An In-field Deployable CsI Detector to Determine ^{226,228}Ra in NORM Oil Scale

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NETL/EPDI Services

- Laboratories for testing radioactive cleanup
- Laboratories for corrosion studies
- Excellent undergraduate and graduate students in interdisciplinary cross-cutting areas
- Commitment to industry/university collaborations

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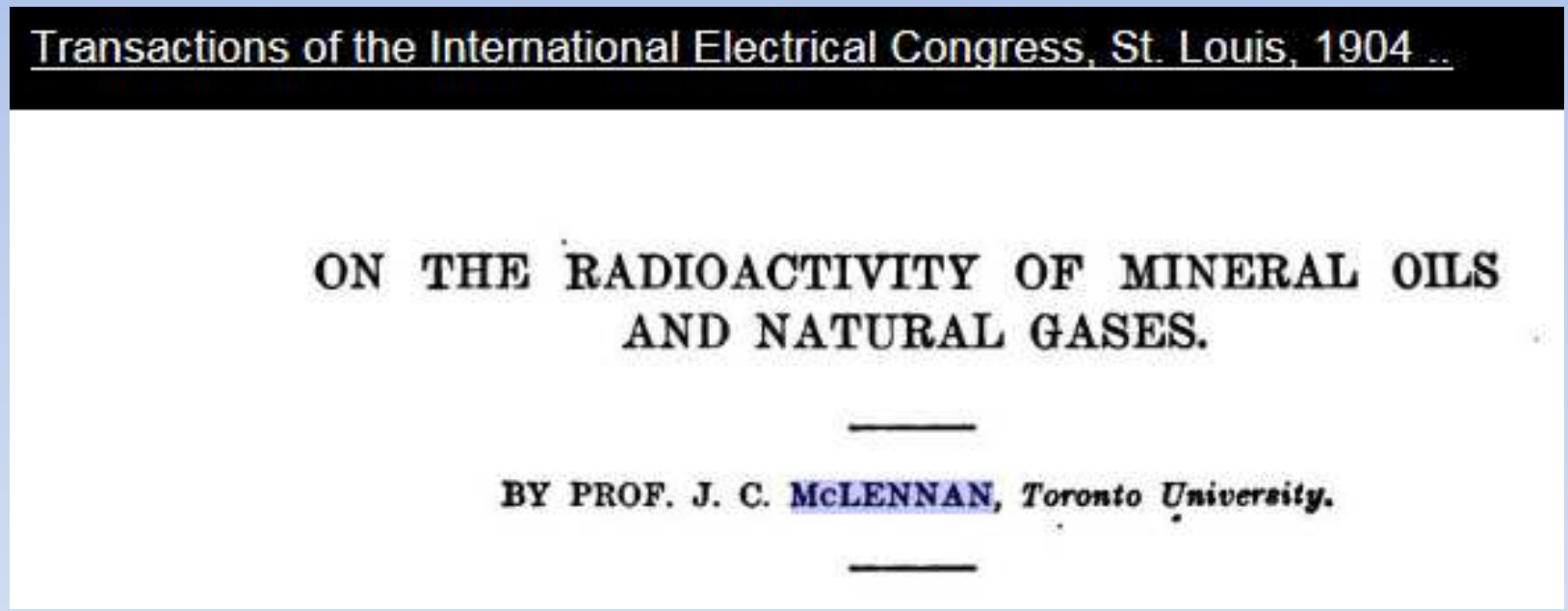
- Radiation Decontamination Site Survey for NORM
- Cathodic Protection Rust, Scale Corrosion Removal
- Chemical Formulation and Product Development
- Anode Assembly Installation
- Salt Water Disposal Chemical Treatment
- Production Well Chemical Treatment
- Scrap Decontamination and Disposal
- Education for field workers

One of the First Papers on NORM in Oil and Gas

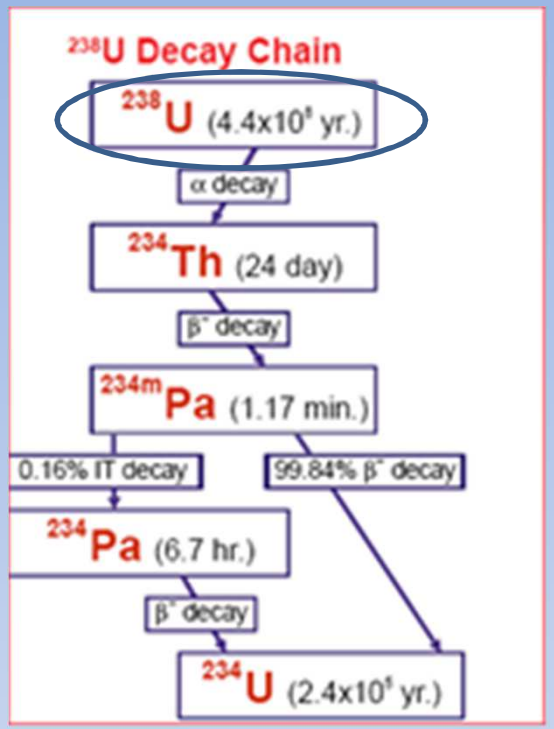


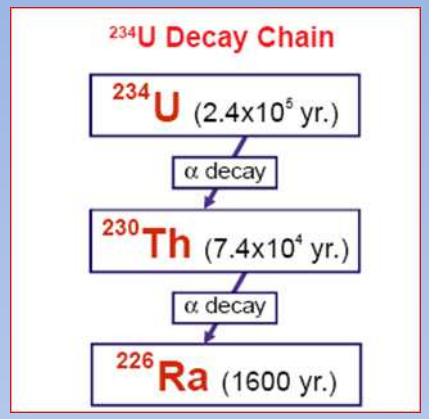
Transactions of the International Electrical Congress, St. Louis, 1904 ..

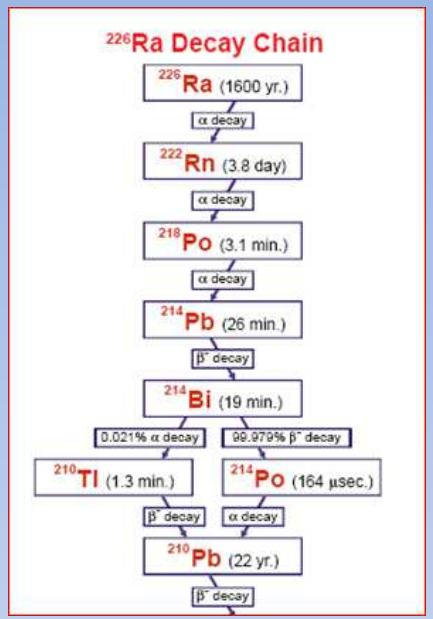
ON THE RADIOACTIVITY OF MINERAL OILS AND NATURAL GASES.

BY PROF. J. C. McLENNAN, *Toronto University.*

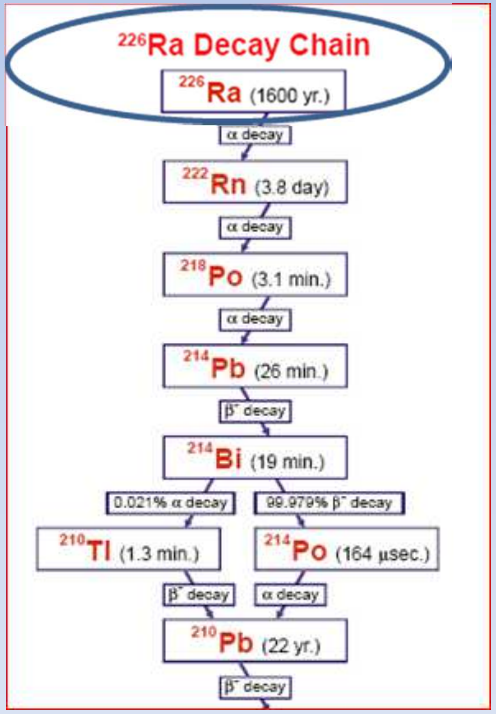
https://archive.org/stream/transactionsint06conggoog#page/n406/mode/2up/search/McLennan

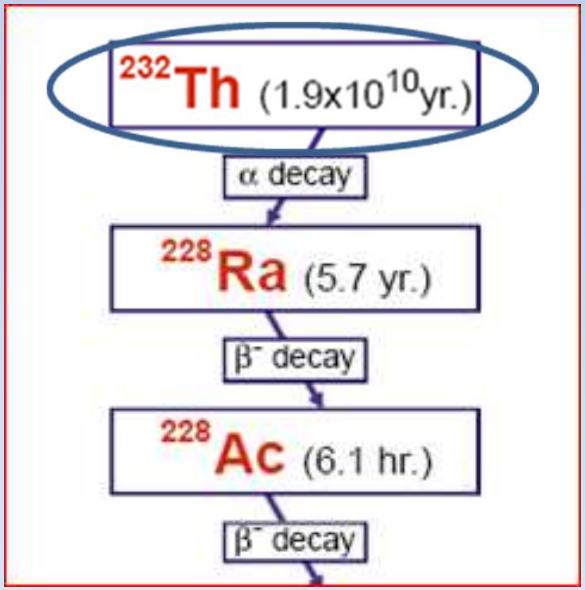






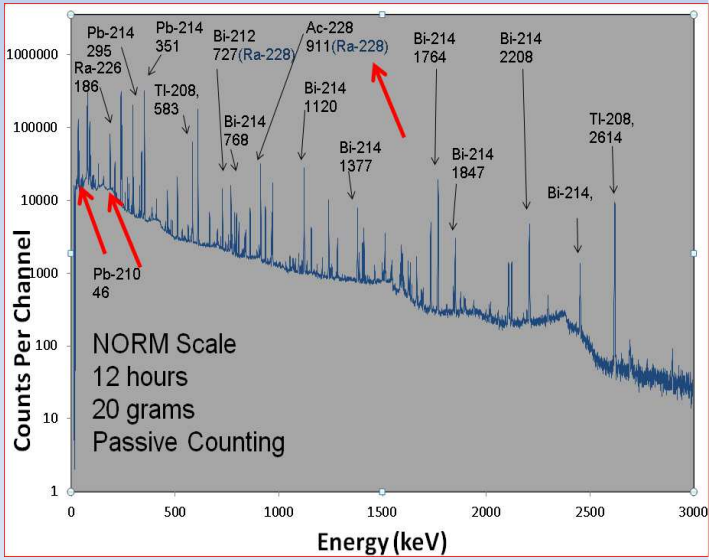
Disequilibrium In Decay Schemes





Overview of Goals

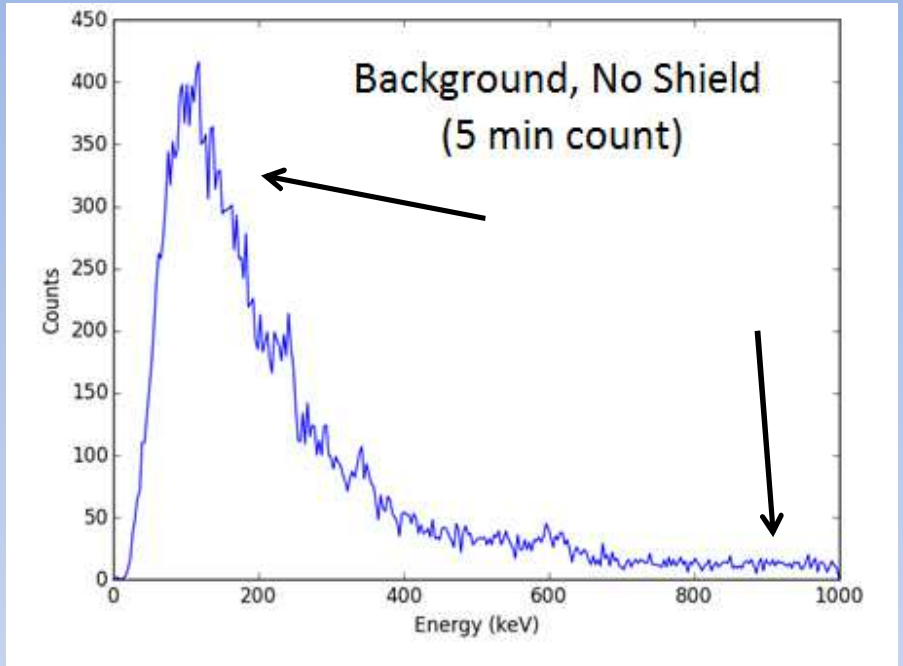
- Homogenize (250 μm) 200 grams of a radioactive scale sample from oil production in the field.
- Prepare a reference material from this sample analyzing the sample in triplicate using EZA standard and high resolution hyper-pure germanium detector.
- Acquisition of a NIST traceable standard was acquired from Ekerdt and Ziegler Analytics (EZA): 931,500 ± 51,233 Bq/kg (25,176 ± 1385 pCi/g) for ^{226}Ra, 18,890 ± 1077 Bq/kg (510 ± 29 pCi/g) for ^{228}Ra

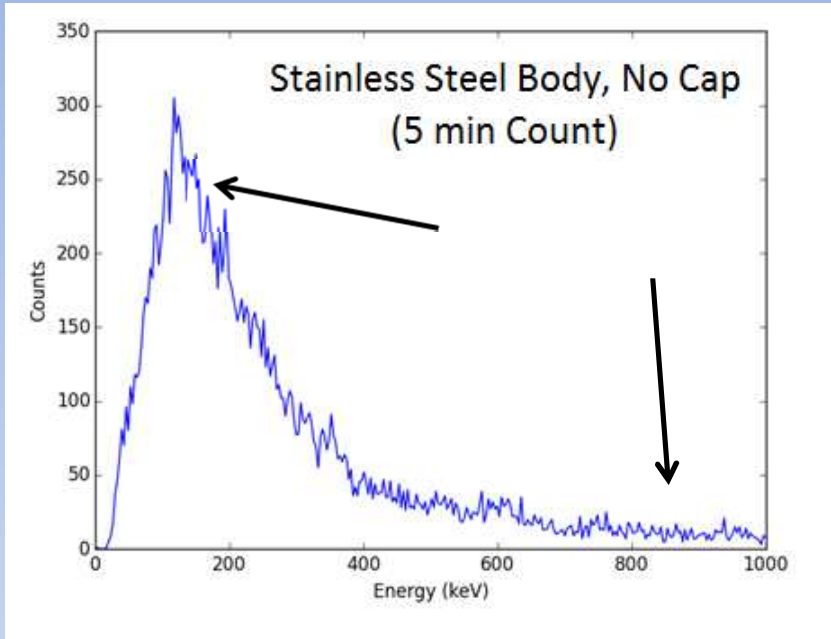


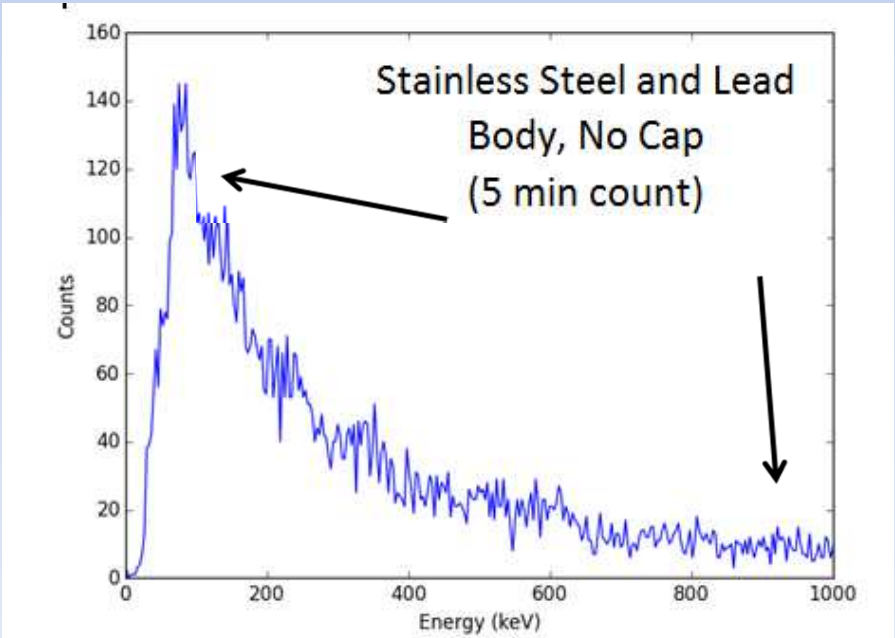
Thin Be Window

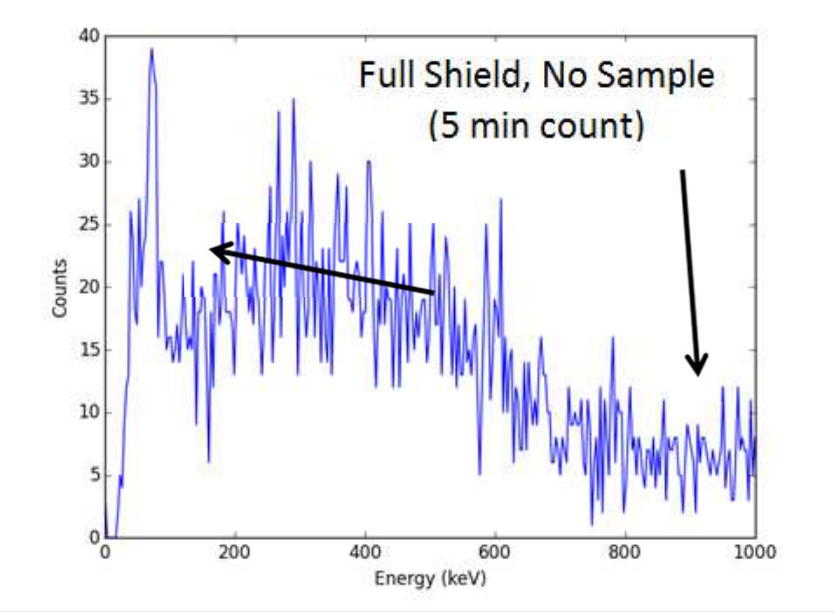
Overview of Goals

- Use this prepared reference material as a “standard” and have the analytical data installed in the software.
- This includes weight of sample, counting time, peak areas and radioactive concentrations in pCi/g (Bq/kg)
- Supply Petrie© dishes and weigh out 20 grams scale sample.
- Software then automatically process giving the final results for ^{226}Ra and ^{228}Ra as well as a combined $^{226,228}Ra$ and detection limits
- Reduce the background radiation collected by CsI detector
  - Shielding needed – what type- what kind- SS, Pb, Cd, Cu
  - Attenuation calculations
  - Improve detection limits

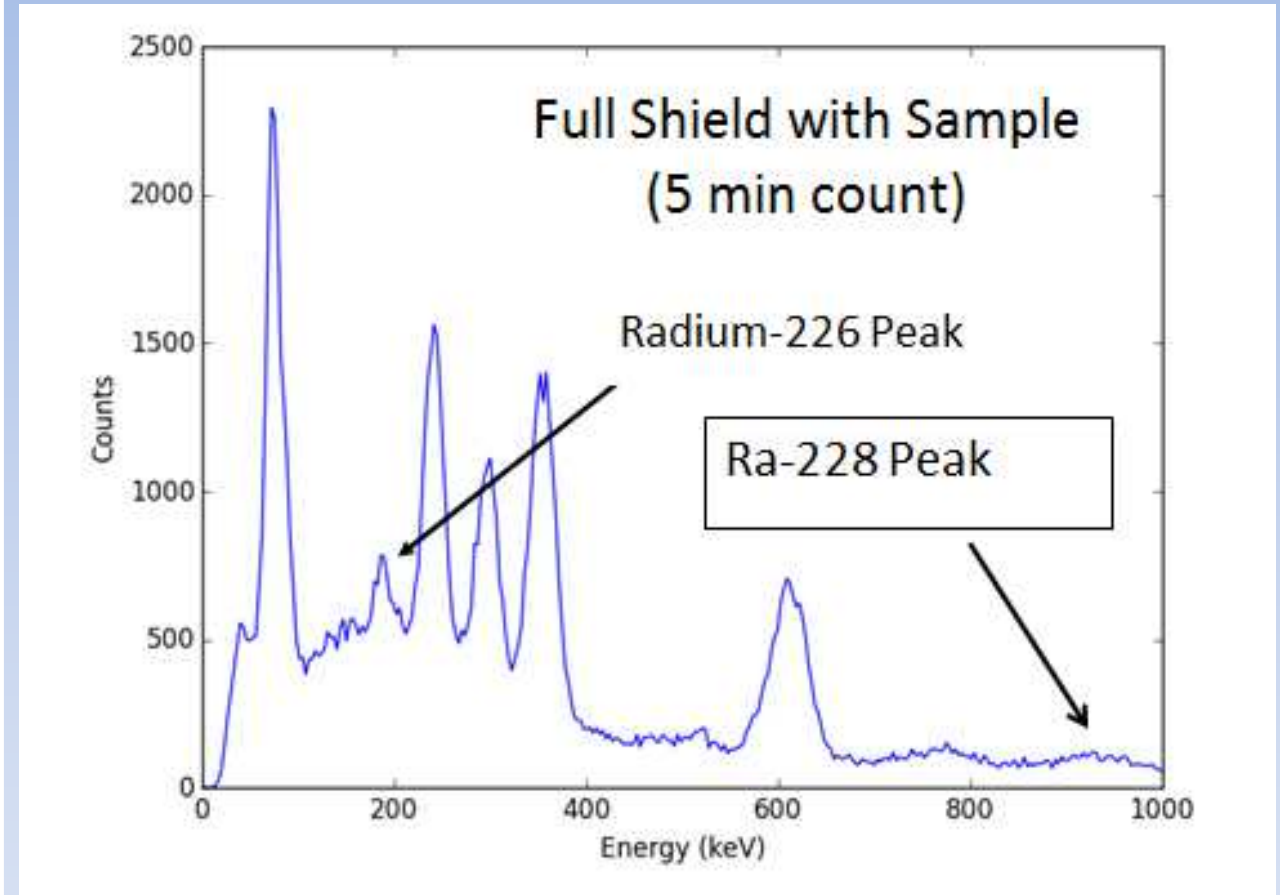

Background, No Shield
(5 min count)
Counts
Energy (keV)
0
50
100
150
200
250
300
350
400
450
0
200
400
600
800
1000


Stainless Steel Body, No Cap
(5 min Count)
Counts
Energy (keV)
0
50
100
150
200
250
300
350
0
200
400
600
800
1000


Stainless Steel and Lead
Body, No Cap
(5 min count)
Counts
Energy (keV)
0
20
40
60
80
100
120
140
160
0
200
400
600
800
1000


Full Shield, No Sample
(5 min count)
Counts
Energy (keV)
0
5
10
15
20
25
30
35
40
0
200
400
600
800
1000

Scale Sample (20 g)



Characterization of CsI

Energy [keV]	HPGe FWHM [keV]	CsI FWHM [keV]	NaI FWHM [keV]	CsI vs NaI Efficiency [%]
186	1.00	16	31	44
1173	1.54	56	119	100

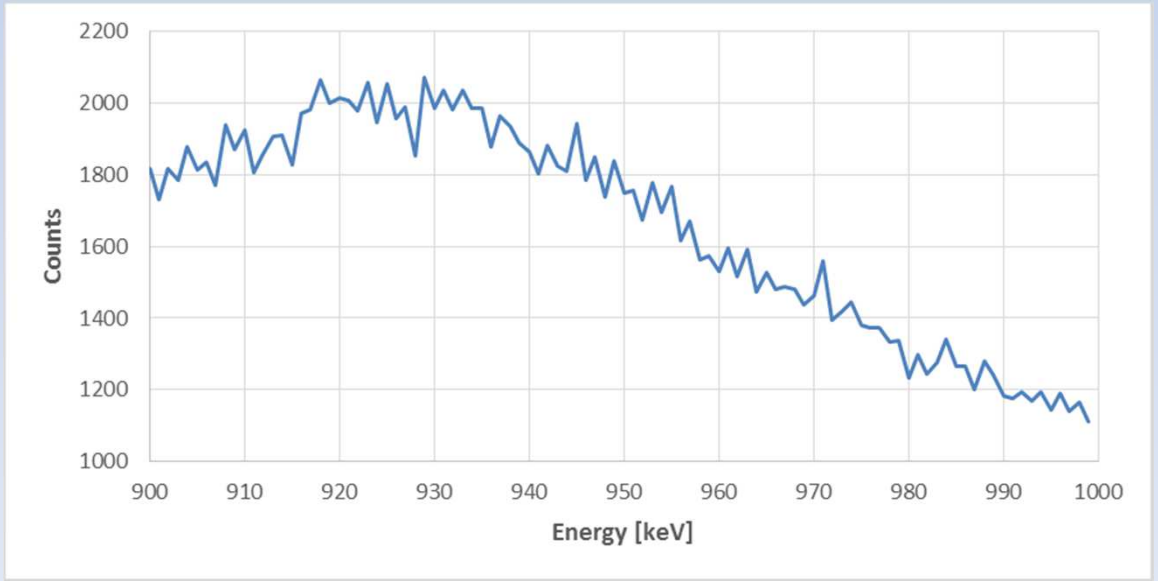
^{226}Ra and ^{228}Ra Determination

^{226}Ra

- 186.4 keV photon spectral interference free from 185.4 keV photon from ^{235}U
- No need to wait for secular equilibrium with ^{222}Rn daughter products
- Resolution good enough not to have any other overlapping peaks

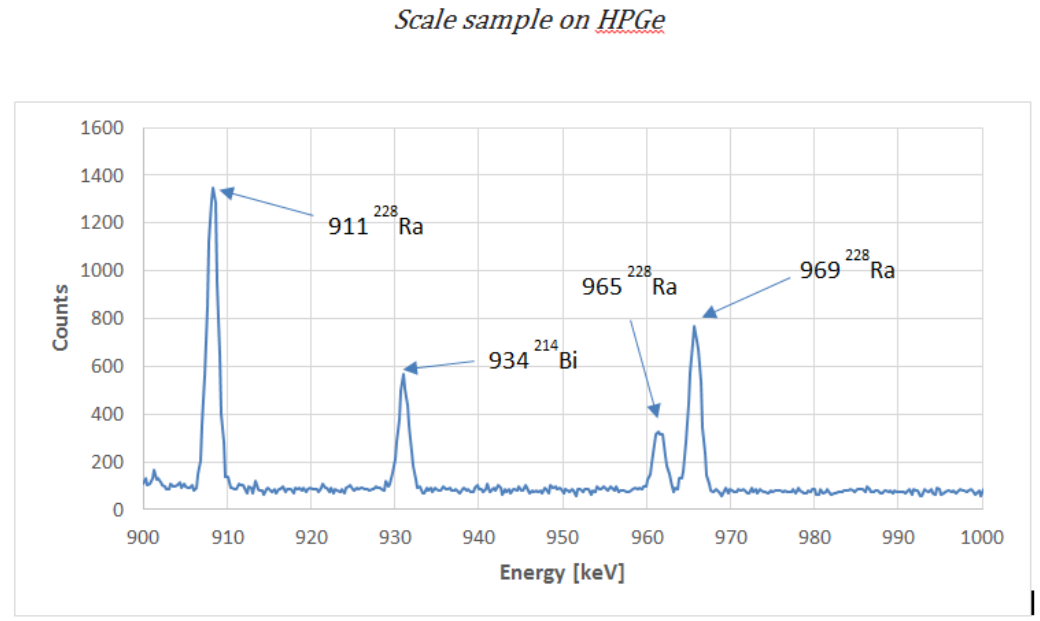
^{228}Ra

- 911 keV photon (^{228}Ac) indistinguishable from other ^{228}Ra (965 keV 969 keV) and ^{214}Bi (934 kev) photopeaks



^{228}Ra Determination

Isotope	Energy [keV]	Net Counts	Uncertainty
^{228}Ra	911	8320	112
^{214}Bi	934	2935	80
^{228}Ra	965	1454	63
^{228}Ra	969	4516	84



The ratio of the 934 keV peak to the total = 0.170