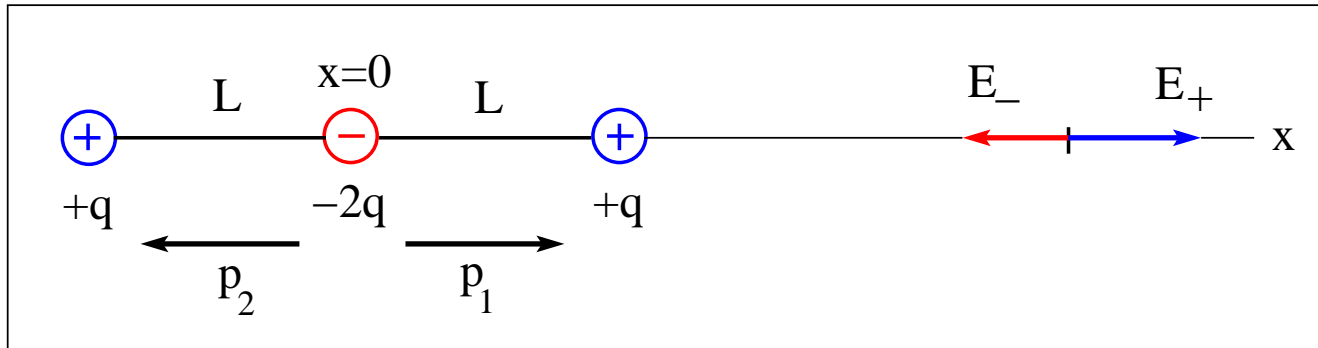


# Electric Quadrupole Field



$$\begin{aligned}
 E &= \frac{kq}{(x-L)^2} + \frac{kq}{(x+L)^2} + \frac{k(-2q)}{x^2} = \frac{kq}{x^2} \left[ \left(1 - \frac{L}{x}\right)^{-2} + \left(1 + \frac{L}{x}\right)^{-2} - 2 \right] \\
 &= \frac{kq}{x^2} \left[ \left(1 + \frac{2L}{x} + \frac{3L^2}{x^2} + \dots\right) + \left(1 - \frac{2L}{x} + \frac{3L^2}{x^2} - \dots\right) - 2 \right] \\
 &\simeq \frac{6kqL^2}{x^4} = \frac{3kQ}{x^4} \quad (\text{for } x \gg L)
 \end{aligned}$$

Electric quadrupole moment:  $Q = 2qL^2$

Different quadrupole configuration:

