

$$q = ne, \quad e = 1.602 \times 10^{-19} \text{ C}$$

$k$  costante e invariante

$$q > 0, < 0, = 0, \quad q_{\text{tot}} = 0$$

interazione elettrostatica

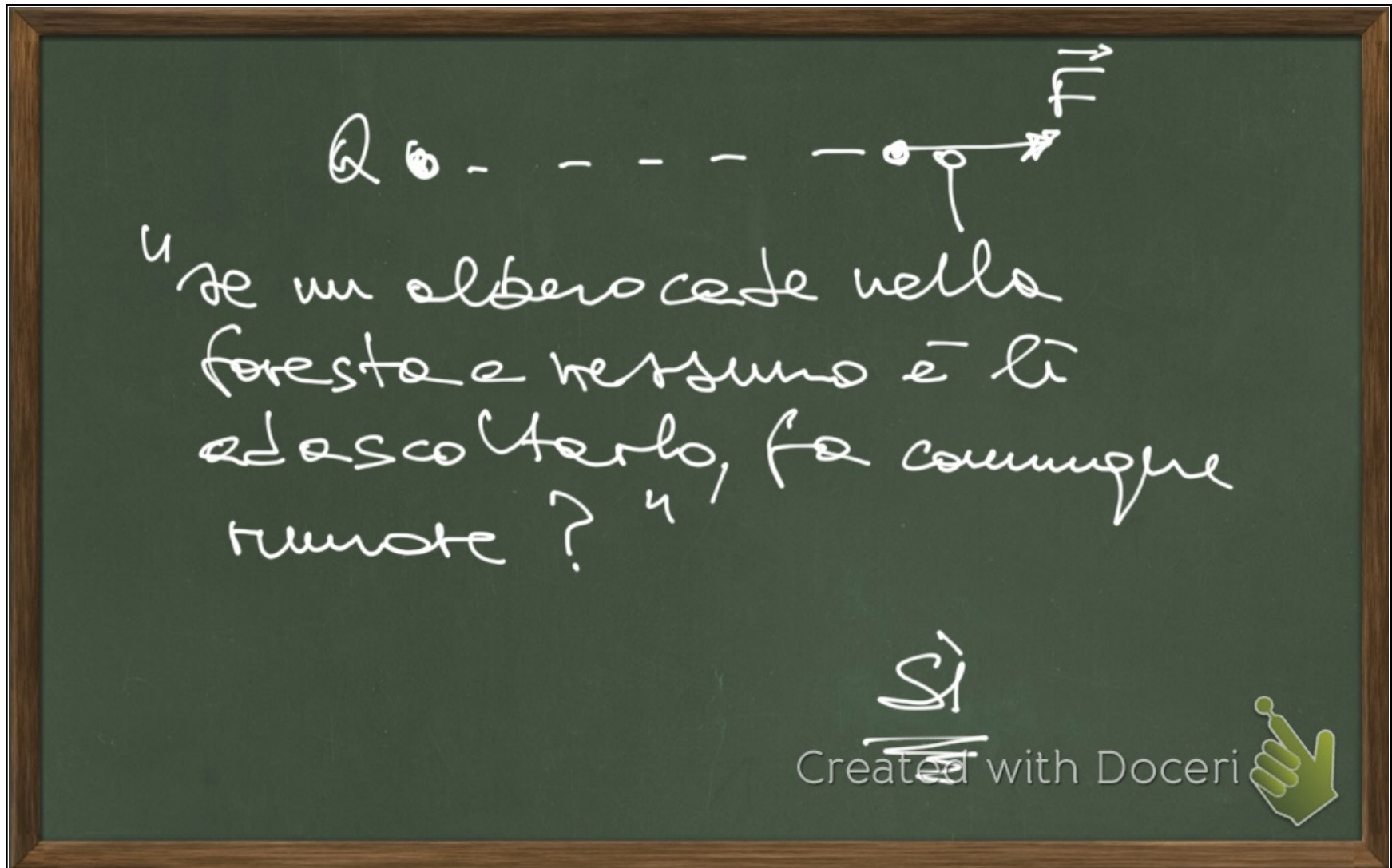


$$\vec{F} = k_e \frac{Qq}{r^2} \hat{r}$$

$$k_e = \frac{1}{4\pi\epsilon_0}$$

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Q. - - - - -

Se un albero cade nella foresta e nessuno è lì ad ascoltarlo, fa comunque rumore? "

Sì

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$\vec{F}$   $\vec{E} = \frac{\vec{F}}{q}$

"numero sentito"      "numero virtuale"

$\vec{E}(\vec{r}) =$  stato dello spazio prodotto dalla carica

**CAMPO ELETTRICO**

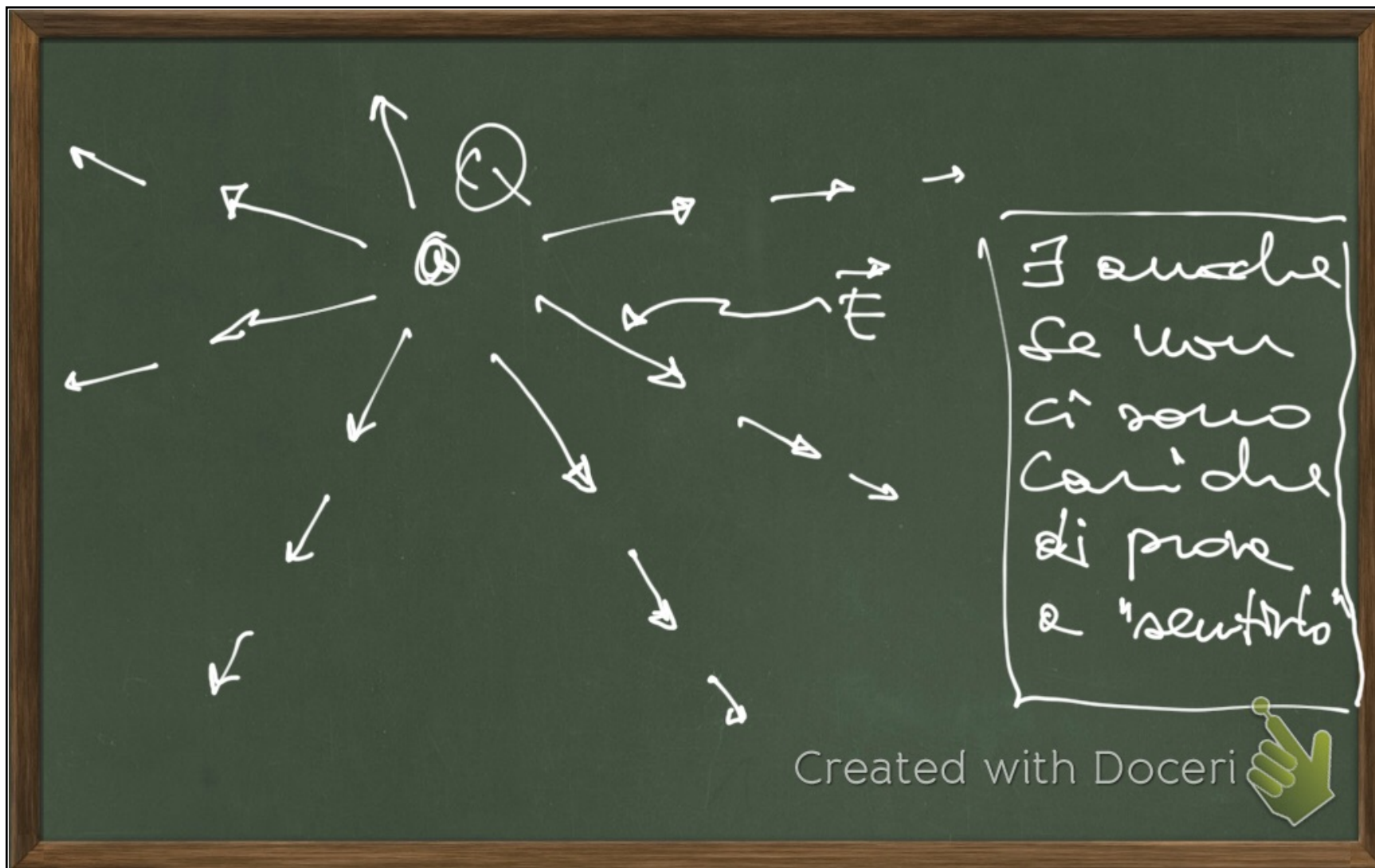
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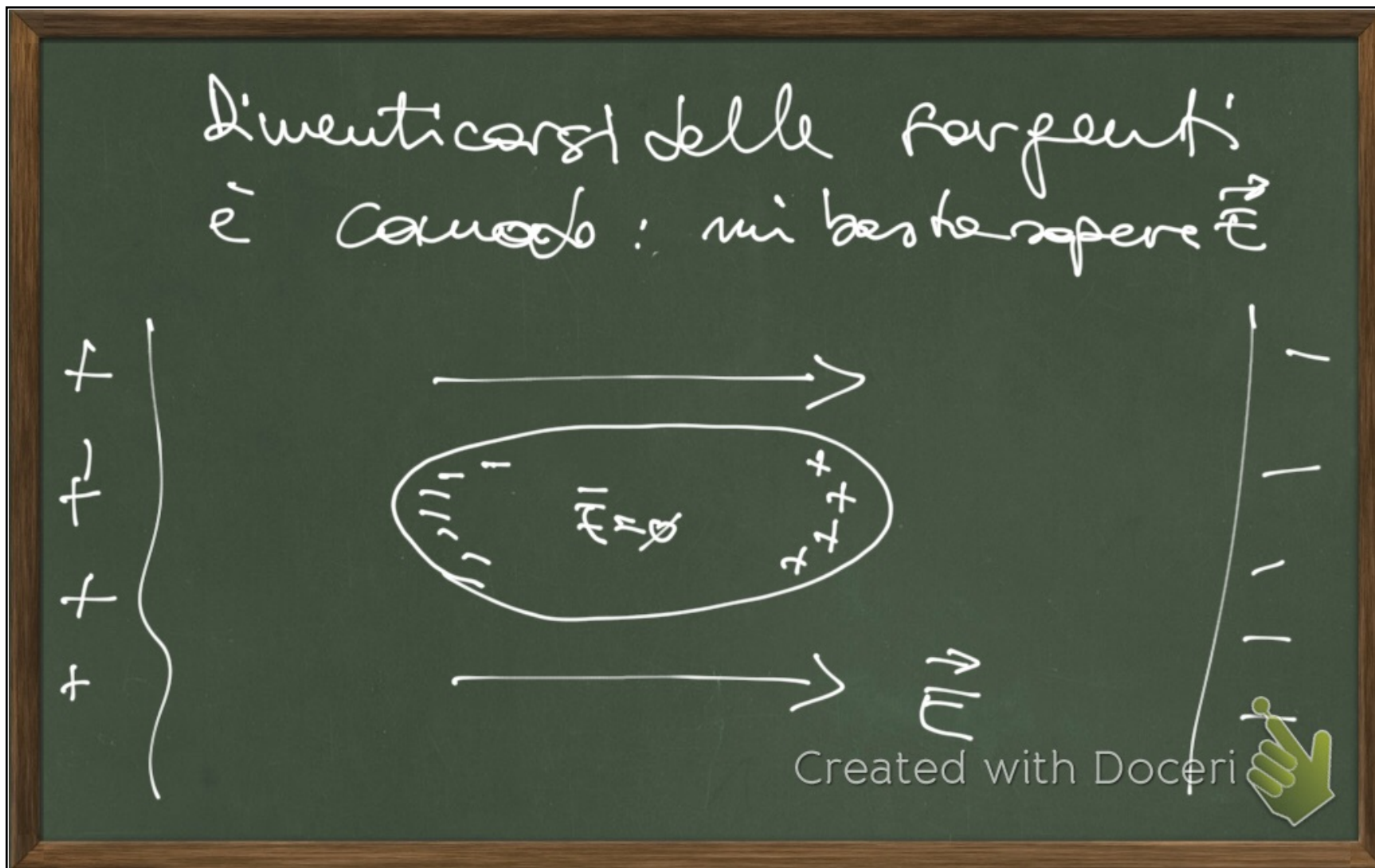
carica puntiforme  $Q$

$$F = k_e \frac{Qq}{r^2} \hat{r}$$

$$\vec{E} = \frac{\vec{F}}{q} = \left[ k_e \frac{Q}{r^2} \hat{r} = E_{c.punt.} \right]$$

dipende solo dalla carica  
"generatrice", non dalla carica





C.P.  $\Rightarrow dq = \int p dV$

$\downarrow$  densità di carica  
 $[S] = \frac{C}{m^3}$

$dq = \sigma dA$ ,  $[\sigma] = \frac{C}{m^2}$

$dq = \lambda dx$ ,  $[\lambda] = \frac{C}{m}$

$\frac{dx, dq}{| |}$

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The diagram illustrates the calculation of the electric field from a rod of length  $\lambda$  and a point charge  $q$ .

**Top Left:** A rod of length  $\lambda$  is shown with a small segment  $dx$  containing charge  $dq$ . A unit vector  $\hat{r}$  points from  $dq$  to a point  $P$ . The electric field contribution is  $d\vec{E}$ .

**Top Right:** The electric field contribution is given by:
 
$$d\vec{E} = \frac{k_e dq}{r^2} \hat{r}$$
 and
 
$$= \frac{k_e \lambda dx}{|R-x|^2} \hat{x}$$
 A circled question mark indicates a point of confusion or a question about the derivation.

**Bottom Left:** A coordinate system with  $x$  and  $y$  axes. A rod of length  $\lambda$  is on the  $x$ -axis. A point charge  $q$  is at a distance  $x$  from the origin. A small segment  $dx$  contains charge  $dq = \lambda dx$ .

**Bottom Right:** A point charge  $q$  is shown. The text "Created with Doceri" and a hand icon are visible.

$dq = \lambda dx$        $\lambda > 0$        $\vec{E} = k_e \frac{\lambda dx \hat{x}}{(x-a)^2}$


$E(a) = k_e \lambda \int_0^L \frac{dx}{(x-a)^2} = k_e \lambda \left[ \frac{1}{(a-x)} \right]_0^L$

$k_e \lambda \left[ \frac{1}{a-L} - \frac{1}{a} \right] = k_e \lambda L \left[ \frac{1}{L(a-L)} - \frac{1}{aL} \right]$

$k_e \lambda \left( \frac{aL - aL + L}{L^2 a (a-L)} \right)$

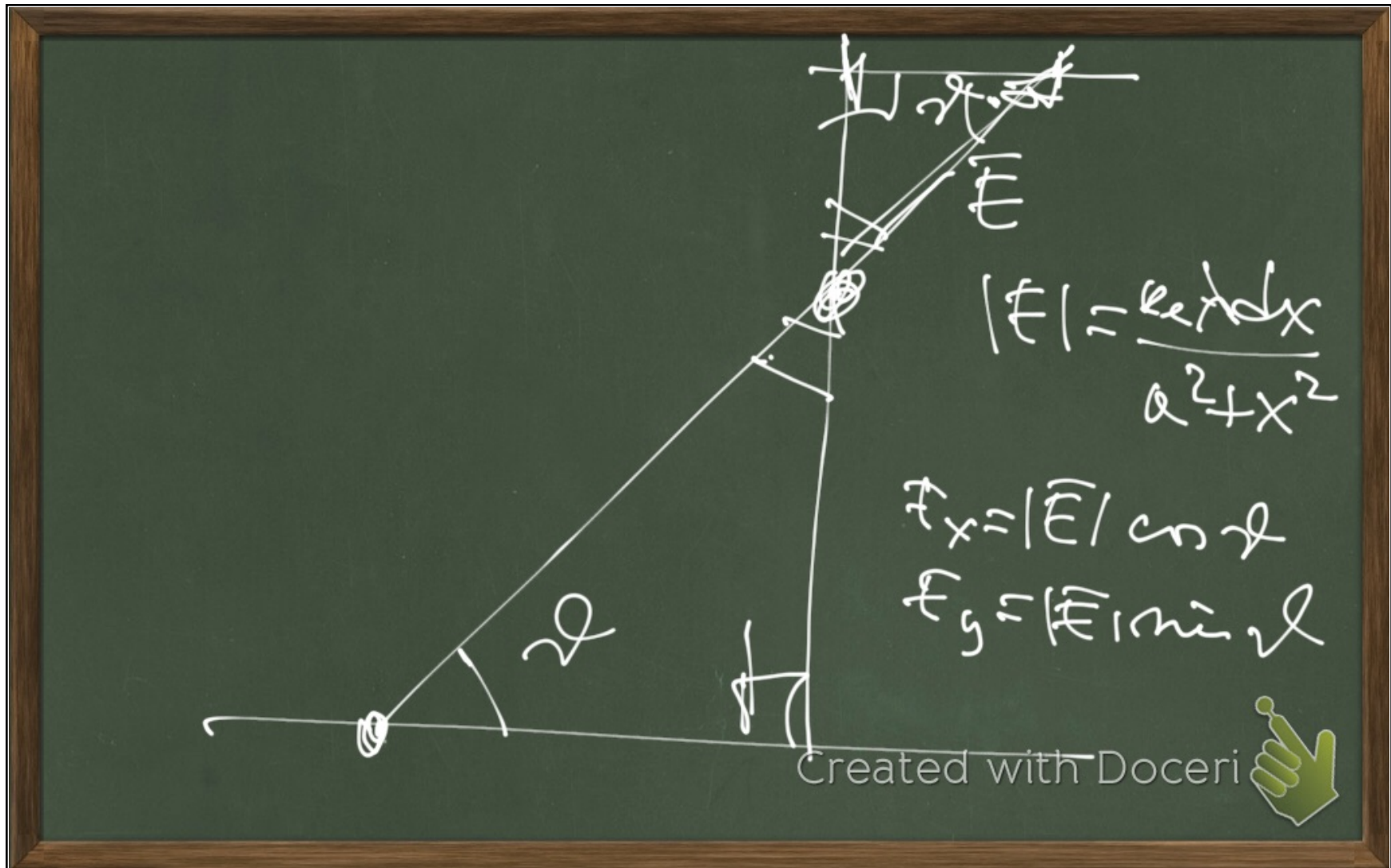
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$$\begin{aligned}
 k_e \lambda \left[ \frac{1}{a-L} - \frac{1}{a} \right] &= k_e \lambda \left( \frac{a - a + L}{a(a-L)} \right) \\
 &= k_e \lambda L \left( \frac{1}{a(a-L)} \right) = \frac{k_e \lambda L}{a(a-L)} \\
 &\xrightarrow{L \rightarrow 0} \frac{k_e \lambda}{a^2}
 \end{aligned}$$

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$dq = \lambda dx$   
 $r = \sqrt{x^2 + a^2}$   
 $\vec{dE} = \hat{y} \frac{\lambda dx}{x^2 + a^2} \sin \theta$   
 $\vec{E} = \hat{y} \int_{-L/2}^{L/2} \frac{dx a}{(x^2 + a^2)^{3/2}} = \hat{y} \lambda a \int_{-L/2}^{L/2} \frac{dx}{(x^2 + a^2)^{3/2}}$

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$$\hat{y} \lambda e \int_{-L/2}^{L/2} \frac{dx}{(x^2 + a^2)^{3/2}} = k_e \lambda a \hat{y} \int_{-L/2}^{L/2} \frac{x}{a^2 (a^2 + x^2)^{1/2}}$$


$$= \frac{k_e \lambda a \hat{y} L}{a^2 (a^2 + L^2/4)^{1/2}}$$

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$$= \frac{k_e \lambda L}{\alpha \left( \alpha^2 + \frac{L^2}{4} \right)^{1/2}} \xrightarrow{L \rightarrow \infty} = \frac{k_e \lambda L}{\cancel{k_e} \left( \frac{\alpha^2}{L^2} + \frac{1}{4} \right)^{1/2}}$$

$$\xrightarrow{L \rightarrow \infty} = \frac{2 k_e \lambda}{\alpha} = E_{file}$$

$$[E] = \left[ \frac{N}{C} \right]$$

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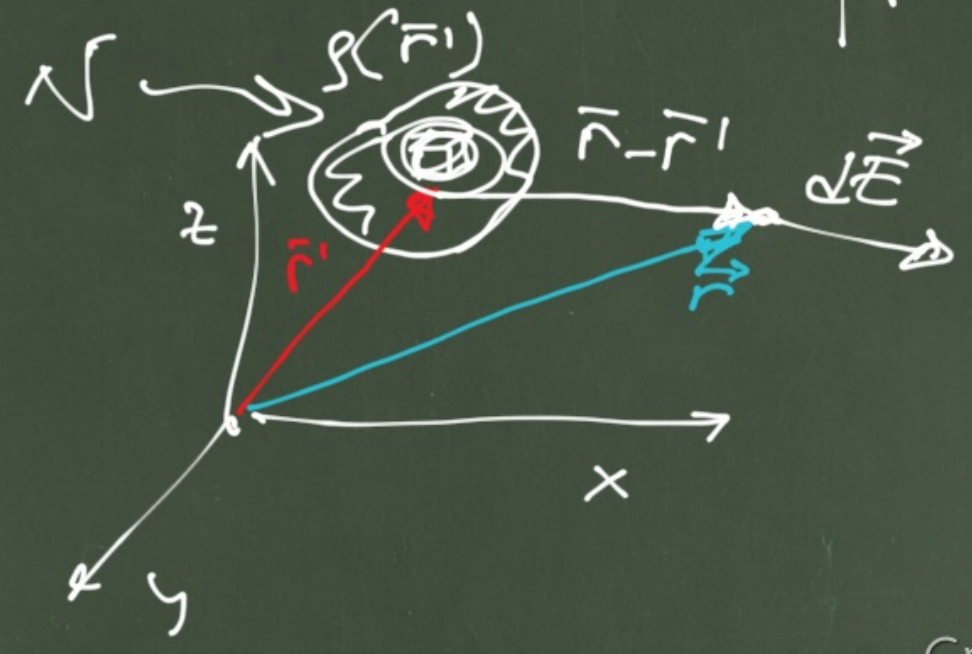
$$= \frac{k_e \lambda L}{2 \left( \lambda^2 + \frac{L^2}{4} \right)^{1/2}} \hat{y} = \frac{k_e Q}{2 \left( \lambda^2 + \frac{L^2}{4} \right)^{1/2}} \hat{\phi}$$

$$\sim \frac{k_e Q}{\lambda^2}$$

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$$\oint \vec{E}(\vec{r}) = k_e \frac{\int \rho(\vec{r}') d\vec{r}'}{|\vec{r} - \vec{r}'|^2}$$



$$d\vec{r} = dx dy dz$$


$$= r^2 \sin \theta dr d\theta d\phi$$

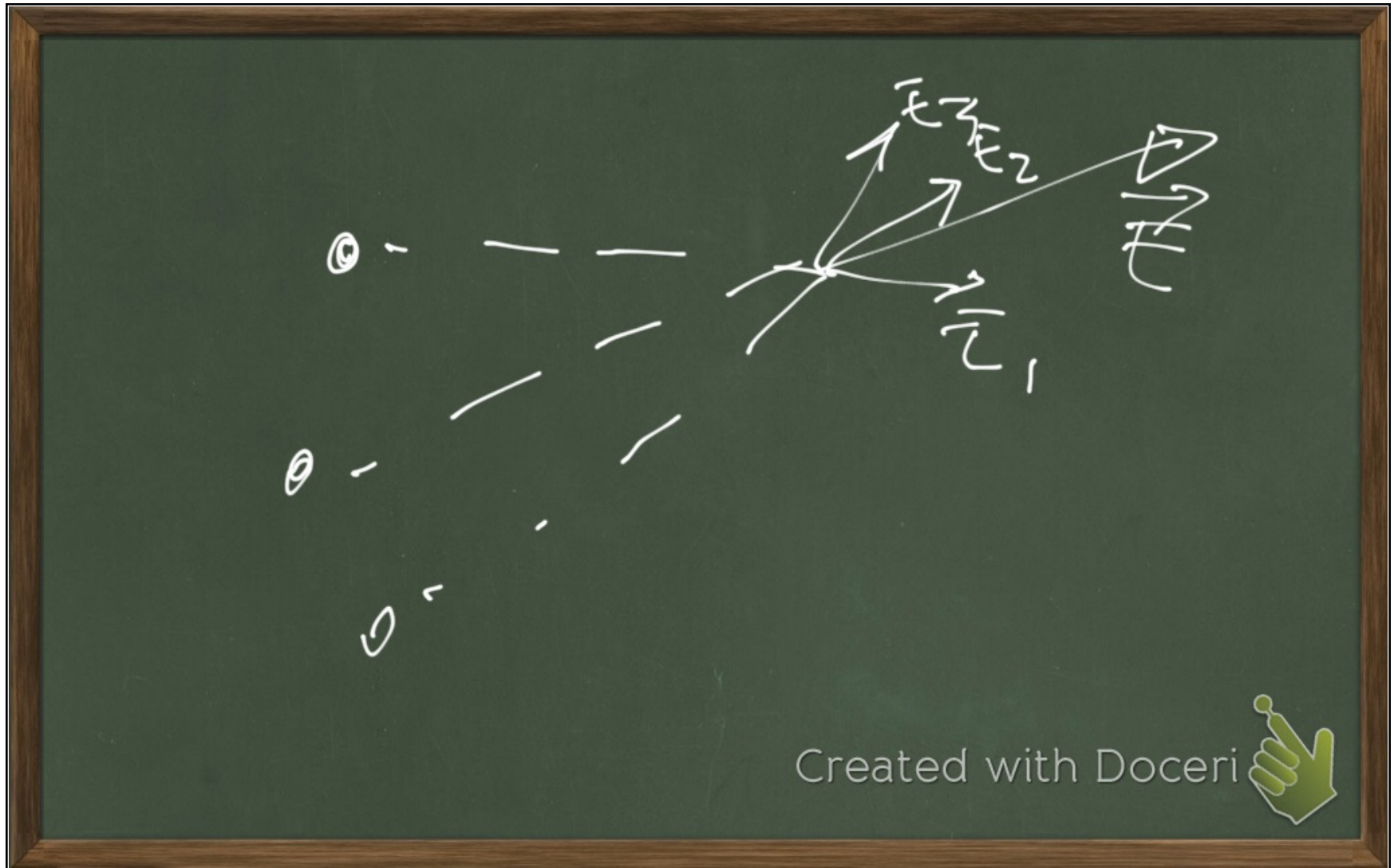
$$|\vec{r}|^2 = r_x^2 + r_y^2 + r_z^2$$

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$$\vec{E}(\vec{r}) = \int_V k_e \frac{q(\vec{r}') d\vec{r}'}{|\vec{r} - \vec{r}'|^2}$$

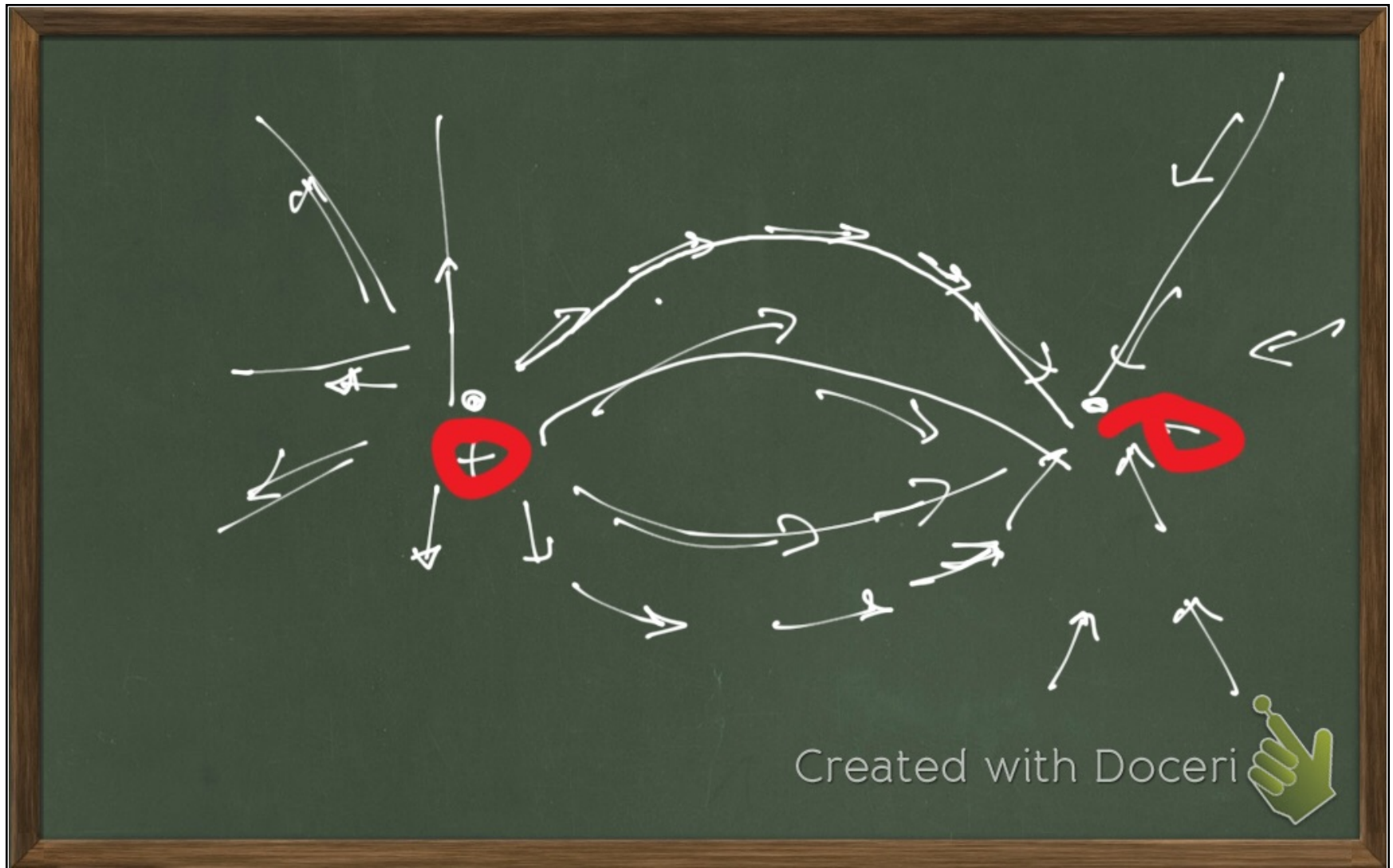
$$E(x, y, z) = k_e \iiint_V \frac{q(x', y', z')}{(x-x')^2 + (y-y')^2 + (z-z')^2} dx' dy' dz'$$

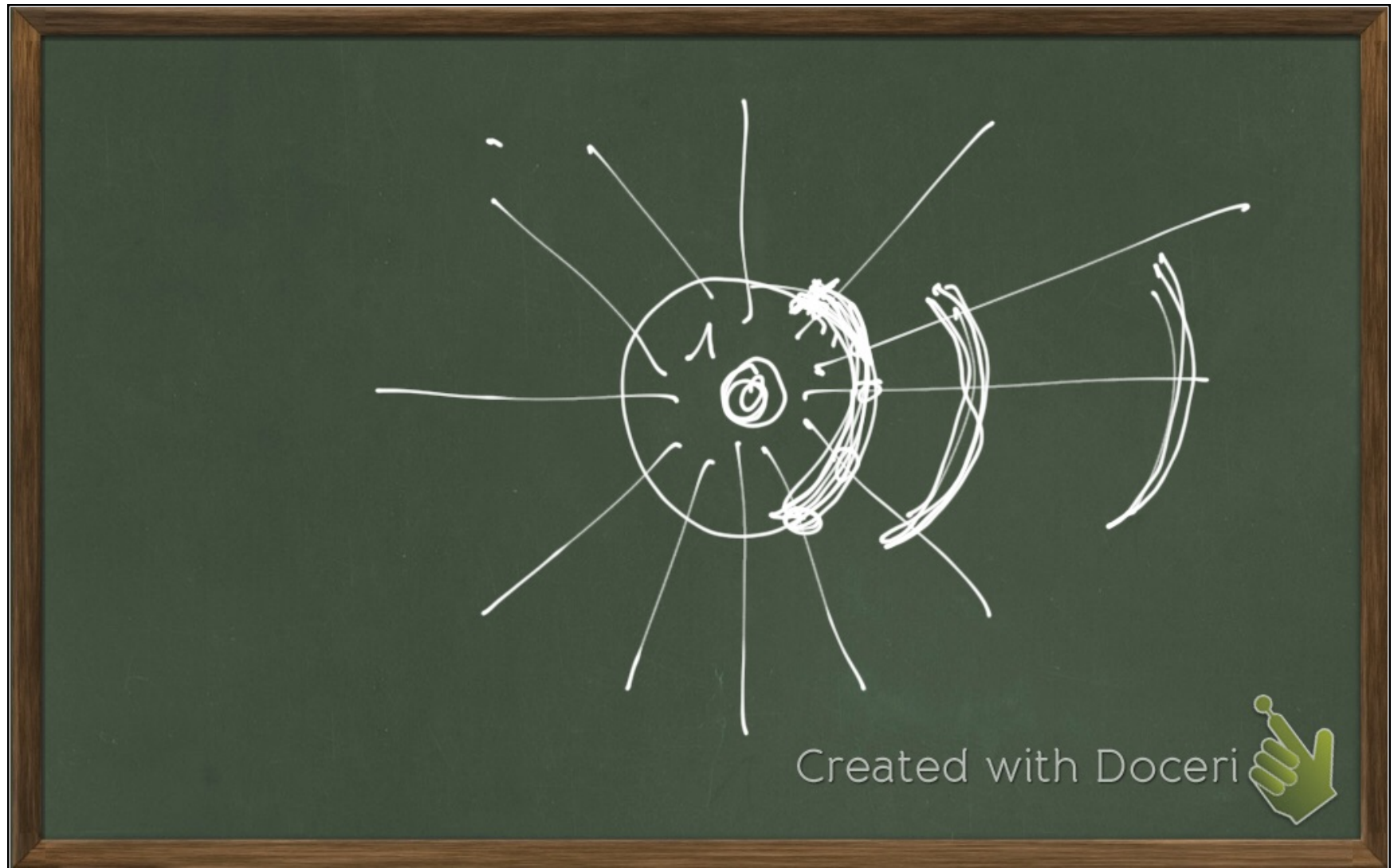
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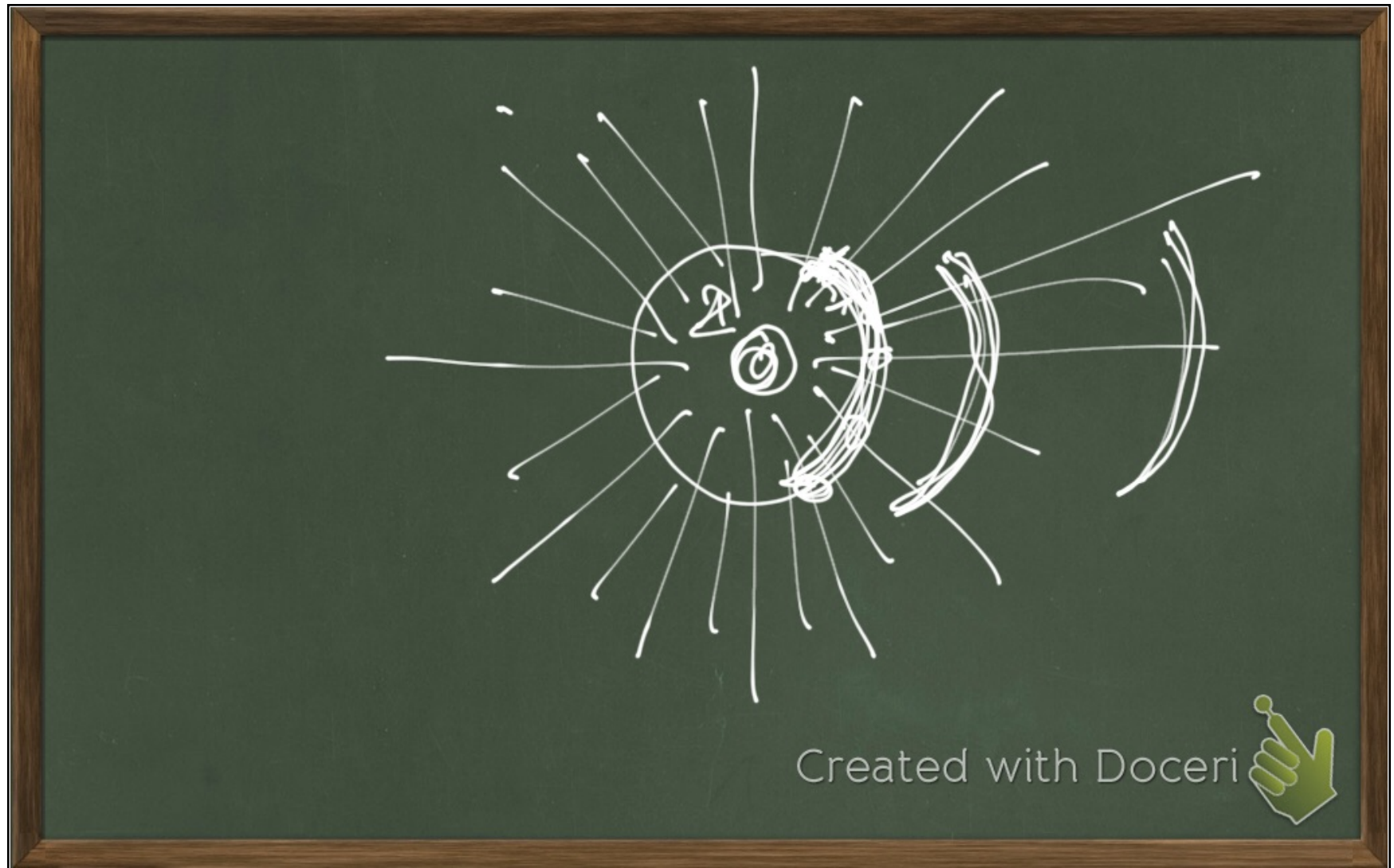


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