RELATIVITY CHALLENGE

PRESENTATION AND DISCUSSION

PHYSICS 3.0: UNDERSTANDING THE FOUNDATIONAL CONCEPTS AND MATHEMATICS OF THE NEXT PHYSICS REVOLUTION

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NATURAL PHILOSOPHY ALLIANCE (NPA)
VIDEO CONFERENCE
WORLDWIDE FROM BERKELEY, CALIFORNIA
OCTOBER 3, 2009

Agenda

1	A Brief Look Back on the History of Moving Systems Equations
2	Math and Conceptual Mistakes and Why They Haven‘t Been Caught Before
3	Why Correcting the Problem Leads to an Easier Theory and Better Math Results

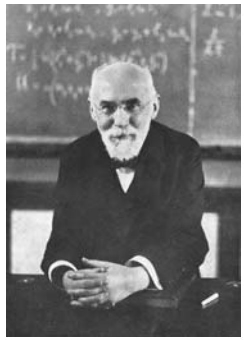
"In Science, as in Logic, if you don't like your ending point, you need to reexamine your starting point."

Glenn Borchardt

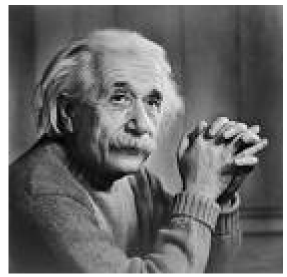
History of Moving Systems Equations

Michelson & Morley

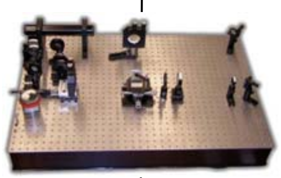
H.A. Lorentz



A. Einstein



1887 | 1895 | 1904 | 1905 | 20th Century | Now



1887

- Experiment to measure Earth Velocity of 30 km/s around the sun
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- Experiment is thought to be correct

1895 / 1904

- Wanted to explain the Michelson-Morley experimental result
- Introduces the concept and math associated with "Length Contraction"

1905

- Introduced "Special Relativity"
- SRT explains Michelson-Morley result as "experimental error"
- Introduces the concept and math associated with "Time Dilation"

20th Century

- LOTS of experiments that support SRT
- Modern navigation and position systems based on SRT principles and mathematics

History of Moving Systems Equations

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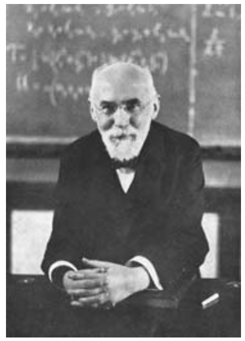

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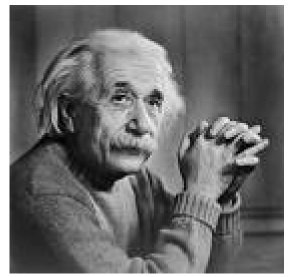
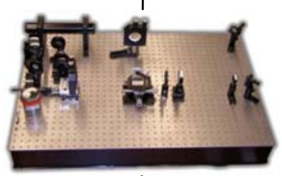


Key Finding — The **Existing Models**, such as SRT, **are well tested and produce really good results**.

Must Explain — How any mistake could go **undetected** for a century and **what difference does it make**.

1887	1895	1904	1905	20^{th} Century	Now



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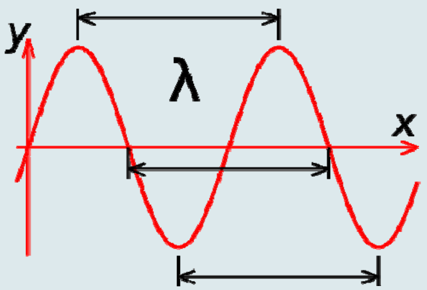
The Undetected Problem

We make the same mistake today, in 2009, that we have made for a century and this prevents us from easily detecting the problem.



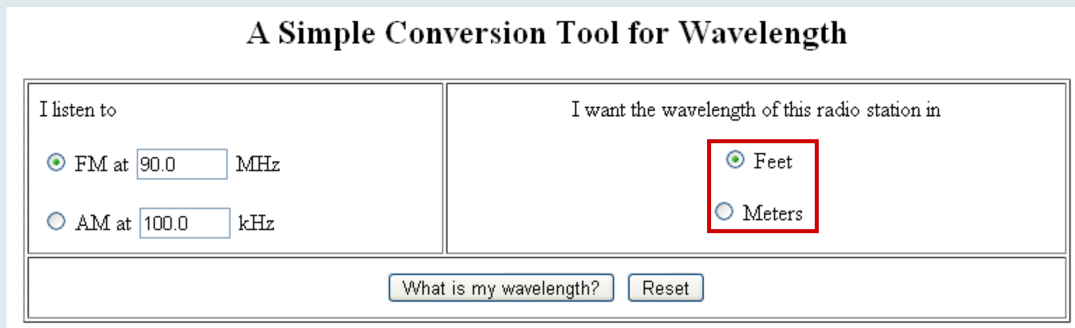
In physics, the wavelength of a sinusoidal wave is the spatial period of the wave – the distance over which the wave's shape repeats.

…, the wavelength of a 100 MHz electromagnetic (radio) wave is about: 3×10^8 m/s divided by 100×10^6 Hz = 3 meters.

Source: Wikipedia, August 2009

If you study waves, you will find that wavelength and frequency are related by an equation

Speed of the wave = Frequency x Wavelength



Source: Nasa.Gov Website, August 2009

…wavelength can be converted into a frequency by the formula

frequency in Hertz = 300,000,000 / λ

where the Greek letter lambda, λ, means wavelength in meters, ...

Source: QST Magazine, September 2009

Distinguishing Types

Rates, such as Miles Per Hour, are different than Measures, such as Miles.

I live in Oakland, which we can see is 60 miles per hour from San Francisco State University.

Speedometer

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Quiz: Which of the following statements is true?

A. 60 Miles Per Hour is Greater Than 60 Miles
B. 60 Miles Per Hour is The Same as 60 Miles
C. 60 Miles Per Hour is Less Than 60 Miles
D. None of the above

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D. None of the above

Key Finding

Generally, we would not mistake a Rate, such as Miles Per Hour, as a Measure, such as Miles.

Key Question

Does our Answer change if I look at my speedometer and say "I live 60 miles from SFSU"?

Distinguishing Types

If Rates are mathematically treated as Measures, we can get the wrong answers.

San Francisco, California

San Jose, California

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Measure (Miles)

60 Miles →

60 Miles ←

= 120 Miles

Added = 120 miles

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Measure (Miles)

60 Miles →

60 Miles ←

= 120 Miles

Added = 120 miles

Rates (Miles Per Hour)

60 Miles Per Hour →

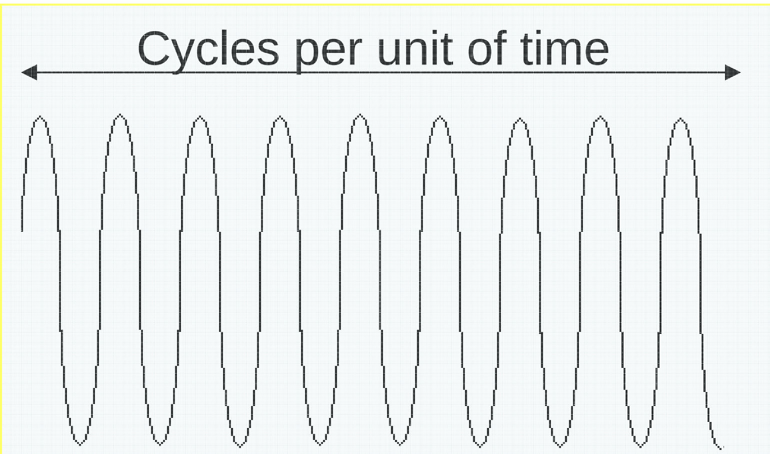
60 Miles Per Hour ←

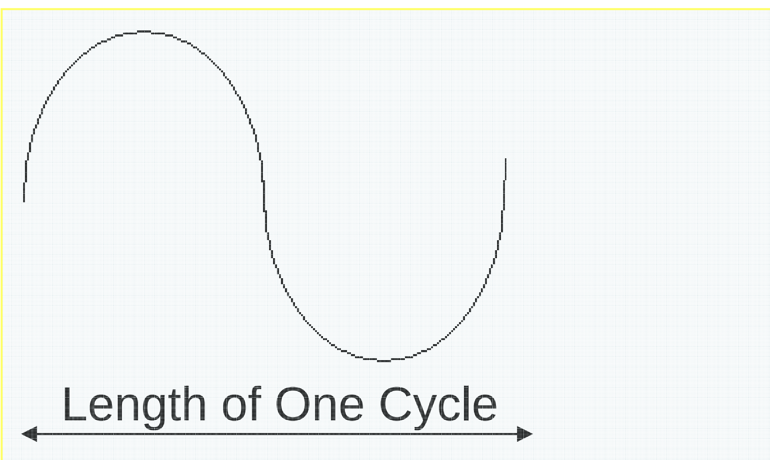
~~= 120 Miles Per Hour~~

Averaged = 60 mph

Distinguishing Types (Continued)

Wavelength, such as Meters Per Cycle, is different than Length, such as Meters.





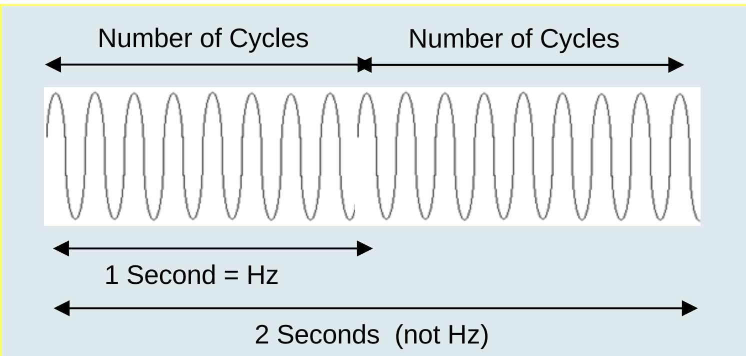
- Frequency
  - Is the Number of Cycles that occurs in some amount of time, usually one second, and is most often expressed in Hertz
- Wavelength
  - Is the Length of One Number of a given Frequency
  - At least 95% of Textbooks misstate Wavelength as Meters
- Equation $$v\ \frac{m}{s} = f\ \frac{c}{s} * \lambda\ \frac{m}{c}$$

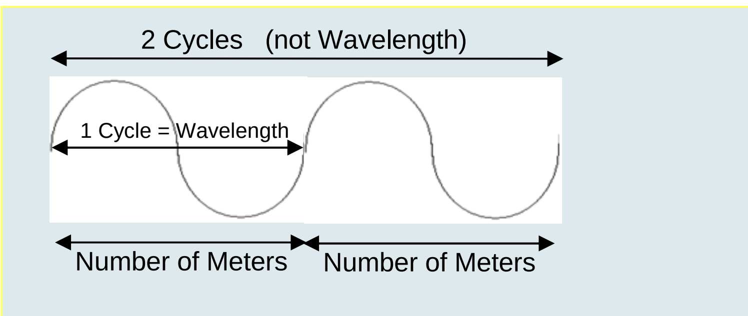
Key Finding

Wavelength, λ, is a **Rate**, expressed as **Meters† Per Cycle**, is different from Length, which is a **Measure** given in Meters†.

Distinguishing Types (Continued): Watch Out!

Mistreating Wavelength for Length can lead to mistakes in Moving Systems algorithms.





- Imagine a mirror is held 300,000,000 meters from a light source. A light is directed at the mirror at frequency f Hz.
  - How many cycles are between the light source and the mirror?
- Now the mirror reflects the light back to the light source.
  - How many cycles are between the light source and the mirror?
  - How many cycles are there in this round trip journey light source to mirror to light source?
  - What is the frequency?
  - What is the wavelength?

Key Finding

- Frequency and Wavelengths are **Rates**
- Wavelength should be **Averaged** instead of Added
- Mistreating Wavelength for Length can produce incorrect results
- **The Michelson-Morley Algorithm "Added"** instead of Averaging

Implications

In order to understand the importance of recognizing Wavelength as a Rate, we must examine how its mistreatment as a Length leads to different conclusions.

λ Units	
λ in meters	**λ in meters per cycle**
- Moving Rods (Length) and Stationary Rods (Length) are the same type - Equations produce "space-time" points - Simultaneity, Length Contraction and Time Dilation	- Moving Rods (Wavelength) and Stationary Rods (Length) are different types - Equations produce the average of the Approaching and Receding Doppler Shifts - Perceived Changes to Frequency
- Adjusts the Michelson-Morley equations $\frac{x'}{1-v^2/c^2}$ by multiplying by $\sqrt{1-v^2/c^2}$, yielding $\boxed{\frac{x'}{\sqrt{1-v^2/c^2}}}$. - Gives good results - Equations serve as a replacement to the Newtonian equations	- Adjusts the Michelson-Morley equations $\frac{x'}{1-v^2/c^2}$ by multiplying by ½, yielding $\boxed{\frac{x'/2}{1-v^2/c^2}}$. - Gives better results - Recognizes that the Rate-based equations and the Length-based Newtonian equations answer different questions

"I don't think you can mount a successful defense of or challenge to SRT without understanding Einstein's Tau Function."

Steven Bryant

Distinguishing Functions

τ is a Function and Functions must be handled differently than Equations: Functions can have local variables and must be invoked.

Feature	Equations	Functions
Definition†	☑	☑
Optimization	--	☑
Invocation†	--	☑
Simplification	☑	☑
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❸ $\frac{1}{2}(\tau_0 + \tau_2) = \tau_1$

oder, indem man die Argumente der Funktion τ beifügt und das Prinzip der Konstanz der Lichtgeschwindigkeit im ruhenden Systeme anwendet:

❷ $$\frac{1}{2}\left[\tau(0,0,0,t) + \tau\left(0,0,0,\left\{t + \frac{x'}{V-v} + \frac{x'}{V+v}\right\}\right)\right] = \tau\left(x', 0, 0, t + \frac{x'}{V-v}\right).$$

Aus diesen Gleichungen folgt, da τ eine *lineare* Funktion ist:

❶ $$\tau = a\left(t - \frac{v}{V^2 - v^2}x'\right),$$

Source: A. Einstein, 1905

Key Question

In Einstein's Function, ❶, can you identify the local and global variables?

** For today's discussion, ignore the global "t" variable in each function invocation and V is replaced with c.*

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Note

Functions should be written with formal signatures to avoid confusing them with equations and to clearly define local variables.

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❶ $\tau(\text{Real } x', \text{Real } y, \text{Real } z, \text{Real } t) = \alpha\left(t - \frac{vx'}{c^2 - v^2}\right)$ **Definition**

❷ **Invocation**

$\tau_0 = \tau(0,0,0,t)$

$\tau_1 = \tau(x',0,0,t + \frac{x'}{c-v})$

$\tau_2 = \tau(0,0,0,(t + \frac{x'}{c-v} + \frac{x'}{c+v}))$

❸ $\frac{1}{2}(\tau_0 + \tau_2) = \tau_1$ **Usage**

** For today's discussion, ignore the global "t" variable in each function invocation and V is replaced with c.*

What Does Einstein's τ() Function do?

Reverse Engineering, using Einstein's five τ() function invocations, tells us what the function does: It answers the question "What is the average of the Approaching and Receding Doppler shifts"?

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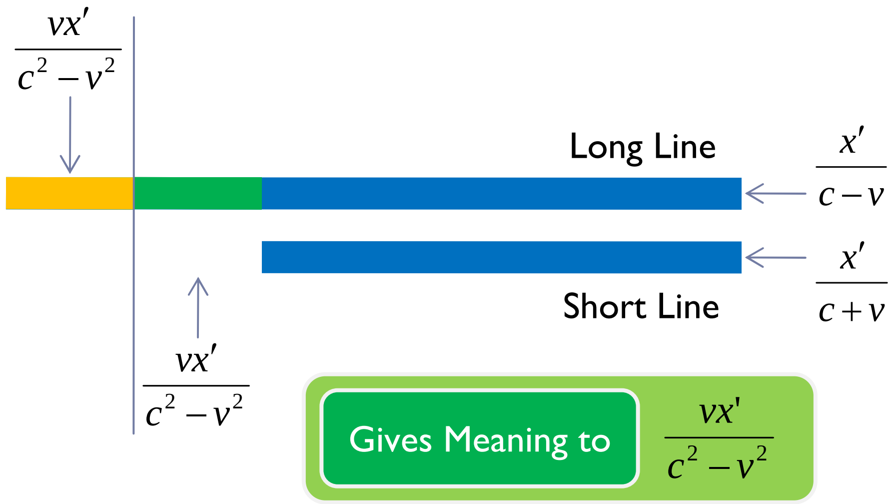

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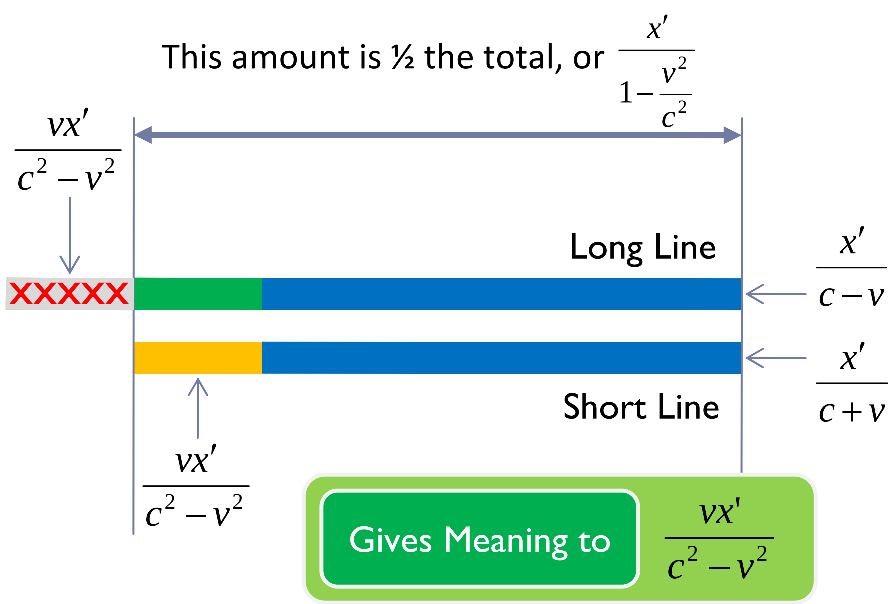

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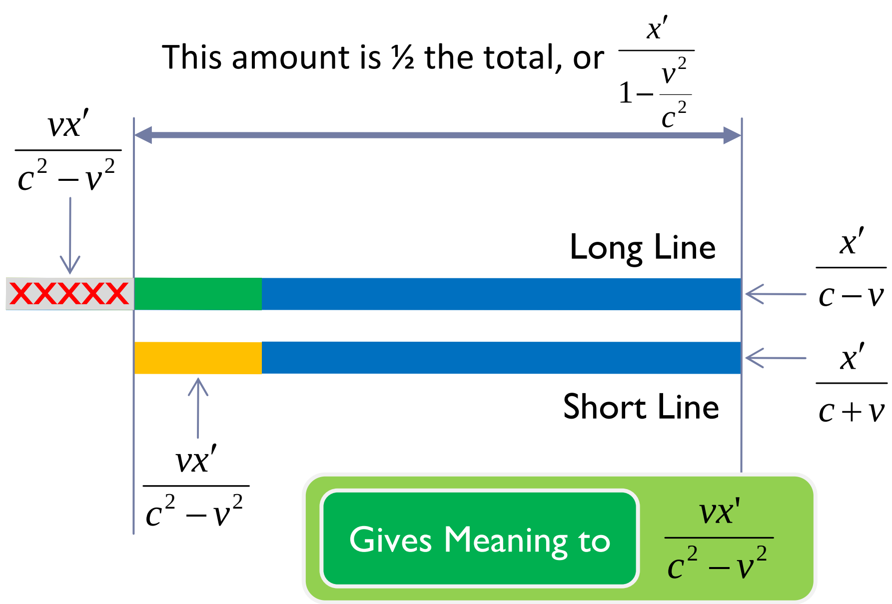

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3. Either subtract ½ **remainder** from long line **or** add to short line

- **Three ways** to find ½ (or the average) of the total:
  - Add $\frac{x'}{c+v}$ to $\frac{x'}{c-v}$ and divide by 2
  - Subtract $\frac{vx'}{c^2-v^2}$ from $\frac{x'}{c-v}$
  - Add $\frac{vx'}{c^2-v^2}$ to $\frac{x'}{c+v}$

Key Finding

Einstein τ() function finds the average of an Approaching and Receding Doppler shifts

$$\xi = c\tau_1 = c\tau(x',0,0,\frac{x'}{c-v}) = c\left[\frac{x'}{c-v} - \frac{vx'}{c^2-v^2}\right] = \frac{x'c^2}{c^2-v^2}$$

Distinguishing Functions (Continued) : Watch Out!

Einstein does not perform a required Function Invocation and incorrectly simplifies τ as if it were an equation; mistreating it as the single time value when there are three – one for each axis!

	Informal (Einstein)	Formal
Function Invocations	$\tau = (t - \frac{vx'}{c^2 - v^2})$, where $t = \frac{x'}{c - v}$ and $x' = x'$ $\tau = (t - \frac{vx'}{c^2 - v^2})$, where $t = \sqrt{\frac{y}{c^2 - v^2}}$ and $x' = 0$ $\tau = (t - \frac{vx'}{c^2 - v^2})$, where $t = \sqrt{\frac{z}{c^2 - v^2}}$ and $x' = 0$	$\tau_x = \tau(x', 0, 0, \frac{x'}{c - v})$ $\tau_y = \tau(0, 0, 0, \sqrt{\frac{y}{c^2 - v^2}})$ $\tau_z = \tau(0, 0, 0, \sqrt{\frac{z}{c^2 - v^2}})$
Optimization versus Simplification	$x' = x - vt$ $\tau = \alpha(t - \frac{vx'}{c^2 - v^2})$ Incorrectly Simplified As An Equation $\tau = \alpha(t - \frac{vx}{c^2})/(1 - \frac{v^2}{c^2})$	$x' = x - vt$ $\tau(\text{Real } x', \text{Real } y, \text{Real } z, \text{Real } t) = a(t - \frac{vx'}{c^2 - v^2})$ Cannot Be Simplified As An Equation

τ is a Function!

Key Finding

In Einstein's derivation, τ is treated like an algebraic equation, making it easy to overlook the need to invoke the function before performing simplification.

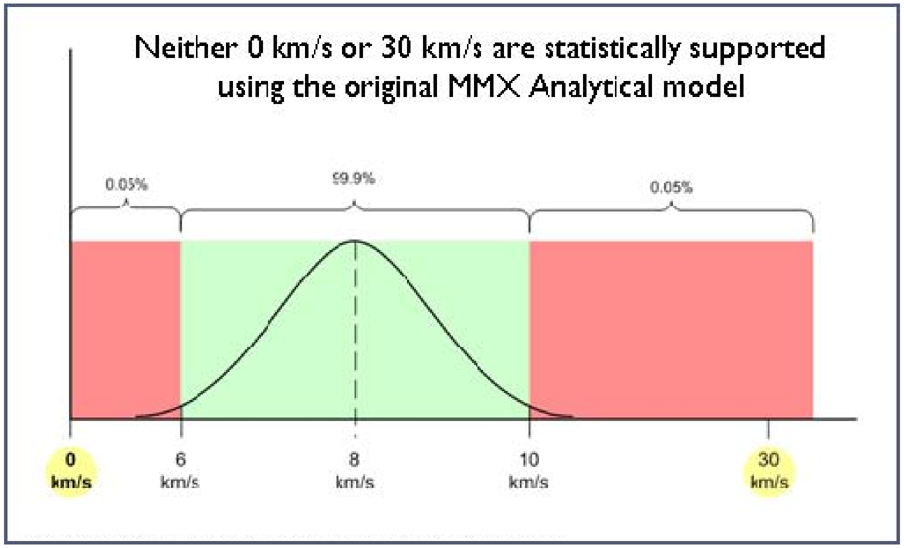
“To reject one paradigm without simultaneously substituting another is to reject science itself.”

Thomas Kuhn

What Changes?
The Michelson-Morley Experiment

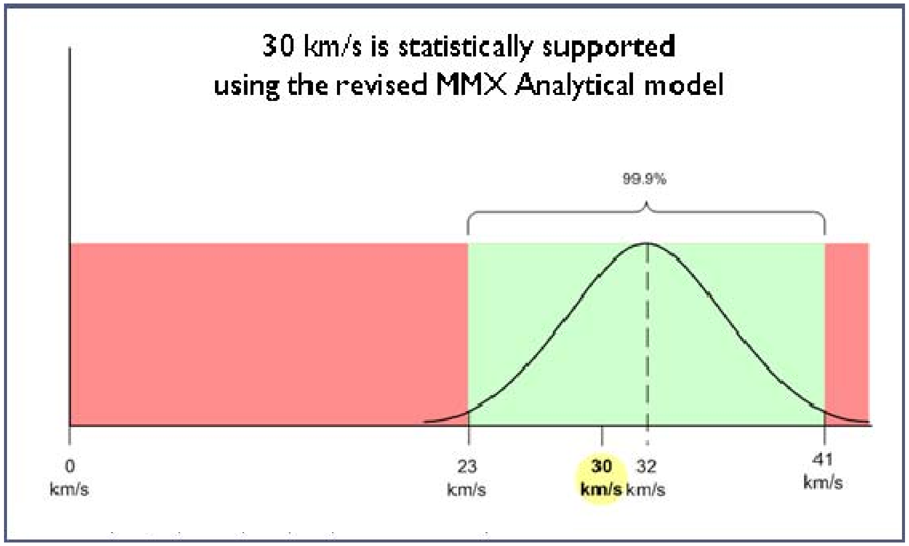
The revised equations incorporate our understanding of Wavelength and Length and statistically supports the expected result of 30 km/s.

Original Algorithm



- Lorentz wanted to explain the failure to get 30 km/s
- SRT requires that the measured results are attributed to "experimental error"
- Interpreted as measuring "**null**" or 0 km/s
- No Experimental Convergence

Revised Algorithm



- Distinguishes between Wavelength and Length Types
- Uses Wavelength versus Length Math Operations
- Aligns Expected Result Measurement Angle with Actual Result Measurement Angle
- 30 km/s is Statistically Supported
- Experimental Convergence with Miller 1933 - 30 km/s!

What Changes?
The Ives-Stillwell Atomic Clock Experiment

The revised algorithm predicts the Ives-Stillwell Atomic Clock experiment with **equal or greater accuracy** than the SRT equations.

Expected and Actual Results of the Doppler Displacement

#	Plate	Actual Result	Einstein Expected Result	Einstein Variance	REVISED Expected Result	REVISED Variance
1	169	10.35	10.3610	0.0110	10.3500	0.0000
2	160	14.02	14.0403	0.0203	14.0201	0.0001
3	163	15.40	15.4245	0.0245	15.4002	0.0002
4	170	16.49	16.5181	0.0281	16.4902	0.0002
5	165	14.07	14.0904	0.0204	14.0701	0.0001
6	172	18.67	18.7060	0.0360	18.6703	0.0003
7	172	15.14	15.1637	0.0237	15.1401	0.0001
8	177	21.37	21.4172	0.0472	21.3704	0.0004
--	**mean**	**15.69**	**15.7151**	**0.0264**	**15.6889**	**0.0002**

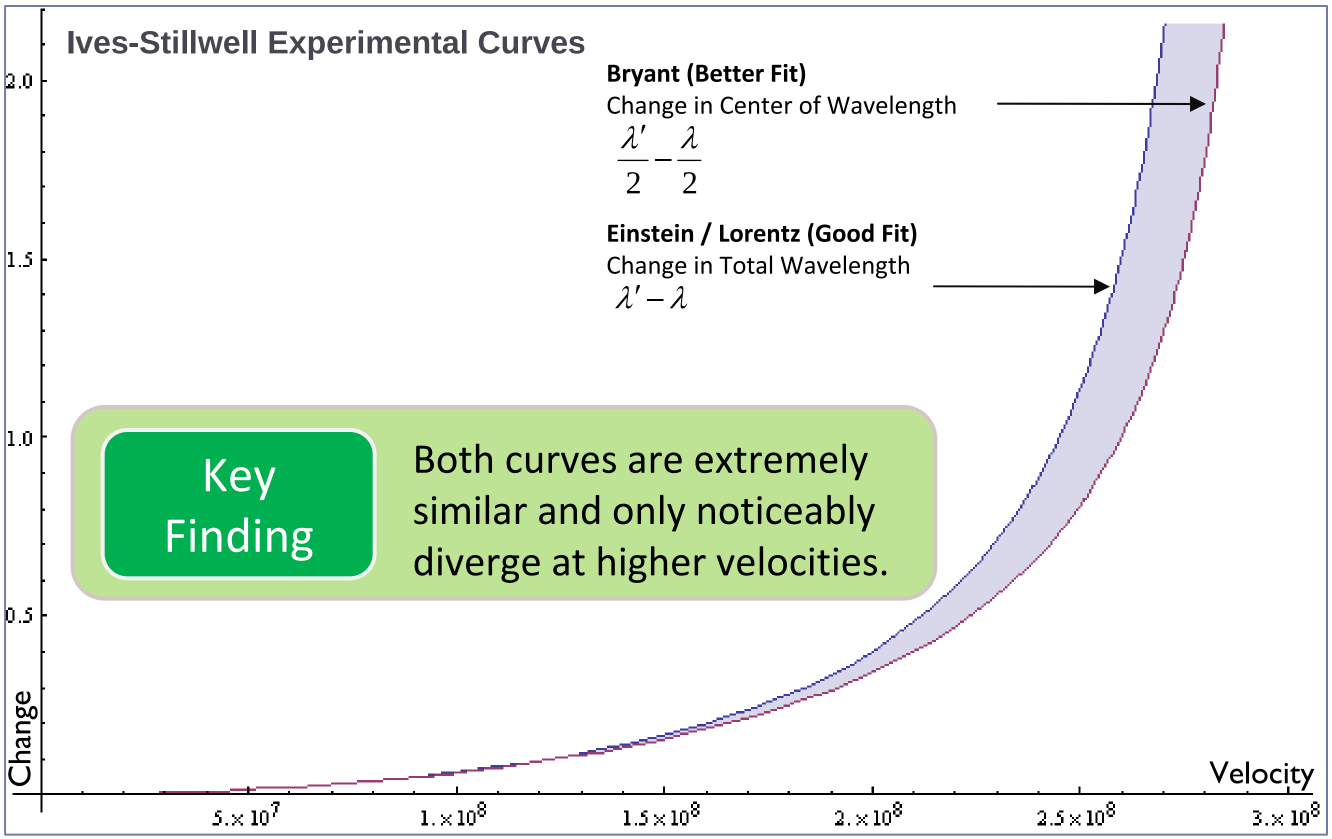
- **Einstein's equations produce close results with a small error of 0.02 to 0.03**, to the degree of accuracy of the experiment
- **The new moving system equations produce 0 error,** to the degree of accuracy of the experiment

Key Finding

Challenges the belief that SRT is the only predictor of the Ives-Stillwell experiment.

If SRT is Wrong, Why Does It Work So Well?

In some cases, the SRT Length-Based Equations and the Revised Rate-Based Equations produce extremely close (or in some cases identical) results, even if their interpretations are different.



“Fortunately, there is a … consideration that can lead scientists to reject an old paradigm in favor of a new. These are the arguments … that appeal to the individual’s sense …[that] the new theory is said to ‘neater,’ ‘more suitable,’ or ‘simpler’ than the old.”

Thomas Kuhn

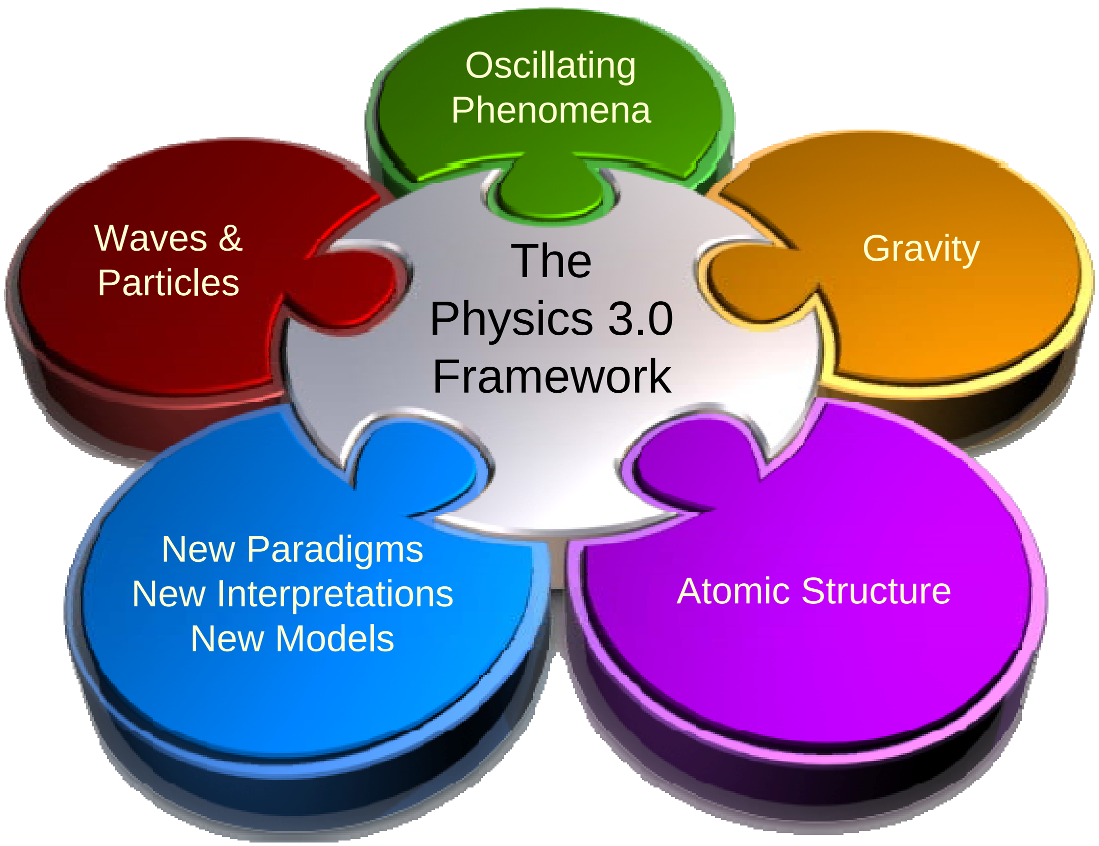
Strategic Requirements

A new model or theory must make it over a high-bar in order to be considered a replacement candidate for the prevailing model.

❶	**Make Better Predictions**	**Produces More Accurate Experimental Results.** The revised Michelson-Morley and Ives-Stillwell equations produce less error than SRT-based Alternatives
❷	**Offer Something That Is Difficult To Disagree With**	**Wavelength is a Rate given in Length Per Cycle** as units (e.g., Meters Per Cycle)
❸	**Explain Why The Problem Has Been Missed**	The Majority of **Textbooks mistreat Wavelength as a Length** (e.g., Meters) **No previous connection was made between Moving Systems Equations and Wavelength (or Frequency) as a Rate** **In many cases, mistreating Wavelength as a length is not a problem**
❹	**Explain Why The Finding Is Significant**	**Illuminates Conceptual and Mathematical Problems in Einstein's and Lorentz's work** **Broad implications** in other areas of Physics (e.g., Acoustics, Fluid Mechanics, Quantum Mechanics) and other Disciplines
❺	**Explain Something That Has Not Been Explained Before**	**Explains Einstein's Tau Function and give a specific meaning to vx'/(c^2-v^2),** which is explained in SRT as "the adjustment to time." **Defines ξ as a Rate that is the Average of the Approaching and Receding Doppler Shifts**, with the same meaning applying to each axis. Replaces Length-based interpretation of "space-time points."

The Physics 3.0 Framework

In the Physics 3.0 Framework, Scientists can work together to build upon the fundamental characteristic that Wavelength is a Rate.



Characteristics

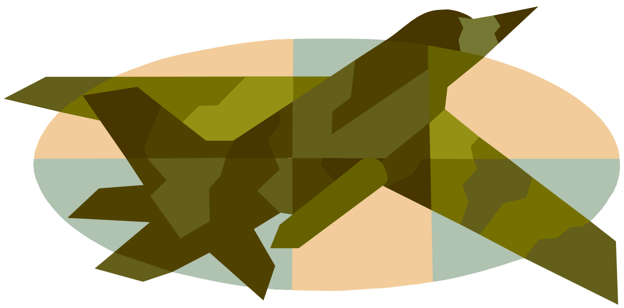
- **Wavelength is a Rate** (length per cycle)
- **Average Wavelength Shift Equations**
- **Generalized Equations** that apply to all Mediums (e.g. "w" to represent wave propagation velocity, instead of "c" which is specific to one medium)
- **Strongly "typed"**

Benefits

- **Foundational Framework for a Unified Theory**
- **Allows for greater consistency and compatibility** between ideas, models, and equations
- **Room to reexamine existing theories**
- **Room to reexamine existing experiments**

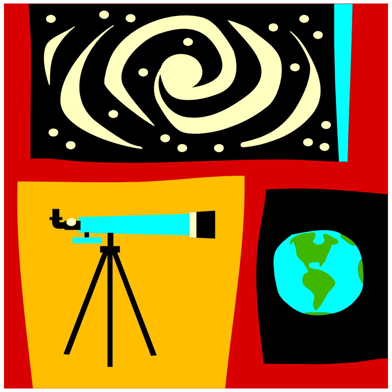
What Does This Mean?

At a minimum, our theoretical understanding of Moving Systems will change and our analytical models and equations can improve.



Improved Navigation Systems

Improved Scientific Instrumentation

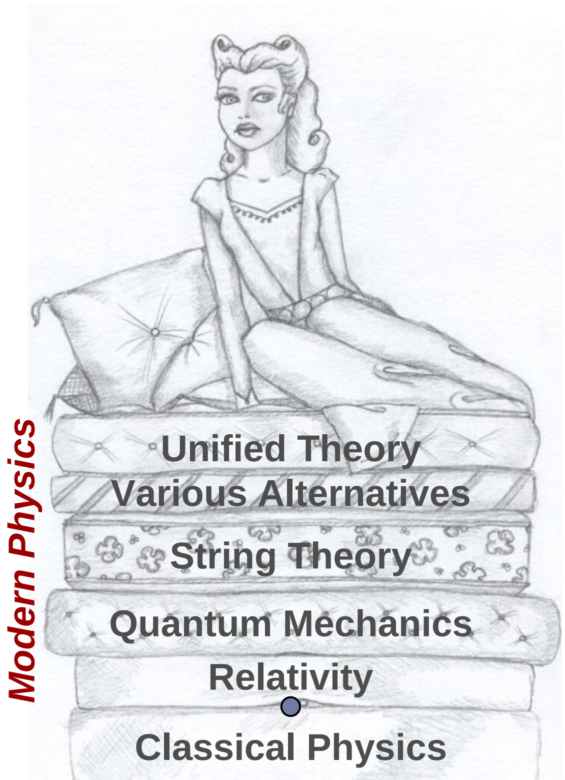


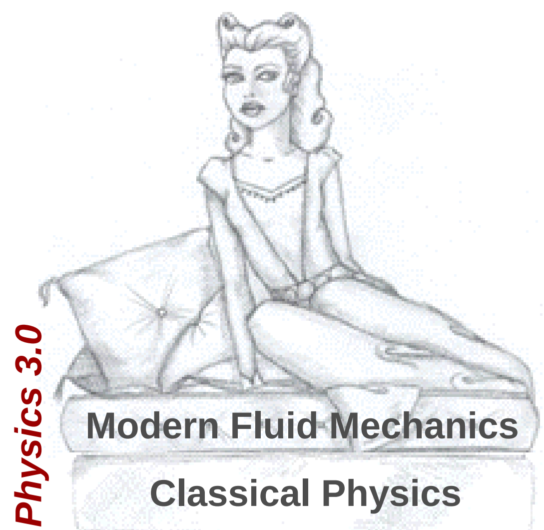
New Moving Systems Models

New Ideas and Products

Key Message: Wavelength Is A Rate

More Mattresses (Theories) will not mask the Pea (mistreatment of Wavelength as a Length). Instead, once we remove the Pea, we will find that we don't need as many Mattresses and can sleep much better.





Original Image Source: Kaci Albert

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Thank You

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www.RelativityChallenge.com
(website, presentations, papers and podcasts)

For More Information

Additional information can be obtained by visiting www.RelativityChallenge.com.

If You Want To Know About	Video To Look At
How Wavelength has been mistreated as a Length and its implications	Episode 20 (AAAS Conference Presentation)
Understand SRT, including Time Dilation, and Length Contraction, and why they are not needed in an Alternative Model	Episode 19
A look at Einstein's 1905 derivation as he performed it and using modern, accepted, function notation	Episode 17
A look at the similarities and differences between the Moving Systems Models [Michelson-Morley(1887), Lorentz(1904), Einstein(1905), Bryant(2003)]	Episodes 16 & 18 (NPA/AAAS Conference Presentations)
Revisiting the Michelson-Morley Experiment to reveal an Earth Orbital Velocity of 30 km/s	Episode 11 (NPA/AAAS Conference Presentation)

Summary

Computer Science techniques provide tools and analytical processes that can improve our understanding of Moving Systems theories and equations.

Area	Summary
Why Hasn't The Mistake Been Detected Sooner?	• We make the mistake all of the time and it hasn't caused us a problem yet, so we ignore it • Requires an understanding of the nuances of Functions
What Does It Change?	• Our understanding of any SRT experiment that uses Frequency or Wavelength • "Moving Rods" = Wavelength and "Static Rods" = Length • Einstein's concept of simultaneity does not apply to Wavelength
What Does It Mean?	• New theories and practical solutions with improved accuracy • We can explain what the τ function does • New algorithms that "live within the error" of the existing models
What Computer Science Tools And Analytical Techniques Do We Use	• Computer Science tools, techniques and approaches will need to be incorporated into Math and Physics • Formal function notation and terms (types) makes problem identification easier
What Do You Need To Remember?	• Averages, Rates, and Functions • The average of the approaching and receding Doppler shifts