On the Value of Gamma

What follows is an informal continuation of the work presented in, "A Computational Model of Time-Dilation" [1],[1] in which we presented a theory of time-dilation rooted in information theory and computer theory, with equations for time-dilation that are identical in form to those given by the special and general theories of relativity. In this note, we present an explanation for the specific value of gamma,

$$\gamma = 1/\sqrt{1 - v^2/c^2}, \qquad \text{(Eq. 1)}$$

thereby completing the model of time-dilation presented in [1].

The Existence of a State-Space

In [1], we presented a model of time-dilation in which elementary particles change "states" over time, thereby eventually decaying into other particles, or sets of particles. That is, an elementary particle transitions through states over time, and eventually, this causes certain elementary particles to reach a state where they no longer have the same properties, and thereby decay (see Section 3.2 of [1]). Though not necessary in order to generate time-dilation, we can think of the transitions undergone by an elementary particle in terms of that particle traversing a space. That is, as an elementary particle transitions through states over time, we can view these transitions as the result of that elementary particle actually physically traversing some space that is outside of ordinary three-dimensional space, which we call the ***state-space***.[2] In short, when an elementary particle changes position in the state-space, its physical characterics in three-space change, eventually causing certain particles to decay.

The Total Velocity of an Elementary Particle

Because we view the state-space as an actual space in which particles change position over time, the rate at which a particle changes position in the state-space as a function of time can be viewed as a velocity. Because time-dilation causes elementary particles to decay at a slower rate, it follows that the greater the velocity of a particle is in physical three-space, the lower the velocity of the particle must be in the state-space, since it takes more time for that particle to decay, implying that the rate at which an elementary particle traverses the state-space must decrease as a function of its velocity in three-space. Specifically, we assume that the ***total velocity*** of an elementary particle is constant, and is given by,

$$||(v_s, v_e)|| = c, \qquad \text{(Eq. 2)}$$

where v_s is the velocity of the particle in the state-space, v_e is the velocity of the particle in three-space, and c is the velocity of light in a vacuum. That is, the total velocity of an elementary particle is the norm

[1] Available at www.researchgate.net/publication/323684258_A_Computational_Model_of_Time-Dilation.
[2] See, "Magnetism, Momentum, and Continuous Waves" generally for a discussion on the notion of a state-space, which is available at www.researchgate.net/project/Information-Theory-16/update/5ba6006ecfe4a76455f52449.

of the vector formed by its component velocities, which includes a velocity in ordinary three-space (v_e), and a velocity in the state-space (v_s).

Because time-dilation exists, there must be a relationship between these two velocities that causes v_s to decrease as a function of v_e. That is, because time-dilation exists, it must be the case that the velocity of an elementary particle through the state-space decreases as its velocity through physical space increases, thereby causing it to transition through its states at a slower rate, ultimately generating time-dilation. We assume that the mathematical relationship between these two velocities is in fact the relationship set out in Equation (2), which requires the norm of the vector formed by these two velocities as components to be a constant, equal to the velocity of light in a vacuum.

The Value of Gamma

In the model of time-dilation presented in [1], time-dilation is due to the rate at which an elementary particle, or larger physical system, progresses through its states. This means that the faster a particle progresses through its states, the more time it will experience over any given interval of objective time.[3] In short, the model of time-dilation we presented in [1] implies that a particle, or larger physical system, will objectively "age" at a faster rate, as a function of objective time, if it progresses through its states at a faster rate, as a function of objective time. The physical explanation we gave for this phenomenon in [1] is rooted in the model of energy we presented in [1], which assumes that energy quite literally contains information, thereby determining the behavior of elementary particles, and larger systems. Specifically, we assumed that kinetic energy "codes" for motion, causing particles to traverse physical space, and mass energy "codes" for a change in state, causing the particle to change states, and eventually, to decay, in some cases. Time is then ultimately measured by how fast an elementary particle within a given frame of reference transitions through its states, with ***absolute time*** being measured by the rate at which any truly stationary particle transitions through its states. Specifically, the number of times an elementary particle changes states is counted, and the more state changes that have occured, the greater the amount of time that has elapsed. The ultimate frame of reference from which we judge all time is that of any truly stationary particle, whose "click rate" is the absolute fastest possible, thereby making all truly stationary particles equivalent, maximum precision clocks, which we call ***zero-energy clocks***, since by definition they have no kinetic energy.

We showed that the model presented in [1] is consistent with the special theory of relativity, since it necessarily implies that $\gamma = E_T/E_M$, where E_T is the total energy of the particle, and E_M is the mass energy of the particle. With the additional assumption of Equation (2), we can now show that the model presented in [1] also implies the same specific value for γ given in Equation (1).

To begin, note that value of v_s is given by,

$$v_s = \sqrt{c^2 - v_e^2}.$$

[3] See Section 3 of [1] generally for a discussion of time-dilation using objective time.

Because we assume that time is measured by the rate at which an elementary particle changes states, it follows that for any given elementary particle, any measurement of time will be proportional to v_s. That is, the greater v_s, the greater the number of times the particle will change states over any interval of absolute time, and therefore, the amount of time that has elapsed, as measured by that particle, will increase as a function of v_s. Note that we are not suggesting that v_s is a "velocity through time", but rather, that v_s is the velocity at which the particle traverses a space which causes it to change its properties in physical space. We assume that each change of state results in the same amount of time being experienced, and as a result, by counting the number of times a particle changes states over an interval of absolute time, we can then measure the amount of time experienced by that particle over that interval of absolute time. Since v_s is a measure of velocity through the state-space, the number of state changes over any interval of absolute time is proportional to v_s, and therefore, the amount of time experienced by an elementary particle over any interval of absolute time is in turn proportional to v_s.

Now assume that an elementary particle is truly stationary. It follows from Equation (2) that the velocity of the stationary particle through the state-space is maximized at c. Further, assume that a second elementary particle is moving with a non-zero velocity v_e through three-space, and therefore, at some velocity $v_s < c$ through the state-space. Because the rates at which the two particles experience time are proportional to the rates at which they progress through their respective states, it follows that the rates at which the two particles experience time are proportional to their respective velocities through the state-space. Specifically, if T and $\overline{T}$ are the amounts of time experienced by the stationary and moving particles, respectively, it follows that,

$$\overline{T} / T = v_s / c = \sqrt{1 - v_e^2/c^2} = 1 / \gamma .$$

Unlike the special theory of relativity, the model presented in [1] does not preclude a particle with mass from having a velocity of c (see Section 3.3 of [1]). As a general matter, the model presented in [1] places no restrictions at all on the velocities of particles or systems, and would even allow (at least in theory) for a particle to have a velocity in excess of c. If, however, we supplement the model presented in [1] with the assumption of Equation (2), then it would clearly not allow for a particle to have a velocity in excess of c, but would allow for a particle with mass to have a velocity of c in three-space, provided the particle has a velocity of zero in the state-space (see Equation 15 in [1]). That is, a particle with mass, such as a neutrino, could have a velocity of exactly c through physical space, provided it is perfectly stable, and never decays. Note that light would also have a velocity of zero in the state-space, which implies that light would be perfectly stable, and never decay, which is consistent with observation.[4]

[4] If the state-space is anything like physical space, then the velocity of a particle through the state-space could be a vector quantity. In this view, the arrow of time would be the result of all systems having a common direction through the state-space, but independent magnitudes of velocity (i.e., independent rates of maturation, which would allow for time-dilation). Bizarrely, this implies at least the theoretical possibility that a system could "change direction" through the state-space, possibly even going "backwards" through its own history of states.