7

Wisp and Special Relativity: Fundamentals

In 1905 Albert Einstein published his special theory of relativity while working in a Swiss Patent Office in Berne. The theory is world-class and has influenced scientific thinking more than any other theory in history. He used the word 'special' to relate to uniform motion in a straight line.

Einstein knew that there was a need for a new theory that could explain the relationship between measurements made in different reference frames for Maxwell's electromagnetic laws, as Newtonian mechanics could not adequately do this.

Einstein solved the problem by joining space and time together, and by using Hendrik Lorentz's coordinate transformations. His remarkable understanding of the nature of time lead to the development of time dilation – time runs slower for moving observers, even though they are unaware of it.

Now, nearly 100 years on, special relativity still remains a powerful mathematical tool. Tests still show its predictions to be correct and it remains a remarkably successful theory. But the theory gives no real answers as to why physical processes behave the way they do, whereas wisp theory does provide answers.

The famous null result of the Michelson–Morley 'ether' experiment secured credibility for Einstein's new concepts of space and time, but wisp theory can explain this result and the physical processes behind it.

Wisp theory does not agree with special relativity's claim that the speed of light stays constant for all observers in motion, although plenty of evidence seems to suggest it does. It challenges both postulates of special relativity, but supports its concept of time dilation. It treats space and time as being separate, and uses the notion of absolute reference frames in which wisps are at rest. Only when observers move through absolute frames do they experience dilation effects.

Wisp theory offers explanations for: the cause of time dilation, mass increase in high-speed subatomic particles, and the Lorentz force law for moving charges.

Special relativity is a simple theory that was developed from simple, clearly defined postulates – even though they appear to defy our common sense notions of space and time. Wisp relativity, too, develops from simple principles, which incorporate: Newtonian mechanics, a type of Galilean relativity, and Einstein's time dilation for moving observers.

First we look at Einstein's two postulates of special relativity, and consider what implications arise from them.

7.1 Postulates and implications of special relativity

7.1.1 Postulate 1: principle of relativity

All laws of physics have the same mathematical form in all reference frames moving at constant velocity.

7.1.2 Postulate 2: absoluteness of the speed of light

The speed of light in a vacuum has the same measured value in all reference frames moving at a constant velocity.

7.1.3 Implications of postulate 1

This postulate expresses the absence of a universal reference frame. It implies that there is no deviation of any laws of

Albert Einstein © Kim Albinson

physics in a ‘vehicle’ travelling at any constant speed in a straight line.

It uses the Lorentz coordinate transformations for this purpose, but this requires that we make changes to our common sense notions of space and time:

- Observers in relative motion do not agree on the times and places of separated events.
- They observe each other’s lengths to contract in their directions of motion.
- They each record the other’s time as running slow.

Experimental evidence for special relativity's predictions seems overwhelming. But when we look for direct proof we find that there is no direct evidence, i.e. no observers have travelled at high-speeds and carried out experiments to see if the laws of physics remain the same.

It is true that fast-moving clocks run slow and fast-moving subatomic particles seem to gain mass. But this does not provide direct evidence to support this postulate.

The experiments that have been carried out on the Earth and aboard satellites are one-sided: the thing being tested moves and is subjected to relativistic effects, while the observers remain practically stationary and experience no relativistic effects. So we cannot truthfully claim that this postulate is correct. Wisp theory will prove that it is incorrect.

In wisp theory, if we set an observer's speed through wisp space to zero, then all of its relativistic equations reduce to those found in special relativity.

7.1.4 Implications of postulate 2

Over the years, experimenters have measured the speed of light with greater and greater accuracy. Today, it is taken for granted that its speed is known exactly, and very few experimenters question this. However, wisp theory shows that these experiments are flawed, because the light always travels in two or more directions – reflected by mirrors.

To measure the speed of light correctly, measurements must be made in one direction only (no mirrors).

No one has accurately measured the speed of light one-way on the surface of the Earth! Wisp theory predicts that if this were to happen, its speed would be found to vary – depending on the motion of the Earth through wisp space. Wisp space is a type of ether medium that limits the speed of light to an exact value.

Many experiments have been carried out to measure the speed of the Earth through the ether. The most famous was the Michelson–Morley experiment in 1887. But it produced the famous null result, casting doubt on the existence of the ether and forming an experimental base for the idea stated in this postulate.

7.2 The principles of wisp relativity

Wisp theory develops using concepts based on common sense notions of space and time, and so avoids the paradoxes found in special relativity. It is a type of ether theory, which predicts the null result of the Michelson–Morley experiment, and all the observable predictions of special relativity for Earth-based observers.

The principles of wisp relativity are as follows:

7.2.1 Principle 1 Laws are different

The laws of physics are different in inertial reference frames moving at speed relative to stationary wisp space.

7.2.2 Principle 2 Absolute speeds are constant

The speeds of light and transverse force through one-state space are equal and constant when measured by an observer at rest in wisp space, and are unaffected by their sources' motions.

7.2.3 Principle 3 Dilation factor

The dilation factor γ is equal to the speed of light c, divided by an observer's absolute relative transverse light speed v_t.
That is $\gamma = c / v_t$.

7.2.4 Principle 4 Jiggle dilation

Bodies of matter agitate or jiggle wisp space as they pass through it.

Jiggle is the sum effect of motions caused by quantum waves passing points in wisp space. Its effect dilates specific properties of matter by the factor γ. It reduces the speed of light and transverse force by γ in directions at right angles to a body's motion through wisp space.

7.2.5 Principle 5 Force and time dilations

In inertial reference frames moving through wisp space, light-pulse clock's time (without jiggle dilation) is slowed by γ. The speed of transverse force is reduced by γ. Mechanical and biological clock's time (including atomic) is slowed by γ (includes the jiggle dilation effect).

Consequently moving observers must apply the *rules for time dilation compensation (Section 7.15.4)* to all physical processes that take place in their reference frames.

7.3 Measurements: absolute and relative

We briefly discussed these measurements here and follow up later with more detail.

7.3.1 Absolute measurements

Absolute measurements are those made in reference frames that are stationary with respect to one-state space. Time in these frames is absolute and unaffected by time dilation.

If we place identically prepared clocks throughout stationary one-state space, they will all remain synchronized and record the same absolute time.

7.3.2 Relative measurements

Relative measurements are those made in reference frames that move through ‘stationary’ wisp space. Clocks placed in these frames would record relative time and run slower than ‘stationary’ absolute clocks, because of the effect of time dilation.

In equations, I show variables primed when they apply to measurements made by observers moving through wisp space, for example:

- t is absolute time measured by observers who are stationary in wisp space.

- t' is relative time measured by observers who are moving through wisp space.

When we move through wisp space, time dilation slows down our bodies’ senses (body clocks), causing us to become unaware of its effects. Consequently, we observe all physical processes to appear to take place at normal speeds within our frames. However, what we are observing are the effects of an illusion. If we could see processes taking place within slower frames, they would appear to take place speeded up.

Since our senses automatically compensate for time dilation, we must apply the *rules for time dilation compensation (Section 7.15.4)* to all physical processes that take place within our frames. (Square brackets [ ] are used to identify time dilation compensation terms within equations.)

If, when we move through wisp space, we were to modify our body clocks to work only in absolute time, we would see things happen in slow motion within our frames, but would see things happen at normal speeds in ‘stationary’ absolute frames.

7.4 Events

An event is an occurrence, which happens at a definite location and time in wisp space.

In wisp theory absolute simultaneity of events is not lost. If observers could record events using absolute clocks, they would all agree on the absolute times and locations of events in wisp space.

But observers who move through wisp space record relative time – due to the effect of time dilation – and so may not agree on the timing of events.

In special relativity all motions are relative (there is no absolute frame) and observers in relative motion will not agree with each others' times or locations for separated events. This loss of simultaneity defies common sense, and many scientists including Lorentz found this too difficult to accept. But Einstein did not, and he developed new ideas for space–time in which an observer's relative motion affects the very fabric of space–time itself.

7.5 Absolute measurements of light's relative speed

We start by determining the relative speed of light in different reference frames. The speed of light c through absolute one-state space is constant when measured in absolute space and time.

Current measurements indicate that the relative speed of light in a vacuum is always constant, regardless of an observer's motion – special relativity's postulate 2, but wisp relativity's principle 2, states that it is not constant. Wisp theory will show that the speed of light gets recorded using current methods as being constant, while at the same time its relative speed varies, so do not be concerned with this.

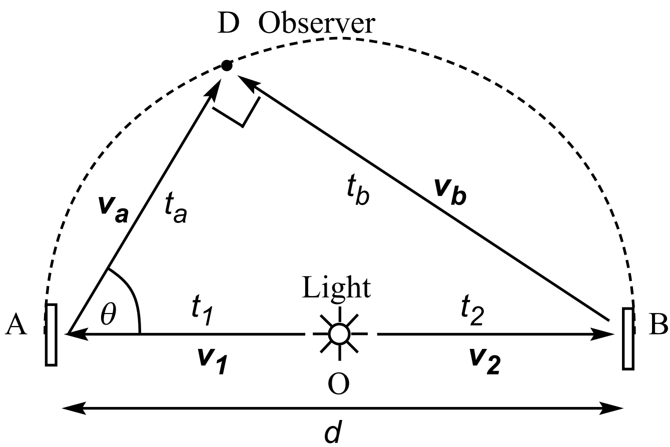


Figure 7.1 Measurements in an absolute frame

(Equation set 7.1)

$t_d =$ Absolute time difference

$$t_d = t_b + t_2 - t_a - t_1$$

But $t_1 = t_2 = \dfrac{d}{2c}$ and $v_1 = v_2 = v_a = v_b = c$

so

$$t_b = \frac{d\sin\theta}{c}$$

$$t_a = \frac{d\cos\theta}{c}$$

$$t_d = \frac{d\left(\sin\theta - \cos\theta\right)}{c}$$

7.5.1 Absolute measurements in a stationary frame

We first calculate the absolute time difference taken by light to travel along separate paths to an observer at D (Figure 7.1). (Many light speed experiments look for a time difference to determine whether or not the speed of light stays constant.)

A light source O is placed centrally between two mirrors A and B. The mirrors lie across the diameter d of a semicircle, and the observer D moves freely on its arc. The apparatus remains stationary in one-state space.

We switch on the light source and record the absolute time difference t_d (Equation set 7.1). All measurements are absolute, since the apparatus is stationary in wisp space.

With $\theta = \pi/4$ radians, D is central, and $t_d = 0$. This shows that the times taken for the two light rays to travel to a centrally placed observer are equal.

7.5.2 Absolute measurements in a moving frame

We repeat the measurements with the apparatus moving through wisp space at speed V (Figure 7.2).

Measurements are taken from absolute clocks fixed throughout wisp space, which record the times when the moving apparatus passes fixed points (relative time is ignored).

Light emits from a fixed point in wisp space (Wisp relativity's principle 2). As the light travels along its separate paths, the apparatus moves through wisp space, and the origin of the semicircle O moves away from the light's point of emission. Equation set 7.2 gives the absolute values for times t_1 and t_2.

A stationary observer in wisp space sees the light strike mirror A first, because the mirror is moving towards light's fixed emission point. And the light takes longer to reach mirror B,

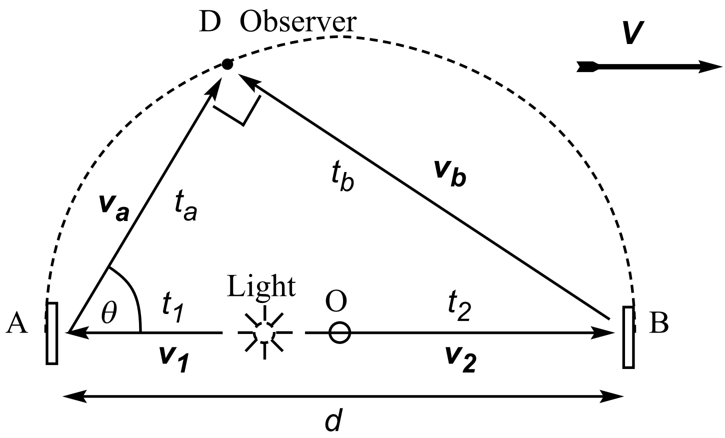


Figure 7.2 Absolute measurements in a moving frame

(Equation set 7.2)

$t_d =$ Absolute time difference

$t_d = t_b + t_2 - t_a - t_1$ But now $t_1 < t_2$

$v_1 = c + V$ and $v_2 = c - V$

so

$$t_1 = \frac{d}{2(c+V)}$$

$$t_2 = \frac{d}{2(c-V)}$$

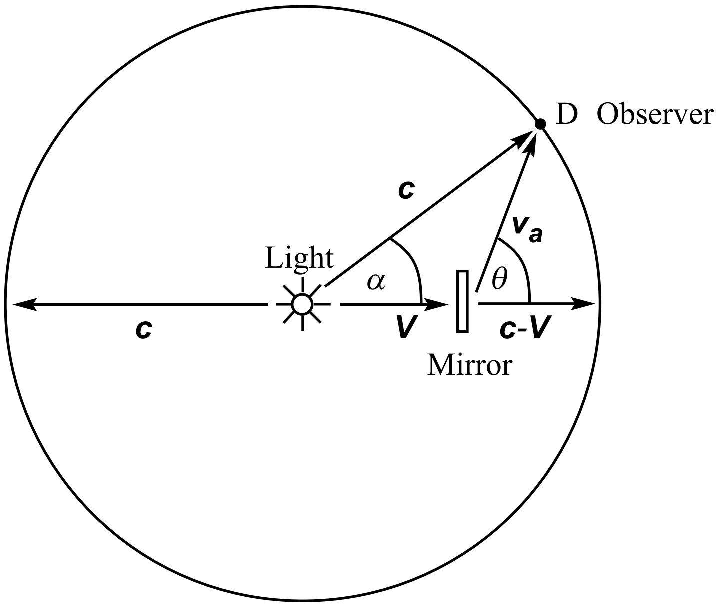


Figure 7.3 Polar diagram showing relative velocity $\boldsymbol{v_a}$ measured with respect to absolute time

which is moving away from the emission point.

Before we calculate absolute values for t_a and t_b we need to determine the absolute measurements of light's relative speed in all directions in the moving frame.

Imagine that you are the observer D moving at speed V through wisp space and your senses have been specially modified to work in absolute time, so that the time dilation effect is absent. You would measure the relative speed of light reflected from the moving mirror to vary depending on the angle θ and speed V.

Figure 7.3 shows the relative velocity of light $\boldsymbol{v_a}$ reflected off the moving mirror – as measured with absolute time. The rela-

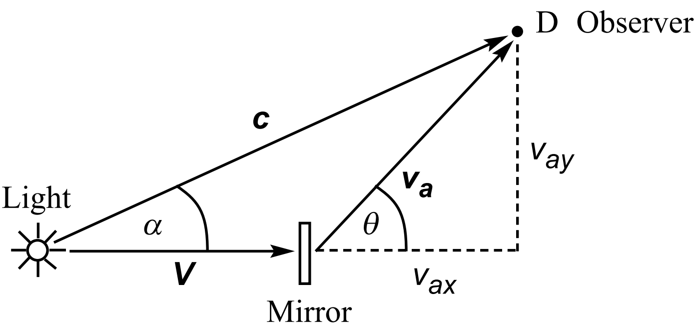


Figure 7.4 Relative velocity components with respect to absolute time

(Equation set 7.3)

Using pythagoras′ theorem

$$(V+v_{ax})^2+v_{ay}{}^2=c^2 \quad \text{and} \quad v_{ax}^2+v_{ay}^2=v_a{}^2$$

Substituting for v_{ay}^2 gives

$$v_a{}^2+2Vv_{ax}+\left(V^2-c^2\right)=0 \quad \text{but} \quad v_{ax}=v_a\cos\theta$$

and so

$$v_a{}^2+2v_aV\cos\theta+\left(V^2-c^2\right)=0$$

The positive root is given as

$$v_a=-V\cos\theta+\sqrt{c^2-V^2\sin^2\theta}$$

(Equation set 7.4)

Since $\cos\left(\frac{\pi}{2}+\theta\right) = -\sin\theta$

and $\sin\left(\frac{\pi}{2}+\theta\right) = \cos\theta$ we can write the formula as

$$v_b = V\sin\theta + \sqrt{c^2 - V^2\cos^2\theta}$$ and so

$$t_a = \frac{d\cos\theta}{-V\cos\theta + \sqrt{c^2 - V^2\sin^2\theta}}$$ and

$$t_b = \frac{d\sin\theta}{V\sin\theta + \sqrt{c^2 - V^2\cos^2\theta}}$$

tive speeds of light clearly differ from speed c, but do not be concerned with this.

We need to find an expression that shows v_a in terms of V, c and angle θ. Equation set 7.3 gives the formula.

Now, referring back to Figure 7.2, ADB is a right-angled triangle and so distance AD = $d \cos \theta$.

Now we just need to find t_a, and

t_a = AD / v_a measured in absolute time.

Similarly v_b (relative speed of light travelling from B to D, Figure 7.2) is found by substituting the angle ($\pi/2 + \theta$) and calculating the positive root (Equation set 7.4). This yields a larger value than v_a because the light has a component of its velocity in the opposite direction to $\boldsymbol{V}$.

Figure 7.4 and Equation set 7.3 shows more detail and the maths used to calculate the relative velocity of light.

We have now produced equations that enable us to calculate absolute time intervals for light's journey in fixed and moving frames. But before we consider how these times relate to an observer placed in a moving frame, we need to consider the effect of Einstein's time dilation.

7.6 Dilation factors

7.6.1 Time dilation: light-pulse clocks

Time is an abstract notion and as such does not exist as a physical substance, but we can use physical systems to measure its flow.

Einstein used a hypothetical 'light-pulse clock' to measure time in special relativity. He predicted the time dilation effect from studying the periodic motion of a pulse of light bouncing between two mirrors.

Time dilation is an expansion of the time interval measurement between ticks in a moving clock, which causes time in moving clocks to run slow.

Wisp relativity's principle 3 states: The dilation factor γ is equal to the speed of light c, divided by an observer's absolute relative transverse light speed v_t. That is $\gamma = c / v_t$.

Our bodies are mechanical and so are affected by time dilation in the same way as moving mechanical clocks are. The mechanical time dilation effect on Earth just happens to be the same as Einstein's light-pulse clock. Everything (except longitudinal force) has its time slowed down by γ. Our senses, how-

(Equation set 7.5)

General dilation equation

$\theta =$ angle from the direction of V

$V =$ Observer's absolute velocity

$\gamma =$ Dilation factor

$$\gamma = \frac{c}{v_a}$$

$$\gamma = \frac{1}{-\frac{V}{c}\cos\theta + \sqrt{1 - \frac{V^2}{c^2}\sin^2\theta}}$$

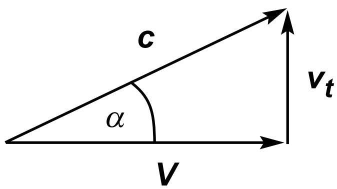
ever, are unaware of the effect – passing of time appears normal to us.

Equation set 7.5 shows the *general dilation equation*. The important point to understand is the way matter-fractals move through wisp space: Their movements displace surrounding wisps at right angles to their directions of motion, and only their fractal shapes travel in their directions of motion through wisp space.

So the dilation effect experienced by all types of moving matter (including mechanical and atomic clocks) is due solely to right-angle motions, where angle $\theta = \pi/2$ radians.

Substituting this value into the *general dilation equation* gives the dilation factor γ, which just happens to be the same formula as that used by Einstein for time dilation in moving clocks. Although Einstein derived time dilation using a different method and based on different principles, the effect is the same.

Figure 7.5 shows a simple vector diagram used to calculate



$$v_t = \sqrt{c^2 - V^2}$$

$$\gamma = \frac{c}{v_t}$$

$$\gamma = \frac{1}{\sqrt{1 - \frac{V^2}{c^2}}}$$

Figure 7.5 Dilation factor γ for $\theta = \pi/2$ radians

the dilation factor for matter moving through wisp space – due solely to right-angled motions of wisps. The relative transverse velocity of light is given as $\boldsymbol{v_t}$.

The time dilation effect measured on the Earth for high-speed subatomic particles is always that given by Einstein's formula (identical to wisp's formula for $\theta = \pi/2$).

An observer who travels in a craft moving at near light speed would be affected by Einstein's time dilation, but would also notice that the relative speed of light varied throughout the craft, creating illusion effects – see front cover image. This is because the relative speed of light is dependent upon the angle θ it makes with the craft's velocity $\boldsymbol{V}$.

7.6.2 Force dilation

Transverse force propagates at the speed of light and so is dilated by the factor γ. The force's substance does not diminish, only its effect near light speed diminishes.

Force dilation is one of two factors that slow time in moving mechanical clocks – the other factor is jiggle.

Force and jiggle dilations also affect moving gravitational and electromagnetic forces.

7.6.3 Jiggle dilation

When matter-fractals move through wisp space, their zero-state spheres push wisp space apart, creating quantum waves patterns. These are transverse waves that cause wisps to oscillate in directions at right angles to the matter-fractals' directions of motion. At any point in wisp space the agitation or jiggle is the sum effect of all transverse waves passing that point. This produces random motions at points in wisp space and causes dilation of the transverse force by the factor γ.

Around any large body moving through wisp space the jiggle motions can be grouped into planes that are at right angles to the body's motion (Figure 7.6).

Jiggle has the effect of reducing the strength of the electric charge on a body moving through jiggle planes. This is equivalent to an effective increase in the value of ε_o – the electric constant or absolute permittivity of free space – by γ.

Similarly μ_o – the magnetic constant or permeability of free space – increases by γ.

The magnetic and electric fields of light move at right angles to its direction of motion. When light travels parallel to jiggle planes, one or both of these fields experience random fluctuations as they transverse through adjacent jiggle planes. This has a net effect of reducing the speed of light by γ (this is the cause of the famous null result of the Michelson–Morley experiment).

Light travelling at right angles to jiggle planes has magnetic and electric fields that move within the planes, and so jiggle motions are equally added and subtracted, producing no net change in the speed of light.

Charged particles that move through jiggle planes will experience a reduction in the strength of their electric charge in all directions of motion:

- Charged particles that travel parallel to jiggle planes displace their electric fields at right angles to their directions of motion. Their charge crosses into adjacent jiggle planes, which reduces its strength by the jiggle dilation factor γ.

- Charged particles that travel at right angles to jiggle planes displace their electric fields within the planes. But the motions of the particles transfer the shape and structure of their electric fields across neighbouring jiggle planes, and so the jiggle motion effect is induced, again reducing the strength of the charge by the jiggle dilation factor γ.

It is the motions of matter-fractals' zero-states spheres through wisp space that are responsible for creating jiggle motions. Since light is an electromagnetic wave, it does not possess a zero-state sphere, and so does not create jiggle motions.

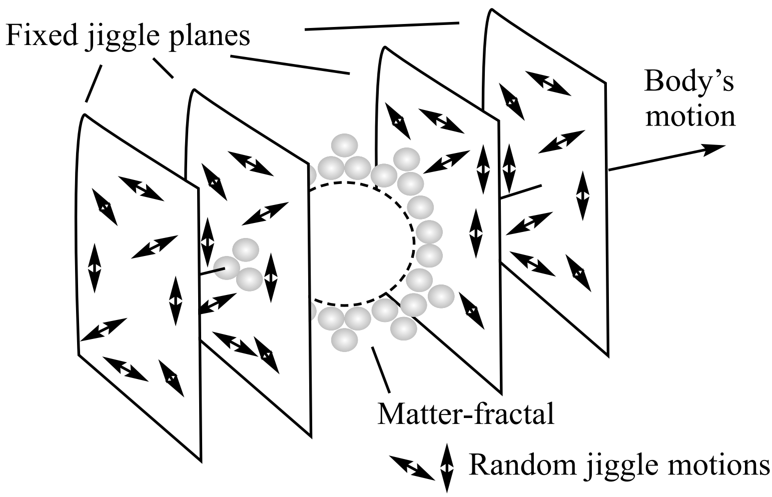


Figure 7.6 Matter-fractal's motion causes jiggle motions

Likewise forces propagate through wisp space without creating jiggle motions.

7.6.4 Time dilation: mechanical/biological clocks

Everything made from matter associates with mechanical clocks for measuring the passing of time – absolute or relative time.

A mechanical clock's internal components move at speeds much less that that of light, and so we can use classical equations to calculate its internal forces.

The rule for time flow in all material bodies is:

> *The strength of the transverse force operating within these bodies determines the rate at which time flows.*

In simple harmonic motion devices such as pendulums and masses on oscillating springs, periodic time intervals vary inversely proportional to the square root of the force – gravitational or spring respectively.

Bodies that move through jiggle planes are affected by both transverse force dilation and jiggle dilation, which has the net effect of reducing the strength of the forces within the bodies by γ squared.

Equation set 7.6 gives an example that shows the time dilation effect in a simple mechanical clock.

The period of oscillation for simple harmonic devices therefore increases by γ. This just happens to produce the same time dilation effect that Einstein discovered.

Time dilation causes all physical processes that happen in moving frames to slow down. However, moving observers are unaware of its effects as their senses are automatically compen-

(Equation set 7.6)

Mechanical spring/mass clock (simple harmonic motion)

$T' =$ Relative period of oscillation (s)

$k' =$ Relative force per unit displacement (N/m)

$m' =$ Realative mass on "light" spring (kg)

$k' = \frac{k}{\gamma^2}$ (Force & jiggle dilation effects)

$F' = -k'x'$ Hooke's law – spring restoring force (N)

$F' = m'a'$ Newton's second law (N)

$$a' = -\frac{k'x'}{m'}$$

$$T' = 2\pi\sqrt{\frac{m'}{k'}} = 2\pi\gamma\sqrt{\frac{m}{k}} = \gamma T$$

$f' = \frac{1}{T'} = \frac{1}{\gamma T}$ Cycles per second

$$f' = \frac{f}{\gamma}$$

and so

$t' = \frac{t}{\gamma}$ Equation for time dilation

sated – see section 7.15.4 (Rules for time dilation compensation).

We now know that a physical process – force and jiggle dilations – causes time dilation, and that it is not an inherent property of time itself that results from Einstein's concept of space–time.

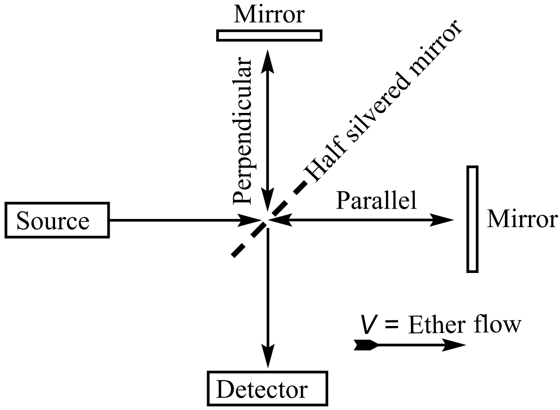


Figure 7.7 The Michelson interferometer

7.7 The Michelson–Morley experiment

Of the experiments designed to measure the speed of the Earth through the supposed luminiferous ether, the most famous was that performed by Michelson and Morley in 1887.

The Michelson interferometer (Figure 7.7) is mounted on a horizontal turntable so that it can be rotated relative to the motion of the ether stream.

Monochromatic (one wavelength) light is directed at a half-silvered mirror, which splits it into two beams. These travel in different directions, along and across the ether stream, and then recombine to interfere either constructively or destructively, producing a pattern of light and dark fringes.

According to classical physics, light should take different times to travel along the paths, and the time difference should show up as a shift in the observed interference pattern.

Even though the experiment was carried out with great accu-

(Equation set 7.7)

The Michelson – Morley experiment

$L =$ Mirror separation (m)

$T_{\leftrightarrow} =$ Parallel journey time (s)

$T_{\updownarrow} =$ Perpendicular journey time (s)

$\Delta T =$ Absolute time difference (s)

$\Delta T' =$ Relative time difference (s′)

$c =$ Absolute speed of light in one-state space (m/s)

$c' =$ Relative speed of light on the Earth's surface (m/s′)

$V =$ Speed of the Earth through wisp space (m/s)

$$\gamma = \frac{1}{\sqrt{1-\frac{V^2}{c^2}}} \quad \text{Dilation factor}$$

Without dilation effects a non-zero result is expected

$$\Delta T = T_{\leftrightarrow} - T_{\updownarrow} = \left(\frac{L}{c-V} + \frac{L}{c+V}\right) - \left(\frac{2L}{\sqrt{c^2-V^2}}\right)$$

$$= \frac{2L/c}{(1-\frac{V^2}{c^2})} - \frac{2L/c}{\sqrt{1-\frac{V^2}{c^2}}} = \frac{2L\gamma^2}{c} - \frac{2L\gamma}{c}$$

With the jiggle effect – affecting perpendicular motions

$$\Delta T = \frac{2L\gamma^2}{c} - \frac{2L\gamma^2}{c} = 0$$

Compensating for time dilation on the Earth gives

$$\Delta T' = \frac{2L\gamma^2}{c'} - \frac{2L\gamma^2}{c'} = 0 \quad \text{or} \quad \Delta T' = \frac{2L\gamma}{c} - \frac{2L\gamma}{c} = 0$$

racy, and repeated with the apparatus rotated through 90°, the results were always the same – zero.

Possible explanations for this result are either that the Earth's motion through the ether cannot be detected by this method or that the supposed ether does not exist.

George Stokes provided a theory on ether drag as a possible solution. It predicted that null result would occur because somehow the Earth dragged the ether along with it.

Wisp theory does not support this notion, because wisps have mass, and the effect of dragging wisp space would increase the Earth's mass enormously. So we can clearly rule out this possibility.

Wisp theory holds the view that the Earth moves effortlessly through wisp space, because it is made of matter-fractals that are part of wisp space. The motion of the Earth (a large body of matter-fractals) through wisp space creates jiggle plane motions. This causes jiggle dilation, which reduces the speed of light in directions at right angles to the Earth's direction of motion.

The Michelson interferometer fails to measure the Earth's motion through wisp space because the effect of jiggle dilation cancels out the expected small time difference for light to travel along opposite paths.

Equation set 7.7 shows the equations for the experiment, which include the jiggle dilation effect. Jiggle dilation produces a zero result for all wisp space (ether) speeds.

It should also be noted that because of the effects of time and jiggle dilation on the Earth's surface, light's measured speed is relative – see section 7.16 (Absolute speed of light).

7.7.1 One-way light speed test

Modern methods that calculate the speed of light by measuring its time along two or more paths are fundamentally flawed.

In the case of the Michelson–Morley experiment, the gain and loss in light's speed along the parallel arm exactly match that for the speed in the perpendicular arm, due to the jiggle dilation effect. So scientist have wrongly assumed that the speed of light is constant in all directions.

Only by making accurate measurements along a single path (no mirrors) can the true relative speed of light on the Earth's surface be determined. But the motion of the Earth through wisp space and the effects of time and jiggle dilation need to be taken into account before the absolute speed of light can be determined – see section 7.16 (Absolute speed of light).

A test to measure the speed of light one-way is as follows:

Two receiver/transmitter stations are placed on the equator a large distance apart, each contains a high-precision atomic clock and high-power laser.

At the moment the stations line up perpendicular to the Earth's orbit, their clocks synchronize by sending pulses of light to each other. Synchronization is possible because the relative speeds of light in perpendicular directions are equal.

Six hours later the stations will be parallel to the Earth's orbit, and each station can independently fire a pulse of light to the other, and separately measure the time light takes to travel one-way.

Wisp theory predicts that the motion of the Earth through wisp space affects the relative speed of light. By comparing one-way journey times, a non-zero difference will result. The difference in time recorded for journeys with and against the wisp space flow is $L \times 6.67\times10^{-13}$ seconds, where L is the distance separating the stations.

7.8 Kennedy-Thorndike experiment

In 1932, Roy Kennedy and Richard Thorndike performed a modified Michelson–Morley experiment, in which the lengths of the light paths were different.

The purpose of the experiment was to check the viability of the Lorentz-FitzGerald contraction proposal – a body moving through the ether contracts by γ in its direction of motion.

Tests carried out over several months found no evidence of contraction effects and the results were unaffected by the Earth's motion rotating the apparatus.

The length contraction proposed by special relativity applies to moving observer reference frames and not the frame in which the test apparatus resides.

Both wisp theory and special relativity predict equal values.

7.9 Stellar aberration

In 1725 James Bradley discovered stellar aberration: a yearly variation in the angular displacement of the position of stars. A combination of the motion of the Earth in its orbit and the speed of light cause this effect.

In 1728 Bradley measured the angular displacement α, and from it calculated the speed of light to within 5 per cent.

The angle α is approximately 20 arc seconds and is calculated using $\alpha = \arctan V/c$, where V is the speed of the Earth orbiting the Sun and c is the speed of light (Figure 7.8).

Early ether theories proposed that the speed of the ether relative to the Earth would affect the direction of light striking it. If the ether was dragged along by the Earth, the approaching light would be carried along with it and remain at the same approach angle and the aberration would be zero.

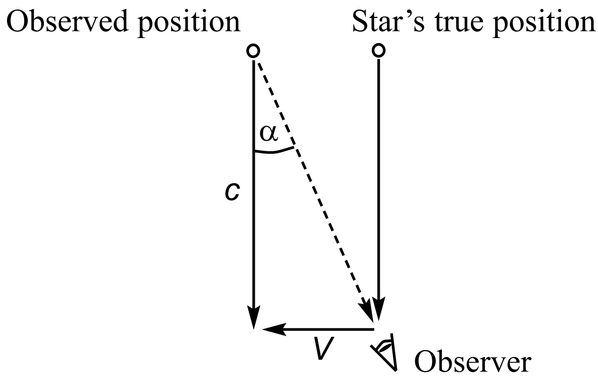


Figure 7.8 Stellar aberration

Wisp theory predicts that the speed of wisp space (ether) relative to the Earth will not change the direction light takes. If during its long journey, the light from the star passes through moving one-state space, its speed will alter slightly but not its direction.

The aberration angle is simply an optical effect that results from the addition of velocities. Both special relativity and wisp theory predict similar results.

7.10 Fizeau’s experiment

In 1851 Armand Fizeau performed an experiment to measure the speed of light in moving water. The purpose of the experiment was to measure the value of the ether drag coefficient predicted earlier by Augustin Fresnel.

Both Fresnel and Einstein developed theories that correctly predicted the speed of light in moving water. Wisp theory uses their equations, but modifies them to conform to wisp theory’s principles.

The results (shown in Appendix B) suggest that the Earth's motion through wisp space cause a small, but constant offset, which increases previously predicted results by a factor of 1.000265.

Using sensitive measuring equipment it may be possible to detect this.

7.11 Wisp coordinate and frame velocity transformations

These allow us to take positions and times measured in one frame, S, and transform them to positions and times measured in another frame, S*'*.

In wisp theory, space and time are absolute, and so we use a variation of the transformations of classical physics developed by Galileo Galilei and Isaac Newton as a starting basis. However, we know that the effect of time dilation on particles moving through wisp space is real, so we must include Einstein's time dilation in moving frames.

Consider an event E_1 occurring at some point in space and time (Figure 7.9). To an observer placed at the origin of frame S – stationary in wisp space – the coordinates of the event are x_1, y_1, z_1, t_1.

A second observer is placed at the origin of moving frame S*'*, which moves through wisp space at speed V in the direction of the x-axis. The axes of their frames remain parallel, and at time $t = 0$, both observers set their clocks to zero. The observer in frame S*'* records the event as x'_1, y'_1, z'_1, t'_1.

The measurements in stationary frame S are with respect to absolute space and time, while those in the moving frame S*'* include the time dilation effect. Both observers will agree on the location within wisp space of the event, but they will not

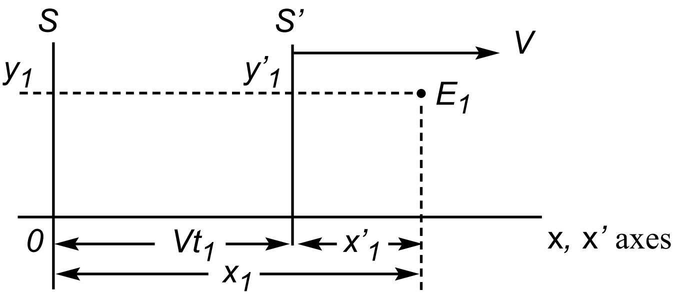


Figure 7.9 Frames recording event E_1 at times t_1 and t'_1

agree on the time at which the event occurred – unless the event occurred at $t = 0$.

Equation set 7.8 shows the wisp coordinate and frame transformations.

7.11.1 Wisp frame velocity transformation

A moving observer's time runs slow because of the effect of time dilation, and stationary observers are seen to approach or recede at faster speeds because of this.

Time has not changed for stationary observers; they see things according to Galilean relativity where time and space remain absolute.

An observer moving through wisp space at light speed divided by 'the square root of two', would see stationary observers approach or recede at the speed of light. If a moving observer's speed through wisp space were greater than this, they would see stationary observers approach or recede at speeds greater than light.

Of course light does not travel faster than speed c through wisp space, but the effect of time dilation on moving observers creates an optical illusion that it does.

(Equation set 7.8)

Wisp coordinate and frame velocity transformations

$$\gamma = \frac{1}{\sqrt{1 - \frac{V^2}{c^2}}}$$

$$x' = x - Vt$$

$$y' = y$$

$$z' = z$$

$$t' = \frac{t}{\gamma}$$

$$V' = \frac{dx'}{dt'} = \gamma \frac{dx'}{dt} = -V\gamma$$

Inverse coordinate and frame velocity transformations

$$\gamma' = \frac{1}{\gamma} = \frac{1}{\sqrt{1 + \frac{(V')^2}{c^2}}}$$

$$x = x' - V't'$$

$$y = y'$$

$$z = z'$$

$$t = \frac{t'}{\gamma'} = t'\gamma$$

$$V = \frac{dx}{dt} = \frac{1}{\gamma} \frac{dx}{dt'} = -V'\gamma'$$

7.12 Invariance of distance

Space is absolute and so all observers whether stationary or moving must agree on distance measurements between points in wisp space.

Wisp theory does not use the notion that moving objects shorten their lengths in their directions of motion relative to stationary observers – known as the Lorentz-FitzGerald contraction.

All observers in wisp space record the same locations and absolute times for events.

Observers in motion through wisp space will experience the time dilation effect and will unknowingly record measurements in relative time. By using wisp transformations we can convert relative measurements to absolute measurements.

7.13 Absolute simultaneity: events

In a stationary frame S a ball rolls across a table, which is 1 m wide, and the table moves at speed V along the positive x-axis (Figure 7.10).

At time $t = 0$, the ball is at the origin of the x-axis (we can think of this as event E_0) and it rolls across the surface of the table at relative speed u in the positive x-axis direction. The absolute speed of the ball is $V+u$. Let u = 1 m/s and $V = 0.6c$. After 1 second of absolute time, the ball reaches the end of the table and the event is recorded in absolute measurements as E_1, where

$$x_1 = (V+u)t = (0.6c + 1) \text{ m}$$

$$t_1 = 1\text{s}$$

$$(x_1 , t_1) = (0.6c + 1, 1).$$

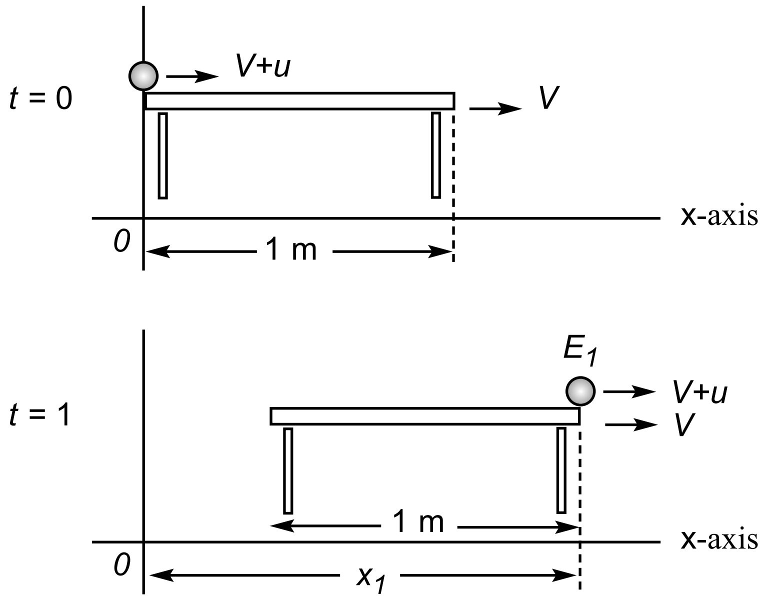


Figure 7.10 Frame S, ball rolling across table – absolute time

An observer moving with the table in frame S*’* (Figure 7.11) will be affected by time dilation, and consequently will record an increase in the speed at which the ball moves across the table. The ball travels faster by the factor γ, when measured using relative time. However, this relative speed increase is an illusion caused by time dilation, and all absolute measurements are unaffected.

The relative time t'_1 taken for the ball to move across the table is therefore shorter than the absolute time by the factor γ. However, the event is recorded as occurring at the same point in space and time when recorded by absolute clocks fixed throughout wisp space.

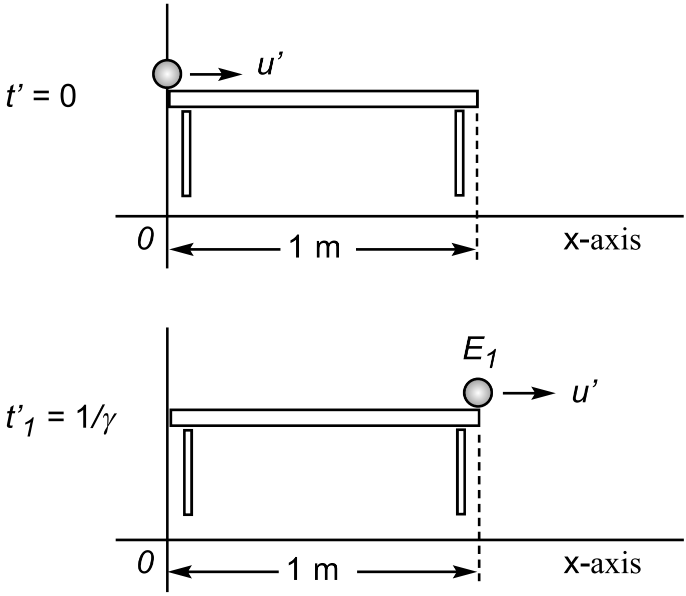


Figure 7.11 Frame S', ball rolling across table – relative time

The event calculates to the same values as before

$x_1 = (V'+u')t' = (V\gamma+u\gamma)t/\gamma = (0.6c + 1)$ m
$t_1 = t'_1 /\gamma = 1$ s
$(x_1 , t_1) = (0.6c + 1, 1)$.

According to both stationary and moving observers, the events (E_0 and E_1) take place at the same points in wisp space and at the same absolute times. So wisp theory supports the concept of absolute simultaneity, whereas special relativity does not.

The effect of time dilation slows time for the moving observer who witnesses the event after a shorter period of relative time $1\gamma'$ or $1/\gamma$ seconds.

Of course being able to detect the motion of wisp space in the first place is essential to establishing a reference to absolute time, and hence be able to determine if the effect of time dilation applies to a particular frame.

Light speed measuring devices capable of measuring speeds one-way will make determining the motion through wisp space commonplace in the near future.

7.14 Mass invariance

In wisp theory, a particle does not gain mass as it speeds up, but it does increase its kinetic energy.

The supposed mass increase of subatomic particles moving at speeds close to light is in fact a quasi-mass increase caused by the effect of transverse force dilation.

Einstein's mass energy equivalence equation $E = mc^2$ suggests that energy and mass are interchangeable, and this is well proven. This does not result from a particle's mass increasing with speed, but is related to a process whereby particles' zero-state spheres join, expand or shrink during collisions – see section 10.2.1 (Energy into mass).

7.14.1 Relativistic mass increase: quasi-mass

It is a known fact that subatomic particles' masses appear to increase as they approach the speed of light.

The standard equation for mass increase is

$$m' = m_0\gamma, \qquad \text{where } \gamma = \frac{1}{\sqrt{1-\frac{V^2}{c^2}}}.$$

Where m' is the mass of the particle moving at relative speed V,

m_o is its rest mass, and c is the speed of light.

However, the numbers of wisps that make up a moving particle's matter-fractals have not increased, and so its real mass stays the same. The only possible explanation for the perceived mass increase is for the force acting on the particle to reduce in strength, because transverse force travels at the speed of light, and consequently it is not possible to accelerate a particle faster than that speed through wisp space.

As the speed of light is approached, the effect of the transverse force drop to zero, giving the impression that the particle's mass has increased. But in reality it has not, its mass stays the same. So we say that mass is invariant or

$$m' = m.$$

We conclude, that the perceived mass increase (quasi-mass) experienced by fast moving particles is due to the effect of the forces acting on it being reduced by the dilation factor γ.

7.14.2 Accelerating subatomic particles

A particle accelerator in a laboratory accelerates electrons (Figure 7.12).

Force-devices in the laboratory generate powerful magnetic and electric forces that act on the electrons, accelerating them along circular paths to near the speed of light.

The force-devices remain stationary with respect to the laboratory's frame and so stay fixed within the laboratory's perpendicular jiggle planes. So jiggle dilation does not affect the forces generated in the laboratory – since positive and negative jiggle motions cancel out within the jiggle planes.

The figure shows the electric force lines F_e grouped into columns within the jiggle planes. For clarity, magnetic field

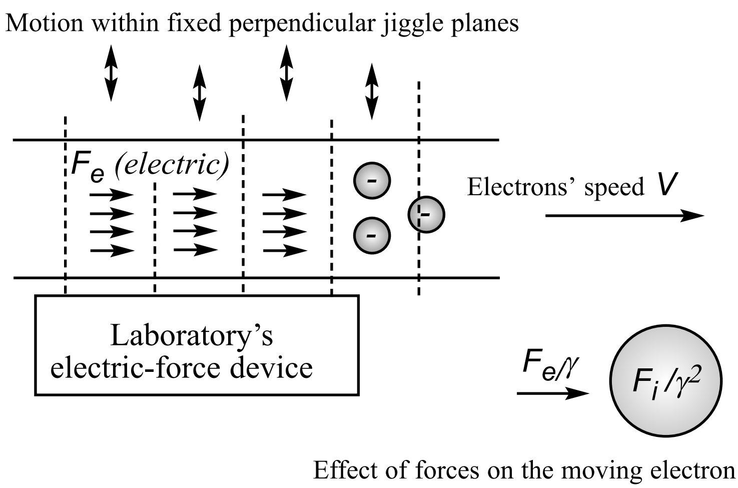


Figure 7.12 Forces on accelerating particles

lines are not shown, but they too would lie within the planes.

The laboratory's forces are unaffected by jiggle motions, but their effects are depleted near the speed of light, due to the effect of transverse force dilation. And so the electrons cannot accelerate past the speed of light. The quasi-mass effect is created as the electrons speed up, but in reality it is the force acting on them that diminishes.

The other effects of importance are the dilations within the moving electrons. Here transverse force dilation occurs, because the electrons are moving at high-speed through wisp space. But also, because they move through the laboratory's perpendicular jiggle planes, they experience the effect of jiggle dilation. As a consequence, the internal forces F_i within the moving electrons are reduced by γ squared, which cause their mechanical clocks to run slower by γ – see section 7.6.4 (Time dilation – mechanical/biological clocks).

7.14.3 Decelerating subatomic particles

If the electric force-device that had previously accelerated the electrons to near the speed of light were suddenly reversed, the energy needed to slow the electrons down would be exactly the same as that used to speed them up.

A ‘reverse’ force dilation process applies, which reduces the effect of the retarding force on particles moving at speeds close to the speed of light. The particles behave as though they have more mass (quasi-mass) and are harder to slow down, but this is not so.

7.15 Wisp accelerations and transformations

We examine the effects of acceleration in four ways.

1. Find the magnitudes of the relativistic forces that act on a charged particle accelerating in a circular particle accelerator.

2. Derive the acceleration transformations from the *wisp coordinate and frame velocity transformations (Section 7.11)* given earlier for a particle accelerating from rest through stationary wisp space.

3. Calculate – using classical dynamics – the absolute accelerations of a particle placed in a force-device, which is first stationary, and then moving. We take into account mass invariance, and the effects of force and jiggle dilations.

4. Examine the affect time dilation has on moving observers' perspectives for physical processes that take place in their local reference frames. We must apply the *rules for time dilation compensation (Section 7.15.4)* to these local processes to compensate for the effect that time dilation has on local observers.

7.15.1 Particle accelerator force magnitudes

Figure 7.12 shows a strong electric field accelerating charged particles in directions parallel to their motions. For simplicity the accelerator is at rest in wisp space.

The rate of change of a particle's relativistic momentum with respect to time is a measure of the effect that a force has on it. Equation set 7.9 shows wisp's interpretation of the standard equation for relativistic momentum.

Equation set 7.10 shows the calculations for determining the magnitudes of magnetic and electric forces that act on a charged particle moving in the stationary accelerator. Remember that in wisp theory a particle's mass m remains constant, while the effect of the force on it diminishes near the speed of light.

Figure 7.13 shows the effects that the two orthogonal forces

(Equation set 7.9)

Wisp's relativistic momentum

$$\gamma_{ua} = \frac{1}{\sqrt{1-\frac{u_a^2}{c^2}}} \quad \text{Dilation factor}$$

$u_a =$ Absolute speed of particle (m/s)

$$p = \gamma_{ua} m u_a \quad \text{Relativistic momentum}$$

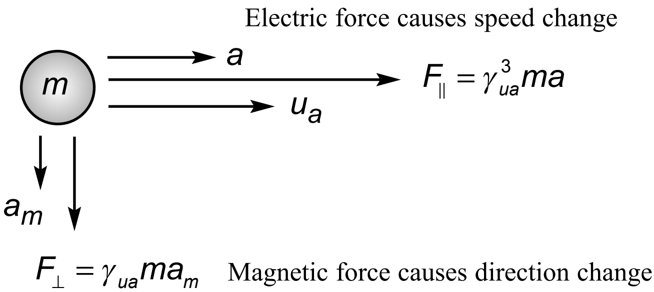


Figure 7.13 Particle accelerator forces

(parallel and perpendicular) have on a charged particle. The magnetic force causes it to accelerate by changing its direction of motion, causing it to follow a circular path (it plays no part in changing its speed) whereas the electric force alters its speed but not its direction.

The results confirm experimental finding that for equal measures of acceleration on a particle travelling near the speed of light, it takes a greater force to accelerate it in a linear direction than it does to keep it on a circular path.

7.15.2 Wisp acceleration transformations

Transformations couple measurements made in one reference frame to those in another. By using them it is possible to predict what observers in different frames will measure.

We compare a stationary observer's measurements made in absolute space and time (frame S) to a moving observer's relative measurements (frame S'). (We do not apply the *rules for time dilation compensation (Section 7.15.4)* to transformation equations, because the equations couple events that are non-local.)

A force-device at rest in absolute frame S accelerates a parti-

(Equation set 7.10)

Forces on a particle in the particle accelerator (frame S)

$$F = \frac{dp}{dt} = \frac{d}{dt}(\gamma_{ua} m u_a) \quad \text{Relativistic force (N)}$$

$$F = \gamma_{ua} u_a \frac{dm}{dt} + \gamma_{ua} m \frac{du_a}{dt} + m u_a \frac{d\gamma_{ua}}{dt}$$

A moving particle's mass is invariant, so $\frac{dm}{dt} = 0$

So the centripetal magnetic force component is

$$F_{\perp} = \gamma_{ua} m \frac{du_a}{dt} + m u_a \frac{d\gamma_{ua}}{dt}$$

and since magnetic force does not speed up the particle

$\frac{d\gamma_{ua}}{dt} = 0,$ and so

$$F_{\perp} = \gamma_{ua} m \frac{du_a}{dt} = \gamma_{ua} m a_m$$

The electric force component is

$$F_{\parallel} = \gamma_{ua} m \frac{du_a}{dt} + m u_a \frac{d\gamma_{ua}}{dt}$$

But now γ_{ua} varies as the particle speeds up, so

$$F_{\parallel} = \frac{m}{(1-\frac{u_a^2}{c^2})^{\frac{1}{2}}} \frac{du_a}{dt} + \frac{m}{(1-\frac{u_a^2}{c^2})^{\frac{3}{2}}} \frac{u_a}{c^2} \frac{du_a}{dt}$$

$$F_{\parallel} = \frac{m}{(1-\frac{u_a^2}{c^2})^{\frac{1}{2}}} a + \frac{m}{(1-\frac{u_a^2}{c^2})^{\frac{3}{2}}} \frac{u_a^2}{c^2} a = \frac{m}{(1-\frac{u_a^2}{c^2})^{\frac{3}{2}}} a$$

$$F_{\parallel} = \gamma_{ua}^3 m a$$

cle in the + x direction with acceleration a. At time $t = 0$ the particle is at rest at the origin, and so its initial speed is zero, $u_o = 0$.

A second observer moves at speed V along the + x direction (frame S'). Time measurements in both frames start at the moment their origins coincide.

The acceleration transformations are given in Equation set 7.11 and they show that $a' = a\gamma^2$. In other words a moving observer sees an accelerating body in frame S accelerate at a faster rate by a factor of γ squared.

The effect of time dilation in a moving frame S' creates the illusion of increased acceleration for a body accelerating in the stationary frame S. This is because the force-device causing the acceleration operates in the stationary frame S and is unaffected by dilation effects (its forces remain strong).

Moving observers' clocks run slow, but they are unaware of this because their body clocks also slow down.

If moving observers wished to determine the absolute accelerations of bodies, they first need to determine their own absolute speeds through wisp space. Only then would they be able to determine true absolute values for accelerations.

7.15.3 Motion produced by a force-device in absolute frame S

A force-device remains fixed in absolute frame S (Figure 7.14) and produces a force F_1 that acts on a small particle of mass m.

The particle accelerates through a distance h, reaching a maximum speed u_1. (This speed is negligible when compared to the speed of light, and so we can ignore $\gamma_{\upsilon 1}$ dilation effects.)

The device is representative of a mechanical/biological clock, to which we can synchronize our body clocks. A series of particles singularly pass through the device, each represent-

(Equation set 7.11)

Wisp velocity and acceleration transformations

$$\gamma = \frac{1}{\sqrt{1-\frac{V^2}{c^2}}}$$

$$\delta t = \gamma \delta t'$$

$$x' = \frac{at^2}{2} + u_0 t - Vt$$

$$u' = \frac{dx'}{dt'} = \gamma \frac{dx'}{dt} = \gamma \frac{d}{dt}\left(\frac{at^2}{2} + u_0 t - Vt\right)$$

$$u' = \gamma (at + u_0 - V)$$

$$a' = \frac{du'}{dt'} = \gamma \frac{du'}{dt} = \gamma^2 \frac{d}{dt}(at + u_0 - V)$$

$$a' = \gamma^2 a$$

Inverse acceleration transformations

$$\gamma' = \frac{1}{\gamma} = \frac{1}{\sqrt{1+\frac{(V')^2}{c^2}}}$$

$$x = \frac{a'(t')^2}{2} - V't'$$

$$u = \frac{dx}{dt} = \frac{1}{\gamma}\frac{dx}{dt'} = \frac{1}{\gamma}(a't' + u_0' - V') = \gamma'(a't' + u_0' - V')$$

$$a = \frac{du}{dt} = \frac{1}{\gamma}\frac{du}{dt'} = \frac{1}{\gamma^2}\frac{d}{dt'}(a't' + u_0' - V') = \frac{1}{\gamma^2}a'$$

$$a = (\gamma')^2 a'$$

ing one beat of our body clocks – say one second.

We can also infer that the beat of this clock is proportional to the speed at which our brains process information and it determines our sense of the flow of time.

The motion of particles in the device is in accordance with classical dynamics, and because the device is stationary in wisp space, relativistic effects are ignored (Equation set 7.12).

7.15.3.1 *Motion produced by a force-device moving in frame S*

A force-device moves through absolute wisp space (frame S) at speed V, and so is subject to the effects of force and jiggle dilations.

In frame S, a stationary observer records absolute measurements of the motions of the particles in the moving force-device. Applying the *rules for time dilation compensation (Section 7.15.4)* to the stationary observer has no effect on the absolute measurements recorded.

The observer notices that the time the particles spend in the moving force-device is now longer than if it were stationary. This is because the effects of force and jiggle dilations physically reduce the effectiveness of forces that operate within the device, causing the particles to accelerate more slowly.

The relative motion of the particle to the force-device is u_2, which is negligible when compared with the speed of light, and so we can ignore additional relativistic effects. However, the speed at which the force-device moves through wisp space could be significant and so we must take into account the effects of force and jiggle dilations acting on the force-device. They reduce the strength of the force F_2 operating within the device, so the classical dynamics equations used earlier need modifying accordingly (Equation set 7.13). All measurements are absolute.

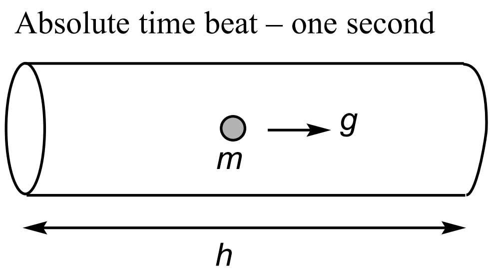


Figure 7.14 Force-device – mechanical clock

(Equation set 7.12)

Classical dynamics equations for a force-device operated at rest in stationary frame S

We ignore the γ_{u1} dilaton factor, as $u_1 << c$

$x = \frac{1}{2}gt^2$	Displacement of particle from origin
$u_1 = \sqrt{2gh}$	Maximum speed of particle
$a_1 = \frac{F_1}{m} = g$	Acceleration of particle in force-device
$t_1 = \sqrt{\frac{2h}{g}}$	Time travelling in force-device
$\Delta E_1 = \frac{1}{2}mu_1^2$	Change in classical kinetic energy
$\Delta p_1 = mu_1$	Change in classical momentum
$F_1 t_1 = mgt_1$	Classical impulse given to particle

If the moving force-device slows its beat by a factor of two, then for two beats of an absolute clock, the moving clock would beat once when measured in absolute time.

Now if we substitute our bodies in place of the force-device, our body clocks would run at half speed in absolute time. But we would be unaware of this fact, because our senses would slow down and time would appear to run at normal speed.

Jiggle and force dilations affect all physical processes that take place on the Earth as it moves through wisp space. But our senses automatically compensate for the effects of time dilation (caused by force and jiggle dilations), which cancels out our awareness of its slowing effect on physical processes that surround us.

Consequently we must apply *rules for time dilation compensation (Section 7.15.4)* to simulate the actions of our senses when confronted with time dilation effects. And we will find that physical systems that move through wisp space behave in the same way as ones that are stationary.

Before testing this out on the moving force-device we will look at the *rules for time dilation compensation.*

7.15.4 Rules for time dilation compensation

Moving observers' body clocks slow in the same manner as moving mechanical clocks do, and so they are unaware of the effect of time dilation. Without their knowledge the *rules for time dilation compensation* (Equation set 7.14) are automatically applied, and any measurements they make are with reference to relative time.

To compensate for observers' time slowing, we must apply the *rules for time dilation compensation* to all physical processes that are 'local' to their moving reference frames.

The next example will demonstrate this.

(Equation set 7.13)
Classical dynamics equations for a force-device moving with respect to absolute frame S

The force-device moves at speed V

$\gamma^2 = \frac{1}{1-\frac{V^2}{c^2}}$ Force-device dilation (force and jiggle)

We ignore the γ_{u2} dilaton factor, as $u_2 << c$

$a_2 = \frac{F_2}{m} = \frac{F_1}{m\gamma^2} = \frac{g}{\gamma^2}$ Absolute acceleration

$x = Vt + \frac{a_2 t^2}{2} = Vt + \frac{gt^2}{2\gamma^2}$ Displacement from fixed origin

$u_2 = V + \sqrt{\frac{2ah}{\gamma^2}} = V + \frac{u_1}{\gamma}$ Absolute maximum speed

$t_2 = \sqrt{\frac{2\gamma^2 h}{g}} = \gamma t_1$ Absolute time in force-device

$\Delta E_2 = \frac{\Delta E_1}{\gamma^2}$ Δ Classical KE due to force-device

$\Delta p_2 = \frac{\Delta p_1}{\gamma}$ Δ Classical momentum due to force-device

$F_2 t_2 = \frac{F_1 t_1}{\gamma}$ Classical impulse given to particle

7.15.4.1 *Motion produced by a moving force-device with respect to frame S'*

An observer travels with a moving force-device and is unaware of its motion through wisp space. In the observer's frame S*'* the force-device appears stationary.

A stationary wisp space observer in frame S sees the force-device moving and sends the moving observer information about its absolute measurements (Equation set 7.13). The moving observer then applies the *rules for time dilation compensation* (Equation set 7.14) to the absolute measurements, which converts them into relative ones.

Equation set 7.15 shows the compensated data. The moving observer's predicted measurements are shown primed. (Square brackets [ ] are used to identify time dilation compensation terms.)

The moving observer then carries out local measurements on the motions of particles in the force-device, and discovers that the measurements agree with those predicted. All timings, accelerations, speeds, energy and momentum increases are identical. Both observers find that their force-devices operate identically in their local reference frames according to known laws of physics.

If they were unaware of the motion of wisp space they each would wrongly conclude that the laws of physics were the same in all inertial frames (special relativity's postulate 1).

Sceptical of the findings, the moving observer asks for confirmation about the truth of the absolute measurements supplied. And both observers agree to watch each other as they repeat their experiments.

The stationary observer in frame S sees the moving observer's force-device operate more slowly. And the moving observer in frame S*'* – although witnessing normal operations locally

(Equation set 7.14)
Rules for time dilation compensation for observers
Compensation terms are shown in [ ]

$x' = x$ No change to distances

$u' = [\gamma]u$ Absolute speeds are increased by γ

$a' = [\gamma^2]a$ Absolute accelerations are increased by γ^2

$F' = [\gamma^2]F$ All absolute forces are increased by γ^2

$\delta t' = \dfrac{\delta t}{[\gamma]}$ Absolute time intervals are reduced by γ

$\Delta E' = [\gamma^2]\Delta E$ Δ Kinetic energy value is increased by γ^2

$\Delta p' = [\gamma]\Delta p$ Δ Momentum is increased by γ

$F'\delta t' = [\gamma]F\delta t$ Force-device impulse is increased by γ

– notices that the force-device in frame S appears to be working more quickly.

The moving observer finally accepts that time dilation, coupled with the effects of force and jiggle dilations, is the reason why both sets of local measurements appear identical.

(Equation set 7.15)

Predicted relative measurements for a moving observer

$a' = [\gamma^2]\dfrac{g}{\gamma^2} = a$ Relative acceleration of body

$x' = \dfrac{a't'^2}{2} = \dfrac{at^2}{2} = x_2$ Displacement from moving origin

$u_2' = [\gamma]\sqrt{\dfrac{2ah}{\gamma^2}} = u_1$ Relative final speed of body wrt S′

$t_2' = \left[\dfrac{1}{\gamma}\right]\sqrt{\dfrac{2\gamma^2 h}{a}} = t_1$ Relative time spent in force-device

$\Delta E_2' = [\gamma^2]\dfrac{\Delta E_1}{\gamma^2} = \Delta E_1$ Change in classical KE wrt S′

$\Delta p_2' = [\gamma]\dfrac{\Delta p_1}{\gamma} = \Delta p_1$ Change in classical momentum

$F_2' t_2 = \dfrac{F[\gamma]t_1}{\gamma} = F_1 t_1$ Classical impulse from force-device

Force-device operated in frame S′

Force, jiggle and time dilation effects apply.

Observer in frame S′ sees

$a' = a$ Acceleration of body

$v' = v$ Final speed of body

$t' = t$ Time travelling in force-device

$\Delta E' = \Delta E$ Change in KE of body due to force-device

$\Delta p' = \Delta p$ Change in momentum due to force-device

$F't' = Ft$ Impulse received from force-device

7.16 Absolute speed of light

The speed of light measured on Earth in a vacuum is 299,792,458 m/s. However, this value does not take into account the effects of time dilation caused by the motion of the Earth through wisp space. We will assume that this is the same as its speed orbiting the Sun (30,000 m/s).

We have unknowingly measured light's speed on the surface of the Earth using relative time. To calculate the true absolute speed of light we need to remove the time dilation effect from our result.

Equation set 7.16 shows that the true absolute value for the speed of light is about 1.5 m slower than the current measurements suggest.

(Equation set 7.16)

Absolute speed of light through one-state space

$c' = 299792458$ m/s Relative light speed on earth

$V = 30000$ m/s Earth's orbital speed through wisp space

$$\gamma \simeq \frac{1}{\sqrt{1-\frac{V^2}{(c')^2}}}$$

$$c = \frac{c'}{\gamma}$$ Absolute speed of light

So the absolute speed of light is

$c = 299792456.5$ m/s

7.17 Earth's absolute and relative times

The effect of time dilation causes all clocks on the Earth to run slow by about 5 ns each second. This happens because the clocks on the Earth measure relative time, which runs slower than absolute time.

A time interval of 1.0 second measured on the surface of the Earth would correspond to 0.999999995 seconds in absolute time (Equation set 7.17).

(Equation set 7.17)

Absolute time measure – second

$t' = 1.0$ second   Relative time measurement on Earth

$V = 30000$ m/s   Earth's orbital speed through wisp space

$$\gamma \simeq \frac{1}{\sqrt{1-\dfrac{V^2}{(c')^2}}}$$

$$t = \frac{t'}{\gamma}$$

$t =$ 0.999999995 seconds   Absolute time measure