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Light Speed and Special Relativity

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This paper reviews the available speed of light (c) measurements of 1994 AD that demonstrate speed variations of inter-planetary light as measured relative to the motion of:... planets, satellites, the solar system, and the Milky Way galaxy.

The idea that light from a remote source maintains a constant speed (c) relative to all observers regardless of their differing speeds and directions, as proposed by the theory of Special Relativity, is shown to be incompatible with the characteristics of light's speed demonstrated by the 1994 AD data, analysis and charts of Io's eclipse timing.

The one single fact that demonstrates that light speed is not constant to all observers is the "**1003 second delay**" in Io's eclipse timing,... as discovered by Roemer circa 1676 AD.

The given facts in this analysis are:

- The light from Jupiter takes 1003 seconds to cross from the near point of Earth's orbit to the far point at the speed of 300,000 km/sec, (c) in relation to Jupiter.
- It is known that Earth takes about 200 days to make this same trip. The Earth's average retreating speed in relation to Jupiter is 17.361 km/sec.
- When two things race between two points at the same time at differing speeds,... they have a relative speed that is equal to the difference between the highest and lowest speed. Therefore the average relative speed is approximately 300,000 minus 17.361 km/sec.

Conclusion:...This **relative** velocity between the retreating Earth and the Jupiter / Io light train is not constant at 300,000 km/sec, and therefore,...**light does not maintain a constant speed (c), relative to all observers**,... as postulated by Special Relativity.

The remainder of this paper presents extensive detailed data and graphs supporting this conclusion, but it can be seen that Roemer's 1003 second delay in Io's eclipse event timing is the **single data point** that clearly demonstrates that it is not possible for the light speed in the intervening space to be constant at (c) in relation to the retreating Earth,... but of course it remains constant at (c) in relation to Jupiter.

Roemer, many other astronomers and NASA have established that the eclipse period of Io in relation to the Sun line to Jupiter is 152,915.9 seconds. The important point concerning this period is the fact that it does not vary.

If the Earth could linger at the near point to Jupiter, it could be observed that Io's timing in crossing the Sun line to Jupiter does not vary over the years. It would make a very accurate clock for Sun dwellers.

When the Earth starts it's orbit and is leaving the near point,... if the speed of light remained constant relative to the Earth, then:

- the timing of Io's period as observed from the Earth would not change,... regardless of the longitudinal speed of the Earth relative to Jupiter.
- All succeeding eclipse events observed during movement would remain in timing synchronism with the events as observed at the stationary near point.
- If this were true, then there would have been no 1003 second accumulated delay for Roemer to record.

If the mechanics of the phrase,... **[*if the speed of light remained constant relative to the Earth, then the observed timing of Io's period would not change*]**,... is not completely clear, the reader will not be able to understand the main argument of this Light Speed versus Special Relative paper.

A second concept which is also critical to understanding the argument is,... **[*you cannot separate the speed and timing of the eclipse event image from the speed of the light.*]**

Accuracy in measuring the eclipse timing and accuracy in the graphs demonstrating the changes of the eclipse period timing **is not critical** nor required to validate this argument. The **single elementary fact** that Roemer's 1003 second delay exists,... makes the second postulate of Special Relativity impossible. Without the second postulate of Special Relativity there is no known foundation or justification for the continued existence and / or advocacy of the Special Relativity and General Relativity Gravitational theories, and their **publicly supported** educational programs and investigative projects.

Light's Variable Speed Relative to Observers in Motion

In our experience with the speed of sound in air including the Doppler effect, we have found that the speed of sound through the air is independent of the relative speed between source and receiver. The speed of sound is constant only in relation to the homogenous medium, through which it is traveling. Sound travels as a longitudinal resonance wave within the physical properties of its medium.

Circa 1676 Olaf Roemer's Io eclipse timing measurements demonstrated that the speed of light is not infinite. Prior to this discovery it was a popular belief that light's speed was infinite. Using the eclipse period timing of Jupiter's moon Io, Roemer found that light took approximately 1000 seconds to cross the 300 million kilometer diameter of the earth's orbit, indicating a speed of about 300,000 km/sec. Thereafter it was assumed that interplanetary light traveled at (c)

through a medium of infinitesimal material particles. This all-pervading medium was called the Aether (ether). The speed of light was **assumed** to be constant in relation to this material Aether of space, in the same manner that the speed of sound is constant relative to its medium. This material Aether was visualized as pervading all planets, objects and space in its entirety. Therefore it was assumed that due to the orbital speed of the Earth, that light from space would show a measurable change in speed depending on the direction of the Earth's motion through this presumed stationary material "Aether". It also seemed reasonable that the light speed perpendicular to the direction of the Earth's motion would always remain at
c, (300,000 km/sec).

In ~1887 Michelson and Morley performed a famous experiment where they compared the speed of local light in the direction of Earth's velocity to the speed of light transverse to the Earth's motion. They found that the motion of the Earth had no effect on the velocity of local light,... relative to the Earth and within its cloak of atmosphere and secondary radiation. The surprising results of this local experiment were widely and erroneously extrapolated to a belief that all of light, including light from non local sources in space, also traveled at the constant c,... "relative to the observing location". In parallel with this development the theory of Special Relativity was published circa 1905, with main tenets that included the concept that not only local light, but that all of light in space,... traveled at c,... " in relation to the observer",... regardless of the observers velocity in relation to the source.

Io's Eclipse Delays

An analysis of light's speed in relation to the motion of Earth is given here by reviewing Roemer's discovery and charting Io's 1994 AD eclipse data available from Astronomy On Line's website. Olaf Roemer's measurements of 1676 AD demonstrated a finite value for the speed of light through interplanetary space. Roemer noticed that the eclipse event timing for Jupiter's moon Io was delayed approximately 1000 seconds when the Earth was at its farthest point from Jupiter in comparison to the event timing measured at the closest point in Earth's orbit. With the current knowledge of the diameter of Earth's orbit at approximately 300 million km, Roemer's delay of 1003 sec. indicates that Sun light reflected from Jupiter travels through space in relation to Jupiter at a speed of 299,103 km per second, (c).

During Earth's orbital trip from the point nearest to Jupiter (opposition), to the farthest point (conjunction), the moon Io completes 113 eclipse cycles as timed at the near point. If this is an exact calculation then the last eclipse event image, number 113 is crossing the near point when the Earth is at the mathematical far point. This last event will not be observed in the vicinity of the far point (conjunction) for another 1003 seconds (16.7 minutes). Many books and reviewers of this phenomenon list the time for Earth's journey from the near point to the far point as 200 days and equate this to 113 Io eclipse event periods as observed at the near point.

NASA's JPL Labs provides data listing a mathematical time period of 152,853.5 seconds (~1.77 days) for Io's sidereal revolution. Io's eclipse revolution time is 152,915.9 seconds, which is 62.4 seconds longer than the sidereal revolution time, due to the relative motion of the Sun line.

The argument about the velocity of Io in orbit does not need to be considered. You can consider the shadow of Io cast on the surface of Jupiter when Io crosses the Sun line,... as representing the timed event. The change in period per Io revolution will remain the same. The only two velocities that need to be considered are "c" and the longitudinal velocity of Earth, both in relation to Jupiter and Jupiter's inertial reference frame.

Roemer's 1003 Second Delay

In order to clarify the issues of this argument we will linearize the arithmetic by assuming to take a spacecraft trip from Earth at the near point, following the diameter to the future far point. This constant longitudinal speed will be set to equal the Earth's average longitudinal speed when retreating in relation to Jupiter. In this scenario the spacecraft will rendezvous with the Earth at the far point after 113 periods elapse (~200 days) plus the 1003 second delay. The 113th event and the spacecraft will arrive at the far point with Roemer's famous 1003 second delay. The longitudinal distance traveled relative to Jupiter is the diameter of the Earth's orbit, ...~300 million km. Therefore Earth's retreating longitudinal trip of 300 million km in 113 orbit periods (~200 days), requires an average speed of 17.36 km per second in relation to Jupiter. The Earth only moves in its orbit approximately one hundredth of a degree during the 1003 second delay. Therefore assuming that the far point and the intercept point for the 113 eclipse event are the same does not introduce any significant error.

Since the diameter distance of 300 million km is evenly divided by the constant speed of the spacecraft , the distance from the start (near point) to the point for the first observed eclipse event will be the total distance, divided by the number of Io eclipse periods, 113. This places the point of observation, for the first eclipse observed by the spacecraft in motion,... at 2.6549 million km from the near point.

The time accounting tells us that if there are 113 Io eclipse orbits during this trip, and the last eclipse event is observed and measured to be 1003 seconds later than predicted,... therefore at the half way point in distance for the linear trip the delay must have been about 501.5 seconds. Continuing with this accounting, the first observed eclipse after leaving the near point on the linear trip, must have exhibited a delay of 8.876 seconds. This is obtained by dividing the total delay of 1003 seconds by the total 113 eclipse observations.

When a light beam is interrupted by a toothed wheel, it is never assumed that the dark sections do not travel at the same speed as the light. In fact many light speed experiments use this obvious physical phenomenon to measure the speed of light. With the same reasoning it appears obvious that images transported by a light beam have to travel at the same speed as the light beam. Movie projectors provide examples of the application of this physical phenomenon. When this reasoning is applied to the images of Io's eclipse events, it does not seem possible to question the fact that the event images travel at the same speed as their constituent light. If there is a Doppler effect for the frequency of the light, there will also have to be a Doppler effect for events or digital information,.. and visa versa. It is necessary that this mutual relationship, between these two Doppler phenomena,... is clear to the reader for understanding the main argument of this paper.

Now if the spacecraft leaves Earth at the near point and at the observation of an eclipse event, then the time to the next observed eclipse event will be 8.876 seconds longer than a stationary period, as calculated above.

The near point and Jupiter have no relative velocity, therefore the train of light imaging Io's eclipse events is traveling at c in relation to:.. Jupiter, and the near point and the first rendezvous point. .

When the next eclipse event passes the near point with the speed of c, it will continue toward the rendezvous with the spacecraft, and it will take light 8.876 seconds to cover the 2.6549 million km to reach the first rendezvous point. This, of course, is the reason for the delay observed by the spacecraft in motion.

Since the light speed, c, in relation to Jupiter is 299,103 km/s , and the spacecraft speed in relation to Jupiter is 17.361 km/sec,... this results in an average reduced relative speed of 299,085.6 km/sec. between the eclipse event image motion and the spacecraft motion.

If the speed of the train of light and events from Jupiter was not reduced in relation to the retreating Earth, succeeding observations of eclipse events would remain in synchronism with the observations of the near point. How could a station 2.6549 million miles further from Jupiter observe an eclipse event at the same time that it is observed at the near point?

The only way there could exist an absence of an observed delay during motion,... would be if the light speed was infinite. There would be no delays during the 200-day retreating movement, and the accumulation of 113 individual delays to equal the total 1003 second delay would not occur. Therefore there would not be a 1003 second delay to be manifested at the far point.

Of course Roemer's 1003 second delay of 1676 AD exists,... and is still measurable today. For 300 plus years this delay has been demonstrating that light from Jupiter exhibits a reduced speed in relation to the retreating motion of Earth. On Earth's return trip a proportionately higher relative light speed will be exhibited as Earth approaches Jupiter. Upon returning to the near point,... Io's observed events will again be in phase synchronism with the previous eclipse events at the near point.

With the light and the space craft racing to the same point at their different speeds,... how is it possible to subscribe to the concept of Special Relativity (SR) that states that the relative light speed does not decrease with changing motion. Furthermore, on Earth's return trip the relative speed will be greater than the "upper limit and constant speed of light" of SR.

Delay versus Transverse Motion.

There exists an argument that attributes the period changes which occur during Earth's orbit to the changing line of sight angle for viewing the eclipse events. If this argument were true the maximum changes in the length of the observed period would occur during the orbital positions when the Earth's motion is transverse to the line of sight to Jupiter. The following graphs plot the changing delay time from actual eclipse data recorded for a retreating and approaching orbital trip. It is seen from the following graphs that the maximum changes in the length of the observed period occur during the orbital positions that provide the highest relative longitudinal velocity between the two planets.

When the Earth is nearest to Jupiter during Earth's orbital trip,... Earth's motion is transverse to the line of sight to Jupiter. At this point of Earth's orbital travel, it is observed that the orbital period of Jupiter's moon Io is essentially the same as the JPL's published eclipse revolution period of 152,915.9758 seconds. Since there is no relative longitudinal motion between the two planets at this near point in Earth's orbit, the speed of the eclipse light train periods is taken to be 300,000 km/sec, c, in relation to both planets. If the Earth could remain at this nearest point for a few orbits of Io it would be found that each succeeding eclipse event would occur with the same predictable period. ***

Charting Io's Eclipse Data

As the Earth starts its orbit and leaves the point nearest to Jupiter there arises an increasing longitudinal velocity between the two planets.

As the light train speed is reduced relative to the retreating Earth, and remains at c in relation to Jupiter, there will be a measurable increasing delay in the events as observed from Earth. The following graphs display the changing delays in event timing (changing period) in relation to the changing longitudinal velocity as the Earth retreats from and approaches toward Jupiter.

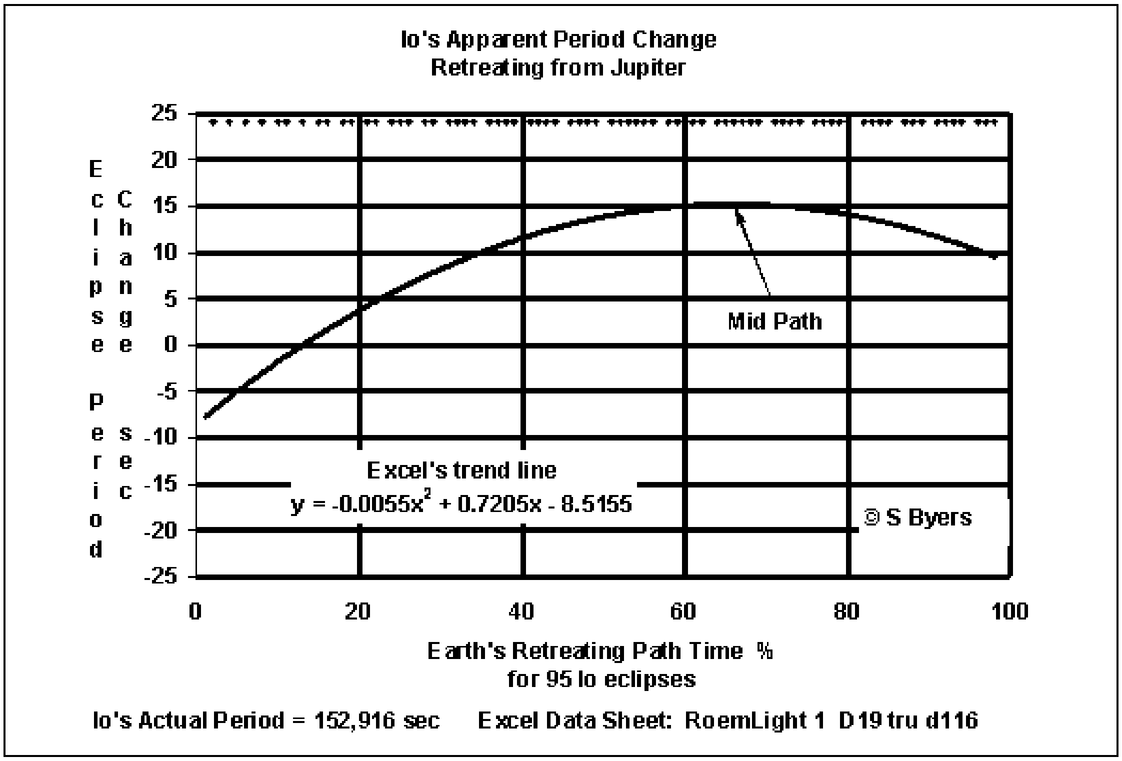
When the Earth retreats from Jupiter the relative longitudinal speed increases to its maximum which is approximately the orbital speed of Earth (29.79 km/sec). This maximum occurs when Earth has traveled through approximately one quarter of its orbit. Since this velocity is nearly one hundredth of one percent (1 X 10^-4) of the speed of light,... the light train traveling past the moving Earth will appear slower by this same percentage. Since the relative light speed is slower it follows that the apparent time period between eclipse events will necessarily be longer by the same percentage. Taking one hundredth of one percent of the eclipse period of 152,916 seconds gives the period a maximum elongation of 15.29 seconds. The charts of eclipse period elongations and reductions are given below which show this period change. Each of these maximum period changes is an independent measurement of the **one-way speed of light,** following Roemer's 1676 AD example.

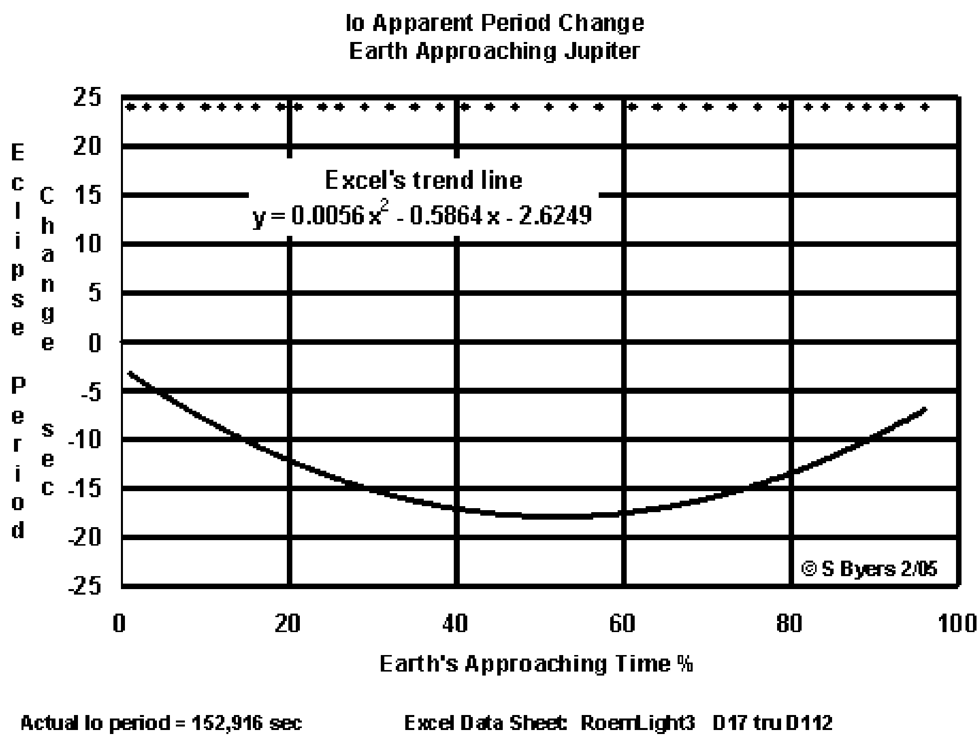
These charts were derived from the eclipse event observation records provided on the web by Astronomy On-Line at the URL http://www.eso.org/public/outreach/eduoff/aol/ or

http://www.eso.org/public/outreach/eduoff/aol/market/experiments/advanced/skills302.html

These Astronomy On-Line records as used in the Excel format are also available on this web site on the page Astronomy On Line Data Excel,

When this Earth / Jupiter / Io scenario is analyzed with the concept of Special Relativity in mind, it is obvious that the light train leaving Jupiter does not arrive at a retreating Earth with a constant speed of c in relation to Earth. However, once a light beam from Jupiter enters the Earth's cloak of atmosphere and secondary radiation,... it's locally measured speed between two points becomes c in relation to Earth. This has no influence on the Doppler frequency changes and the Doppler period changes which are caused by the relative speed changes due to Earth's orbital velocity referenced to Jupiter and the eclipse light train. If our atmosphere exhibited a local light speed radically different then c, such as that speed change which occurs in water, Roemer's delay would still be evident.





When reviewing these charts it must be recognized that only the shape of the curve is needed to demonstrate the main point:...the maximum timing change occurs during Earths maximum longitudinal speed (29.79 km/sec) in relation to Jupiter.

Link to Astronomy On Line Data Excel, for the above charts. Web site link Astronomy On Line Data

These charts are generated by producing a moving average of an incomplete set of eclipse events. A complete record of a set of 113 eclipse events is not available due to the line of sight interference by the Sun. The moving average is obtained with the trend line sub-program available in the MS Excel spreadsheet program. The chart lines would not be offset and would intercept the zero second delay line at the near and far points, except for the absence of data points and the averaging characteristic of the sub-program. The absolute values shown on the changing delay chart should not be used for precise representations of the actual delays corresponding to Earth's actual orbital positions. The data points were not recorded to the second, so this necessitated the use of a moving average plot to obtain the actual trend. The 1994 AD data sets used from Astronomy On Line were checked against the scattered data points available from the Galilean Satellite Eclipse Timing Data. The citation for this data is "Galilean Satellite Eclipse Timing Data by A. Mallama, P. Nelson, J. Park, D. Collins, and B. Krobusek, 2003,

No discrepancies were found between the two data sources.

Citations and links to the supporting data sources have been included in order to encourage and aid other researchers to replicate this article. If any researchers wish to obtain the Excel files containing the data and charts used to produce this article, please email a request to sbyers11@comcast.net . The original data from Astronomy On Line as converted to Excel format is now (4/8/2007) available at this web site page Astronomy On Line Data, All reviews, alternate views, and comments are welcome.

Approximately 100 years have passed since the theory of Special Relativity (SR) appeared in 1905. The SR postulate that the velocity of light is constant in all inertial systems implied the necessity to revise the ideas of length, time and simultaneity. The data provided here indicates that this postulate is not compatible with the actual characteristics of light. This empirical data demonstrates that the speed of emitted light is isotropic and at c in relation to the source, and the observed light speed will be modified depending on the relative motion of the observer and the source. Newton's, Faraday's and Maxwell's concepts of physical systems, length, time, simultaneity, radiation and energy remain unchanged when the system of light (EM) transportation is recognized to function as the above data demonstrates.

Light's Moving Medium via Prime Force Radiation.

In reviewing the data demonstrating that emitted light is isotropic from a moving source, it becomes necessary to propose a medium that moves with the source. This requirement eliminates the possibility of a material medium consisting of ultra mundane particles. The non EM Prime Force background radiation (Pf) as described in the article "Radiant Pressure Model of Remote Force" provides the transport medium for inertia and light. EM radiation, including light, is propagated as a resonance within the non EM Prime Force radiation (Isotropic E field radiation frequencies).

Our total Solar system has a motion referenced to sidereal space (star background) due to the rotation with the Milky Way. Due to the different Solar system orbits speeds of Earth and Jupiter, there will be times when Jupiter leads Earth and times when Earth leads Jupiter relative to the direction of our sidereal motion. In spite of our system's Milky Way sidereal motion,... the light from Jupiter remains at c in relation to Jupiter. If this were not so we would measure different speeds for light depending on the line of sight orientation with the Milky Way motion. Consequently the light emanating from a non accelerating source object is at c, and isotropic in relation to the source,... regardless of the speed and direction of the source in relation to other systems. The average published speed of our solar system in its trip around the Milky Way is 220 km/sec. This is almost 10 times faster than the Earth's orbital speed (29.79 km/sec) within the solar system.

A second example of this isotropic velocity phenomenon is the Earth Moon system. Whether the Moon is leading or trailing the Earth in its orbit, the same velocity of Earth-shine light will exist arriving at the Moon. This fact disputes the intuitive and SR concept that light must travel through a medium and have a constant speed relative to this medium. It appears that for light to exist as a phenomenon of a background medium, each planet and Sun must have a medium that moves with it. This appears like an impossibility for a material medium,... however it is a reasonable concept for a Prime Force (Pf) radiation medium with a near infinite frequency spectrum.

Summary of Light's Characteristics

In summary, this review of available data demonstrates that these characteristics for light exist, when it is acknowledged that the Doppler effect for light cannot be independent of the Doppler effect for the event images which are propagated with the light:

- Light speed is isotropic and at c only relative to its non-accelerating source.
- There is no known speed limit for light relative to space or remote objects.

These characteristics are in direct opposition to the apparent concept from Einstein's 1912 manuscript for Special Relativity page 56:

> Quote "There exists a coordinate system with respect to which every light ray propagates in vacuum with the velocity c". Unquote.

This author's interpretation of this statement, which corresponds with the interpretations quoted by the Special Relativity Advocates listed above in this paper, is as follows:

- The vacuum is taken to be the "one vacuum" of the complete and "one uni-verse". This vacuum is also characterized by terms such as Inertial space, Sidereal space, Fixed Star Field space, and Outer space.
- The terms "a coordinate system" is not taken to mean a separate Inertial frame for each emitting object or observer.
- Now according to Einstein's constant c statement:... as light is emitted from Jupiter it will have a constant speed of c in relation to the vacuum and all observers, regardless of the sidereal motion of Jupiter or the relative motion of any observers.

This is obviously an extremely counter intuitive concept, and is the only concept that this paper "Light Speed versus Special Relativity" was designed to address.

Additional Demonstrations of Light's "Non" Constant Speed

In addition to Roemer's discovery there are two other examples of EM radiation demonstrating that light speed is constant in relation to it's non accelerating source,... and is **not** constant to all observers regardless of their line of sight velocity relative to the source.

One clear example is provided by a problem with data rates between the Cassini spacecraft and it's Titan lander Huygens. The fact that Doppler effects are also utilized between Earth and spacecraft is another sure indication that EM radiation maintains "c" in relation to the source and not the observer. When the radio carrier frequency of a spacecraft is known and a Doppler shift or a change in a Doppler shift of the carrier and data is observed, how is it possible to assume that the "free space speed of the EM radiation" did not change in relation to the observer (receiver)?