

## Lecture 23 (3/11/05)

### Multipoles and Dielectrics

#### 4. Electrostatic Energy in Dielectric Media

$$W = \frac{1}{2} \int \vec{E} \cdot \vec{D} d^3x$$

Change in energy (with charges FIXED) due to the introduction of a dielectric volume  $V_2$  with dielectric constant  $\epsilon_2$  into a dielectric with field  $\vec{E}_1$  and dielectric constant  $\epsilon_1$ :

$$\Delta W = -\frac{1}{2} \int_{V_2} d^3x (\epsilon_2 - \epsilon_1) \vec{E} \cdot \vec{E}_1$$

$$F_\xi = -\left. \frac{\partial W}{\partial \xi} \right|_Q$$