

# A SPACE-TIME INFORMATION PARADOX

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If we study cosmic phenomena or life, ultimately, we can simply state that nature is the interaction with the rest of the universe. Alternately expressed, a change of state is the result of the interaction with the information content presented by the universe. Information is thus a preserved quantity; this philosophical view sparked the black hole information paradox debate. This essay explores the question if information is preserved in space-time. Using the established physics theories a new paradox is uncovered that has been ignored by whoever it was presented to; an answer is still outstanding!

Information in a physical sense is that what causes the state of a physical entity to change. Viewed in this way, information is fundamental and it is a preserved quantity. Thus, the first and foremost law of nature is "The information content of the universe is constant." All other laws (energy conservation, momentum conservation, charge conservation, parity conservation etc) are all derivatives. Information defined this way can be contained in a single particle or encoded in a cluster of particles, e. g. a DNA molecule. The cluster of particles need not be solid, it can also be a photon ray, i. e. a train of photons that make up an electromagnetic beam. It is such a photon ray or electromagnetic beam that we study in space-time and analyse its information content.

Let's presume ideal conditions, a ray produced by a laser who's beam does not diverge with distance. We can formulate the following axioms:

1. Information can be encoded on/in the ray by the transmitter, the information density is proportional to the frequency and/or number of photons in the ray and can be received in full by a receiver.
2. The encoded information is not lost when the ray is reflected off an ideal mirror.

3. All encoded information content is identical irrespective of the inertial reference systems of the transmitter, receiver and mirror, that may translate at various velocities relative to each other.

With the above understanding, we consider following gedanken experiment. Alice the transmitter, and Charlie the receiver, are both in the same reference system. Alice encodes information onto a photon ray that is reflected from Bob's mirror some distance away in a spaceship, moving away from Alice and Charlie. Bob can eavesdrop and receives the same information as Charlie.

Bob now modifies the setup: He places a shutter between the mirror and the source. It is a one way shutter that excludes further signals from Alice but passes the reflected ray to Charlie. The shutter is instantaneously activated once it detects the reflected beam from the mirror, thus truncating the beam to the extent what is between the shutter and the mirror in the up and down paths. Bob again eavesdrops on this truncated message, but this time round we have the paradox: Charlie's received information content differs from that of Bob, expressed by following relationship. (Refer to Appendix for the complete analysis)

$$\frac{I_{Charlie}}{I_{Bob}} = \frac{c^2 + v^2}{c^2 - v^2}$$

This is a contradiction of Axiom-3 above.

From this result it is very clear to me that information based physics and Einstein's relativity are not compatible. Black holes, the black hole information paradox and Hawking radiation are artifacts derived from paradoxical physics. That the CMB data shows that we are the centre of the universe is a closely related phenomenon[1, 2]

What more can I say other than: Its time to move on from Einstein and lay the mathematical groundwork on which information based physics can be build on. Anything else is superfluous!

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## APPENDIX

That the null result of the Michelson-Morley (MM) experiment [3] is successfully explained by Einstein's theory of special relativity [4], and that the experiment is central in investigating the Lorentz invariance [5] need not be elaborated. Below a more comprehensive analysis of the MM experiment which includes:

- A phasing study of an electromagnetic propagation, which takes into account the Doppler shifts of the reflected signals;
- A geometry study to check the reflection of the moving mirror including relativistic effects are as is presumed in the traditional MM analysis.
- A information study that analyses the information content. Information content is simply defined as the number of cycles of the electromagnetic propagation within the apparatus at any given time.

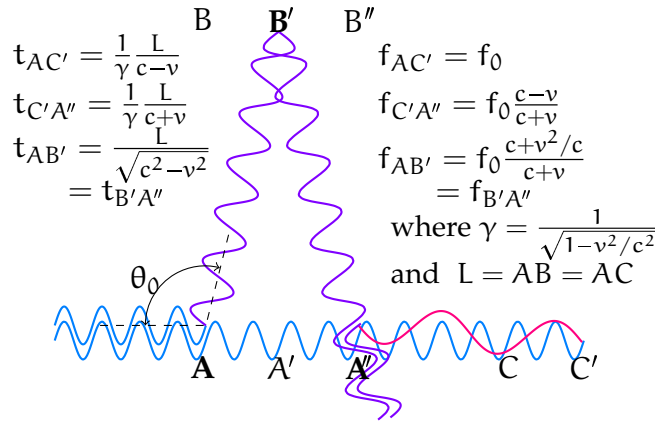


Figure 1: The Michelson-Morley geometry.

From an assumed stationary observation frame (SOF), Fig. 1 sketches the geometry of the MM-apparatus, having constant translatory motion of velocity  $v$  in the direction  $AC$ ; for clarity the mirrors are omitted. The sketch is augmented by a table listing the time of flight and the frequency in each respective leg of the apparatus, these take the relativistic and Doppler effects into account. The source of the electromagnetic propagation is observed as a frequency  $f_0$  in the SOF. The timing equivalence is demonstrated by

$$t_{AC'} + t_{C'A''} = t_{AB'} + t_{B'A''} \quad (1)$$

and the phase equivalence is given by

$$t_{AC'} f_{AC'} + t_{C'A''} f_{C'A''} = t_{AB'} f_{AB'} + t_{B'A''} f_{B'A''} \quad (2)$$

Using the Huygens-Fresnel principle, the angle that the moving mirror reflects the light beam is calculated as <sup>1</sup>.

$$\begin{aligned}
 \theta_0 &= \pi - 2 \arctan \frac{AB}{AC'} \\
 &= \pi - 2 \arctan \frac{1 - v/c}{\sqrt{1 - v^2/c^2}} \\
 &= \frac{\pi}{2} + \arcsin \frac{v}{c}
 \end{aligned} \tag{3}$$

If the electromagnetic beam is continuous, (think one cycle equals one photon) then at any given time, the number of cycles enclosed in one leg of the apparatus is calculated by using either the left or right hand term of Equation (2)

$$\begin{aligned}
 N_0 &= t_{AC'} f_{AC'} + t_{C'A''} f_{C'A''} \\
 &= \frac{2f_0 L (c^2 + v^2)}{c(c + v)\sqrt{c^2 - v^2}}
 \end{aligned} \tag{4}$$

The equivalences of Eq. (1) and (2) as well as the angle of the reflection Equation (3) were expected. However, Eq. (4) is paradoxical when compared to the number of cycles predicted in the moving observation frame (MOF), which are

$$N_v = \frac{2f_0 L}{c} \sqrt{\frac{c - v}{c + v}} \tag{5}$$

and the ratio of the predicted information content in SOF and MOF is

$$\frac{N_0}{N_v} = \frac{c^2 + v^2}{c^2 - v^2} \tag{6}$$

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<sup>1</sup> Equation (3) is reduced using the following two trigonometrical identities

$$\begin{aligned}
 \arccos x &= 2 \arctan \frac{\sqrt{1 - x^2}}{1 + x} \\
 \arccos x &= \frac{\pi}{2} - \arcsin x
 \end{aligned}$$

## REFERENCES

- [1] Copi,C.J. Huterer,D. Schwarz,D.J. Starkman,G.D.“The Uncorrelated Universe: Statistical Anisotropy and the Vanishing Angular Correlation Function in WMAP Years 1-3” *arXiv:astro-ph/0605135v2*
- [2] Krauss L. M., “The Energy of Space that isn’t Zero” *A Talk with Lawrence Krauss* accessed May 3, 2013(last two paragraphs):  
[http://www.edge.org/3rd\\_culture/krausso6/krausso6.2\\_index.html](http://www.edge.org/3rd_culture/krausso6/krausso6.2_index.html)
- [3] Michelson, A. A.and Morley, E. W. “On the Relative Motion of the Earth and the Luminiferous Ether,” *The American Journal of Science*, Vol. XXXIV, 333-341 (1887).
- [4] Einstein, A., “Zur Elektrodynamik bewegter Körper”, *Annalen der Physik* 17: 891 (1905).
- [5] Herrmann,S. Senger,A. Möhle,K. Nagel,M. Kovalchuk,E.V. Peters,A., “Rotating optical cavity experiment testing Lorentz invariance at the  $10^{-17}$  level”, [prd] *Physical Review D* 80 : 105011.