Lecture 1

- $\mathbf{E} = ne\mathbf{v}$
- $\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$
- $\nabla \cdot \mathbf{B} = 0$
- $\nabla x \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$
- $\nabla x \mathbf{B} = \mu_0 \mathbf{J} + \mu_0 \epsilon_0 \frac{\partial \mathbf{E}}{\partial t}$
  In matter
- $\nabla \cdot \mathbf{D} = \rho$
- $\nabla \cdot \mathbf{B} = 0$
- $\nabla x \mathbf{E} = \frac{\partial \mathbf{B}}{\partial t}$
- $\nabla x \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial \mathbf{t}}$
  Popular gauges:
- $\nabla \cdot \mathbf{A} = 0$
- $\mathbf{A} = -\mathbf{r} x \mathbf{B}/2$
- $\nabla \cdot \mathbf{A} + \frac{1}{c^2} \frac{\partial \Psi}{\partial t} = 0$ END POPULAR GAUGES.
- Matter-Field Interaction: $H_{int} = \iint dt \mathbf{E} \cdot \mathbf{J} dV = -\int \mathbf{A} \cdot \mathbf{J} dV$
- $\nabla \cdot \mathbf{J} = -\frac{\partial \rho}{\partial t}$
- $E = \frac{|\mathbf{p}|^2}{2m}$
- $\omega = c|\mathbf{k}|$
- $\mathbf{p} = \hbar \mathbf{k}$
- $E = \hbar \omega$
- $E = i\hbar \partial_t \Psi = -\frac{\hbar^2}{2m} \nabla^2 \Psi + V(\mathbf{r}, t) \Psi$
- $J_{prob} = \frac{-i\hbar}{2m} (\Psi^* \nabla \Psi - \Psi \nabla \Psi^*)$
- $\oint \frac{dl}{\lambda} \rightarrow \lambda = \frac{h}{p} \rightarrow \oint dlp = hn$