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The Timeline of **Radioactive Decay for Uranium^{238}** (U^{238})

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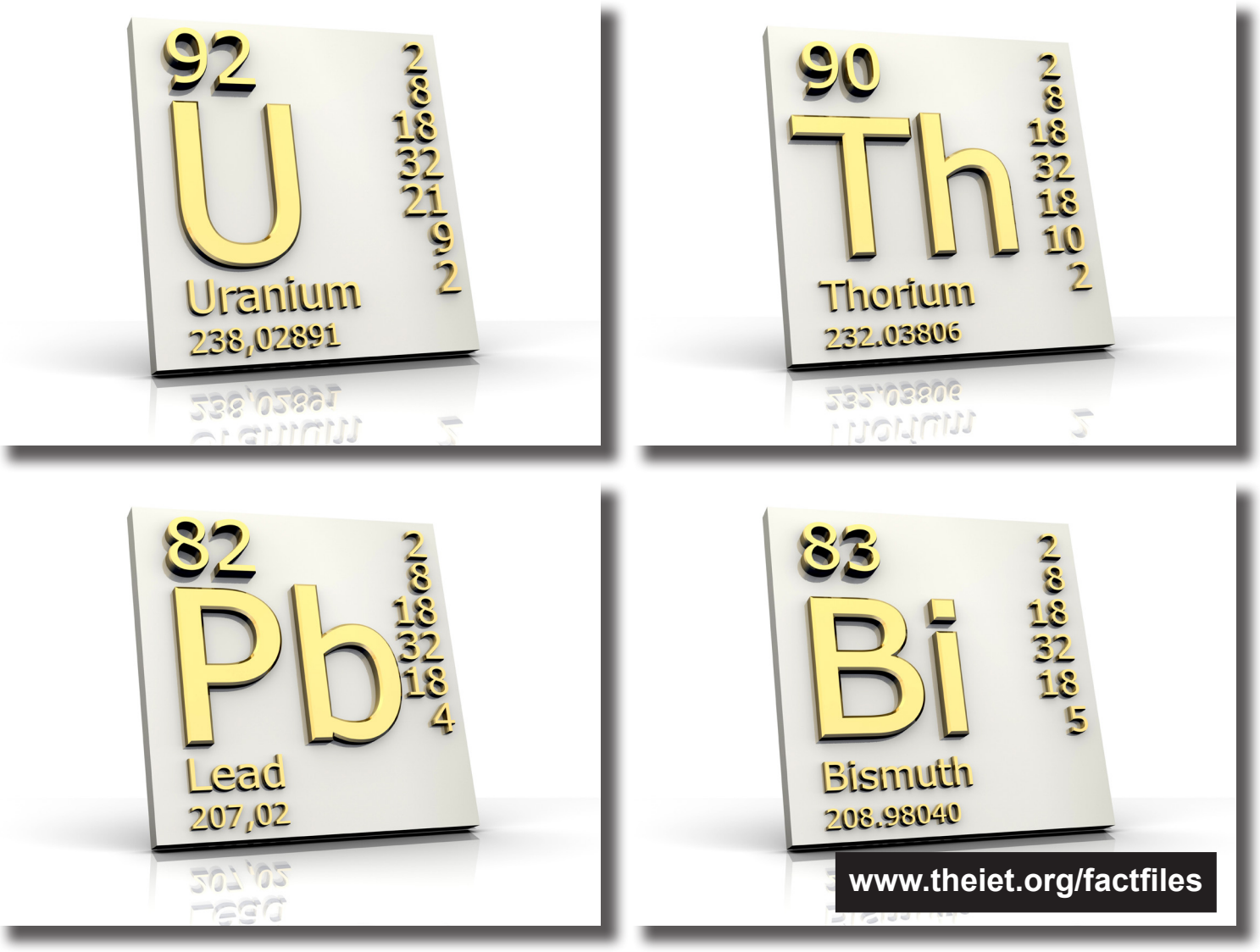

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Cover images (clockwise from top left)

- Uranium
- Thorium
- Bismuth
- Lead

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Summary

This Factsheet shows the radioactive decay chain of uranium^{238}, the resulting products, the radition emitted in the process and the timescales involved.

Uranium^{238} (U^{238}) Radioactive Decay

Type of Radiation[2] (α, β, γ)	Nuclide	Half-Life
α γ	Uranium^{238} [3]	4.47 billion years [1]
β γ	Thorium^{234}	24.1 days
β γ	Protactinium^{234m}	1.17 minutes
α γ	Uranium^{234}	245000 years
α γ	Thorium^{230}	80000 years
α γ	Radium^{226}	1600 years
α	Radon^{222}	3.823 days
α β	Polonium^{218}	3.05 minutes
β γ	Lead^{214}	26.8 minutes
α β γ	Bismuth^{214}	19.7 minutes
α	Polonium^{214}	0.000164 seconds
β γ	Lead^{210}	22.3 years
α β	Bismuth^{210}	5.01 days
α γ	Polonium^{210}	138.4 days
	Lead^{206}	stable

α – Alpha Radiation
β – Beta Radiation
γ – Gamma Radiation

Notes

1. The half-life of Uranium^{238} is 4.47 billion years. Given that the estimated age of the Earth is also about 4.5 billion years, in this time period, about half of the Uranium present when the Earth was formed has decayed and about half still exists today.

2. Radioactivity is the emission of particles or electromagnetic energy from the nucleus of an atom. The three types of radioactive decay are alpha (**α**), beta (**β**) and gamma (**γ**).

   Alpha particles are helium nuclei each made up of two protons and two neutrons.

   Taking the example:

   ^{238}Uranium ⟶ ^{234}Thorium + ^{4}Helium

   the daughter nucleide, Thorium has two fewer protons and two fewer neutrons than the parent nucleide.

   Beta particles are electrons, the mass of which are negligible on the atomic weight scale. In beta emissions, the parent and daughter elements have virtually the same atomic weights.

   Gamma rays are very high frequency electromagnetic radiation emitted in many radioactive changes irrespective of whether alpha or beta particles are emitted.

3. Uranium^{238} is also fertile in that it can capture a neutron transforming. following radioactive decay, into Plutonium which is fissile and can be used as fuel in a nuclear reactor.

   Uranium^{238}
   ↓ Capture of Neutron
   Uranium^{239}
   ↓ **β** decay
   Neptunium^{239}
   ↓ **β** decay
   Plutonium^{239}

Further Information

- **IET Energy related factfiles**
  http://www.theiet.org/factfiles/energy/

IET nuclear factfile series

- **The principles of nuclear power**
  http://www.theiet.org/factfiles/energy/nuc-prin-page.cfm
- **Nuclear reactor types**
  http://www.theiet.org/factfiles/energy/nuc-reac-page.cfm
- **Nuclear safety**
  http://www.theiet.org/factfiles/energy/nuc-safety-page.cfm
- **Legal framework of nuclear power in the UK**
  http://www.theiet.org/factfiles/energy/legal-frame-nuc-page.cfm
- **Nuclear decommissioning**
  http://www.theiet.org/factfiles/energy/nuc-dec-page.cfm
- **Nuclear waste disposal and transport of spent fuel**
  http://www.theiet.org/factfiles/energy/nuc-waste-page.cfm
- **The nuclear fuel cycle**
  http://www.theiet.org/factfiles/energy/nuc-fuel-page.cfm
- **The radioactive decay of uranium^{238}**
  http://www.theiet.org/factfiles/energy/uranium238-page.cfm
- **Glossary of nuclear terms**
  http://www.theiet.org/factfiles/energy/nuc-terms-page.cfm

Further Reading

- Wood, J. **Nuclear Power** (IET Power and Energy Series 52); Institution of Engineering and Technology (2007) ISBN 0863416683

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