

Lecture 29 (4/1/05)

Plane Waves (Electrodynamics)

3. Stress tensor in vacuum

$$T^{\mu\nu} = -F^{\mu\gamma} F_{\gamma}^{\nu} + \frac{1}{4} \eta^{\mu\nu} F_{\alpha\beta} F^{\alpha\beta}$$

$$T^{0i} = F^{0\gamma} F_{\gamma}{}^i = (\vec{E} \times \vec{B})^i$$

$$T^{00} = \frac{1}{2}(\vec{E}^2 + \vec{B}^2)$$

4. In the presence of medium

$$T^{00} = \frac{1}{2}(\vec{E} \cdot \vec{D} + \vec{H} \cdot \vec{B})$$

$$T^{0i} = (\vec{S})^i = (\vec{E} \times \vec{H})^i$$

5. In complex basis,

$$\vec{S} = \frac{1}{2} \vec{E} \times \vec{H}^*$$

$$\langle \vec{E}(t, \vec{x}) \times \vec{H}(t, \vec{x}) \rangle_t = \frac{1}{2} \Re(\vec{E} \times \vec{H}^*)$$

6. Linear and circular polarization (Jackson 7.2)