OAK RIDGE National Laboratory

Development of Revised Radioanalytical Procedure for ^{210}Po in Urine and more…

Dosimetry Services Group

Oak Ridge National Laboratory

Hiromu Kurosaki

ORNL is managed by UT-Battelle, LLC for the US Department of Energy

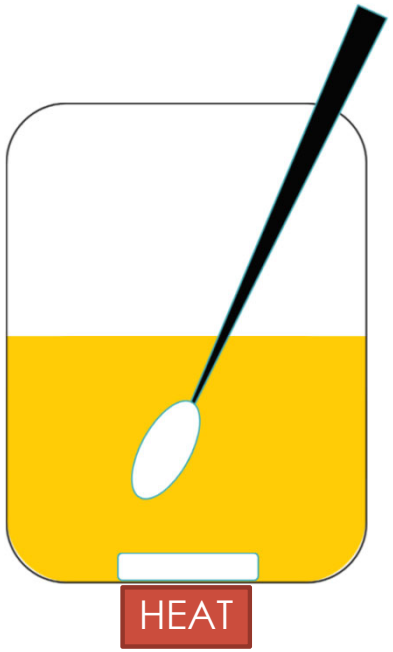
U.S. DEPARTMENT OF ENERGY

In Vitro Radiobioassay Program at ORNL

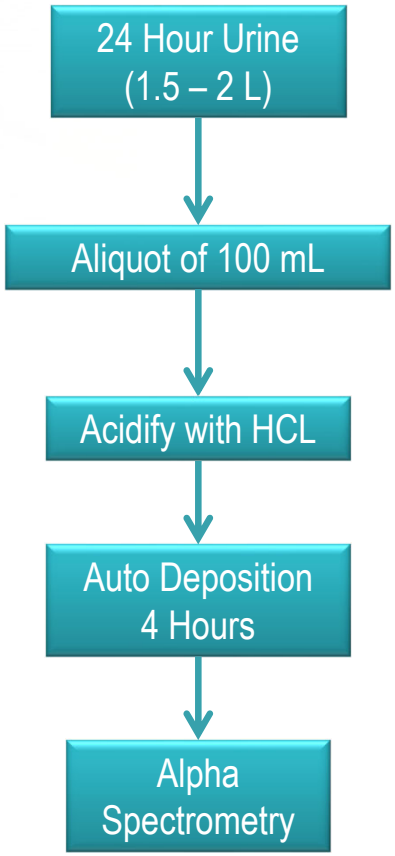
- Routine Analyses
  - 24 Hour Void Urine
  - PAS (Personal Air Sampler) Filters for ^{227}Ac
- Incident (Emergency) Analyses
  - Urine, Fecal, etc.
- Analytes of Interest
  - Alpha (^{225}Ac, ^{241}Am, ^{243}Am, ^{242}Cm, ^{244}Cm, ^{248}Cm, ^{252}Cf, ^{237}Np, ^{210}Po, ^{238}Pu, ^{239}Pu, ^{242}Pu, ^{244}Pu, ^{226}Ra, ^{228}Th, ^{229}Th, ^{230}Th, ^{232}Th, ^{232}U, ^{234}U, ^{235}U, ^{238}U)
  - Beta (^{227}Ac, ^{249}Bk, ^{14}C, ^{36}Cl, ^{3}H, ^{63}Ni, ^{241}Pu, ^{35}S, $^{89/90}Sr$, ^{99}Tc)
  - Gamma Emitters
  - ICP-MS (^{235}U, ^{238}U, Ratio)

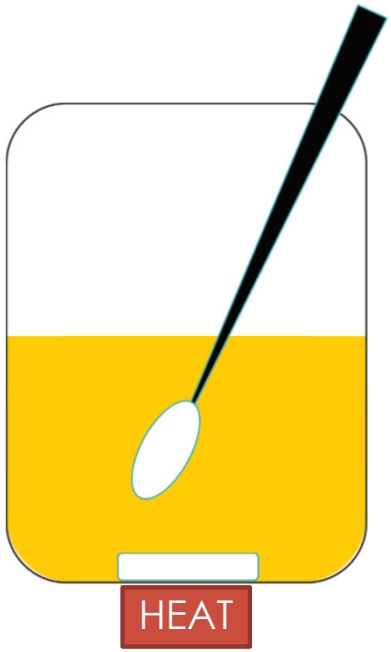
Auto Deposition onto Ag/Cu/Ni Disks

- Simple and Quick



Auto Deposition onto Ni Disks

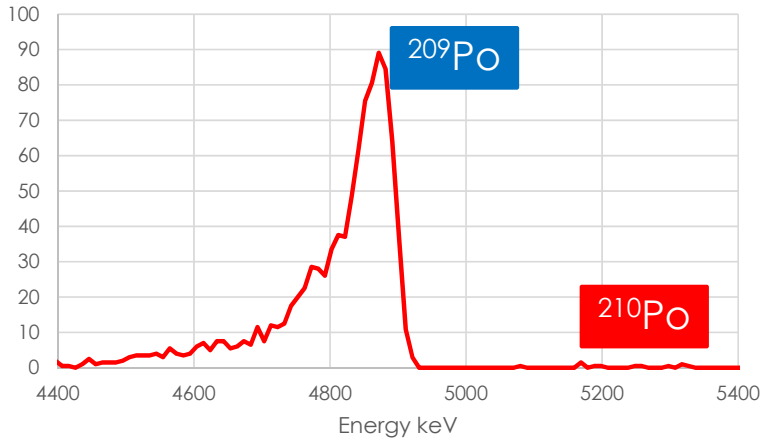




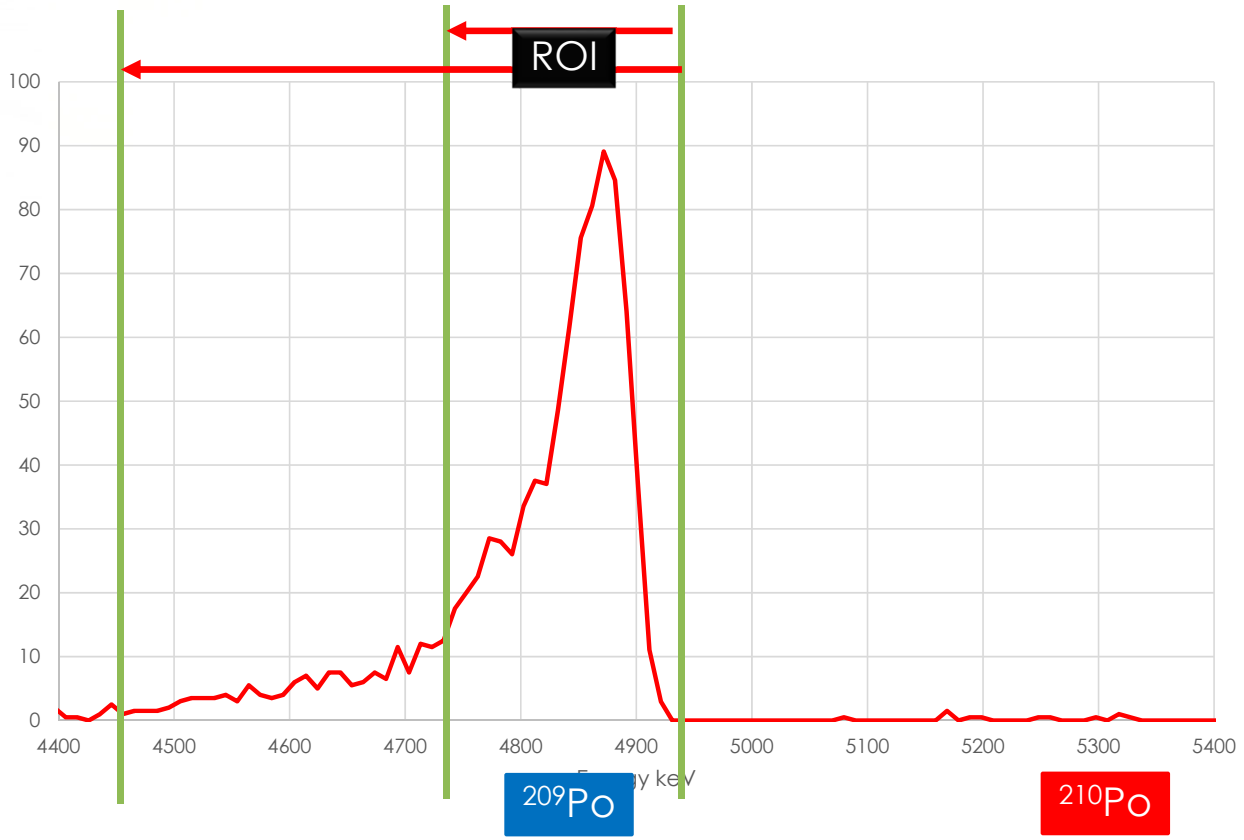
OAK RIDGE National Laboratory

Auto Deposition onto Ni Disks

- Simple and Quick
- Poor Ni disks resolution
  - ROI setting difficulty



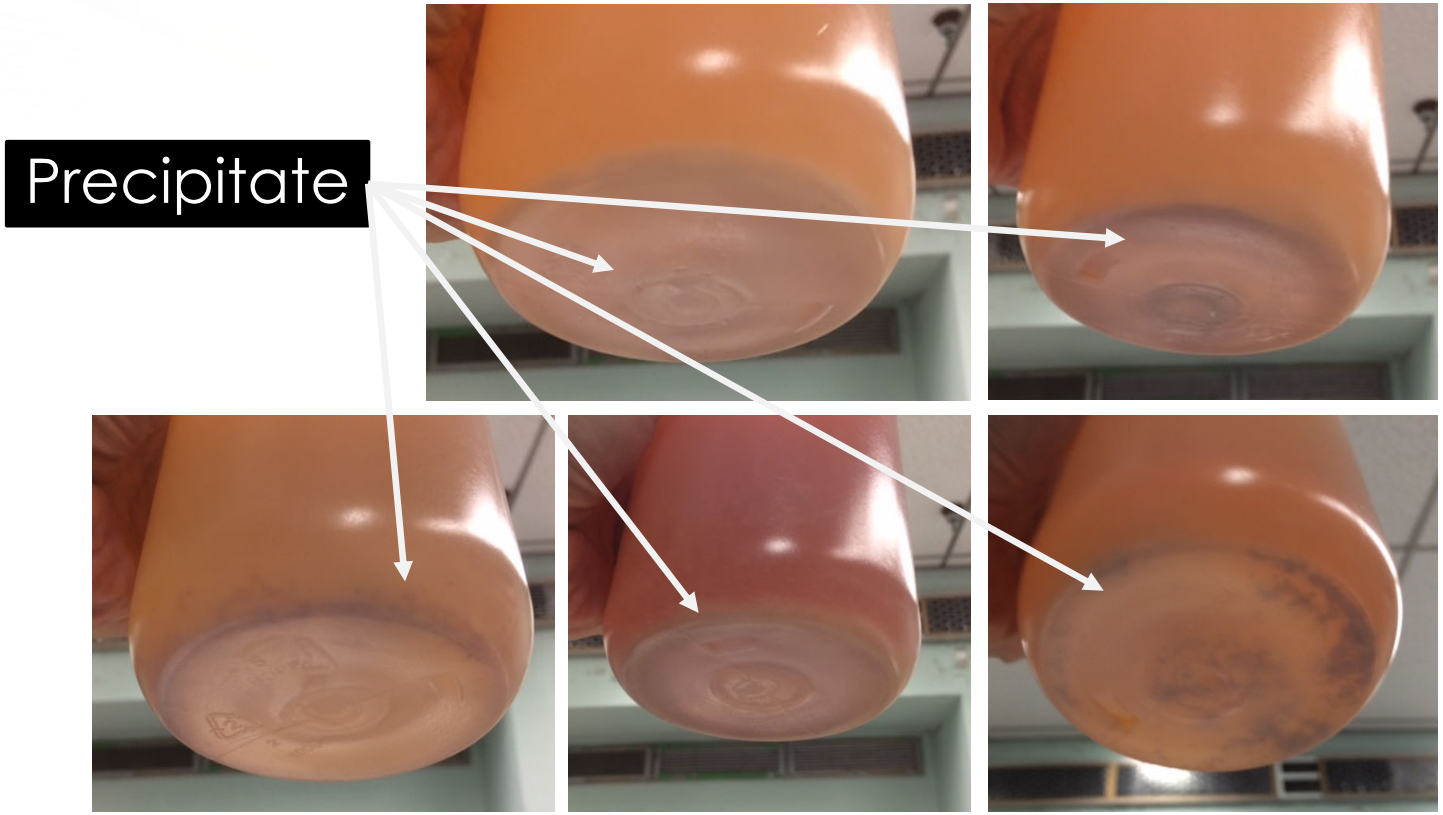
Setting ROI automatically is difficult.



Auto Deposition onto Ni Disks

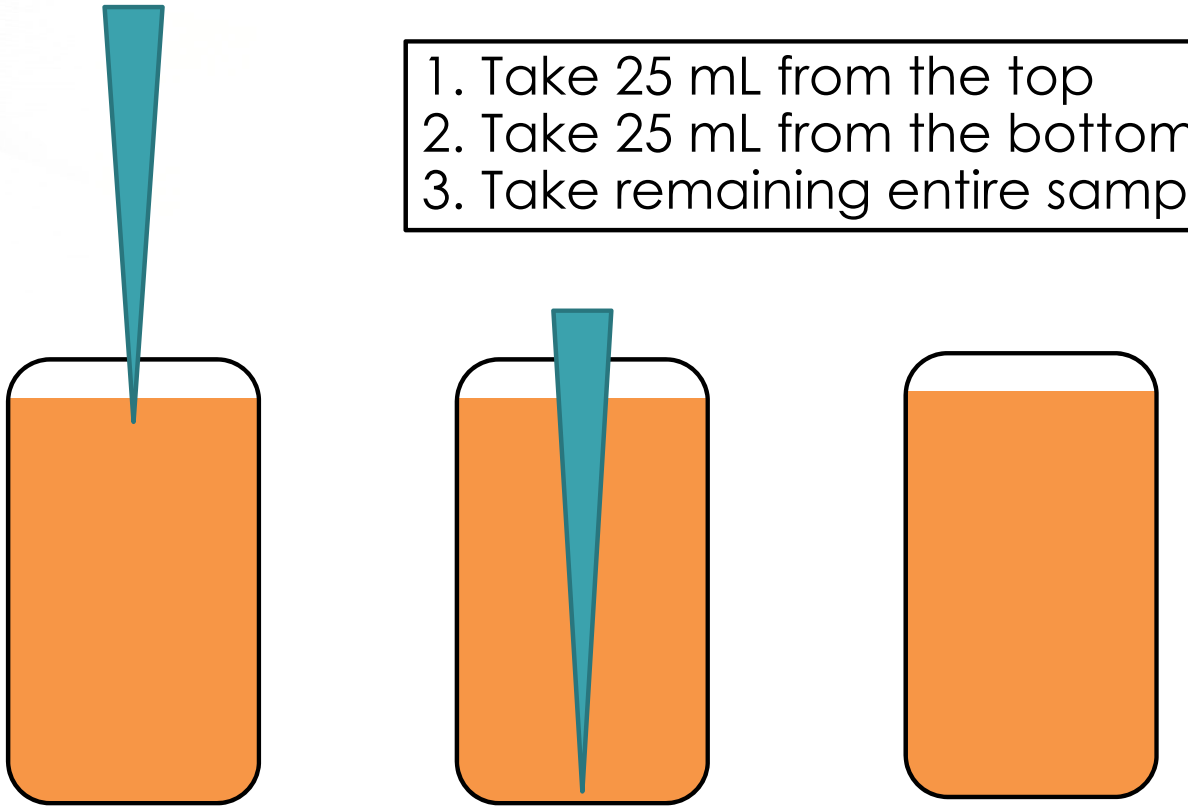
- Simple and Quick
- Poor Ni disks resolution
  - ROI setting difficulty
- Sub-sampling required
  - Another source of uncertainty

How would you take sub-sample from these ?



We tried three sampling methods for ^{238}U.

1. Take 25 mL from the top
2. Take 25 mL from the bottom
3. Take remaining entire sample (950 mL)



Supernate

1

From the Bottom

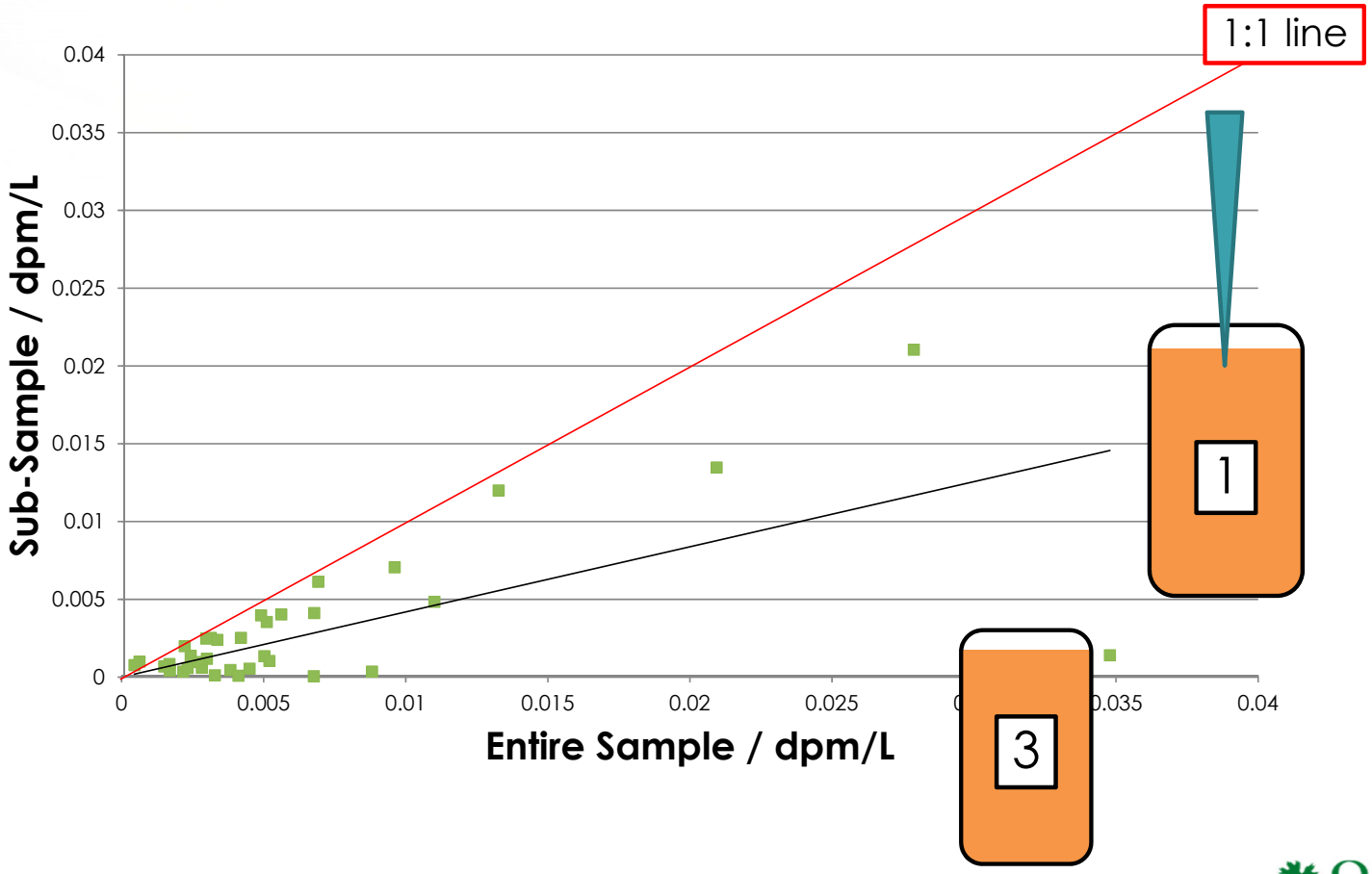
2

Entire Sample

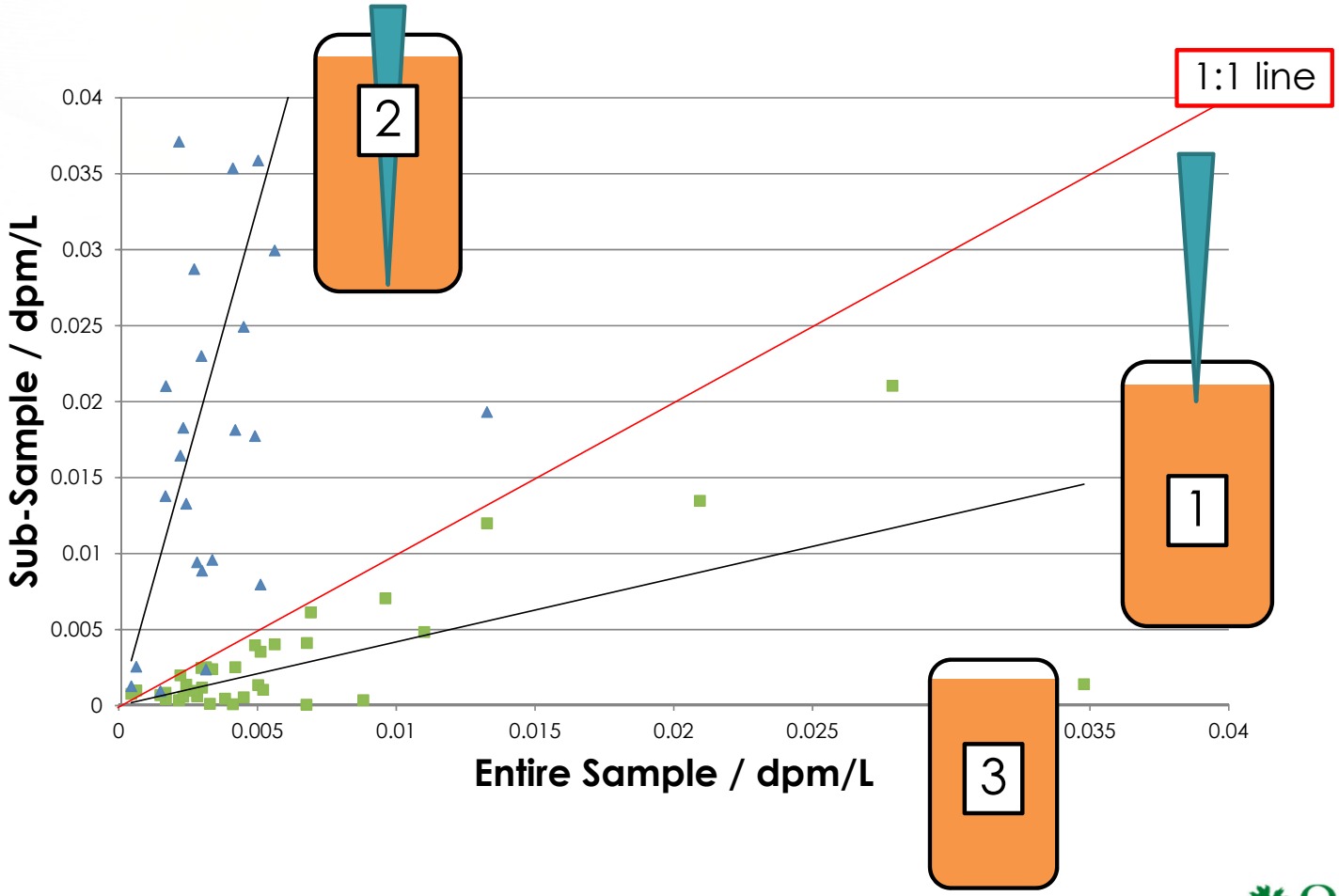
3

OAK RIDGE National Laboratory

^{238}U Activity: 3 > 1



^{238}U Activity: 2 > 3 > 1



Another Source of Uncertainty

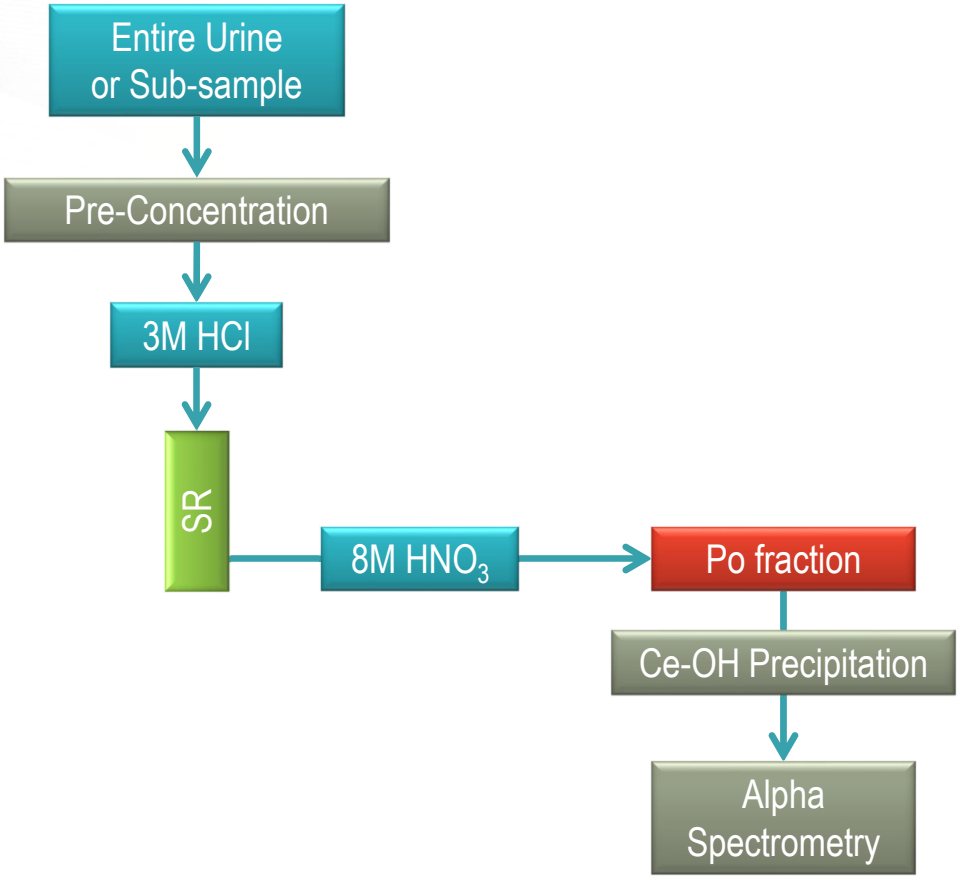
- Sub-sampling uncertainty can be critical.
  - Good Sub-sampling procedure is necessary.

- Or process entire samples.
  - Eliminates sub-sampling uncertainty.
  - Provides better detection limit.

Auto Deposition onto Ni Disks

- Simple and Quick
- Poor Ni disks resolution
  - ROI setting difficulty
- Sub-sampling required
  - Another source of uncertainty
- Sequential analysis difficult
  - Extraction chromatography makes it easy!

Po Analysis with Separation



After Column Separation, Takes < 30 Minutes

Elute

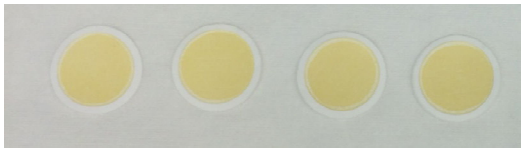
Add Ce Carrier

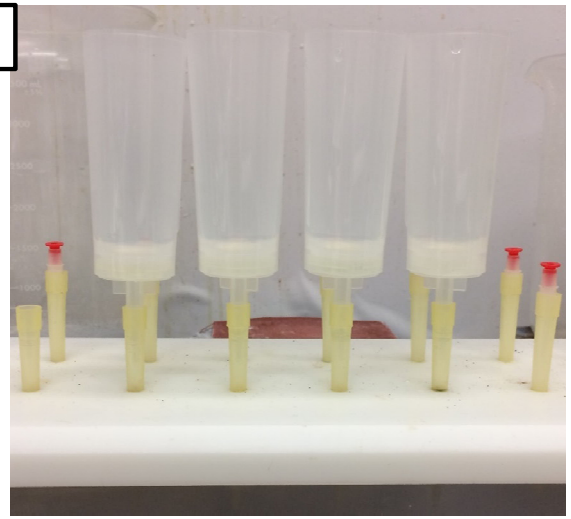
Add H_2O_2

Add pH Indicator

Adjust pH

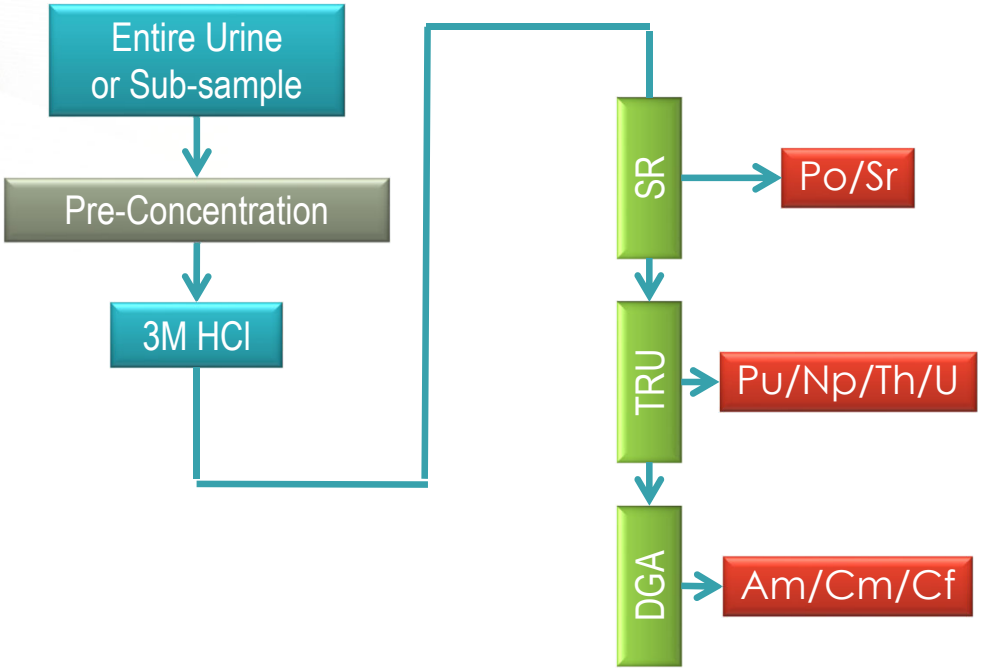
Filter



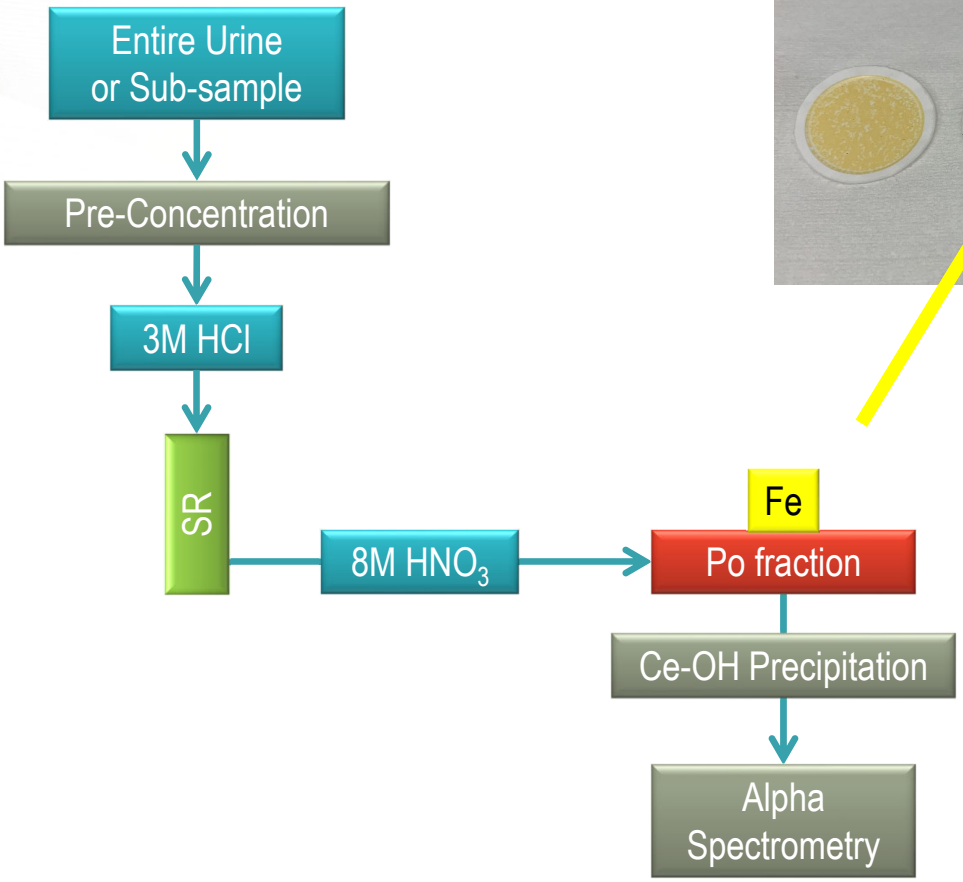


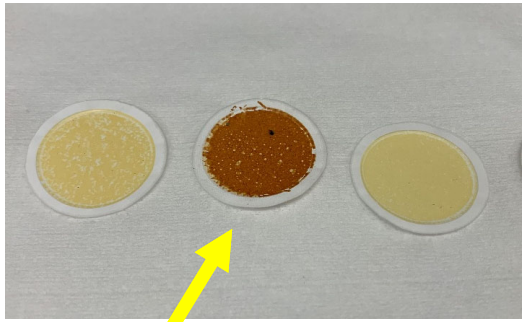
OAK RIDGE National Laboratory

Sequential Analysis Possible

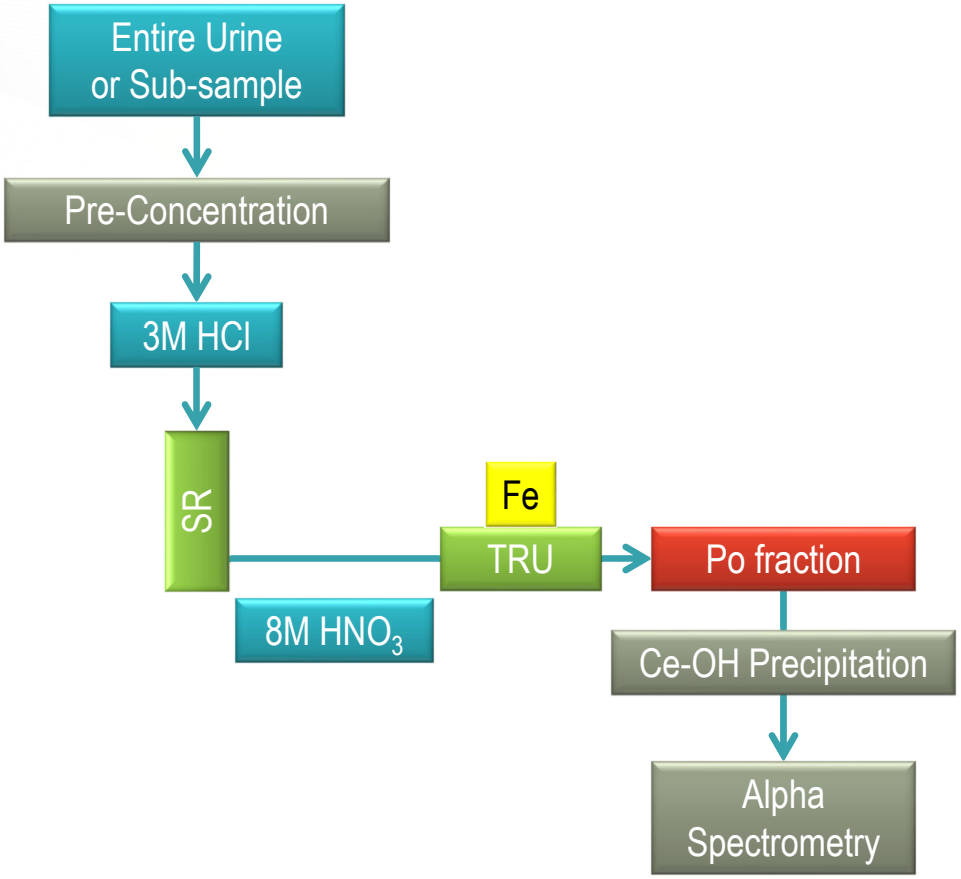


Fe may Follow Po



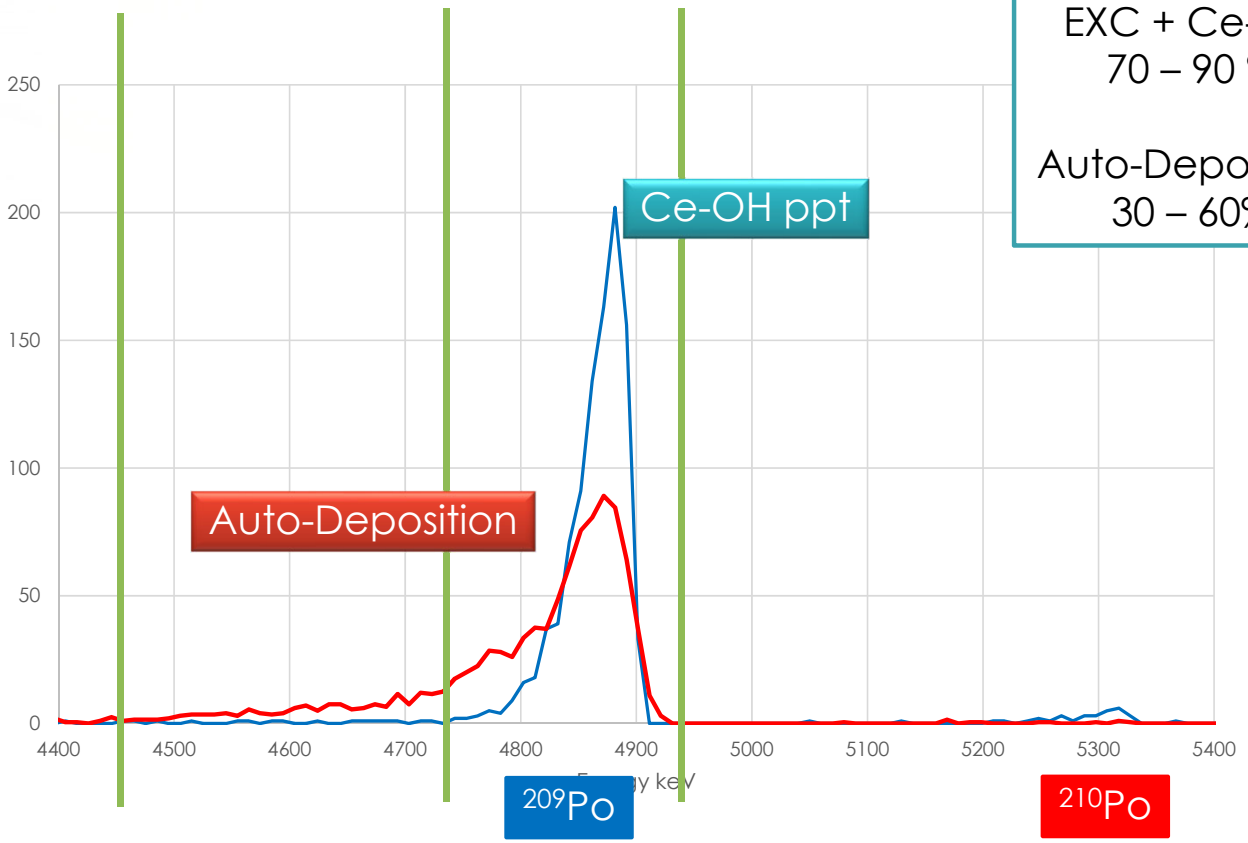


TRU Removes Fe upon Po Elution



OAK RIDGE National Laboratory

Sharper Peak, Greater Recovery



Recovery range:
EXC + Ce-OH
70 – 90 %

Auto-Deposition
30 – 60%

OAK RIDGE National Laboratory

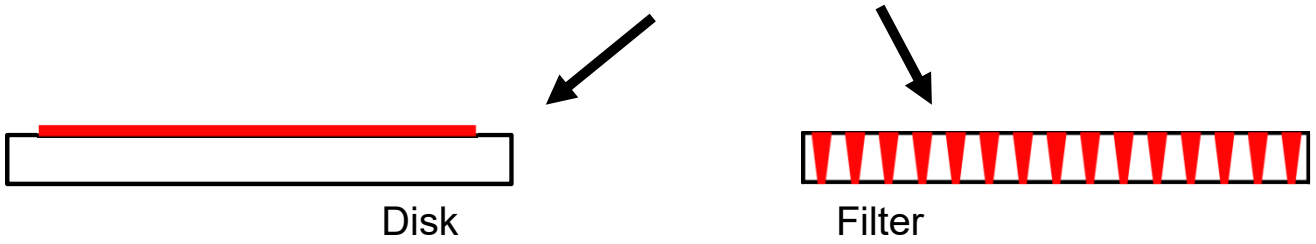
Who cares about accurate alpha detector efficiency?

- If alpha tracer is used, efficiency cancels.
- It only affects recovery calculation.

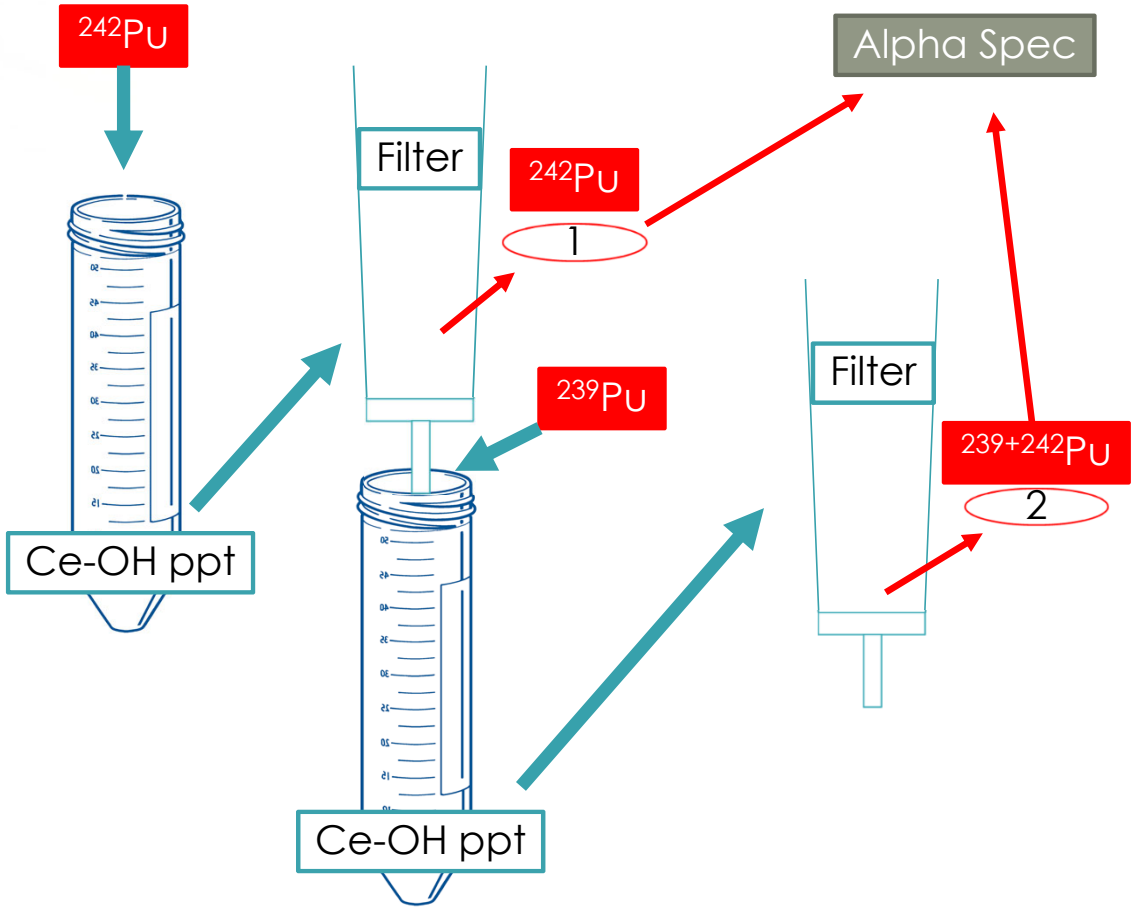
- But beta tracers (^{234}Th and ^{239}Np) are used at ORNL
- So correct detector efficiency is required.

How do we calculate efficiency?

- Use NIST traceable source (Electroplated)
- Are the efficiencies the same for ED and PPT?



How do you calculate efficiency of PPT?



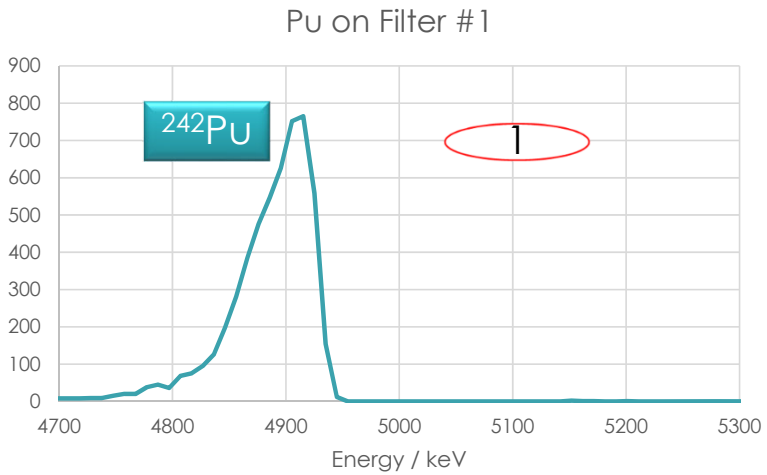
Added ^{242}Pu

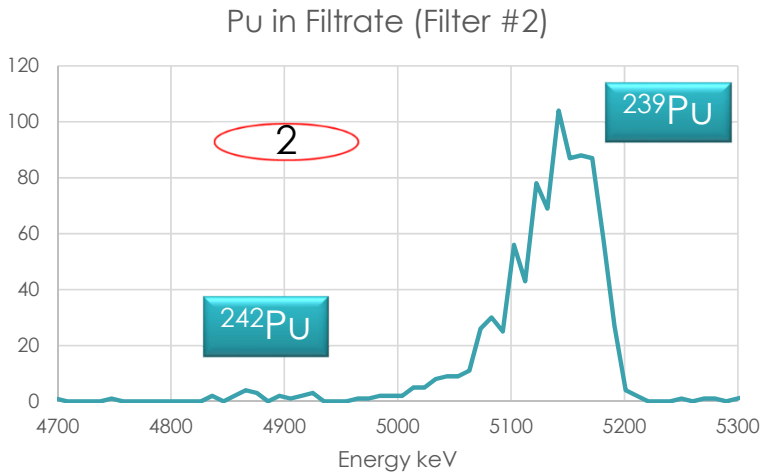
minus

^{242}Pu left in filtrate (Calculated from filter #2)

Should be equivalent to

^{242}Pu on filter #1





OAK RIDGE National Laboratory

Added ^{242}Pu

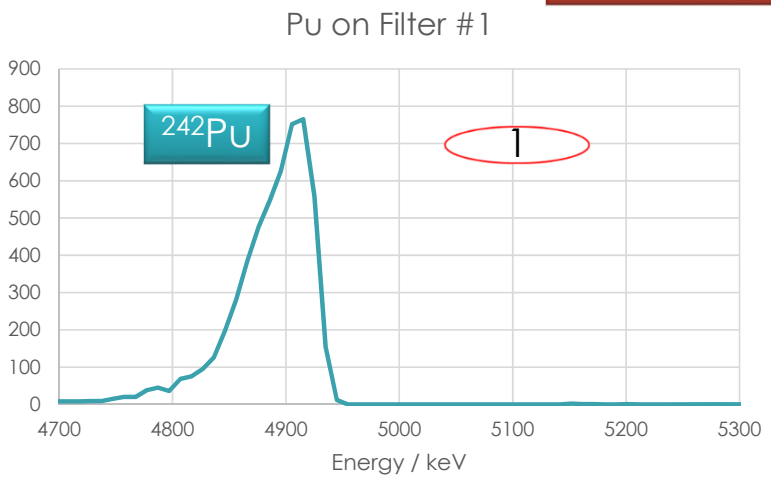
minus

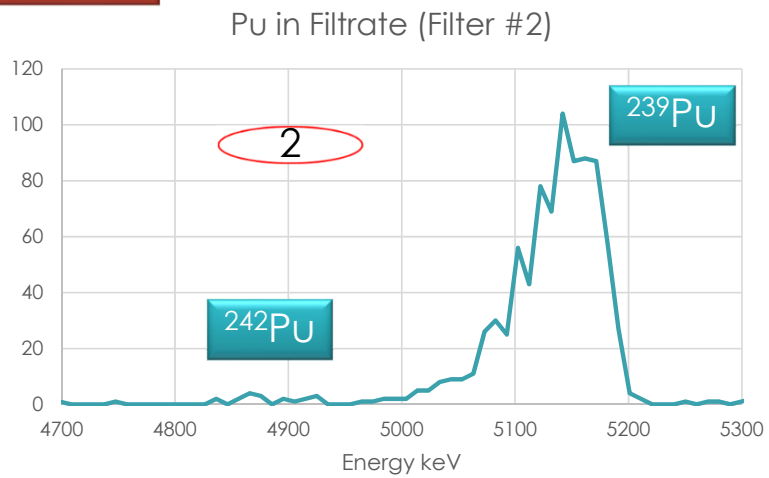
^{242}Pu left in filtrate (Calculated from filter #2)

Should be equivalent to

^{242}Pu on filter #1

ED > PPT ?





OAK RIDGE National Laboratory

Summary

- The new ^{210}Po procedure provides
  - Sharper Peak
  - Greater Recovery
  - No Sub-Sampling Uncertainty
  - Sequential Analysis

- How are you handling efficiency of micro-precipitation?

Acknowledgement

- Group Leader (Dosimetry)
  - Govind Rao
- Radiobioassay Lab
  - April Tucker
  - Kim Johnson
  - John Keaton Jr.
  - Michelle Kinnebrew
  - Pam McConkey
  - Jamie Daum
  - Hayden Nelson

- Counting Room
  - Joe Conner
  - Susan Lambert

OAK RIDGE National Laboratory

Thank you!

kurosakih@ornl.gov

ORNL is managed by UT-Battelle, LLC for the US Department of Energy

U.S. DEPARTMENT OF ENERGY