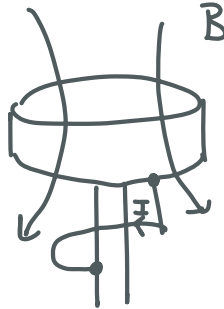


Self-Excited generators

[Electric Part]

ohmic Decay.

① We have a rotor through a B-field.



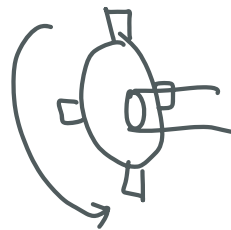
A conductor moving through a B field induces an EMF (E-field) which drives e^- flow (I).

$$E = \frac{d\psi}{dt}$$

lllll

How does the inductor work?

When cutting flux, an EMF is induced.



How do geodynamos work.

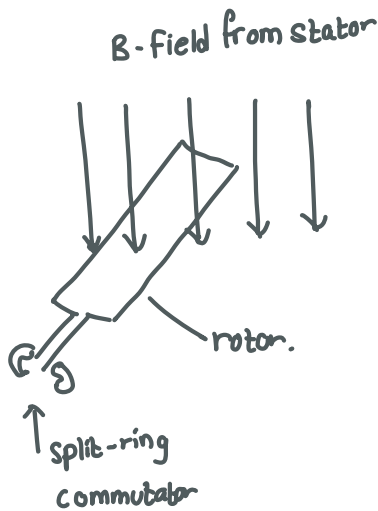
A dynamo converts mechanical energy into electrical energy.

↓
DC

Alternator
AC

| The same concept applies for a geodynamo.

How does a regular dynamo work?



$$E = - \frac{d\psi}{dt}$$

$$\nabla \times E = - \frac{\partial B}{\partial t}$$

↓
An E-field always accompanies a time-varying B-field!

- A changing magnetic flux produces a 'curly' E-field.

- A changing Electric flux produces a 'curly' Magnetic field.

$$\nabla \times B = \frac{\partial E}{\partial t} + J$$

• •

① The Iron core of our planet cuts the heliospheric magnetic flux. [As the core rotates]

② This change in magnetic flux induces circular electric currents [Eddy currents] according to

Faraday's Law of induction: $\nabla \times E = -\frac{\partial B}{\partial t}$

③ From the Ampere-Maxwell Law: $\nabla \times B = \frac{\partial E}{\partial t} + J$, a circulating electric current has a B-field $\perp$ to it.

④ The B-field obtained is the geomagnetic field. It is weak for now but its amplification will be made by the Earth's core itself.

Amplification Procedure: With $\sigma = \infty$, B-field is frozen into the fluid.
↳ It can be freely distorted!

$$\frac{\partial B}{\partial t} = \eta \nabla^2 B + \nabla \times (U \times B)$$

Diagram illustrating the equation $\frac{\partial B}{\partial t} = \eta \nabla^2 B + \nabla \times (U \times B)$ and its components:

- $\frac{\partial B}{\partial t}$ is labeled "Changing B-flux."
- $\eta \nabla^2 B$ is labeled "Represents the Electric field."
- $\nabla \times (U \times B)$ is labeled "Curl of (U x B)" and "Represents the E field is $\perp$ to (U x B)".
- A vector diagram shows U (velocity), B (magnetic field), and E (electric field) vectors. E is perpendicular to the plane formed by U and B .

The E flux is generated $\perp$ to the changing B-field!

