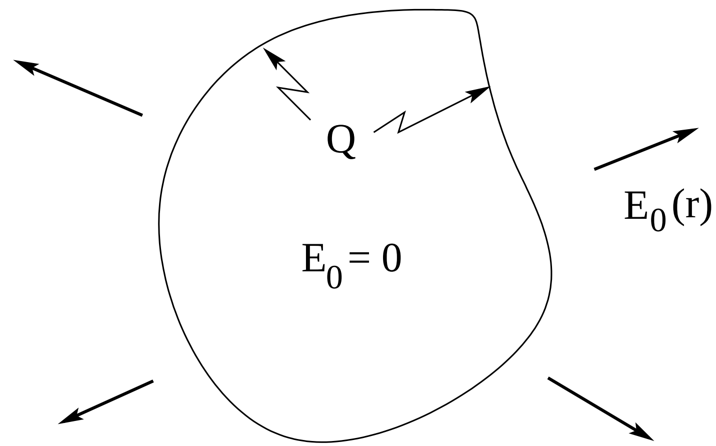
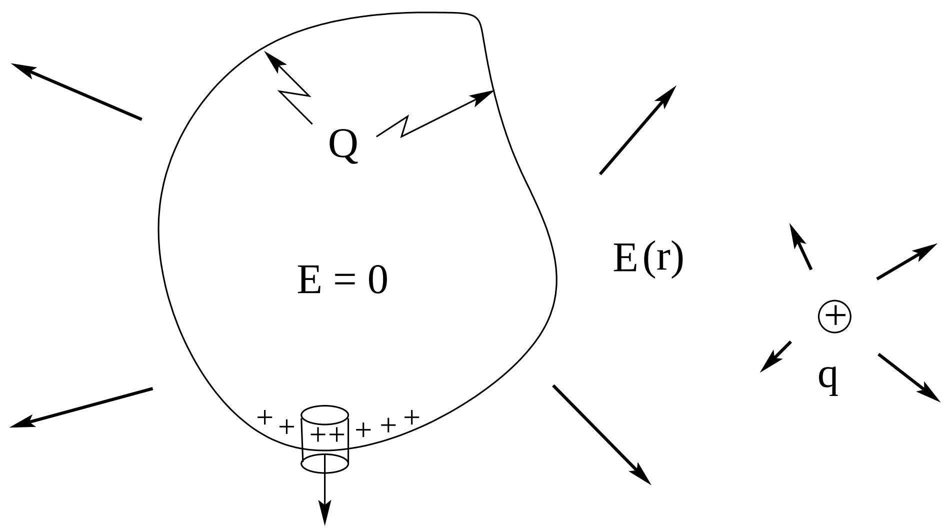
Charged Conductor at Equilibrium (1)

- Consider a conductor with excess charge Q in isolation.
- The mobile charges (electrons) are rearranged spontaneously until we have $\vec{E}_0 = 0$ everywhere inside the conductor.
- If $\vec{E}_0 = 0$ inside the conductor, then Gauss's law implies that there can be no net flux through any Gaussian surface that is inside the conductor.
- Hence there can be no net charge in any region inside the conductor.
- Hence all excess charge must be at the surface, where it produces an electric field $\vec{E}_0(\vec{r})$ on the outside only.



Charged Conductor at Equilibrium (2)

- Now place a point charge q near the charged conductor.
- The electric field produced by q causes a further rearrangement of mobile surface charges until we have again $\vec{E} = 0$ in the interior.
- Locally, the electric field $\vec{E}$ is perpendicular to the surface of the conductor, and its magnitude is proportional to the charge per unit area: $E = \sigma/\epsilon_0$.



Charged Conductor at Equilibrium (3)

- Consider a conductor with a cavity and excess charge Q.
- Gauss's law implies that there is no net charge on the surface of the cavity.
- The external field is $\vec{E}_0(\vec{r})$. There is no field in the cavity.
- Now place a point charge q inside the cavity.
- Gauss's law implies that there is a charge $-q$ on the surface of the cavity.
- Charge conservation implies that there is a charge $Q + q$ on the outer surface of the conductor.
- The external field changes to $\vec{E}(\vec{r})$. There is a nonzero electric field field inside the cavity.