

Title: Relativity 4

Date: Jul 27, 2008 09:00 AM

URL: <http://pirsa.org/08070042>

Abstract:

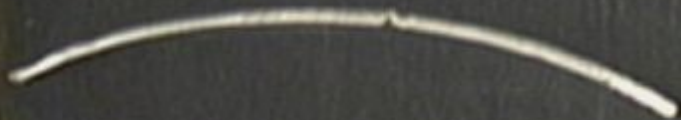
Einstein's Rotating Disk Thought Expt.



Einstein's Rotating Disk Thought Expt.



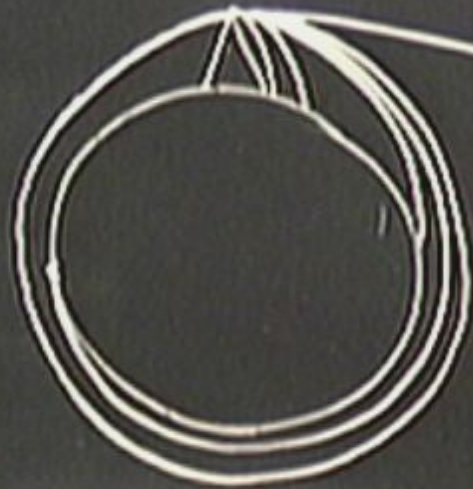
Weightless



Einstein's Rotating Disk Thought Expt.

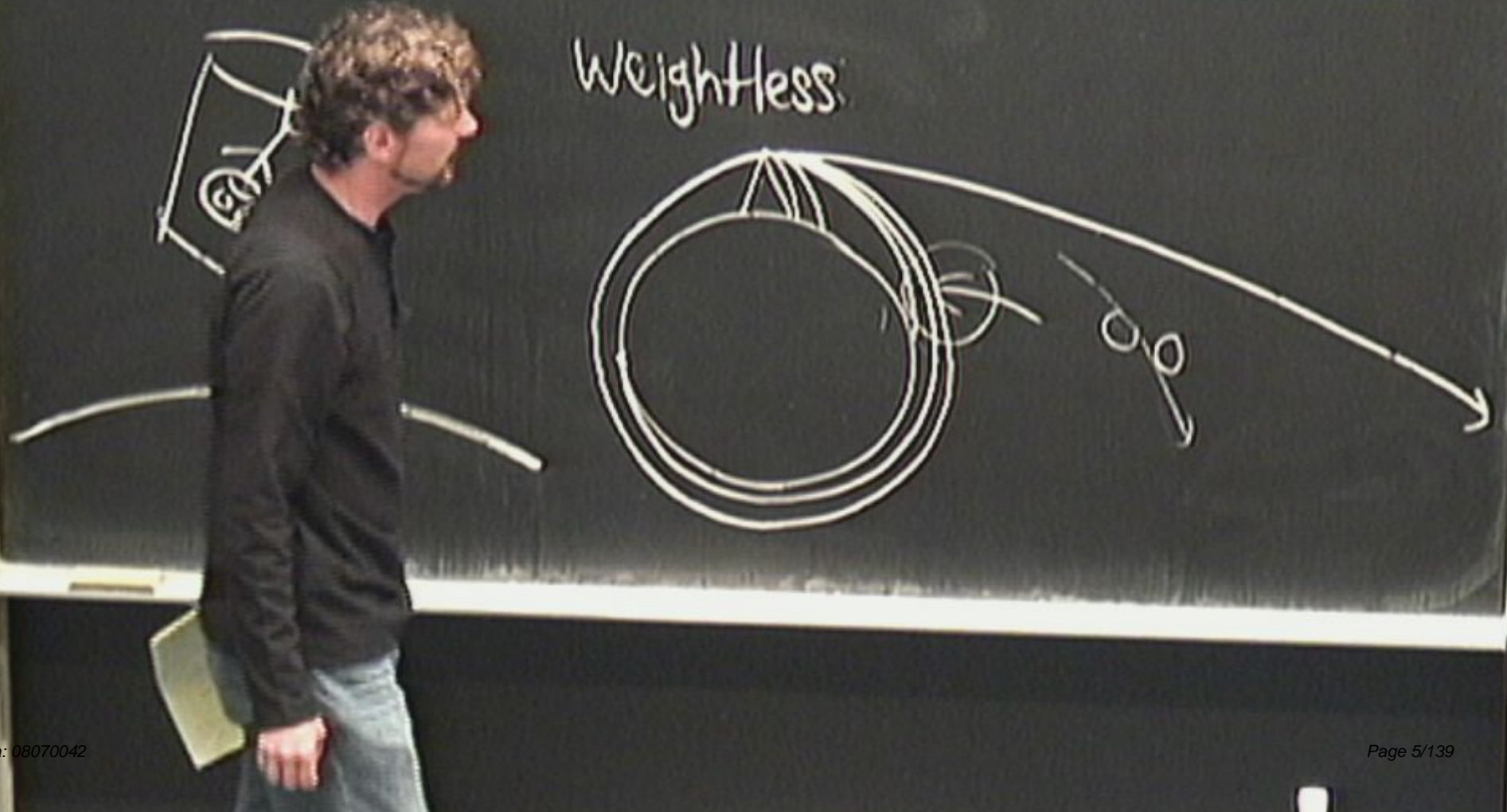


Weightless

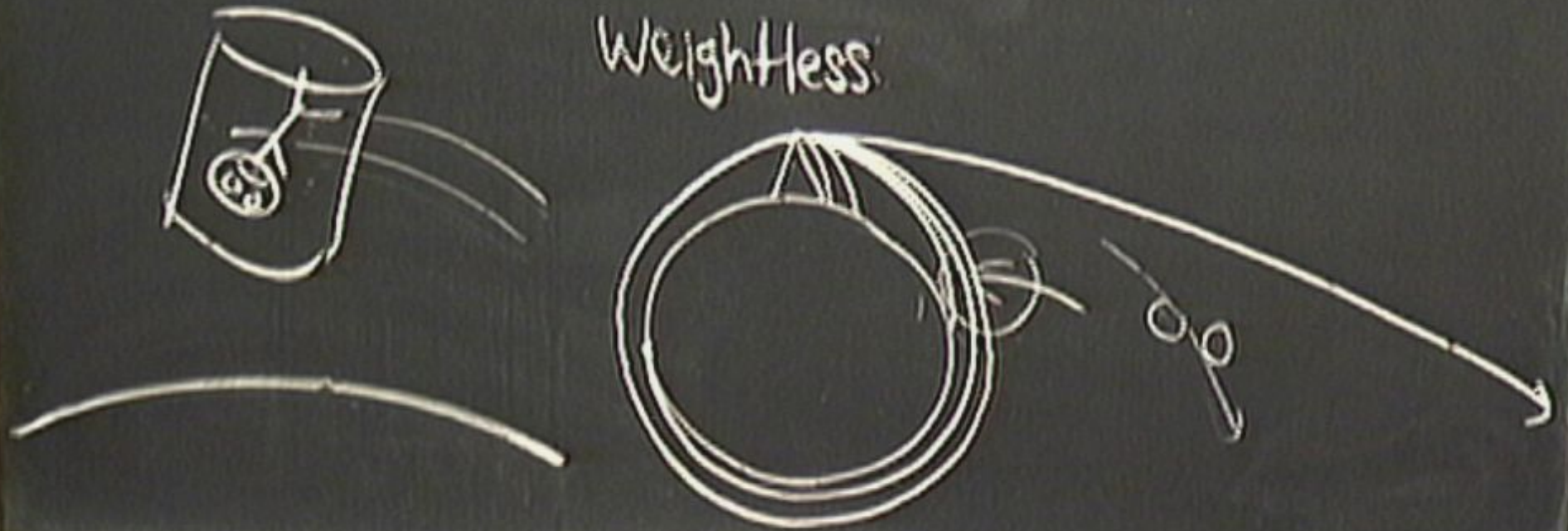


Einstein's Rotating Disk Thought Expt.

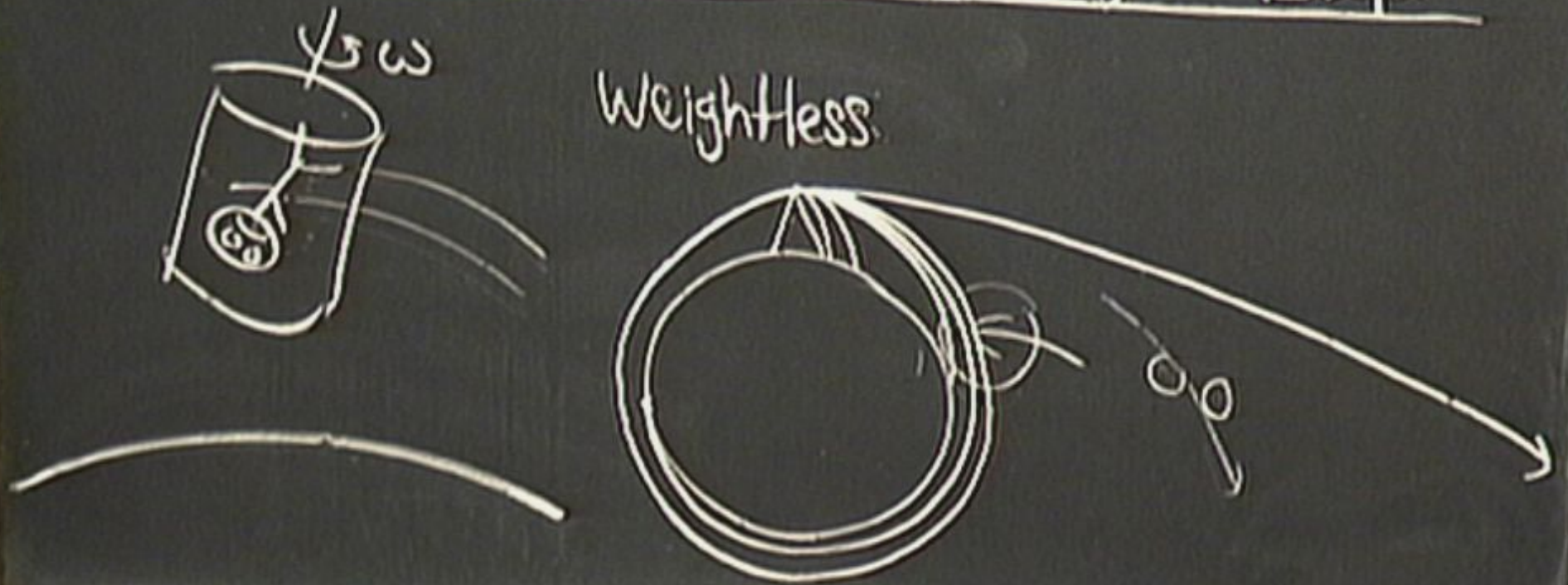
Weightless

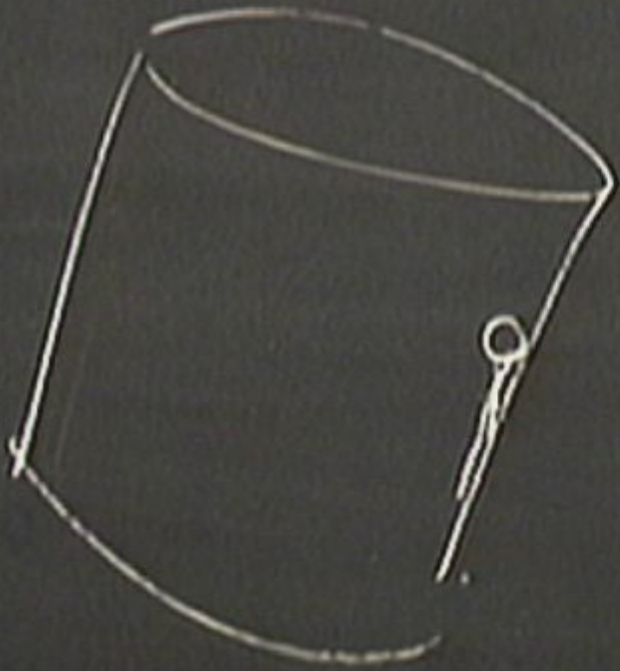


Einstein's Rotating Disk Thought Expt.

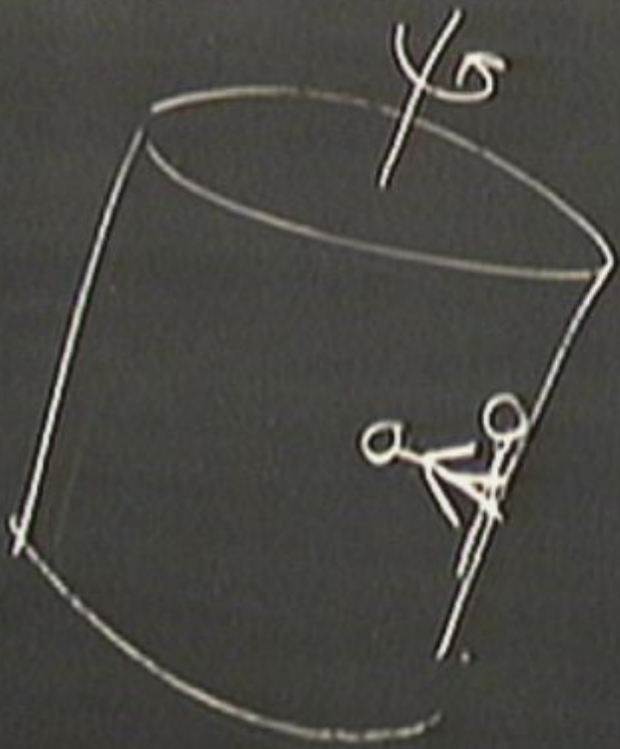


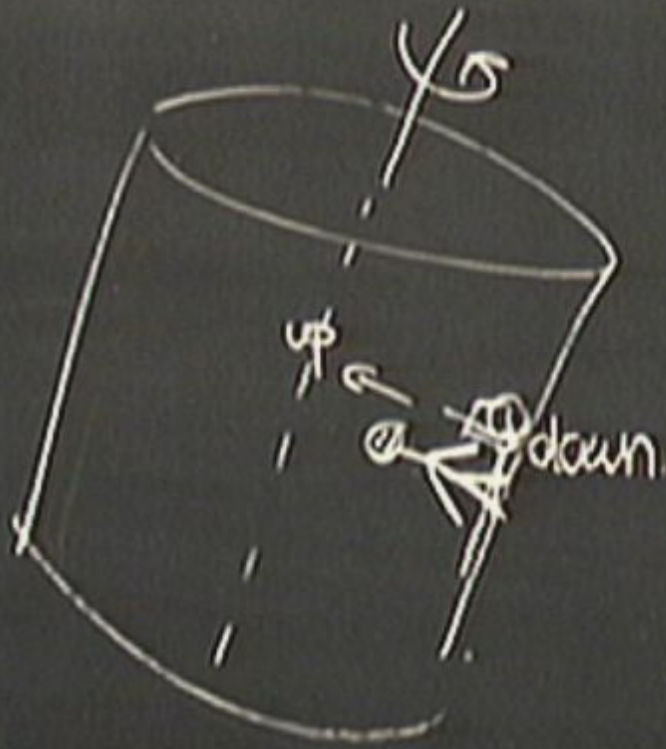
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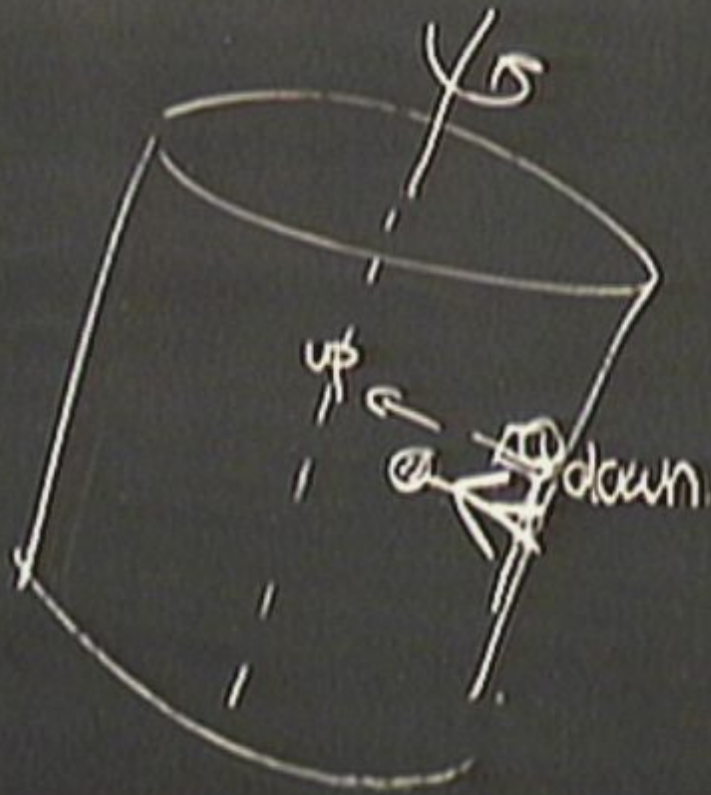




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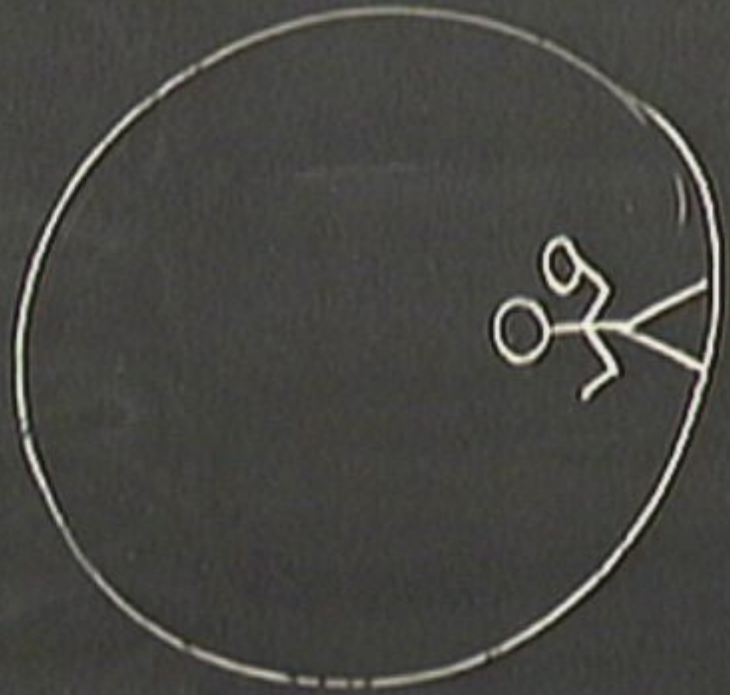
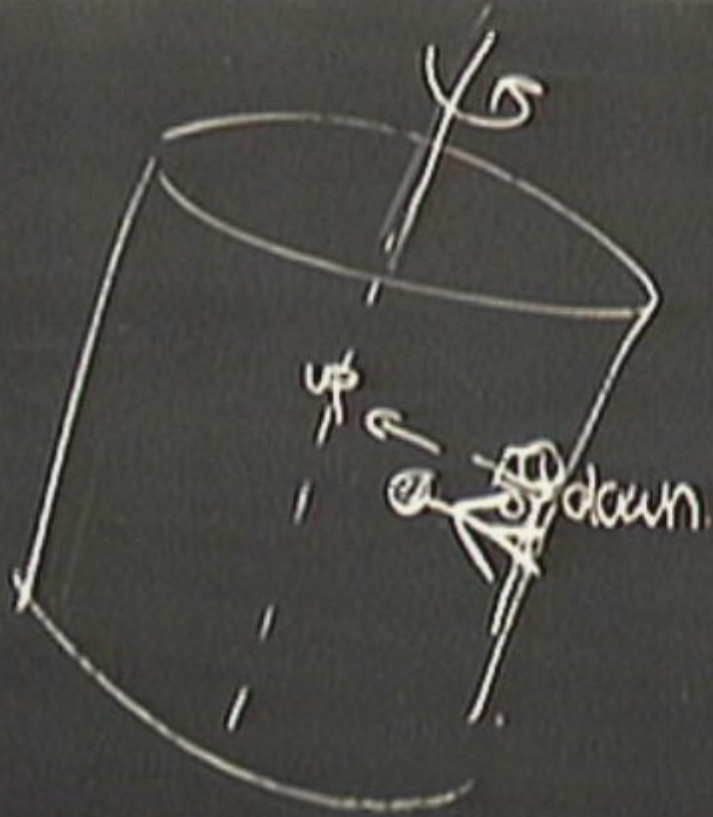




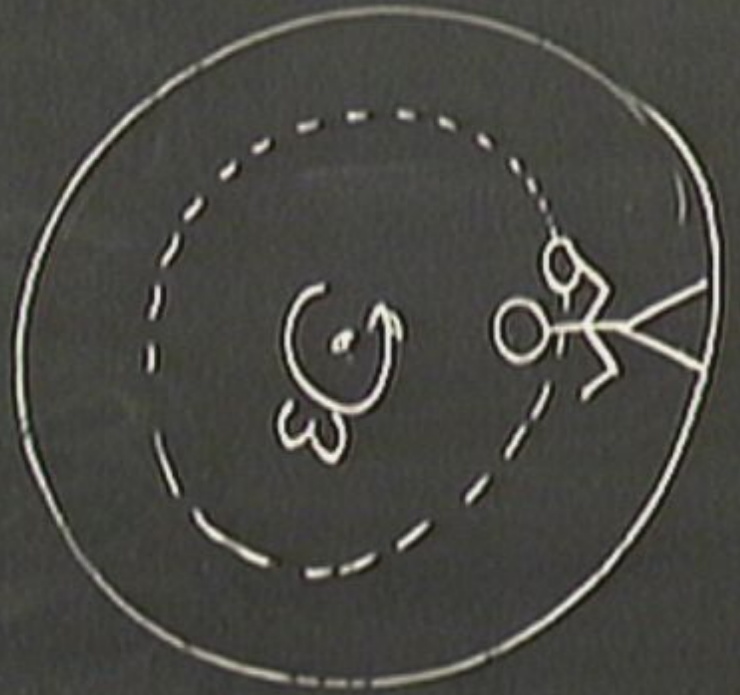
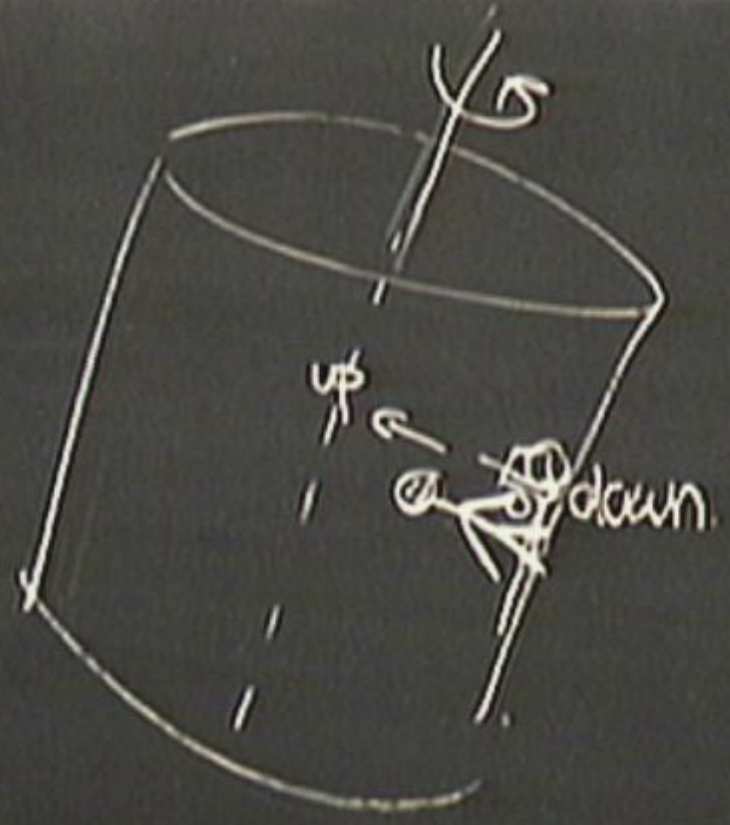


mimicing "real" gravity.

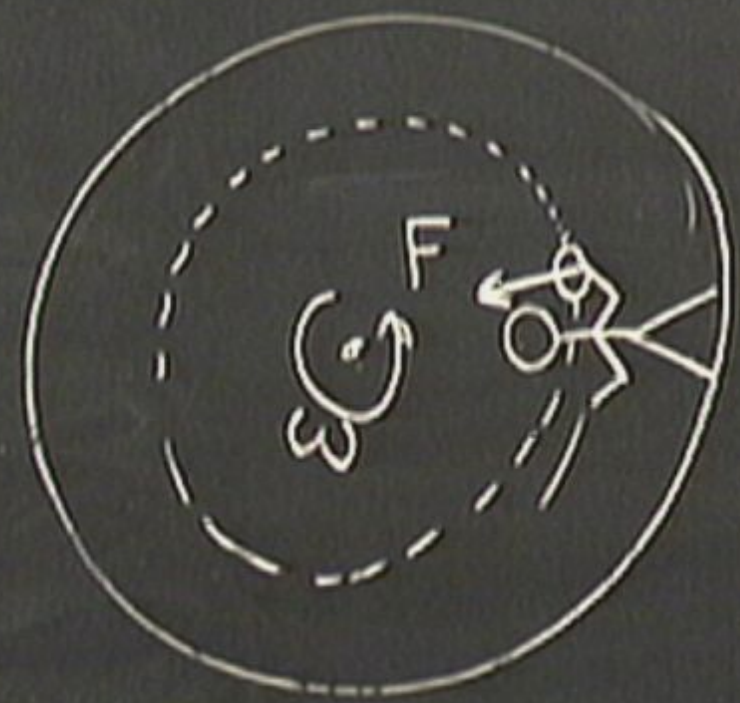
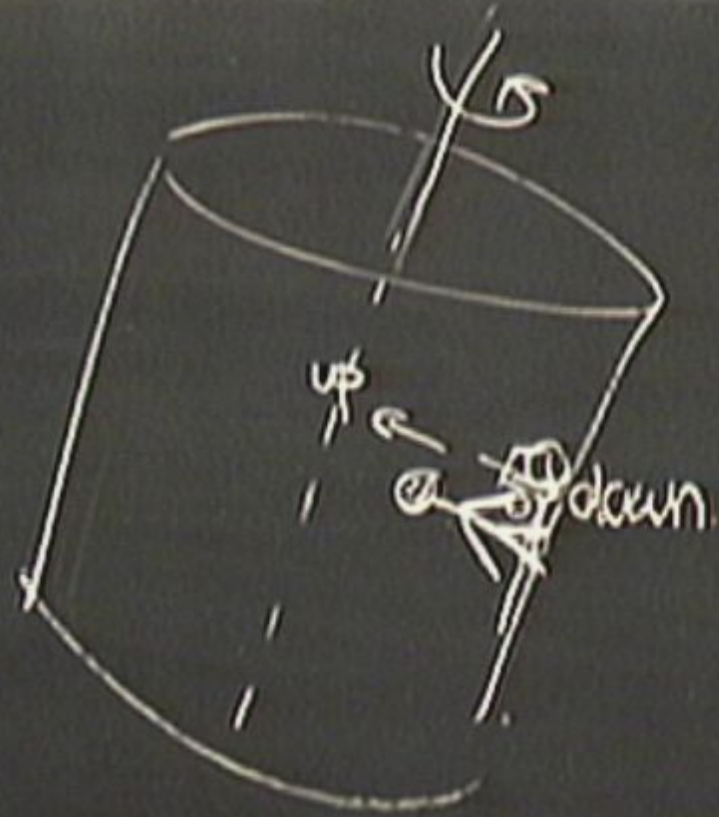
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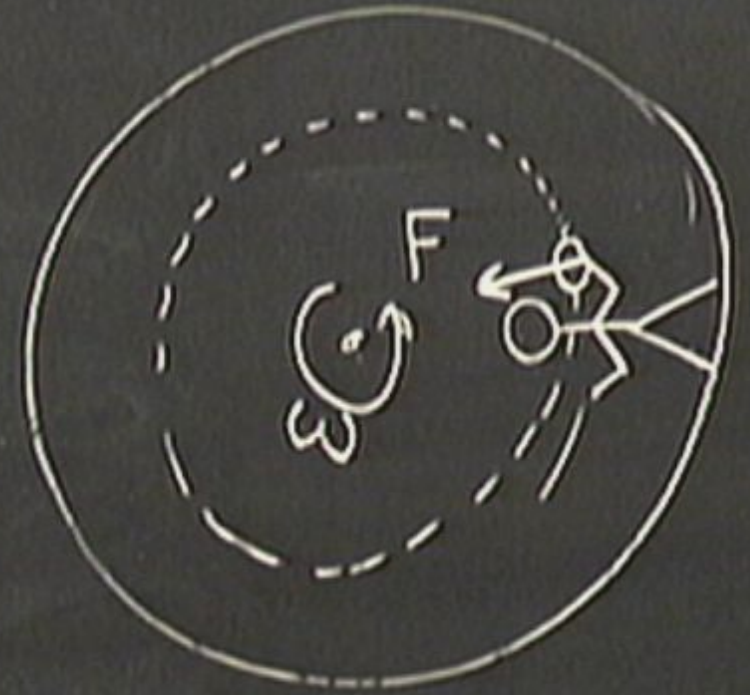
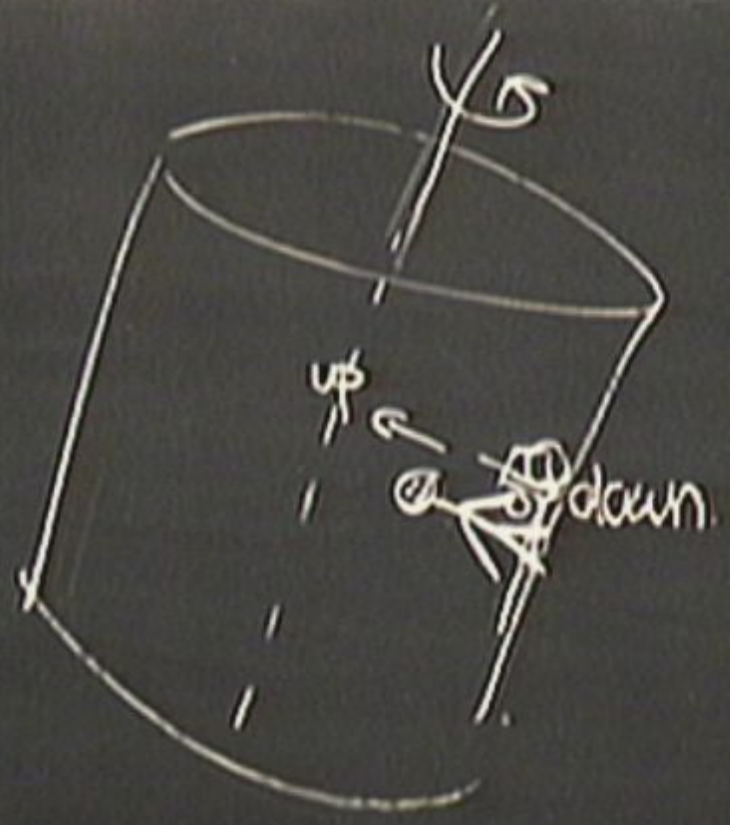
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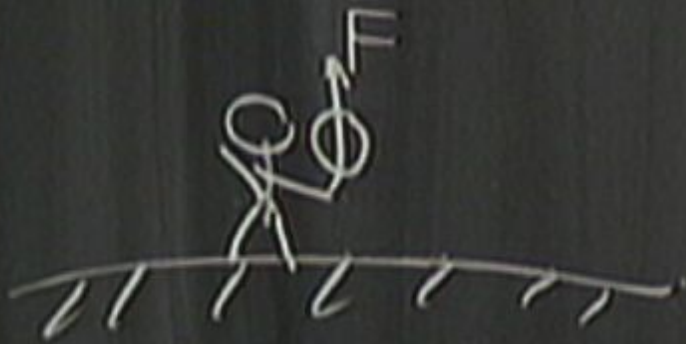


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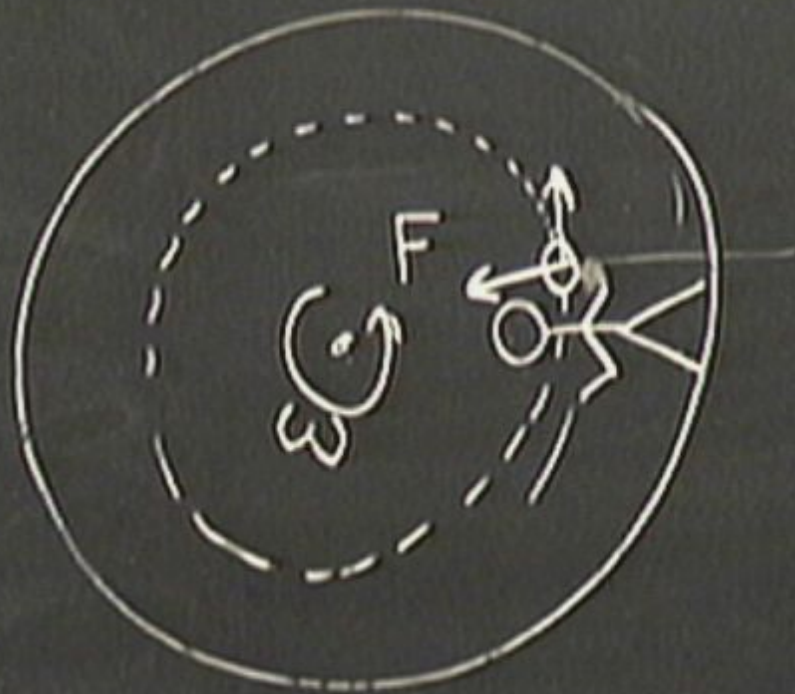
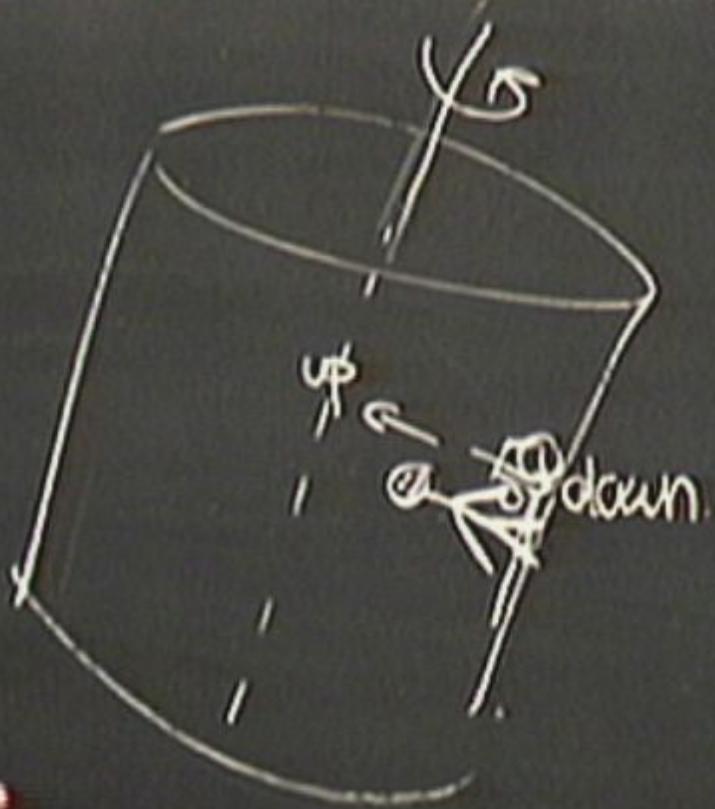


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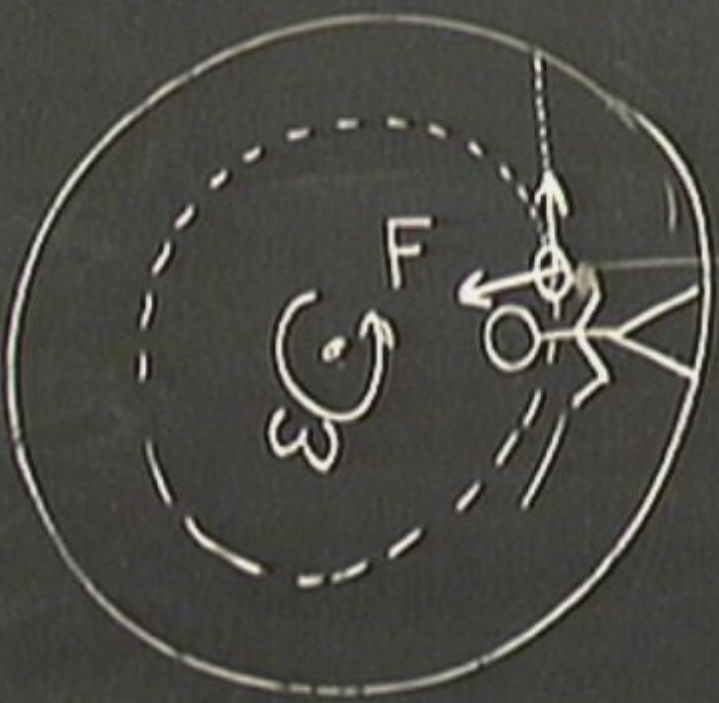
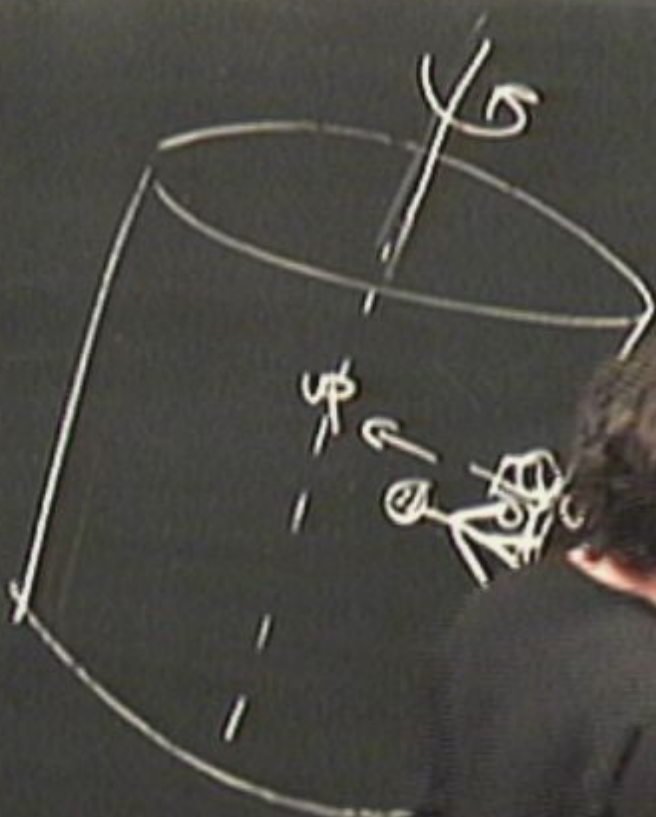




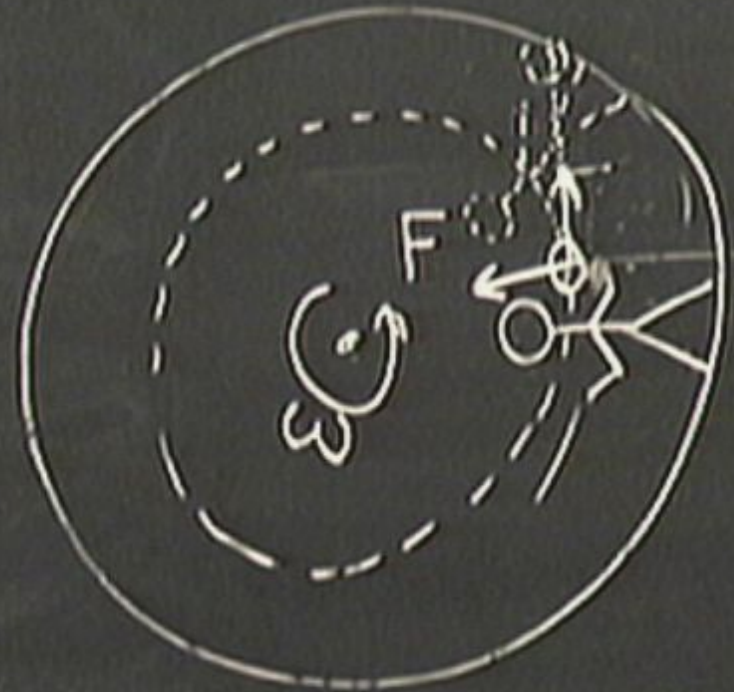
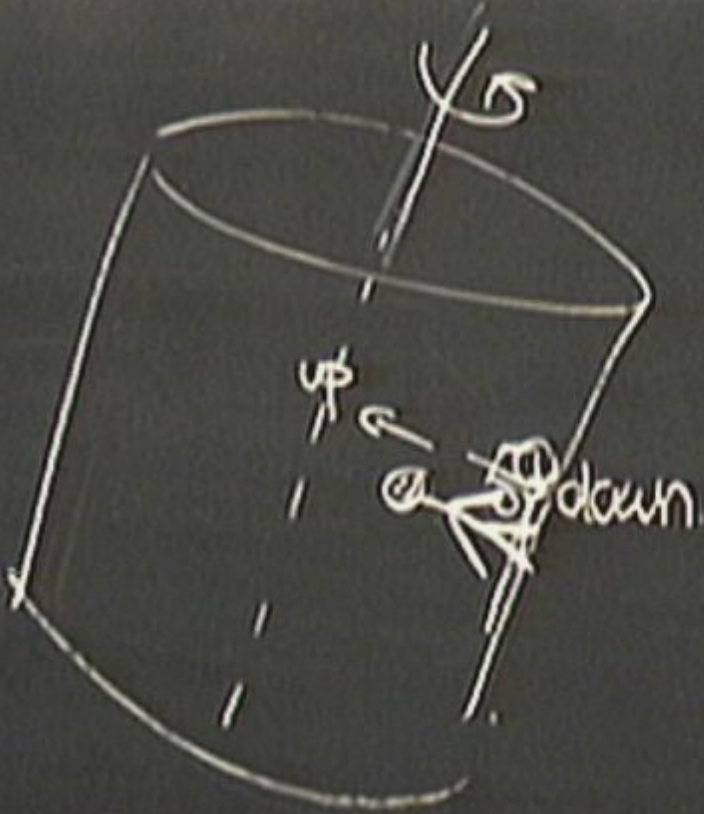
mimicing "real" gravity



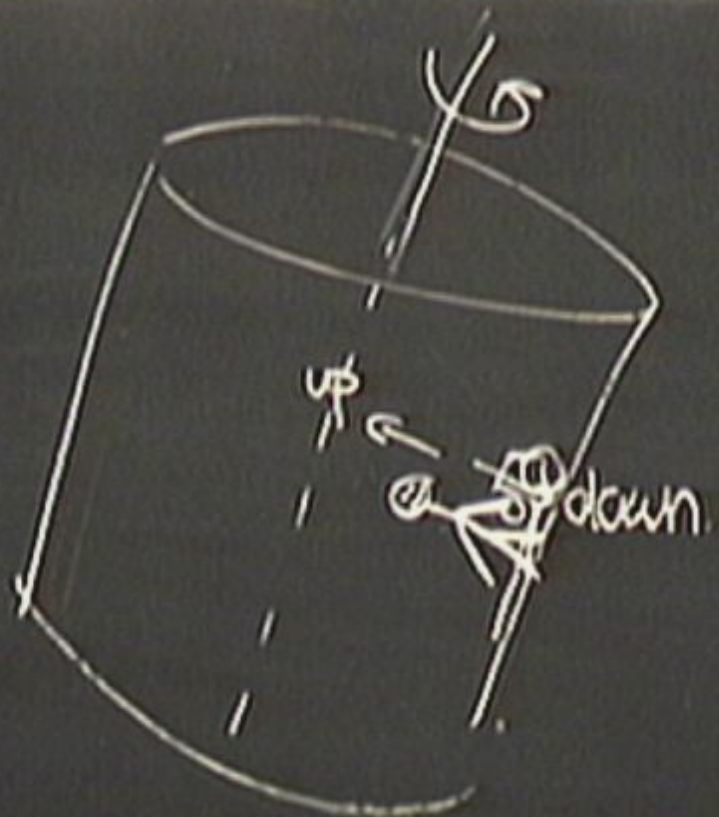
mimicing "real" gravity



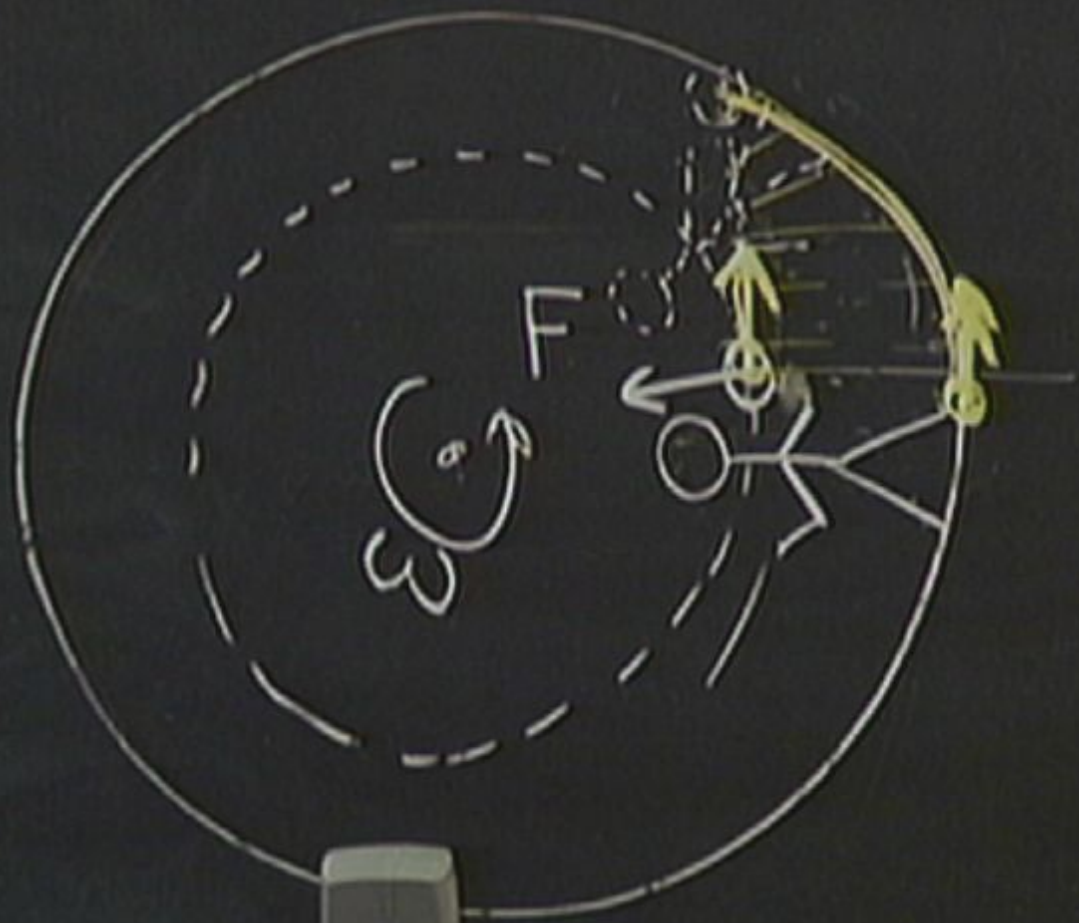
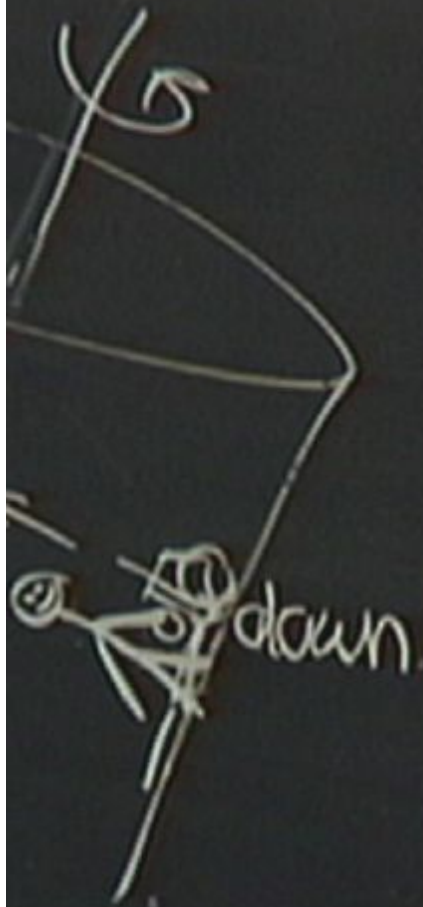
mimicking "real" gravity



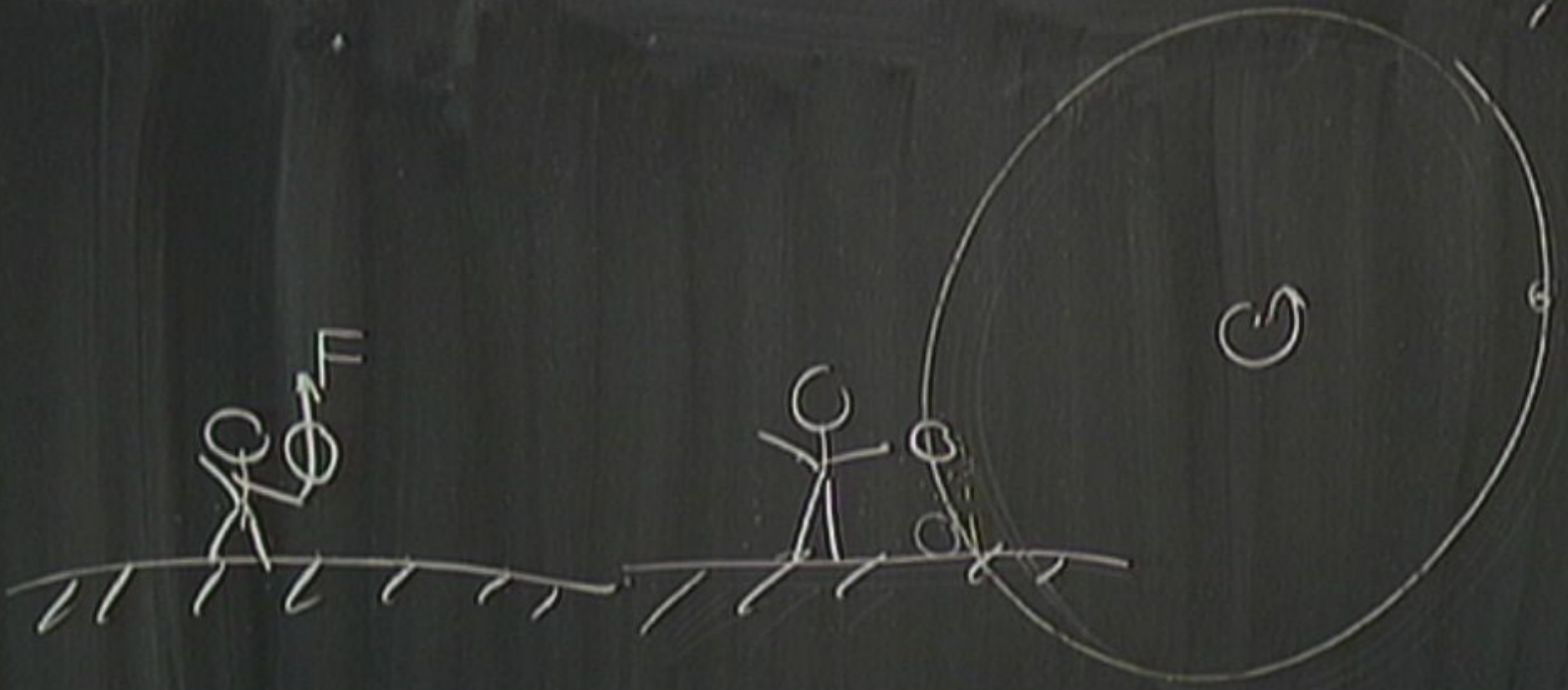
mimicing "real" gravity

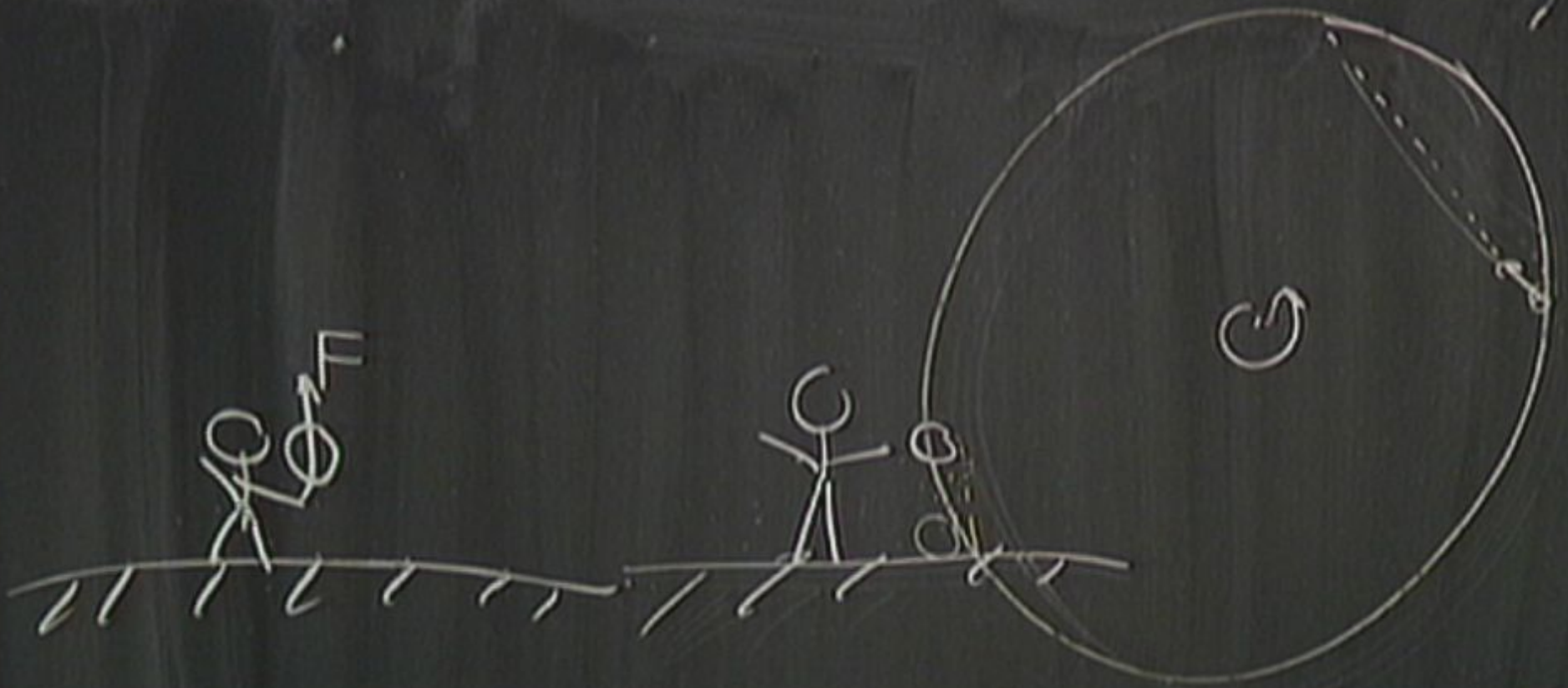


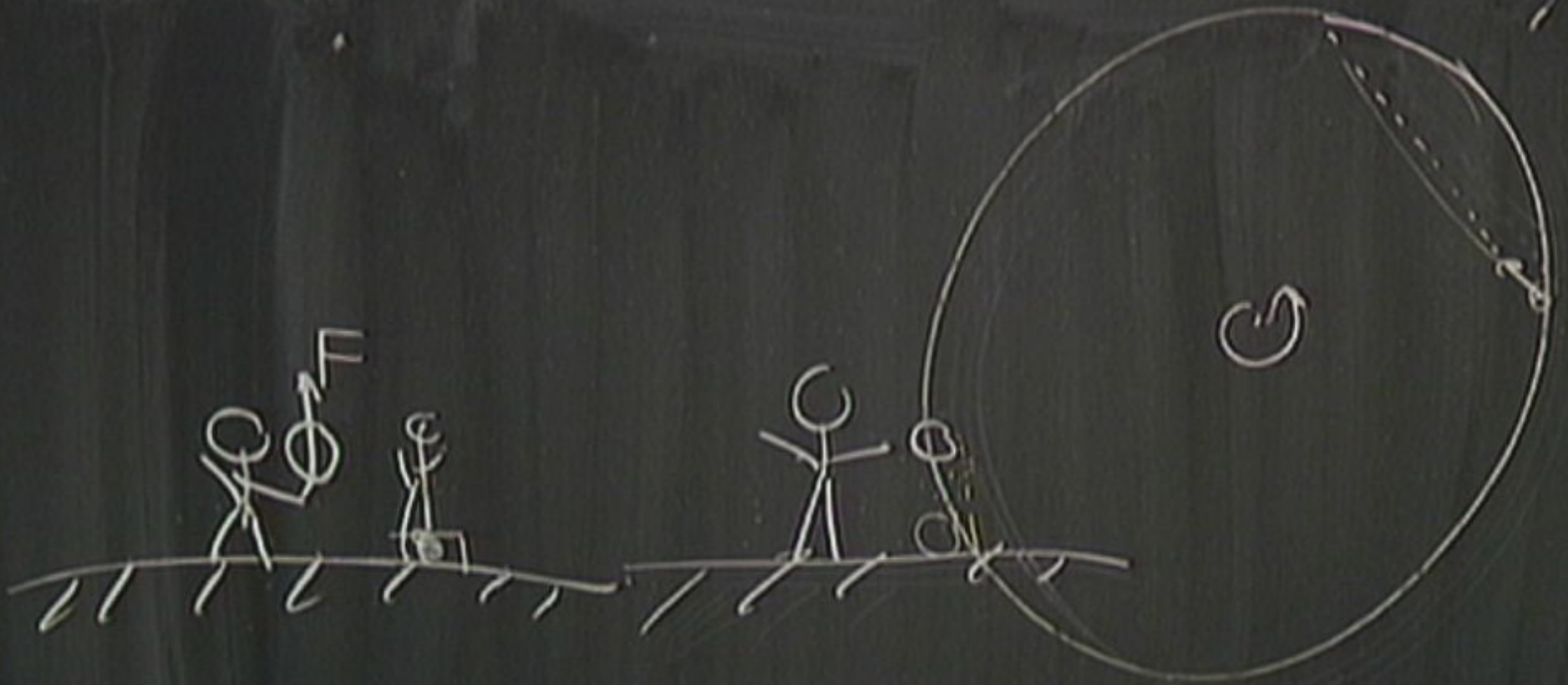
mimicing "real" gravity

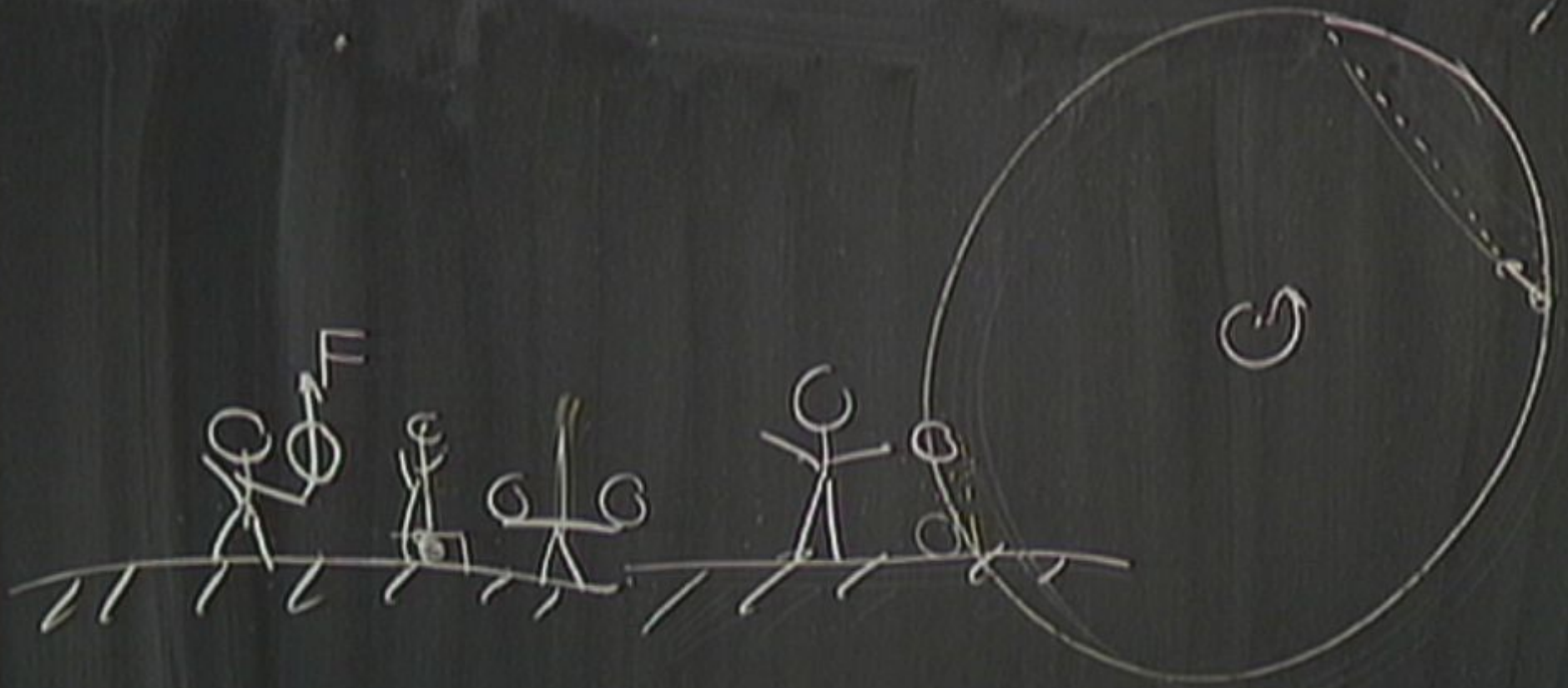






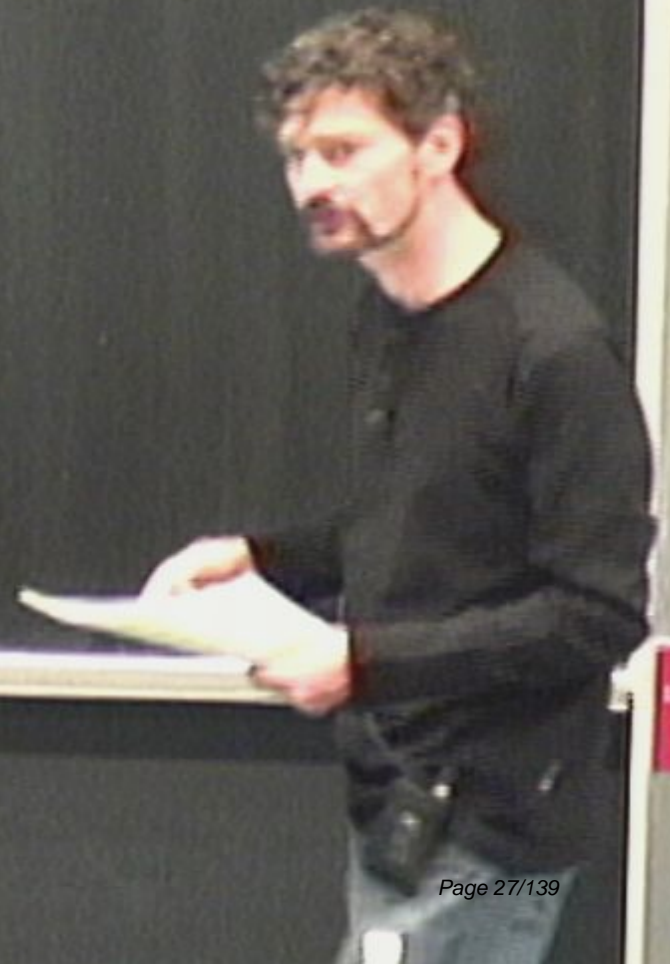






Erstein: Newton's model of gravity = wrong

(1)

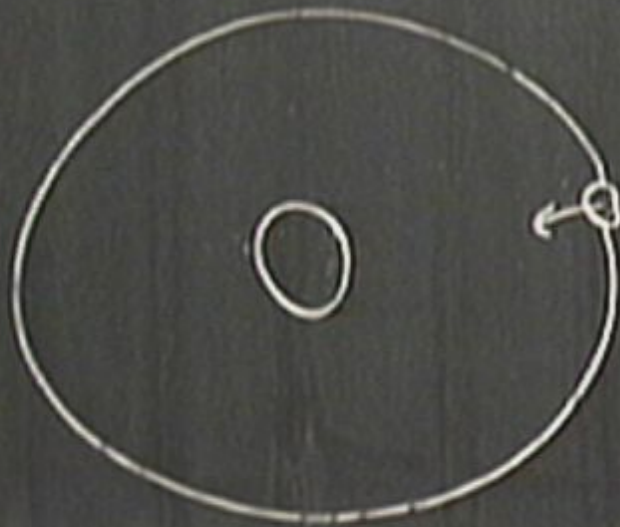


Einstein: Newton's model of gravity = wrong

(1) Theory: c = speed limit

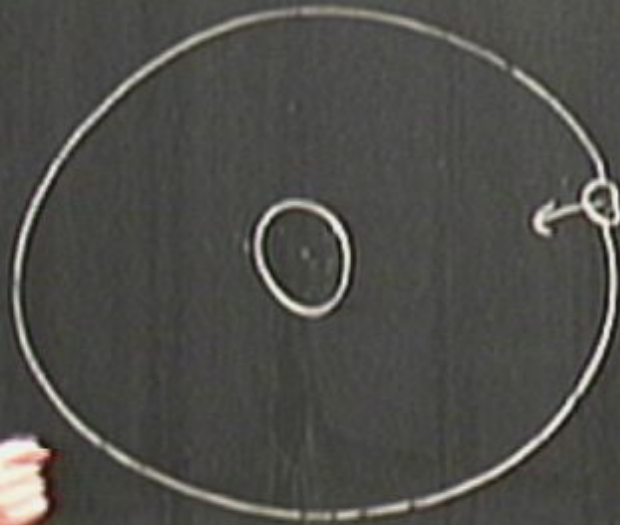
Einstein: Newton's model of gravity = wrong

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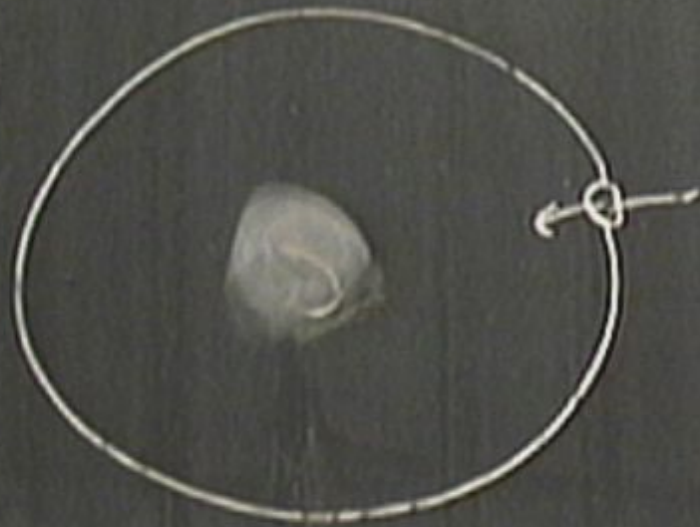
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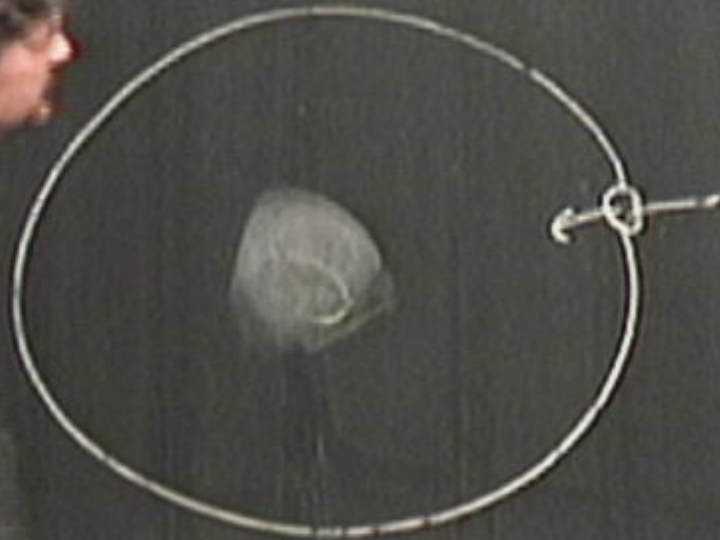
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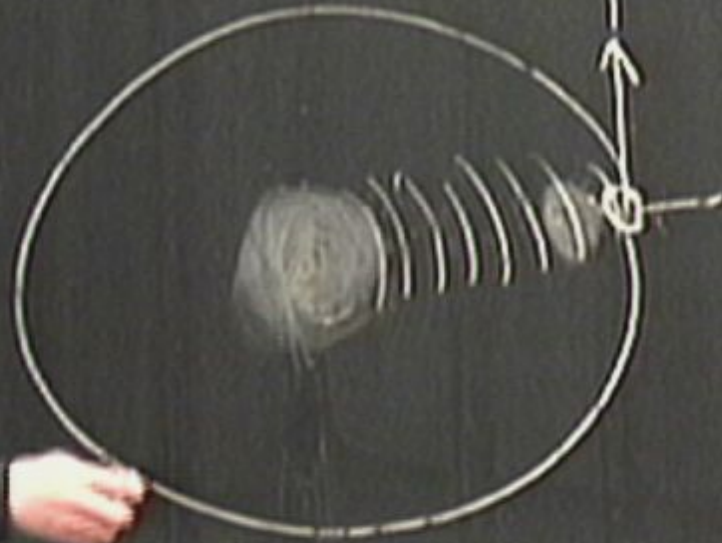
(1) Theor. ∴ $c =$ speed limit



$$F = G \frac{Mm}{r^2}$$

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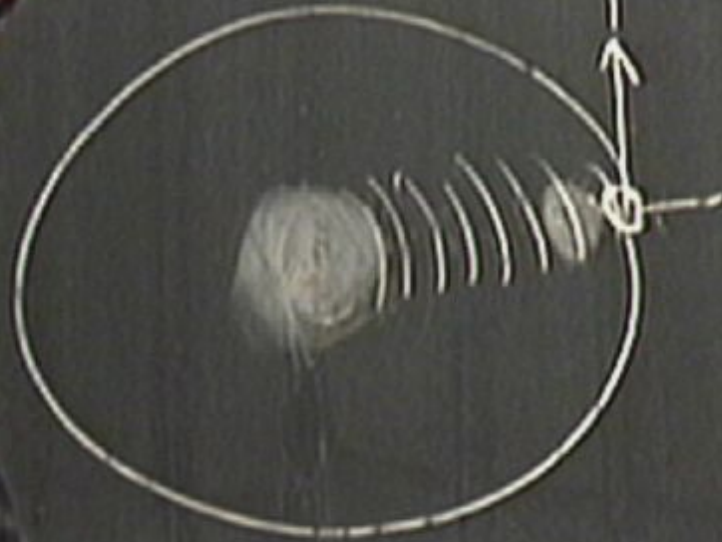
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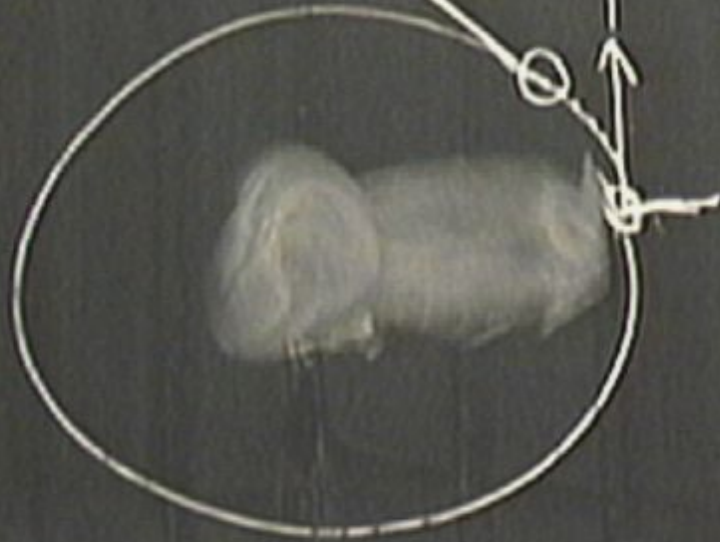
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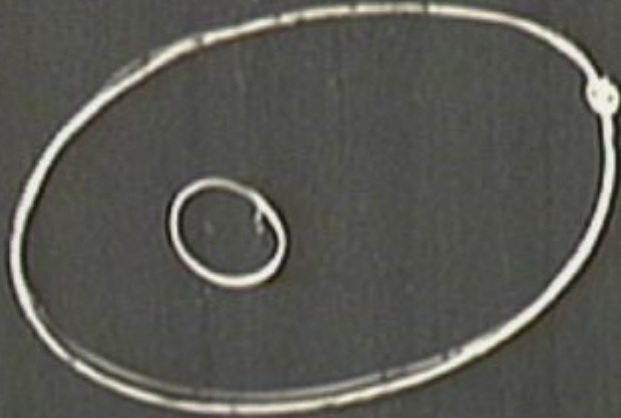
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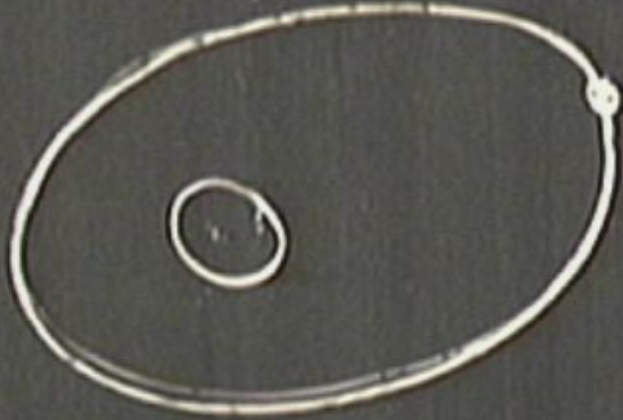


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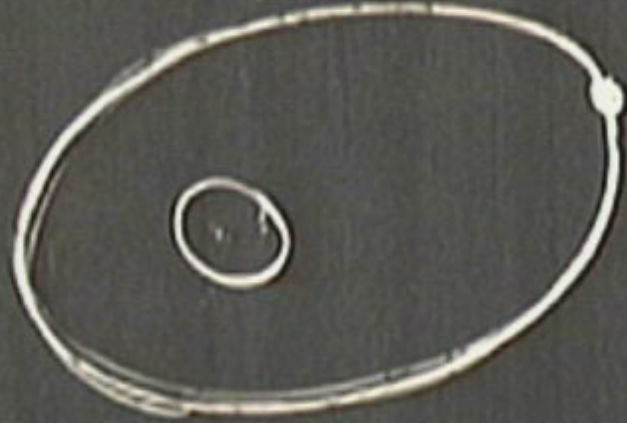
(2) Expt.: Mercury.



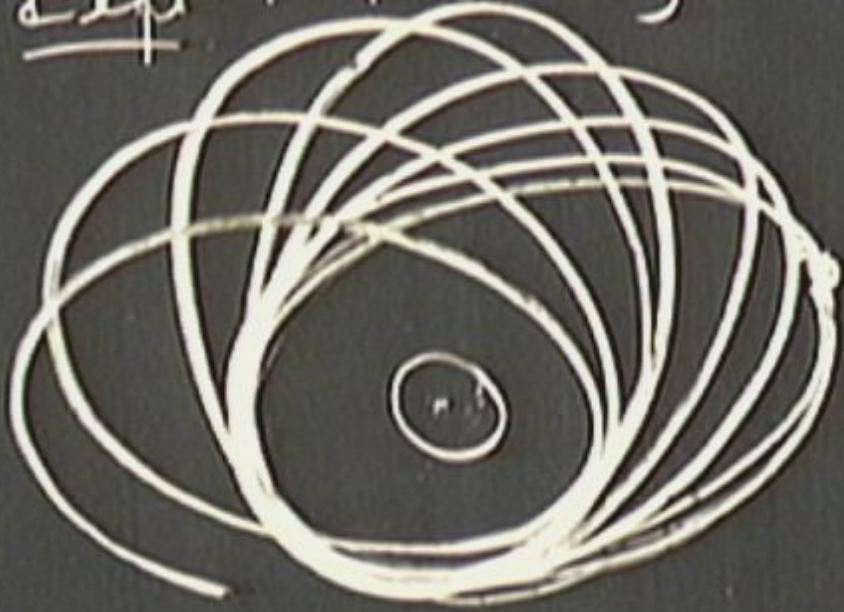
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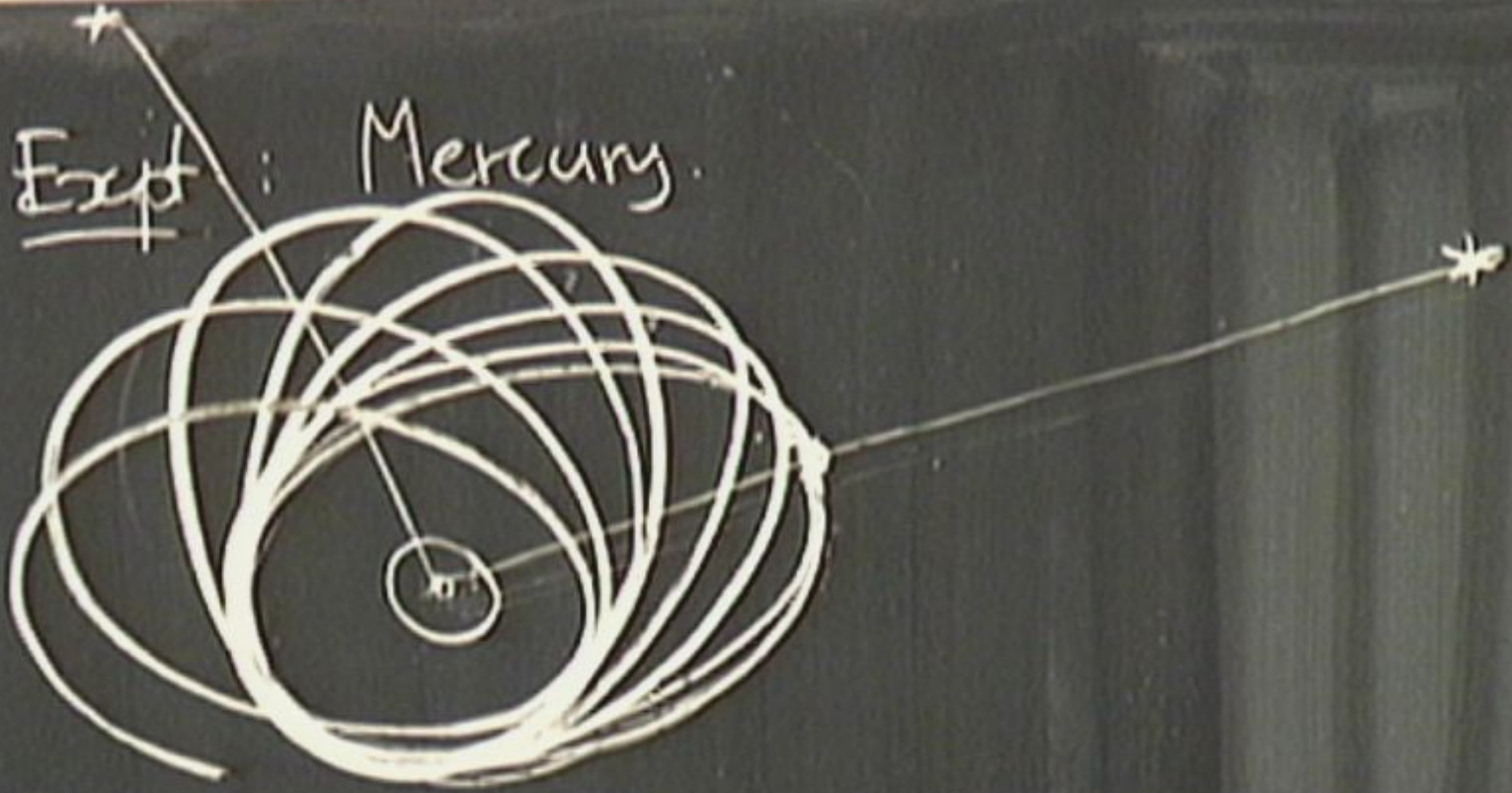
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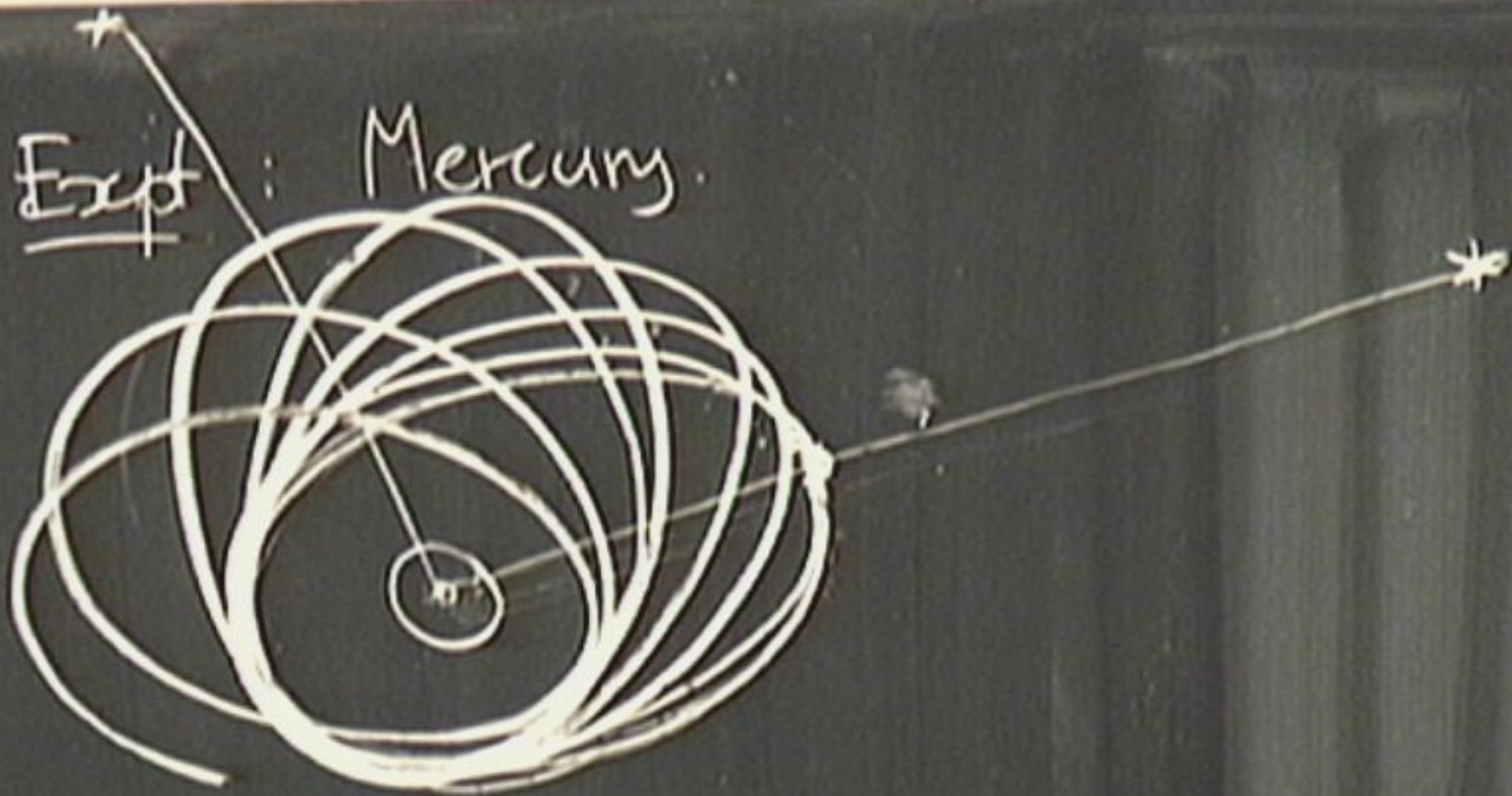
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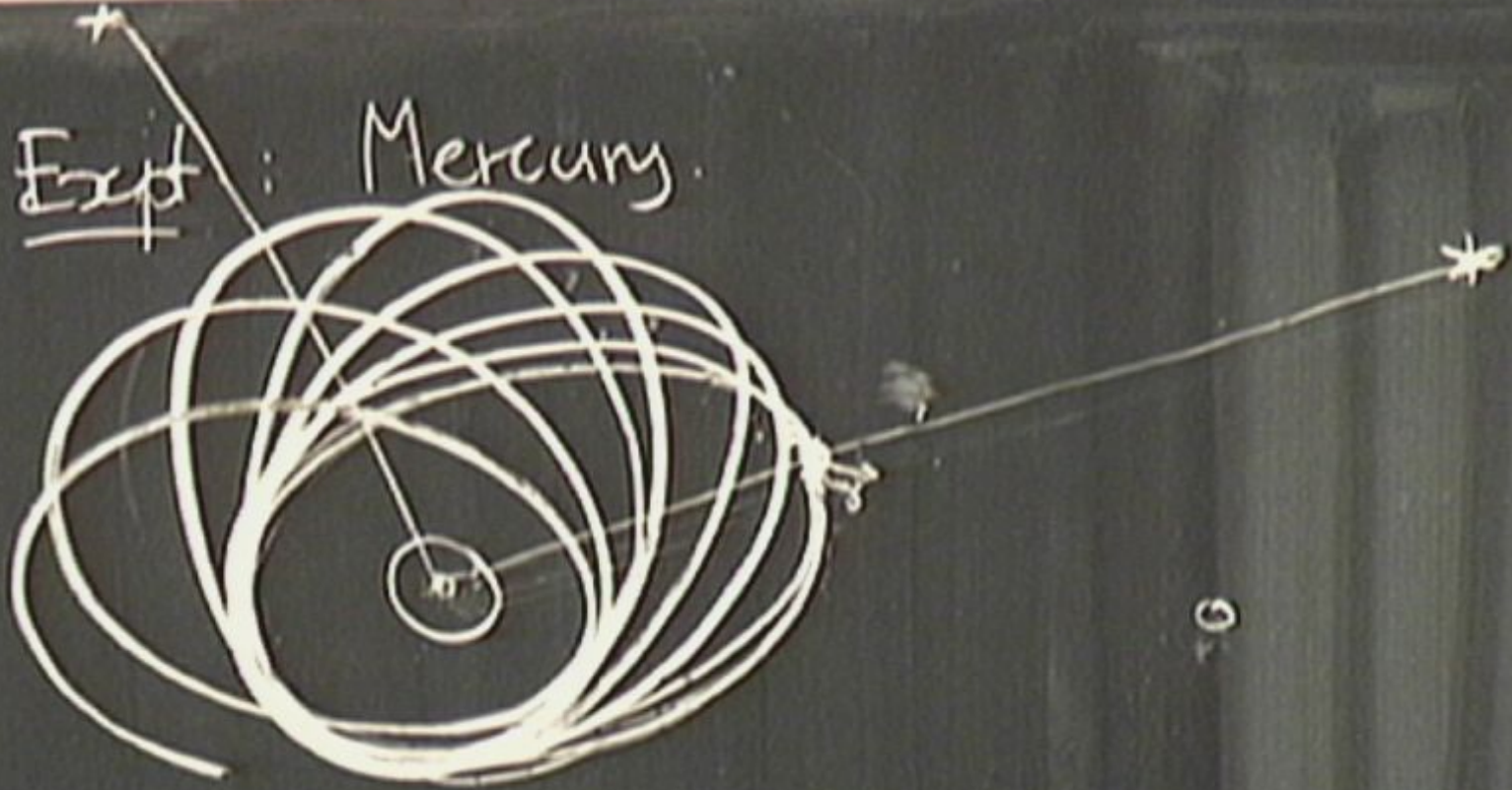
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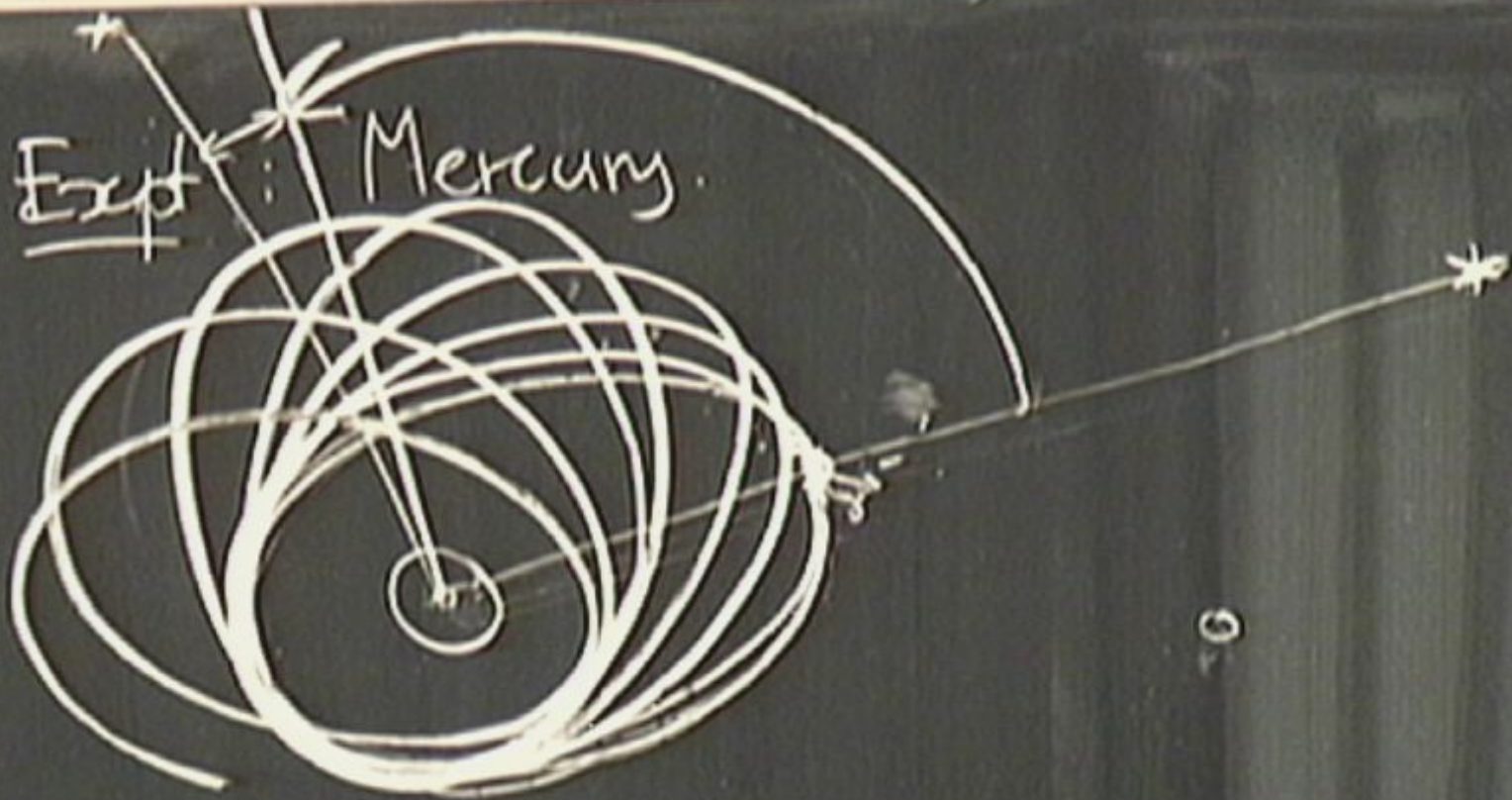
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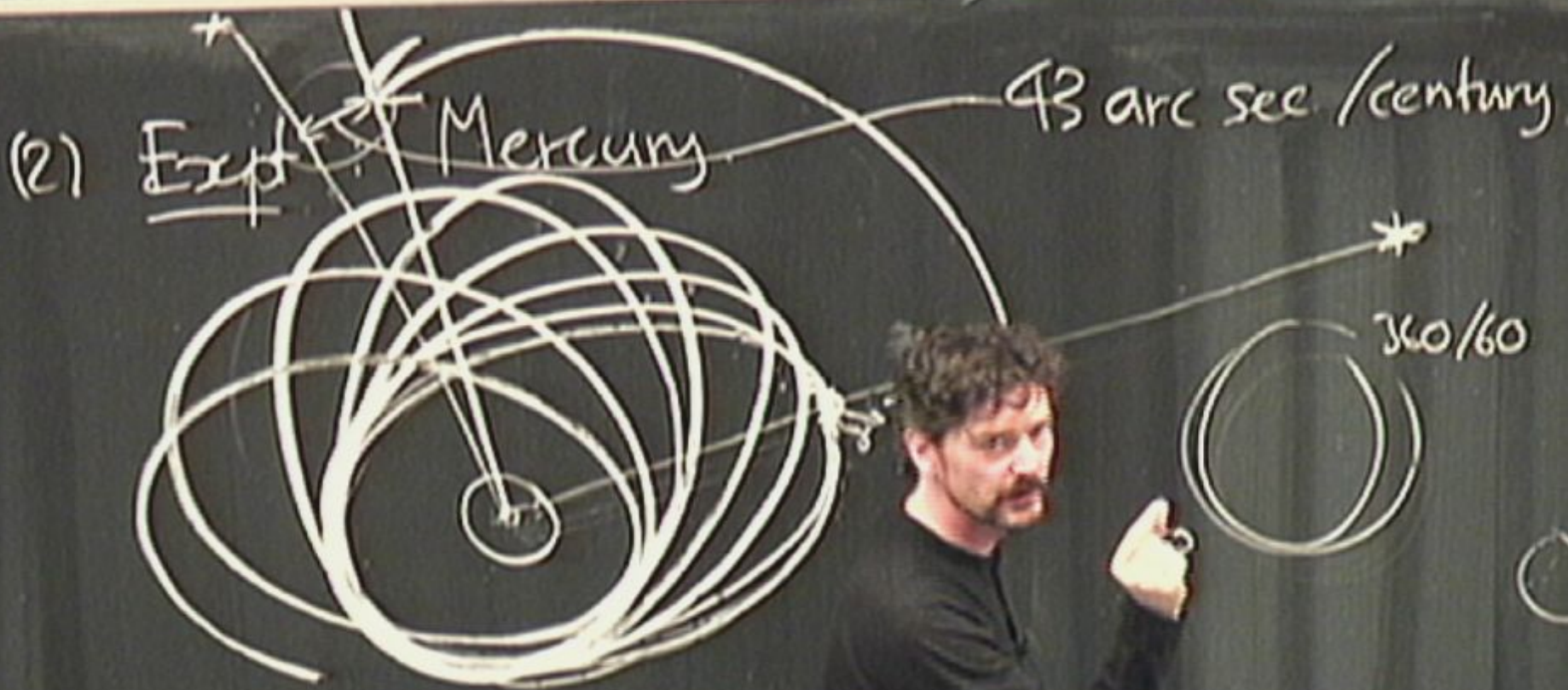


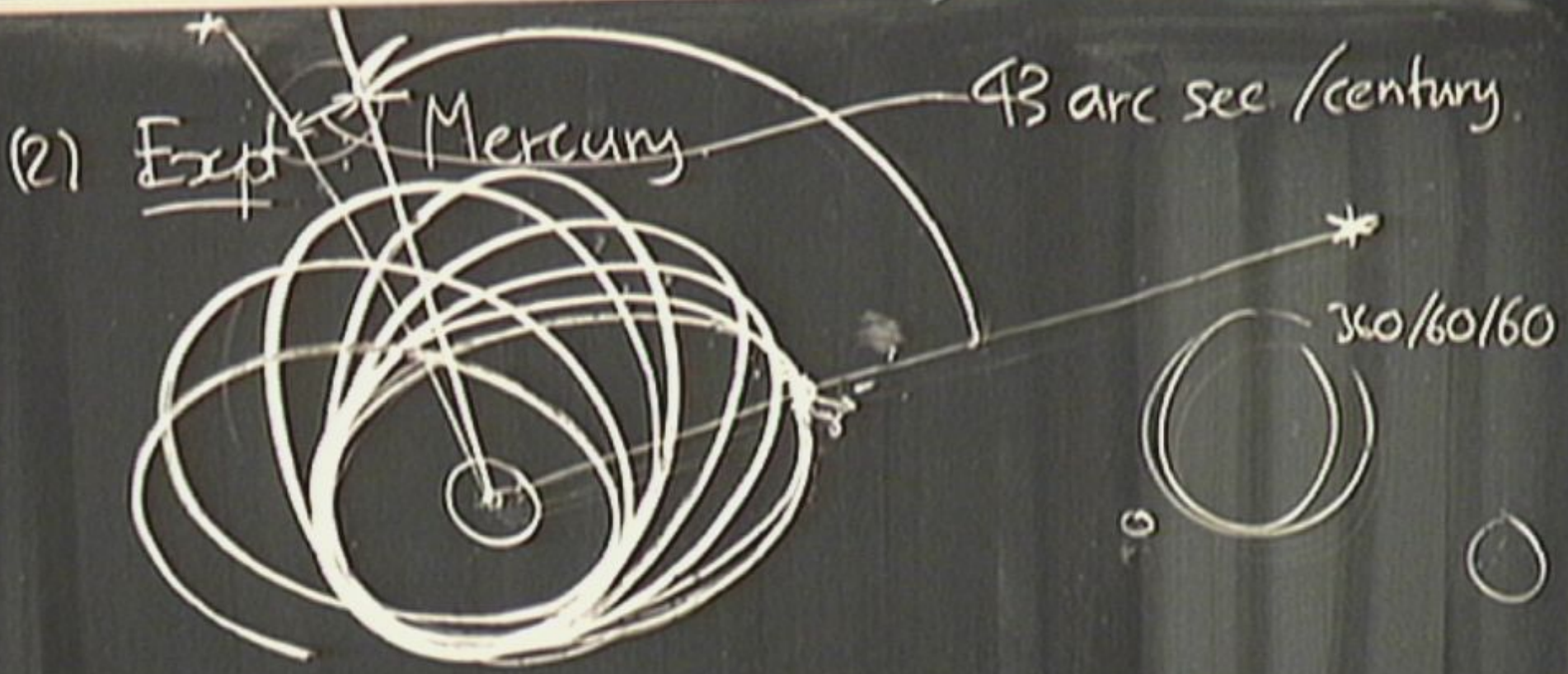
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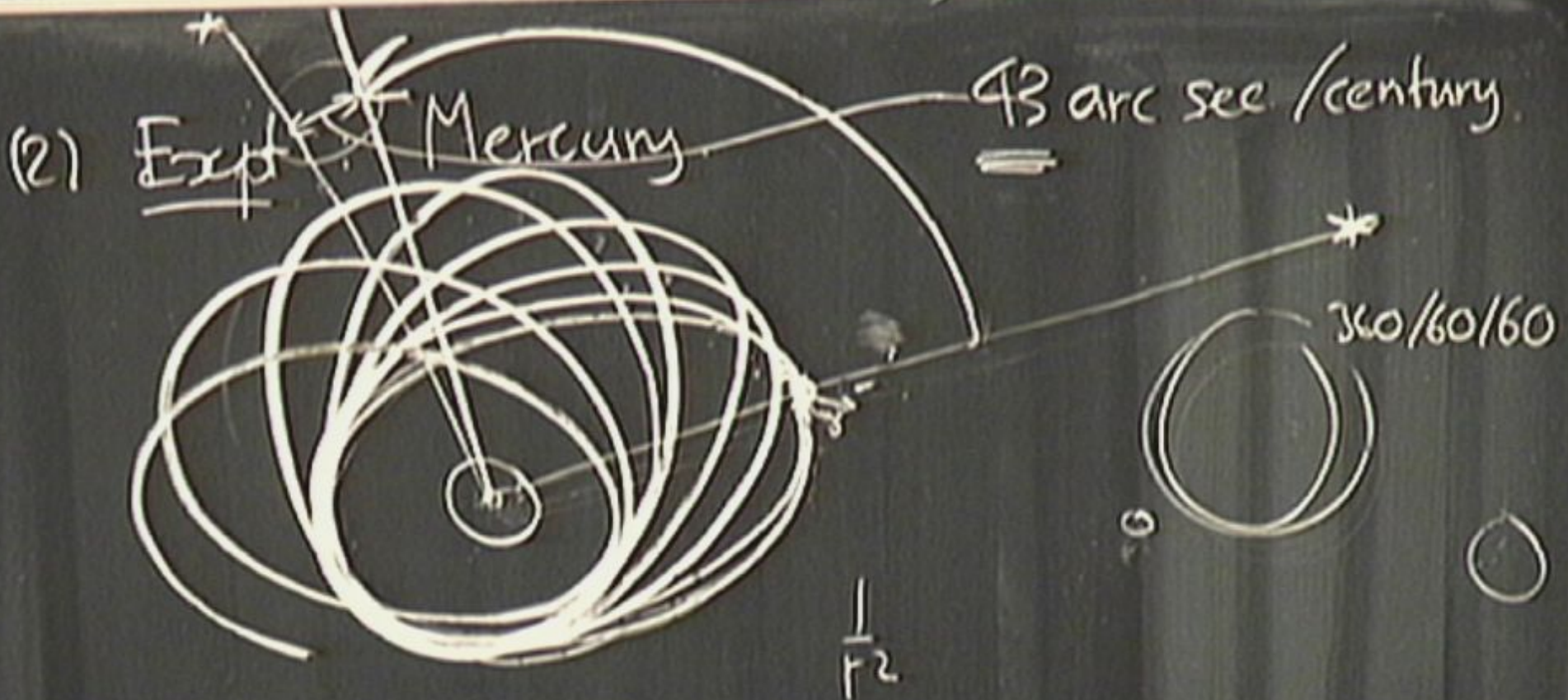


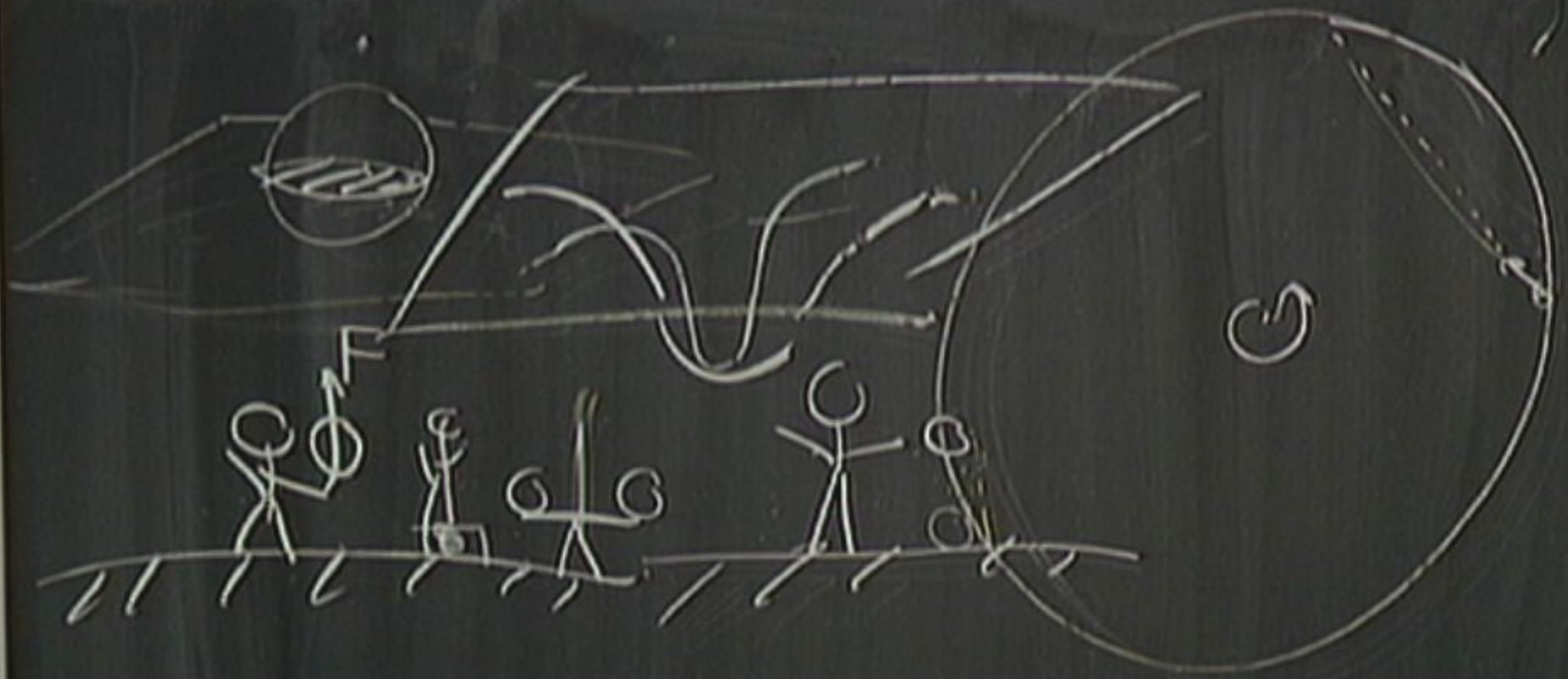
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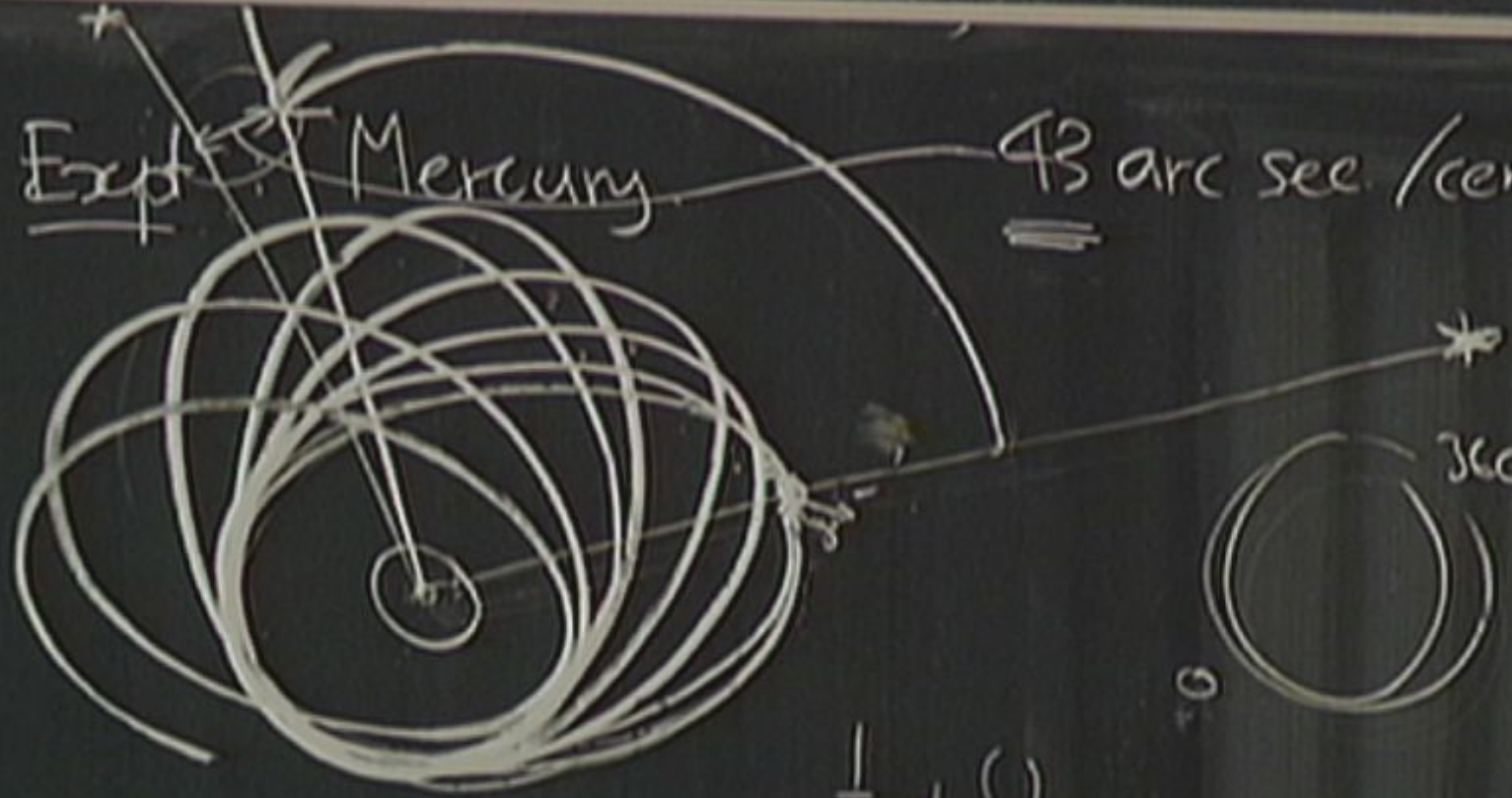






(2) Expt Mercury

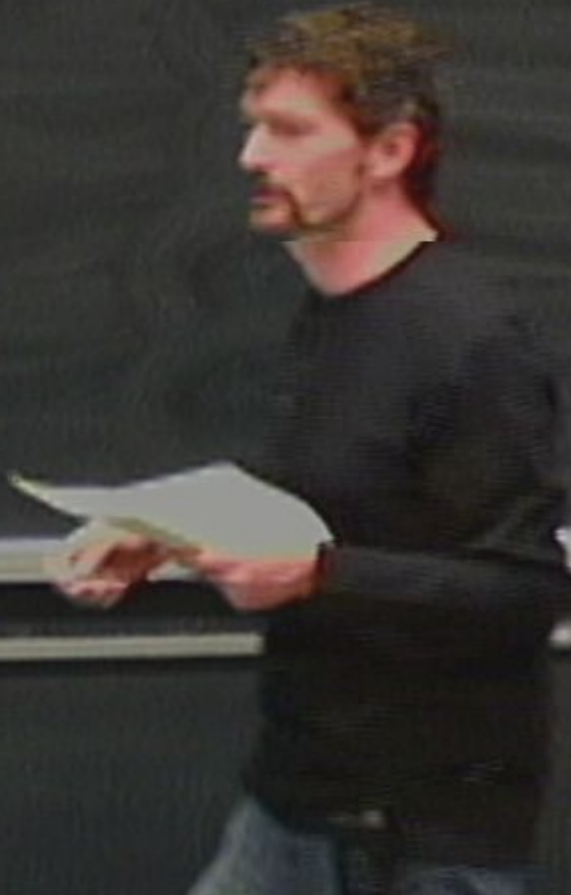
43 arc sec / century

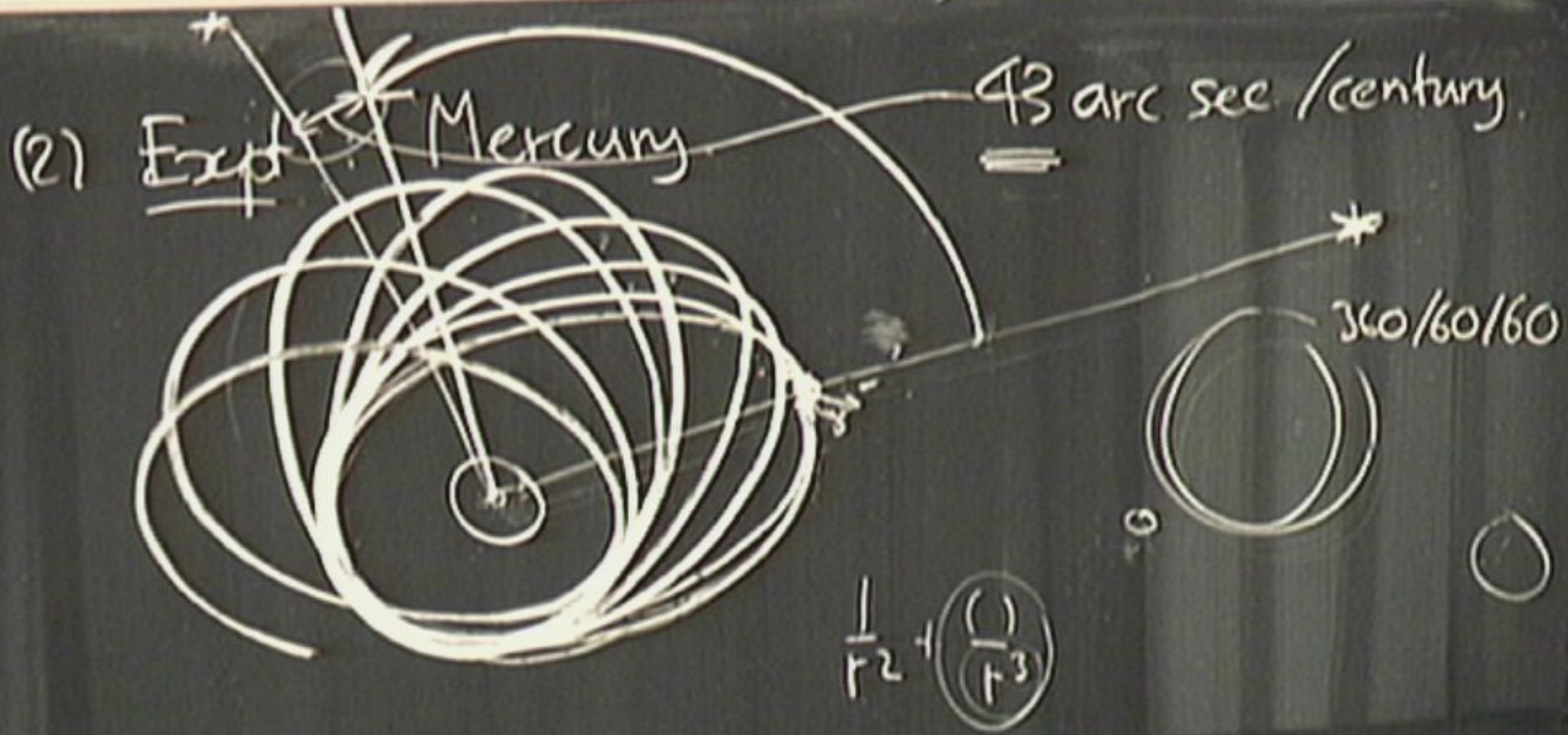


360/60/60

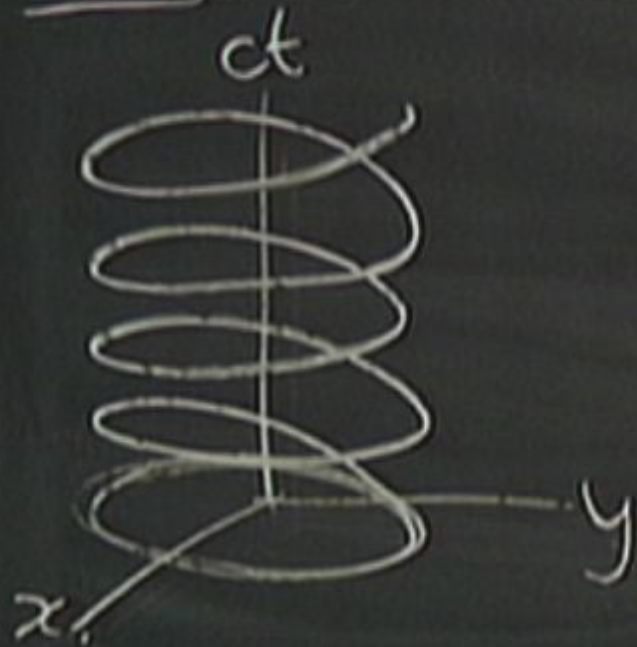
$\frac{1}{2} + \frac{1}{3}$

Idea: Analyze artificial grav. for hints about real grav.

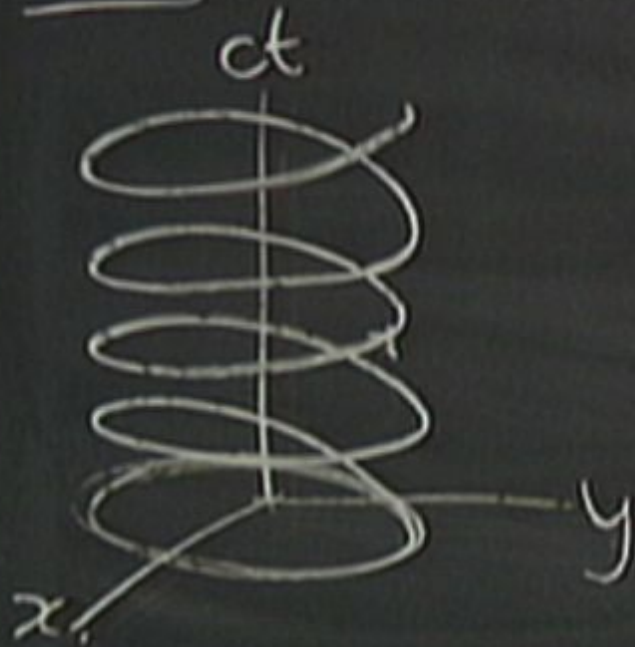




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Time Dilation

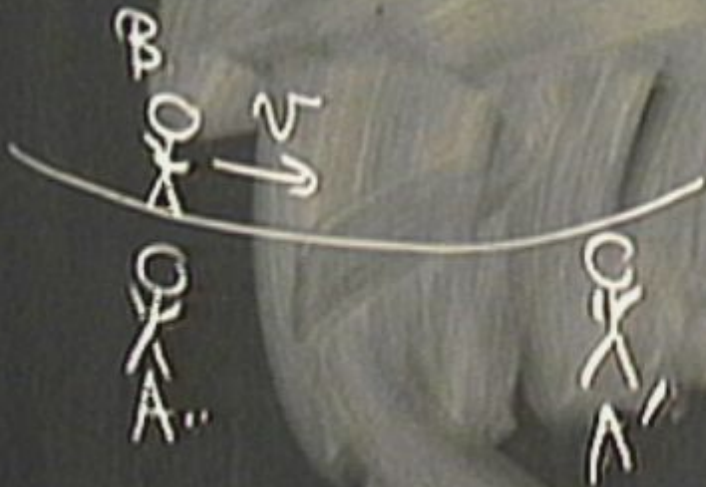


Time Dilation

B
O
K
↓
↓

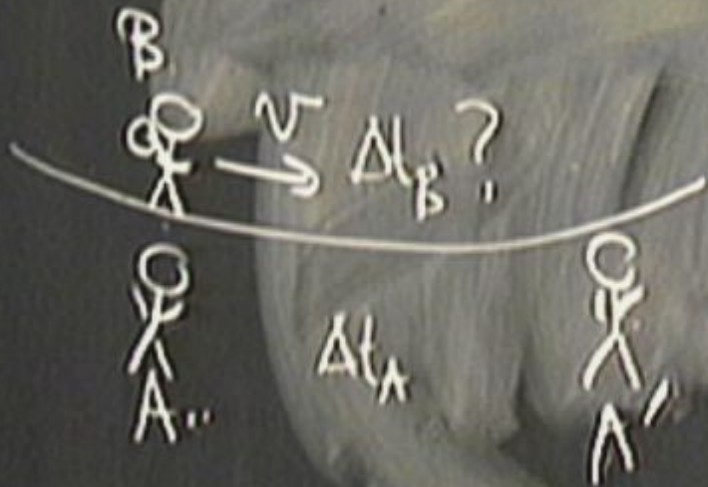


Time Dilation



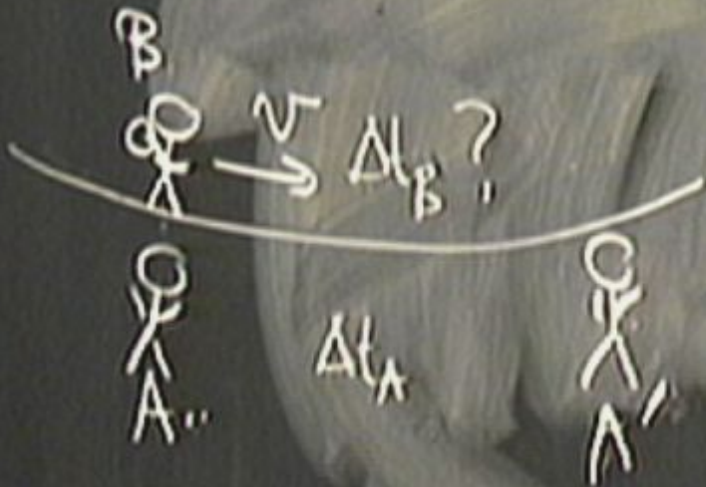
Time Dilation

$$\Delta t_B =$$

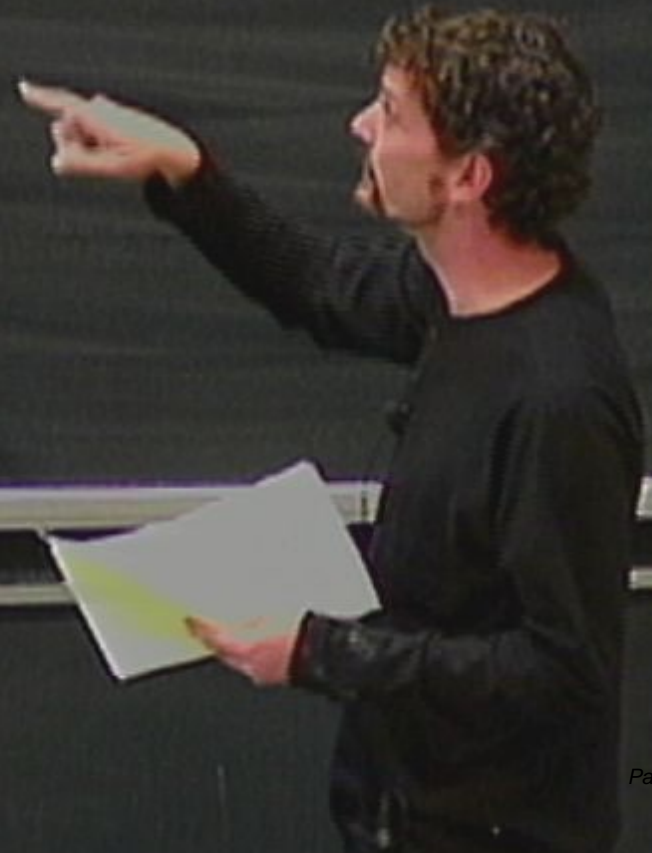
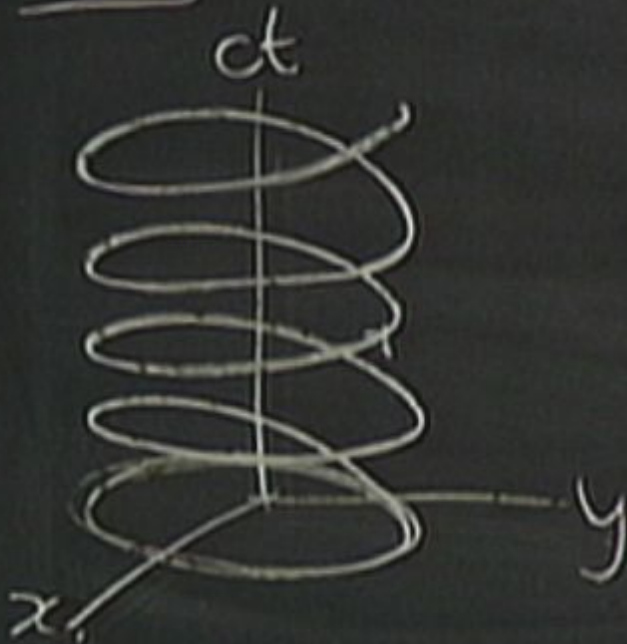


Time Dilation

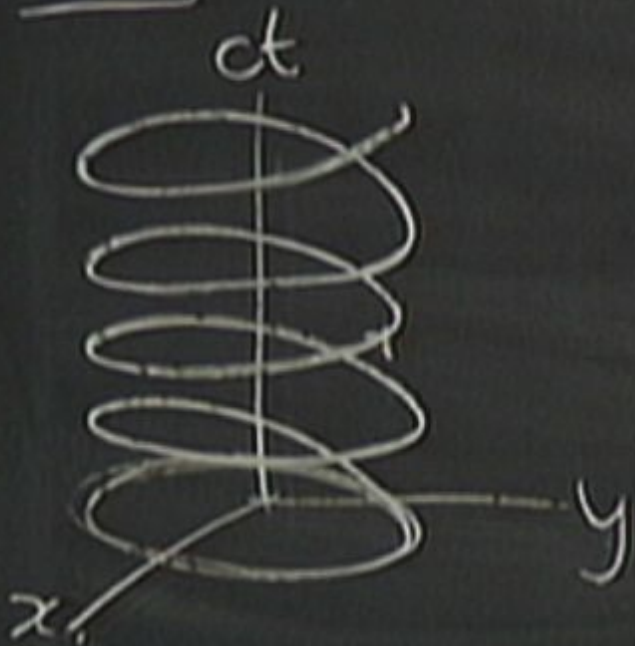
$$\Delta t_B = \sqrt{1 - v^2/c^2} \Delta t_A < \Delta t_A$$



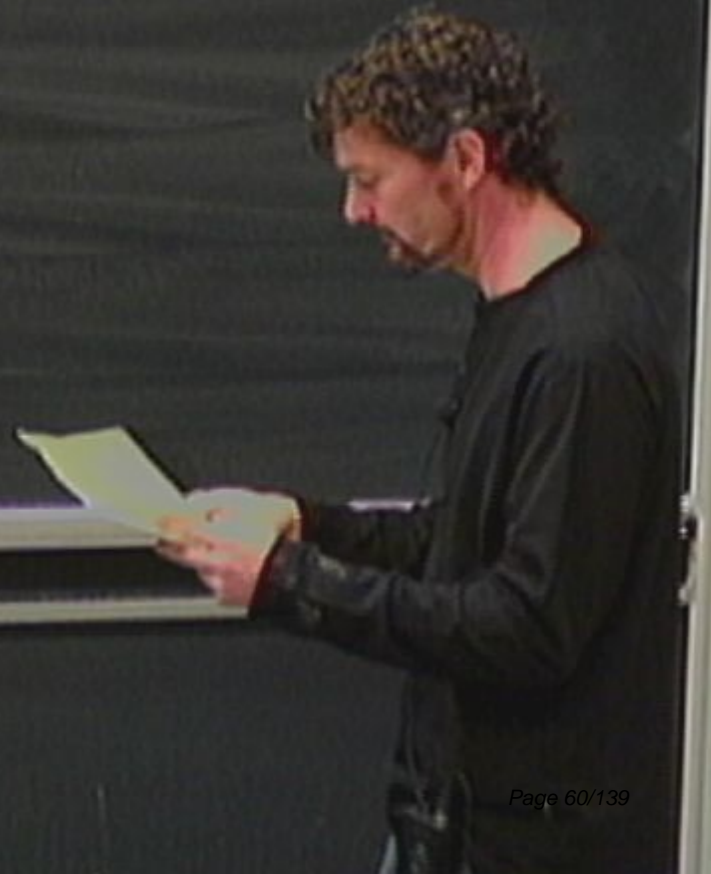
Idea: Analyze artificial grav. for hints about real grav.



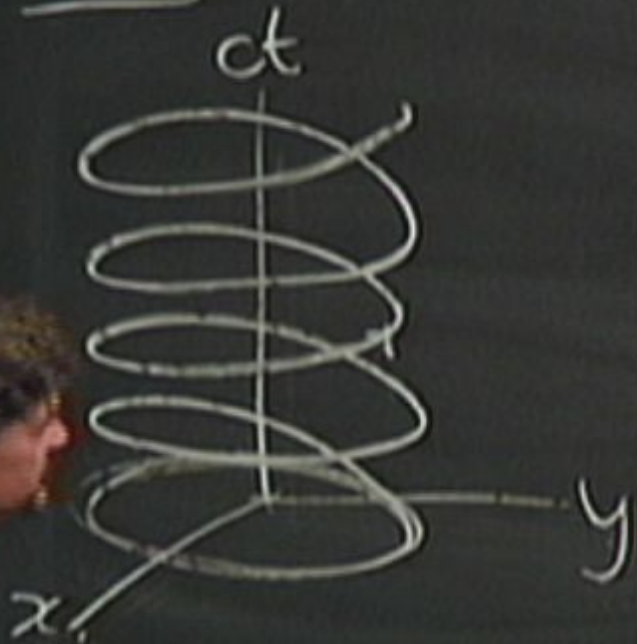
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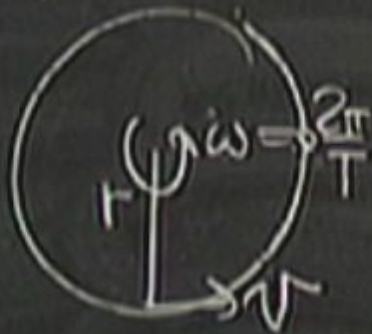
$$"g" = a_c = \frac{v^2}{r}$$



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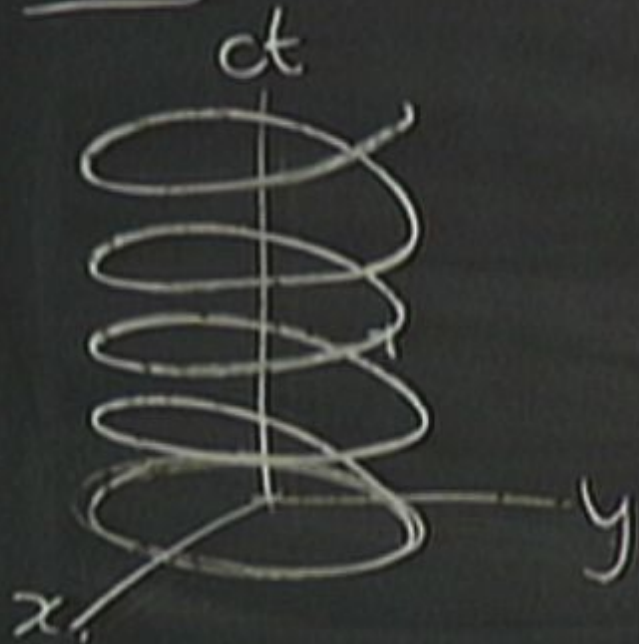


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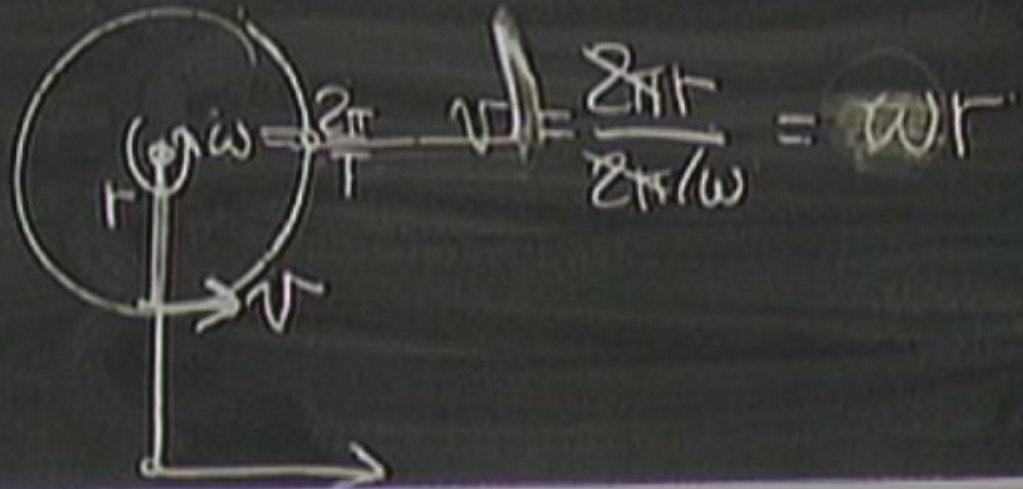


$$v = \frac{2\pi r}{2\pi/\omega} = \omega r$$

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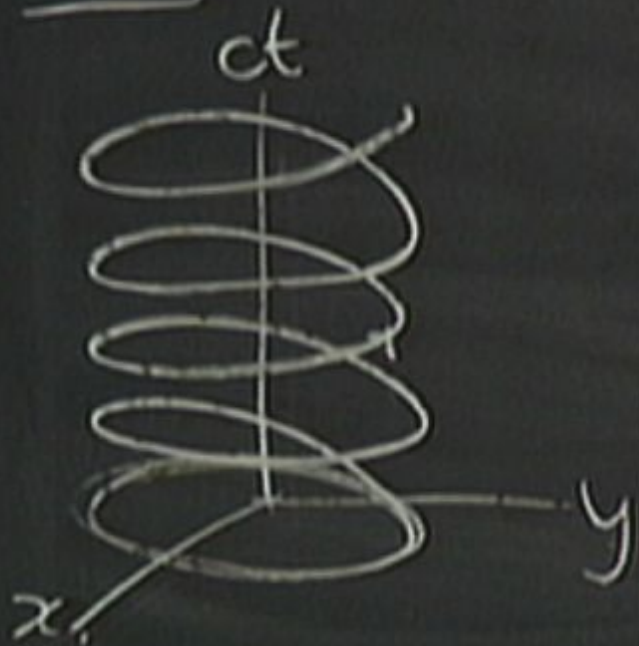


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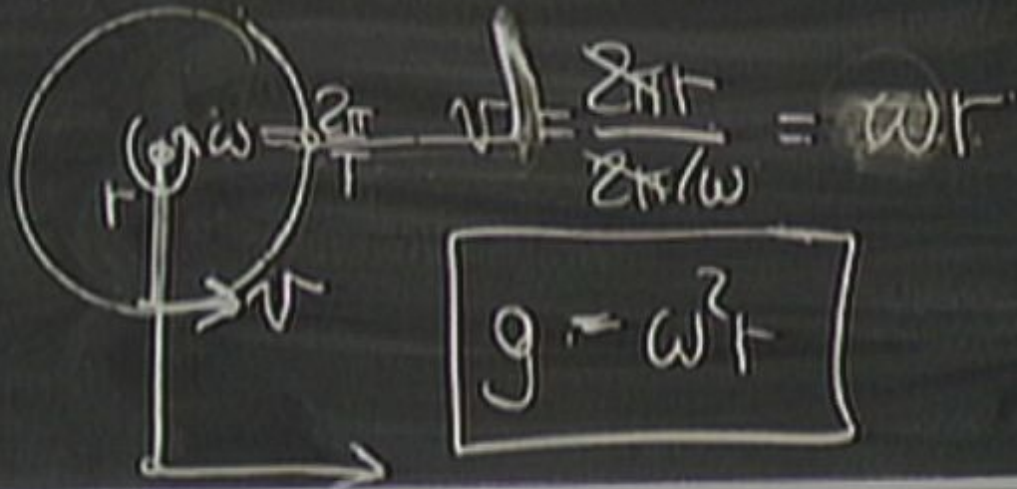


$$\frac{2\pi r}{2\pi/\omega} = \omega r$$

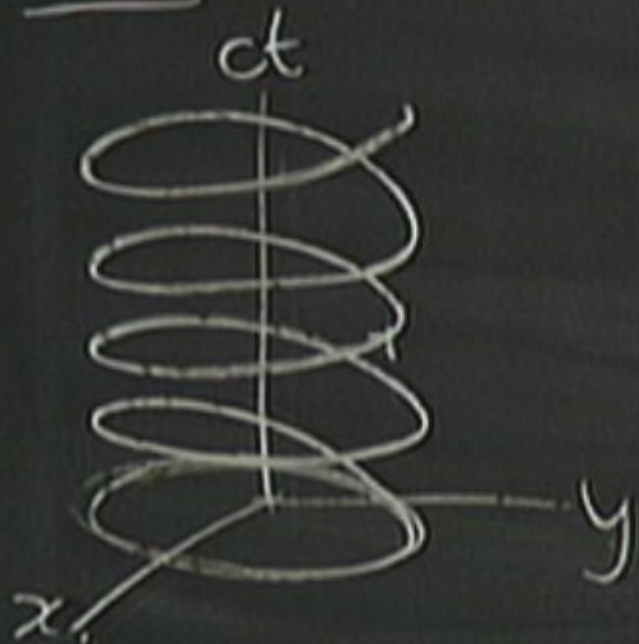
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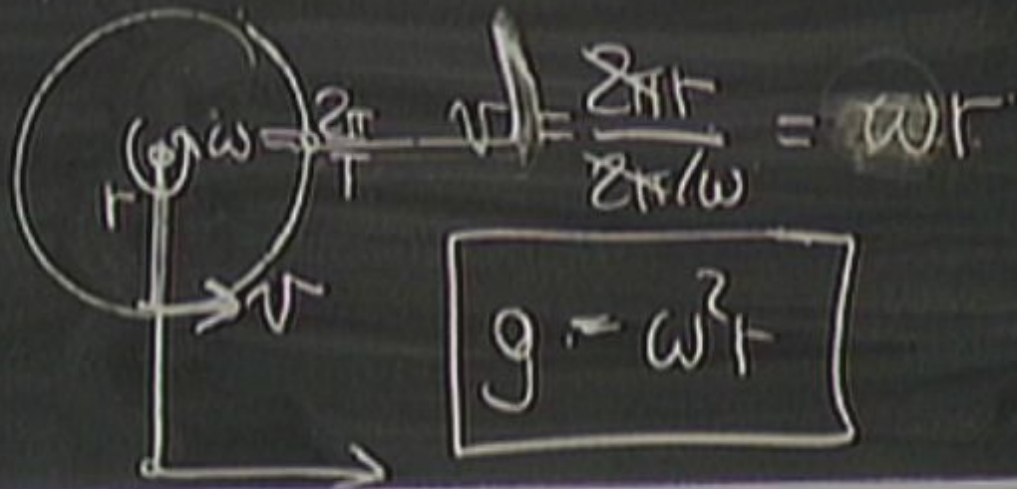
$$"g" = a_c = \frac{v^2}{r}$$



Idea: Analyze artificial grav. for hints about real grav.



$$"g" = a_c = \frac{v^2}{r}$$

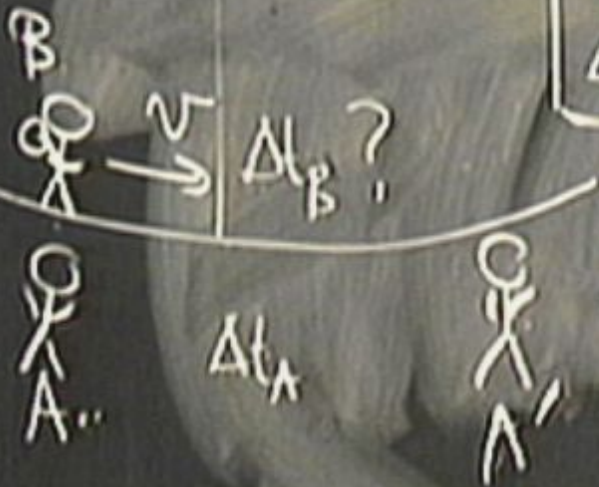


$$g = \omega^2 r$$

Time Dilation

$$\Delta t_B = \sqrt{1 - v^2/c^2} \Delta t_A < \Delta t_A$$

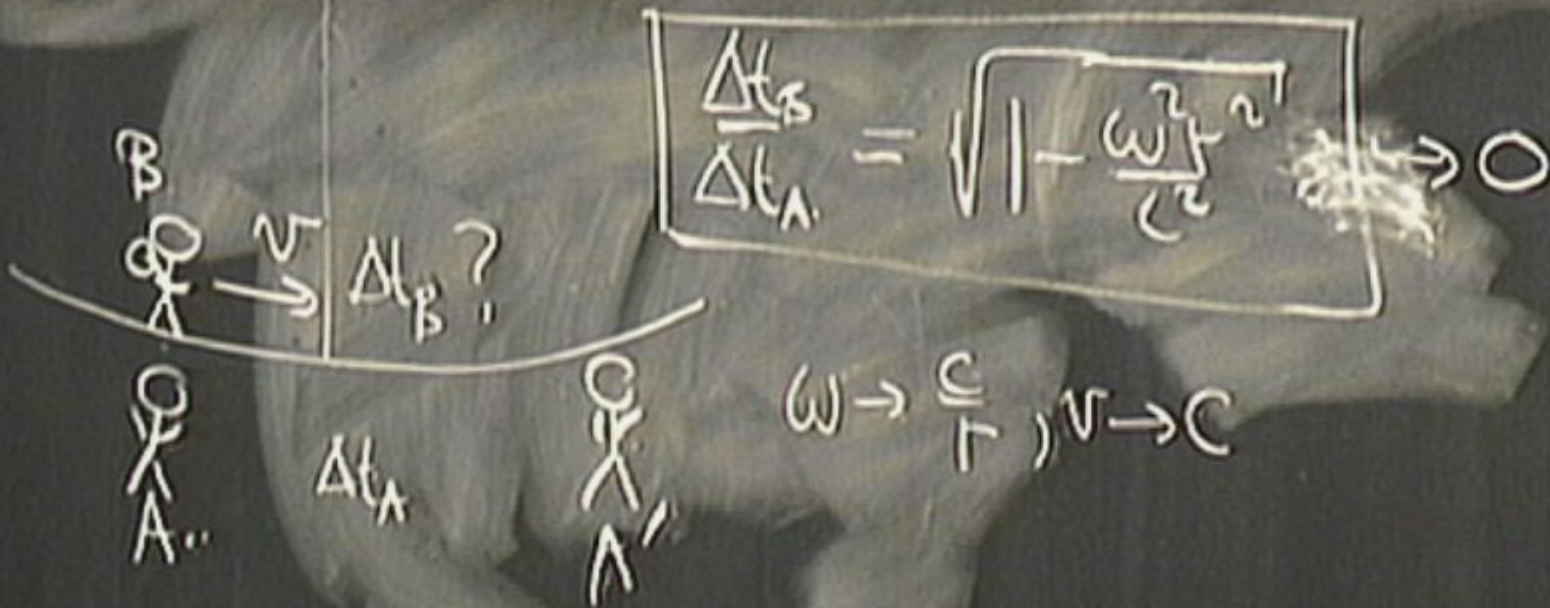
$$\frac{\Delta t_B}{\Delta t_A} = \sqrt{1 - \frac{v^2}{c^2}} \rightarrow 0$$



$$\omega \rightarrow \frac{c}{T}, v \rightarrow c$$

Time Dilation

$$\Delta t_B = \sqrt{1 - v^2/c^2} \Delta t_A < \Delta t_A$$



A



A



S
X
B



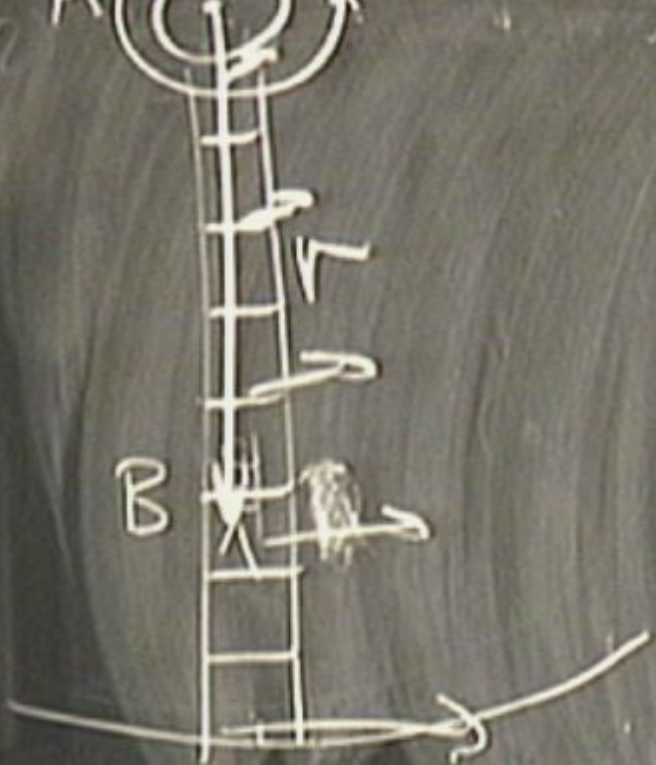


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SOLUTIONS
SERIES
1000-10

A ω



B



r decreases (climbs against grav.)

→ less slowing

→ time moves faster.



r decreases (climbs against grav.)

→ less slowing

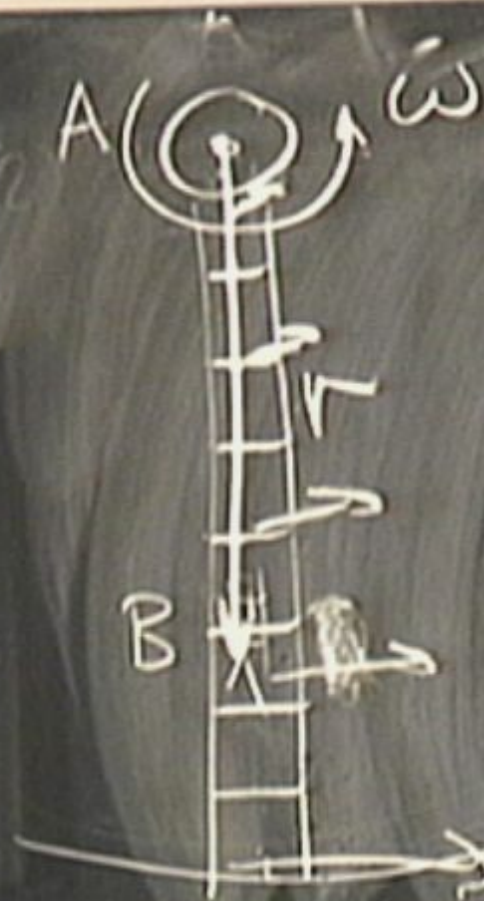
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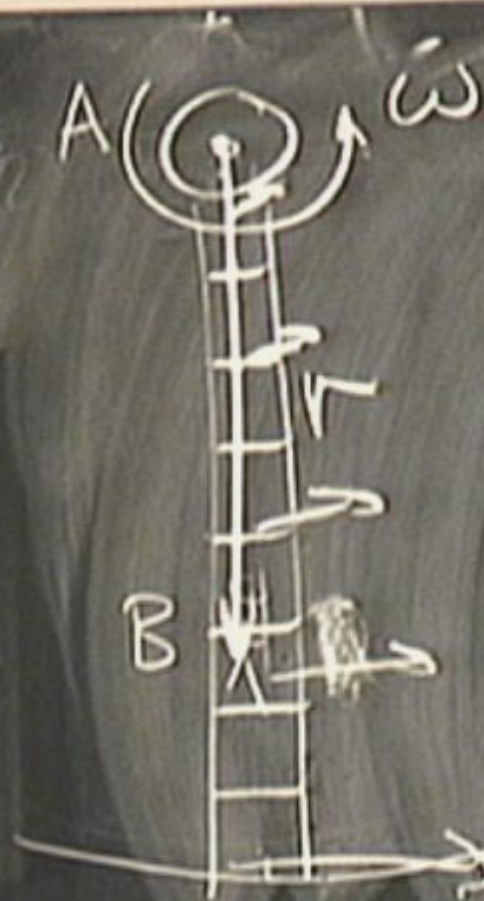
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... true of real grav field?





r decreases (climbs against grav.)

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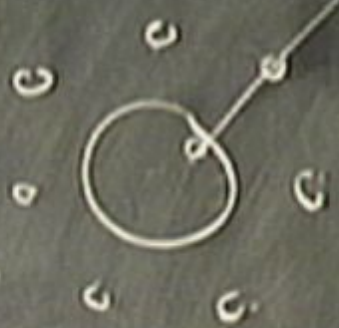


true of real grav field? YES



r decreases (climbs against grav.)

- less slowing
- time moves faster



true of real grav field? YES

Length Contraction

$\beta = 1$

$\beta = 0.8$

$\beta = 0.6$

$\beta = 0.4$

$\beta = 0.2$

$\beta = 0.1$

$\beta = 0.05$

$\beta = 0$

$\beta = 0$

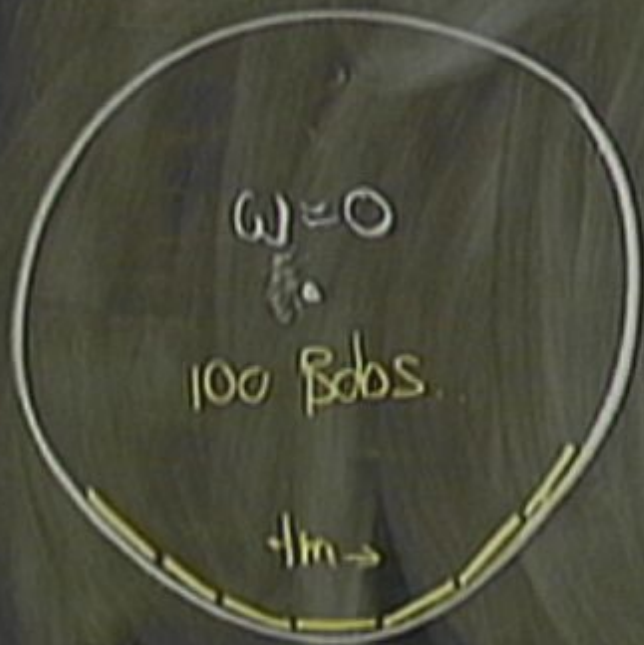
Length Contraction



Length Contraction



Length Contraction

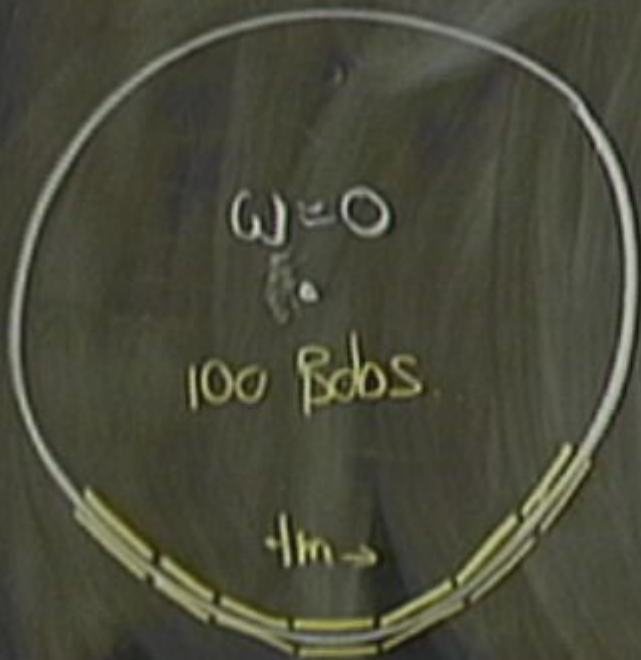


Length Contraction



100
Alices

Length Contraction



100
Alices



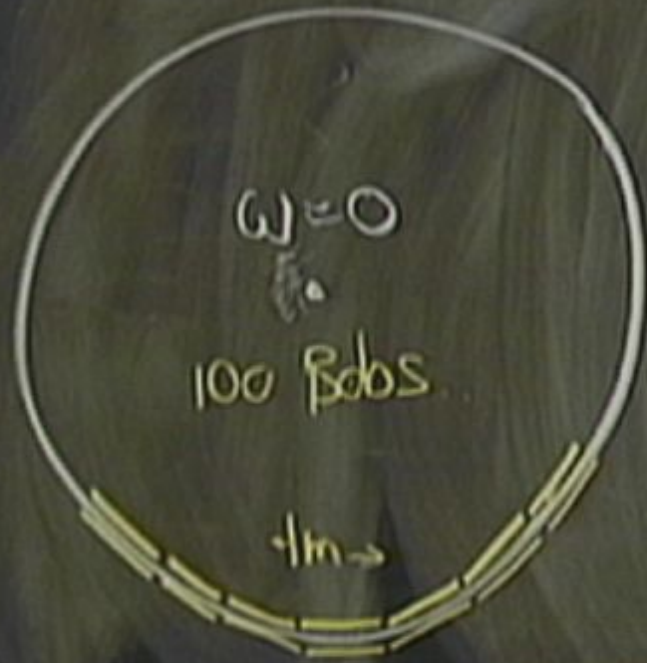
Length Contraction



160
Alices



Length Contraction



100
Alices



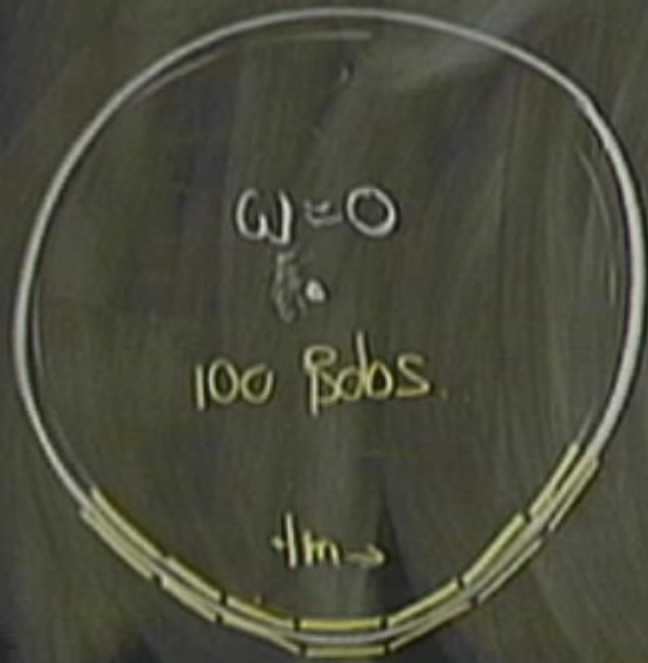
Length Contraction



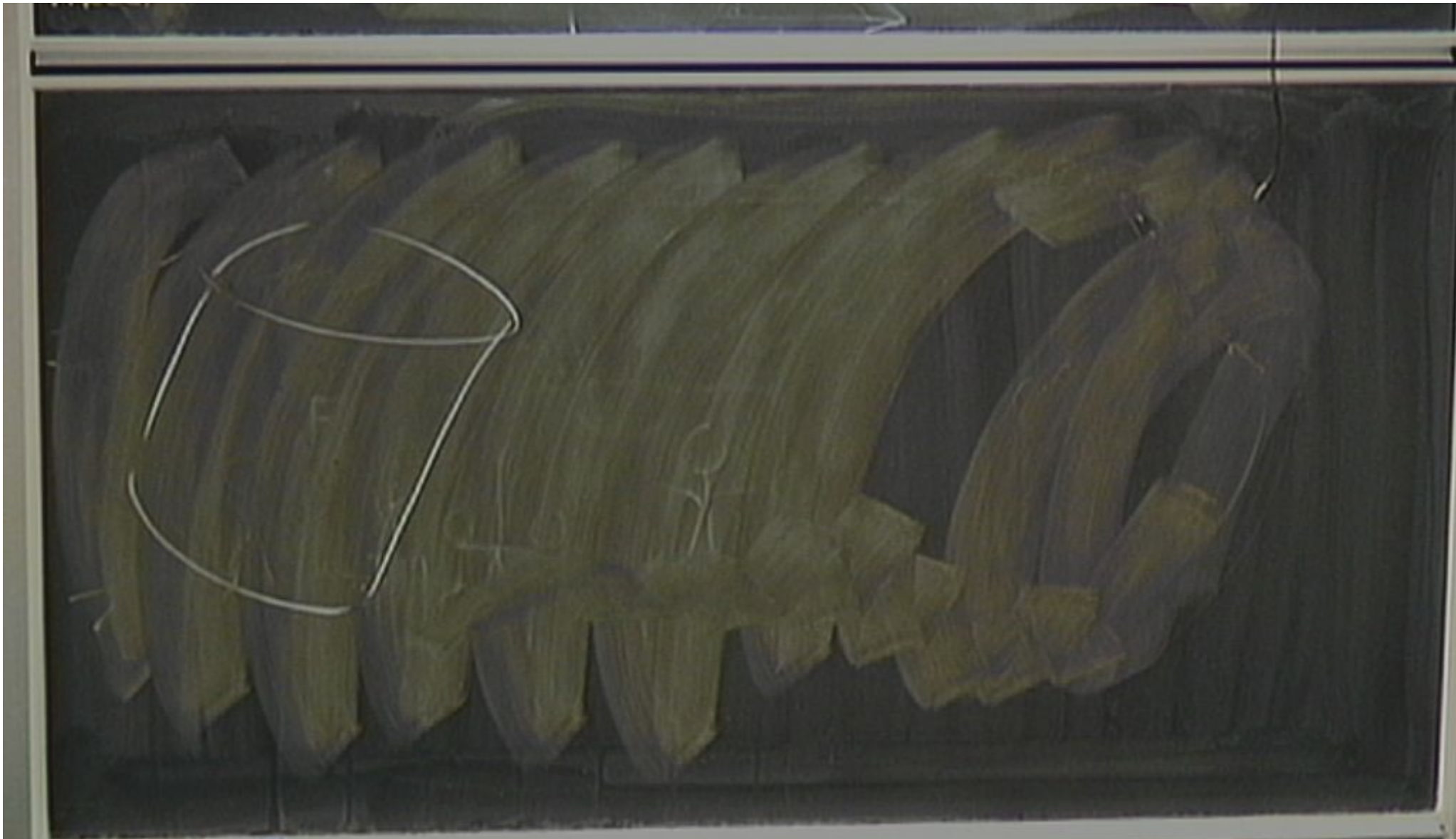
100
Alices

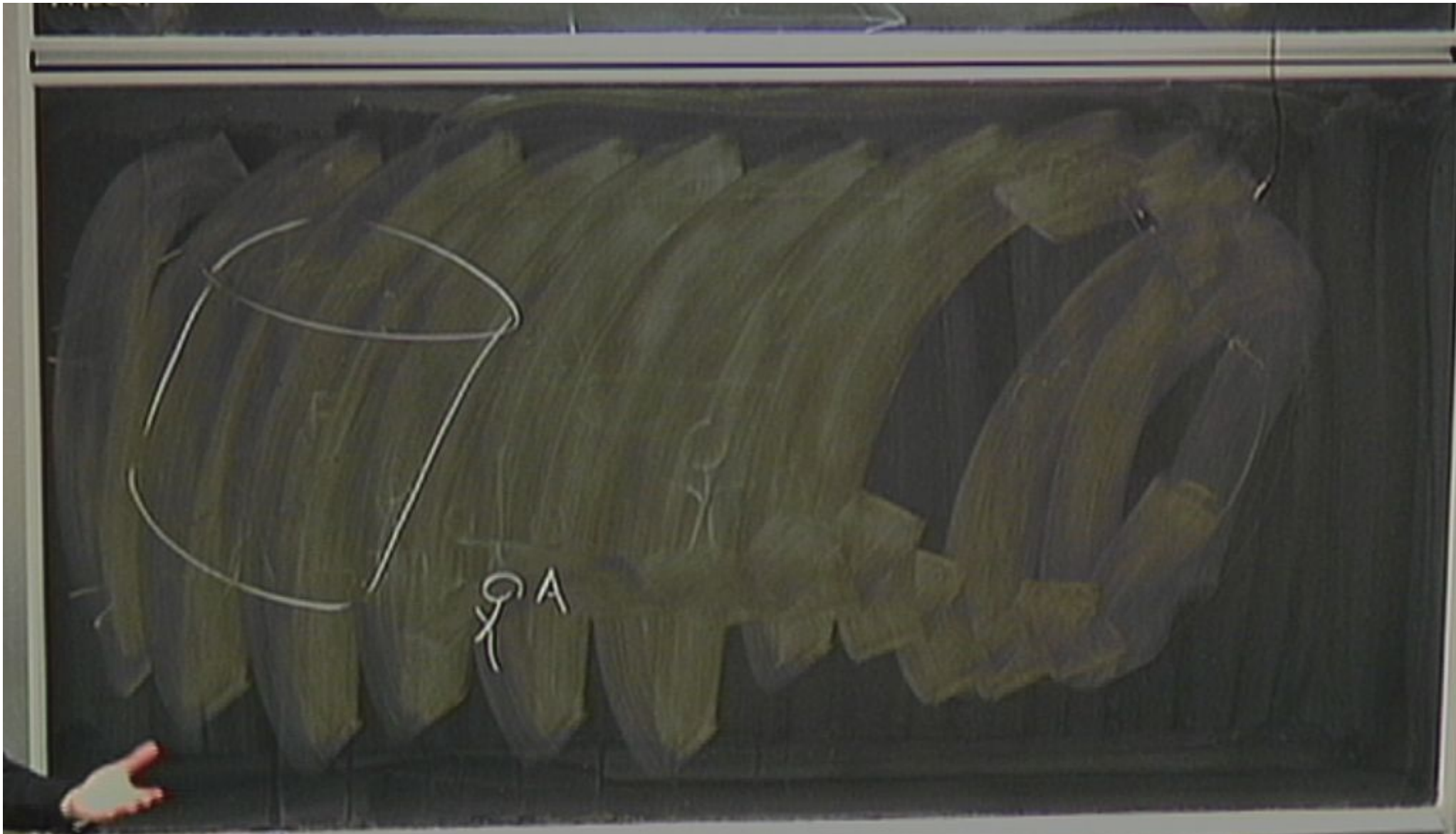


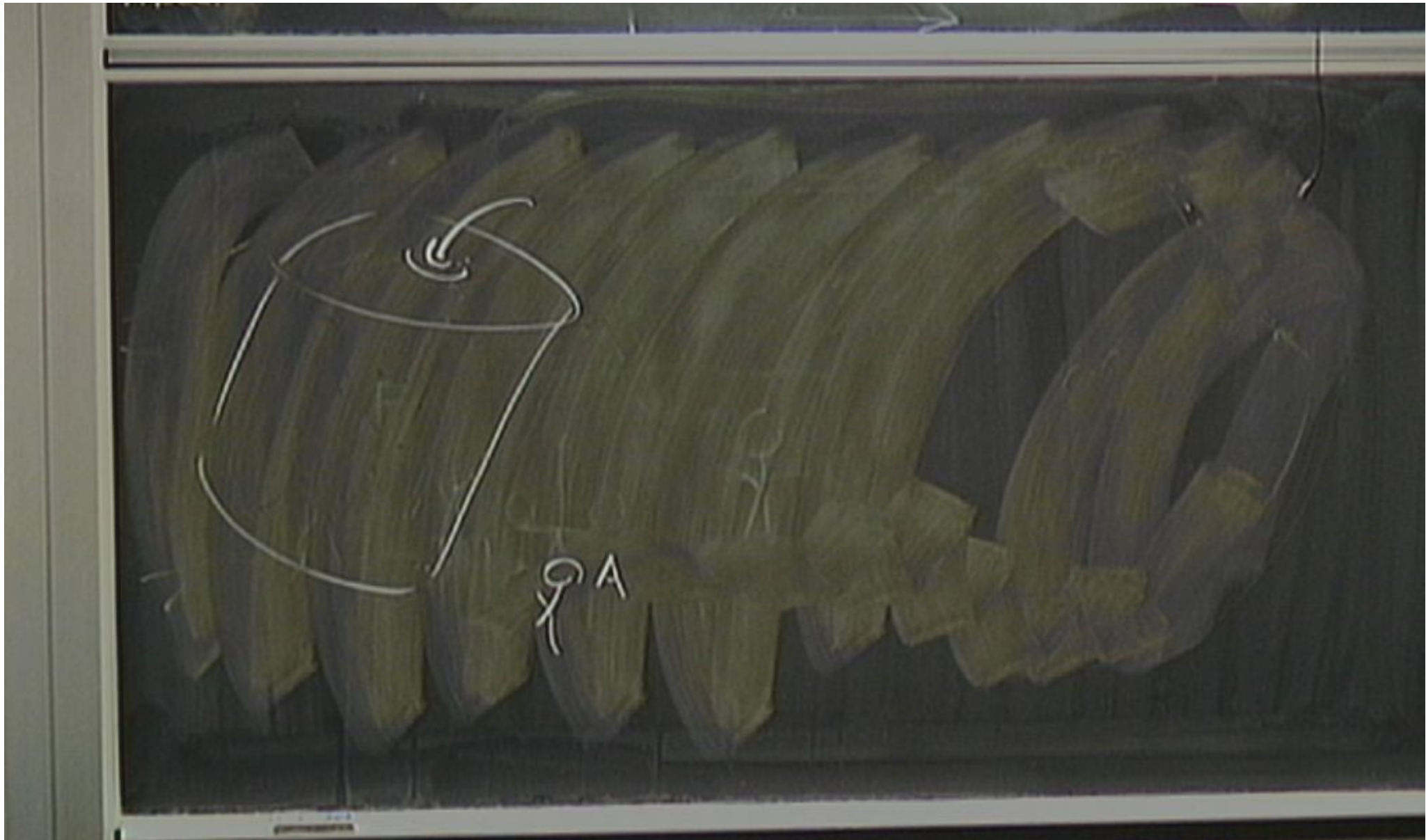
Length Contraction



inside
circumference
(rotating)
greater



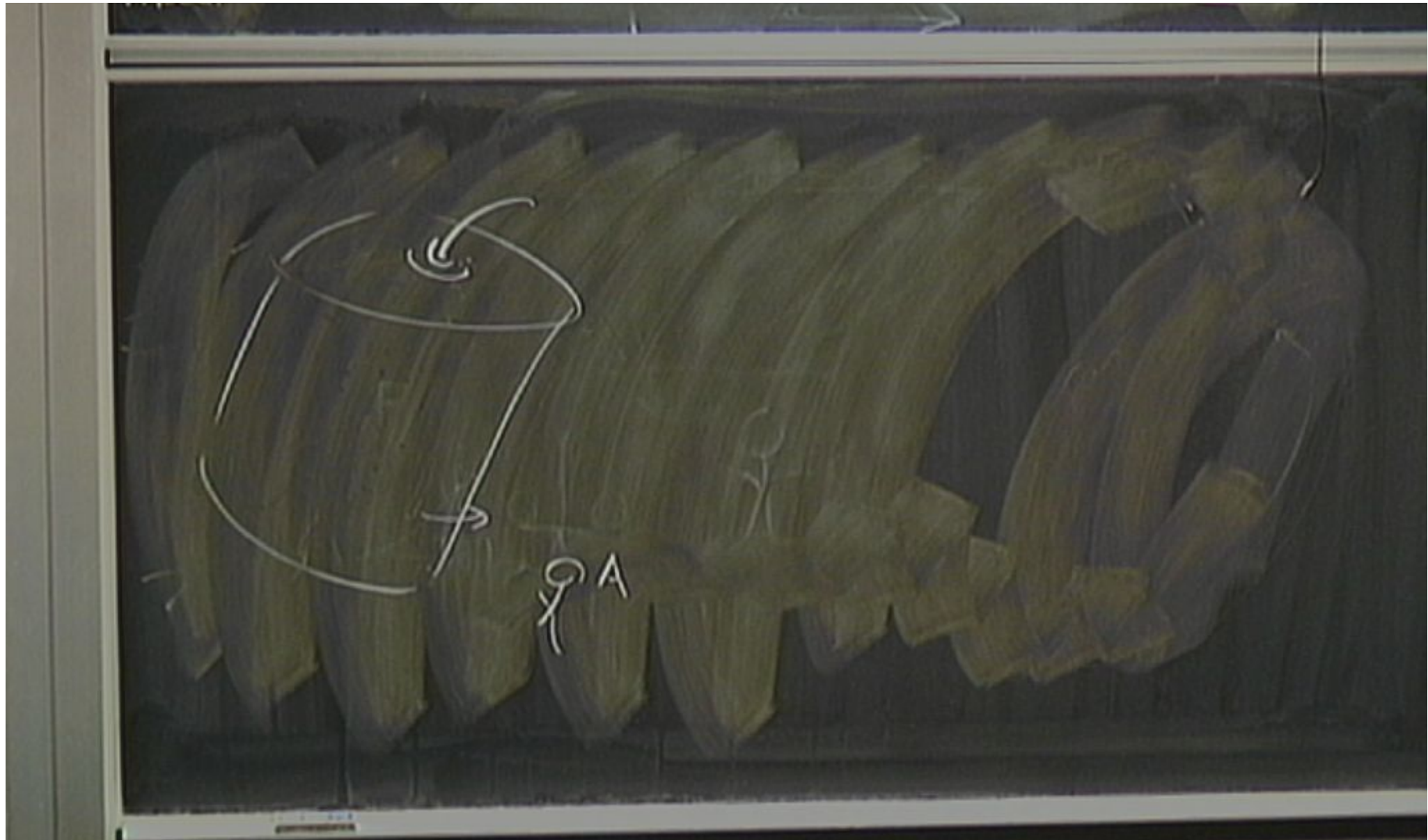




FAH
SOLUTION
SOLUTION

Pirsa: 08070042

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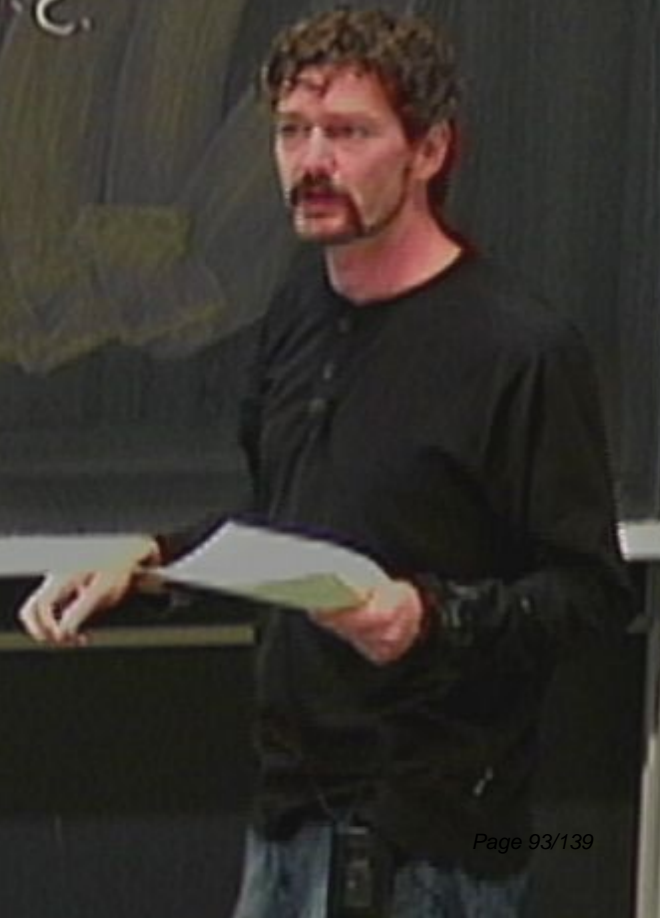
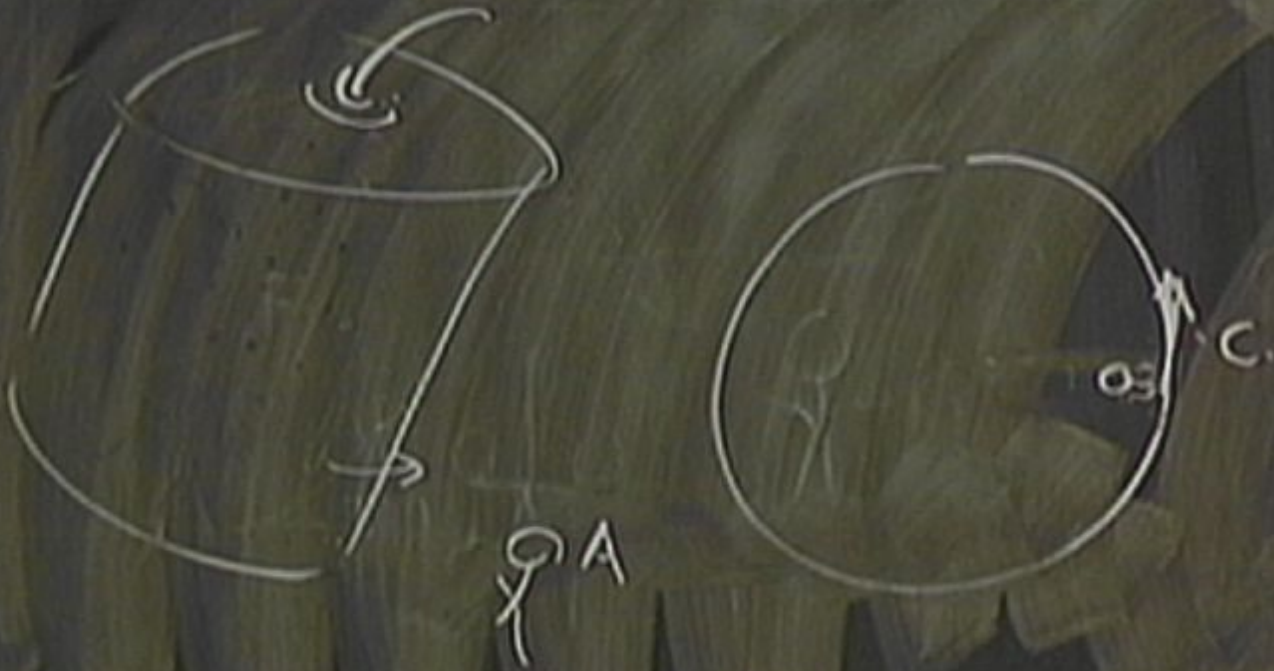
CAUTION
DO NOT TOUCH
THIS BOARD



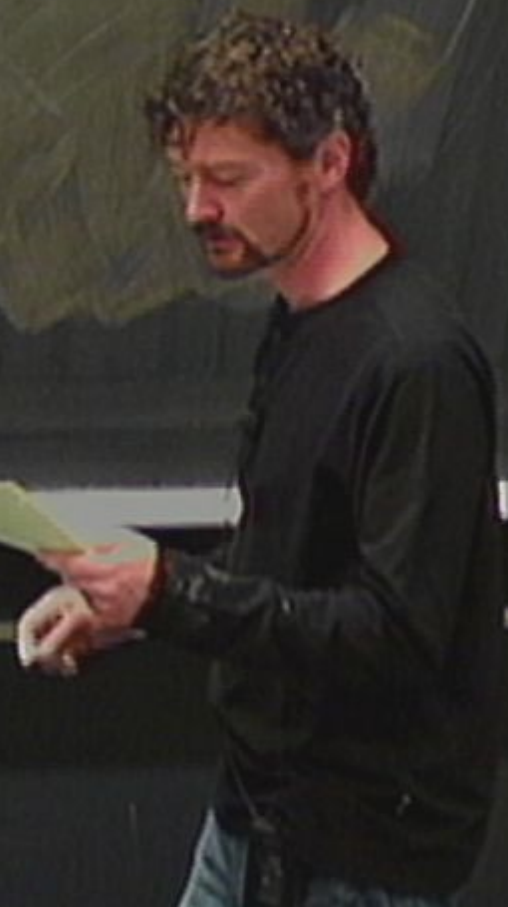
ρA



$L = \text{proper width of Bob.}$



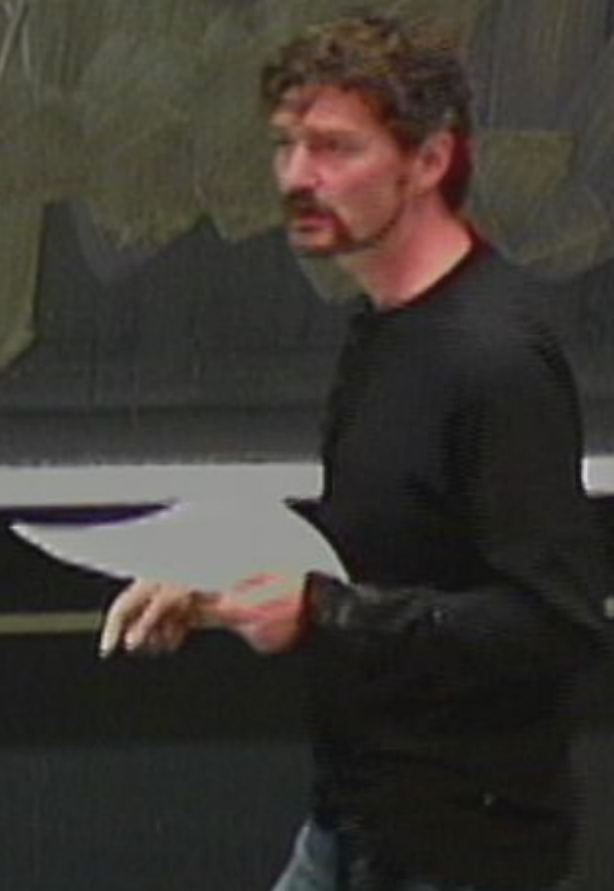
$L = \text{proper width of Bob. (same Alice)}$
 $l = \text{moving " " "}$



L = proper width of Bob. (same Alice)

l = moving " " "

$$= \sqrt{1 - v^2/c^2} \cdot L$$



L = proper width of Bob. (same Alice)

l = moving " " " "

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ϕ_A



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l = moving " " " "

$$= \sqrt{1 - v^2/c^2} \cdot L$$



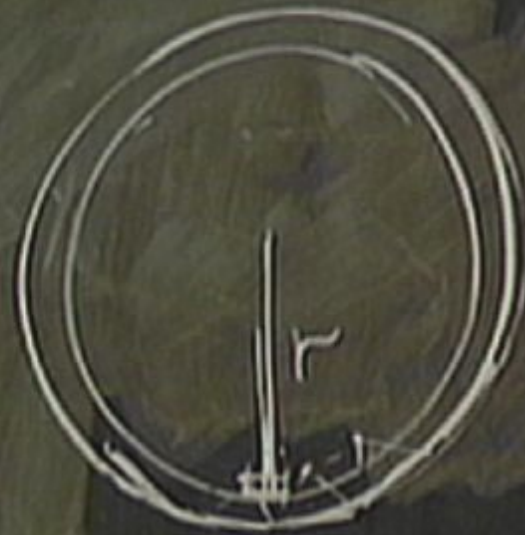
\mathcal{O}' A



L = proper width of Bob. (same Alice)

l = moving " " " "

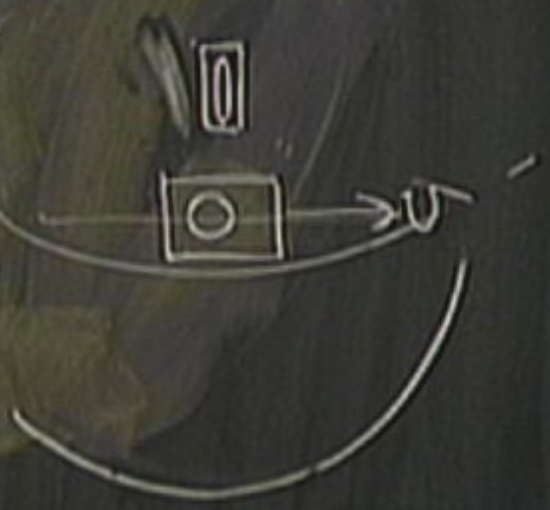
$$= \sqrt{1 - v^2/c^2} \cdot L$$



$L =$ proper width of Bob. (same Alice)

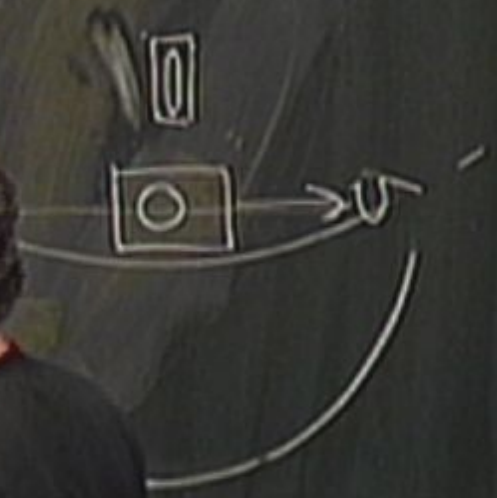
$l =$ moving " " "

$$= \sqrt{1 - v^2/c^2} \cdot L$$



100
Alices.

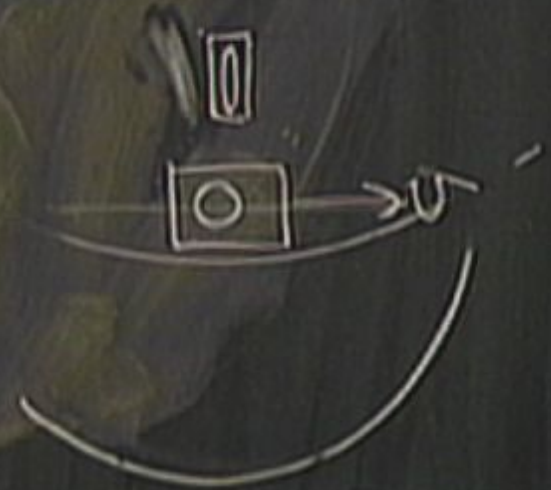
L = proper width of Bob. (same Alice)
 l = moving " " "
 $= \sqrt{1 - v^2/c^2} \cdot L$



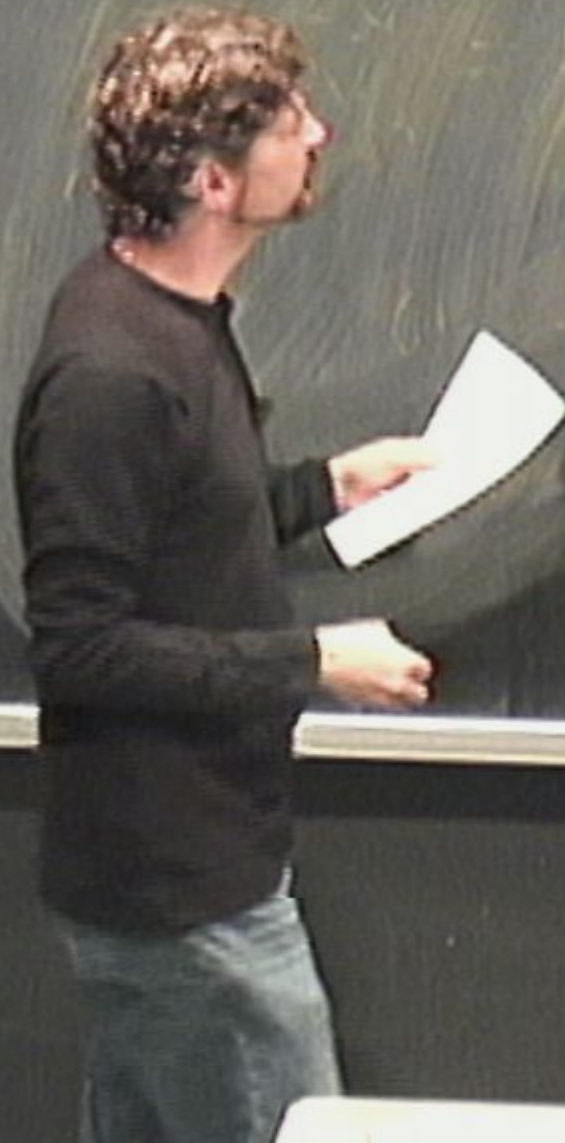
L = proper width of Bob. (same Alice)

l = moving " " " "

$$= \sqrt{1 - v^2/c^2} \cdot L$$

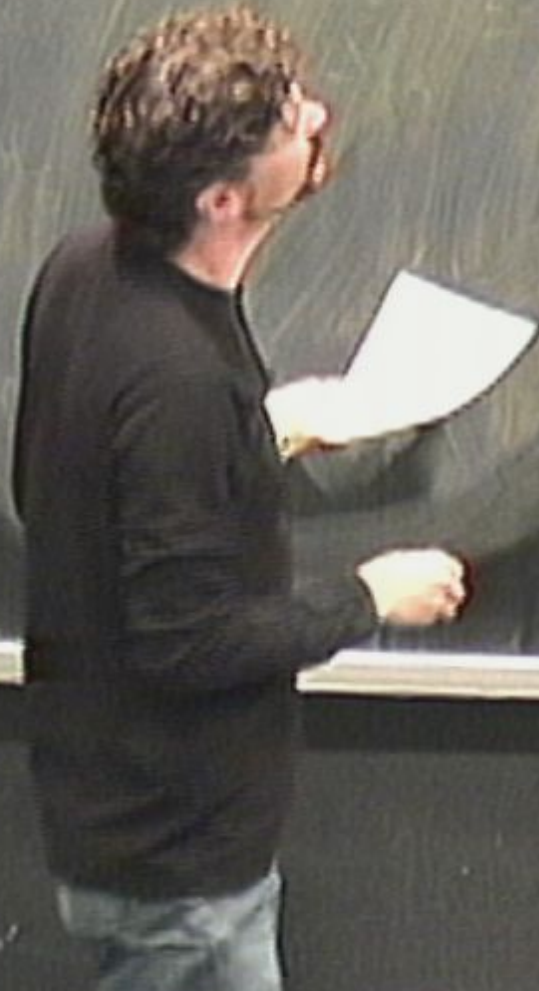


In rotating space $C = 2\pi r$



In corotating space $C = 2\pi\hbar$

In corotating space $C = \frac{2\pi r}{\sqrt{1 - \dots}}$

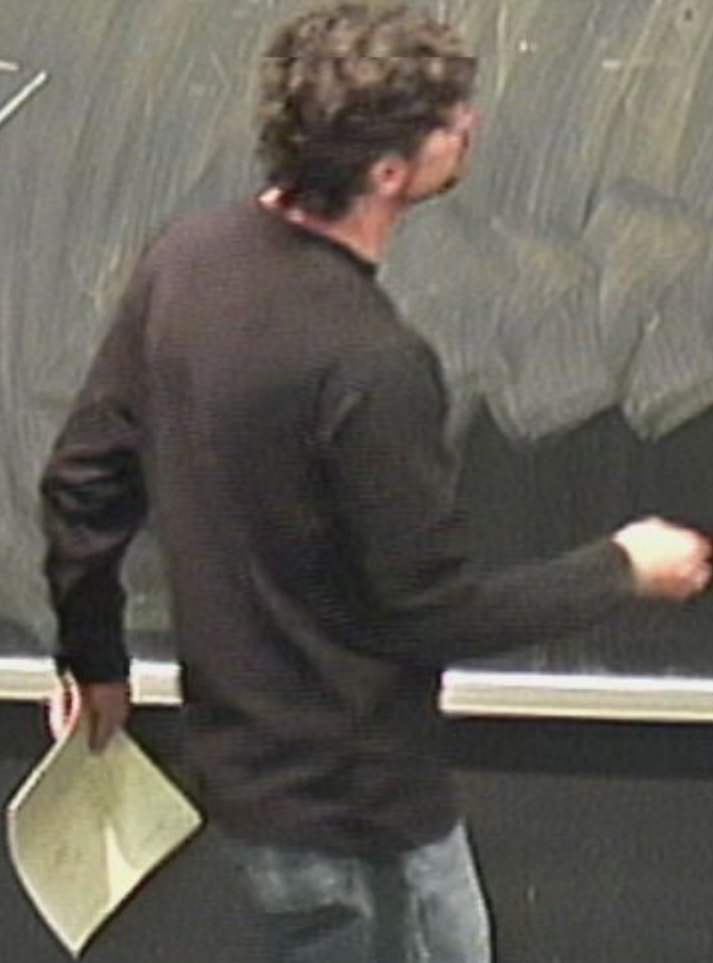


In corotating space

$$C = \frac{2\pi r}{\sqrt{1 - \omega^2 r^2 / c^2}}$$

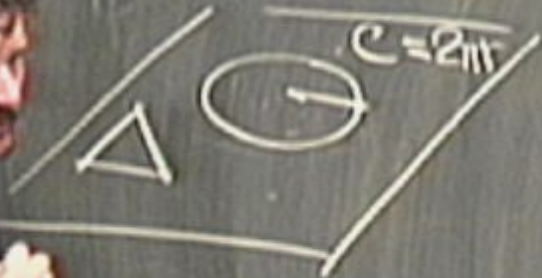
In corotating space

$$C = \frac{2\pi r}{\sqrt{1 - \omega^2 r^2 / c^2}}$$



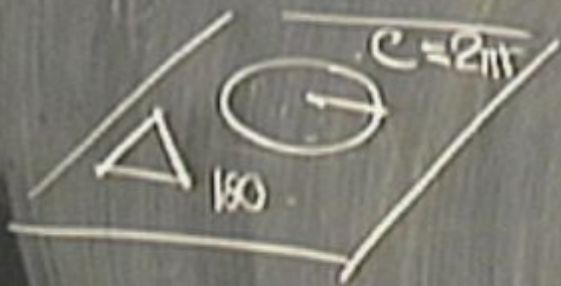
In corotating space

$$C = \frac{2\pi r}{\sqrt{1 - \omega^2 r^2 / c^2}}$$

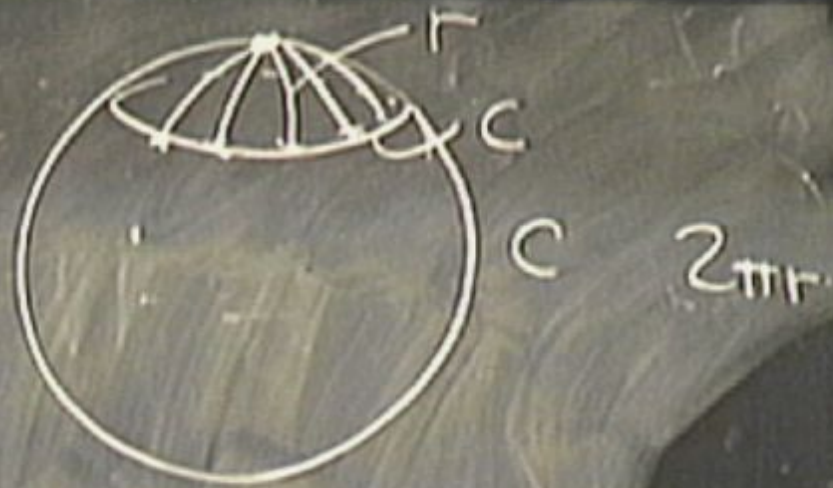
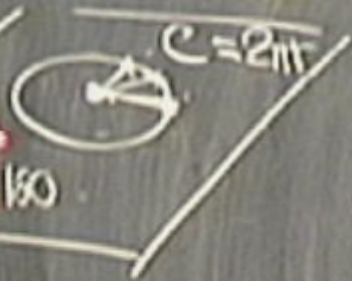


In corotating space

$$C = \frac{2\pi r}{\sqrt{1 - \omega^2 r^2 / c^2}}$$

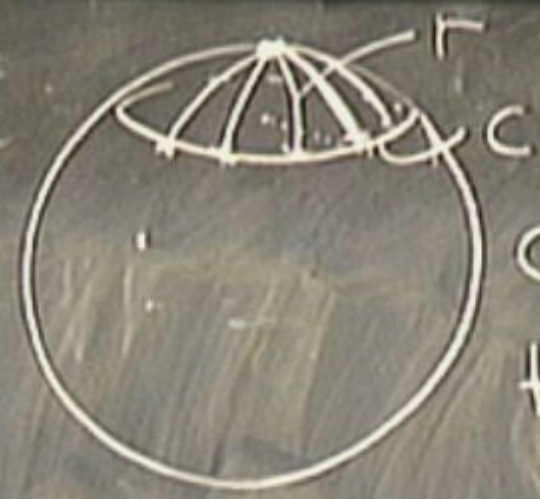
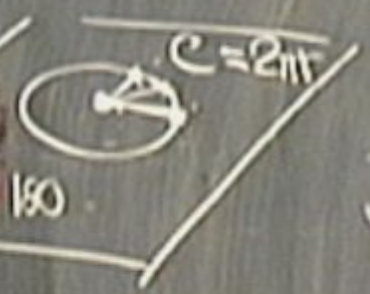


In corotating space



$$C > 2\pi r$$

In corotating space

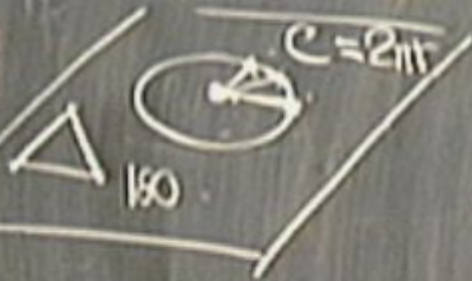


$C < 2\pi r$
+ curv.



In corotating space

$$C > 2\pi r$$



$$C < 2\pi r$$

+ curv.

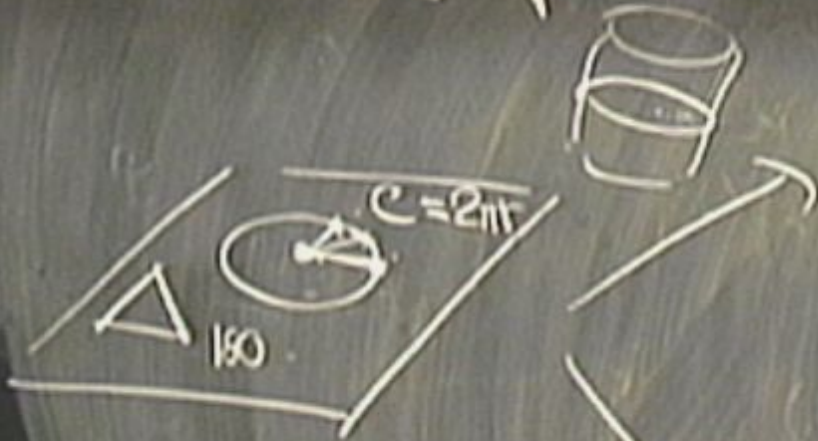


$$C > 2\pi r$$

- curv.

In corotating space

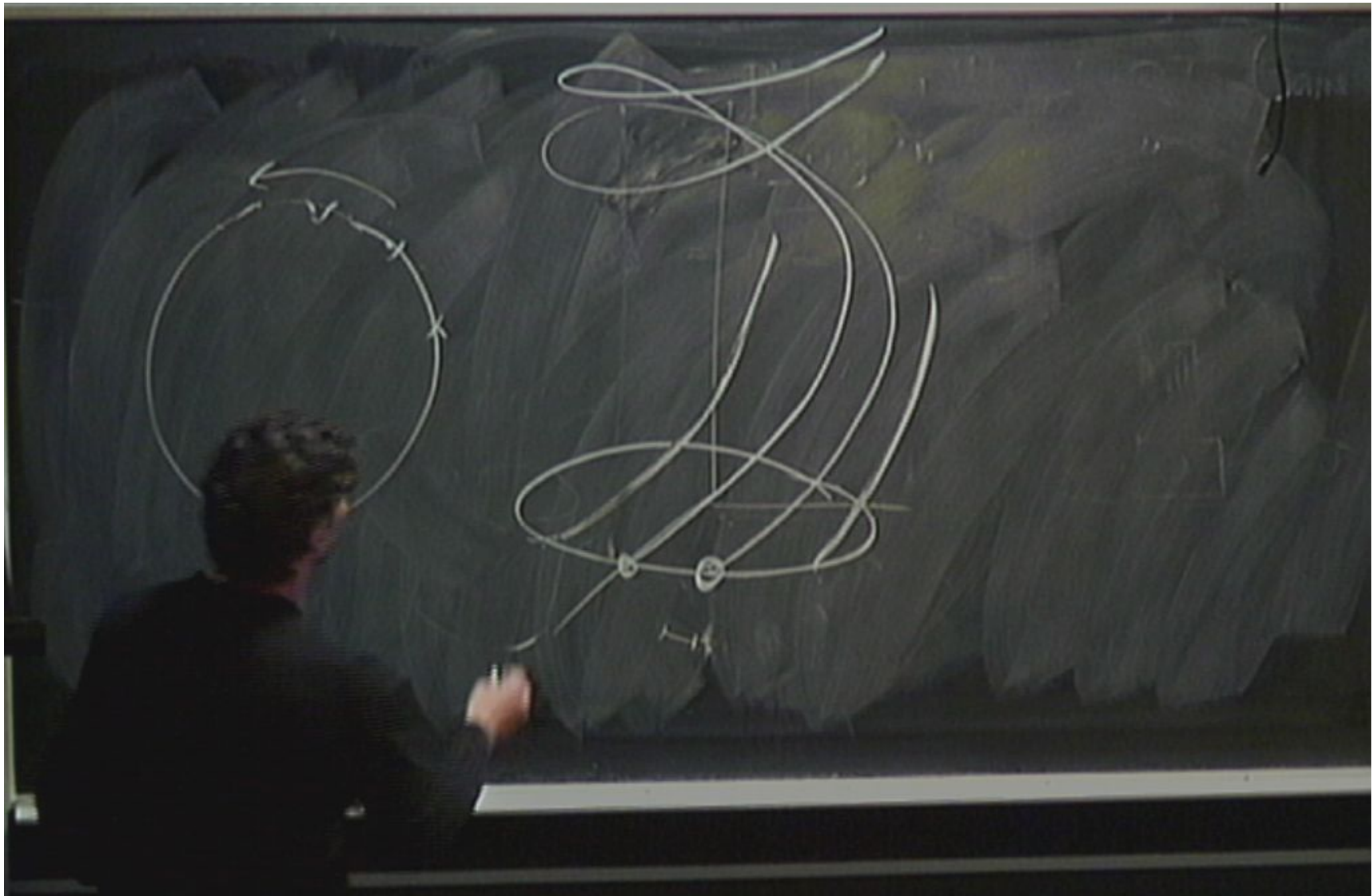
$$C > 2\pi r$$

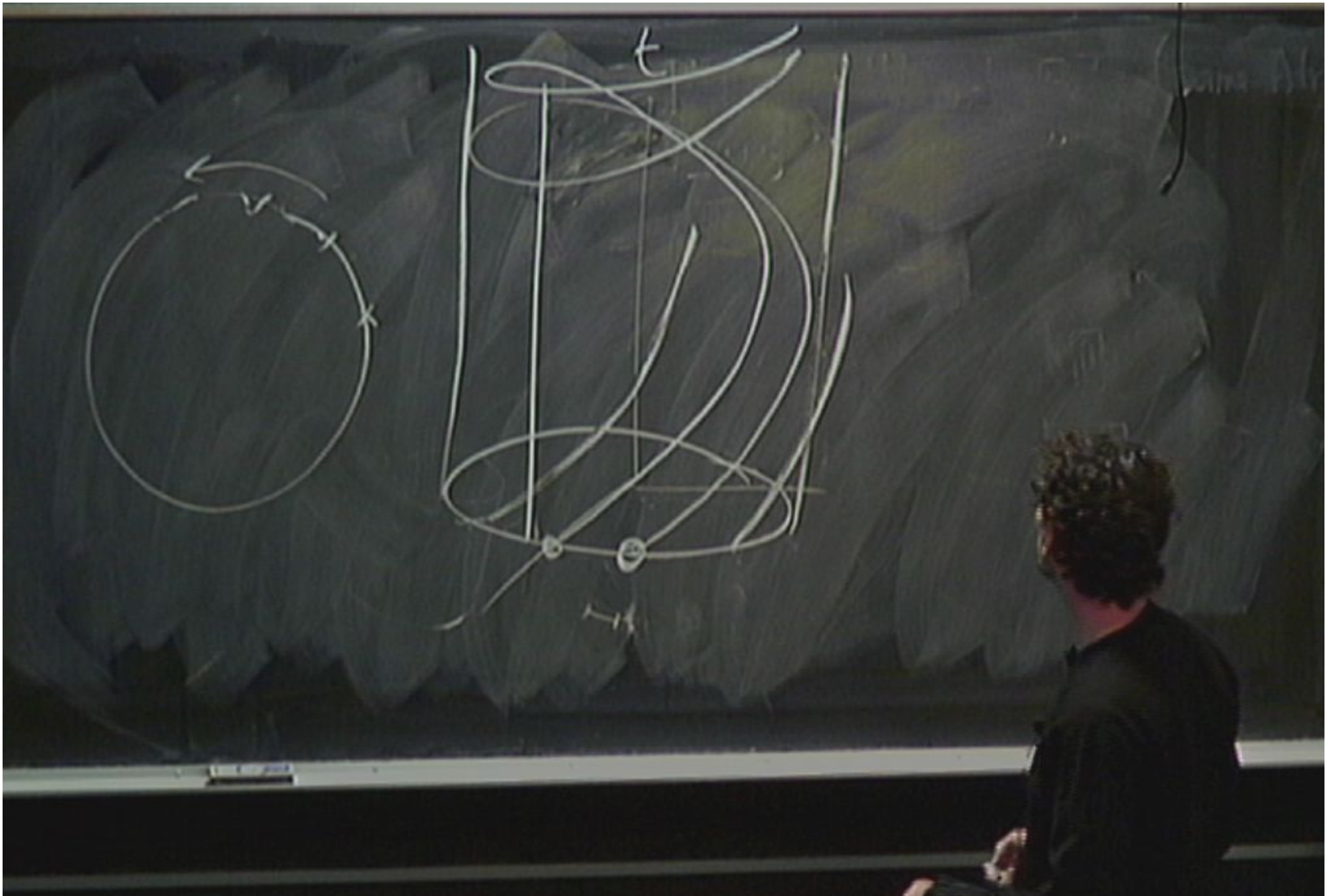


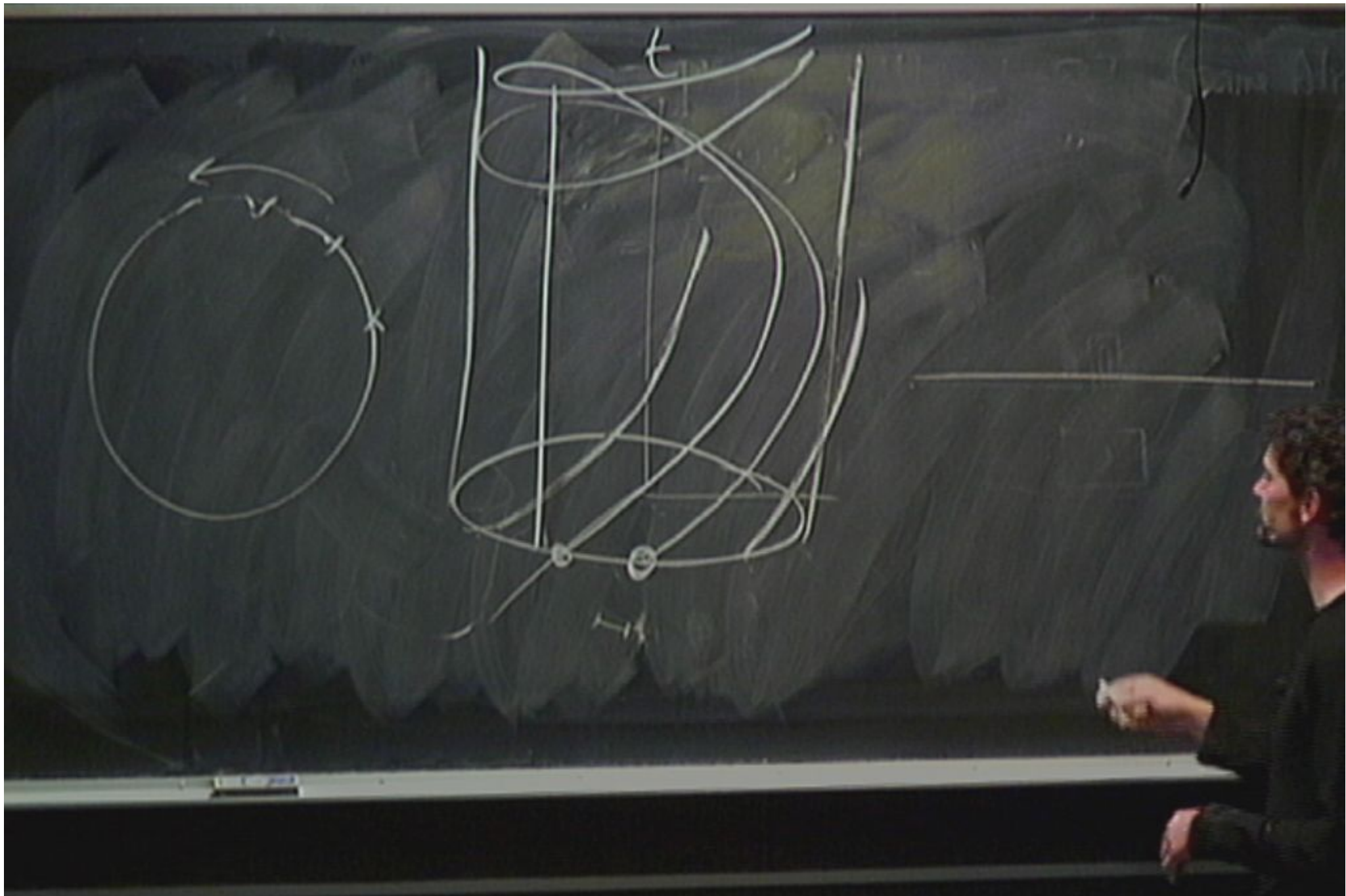
$C < 2\pi r$
+ curv.

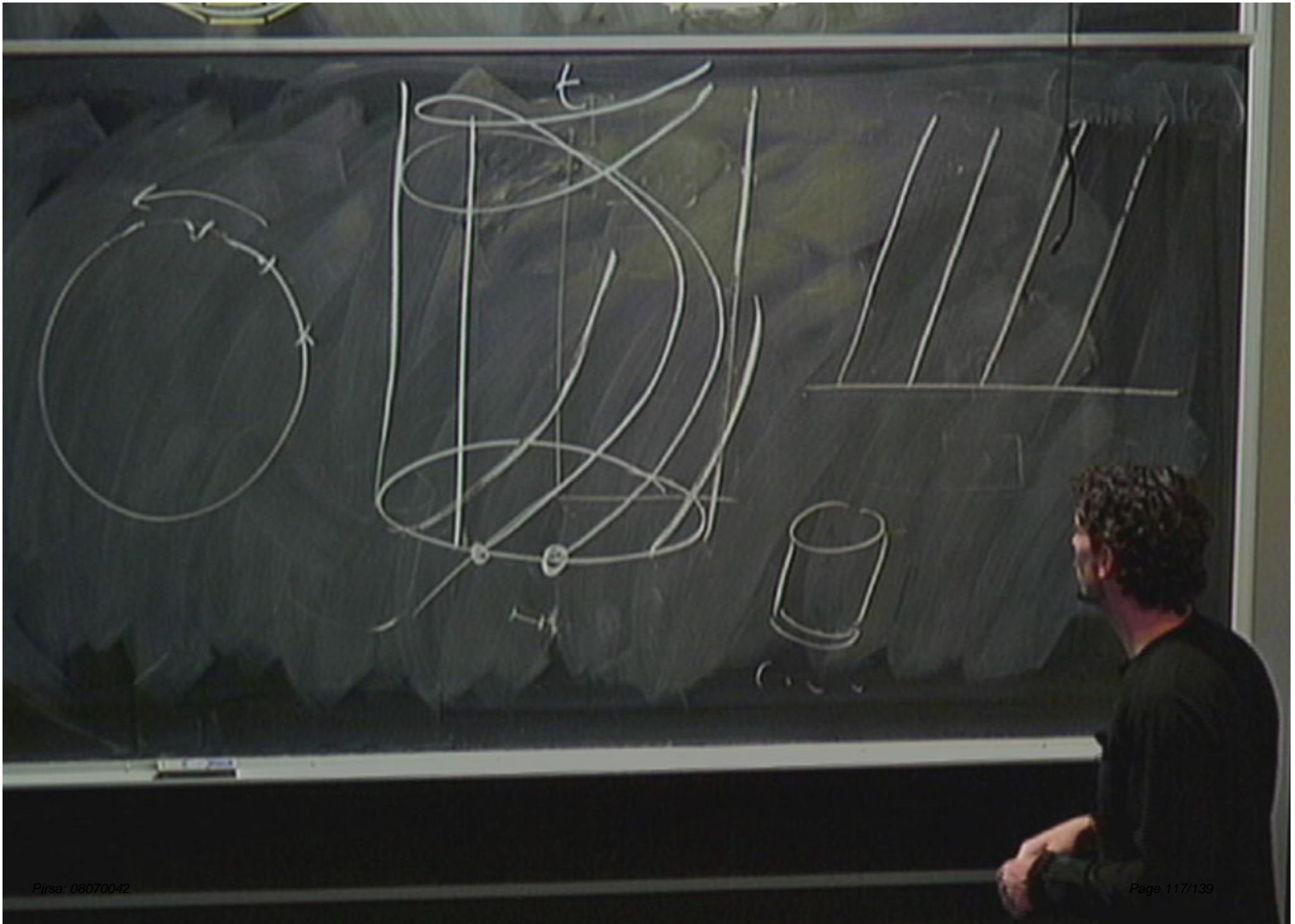


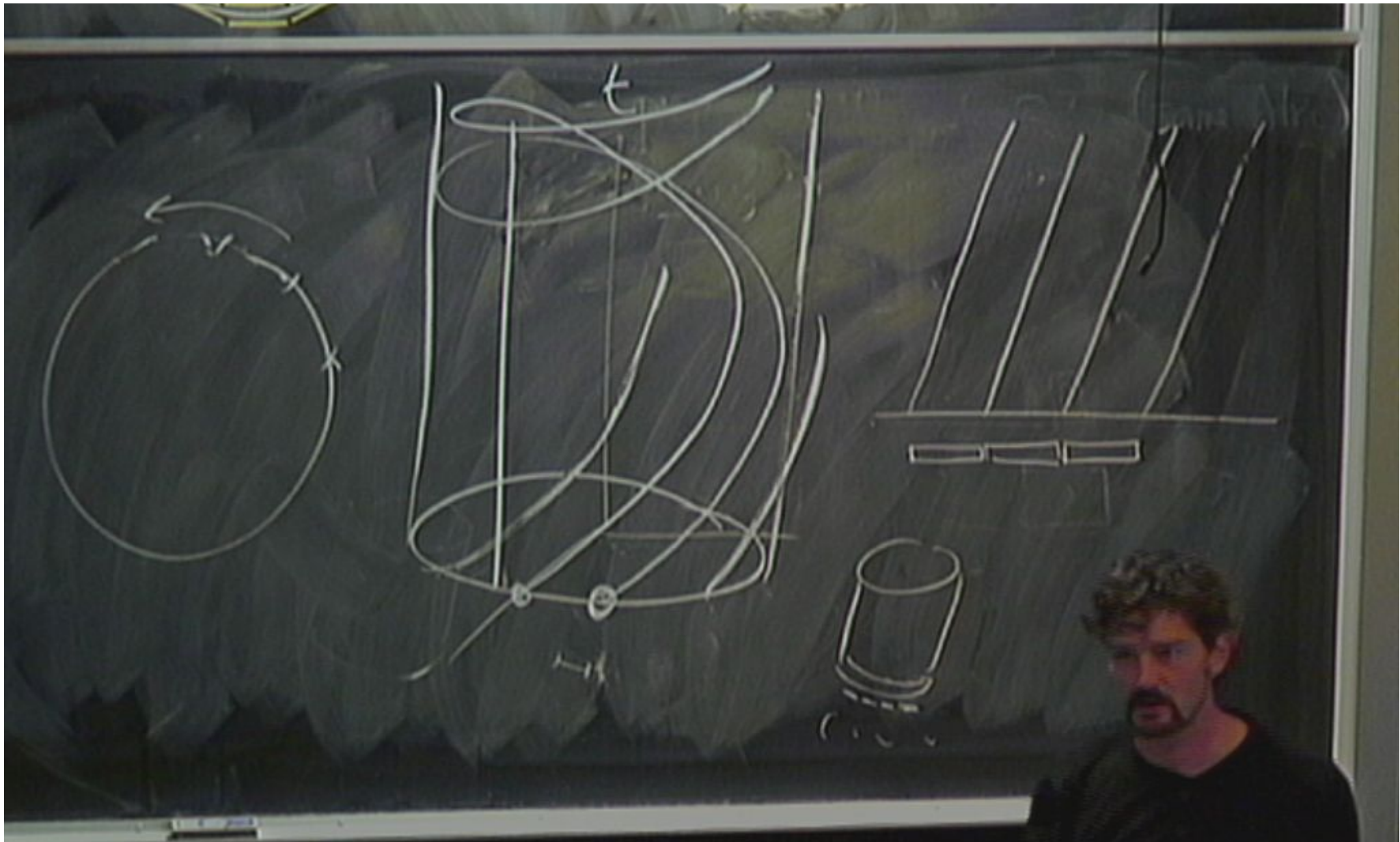
$C > 2\pi r$
- curv.

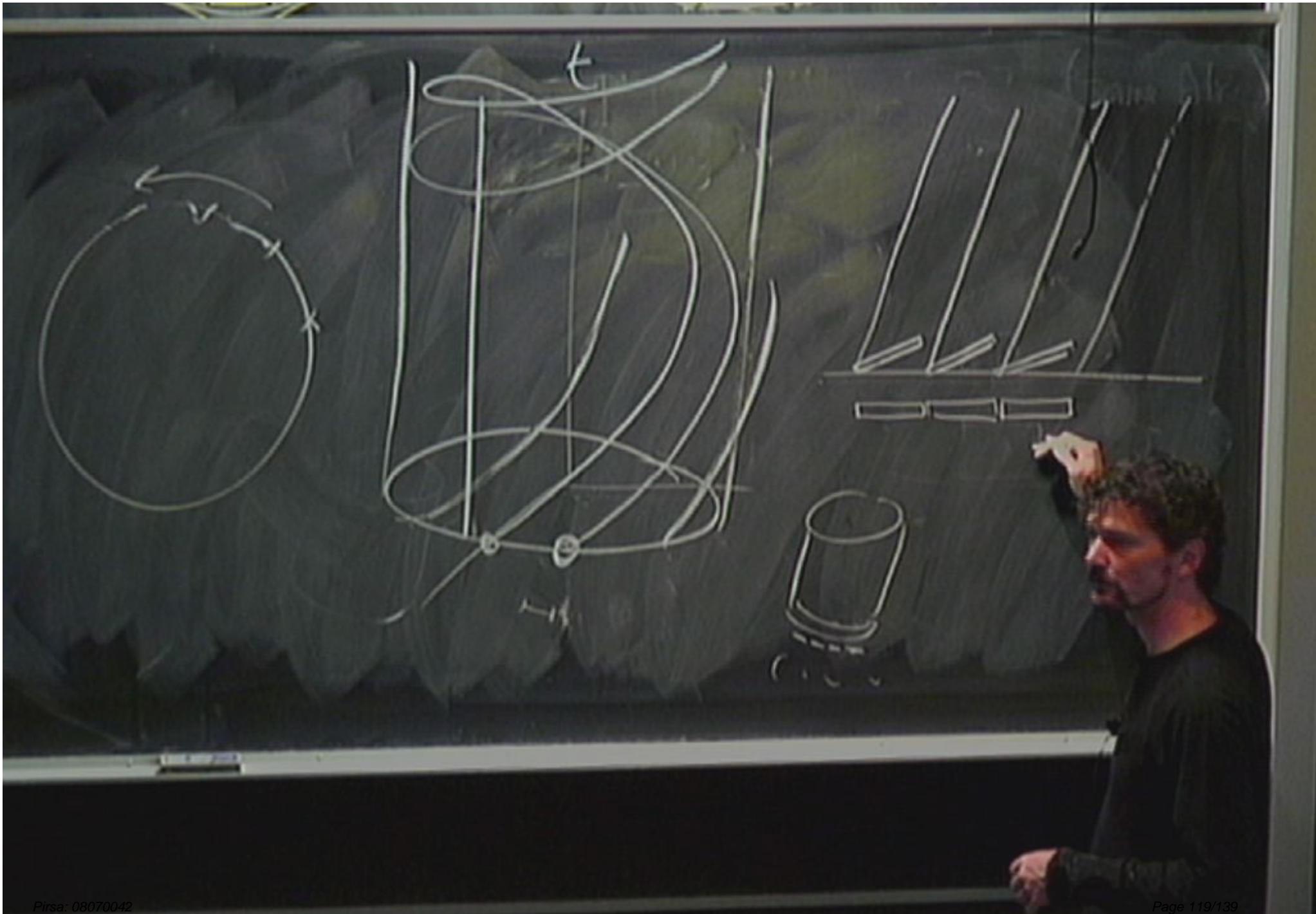




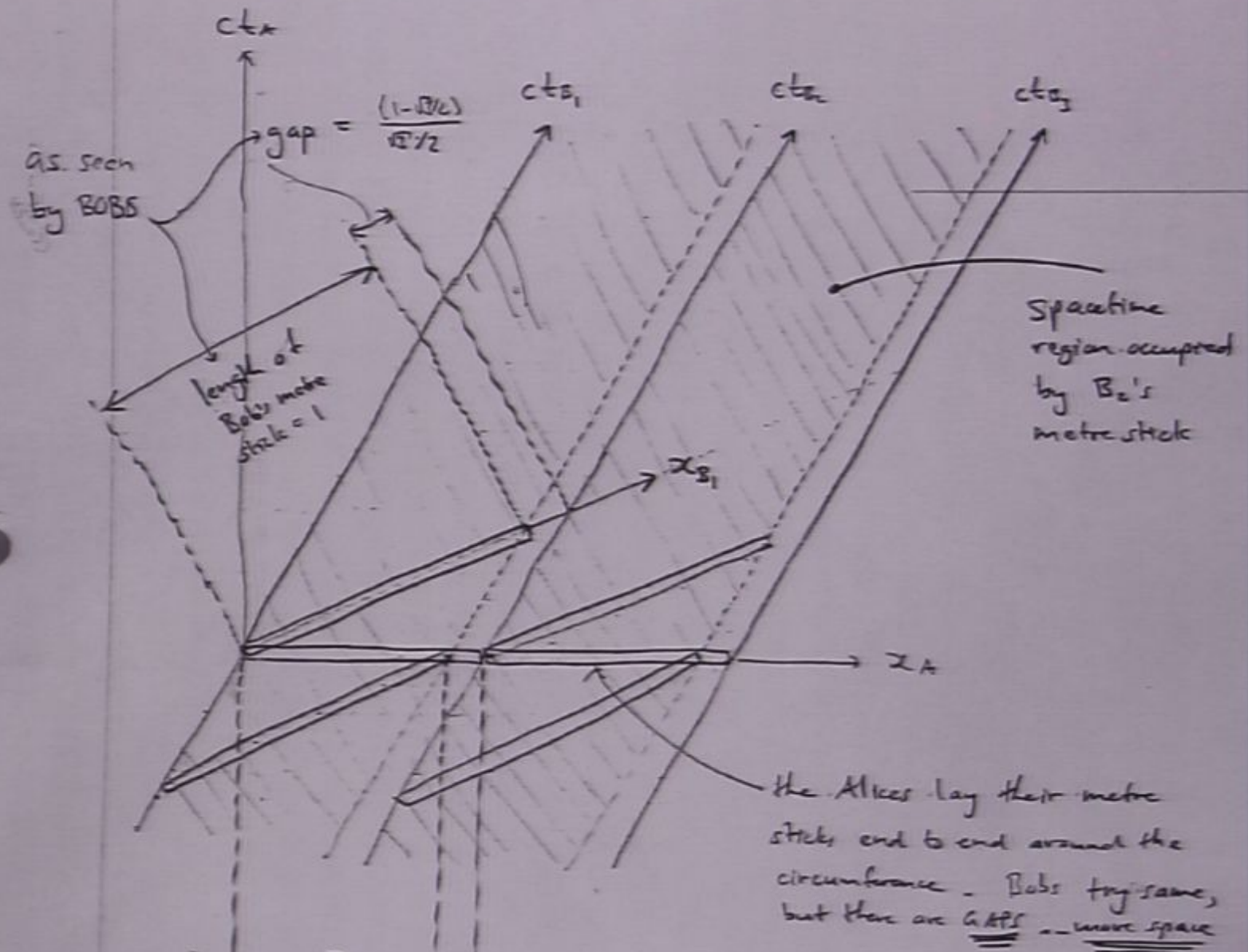






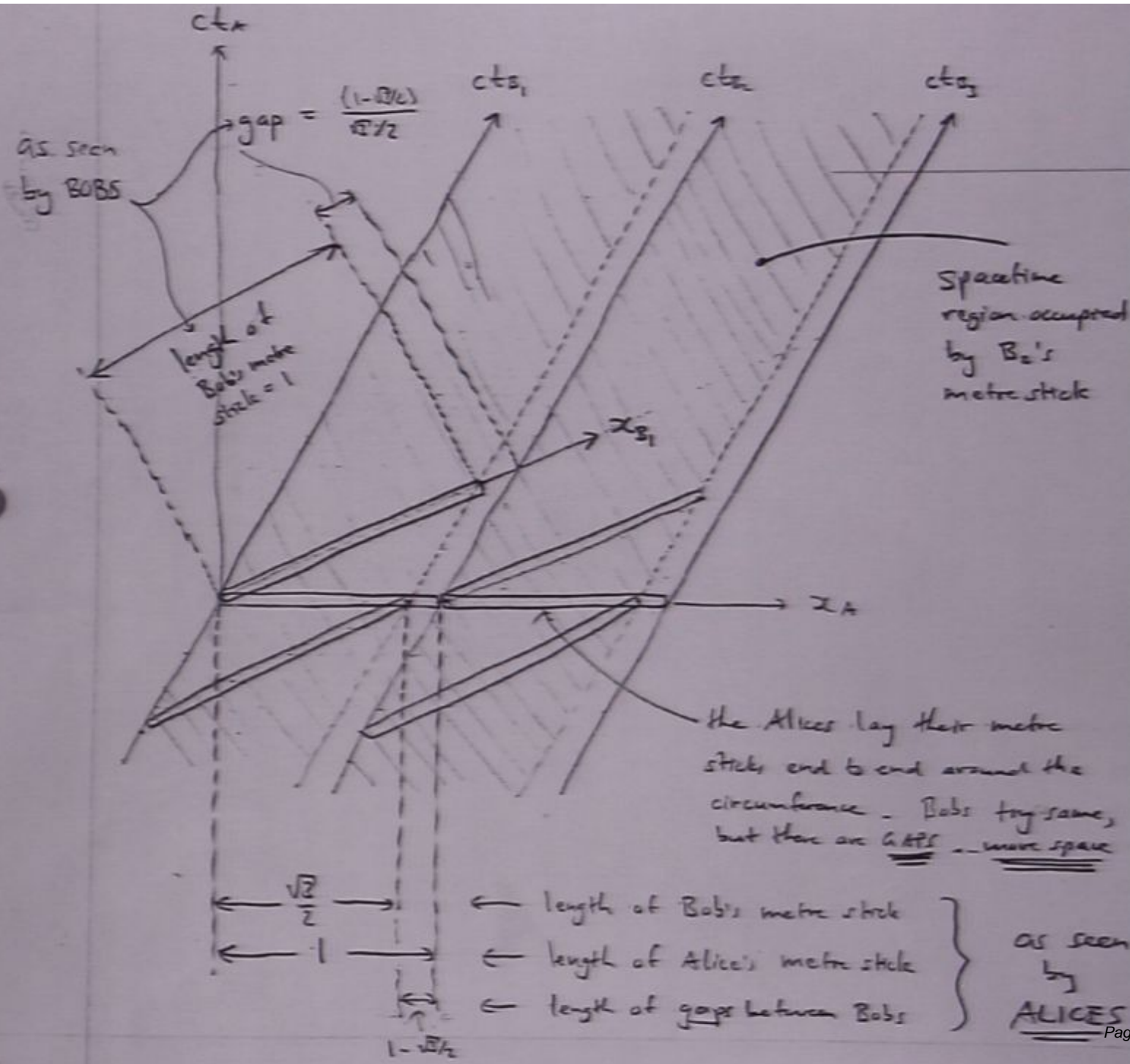


let all Alices & Bobs have identical metre sticks.



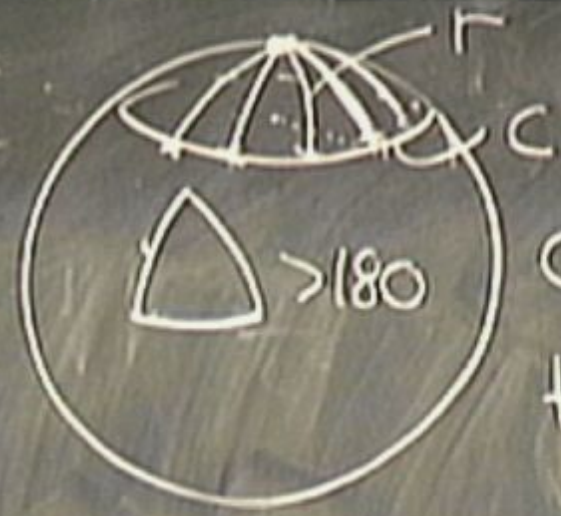
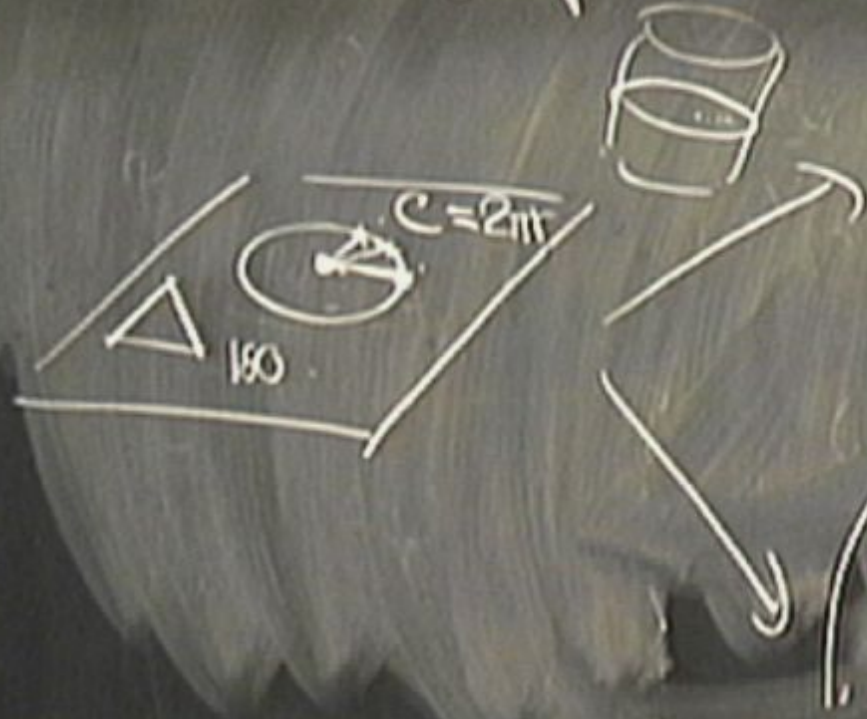
the Alices lay their metre sticks end to end around the circumference - Bobs try same, but there are GAPS - more space

$\left. \begin{array}{l} \leftarrow \frac{\sqrt{2}}{2} \leftarrow \text{length of Bob's metre stick} \\ \leftarrow 1 \leftarrow \text{length of Alice's metre stick} \\ \leftarrow \text{length of gap between } \dots \end{array} \right\} \text{as seen by Alice}$



$$C > 2\pi r$$

In rotating space



$C < 2\pi r$
+ curv.



