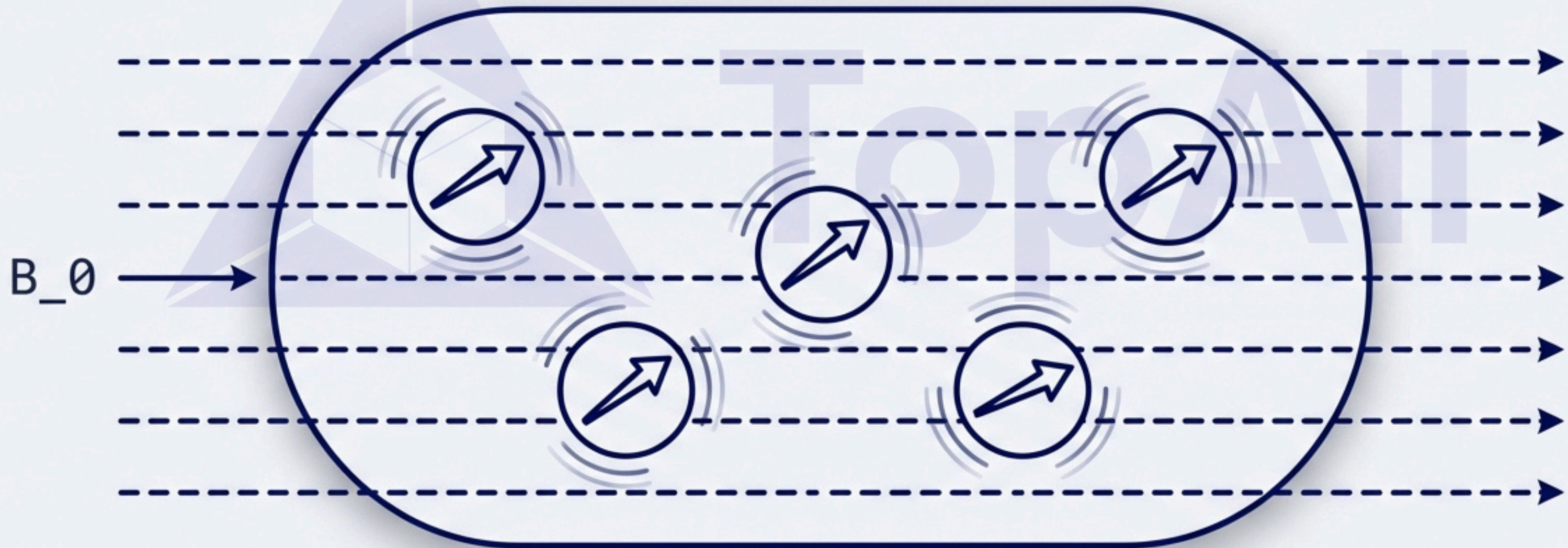
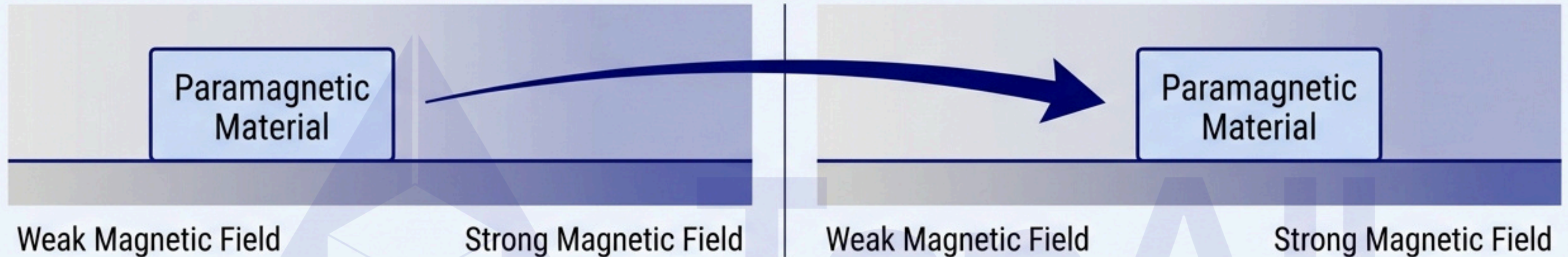


# Paramagnetism

Weak attraction, permanent atomic dipoles, and the battle against thermal agitation.



# Macroscopic Behavior: Weak Attraction



Paramagnetic substances get weakly magnetised in an external field. When placed in a non-uniform field, they tend to move from a region of weak field to a strong field.

[ Aluminium ]

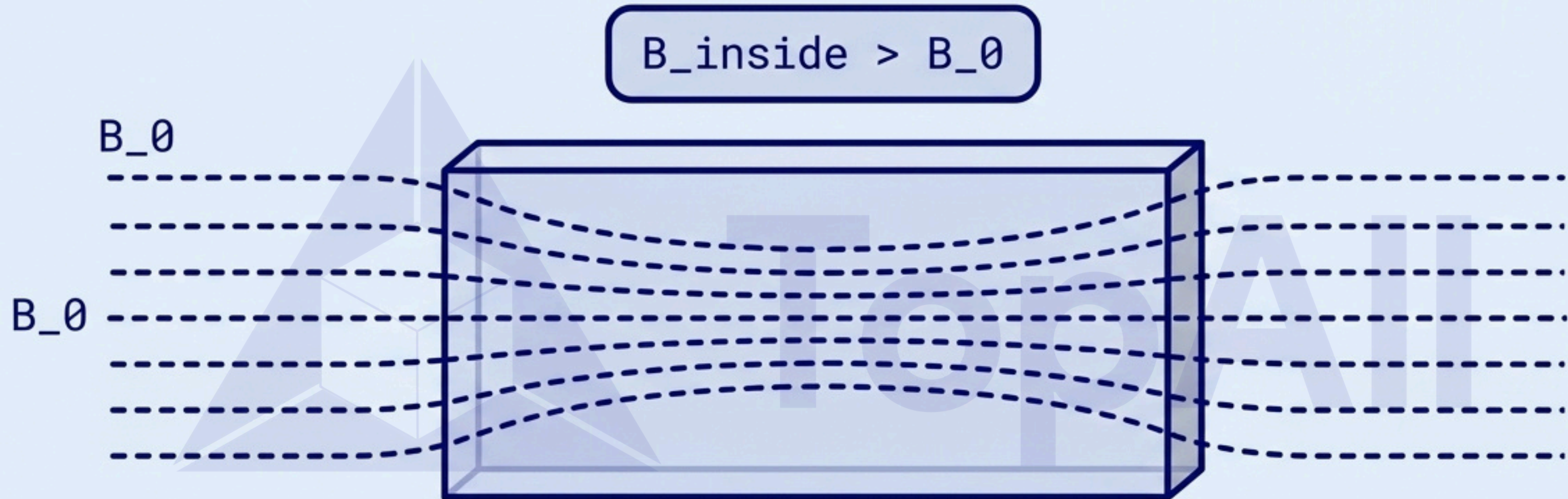
[ Sodium ]

[ Calcium ]

[ Oxygen (at STP) ]

[ Copper Chloride ]

# Magnetic Field Line Interaction



The field lines get concentrated inside the material, and the field inside is enhanced. This enhancement is slight—typically only one part in  $10^5$ .



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

$$E=mc^2$$



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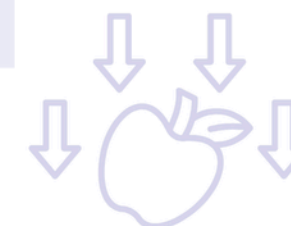
**Practice Now**



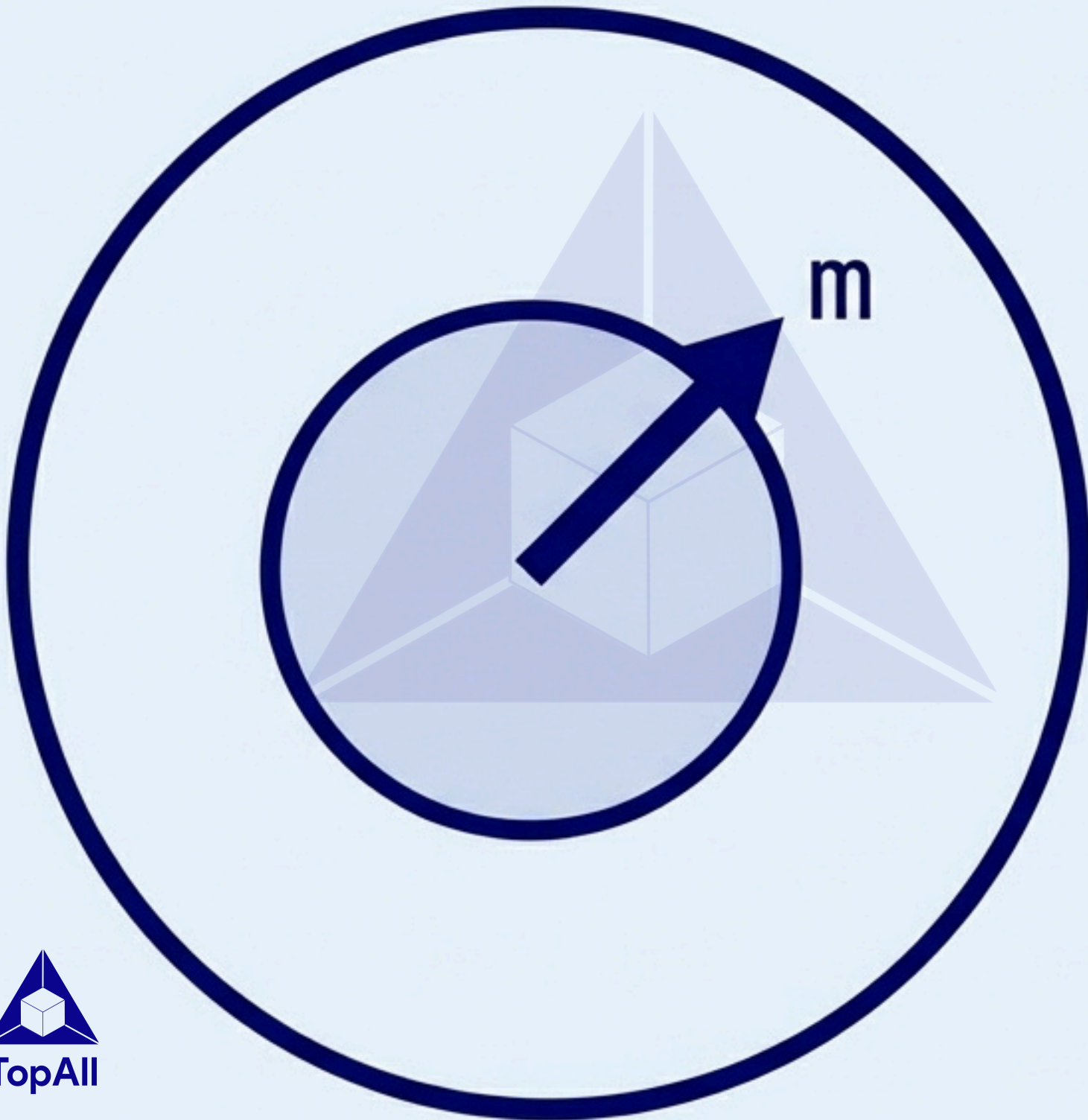
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- » Push Your Limits with Level-Based Challenges
- » Climb the Leaderboard Among Fellow Aspirants
- » Practice Unlimited MCQs for NEET & JEE
- » Get Clear Explanations, Not Just Marks
- » Track Your Performance Smarter



# The Microscopic Root: Permanent Dipoles



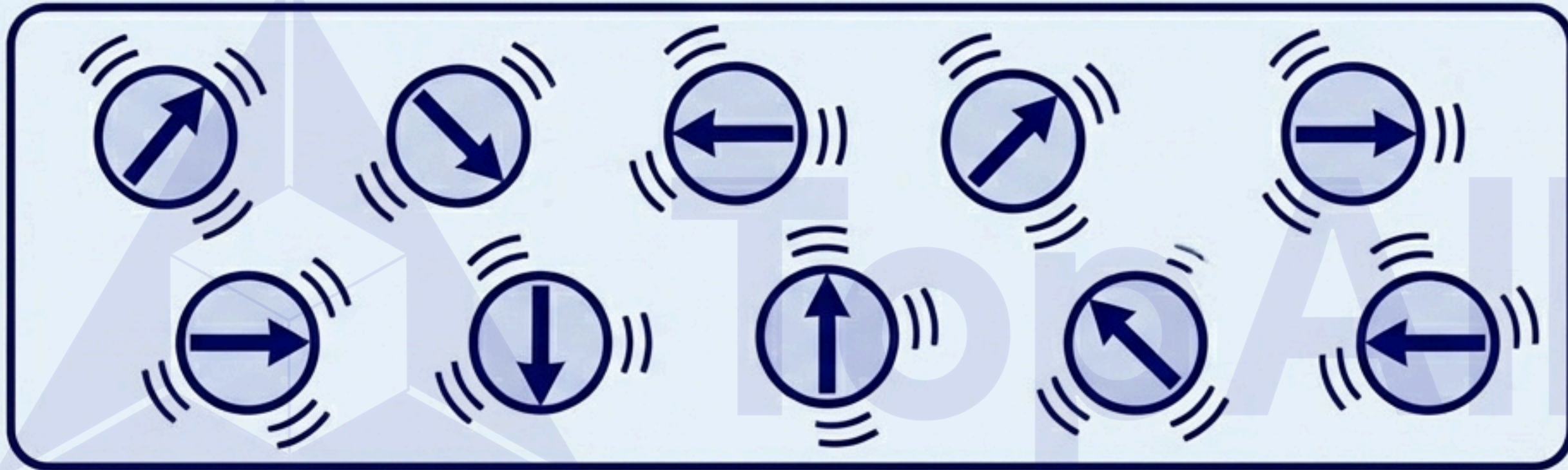
## Intrinsic Magnetic Moment

Unlike diamagnetic materials, the individual atoms, ions, or molecules of a paramagnetic material possess a permanent magnetic dipole moment of their own.

Net atomic dipole  $\neq 0$

# The Conflict: Thermal Agitation

External Field  $B_0 = 0$

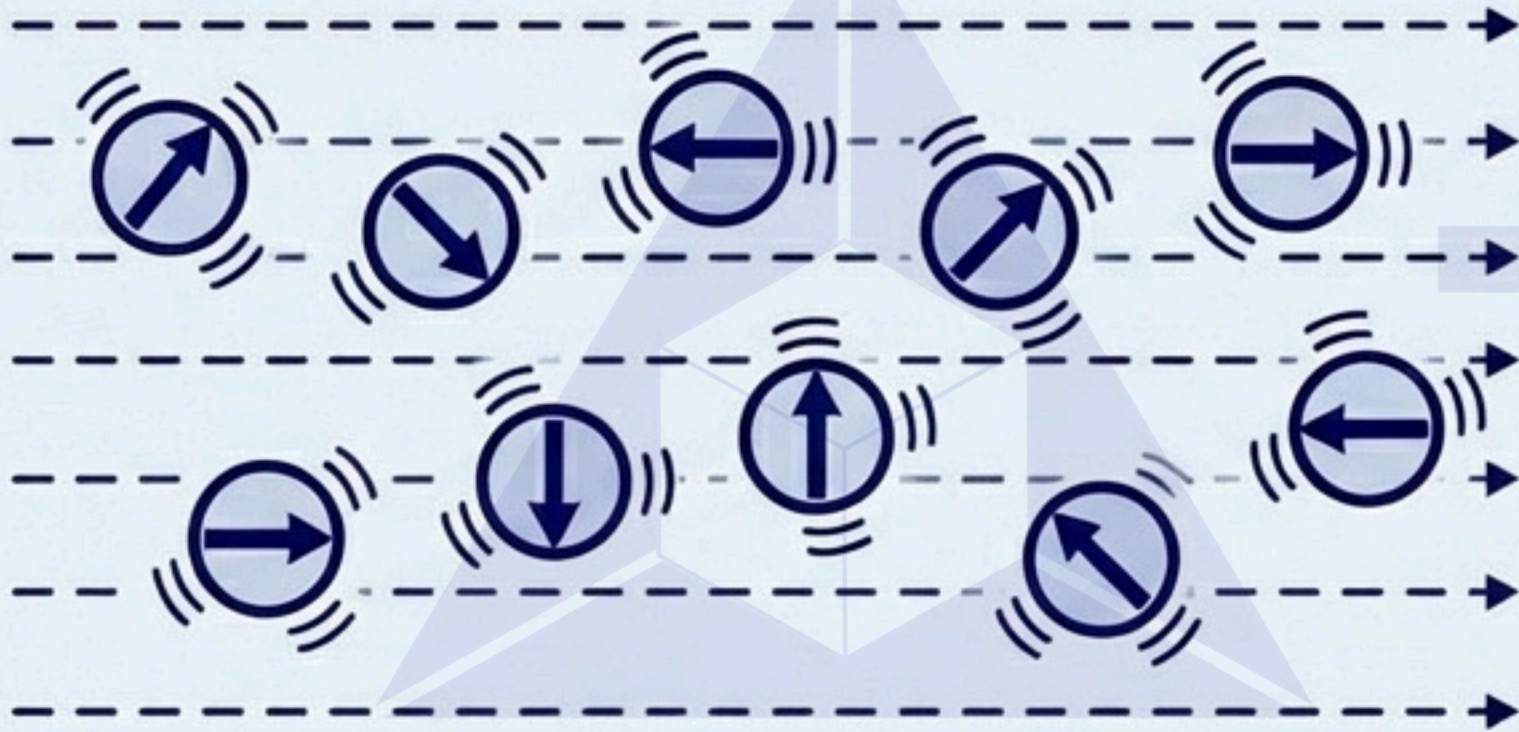


$M = 0$  (Net Magnetisation is zero)

On account of ceaseless, random thermal motion, the atoms tumble chaotically. The individual dipole moments cancel each other out, resulting in no net macroscopic magnetisation.

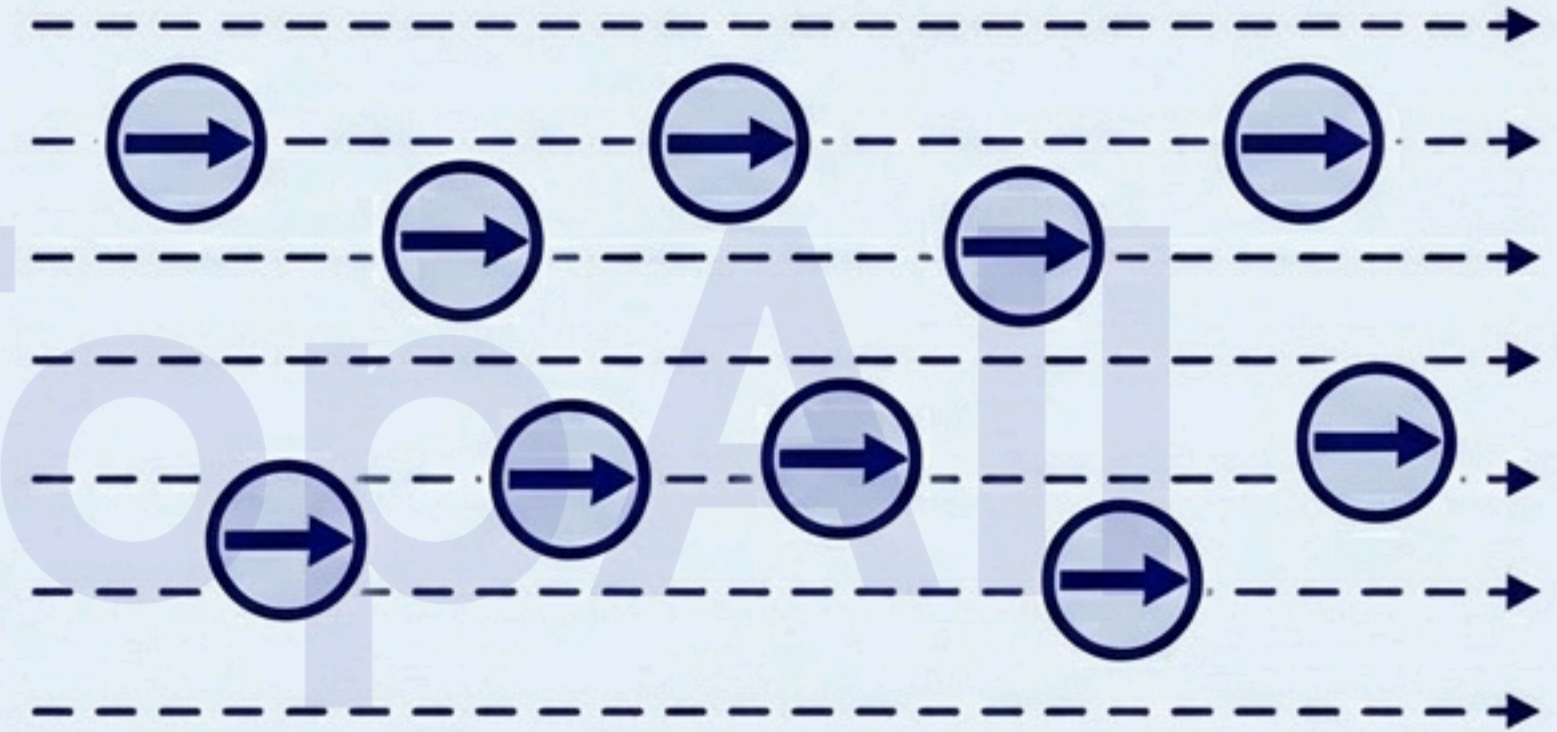
# The Resolution: Forcing Alignment

Strong Field ( $B_0 > 0$ ), High Temp ( $T$ )



Partial Alignment

Strong Field ( $B_0 \gg 0$ ), Low Temp ( $T$ )



Perfect Alignment = Saturation

As the external field is increased or temperature is lowered, magnetisation increases. It eventually reaches a **Saturation Value** where all dipoles are perfectly aligned with the field.

# NEET Exam Summary: Paramagnetism



| Qualitative Behavior                               | Quantitative Bounds                                         |
|----------------------------------------------------|-------------------------------------------------------------|
| <b>Movement:</b> Weak to Strong Field (Attraction) | <b>Susceptibility</b> $0 < \chi < \infty$ (Small, positive) |
| <b>Field Lines:</b> Concentrate inside material    | <b>Relative Permeability</b> $1 < \mu_r < 1 + \infty$       |
| <b>Micro-cause:</b> Permanent atomic dipoles       | <b>Permeability</b> $\mu > \mu_0$                           |
| <b>Disruptor:</b> Thermal agitation                | <b>Permeability</b>                                         |

**Remember:** Both  $\chi$  and  $\mu_r$  depend on sample temperature.



# You've Learned the Theory.

## Now Let's Test It.

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