# Special Relativity fails to resolve cosmic muon decay

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## 1 Abstract

The Special Theory of Relativity does not explain the cosmic muon decay phenomenon; it is not evidence of time dilation. The "dilated time" of special relativity has no physical interpretation as time as interpreted in physics; therefore, the extended lifetime of the muon, arrived at through the used of time dilation, cannot be used in the simple formula : distance = speed x time. So far, no one seems to have pointed to this simple fact. An invalid argument has been repeated and propagated for decades that purportedly resolves the cosmic muon decay phenomenon.

Furthermore, the best experiment by CERN [3] measured the average lifetime of muon as 64.368(29) $\mu s$, ($\gamma$ = 29.33, v = 0.9994 c). The now accepted mean proper lifetime for $\mu_-$ = 2.19489(10) $\mu s$ is a value computed from the relativistic time dilation formula using the figure of 64.368(29) $\mu s$ assuming the validity of Special Relativity Theory; it is not an empirical value from experiments.

### 1.1 keywords

special relativity;muon;cosmic muon;decay;muon lifetime.

## 2 The cosmic muon decay phenomenon

Data information are from the book [1].

Cosmic muons are created in the upper atmosphere, usually above heights of 6000 meter, through cosmic rays interactions. The average lifetime (at rest) of the muon is about 2 $\mu s$ and travels at the speed of 0.998 c. At even such a speed close to that of the speed of light, it still could only travel a distance of about 600 m before it decays. It is not expected that muons could be detected at sea level; but they are detected and the density of them arriving at sea level does not have a classical explanation.

The conventional resolution of the phenomenon invokes special relativity. From the frame of the earth, the time of the muon's clock runs slower by an extended factor of about 16 times giving it an extended lifetime of $31.6\mu s$ in the earth's frame. With such an extended liftetime, it could cover a distance of : $0.998c \times 31.6\mu s = 9500m$. This explains the statistic of the number of muons that could survive its descent to sea level.

# 3 The resolution through special relativity flawed

I have shown in another article of mine [2], that time dilation and length contraction of special relativity are unreal; they cannot be used where real values are required :

> In fact, the event $E'$, a projection from a Lorentz transformation, cannot have any relevance to our real physical world. Performing a mathematical operation on an event or variables that have physical interpretation does not naturally make values of the projection, or any extracted values, to acquire any or corresponding real physical interpretation. The Lorentz transformation is just a type of abstract mathematical linear transformation; it does not rest on any physical principle that ensures real physical values be mapped onto real physical values. The common relativistic convention of merely calling a real number extracted from a mathematical operation as ***"dilated time"*** does not in any way make the number a time - time as interpreted in physics. The dilated time of special relativity has no physical significance and cannot be used in any way where a real physical time is required.

The simple formula : $distance = speed \times time$, takes only values that are real.

The speed of $0.998c$ is the relative velocity between the frame of the muon and that of the earth's frame; it is a real velocity obtained from dividing a real distance by real time. So only real times may be used in the formula. But the extended lifetime of a muon,$31.6\mu s$, due to time dilation does not naturally take on time as interpreted in physics; in fact, dilated time has no physical interpretation. So the computation of the distance traversed by a muon in its descent down to sea level through:$distance = 0.998c \times 31.6\mu s$, is not allowed.

# 4 Conclusion

For many decades, an invalid explanation has been repeated and propagated that attempts to explain the phenomenon of the cosmic muon decay; the explanation is flawed. So far, no one seems to have pointed out the error.

# 5 Further Notes

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Most textbooks and many web pages use the cosmic muon decay as evidence that support relativistic time dilation; it is incorrect. The figure of about 2.0 $\mu s$ for the average lifetime is used together with the speed of the muon near the speed of light; it is then shown that the distance covered is still only about 600 m, insufficient for muons to reach sea level in sufficient numbers as detected. Then it is explained that time dilation or length contraction would resolved the paradox.

There is actually no need to invoke Special Relativity to resolve any "paradox" as there is none. The true average lifetime as measured in the CERN laboratory for a speed of 0.9994 c is $64.368(29)\mu s$; so the muon could cover a distance of 19000 meter and not just 600 meter.

From J. Bailey et al [3]:

> "The lifetime of both relativistic ($\gamma = 29.33$) positive and negative muons have been measured in the CERN muon storage ring with the result : $\tau^+ = 64.419(58)\mu s$, $\tau^- = 64.368(29)\mu s$. Assuming special relativity, the mean proper lifetime for $\mu^-$ is found (my comment: meaning computed) to be : $\tau_0^- = 2.19489(10)\mu s$."

# References


[1] Concepts of Modern Physics, Arthur Beiser.

[2] The Lorentz transformation fails Special Relativity; Chan Rasjid : http://vixra.org/abs/1408.0077

[3] Nature, Vol 268 28 July 1977 Title: Measurements of relativistic time dilatation for positive and negative muons in a circular orbit. J. Bailey et al; Daresbury Laboratory, UK; H. Drumm, European Organization for Nuclear Research.