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cc. CERN General Director, Prof. Rolf Heuer
CERN Scientific Director, Prof. Sergio Bertolucci
CERN Atlas Experiment Deputy Spokesman, Prof. Andy Lankford

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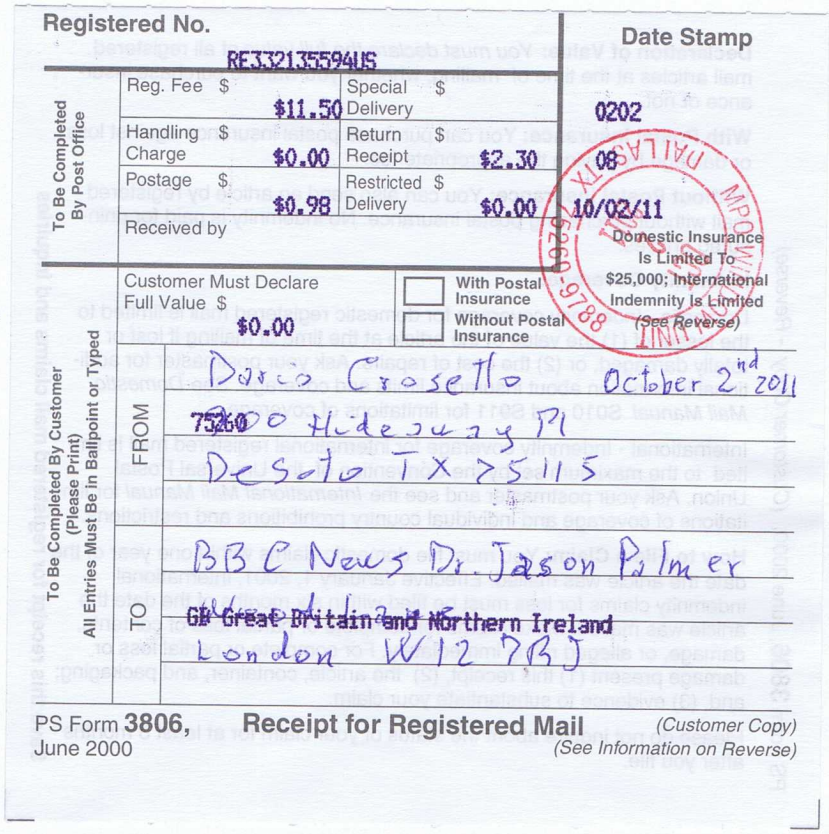
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PS Form 3806, June 2000 Receipt for Registered Mail (Customer Copy) (See Information on Reverse)

October 2nd, 2011

Dear Antonio,

I am taking you up on your appeal for scrutiny of the results from the OPERA experiment that you made public at a BBC News interview on September 22nd, 2011 (http://www.bbc.co.uk/news/science-environment-15017484) :

"we want just to be helped by the community in understanding our crazy result – because it is crazy".

When I heard your name on TV, in newspapers, etc. I was reminded of, and hopefully you will recall, the several dinners and gatherings over several years we shared at CERN 30 years ago with Luciano Ramello, Tiziano Camporesi, Mario Caria, Vittorio Remondino, etc. when I was working at CERN on the trigger of the Delphi experiment.

Here is my scrutiny of the results of your experiment.

I will first summarize what you stated - that you measured the time it took for a neutrino beam to travel a distance of 732 Km, and it took 60 nanoseconds less time than it would have taken a light beam to travel the same distance.

After trying and failing to find any errors you stated:

> "*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'.* "

The most logical step to have taken the first time you found this "*crazy*" result three years ago would have been to plan a specific low cost experiment that would clarify this discrepancy. Instead, you kept doing and redoing the same experiment for three years acquiring "*travel times of neutrino bunches some 16,000 times*"! Remember Albert Einstein's definition of insanity: Doing the same thing over and over again and expecting different results."

You needed to clarify the discrepancy of a Time of Flight (TOF) measurement of 60 nanoseconds (equivalent to 60,000 picoseconds) over a total duration of 2.43 milliseconds.

There exist thousands of articles describing apparatus (detectors and electronics) that can make accurate TOF measurement with a resolution as precise as 10 picoseconds (or even 6 picoseconds as presented some time ago at a workshop at Stanford Linear Accelerator –SLAC-).

So this is what I would have done three years ago:

Since the discrepancy you found is so big, you do not need the neutrino to travel 732 Km in order to see this discrepancy. Using simple proportions traveling just 3.2 Km distance should give you a difference of about 260 picoseconds which is 26 times greater than the 10 picoseconds resolution step of your measuring apparatus.

Remember Galileo's simple experiment of taking two stones of different weights and dropping them at the same instant from the leaning tower of Pisa and then verifying that they reached the ground at the same time.

Now, send two beams in burst of bunches (these can be sent separately, but simultaneously and repetitively will facilitate viewing the minimum differences in real-time), one light and one neutrino in the underground 3.2 Km SLAC tunnel (or take two LHC experiment sites A and B at CERN of approximately 5 to 7 Km distance from each other, send neutrino bunches underground and send light bunches between 2 towers above ground from site A to site B); build two identical electronic channel circuits (or purchase off-the-shelf components) with a time resolution of 10 picoseconds (or 6 picoseconds) to measure the traveling time of the two beams; within the detector, use the same transducer (if possible) to convert light into electrical signals (e.g. Photek PMT240 or fast SiPM from Hamamatsu or STMicroelectronics); then SWAP THE TWO ELECTRONIC CHANNEL CIRCUITS and repeat the experiment on the two burst of bunches to make sure that the neutrino beam (as well as the light beam) has the same speed regardless of which electronic channel is used (otherwise the fault would lie in the measuring device). By synchronizing the start of the burst of bunches, at the arrival point you would be able to see in real time with a fast oscilloscope the minimum difference on travel time between the two beams (just like two cars racing).

If the discrepancy (neutrino bunches arriving faster than the light bunches) still persists, then you should be confident of having done a diligent accurate experiment and others should be able to obtain the same results.

The reason for measuring the speed of the light beam as well as the neutrino beam is not because it is necessary to measure one more time the speed of light which has been measured thousands of times, but the goal is to test the accuracy or your electronics (achieved by swapping electronic channel circuits), with the speed of light as your source of calibration or reference. Believe me, it was not trivial for me to design DUT (Device Under Test) boards at the Superconducting Super Collider in 1992 for the HP8200 half-million dollar test station of integrated circuits with a time resolution accuracy of 50 picoseconds at all pins of the device under test. I was certain that my design and circuit implementation were correct only by comparing signals.

In scientific research it is necessary to master calculations that will predict specific results. It is necessary to master how to conduct an experiment, to master the knowledge of electronics, detectors, and all components that will be used in the experiment. It is necessary to know the expected results, reproducible by different instrumentation (swapping electronic channel circuits), and ultimately confirm or reject calculations. Only then is money not wasted, experiments can confirm calculations, and the door to progress is opened. Here it looks like nothing has been mastered because the discrepancy is not explained with calculations, it is not explained from the results of the experiment, and it is just called "*crazy results*." Results from untested performance of the measuring instrumentation (achievable by swapping electronic channel circuits that measure two parameters), risks alarming many people, discredits scientific research and wastes a lot of newspaper ink and TV time.

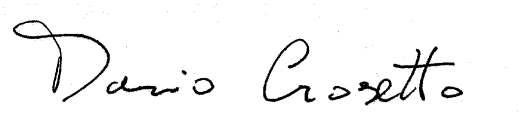
Have you calculated how much money you and your collaborators have spent these past three years on conducting inconclusive tests instead of comparing in a scientific way the speed of two beams?

There would be no need to mention the word "*crazy*" after having conducted this scientific procedure.

In research it is important to discuss, identify, and implement scientific procedures that allow the laws of nature to be understood. A dialogue is key to identifying the most cost effective scientific procedure that will yield the most accurate results.

I hope this example of a scientific procedure to check if neutrino breaks the speed of light helps.

Best regards,



Dario Crosetto

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Link to the BBC NEWS: "Speed-of-light results under scrutiny at Cern"

http://www.bbc.co.uk/news/science-environment-15017484

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