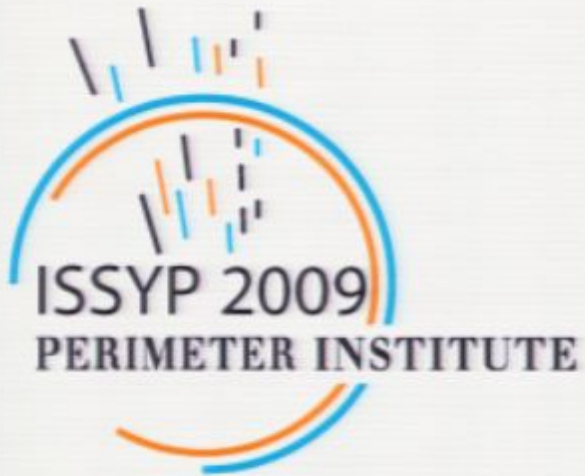


Title: Relativity 1

Date: Aug 10, 2009 01:00 PM

URL: <http://pirsa.org/09080048>

Abstract: Spacetime diagrams, a Doppler shift thought experiment, and introduction to Einstein's two principles.



special relativity

$$(1+x)^n = 1 + \frac{n}{1}x + \frac{n(n-1)}{1 \cdot 2}x^2 + \dots$$

↑ 2.0005276

↑ class; quantum.

2 + [

$$d = 4 + \epsilon$$

$$(1+x)^n = 1 + \frac{n}{1}x + \frac{n(n-1)}{1 \cdot 2}x^2 + \dots$$

$$\uparrow \quad 2.0005276$$

↑
class: quantum.

$$d = 4 + \epsilon$$

$$2 + \left[\frac{16\pi}{\epsilon} + 0.0005276 + 2.6\epsilon + 5.7\epsilon^2 + \dots \right]$$

$$(1+x)^n = 1 + \frac{n}{1}x + \frac{n(n-1)}{1 \cdot 2}x^2 + \dots$$

↑ 2.0005276

↑ class, quantum.

$$2 + \left[+ 0.0005 \right]$$

$$d = 4 + \epsilon$$

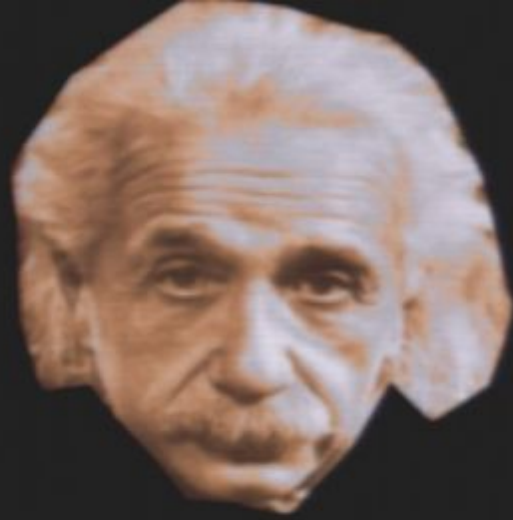
$$(1+x)^n = 1 + \binom{n}{1}x + \frac{\binom{n}{2}}{2}x^2 + \dots$$

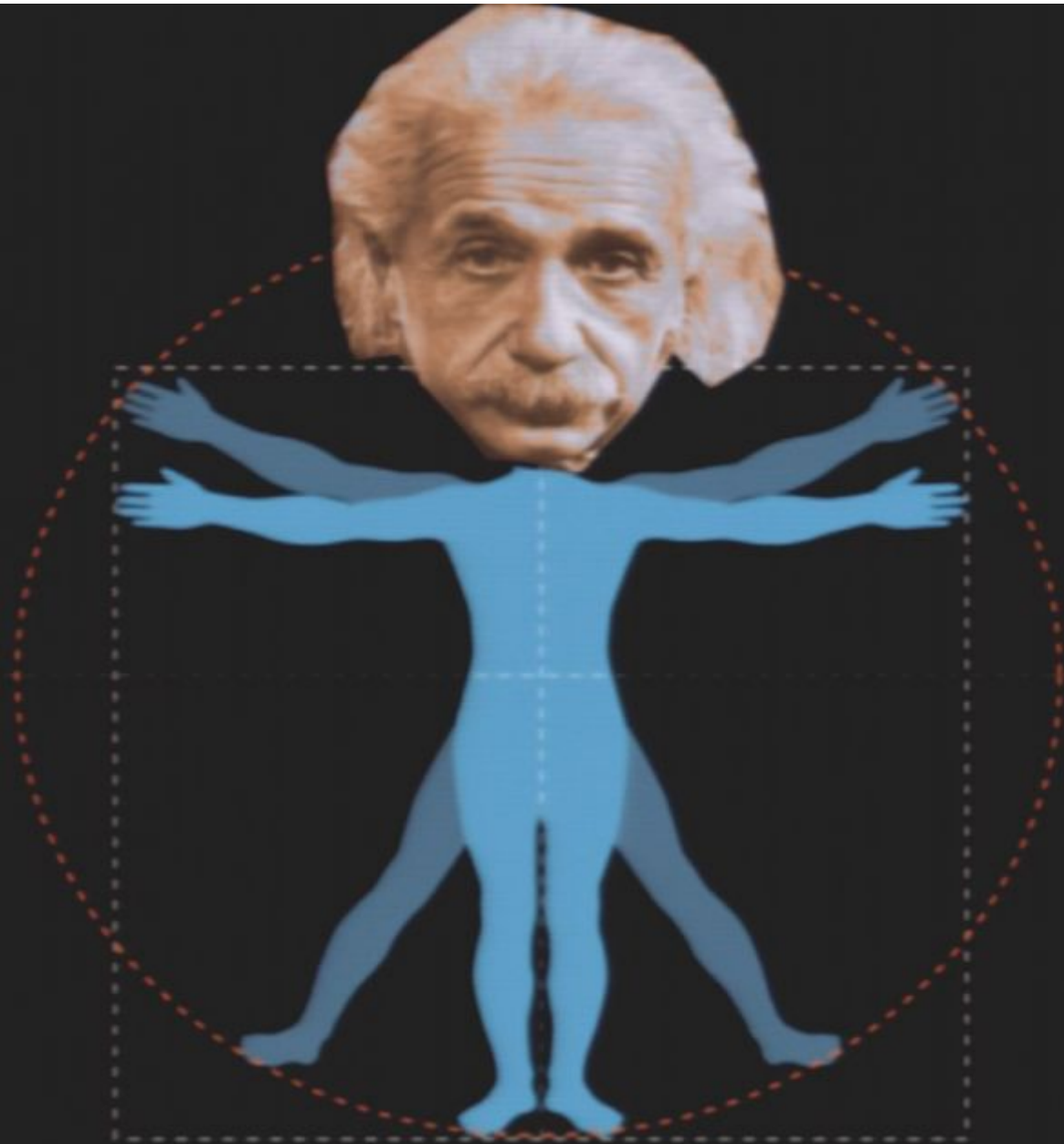
\uparrow
 2.0005276

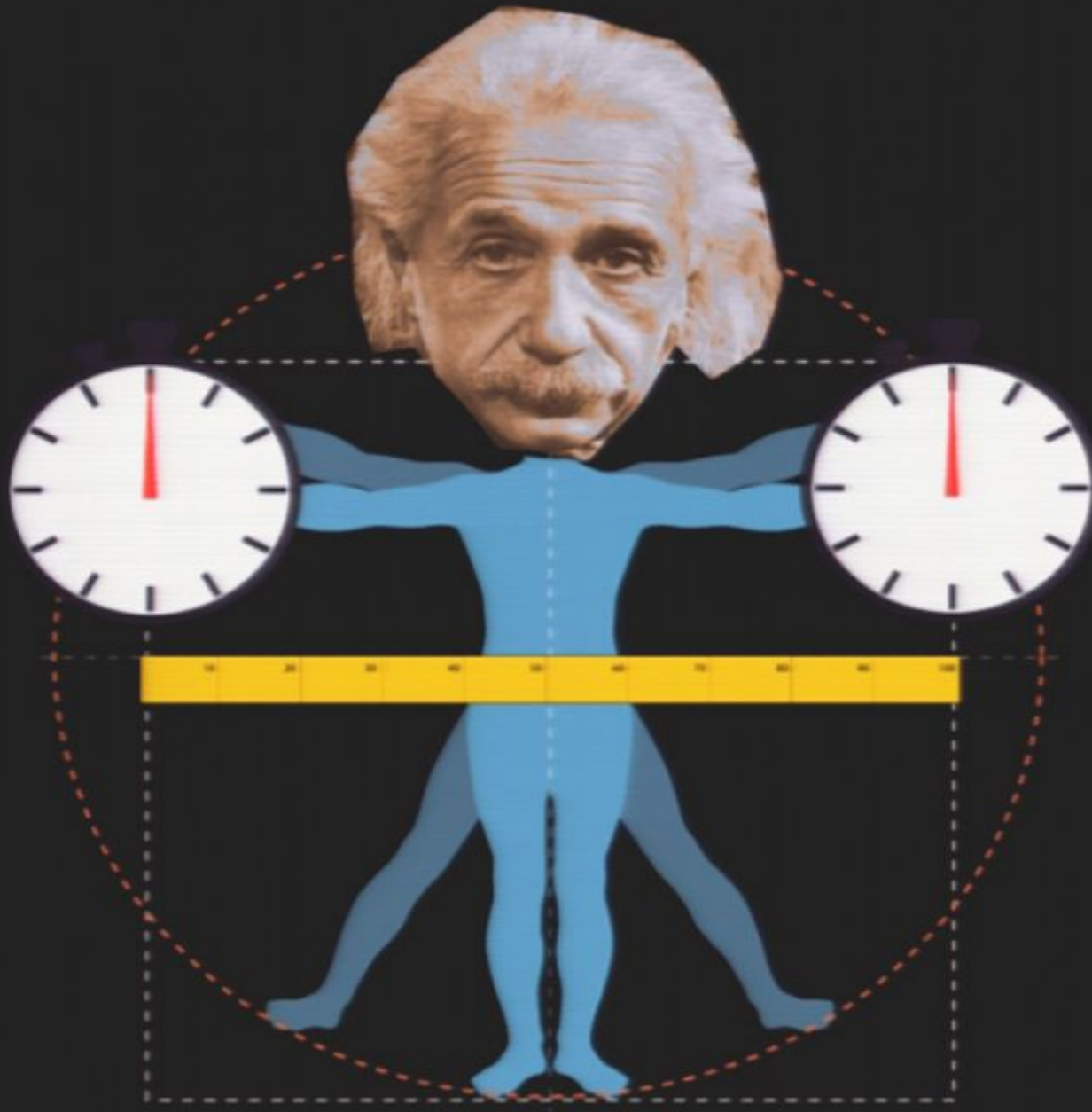
\uparrow
 class: quantum.

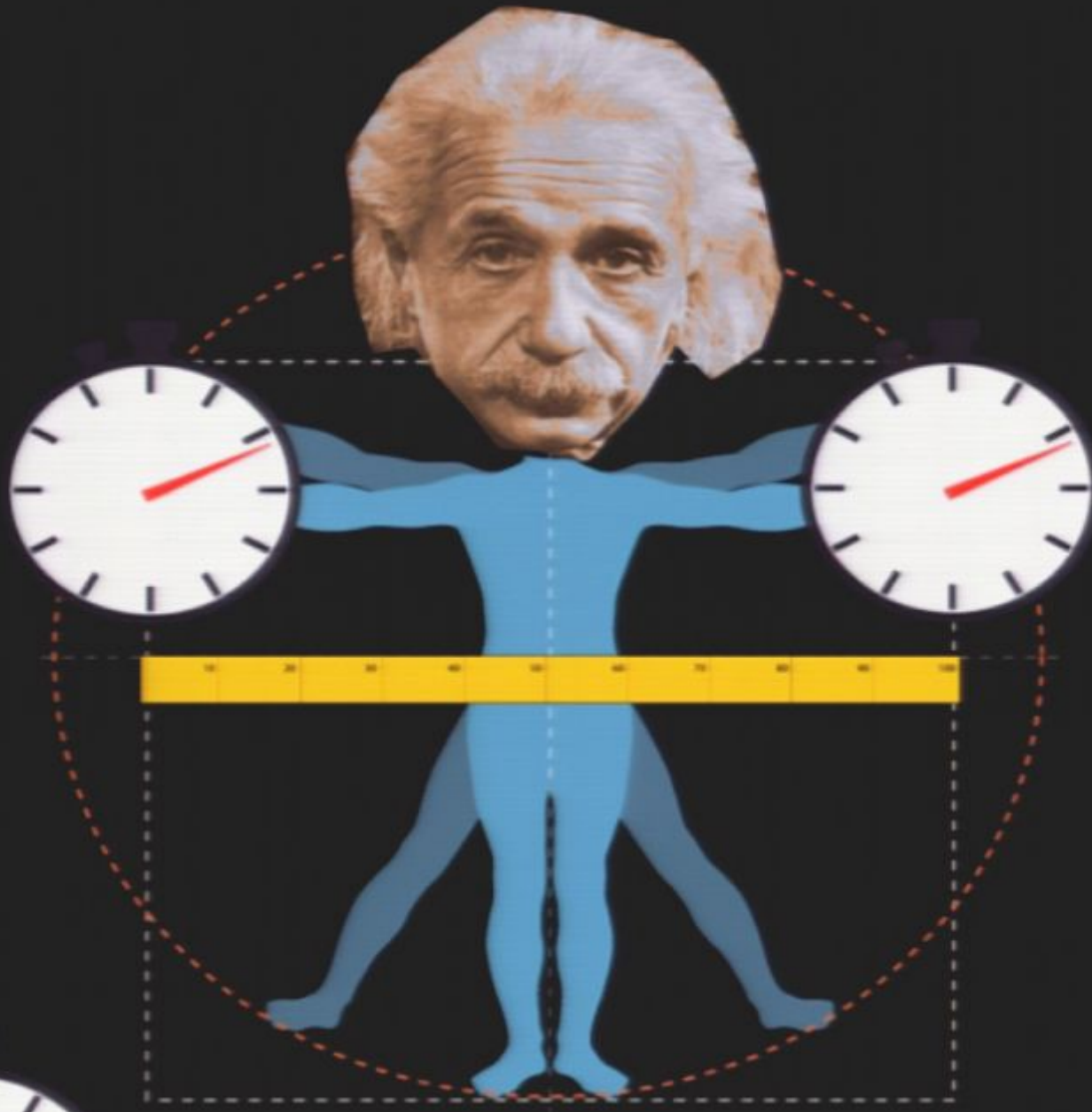
$$d = 4 + \epsilon$$

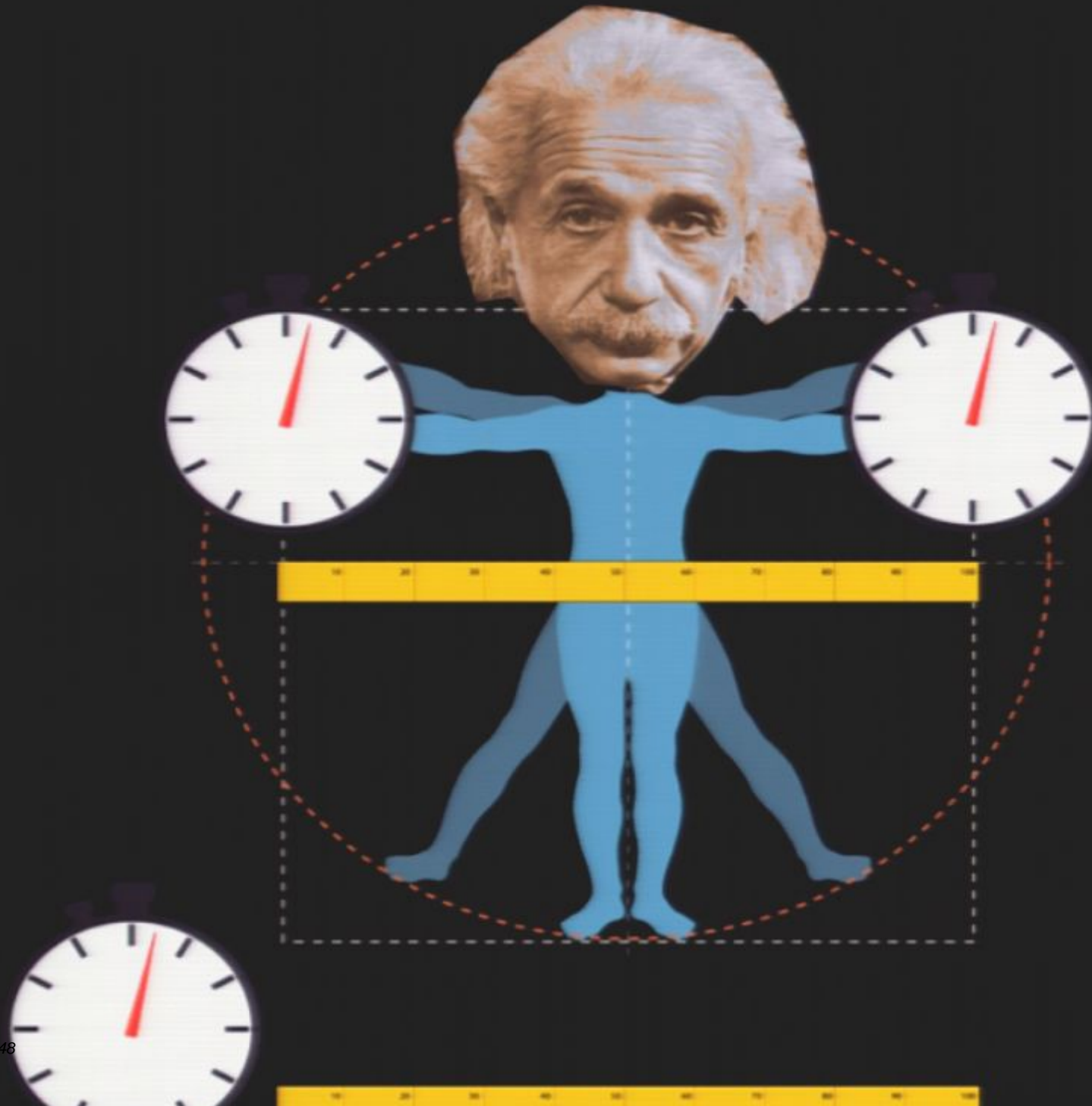
$$2 + \left[+0.0005276 + \cancel{2.6\epsilon} + \cancel{5.7\epsilon^2} \right]$$





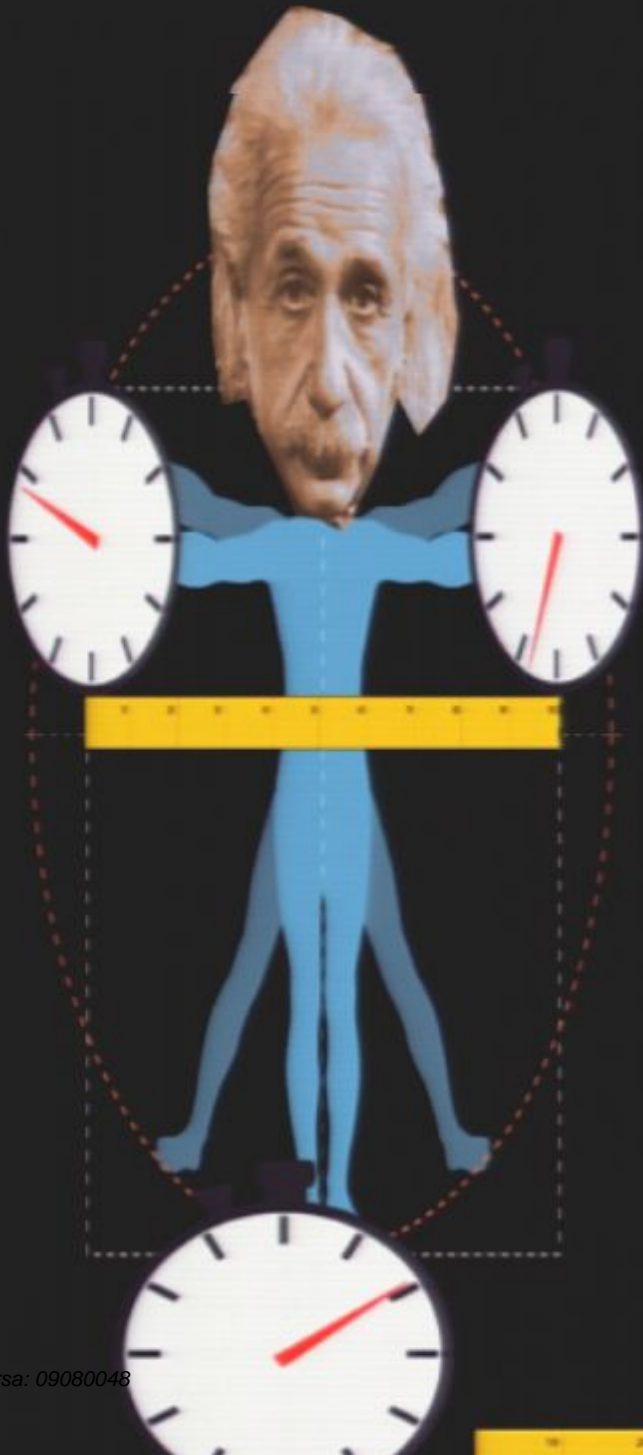


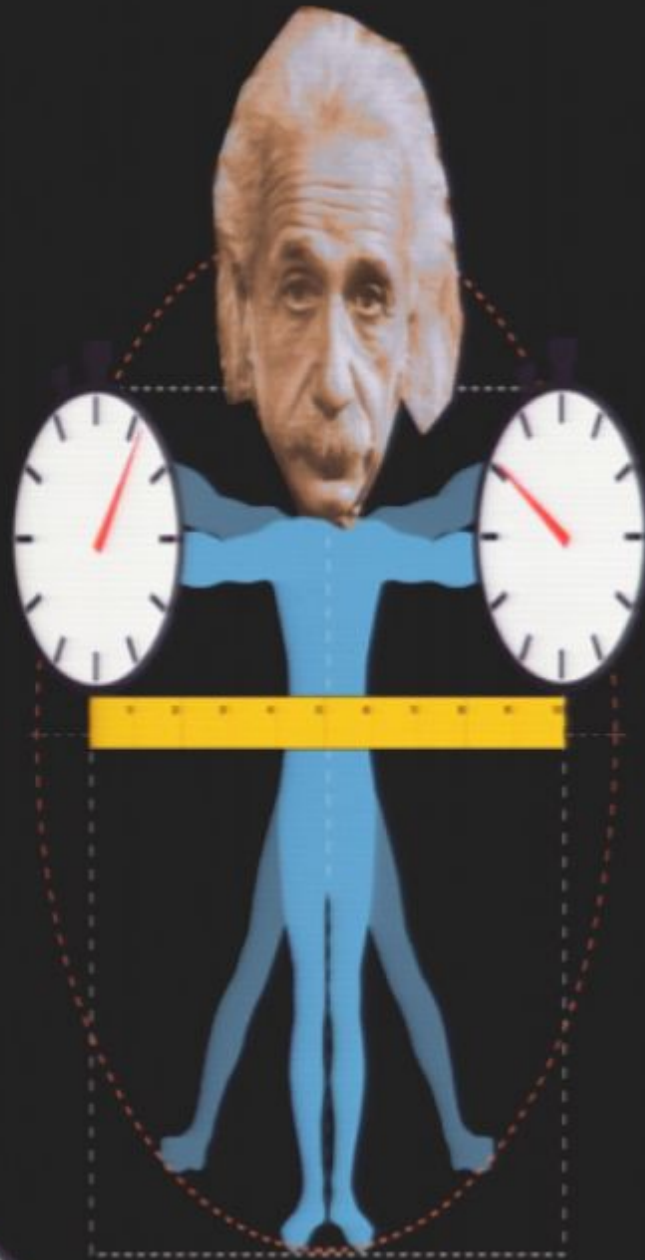


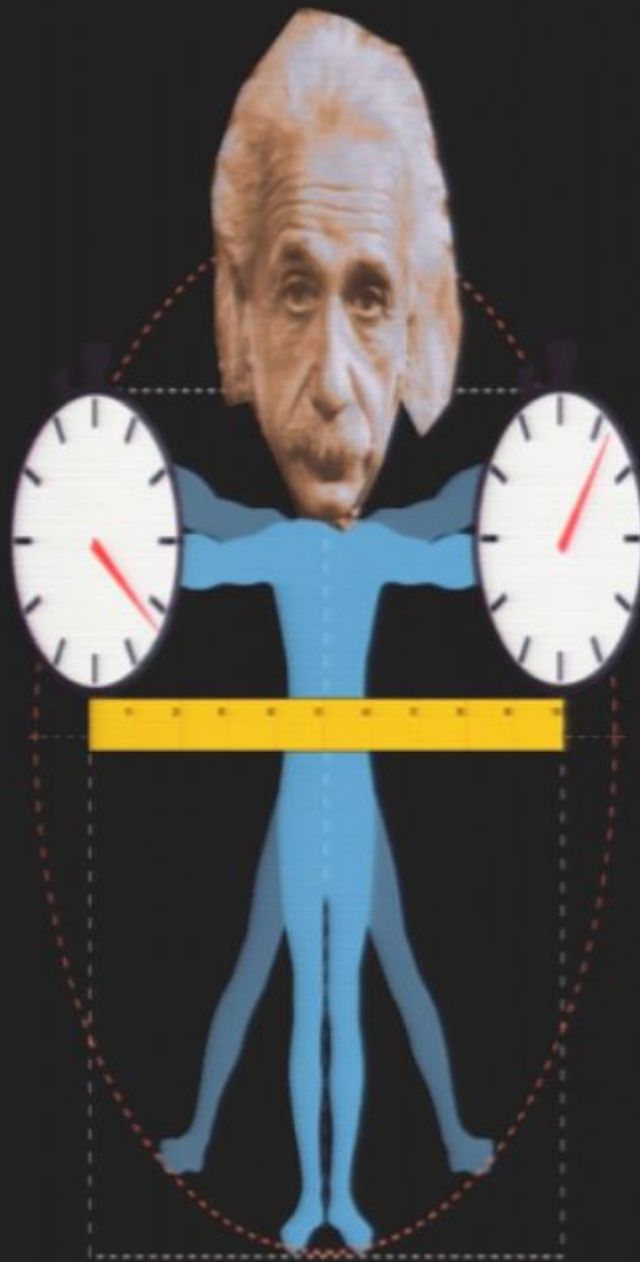










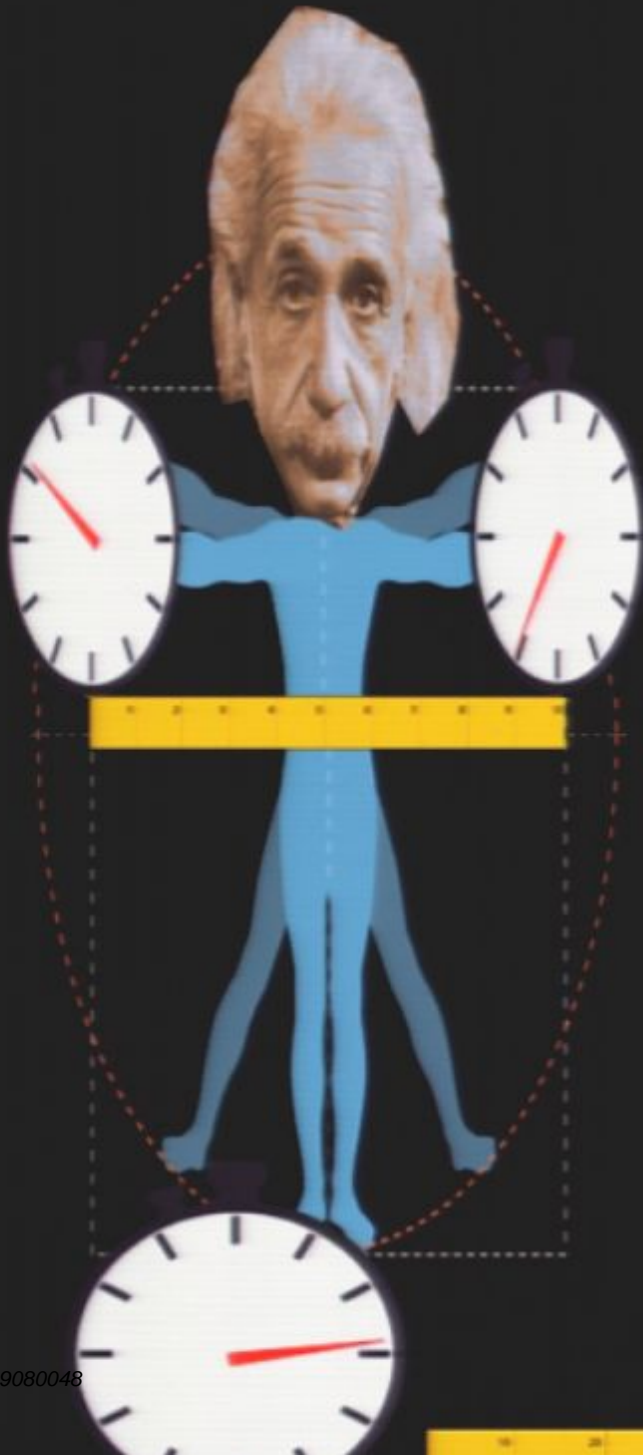


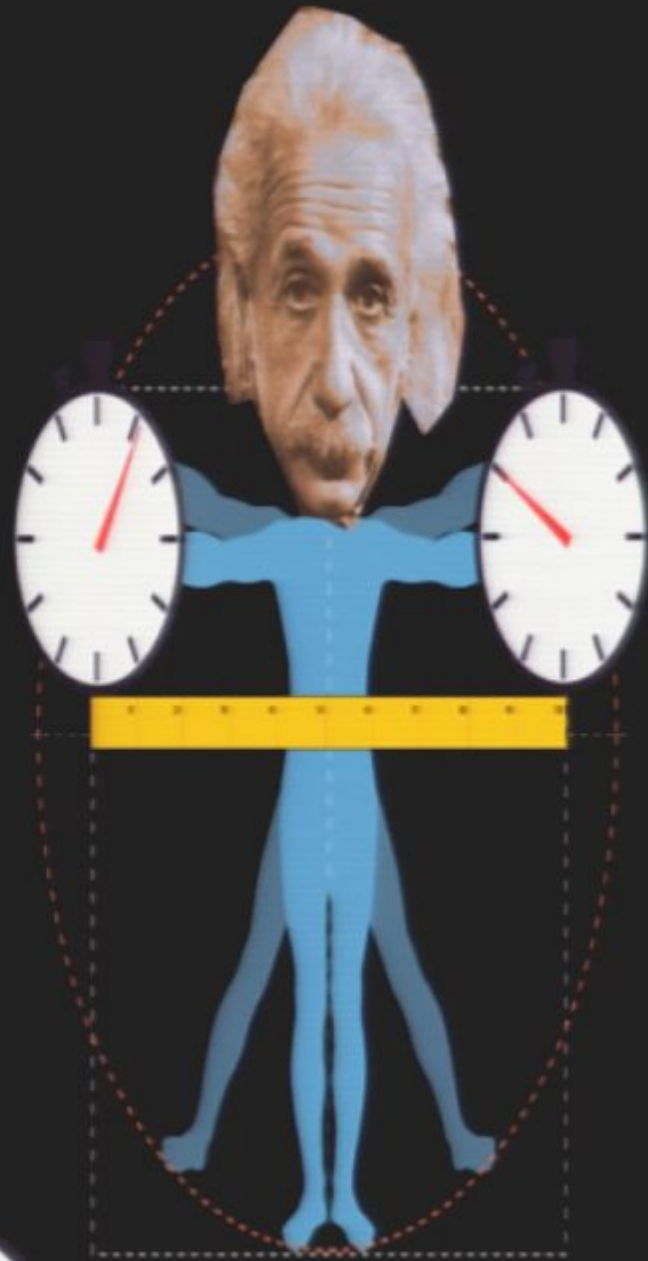


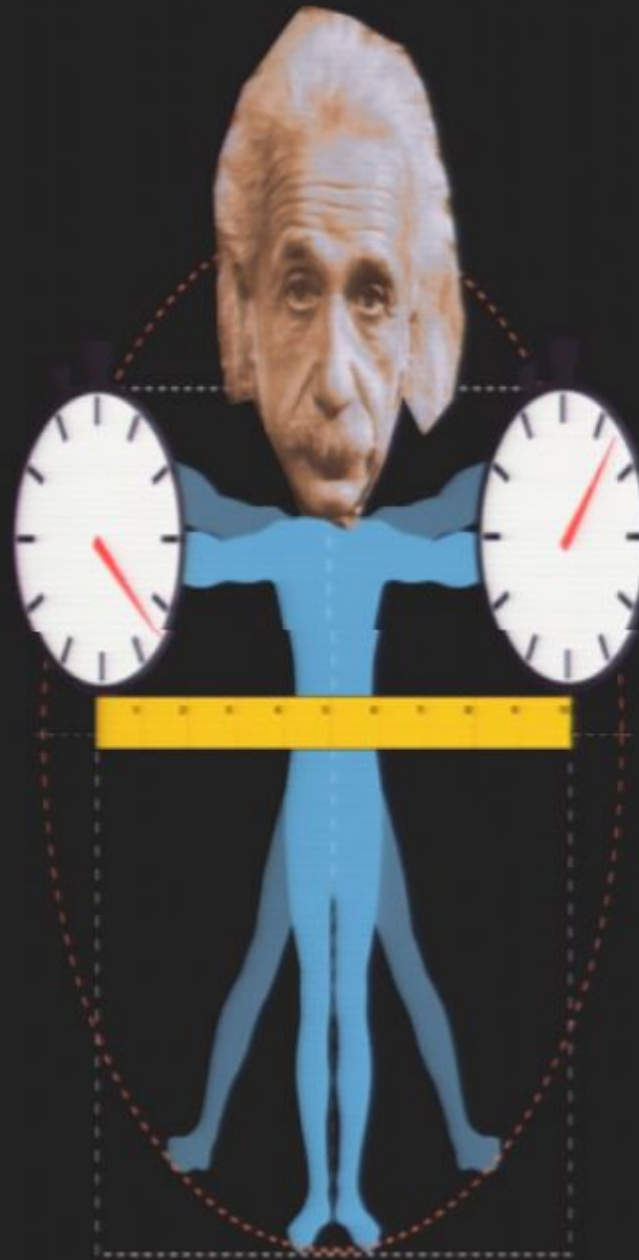


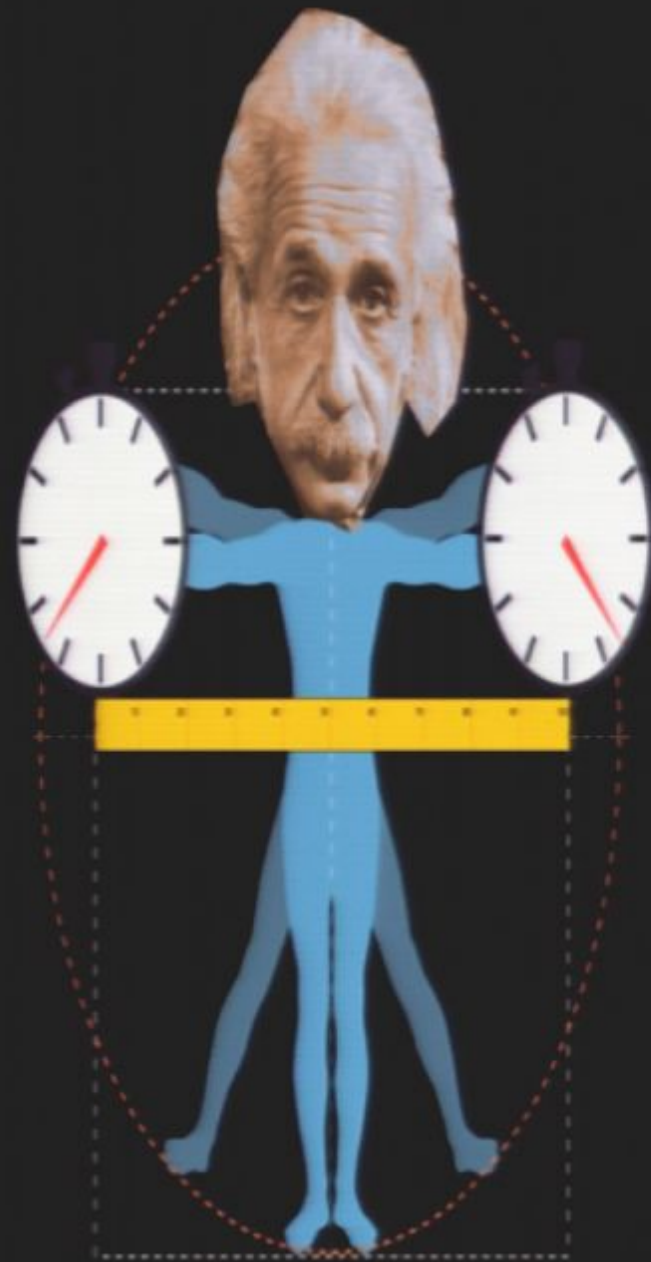






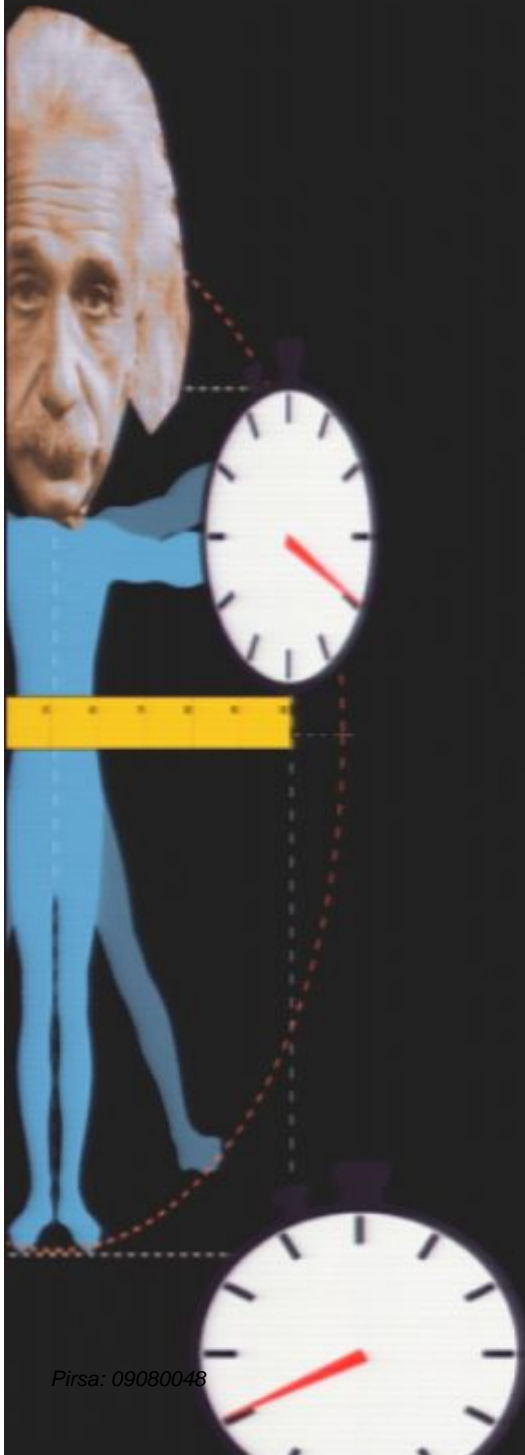


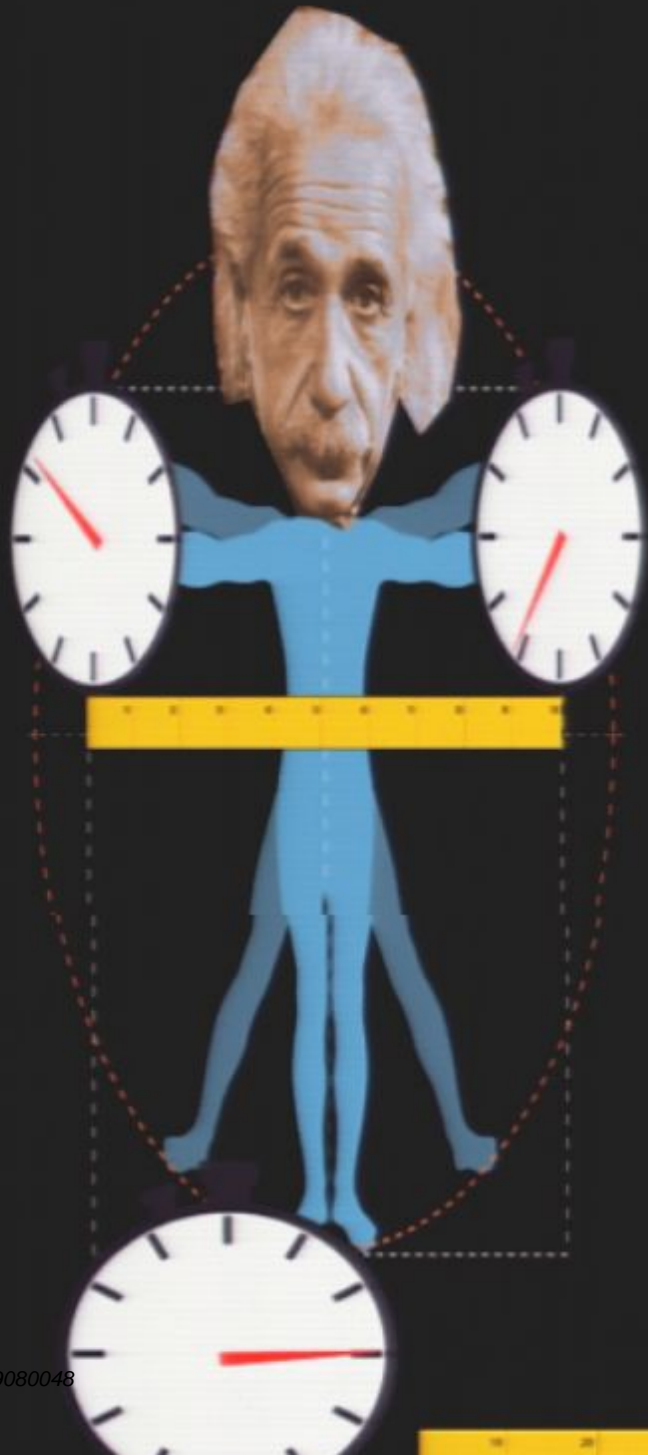


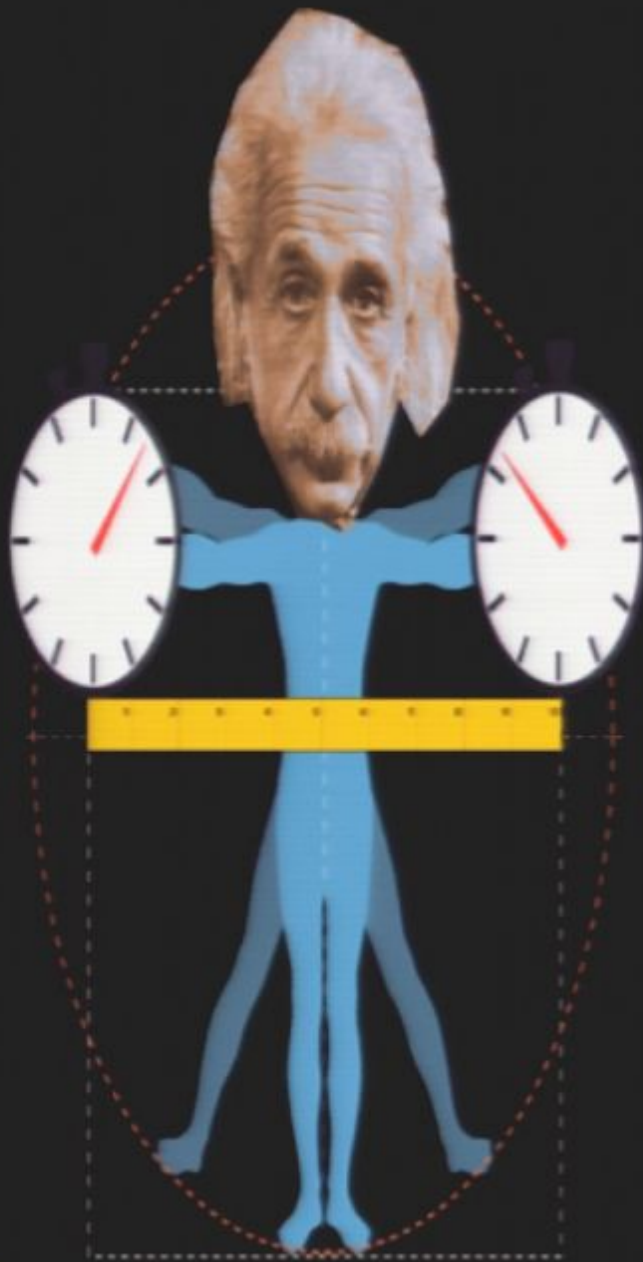


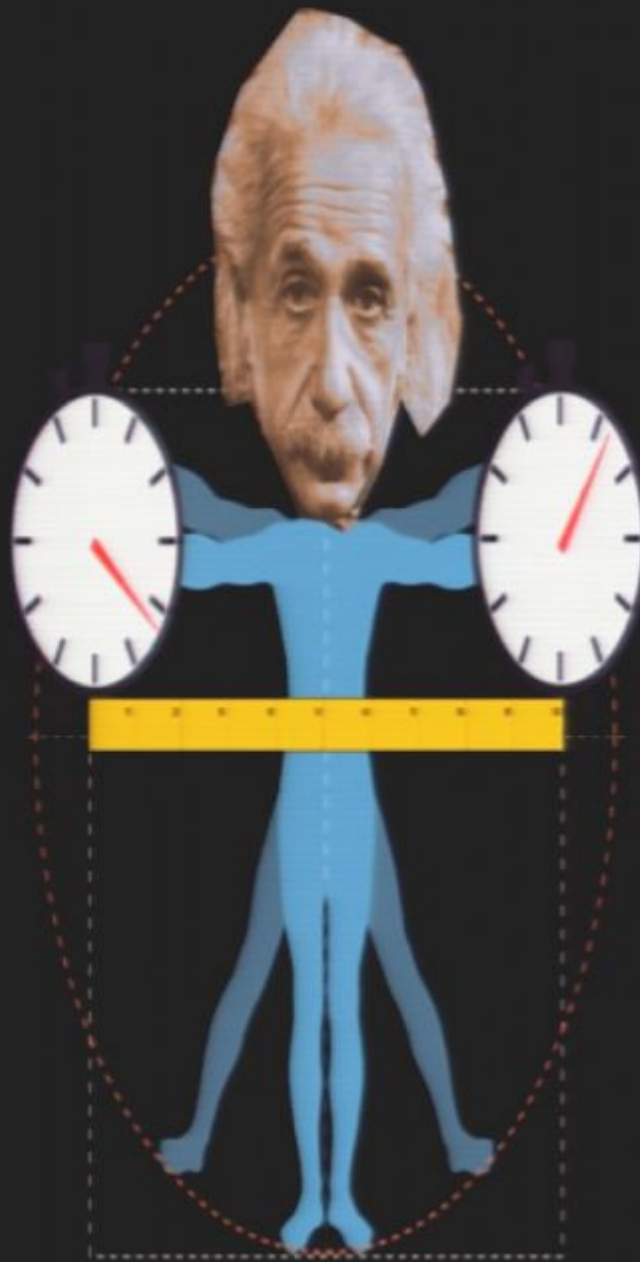


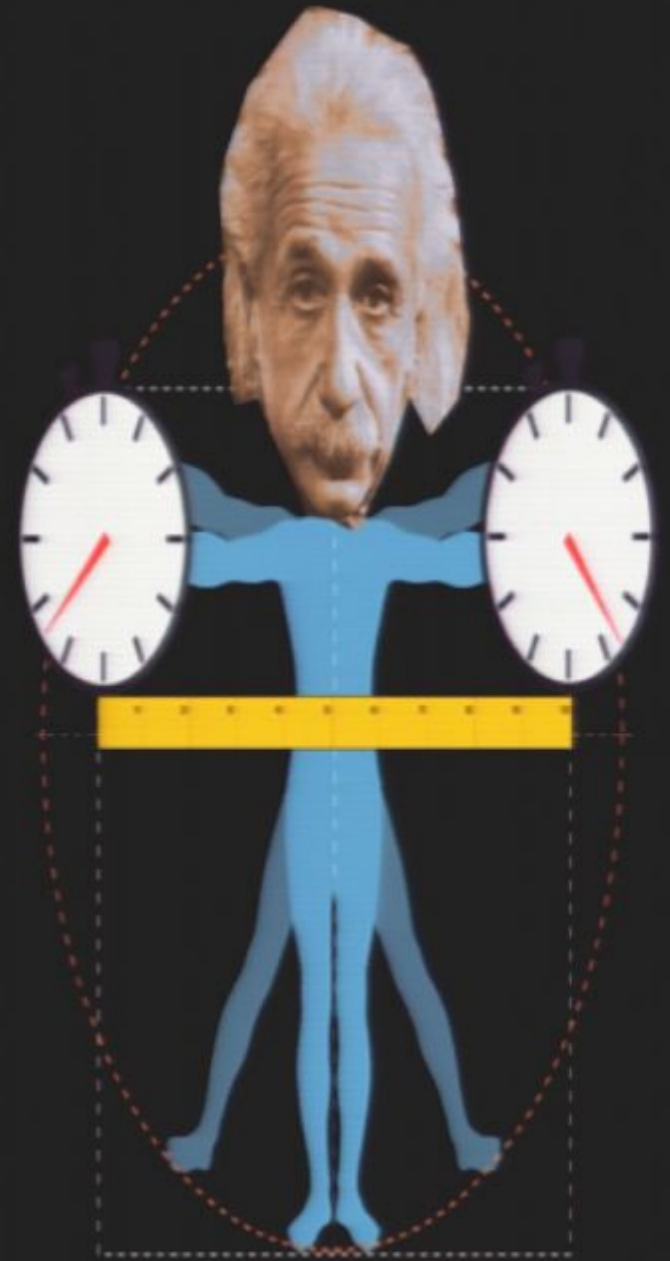










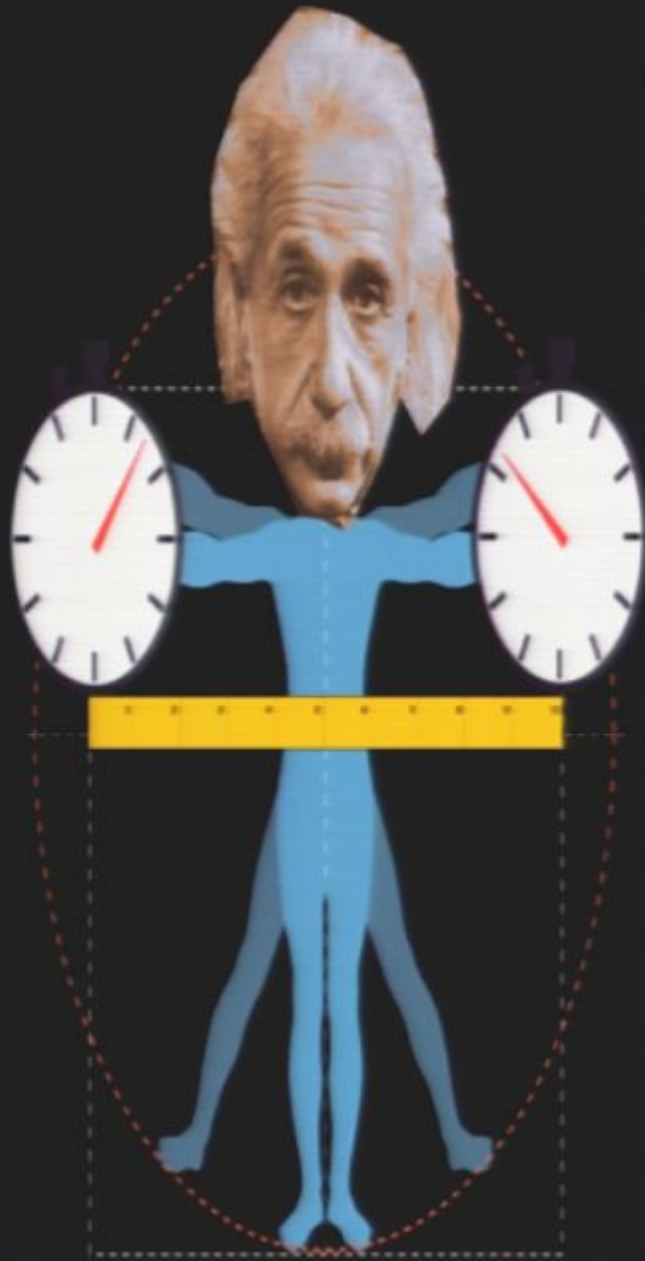












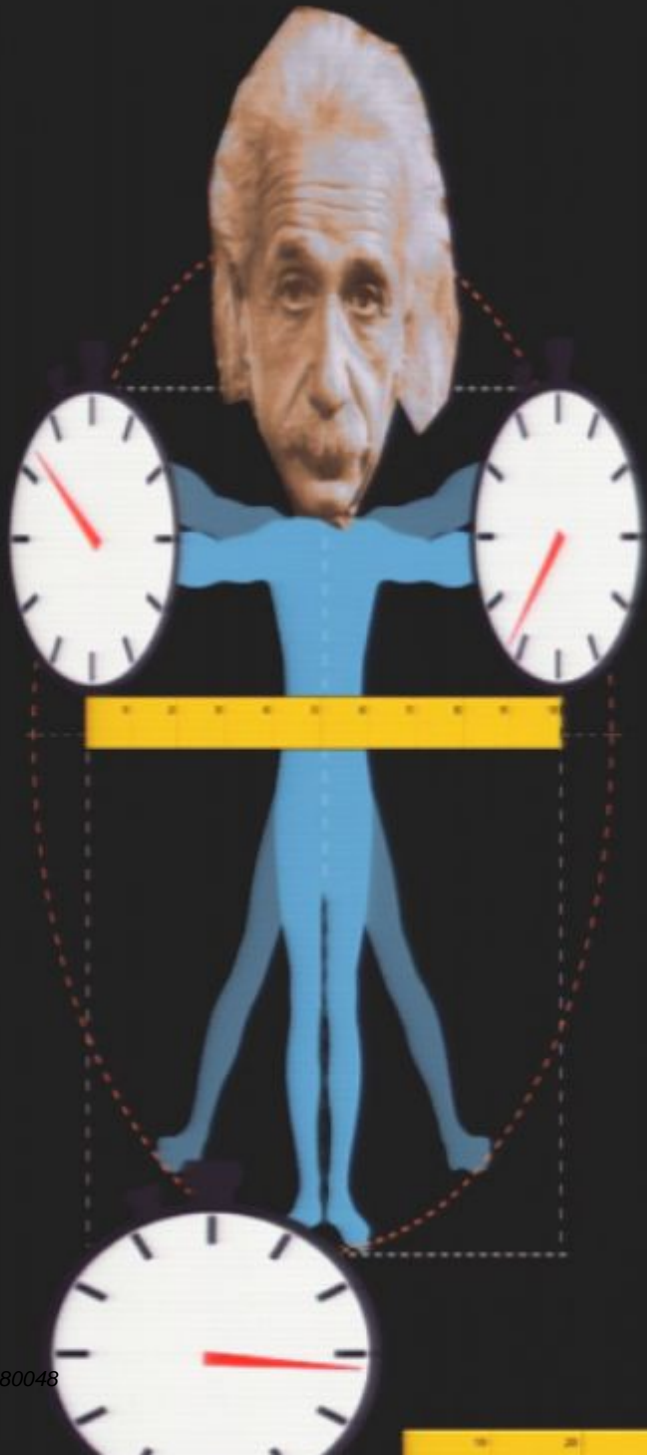


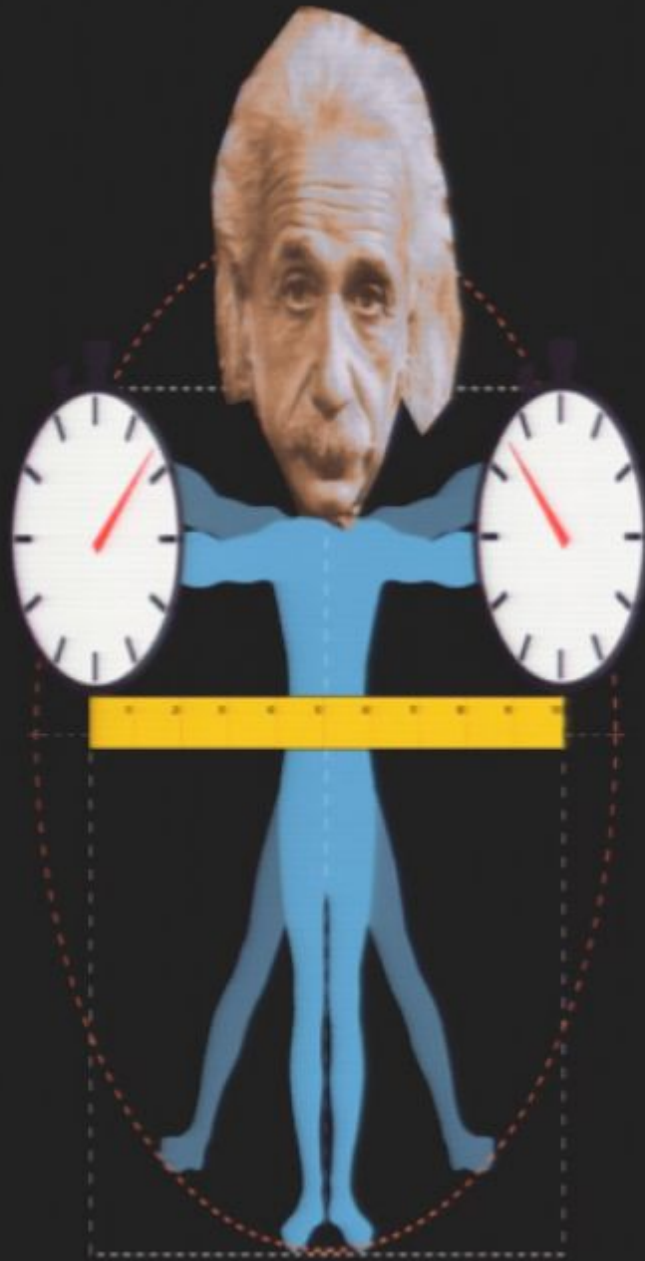


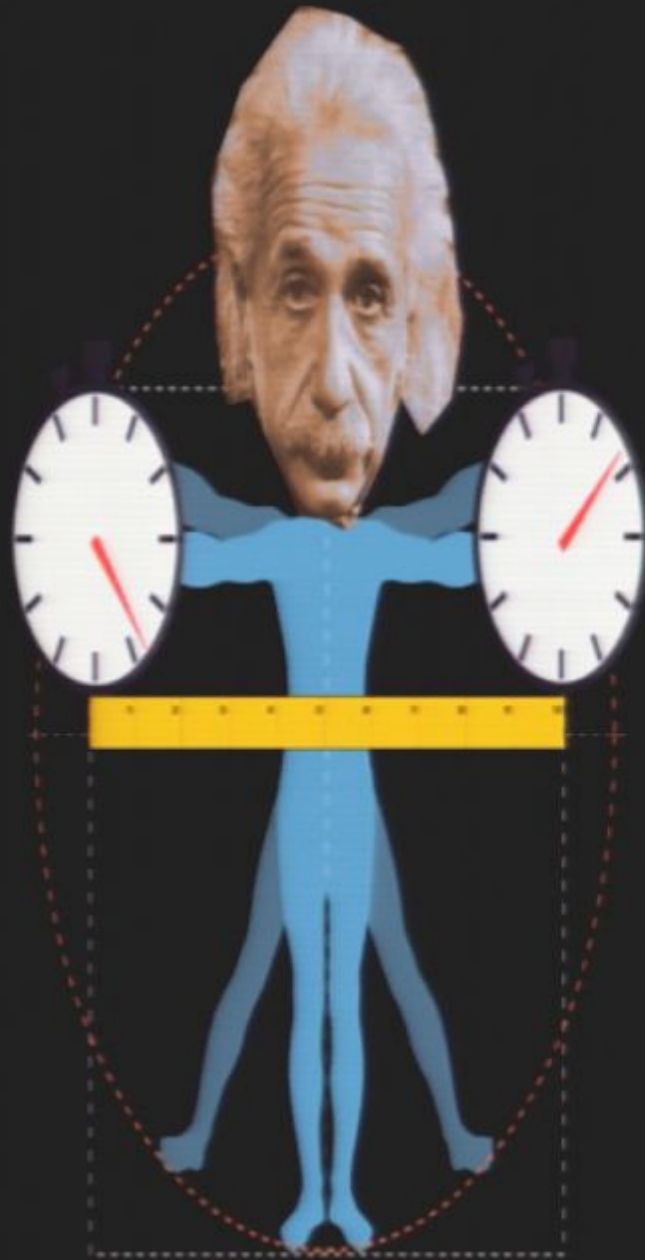








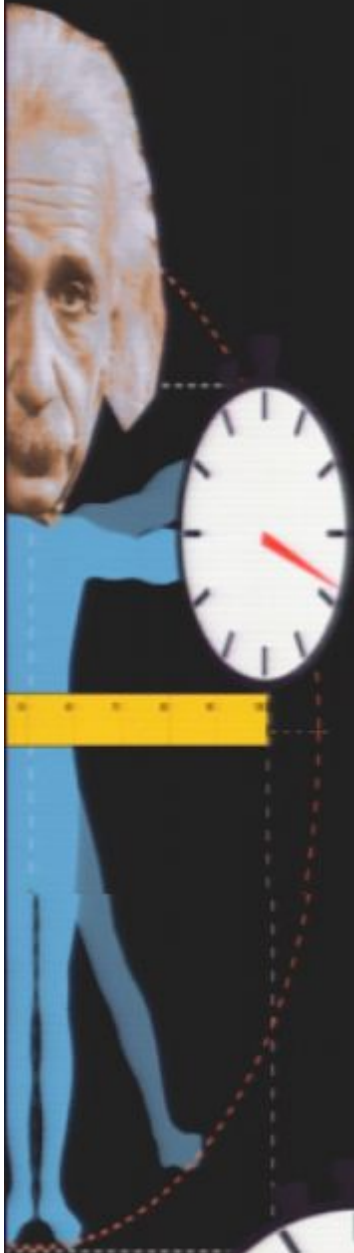


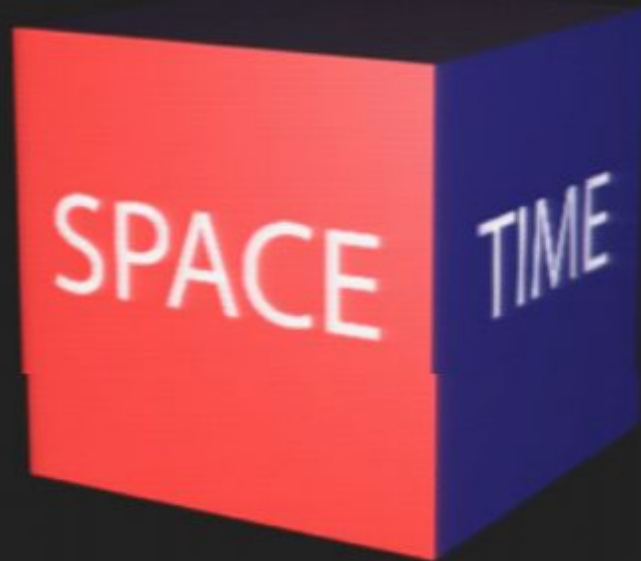












= 0 ←

crest

Space time Diagrams

$= 0 \leftarrow$

Crest

Space time Diagrams

~~Universal Time~~



= 0 ←

crest

Space time Diagrams

~~Universal Time~~

SR



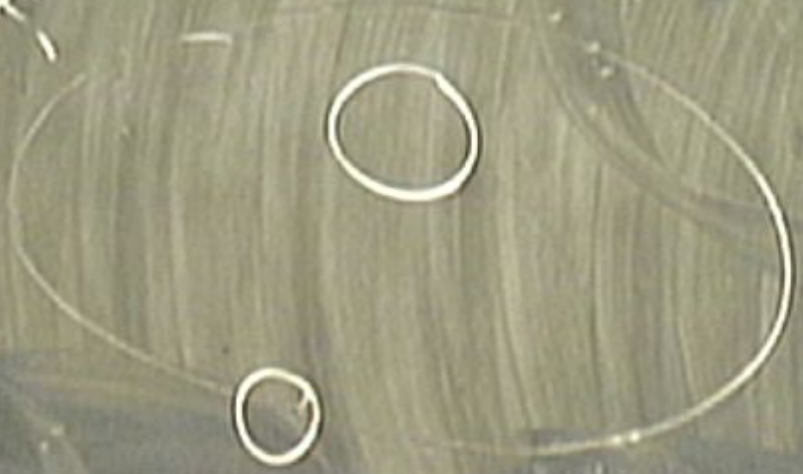
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crest

Space time Diagrams

~~Universal Time~~

SR

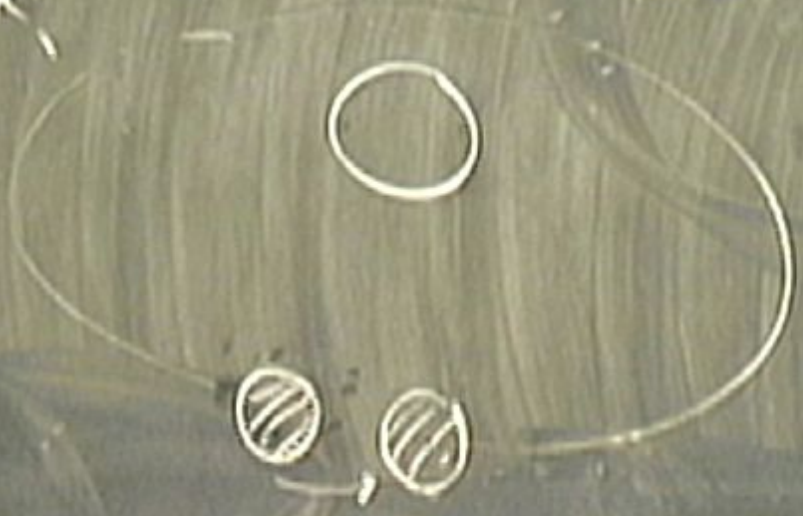


= 0 ←

crest

Space time Diagrams

~~Universal Time~~
SR



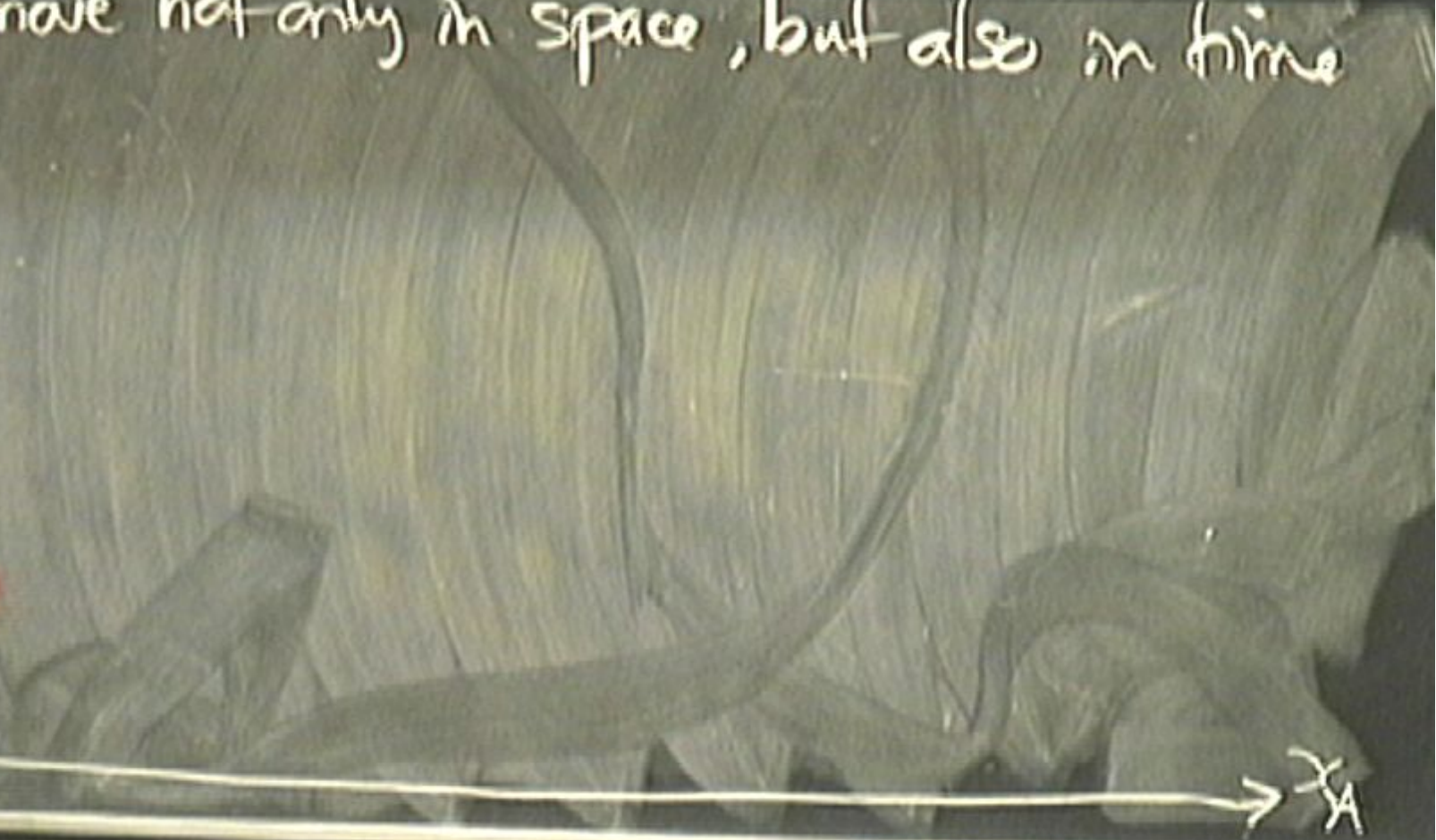
objects move not only in space, but also in time

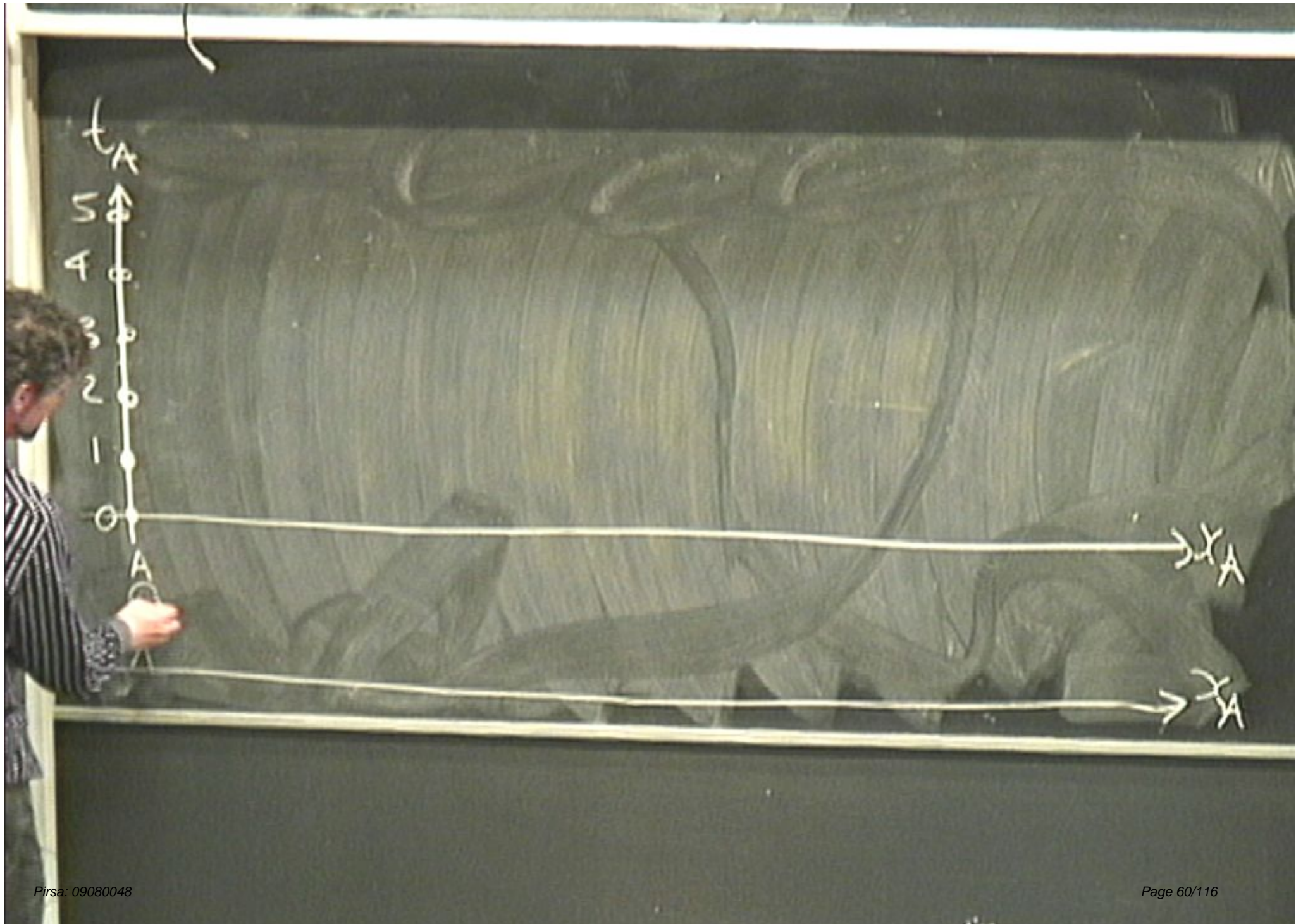
objects move not only in space, but also in time

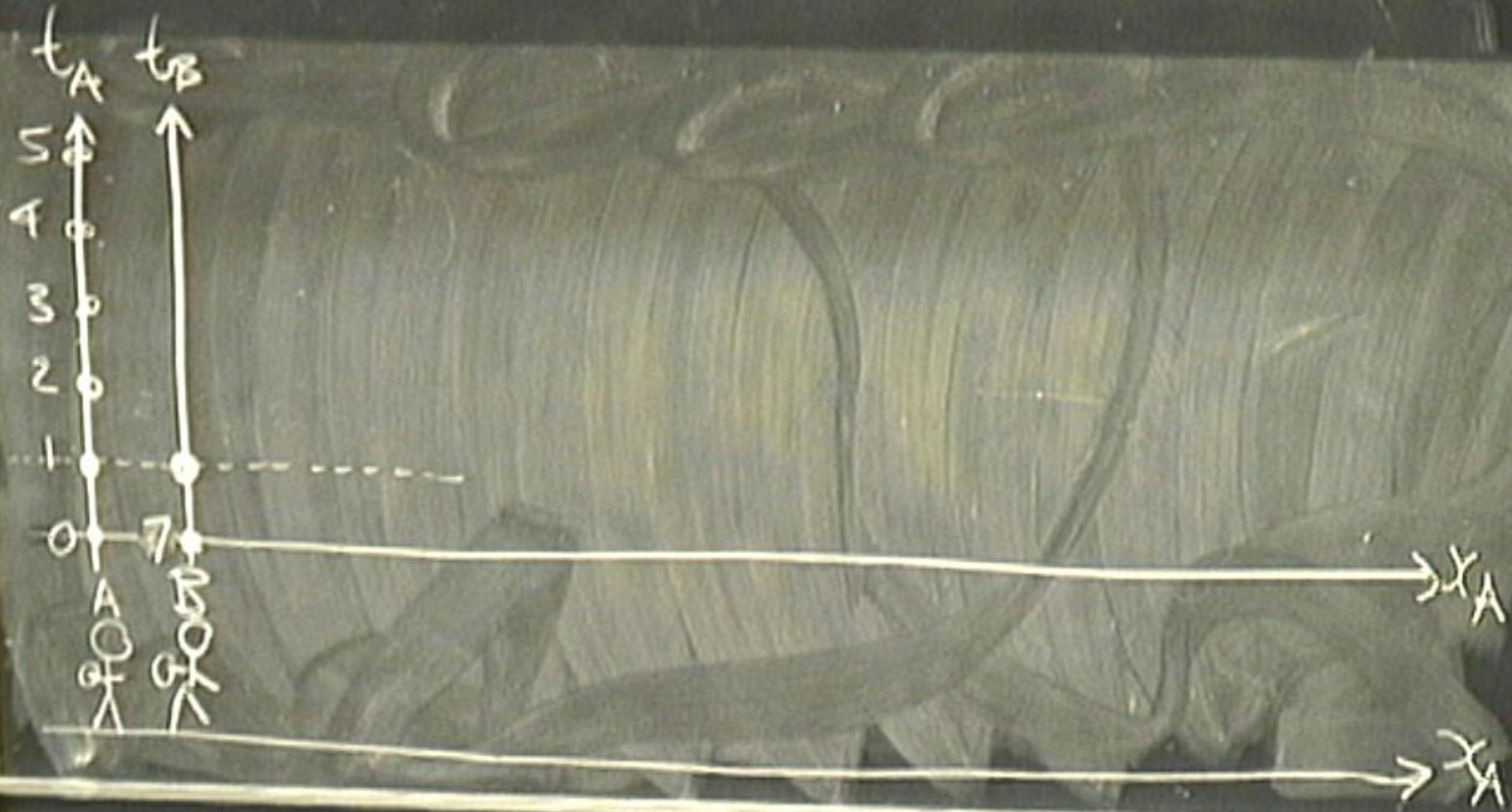
A

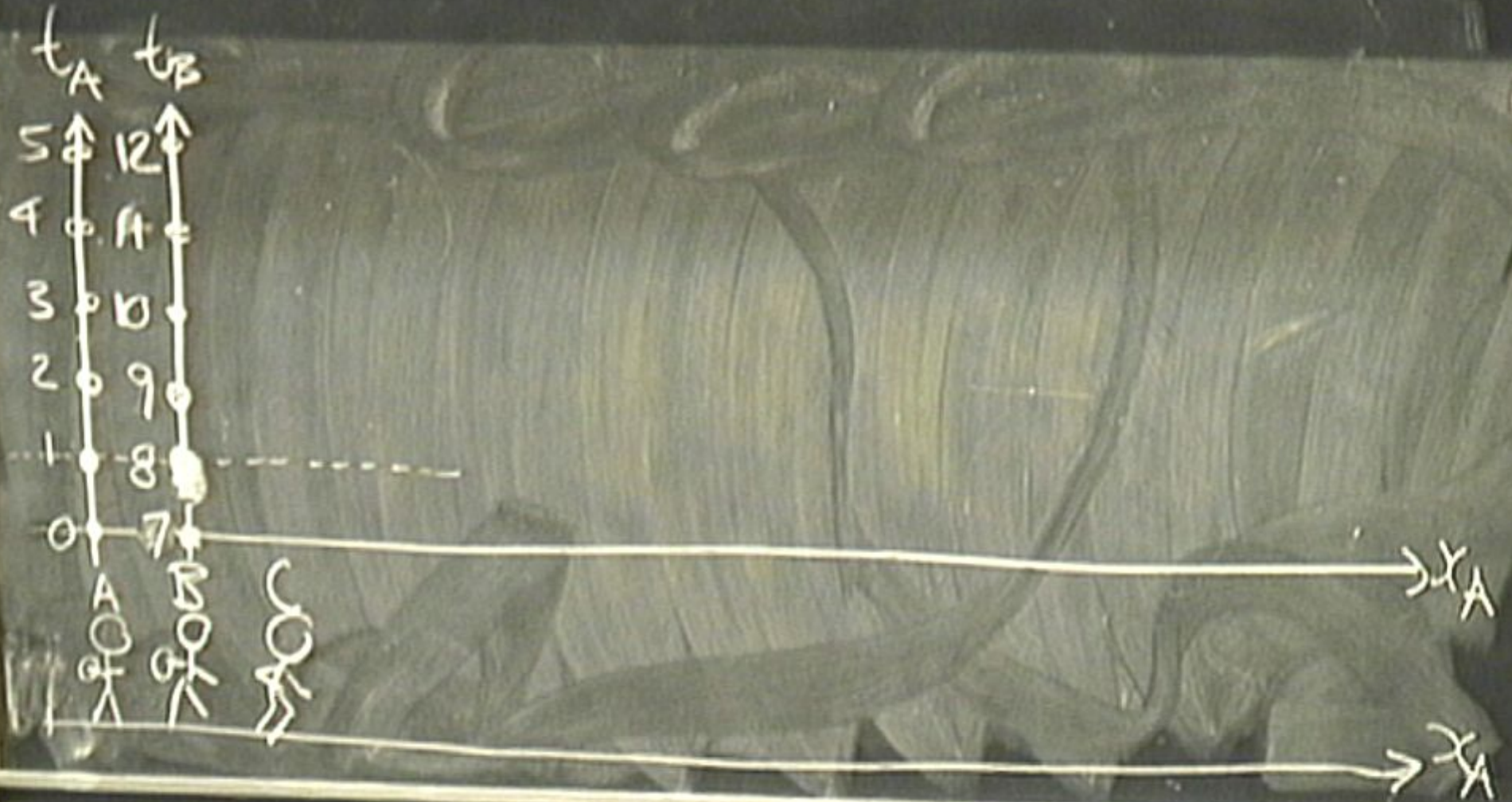


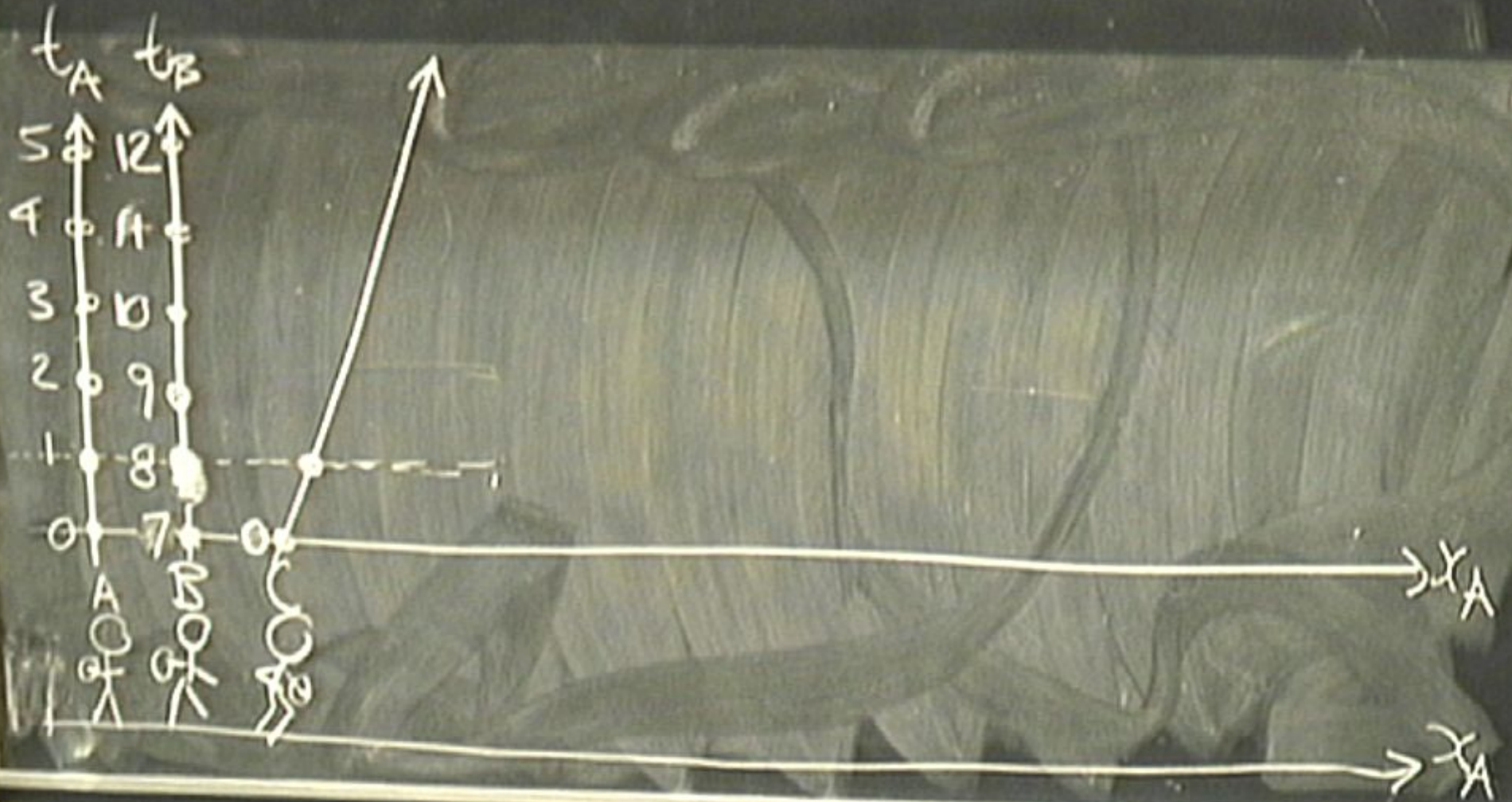
objects move not only in space, but also in time

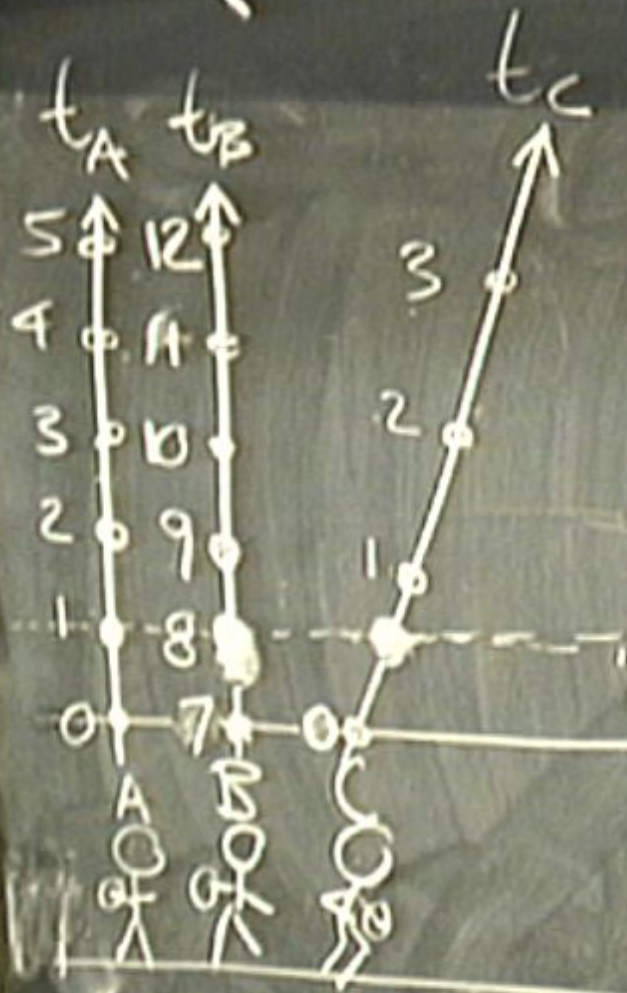


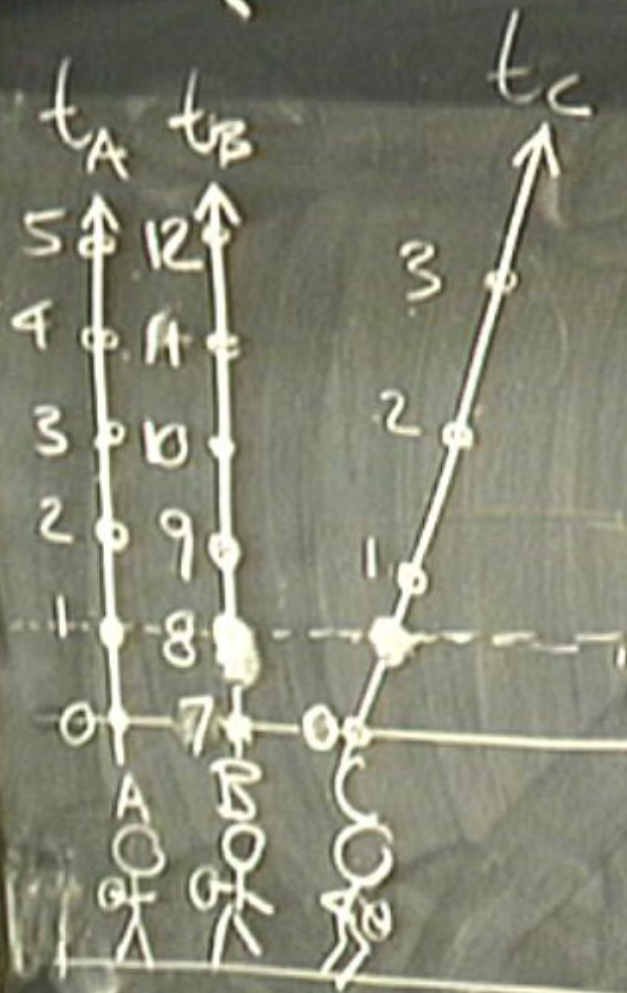






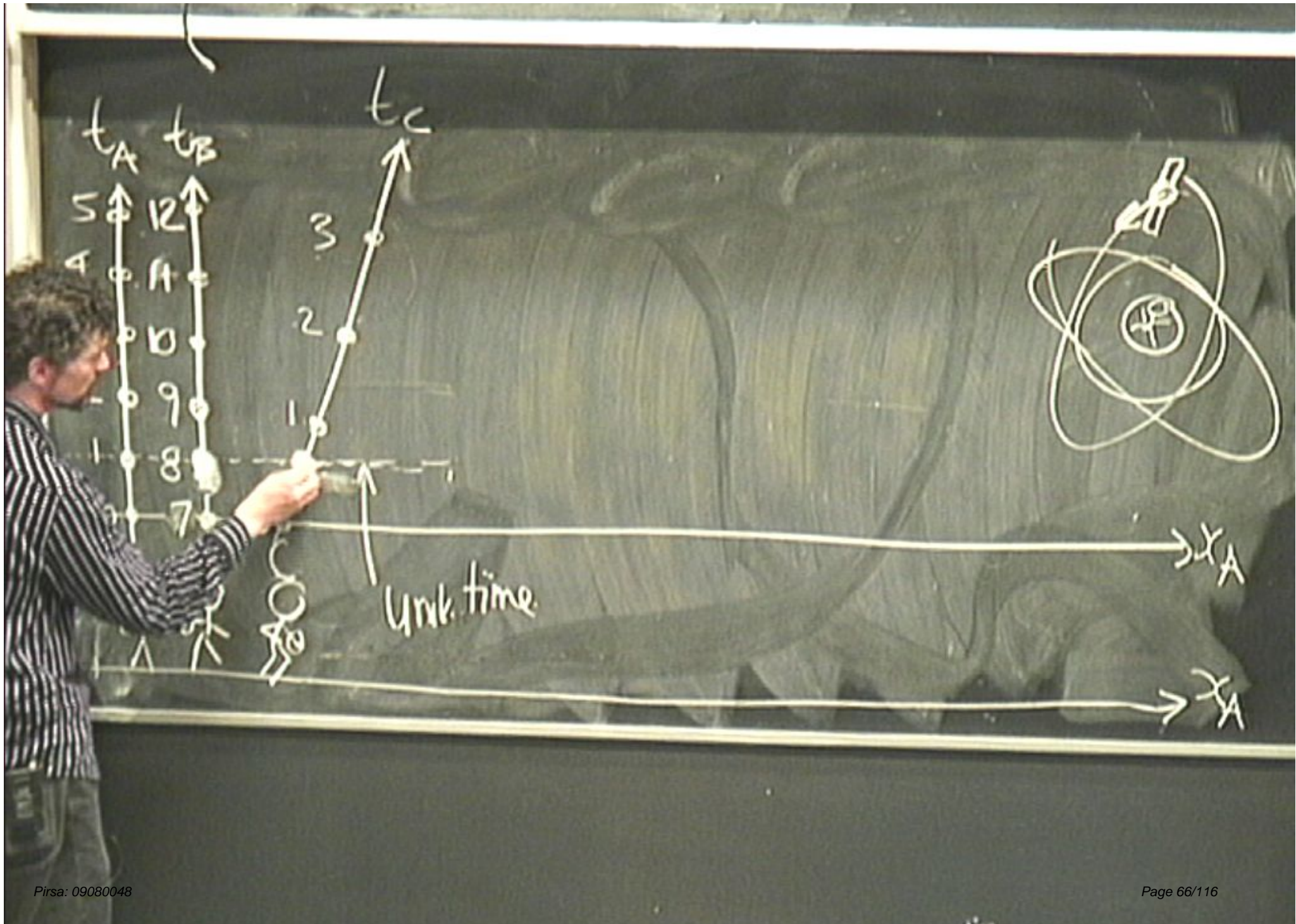


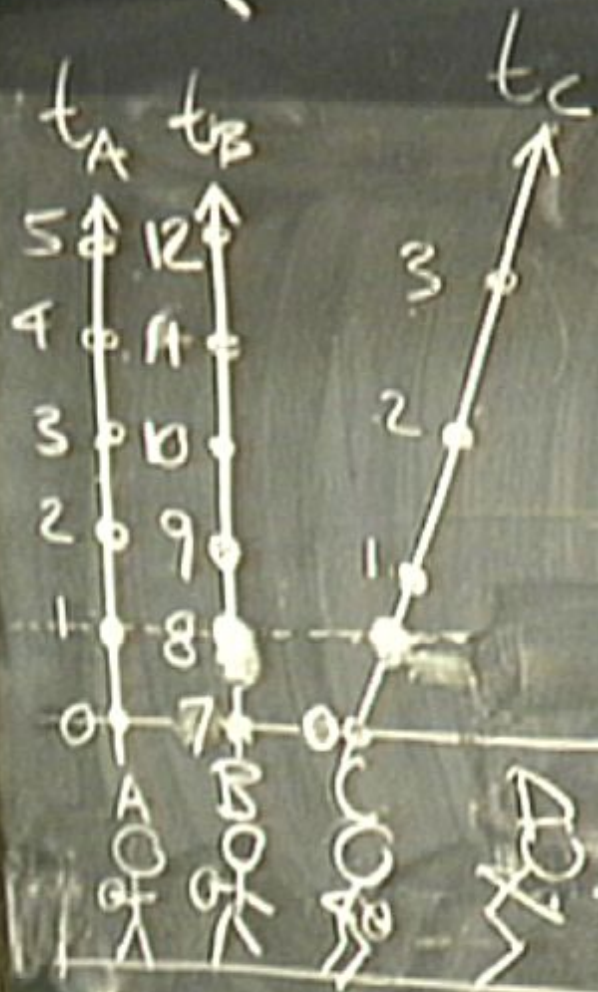




x_A

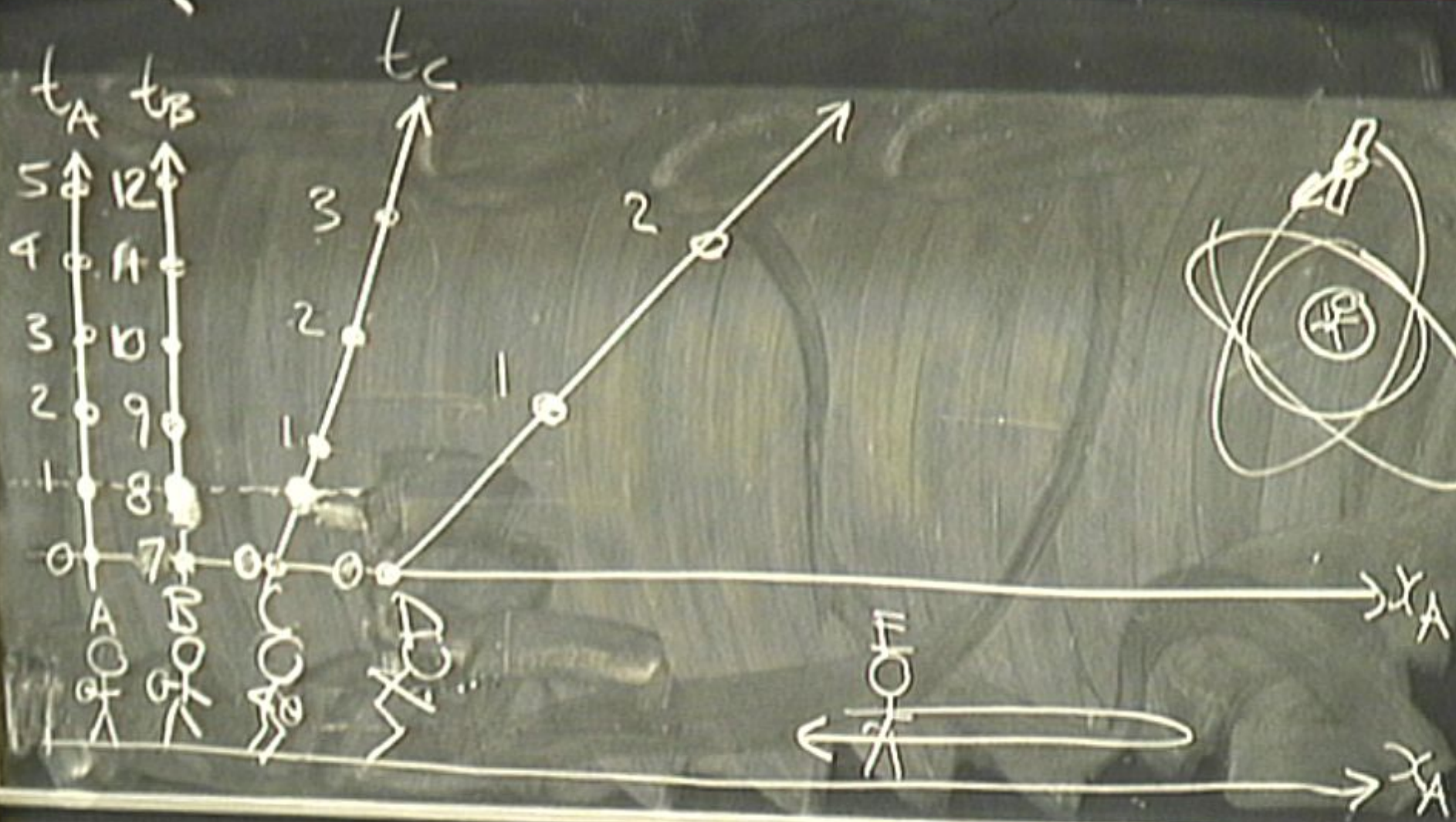
x_A

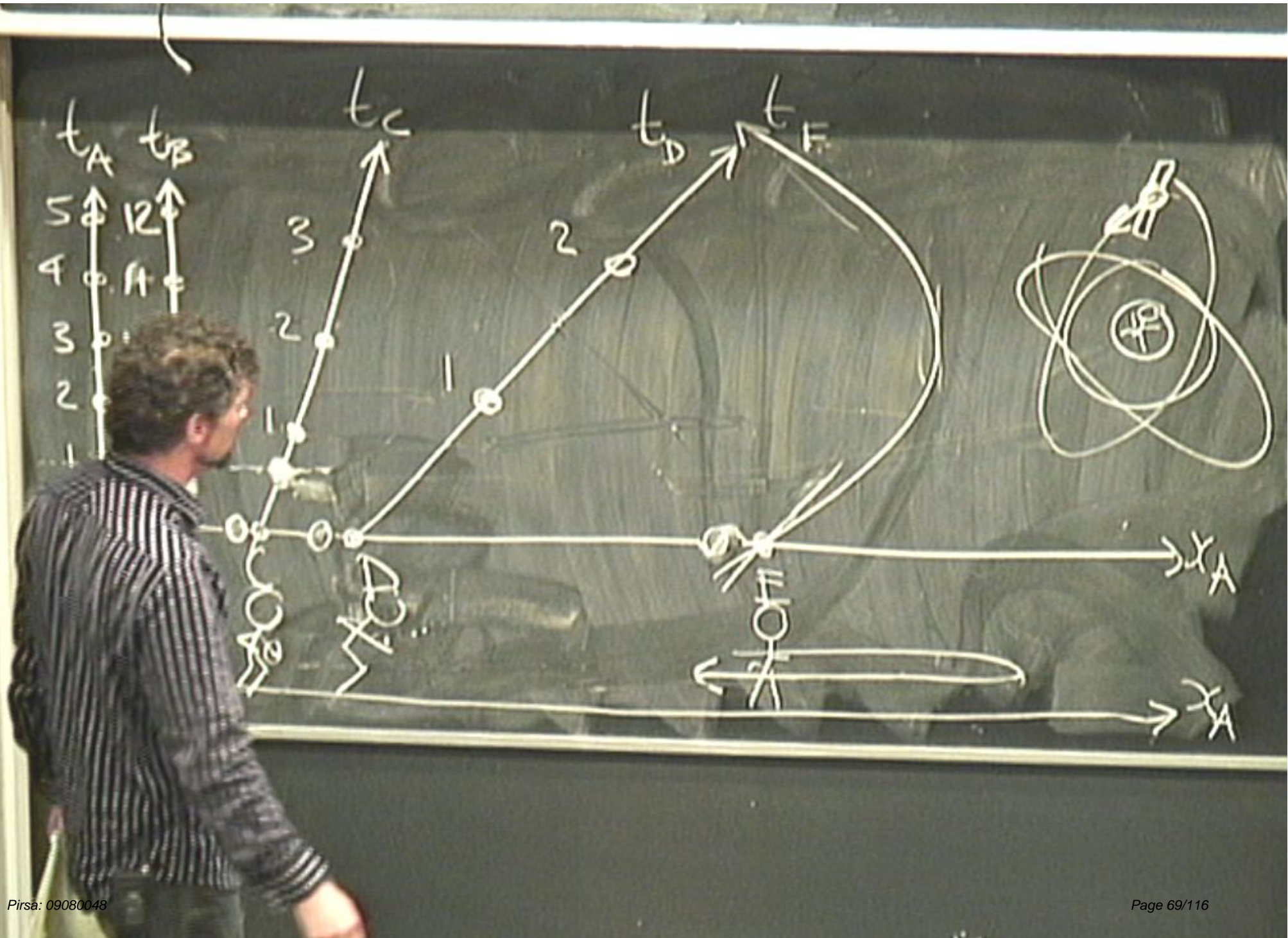


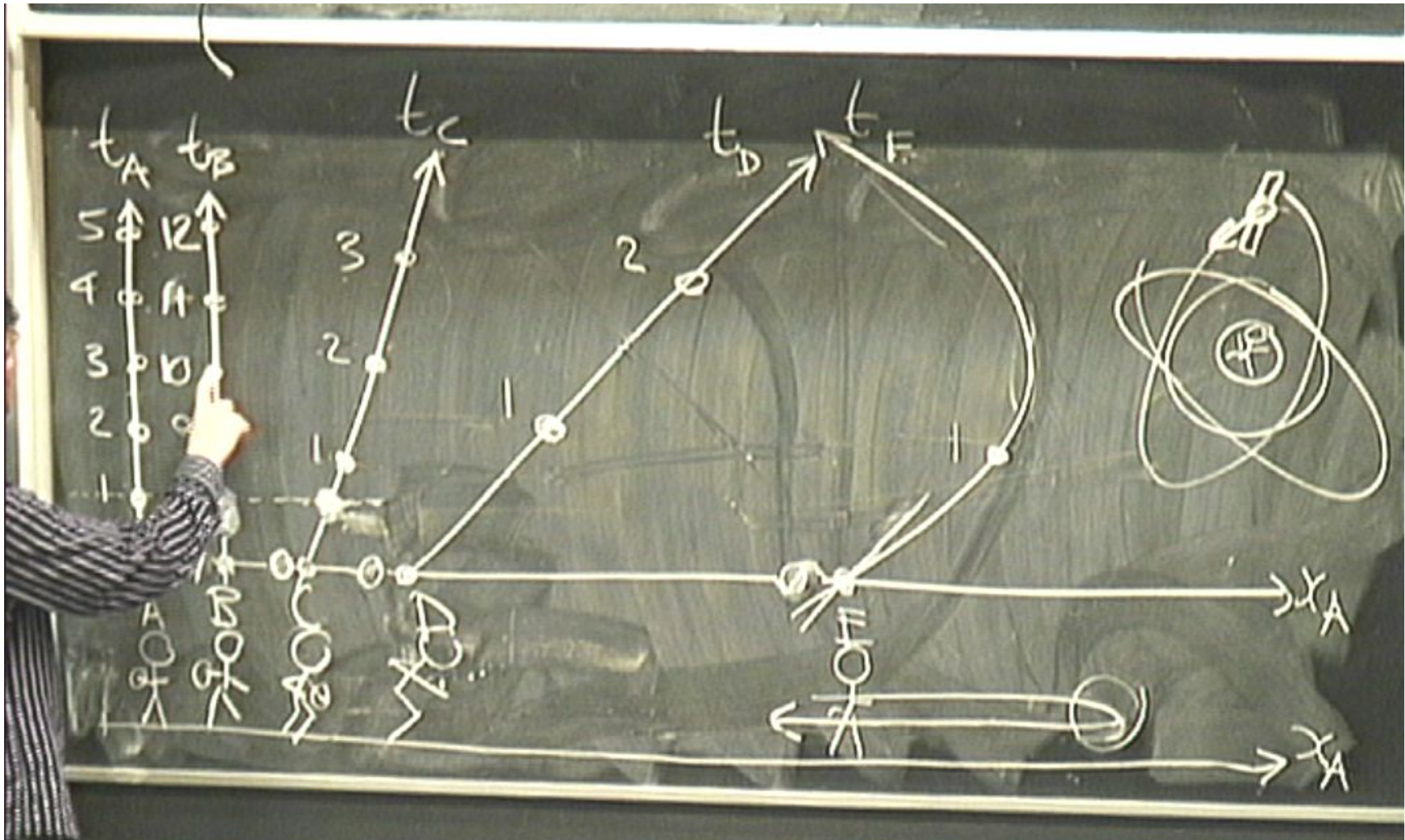


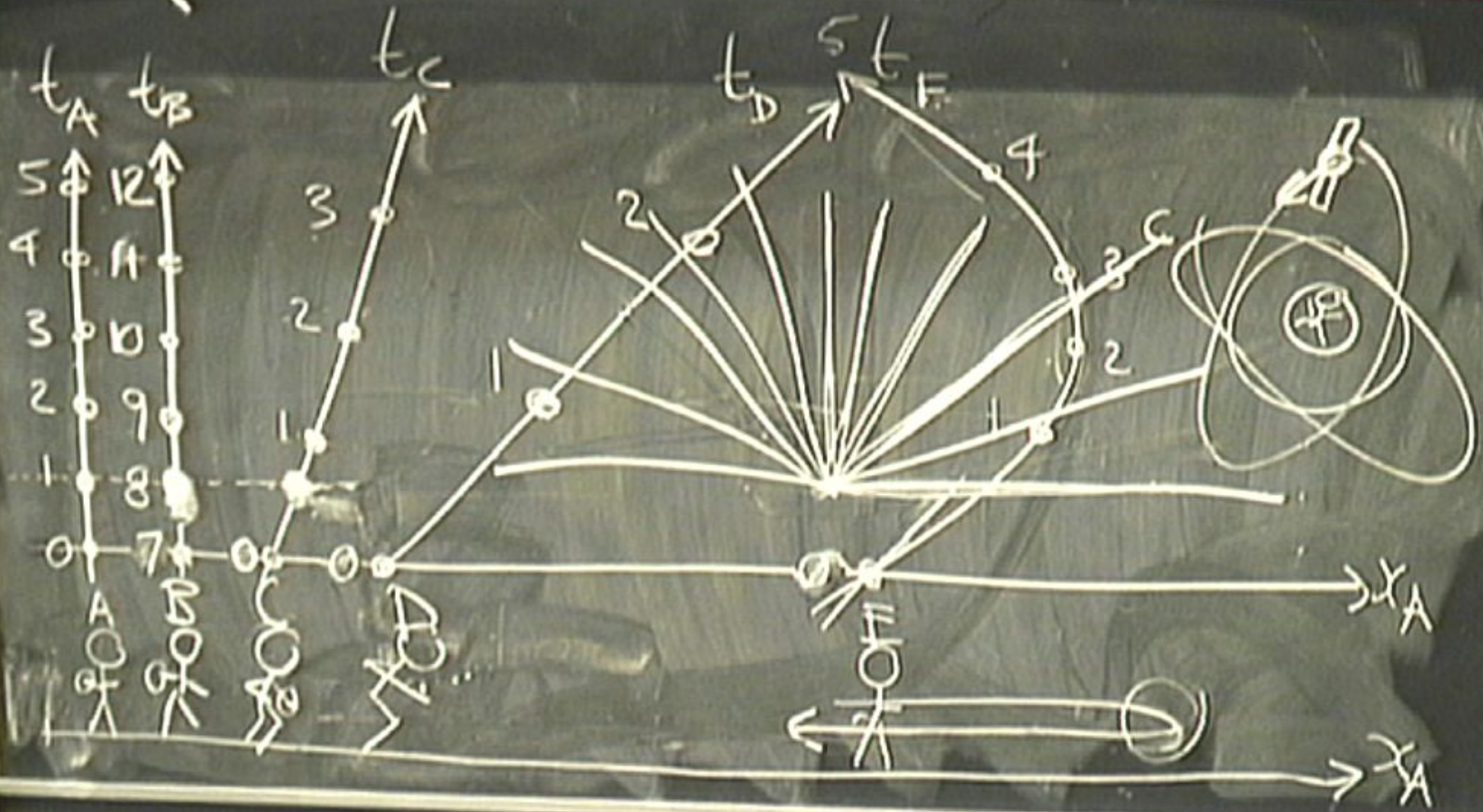
x_A

x_A

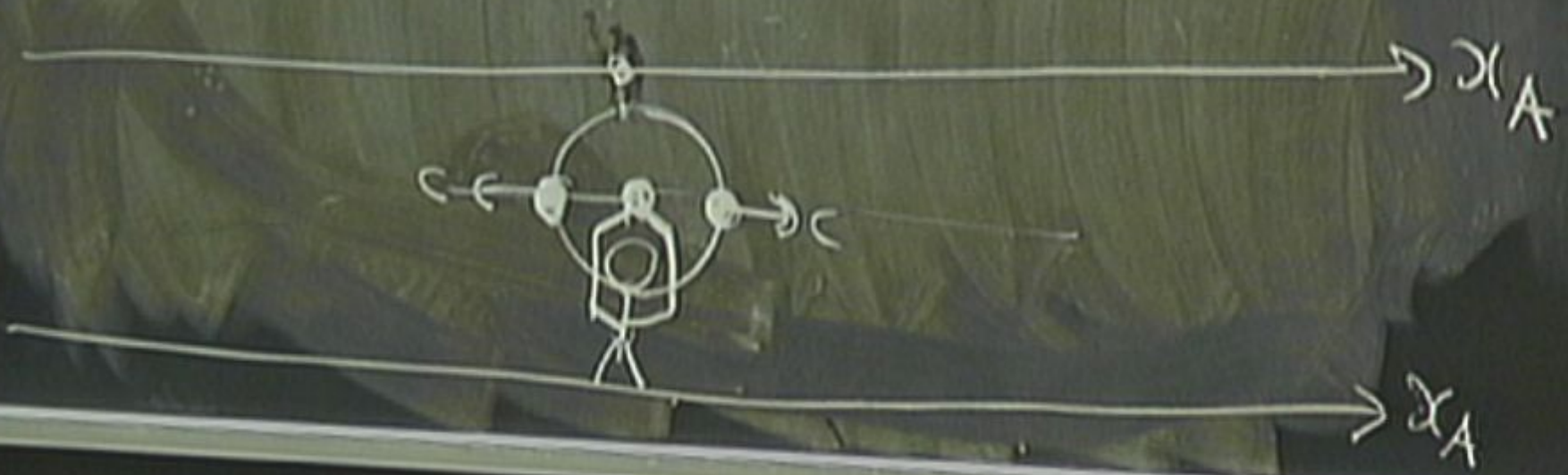






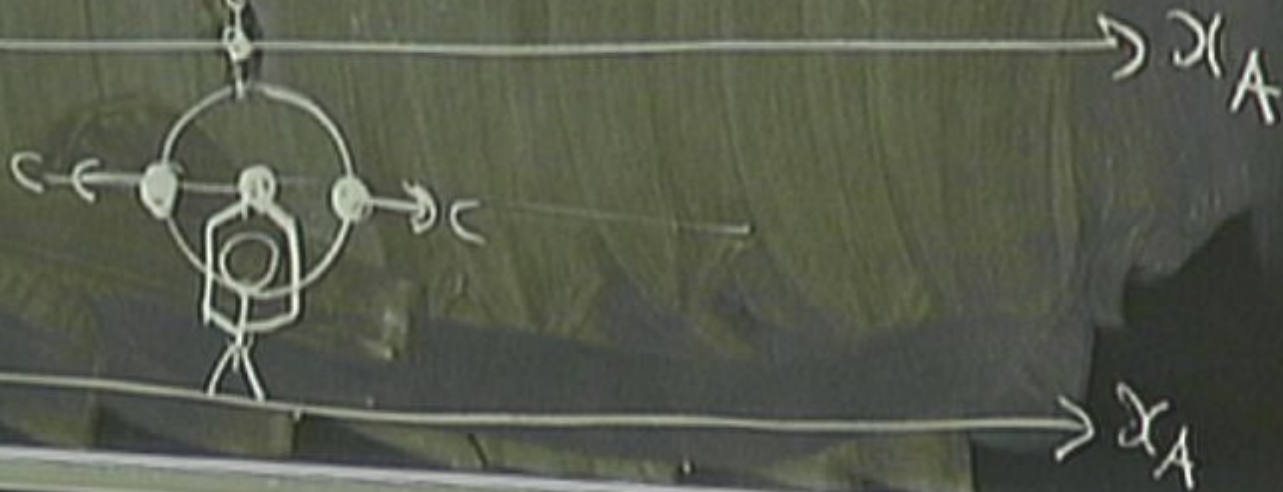


Sound in Air

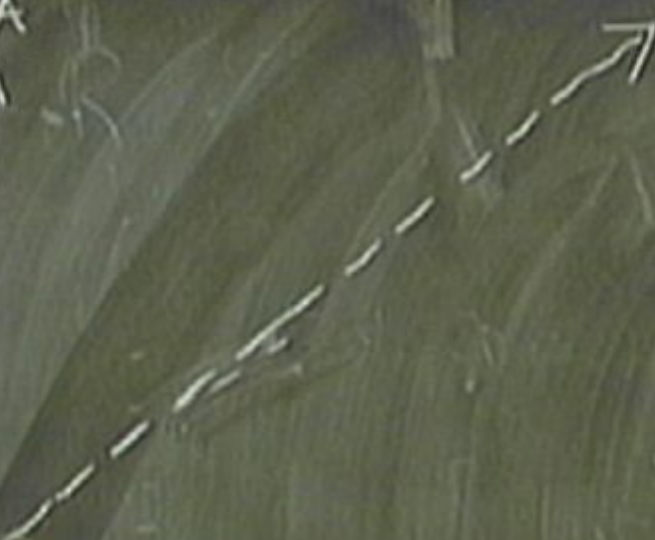


Sound in Air

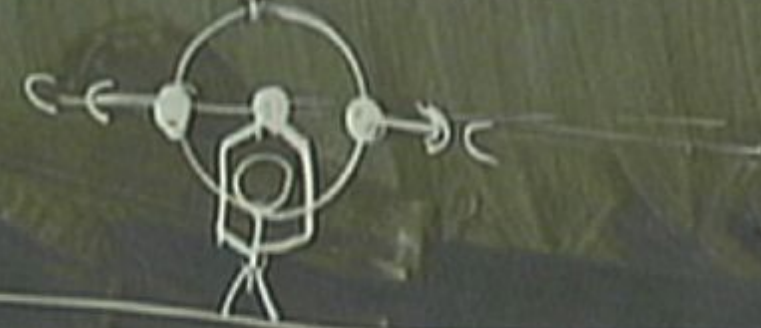
t_A



ct_A



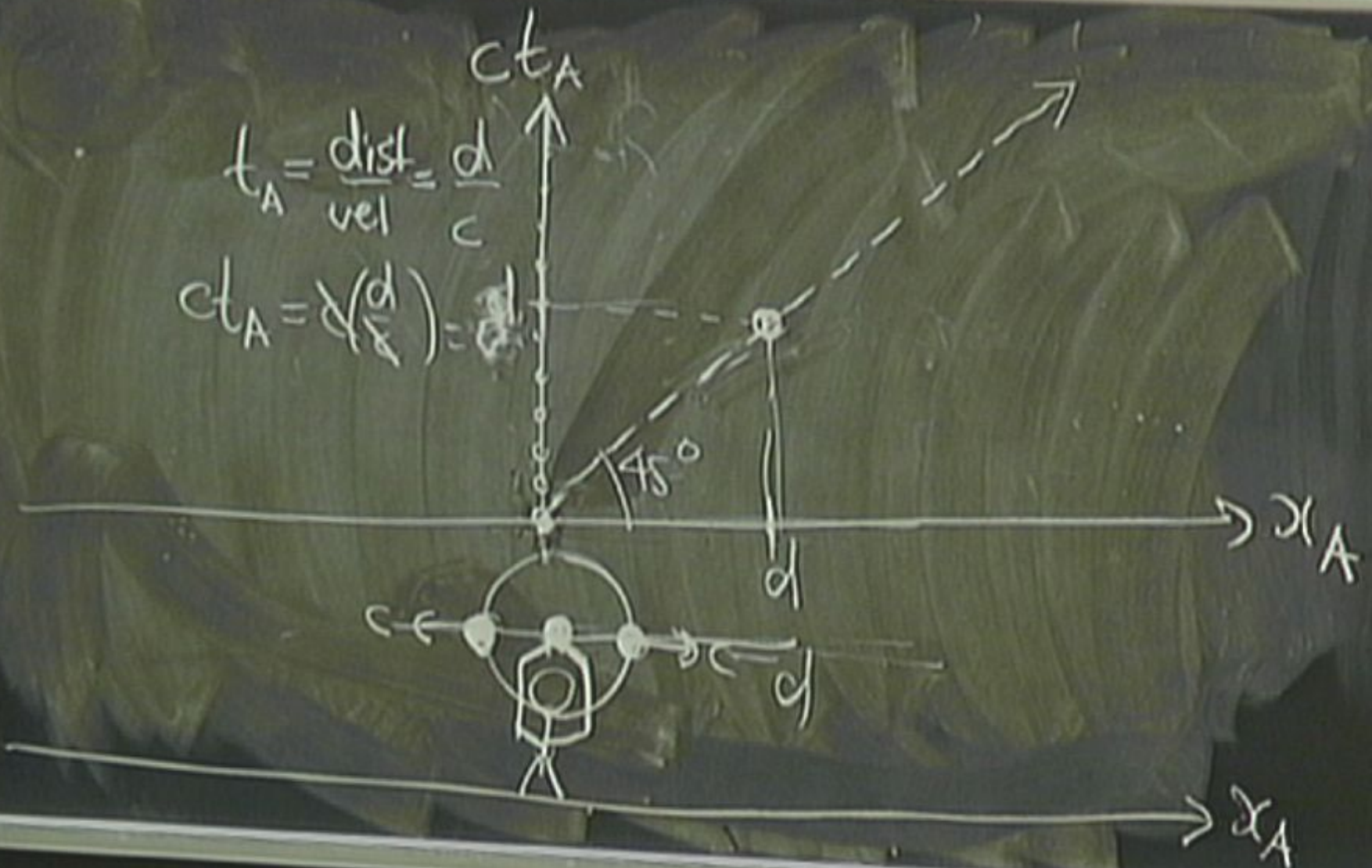
x_A

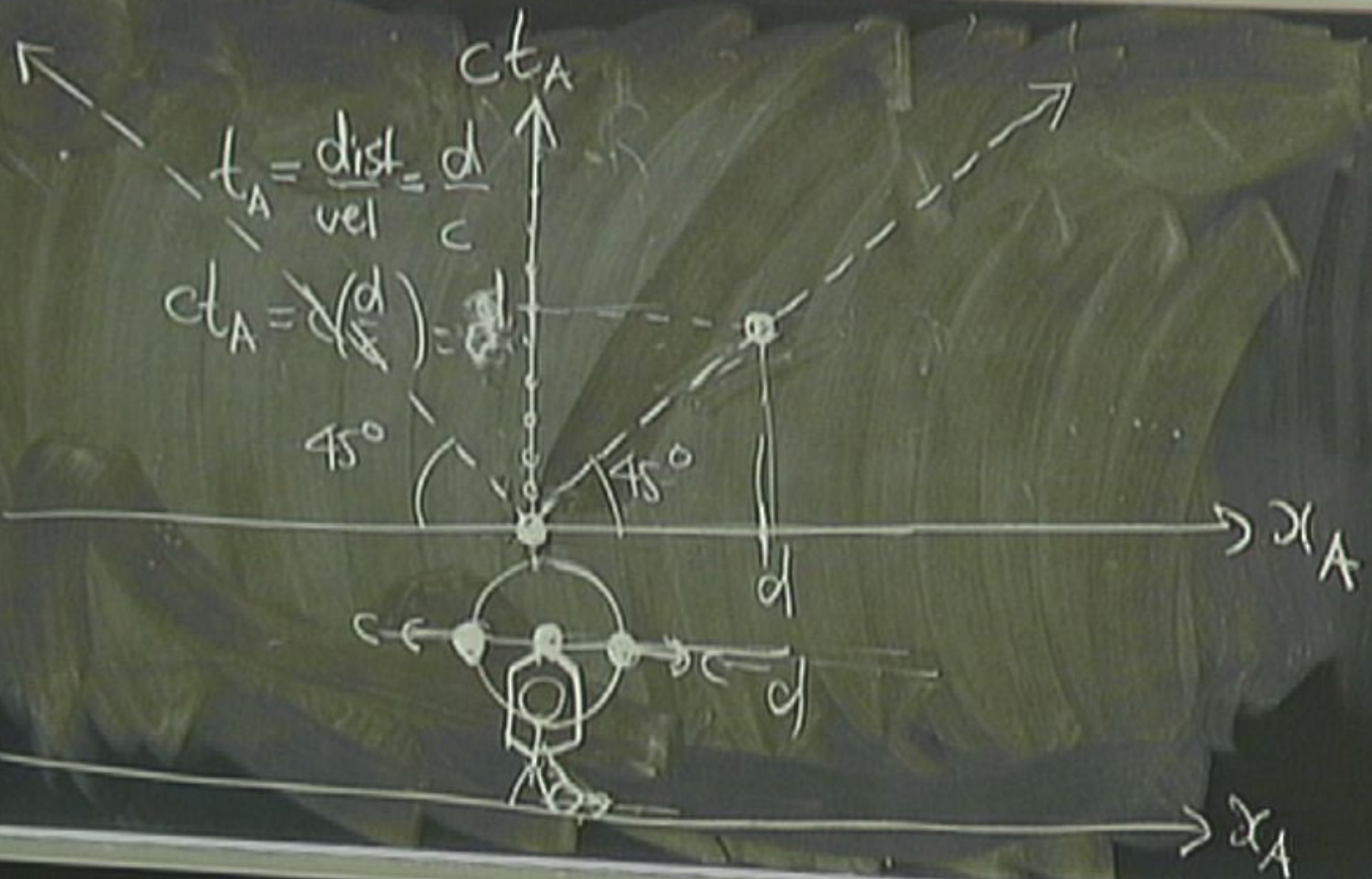


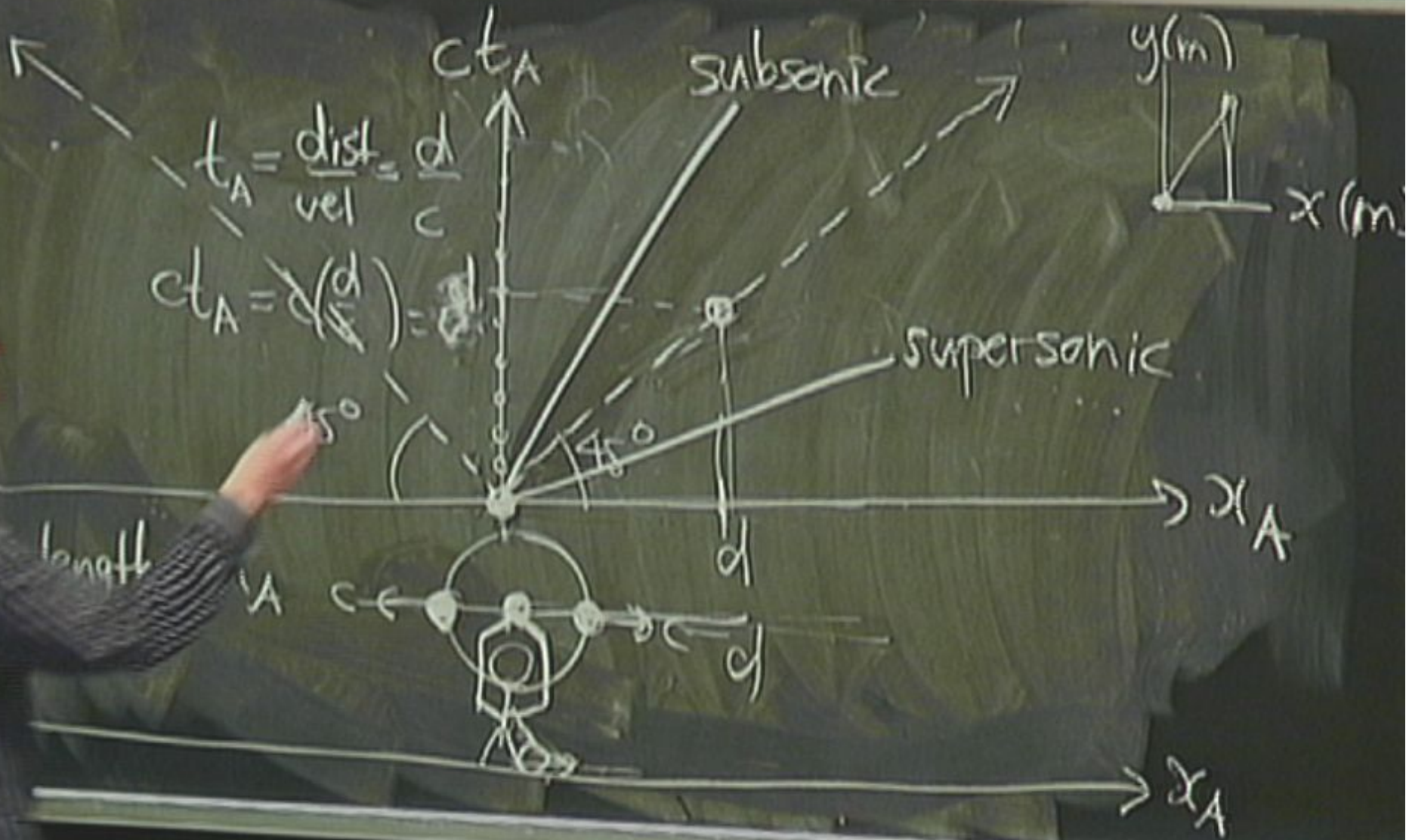
x_A

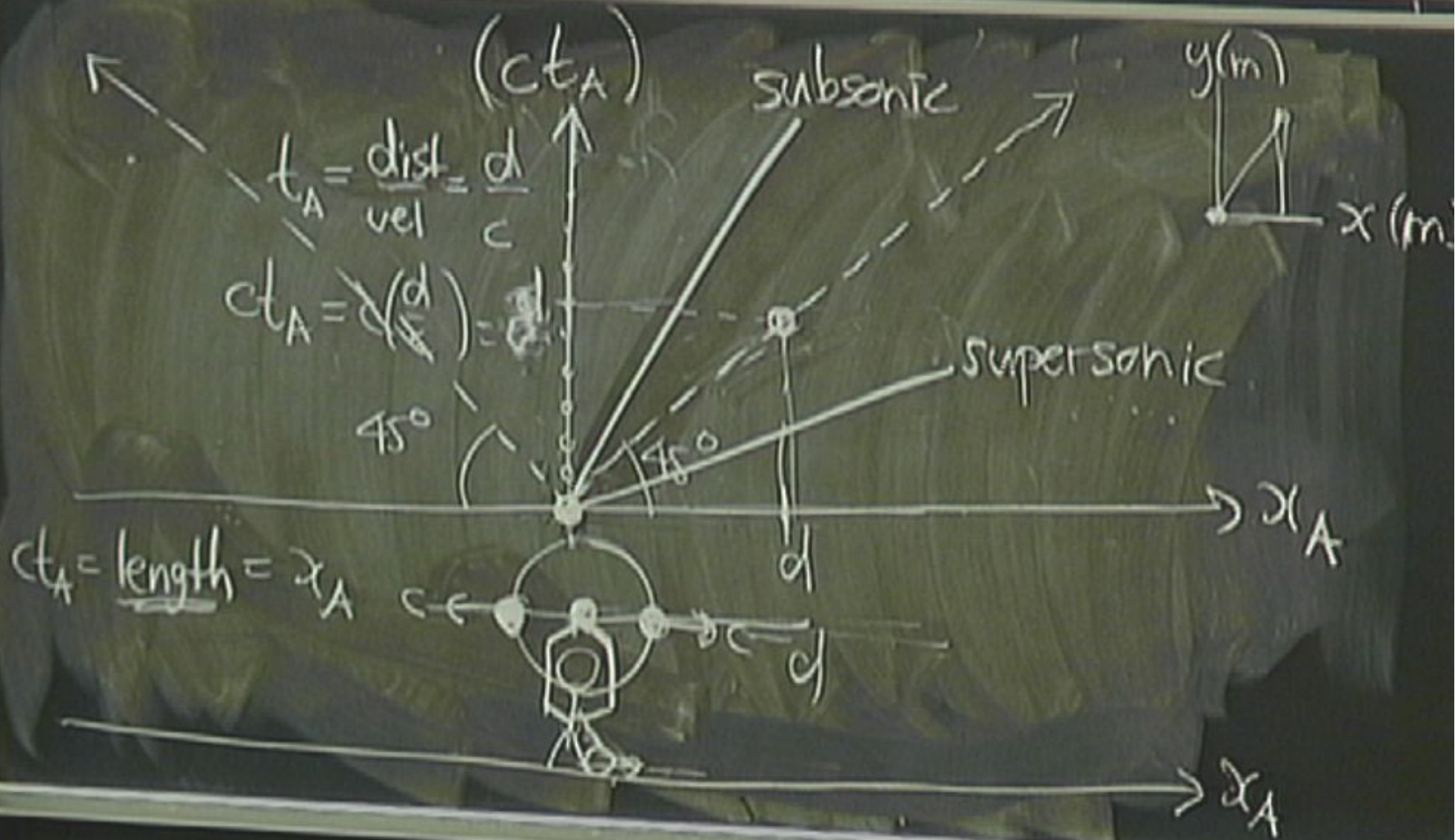
$$t_A = \frac{\text{dist}}{\text{vel}} = \frac{d}{c}$$

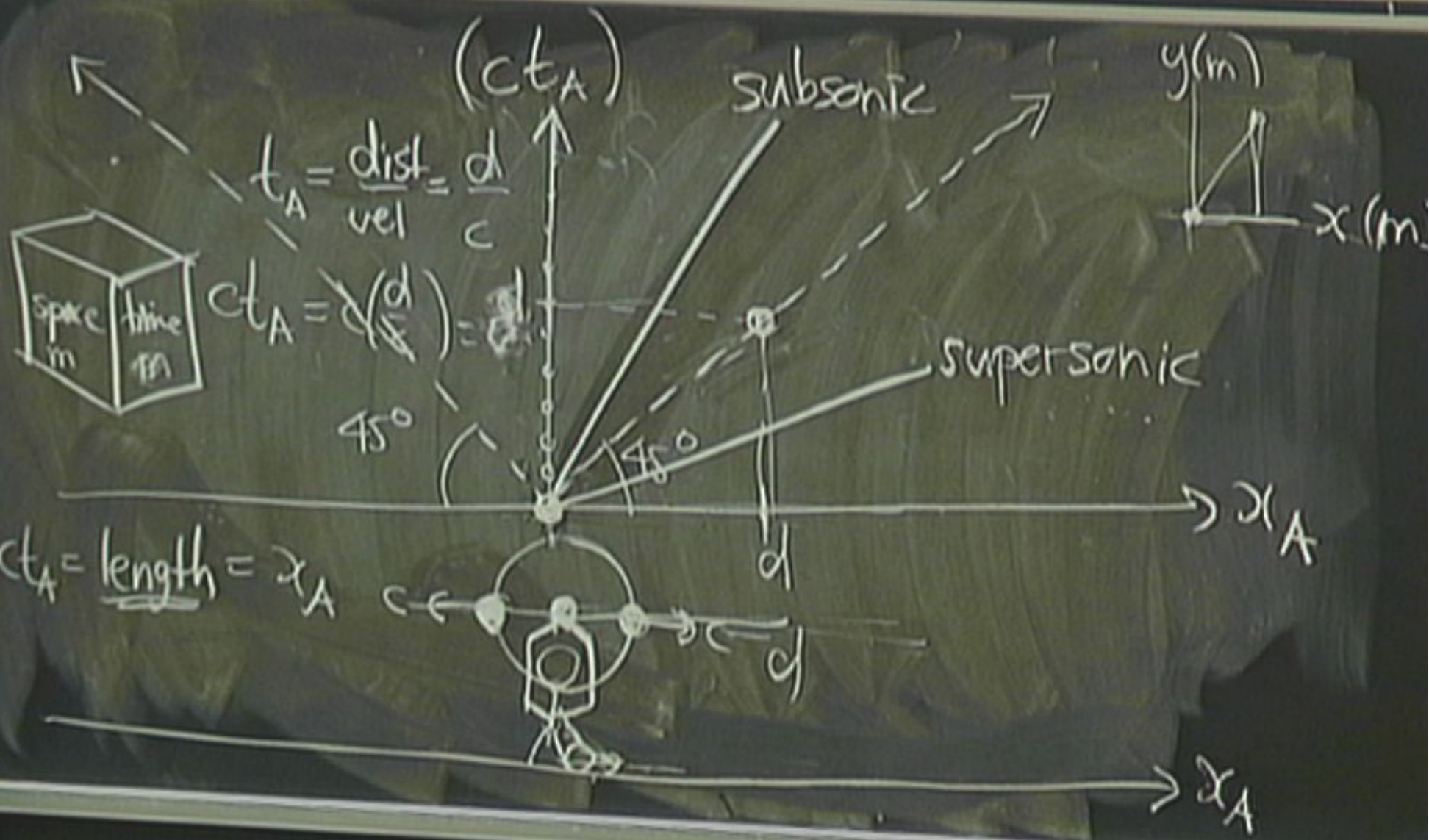
$$ct_A = \sqrt{\frac{d}{\cancel{c}}} = \frac{d}{\cancel{c}}$$











Key Thought Expt.

AC




Key Thought Expt.

A C B C U
X X



x_A

x_A

Key Thought Expt.

c_A

A C B C \cup
X X

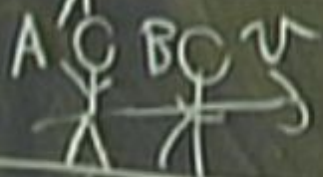


x_A

x_A

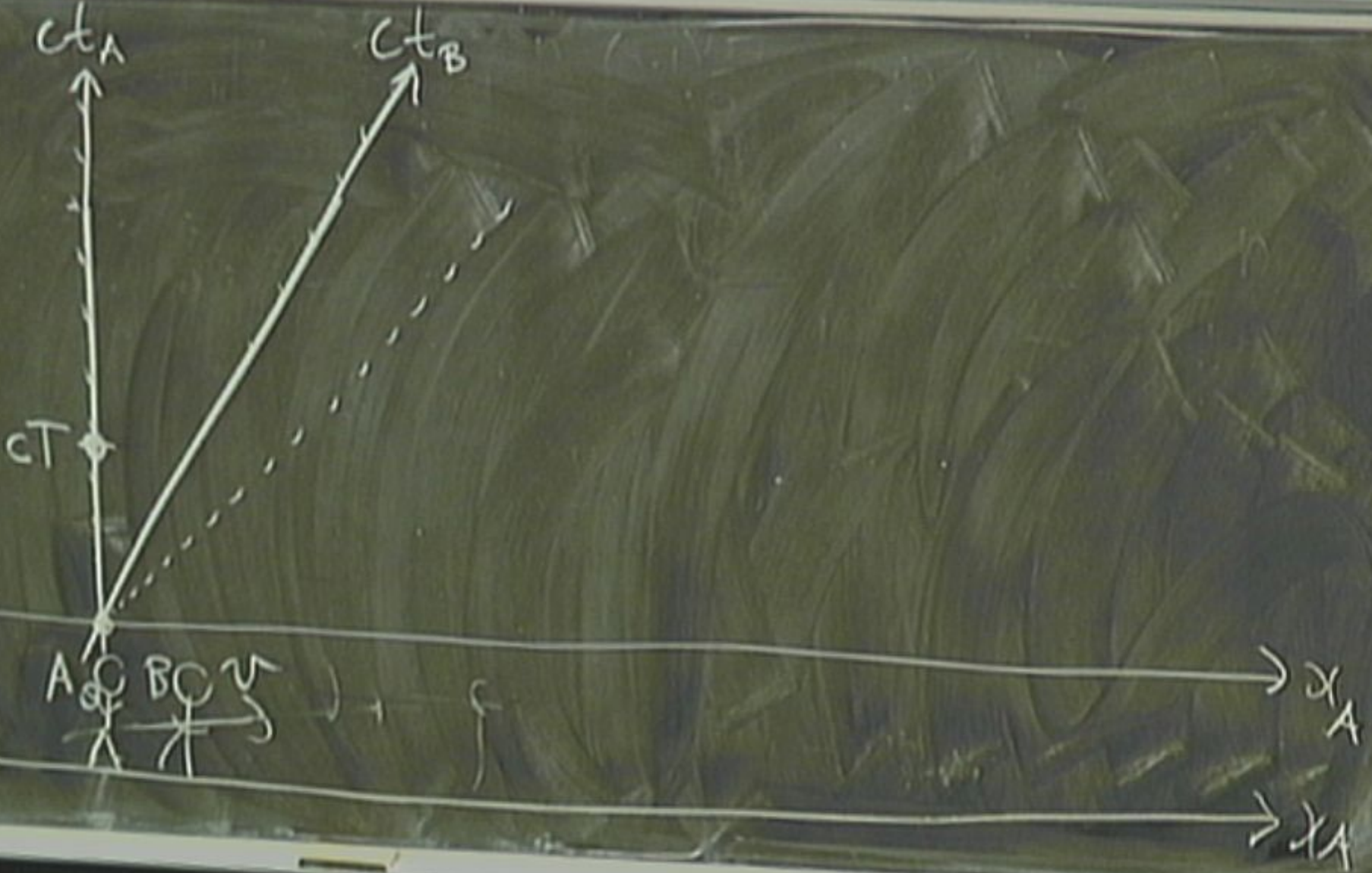
Ct_A

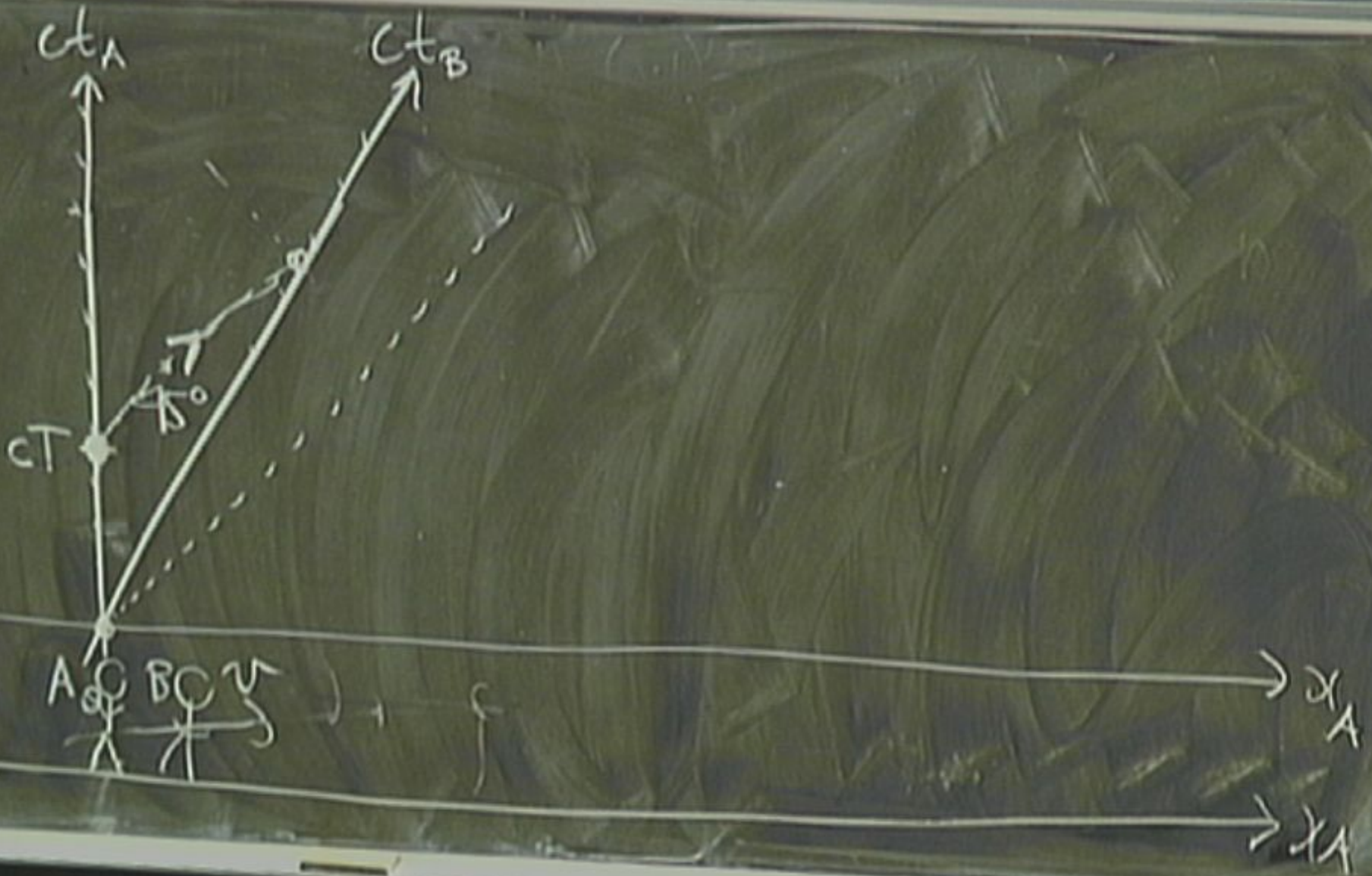
Ct_B

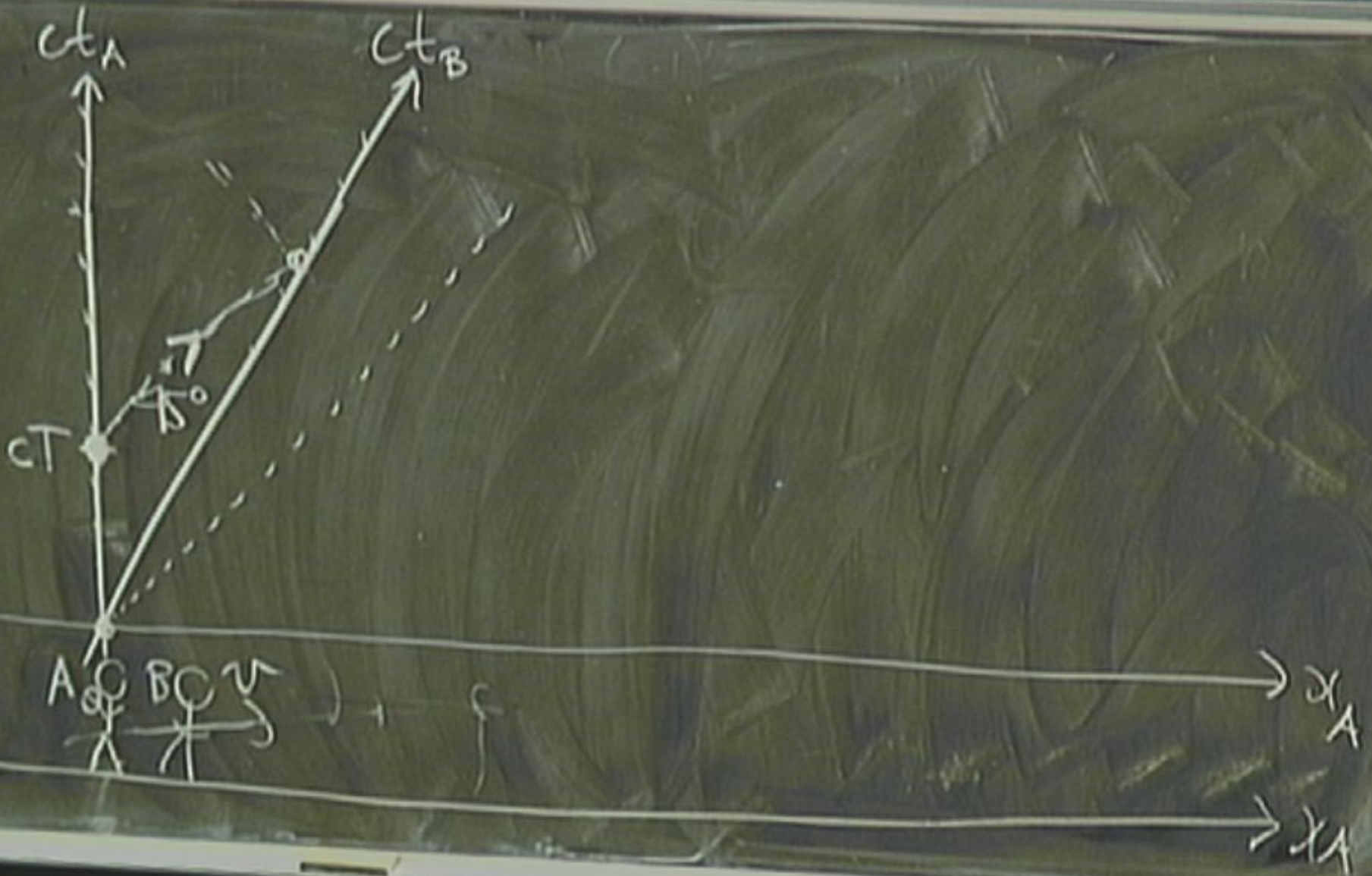


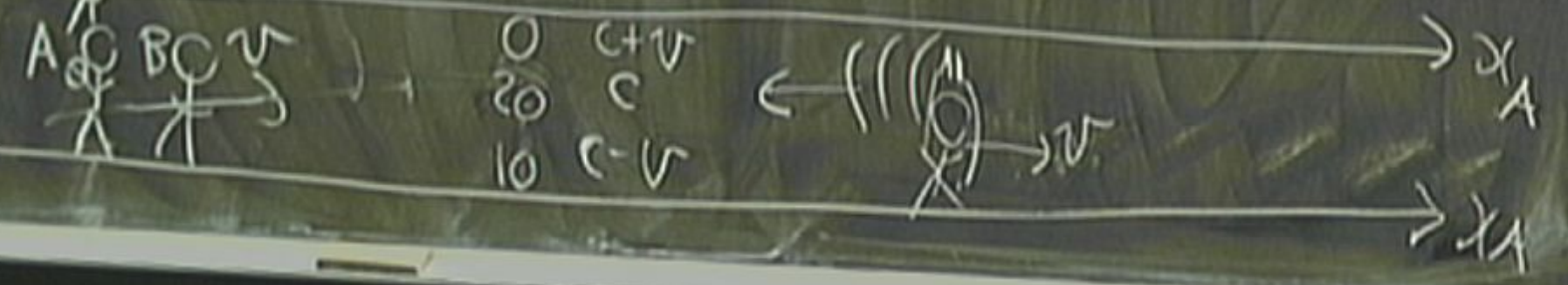
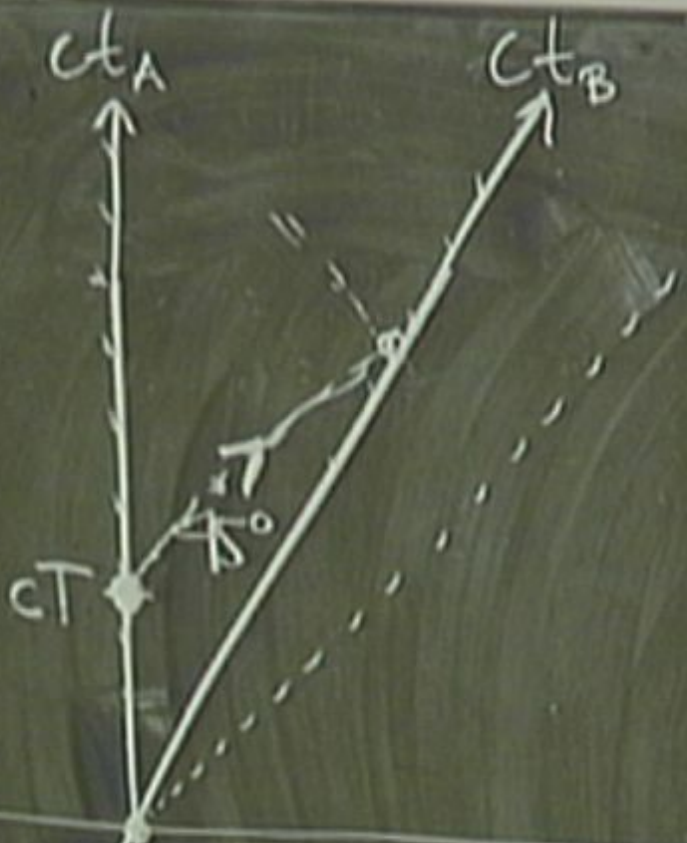
x_A

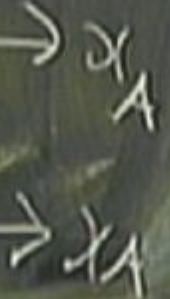
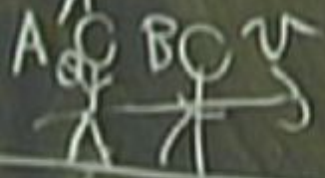
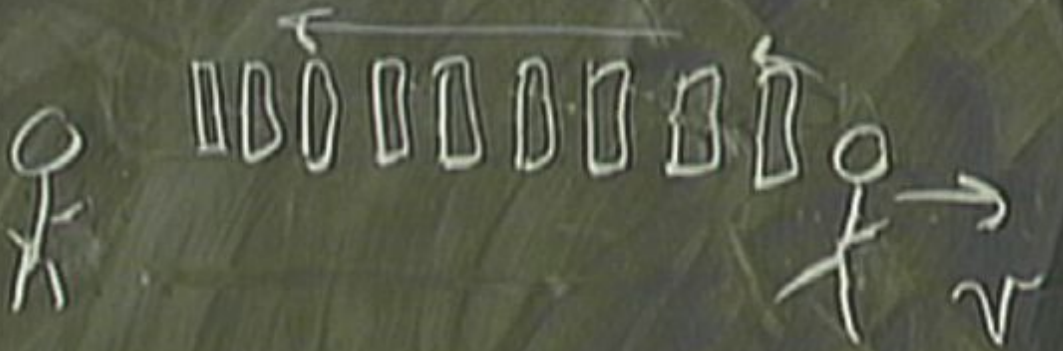
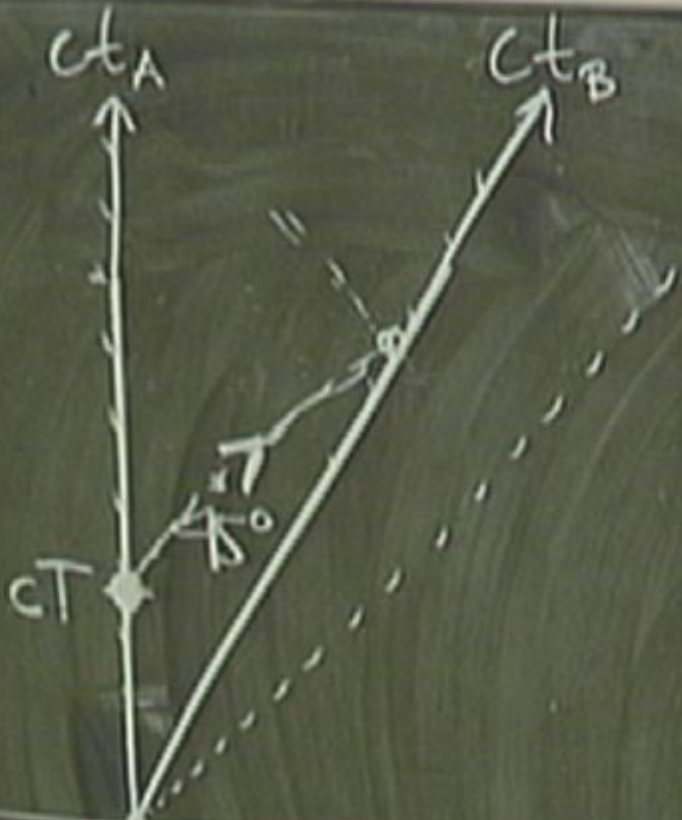
x_A

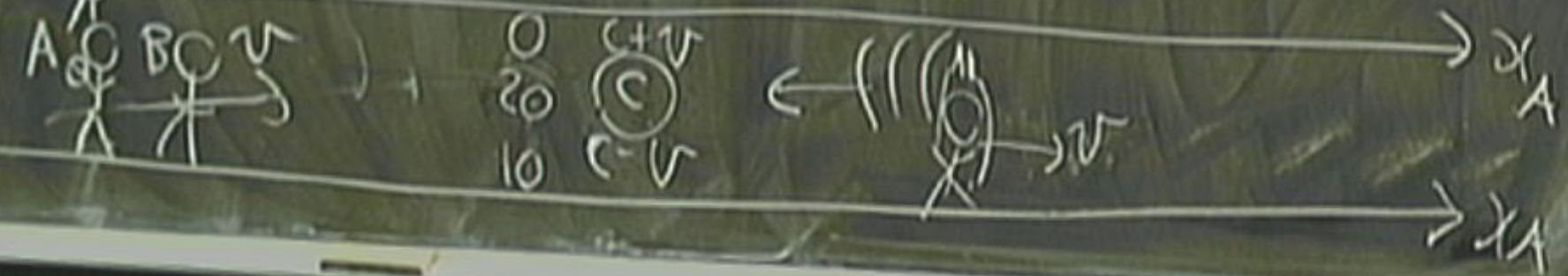
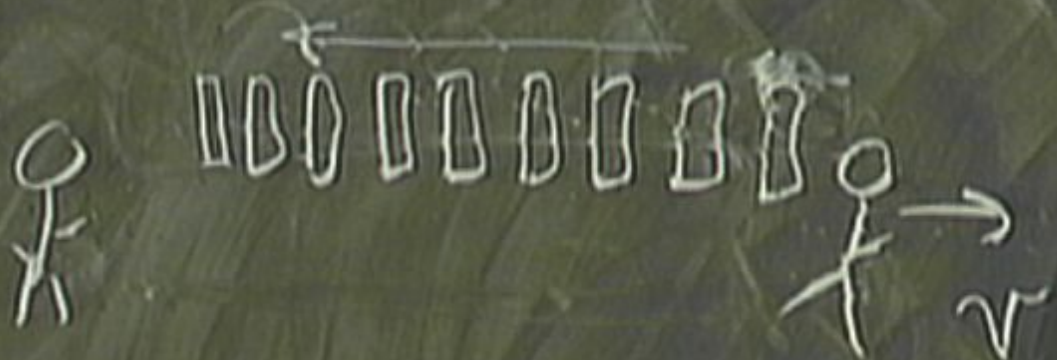
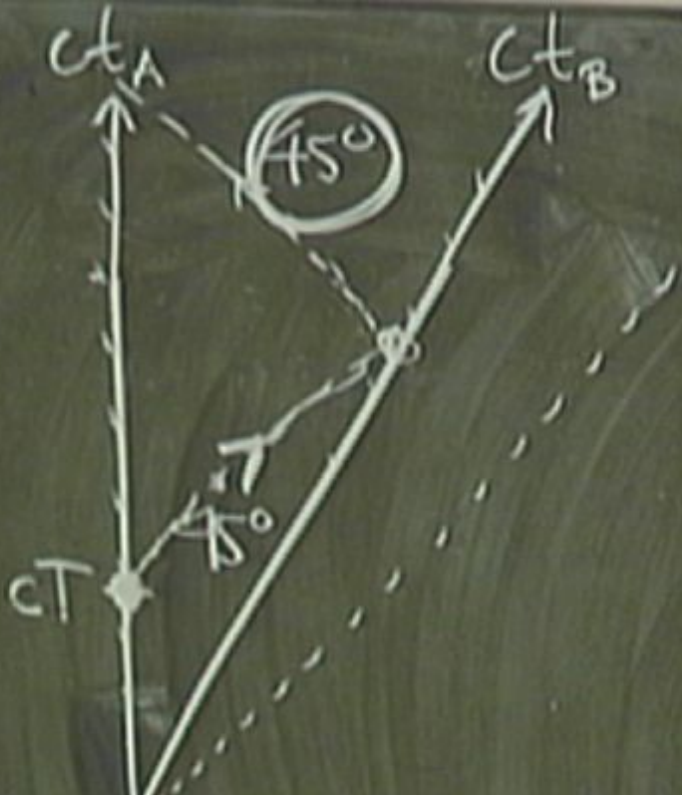


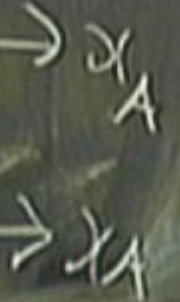
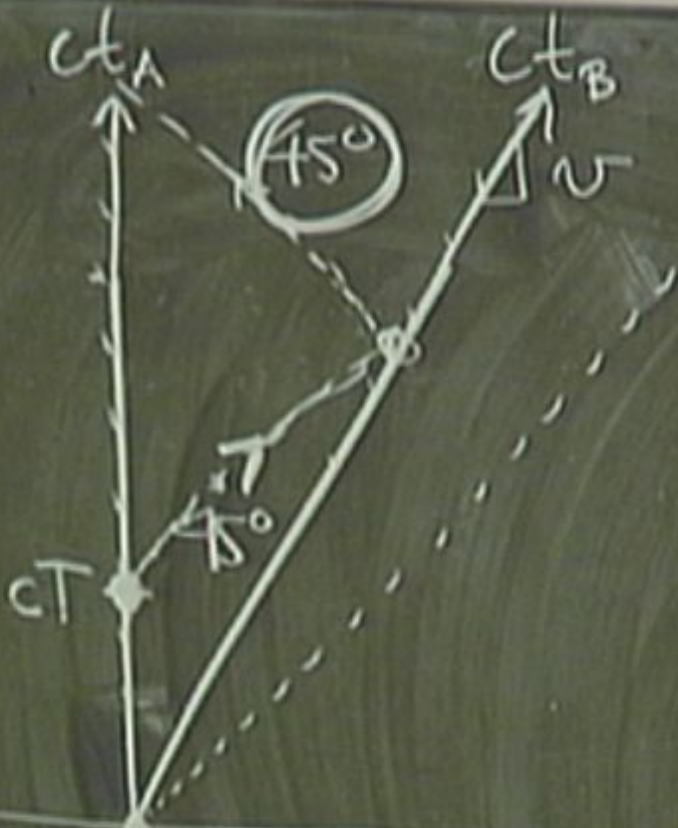


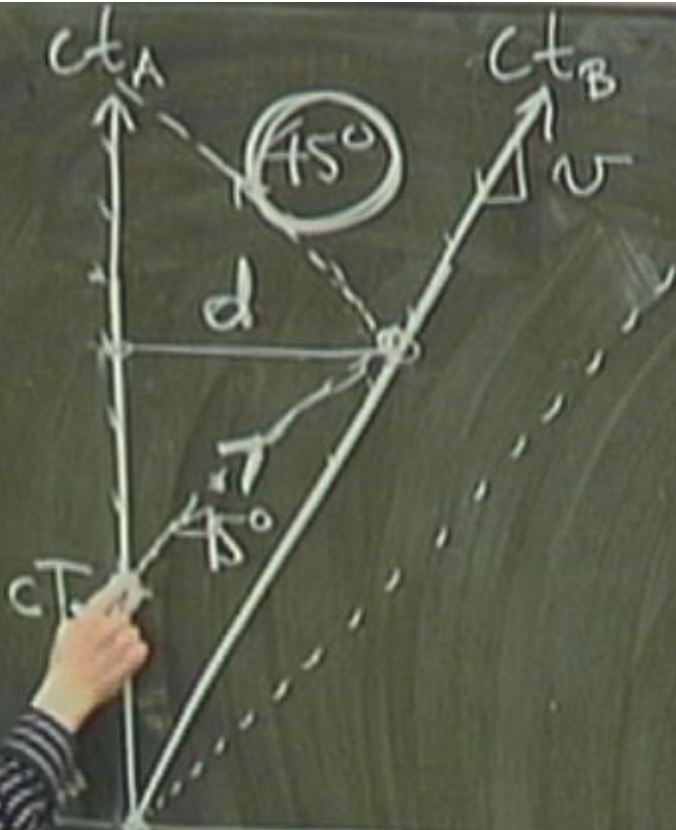




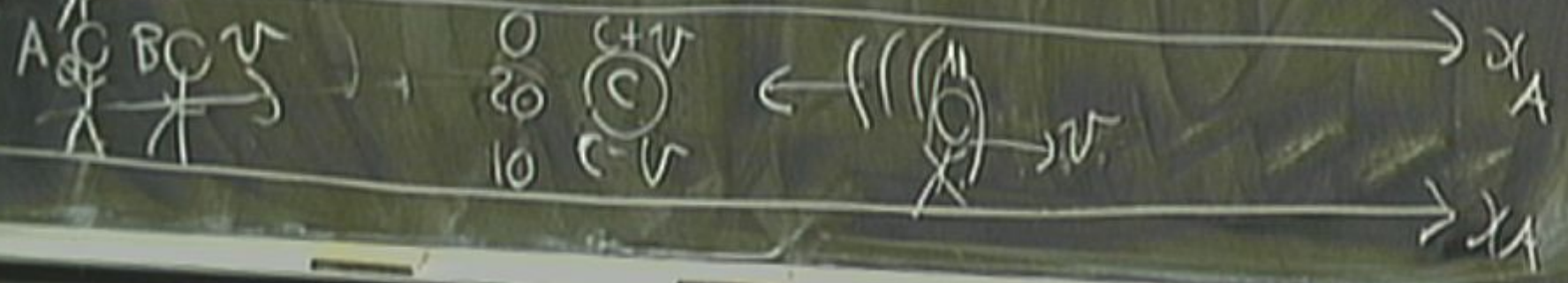


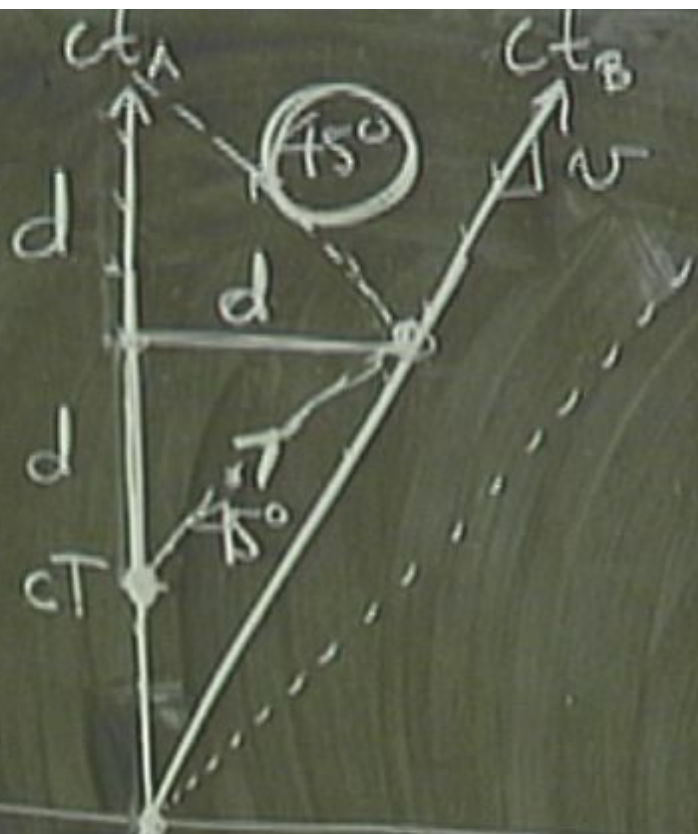




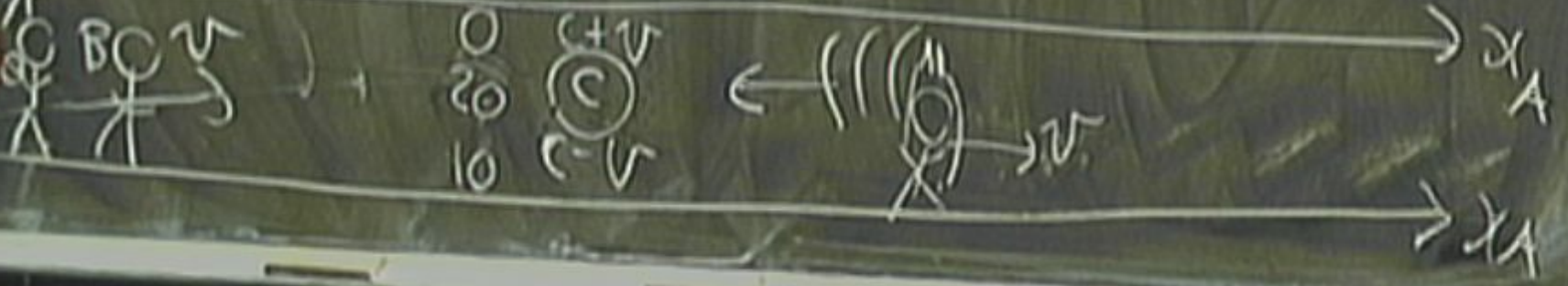


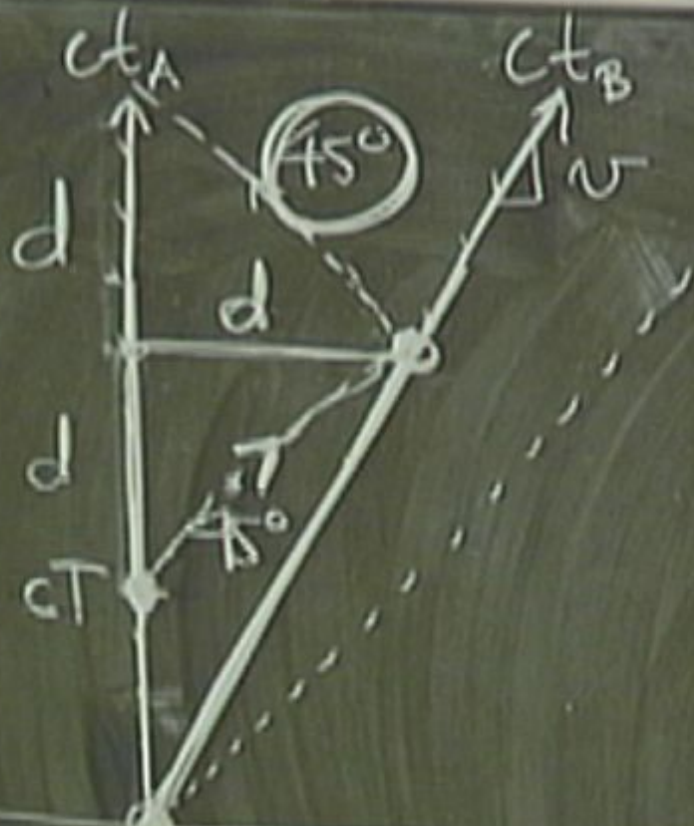
$d = \text{vel} \times \text{time}$





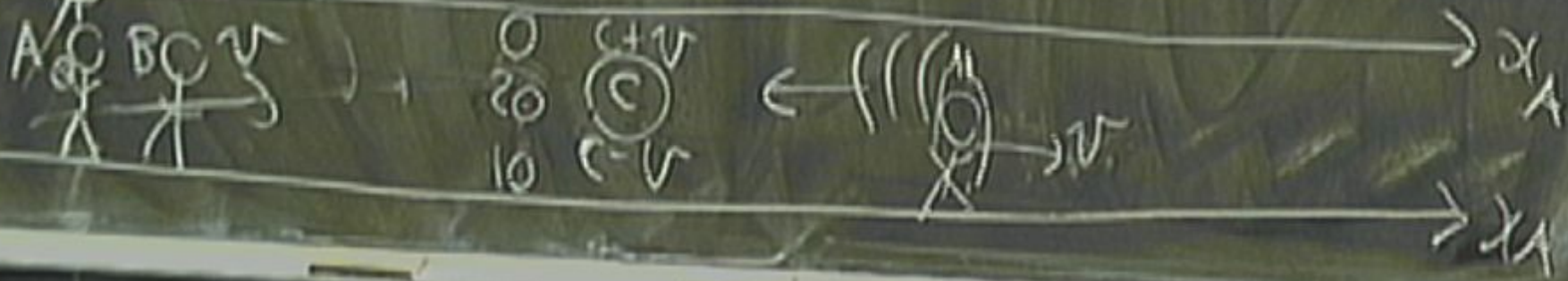
$d = \text{vel} \times \text{time}$
 $= \sim$

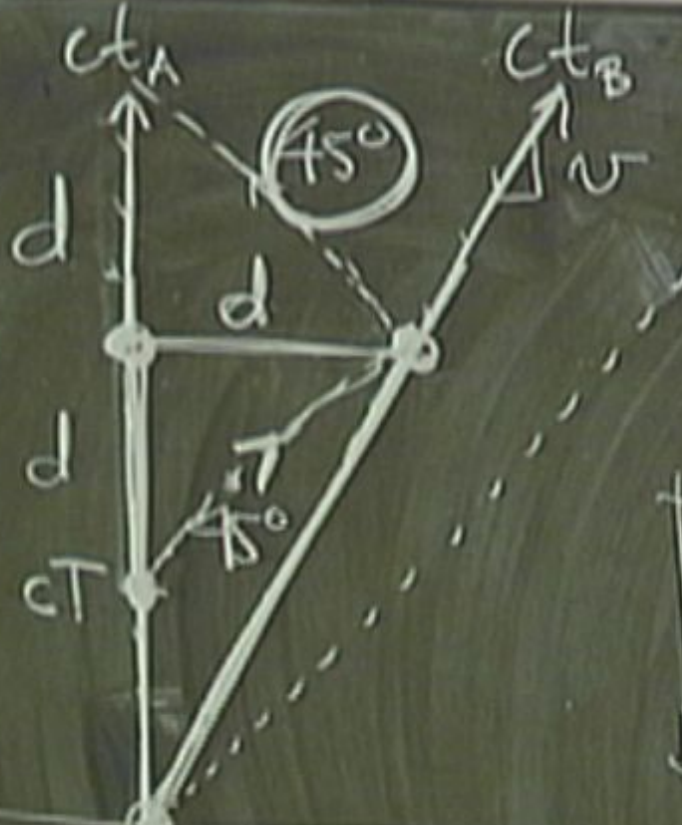




$$d = \text{vel} \times \text{time}$$

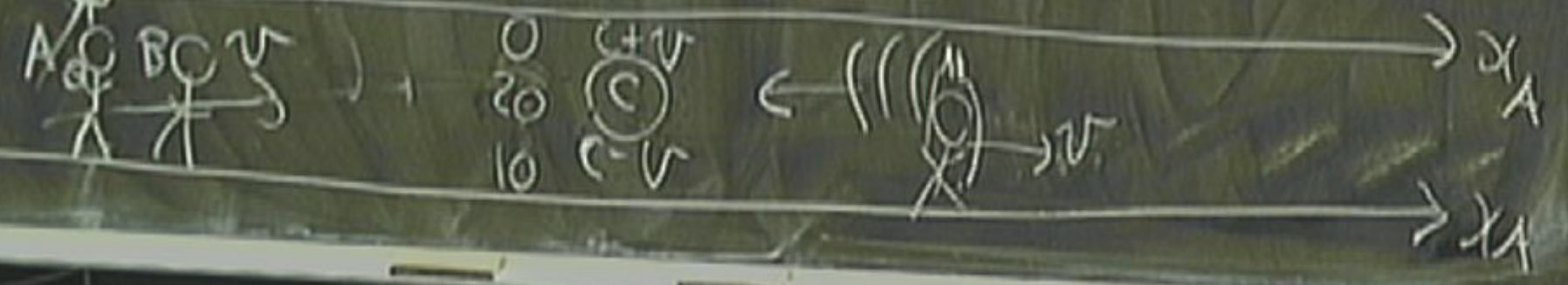
$$= \sim$$

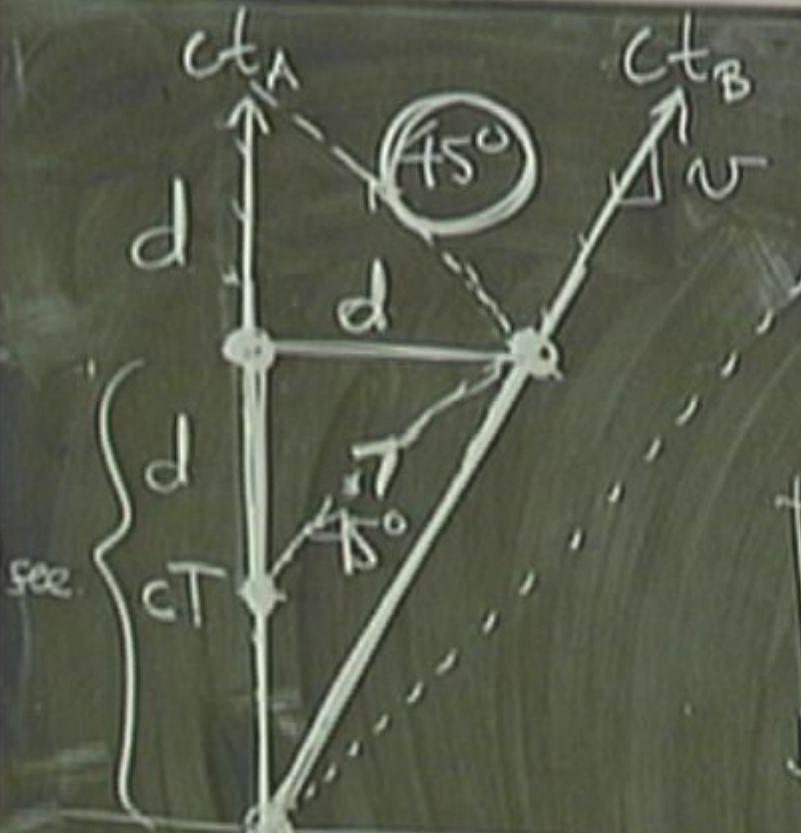




$d = \text{vel} \times \text{time}$
 $= v \frac{ct + d}{c}$

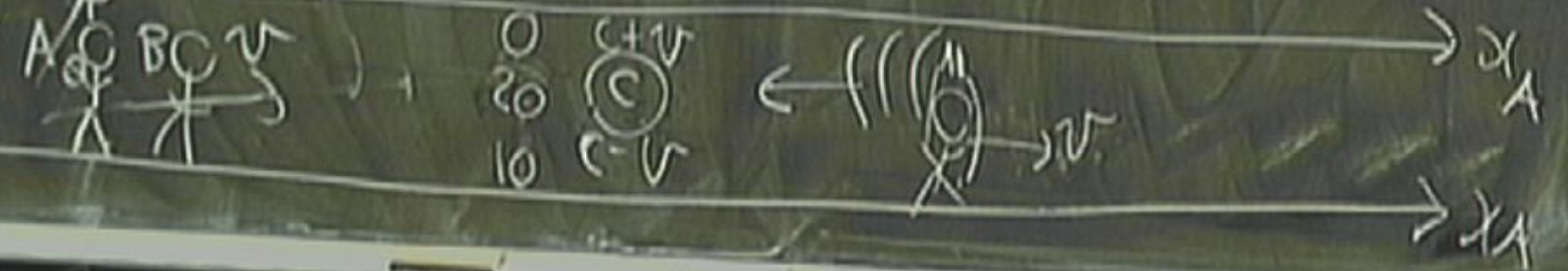
$$\frac{ct}{d} = \frac{v/c}{1 - v/c} \quad (1)$$

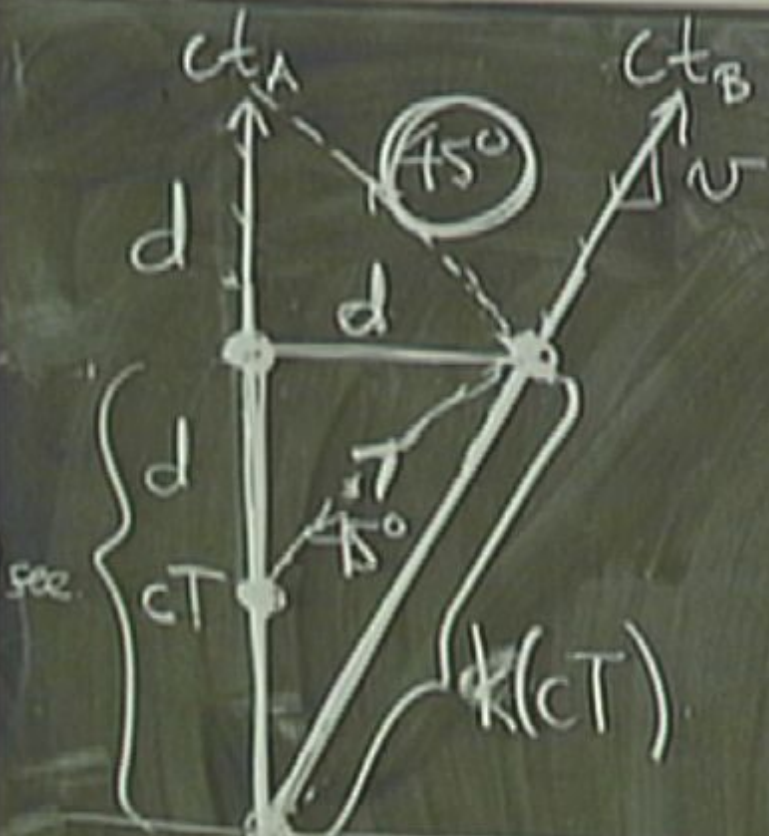




$d = \text{vel} \times \text{time}$
 $= \sim \frac{cT + d}{c}$

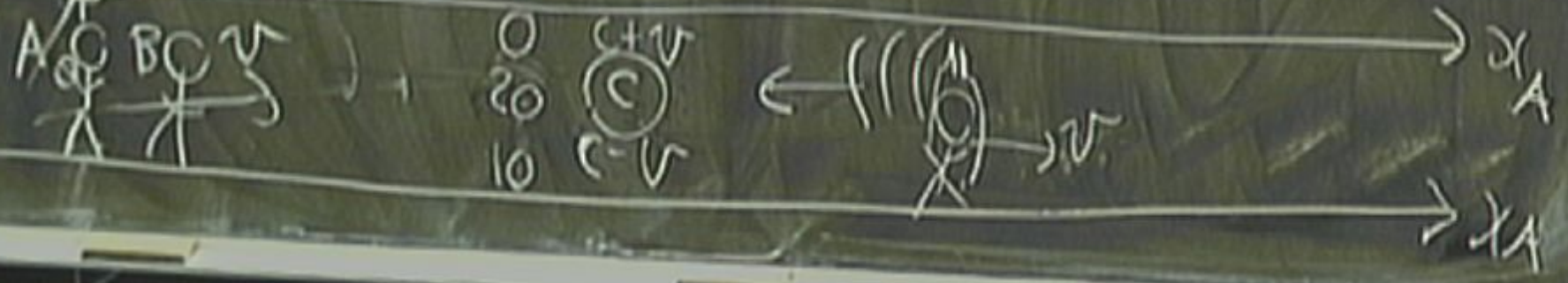
$$\frac{cT}{c} = \frac{v/c}{1 - v/c} \quad (1)$$

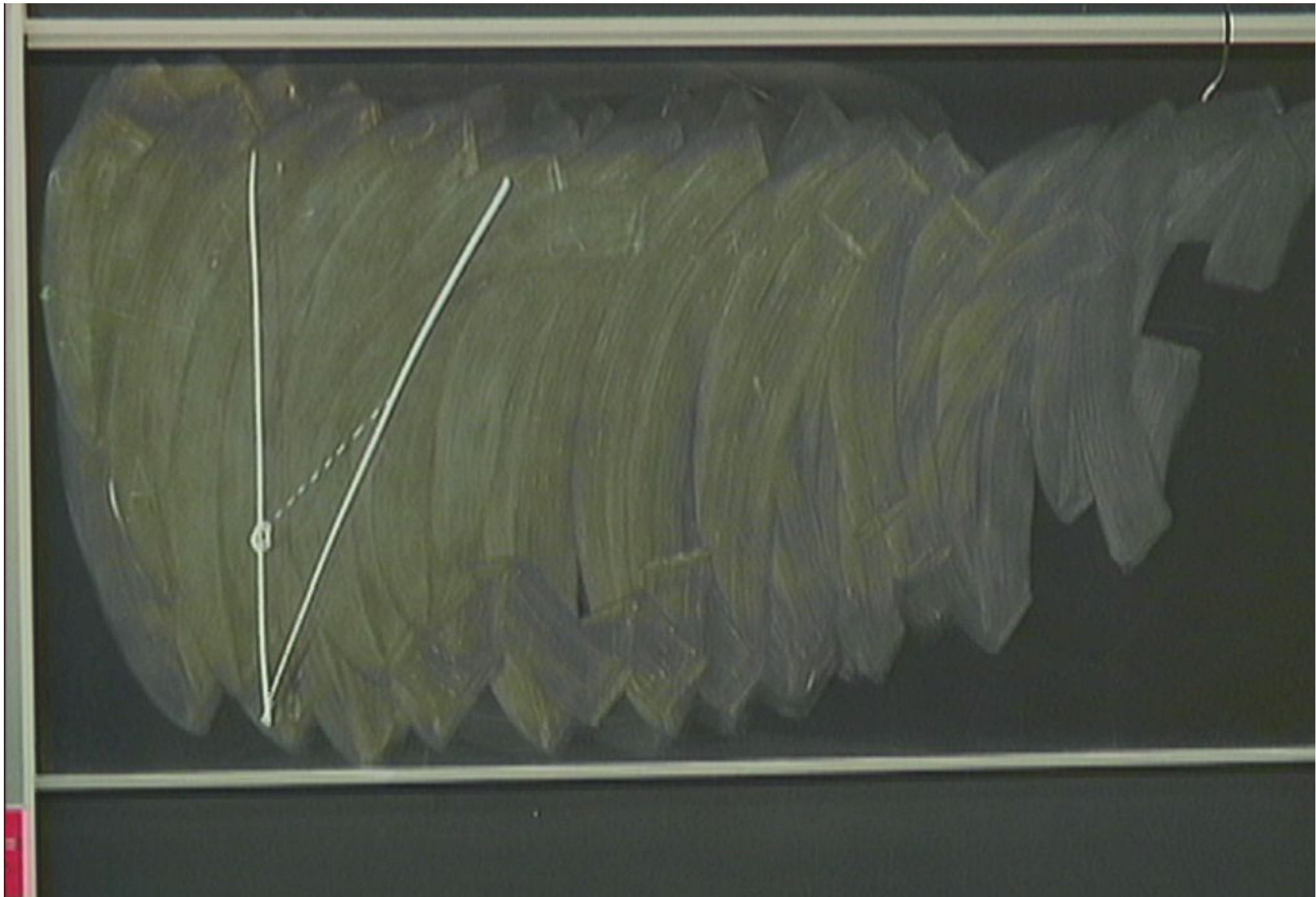




$d = \text{vel} \times \text{time}$
 $= \sim \frac{ct + d}{c}$

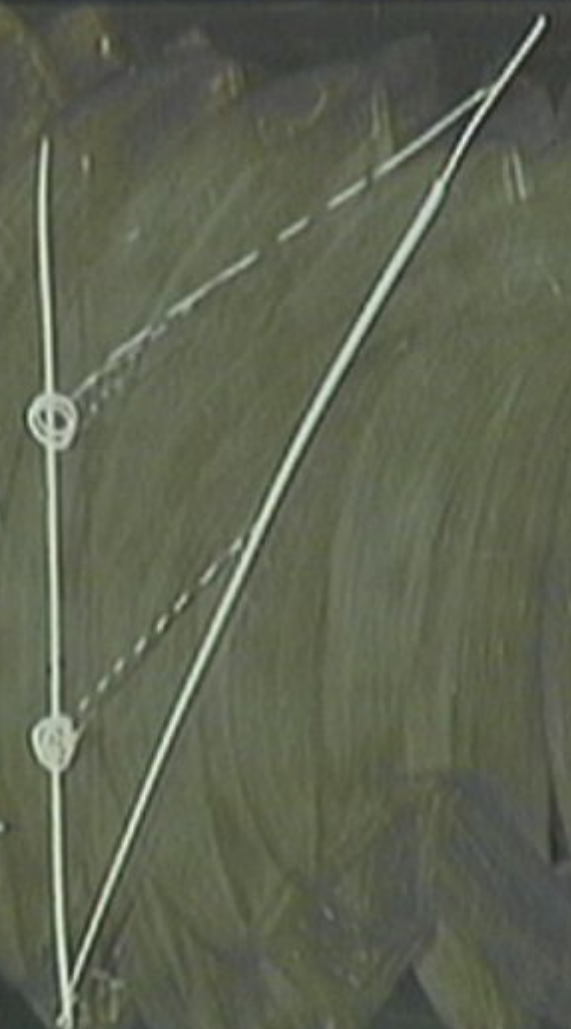
$$\frac{ct_B}{ct_A} = \frac{v/c}{1 - v/c} \quad (1)$$

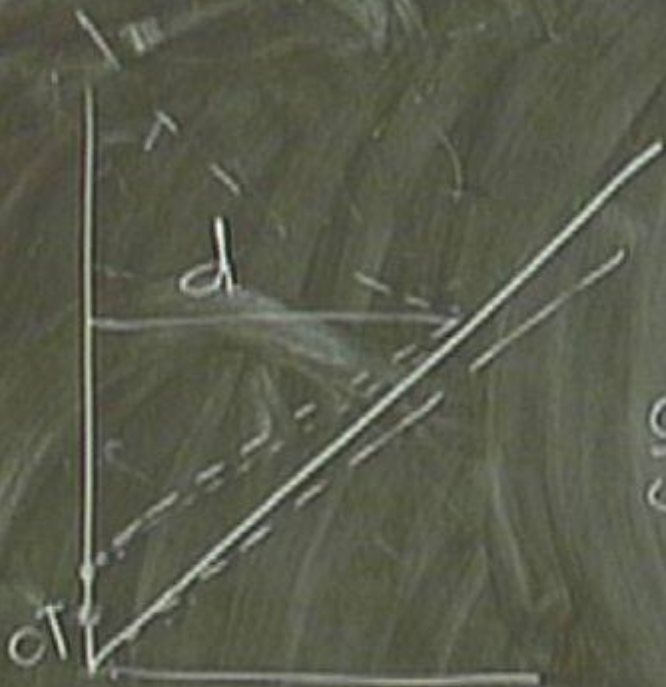




$2cT$

cT





CTD → ∞



Determine k

Assume: Universal time

$$\Rightarrow cT + d = kcT$$

Determine k

Assume: Universal time

$$\Rightarrow cT + d = kcT$$

$$\boxed{T + \frac{d}{c} = kT} \quad (2)$$

(1) + (2) \Rightarrow

$$\boxed{k = \frac{1}{1 - v/c}}$$

Determine k



Assume: universal time

$$\rightarrow ct + d = kcT$$

$$\boxed{T + \frac{d}{c} = kT} \quad (2)$$

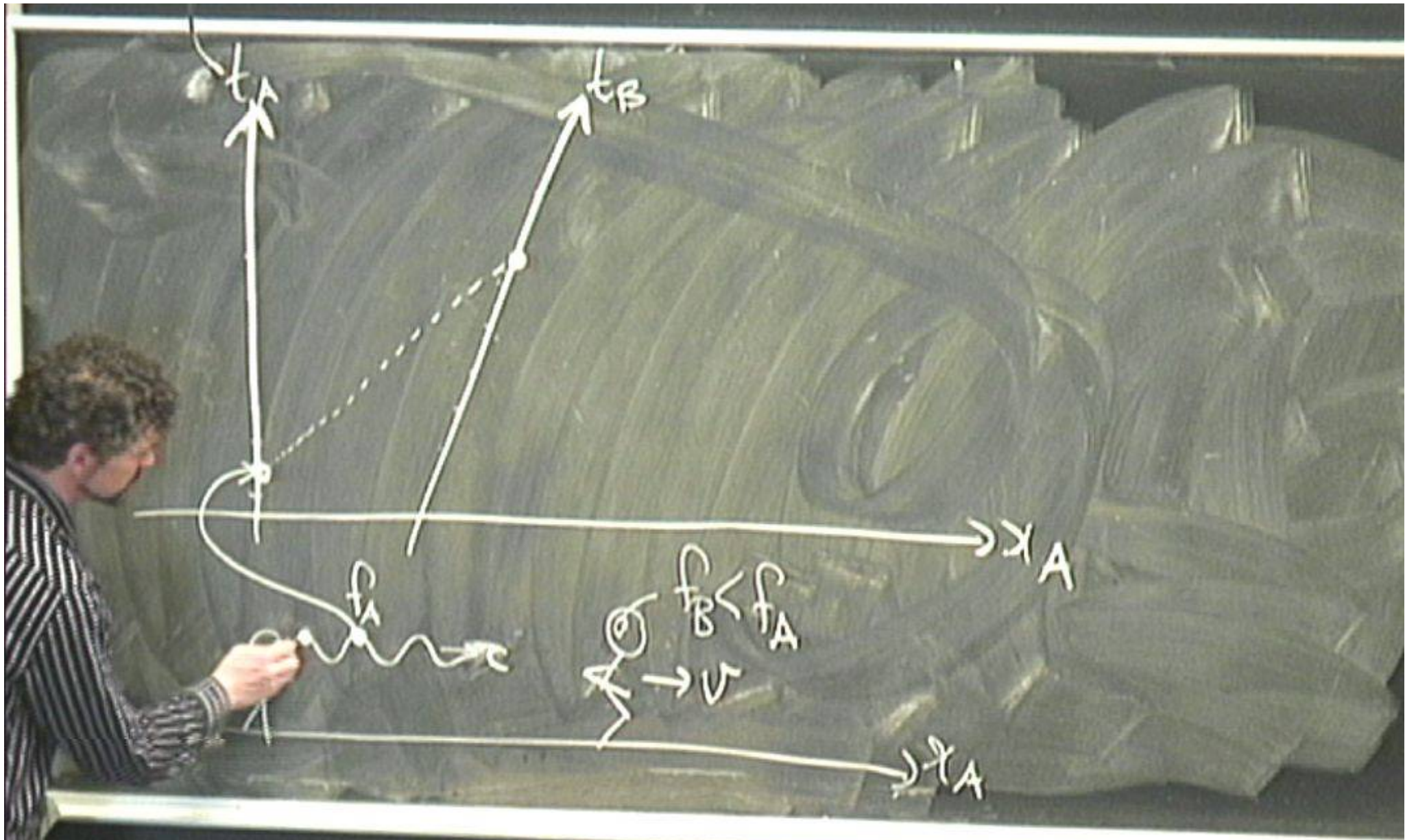
$$(1) + (2) \Rightarrow$$

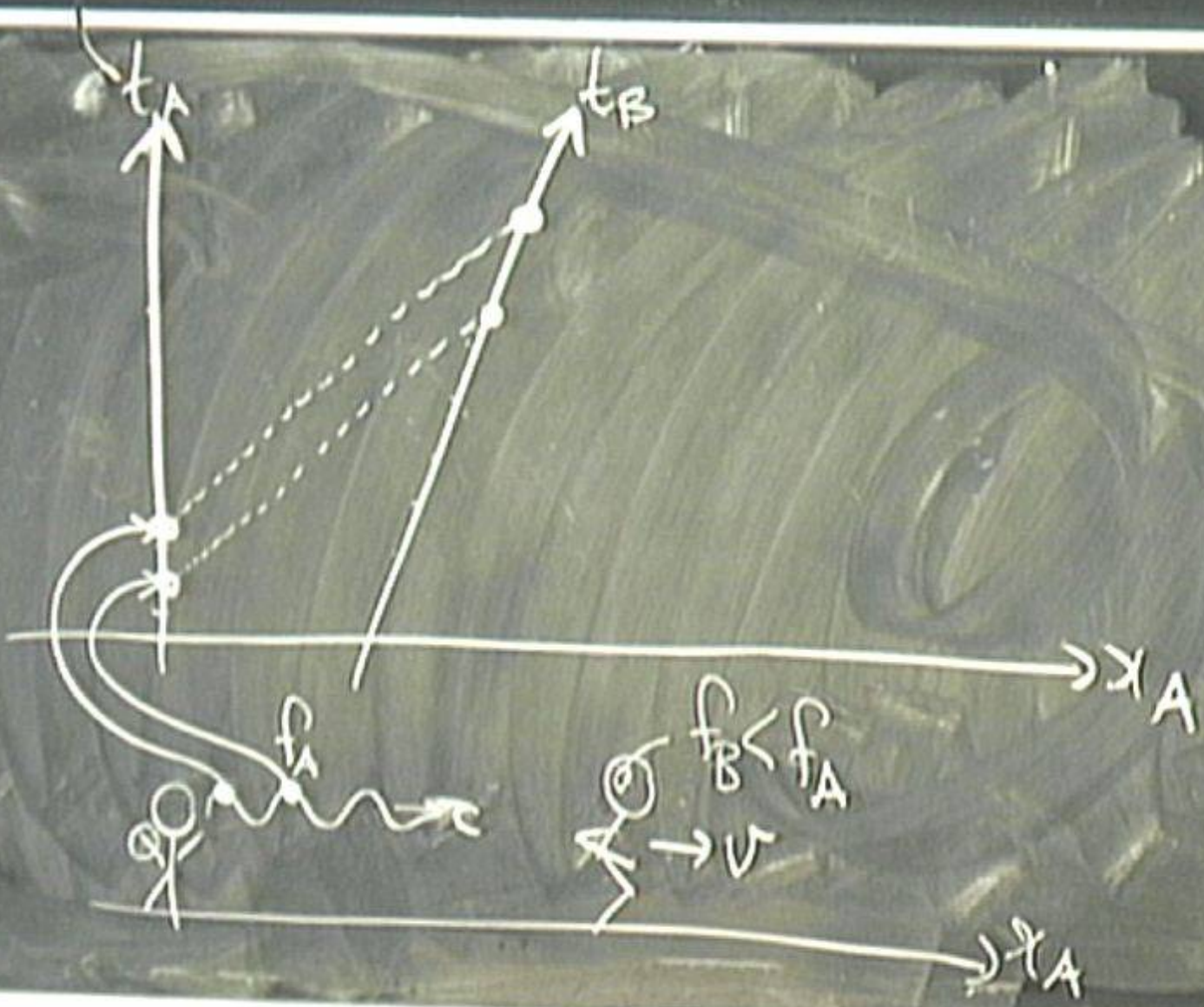
$$\boxed{k = \frac{1}{1 - v/c}}$$

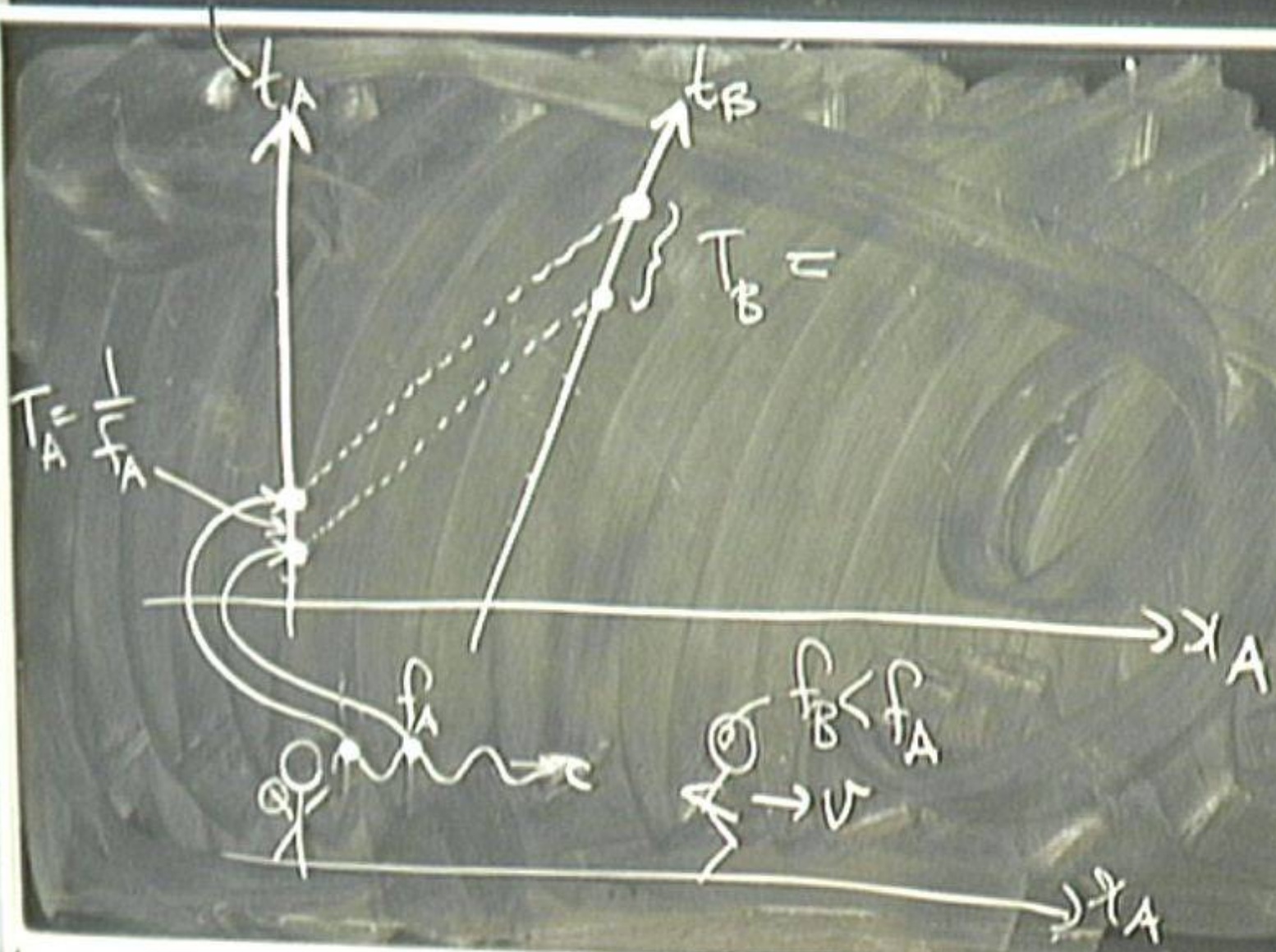
Doppler

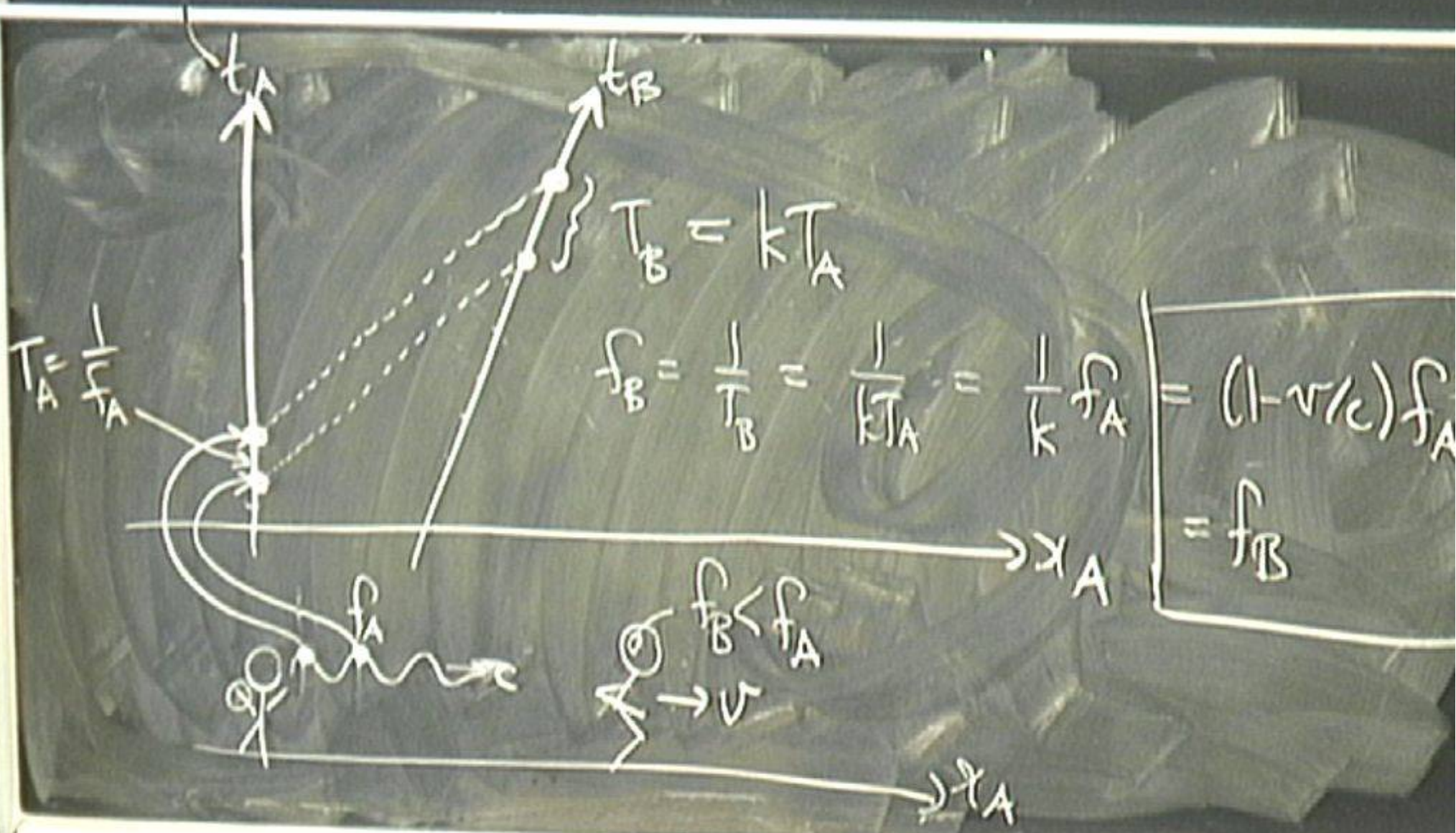


λ_A







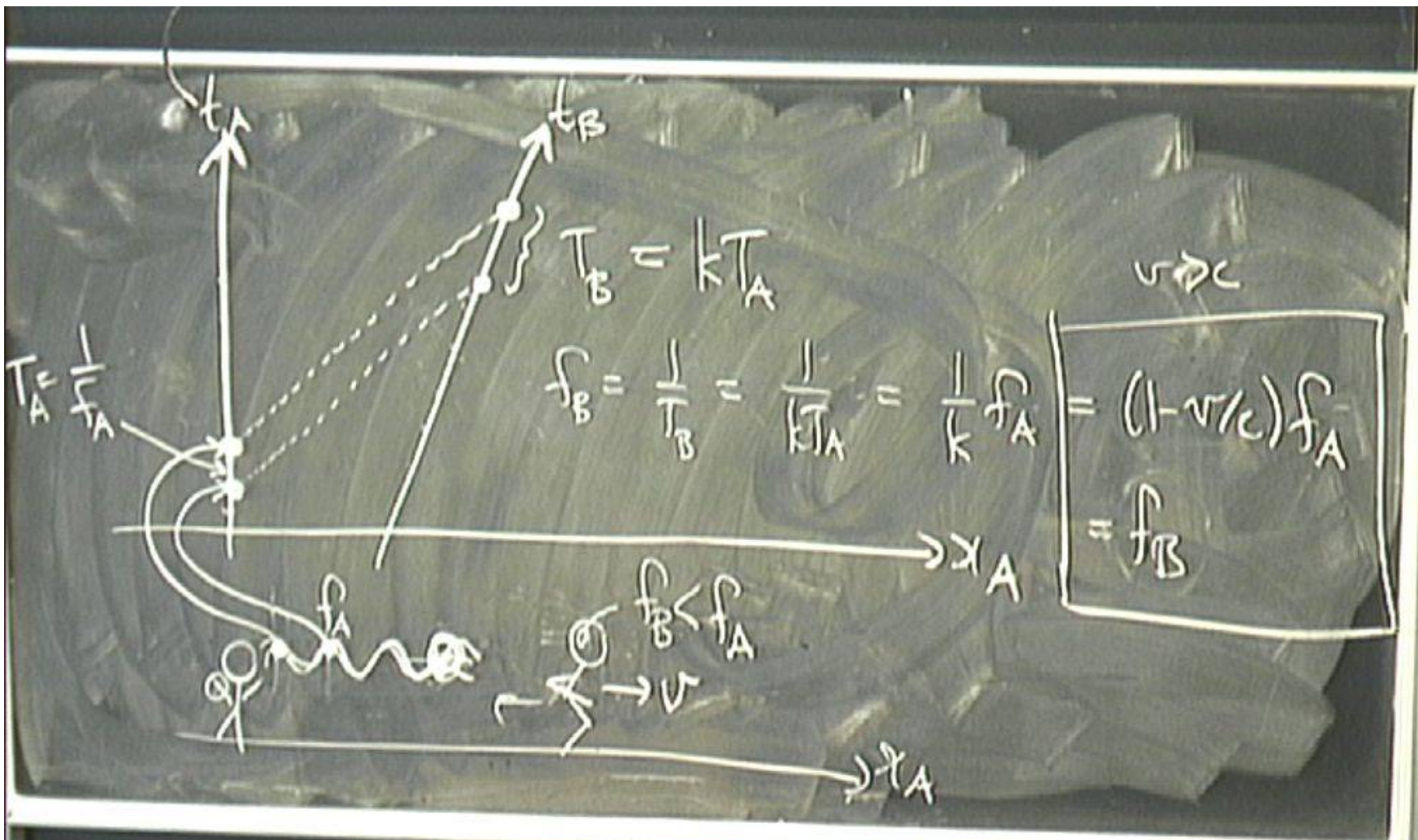


$$T_B = k T_A$$

$$f_B = \frac{1}{T_B} = \frac{1}{k T_A} = \frac{1}{k} f_A = (1 - v/c) f_A = f_B$$

$$f_B < f_A$$

$\rightarrow v$



$$T_B = k T_A$$

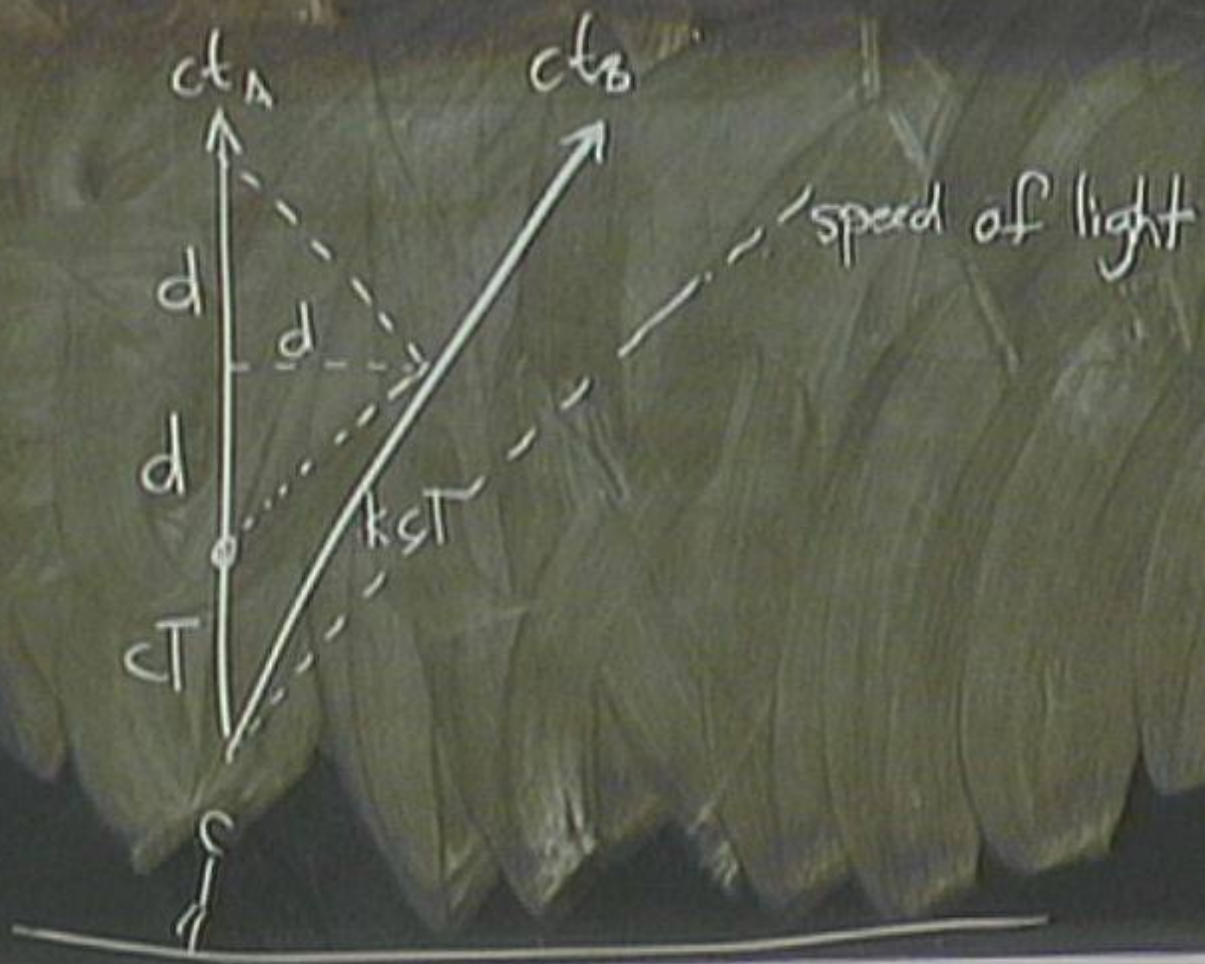
$$f_B = \frac{1}{T_B} = \frac{1}{k T_A} = \frac{1}{k} f_A$$

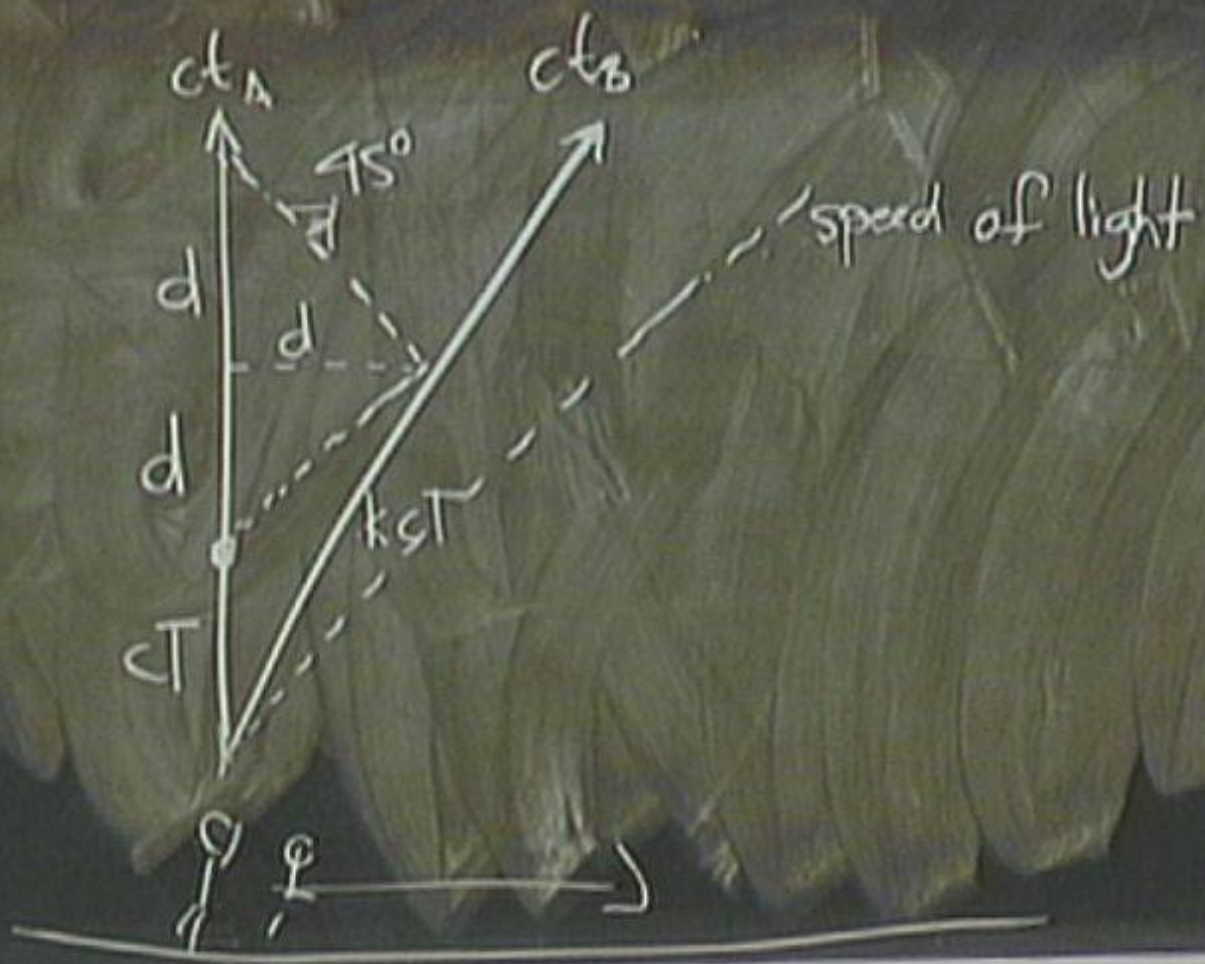
$$= (1 - v/c) f_A = f_B$$

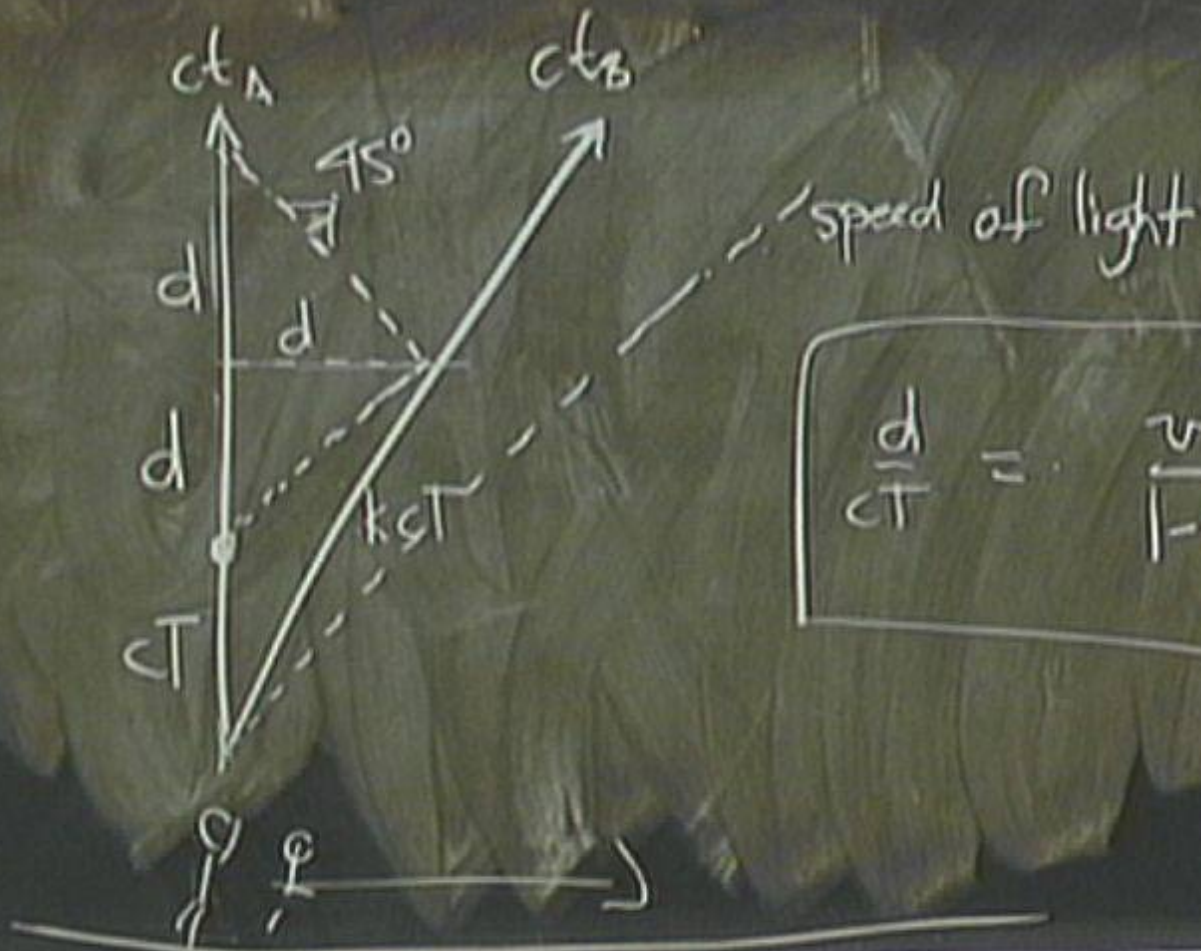
Sound \rightarrow Light

Sound \rightarrow Light

assume light \rightarrow wave-in-ether.







$$\frac{ct'd}{ct} = \frac{v/c}{1 - v/c}$$

(1)

P2 : (speed of light)

For an observer "at rest", the speed of light is c , independent of motion of source.

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