

UNIT 4 • d- AND f-BLOCK ELEMENTS

Atomic and Ionic Sizes of the Lanthanoids

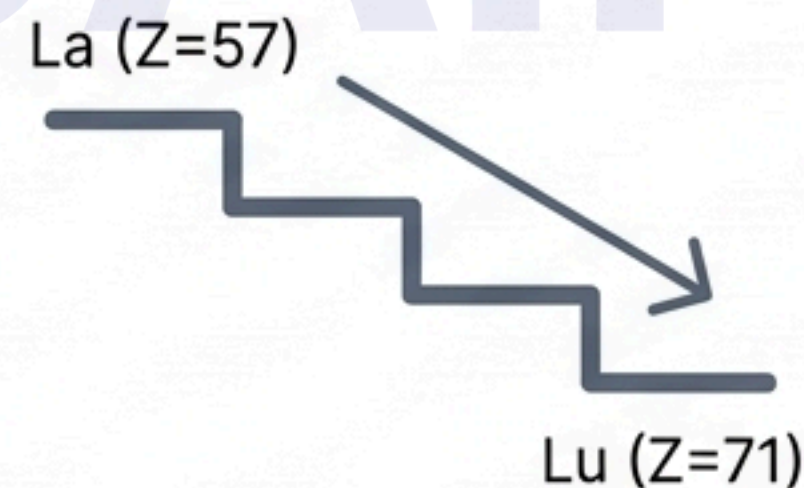
Mastering the Lanthanoid Contraction
and its Consequences.

Key Vocabulary: Lanthanoid Contraction

The steady, cumulative decrease in atomic and ionic radii from Lanthanum (La) to Lutetium (Lu).

Mechanism

Imperfect shielding of one 4f electron by another as nuclear charge increases.





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

$$E=mc^2$$



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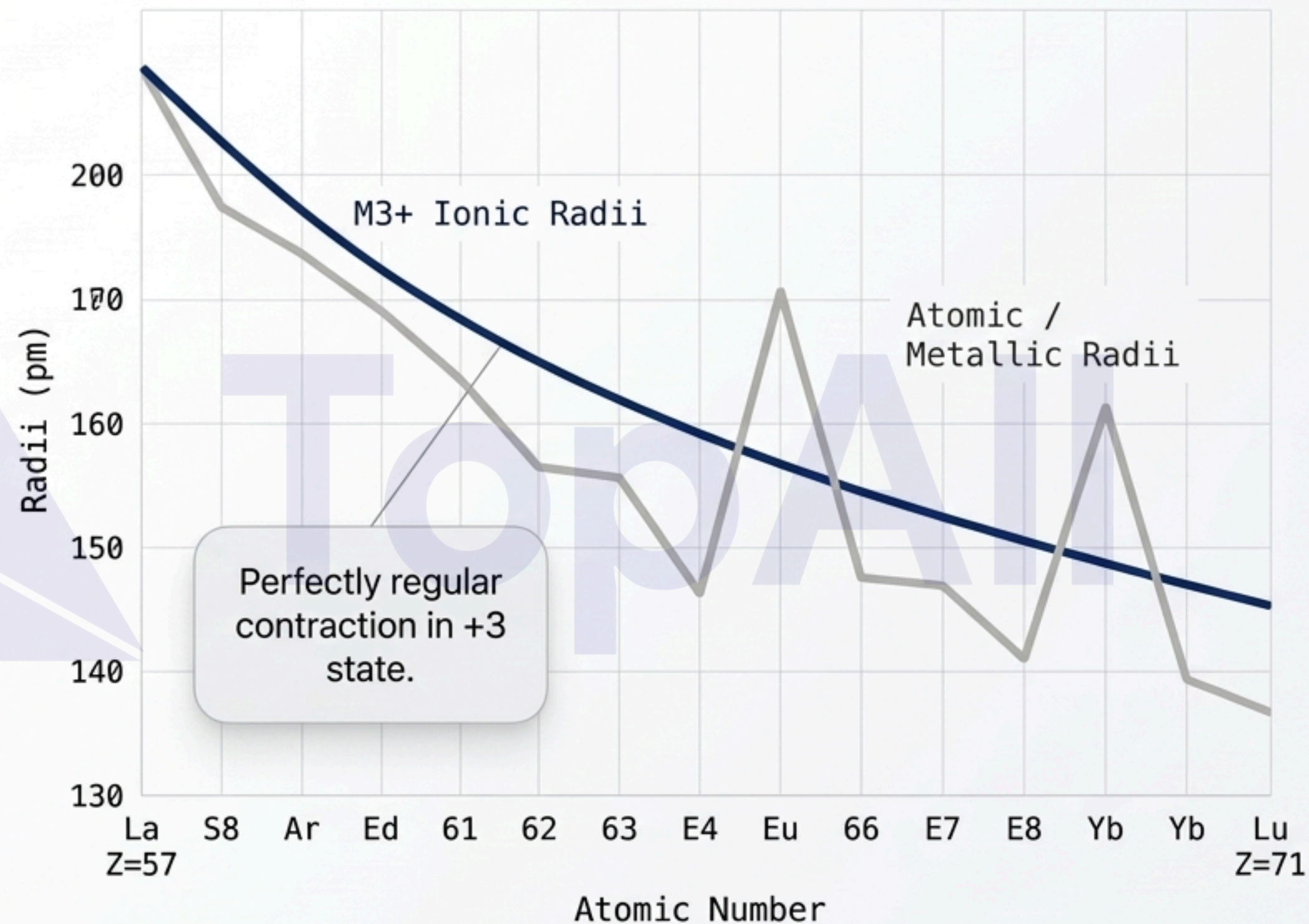
Key Highlights

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- » Push Your Limits with Level-Based Challenges
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The Two Faces of the Trend

The contraction manifests differently depending on the oxidation state.



The Consequence: Transition Series Overlap

Because 4f orbitals fill *before* the 5d series begins, the expected size increase from the 2nd to 3rd transition series is entirely canceled out.

Zirconium (Zr)

4d Series

Radius = 160 pm



Hafnium (Hf)

5d Series

Radius = 159 pm

Chemical Twins: Nearly identical sizes make them incredibly difficult to separate in nature.

JEE/NEET Trap Alert

Watch for this common exam nuance regarding trend regularity:

Examiners will test if you assume the Lanthanoid contraction is perfectly smooth across *all* states.

The size decrease is perfectly regular in M^{3+} ionic radii (due to consistent +3 configurations). However, the trend is **LESS** regular in atomic (metallic) radii.



Key Takeaways

The Cause: The Lanthanoid contraction is caused by poor shielding of 4f electrons, resulting in a steady size decrease from La to Lu.

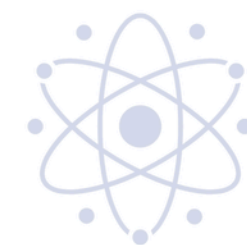
The Nuance: The contraction is highly regular for M³⁺ ionic radii, but irregular for metallic radii.

The Consequence: This contraction causes the 2nd and 3rd transition series to have nearly identical radii (e.g., Zr [160pm] $\approx$ Hf [159pm]), resulting in chemical twins.



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