

Automated Preparation of ^{211}At for Targeted Alpha Therapy Applications

GRAHAM MARSHALL

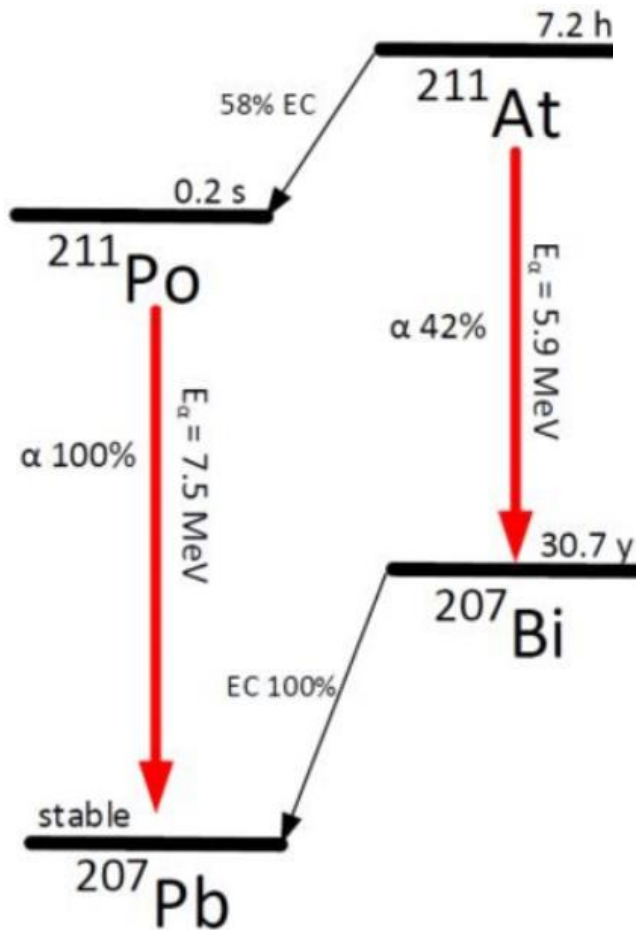
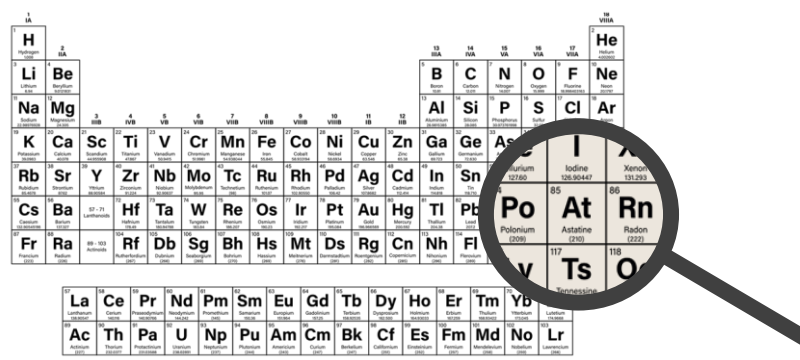
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MATTHEW O'HARA



^{211}At



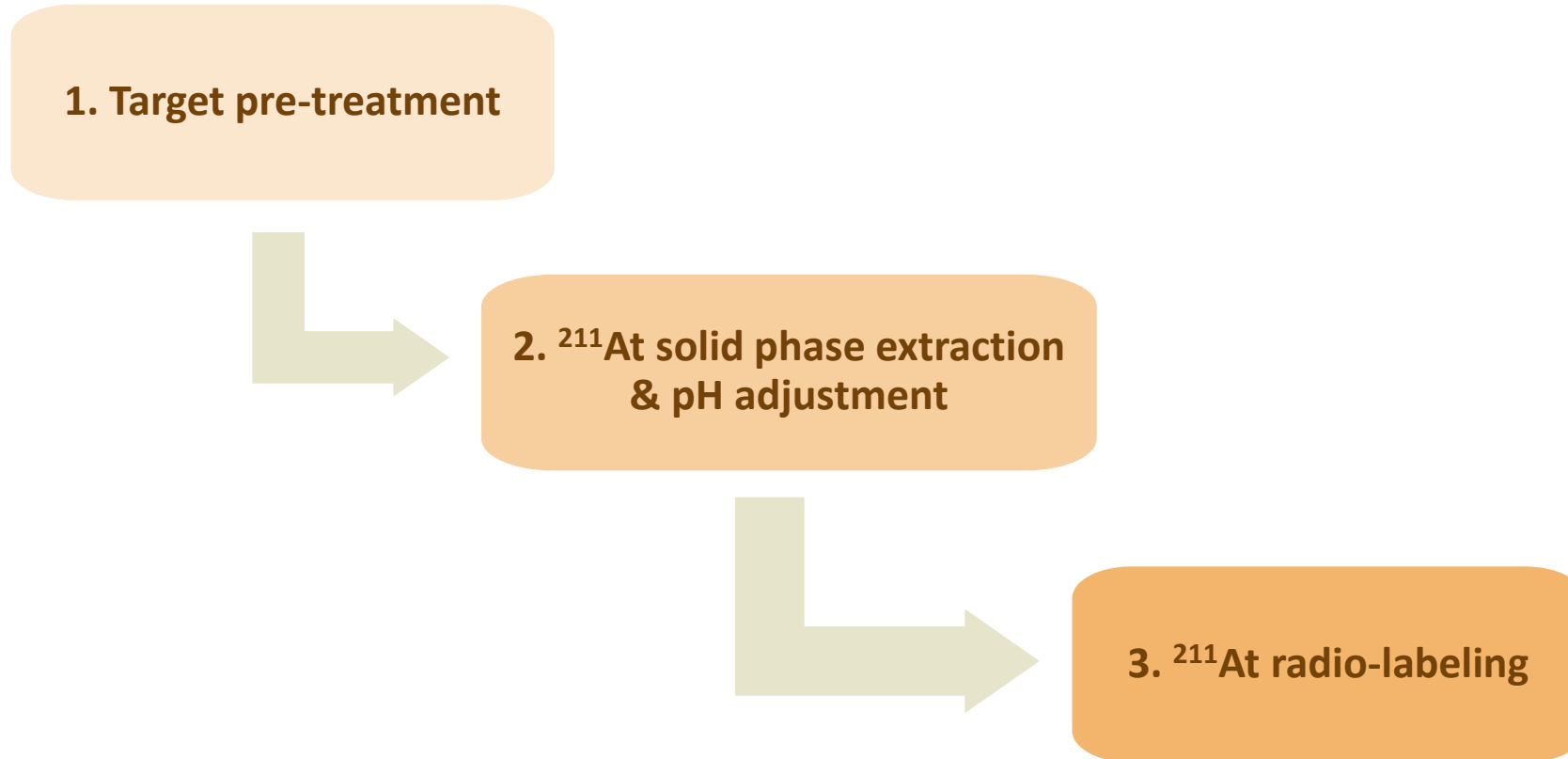
Present US cyclotrons capable of producing ^{211}At
 University of Washington
 Texas A&M
 Duke University
 University of Michigan
 Penn Medicine
 Crocker Nuclear Laboratory, UC Davis
 NIH – Bethesda

Objective

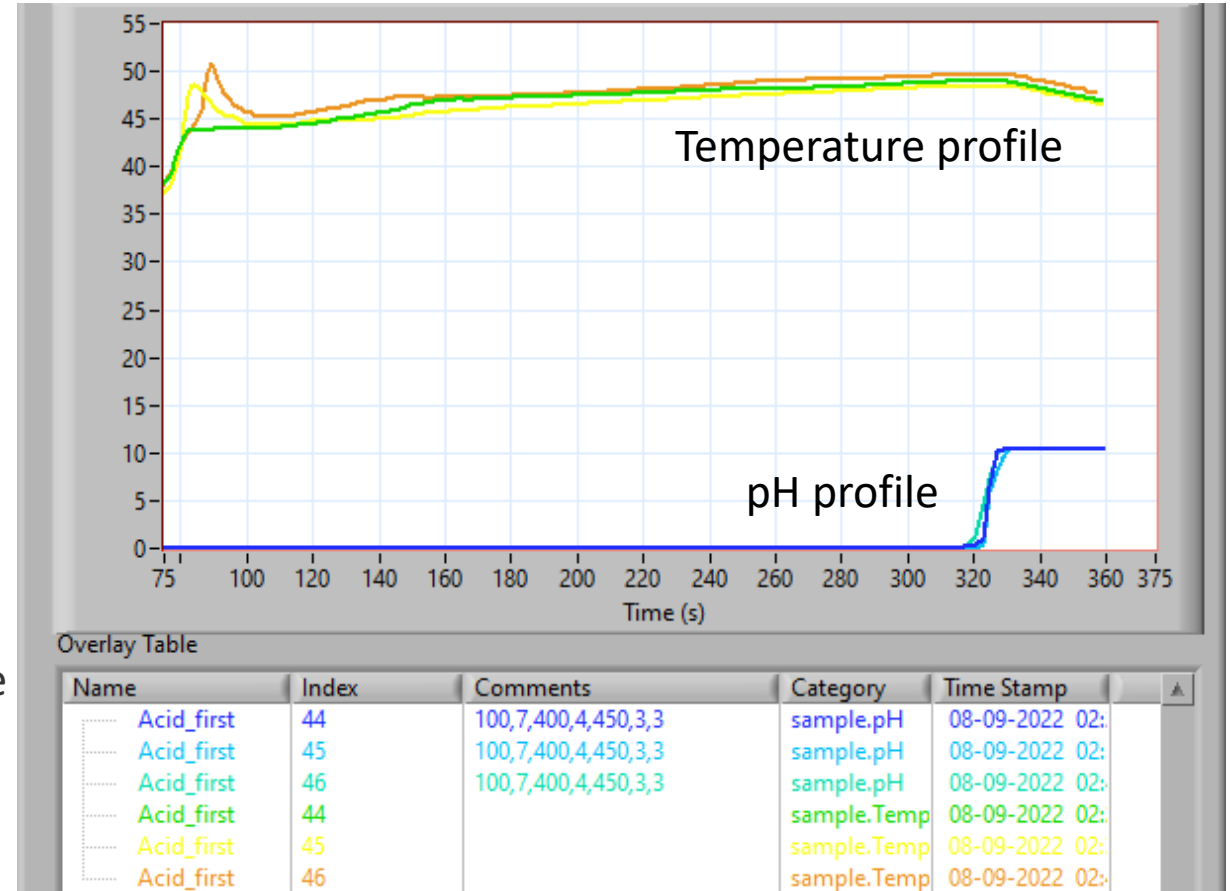
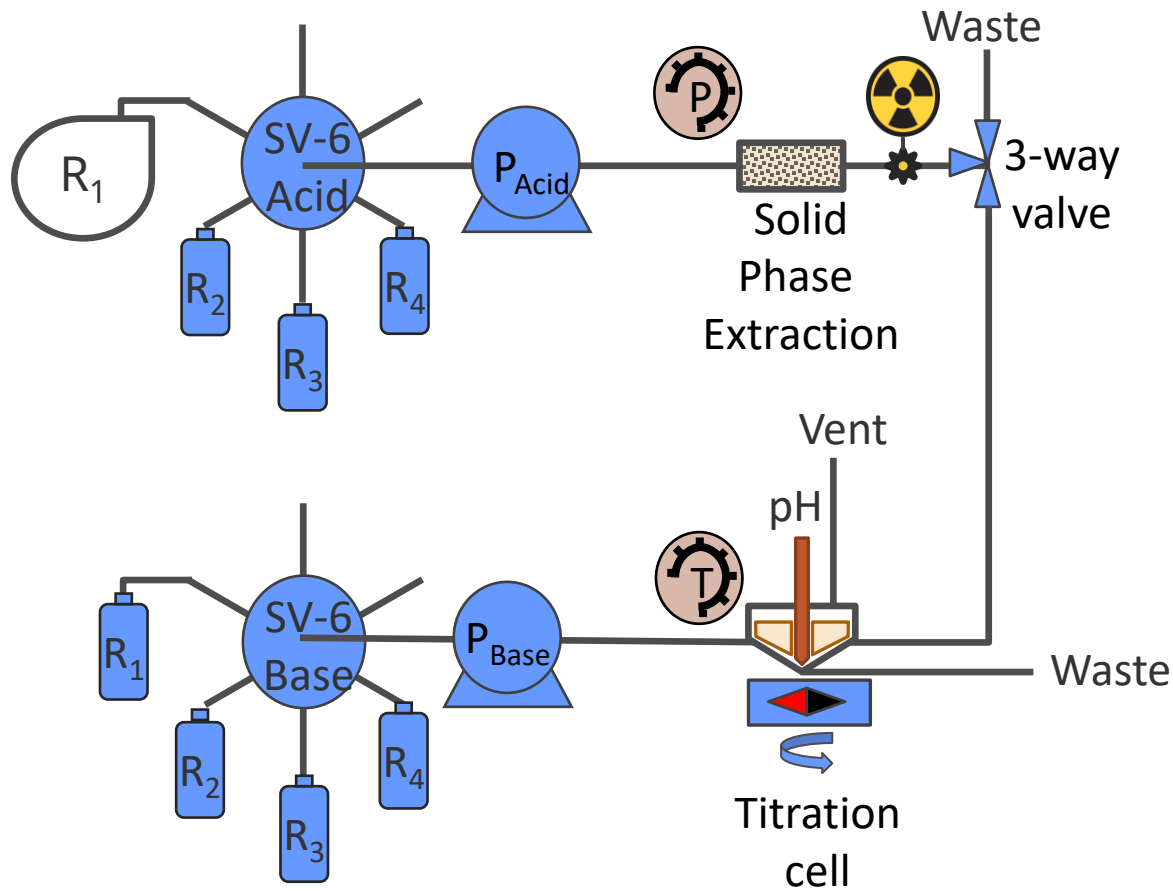
DOE Office of Nuclear Physics primary goal - support research and development of methods and technologies that assure availability of critical radioisotopes.

Objective of this work – Develop a platform that will isolate both research and therapeutic quantities of ^{211}At in a rapid, automated, and safe manner

Purification Scheme



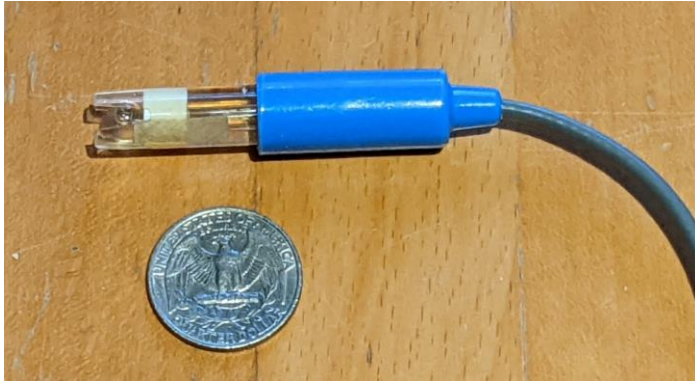
Neutralization of SPE Eluent



pH Titration



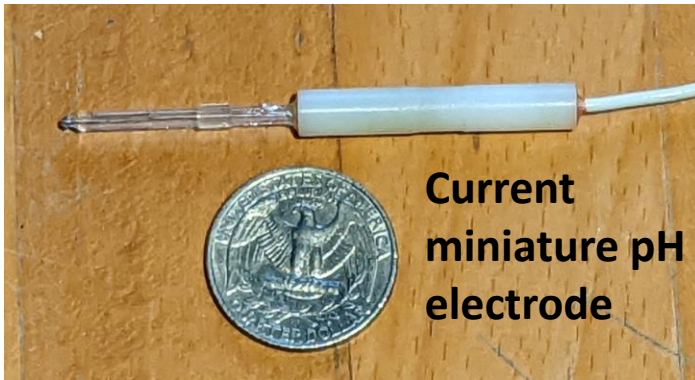
ISPHET



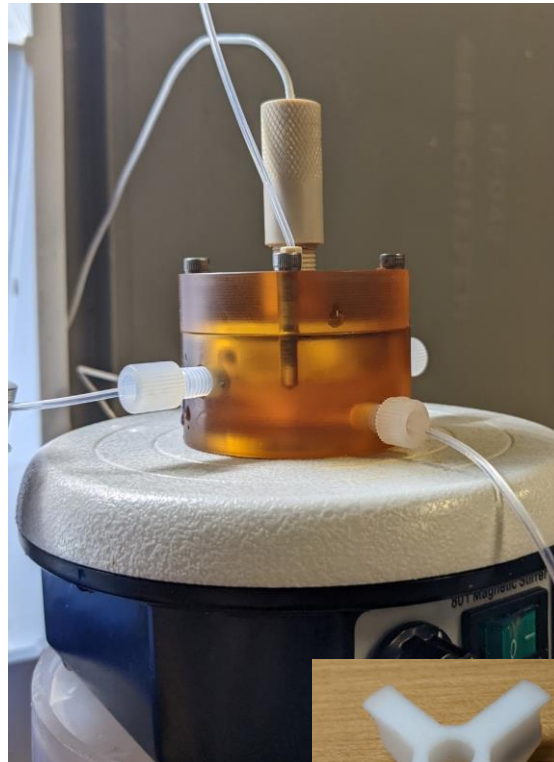
6mm combination electrode



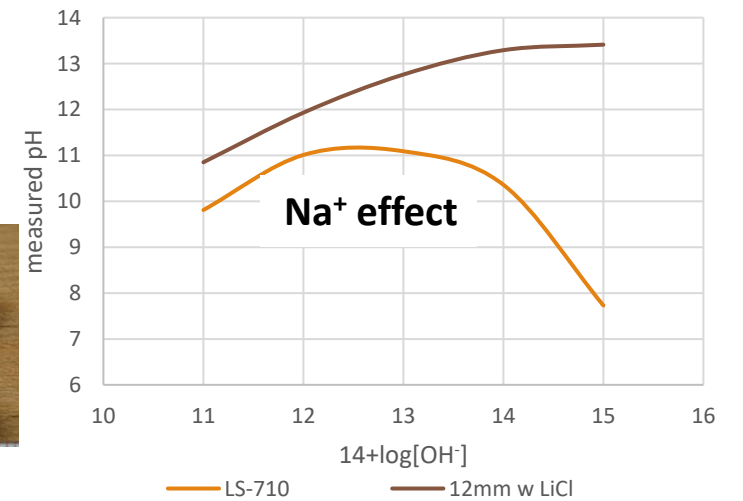
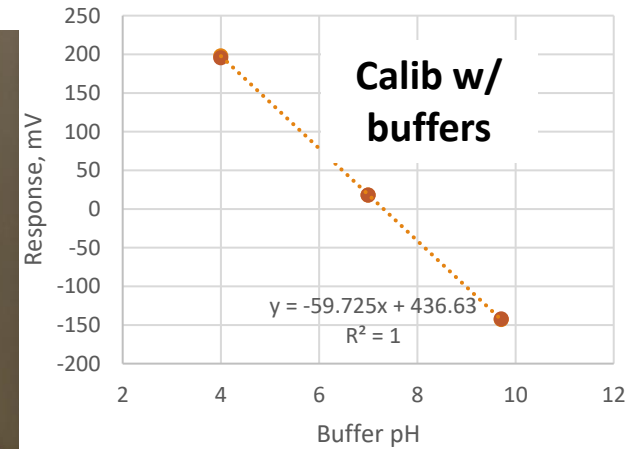
1/4-28 fitting
Separate pH & Ref

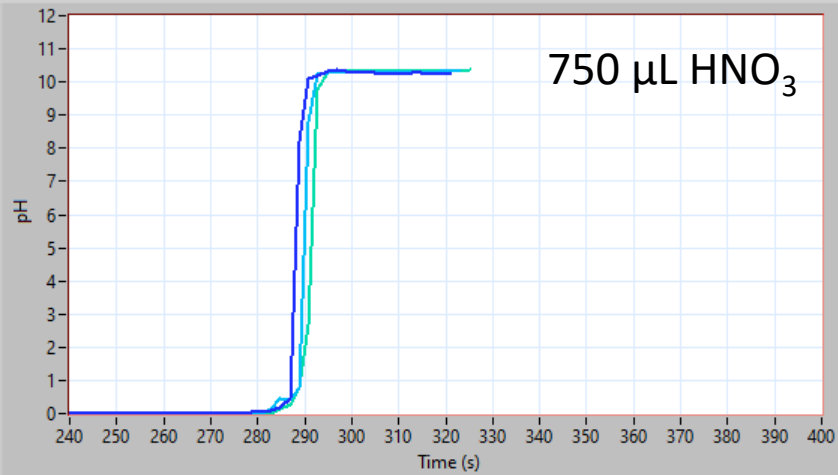


Current miniature pH electrode



Titration cell & magnet



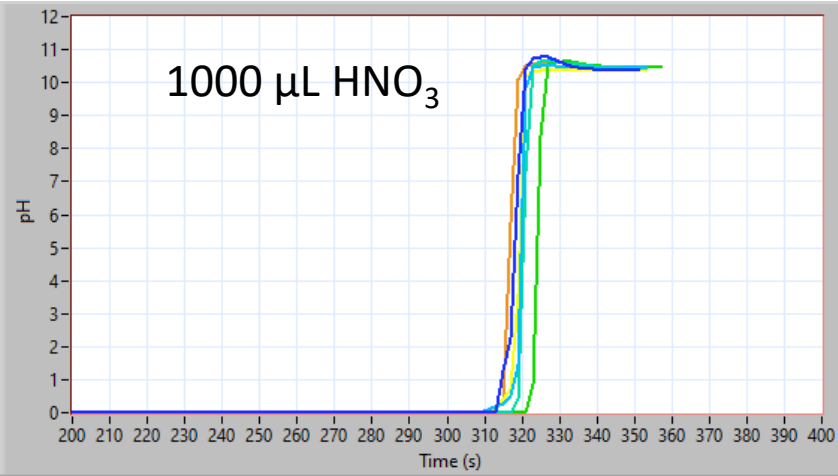


750 µL HNO₃

Trial	Actual pH (12mm)	NaOH vol, µL	Molarity (M)
24	11.7	732.9	10.2
25	12.0	738.4	10.2
26	12.2	745.0	10.1
average	12.0	738.7	10.2
SD			0.0830
%RSD			0.82%

Overlay Table

Name	Index	Comments	End pH	HNO3 Vol	NaOH Vol	Temp Max
Acid_first	24	50,4,400,3,250,2,5,2,5	10.250000	750	732.900653	54.560000
Acid_first	25	50,4,400,3,250,2,5,2,5	10.320000	750	738.352662	53.630000
Acid_first	26	50,4,400,3,250,2,5,2,5	10.350000	750	744.968929	54.560000

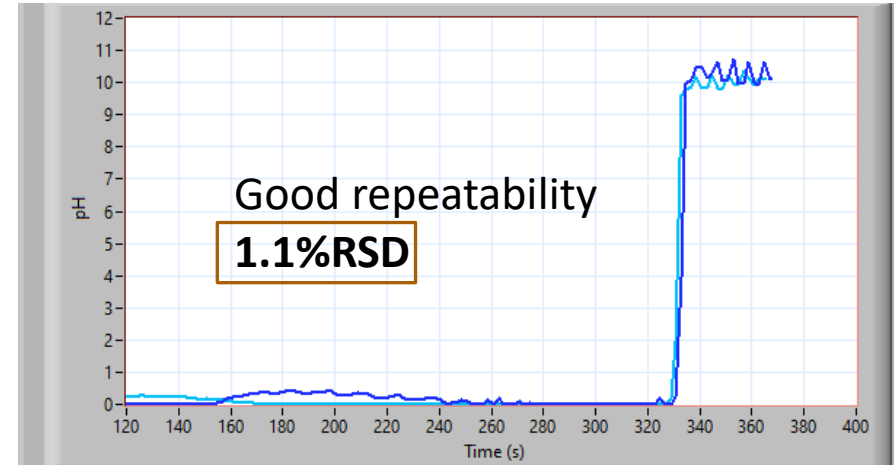


1000 µL HNO₃

Trial	Actual pH (12mm)	NaOH vol, µL	Molarity, M
13	12.1	978.1	10.2
14	12.3	990.4	10.1
16	12.2	989.8	10.1
17	12.2	1001.1	10.0
19	12.2	987.4	10.1
20	12.1	982.9	10.2
21	11.9	976.3	10.2
average	12.1	986.6	10.1
SD			0.08666
%rsd			0.85%

Overlay Table

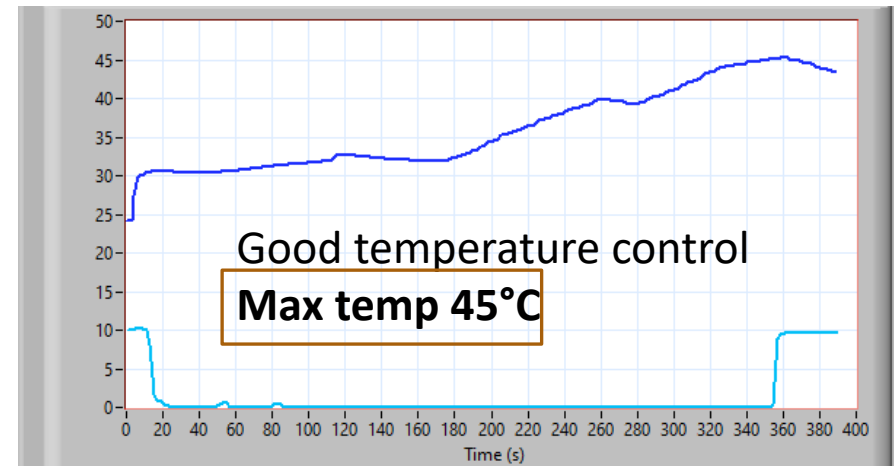
Name	Index	Comments	End pH	HNO3 Vol	NaOH Vol	Temp Max
Acid_first	13	100,5,400,4,450,3,3	10.400000	1000	978.711854	54.060000
Acid_first	14	100,5,400,4,450,3,3	10.460000	1000	990.424104	53.750000
Acid_first	16	100,5,400,4,450,3,3	10.430000	1000	989.778745	55
Acid_first	17	100,5,400,4,450,3,3	10.440000	1000	1001.136355	48.190000
Acid_first	19	100,5,400,4,450,3,3	10.390000	1000	987.432812	54.690000
Acid_first	20	100,5,400,4,450,3,3	10.350000	1000	982.864437	53.500000



Good repeatability
1.1% RSD

Overlay Table

Name	Index	Comments	End pH	HNO3 Vol	NaOH Vol	Temp Max
Acid_simu	62	8,3,400,5,525,3,4	9.940000	900	1176.268949	45.060000
Acid_simu	63	8,3,400,5,525,3,4	9.820000	900	1168.102118	45.500000

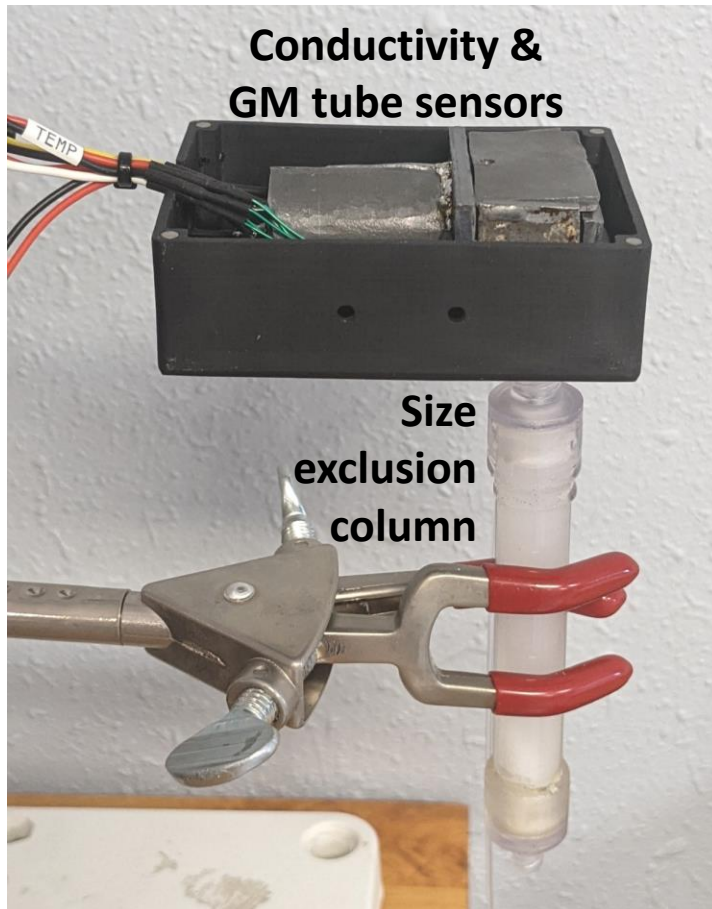


Good temperature control
Max temp 45°C

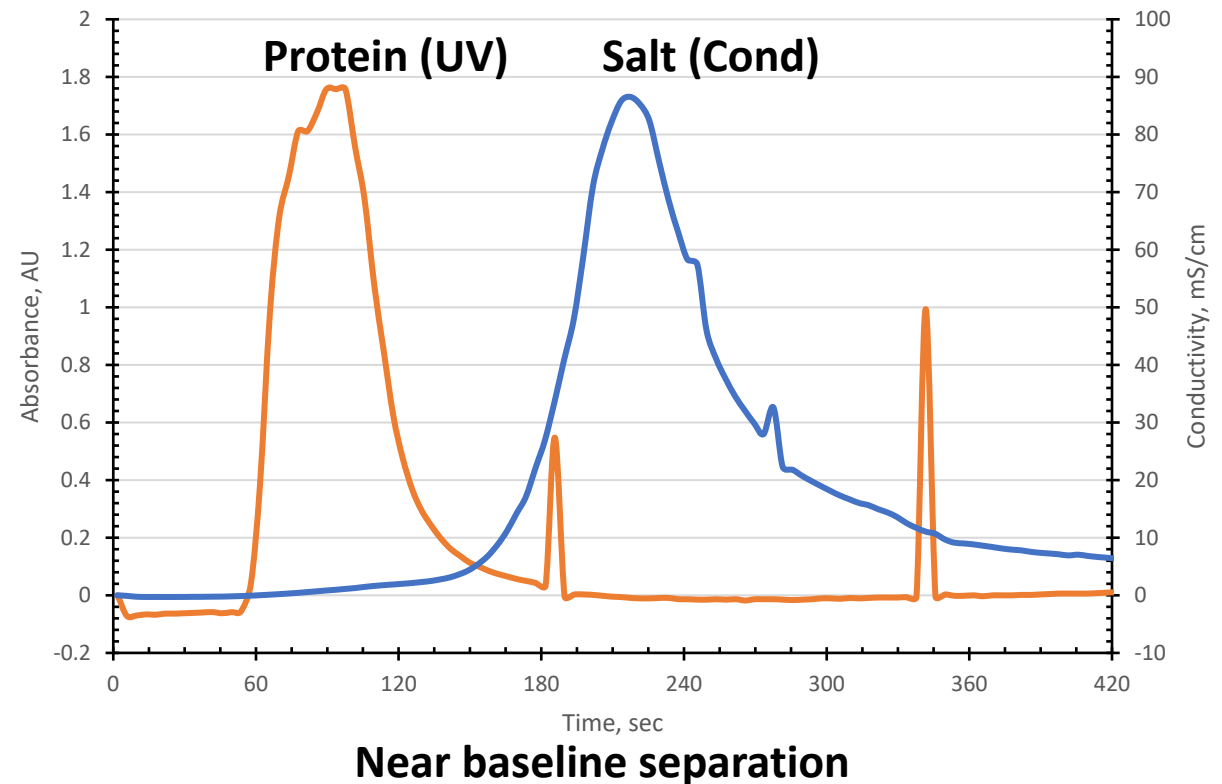
Overlay Table

Name	Index	Comments	Category	Time Stamp
Acid_simu	61		sample.Ten	08-17-2022
Acid_simu	61	8,3,400,5,525,3,4	sample.pH	08-17-2022

Isolation of the ^{211}At Product using Size Exclusion Chromatography

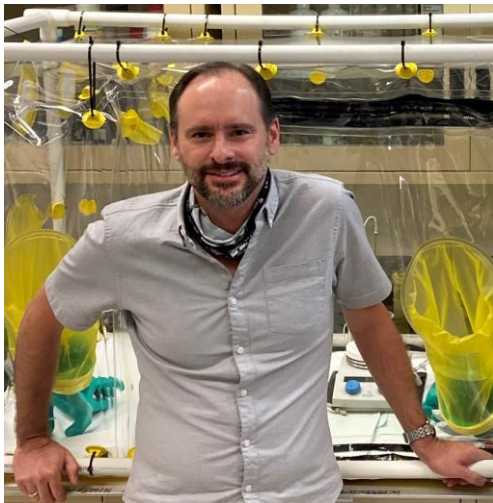


Profiles from UV and Conductivity cell,
30 $\mu\text{L}/\text{sec}$ for 3 min and 40 $\mu\text{L}/\text{sec}$ for 4 min



Acknowledgements

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PNNL

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Global FIA team

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