Electricity

Zeroeth Law of Elec.

Electric Charge exists.

$+$ ← proton

$-$ ← electron

$q \rightarrow$ "small"

q_{proton} $q_{electron}$

$Q \rightarrow$ "large"

SI unit Coulomb. C

$$q_p = + \overset{e}{\boxed{1.602 \times 10^{-19}}}\ C = +e$$

$$q_e = -1.602 \times 10^{-19}\ C = -e$$

$$Q_{cat} = +36.4\ \mu C$$

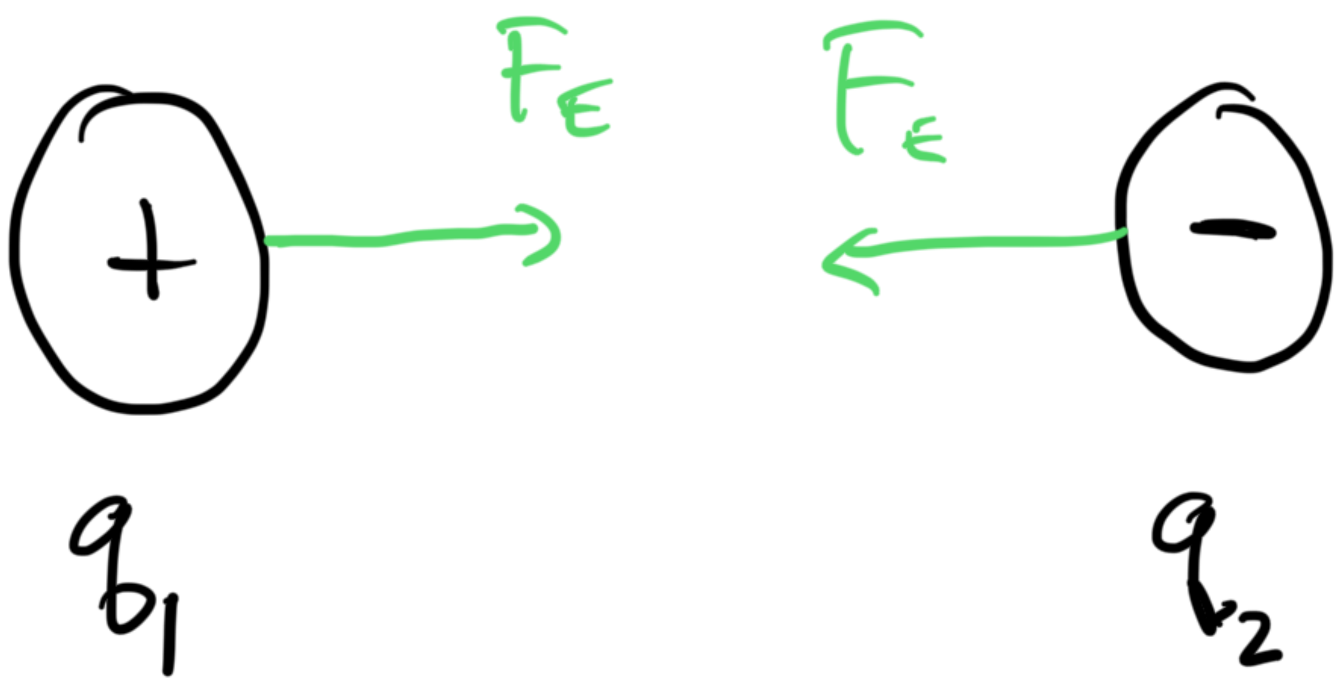
Electric Forces.

$$|\vec{F}_E| = k_E \frac{q_1 q_2}{r^2}$$

$$k_E = 8.99 \times 10^{9} \frac{N \cdot m^2}{C^2}$$

$$G = 6.67 \times 10^{-11} \frac{N \cdot m^2}{C^2}$$

$$|F_E| = k_E \frac{q_1 \; q_2}{r^2}$$



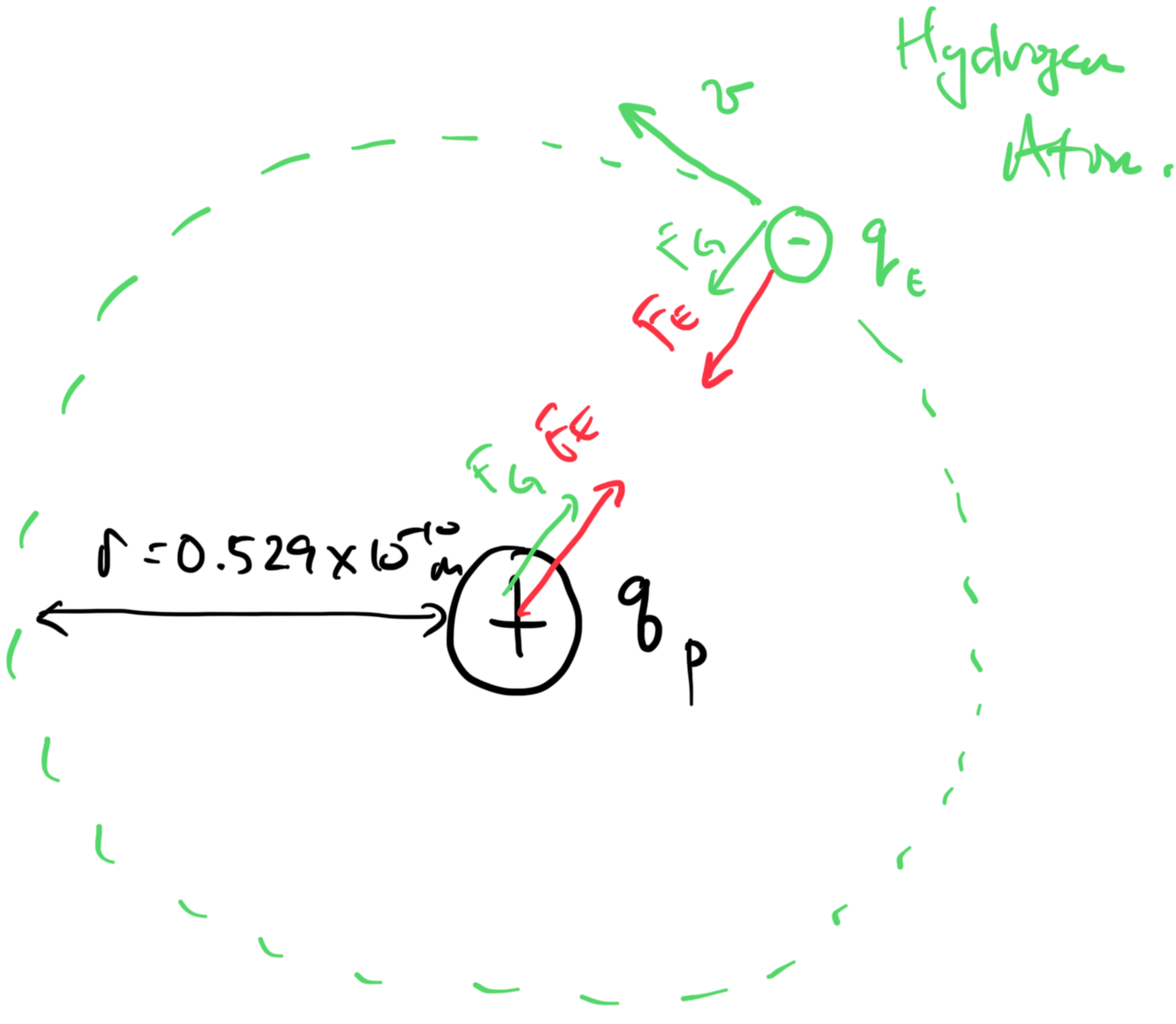
$$|\vec{F}_E| = k_E \frac{q_1 \; q_2}{r^2}$$

One Law:

$$|\vec{F}_E| = k_E \frac{|q_1|\,|q_2|}{r^2}$$

+

"Opposites attract, likes repel"



$$|\vec{F}_E| = k_E \cdot \frac{|q_p||q_e|}{r^2}$$

$$= \left(8.99 \times 10^9\right)\left(1.602 \times 10^{-19}\right)\left(1.602 \times 10^{-19}\right)$$

$$(0.529 \times 10^{-10})^2$$

$$\boxed{= 8.24 \times 10^{-8}\ \text{N}}$$

$$|F_G| = G\,\frac{m_p\, m_e}{r^2}$$

$$= \frac{(6.67 \times 10^{-11})(1.67 \times 10^{-27}) \cdot (9.11 \times 10^{-31}\,\text{kg})}{(.529 \times 10^{-10})^2}$$

$$\boxed{= 3.62 \times 10^{-47}\ \text{N}}$$

$$|F \quad | \quad 8.24 \quad 10^{-8}$$

$$\frac{|F_E|}{|F_G|} = \frac{8.24 \times 10^{-8}\ \text{N}}{3.62 \times 10^{-47}\ \text{N}}$$

$$= 2.27 \times 10^{39}$$

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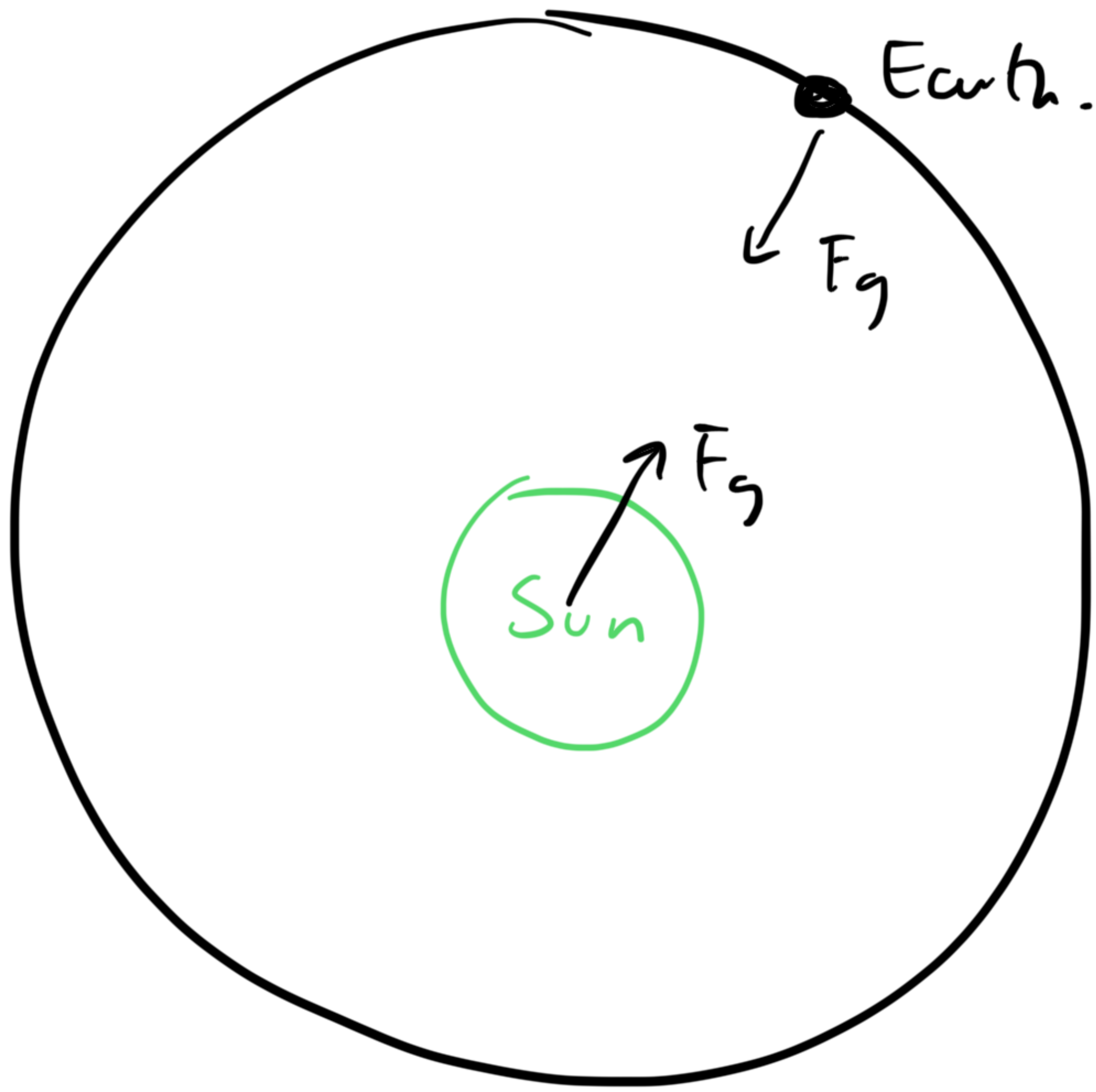
00000 x larger.

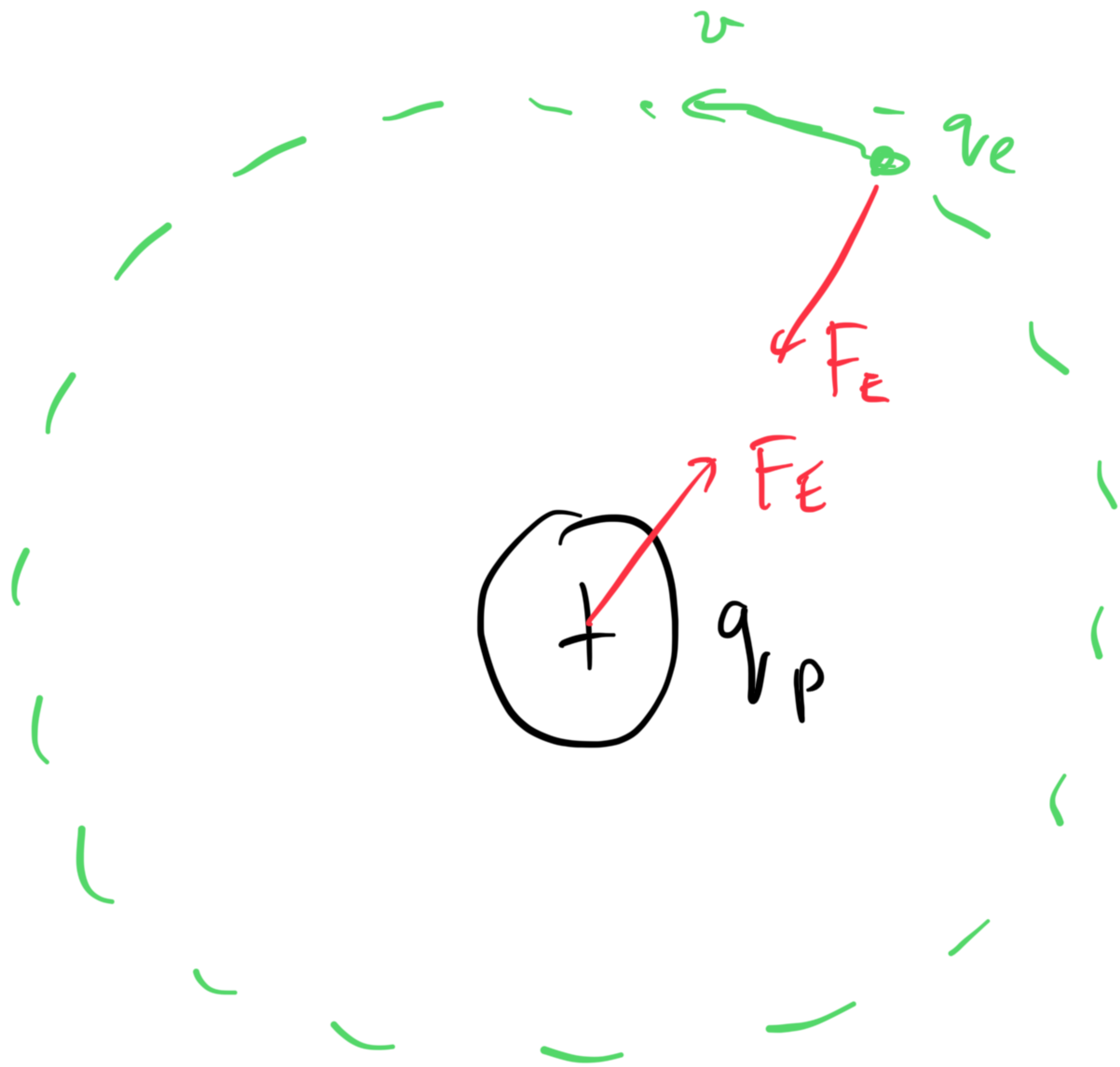
In problems with electricity, we often ignore gravity!



$$|\vec{F}_g| = \frac{G\, m_s\, \cancel{m_E}}{r^2} = \cancel{m_E}\, |\vec{a}|$$

Acceleration Field :

$$|\vec{a}| = \frac{G\, m_s}{r^2}$$



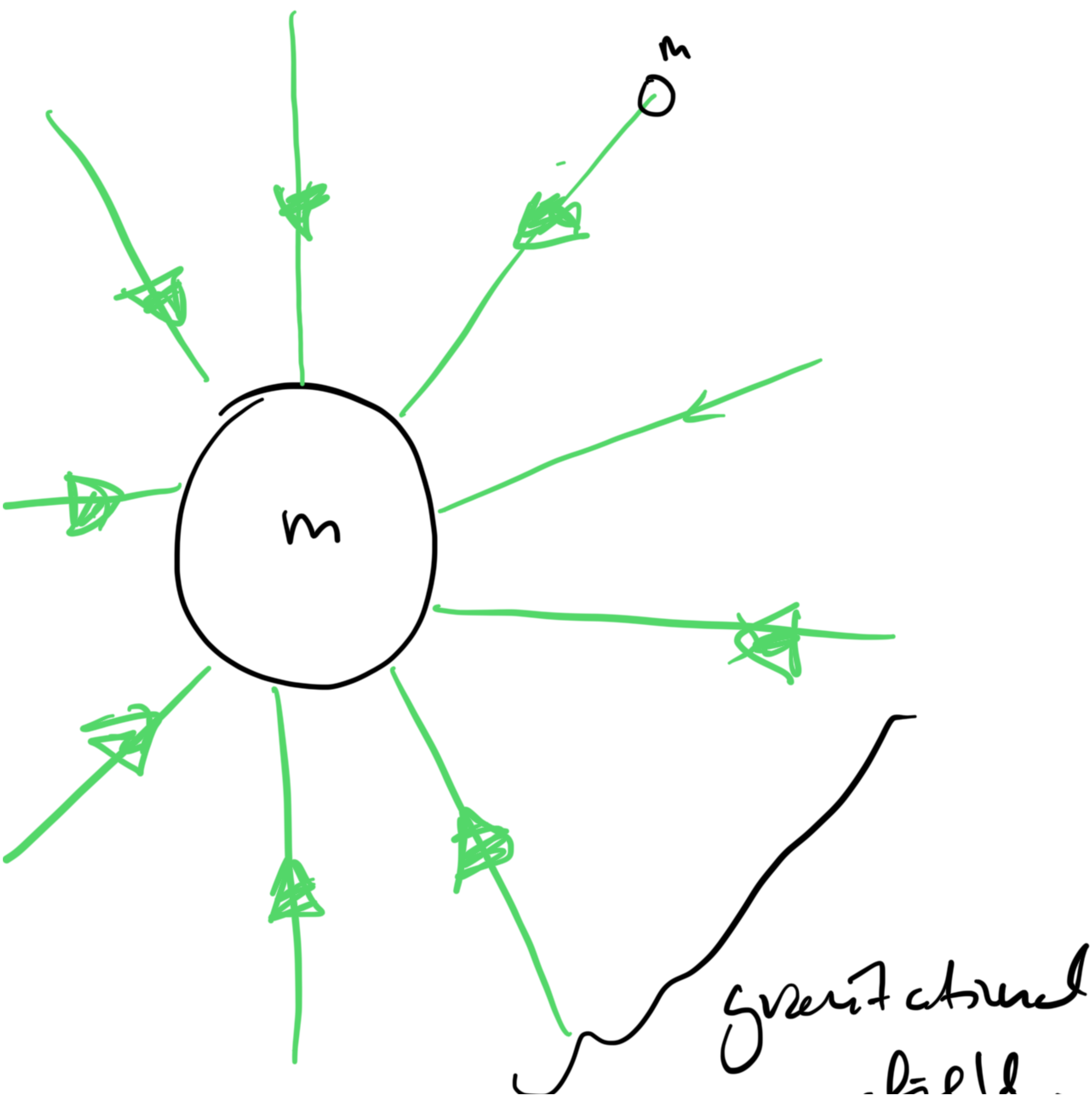
$$|\vec{F}_E| = k_E \frac{|q_p|\,\cancel{|q_e|}}{r^2} = \cancel{|q_e|}\,\boxed{|\vec{E}|}$$

$$|\vec{E}| = \frac{k_e\,|q_p|}{r^2}$$

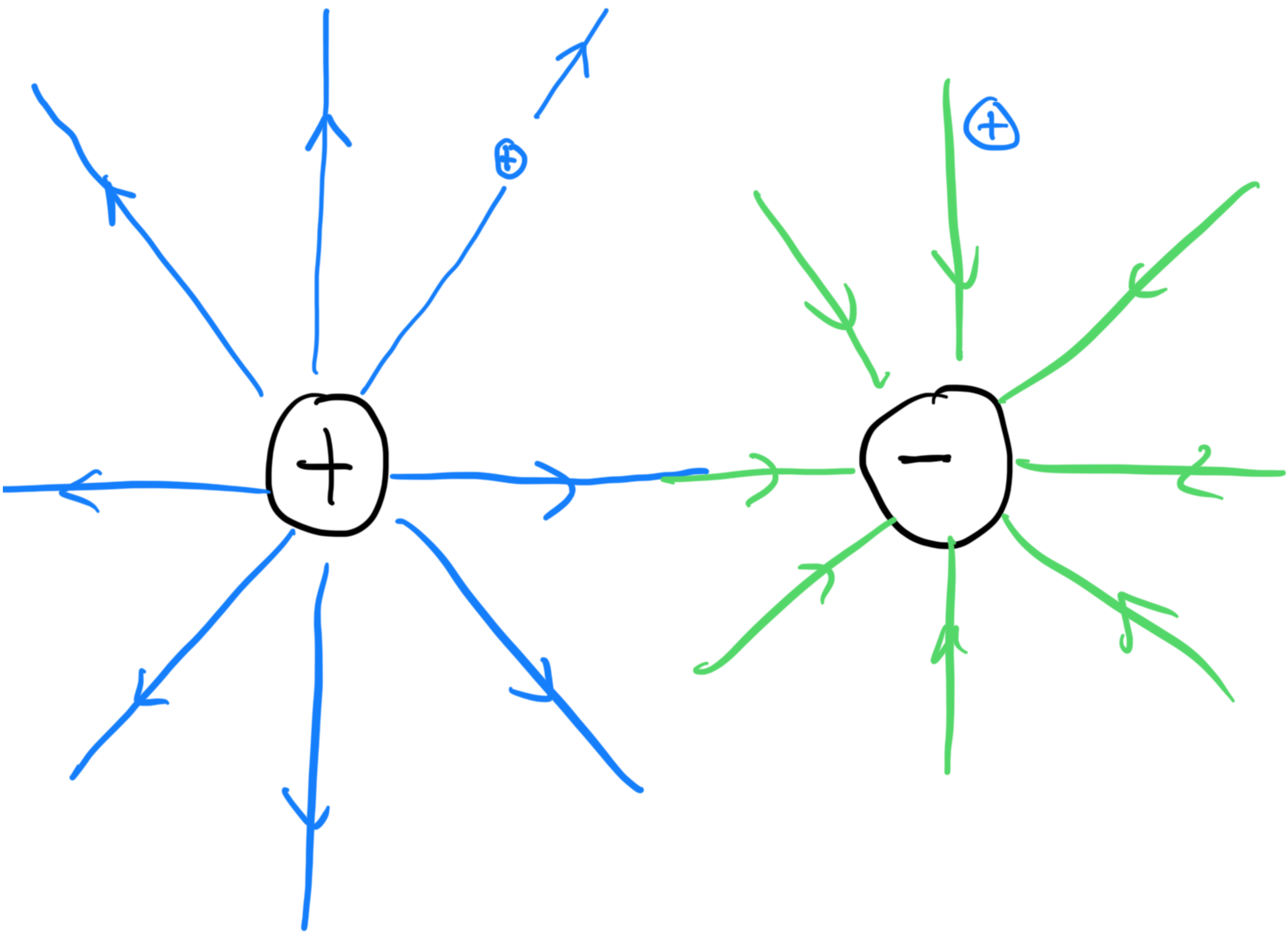
Field Model of Forces.

→ Isaac Newton, Rene DesCartes, Robert Hooke, ...

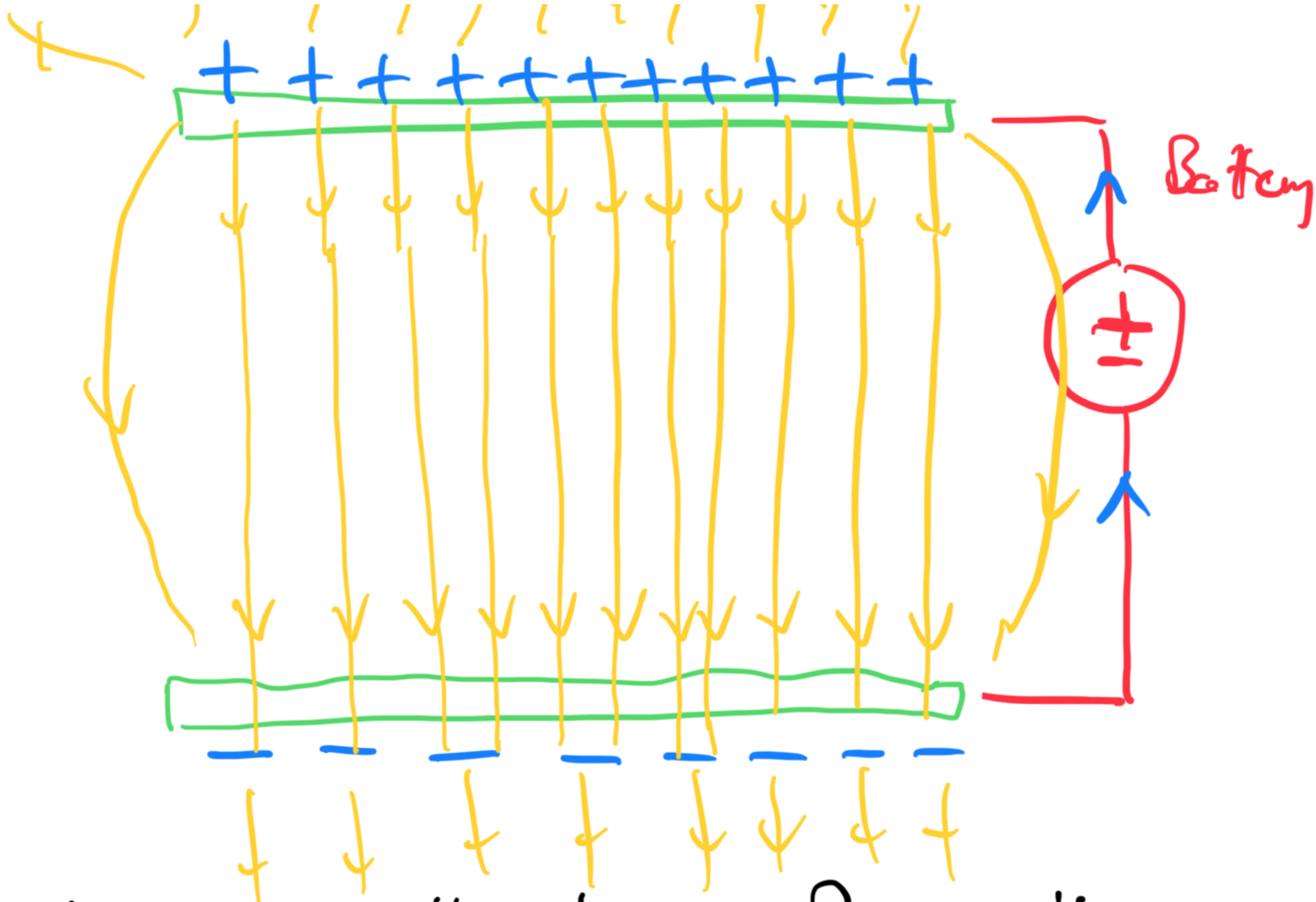
"Action at a Distance"



$$|\vec{a}| = \frac{G\, M_{central}}{r^2}$$



Electrostatic Plates



<u>Battery</u>: "Charge Pumps"

Batteries pump positive charge from the negative terminal to the positive terminal.

$$\vec{F}_G = m\vec{a}_G$$

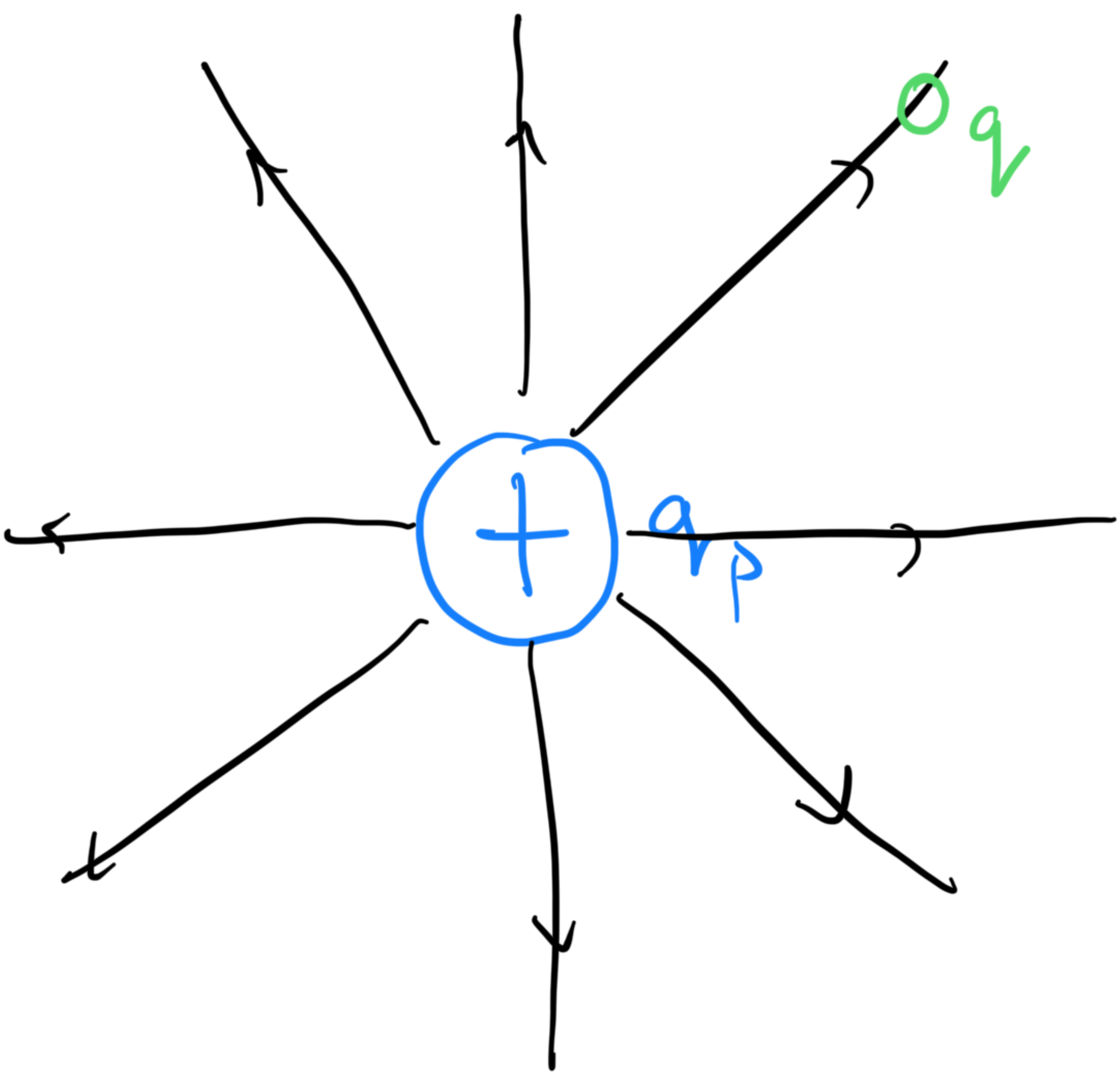
$$\vec{F}$$ $$\vec{F}$$

$$F_E = q\,E$$

generated by some charge distribution.

place this charge in

$$|\vec{E}| = \frac{k_E |q_p|}{r^2}$$

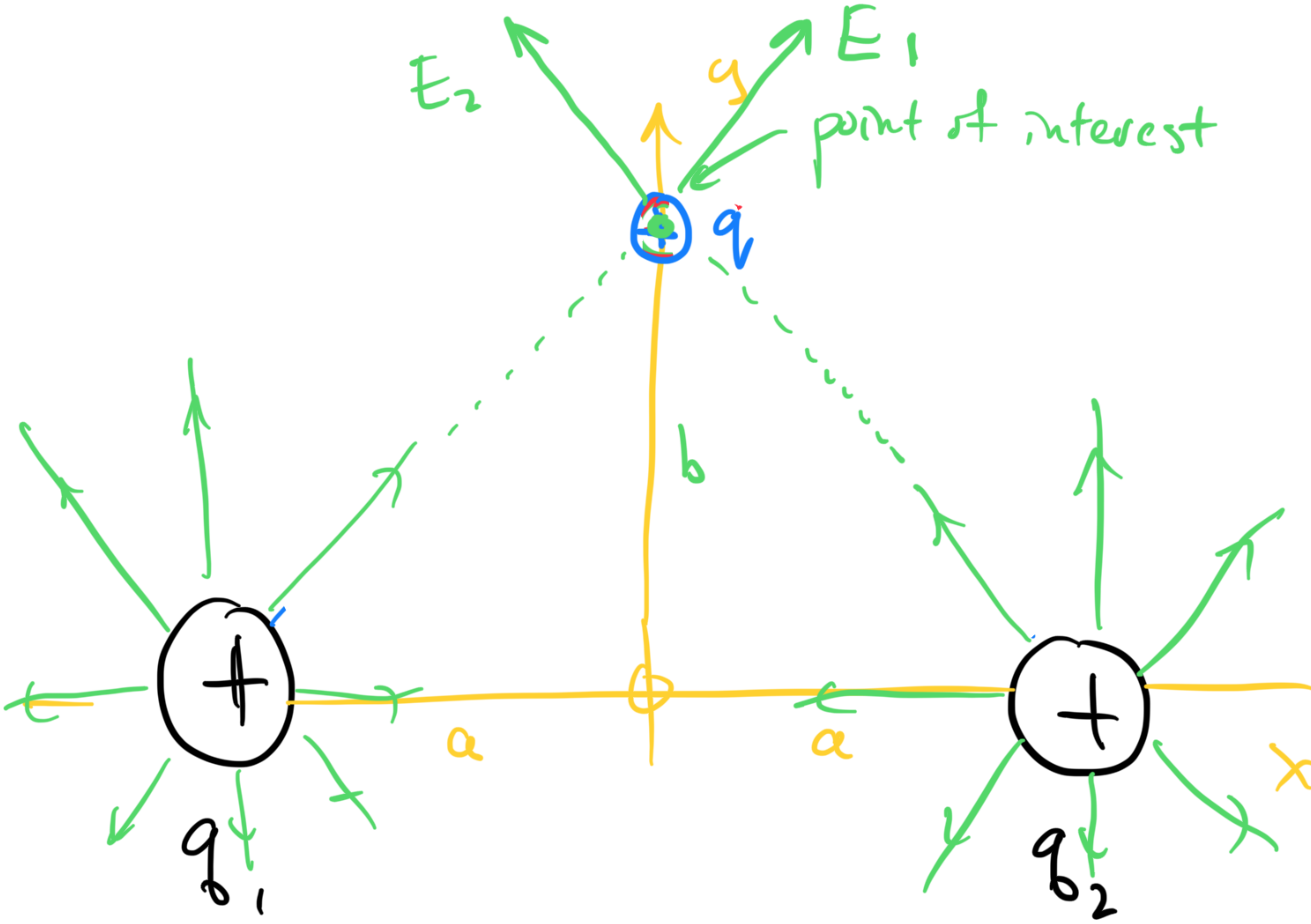


$$|\vec{F}_E| = |q|\,|\vec{E}|$$

q

$$= |q| \left(\frac{k_E |q_p|}{r^2} \right.$$

$$|\vec{F}_E|_q = \frac{k_E |q_p| |q|}{r^2}$$



$\vec{F}$ $\quad$ $\vec{F}$ $+$ $\vec{F}$

$$F_{NET/q_3} = F_{E1} + F_{E2}$$

$$\underbrace{q_3 \vec{E}_{TOTAL}}_{\vec{F}_{NET/q_3}} = \underbrace{q_3 \vec{E}_1}_{\vec{F}_{E1}} + \underbrace{q_3 \vec{E}_2}_{\vec{F}_{E2}}$$