Faster-than-light tachyons: Messengers from the future?

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Let's start with a fun short video
https://www.youtube.com/watch?v=cMyo-lLmxJY&feature=youtu.be

Link between FTL speed & time travel

There was a young lady
named Bright

whose speed was far
faster than light.

She set out one day
in a relative way

and returned the previous
night.

A.H. Reginald Buller

FTL speed ⇒ time travel

Based on the equations of relativity

Hypothetical FTL particles are known as tachyons

Tachyons might be able to send messages back in time

Most physicists do not believe FTL tachyons exist

Why are most physicists dubious about tachyons?

Warp [FTL]speed is unfeasible based on absolutely everything we know about the laws of physics. I am 99.99% confident of that.

Sean Carroll, Cal Tech physicist

Never seen in an experiment

Many false sightings

Weird properties

- imaginary mass
- violate "causality"
- destabilize universe

Many flaky uses of "tachyon"

"Faster-than-light speeds have no possibility of existence."

Young Einstein at the Swiss Patent Office in Bern ~1905

Where did Einstein get this idea?

A 16 yr old's "***gedanken*** experiment"

What would I see if I caught up to a light beam?

If I moved with a light beam, what would I see

https://commons.wikimedia.org/wiki/File:EM-Wave.gif

- **A “frozen” light wave is ridiculous**
- **Therefore, no way to catch up to a light beam**
- **Thus, no way to exceed speed of light either**

Some FTL speeds are OK

Daily sky motion

Light spots and shadows

Closing speeds

“Quantum entanglement”

Einstein only forbade FTL motion of mass or information and only for objects starting out slower than light, which are gradually accelerated

One more example of an allowed FTL speed

Quantum Entanglement

Man, that is spooky!

Information about their quantum states are so inextricably linked that finding the color of one particle can tell you about the other ***instantly.***

Does this permit FTL communication? No!

The most famous equation in the world

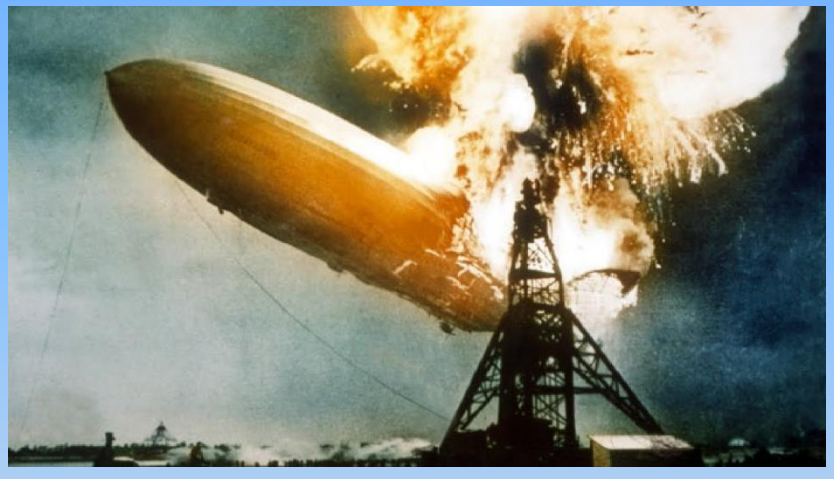
$$E = mc^2$$

c is speed of light in vacuum 299,792,458 m/s

Equation Meaning?

Meaning of $E = mc^2$

Mass is a form of energy & c^2 is the "exchange rate"

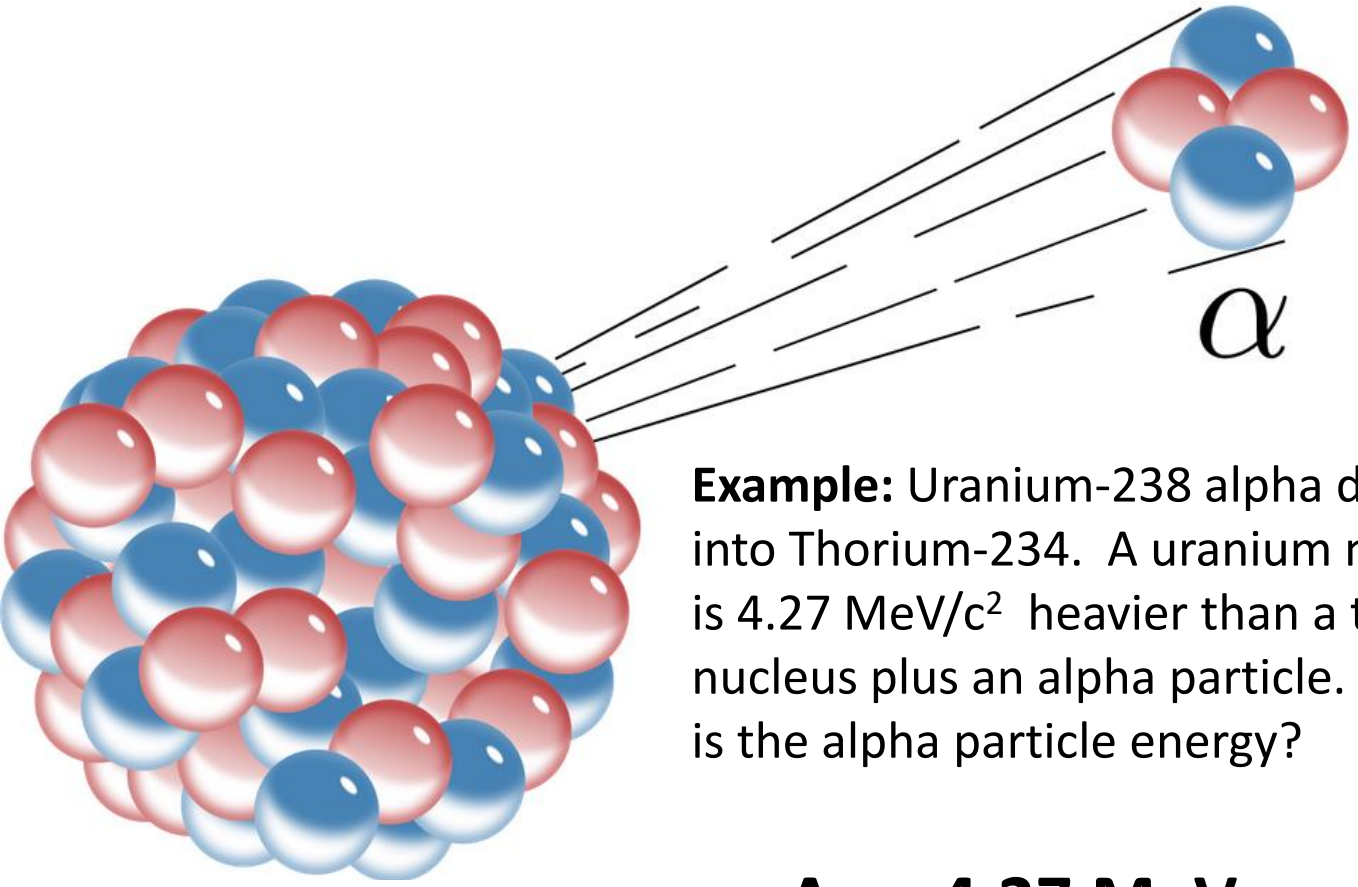


Since c^2 is such a large number you get a **lot** of energy from a tiny amount of mass

Get a **Gigantic** amount of energy from a bit less tiny amount of mass

Another example of $E = mc^2$

Alpha particle emission from uranium



Example: Uranium-238 alpha decays into Thorium-234. A uranium nucleus is 4.27 MeV/c^2 heavier than a thorium nucleus plus an alpha particle. What is the alpha particle energy?

Ans: 4.27 MeV

(MeV = million electronvolts)

An upper limit to speed seems crazy

"Simple" way to reach FTL speed:

1 g acceleration means ship gains about 10 m/s each second

Should reach light speed in 1 year

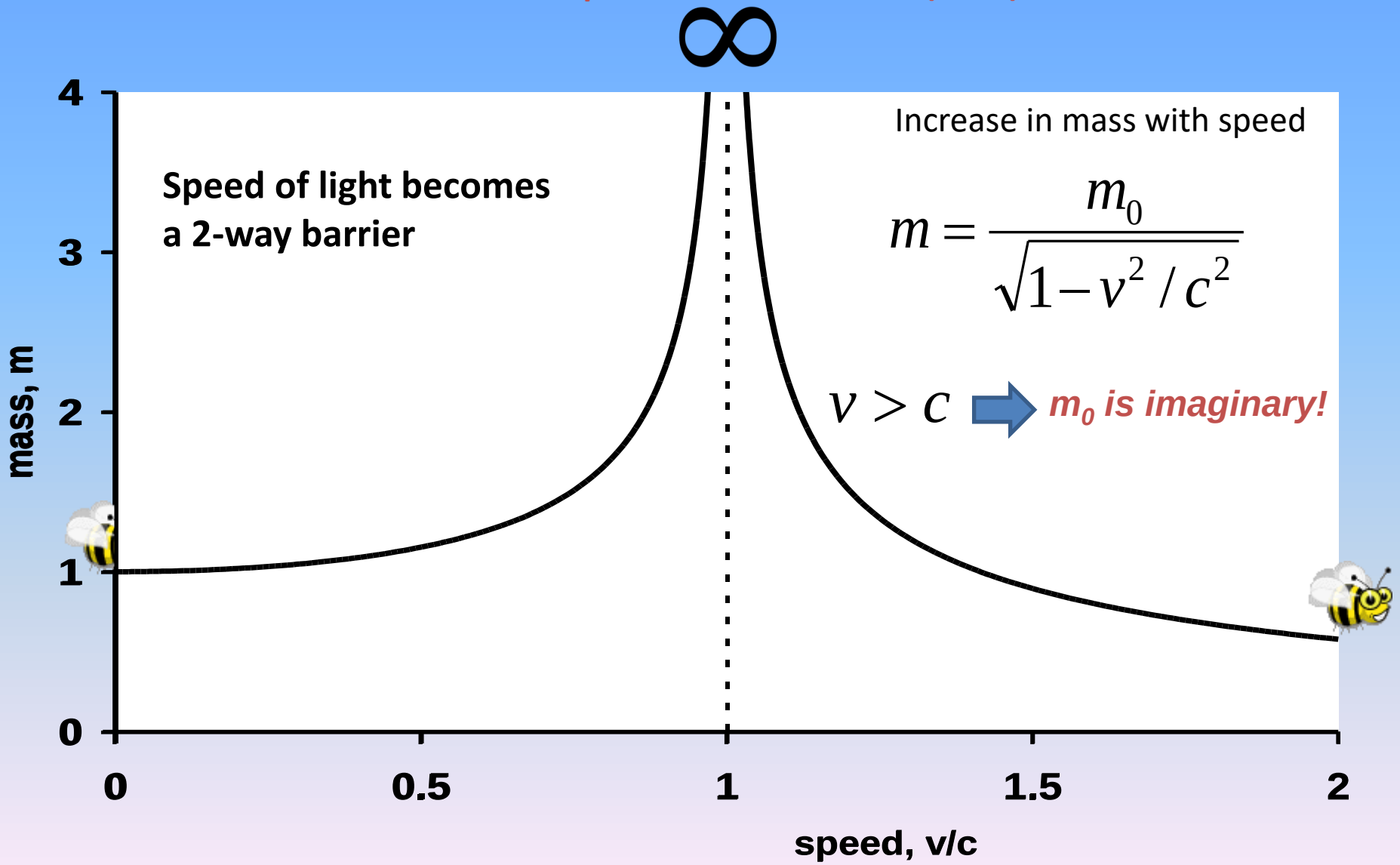
No! Einstein showed an object's mass increases with its speed

→ ***Less speed gain each second***

The tachyon “loophole”

Extending relativity beyond v=c

Bilaniuk, Deshpande, and Sudarshan (1962)



The tachyon "loophole"

Ban on FTL speed only applies to particles initially slower than light, which would require infinite energy to raise to light speed, c

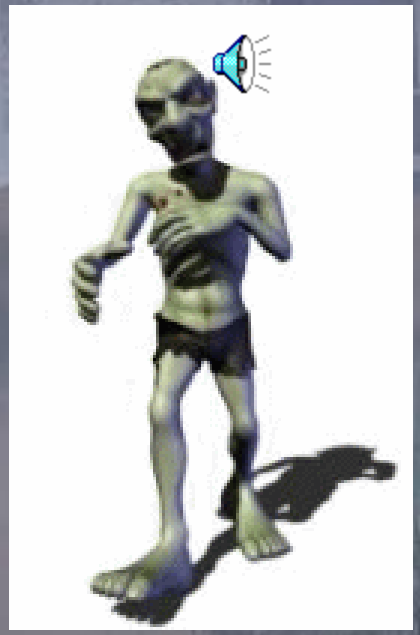
No problem with particles that ***always*** had FTL speed from the moment of their creation (from energy)

Are there any tachyon candidates among the known particles?

"Tachyon candidates" are any particles which have never been found to have $v < c$ or $m^2 > 0$

The only tachyon candidates are neutrinos

the "ghostliest" of the known subatomic particles



Why Pauli proposed the neutrino in 1930

Fraction of beta particles

Some unobserved neutral particle must be emitted in beta decay to account for the "missing" energy

Neutrino properties

First postulated by Wolfgang Pauli (1930)

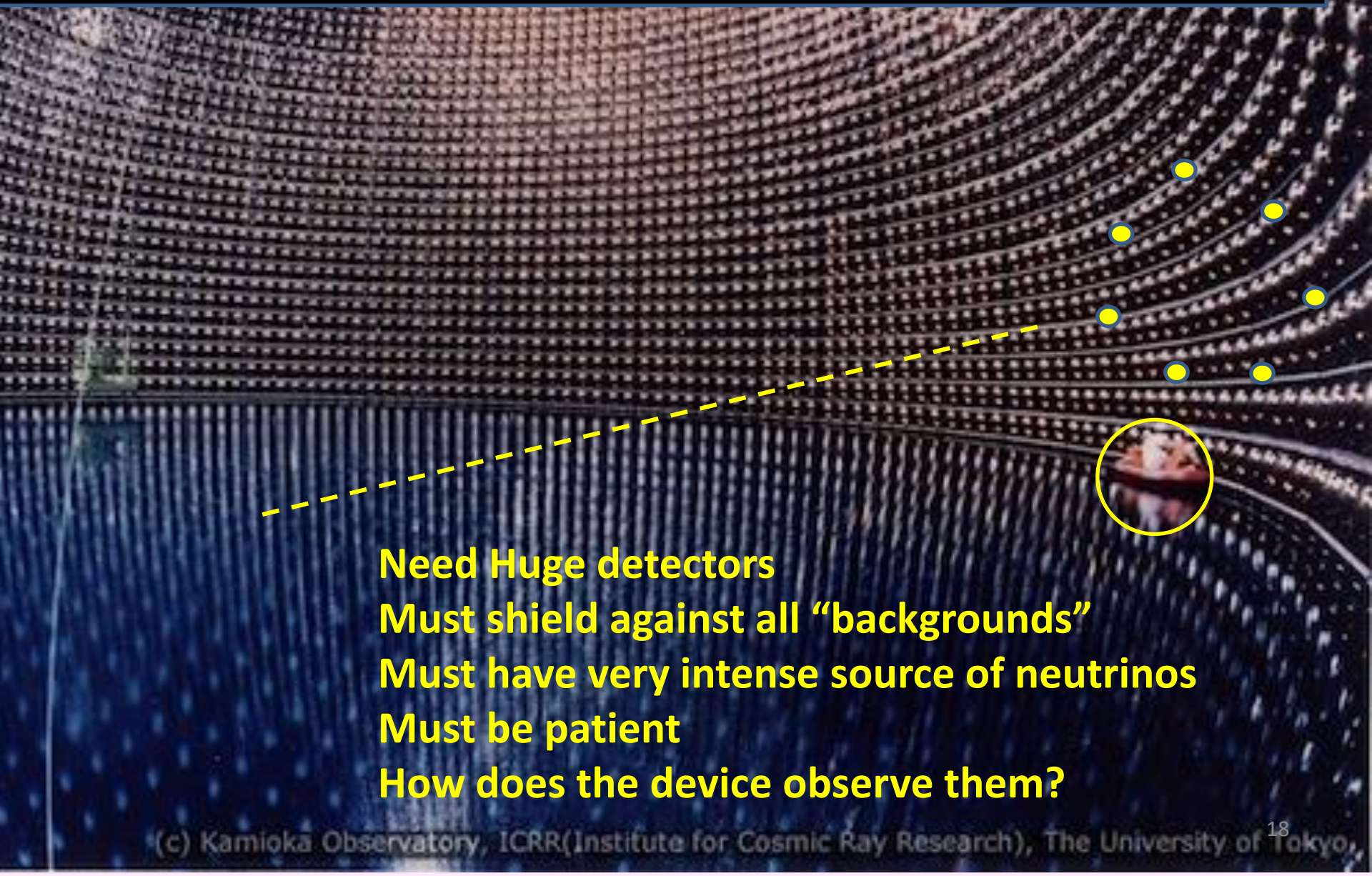
"I have done something very bad today. I have postulated a particle that cannot be detected."

Actually detected but not until 26 years later (1956)

Can pass through a light-year(!) of lead without being absorbed

They come in 3 flavors having nearly the same mass

Super-Kamiokande Neutrino detector
underneath Mount Ikeno



Need Huge detectors
Must shield against all “backgrounds”
Must have very intense source of neutrinos
Must be patient
How does the device observe them?

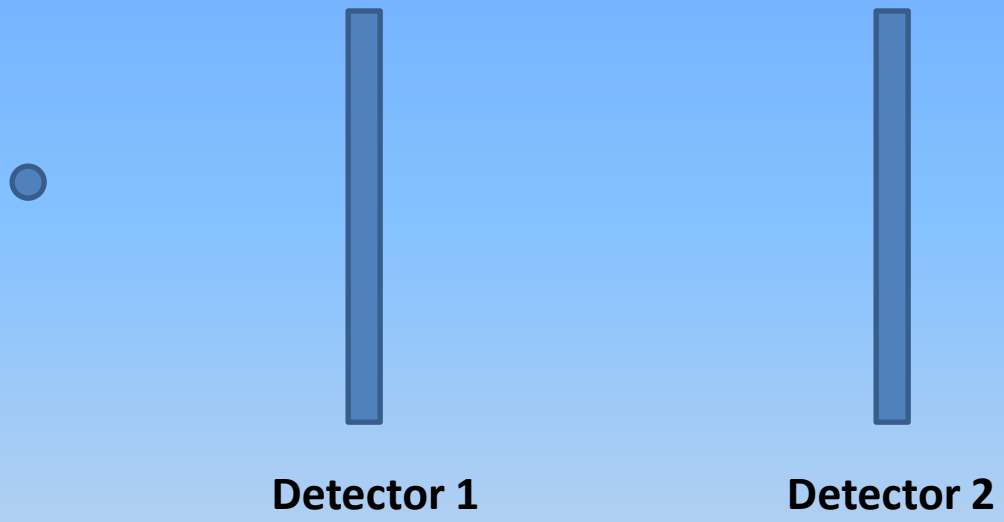
How to tell if neutrinos are tachyons

See if some neutrinos have an imaginary mass or a negative m^2

See if a beam of neutrinos outrace light over some accurately measured distance

There are at least six other ways

How to measure a particle's speed

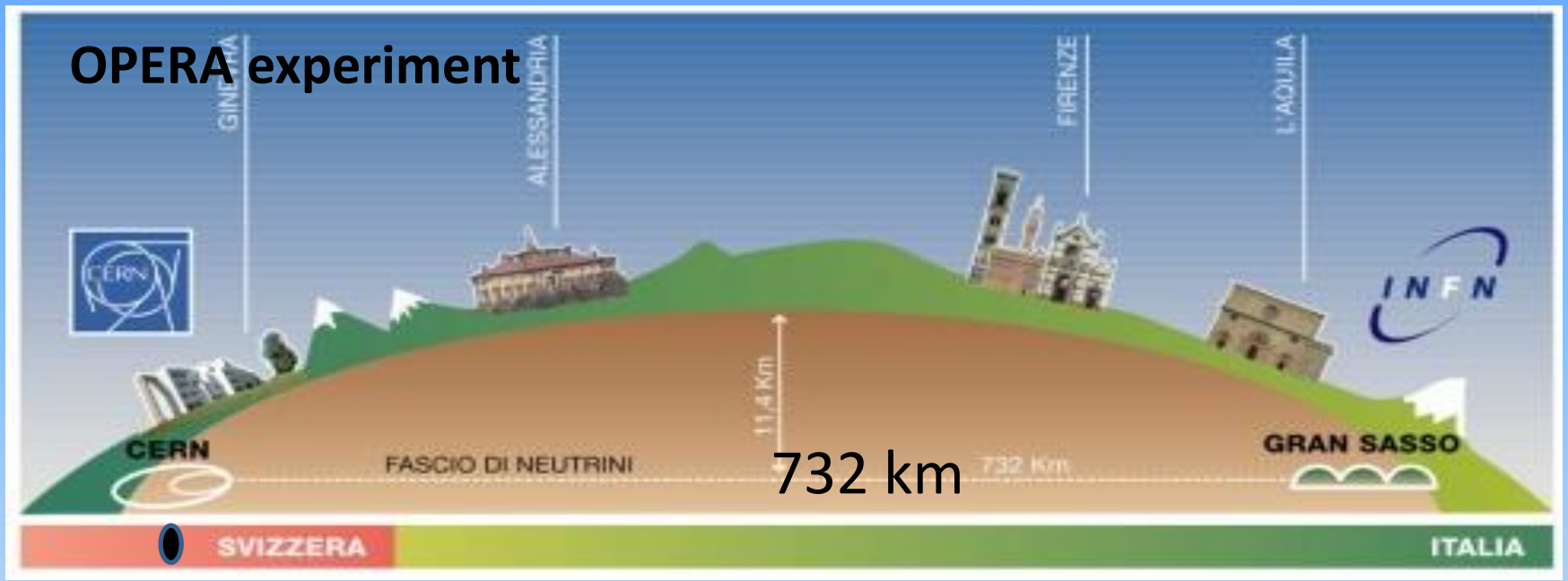


For any normal particle just measure time delay between the two activations for detectors some known distance apart – ***impossible for an individual neutrino (Why?)***

Solution: create a short burst of many neutrinos

Measuring the speed of neutrinos

2011 claim that beam of neutrinos outraced light



Bunches of neutrinos arrived 60.7 ns less time than light

Oops – "Phantom of the OPERA"

Corrected result: Neutrino speed consistent with light within uncertainties

Could gain sensitivity if burst of neutrinos travels much more than 732 km

Where to find the most distant neutrino burst?

Supernovae create huge neutrino bursts

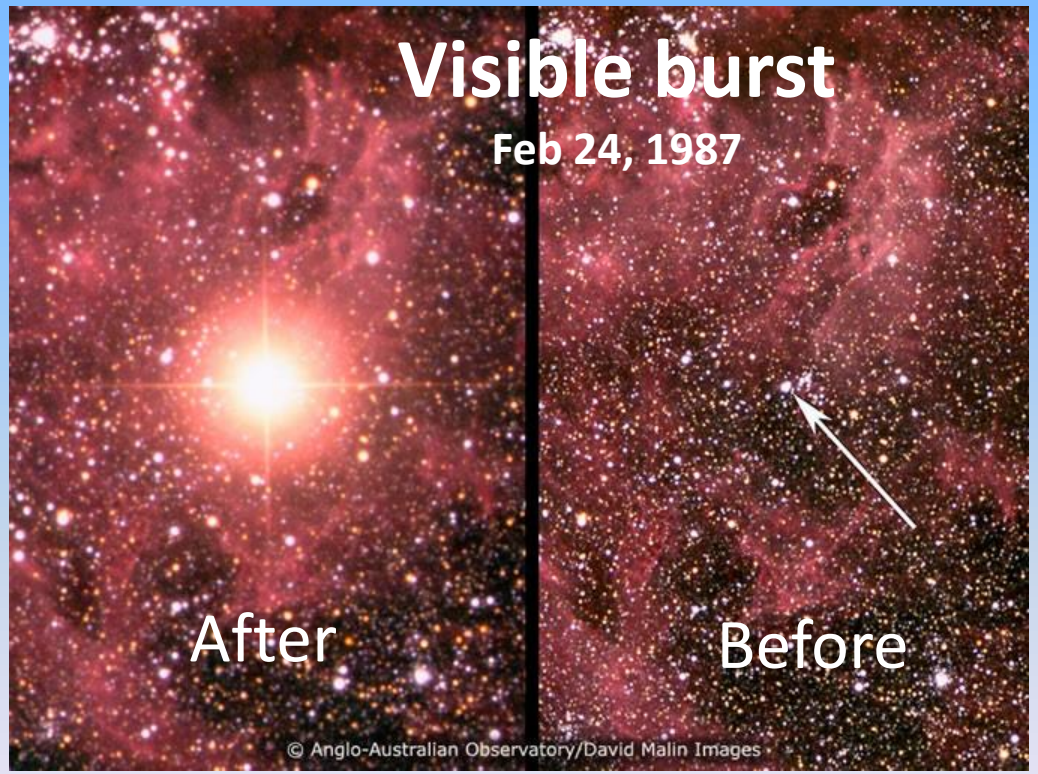
Our sun will not end its life that way

SN briefly outshine the entire galaxy

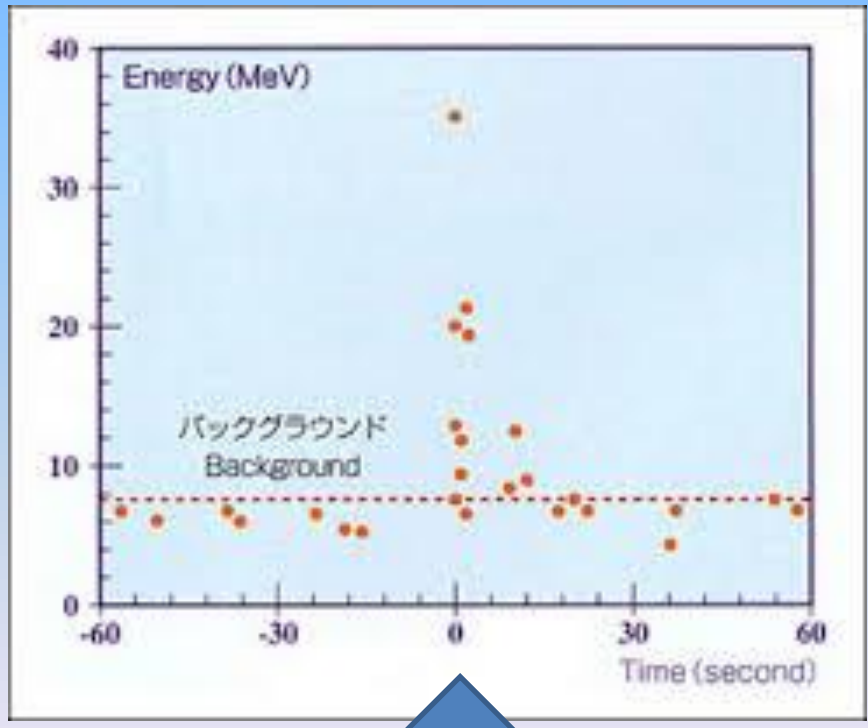
They occur only once or twice a century in our galaxy

First & only one in the era of neutrino detectors was in 1987

Supernova SN 1987A and its neutrinos



Neutrino "burst"
In Kamiokande



Analysis of supernova neutrinos

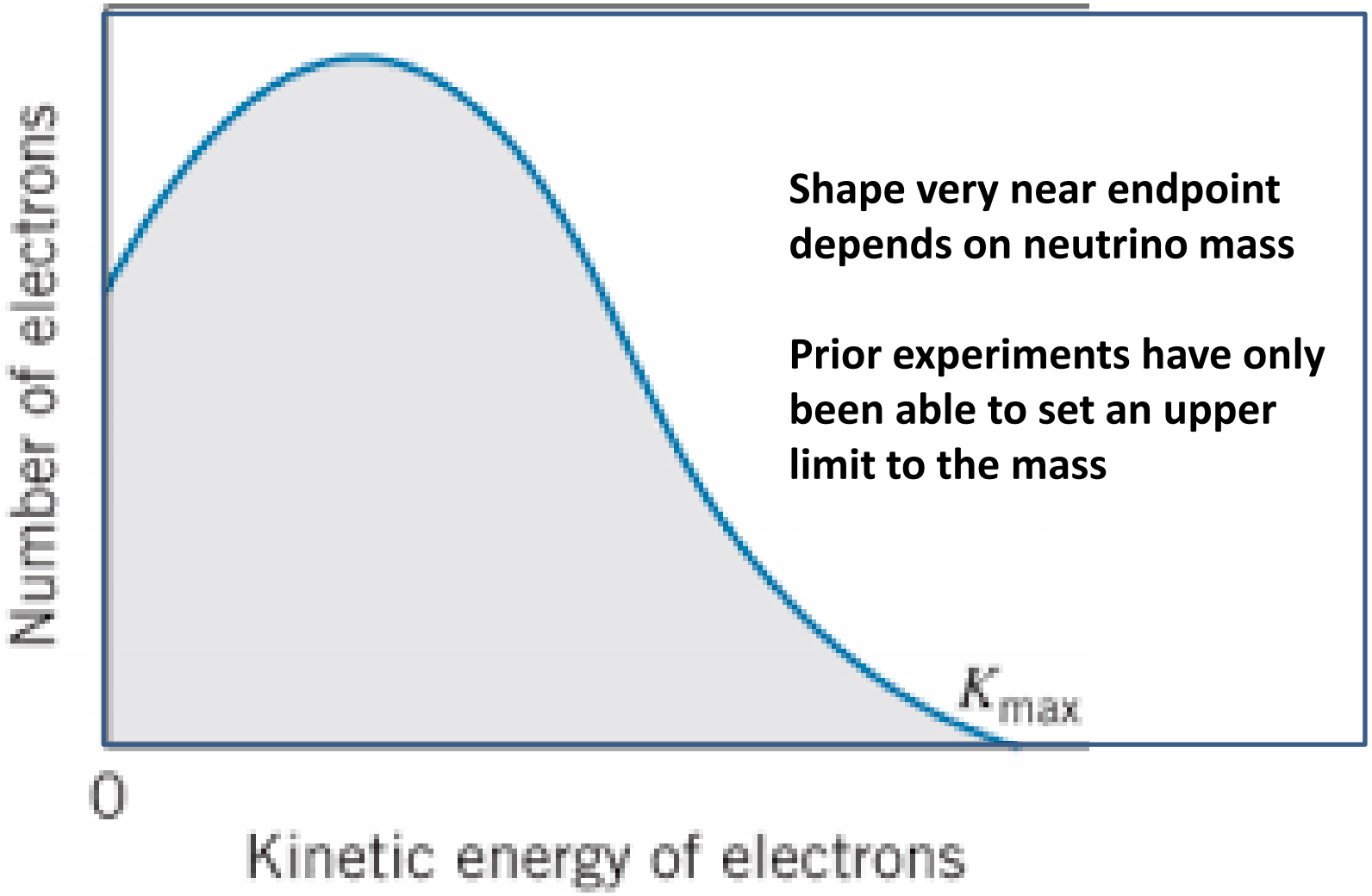
According to most physicists we just find an upper limit to neutrino mass

Instead, in a 2013 paper I have claimed we find three different masses are present, one of which is a tachyon ("3 + 3" model)

Various pieces of supporting evidence published since then

How can we test 3 + 3 model without waiting for the next supernova?

Can find neutrino mass from beta spectrum shape



Shape very near endpoint depends on neutrino mass

Prior experiments have only been able to set an upper limit to the mass

KATRIN experiment to measure neutrino mass

Inside KATRIN main spectrometer

Spectrometer being hauled through nearby town

Nearly everyone expects to find a single mass having m < 1 eV

My "3+3" model says they will find 3 much larger masses one of which is imaginary, that is, a tachyon

First results from KATRIN are consistent with ***both*** 3 + 3 model and the standard one of a single mass less than 1 eV.

By end of experiment, they should have enough data to tell which is right

Now some fun stuff

Precognition

Ability to see or receive messages from the future

Possibilities:

1. Phenomenon does not exist
2. Only certain gifted people can do it
3. Only occurs in extreme cases, e.g., a premonition of disaster
4. Signal is small & almost always hidden by the "noise"
5. Technology for receiving messages does not yet exist
6. The technology exists but we are unaware of it
7. It occurs only in dreams

It need not be a "psychic ability" & tachyons might conceivably offer a way to do it if they exist

Which do you think is the most likely possibility?

How to send a message to your earlier self

Use ring of relay satellites and a bunch of tachyons

Encode message using bunch of tachyons to send messages arbitrarily far back in time depending on number of circuits it makes

Feasibility???

Sending your past self messages can be useful

Paradox: Who invented it?

Suppose your future self (FS) 20 yrs from now finds a note under a rock explaining a technology for sending messages back in time

FS sends you in the present those plans with instructions to place the note containing the plans under a rock, which FS will later find.

Who invented the technology???

Paradox: Why fix a non-problem?

Dr. X (20 yrs in the future) sends us a message with a simple fix to catastrophic climate change.

We implement the fix and avoid the climate catastrophe.

Why would Dr. X in the future bother to send a message to us to fix a nonexistent future problem?

Summary of talk

FTL speed is connected to time travel & backward time messaging in relativity

Hypothetical FTL tachyons exploit a loophole in relativity

Most physicists believe tachyons do not exist

FTL Tachyons would always have $v > c$ and imaginary mass

Neutrinos, the "ghostliest" of the subatomic particles, are the only tachyon candidates

My 3 + 3 model based on supernova data says one neutrino is a tachyon & specifies 3 specific masses for the neutrinos.

The model makes a prediction for the ongoing KATRIN experiment

Sending messages back in time using tachyons would create various paradoxes – which does not mean they are impossible

2022 book:

web site:
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