Songs to Solve Electrodynamics to

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Recepção Tensorial 2019

Blank Space

$$\left\{egin{aligned} oldsymbol{
abla} \cdot \mathbf{E} &= rac{
ho}{\epsilon_0} \ oldsymbol{
abla} imes \mathbf{E} &= \mathbf{0} \end{aligned}
ight.$$

$$\mathbf{E} = \frac{1}{4\pi\epsilon_0} \int \frac{\rho}{\epsilon^2} \hat{\boldsymbol{z}} \, \mathrm{d}\tau'$$

$$\begin{cases} \nabla \cdot \mathbf{B} = 0 \\ \nabla \times \mathbf{B} = \mu_0 \mathbf{J} \end{cases}$$

$$\mathbf{B} = \frac{\mu_0}{4\pi} \int \frac{\mathbf{J} \times \mathbf{z}}{\mathbf{z}^2} \, \mathrm{d}\tau'$$

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$$\mathbf{E} = \frac{1}{4\pi\epsilon_0} \int \frac{\rho}{\boldsymbol{z}^2} \hat{\boldsymbol{z}} \, \mathrm{d}\tau'$$

$$\begin{cases} \mathbf{\nabla \cdot B} = 0 \\ \mathbf{\nabla \times B} = \mu_0 \mathbf{J} \end{cases}$$



$$\begin{cases} \nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0} \\ \nabla \times \mathbf{E} = \mathbf{0} \end{cases} \qquad \begin{cases} \nabla \cdot \mathbf{B} = 0 \\ \nabla \times \mathbf{B} = \mu_0 \mathbf{J} \end{cases}$$

$$\downarrow \qquad \qquad \downarrow \qquad \qquad \downarrow$$

$$\mathbf{E} = \frac{1}{4\pi\epsilon_0} \int \frac{\rho}{\epsilon^2} \hat{\boldsymbol{z}} \, d\tau' \qquad \qquad \mathbf{B} = \frac{\mu_0}{4\pi} \int \frac{\mathbf{J} \times \boldsymbol{z}}{\epsilon^2} \, d\tau'$$

$$\mathbf{
abla} imes \mathbf{E} = \mathbf{0}$$

$$\mathbf{E} = -\nabla V$$

$$\nabla^2 V = -\frac{\rho}{\epsilon_0}$$

$$V = \frac{1}{4\pi\epsilon_0} \int \frac{\rho}{\epsilon} \, \mathrm{d}\tau'$$

$$\nabla \cdot \mathbf{B} = 0$$

$$B = \nabla \times A$$

$$\nabla^2 \mathbf{A} = -\mu_0 \mathbf{J}$$

$$\mathbf{A} = \frac{\mu_0}{4\pi} \int \frac{\mathbf{J}}{\varepsilon} \, \mathrm{d}\tau'$$

$$\mathbf{\nabla} imes \mathbf{E} = \mathbf{0}$$

$$\mathbf{E} = -\nabla V$$

$$\nabla^2 V = -\frac{\rho}{\epsilon_0}$$

$$V = \frac{1}{4\pi\epsilon_0} \int \frac{\rho}{\lambda} \, \mathrm{d}\tau'$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\downarrow$$

$$\mathbf{B} = \nabla \times \mathbf{A}$$

$$\nabla^2 \mathbf{A} = -\mu_0$$

$$\mathbf{A} = \frac{\mu_0}{4\pi} \int \frac{\mathbf{J}}{2} \, \mathrm{d}\tau'$$

$$\mathbf{
abla} imes\mathbf{E}=\mathbf{0}$$

$$\downarrow \downarrow$$

$$\nabla^2 V = -\frac{\rho}{\epsilon_0}$$

$$V = \frac{1}{4\pi\epsilon_0} \int \frac{\rho}{4\pi} \,\mathrm{d}\tau'$$



$$\mathbf{B} = \mathbf{
abla} imes \mathbf{A}$$

$$abla^2 \mathbf{A} = -\mu_0 \mathbf{J}$$



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abla^2 V &= -rac{
ho}{\epsilon_0} \ &\downarrow \ &\downarrow \ &V &= rac{1}{4\pi\epsilon_0} \int rac{
ho}{\imath} \, \mathrm{d} au' \end{aligned}$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\downarrow \qquad \qquad \downarrow$$

$$\mathbf{B} = \nabla \times \mathbf{A}$$

$$\downarrow \qquad \qquad \downarrow$$

$$\nabla^2 \mathbf{A} = -\mu_0 \mathbf{J}$$

$$\downarrow \qquad \qquad \downarrow$$

$$\mathbf{A} = \frac{\mu_0}{\mathbf{B}} \int \frac{\mathbf{J}}{\mathbf{J}} d\tau$$



$$\nabla \cdot \mathbf{B} = 0$$

$$\mathbf{B} = \mathbf{
abla} imes \mathbf{A}$$

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$$\nabla \cdot \mathbf{B} = 0$$

$$\downarrow \mathbf{B} = \nabla \times \mathbf{A}$$

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$$\downarrow \mathbf{B}$$

$$\mathbf{A} = \frac{\mu_0}{4\pi} \int \frac{\mathbf{J}}{\mathbf{z}} \, \mathrm{d}\tau'$$

$$abla imes \mathbb{E} = 0$$

$$\mathbb{E} = -\nabla V$$

$$\mathbb{V}^2 V = -\frac{\rho}{\epsilon_0}$$

$$\psi$$

$$V = \frac{1}{4\pi\epsilon_0} \int \frac{\rho}{\imath} \, \mathrm{d}\tau'$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\downarrow \qquad \qquad \downarrow$$

$$\mathbf{B} = \nabla \times \mathbf{A}$$

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$$\nabla^2 \mathbf{A} = -\mu_0 \mathbf{J}$$

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$$\mathbf{A} = \frac{\mu_0}{4\pi} \int \frac{\mathbf{J}}{z} \, \mathrm{d}\tau'$$



$$egin{array}{c} & & \downarrow \ & \mathbf{B} = \mathbf{
abla} imes \mathbf{A} \ & & \downarrow \end{array}$$

$$\mathbf{A} = \frac{\mu_0}{4\pi} \int \frac{\mathbf{J}}{\mathbf{z}} \, \mathrm{d}\tau'$$

Live While We're Young - One Direction

$$\begin{cases} \partial_{\nu} F^{\mu\nu} = \mu_0 J^{\mu} \\ \partial_{\nu} G^{\mu\nu} = 0 \end{cases}$$

Take On Me - a-ha

$$\begin{cases} \mathbf{\nabla \cdot E} = \frac{\rho}{\epsilon_0} \\ \mathbf{\nabla \cdot B} = 0 \\ \mathbf{\nabla \times E} = -\frac{\partial \mathbf{B}}{\partial t} \\ \mathbf{\nabla \times B} = \mu_0 \mathbf{J} + \mu_0 \epsilon_0 \frac{\partial \mathbf{E}}{\partial t} \end{cases}$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\downarrow$$

$$\mathbf{B} = \nabla \times \mathbf{A}$$

$$\nabla \times \left(\mathbf{E} + \frac{\partial \mathbf{A}}{\partial t} \right) = 0$$

$$\mathbf{E} + \frac{\partial \mathbf{A}}{\partial t} = -\nabla V$$

$$\mathbf{\nabla} \times \mathbf{E} = \mathbf{\nabla} \times \mathbf{B} = 0$$

$$\downarrow \qquad \qquad \qquad \nabla \times \left(\mathbf{E} + \frac{\partial}{\partial \mathbf{B}} \right)$$

$$\mathbf{B} = \mathbf{\nabla} \times \mathbf{A}$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\downarrow \qquad \qquad \qquad \nabla \times \left(\mathbb{E} + \frac{\partial \mathbf{A}}{\partial t} \right) =$$

$$\mathbf{B} = \nabla \times \mathbf{A}$$

$$\downarrow \qquad \qquad \qquad \downarrow$$

$$\mathbb{E} + \frac{\partial \mathbf{A}}{\partial t} = -\nabla V$$

$$\mathbf{
abla} imes \mathbf{E} = -rac{\partial \mathbf{E}}{\partial t}$$
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$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \cdot \mathbf{B} = 0$$

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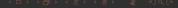
$$\mathbf{E} + \frac{\partial \mathbf{A}}{\partial t} = -\nabla V$$

Superman (It's Not Easy) - Five for Fighting

$$\begin{split} & \nabla^2 V + \frac{\partial}{\partial t} \left(\boldsymbol{\nabla} \cdot \mathbf{A} \right) = -\frac{\rho}{\epsilon_0} \\ & \left(\nabla^2 \mathbf{A} - \mu_0 \epsilon_0 \frac{\partial^2 \mathbf{A}}{\partial t^2} \right) - \boldsymbol{\nabla} \bigg(\boldsymbol{\nabla} \cdot \mathbf{A} + \mu_0 \epsilon_0 \frac{\partial V}{\partial t} \bigg) = -\mu_0 \mathbf{J} \end{split}$$

Somebody That I Used To Know - Gotye, Kimbra

$$\nabla^2 V - \frac{1}{c^2} \frac{\partial^2 V}{\partial t^2} = -\frac{\rho}{\epsilon_0}$$
$$\nabla^2 \mathbf{A} - \frac{1}{c^2} \frac{\partial^2 \mathbf{A}}{\partial t^2} = -\mu_0 \mathbf{J}$$



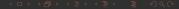
Somebody That I Used To Know - Gotye, Kimbra

$$\nabla^2 V - \frac{1}{\infty} \frac{\partial^2 V}{\partial t^2} = -\frac{\rho}{\epsilon_0}$$
$$\nabla^2 \mathbf{A} - \frac{1}{\infty} \frac{\partial^2 \mathbf{A}}{\partial t^2} = -\mu_0 \mathbf{J}$$



Somebody That I Used To Know - Gotye, Kimbra

$$abla^2 V = -rac{
ho}{\epsilon_0}$$
 $abla^2 \mathbf{A} = -\mu_0 \mathbf{J}$



Feel So Close - Calvin Harris

$$V(\mathbf{r},t) = \frac{1}{4\pi\epsilon_0} \int \frac{\rho(\mathbf{r}',t)}{\imath} \, \mathrm{d}\tau'$$

$$\mathbf{A}(\mathbf{r},t) = \frac{\mu_0}{4\pi} \int \frac{\mathbf{J}(\mathbf{r}',t)}{\mathbf{z}} \, \mathrm{d}\tau'$$

Feel So Close - Calvin Harris

$$V(\mathbf{r},t) = \frac{1}{4\pi\epsilon_0} \int \frac{\rho(\mathbf{r}',t-\frac{\mathbf{z}}{c})}{\mathbf{z}} d\tau'$$

$$\mathbf{A}(\mathbf{r},t) = \frac{\mu_0}{4\pi} \int \frac{\mathbf{J}(\mathbf{r}',t-\frac{\mathbf{z}}{c})}{\mathbf{z}} d\tau'$$

Best Day Of My Life - American Authors

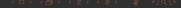
$$\mathbf{E}(\mathbf{r},t) = -\nabla V - \frac{\partial \mathbf{A}}{\partial t}$$

$$\mathbf{B}(\mathbf{r},t) = \mathbf{\nabla} \times \mathbf{A}$$

Best Day Of My Life - American Authors

$$\mathbf{E}(\mathbf{r},t) = \frac{1}{4\pi\epsilon_0} \int \frac{\hat{\mathbf{z}}}{\mathbf{z}^2} \left[\rho \right] + \frac{\hat{\mathbf{z}}}{c \, \mathbf{z}} \left[\frac{\partial \rho}{\partial t} \right] - \frac{1}{c^2 \, \mathbf{z}} \left[\frac{\partial \mathbf{J}}{\partial t} \right] d\tau'$$

$$\mathbf{B}(\mathbf{r},t) = \frac{\mu_0}{4\pi} \int \left[\frac{1}{\mathbf{z}^2} \left[\mathbf{J} \right] + \frac{1}{c \, \mathbf{z}} \left[\frac{\partial \mathbf{J}}{\partial t} \right] \right] \times \hat{\mathbf{z}} d\tau'$$



A Cruel Angel's Thesis Yoko Takahashi

Deja Vu (Initial D) - Tsuko G

$$\begin{cases} \mathbf{\nabla \cdot D} = \rho \\ \mathbf{\nabla \cdot B} = 0 \\ \mathbf{\nabla \times E} = -\frac{\partial \mathbf{B}}{\partial t} \\ \mathbf{\nabla \times H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t} \end{cases}$$

$$\begin{cases} \mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P} \\ \mathbf{H} = \frac{1}{u_0} \mathbf{B} - \mathbf{M} \end{cases}$$

Deja Vu (Initial D) - Tsuko G

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$$egin{cases} \mathbf{D} = \epsilon \mathbf{E} \ \mathbf{H} = rac{1}{\mu} \mathbf{B} \end{cases}$$

Don't Go Breaking My Heart - Backstreet Boys

$$\begin{cases}
\nabla^{2}\mathbf{E} - \mu\epsilon \frac{\partial^{2}\mathbf{E}}{\partial t^{2}} = \frac{1}{\epsilon} \nabla \rho + \rho \nabla \frac{1}{\epsilon} - \nabla \left(\frac{\mathbf{E} \cdot \nabla \epsilon}{\epsilon} \right) \\
+ \mu \frac{\partial \mathbf{J}}{\partial t} + \mu \nabla \left(\frac{1}{\mu} \right) \times (\nabla \times \mathbf{E}) \\
\nabla^{2}\mathbf{B} - \mu\epsilon \frac{\partial^{2}\mathbf{B}}{\partial t^{2}} = \mathbf{J} \times \nabla \mu - \mu \nabla \times \mathbf{J} - \nabla \times \left[\mu \mathbf{B} \times \nabla \left(\frac{1}{\mu} \right) \right] \\
+ \left[\frac{\nabla \times \mathbf{B}}{\mu \epsilon} - \frac{\mathbf{J}}{\epsilon} - \frac{\mathbf{B} \times \nabla \left(\frac{1}{\mu} \right)}{\epsilon} \right] \times \left[\mu \nabla \epsilon + \epsilon \nabla \mu \right]
\end{cases}$$

I Want It That Way - Backstreet Boys

Hipóteses sobre o meio:

- 1 linear;
 - 2 dielétrico ($\mu = \mu_0$)
 - $oldsymbol{\mathsf{B}}$ homogêneo $(
 abla\epsilon=\mathbf{0})$

I Want It That Way - Backstreet Boys

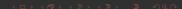
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I Want It That Way - Backstreet Boys

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I Want It That Way - Backstreet Boys

Hipóteses sobre o meio:

- linear;
- **2** dielétrico $(\mu = \mu_0)$;
- f 3 homogêneo ($f
 abla \epsilon = 0$).

Happier - Marshmello, Bastille

$$\begin{cases}
\nabla^{2}\mathbf{E} - \mu_{0}\epsilon \frac{\partial^{2}\mathbf{E}}{\partial t^{2}} = \frac{1}{\epsilon}\nabla\rho + \rho\nabla\frac{\mathbf{I}}{\epsilon} - \nabla\left(\frac{\mathbf{E}\cdot\nabla\epsilon}{\epsilon}\right)^{\mathbf{0}} \\
+ \mu_{0}\frac{\partial\mathbf{J}}{\partial t} + \mu_{0}\nabla\left(\frac{\mathbf{J}}{\mu_{0}}\right) \times (\nabla\times\mathbf{E})
\end{cases}$$

$$\nabla^{2}\mathbf{B} - \mu_{0}\epsilon \frac{\partial^{2}\mathbf{B}}{\partial t^{2}} = \mathbf{J} \times \nabla\mu_{0} - \mu_{0}\nabla\times\mathbf{J} - \nabla\times\left[\mu_{0}\mathbf{B} \times \nabla\left(\frac{\mathbf{J}}{\mu_{0}}\right)\right]^{\mathbf{0}}$$

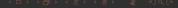
$$+ \left[\frac{\nabla\times\mathbf{B}}{\mu_{0}\epsilon} - \frac{\mathbf{J}}{\epsilon} - \frac{\mathbf{B}\times\nabla\left(\frac{\mathbf{J}}{\mu_{0}}\right)}{\epsilon}\right]^{\mathbf{0}} \times \left[\mu_{0}\nabla\epsilon + \epsilon\nabla\mu_{0}\right]^{\mathbf{0}}$$

Happier - Marshmello, Bastille

$$\begin{cases} \nabla^2 \mathbf{E} - \mu_0 \epsilon \frac{\partial^2 \mathbf{E}}{\partial t^2} = \frac{1}{\epsilon} \nabla \rho + \mu_0 \frac{\partial \mathbf{J}}{\partial t} \\ \nabla^2 \mathbf{B} - \mu_0 \epsilon \frac{\partial^2 \mathbf{B}}{\partial t^2} = -\mu_0 \nabla \times \mathbf{J} \end{cases}$$

Wouldn't It Be Nice - The Beach Boys

$$\mathbf{E}(\mathbf{r},t)=rac{1}{4\pi\epsilon_0}\int_{\mathcal{V}_0}$$
 solução no vácuo $\mathrm{d} au'+rac{1}{4\pi\epsilon_1}\int_{\mathcal{V}_1}$ solução no meio $\mathrm{d} au'$



- reflexão e refração:
- mudanças de velocidade;
- presença de um dielétrico afeta a solução
- 4 et cetera.

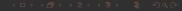
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- reflexão e refração;
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- 💶 reflexão e refração;
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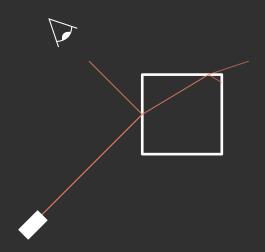
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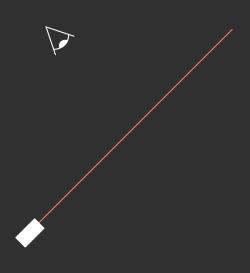
In The End Linkin Park

Everybody (Backstreet's Back) Backstreet Boys

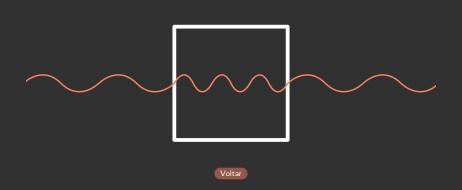
You Found Me - The Fray



Don't Matter - Akon



Stop - Spice Girls



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