Electric field E and electric potential V

Physics 225 – Background wiki

Equipotentials

An equipotential is a surface of constant electric potential V. Figure 1 shows a cross-section of the equipotentials for an electric dipole (the electric field vectors are shown as arrows). The second view shows the same equipotentials, but V has been rendered as height:

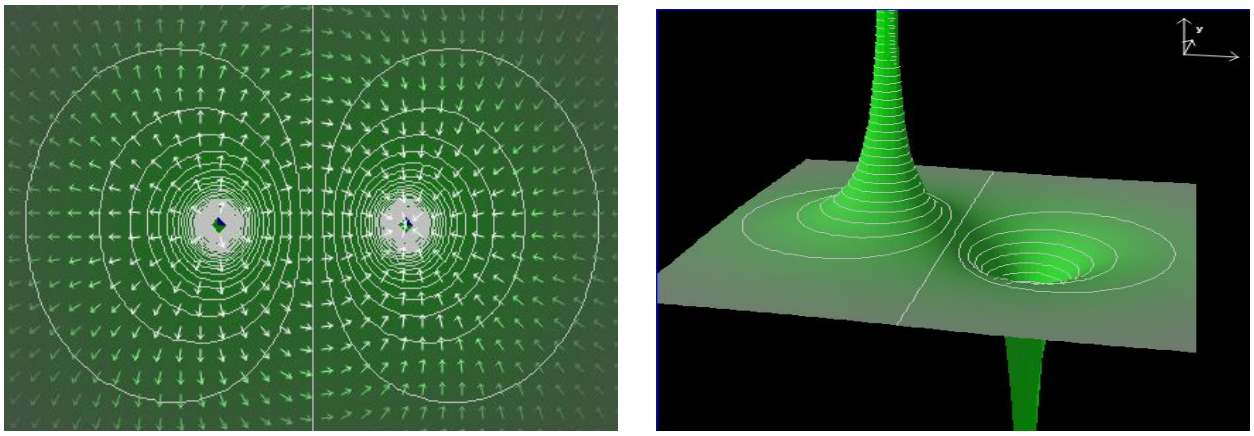

Figure 1: Electric dipole equipotentials source: http://www.falstad.com/vector2de/

Finding E from V

The electric field vectors point perpendicular to the equipotential surfaces, in the direction of decreasing electric potential. The magnitude is given by the (directional) derivative:

$$E_s = -\frac{dV}{ds} \qquad \text{(Equation 1)}$$

In Equation 1:

- s is the direction along which V is increasing
  - the - sign is a reminder that E points along the direction of decreasing V
- V is the electric potential

Finding V from E

In moving from an initial to a final position along a path, the change in electric potential is

$$\Delta V = -\int_{\vec{r}_i}^{\vec{r}_f} \vec{E} \cdot d\vec{s}$$ (Equation 2)

In Equation 2:

- $\vec{r}_i$ is the initial position
- $\vec{r}_f$ is the final position
- $d\vec{s}$ is a differential step along the path

Credits

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