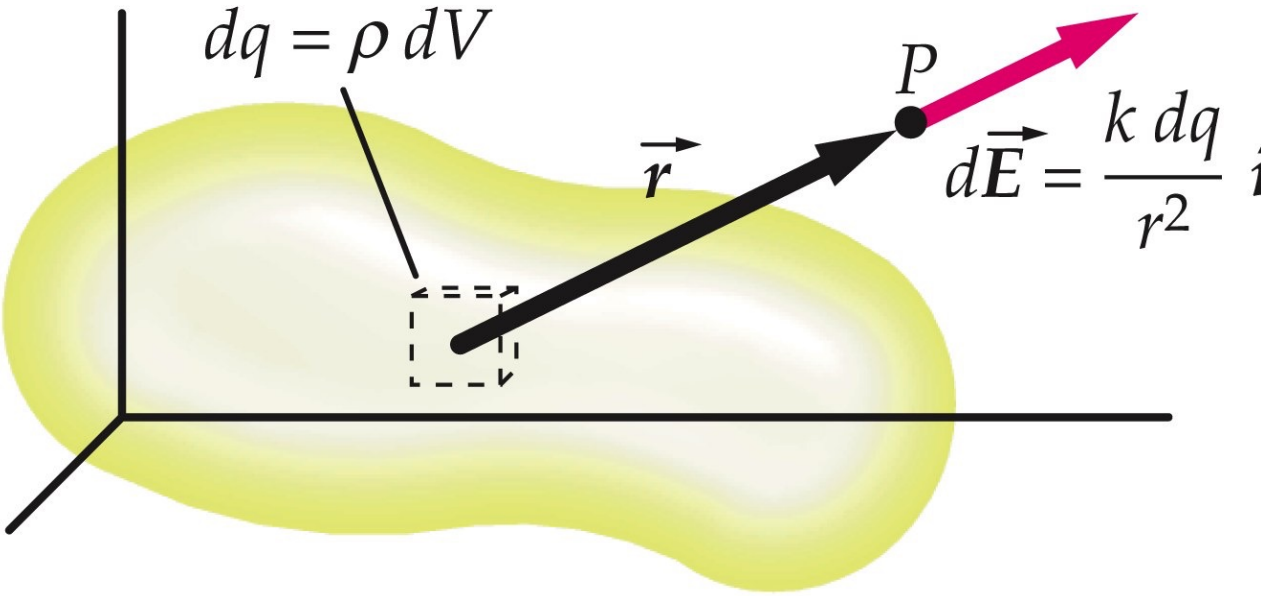
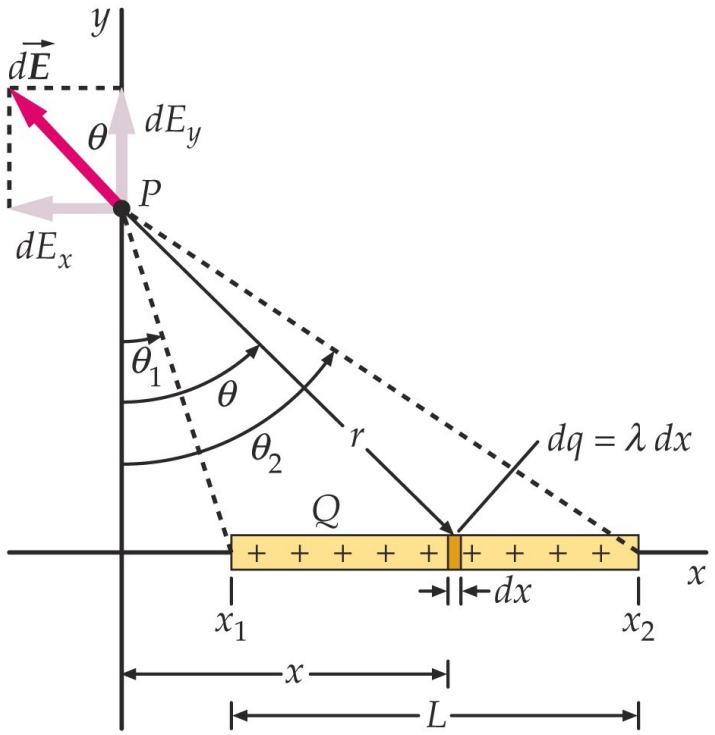
Chapter 15: The Electric Field of Distributed Charges

- We extend the concepts of electric field calculations from a few point charges to a distribution of a large number of point charges
- In the limit the number of point charges goes to infinity, then we obtain a continuous distribution of charge
- In this chapter, we'll obtain analytical electric field equations for certain, restricted configurations of charged rods, rings, arcs, cylinders, disks, and spheres

Continuous Charge Distributions

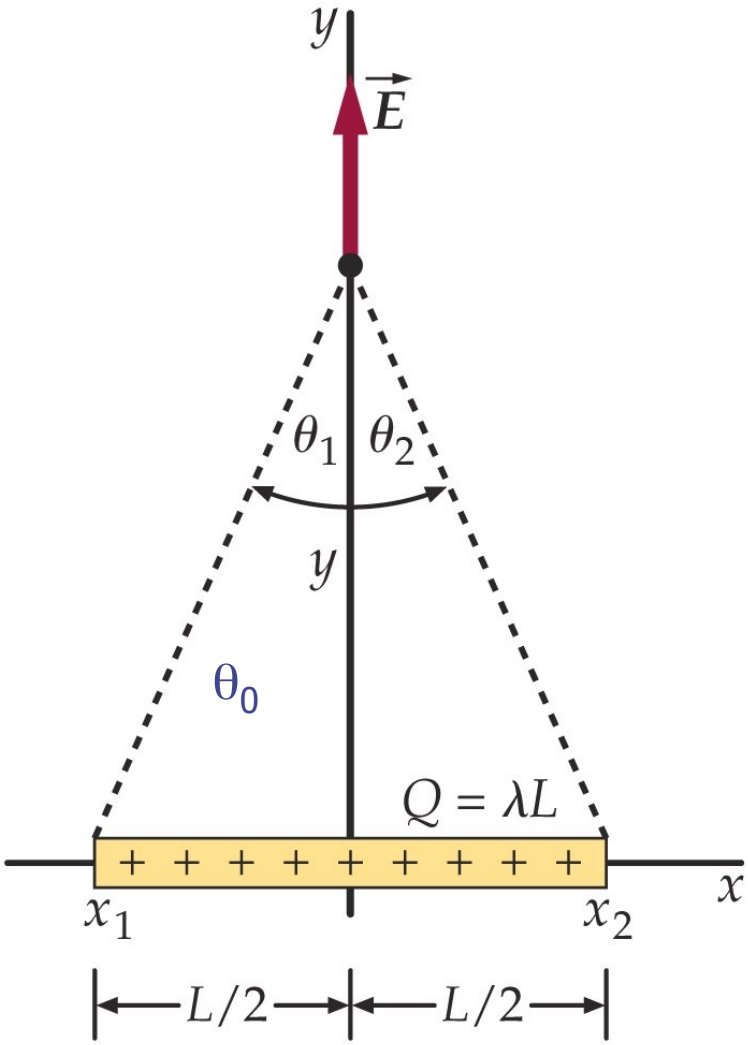
- Electric fields for arbitrary observation points of these simple objects, cannot easily be done analytically





- Computational models are needed for theses cases
- Electric fields of arbitrary charge distributions also require computational models
- Generally, we can define three types of continuous charge distributions
  - linear charge density Q/L (C/m)
  - surface charge density Q/A (C/m^2)
  - volume charge density Q/V (C/m^3)
- From these, we can define infinitesimal elements of charge and coordinates

Example Problem



- A thin rod of length L and uniform linear charge density λ lies along the x axis. (a) Show that the electric field a distance y from the rod along its perpendicular bisector, has no x component and is given by $E=2k_e\lambda\sin\theta_0/y$. (b) Using this result show that the field of a rod of infinite length is $E=2k_e\lambda/y$.