CERN Experiment: Are neutrinos indeed faster than light?

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Abstract: We report on efforts made by the community of critics in Germany to achieve unambiguous clarification from those officially responsible on the important question as to how the clocks used for the neutrino measurements between CERN (Switzerland) and LNGS Gran Sasso (Italy) in 2011 and 2012 were synchronized. In accordance with Einstein's assumption of c=const or with Sagnac's c+v?

As is known, in 2011 the sensational announcement spread through the press, that CERN, after repeated measurements, had confirmed a neutrino speed that was faster than that of light; a claim that would refute Einstein's STR. In 2012 it was then reported that the "error" had been found. A defective cable or a loose socket had caused the "wrong measurement". After repair of the measuring equipment new measurements had confirmed that neutrinos do not travel faster than light, and Einstein's theory remained valid.

Against this background of confusion the physicist Dr. Wolfgang Engelhardt (a former employee of the Max-Planck-Institut für Plasmaphysik [Max Planck Institute for Plasma Physics], Garching, Germany) tried to find out, by enquiries sent to many of those involved, whether the synchronization of the clocks was based on c=const in accordance with Einstein, or on c+v in accordance with Sagnac. Unfortunately this approach proved unable to resolve the matter, since the replies he received were both different and contradictory.

In Germany the "Informationsfreiheits-gesetz" [Freedom of Information Act] gives every citizen the right to obtain, from the relevant and responsible authorities, any information in which he or she is interested:

Berlin Informationsfreiheitsgesetz - Section § 1

"The purpose of this law is to promote, by way of a comprehensive right to information, direct access by the public at large to the knowledge and activities of public bodies stored in files - while ensuring at the same time that person-specific data is protected - as a means of extending existing access to information in the interests of the democratic processes of opinion-forming and the setting of objectives, and as a means of enabling control of state activities."

Since it is a question of higher scientific importance for the scientific community as well as for the general public, which finances these extremely expensive experiments from taxpayers' money, in May 2012 Ekkehard Friebe and Jocelyne Lopez took the initiative of sending an official enquiry on clarification of this question to the German Metrologie-Institut (Physikalisch-Technische Bundesanstalt – PTB), which undertook the synchronization of the clocks for these measurements, together with the Swiss metrology institute METAS.

Even the two answers received from the PTB to this enquiry were unfortunately not unambiguous and contained contradictions. On 28.06.12

the PTB answered that c=const was used as the basis for synchronization of the clocks. In response to a subsequent enquiry, by contrast, they answered on 20.07.12 that they assumed that c=const had been corrected by the Sagnac effect c+v, but that they could give no further information on this since they had no precise knowledge of the software applied. On 6.03.2013 we sent the following reply to the PTB:

To the President of the Physikalisch-Technischen Bundesanstalt (PTB)
Professor Dr. Joachim Hermann Ullrich
Neutrino Experiment between CERN and LNGS

Dear Professor Ullrich

I come back to our above-mentioned exchange in the year 2012, the content of which can be found, for an easier overview, on the following website:

Neutrino-Experiment: Anfrage an die Physikalisch-Technische Bundesanstalt

For me, as a person interested in natural science, there is still an important need for clarification of a question relating to the interpretation of the experiment. Unfortunately I can neither understand the point from my own reflections nor from those arising from a stimulating exchange of views in discussion forums.

On 28.06.12 you wrote that the effects of the theory of relativity on synchronization of the clocks had been taken as a basis correctly – this in the context of the assumption of c=const – and that the experiment had confirmed the theory of relativity. The neutrinos do not travel faster than the speed of light:

Quote: PTB 28.06.12

"You had contacted the Physikalisch-Technische Bundesanstalt with the question as to whether during the GPS calibration for the neutrino running-time measurements of the OPERA experiment everything was undertaken correctly. To keep it short: yes. The calibration of the GPS time-synchronization connections has been a routine matter for years now for the time laboratories of this world. The high precision achieved there is only possible when all of the relevant effects of the theory of relativity, of atmospheric physics and of the electronics in the satellite terminals have been taken into consideration. You can therefore rest assured that nothing there went wrong. [...] And then in March new data was presented from the ICARUS experiment, which was constructed right next to OPERA. Result: the neutrinos do not travel faster than the speed of light. After repair of its structure, OPERA can now also confirm this. So the original problem has been fully clarified and in this respect the world is again all right."

On 20.07.2012, by contrast, you wrote - in contradiction to this, in my view - that you assume that during the synchronization of the clocks the relativistic assumption of c=const had been "corrected" by the Sagnac effect, c + v :

Quote: PTB 20.07.12

"We have never doubted that both the manufacturers of our receiver and the author of the R2CGGTTS software, which is cared for and

> *distributed by BIPM, have correctly allowed for the Sagnac effect. [...] Please understand that we cannot give you more information on the internal structure of the external software for the simple reason that we ourselves know no more. As already said, since all of the results are consistent with each other we have no reason to assume that the BIPM software could have contained an error in the correction of the relativistic effects (Sagnac).”*

For me this gives rise - physically as well as mathematically and logically - to an irresolvable problem of conceptualization.

How can one correct the assumption of c=const by the assumption of c+v and nevertheless retain the result of c=const?

You write that “*the results are consistent*”. This is a claim that I cannot understand at all. With what are the results consistent? With c=const or with c+v? Both claims exclude each other completely, mathematically as well as logically. Both cannot be valid at the same time. Physically, too, they are incompatible. The neutrinos either travel at speed c or they travel at speed c+v. Even professionally qualified participants in the discussion forums during the past few months have been unable to explain the contradiction in the official interpretation of the experiment, whether mathematically or physically. Since the interpretation of the results of the experiment raises fundamental questions of public interest, I would ask you to present the argumentation for the interested public citizen understandably, explaining what it is that has led you to your interpretation that the neutrinos do not travel faster than c, although the Sagnac effect of c+v was correctly integrated in the calculations.

With the request for an answer by 16.04.2013 and my thanks in advance, I remain
yours sincerely,

Jocelyne Lopez

At the time of submission of my article for the NPA Conference the PTB had still not resolved the contradiction, preferring to duck the issue - instead of offering a clear solution to the question - with the claim that laymen in physics are not able to understand the theory of relativity. Understanding requires that use be made of correct and complete mathematical formalism that students of physics first learn in later courses of study. We will continue, on the basis of our right to information for the public, to press the relevant authorities for unambiguous clarification of the issue. The complete correspondence, with all updates, is and will continue to be available in our blog: Neutrino-Experiment: Anfrage an die Physikalisch-Technische Bundesanstalt