

Isotopes of Protactinium

Isotope	Atomic Mass	Half-life	Mode of Decay	Nuclear Spin	Nuclear Magnetic Moment
Pa-228	228.03100	22.00 hours	EC to Th-228; α to Ac-224	3	3.5
Pa-229	229.03209	1.50 days	EC to Th-229; α to Ac-225	5/2	No data available
Pa-230	230.03453	17.40 days	EC to Th-230; α to Ac-226; β^- to U-230	2	2.0
Pa-231	231.035880	32,500 years	α to Ac-226; SF	3/2	2.01
Pa-232	232.03858	1.31 days	EC to Th-232; β^- to U-232	2	No data available
Pa-233	233.04024	27.00 days	β^- to U-233	3/2	4.0
Pa-234	234.04330	6.69 hours	β^- to U-234	4	No data available

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Pa

Protactinium was discovered in 1913 by Otto Hahn, Lise Meitner, Frederick Soddy and John Cranston. Its name originates with the Greek word *protos*, meaning “first.”

A shiny white metal with bright metallic luster, protactinium is also hard and malleable, with a body-centered tetragonal structure. It has a vapor pressure of 3.88×10^{-2} torr at about 1930 °C and is superconducting below -271.75 °C. In solution, Pa⁴⁺ is oxidized to Pa⁵⁺ by atmospheric oxygen. The chemistry of pentavalent protactinium is quite similar to that of niobium and tantalum. A number of salts and complexes are known. No commercial application of protactinium isotopes is known outside of scientific research. For this purpose, protactinium is generally extracted from spent nuclear fuel.

Protactinium is a very dangerous substance to work with. It is highly toxic and presents a radiation hazard (alpha emitter). The Protactinium-231 isotope is a long-lived alpha-emitter and is not excreted readily. Exposure can cause cancer.

Properties of Protactinium

Name	Protactinium
Symbol	Pa
Atomic number	91
Atomic weight	231.03588
Standard state	Solid at 298 °K
CAS Registry ID	7440-13-3
Group in periodic table	N/A
Group name	Actinoid
Period in periodic table	7 (Actinoid)
Block in periodic table	f-block
Color	Silvery metallic
Classification	Metallic
Melting point	1568 °C
Boiling point	4000 °C
Thermal conductivity	47.00 (estimate) W/(m·K)
Electrical resistivity	$18 \times 10^{-8} \Omega \cdot m$
Electronegativity	1.5
Heat of vaporization	$470.00 \text{ kJ} \cdot \text{mol}^{-1}$
Heat of fusion	$15.00 \text{ kJ} \cdot \text{mol}^{-1}$
Density of solid	15.37 g/cm^3
Electron configuration	$[\text{Rn}]5f^26d^17s^2$
Atomic radius	1.63 Å (coordination number 12)
Oxidation states	+4, +5