Physics in 5 Dimensions

OBJECTIVE VIEW OF PHYSICS – continued

Following the introduction to 5-dimensional space, where we started with the simple example of two spacecraft travelling through outer space on adjacent parallel paths, we now look at the case of observers and objects in general.

General case for all matter moving in space with the velocity of light: While we have developed the idea of 5-dimensional space based on the two spacecraft example, we now consider the general case and ask: Can an observer ever be considered to be at “rest”? The answer is certainly “no” because we cannot imagine a situation where the observer is not moving in the universe in some way. For example, an observer on the surface of Earth has a motion arising from the sum of the following: - the Earth’s rotation, - the Earth orbiting the Sun, - the Sun moving in the Milky Way, - the Milky Way rotating and moving within the Universe and so on. So certainly the observer and all other objects are moving in the universe with some accumulated relative velocity. We will shortly see that the outcome of our specific spacecraft example, which includes Einstein’s expressions for energy and mass, does make a strong case for considering that all matter has a path in space with a relative velocity equal to the speed of light and is a necessary condition to be in agreement with the fundamentals of physics. The review of many fields of physics also supports this view and I have not found a field yet where this is not the case.

According to Einstein’s relativity theory the mass of an object is dependent on the velocity of the object with respect to the observer, so the values for an object “at rest” are a special case in 4-dimensional space. For an object “at rest” in 4-dimensional space, Einstein’s energy term becomes \( E_0 = m_0 c^2 \) and the momentum term \( p_0 = m_0 c \), where the subscript \( 0 \) denotes the special “at rest” case values of the associated parameters. We will show later that this view belongs to the physics of 4-dimensional space and that in 5-dimensional space the mass \( m \) is always constant.

Differences between 4- and 5-dimension physics: For an observer \( P \) and object \( O \) following parallel paths with velocity \( c \), the object appears to be at rest relative to the observer and we now consider the condition under which the object moves with a velocity \( v_4 \) relative to the observer or, in the case of the two spacecraft, what has to happen for me as the observer to see you as the object attain a non-zero relative
velocity. We define the scalar value of $v_4$ to be the same relative velocity between observer and any object as viewed in our conventional 4-dimensional space, and in 5-dimensional space define the vector $v_4$ to be at right angles to the path of the observer with the speed of light (aligned with the y-axis in the diagram below). We now consider the following hypothesis: - If we apply a force to the object, i.e. in our example we use the engines of the object spacecraft, we can change the direction of its path with the speed of light $c$, however we don’t change its velocity with the speed of light. After the engines are stopped, the observer and object now have non-parallel paths of velocity $c$, and clearly the object will move away or closer to the observer with time depending on the angle $\theta$ subtended by their respective paths with the velocity of light. From the diagram above, we see that the angle $\theta$ determines the value of $v_4$ where $\sin \theta = v_4/c$. Acceleration (rate of change of velocity) in 4-dimensional space corresponds to the rate of change of the angle $\theta$ in 5-dimensional space. When the accelerating force stops acting (engine switched off) then the velocity $v_4$ and angle $\theta$ stop changing.

Clearly the value of $v_4$ will be different for different observers viewing a single object because the angle $\theta$ between the observers and object can be different in all cases. Therefore the value of $v_4$ only has significance for a particular particle or body relative to a specific observer.

In the above diagram, a triangle of velocity vectors is formed with two sides representing the common constant velocity vector $c$ and the relative velocity vector $v_4$ and this leaves the third side representing another relative velocity vector $v_5$ of the object which is parallel to the path of observer $P$ with velocity $c$ (parallel to the y-axis). This velocity vector is labelled $v_5$ because it belongs to 5-dimensional space and is unknown and therefore ignored from our 4-dimensional view of space and the associated physics. The scalar relationship between these velocities is given simply by $c^2 = v_4^2 + v_5^2$. With $c$ fixed, the other two relative velocities can only exchange values within the limits that when $v_4 = 0$ then $v_5 = c$ and when $v_4 = c$ then $v_5 = 0$.

In terms of Einstein’s relativity theory, we use his definition of the mass $m_0$ of an object at “rest” and mass $m$ associated with an object of velocity $v_4$ and use them in our scalar expression. First we multiply the expression with the scalar velocities by the mass term $m^2$ giving $m^2 c^2 = m^2 v_4^2 + m^2 v_5^2$. In 5-dimensional space we have the general object momentum term $p = m v_5$ and when $v_4 = 0$, $v_5 = c$ so that this becomes $p_0 = m_0 c$ for an object “at rest”. $p$ varies with changing $v_5$ and $v_4$ in 5-dimensional space, but in 4-dimensional space there is no concept of the velocity vector $v_5$ or of a momentum term $p = m v_5$ and we now look at the 4-dimensional result that arises from the 5-dimensional expression when we ignore the change of momentum term with velocity and simply let $m v_5 = m_0 c$ as the only possible option to use from a 4-dimensional space perspective.
Then the expression: \[ m^2 c^2 = m^2 v_4^2 + m^2 v_5^2 \]

Becomes

\[ m^2 c^2 = m^2 v_4^2 + m_0^2 c^2 \]

And rearranged gives: \[ m^2 (c^2 - v_4^2) = m_0^2 c^2 \]

So that: \[ m = m_0 / (1 - v_4^2 / c^2) \]

This expression is exactly the same as the relativistic mass relationship derived by Einstein in his Special Theory of Relativity where in Einstein’s case the value of \( c \) is also the speed of light.

So the above approach, with all matter moving in space with the speed of light, and the linking of 4- and 5-dimensional spaces using \( m v_5 = m_0 c \), are plausible options that agree with the fundamentals of physics represented in this case by Einstein’s expression of energy \( E = m c^2 \) and his expression for the mass \( m \) of an object varying with velocity \( v_4 \).

We note that when \( v_4 = c \) then the mass \( m \) in the above equation goes to infinity, which implies that an object can never reach the speed of light. This is the view of 4-dimensional space and is not the same in 5-dimensional space where \( m (= m_0) \) has a fixed value and is not dependent on the velocity \( v_4 \).

In 4-dimensional space, and in our example, the perspective of the observer is limited and the observer knows nothing about the common velocity \( c \) or the velocity vector \( v_5 \). Therefore the observer can only register the object velocity \( v_4 \). With the observer \( P \) still travelling with velocity \( c \) parallel to the \( y \) axis, we can see from the previous diagram that \( v_5 < c \) and the object will not keep up with the observer’s position relative to the \( y \)-axis. As judged from a coordinate system rigidly attached to the observer, object \( O \) has one velocity vector \( v_4 \) aligned with the \( x \) axis and an additional relative velocity vector \( \Delta v_5 = (c - v_5) \) aligned with the \( y \) axis. When \( v_4 << c \) then \( \theta \) is small and \( v_5 \approx c \) in which case \( (c - v_5) \approx 0 \). Therefore, under these conditions, the observer will “see” the object move away in the direction parallel to the \( x \)-axis with velocity \( v_4 \) but may not be aware of the very small additional velocity vector \( \Delta v_5 = (c - v_5) \) in the direction parallel to the \( y \)-axis.

With experiments in 4-dimensional space, the velocity vectors \( c \) and \( v_5 \) cannot be taken into account when reviewing theoretical and measured results. Therefore, if the hypothesis of the common constant velocity in 5-dimensional space is “true”, we must be able to associate some physical effect in 4-dimensional space with the lack of knowledge about the small additional velocity vector \( \Delta v_5 = (c - v_5) \). From the above review, we see that this physical effect is the variable relativistic mass \( m \) in 4-dimensional space which is required to match the theoretical and experimental results of classical physics. In 5-dimensional space the mass does not change with velocity.

The dynamic view of matter gives considerable physical objectivity to the conservation of both momentum and energy in 5-dimensional space: Allocating the velocity of light \( c \) to all particles and bodies of mass \( m \) provides a dynamic view of matter which gives considerable physical objectivity to the conservation of both momentum and energy in 5-dimensional space. The mass \( m \) and the velocity of light \( c \) are inseparable properties.
of all particles and bodies and this view of matter is consistent with Einstein’s terms for energy $E = mc^2$ and momentum $p = mc$. Also the momentum $p_4$ in 4-dimensional space is given by $p_4 = m v_4$ and can be seen to be equally conserved as long as $v_4$ and therefore the $\theta$ angle remain the same which is the case as both observer and object continue to follow their paths with the speed of light.

**Differences between classical physics in 4-dimensions and physics in 5-dimensions:** The term "Physics in 5 dimensions" was selected to convey the idea of adding a new property, a new dimension, to the four dimensions of space and time used in classical physics. The effect of physics in 5-dimensions on our current perspective of physics in 4-dimensions are subtle however very significant. The research over many fields of physics was motivated by the results of each new field reviewed and an ever improving “common” and “unifying” perspective of physics in 5-dimensions.

The justification of the results can be found in the book "Physics in 5 Dimensions" – the content covered is summarized in the [index of the book here](#).

**The book *Physics in 5 Dimensions***

*Physics in 5 Dimensions* is available as a [Hardcover Version](#) and also as a [PDF Version](#) for [Members of ResearchGate - the social networking site for scientists and researchers](#).