PHYS 1444 – Section 004
Lecture #16

Wednesday, April 4 2007
Dr. Andrew Brandt

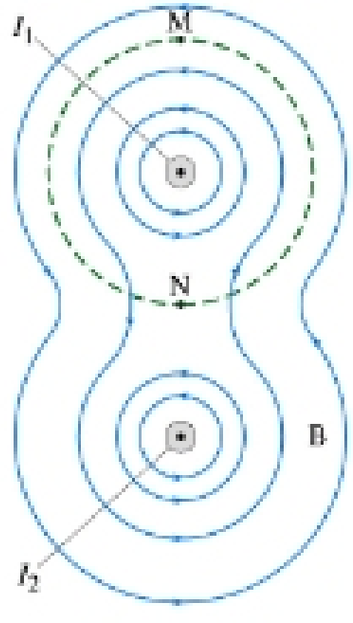
- Solenoid and Toroidal Magnetic Field
- Biot-Savart Law
- Magnetic Materials
- B in Magnetic Materials
- Hysteresis
- Induced emf

HW7 due Mon 4/9 at 11 pm
Test moved back one week to Weds 4/18

Ampére's Law

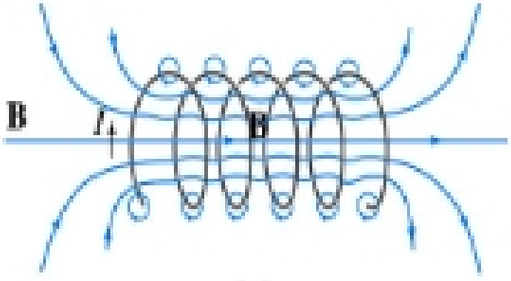
$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{encl}$$

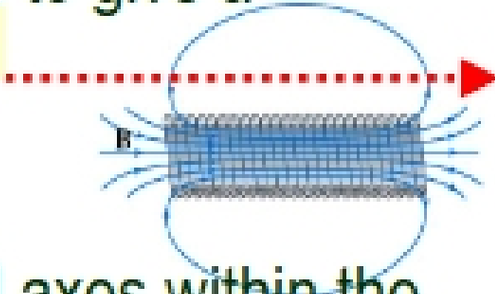
- Since Ampere's law is valid in general, B in Ampere's law is not necessarily just due to the current I_{encl}.
- B is the field at each point in space along the chosen path due to all sources
  - Including the current I enclosed by the path but also due to any other sources
- How do you obtain B in the figure at any point?
  - Vector sum of the field by the two currents
- The result of the closed path integral in Ampere's law for green dashed path is still $\mu_0 I_1$. Why?
- While B for each point along the path varies, the integral over the closed path still comes out the same whether there is the second wire or not.



Solenoid and Its Magnetic Field

- What is a solenoid?
  - A long coil of wire consisting of many loops
  - If the space between loops is wide
    - The field near the wires is nearly circular
    - Between any two wires, the fields due to each loop cancel
    - Toward the center of the solenoid, the fields add up to give a field that can be fairly large and uniform





  - For long, densely packed loops
    - The field is nearly uniform and parallel to the solenoid axes within the entire cross section
    - The field outside the solenoid is very small compared to the field inside, except at the ends