

## Electric Field of Charged Rod (2)



- Charge per unit length:  $\lambda = Q/L$
- Charge on slice  $dx_s$ :  $dq = \lambda dx_s$
- Trigonometric relations:

$$y_p = r \sin \theta, \quad -x_s = r \cos \theta$$
$$x_s = -y_p \cot \theta, \quad dx_s = \frac{y_p d\theta}{\sin^2 \theta}$$

$$\bullet \quad dE = \frac{k\lambda dx_s}{r^2} = \frac{k\lambda dx_s}{y_p^2} \sin^2 \theta = \frac{k\lambda d\theta}{y_p}$$

$$\bullet \quad dE_y = dE \sin \theta = \frac{k\lambda}{y_p} \sin \theta d\theta \Rightarrow E_y = \frac{k\lambda}{y_p} \int_{\theta_1}^{\theta_2} \sin \theta d\theta = -\frac{k\lambda}{y_p} (\cos \theta_2 - \cos \theta_1)$$

$$\bullet \quad dE_x = dE \cos \theta = \frac{k\lambda}{y_p} \cos \theta d\theta \Rightarrow E_x = \frac{k\lambda}{y_p} \int_{\theta_1}^{\theta_2} \cos \theta d\theta = \frac{k\lambda}{y_p} (\sin \theta_2 - \sin \theta_1)$$

