

Crunch Time

100,000,000,000,000,000,
000,000,000 kilometers
(1×10^{23} km)

13,700,000,000,000
years old
(13.7×10^9 yr.)

10,000,000,000,000,
000,000,000,000,000,
000,000,000,000,000,
000,000,000

1×10^{52} kilograms

100,000,000,000,000,000,
000,000

1×10^{20} times smoother
than giant black hole

MATLAB R2010a Adobe Reader 9 CYGWIN home Printers - Shortcut Thick2 - Shortcut

Skype Setting up GridPP2 Recycle Bin - Shortcut Various Shortcuts UCD2020 - Shortcut

Zune TRANSFER FOLDER Dear Virginia Remote Desktop ... 1111.4948v2

DWAS Invited Scie... AAAC Feb 2012 - S... Documents - Shortcut runemac - Shortcut

Scratch BlackBerry Desktop ... Instructor's Form W-12 TeXworks editor NDWG Feb 2012 - Sh...

Albrecht2...

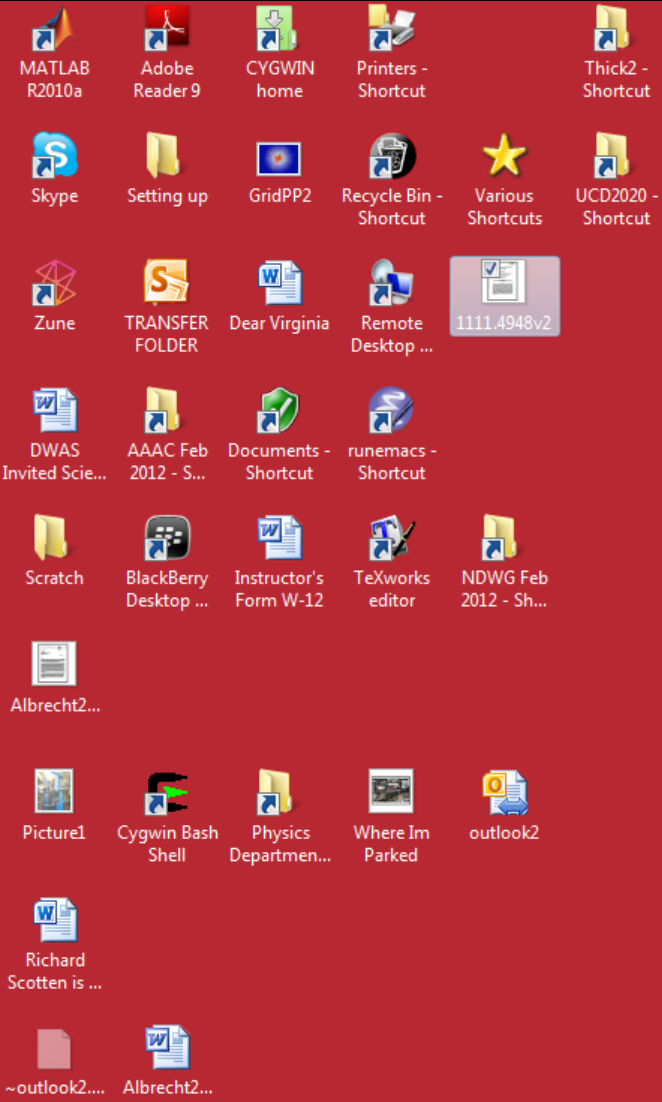
Picture1 Cygwin Bash Shell Physics Departmenten... Where Im Parked outlook2

Richard Scotten is ...

~outlook2.... Albrecht2...

PennState 2012 - S...

Windows Start Taskbar: TEDx Davis 2012 - M... TEDxUCDavis 2012 Albrecht_TEDxUCDa... 68% < > 12:31 PM



File Home Insert Design Transitions Animations Slide Show Review View MathType MathType

Paste Cut Copy Format Painter New Slide Section Slides

Font: 66, A⁺, A⁻, B, I, U, S, abe, AV, Aa, A

Paragraph: Text Direction, Align Text, Convert to SmartArt

Drawing: Arrange, Quick Styles, Shape Fill, Shape Outline, Shape Effects

Editing: Find, Replace, Select

Slides Outline

11  Here's one I made earlier!

12  Let's put these photos in order

13  Let's put these photos in order

14  Which came first, photo A or B?

15  Which came first, photo A or B?



Better to be small than pixelated

Slide 11 of 41 "Metro" 70% 15% 4:19 PM

Launchbar - Micros... TEDxUCDavis 2012 Albrecht_TEDxUCDa...

File Home Insert Design Transitions Animations Slide Show Review View MathType MathType

Paste Copy Format Painter New Slide Section

Clipboard Slides

Font Paragraph Drawing

Text Direction Align Text Convert to SmartArt

Shape Fill Shape Outline Shape Effects

Find Replace Select Editing

Slides Outline

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Slide 11 of 41 "Metro" Slide Show 70%

Launchbar - Micros... TEDxUCDavis 2012 Albrecht_TEDxUCDa...

19% 4:23 PM



Here's one I made earlier!







Let's put these photos in order

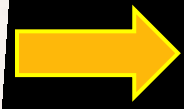


A



B

Which came first, photo A or B?



Which came first, photo A or B?



C



D

Which came first, photo C or D?



C



D

Which came first, photo C or D?



E



F

Which came first, photo E or F?

?



E

F

Which came first, photo E or F?



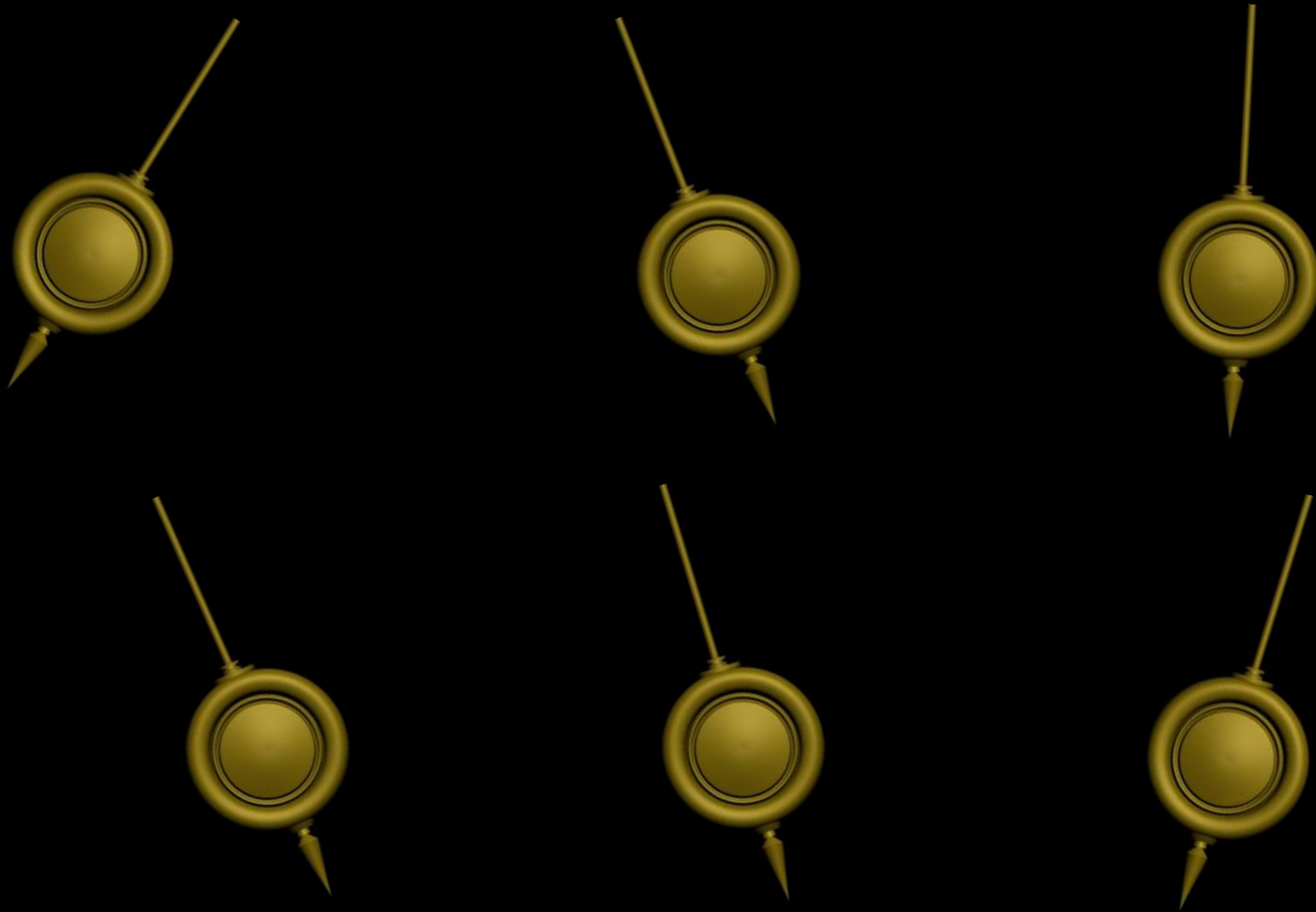
The photos are easy to order...



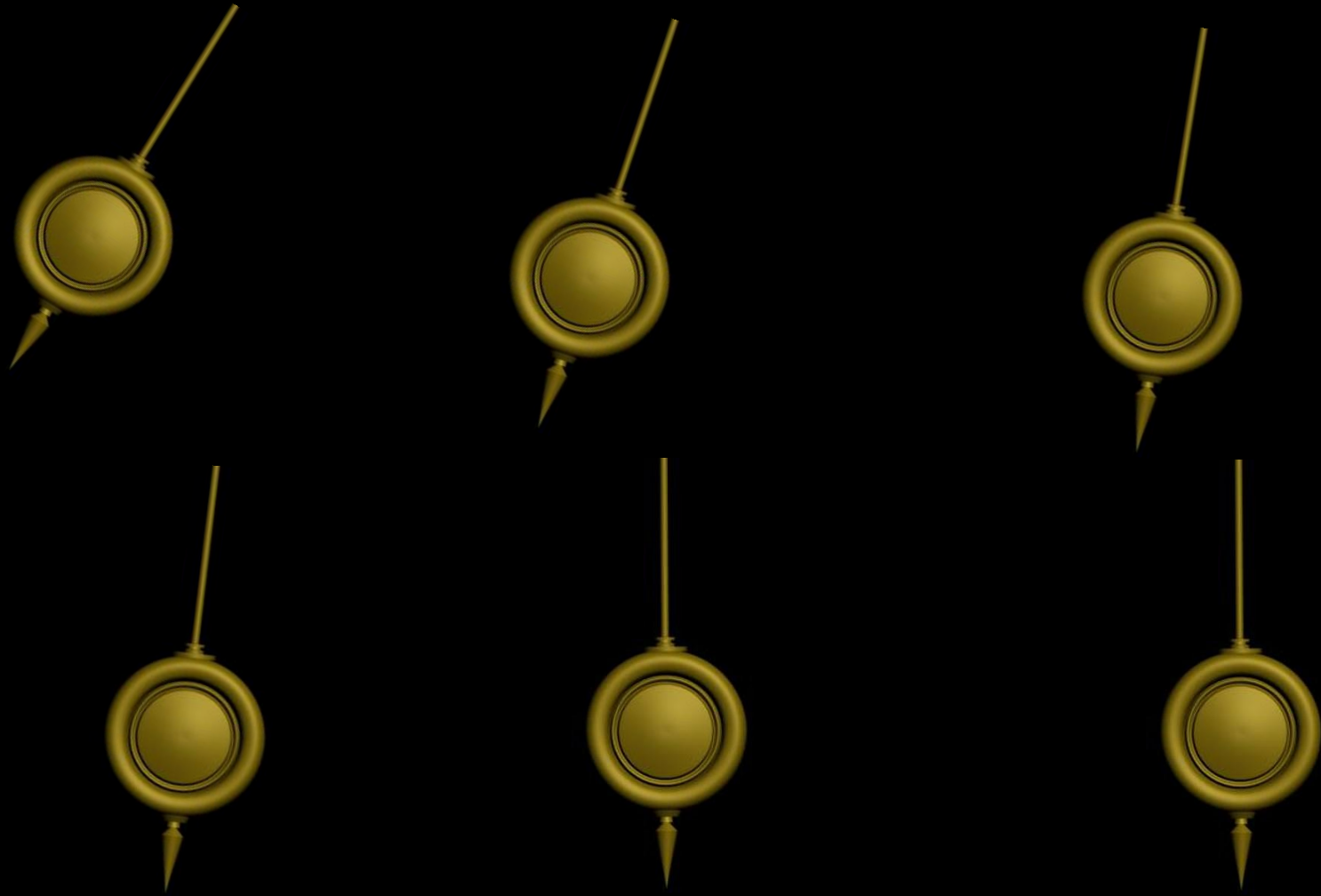
... except when there is no destruction!



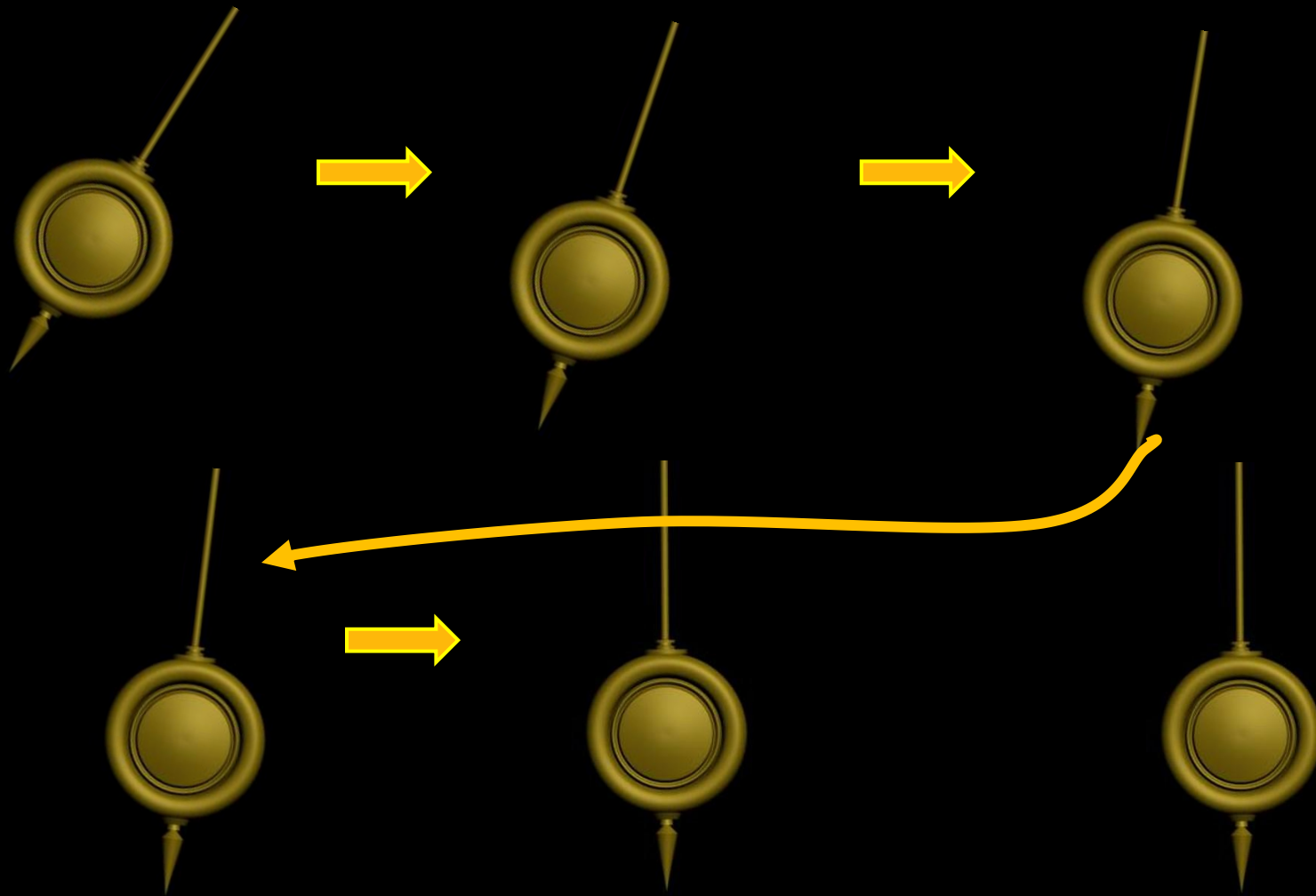
Destruction is needed to track the flow of time



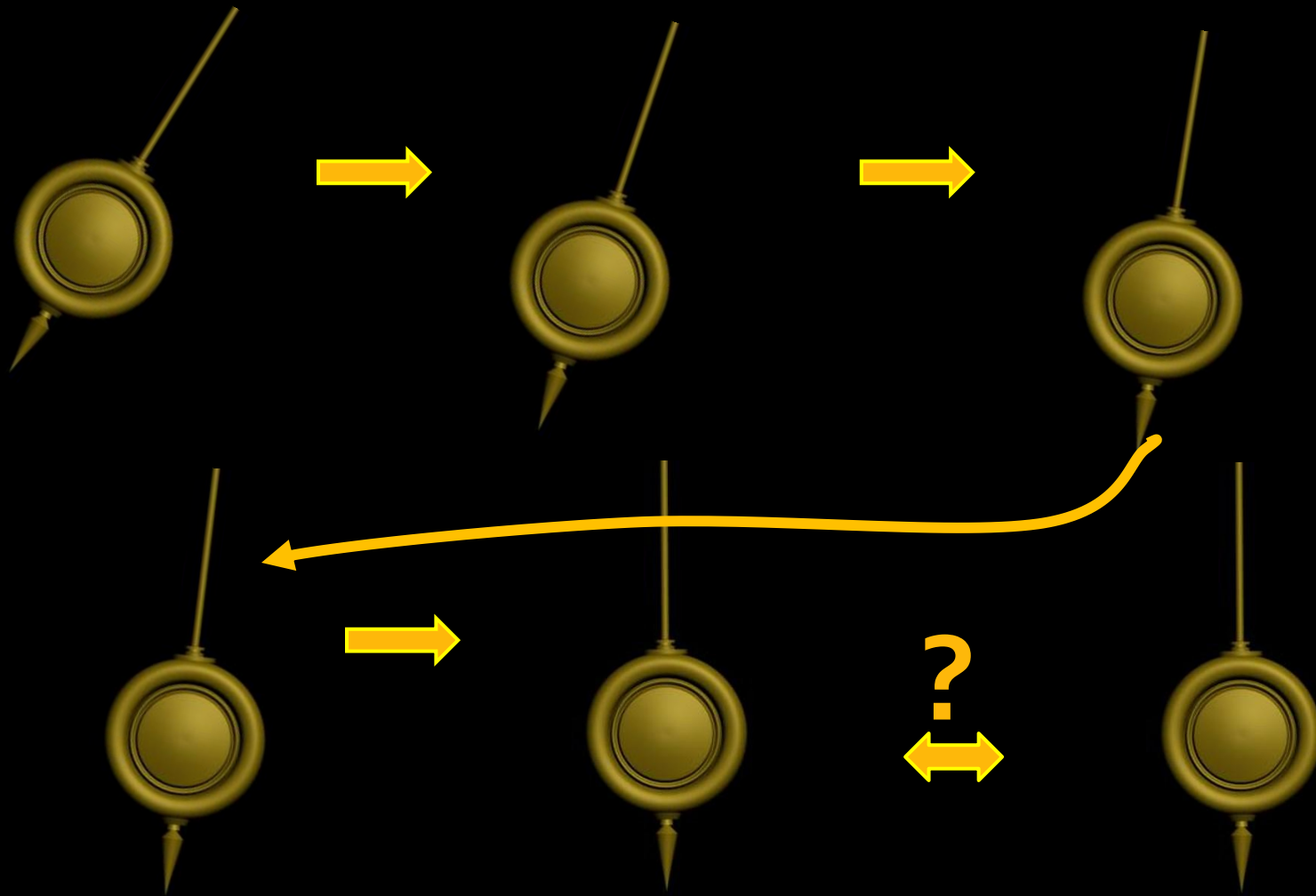
Motion is not enough: These snapshots of a pendulum (with no destruction) cannot be time-ordered.



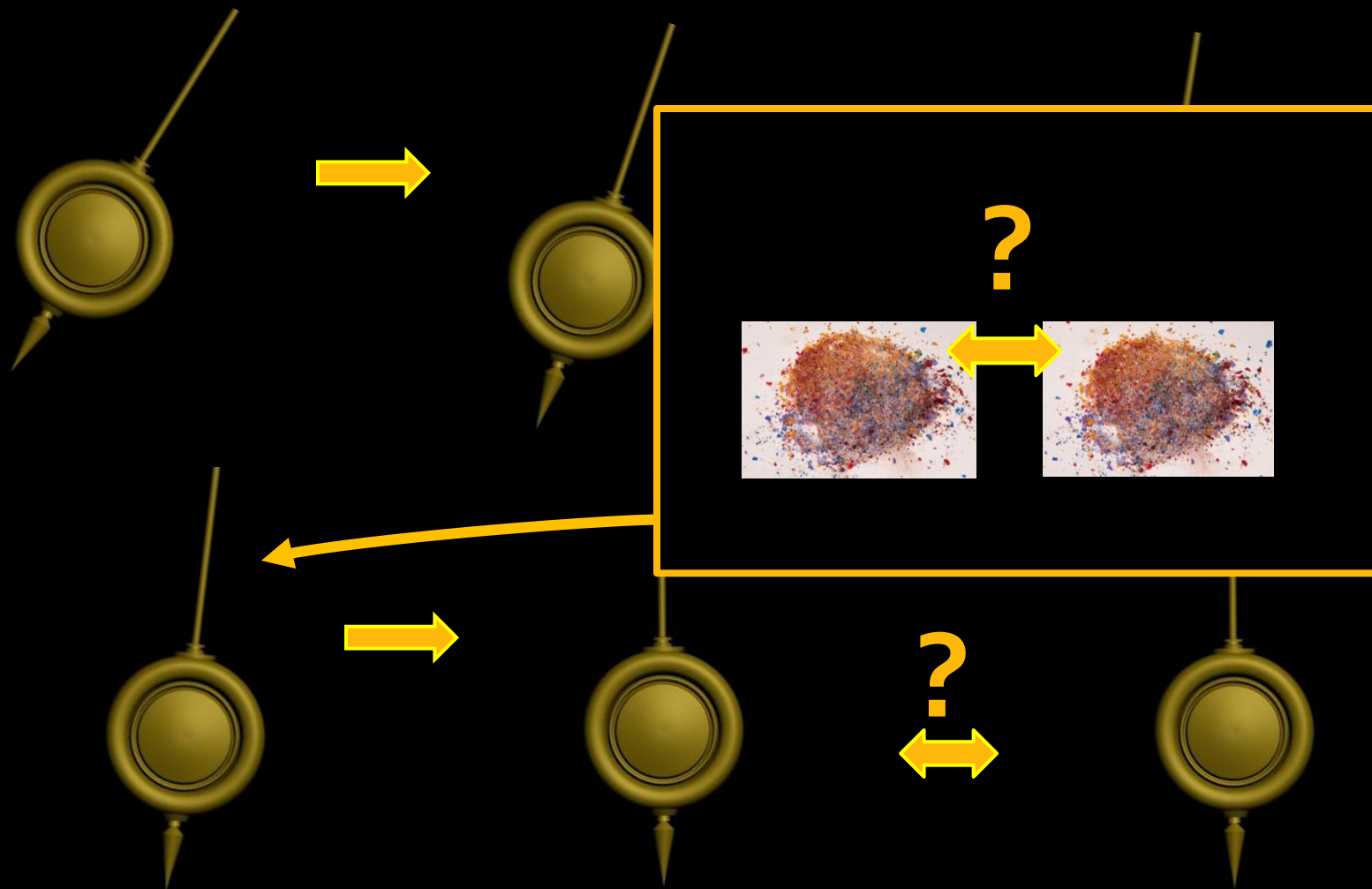
But friction (destruction of motion) will eventually affect the pendulum. When it does, you can time-order the snapshots



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Destruction is needed to track the flow of time!

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--- AKA ----

“Thermodynamic arrow of time”

Destruction is needed to track the flow of time!

--- AKA ----

“Thermodynamic arrow of time”

“Second law of thermodynamics”

Destruction is needed to track the flow of time!

--- AKA ----

“Thermodynamic arrow of time”

“Second law of thermodynamics”

“Increase of Entropy”

Destruction is needed to track the flow of time!

--- AKA ----

“Thermodynamic arrow of time”

“Second law of thermodynamics”

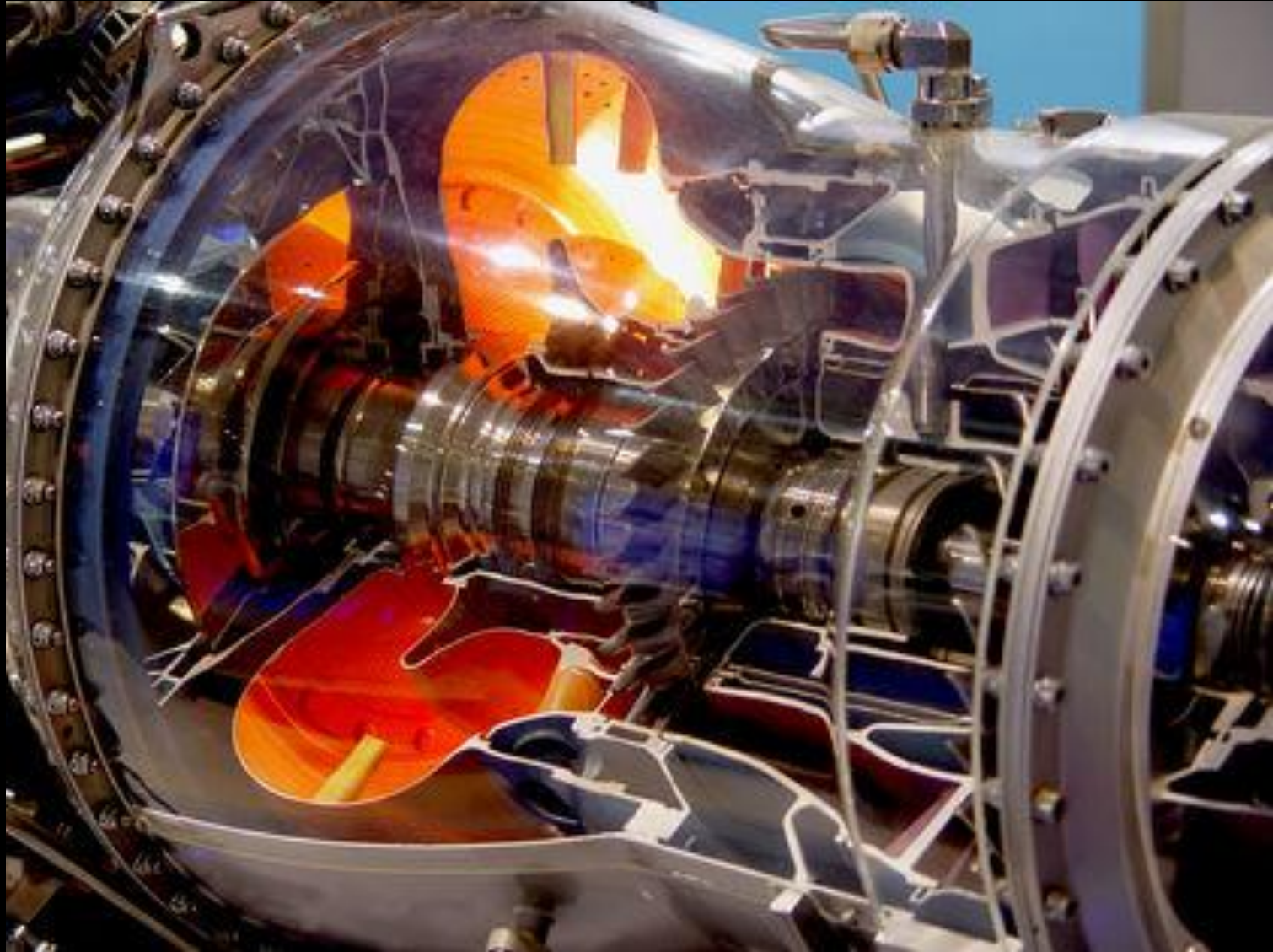
“Increase of Entropy”

“The arrow of time”

The arrow of time is all around us and critical for everyday activities:

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Engines



The arrow of time is all around us and critical for everyday activities:



Metabolism

The arrow of time is all around us and critical for everyday activities:

Records

The arrow of time is all around us and critical for everyday activities:

Records



The arrow of time is all around us and critical for everyday activities:

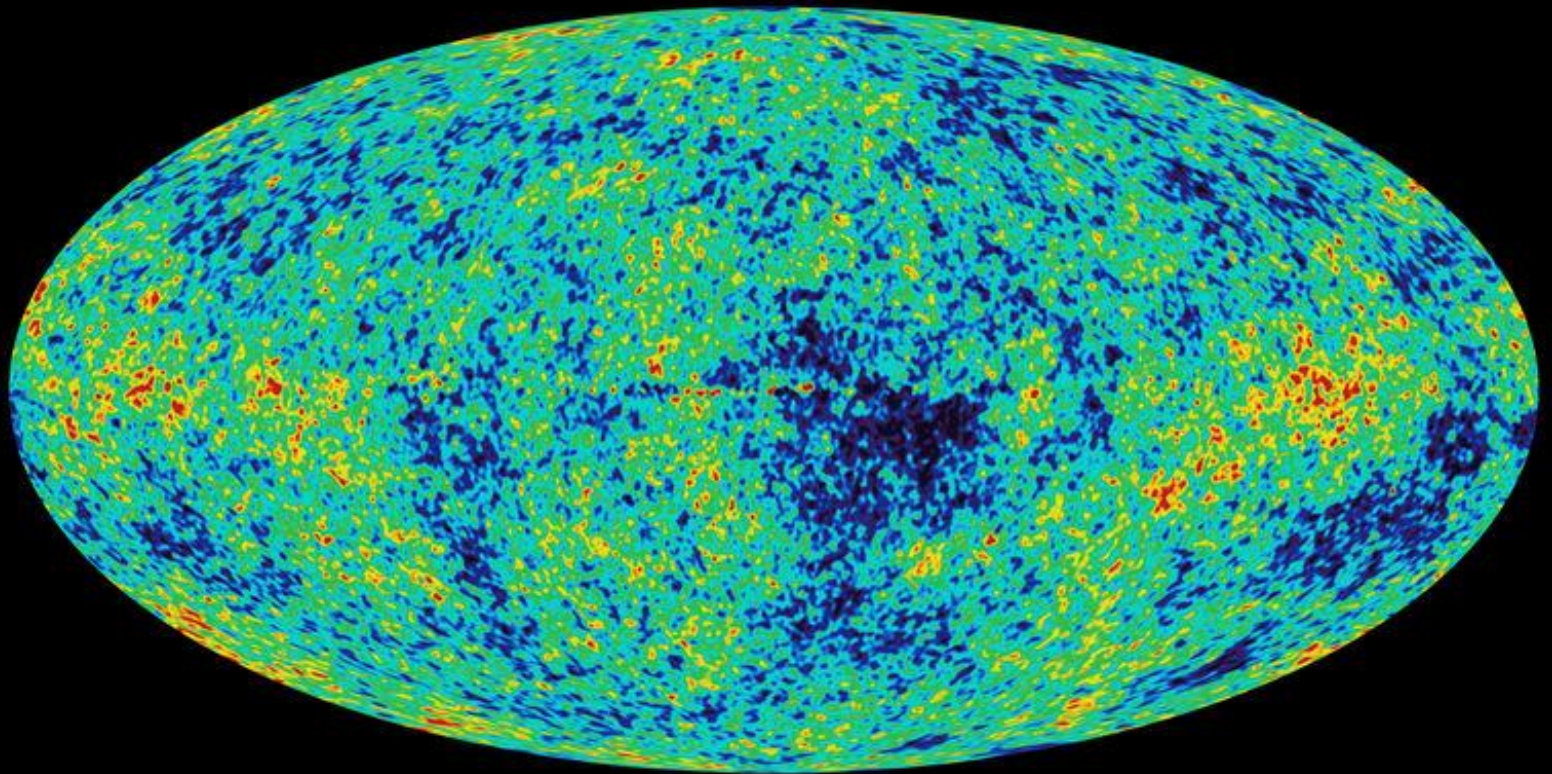
*Memory &
Psychological Time*



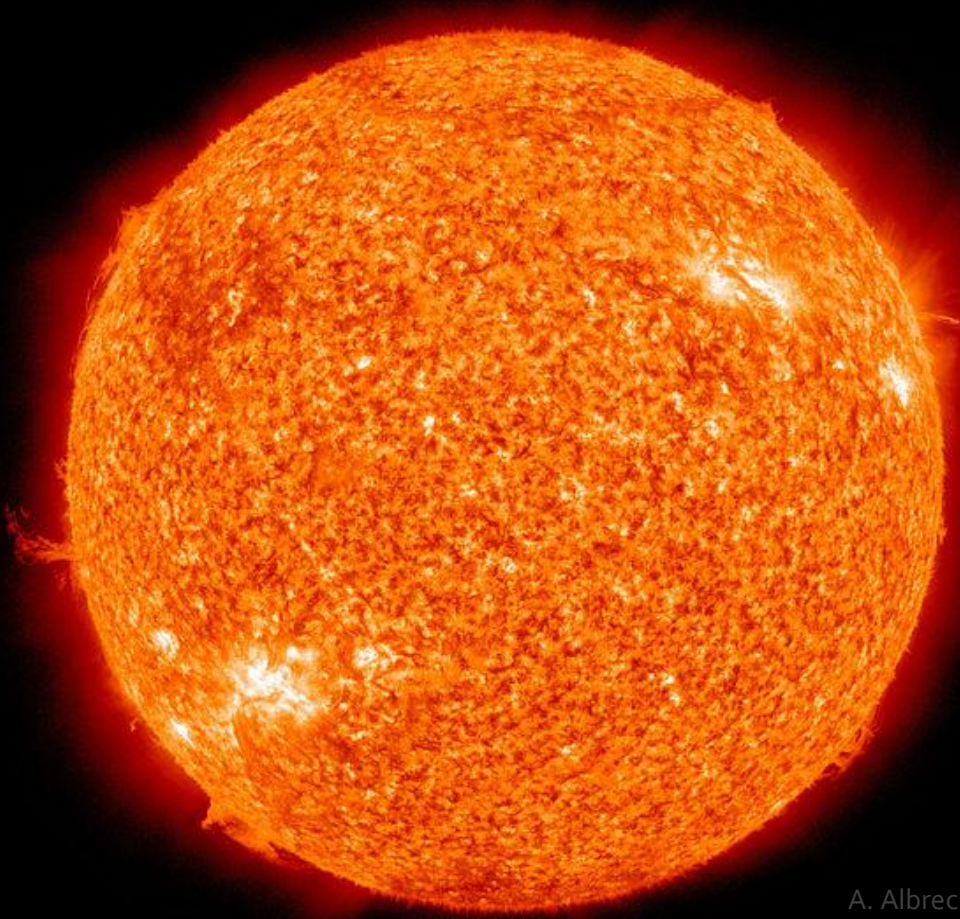
Q: What is destroyed in the Universe to allow time to flow?

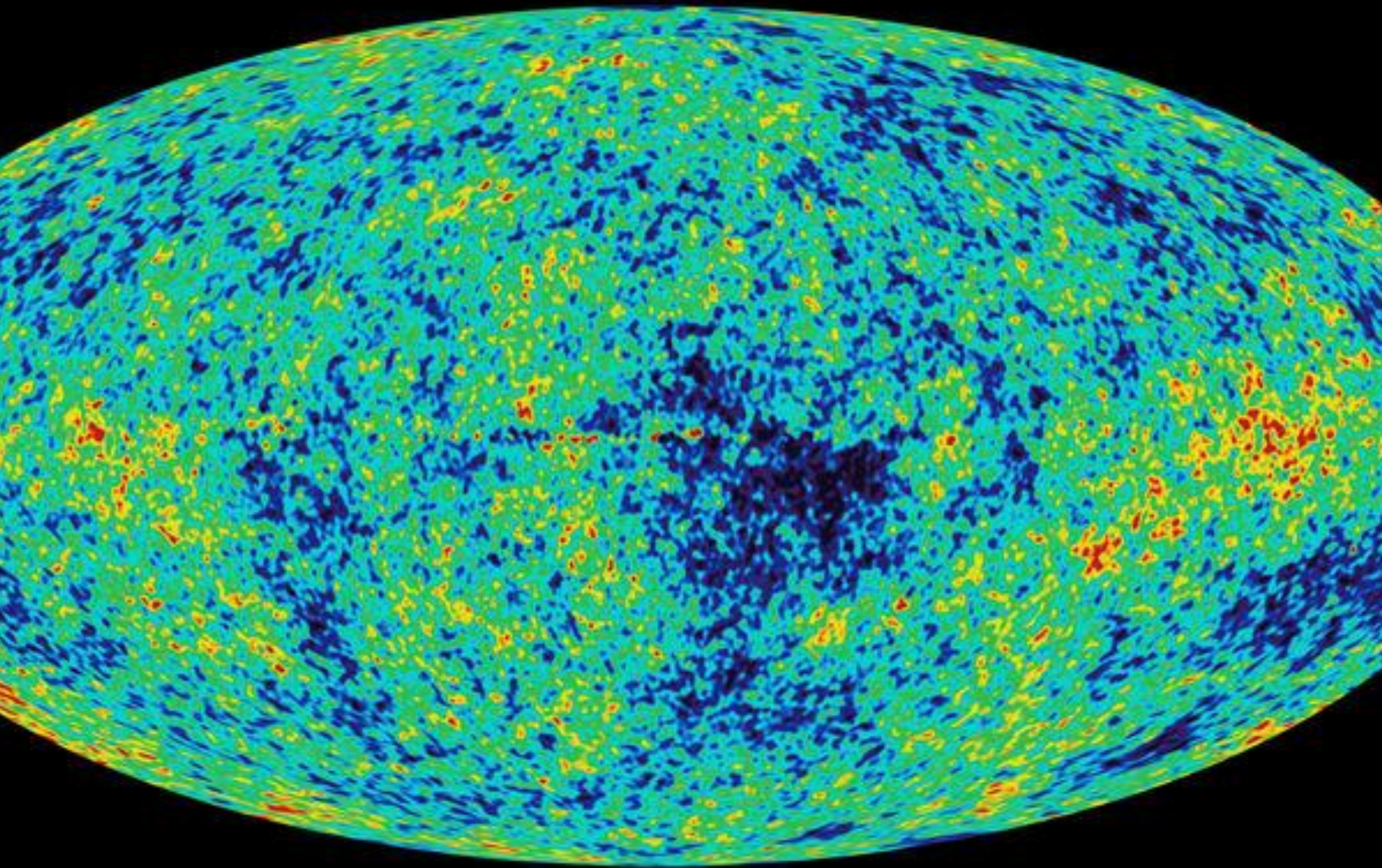
Q: What is destroyed in the Universe to allow time to flow?

A: The smoothness:











End

Thank You!

D. Zumpano, C. Warshaw, M. Lyans, G. Albrecht,
J. Vasquez, L. The Hinh, A. Jervi, P. Chu, R. Haga
J. Grove, B. Jacobs, A.C. Albrecht

Also
R. Penrose



Alfonso's Breakaway Glass

IMAGES

Pendulum: http://files.turbosquid.com/Preview/Content_2009_07_13_21_52_27/Pendulum_03.jpgg956900b3-5b93-433b-aafe-f83b840a3823Larger.jpg

Engine: <http://www.scienceclarified.com/He-In/Internal-Combustion-Engine.html>

Digestion: <http://www.doctorsaputo.com/upload/cms/images/digestive-tract.jpg>

Computer Disk: <http://rismann.com/forensics.html>

Brain: <http://web.mit.edu/newsoffice/2011/illuminating-brain-0128.html>

Microwave Sky: <http://map.gsfc.nasa.gov/resources/cmbimages.html>

Black Hole: <http://www.jpl.nasa.gov/news/news.cfm?release=2010-088>

Sun: <http://en.wikipedia.org/wiki/Sun>

Earth: http://eoimages.gsfc.nasa.gov/images/imagerecords/57000/57723/globe_east_2048.jpg

A. Albrecht
TEDxUCDavis
March 19 2012