1.19 $\vec{J}' = \sigma \vec{E}'$ (OHM'S LAW)

FOR NON-REL. VELOCITIES

$$\vec{E}' = \vec{E} + \vec{v} \times \vec{B}$$

$$\Rightarrow j^\mu = (\rho c, \vec{J}) = [\rho c, \rho \vec{v} + \sigma (\vec{E} + \vec{v} \times \vec{B})]$$

WHAT is the RELATIVISTIC GENERALIZATION?

(SHOW $j^\mu = \frac{1}{c^2}(u_\nu j^\nu) u^\mu + \sigma F^{\mu\nu} u_\nu$

CONSIDER the non Relativistic Limit of

$$j^\mu = \frac{1}{c^2}(u_\nu j^\nu) u^\mu + \sigma F^{\mu\nu} u_\nu$$

$$= \frac{1}{c^2}\left[u_0 \gamma^\circ - \vec{u} \cdot \vec{J}\right](\gamma c, \gamma \vec{v}) + \sigma\left[+\frac{\vec{E}}{c} \cdot \vec{v},\right.$$

$$= \frac{1}{c^2}\left[\gamma c \rho c - \vec{v} \cdot \vec{J}\right]($$

$$\gamma c \frac{E_x}{c} - \gamma(B_z v_y - B_y v_z)$$

$$+ \gamma c \frac{E_y}{c} - (\quad)$$

$$+ \gamma c \frac{E_z}{c} - (\quad)$$

$$\left. \gamma \vec{E} + \gamma \vec{v} \times \vec{B} \right]$$

$$j^\mu = \left[\rho c - \frac{\vec{v} \cdot \vec{J}}{c^2}\right][c, \vec{v}] + \sigma\left[\frac{\vec{E}}{c} \cdot \vec{v}, \vec{E} + \vec{v} \times \vec{B}\right]$$

$$= \left[\rho c + \sigma \frac{\vec{E} \cdot \vec{v}}{c}, \rho \vec{v} + \sigma(\vec{E} + \vec{v} \times \vec{B})\right] \quad \text{QED}$$