

**WHAT
IS
NORM
AND
WHY
DO
I
CARE?**



Overview

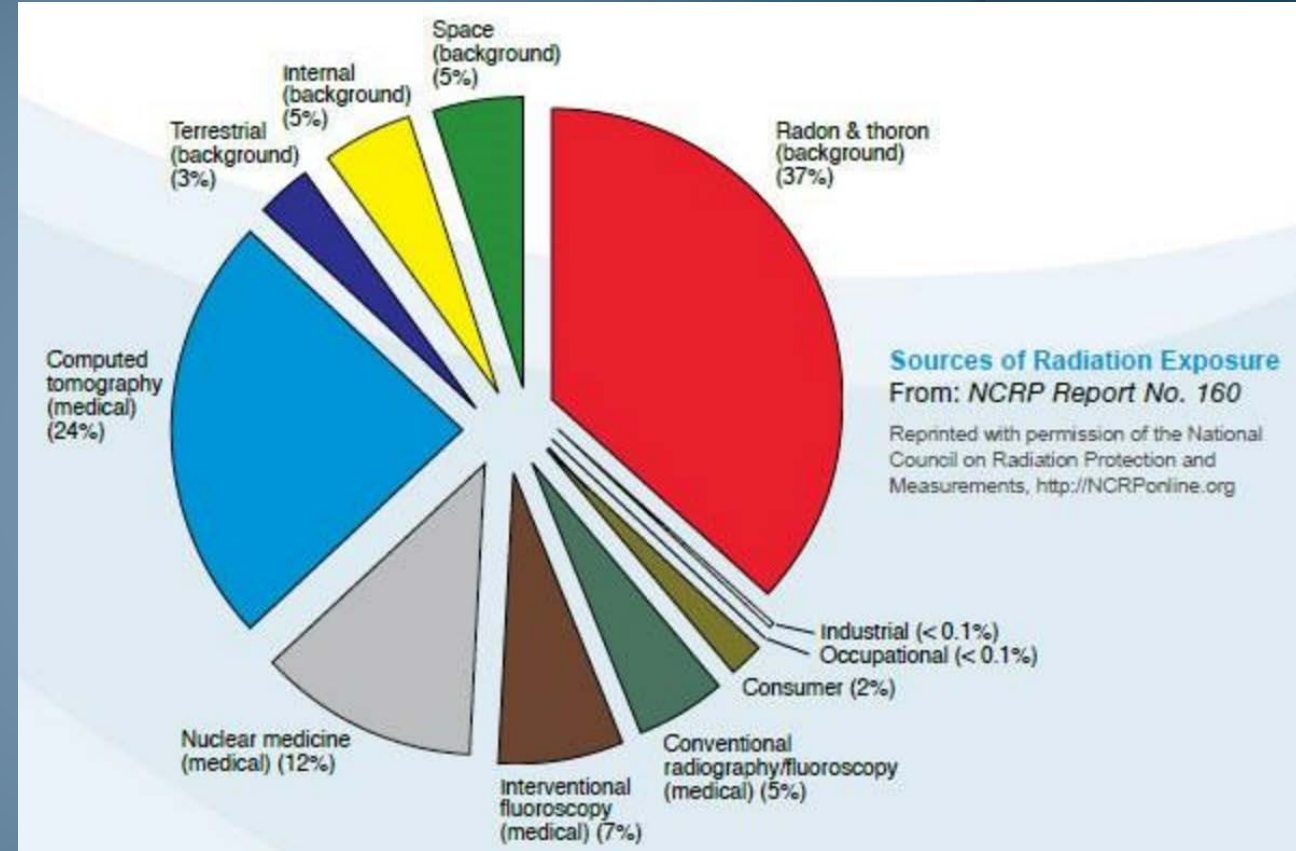
- The Big Deal
- Creation of the Universe
- Primordial Radionuclides
- Series Decay and Secular Equilibrium
- Measurement and Detection
- Conclusions



Naturally Occurring Radioactive Material

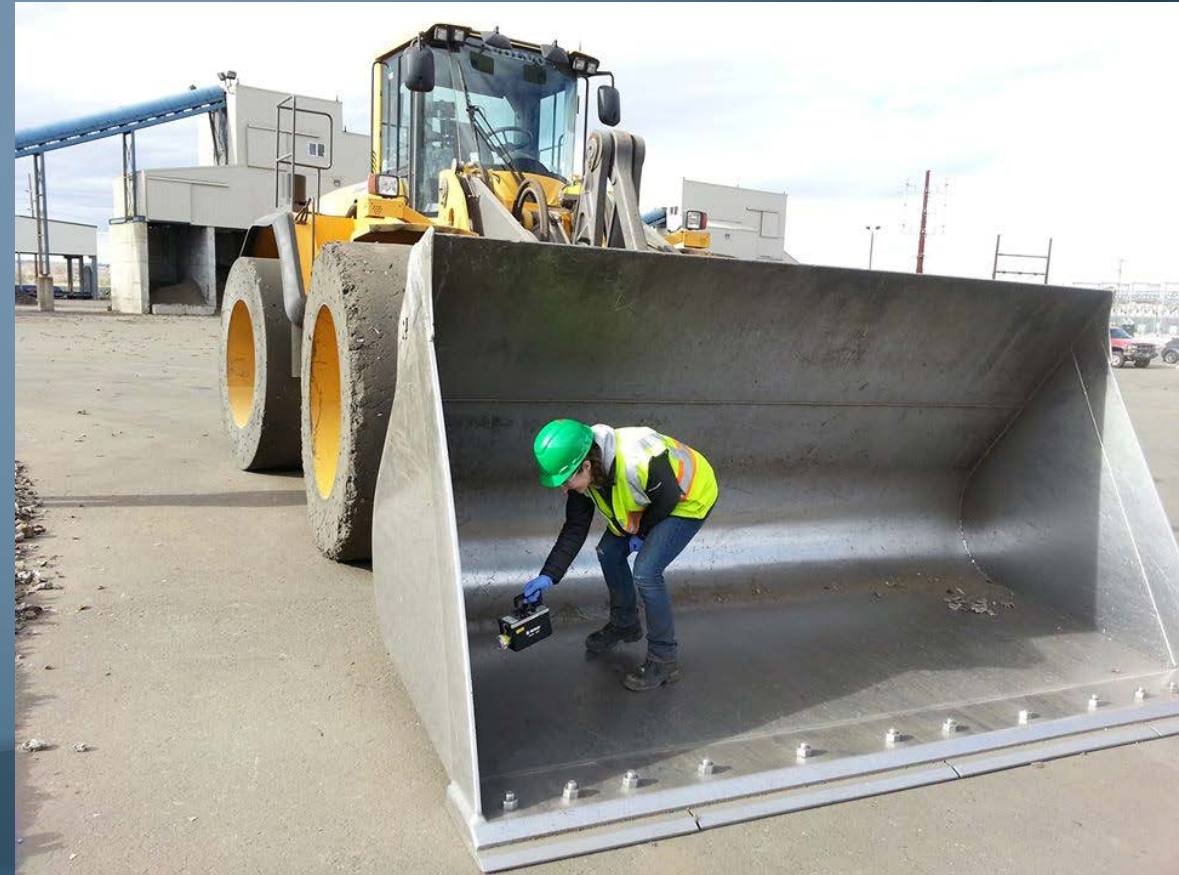
The Big Deal, Real Simple

- ⦿ NORM is everywhere
- ⦿ Chemistry stuff happens (M.S. Al-Masri)
- ⦿ Now you have a lot of NORM!
- ⦿ You can't get rid of it (HCN, business insider)
- ⦿ You're getting exposed (EPA1, NCRP160)



It's a Big Deal to who?

- ① Affects raw materials and commodities (and those jobs). (EPA1)
 - Metal Recycling
 - Building material disposal or recycling
 - Particularly asphalt, concrete, and bricks.
 - Oil and Gas production
 - Traditional and fracking (HCN)
 - Any Ore Processing (potash, bauxite, etc)



Creation of the Universe

Let's get to some physics

- ⦿ Early Universe hot soup

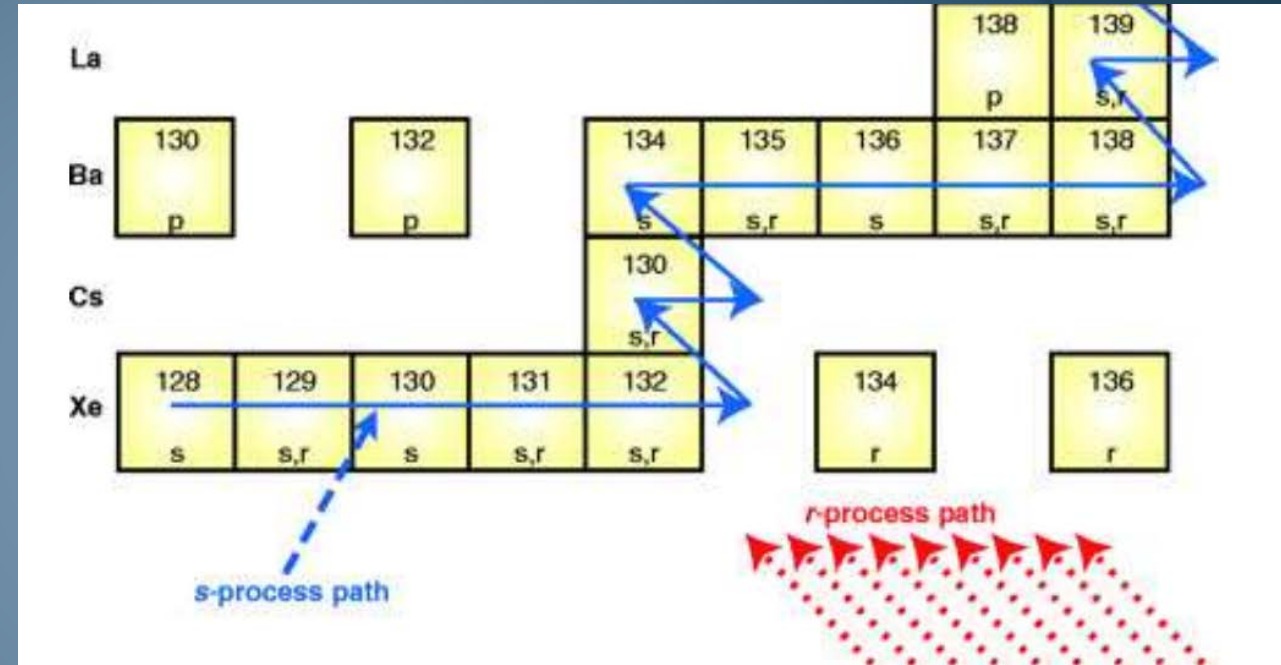
- Cross section

- ⦿ Slowing down and clustering

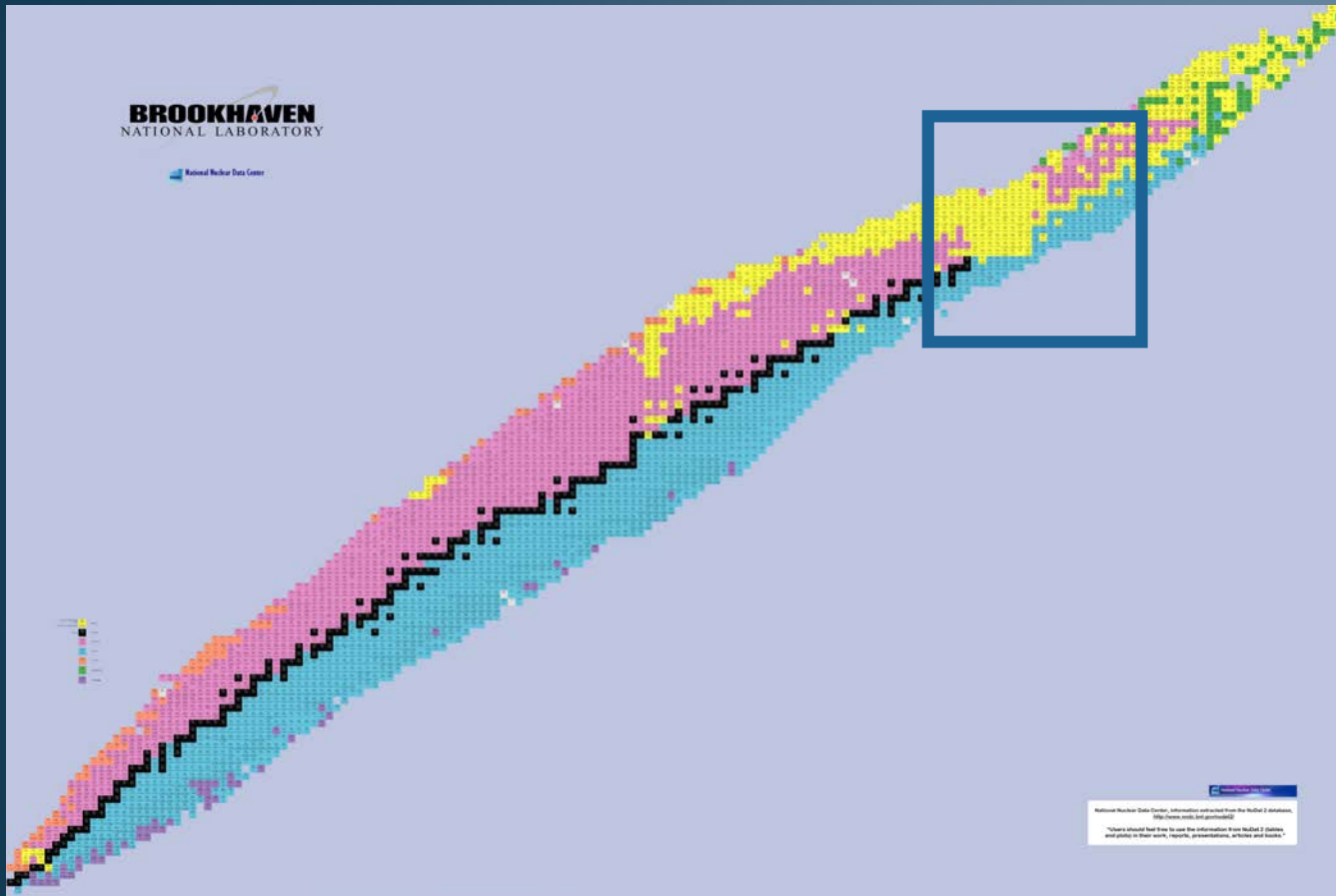
- ⦿ p-process (suny)

- ⦿ s- and r- processes (suny)

- Neutron capture governed by beta decay and binding energy
- S-process up to Bi-209



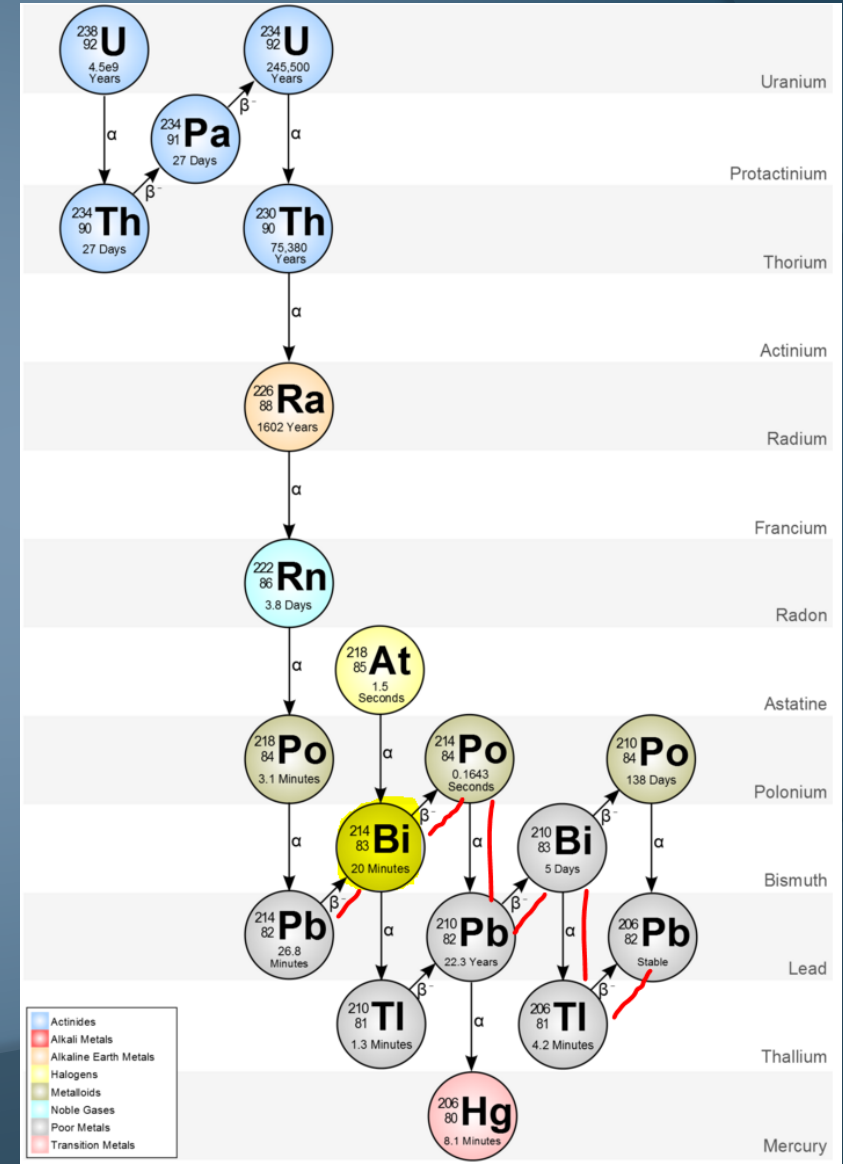
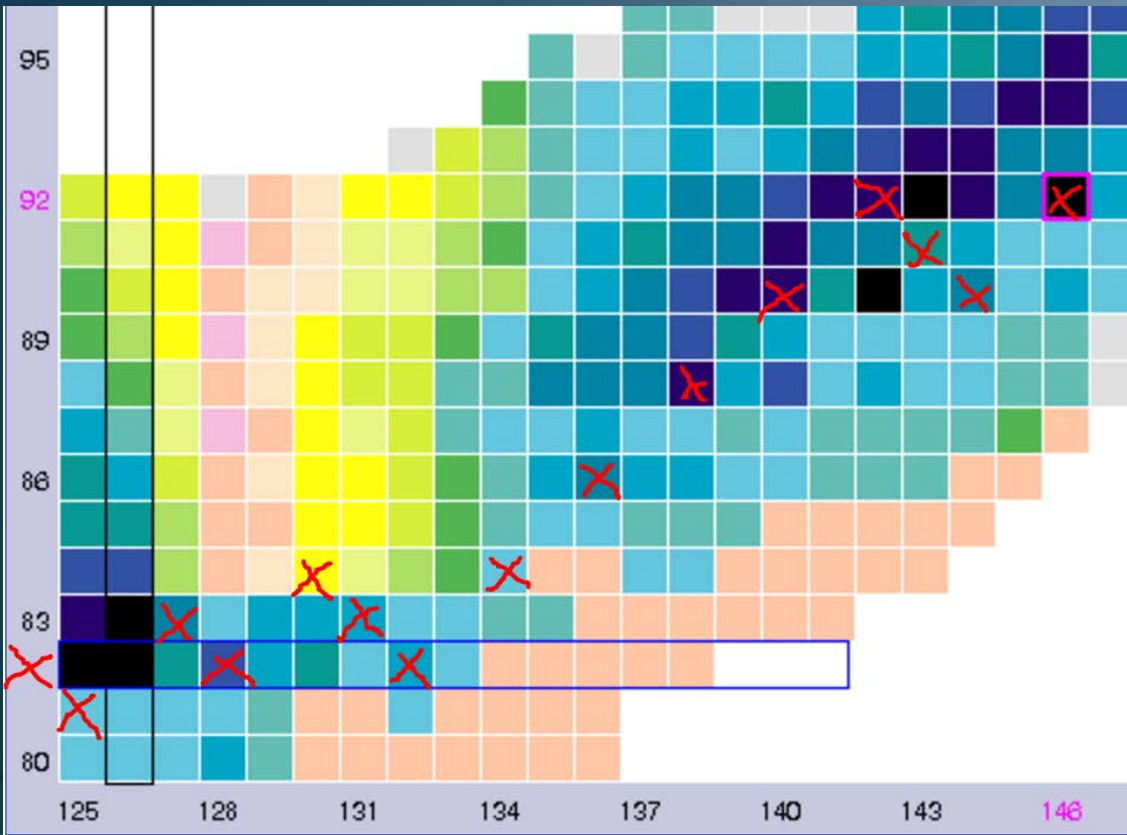
Radionuclides (some not so Primordial)



- Shedding particles
 - Alpha, beta, positron (or EC) decay
- Shedding energy
- Valley of stability
- Takes time
- Takes steps
- Randomness

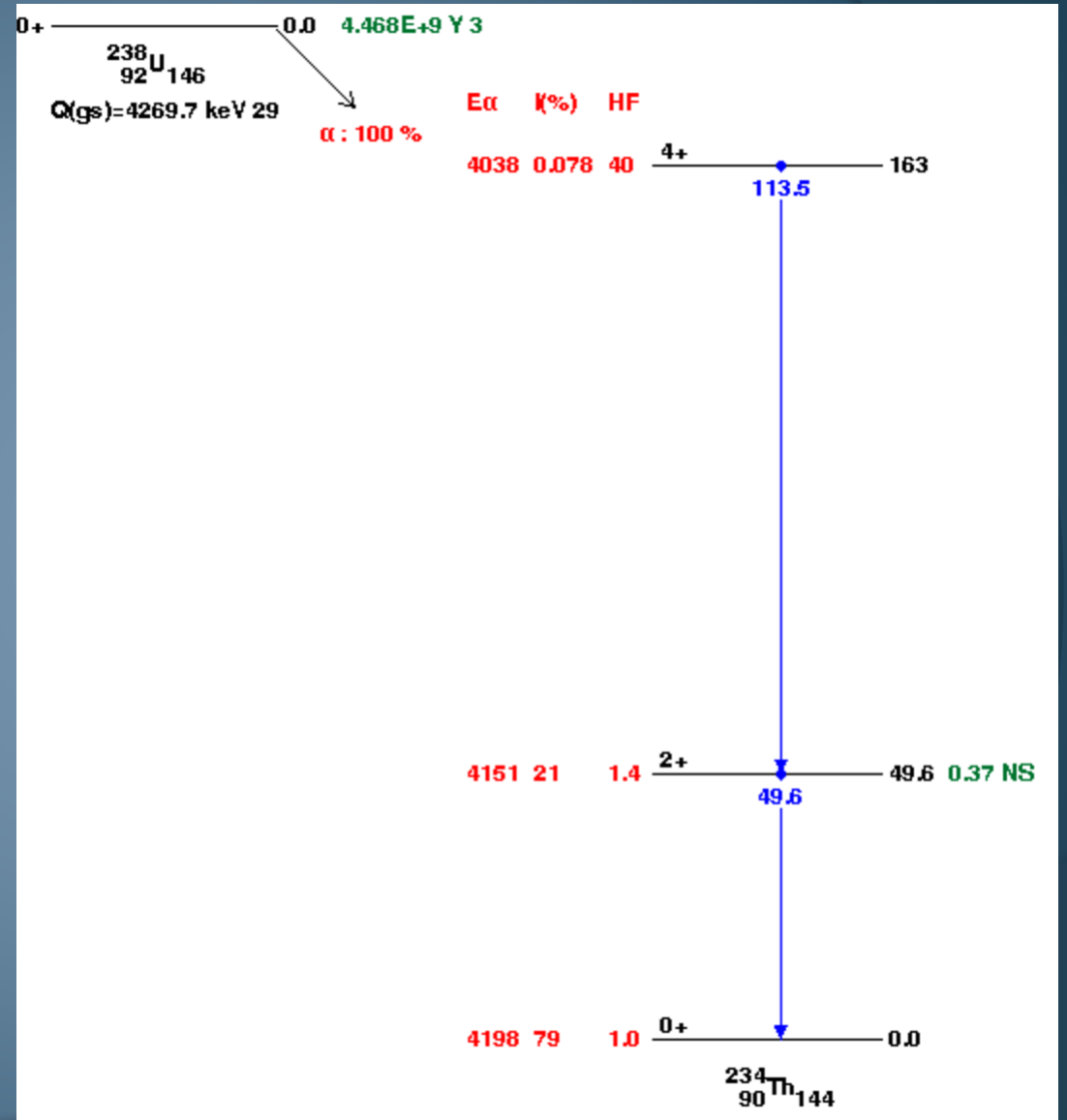
Series Decay

- Decay path to stability
- Energy emitted at every step



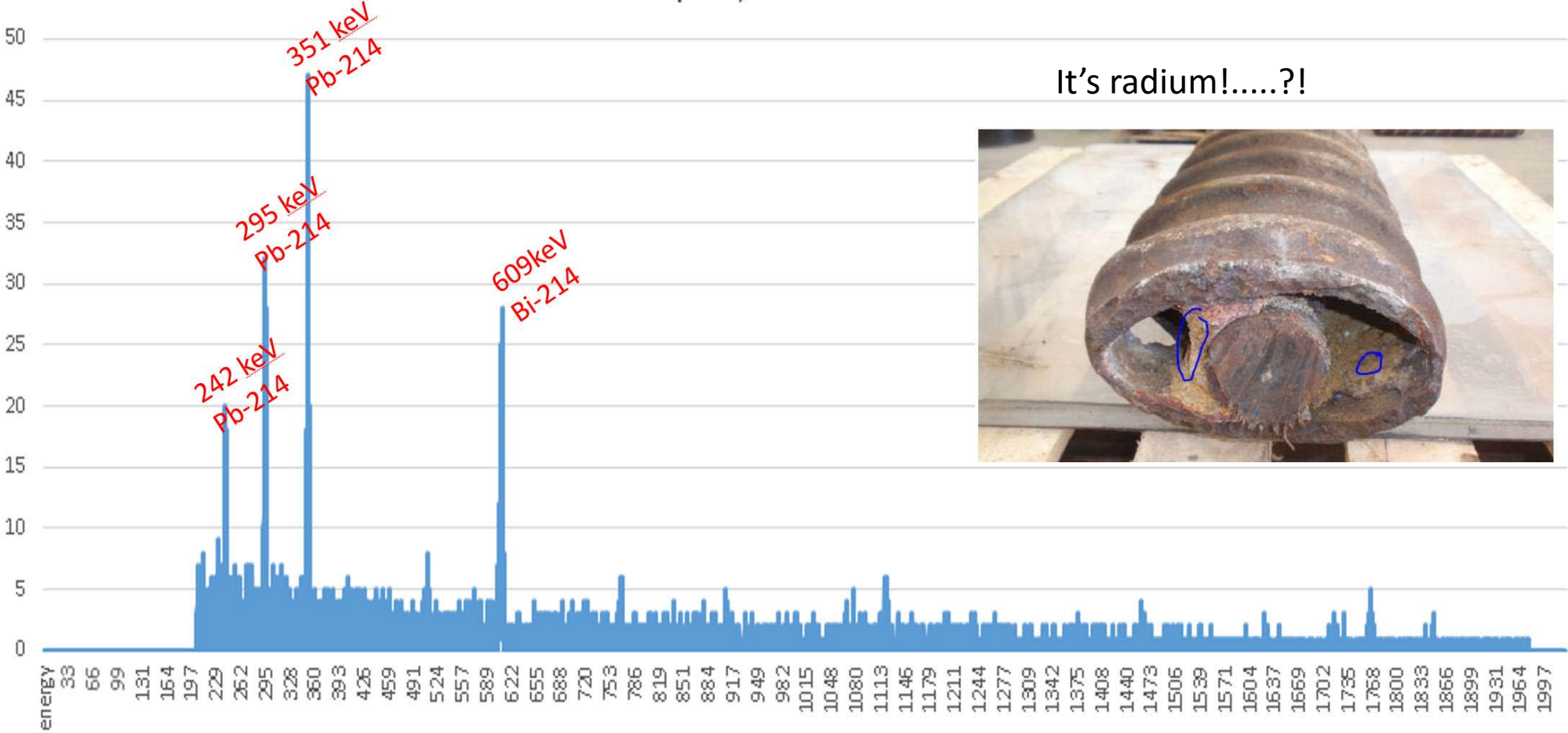
Decay Scheme

- Decay path to stability
- Energy emitted at every step
 - First step



Series Decay and Secular Equilibrium

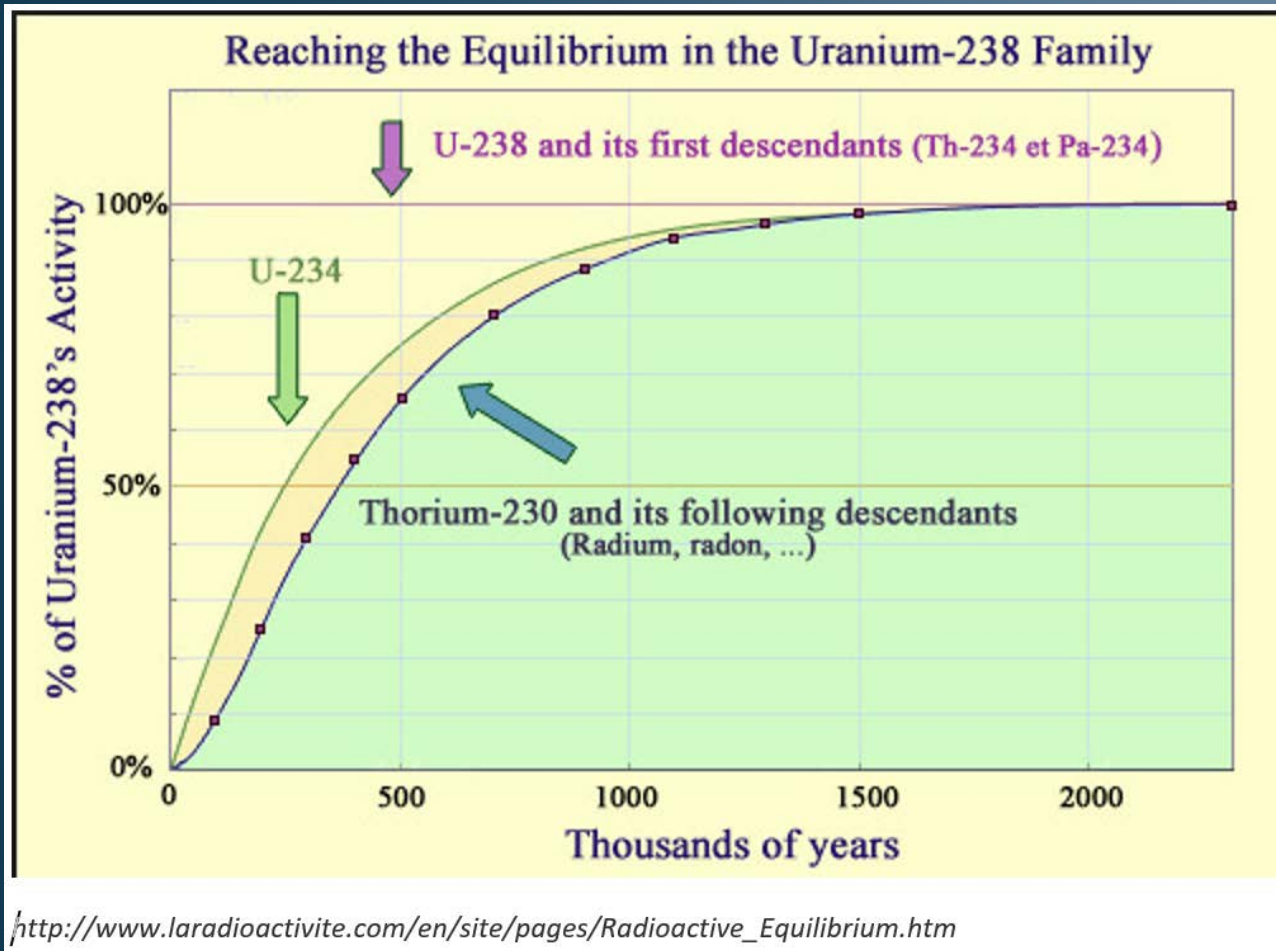
Sample 6, 15 minute count



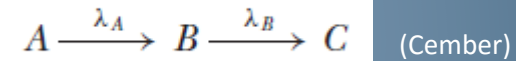
It's radium!.....?!



Series Decay and Secular Equilibrium



- This is how we know it's radium.
- Standard DifEQ



rate of change = rate of formation – rate of transformation,

$$\frac{dN_B}{dt} = K - \lambda_B N_B.$$

$$N_B = \frac{\lambda_A N_A}{\lambda_B} (1 - e^{-\lambda_B t}).$$

$$Q_B = Q_A (1 - e^{-\lambda_B t}),$$

Measurement and Detection



Measurement and Detection, why?

- ⦿ Usually some level of panic
- ⦿ Planned demolition or sale
- ⦿ Bottom line- liability
- ⦿ Regulatory scrutiny due to public perception



Measurement and Detection

⦿ RESRAD, MARSSIM and VSP

- Federally sanctioned statistical approaches used to show compliance with regulatory limits
- Radioactive decay is random
- Using background
- 96% confidence or more
- Biased and unbiased

⦿ RESRAD, BEIR

- Evaluate pathways
- Use the measurement



Conclusions

- NORM was created by the Universe, for the Universe.
- We can use the secular equilibrium principles of series decay to estimate activity and risk.
- Detection is not danger. Education of public, workers and users, as well as promulgation of regulation is essential.
- Call Sulas Radiation Safety Consultants!
www.SulasRadSafety.com

