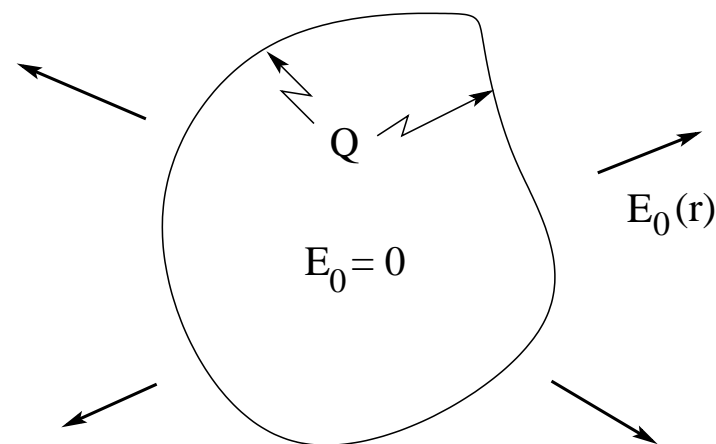


# Charged Conductor at Equilibrium (1)



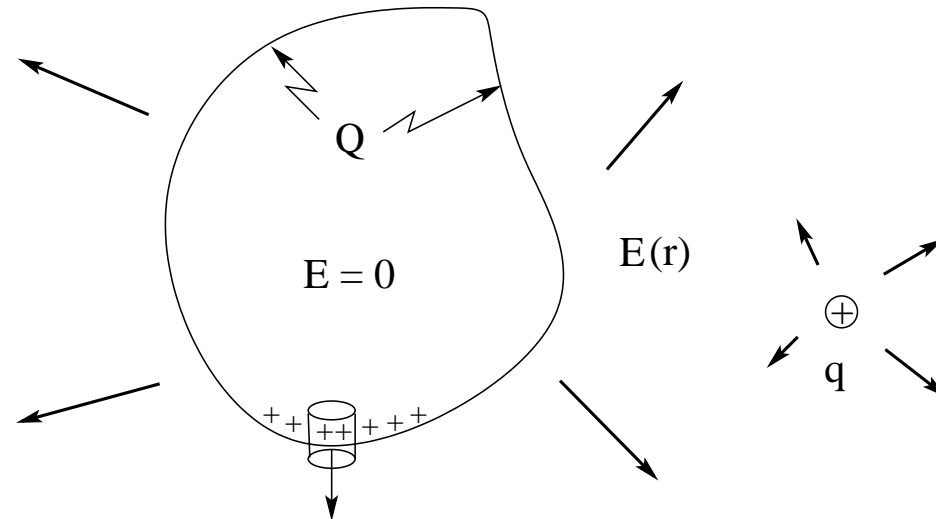
- Consider a conductor with excess charge  $Q$  in isolation.
- The mobile charges (electrons) are rearranged spontaneously until we have  $\vec{E}_0 = 0$  everywhere inside the conductor.
- If  $\vec{E}_0 = 0$  inside the conductor, then Gauss' law implies that there can be no net flux through any Gaussian 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' 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' 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 inside the cavity.

