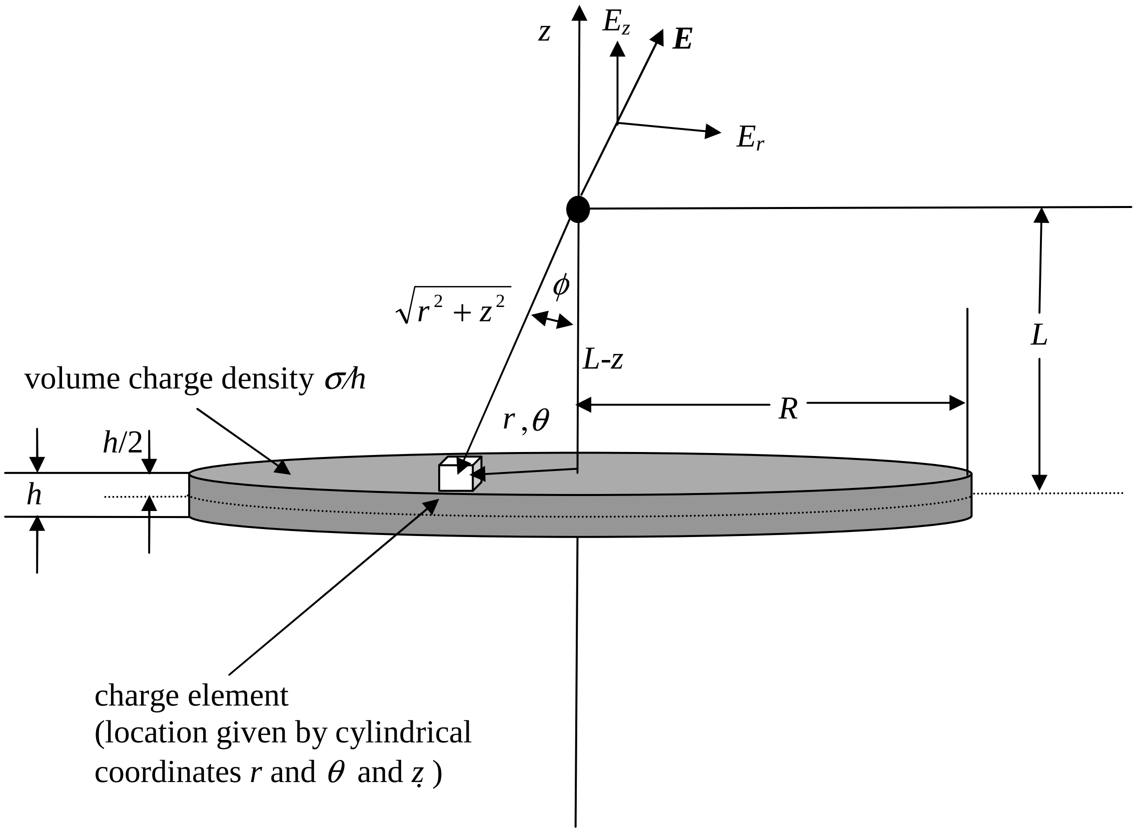

Find the magnitude of field components on the z-axis as a function of L

$E_r = 0$ due to symmetry

$$E_z = \int_{-h/2}^{+h/2}\int_{0}^{R} \frac{\sigma}{2\cdot\varepsilon\cdot h\cdot\left(r^2+(L-z)^2\right)}\cdot r\cdot\cos\phi\cdot dr\cdot dz = \int_{-h/2}^{+h/2}\int_{0}^{R} \frac{\sigma\cdot(L-z)}{2\cdot\varepsilon\cdot h\cdot\left(r^2+(L-z)^2\right)^{\frac{3}{2}}}\cdot r\cdot dr\cdot dz$$

$$E_z = \frac{\sigma}{2\cdot\varepsilon\cdot h}\cdot\int_{-h/2}^{+h/2}\left(\frac{L-z}{\sqrt{(L-z)^2}} - \frac{L-z}{\sqrt{R^2+(L-z)^2}}\right)\cdot dz$$

$$E_z = \frac{\sigma}{2\cdot\varepsilon\cdot h}\cdot\left(\sqrt{R^2+L^2-h\cdot L+\left(\frac{h}{2}\right)^2} - \sqrt{L^2-h\cdot L+\left(\frac{h}{2}\right)^2} - \sqrt{R^2+L^2+h\cdot L+\left(\frac{h}{2}\right)^2} + \sqrt{L^2+h\cdot L+\left(\frac{h}{2}\right)^2}\right)$$

Note that if L is set to zero we get the field at the center of the disk $E_z = 0$

If one takes the limit as h goes to zero, we approach the thin disk with surface charge density.

$E_z = \frac{\sigma}{2\cdot\varepsilon}\cdot\left(1-\frac{L}{\sqrt{R^2+L^2}}\right)$ Once the limit is taken, the answer at L=0 is indeterminate.