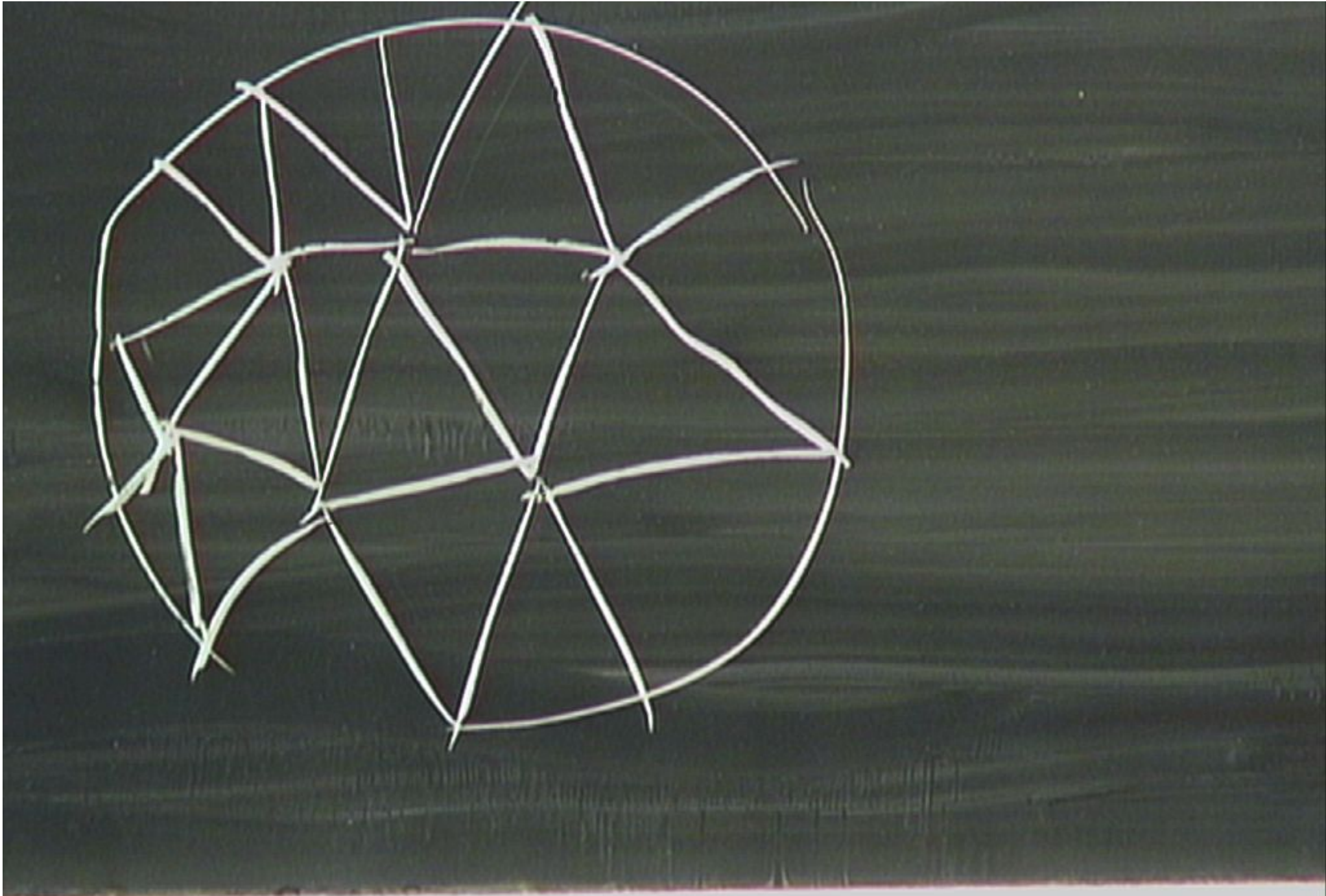


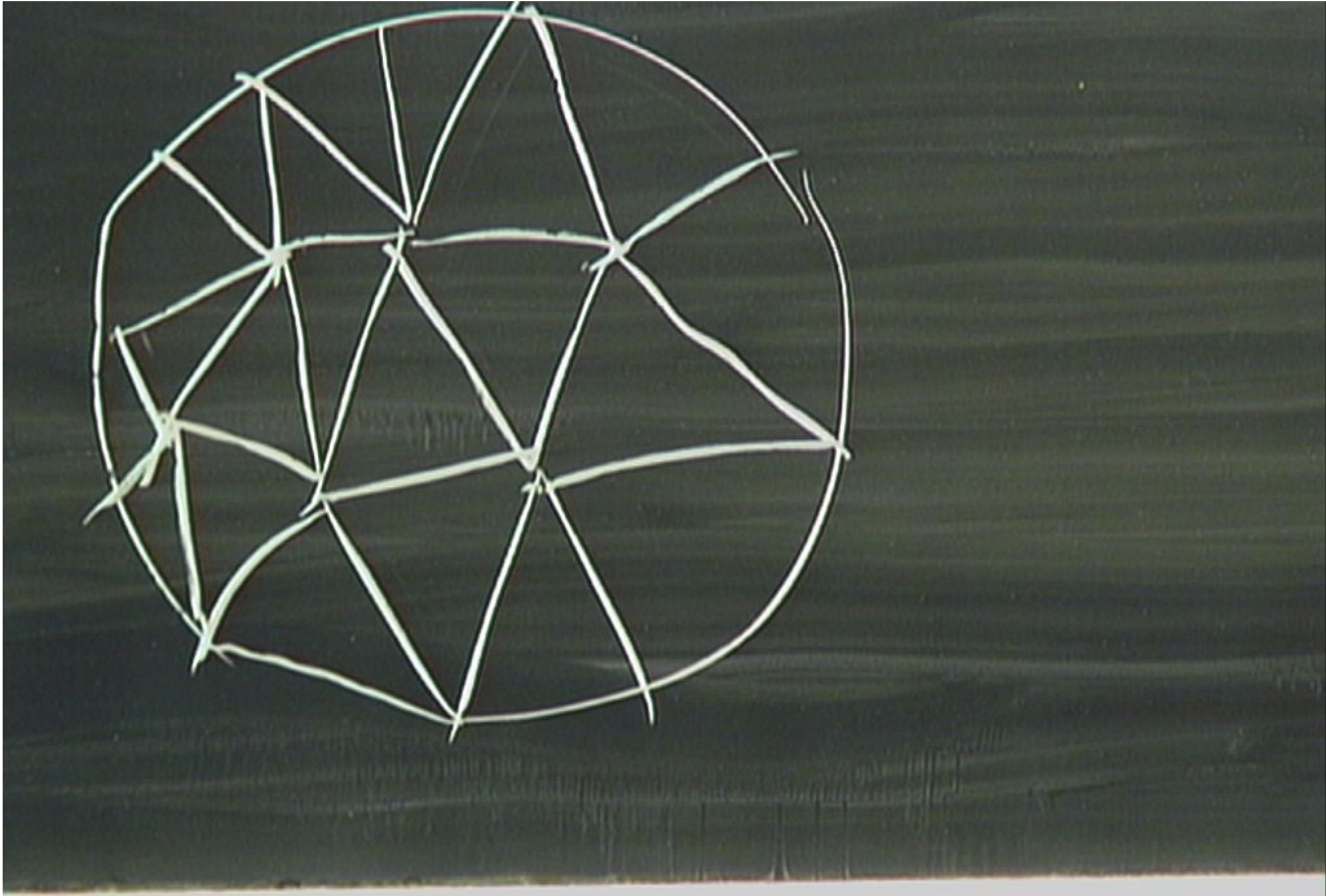
Title: The Nature of Space and Time

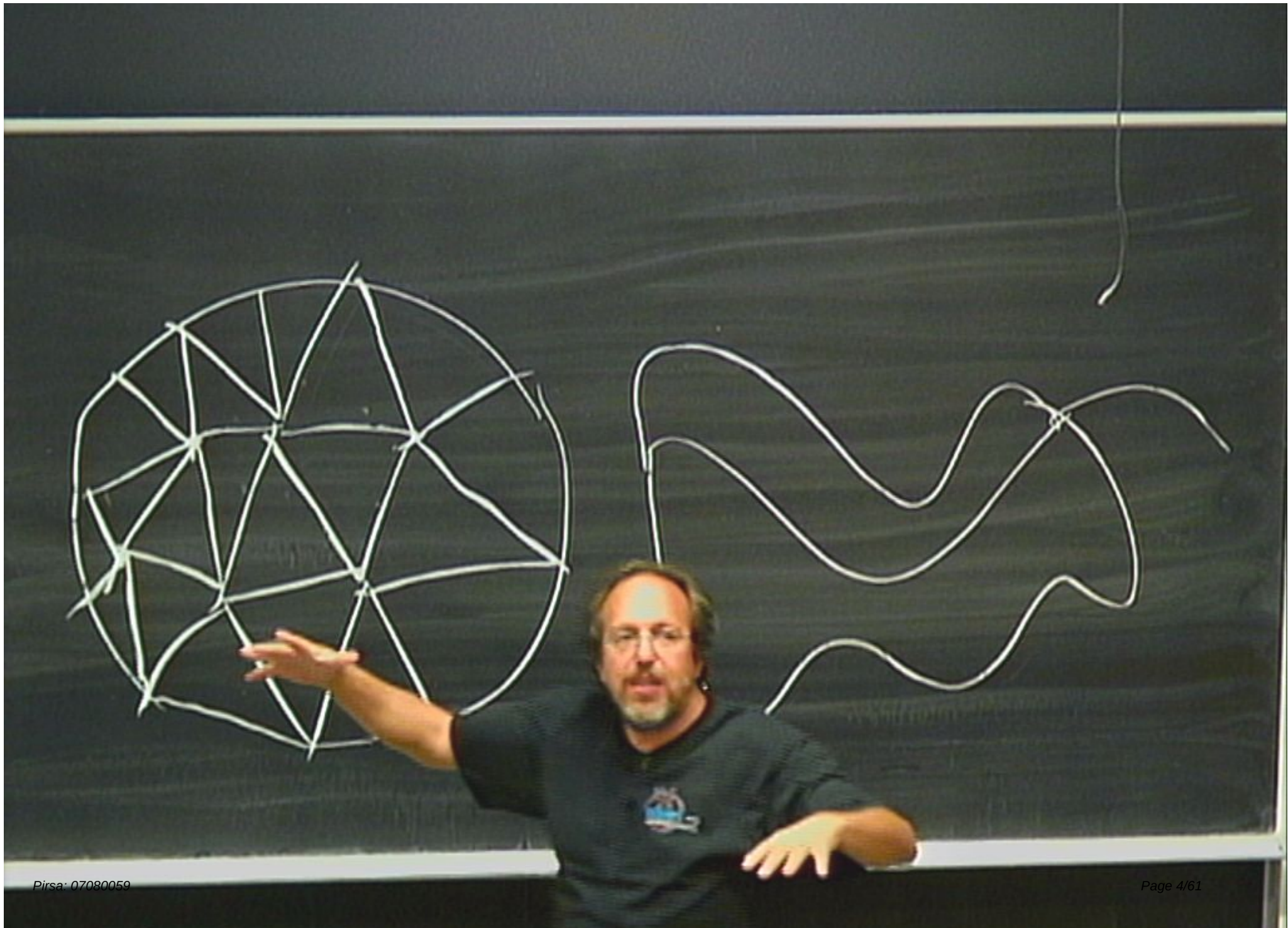
Date: Aug 01, 2007 01:00 PM

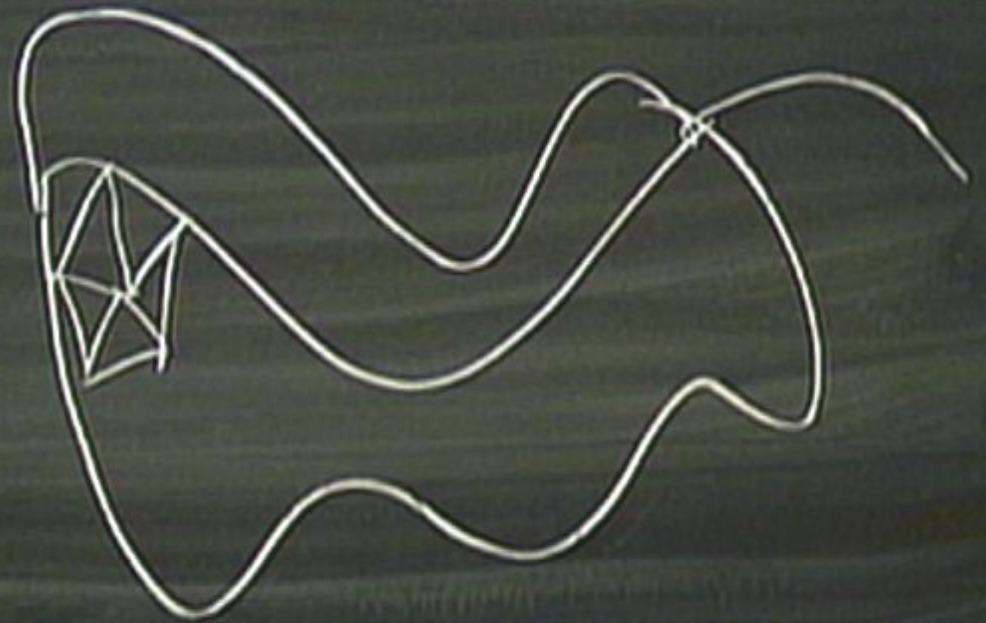
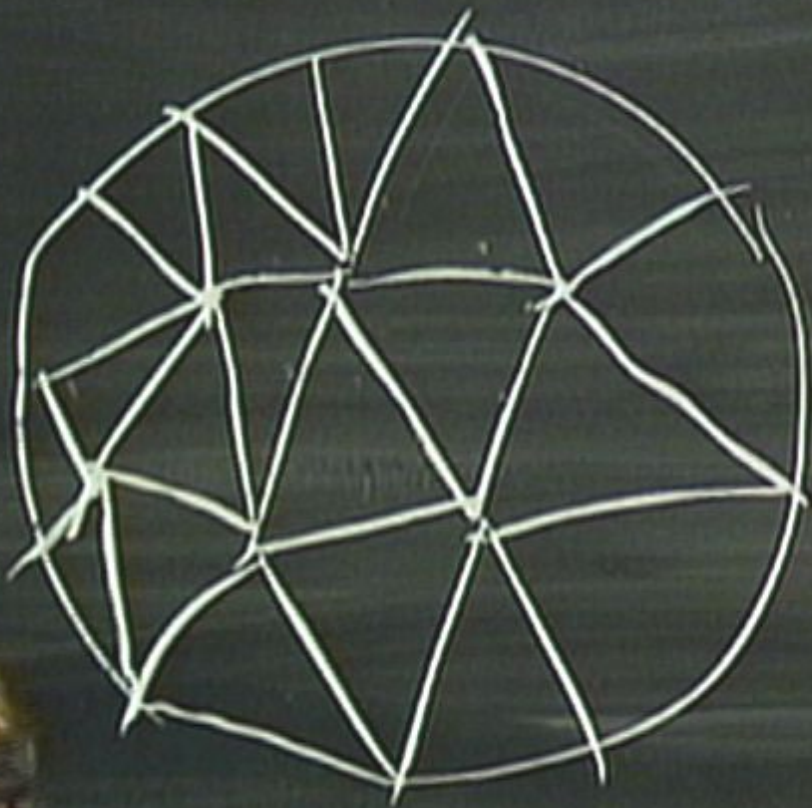
URL: <http://pirsa.org/07080059>

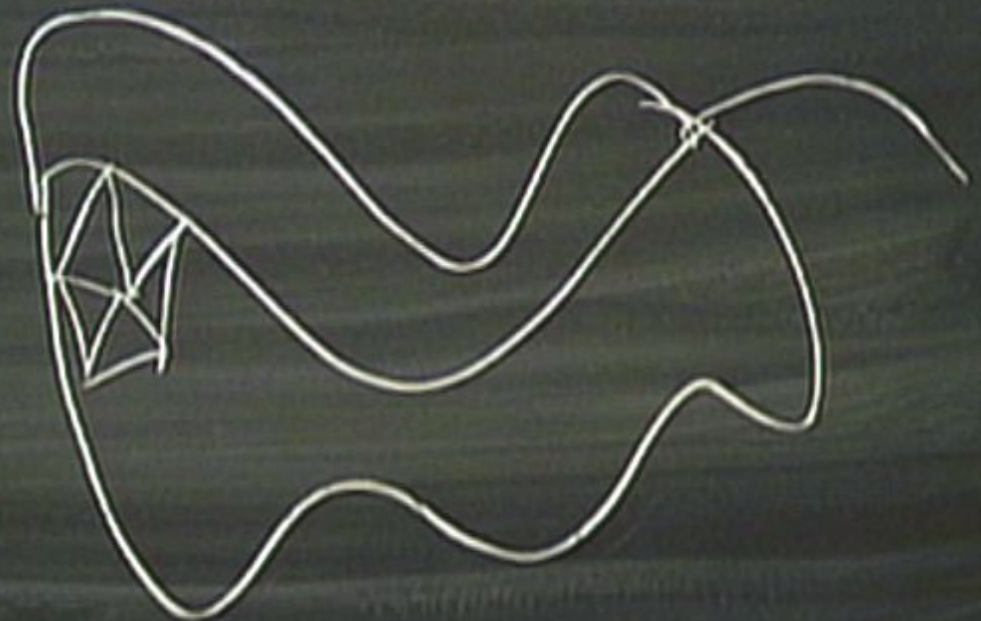
Abstract: An autobiographical story of how Prof. Lee Smolin got interested in theoretical physics, followed by a broad and deep introduction to what Einstein did.











why are we ~~here~~?

why are we ~~driven~~ driven?
what is everything made of?



why are we ~~here~~ here?

what is everything made of?

how do things work?

why things are the way they are?

why are we ~~here~~ here?

what is everything made of?

how do things work?

why things are the way they are?

what is time?

why are we here?
what is everything made of?
how do things work?
why things are the way they are?
what is time?
Does God play dice?

why are we ~~here~~ here?
what is everything made of?
how do things work?
why things are the way they are?
what is time?
Does God play dice?
what is physics?
How was space created?

Why are we here?

What is everything made of?

How do things work?

Why things are the way they are?

What is time?

What is space?

Does God play dice?

What is physics?

How was space created?

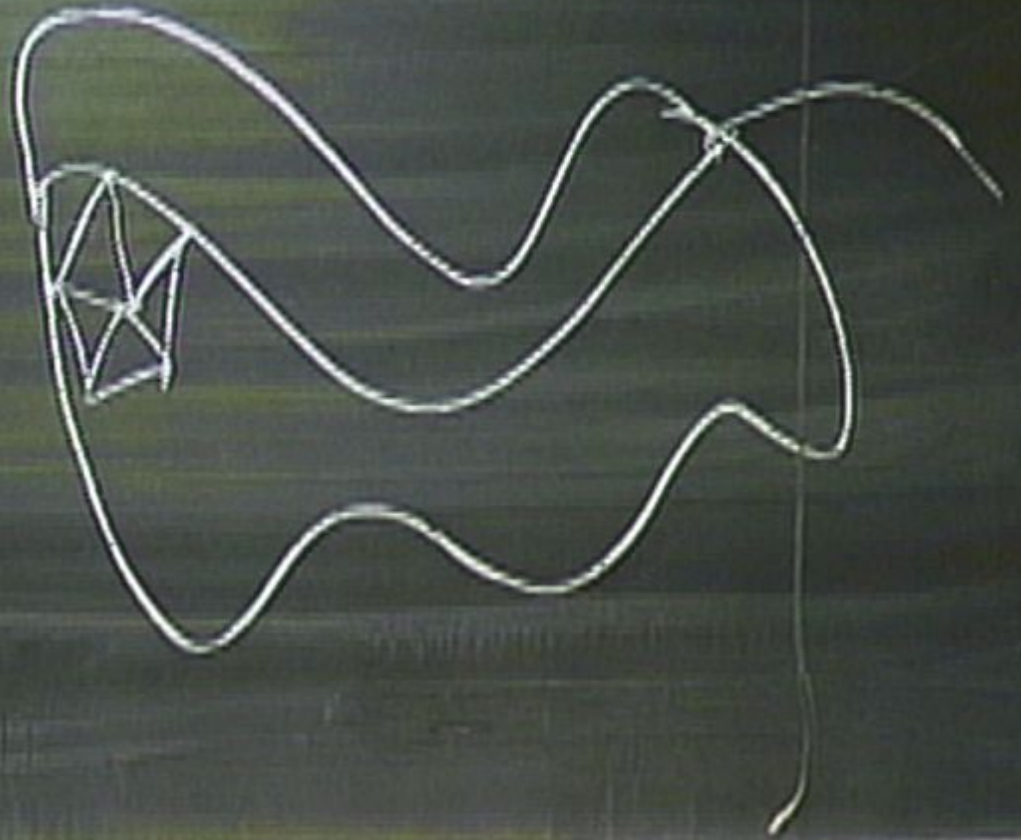
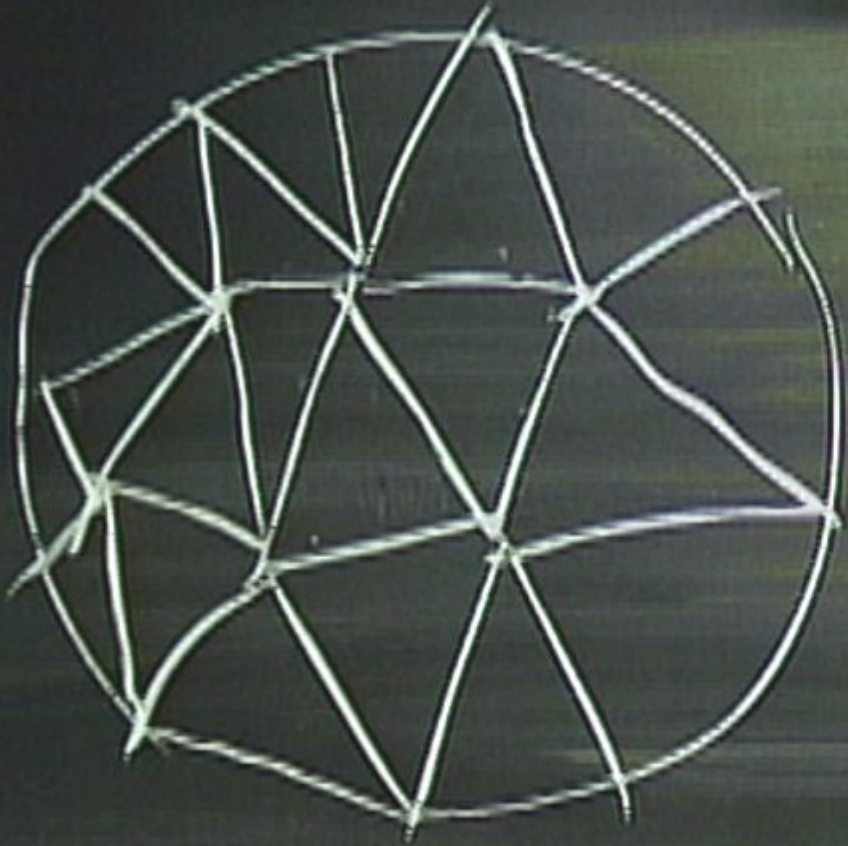
Why are we here?
What is everything made of?
How do things work?
Why things are the way they are?
What is time? What is space?
Does God play dice?
What is physics?
How was space created?

Theory of
everything

Why are we ~~here~~? Theory of
everything
What is everything made of?
How do things work?
Why things are the way they are?
What is time? What is space?
Does God play dice?
What is physics?
How was space created?

Why are we ~~here~~? Theory of
What is everything made of? everything
How do things work?
Why things are the way they are?
What is time? What is space?
Does God play dice?
What is physics?
How was space created?

Vnger



Time?

Measurement of change

4th dimension



Time?

Measurement of change

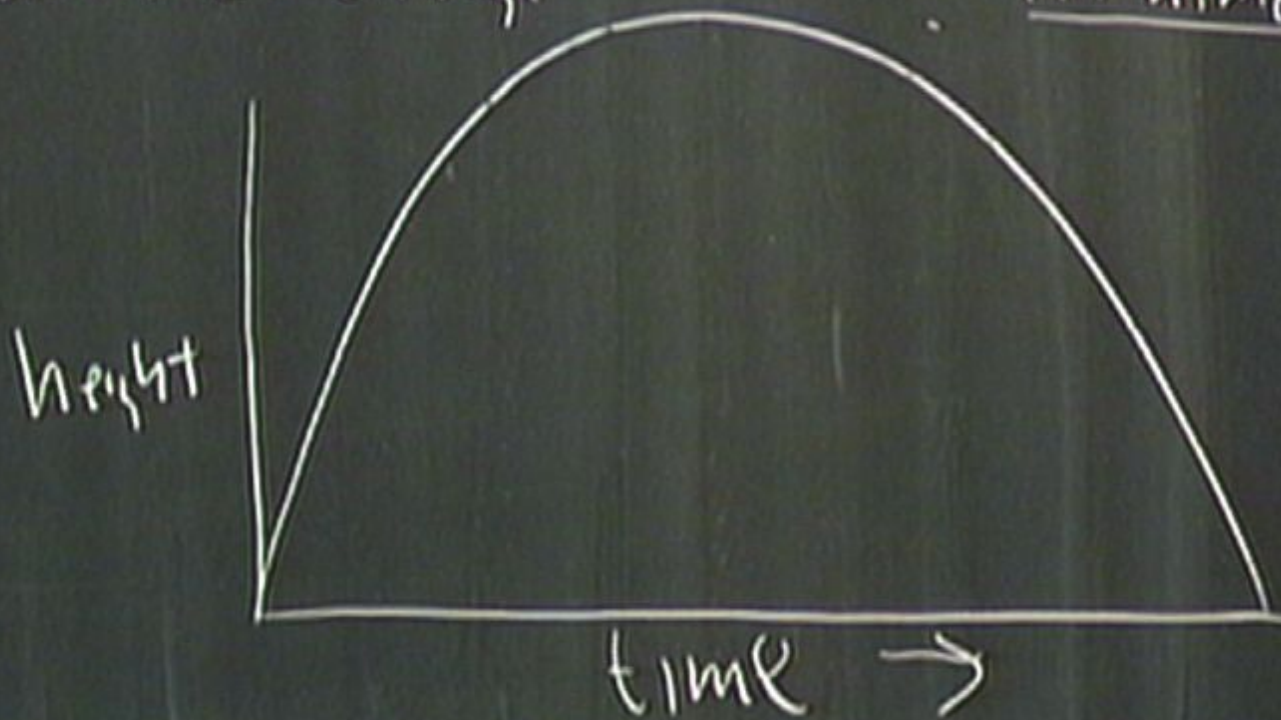
4th dimension



Time?

Measurement of change

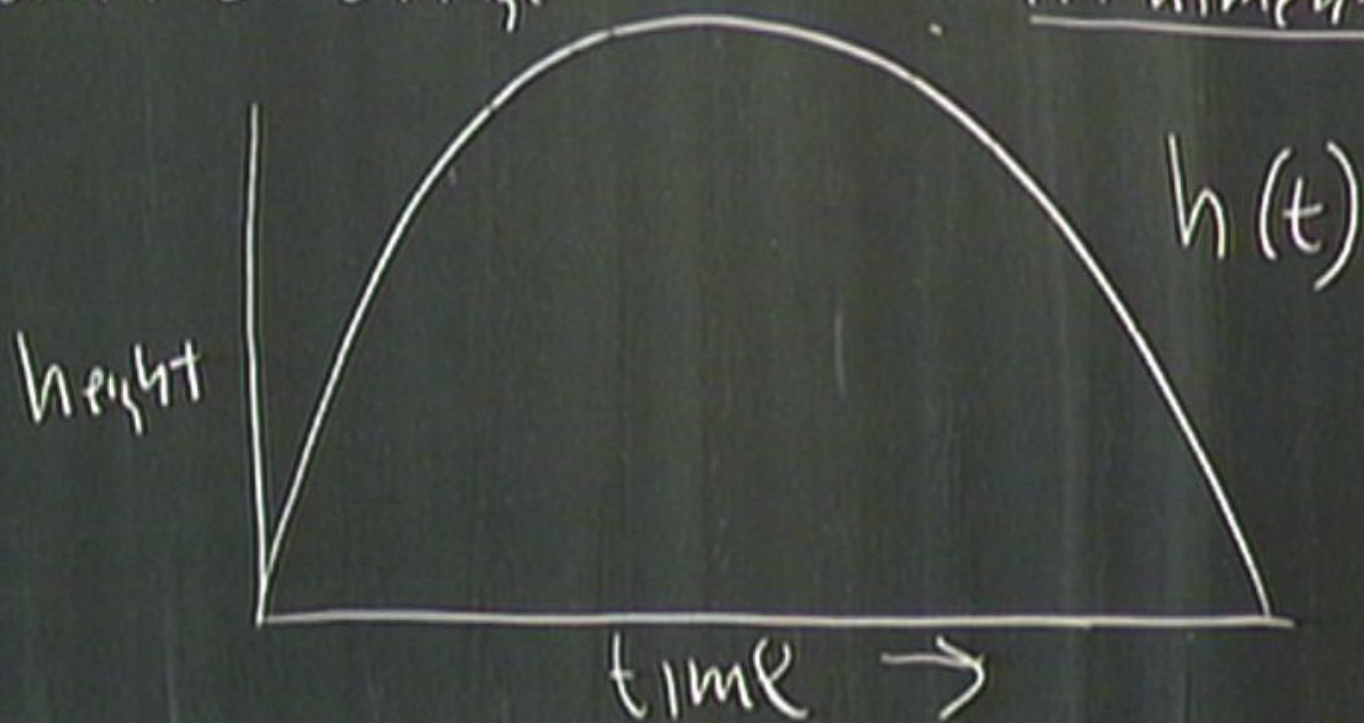
4th dimension



Time?

Measurement of change

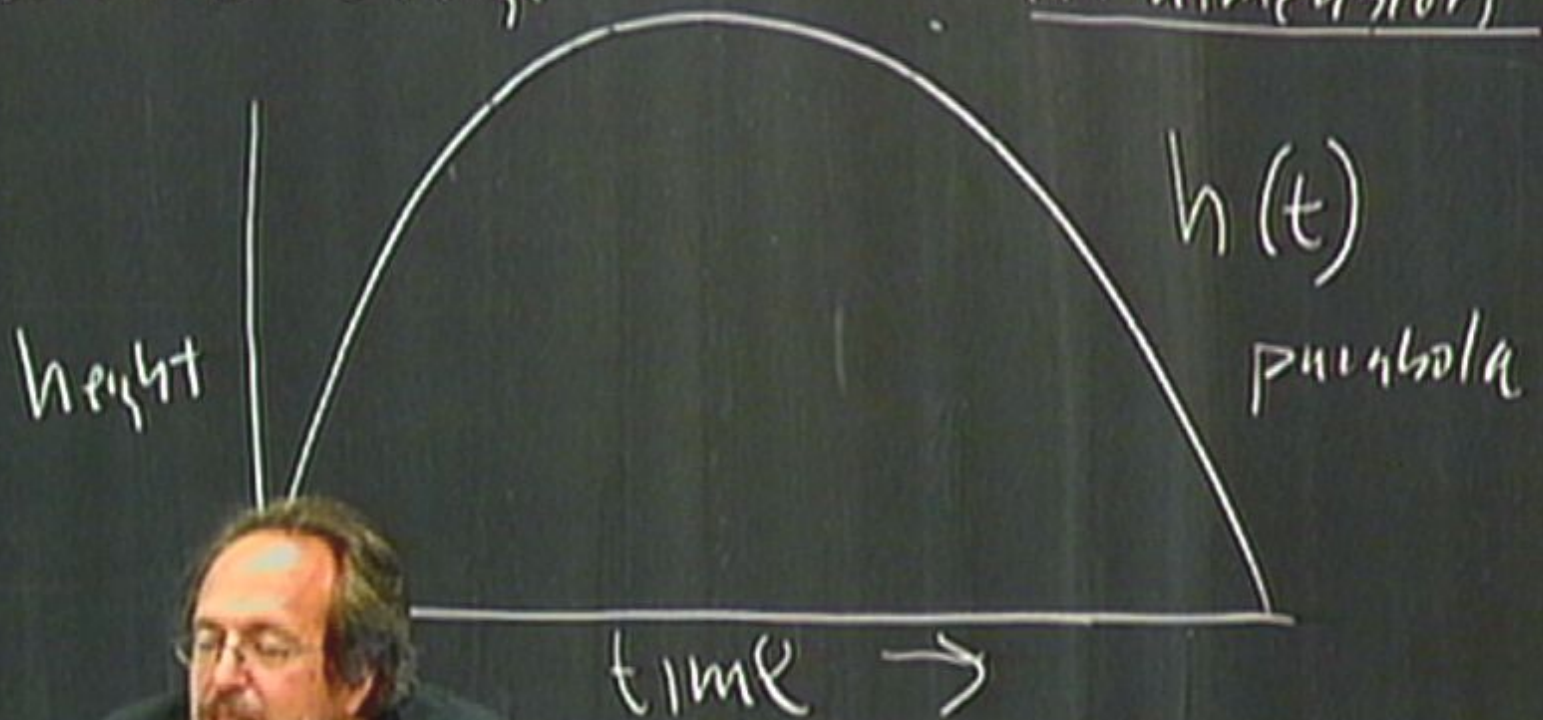
4th dimension



Time?

Measurement of change

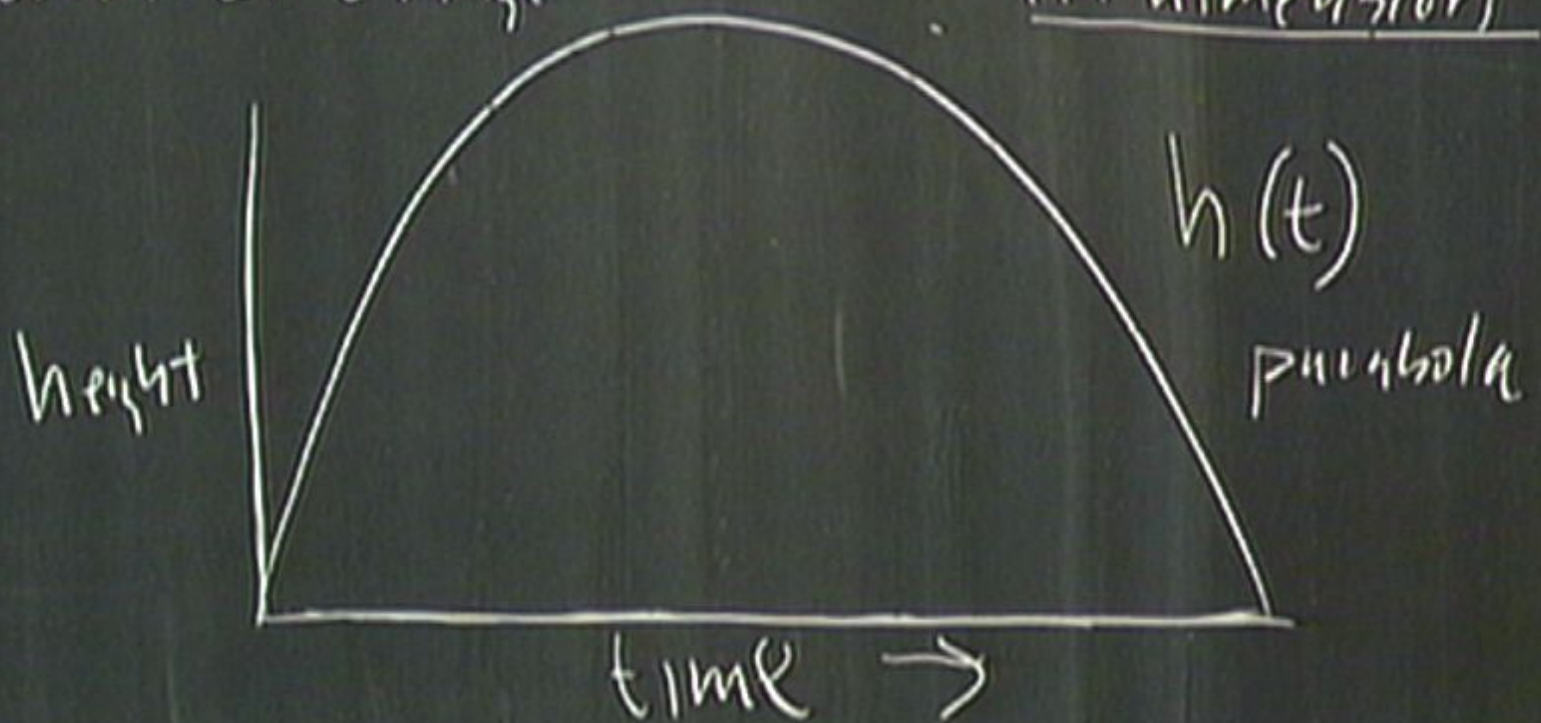
4th dimension



Time?

Measurement of change

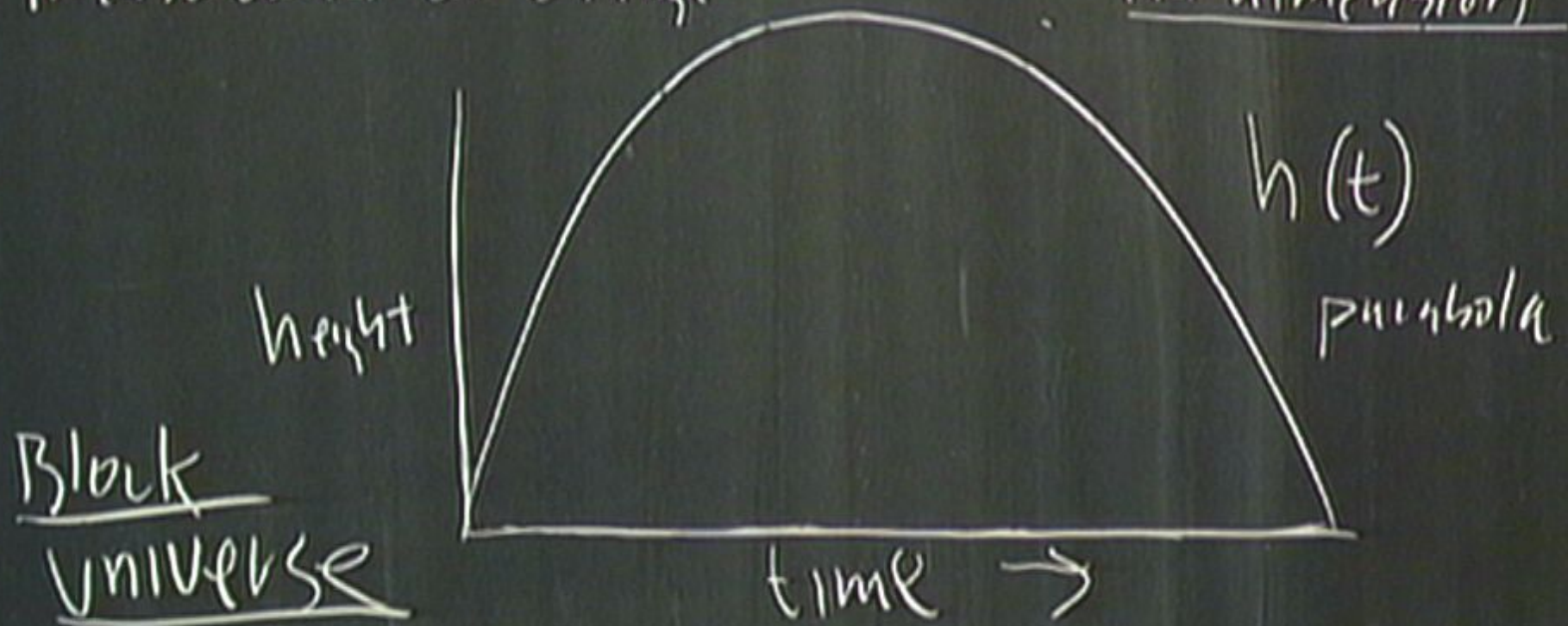
4th dimension



Time?

Measurement of change

4th dimension



space time

If no change is there time?



time
If no change is there time?

YES

NO



time
If no change is there time?

YES 24

NO 22

time
If no change is there time?

YES 24

NO 22

Newton

time
If no change is there time?

YES 24

NO 22

Newton

Time is absolute & mathematical

time
If no change is there time?

YES 24

NO 22

Newton

Time, absolute & mathematical

time
If no change is there time?

YES 24

NO 22

Newton

Time, absolute & mathematical
hit

If no change is there time?

YES 24

NO 22

Newton

Time absolute & mathematical

$h(t)$

$$v = \frac{\Delta p_{\text{sh}}}{\Delta \text{time}}$$

If no change is there time?

YES 24

Newton

Time absolute & mathematical

$h(t)$

$$v = \frac{\Delta p_{\text{with}}}{\Delta \text{time}}$$

NO 22

Descartes, Huygens
Leibniz

If no change is there time?

YES 24

Newton

Time absolute & mathematical

$h(t)$

$$v = \frac{\Delta p_{\text{pos}}}{\Delta \text{time}}$$

NO 22

Descartes, Huygens
Leibniz

If no change is there time?

YES 24

Newton

Time absolute & mathematical

hit

$$v = \frac{\Delta p_{\text{hit}}}{\Delta \text{time}}$$

NO 22

Descartes, Huygens
Leibniz

If no change is there time?

YES 24

Newton

Time absolute & mathematical

$h(t)$

$$v = \frac{\Delta \text{position}}{\Delta \text{time}}$$

NO 22

Descartes, Huygens
Leibniz

Time is change in
relationships

If no change is there time?

YES 24

Newton

Time absolute & mathematical

$h(t)$

$$v = \frac{\Delta p_{\text{sit}}}{\Delta \text{time}}$$

NO 22

Descartes, Huygens
Leibniz

Time is change in
relationships

If no change is there time?

YES 24

Newton

Time absolute & mathematical

hit

$$v = \frac{\Delta p - \text{sh}}{\Delta \text{time}}$$

NO 22

Descartes, Huygens

Leibniz

Time is change in relationships

Einstein

(Neil Stephenson)

Why are we ~~here~~?

Theory of everything

What is everything made of?

How do things work?

Why things are the way they are?

What is time?

What is space?

Does God play dice?

What is physics?

How was space created?

Newton

3-d Euclidean geometry, infinite

Newton

3-d Euclidean geometry, infinite
why?

Newton

3-d Euclidean geometry, infinite
why? Kant....

Newton

3-d Euclidean geometry, infinite
why? Kant....

Einstein

3d(p)

Newton

3-d Euclidean geometry, infinite

why? Kant....

Einstein

3d(p) geometry is anything
changes in space
changes in time

Newton

3-d Euclidean geometry, infinite

why? Kant....

Einstein

3d(?) geometry is anything
changes in space
changes in time
responds to matter

Newton

3-d Euclidean geometry, infinite

why? Kant....

Einstein

3d(?) geometry is anything
changes in space
changes in time
responds to matter
only relationships

If no change is there time?

YES 24

Newton

Time absol d mathematical
hit

NO 22

Descartes, Huygens

Leibniz

Time is change in
relationships

Einstein

If no change is there time?

YES 24

Newton

Time absolute & mathematical

hit

$$v = \frac{\Delta \text{position}}{\Delta \text{time}}$$

NO 22

~~Descartes~~, Huygens

Leibniz

Time is change in relationships

Einstein

If no change is there time?

YES 24

Newton

Time absolute & mathematical

hit

$$v = \frac{\Delta \text{position}}{\Delta \text{time}}$$

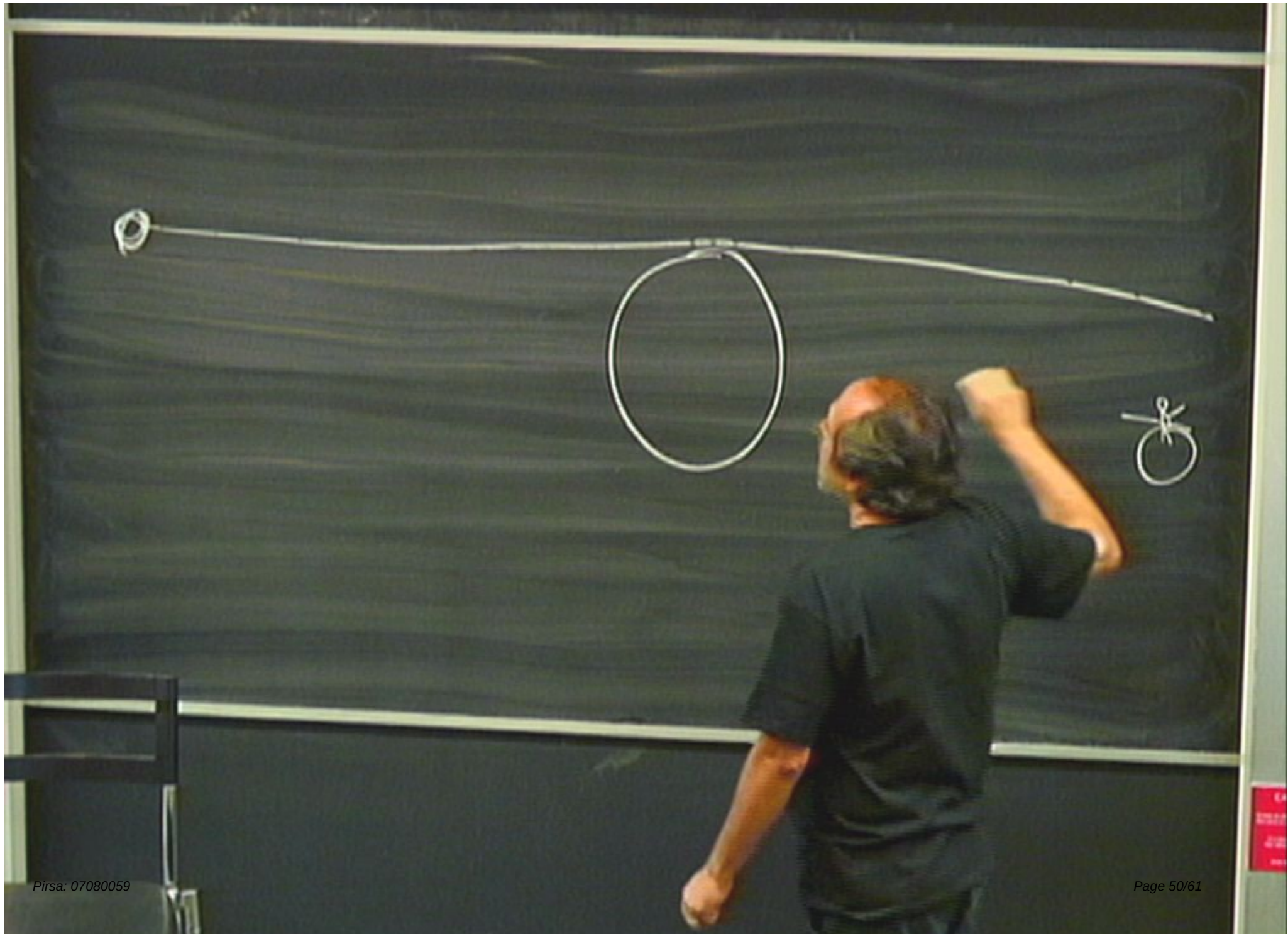
NO 22

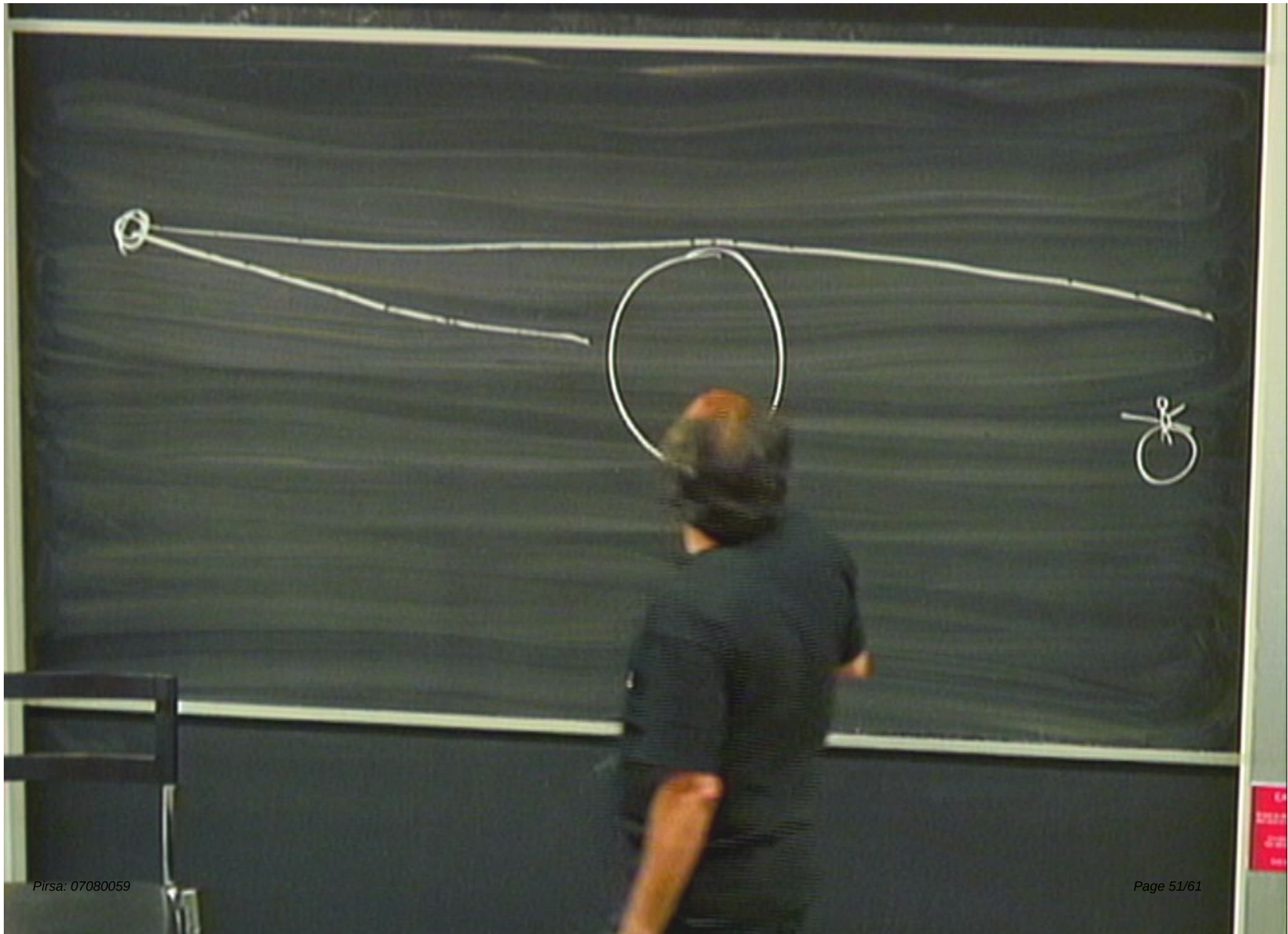
Descartes, Huygens

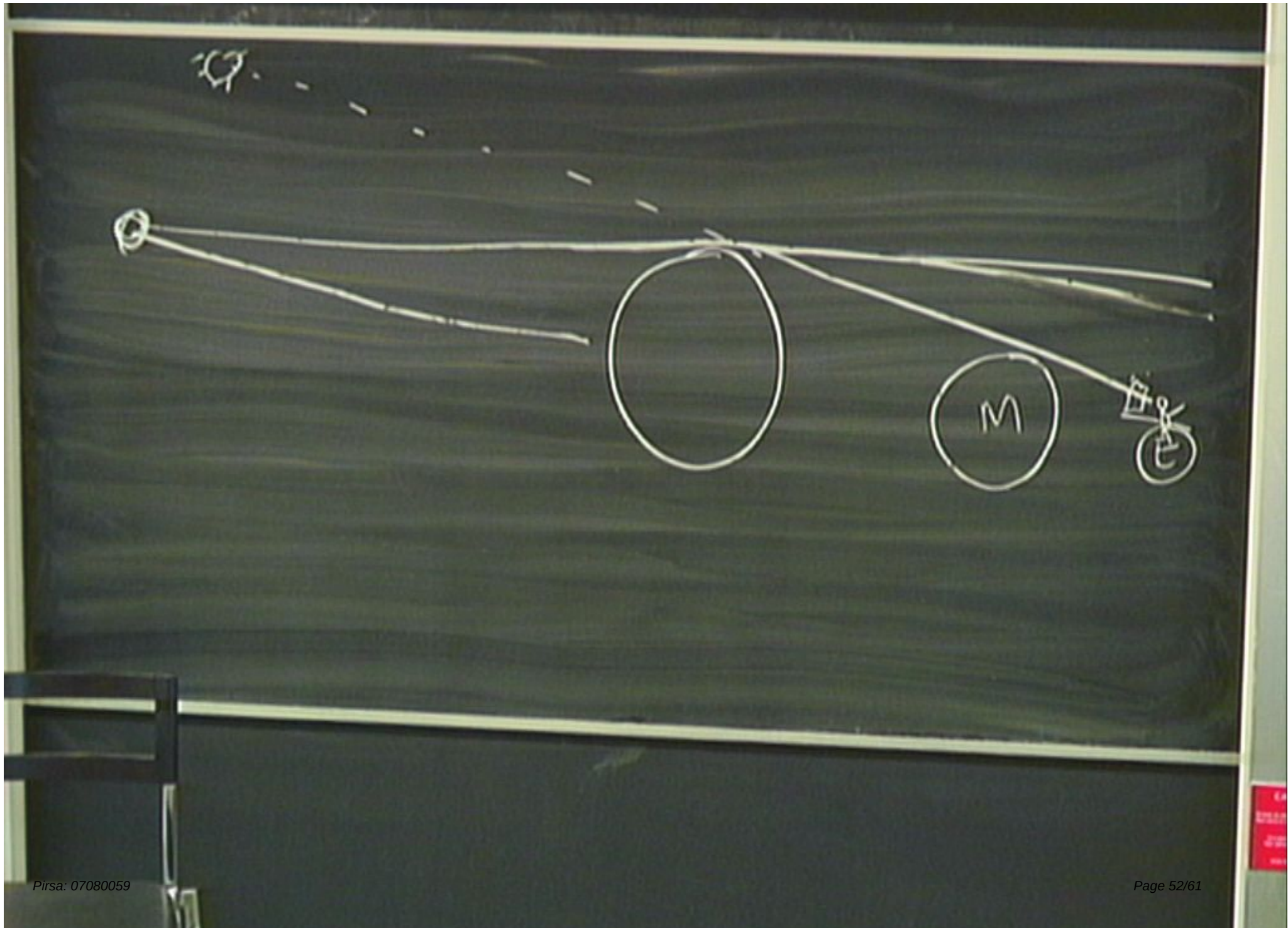
Leibniz

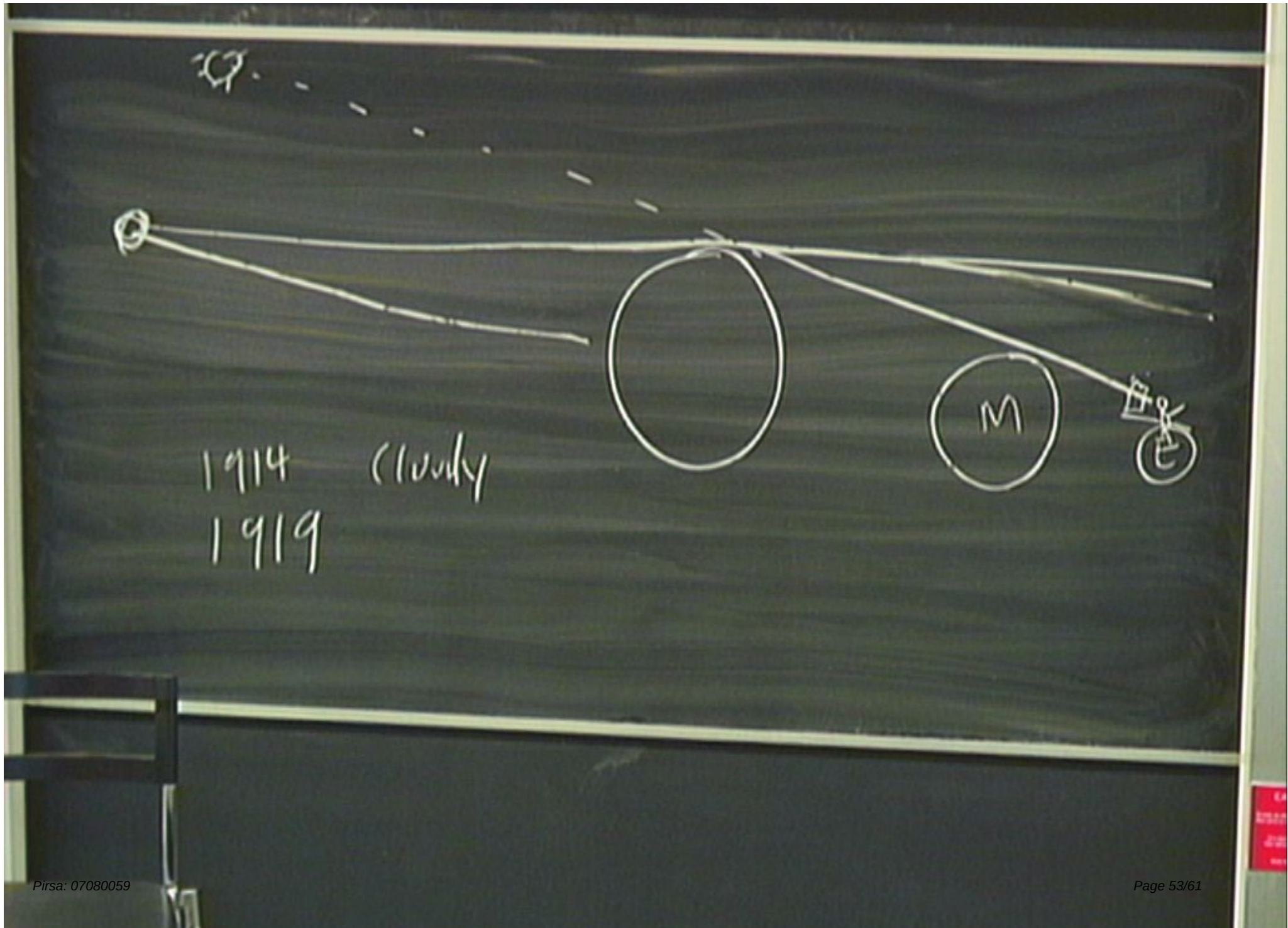
Time is change in relationships

Einstein

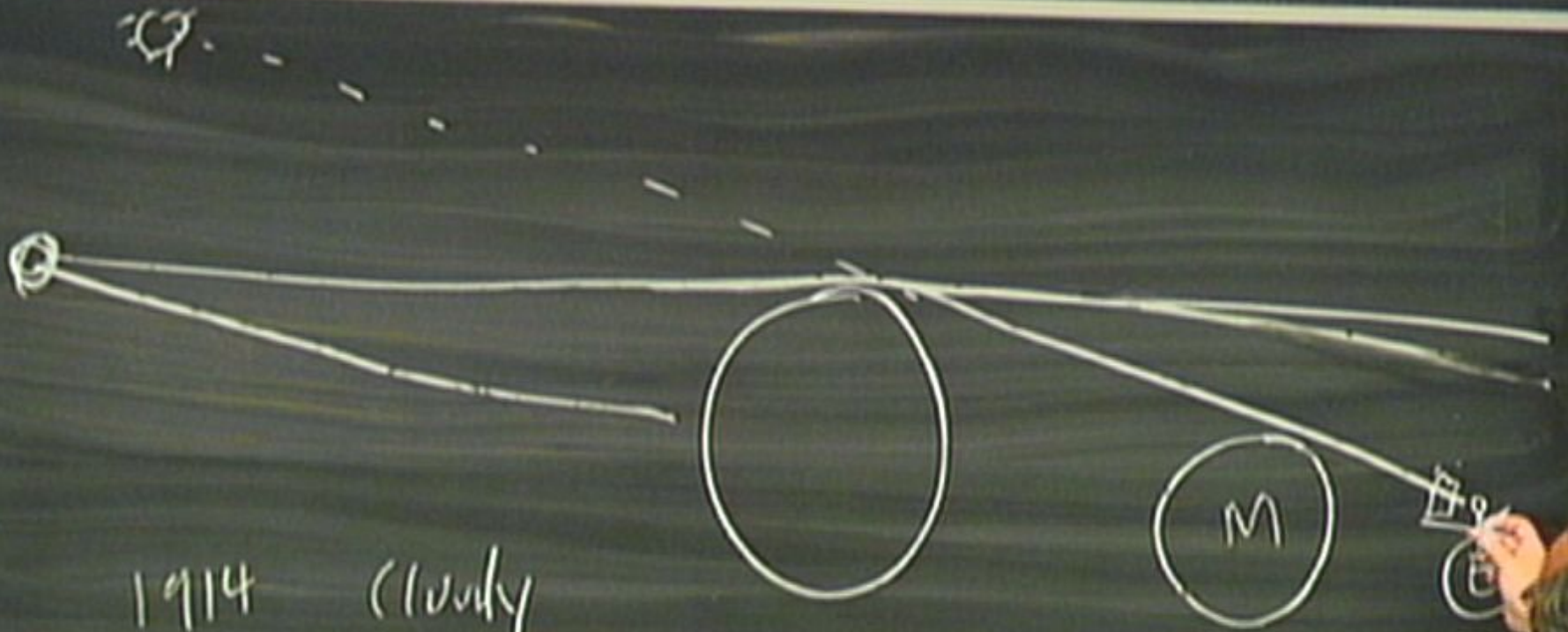




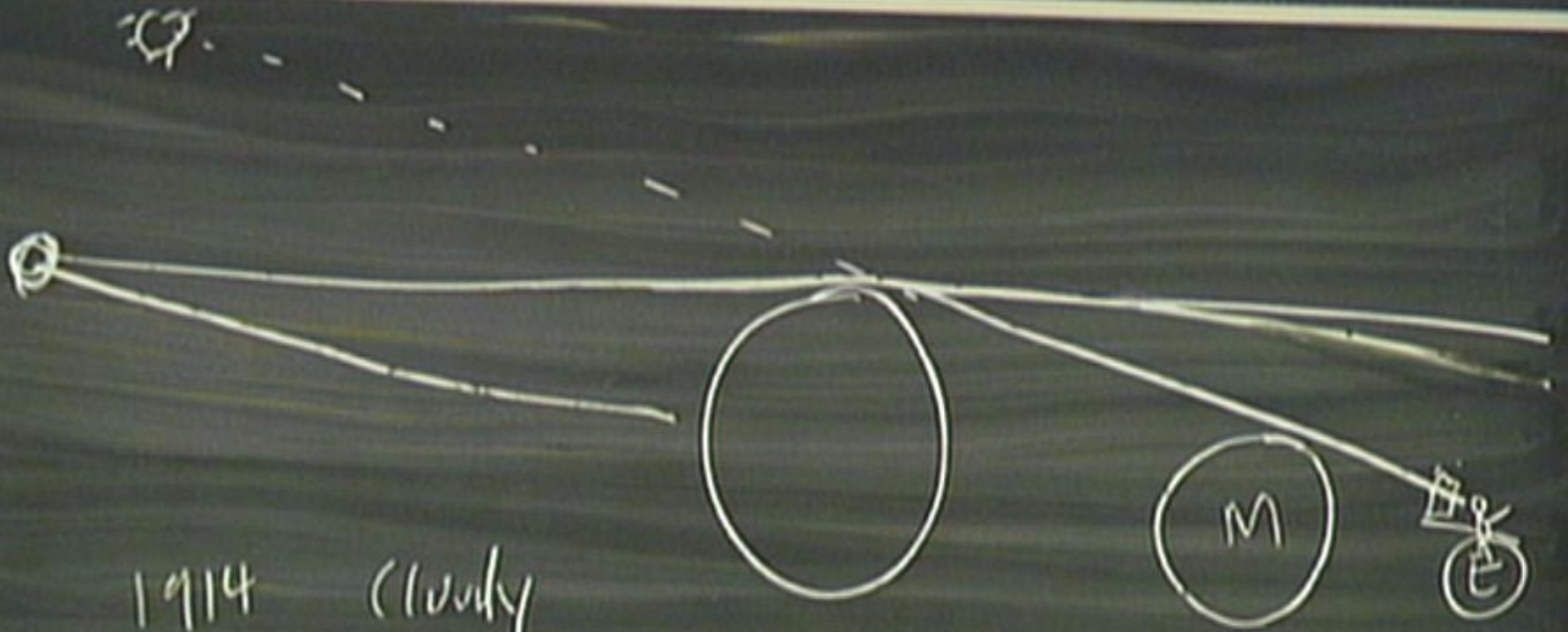




1914 cloudy
1919



1914 cloudy
1919 Eddington



1914 cloudy
1919 Eddington

If no change is there time?

YES 24

Newton

Time absolute & mathematical

hit

$$v = \frac{\Delta \text{position}}{\Delta \text{time}}$$

NO 22

Descartes, Huygens

Leibniz Mach

Time is change in relationships

Einstein ✓

If no change is there time?

YES 24

Newton

Time absolute & mathematical

hit

$$v = \frac{\Delta p - qh}{\Delta \text{time}}$$

NO 22

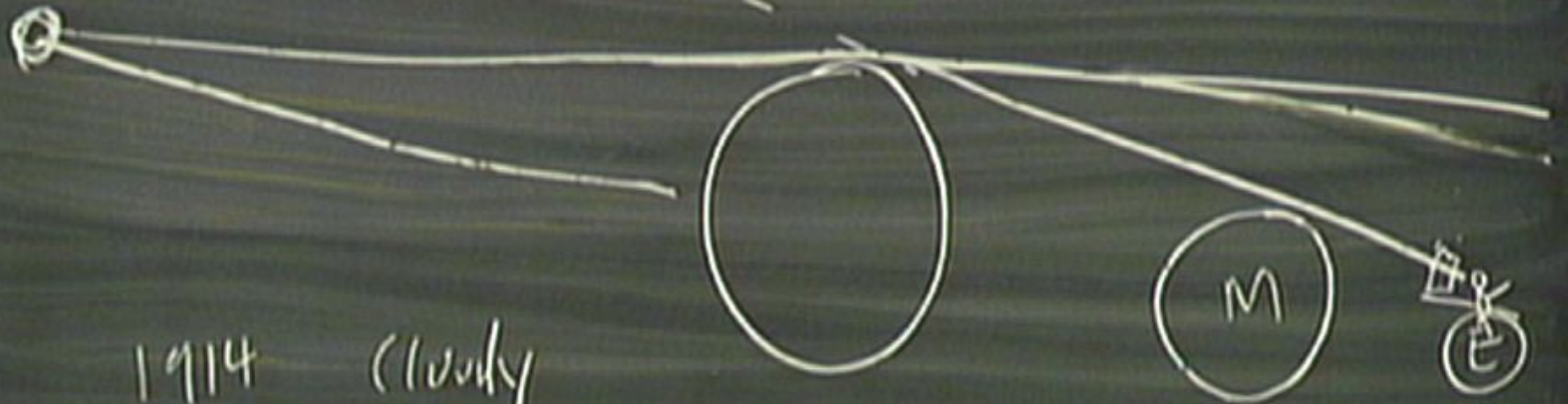
Descartes, Huygens

Leibniz Mach

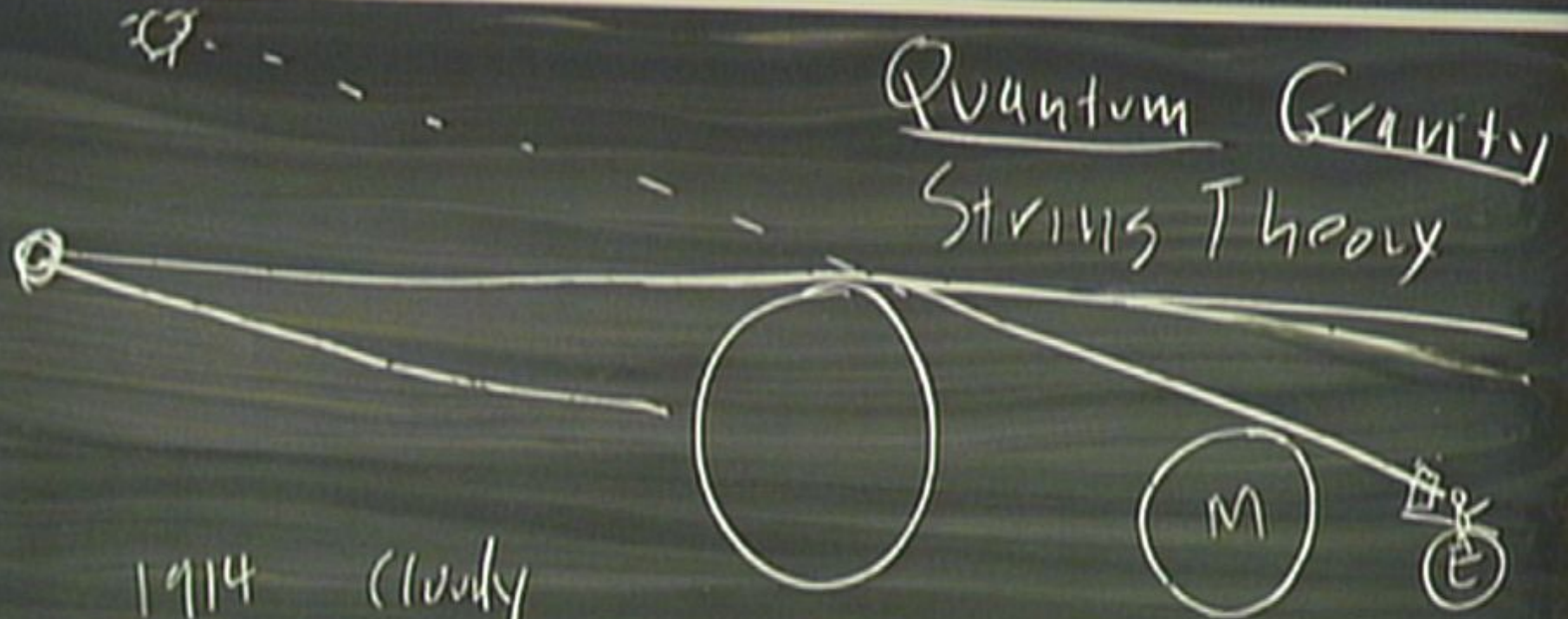
Time is change in relationships

Einstein ✓

Quantum Gravity



1914 (Lorentz)
1919 Eddington



1914 (lucky)
1919 Eddington

