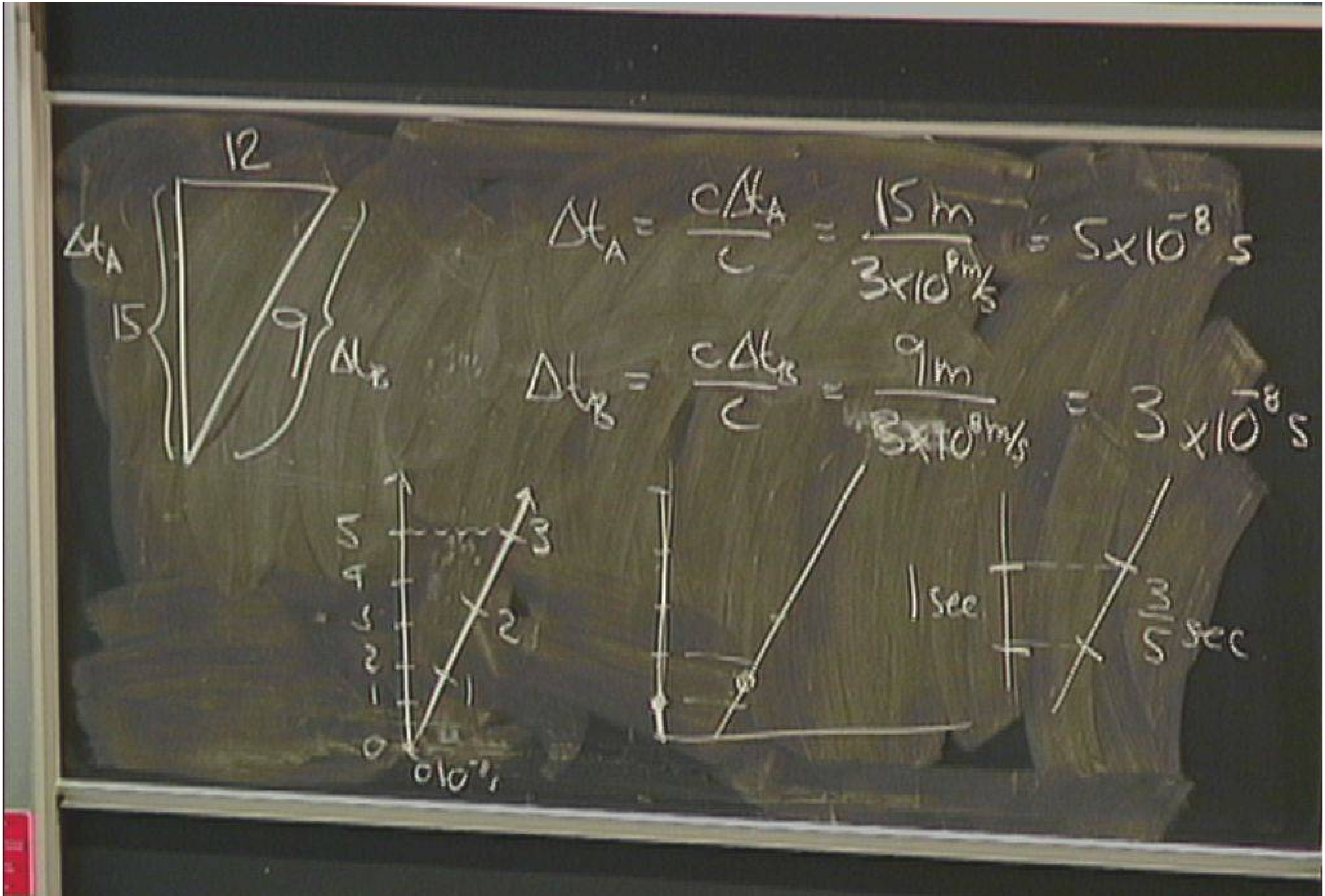
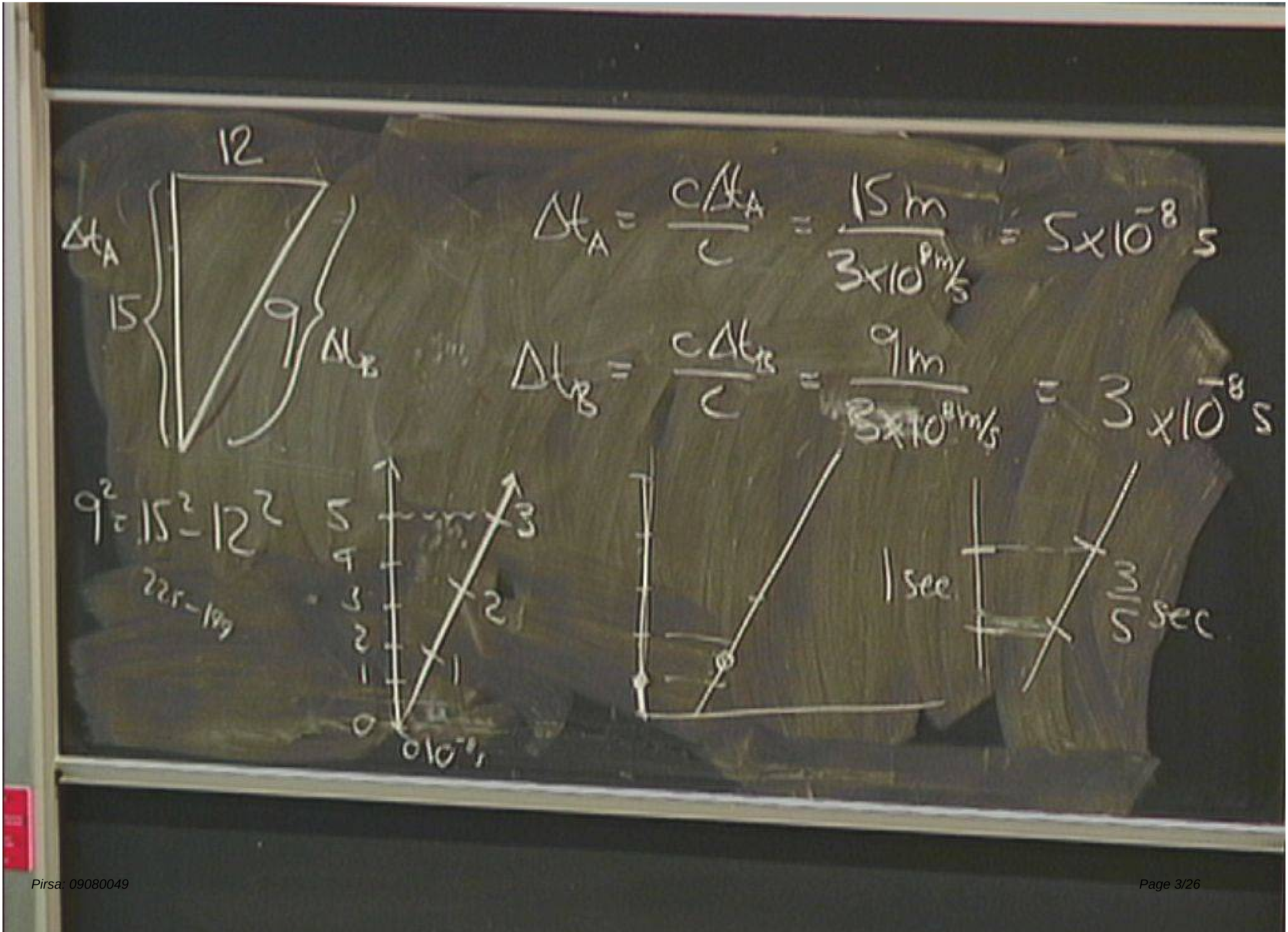
Title: Relativity 2

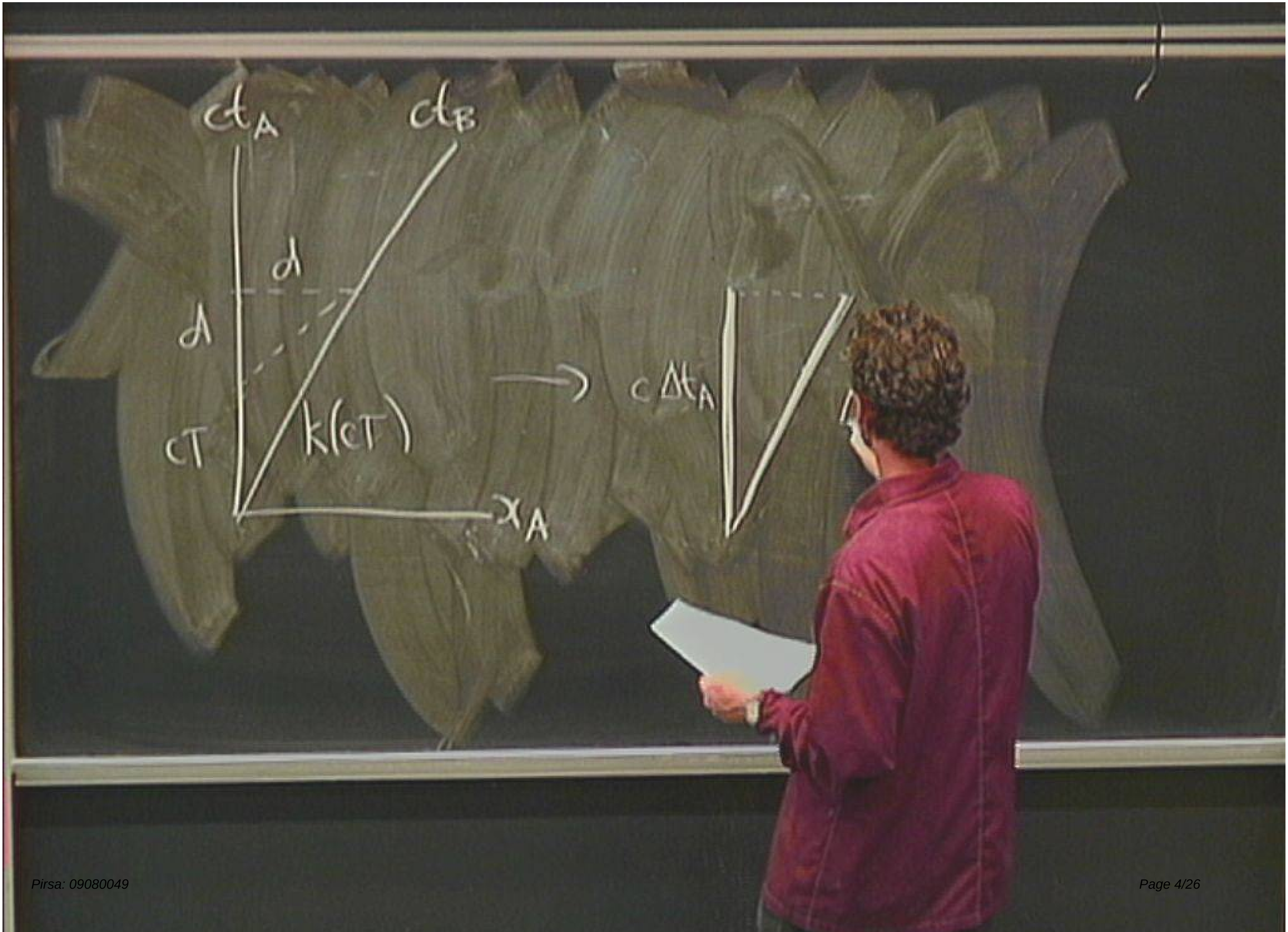
Date: Aug 11, 2009 01:00 PM

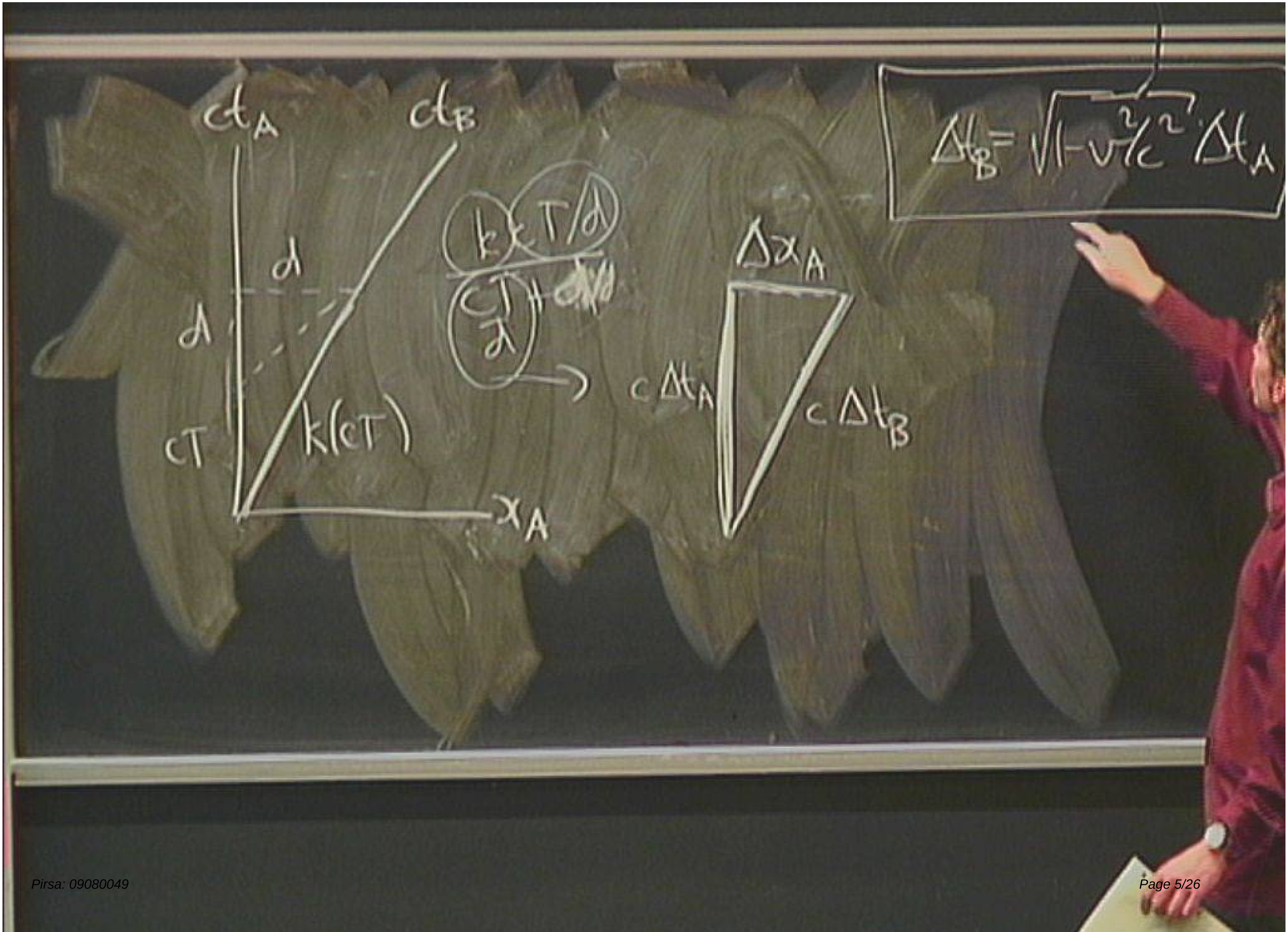
URL: http://pirsa.org/09080049

Abstract: Einstein's two principles (continued), the relativistic Doppler shift, nature of time, and the geometry of spacetime.

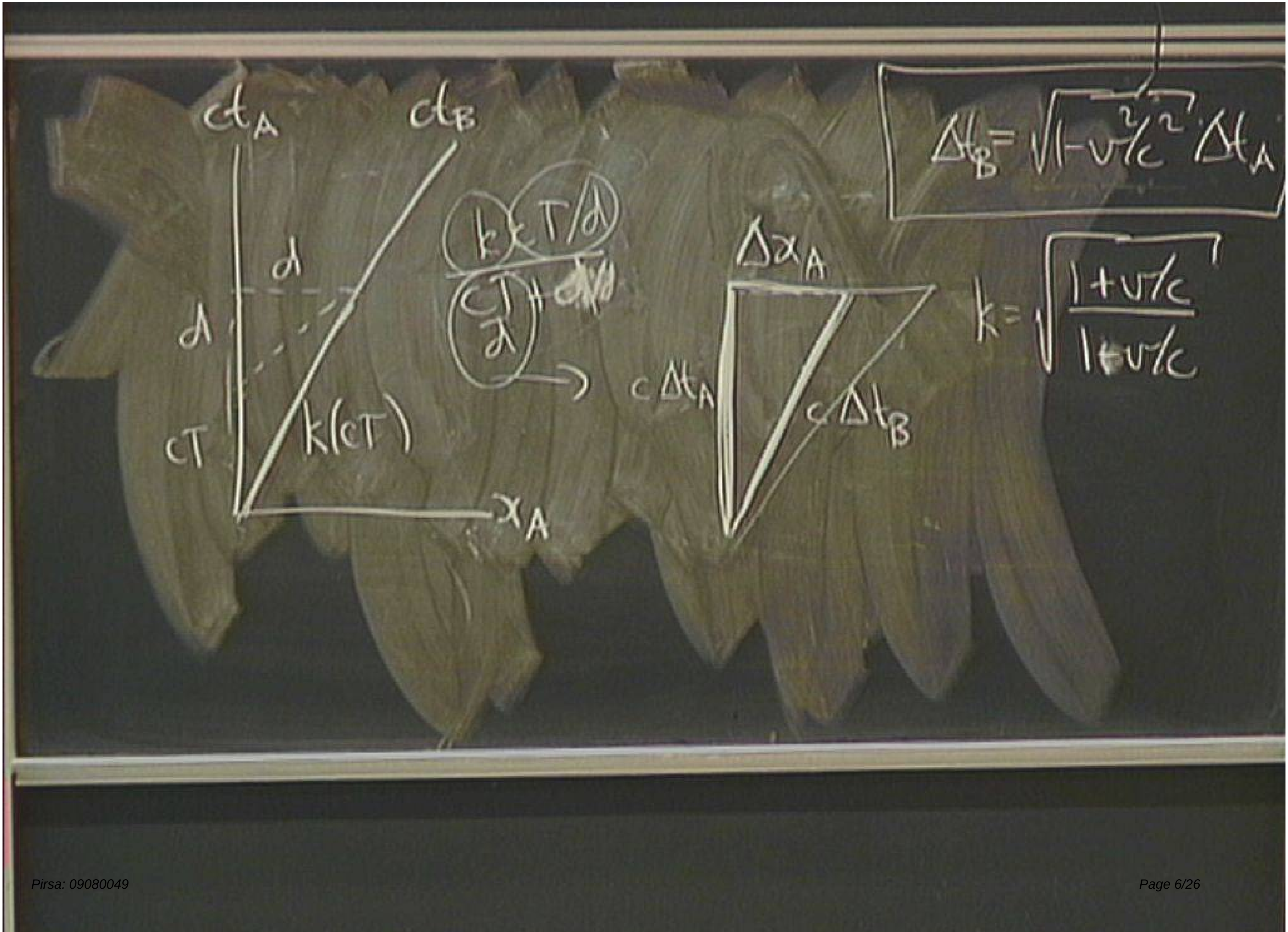

12
Δt_A
15
9
Δt_B
Δt_A = cΔt_A / c = 15 m / 3×10^8 m/s = 5×10^-8 s
Δt_B = cΔt_B / c = 9 m / 3×10^8 m/s = 3×10^-8 s
5
4
3
2
1
0
3
2
1
1 sec
3/5 sec

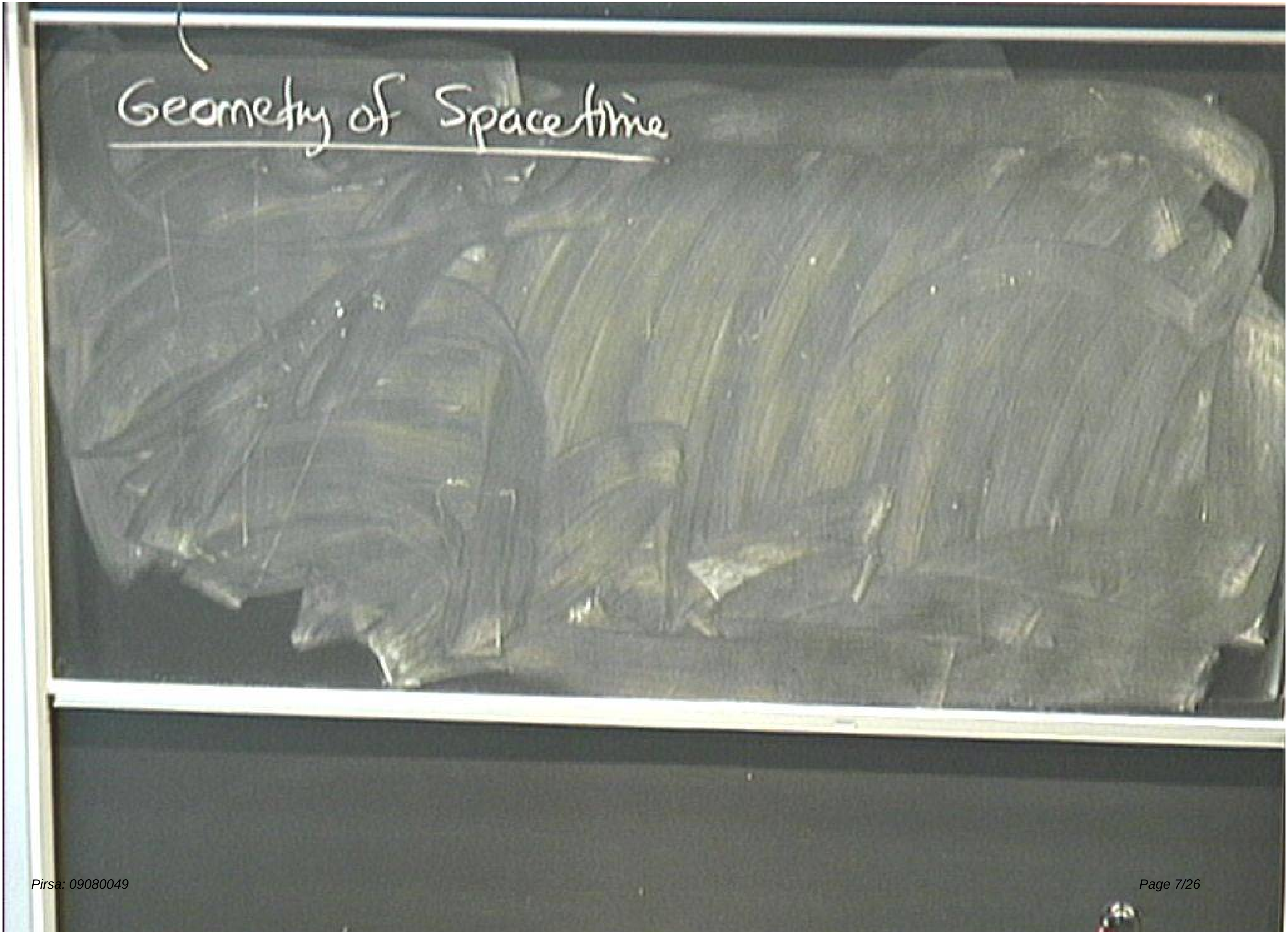

12
Δt_A
15
9
Δt_B
Δt_A = cΔt_A / c = 15 m / 3×10^8 m/s = 5×10^-8 s
Δt_B = cΔt_B / c = 9m / 3×10^8 m/s = 3 ×10^-8 s
9^2 = 15^2 - 12^2
225 - 144
5
4
3
2
1
0
3
2
1
0 10^-8 s
1 sec
3/5 sec

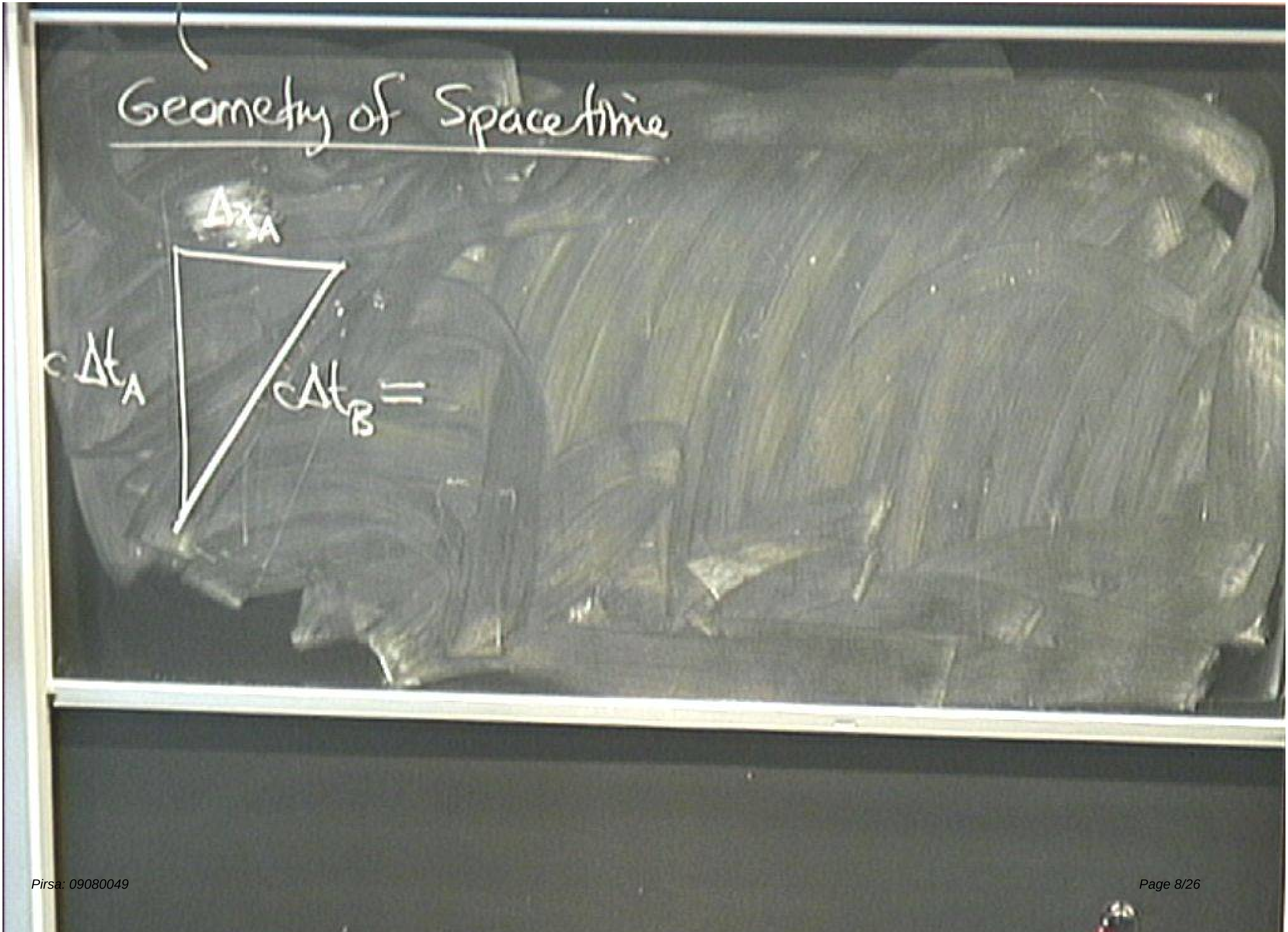

ct_A
ct_B
d
d
cT
k(cT)
x_A
cΔt_A

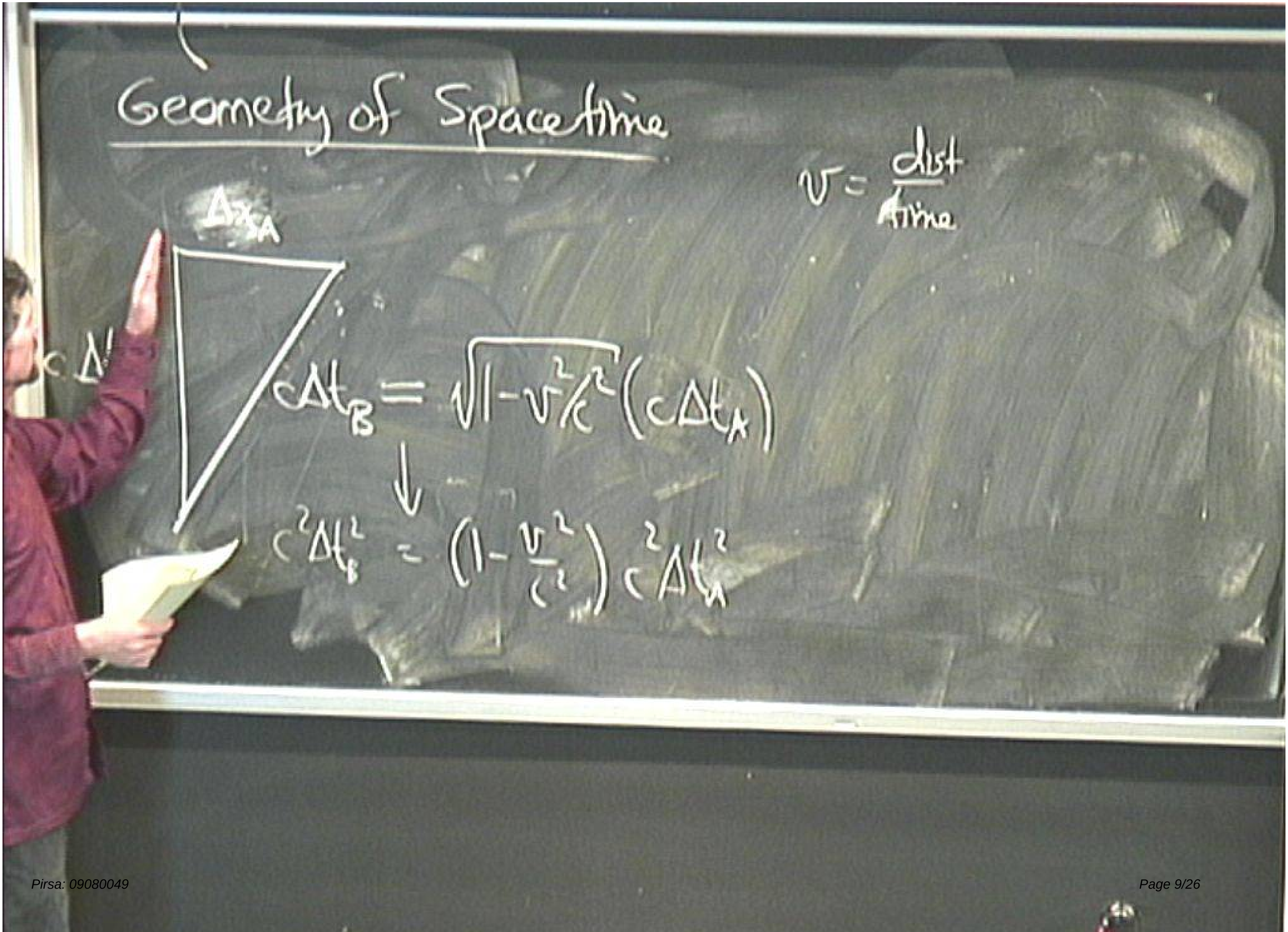


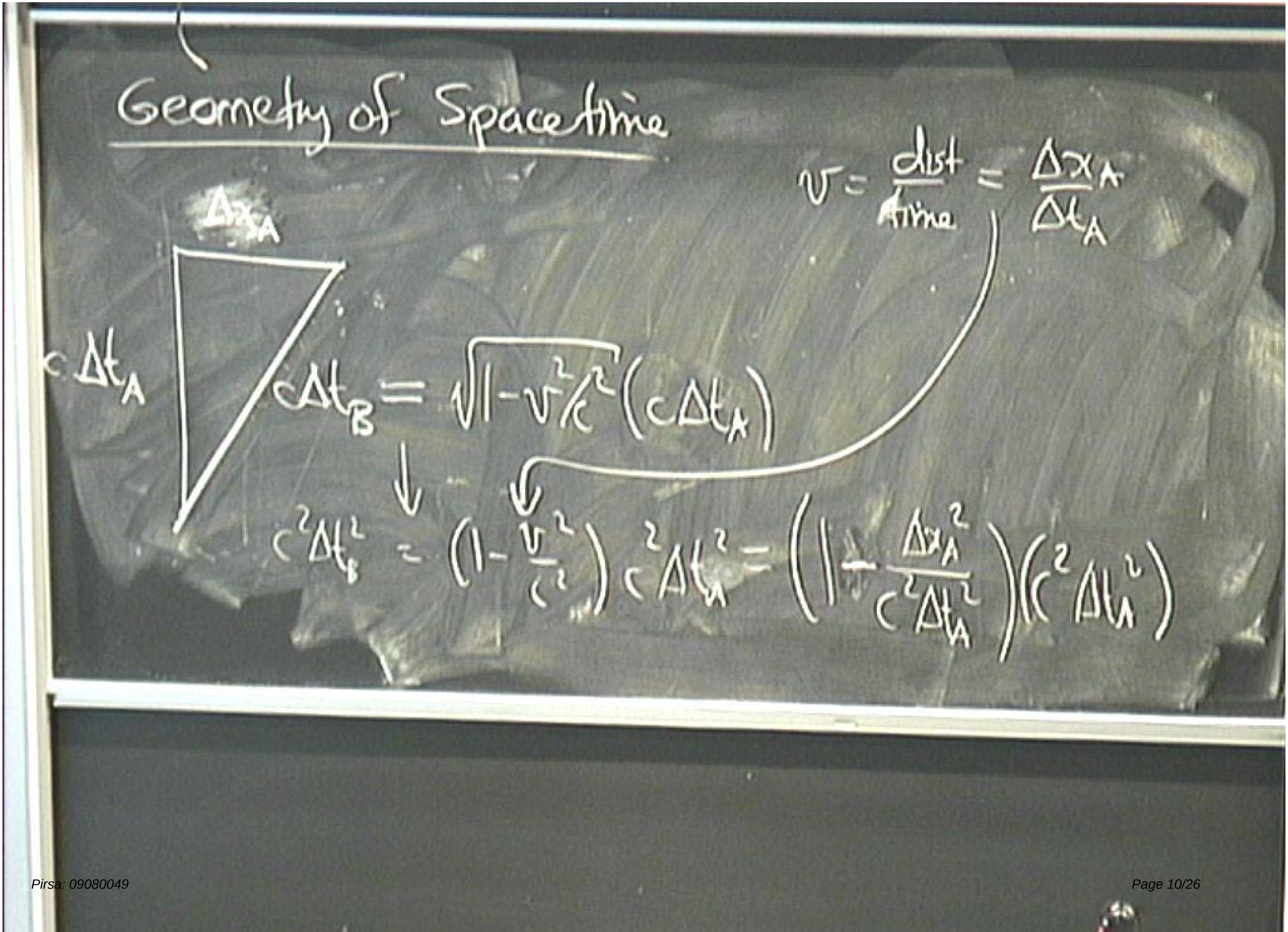
ct_A
ct_B
d
d
cT
k(cT)
x_A
k cT/d
cT
d
Δx_A
cΔt_A
cΔt_B
Δt_B = √(1 − v²/c²) Δt_A

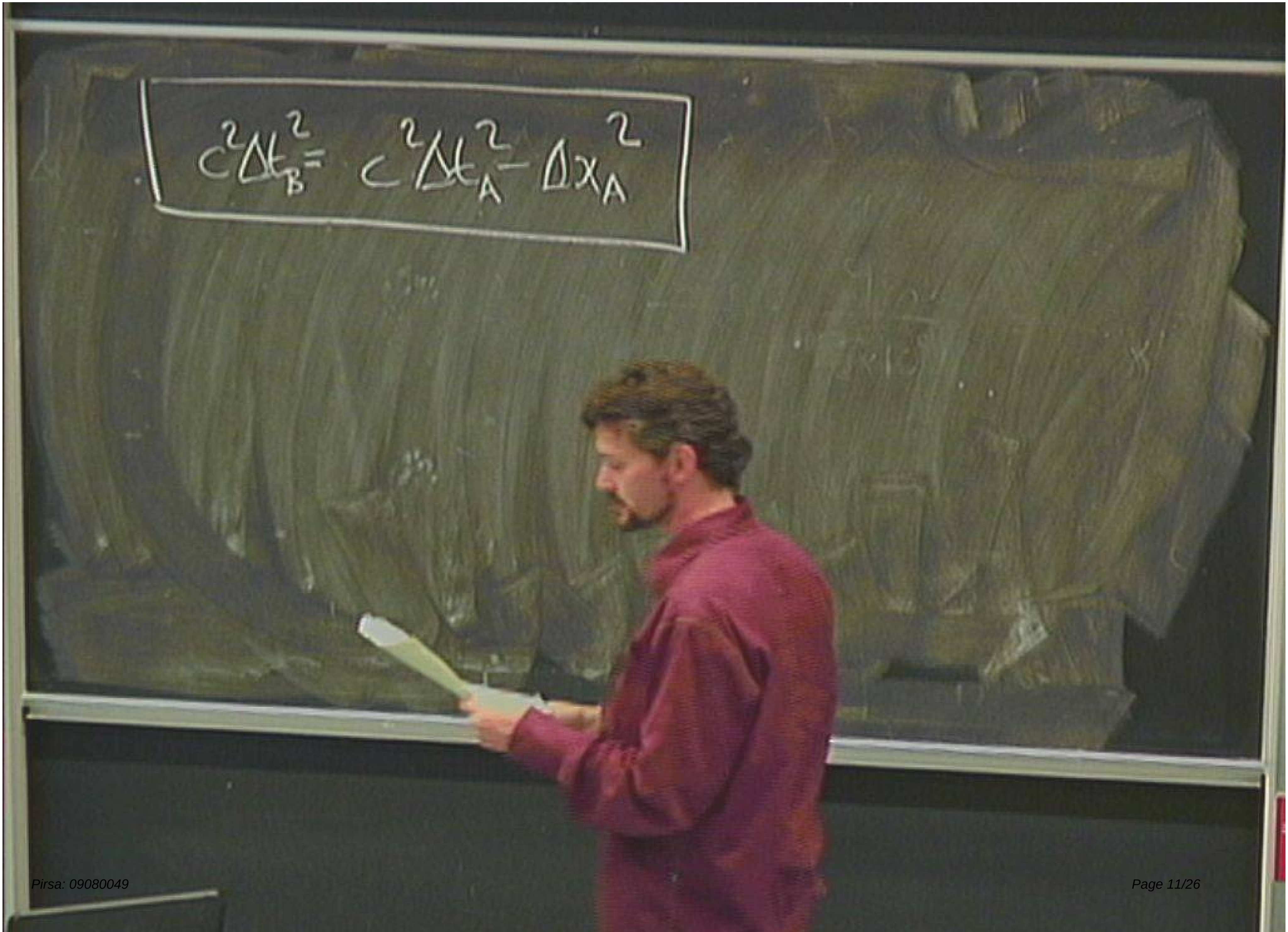

ctA
ctB
d
d
cT
k(cT)
xA
kcT/d
cT/d
ΔxA
cΔtA
cΔtB
ΔtB = √(1−v²/c²) ΔtA
k = √((1+v/c)/(1−v/c))

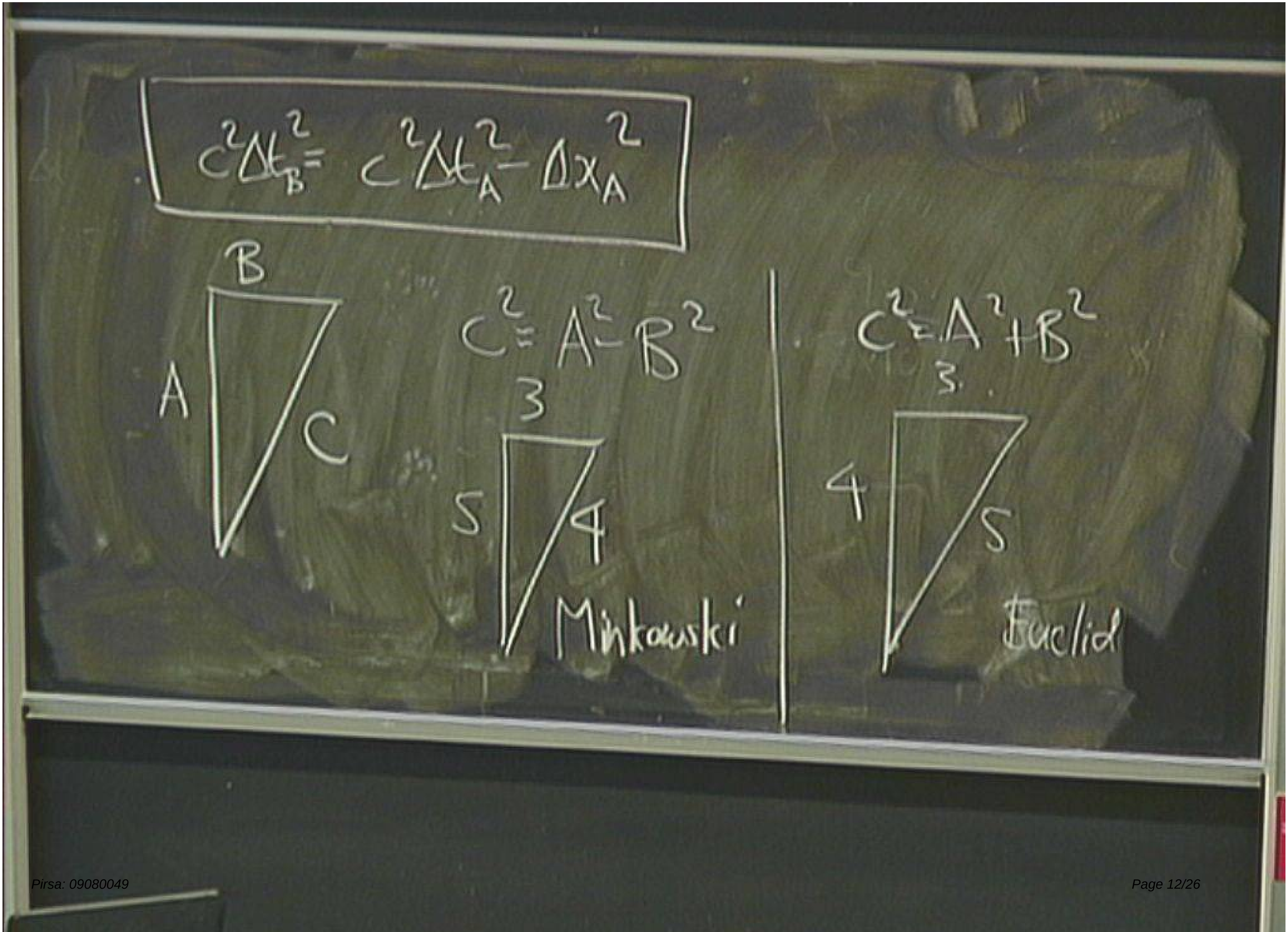

Geometry of Spacetime

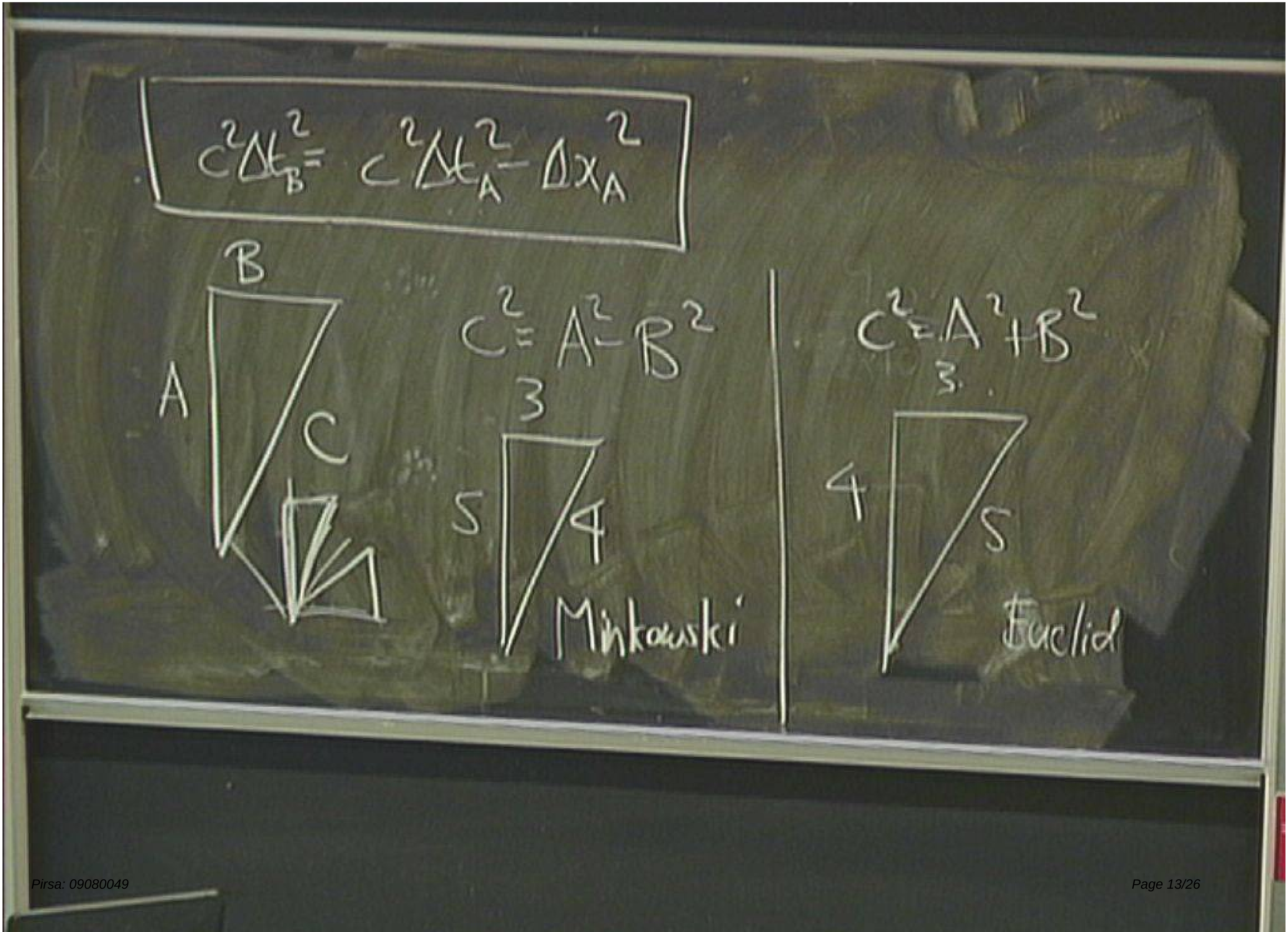

Geometry of Spacetime
Δx_A
cΔt_A
cΔt_B =

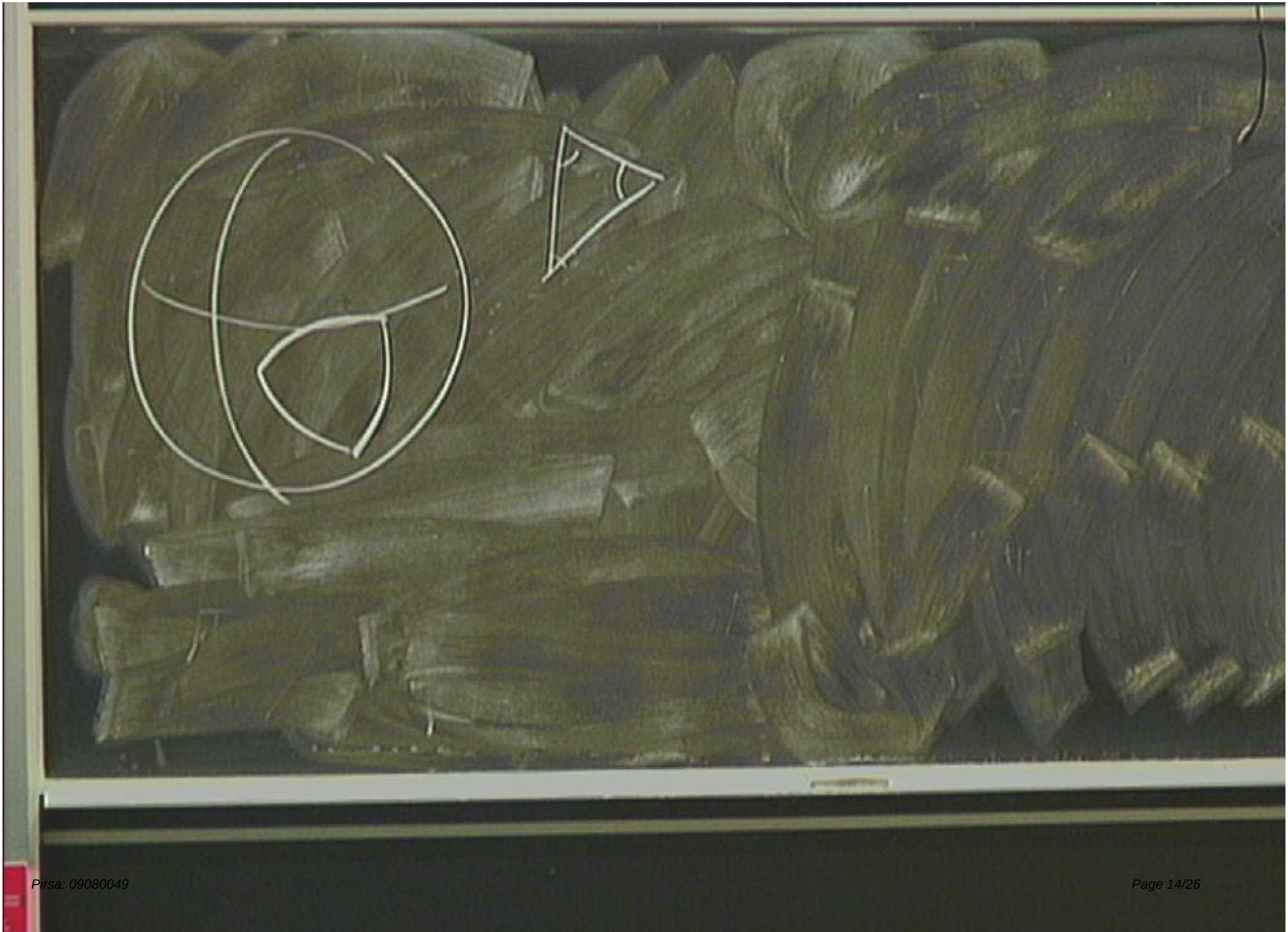

Geometry of Spacetime
$v = \frac{\text{dist}}{\text{time}}$
Δx_A
$c\Delta t_B = \sqrt{1 - v^2/c^2}\,(c\Delta t_A)$
$c^2\Delta t_B^2 = \left(1 - \frac{v^2}{c^2}\right) c^2\Delta t_A^2$

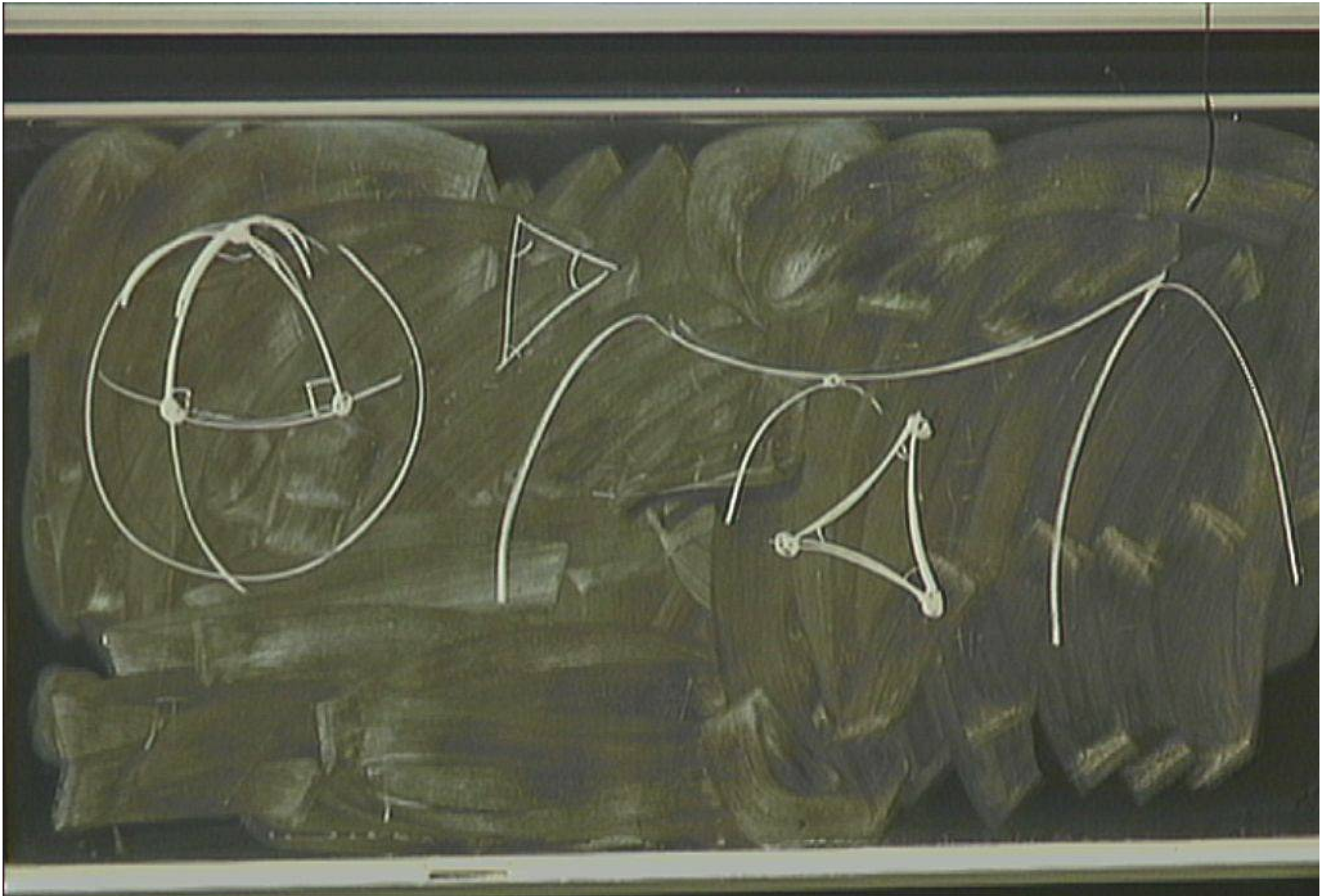

Geometry of Spacetime
$v = \frac{dist}{time} = \frac{\Delta x_A}{\Delta t_A}$
Δx_A
$c\Delta t_A$
$c\Delta t_B = \sqrt{1 - v^2/c^2}\,(c\Delta t_A)$
$c^2\Delta t_B^2 = (1 - \frac{v^2}{c^2})\,c^2\Delta t_A^2 = (1 - \frac{\Delta x_A^2}{c^2\Delta t_A^2})(c^2\Delta t_A^2)$

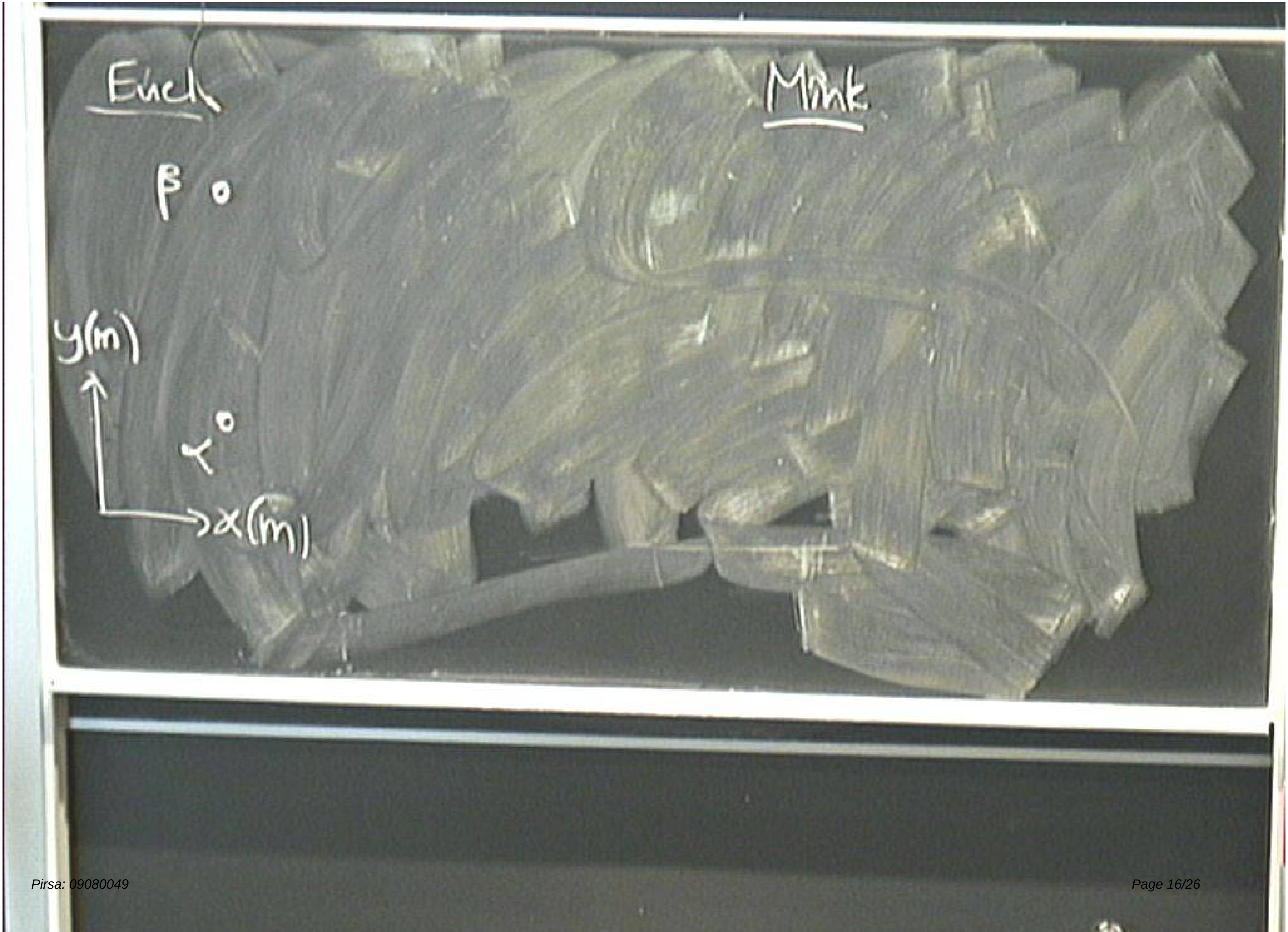

$c^2\Delta t_B^2 = c^2\Delta t_A^2 - \Delta x_A^2$

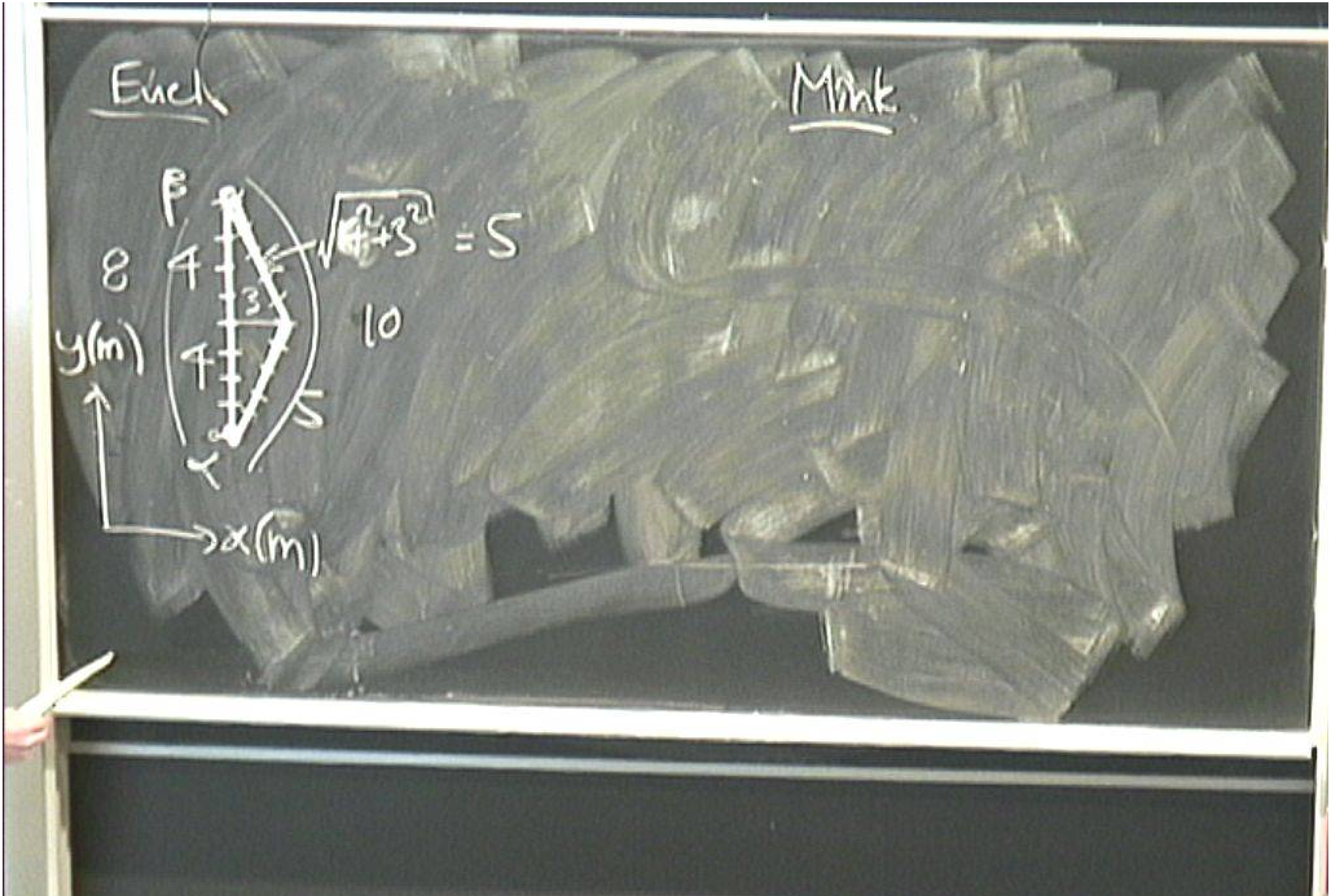

$c^2\Delta t_B^2 = c^2\Delta t_A^2 - \Delta x_A^2$
B
A
C
$C^2 = A^2 - B^2$
3
5
4
Minkowski
$C^2 = A^2 + B^2$
3
4
5
Euclid

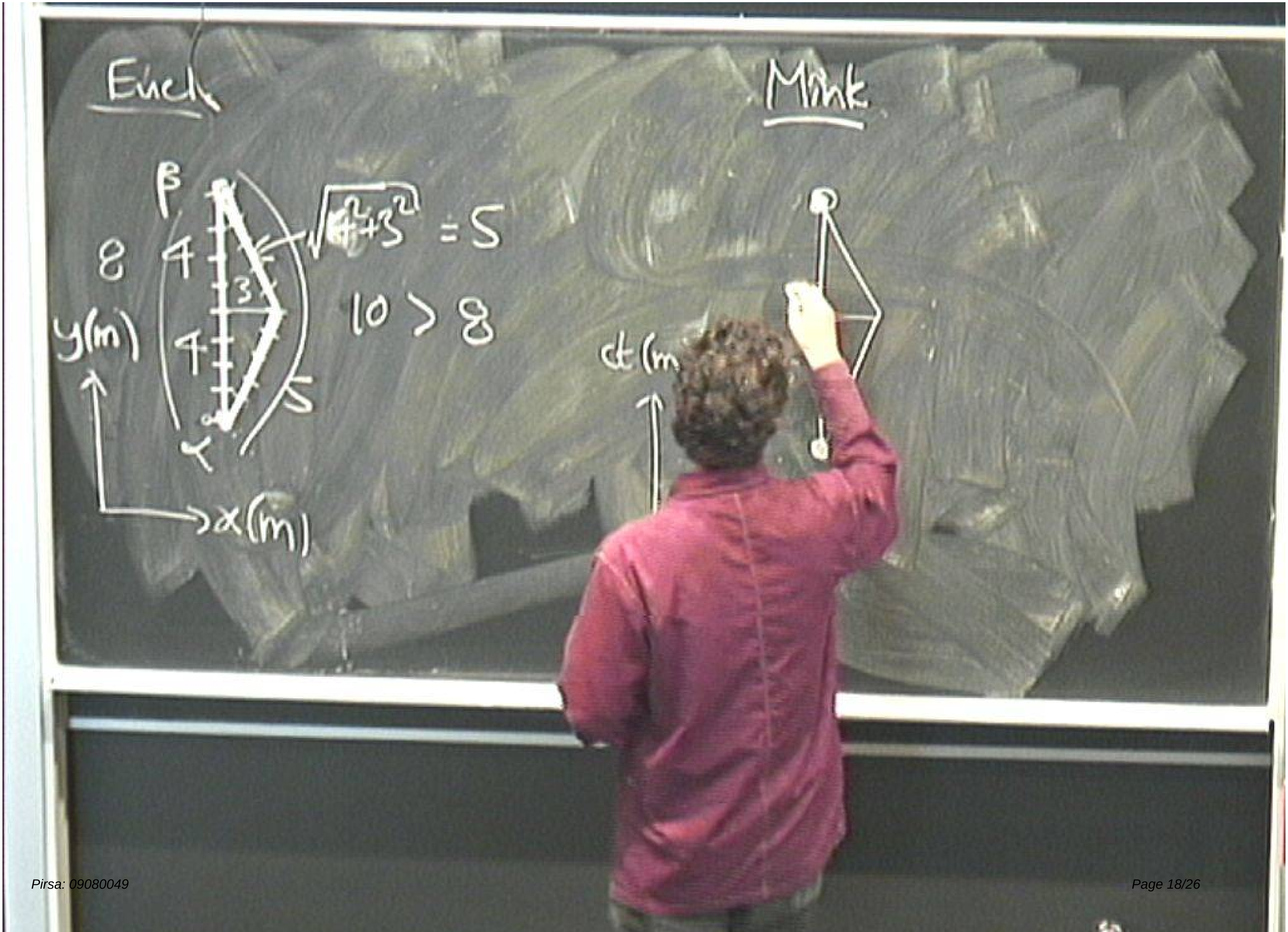

$c^2\Delta t_B^2 = c^2\Delta t_A^2 - \Delta x_A^2$
B
A
C
$C^2 = A^2 - B^2$
3
5
4
Minkowski
$C^2 = A^2 + B^2$
3
4
5
Euclid

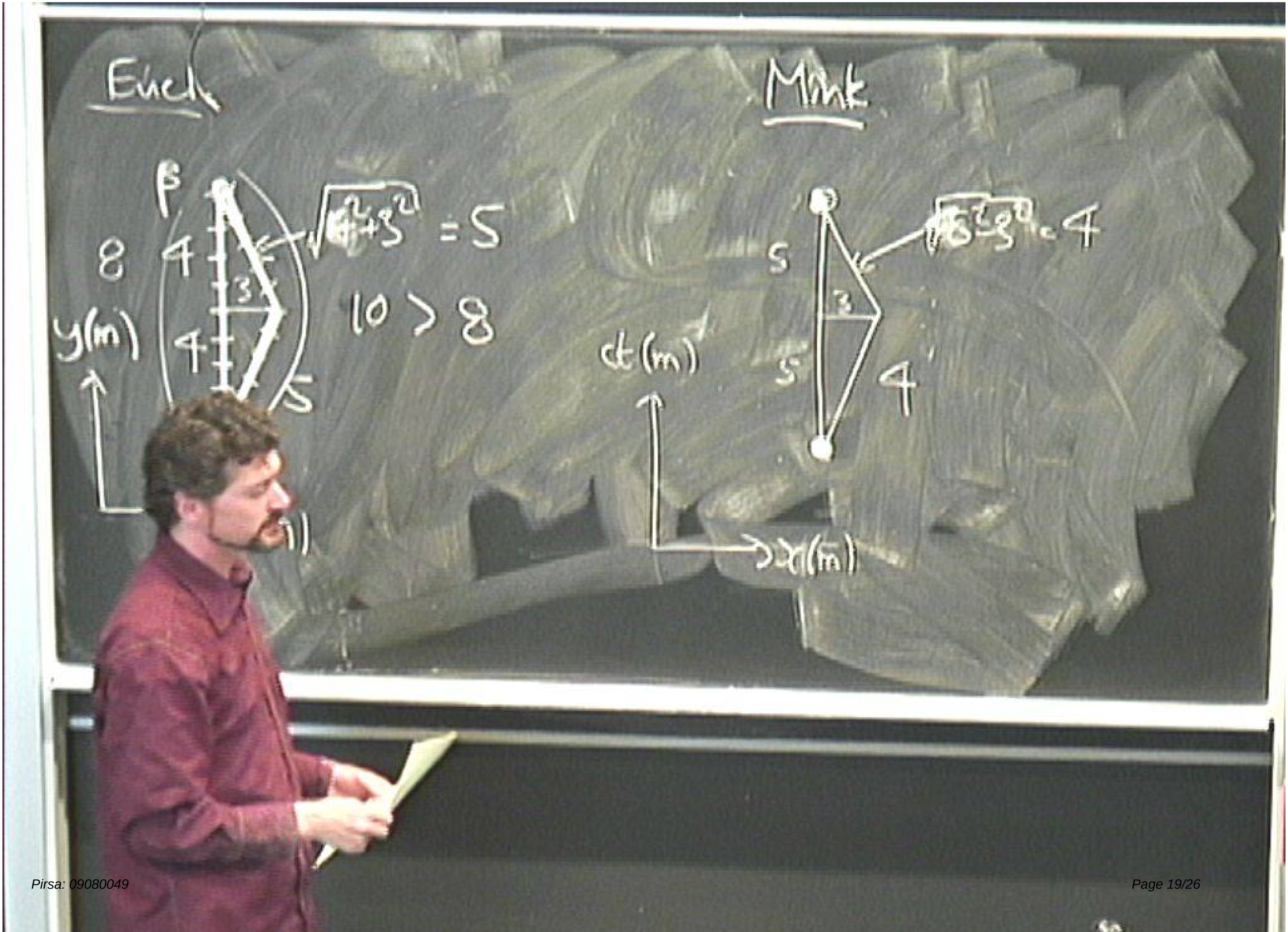


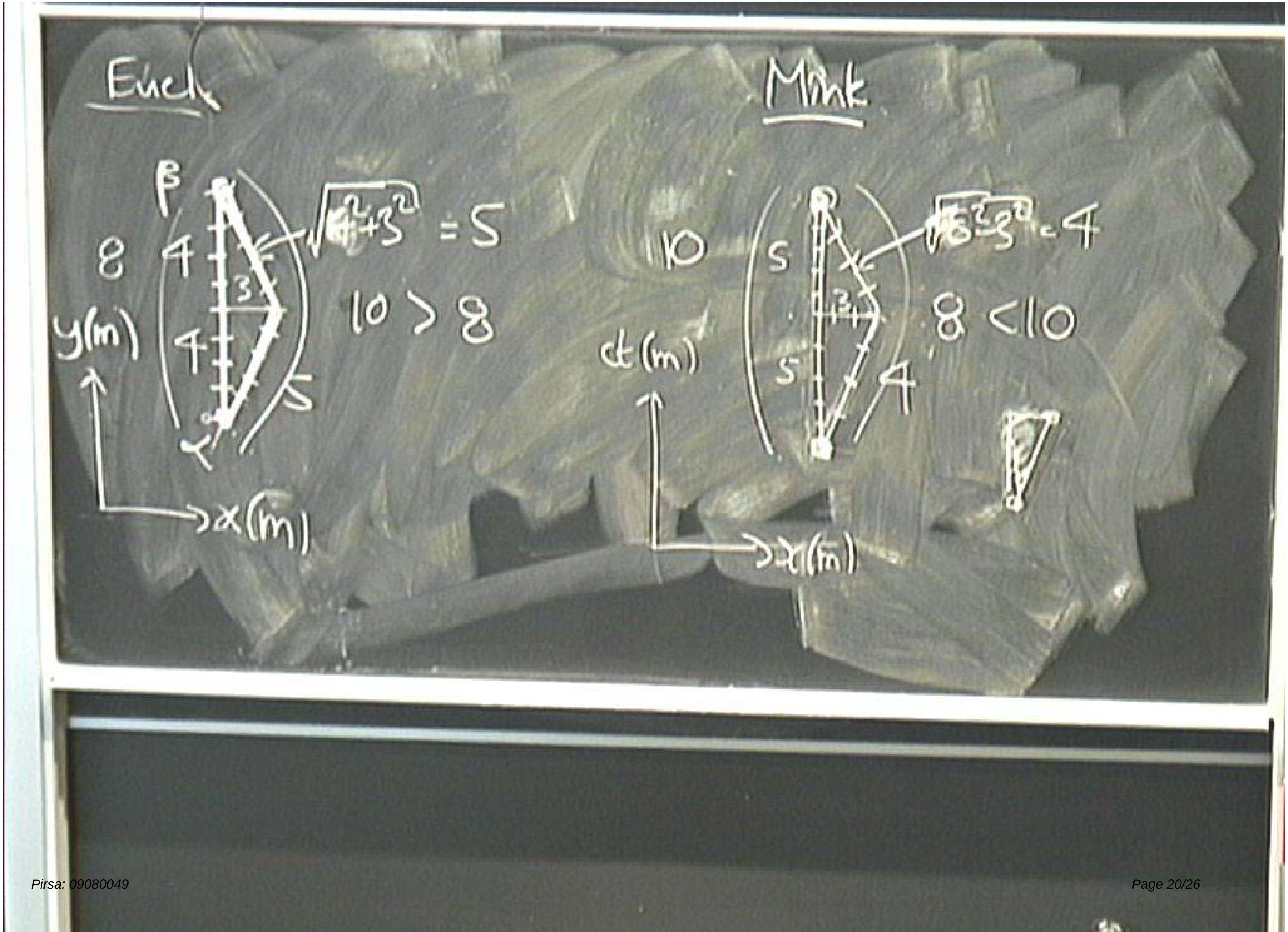



Eucl
Mink
β
γ
y(m)
x(m)

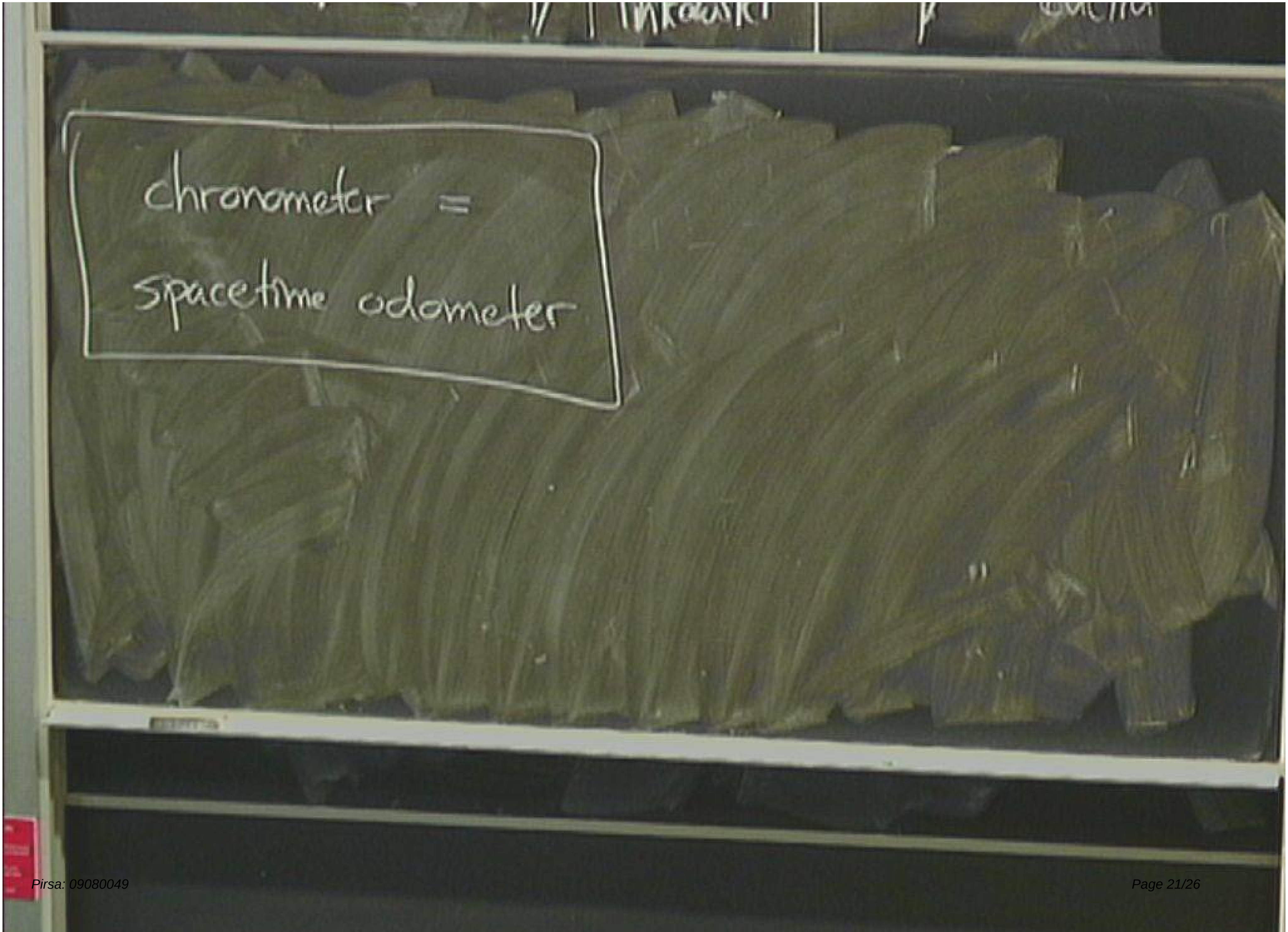

Eucl
Mink
$\sqrt{4^2+3^2} = 5$
10
8
4
4
3
5
y(m)
x(m)

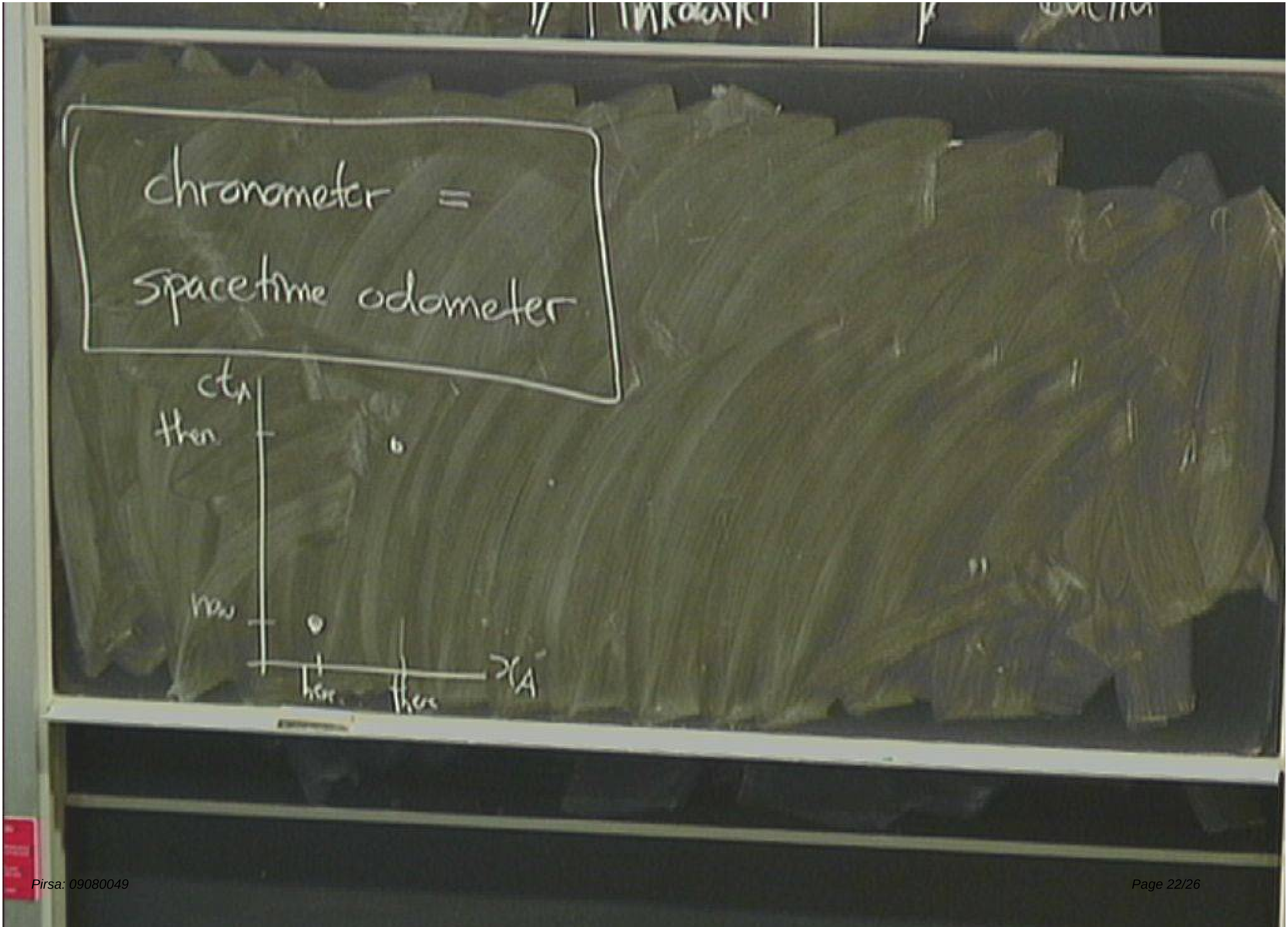

Eucl.
Mink
β
8
4
3
4
5
y(m)
x(m)
γ
$\sqrt{4^2+3^2} = 5$
10 > 8
ct(m

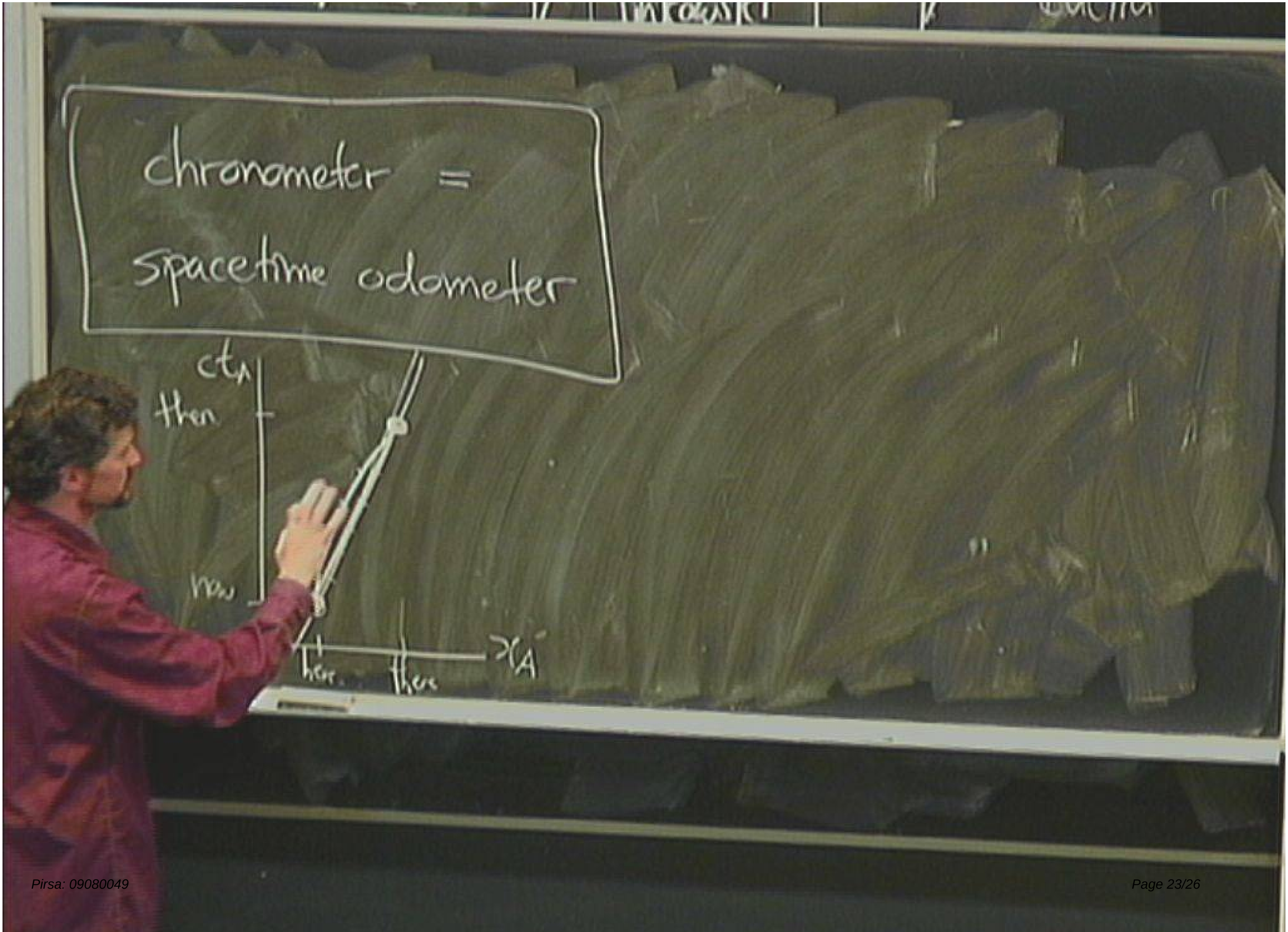

Eucl
Mink
y(m)
ct(m)
x(m)
10 > 8
= 5
= 4



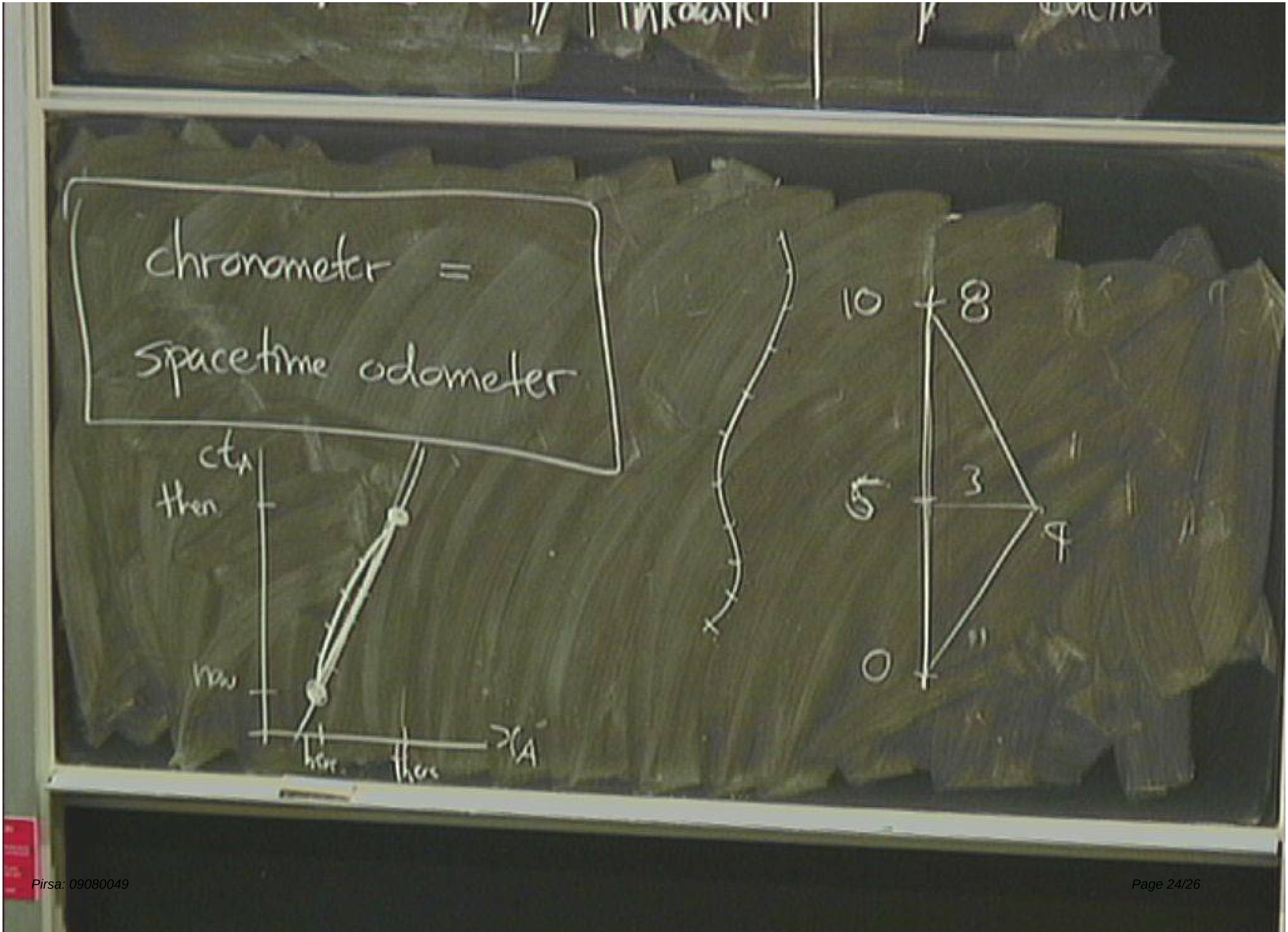
Eucl.
Mink
10 > 8
8 < 10
y(m)
x(m)
ct(m)


chronometer =
spacetime odometer


chronometer =
spacetime odometer
ct_A
then
now
here
there
x_A



chronometer =
spacetime odometer
ct_A
then
now
here
there
x_A


chronometer =
spacetime odometer
ct_A
then
now
here
there
x_A
10
8
5
3
4
0