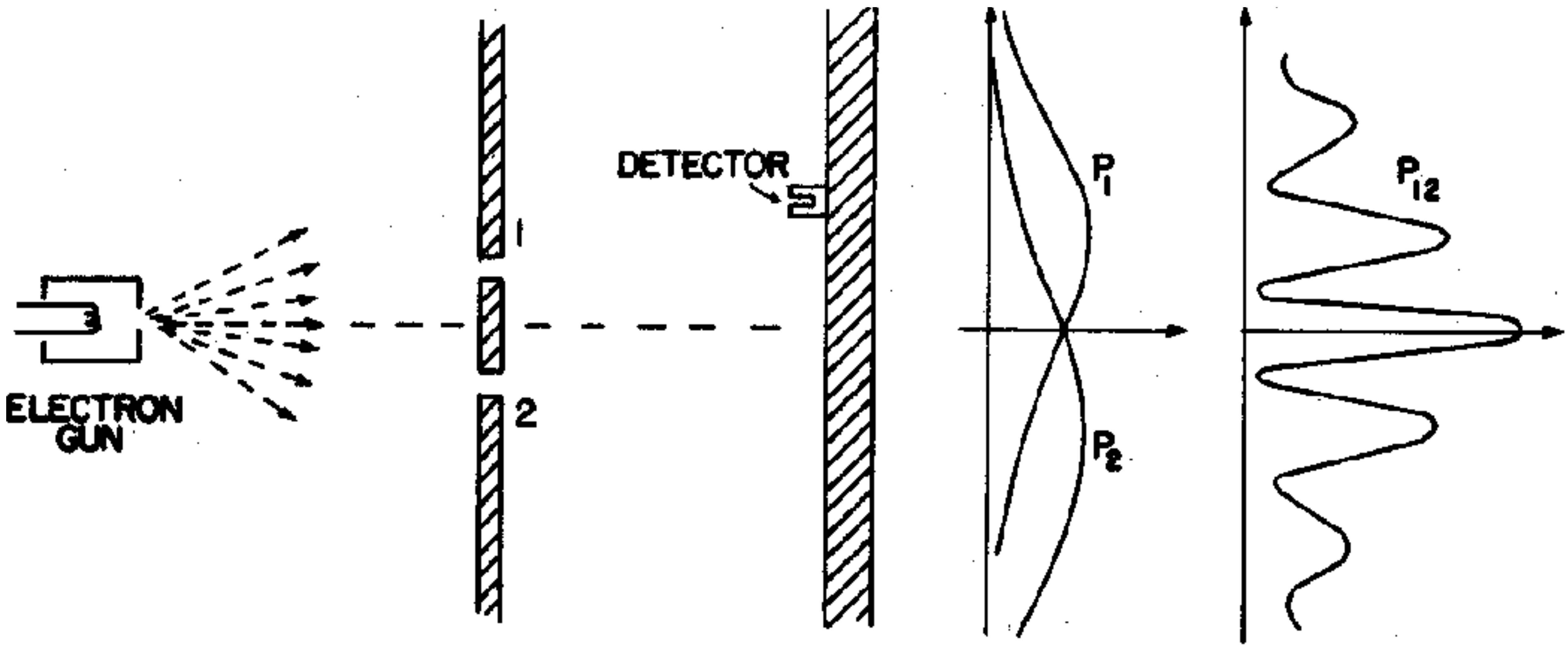
DETECTOR
1
2
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P_1
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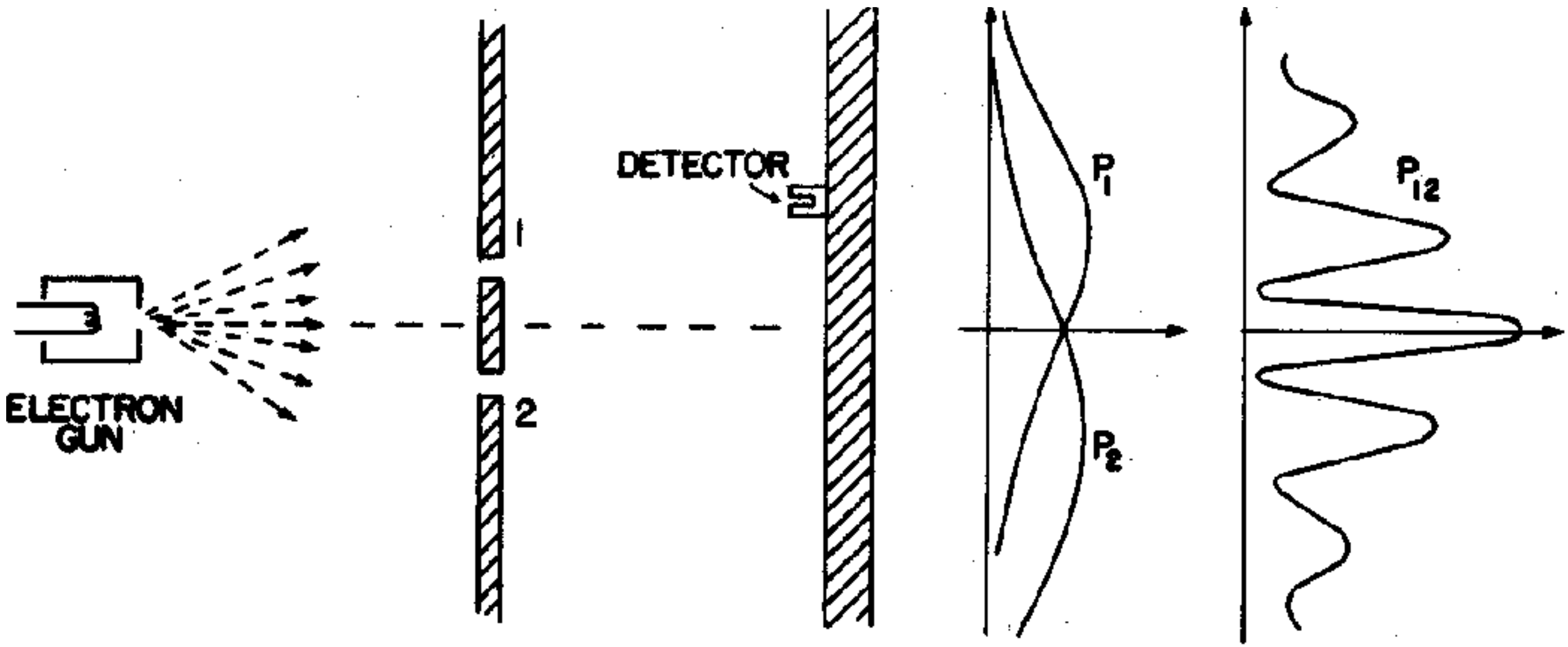
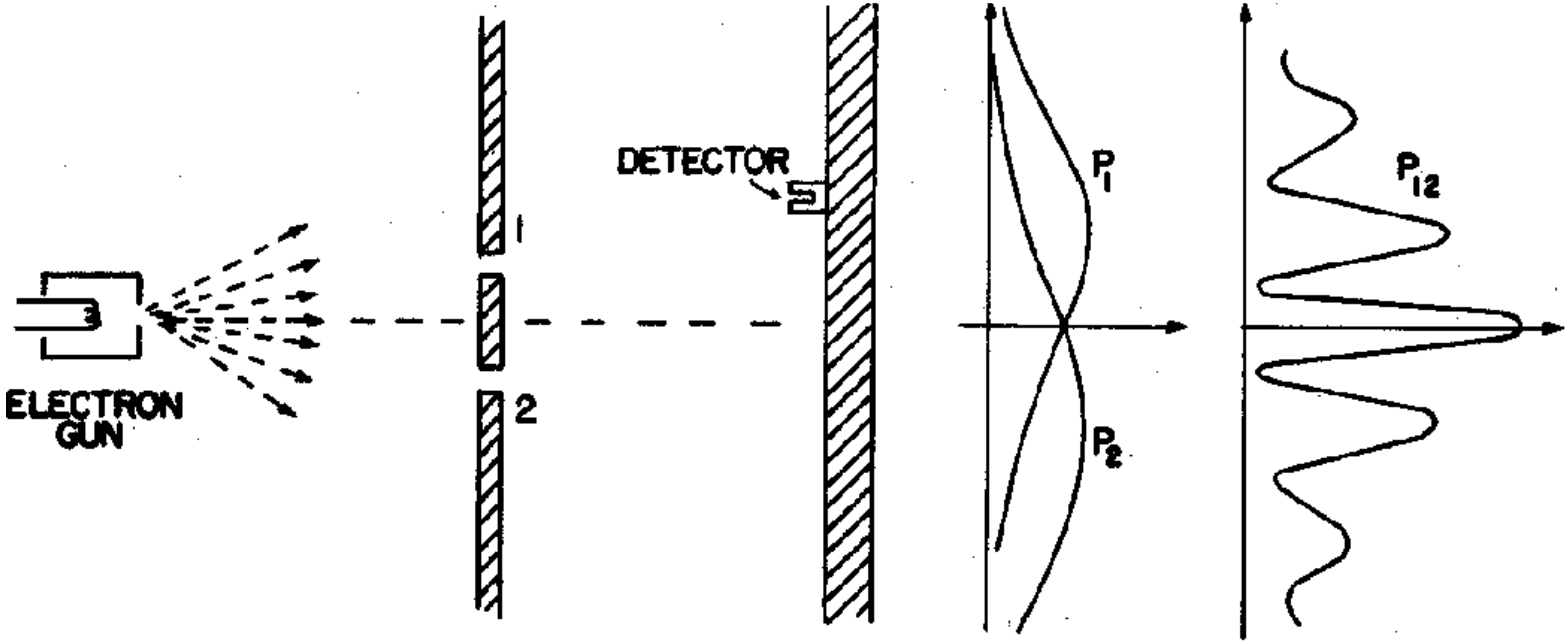


One might still like to ask: “How does it work? What is the machinery behind the law?” No one has found any machinery behind the law. No one can “explain” any more than we have just “explained.” No one will give you any deeper representation of the situation. We have no ideas about a more basic mechanism from which these results can be deduced.



One might still like to ask: “How d[illegible] What is the machinery behind the law?” N[illegible]achinery behind the law. No one can “[illegible]han we have just “explained.” No one wi[illegible]eper representation of the situation. We have no ide[illegible]ut a more basic mechanism from which these results can be deduced.

Challenge accepted!

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Quantum principle of relativity

Andrzej Dragan[1,2] and Artur Ekert[2,3]

1 Institute of Theoretical Physics, University of Warsaw
2 Centre for Quantum Technologies, National University of Singapore
3 Mathematical Institute, University of Oxford

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Quantum principle of relativity

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[1] Institute of Theoretical Physics, University of Warsaw
[2] Centre for Quantum Technologies, National University of Singapore
[3] Mathematical Institute, University of Oxford

Pole among candidates for Nobel Prize in physics

SCIENCE

(PAP) JCH OCTOBER 06, 2019

Artur Ekert is being considered by the Nobel committee as a result of his work on information technologies, including quantum cryptography.
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科学家普遍认为，量子力学的描述是更基本
。华沙大学(FUW)物理系Andrzej Dragan博
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，其研究成果发表在《新物理学》期刊上
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理，可以在狭义相对论的框架内加以解释
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kwantowej egz
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ventos acima da ve
Quântica e Relatividade
Com informações da Universidade de Varsóvia - 03/0
Albert Einstein @AlbertEinstein · Apr 6
Does relativity lie at the source of quantum exoticism?
Does relativity lie at the source of quantum exoticism?
Since its beginnings, quantum mechanics hasn't ceased to amaze u
with its peculiarity, so difficult to understand. Why does one partic
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La relativité et la
compatibles
C'est l'hypothèse révolution
mars 2020, réf
Yazıyı beğendiyseniz lütfen Paylaşın
Görelilik kuantum egzotizminin kaynağında mı
Olasılıkların evrimi ve kuantum mekaniğinin "imkansız" fenomenleri, Va
üniversitelerden fizikçilerin önerdiği gibi, özel görelilik teorisinden
Başlangıcından beri, kuantum mekaniği tuhaflığıyla bizi
parçacık neden aynı anda iki yarıktan geçiyor gibi
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A rebel physicist has an elegant
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Crash course on special relativity

Crash course on special relativity

$$
\begin{aligned}
x' &= A(V)\,x + B(V)\,t, \\
x &= A(-V)\,x' + B(-V)\,t'
\end{aligned}
$$

Crash course on special relativity

$$x' = A(V)\,x + B(V)\,t,$$

$$x = A(-V)\,x' + B(-V)\,t'$$

$$x' = 0$$

Crash course on special relativity

$$x' = A(V)\,x + B(V)\,t,$$

$$x = A(-V)\,x' + B(-V)\,t'$$

$$x' = 0 \qquad x = Vt$$

Crash course on special relativity

$$x' = A(V)\,x + B(V)\,t,$$

$$x = A(-V)\,x' + B(-V)\,t'$$

$$x' = 0 \qquad x = Vt \qquad \frac{B(V)}{A(V)} = -V$$

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x' &= A(V)\,x + B(V)\,t, \\
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$$x' = 0 \qquad x = Vt \qquad \frac{B(V)}{A(V)} = -V$$

$$
\begin{cases}
x' = A(V)(x - Vt), \\
t' = A(V)\left(t - \dfrac{A(V)A(-V) - 1}{V^2 A(V)A(-V)} Vx\right).
\end{cases}
$$

Crash course on special relativity

$$x' = A(V)\,x + B(V)\,t,$$

$$x = A(-V)\,x' + B(-V)\,t'$$

$$x' = 0 \qquad x = Vt \qquad \frac{B(V)}{A(V)} = -V$$

$$\begin{cases} x' = A(V)(x - Vt), \\ t' = A(V)\left(t - \dfrac{A(V)A(-V) - 1}{V^2 A(V) A(-V)} V x\right). \end{cases}$$

symmetric
or antisymmetric

Crash course on special relativity

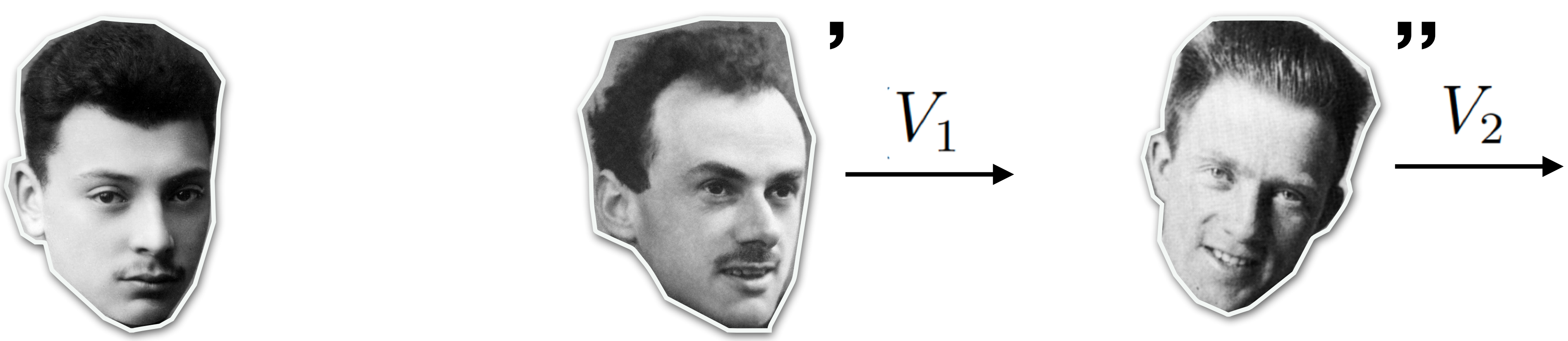
$$x' = A(V)\,x + B(V)\,t,$$

$$x = A(-V)\,x' + B(-V)\,t'$$

$$x' = 0 \qquad x = Vt \qquad \frac{B(V)}{A(V)} = -V$$

symmetric
or antisymmetric

$$\begin{cases} x' = A(V)(x - Vt), \\ t' = A(V)\left(t - \dfrac{A(V)A(-V) - 1}{V^2 A(V)A(-V)} V x\right). \end{cases}$$



$$
\begin{aligned}
x'' &= A(V_1)A(V_2)x\left(1 + V_1V_2\frac{A(V_1)A(-V_1) - 1}{V_1^2A(V_1)A(-V_1)}\right) \\
&\quad -A(V_1)A(V_2)(V_1 + V_2)t.
\end{aligned}
$$

$$
\begin{aligned}
x'' &= A(V_1)A(V_2)x\left(1 + V_1 V_2 \frac{A(V_1)A(-V_1) - 1}{V_1^2 A(V_1)A(-V_1)}\right) \\
&\quad - A(V_1)A(V_2)(V_1 + V_2)t.
\end{aligned}
$$

$$x' = A(V)(x - Vt)$$

$$
\begin{aligned}
x'' &= A(V_1)A(V_2)x\left(1 + V_1 V_2 \frac{A(V_1)A(-V_1) - 1}{V_1^2 A(V_1)A(-V_1)}\right) \\
&\quad - A(V_1)A(V_2)(V_1 + V_2)t.
\end{aligned}
$$

$$
x' = A(V)(x - Vt)
$$

$$
V = \frac{V_1 + V_2}{1 + V_1 V_2 \frac{A(V_1)A(-V_1)-1}{V_1^2 A(V_1)A(-V_1)}}.
$$

$$x'' = A(V_1)A(V_2)x\left(1 + V_1V_2\frac{A(V_1)A(-V_1) - 1}{V_1^2A(V_1)A(-V_1)}\right)$$

$$-A(V_1)A(V_2)(V_1 + V_2)t.$$

$$x' = A(V)(x - Vt)$$

$$V = \frac{V_1 + V_2}{1 + V_1V_2\frac{A(V_1)A(-V_1)-1}{V_1^2A(V_1)A(-V_1)}}. \qquad -V = \frac{-V_2 - V_1}{1 + V_2V_1\frac{A(-V_2)A(V_2)-1}{V_2^2A(-V_2)A(V_2)}}.$$

$$x'' = A(V_1)A(V_2)x\left(1 + V_1V_2\frac{A(V_1)A(-V_1)-1}{V_1^2A(V_1)A(-V_1)}\right)$$

$$-A(V_1)A(V_2)(V_1+V_2)t.$$

$$x' = A(V)(x - Vt)$$

$$V = \frac{V_1+V_2}{1+V_1V_2\frac{A(V_1)A(-V_1)-1}{V_1^2A(V_1)A(-V_1)}}. \qquad -V = \frac{-V_2-V_1}{1+V_2V_1\frac{A(-V_2)A(V_2)-1}{V_2^2A(-V_2)A(V_2)}}.$$

$$\frac{A(V_1)A(-V_1)-1}{V_1^2A(V_1)A(-V_1)} = \frac{A(V_2)A(-V_2)-1}{V_2^2A(V_2)A(-V_2)}$$

$$x'' = A(V_1)A(V_2)x\left(1 + V_1V_2\frac{A(V_1)A(-V_1)-1}{V_1^2A(V_1)A(-V_1)}\right)$$
$$-A(V_1)A(V_2)(V_1+V_2)t.$$

$$x' = A(V)(x - Vt)$$

$$V = \frac{V_1+V_2}{1+V_1V_2\frac{A(V_1)A(-V_1)-1}{V_1^2A(V_1)A(-V_1)}}. \qquad -V = \frac{-V_2-V_1}{1+V_2V_1\frac{A(-V_2)A(V_2)-1}{V_2^2A(-V_2)A(V_2)}}.$$

$$\frac{A(V_1)A(-V_1)-1}{V_1^2A(V_1)A(-V_1)} = \frac{A(V_2)A(-V_2)-1}{V_2^2A(V_2)A(-V_2)}$$

$$\frac{A(V)A(-V)-1}{V^2A(V)A(-V)} = K.$$

$$A(-V) = A(V)$$

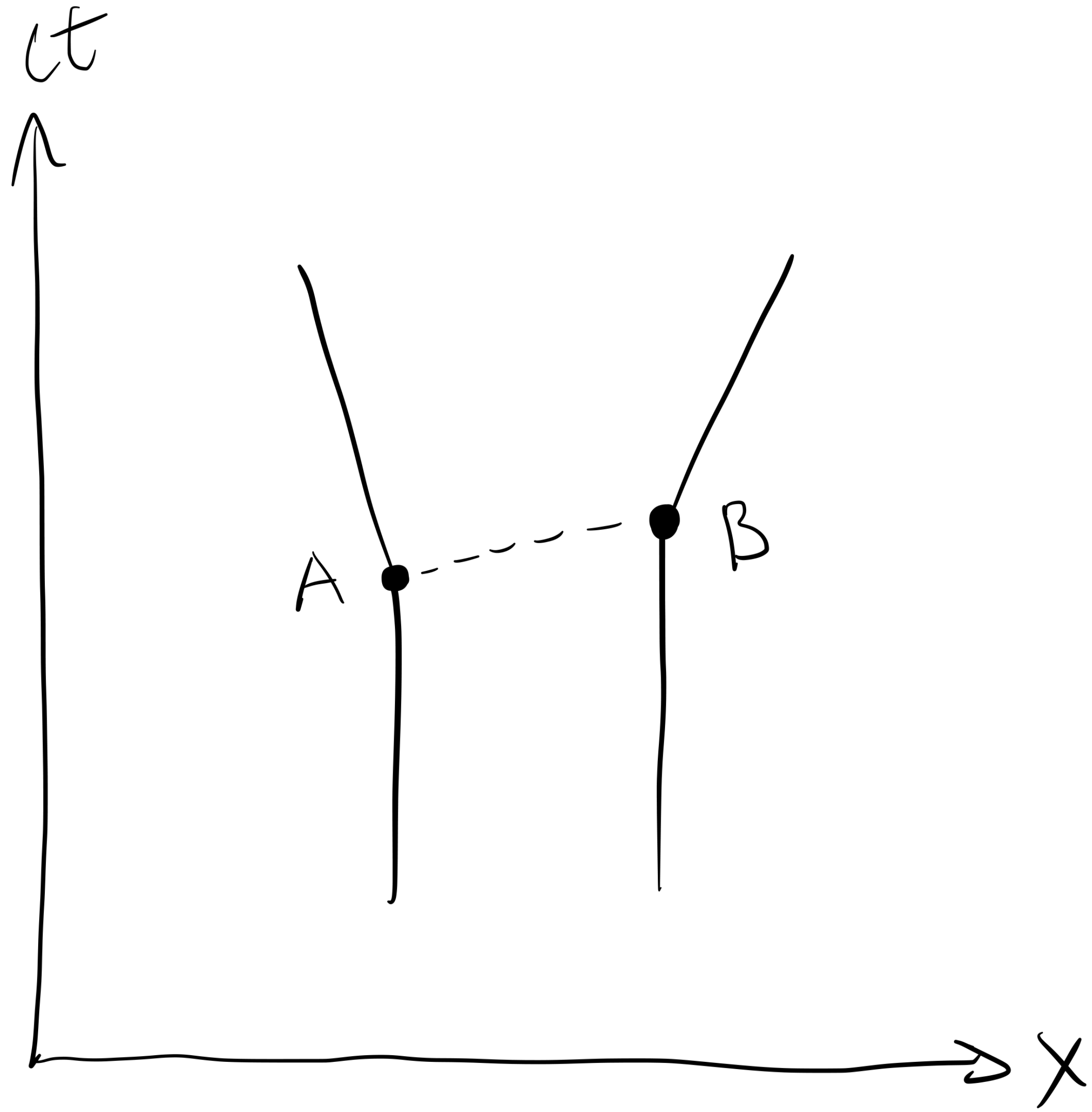
$$A(-V) = A(V) \longrightarrow \begin{cases} x' = \dfrac{x - Vt}{\sqrt{1 - V^2/c^2}}, \\ t' = \dfrac{t - Vx/c^2}{\sqrt{1 - V^2/c^2}}. \end{cases}$$

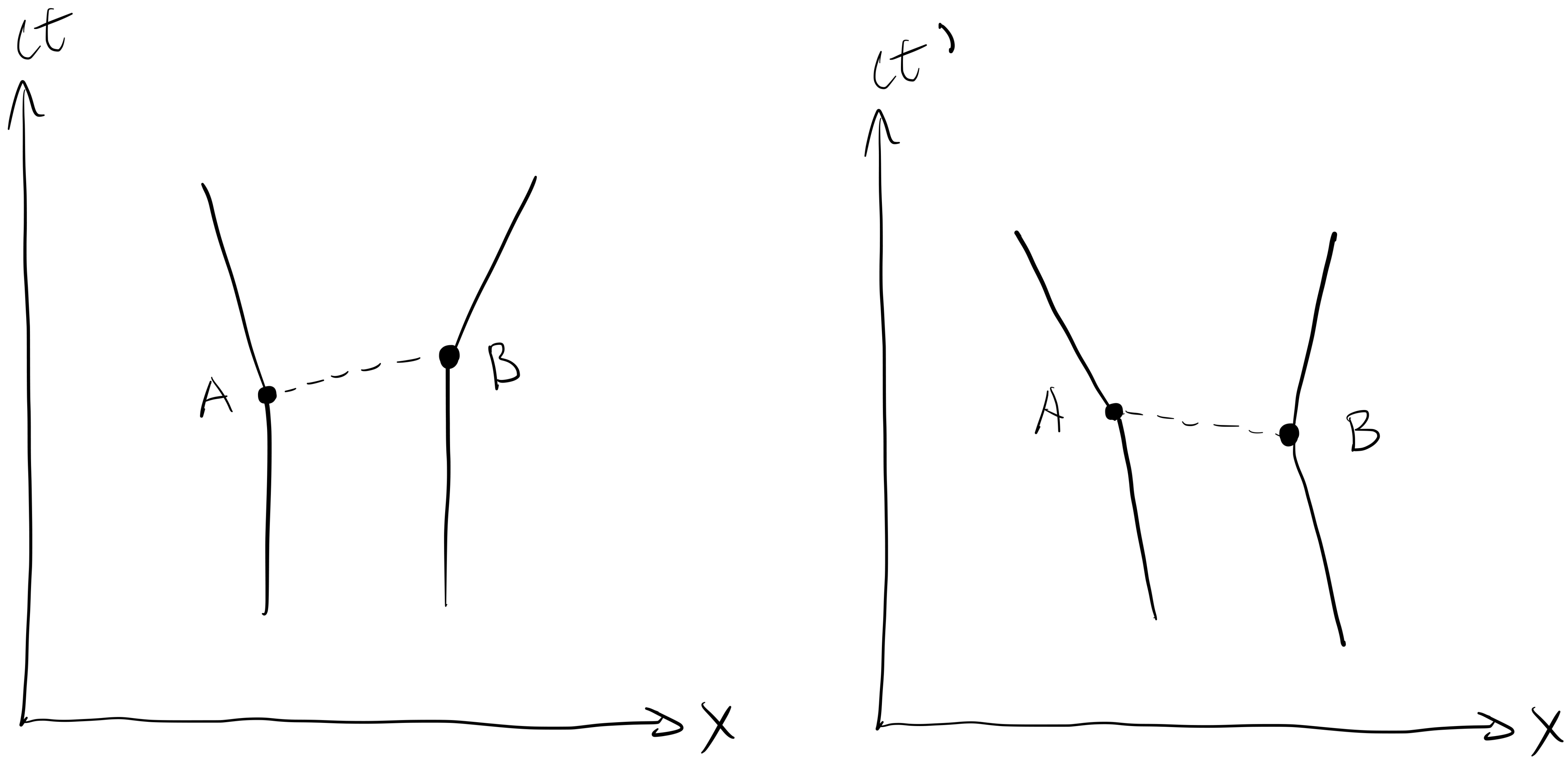
$$A(-V) = A(V) \longrightarrow \begin{cases} x' = \dfrac{x - Vt}{\sqrt{1 - V^2/c^2}}, \\ t' = \dfrac{t - Vx/c^2}{\sqrt{1 - V^2/c^2}}. \end{cases}$$

$$A(-V) = -A(V)$$

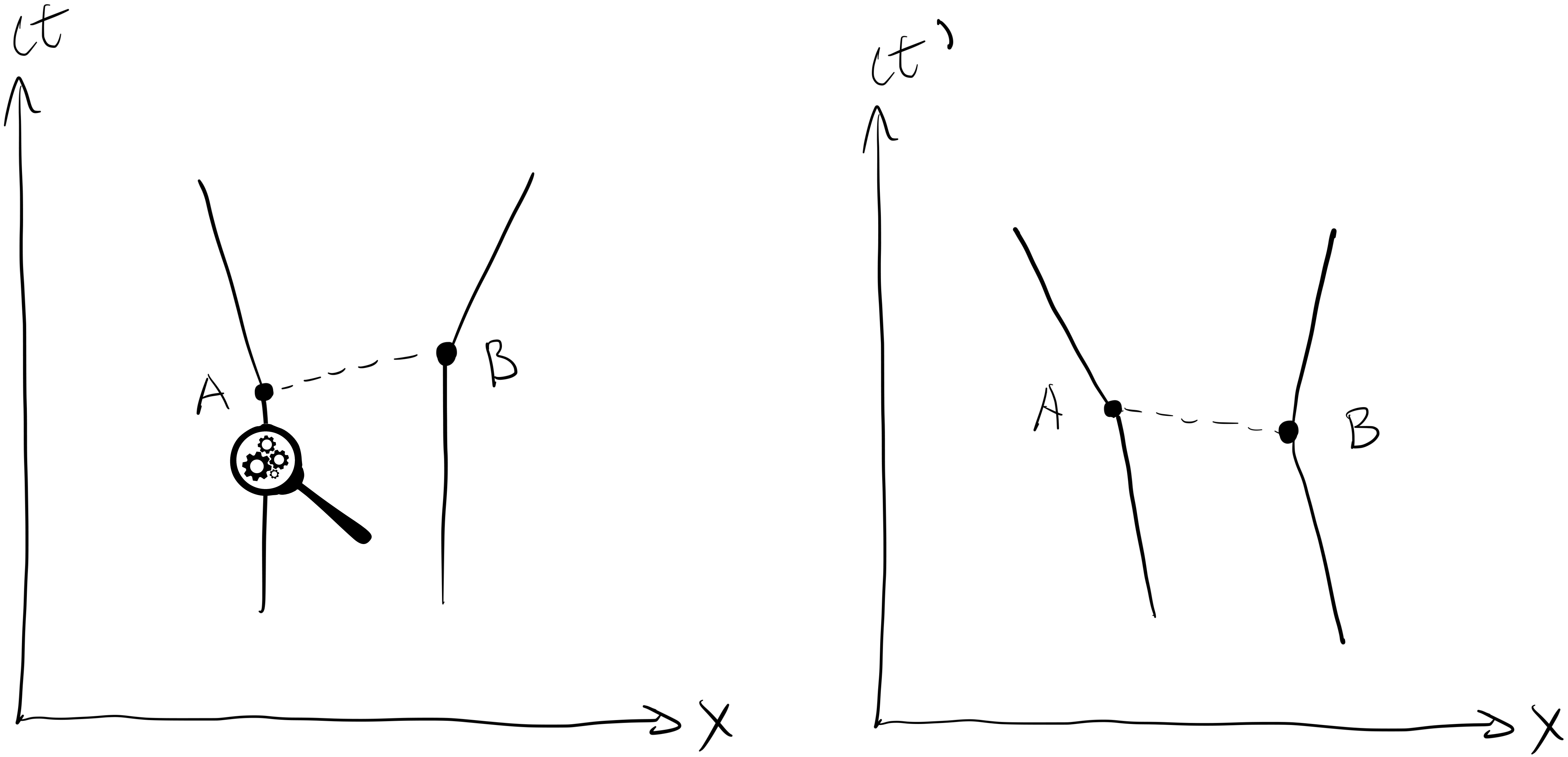
$$A(-V) = A(V) \longrightarrow \begin{cases} x' = \dfrac{x - Vt}{\sqrt{1 - V^2/c^2}}, \\ t' = \dfrac{t - Vx/c^2}{\sqrt{1 - V^2/c^2}}. \end{cases}$$

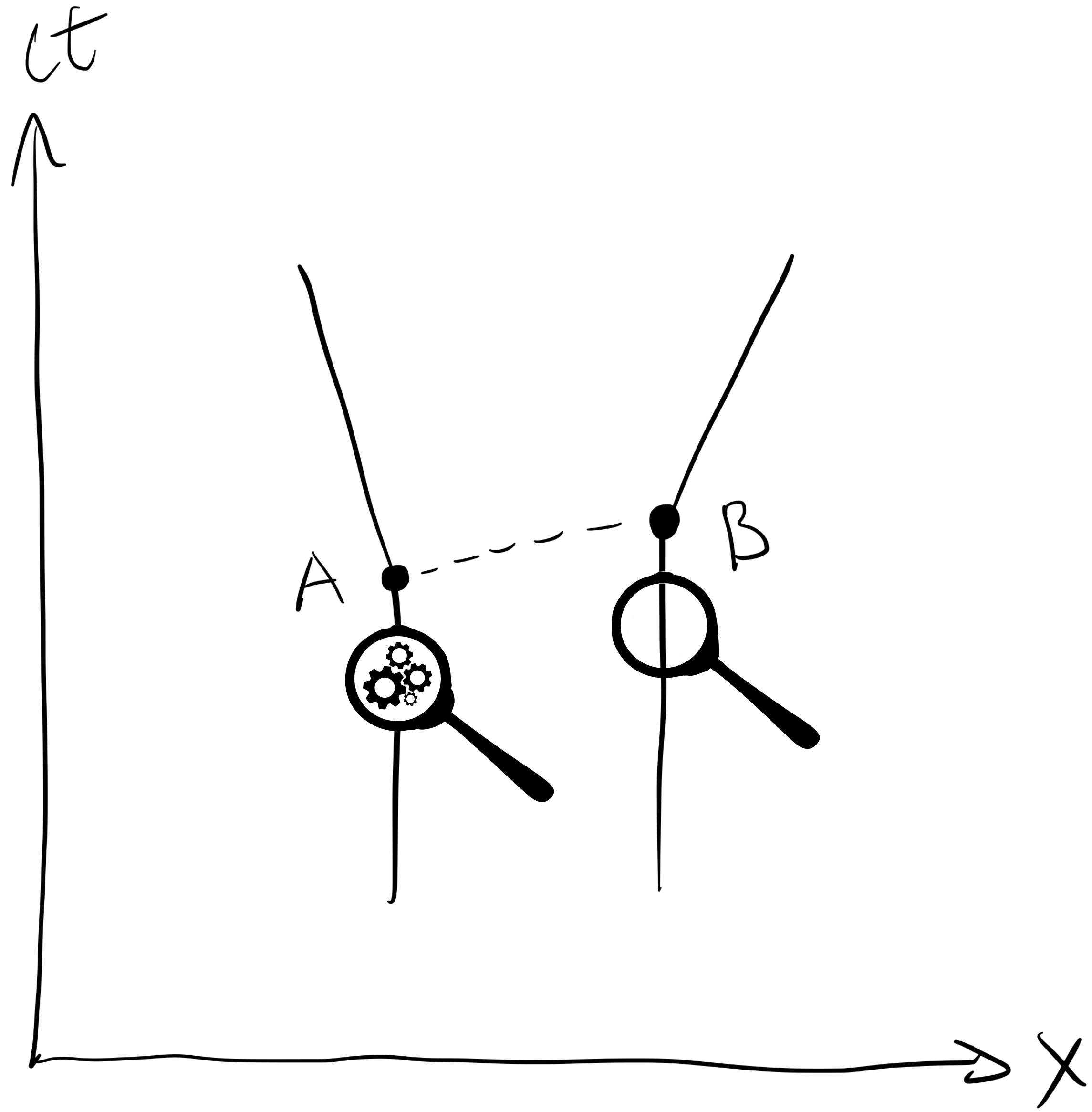
$$A(-V) = -A(V) \longrightarrow \begin{cases} x' = \pm\dfrac{V}{|V|}\dfrac{x - Vt}{\sqrt{V^2/c^2 - 1}}, \\ t' = \pm\dfrac{V}{|V|}\dfrac{t - Vx/c^2}{\sqrt{V^2/c^2 - 1}}. \end{cases}$$

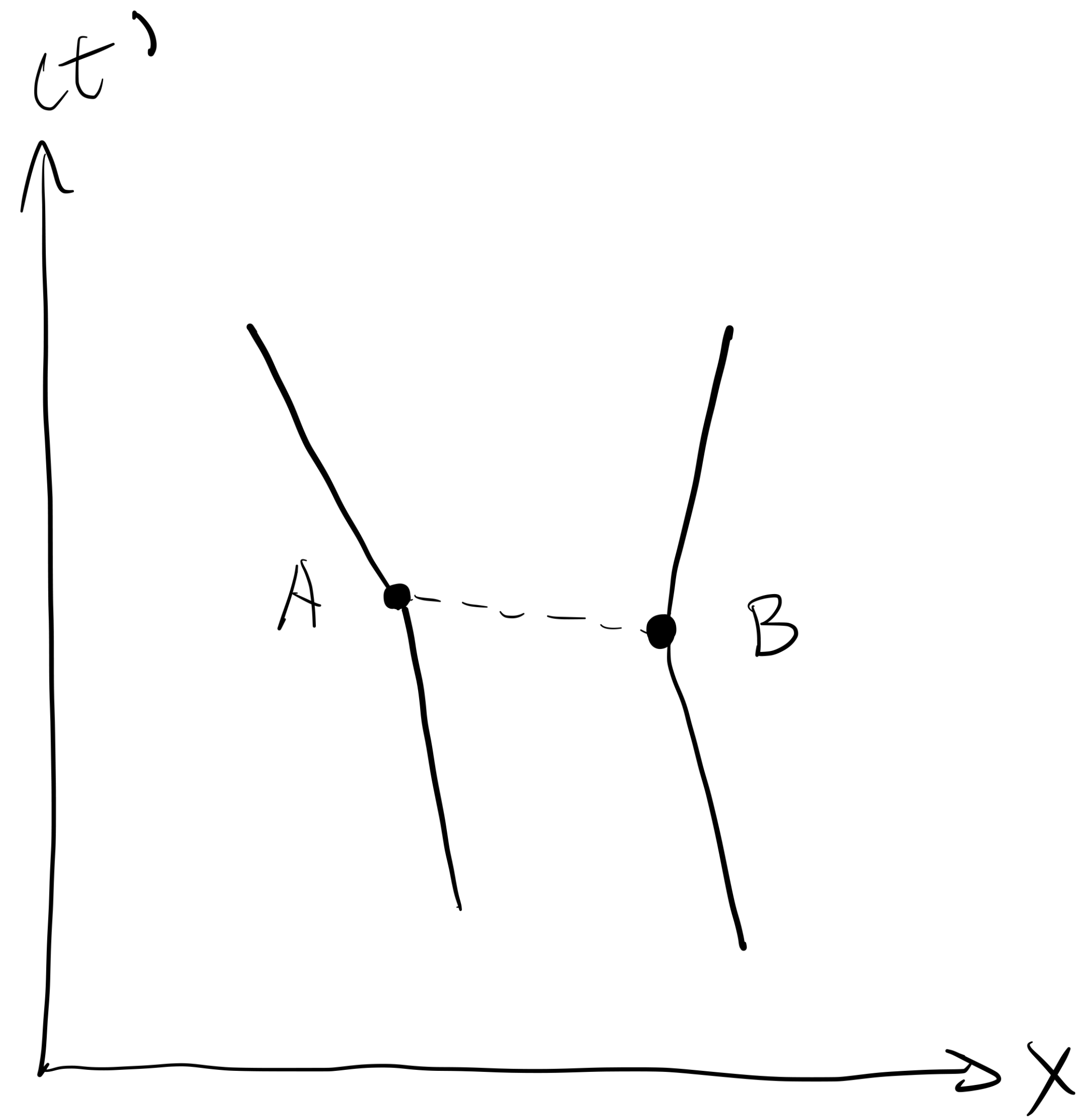

ct
A
B
x

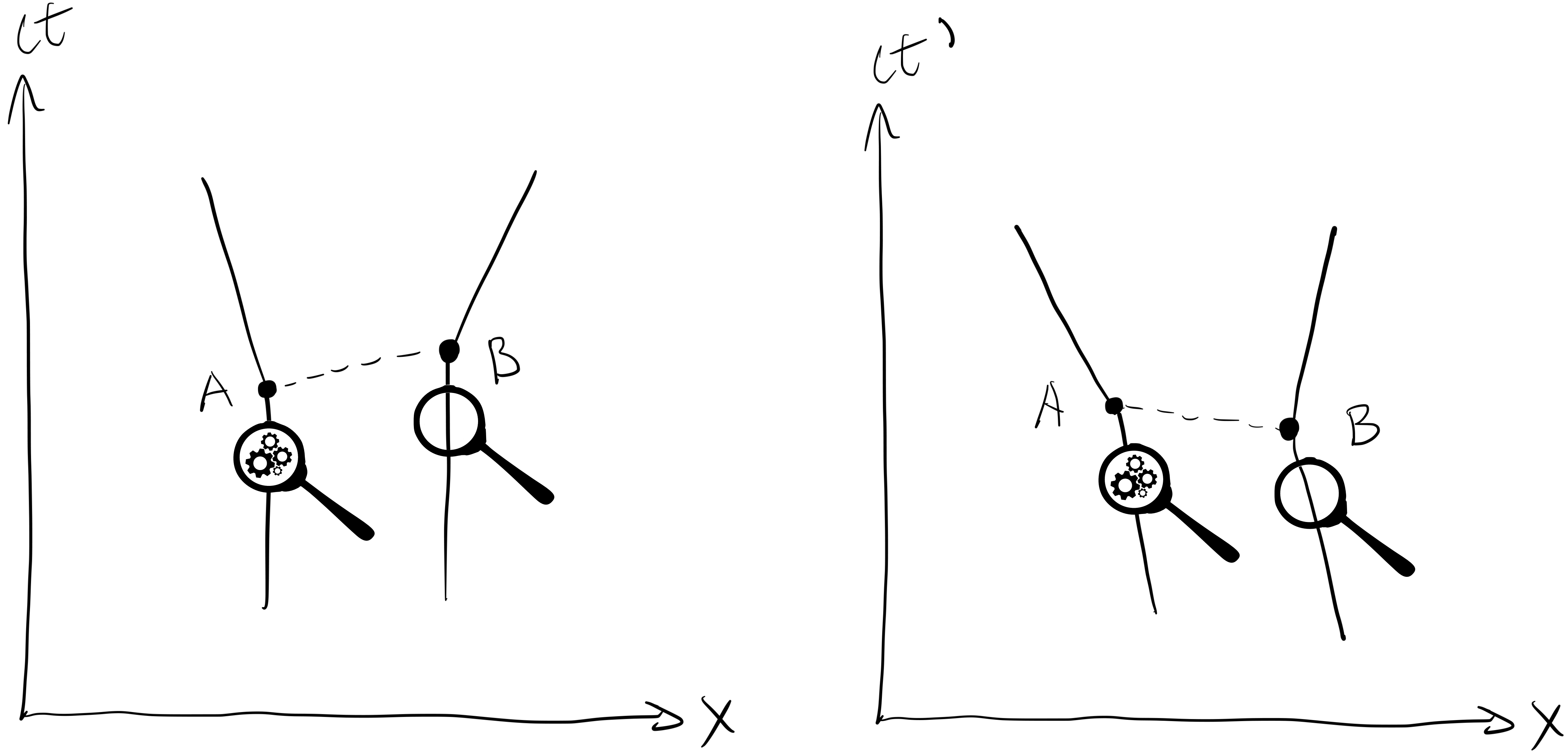


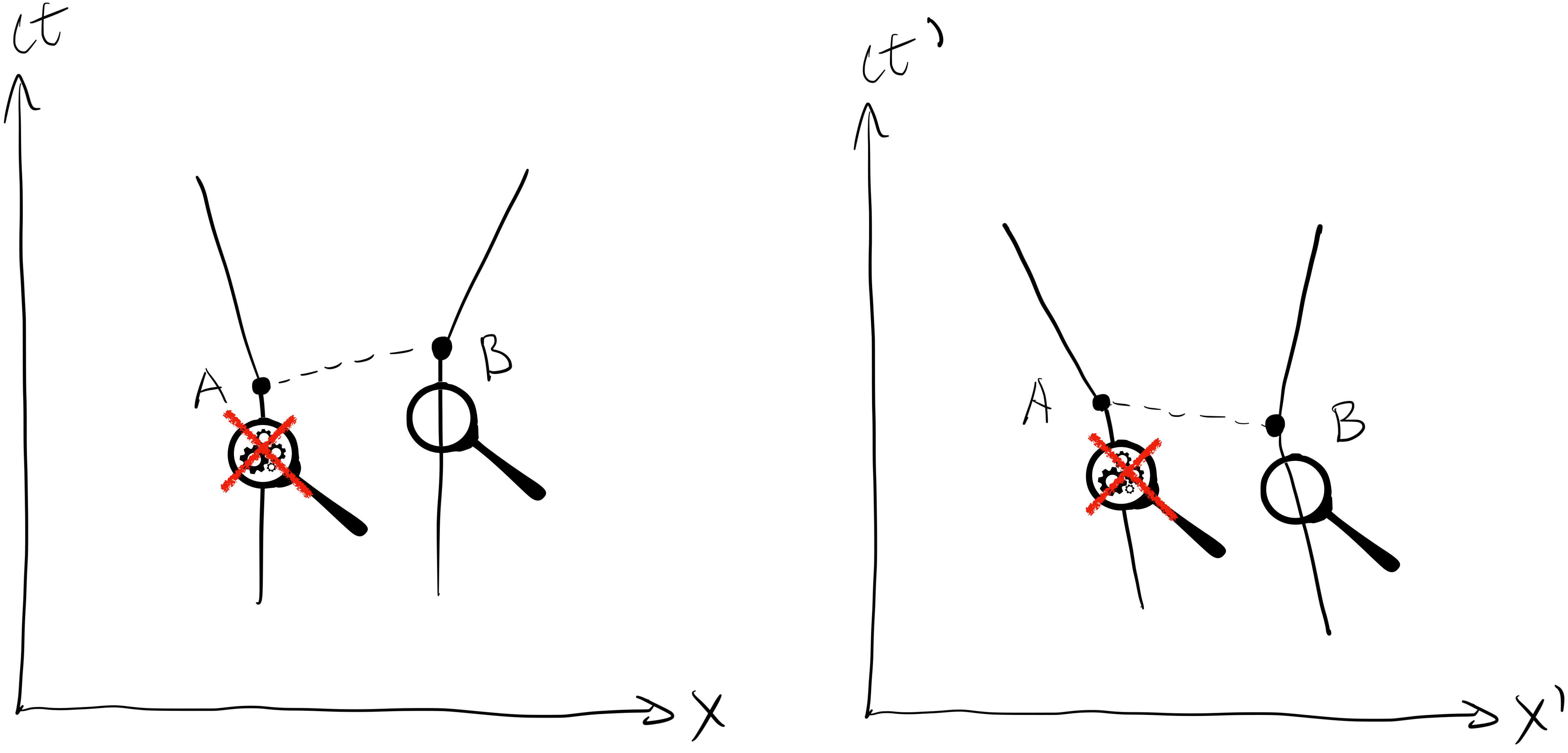
ct
x
A
B
ct'
x'
A
B

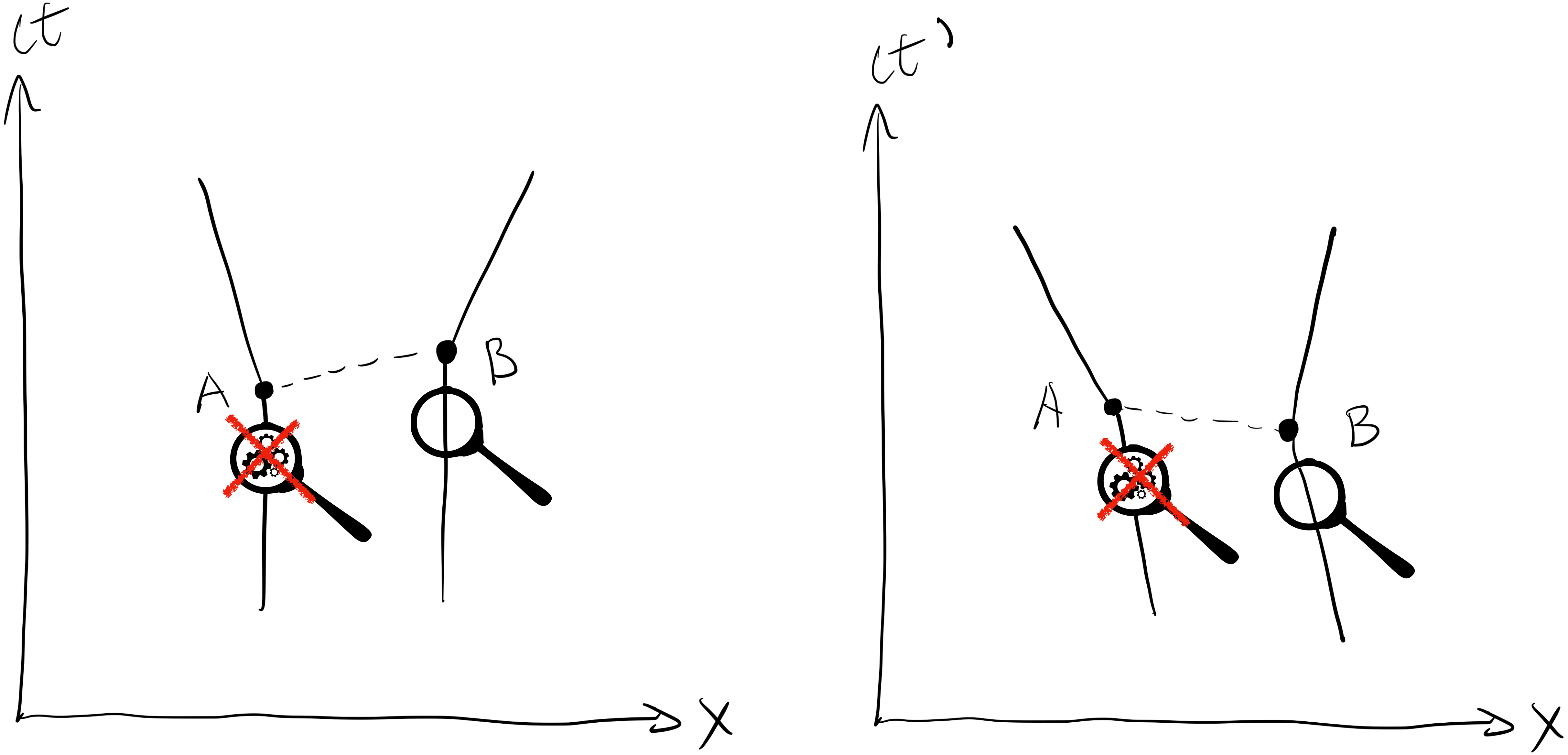

ct
x
A
B
ct'
x'
A
B


ct
A
B
x

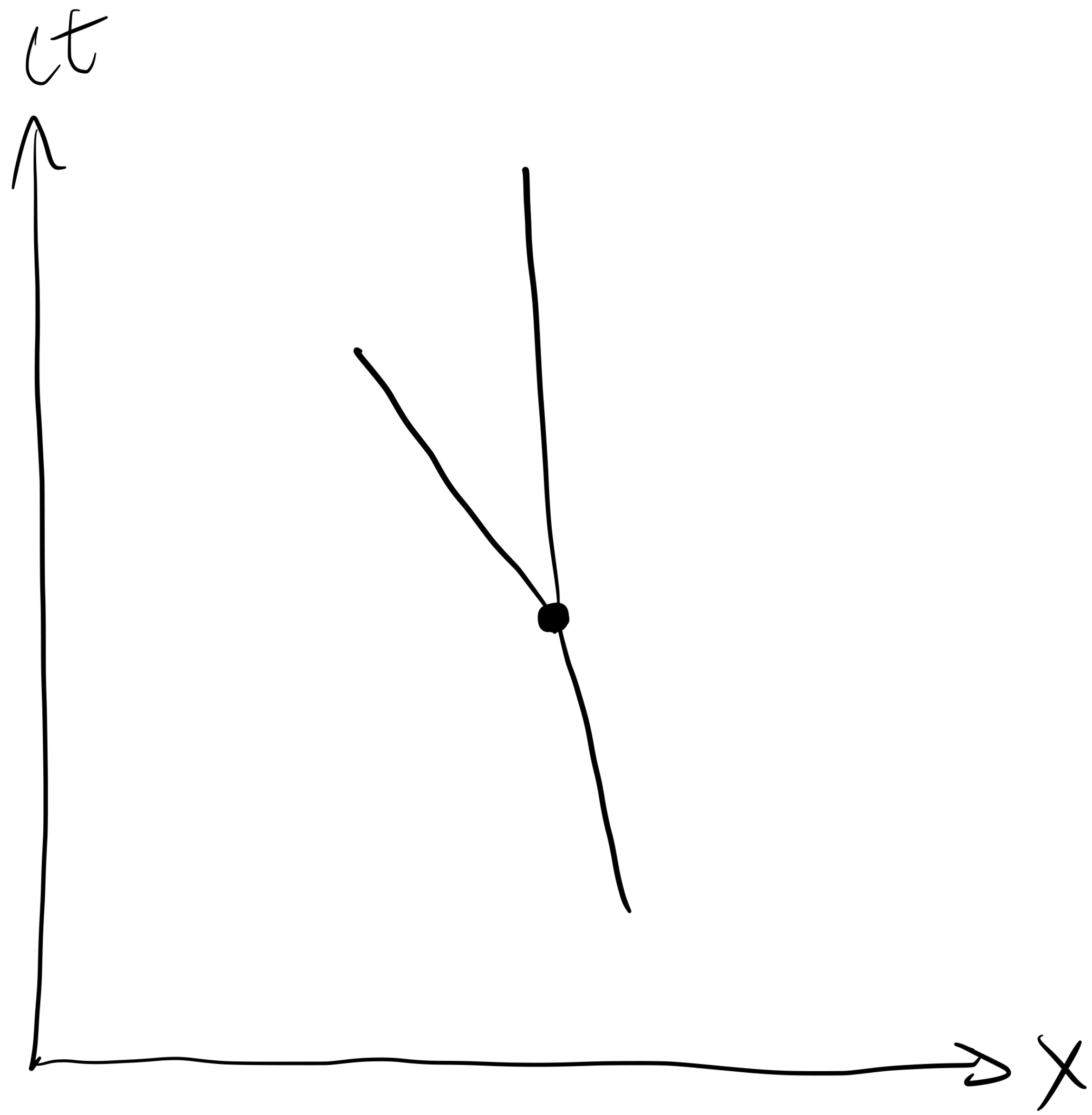

ct'
A
B
x'

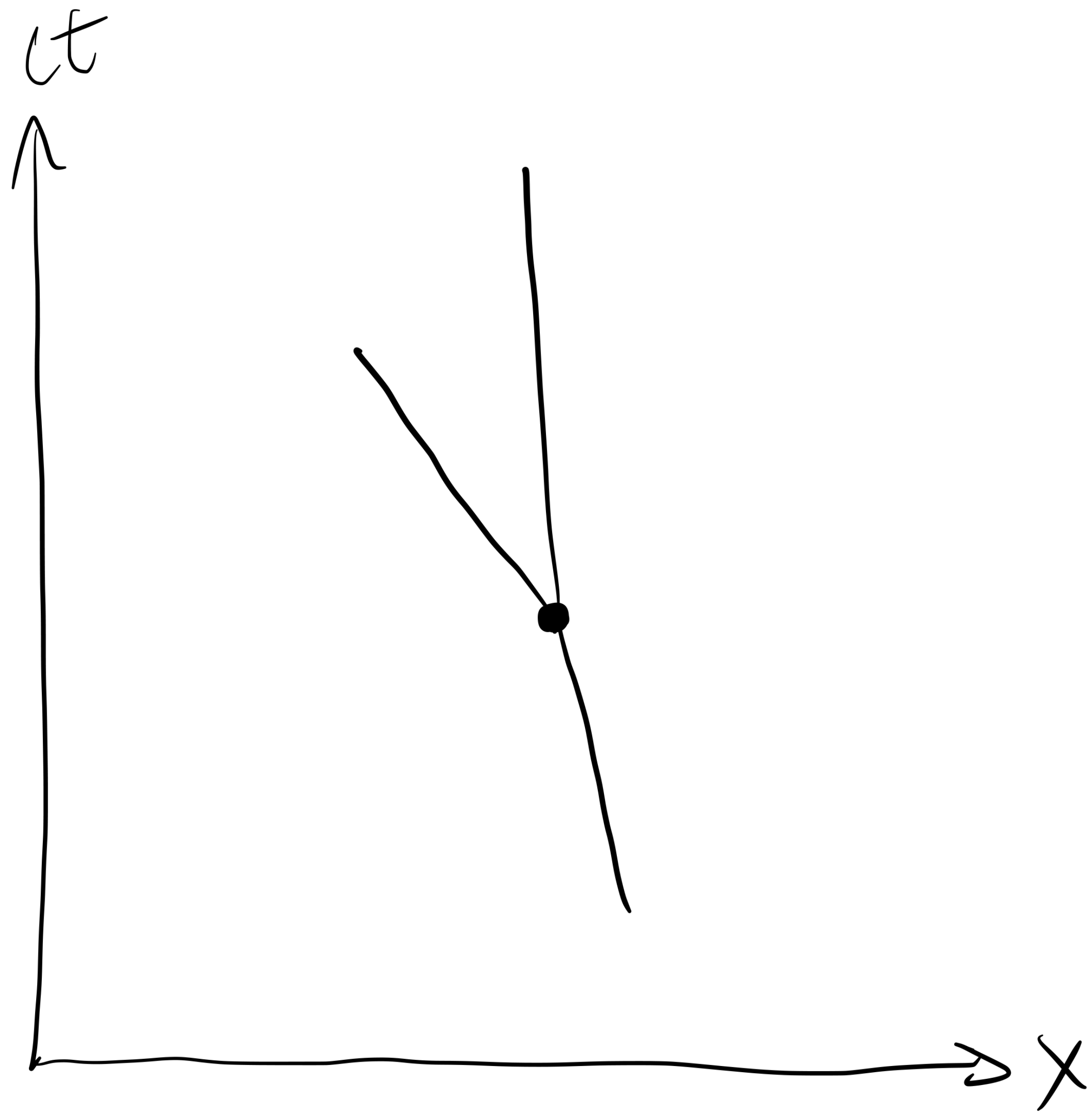

ct
x
A
B
ct'
x'
A
B


ct
A
B
x
ct'
A
B
x'



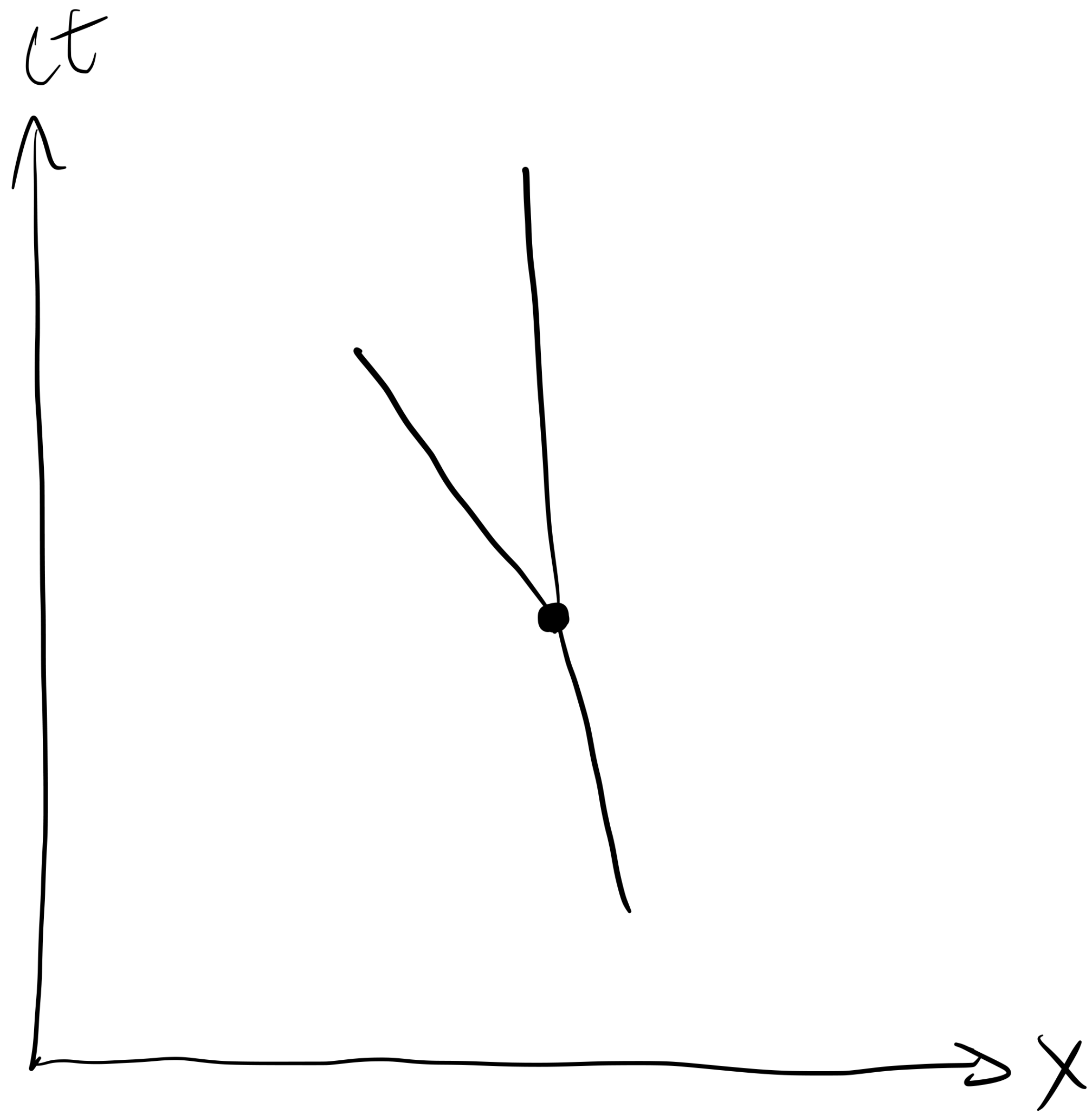
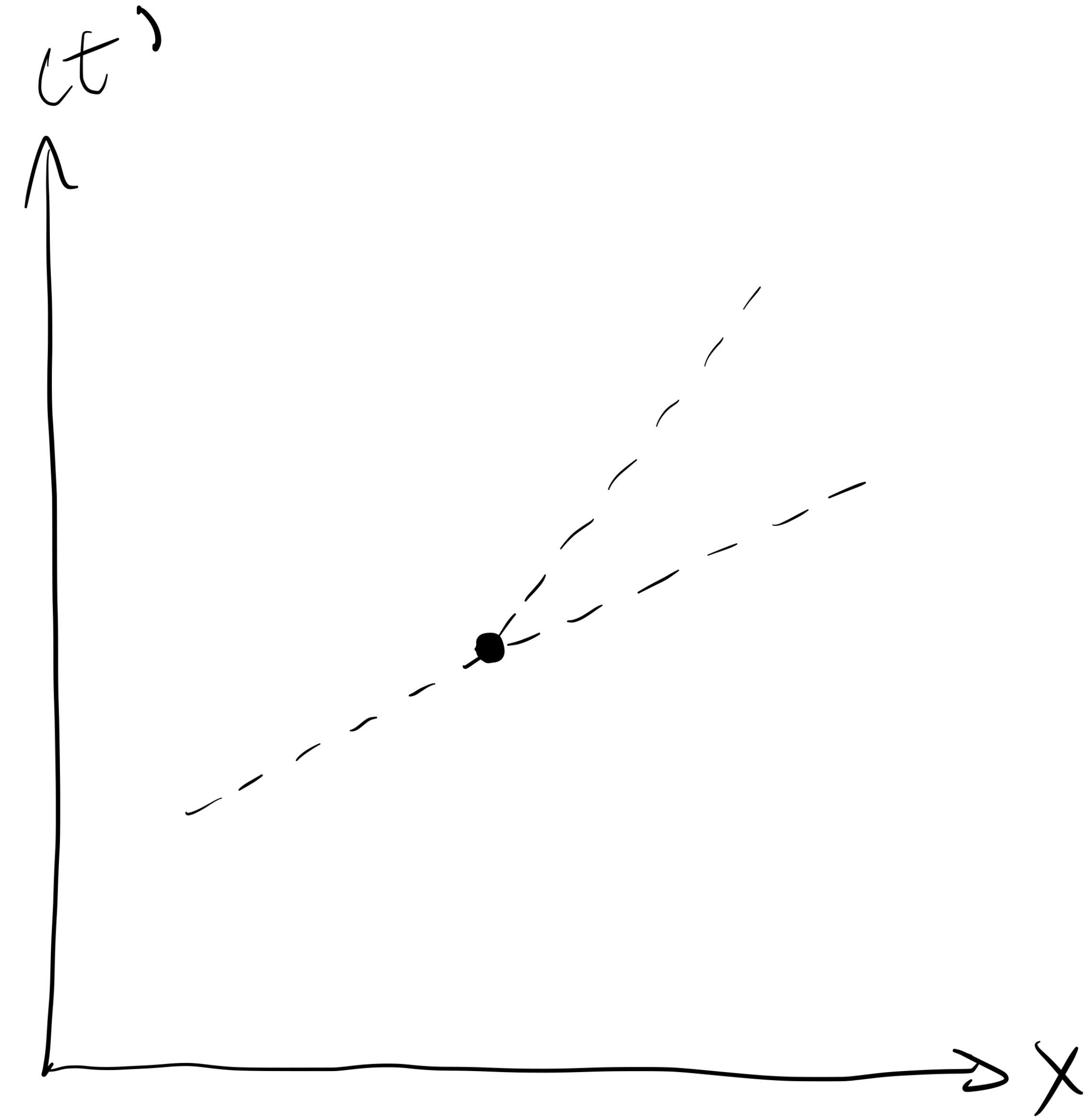
No local, deterministic and relativistic description!

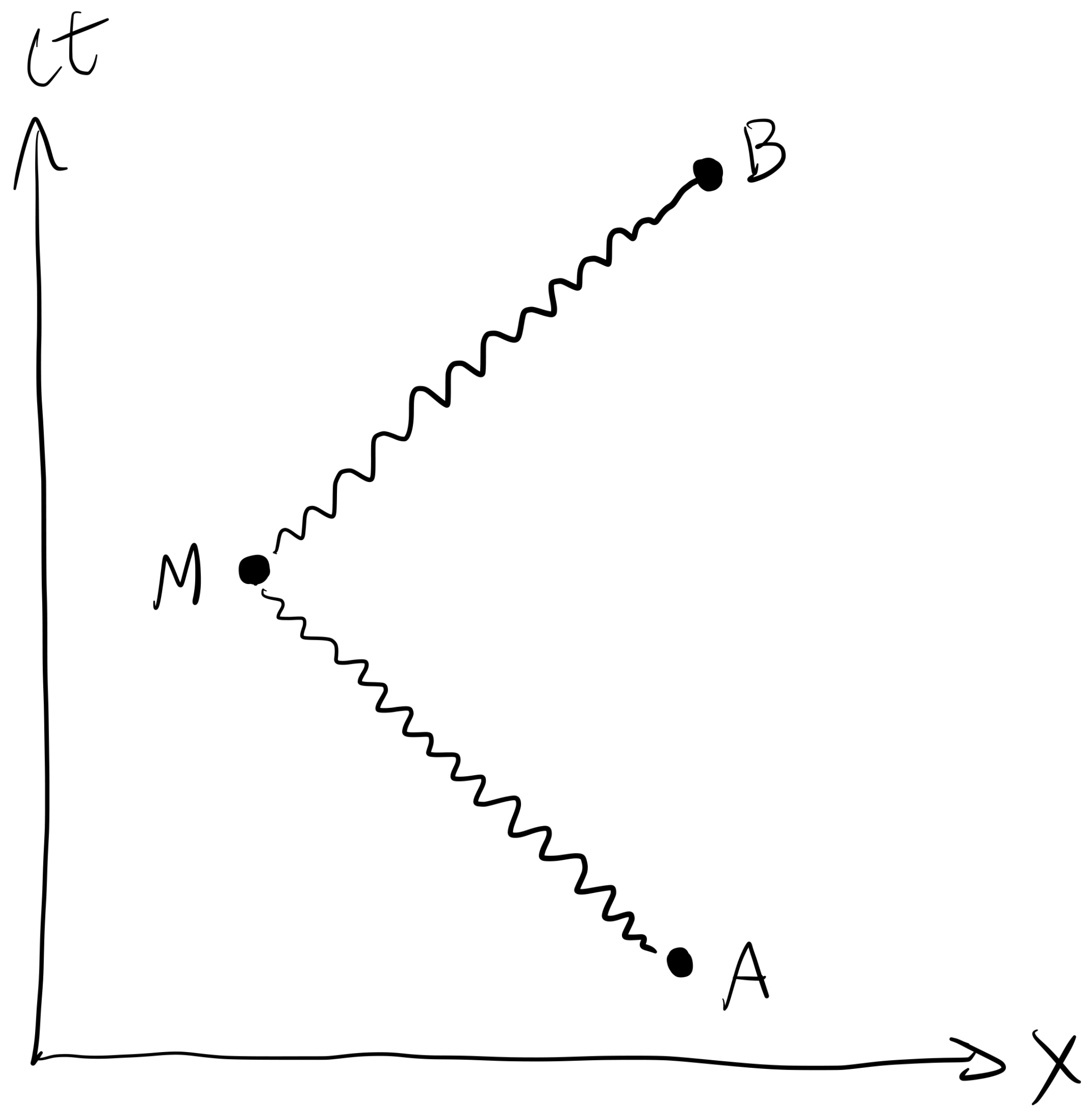

ct
x

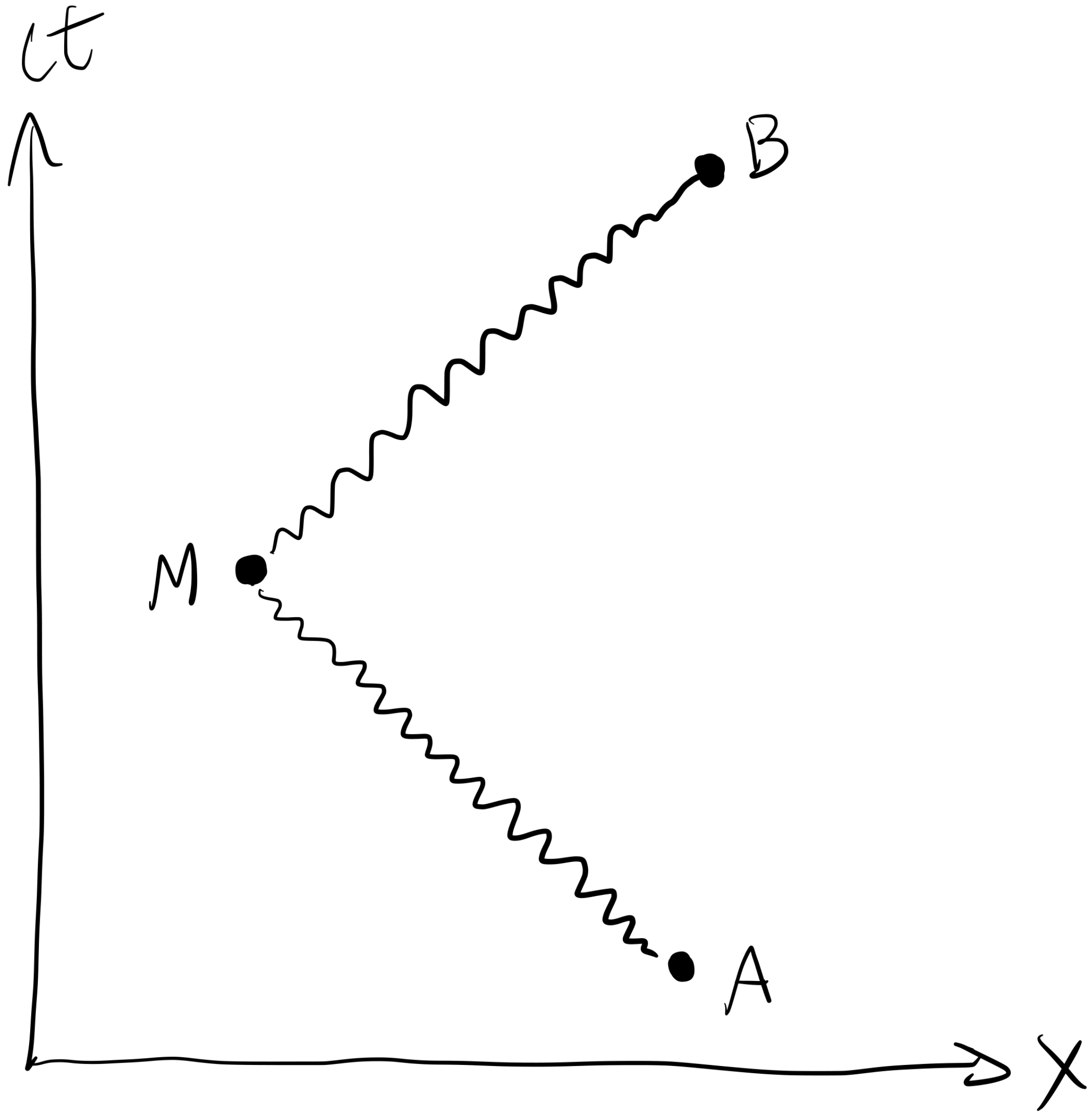


$$x' = ct,$$

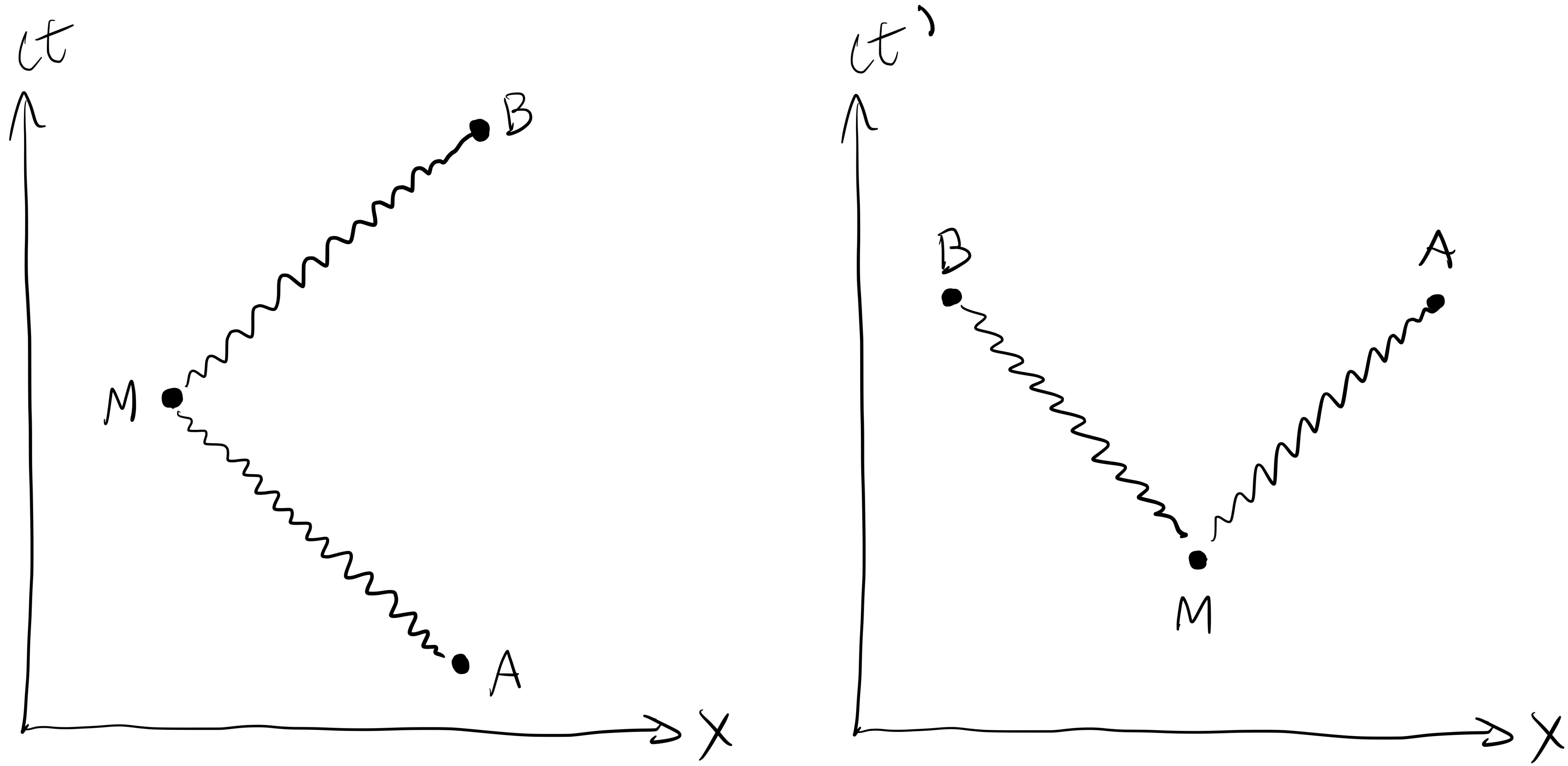
$$ct' = x.$$

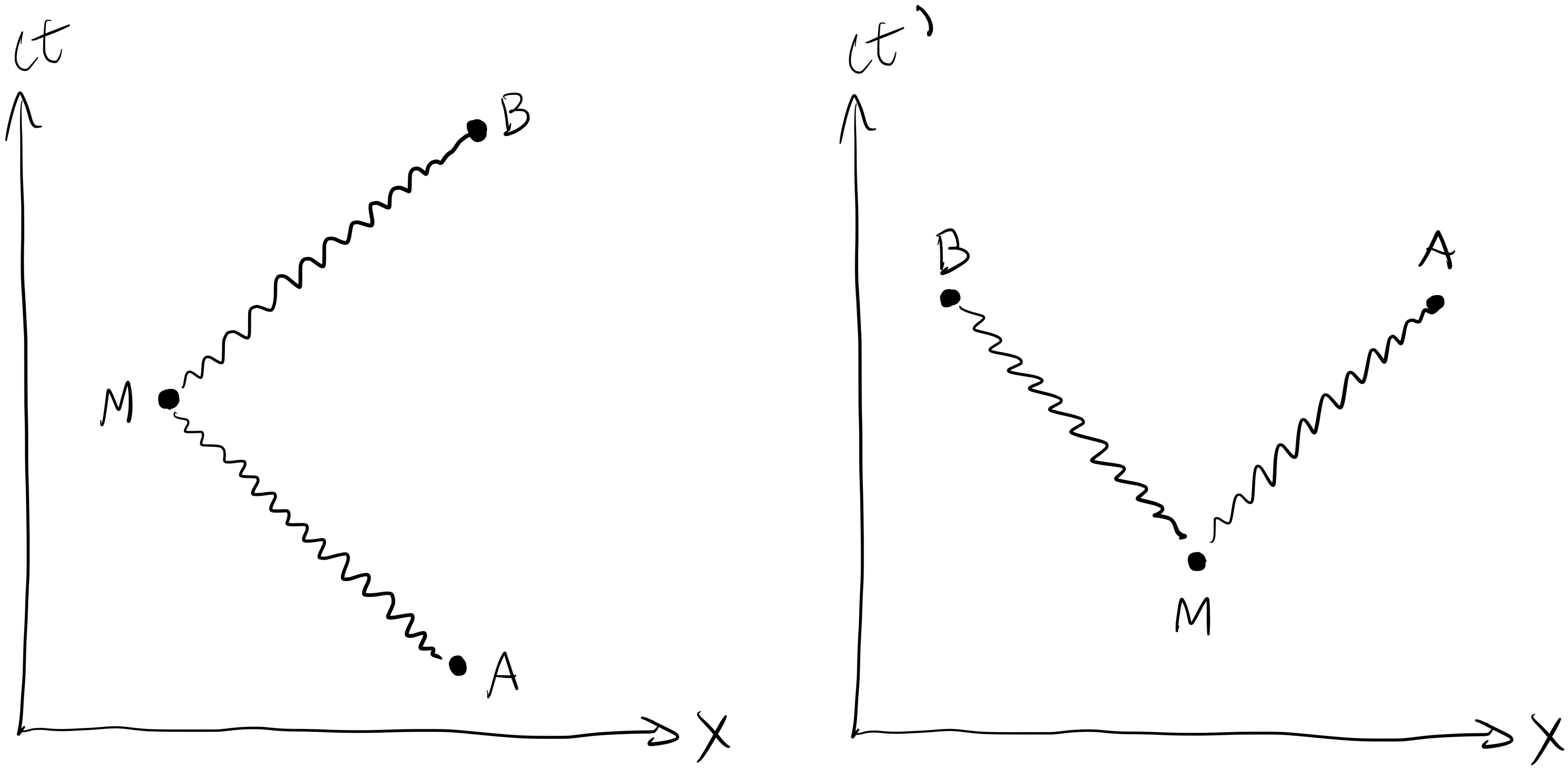

ct
x

ct'
x'


ct
B
M
A
X



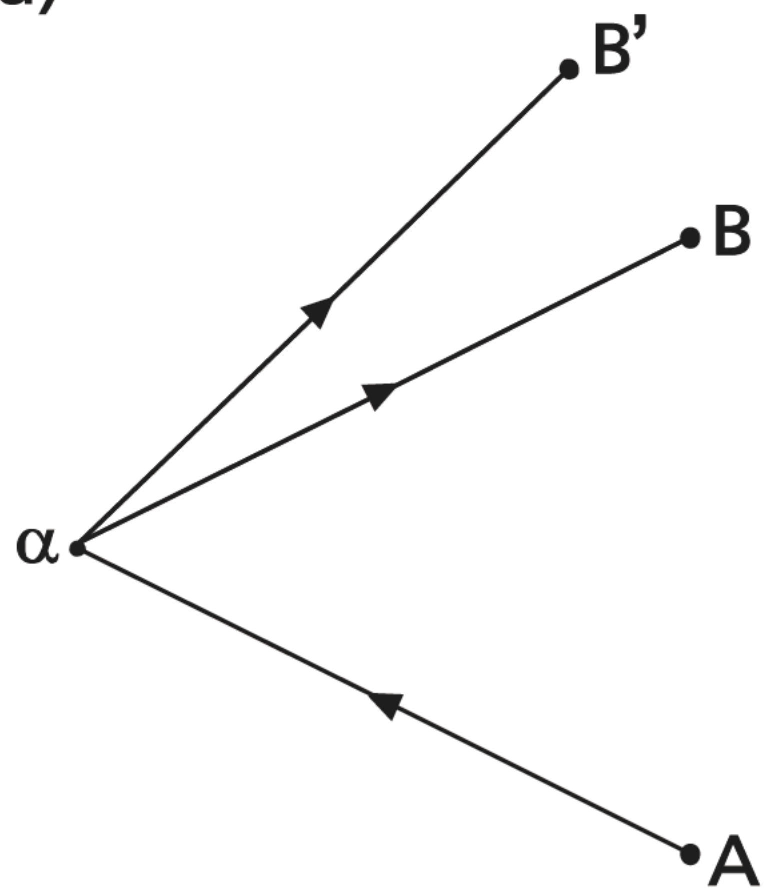
$$
\begin{aligned}
x' &= ct, \\
ct' &= x.
\end{aligned}
$$

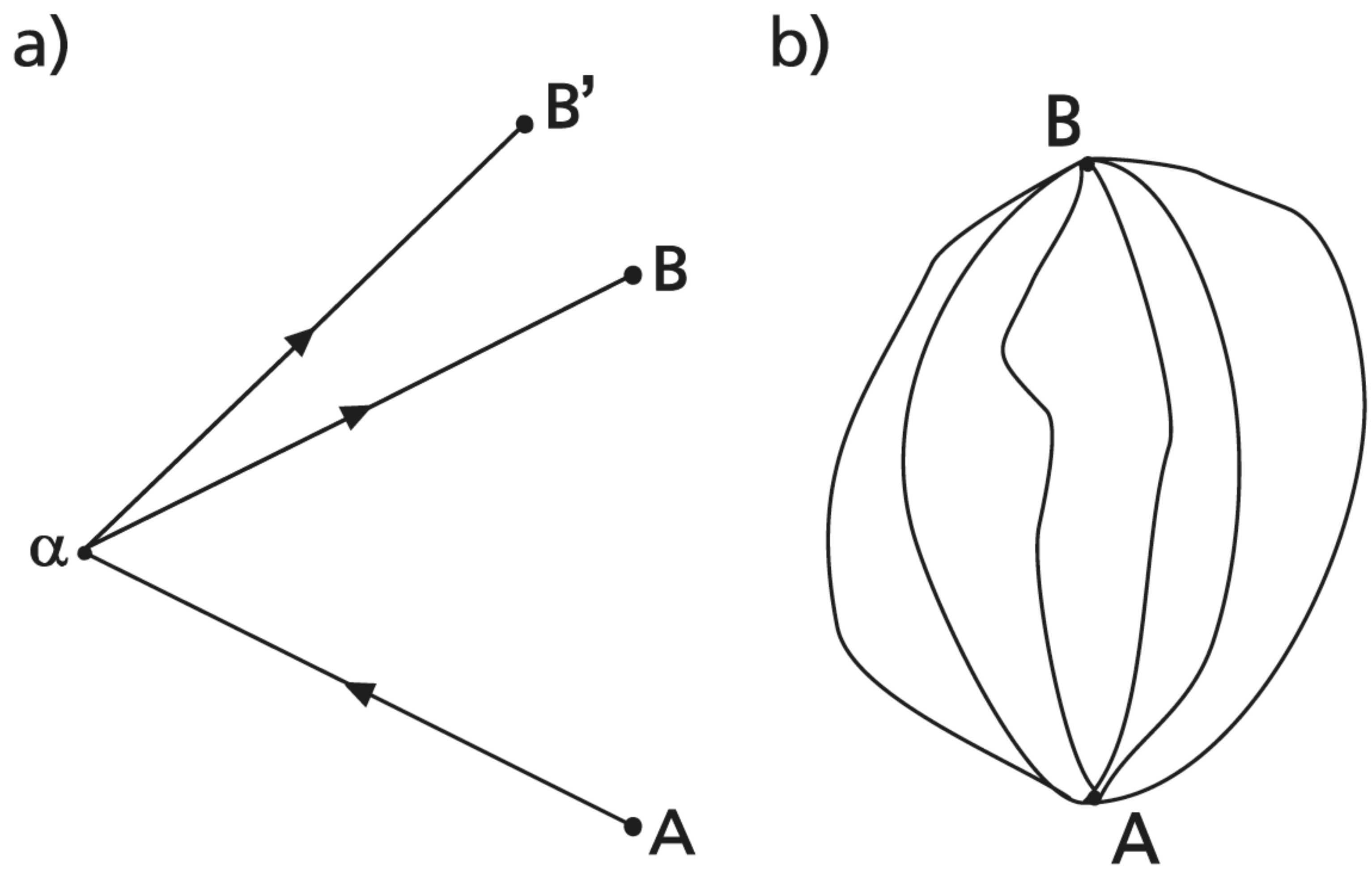

ct
B
M
A
x
ct'
B
A
M
x'

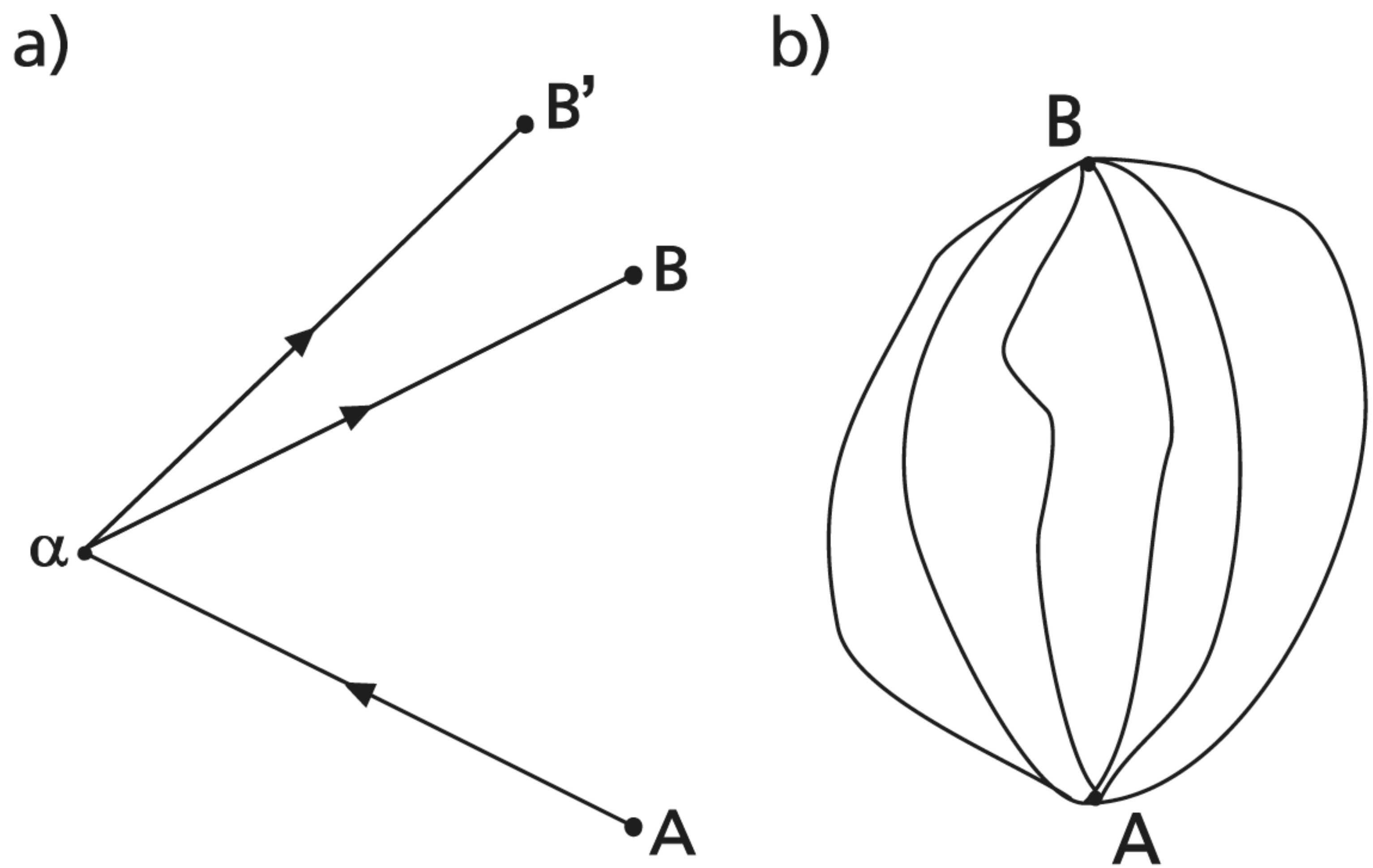


Principle of superposition is inevitable.

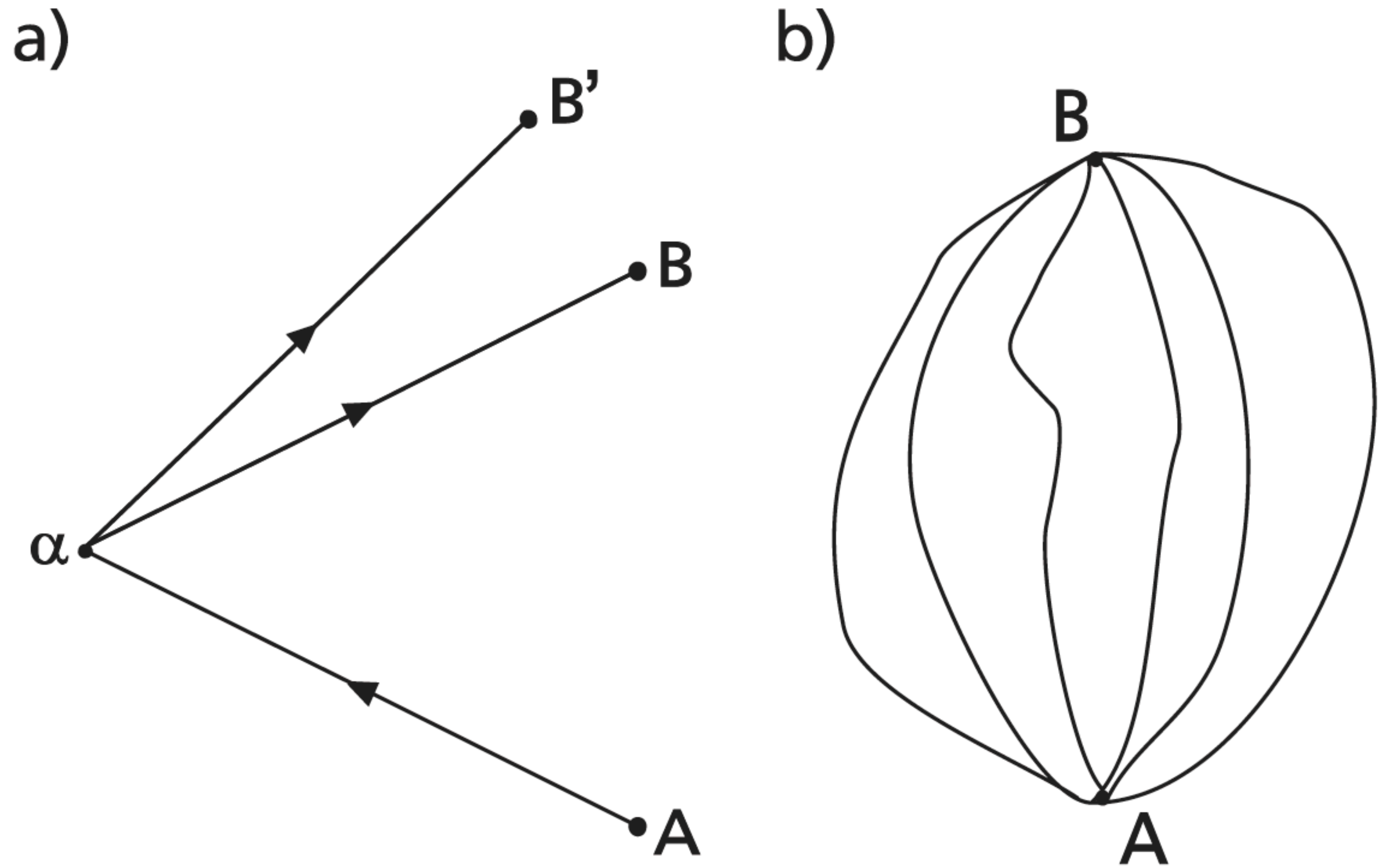
a)




a)
B’
B
α
A
b)
B
A



$$\phi \sim \int_{\mathsf{A}}^{\mathsf{B}} \sqrt{1 - v^2/c^2}\,\mathrm{d}t$$



$$\phi \sim \int_{\mathsf{A}}^{\mathsf{B}} \sqrt{1 - v^2/c^2}\,\mathrm{d}t \sim \int_{\mathsf{A}}^{\mathsf{B}} (E\,\mathrm{d}t - p\,\mathrm{d}x)$$

$$E \sim \frac{1}{\sqrt{1-v^2/c^2}} \qquad p \sim \frac{v}{\sqrt{1-v^2/c^2}}$$

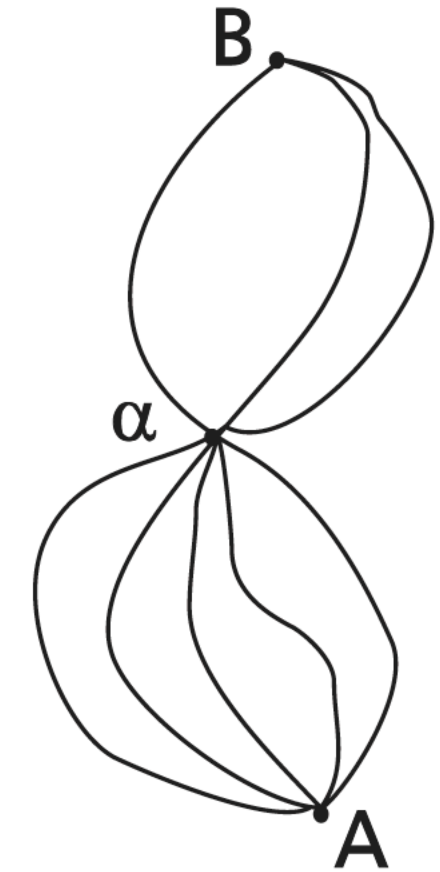
$$\mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n) = \mathcal{P}^{(n)}(\phi_{\pi(1)}, \phi_{\pi(2)}, \ldots, \phi_{\pi(n)})$$

$$\mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n) = \mathcal{P}^{(n)}(\phi_{\pi(1)}, \phi_{\pi(2)}, \ldots, \phi_{\pi(n)})$$

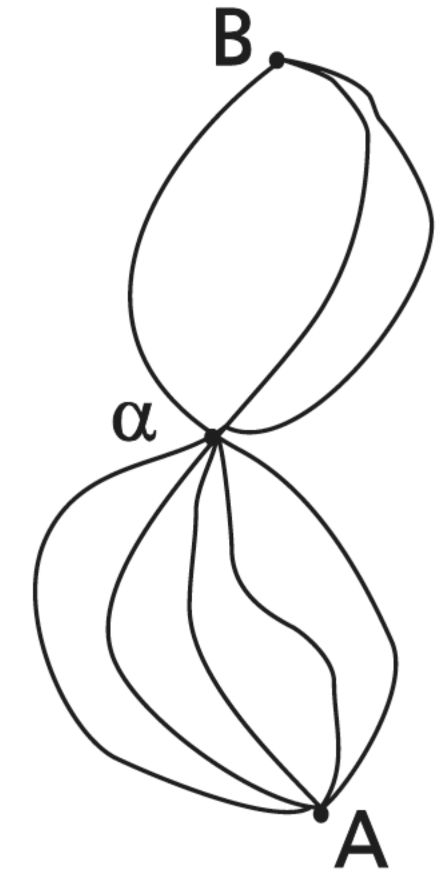
$$\mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n) = \mathcal{P}^{(n)}(-\phi_1, -\phi_2, \ldots, -\phi_n)$$

$$\mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n) = \mathcal{P}^{(n)}(\phi_{\pi(1)}, \phi_{\pi(2)}, \ldots, \phi_{\pi(n)})$$

$$\mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n) = \mathcal{P}^{(n)}(-\phi_1, -\phi_2, \ldots, -\phi_n)$$



$$\mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n) = \mathcal{P}^{(n)}(\phi_{\pi(1)}, \phi_{\pi(2)}, \ldots, \phi_{\pi(n)})$$

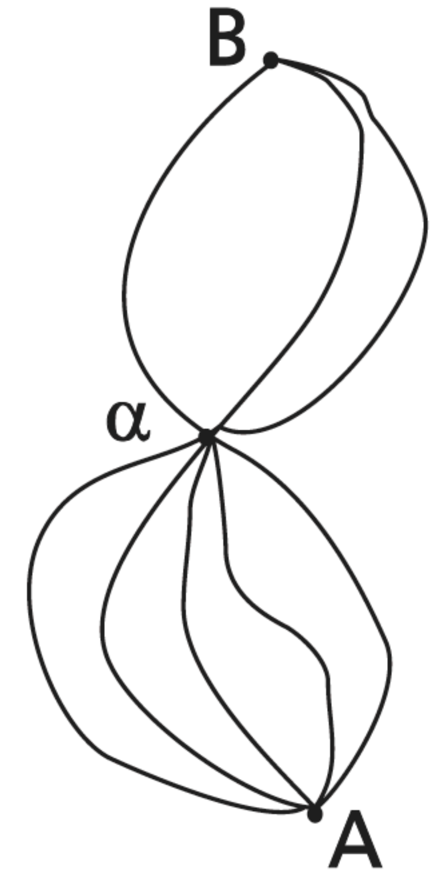


$$\mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n) = \mathcal{P}^{(n)}(-\phi_1, -\phi_2, \ldots, -\phi_n)$$

$$\mathcal{P}^{(nm)}(\phi_1 + \xi_1, \phi_1 + \xi_2, \phi_1 + \xi_3, \ldots, \phi_n + \xi_m) = \mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n)\mathcal{P}^{(m)}(\xi_1, \xi_2, \ldots, \xi_m)$$

$$\mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n) = \mathcal{P}^{(n)}(\phi_{\pi(1)}, \phi_{\pi(2)}, \ldots, \phi_{\pi(n)})$$

$$\mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n) = \mathcal{P}^{(n)}(-\phi_1, -\phi_2, \ldots, -\phi_n)$$



$$\mathcal{P}^{(nm)}(\phi_1 + \xi_1, \phi_1 + \xi_2, \phi_1 + \xi_3, \ldots, \phi_n + \xi_m) = \mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n)\mathcal{P}^{(m)}(\xi_1, \xi_2, \ldots, \xi_m)$$

$$\downarrow$$

$$\mathcal{P}^{(n)}(\phi_1, \phi_2, \ldots, \phi_n) = \frac{1}{n^\beta} \left(e^{\alpha\phi_1} + e^{\alpha\phi_2} + \ldots + e^{\alpha\phi_n}\right)^\gamma \left(e^{-\alpha\phi_1} + e^{-\alpha\phi_2} + \ldots + e^{-\alpha\phi_n}\right)^\gamma$$

3+1 dimensional case

3+1 dimensional case

$$c^2\mathrm{d}t^2 - \mathrm{d}x^2 - \mathrm{d}y^2 - \mathrm{d}z^2 = -c^2\mathrm{d}t'^2 + \mathrm{d}x'^2 - \mathrm{d}y'^2 - \mathrm{d}z'^2$$

3+1 dimensional case

$$c^2 \mathrm{d}t^2 - \mathrm{d}x^2 - \mathrm{d}y^2 - \mathrm{d}z^2 = -c^2 \mathrm{d}t'^2 + \mathrm{d}x'^2 - \mathrm{d}y'^2 - \mathrm{d}z'^2$$

$$\begin{cases} \boldsymbol{r}' = \boldsymbol{r} - \dfrac{\boldsymbol{V} \cdot \boldsymbol{r}}{V^2} \boldsymbol{V} + \dfrac{\frac{\boldsymbol{V} \cdot \boldsymbol{r}}{V^2} - t}{\sqrt{1 - V^2/c^2}} \boldsymbol{V}, \\ ct' = \dfrac{ct - \frac{\boldsymbol{V} \cdot \boldsymbol{r}}{c}}{\sqrt{1 - V^2/c^2}}. \end{cases}$$

3+1 dimensional case

$$c^2 \mathrm{d}t^2 - \mathrm{d}x^2 - \mathrm{d}y^2 - \mathrm{d}z^2 = -c^2 \mathrm{d}t'^2 + \mathrm{d}x'^2 - \mathrm{d}y'^2 - \mathrm{d}z'^2$$

$$\left\{ \begin{aligned} \boldsymbol{r}' &= \boldsymbol{r} - \frac{\boldsymbol{V} \cdot \boldsymbol{r}}{V^2}\boldsymbol{V} + \frac{\frac{\boldsymbol{V}\cdot\boldsymbol{r}}{V^2} - t}{\sqrt{1 - V^2/c^2}}\boldsymbol{V}, \\ ct' &= \frac{ct - \frac{\boldsymbol{V}\cdot\boldsymbol{r}}{c}}{\sqrt{1 - V^2/c^2}}. \end{aligned} \right.$$

$$\left\{ \begin{aligned} x' &= \frac{Vt - \frac{\boldsymbol{V}\cdot\boldsymbol{r}}{V}}{\sqrt{V^2/c^2 - 1}}, \\ \boldsymbol{ct}' &= \boldsymbol{r} - \frac{\boldsymbol{V} \cdot \boldsymbol{r}}{V^2}\boldsymbol{V} + \frac{\frac{\boldsymbol{V}\cdot\boldsymbol{r}}{Vc} - \frac{ct}{V}}{\sqrt{V^2/c^2 - 1}}\boldsymbol{V}. \end{aligned} \right.$$

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