

Calculating \vec{E} from Gauss' Law: Charged Wire



- Consider a uniformly charged wire of infinite length.
- Charge per unit length on wire: λ (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 inside Gaussian surface: $Q_{in} = \lambda L$.
- Gauss' law $\oint \vec{E} \cdot d\vec{A} = \frac{Q_{in}}{\epsilon_0}$ becomes $E(2\pi RL) = \frac{\lambda L}{\epsilon_0}$.
- Electric field at radius R : $E = \frac{1}{2\pi\epsilon_0} \frac{\lambda}{R}$.

