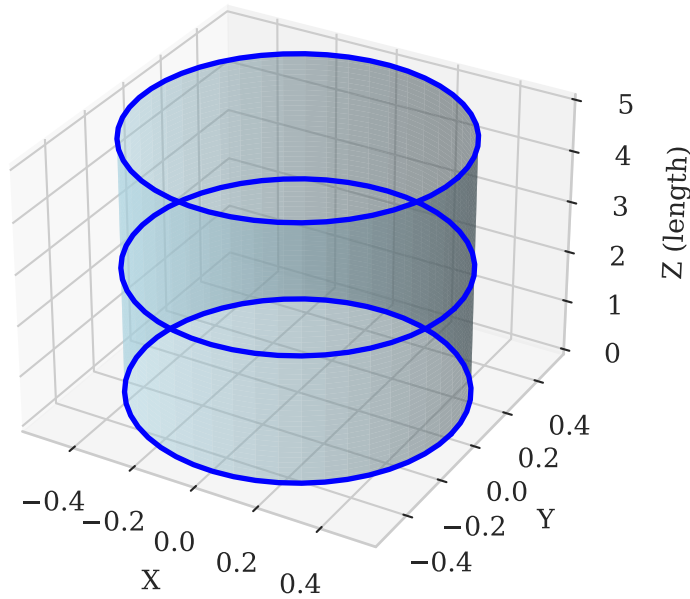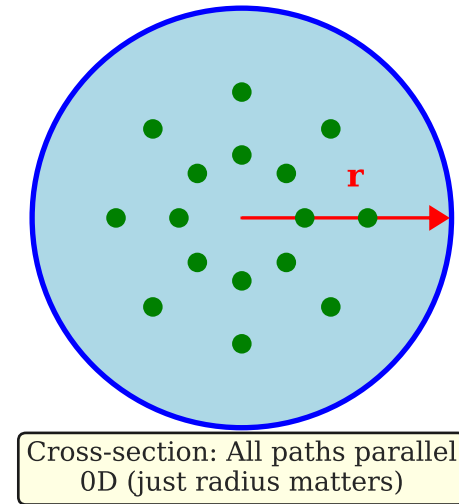# Panel C-2: Dimensional Reduction — Wire as Cross-Section × S-Transform
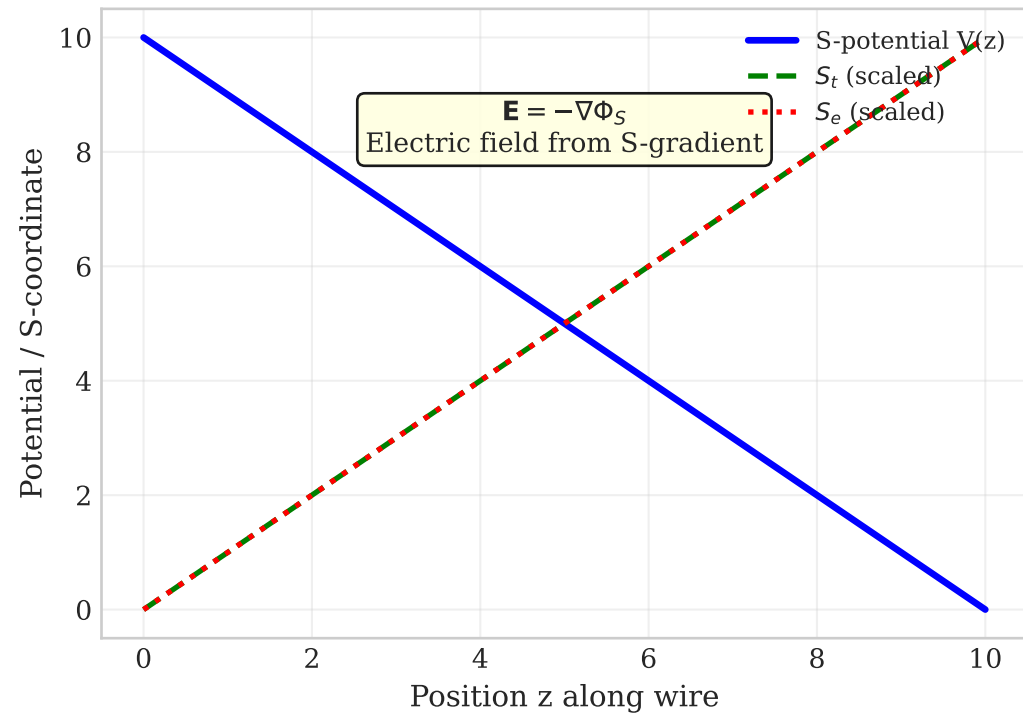
(A) 3D Wire: Infinite Degrees of Freedom

(B) 0D Cross-Section: Radius Only

Cross-section: All paths parallel
0D (just radius matters)

(C) 1D S-Transformation Along Length

- S-potential V(z)
- S_t (scaled)
- S_e (scaled)

$\mathbf{E} = -\nabla\Phi_S$
Electric field from S-gradient

Potential / S-coordinate

Position z along wire

(D) Complete Reduction: 3D → 0D × 1D

3D — Reduce → 0D × 1D

Wire — $\mathcal{S}$-transform

$$\text{Wire} = \int_0^R 2\pi r\, dr \times \mathcal{S}$$

$$R = \rho\frac{L}{A} = \rho\frac{L}{\pi r^2}$$

Resistance from 0D (area) × 1D (length/conductivity)