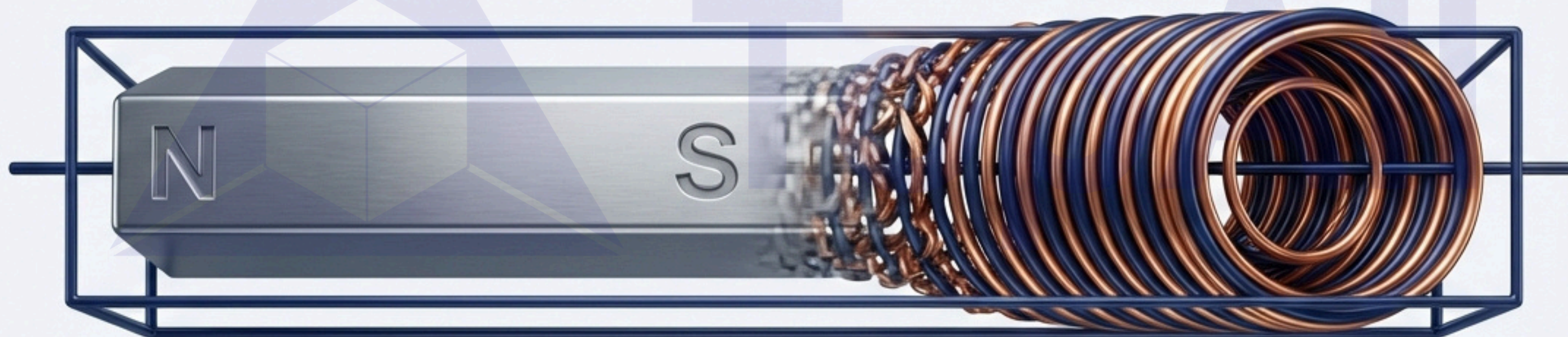
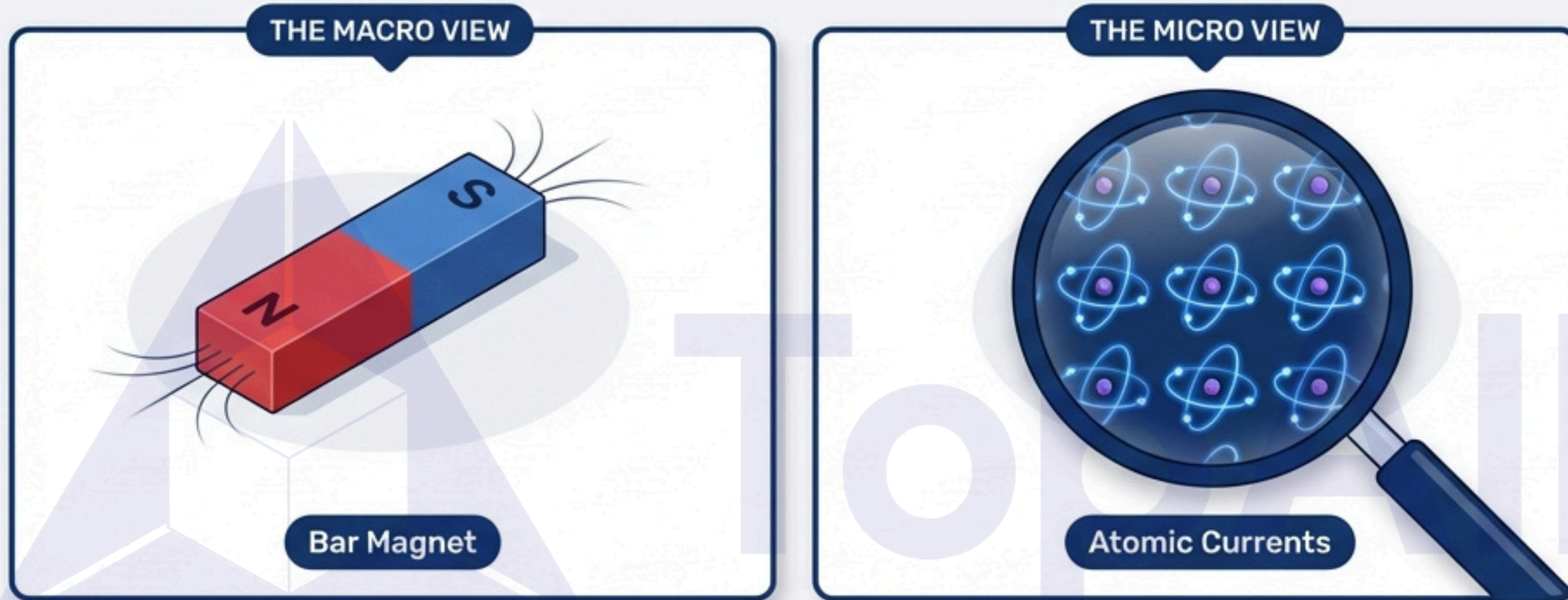


Bar Magnet as an Equivalent Solenoid

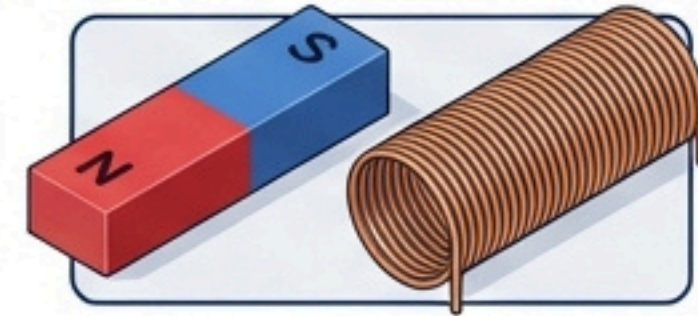


The Origin of Magnetism



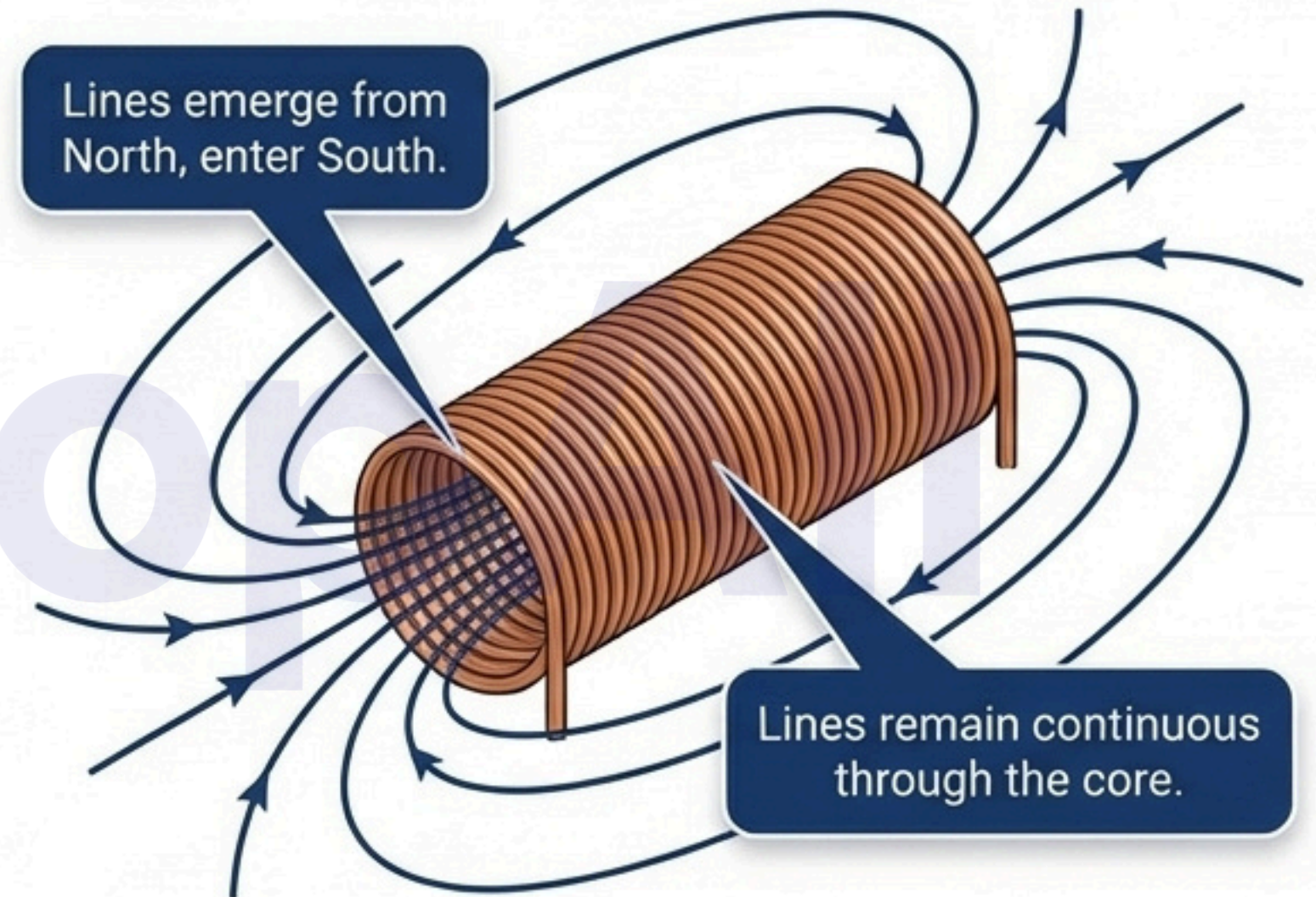
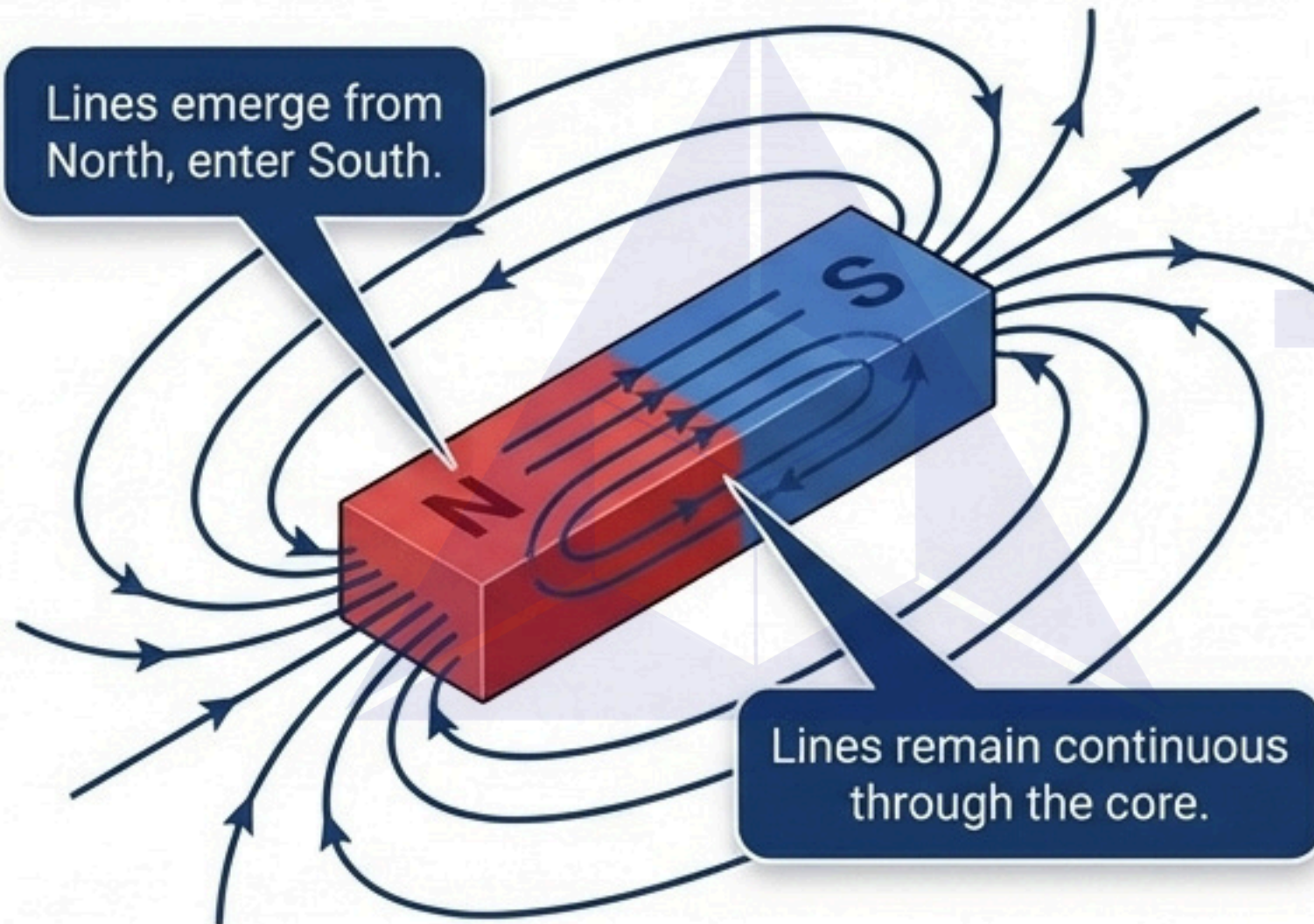
Ampere's Hypothesis

All magnetic phenomena can be understood in terms of circulating electric currents.



A bar magnet is essentially a large number of circulating microscopic currents—behaving exactly like a scaled-up solenoid.

Continuous Closed Loops



Testing the Analogy: Moving a compass needle near both the bar magnet and the solenoid produces the exact same deflection patterns.



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

$$E=mc^2$$



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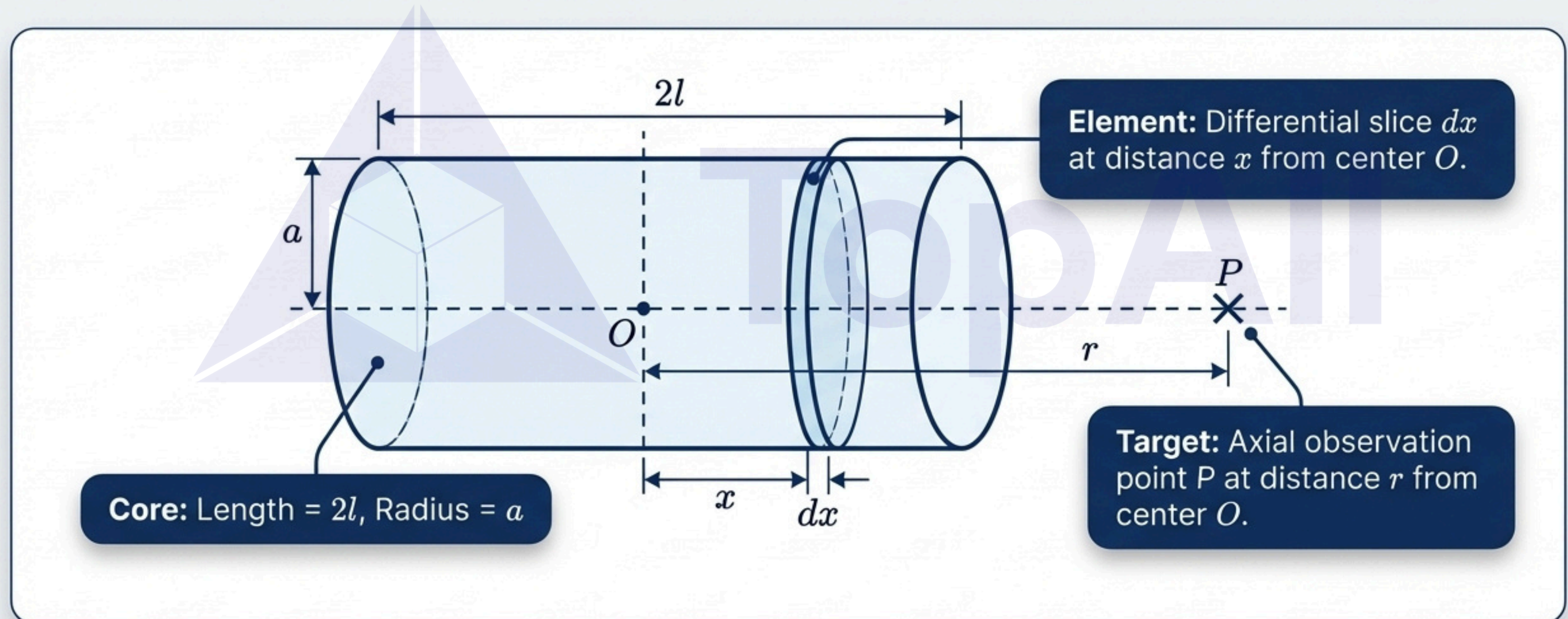
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Setting up the Calculation



The Axial Field at Point P

$$B = \frac{\mu_0}{4\pi} \frac{2m}{r^3}$$

$$[m]$$

Magnetic moment of
the solenoid

$$[r]$$

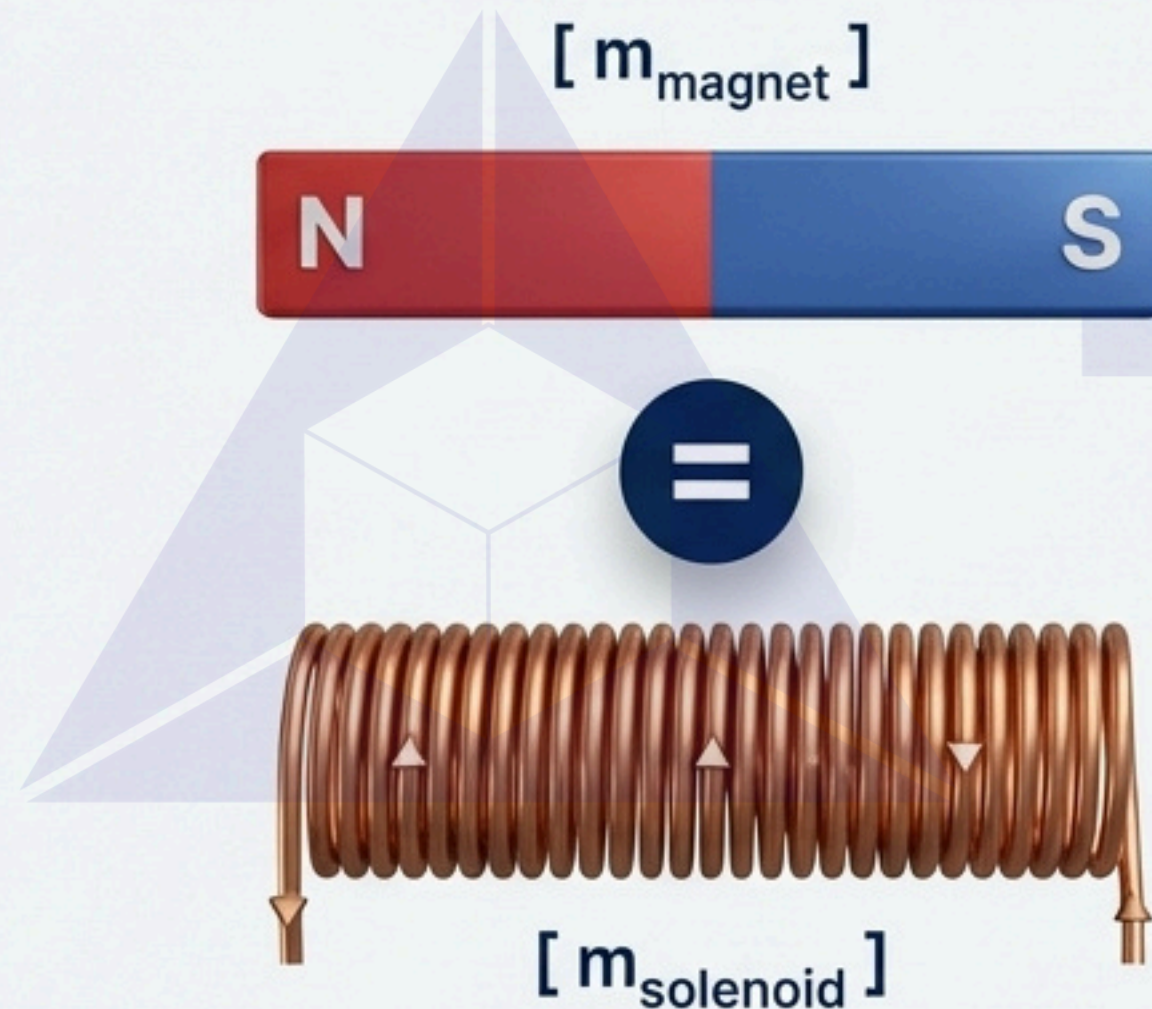
Distance to point P
(where $r \gg a, l$)

$$[\mu_0]$$

Permeability of
free space

Proof Complete: This is the exact same far-axial magnetic field equation derived experimentally for a bar magnet.

The Equivalence Principle



A bar magnet can be treated mathematically and physically as an equivalent solenoid.

[EXAM TAKEAWAY]

The magnetic moment of a bar magnet is identically equal to the magnetic moment of an equivalent solenoid that produces the same magnetic field.



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