Lecture 24

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1 DC Motors

A commutaor is when the current is off for half of the rotation, so the motor spins in one direction.

Example 1.1 (Mendochino Motors)**.** There is a source of magnetic field (magnet), current source (battery), and a commutator that makes it spin.

2 Magnetic Vector Potential

$$\vec{\nabla} \cdot \vec{B} = 0 \Leftrightarrow \oiint_S \vec{B} \cdot d\vec{S} = 0$$

From one of the Maxwell's equations, we see all magnetic fields have no divergence (solenoidal). Since the divergence of a curl is always 0, we can think of $\vec{B}$ as a curl, namely

$$\vec{B} = \vec{\nabla} \times \vec{A}$$

We can relate this with the current through

$$\vec{\nabla}^2 \vec{A} = -\mu_0 \vec{J}$$

Which gives

$$\vec{A} = \frac{\mu_0}{4\pi} \int \frac{I d\vec{l}}{|\vec{R} - \vec{R}'|}$$

or

$$\vec{A} = \frac{\mu_0}{4\pi} \iiint_V \frac{\vec{J} dV}{|\vec{R} - \vec{R}'|}$$

We define Φ_m as below, and

$$\Phi_m = \oint_C \vec{A} \cdot d\vec{l} = \iint_S \vec{B} \cdot d\vec{S}$$

by Stokes'.

3 Biot-Savart Law

$$d\vec{B} = \frac{\mu_0 I d\vec{l} \times (\vec{R} - \vec{R}')}{4\pi |\vec{R} - \vec{R}'|^3}$$