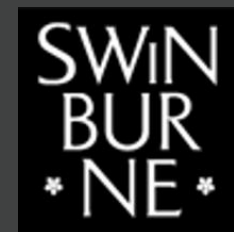


Radioimpurities in Detector Materials: 4^0K

Dark Matter Annual Meeting
29 November – 01 December
2021

Zuzana Slavkovská

Postdoctoral Fellow
Australian National
University



Metrology Team at ANU

Development of ultra-sensitive techniques to measure radionuclides

SABRE: Impurity estimation
Low-background needed

How much radioactivity present?

^{40}K , ^{129}I , ^{210}Pb , ^{232}Th , ^{238}U , ...



Steve
Tims



Michaela
Froehlich



Zuzana
Slavkovská



Ferdos
Dastgiri

Radioimpurities in Detector Materials: ^{40}K

$t_{1/2} (^{40}\text{K}) = 1.25 \text{ Ga}$, primordial origin

$$^{40}\text{K}/^{39}\text{K} = 1.255 \times 10^{-4}$$

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Inductively Coupled Plasma – Mass Spectrometry (ICP-MS)

Collaboration with

Research School of Earth Sciences at ANU

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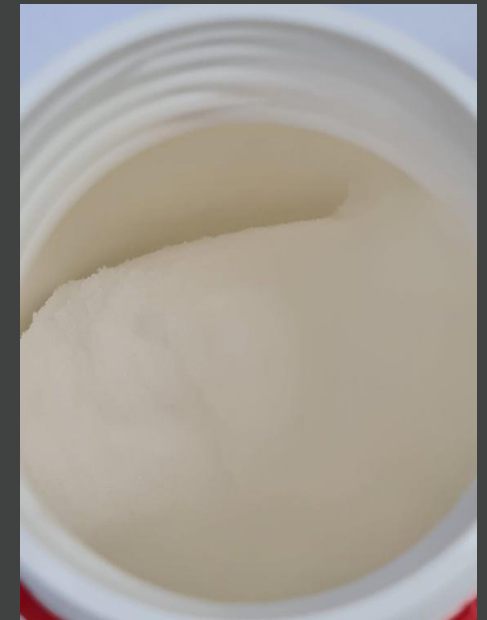
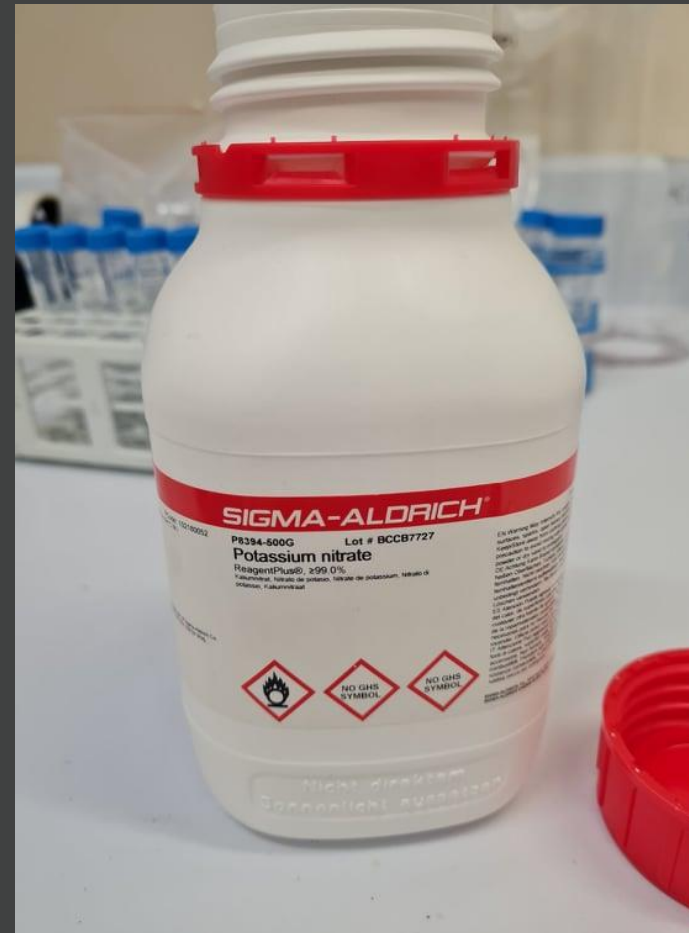
Type of NaI Powder	^{39}K Content	^{40}K Activity
Growth Grade (2016)	340 $\mu\text{g/g}$	10 mBq/g
Astro Grade (2016)	140 ng/g	4.4 $\mu\text{Bq/g}$

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Dilution series:

KNO_3 + purified H_2O

- Verify the credibility



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Potassium concentration

~ 20 ppb - 500 ppm

ppb = parts per billion = μg per Liter

ppm = parts per million = mg per Liter

Radioimpurities in Detector Materials: ^{40}K

Dilution series:

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Radioimpurities in Detector Materials: ⁴⁰K

Dilution series:

KNO₃ + purified H₂O

- Verify the credibility

Potassium concentration

~ 20 ppb - 500 ppm

ppb = parts per billion = μg per Liter

ppm = parts per million = mg per Liter

Sample Numbers	Produced K Concentration
1, 2	500 ppm
3	222 ppm
4	77 ppm
5	950 ppb
6	111 ppb
7, 8	22 ppb
9	Blank 10 ml H ₂ O
10	Blank 700 ml H ₂ O
11	Blank 1 L H ₂ O

Radioimpurities in Detector Materials: ^{40}K

Dilution series:

KNO_3 + purified H_2O

- Verify the credibility

Potassium concentration

~ 20 ppb - 500 ppm

15 ml centrifuge tubes

10 ml solution



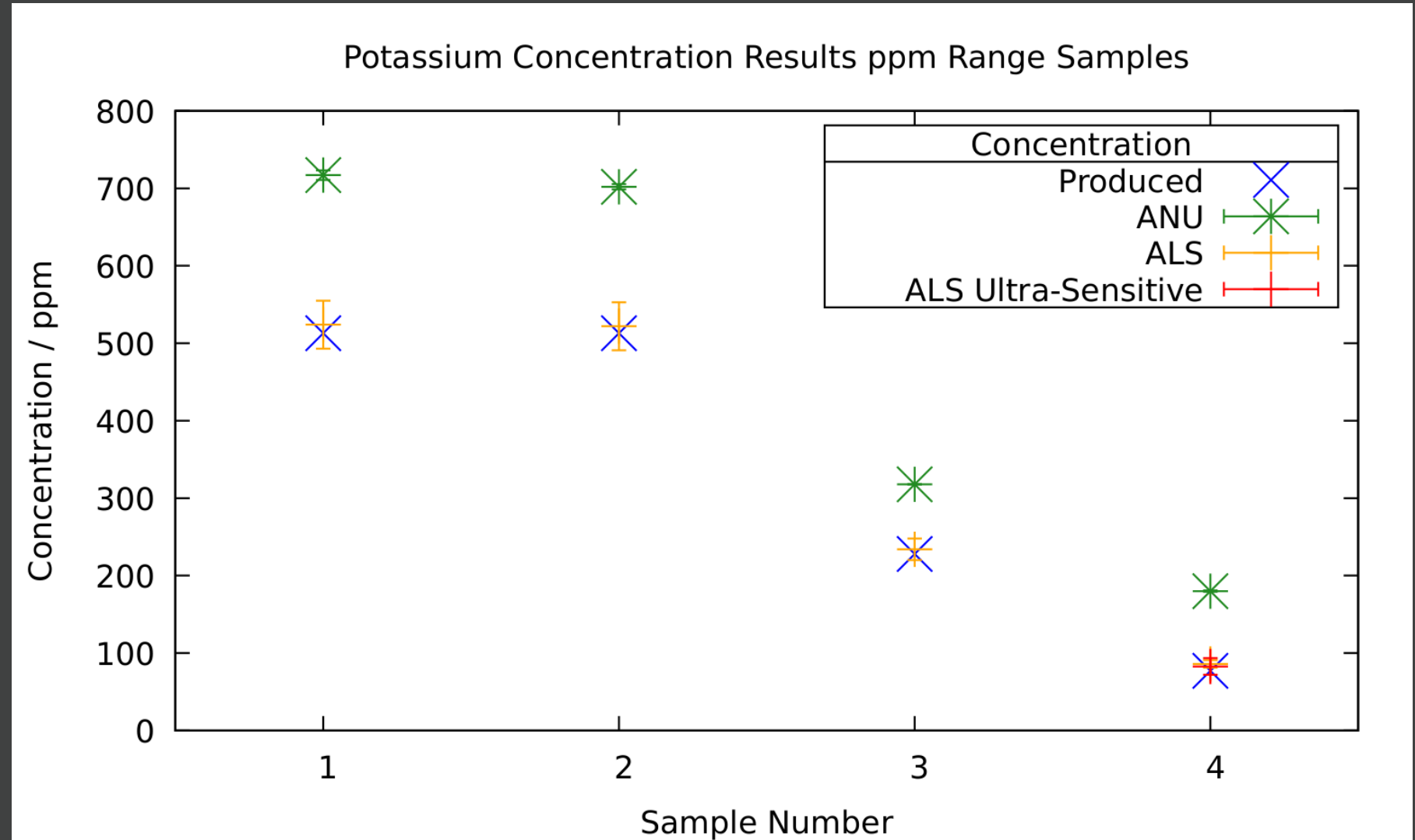
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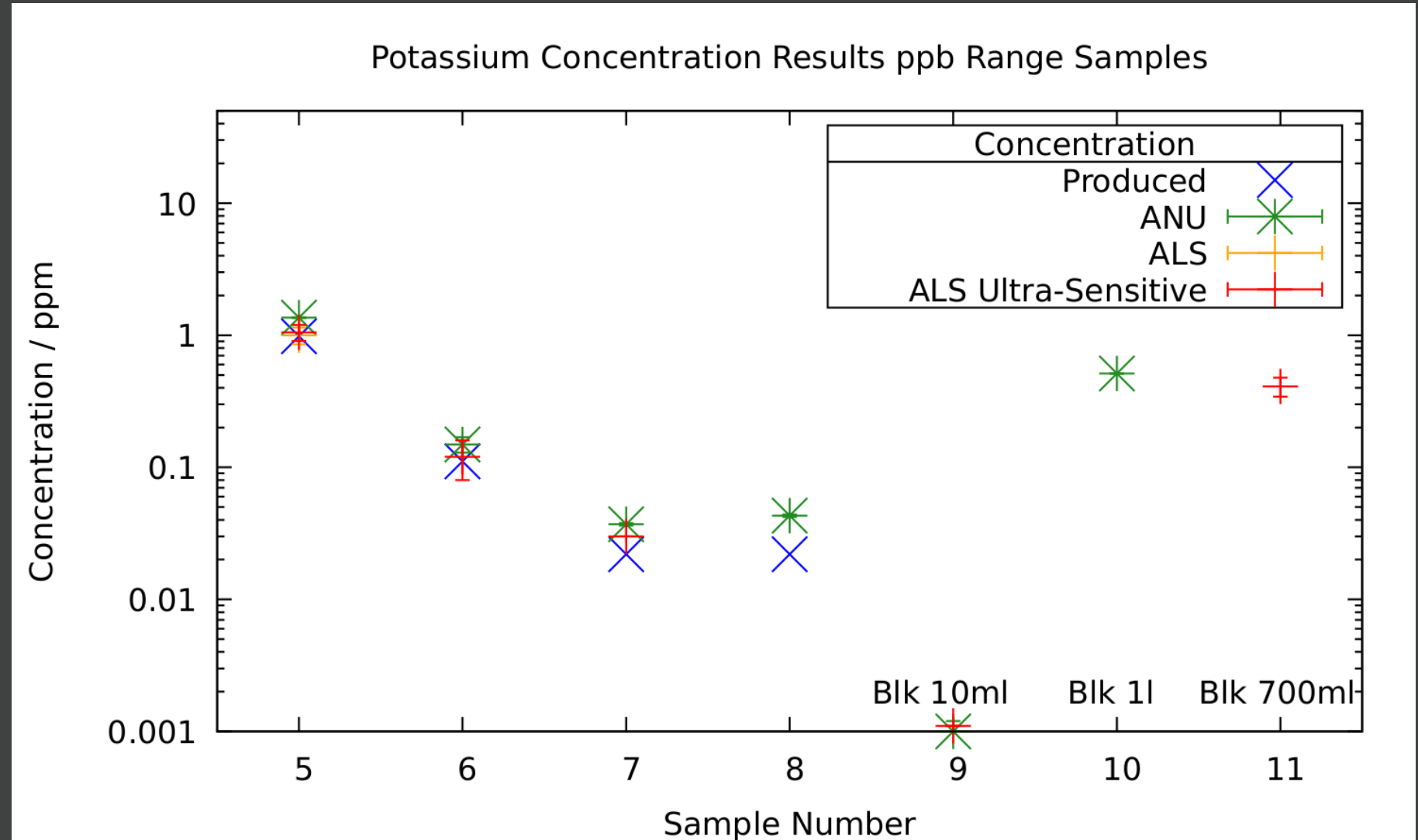
Collaboration with

- **Research School of Earth Sciences at ANU**
- **ALS* Environmental Testing, Sydney, Water Resources Group**

Radioimpurities in Detector Materials: ^{40}K



Radioimpurities in Detector Materials: ^{40}K



Radioimpurities in Detector Materials: 4^0K

Inductively Coupled Plasma – Mass Spectrometry (ICP-MS)

Collaboration with

- **ALS Environmental Testing, Sydney**, Water Resources Group

- credibility approved
- low price
- quick

Multi element ICP-MS standard

- measure with high accuracy

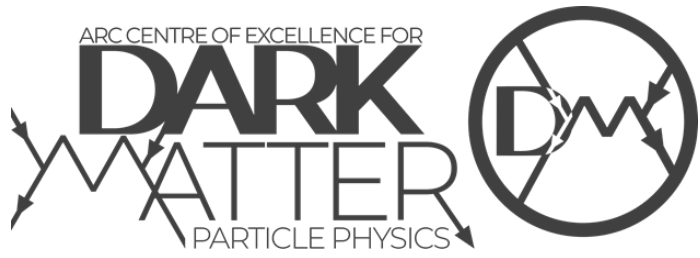
Radioimpurities in Detector Materials: ^{40}K

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Type of NaI Powder	^{39}K Concentration	^{40}K Activity
Growth Grade (2016)	?	?
Astro Grade (2016)	?	?
Astro Grade (2022)	?	?



INTERNATIONAL PARTNER ORGANISATIONS:



The University Of Sheffield.

