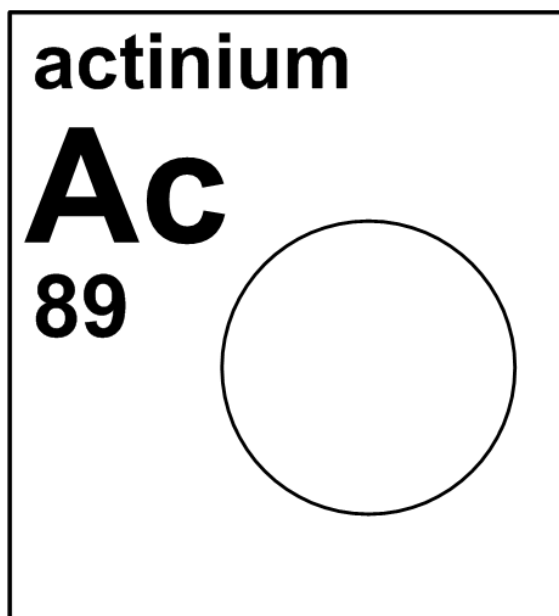





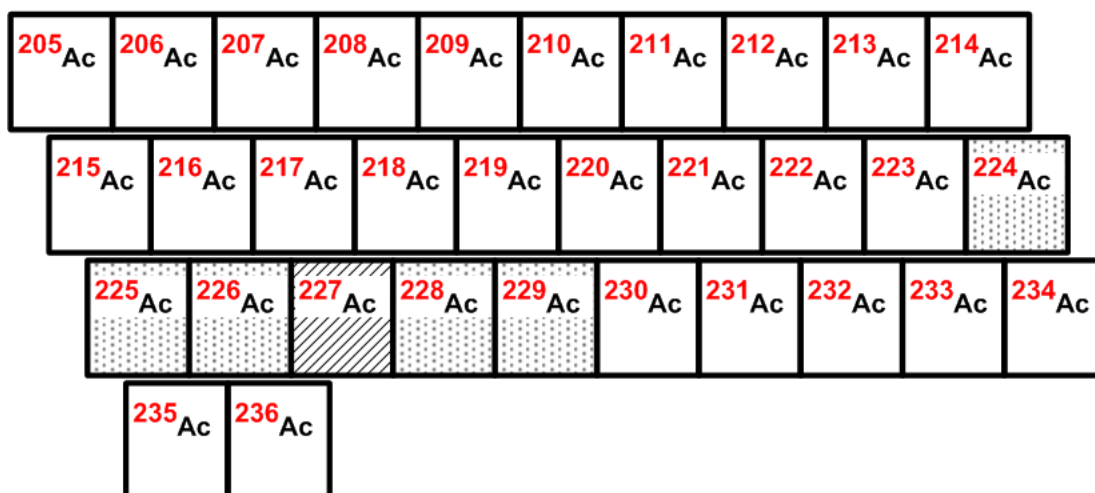
4.89 actinium



Stable isotope	Relative atomic mass	Mole fraction
(none)		

Half-life of radioactive isotope

Less than 1 hour	
Between 1 hour and 1 year	
Greater than 1 year	



4.89.1 Actinium isotopes in Earth/planetary science

^{227}Ac (with a **half-life** of 21.77 years) has been used as a **tracer** of deep-sea mixing in the oceans. By determining concentrations of ^{227}Ac in a water column, scientists can study the rates and patterns of mixing and other vertical exchange processes [580]. As a product of the ^{235}U decay chain, ^{227}Ac and other **radioisotopes** have been used to determine information about the movement of fluids in mid-oceanic ridges and basaltic melts [581, 582].

4.89.2 Actinium isotopes in medicine

^{225}Ac can be used in cancer treatments (Figure 4.89.1). The **isotope** is attached to a chelating agent (a substance that can form multiple bonds to a single metal ion) and delivered to the problem site. The emissions of **alpha particles** from actinium and its **daughter products** cause tumor death [583]. ^{225}Ac decays to ^{213}Bi , which is also used for **radioimmunotherapy** [584].



Fig. 4.89.1: The Medical Actinium for Therapeutic Treatment (MATT) is a separations process that recovers ^{225}Ac from unused nuclear fuel so the **isotope** can be used in cancer treatment and research. (Image Source: Idaho National Laboratory) [585].

4.89.3 Actinium isotopes used as a source of radioactive isotope(s)

^{225}Ac , which is a pure alpha emitter with a **half-life** of 10 days, is used to produce ^{213}Bi with an $^{225}\text{Ac}/^{213}\text{Bi}$ radionuclide generator (Figure 4.89.2). ^{213}Bi is a mixed alpha and beta emitter having a half-life of 46 minutes. The primary mode of decay is by beta emission to the very short-lived, alpha emitter ^{213}Po . The 8.4 MeV alpha particle emitted by ^{213}Po has a path length of 76 μm in human tissue and is responsible for its cytotoxic effects.

IUPAC

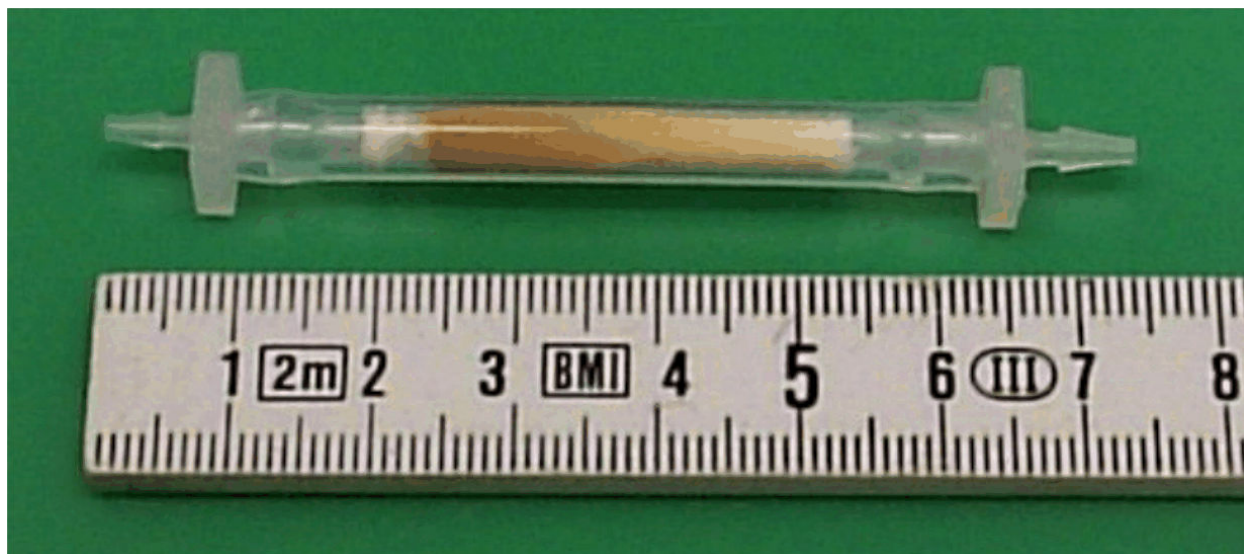


Fig. 4.89.2: Institute for Transuranium Elements (ITU) Standard $^{225}\text{Ac}/^{213}\text{Bi}$ Radionuclide Generator. Image kindly provided by Dr. Alfred Morgenstern, European Commission, Joint Research Centre – Institute for Transuranium Elements, Karlsruhe, Germany.