



...read a

science article

3 - 5 articles in the semester (depending on time)



Topics on recent physics research around the world



Summarise in 3 - 5 sentences



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## Speed-of-light results under scrutiny at Cern

[COMMENTS \(1165\)](#)

By Jason Palmer  
Science and technology reporter, BBC News



Enormous underground detectors are needed to catch neutrinos, that are so elusive as to be dubbed "ghost particles"

A meeting at Cern, the world's largest physics lab, has addressed results that suggest subatomic particles have gone faster than the speed of light.

The team **has published its work** so other scientists can determine if the approach contains any mistakes.

If it does not, one of the pillars of modern science may come tumbling down.

Antonio Ereditato added "words of caution" to his Cern presentation because of the "potentially great impact on physics" of the result.

The speed of light is widely held to be the Universe's ultimate speed limit, and much of modern physics - as laid out in part by Albert Einstein in his theory of special relativity - depends on the idea that nothing can exceed it.

Thousands of experiments have been undertaken to measure it ever more precisely, and no result has ever spotted a particle breaking the limit.

"We tried to find all possible explanations for this," the report's author Antonio Ereditato of the **Opera collaboration** told BBC News on Thursday evening.

"We wanted to find a mistake - trivial mistakes, more complicated mistakes, or nasty effects - and we didn't.

"When you don't find anything, then you say 'well, now I'm forced to go out and ask the community to scrutinise this'."

Friday's meeting was designed to begin this process, with hopes that other

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“

**We want to be helped by the community in understanding our crazy result - because it is crazy"**

Antonio Ereditato  
Opera collaboration

[Light speed: Flying](#)

Don't worry if you cannot understand everything



You only need the big picture



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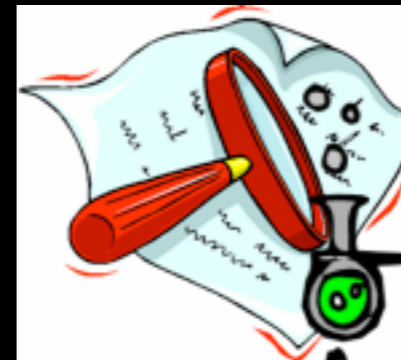
Antonio Ereditato  
Opera collaboration

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# What to look for



**WHAT** was discovered?



**HOW** was it done?



**WHY** is it exciting?



# Speed-of-light results under scrutiny at Cern

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By Jason Palmer

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Enormous underground detectors are needed to catch neutrinos, that are so elusive as to be dubbed "ghost particles"

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Example: article from BBC news website

# Speed-of-light results under scrutiny at Cern

COMMENTS (1165)

By Jason Palmer

Science and technology reporter, BBC News



Look at the title:

Speed-of-light results



Enormous underground detectors are needed to catch neutrinos, that are so elusive as to be dubbed "ghost particles"

**A meeting at Cern, the world's largest physics lab, has addressed results that suggest subatomic particles have gone faster than the speed of light.**

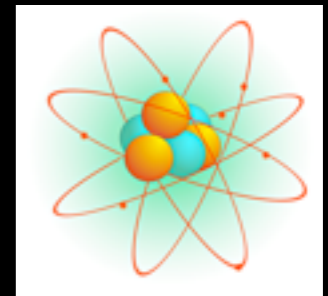
The team has published its work so other scientists can determine if the approach contains any mistakes.

Look at the 1st paragraph:

Cern: world's largest physics lab

Subatomic particles have gone faster than the speed of light

<



smaller than atom



Enormous underground detectors are needed to catch neutrinos, that are so elusive as to be dubbed "ghost particles"

**A meeting at Cern, the world's largest physics lab, has addressed results that suggest subatomic particles have gone faster than the speed of light.**

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Look at the 1st paragraph:

Cern: world's largest physics lab

Subatomic particles have gone faster than the speed of light

WHAT



Big claim!



The team **has published its work** so other scientists can determine if the approach contains any mistakes.

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The speed of light is widely held to be the Universe's ultimate speed limit, and much of modern physics - as laid out in part by Albert Einstein in his theory of special relativity - depends on the idea that nothing can exceed it.

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WHY

Einstein said nothing can travel faster than the speed of light.

Yet, scientists have measured a particle going faster.

This result is  
very surprising!

It must be  
checked very  
very carefully

"We tried to find all possible explanations for this," the report's author Antonio Ereditato of **the Opera collaboration** told BBC News on Thursday evening.

"We wanted to find a mistake - trivial mistakes, more complicated mistakes, or nasty effects - and we didn't.

"When you don't find anything, then you say 'well, now I'm forced to go out and ask the community to scrutinise this'."

Friday's meeting was designed to begin this process, with hopes that other scientists will find inconsistencies in the measurements and, hopefully, repeat the experiment elsewhere.

"Despite the large [statistical] significance of this measurement that you have seen and the stability of the analysis, since it has a potentially great impact on physics, this motivates the continuation of our studies in order to find still-unknown systematic effects," Dr Ereditato told the meeting.

"We look forward to independent measurement from other experiments."

“Extraordinary claims require extraordinary evidence”

Carl Sagen

## HOW

Neutrinos come in a number of types, and have recently been seen to switch spontaneously from one type to another.

The Cern team prepares a beam of just one type, muon neutrinos, and sends them through the Earth to an underground laboratory at Gran Sasso in Italy to see how many show up as a different type, tau neutrinos.

In the course of doing the experiments, the researchers noticed that the particles showed up 60 billionths of a second earlier than they would have done if they had travelled at the speed of light.

This is a tiny fractional change - just 20 parts in a million - but one that occurs consistently.

The team measured the travel times of neutrino bunches some 16,000 times, and have reached a level of statistical significance that in scientific circles would count as a formal discovery.

A type of particle (“muon neutrino”) was sent from Switzerland (Cern) to Italy.

It arrived slightly early, meaning it must have moved faster than light.

## Cern test 'breaks speed of light'

**0.0024 seconds**

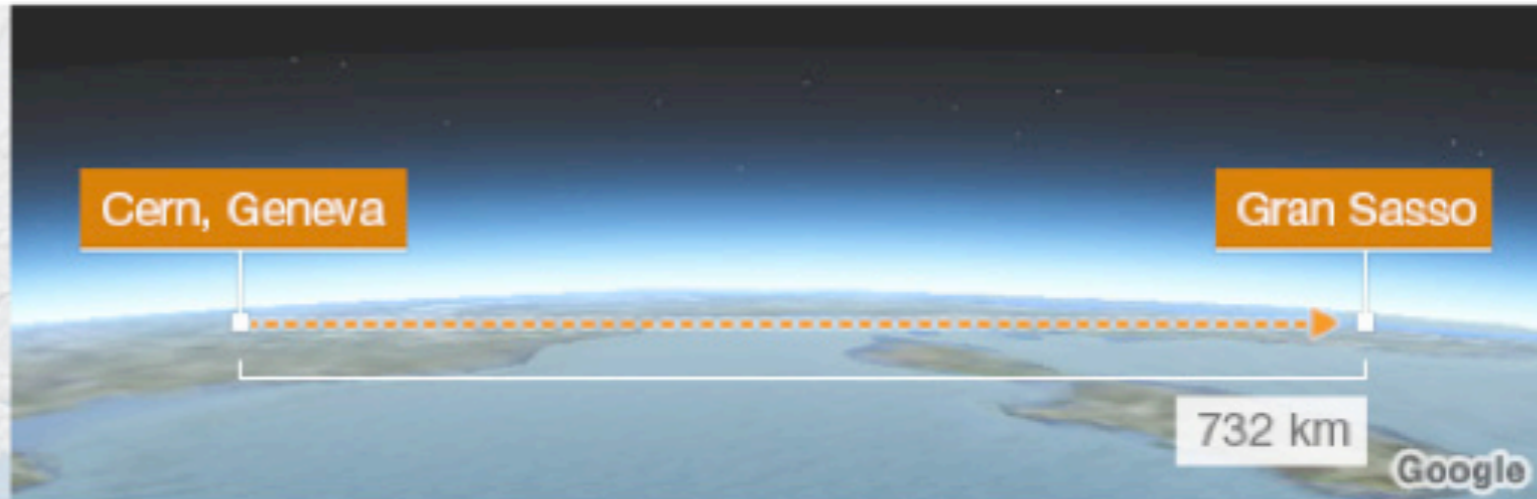
time taken by neutrinos

**0.00000006 seconds**

faster than the expected time

**732 km**

distance travelled through rock



Cern, Switzerland: A beam of neutrino particles is sent through rock towards Italy



Gran Sasso, Italy: Bricks with ultrasensitive covering at underground laboratory detect arrival

But the group understands that what are known as "systematic errors" could easily make an erroneous result look like a breaking of the ultimate speed limit.

That has motivated them to publish their measurements.

"My dream would be that another, independent experiment finds the same thing - then I would be relieved," Dr Ereditato told BBC News.

But for now, he explained, "we are not claiming things, we want just to be helped by the community in understanding our crazy result - because it is crazy".



Professor Antonio Er  
understatement that  
results"



00.00

The result is very exciting!

But... could be wrong

Scientists have found a particle that may travel faster than light.

WHAT

They measured the speed of “muon neutrinos” travelling between Switzerland and Italy. HOW

Einstein said that nothing can travel faster than light. This result would change the whole of physics!

WHY

Remember to use your own words!

(Don't copy)

# Neutrinos clocked at light-speed in new Icarus test

By Jason Palmer

Science and technology reporter, BBC News

An experiment to repeat a test of the speed of subatomic particles known as neutrinos has found that they do not travel faster than light.

Results announced in September suggested that neutrinos can travel faster than light, but were met with scepticism as that would upend Einstein's theory of relativity.

A test run by a different group at the same laboratory has now clocked them travelling at precisely light speed.

The results [have been posted online](#).

The results in September, from the Opera group at the Gran Sasso underground laboratory in Italy, shocked the world, threatening to upend a century of physics as well as relativity - which holds the speed of light to be the Universe's absolute speed limit.



Four different neutrino experiments are at work in the massive underground laboratory at Gran Sasso

## Related Stories

[Flaw found in fast neutrino story](#)

[Faster-than-light results queried](#)

[Faster-than-light test](#)

Later, the result was proven to be untrue!

But, questioning even the oldest science ideas is exciting