

CelebrityLife<sup>™</sup>  
Activities

## Can We Time Travel? Ten Answers?

**B E Y O N D**  
THE  
**P O D I U M**

GUEST SPEAKER SERIES



Peter Watson



xkcd.com.

10 answers

~~10~~ 11 answers

~~10~~ ~~11~~ 12 answers

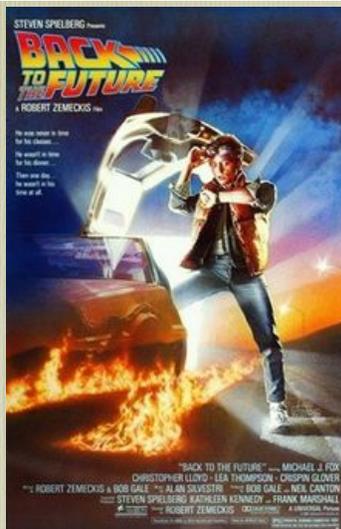
~~10~~ ~~11~~ 12<sup>1/2</sup> answers

## Movies are obsessed by Time

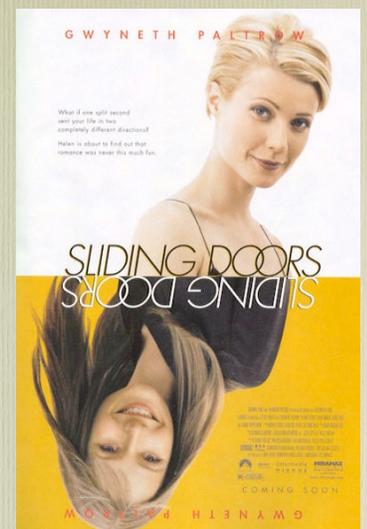
- Vertigo (Alfred Hitchcock, 1958)
- Citizen Kane (Orson Welles 1941)
- Cleo from 5 to 7 (Agnes Varda, 1960)
- La Jetée (Chris Marker, 1962)
- Time Bandits (Terry Gilliam, 1981)
- 12 Monkeys (Terry Gilliam, 1995)
- Timecode (Mike Figgis, 2000)
- Russian Ark (Alexander Sokurov, 2002)
- Run, Lola, Run

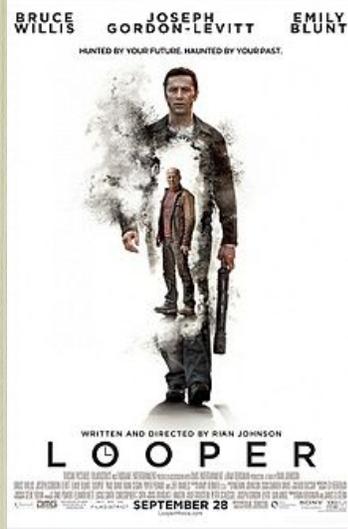
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30th  
Anniversary!



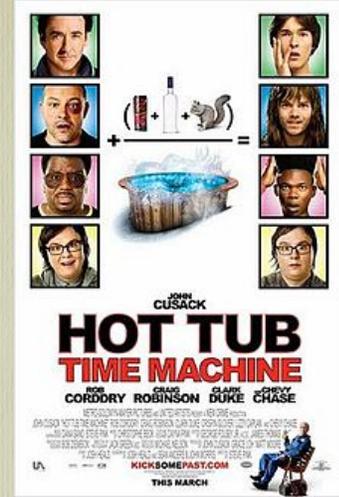
PW





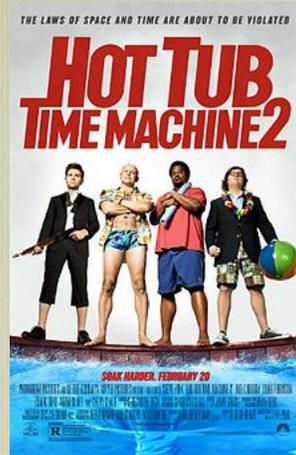
ext

The Worst  
Time Travel  
movie



Text

until.....



Text

and the  
best one



ext

We live in Time,  
like a fish lives in water

- Could a fish think about snow, or understand rainbows or design a steam engine?
- Can we think “outside of time”?
- How do we think about time?

PW

Why is Time difficult?

- Language represents a “[window into the mind](#)” (Pinker)
- We think in “mentalese” and translate it into a language

12

- I picked the car up yesterday, so that, if you go to the supermarket now, I will have time to drive to Montreal.

- I picked the car up yesterday, so that, if you go to the supermarket now, I will have time to drive to Montreal.

- J'ai pris la voiture hier, de sorte que, si vous aller au supermarché maintenant, j'ai le temps pour conduire à Montréal.

- I picked the car up yesterday, so that, if you go to the supermarket now, I will have time to drive to Montreal.

- J'ai pris la voiture hier, de sorte que, si vous aller au supermarché maintenant, j'ai le temps pour conduire à Montréal.

- Ich habe das Auto gestern auf, damit, wenn Sie zum Supermarkt jetzt gehen können, ich Zeit habe, nach Montreal zu Fahren.

- I picked the car up yesterday, so that, if you go to the supermarket now, I will have time to drive to Montreal.

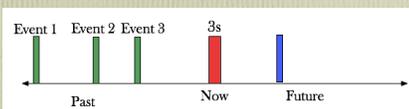
- J'ai pris la voiture hier, de sorte que, si vous aller au supermarché maintenant, j'ai le temps pour conduire à Montréal.

- Ich habe das Auto gestern auf, damit, wenn Sie zum Supermarkt jetzt gehen können, ich Zeit habe, nach Montreal zu Fahren.

- Ayer recogí el coche, así que, si puedes ir al supermercado ahora, tendré suficiente tiempo para conducir a Montreal

# The Biggest Problem: why is there a "Now"?

We tie down past and future with events.



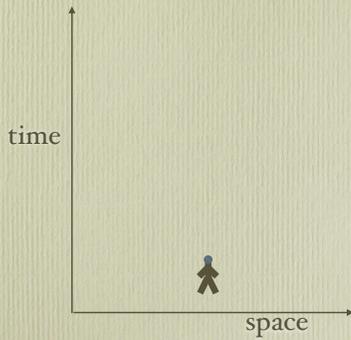
We'll call this the linear model

Note artists tend to be locked into the moment

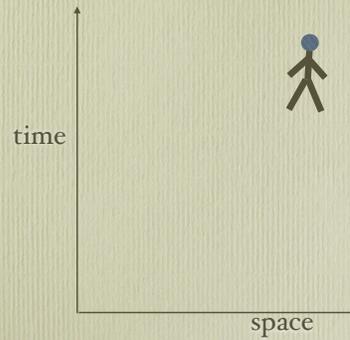


David: Napoleon Crossing the Alps

Note that **we** see a sequence of events

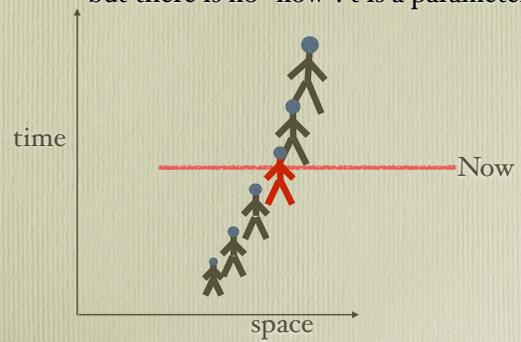


Note that **we** see a sequence of events



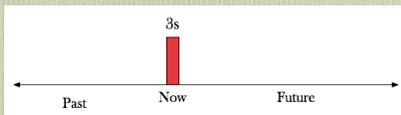
Physics is quite happy with a trajectory

- but there is no "now":  $t$  is a parameter!



i.e. **"now"** seems to be a construct of life

An (unspoken) model of time: Note 3 s "now" is confirmed by psychology



Is it possible "consciousness" solves the now problem?

- e.g. we have a biological "now" clock which synchronizes for all humans?
- switches off when we are unconscious....

## E.g. We can construct “impossible” sentences

- I might stop for a coffee on the way to Montreal
- I might stop for a coffee on my way to the garage yesterday

25

Text

## E.g. We can construct “impossible” sentences

- I accidentally ran over an old lady on the way to the garage
- I will accidentally run over an old lady on the way to Montreal

26

Text

## Free-will/Determinism

- English is biased in favour of free-will: e.g.
- “I decided to go to the movie tomorrow”
- “I decided not to go to the movie tomorrow”
- Both sound sensible, but
- “It is predetermined that I will go to the movie tomorrow” sounds stupid

27

## The past, present and future walked into a bar.

The situation was tense

### TIME TRAVEL INTO THE PAST

There is no debate, even among science fiction writers, that this is completely impossible. It not only involves violations of the laws of physics, particularly the Second Law of Thermodynamics, but literally and actually involves gross logical contradictions. The idea is that mad Dr. Soandso gets into his time machine .. and somehow goes back to ancient Rome, where he gives a translated handbook of physics and chemistry to a Roman scholar, and thus utterly changes the course of human history .... the atomic bomb, for instance, is then invented by Claudius Festus Arpinna in 350 AD.

Despite the fact that even the writers agree time trips into the past are an impossibility, they love to play with them, because of the plot complications that can be generated by the logical contradictions that arise. My favourite books of this type are Dinosaur Beach by Keith Laumer and The End of Eternity by Isaac Asimov. The time-travel short story to end all time-travel short stories is “[All You Zombies!](#)” By Robert A. Heinlein. Wells’ 19th Century Time Machine is the genre’s daddy.

If we could construct a time machine, can we evade the paradoxes?

## Is Time Travel Possible

PW

# Time travel is

1. **impossible**: if it were possible we'd have done it already
2. **impossible**: forbidden by increase of entropy
3. **impossible**: forbidden by relativity
4. **impossible**: forbidden by requirement that universe must have positive energy everywhere.
5. **impossible**: time must flow and we have no control over it
6. **impossible**: forbidden by logical paradoxes
7. **impossible**: forbidden by cosmic censorship

# Time travel is

8. **possible in theory**, but in practice impossible (e.g. costs too much energy)
9. **possible**: paradoxes avoided by many-worlds model
10. **possible**: past can be seen as movie, but not altered
11. **possible**: free-will is an illusion, so it is irrelevant!
12. **irrelevant**: time is an illusion

"space travel is utterly impossible"

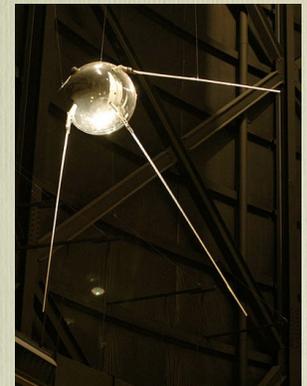
Richard Woolley  
Astronomer Royal

**impossible: if it were possible we'd have done it already**

PW

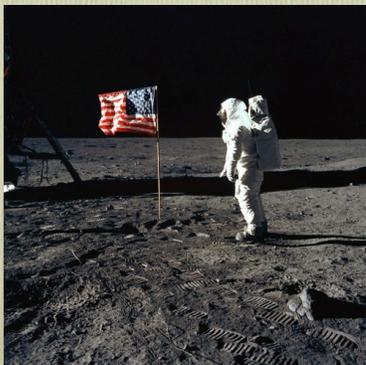
First artificial satellite: Sputnik 1  
("Спутник-1")

4 October 1957.



PW

- Neil Armstrong/Buzz Aldrin 1969



Apollo 11

IF we could time-travel, we run into problems

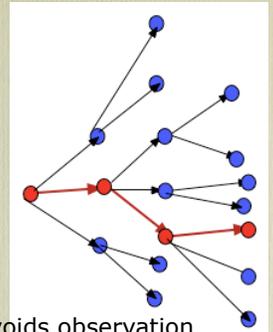
- **The "Grandfather Paradox"**; if I have a time-travel machine, I can time-travel to the past and kill my grandfather before he meets my grandmother, so I am not born so I can't have the machine so I can't kill my grandfather.
- **The "Where's My Grandfather?"** paradox: if time travel is possible, then I can go back in time and run by time tourists.

**impossible: forbidden by logical paradoxes**

**avoided by many worlds theory?**

## Evaded by many worlds theory?

Every time a choice is made, the universe subdivides into separate universes that correspond to every possible outcome



Avoids observation problems, but not testable (?) and not very economical!

In all fictional works, each time a man is confronted with several alternatives, he chooses one and eliminates the others; in the fiction of Ts'ui Pên, he chooses-simultaneously-- all of them. He creates in the diverse way, diverse futures..which themselves also proliferate and fork.

The Garden of Forking Paths, Borges.

What might have been is an abstraction  
Remaining a perpetual possibility  
Only in a world of speculation.  
What might have been and what has been  
Point to one end, which is always present.  
Footfalls echo in the memory  
Down the passage which we did not take  
Towards the door we never opened  
Into the rose-garden.

T. S. Eliot (Burnt Norton)

# The Second Biggest

Problem: why are the past and future different?



## Increase of Entropy?

2nd Law of Thermodynamics

Formally: "Entropy tends to increase in a closed system"

Informally: "systems become more disordered"

**impossible: forbidden by increase of entropy**

- Low entropy Macintosh!

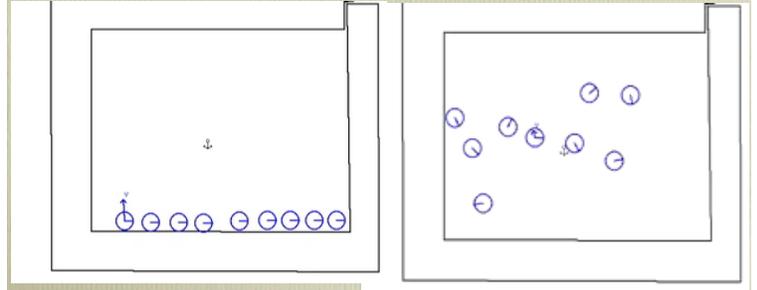


- High Entropy Macintosh!
- It is very probable that dropping a Mac will rearrange it in a more randomly ordered form!
- Dropping it again (once or one million times) is not likely to get it working again!



## Entropy/ Second Law

- Which movie runs forward?



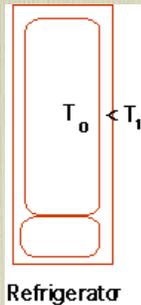
## 2nd Law of Thermodynamics

Entropy tends to increase in a closed system, or systems become more random

Note we can decrease entropy locally as long as it increases overall

Initially room and fridge at same temp., afterwards  $T_0 < T_1$

So we would need a "time-refrigerator" to travel into the past



Refrigerator

PW

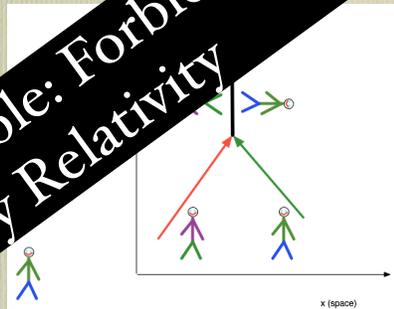
## Increase of Entropy?

- Unsatisfactory for forbidding time travel since it doesn't forbid travel into the future
- (let's skip tomorrow and move on to Sunday!)

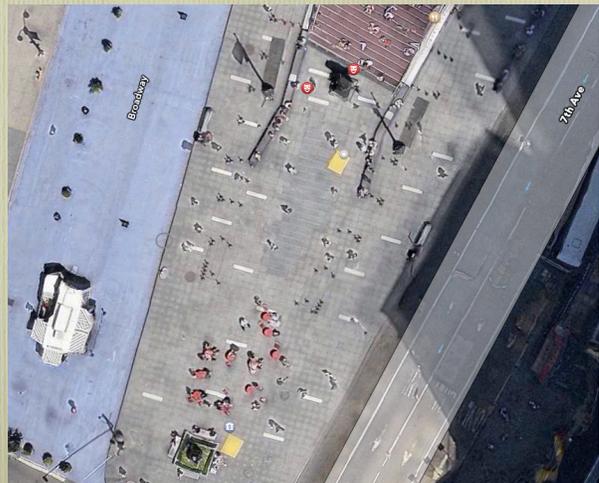
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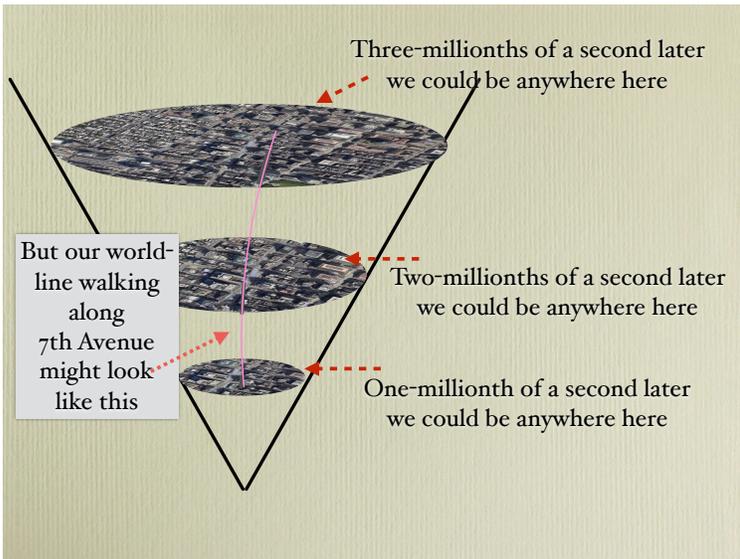
- Einstein's concept of time can be expressed graphically by "worldlines" in a spacetime diagram.

- e.g 2 men walk into each and fall over.



e.g. Lets start at Times Square

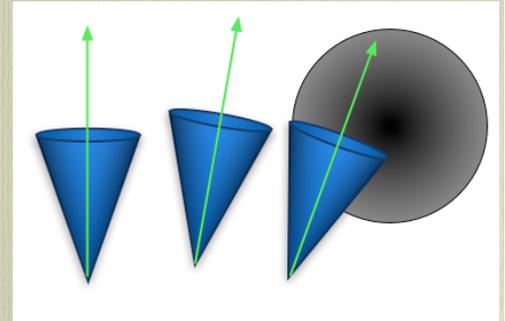




## What happens to time near a black hole

- Gravity modifies the light cone
- close to a black hole, all your futures include falling into it!

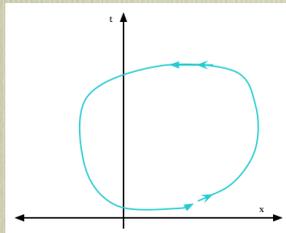
A consequence: time stops at the edge of a black-hole for an external observer.



## So can we build a time-machine?

Now we know the question to ask;

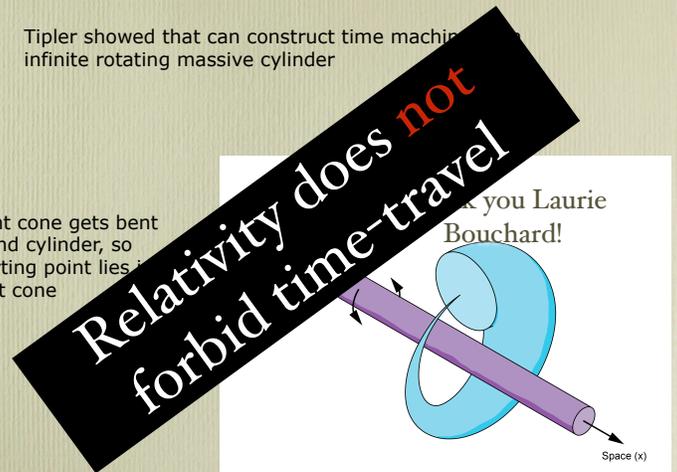
- Can we arrange for world-lines to be closed?



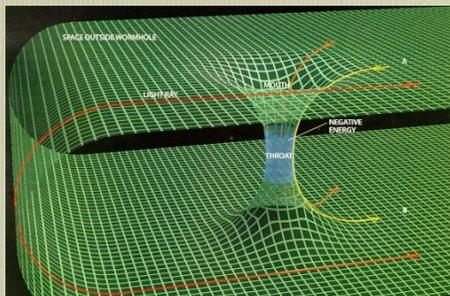
PW

Tipler showed that can construct time machine infinite rotating massive cylinder

Light cone gets bent round cylinder, so starting point lies in light cone



However once we allow space to be bent, we can construct wormholes!



- Allow instantaneous communication across space
- (And innumerable stupid TV shows)
- But they requires negative energy: now known (see Ford and Roman Sci Am. article) that negative energy allows time-travel, so probably can't construct in practice.

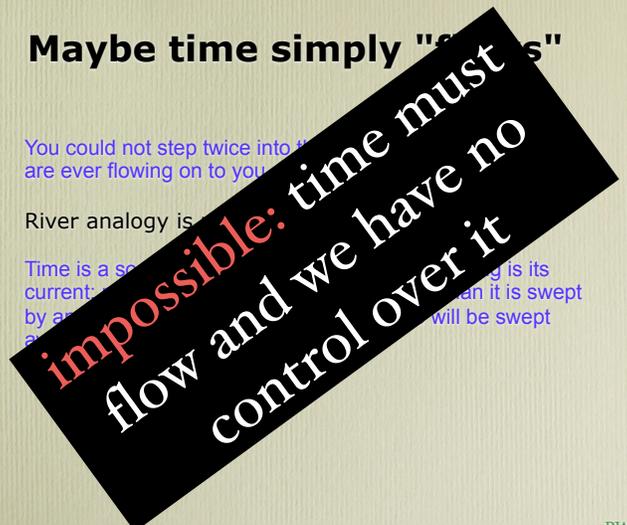
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## Maybe time simply "flows"

You could not step twice into the same river because you are ever flowing on to you

River analogy is

Time is a sea of flowing water. If you are standing in it, you are being swept along by its current. You can't stand still because it is swept away by the current. If you are standing in it, you will be swept away by the current.



PW

# Oh god, our help in Ages Past

- Time, like an ever rolling stream,  
Bears all its sons away;  
They fly, forgotten, as a dream  
Dies at the opening day.
- Isaac Watts

PW

# Does time "flow"

- e.g. Music  
"From me flows that which you call time"  
(Takemitsu)
- "Of time and rivers flowing  
The seasons make a song."  
Peter Seeger
- River of Time (Jorma Kaukonen)



PW

# Does time "flow"

But in reality the analogy of time flowing is not very useful:

flow of something is "rate of change"

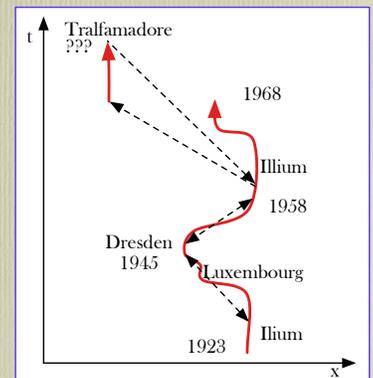
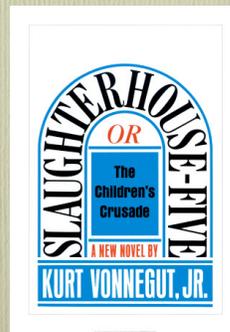
e.g. flow of a river is amount of water that passes you in a given time.

If time is to flow, it is the amount of time that passes you in a given time .... at the rate of 1 second per second?

PW

# Slaughterhouse-Five: So it goes

Billy Pilgrim has become unstuck in time



PW

# Free will doesn't exist

"O...  
is t...  
Vor...  
• C...  
There was a young man who  
It is suddenly borne on  
An engine that  
In predesti...  
I'm not...  
possible: free-will is an illusion

# Unknown physical principle?

- This says we cannot time-travel  
cannot time-travel

impossible: forbidden by cosmic censorship

PW

## Time as an Illusion

- Can evade all the paradoxes if time does not exist in the way we think it does
- Suppose "Slaughter-House Five" is correct...
- Tralfamadorians have access to all of time: our consciousness is such that we have access to "now" ONLY
- "Among the things Billy Pilgrim could not change were the past, the present, and the future."

## Time as an illusion: Is the Queensway ordered in time?



PW

So you want a summary?

Can we time travel?

Probably Not!

Peter Watson

[themachine.wikia.com/Xaq](http://themachine.wikia.com/Xaq)