Jan 16 Sec 1-4 & 2-4 & conservation of charge

(1) Gauss's Law $\oint \vec{E} \cdot d\vec{a} = \frac{Q_{enclosed}}{\epsilon_0}$

Incongruous:

Congruous:

Modifying:

Generalizing/Analogy:

Causal/Creative:

Informational:

(2) Conservation of charge

Expressed as a PDE using flux (chapter 9 in Shadowitz for conductors)

Flow of charge thru a surface

$= \int \vec{J} \cdot d\vec{a}$ $\qquad \vec{J} \equiv \rho \vec{v}$ $\qquad \frac{\text{Coulombs}}{m^3} \frac{m}{s}$

$\Downarrow$

$\frac{C}{s} \frac{1}{m^2}$

flux: $\frac{\text{Coulombs}}{s}$

$\oint \vec{J} \cdot d\vec{a}$ NET flow of charge IN/OUT of Closed surface

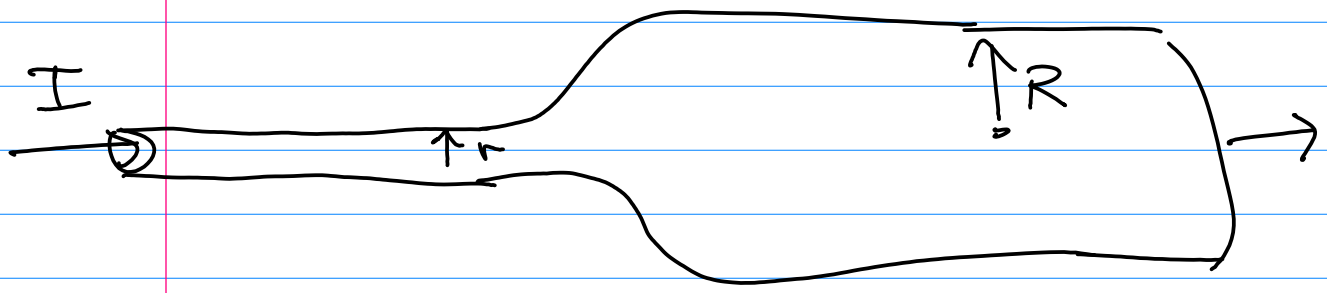
↖ closed surface

There is no source or sink of charge so the net charge coming out of surface must be due to

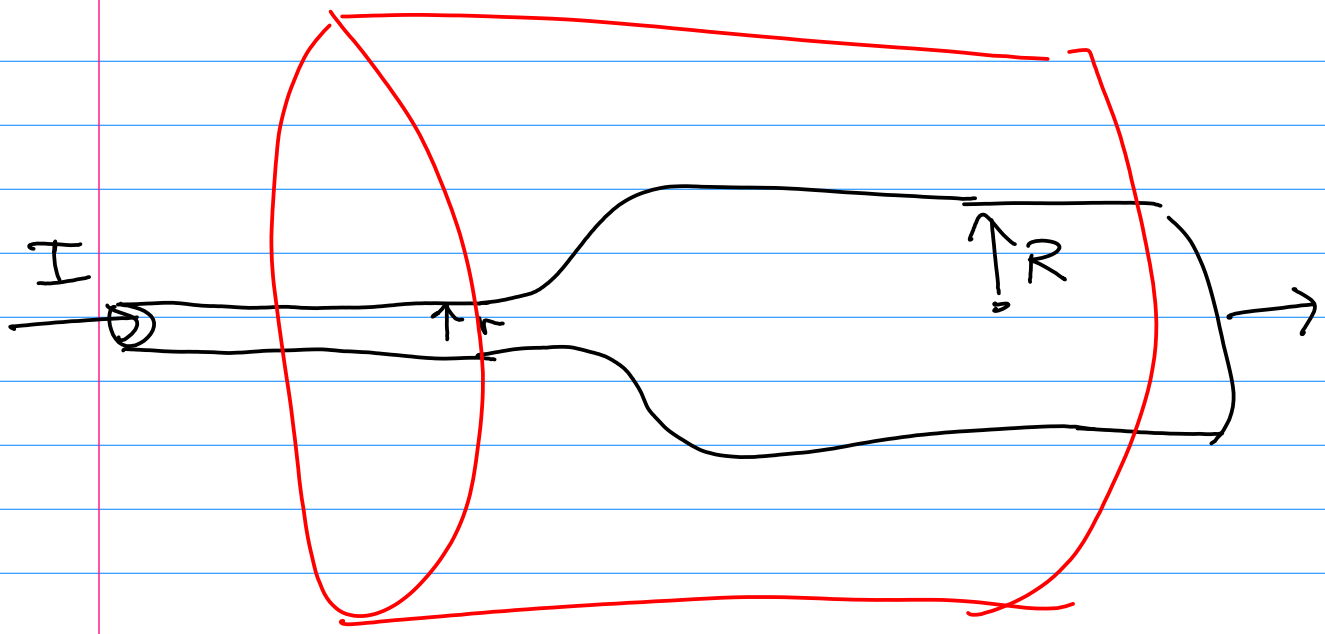
Is there a piling up of electric field lines in a closed surface?

In a conductor $\rho \simeq$ constant

$$\int \vec{J} \cdot d\vec{a} = \int \rho \vec{v} \cdot d\vec{a} \qquad \frac{C}{s} \text{ or Amps}$$



Informational: If the conductor is neutral what does the charge density mean?

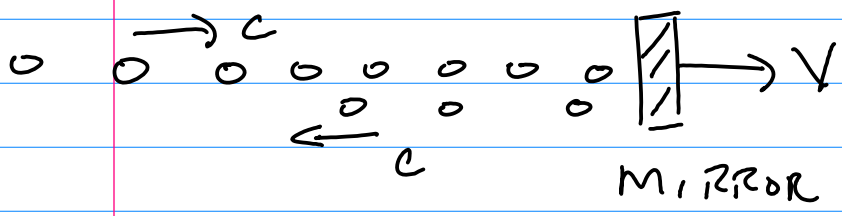


$$\oint \vec{J} \cdot d\vec{a} = \frac{dQ_{enclosed}}{dt}$$

Congruous: How do I calculate the consequences of conservation of charge?

Informational: Does charge build up within the closed surface?

Photons reflecting as a stream of particles 1-D



$\vec{J}_{in} = \rho_{in} \vec{v}_{in} \rightarrow$

$J_{reflected} = \rho_{ref} \vec{v}_{ref} \rightarrow$

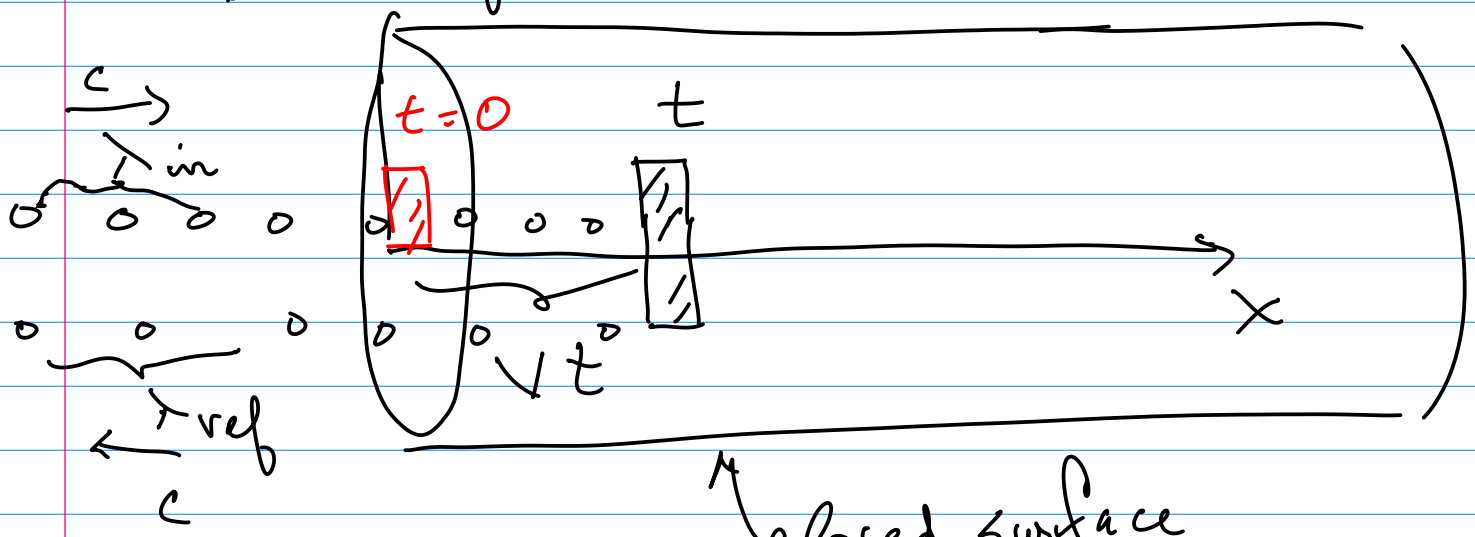
Model

$\vec{J}_{in} = \lambda_{in} c \hat{x}$

$\vec{J}_{ref} = -\lambda_{ref} c \hat{x}$

Reality

$10^{14} \frac{\text{photons}}{\text{sec}} \pm \sqrt{10^{14}}$



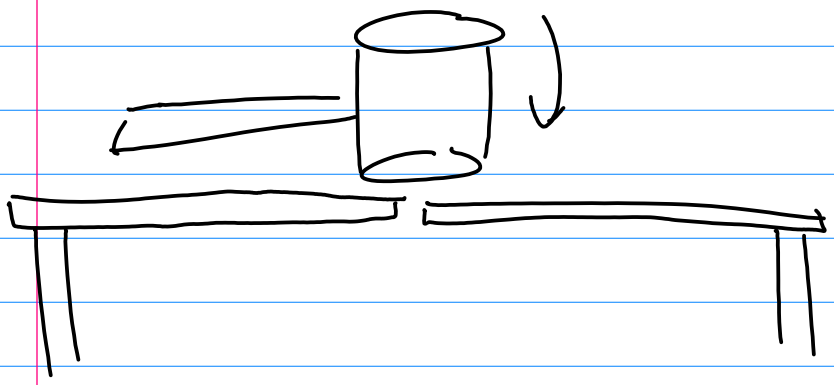
closed surface

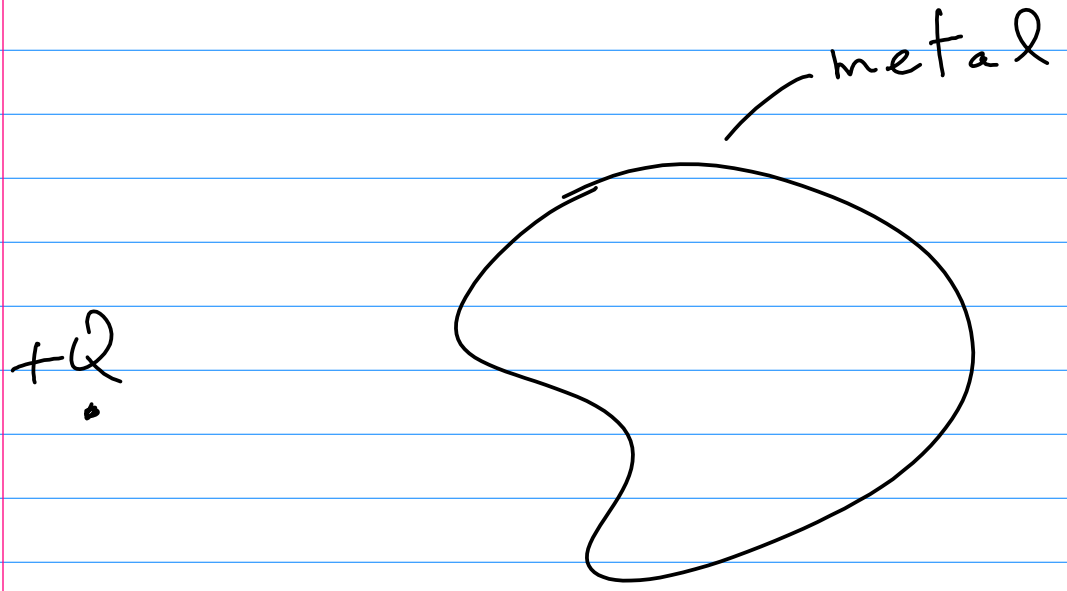
Conservation eqn ?

Homework posted on the wiki

(3) Conductors

Some electrons are free to move





Congruous: How are charges distributed?