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Measurements With Radiacode

What is Radiacode?

Radiacode is a portable beta and gamma radiation detector. It can be used to measure dose rates and accumulated total dose. It can also measure the spectrum of the radiation. It can be used stand-alone or through an app on your smartphone.

What is inside?

Radiacode uses a CsI(Tl) scintillator detector working together with a silicon photomultiplier:

Getting started with the device

Refer to the RC-10x Device Manual, in particular the following chapters:

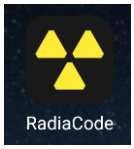
- 3.2 Buttons
- 3.3 Turning on and off
- 3.4 Display
- 3.9 Menue settings
- 3.10 Device settings

Installing the software

If you have an Android device available we recommend to use it because the Android app has most features. The iPhone app also works well. Both apps connect using Bluetooth.

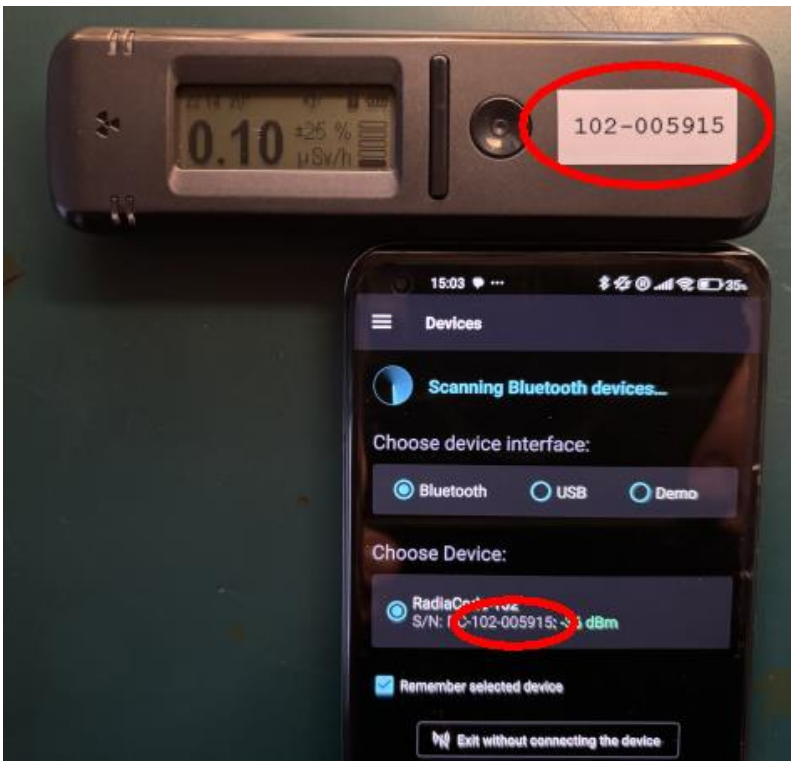
You can use Radiacode with a Windows computer but only USB connection is supported – which makes it rather cumbersome to use

Install the app on your device:



Couple the Radiacode using Bluetooth

In the classroom with several Radiacodes in use you have to make sure that you couple to your Radiacode (and not your neighbour's!): under «Devices» identify the serial number of your Radiacode (white label on the Radiacode)



Android App Manual

There is a detailed manual for the Android app. The iPhone app is similar enough that you can mostly use the Android manual.

Particularly interesting are:

- Chapter 4 Main Screens
- Chapter 6 Spectrum
- Chapter 10 Maps and tracks

If you are upset by the sounds from the Radiacode see Chapter 14 Device Settings for how to mute it

Location of the detector

For the following experiments note the location of the scintillation detector crystal – it is marked by the «PLUS» sign on the back of the Radiacode:

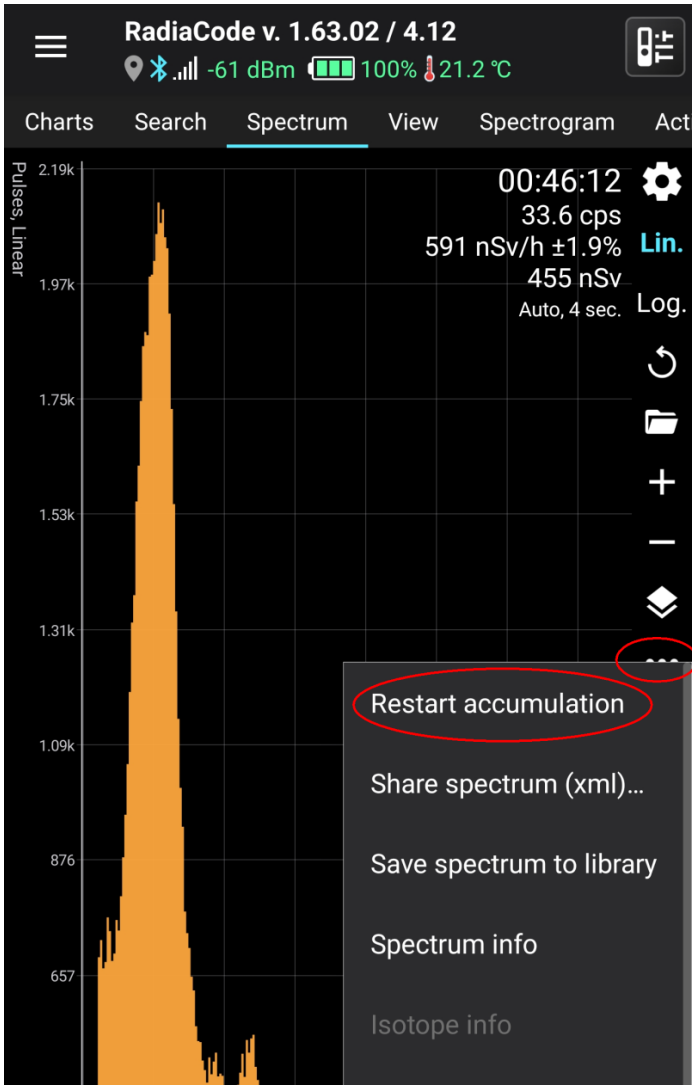
Place the detector close to the sample that you want to measure, e.g. the luminescent hand of the alarm clock:

Exercise 1: Dose Rate

- Measure the dose rate for the different objects.
- Which part of the object is active?
- Relate the dose rate to the natural background

Exercise 2: Isotope identification

Before starting a measurement make sure to clear the old spectrum data: click on the 3 dots in the menue on the right, the choose «Restart accumulation»:



The decay of the active isotopes leaves a series of «daughter isotopes» which often are first in an excited state; falling into the ground state is accompanied by a gamma emission of a specific energy, showing up as a peak in the gamma spectrum measured by the Radiacode. The combination of these lines forms a pattern which is characteristic of the original active isotope, thus allowing its identification.

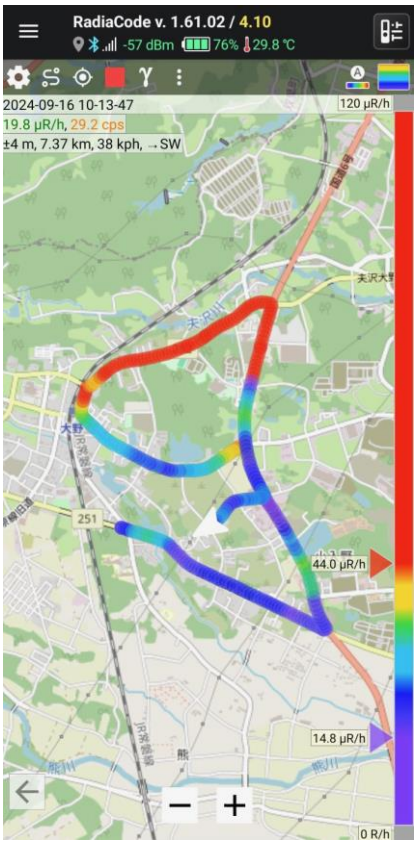
See the example of the Ra-226 decay series in the appendix.

The different objects have different active isotopes. Measure the spectrum using the app and identify the characteristic lines. Radiacode gives you hints to identify the corresponding decay series (again, see the Ra-226 example in the appendix).

Search the Internet for characteristic spectra, e.g. google for «Radium 226 gamma spectrum», «Lutetium 176 gamma spectrum», «Thorium 232 gamma spectrum»

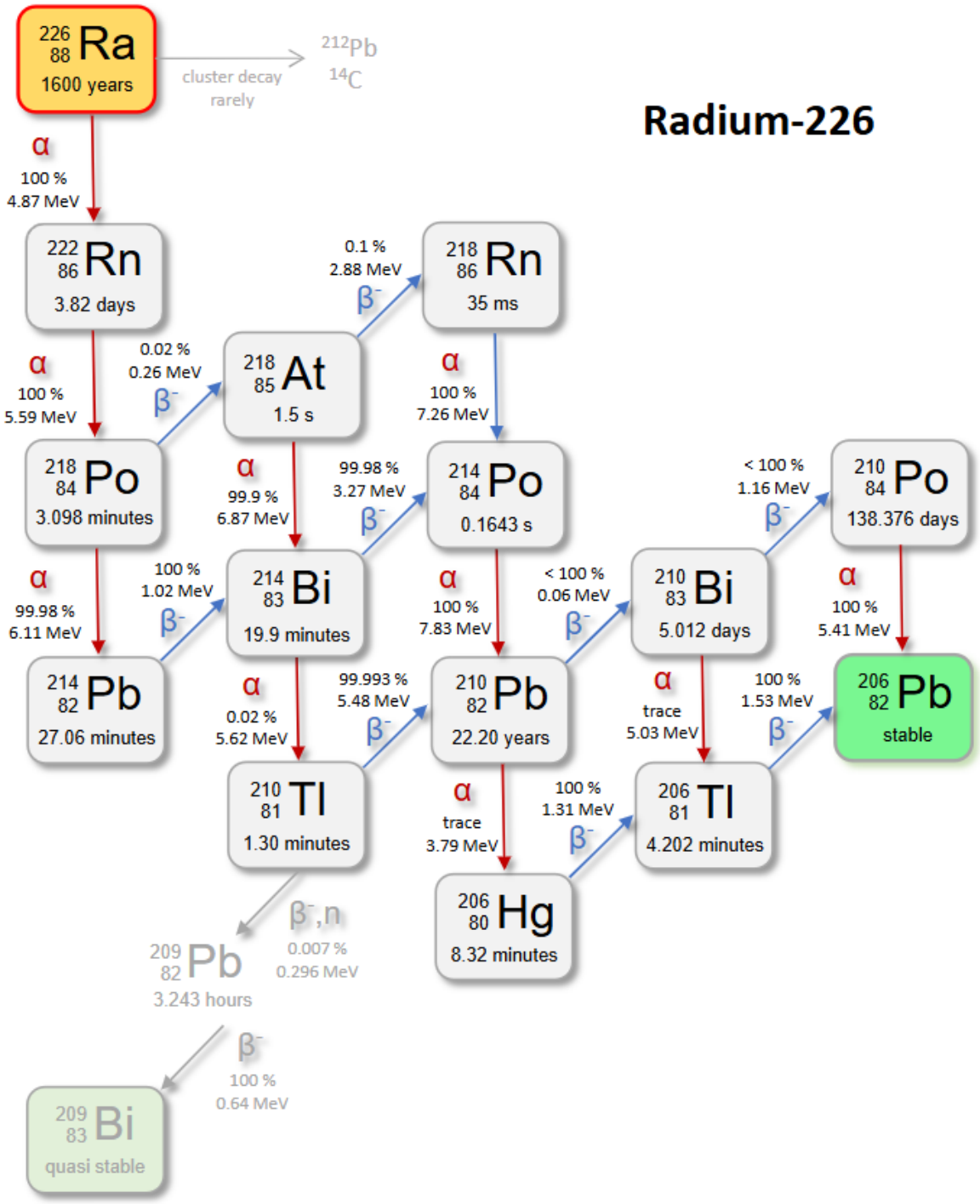
Mapping

The app allows you to combine the measured dose rate with GPS data from your mobile phone. If you move around in an area with varying activity you can get a map – here is an example a previous school



Appendix: Ra-226 spectrum

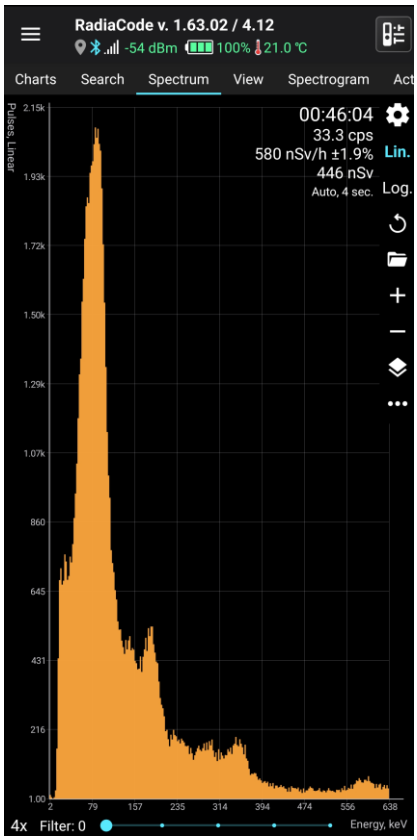
The diagram shows the decay series of Ra-225:



The alpha decay of Ra-226 is accompanied by a 186 keV gamma. Several of the isotopes in the decay chain leave other characteristic spectral lines, highlighted in yellow in the table below:

Decay Mode: α		Half-Life: (584400 ± 2600) d					[2]
Radiation Type		Energy (keV)			Intensity (%)		Ref.
Auger-L		8.7			0.97	10	[4]
ce-K-1		87.59			0.677	23	[4]
ce-L-1		167.94			1.29	4	[4]
ce-M-1		181.52			0.345	14	[4]
ce-NOP-1		184.90			0.119	7	[4]
α		4601.7			5.94	12	[4]
α		4784.4			94.05	12	[4]
X-ray L	Σ	12.1	-	13.6	14.3	14	[2]
X-ray Kα	Σ	74.8	-	83.8	19.5	22	[2]
X-ray Kβ	Σ	87.2	-	97.9	5.62	13	[2]
γ		186.10			3.51	6	[2]
γ	Pb-214	242.0			7.12	11	[2]
γ	Pb-214	295.22			18.15	22	[2]
γ	Pb-214	351.93			35.1	4	[2]
γ	Bi-214	609.31			44.6	5	[2]
γ	Bi-214	665.45			1.46	3	[2]
γ	Bi-214	768.36			4.76	7	[2]
γ	Pb-214	785.96			1.04	2	[2]
γ	Bi-214	806.17			1.22	2	[2]
γ	Bi-214	934.06			3.07	4	[2]

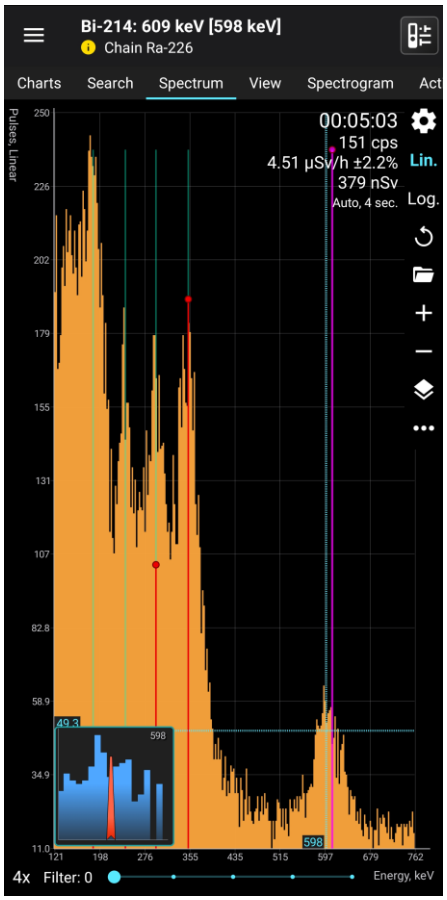
Can you identify these lines in the spectrum measured by Radiacode?

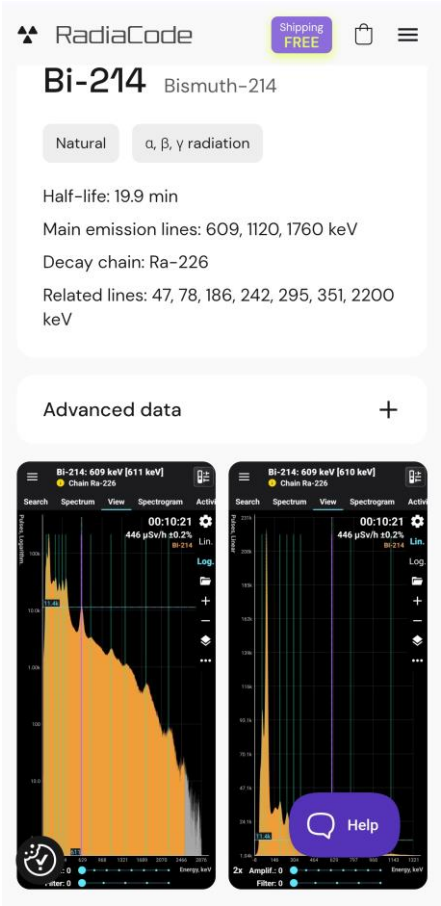


Radiacode can help you identify the isotope: hold your finger on the screen in the display area of the spectrum. A magenta line appears. Move it over one line, e.g. at 609 keV. It gets identified as originating from Bi-214 which is part of the Ra-226 series. The green and red lines to the left indicate

the 186 keV from the Ra-226 decay, and then the 3 Pb-214 lines at 242, 295 and 352 keV. Very clear is also the Kα X-ray peak at 75…84 keV.

If you touch the yellow info button next to «Chain Ra-226» a webpage opens which tells you more detail.





Compare this to a «Radium 226 gamma spectrum» which you can find online: