

## Chapter 28 – Sources of Magnetic Field

- Magnetic Field of a Moving Charge
- Magnetic Field of a Current Element
- Magnetic Field of a Straight Current-Carrying Conductor
- Force Between Parallel Conductors
- Magnetic Field of a Circular Current Loop
- Ampere's Law
- Applications of Ampere's Law
- Magnetic Materials

# 1. Magnetic Field of a Moving Charge

- A charge creates a magnetic field only when the charge is moving.

**Source point:** location of the moving charge.

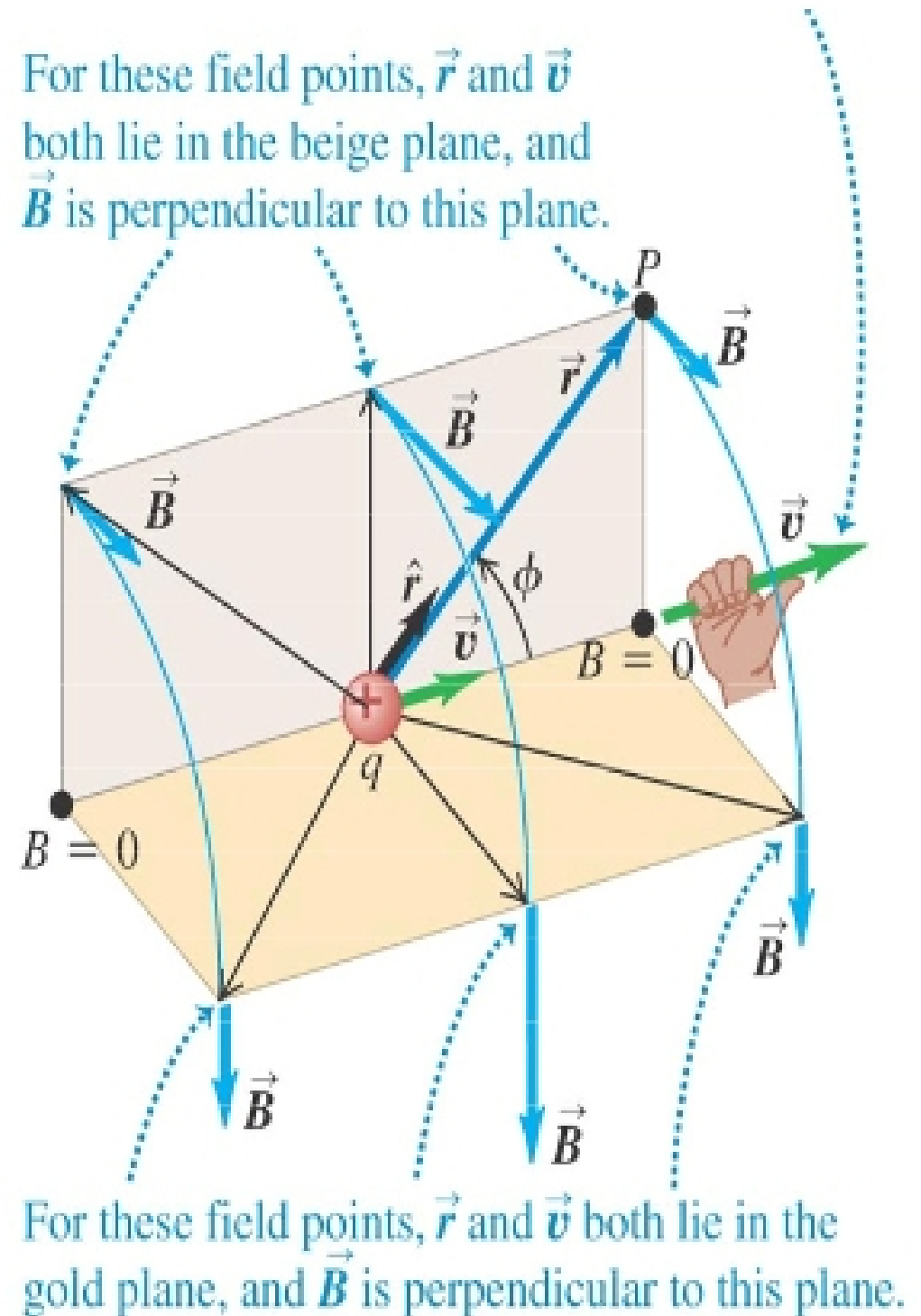
**Field point:** point P where we want to find the field.

Magnetic field from a point charge moving with constant speed

$$B = \frac{\mu_0}{4\pi} \frac{|q|v \sin \phi}{r^2}$$

$$\mu_0 = 4\pi \cdot 10^{-7} \text{ Wb/A}\cdot\text{m} = \text{N s}^2/\text{C}^2 = \text{N/A}^2 \\ = \text{T m/A (permeability of vacuum)}$$

$$c = (1/\mu_0 \epsilon_0)^{1/2} \rightarrow \text{speed of light}$$



## Magnetic field of a point charge moving with constant velocity

$$\vec{B} = \frac{\mu_0}{4\pi} \frac{q\vec{v} \times \hat{r}}{r^2}$$

$\hat{r} = \vec{r} / r =$  vector from source to field point

### Moving Charge: Magnetic Field Lines

- The magnetic field lines are circles centered on the line of  $\vec{v}$  and lying in planes perpendicular to that line.

- **Direction of field line:** right hand rule for + charge  $\rightarrow$  point right thumb in direction of  $\vec{v}$ . Your fingers curl around the charge in direction of magnetic field lines.

View from behind the charge

