Calculating $\vec{E}$ from Gauss’s Law: Charged Wire

- Consider a uniformly charged wire of infinite length.
- Charge per unit length on wire: $\lambda$ (here assumed positive).
- Use a coaxial Gaussian cylinder of radius $R$ and length $L$.
- Electric flux through Gaussian surface: $\Phi_E = \oint \vec{E} \cdot d\vec{A} = E(2\pi RL)$.
- Net charge charge inside Gaussian surface: $Q_{\text{in}} = \lambda L$.
- Gauss’s law $\oint \vec{E} \cdot d\vec{A} = \frac{Q_{\text{in}}}{\epsilon_0}$ becomes $E(2\pi RL) = \frac{\lambda L}{\epsilon_0}$.
- Electric field at radius $R$: $E = \frac{1}{2\pi\epsilon_0} \frac{\lambda}{R}$.