Answer on Question #58174-Physics-Electromagnetism

What other symmetries we can use in gauss law other than spherical, cylindrical?

Answer

Gauss' law can be used to solve a number of electrostatic field problems involving a special symmetry—usually spherical, cylindrical, or planar symmetry.

Let's consider the example of planar symmetry.

Infinite Plane of Charge

 One other geometry with sufficient symmetry to apply Gauss's law is an infinite sheet of charge. Let the surface charge density of the plane be σ. Here, symmetry requires the electric field to be perpendicular to the plane everywhere in space. There can be no component up or down, left or right, as there is nothing special about any given direction. The perpendicular surfaces are planes parallel to the charged plane. We can construct as a Gaussian surface anything that has two surfaces parallel to the plane; a cube of side a is a simple choice. We orient the cube so that the plane passes through the cube's center with two faces parallel to the plane.

Because the electric field is pointing outward from the plane, the only flux is through the surfaces parallel to the plane. Each surface has outward (hence positive) flux of Ea^2, so the net flux is twice that. The charge enclosed in the cube is $q_{enc} = \sigma a^2$. Gauss's law then gives:

$$E = \frac{\sigma a^2}{\varepsilon_0 2a^2} = \frac{\sigma}{2\varepsilon_0}$$
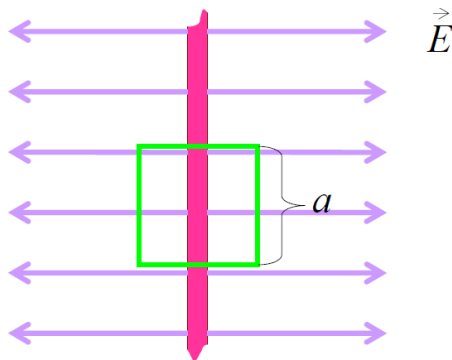
Gaussian surface for a planar charge distribution.