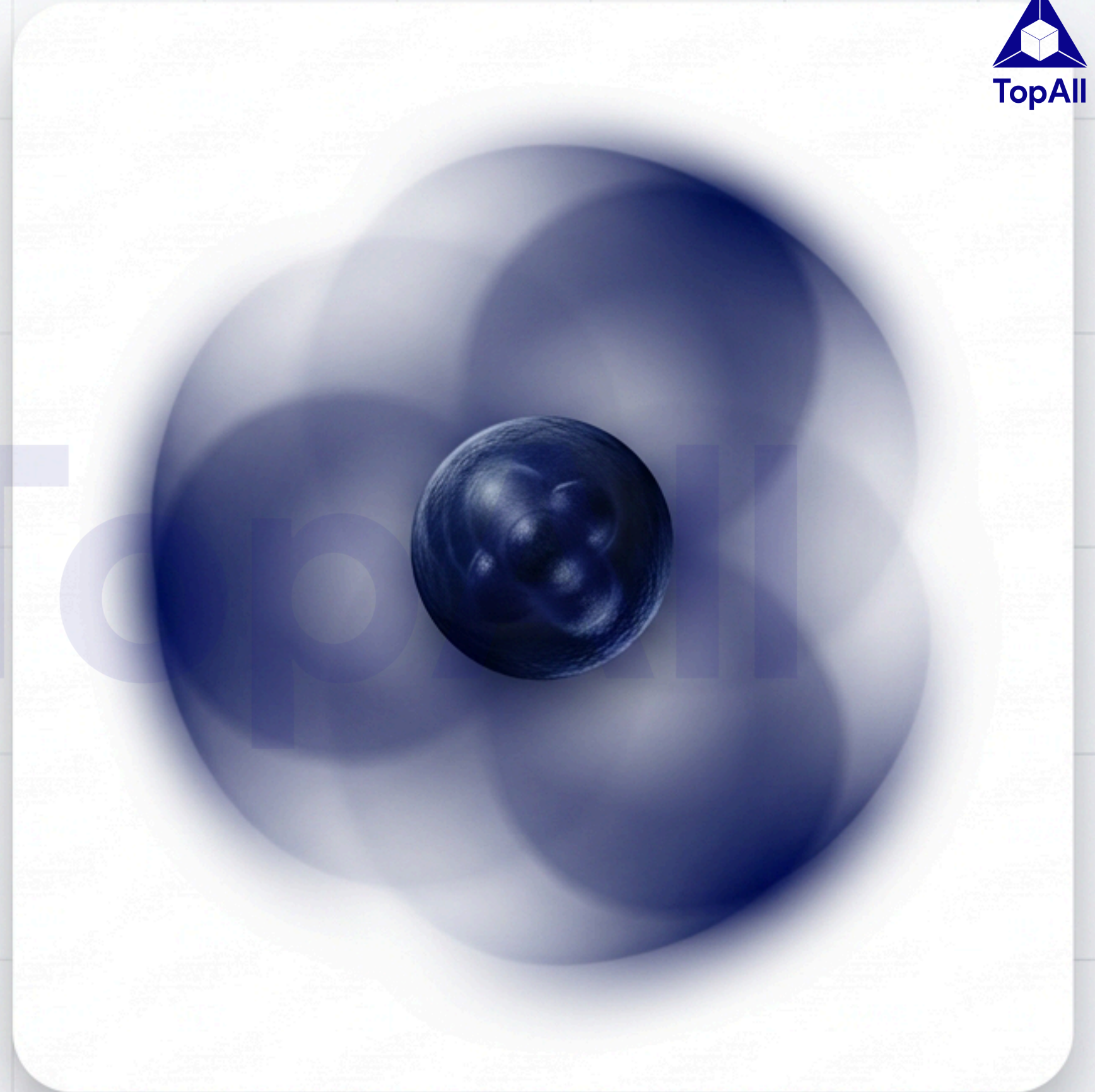


# 4.6.2 Ionic Sizes of Actinoids

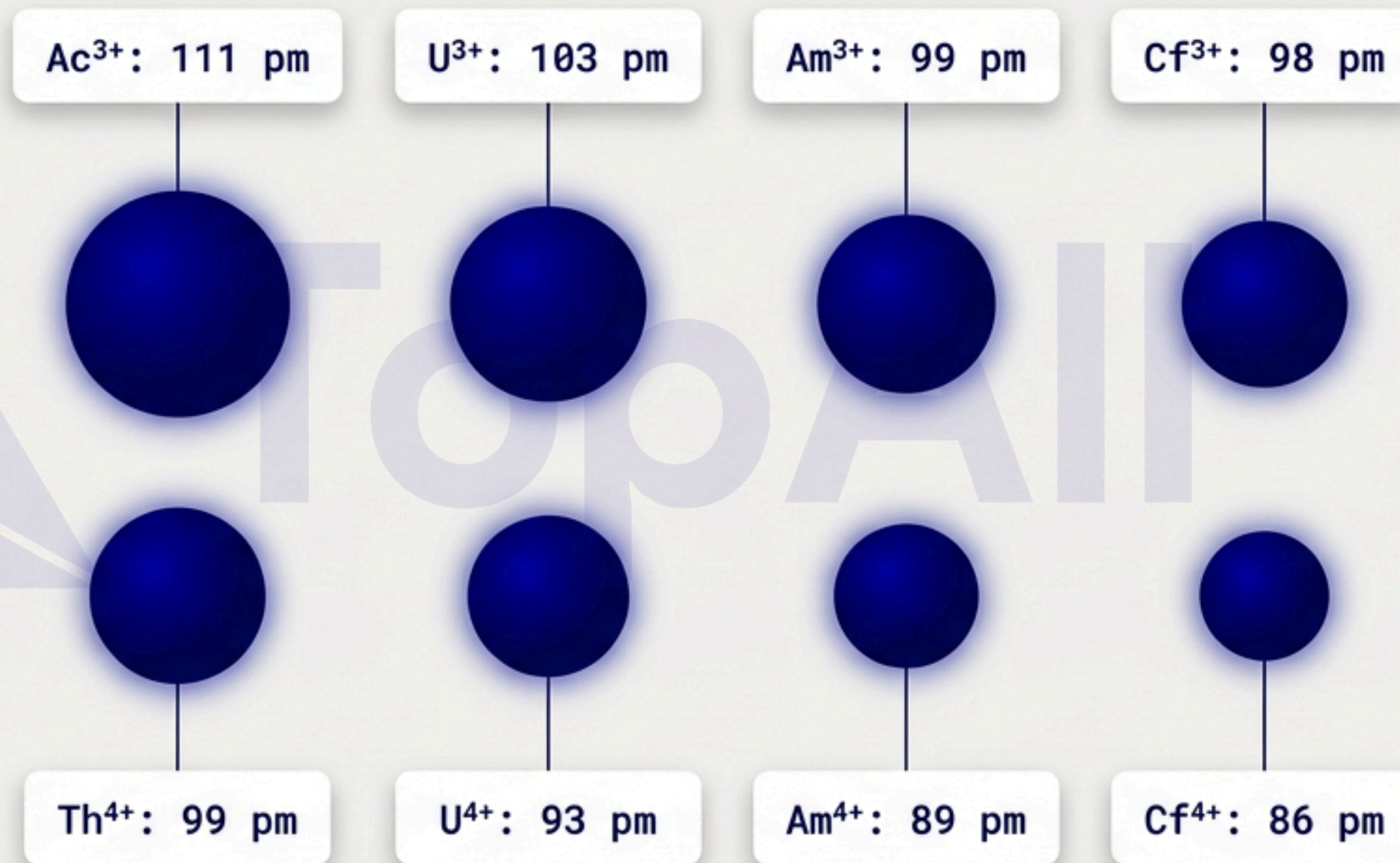
Understanding the  
Actinoid Contraction  
and 5f Shielding



# The Evidence: A Gradual Decrease in Size

Observation of the series reveals a consistent reduction in the ionic radii of actinoids across the period.

## Shrinking Ion Series



# Defining the Actinoid Contraction



Increasing Nuclear  
Charge (Z)



Successive addition  
of 5f electrons



Gradual decrease in  
atomic and ionic sizes

**This gradual decrease in the size of atoms or  $M^{3+}$  ions across the series may be referred to as the actinoid contraction.**

$$[Z: \uparrow] + [5f e^-: \uparrow] = [Radius: \downarrow]$$



# You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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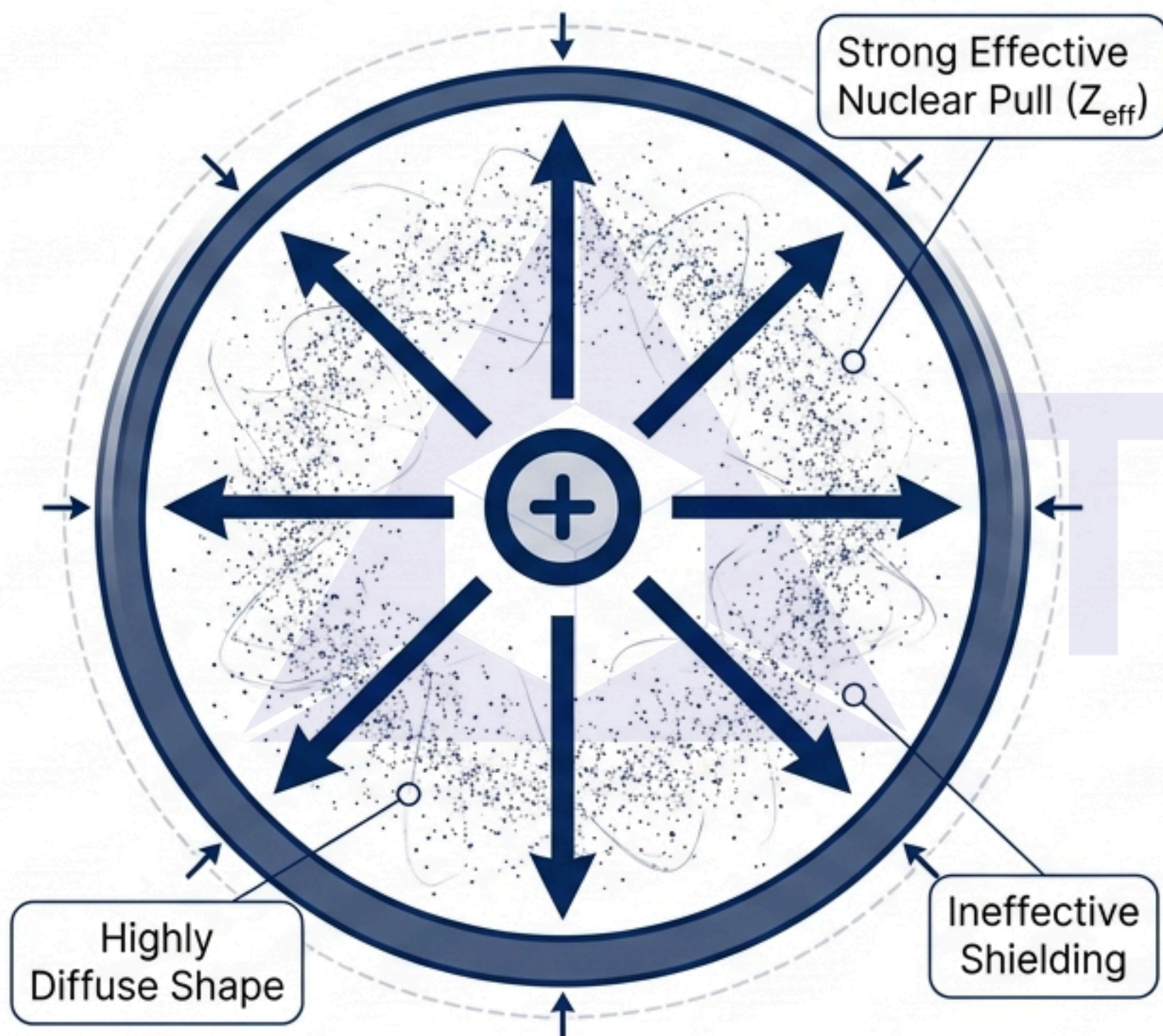
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## Atomic Comparison



## The Mechanism: Poor 5f Shielding

The contraction is steeper from element to element due to the **highly diffuse** shape of the 5f orbitals.

$$[\text{Nuclear Pull: } \uparrow] + [\text{5f Shielding: } \downarrow\downarrow] = [\text{Net Contraction: } \uparrow\uparrow]$$

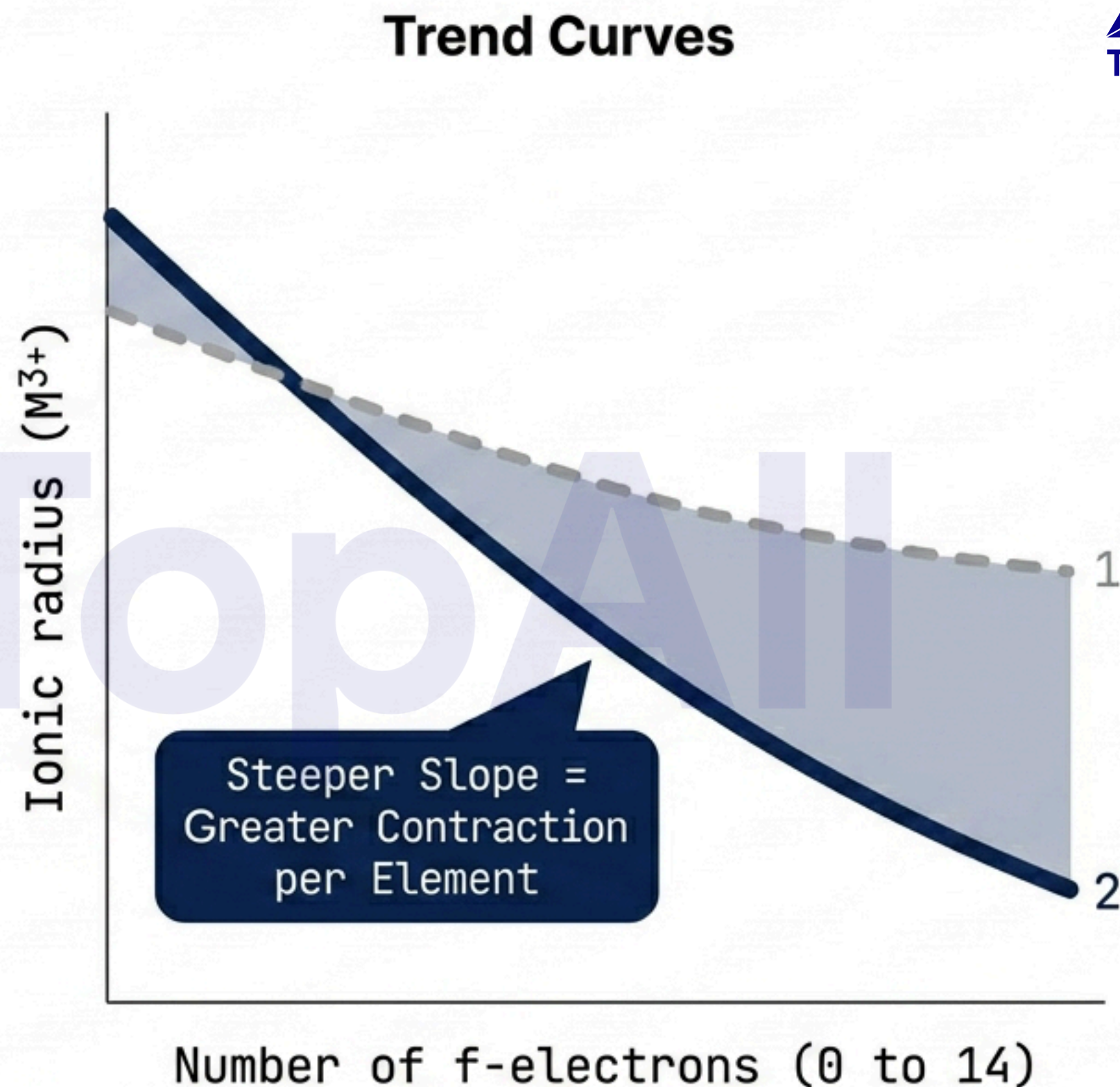
# F-Block Showdown: Actinoids vs. Lanthanoids

| Feature                        | Lanthanoids (4f) | Actinoids (5f) |
|--------------------------------|------------------|----------------|
| Subshell Filling               | 4f               | 5f             |
| Shielding Effectiveness        | Poor (4f)        | Poorer (5f)    |
| Element-to-Element Contraction | Steady           | <b>Greater</b> |

**The contraction is greater from element to element in this series resulting from poor shielding by 5f electrons.**

# Visualizing the Contraction Gap

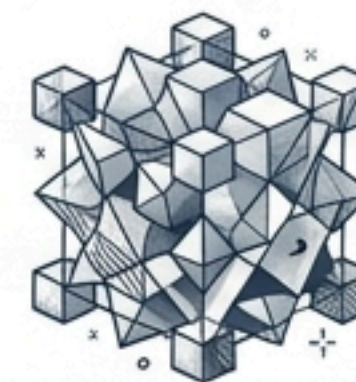
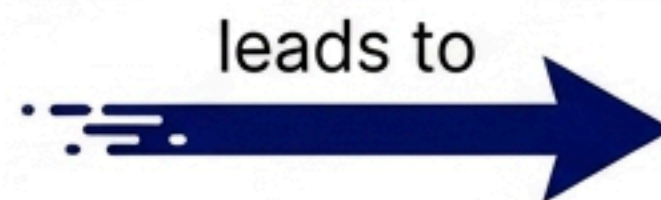
Because 5f shielding is even less effective than 4f shielding, the actinoid series experiences a sharper, steeper drop in ionic radii per added proton.



# Periodic Implications



Microscopic  
Contraction



Macroscopic  
Irregularities

The actinoid metals are silvery in appearance but display a wide variety of structures compared to lanthanoids.

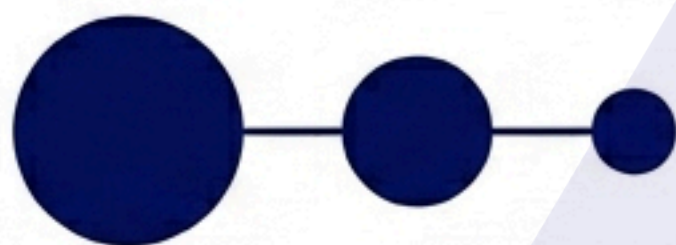


## NEET/JEE Exam Tip

The structural variability is obtained due to irregularities in metallic radii which are far greater than in lanthanoids.

**If asked why actinoid metals have more complex lattice structures than lanthanoids, the answer is the magnified actinoid contraction.**

# Quick Revision



## The Trend: Actinoid Contraction

Gradual decrease in atomic and  $M^{3+}$  /  $M^{4+}$  ionic radii across the series.



## The Cause: Poor 5f Shielding

5f electrons are highly diffuse, failing to shield outer electrons from the increasing nuclear charge.



## The Comparison: > Lanthanoids

Actinoid contraction is greater from element to element than lanthanoid contraction due to 5f shielding being poorer than 4f.



# You've Learned the Theory.

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