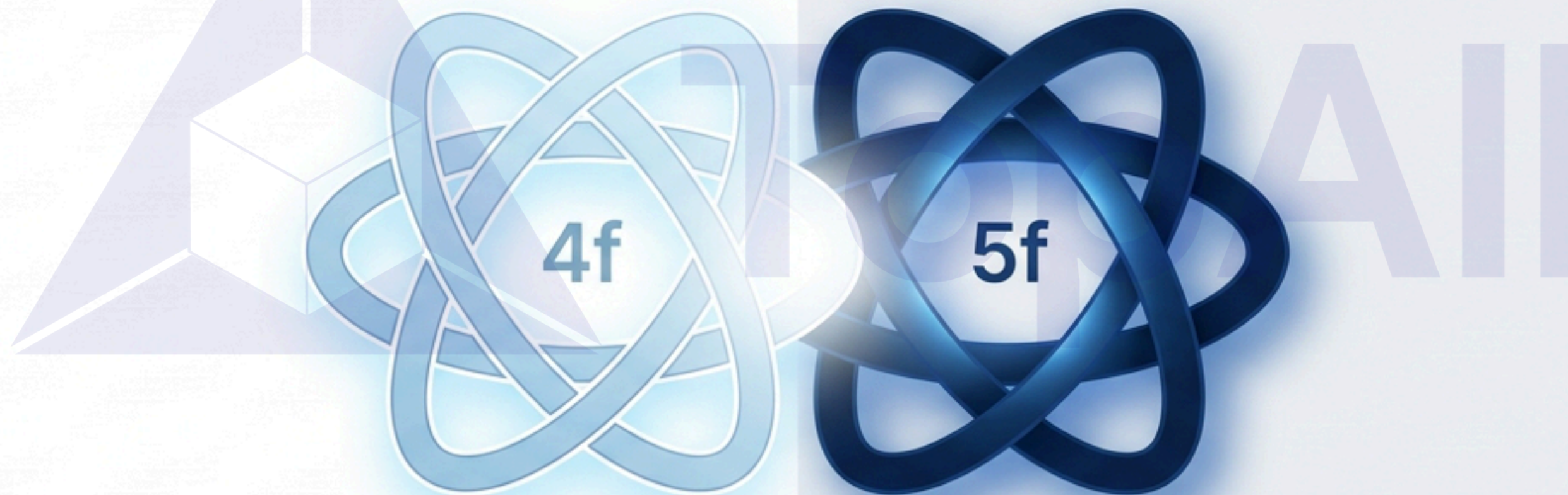


Unit 4.6.4

Actinoids vs Lanthanoids

The Ultimate f-Block Comparison



NEET Revision Series

JEE High-Yield Chemistry

The 4f Series

Cerium (Ce) to Lutetium (Lu)



Relatively stable, highly consistent chemical behavior.

Shared
Principal
Oxidation
State: +3

The 5f Series

Thorium (Th) to Lawrencium (Lr)



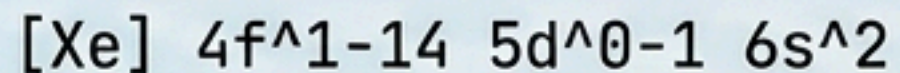
Highly complex, universally radioactive elements.



Increasing Energy

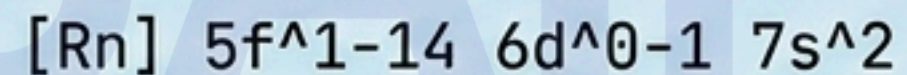
Deeply Buried 4f

There is a large energy gap between the 4f and 5d orbitals. The 4f electrons are shielded deeply within the atom and participate less in bonding.



Protruding 5f

Comparable energies exist between the 5f, 6d, and 7s subshells. The 5f orbitals extend further into space, allowing them to participate readily in chemical bonding.





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Let's Test Them Now.**

$$E=mc^2$$



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Atomic/Ionic Radius

Lanthanoid Contraction:
Due to imperfect shielding of one 4f electron by another.

Lanthanoids

Actinoid Contraction:
Greater decrease from element to element.

Actinoids

Elements across the series

Why is Actinoid Contraction greater?



The 5f electrons provide extremely poor shielding from the increasing nuclear charge compared to 4f electrons.

Narrow Spread

+2 (e.g., Eu^{2+} , Yb^{2+})

+3

+4 (e.g., Ce^{4+})

The comparable energies of 5f, 6d, and 7s orbitals in Actinoids allow a much wider variety of electrons to be removed or shared, creating complex, variable oxidation states.

Wide Spread

+3

+4

+5

+6

Np
(+7)

Pu
(+7)

Predictable Reactivity



Tarnish rapidly in air.

React with water to yield $+3$ ions.

Mostly non-radioactive (Exception: Promethium).

Volatile & Radioactive

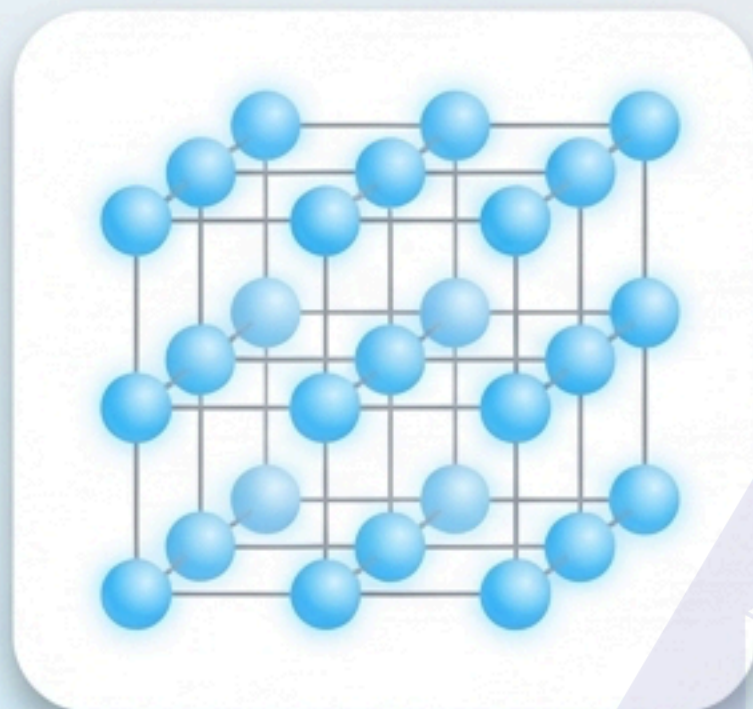


Highly reactive metals, especially when finely divided.

Boiling water yields a mixture of oxide and hydride.

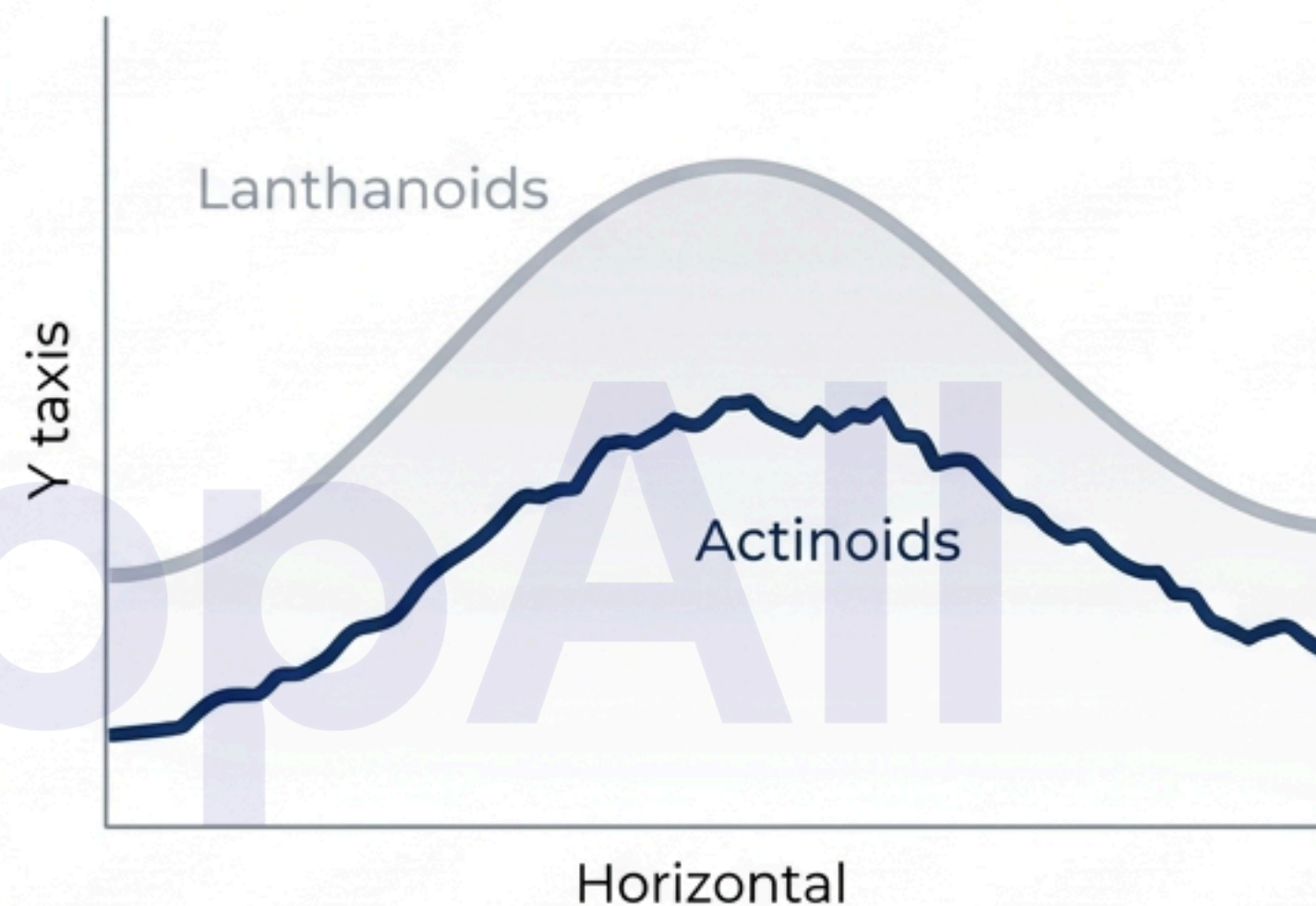
ALL are radioactive (Early members: long half-lives; Z=103 Lawrencium: 3-minute half-life).

Structural Variability



Actinoids display far greater structural variability due to extreme irregularities in their metallic radii.

Magnetic Susceptibility



Variation roughly parallels each other, but Actinoids exhibit more complex behavior. Lanthanoids generally record higher absolute values.

Property

Lanthanoids

Actinoids



Orbitals Involved

4f, 5d, 6s
(Deeply shielded)

5f, 6d, 7s
(Protruding)

Oxidation States

Principally +3
(Rarely +2, +4)

+3 common, highly
variable up to +7

Contraction

Steady (Lanthanoid
Contraction)

Greater element-to-
element
(Poor 5f shielding)

Radioactivity

Non-radioactive
(Except Promethium)

All elements are
radioactive

Reactivity

Less reactive overall

Highly reactive,
especially finely divided

High-Yield Exam Triggers



Most common
oxidation state?

→ **+3 for both
series**



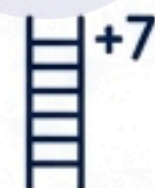
Which
contraction is
greater?

→ **Actinoid (due to
extremely poor
5f shielding)**



Radioactive
anomalies?

→ **Promethium
(only
radioactive
Lanthanoid) vs
ALL Actinoids**



Maximum
actinoid
oxidation
states?

→ **+7, specifically
observed in
Neptunium (Np)
and Plutonium
(Pu)**



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