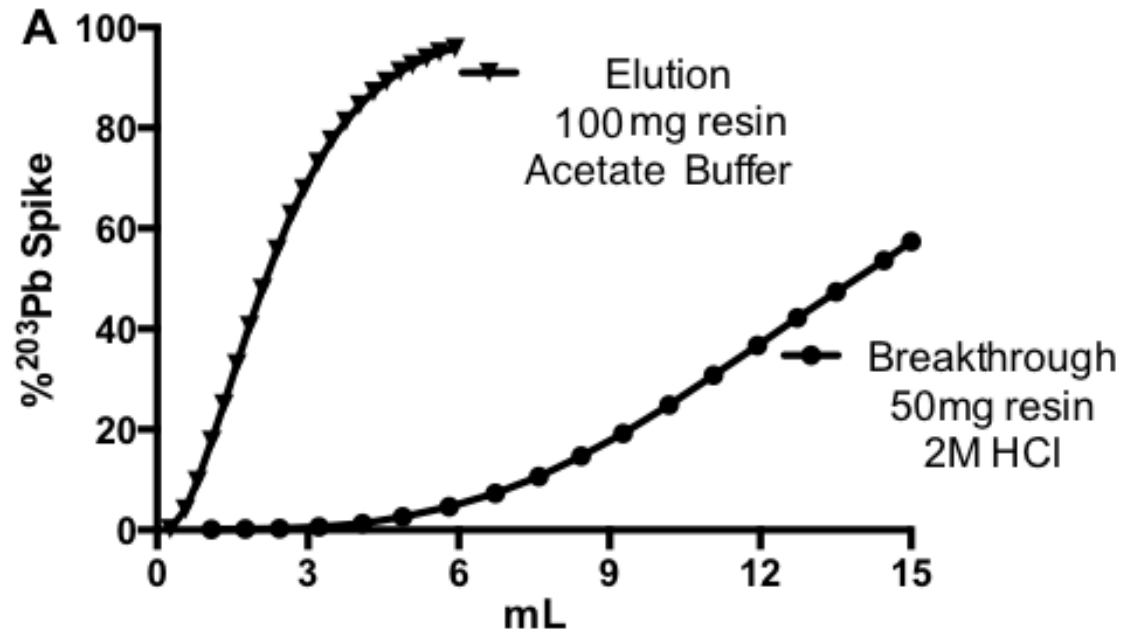
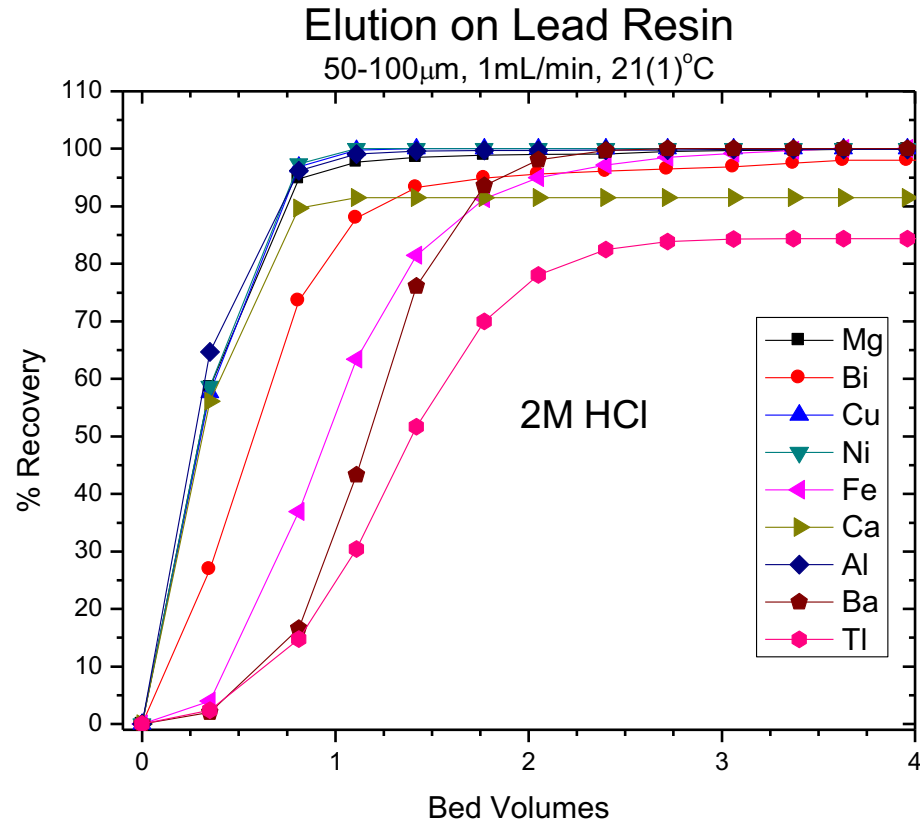


Mengshi Li^{a,1}, Xiuli Zhang^b, Thomas P. Quinn^b, Dongyoul Lee^a, Dijie Liu^c, Falk Kunkel^d, Brian E. Zimmerman^e, Daniel McAlister^f, Keith Olewein^g, Yusuf Menda^h, Saed Mirzadehⁱ, Roy Coppingⁱ, Frances L. Johnson^{j,k}, Michael K. Schultz^{a,c,h,j,l,m,*}

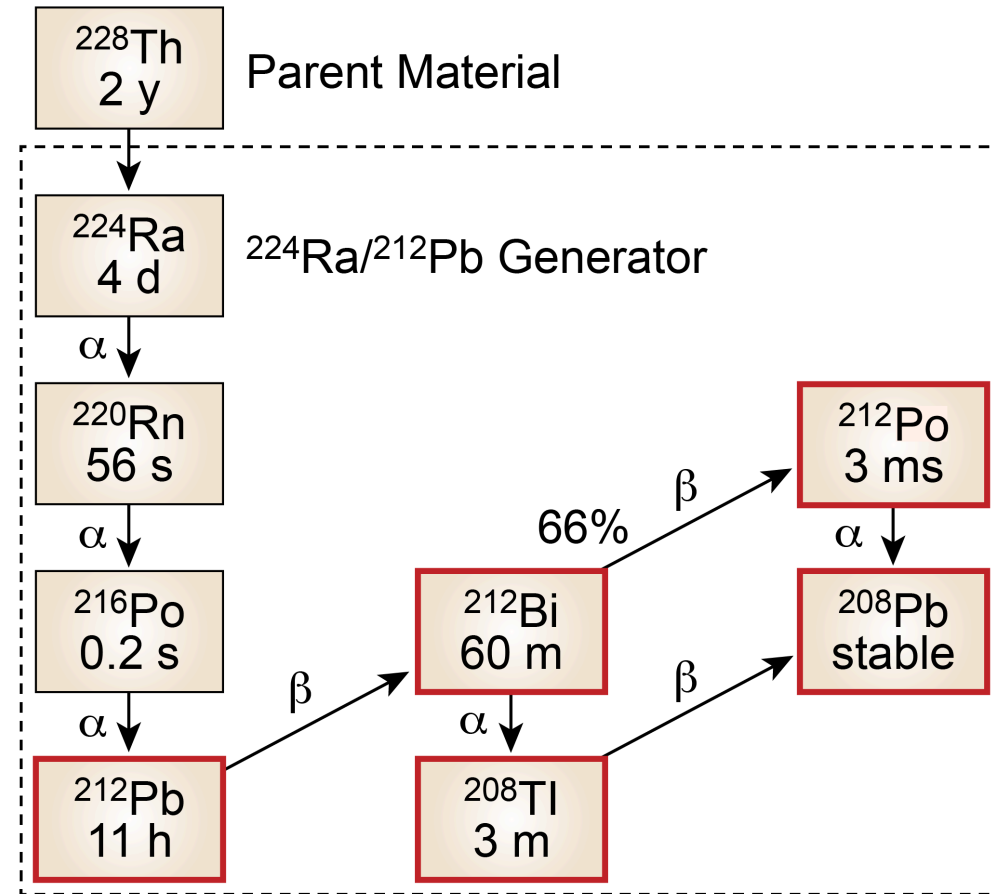
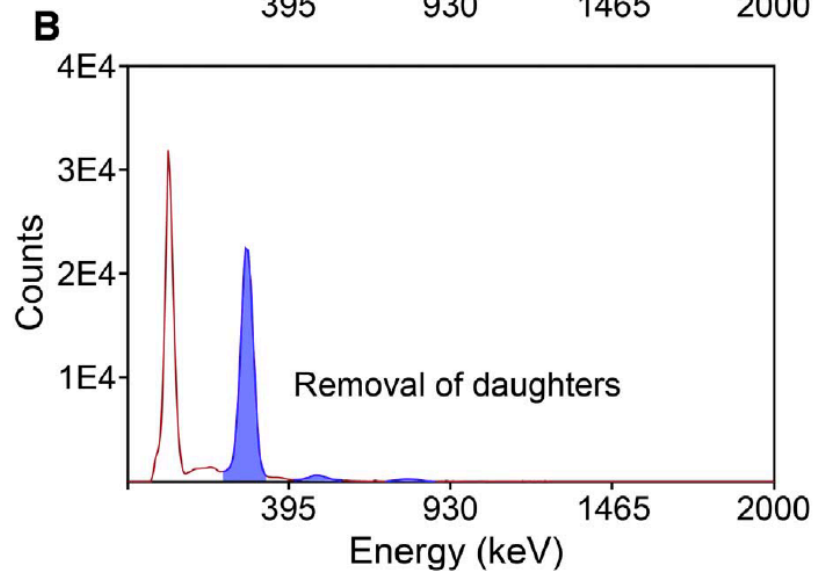
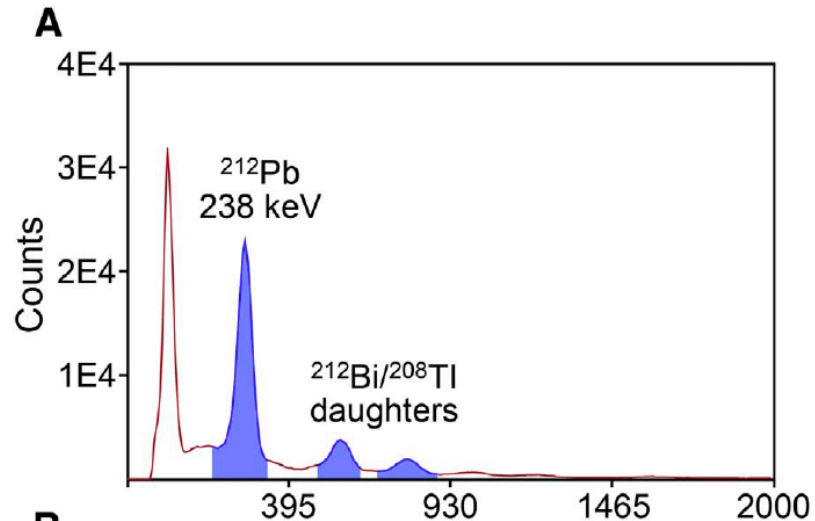
4,4'(5')-di-*t*-butylcyclohexano 18-crown-6



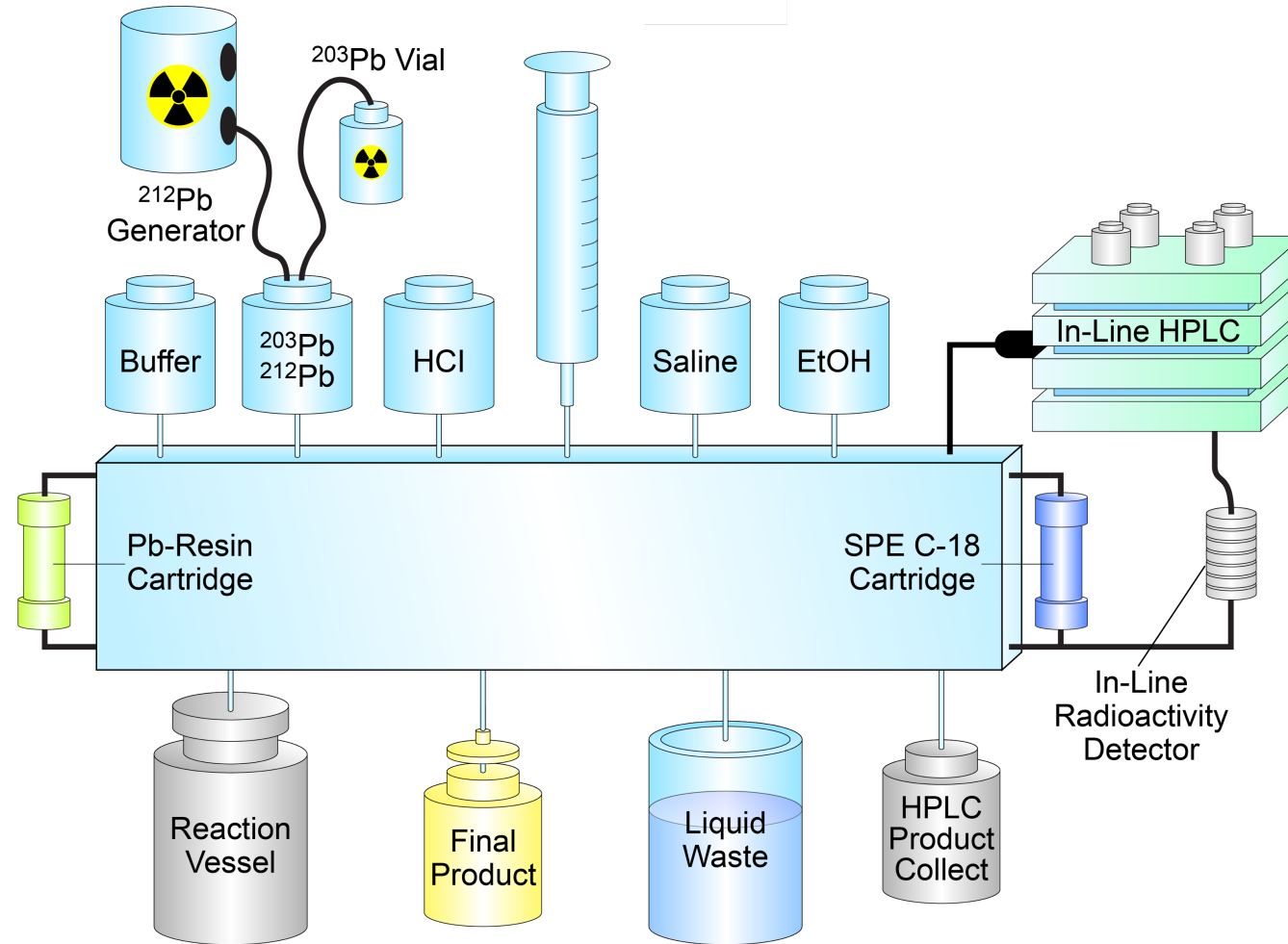
Purification of Pb isotopes on Pb-resin



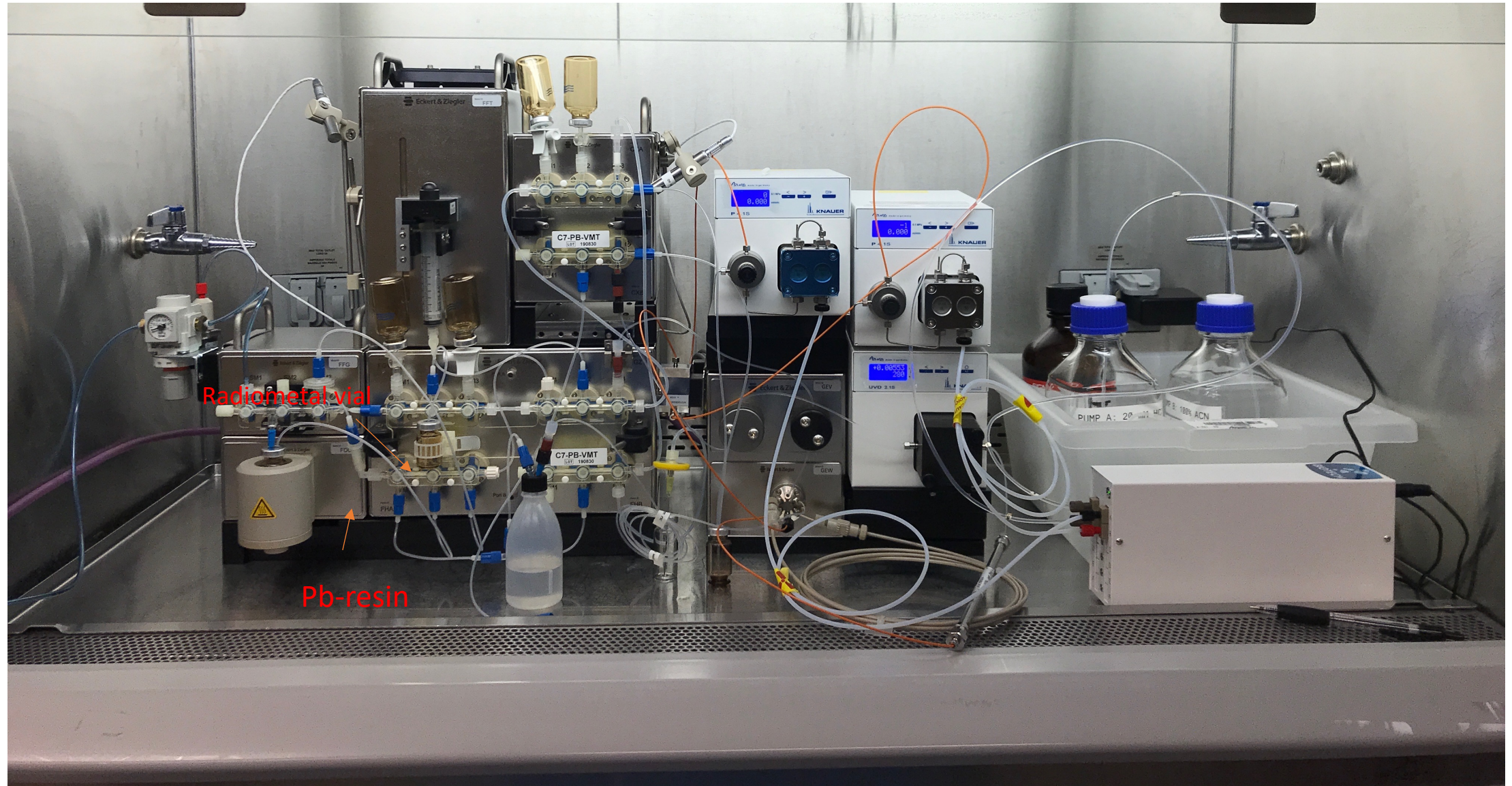
Purification of Pb-212 from Ra-224 Decay Chain



Production of Pb-203/Pb-212 radiopharmaceutical with in-line HPLC



Set up for clinical production with in-line HPLC



50 mCi input

↓

60-70% total yield

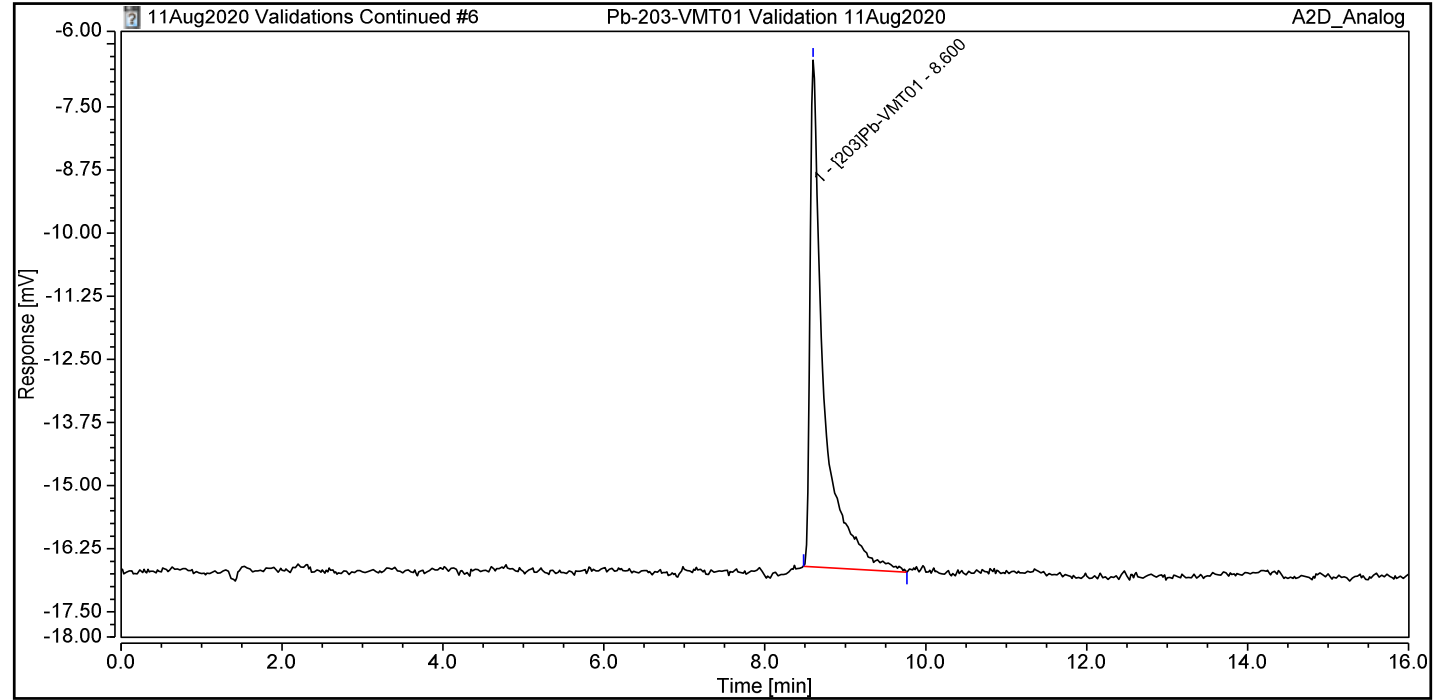
↓

30-35 mCi Final product

Chromatogram and Results

Injection Details		
Injection Name:	Pb-203-VMT01 Validation 11Aug2020-validation 1 t=0	Run Time (min): 16.00
Vial Number:	5	Injection Volume: 20.00
Injection Type:	Unknown	Channel: A2D_Analog
Calibration Level:		Wavelength: 280
Instrument Method:	(203PB)VMT01QC	Bandwidth: n.a.
Processing Method:	203PbVMT01 PROCESSING METHOD	Dilution Factor: 1.0000
Injection Date/Time:	11/Aug/20 20:23	Sample Weight: 1.0000

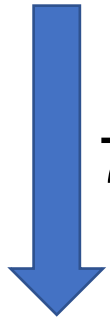
Chromatogram



Integration Results							
No.	Peak Name	Retention Time min	Area mV*min	Height mV	Relative Area %	Relative Height %	Amount
1	[203]Pb-VMT01	8.600	1.997	10.038	100.00	100.00	n.a.
Total:			1.997	10.038	100.00	100.00	

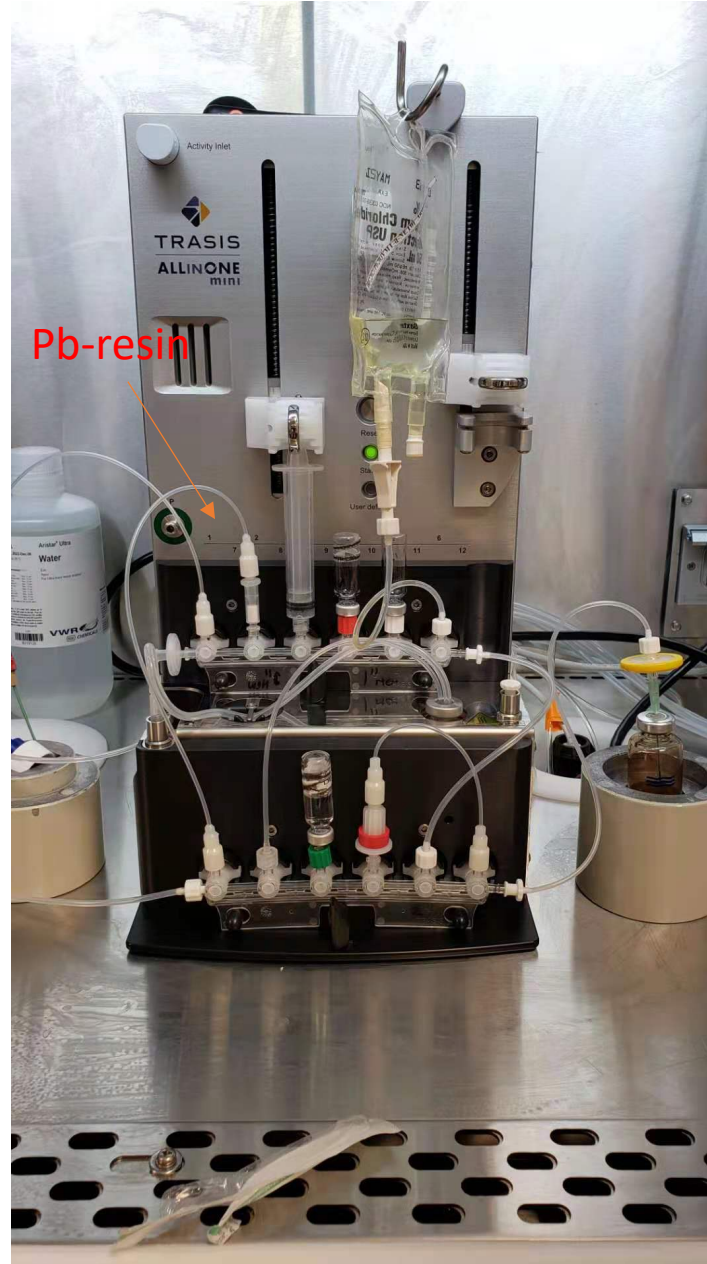
Set up for clinical production without in-line HPLC

25-30 mCi input



70-80% total yield

17-25 mCi Final product



Acknowledgements

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