Measurable relativistic effects associated with tachyonic neutrino data from the OPERA detector

George Soli, Integrated Detector Systems
APS NWS 2011, Oregon State University, Corvallis OR, October 2011

- The OPERA collaboration published “tachyon” neutrino “weak” “phase” velocity data [1].

- Special Relativity tachyon theory demands a sidereal tachyon velocity relative to the Cosmic Microwave Background (CMB) dipole for tachyon neutrinos.
    - If we assume that the (CMB Rest) CMBR frame coincides with the tachyon preferred frame.
    - If we use the Chang-Thangherlini (CT) nonstandard clock synchronization scheme rather than the Einstein–Poincare (EP) clock synchronization scheme.

- The OPERA time of flight (TOF) measurements must oscillate with the direction of tachyon neutrino propagation relative to the CMB dipole.
    - Tachyon neutrinos have a preferred frame in order to satisfy causality in the Special Relativity tachyon theory we are testing here [2].
    - The magnitude and direction of this TOF oscillation is a measurement of the Earth’s velocity relative to the CMBR frame, which averages 371 km/s.

[1] OPERA collaboration, “Measurement of the neutrino velocity with the OPERA detector in the CNGS beam”. http://arxiv.org/ftp/arxiv/papers/1109/1109.4897.pdf
[2] J. Rembielinski, “Quantization of the tachyonic field and the preferred frame”, http://arxiv.org/PS_cache/hep-ph/pdf/9509/9509219v2.pdf

George Soli, Integrated Detector Systems, LLC, georges@integrateddetectors.com

Measurable relativistic effects:

● The CMB dipole is formed by the redshift and blueshift of the CMB electromagnetic radiation caused by the motion of the Earth relative to the CMBR frame.

● The CMB dipole redshift direction is into 81 degrees on the tangent plane to the Earth's surface at Gran Sasso. The line, CERN to Gran Sasso, is 122 degrees.

● We first go from the Einstein–Poincare (EP) to the Chang-Thangherlini (CT) nonstandard clock synchronization scheme (eq. 15 in [2]).

$$v(CT)/c = [v(EP)/c]/[1-\sigma(EP)v(EP)/c^2] = 1.00126$$

Where Earth's absolute velocity $\sigma(EP)/c = 1.234E\text{-}3$ relative to CMBR frame and the measured tachyon velocity $v(EP)/c = 1.0000249$ is greater than c. We approximate,

$$\sigma(CT)/c = \sigma(EP)/c \text{ and } \gamma_0 = 1.$$

● Projecting the tachyon velocity onto the CMB dipole redshift direction, (122 – 81) degrees = 41 degrees and cos(41) = 0.755. **Coordinate time is rescaled by the positive factor gamma (γ)** (eq. 19 in [2]).

$$\gamma(\text{redshift}) = |(1+\sigma(CT)[0.755]v(CT)/c^2\gamma_0{}^2)^2 - (v(CT)/c)^2|^{1/2} = 2.56E\text{-}2$$

George Soli, Integrated Detector Systems, LLC, georges@integrateddetectors.com

Measurable relativistic effects:

● The tachyon neutrinos arrive at Gran Sasso 60.7 ns before they would have traveling at the vacuum speed of light [1].

● If we assume $\sigma(CT) = 0$ so we can compute the effects of Earth's absolute motion relative to the CMBR frame, then,

$$\gamma(\sigma(CT)=0) = |1 - (v(CT)/c)^2|^{1/2} = 5.02E\text{-}2$$

● Now, $\gamma(\text{redshift})/\gamma(\sigma(CT)=0) = 2.56E\text{-}2/5.02E\text{-}2 = 0.51$,

(0.51 x 60.7) ns = **31** ns,
(60.7 + 31) ns = **92** ns,
and (60.7 – 31) ns = **30** ns.

● The CMB dipole is in the Earth's tangent plane at Gran Sasso twice per day, once when the neutrino velocity, projected onto the dipole, is the opposite to Earth's motion along the dipole, and this is when the fastest neutrino speed would occur.

● On the 19 September (2011) the neutrinos would be fastest at 5:02 pm Gran Sasso time. They should be earlier than light in vacuum by about **92** ns, and twelve hours minus 2 minutes latter (5:00 am 20 September) they should be early by only **30** ns.

George Soli, Integrated Detector Systems, LLC, georges@integrateddetectors.com

Measurable relativistic effects:

● The OPERA collaboration published the two bin data [1]:

day -vs- night = (17.1 ± 15.5) ns

● According to the above computation, the two bin sidereal data would produce:

CMB dipole redshift -vs- CMB dipole blueshift = (**31** ± 15.5) ns

● Also, Special Relativity plus the OPERA data, predicts a – 0.014 GeV^2 neutrino mass squared, that does not jive with other muon neutrino mass squared data – 0.016±0.023 MeV^2 [3].

● Quantum-coherence enhanced-forward-scattering produces a less-than-one index of refraction, producing the measured superluminal "phase" velocity [4].

● And the "weak" measurement averages to measure causal superluminal phase velocity [5].

[3] J. Ciborowski1 and J. Rembielinski, "Comments on the recent velocity measurement of the muon neutrinos by the OPERA Collaboration", http://arxiv.org/PS_cache/arxiv/pdf/1109/1109.5599v1.pdf
[4] R. Brustein and D. Semikoz, "Apparent superluminal neutrino propagation caused by nonlinear coherent interactions in matter", http://arxiv.org/PS_cache/arxiv/pdf/1110/1110.0762v1.pdf
[5] S. Tanimura, "Apparent Superluminal Muon-neutrino Velocity as a Manifestation of Weak Value", http://arxiv.org/PS_cache/arxiv/pdf/1110/1110.1790v1.pdf

George Soli, Integrated Detector Systems, LLC, georges@integrateddetectors.com