Universal Specificity Investigation 4: Inducing the Cause of Total Time Dilation and Total Energy's Relation to Potential Energy

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The results from previous investigations have lead to the following causal relationship: changes in inertial time differentials (ITDs) are related to work done, either changes in specific kinetic or specific potential energy. These relationships are summarized in Equation (1).

$$\frac{dt}{dt'} = \sqrt{1 - \frac{w}{e_T}} \tag{1a}$$

$$\frac{dt}{dt'} = \sqrt{1 - \frac{\Delta e_K}{e_T}} \tag{1b}$$

$$\frac{dt}{dt'} = \sqrt{1 - \frac{\Delta e_P}{e_T}} \tag{1c}$$

Additionally, previous investigations revealed an update to the relativistic mass, kinetic energy and total energy models, as summarized in Equation (2).

$$m = \frac{m_\gamma}{1 - \frac{v^2}{c^2}} = \text{Invariant} \tag{2a}$$

$$\Delta K = \frac{1}{2}mv^2 \tag{2b}$$

$$E_T = \frac{1}{2}mc^2 = \frac{1}{2}m_\gamma c^2 + \frac{1}{2}mv^2 \tag{2c}$$

I now relate changes in ITDs to changes in total external specific energy, as in ignoring internal potential energy, $\frac{1}{2}m_\gamma c^2$, and then I will update the total energy model to include potential energy.

Changes in specific kinetic or potential energy are related to changes in ITDs, but this is only half of the picture because we tacitly assumed all else remained equal. Now we test what if all else does not remain equal to discover a more precise cause to changes in ITDs.

In reviewing Equation (1), simple analysis reveals that transferring some amount of specific kinetic energy to some amount of specific potential energy (or vice versa) would not cause an overall change in the ITD. As an example, consider an object with some amount of specific potential energy that then enters a state with equal specific kinetic energy, but without the potential. Equation (3) shows that the two ITDs in each state are equivalent.

$$\text{Let } \Delta \mathrm{e_P} > 0.$$

$$\text{Let } \frac{1}{\gamma} = \frac{dt}{dt'} \tag{3a}$$

$$\frac{1}{\gamma_P^2} = 1 - \frac{\Delta e_P}{e_T} \tag{3b}$$

$$1 - \frac{1}{\gamma_P^2} = \frac{\Delta e_P}{e_T} \tag{3c}$$

$$\left(1 - \frac{1}{\gamma_P^2}\right) e_T = \Delta e_P \tag{3d}$$

$$\Delta e_P \Longrightarrow \Delta e_K \tag{3e}$$

$$\left(1 - \frac{1}{\gamma_P^2}\right) e_T = \Delta e_K \tag{3f}$$

$$1 - \frac{1}{\gamma_P^2} = \frac{\Delta e_K}{e_T} \tag{3g}$$

$$\frac{1}{\gamma_P^2} = 1 - \frac{\Delta e_K}{e_T} \tag{3h}$$

$$\frac{1}{\gamma_P^2} = \frac{1}{\gamma_K^2} \blacksquare \tag{3i}$$

Invoking the method of agreement: observing that changes in specific potential energy and changes in specific kinetic energy occurred, while no changes in ITD occurred, proves inductively that they are not the fundamental causes to changes in ITDs—they each play half a role.

The same change in total specific energy in each state caused the same change in ITDs. This proves inductively, via method of agreement, that changes in ITD are caused by a change in total specific energy, and vice versa.

Next, I derive the math model relating changes in total specific energy and changes in ITD. I begin this derivation by trying to solve the ITD for an object stationary within a gravitational field. Then I proceed to determine how a change in kinetic energy, as measured from the stationary position within the gravitational field, affects the ITD. This situation is depicted in Figure 1.

Ultimately, the desire is to measure total effective ITD, $\frac{dt_2}{dt'}$, for the moving object within the gravitational field. $\frac{dt_1}{dt'}$ and $\frac{dt_2}{dt_1}$ can be measured, and both of these ITDs are relatable to the total effective ITD using the chain rule, as shown in Equation (4).

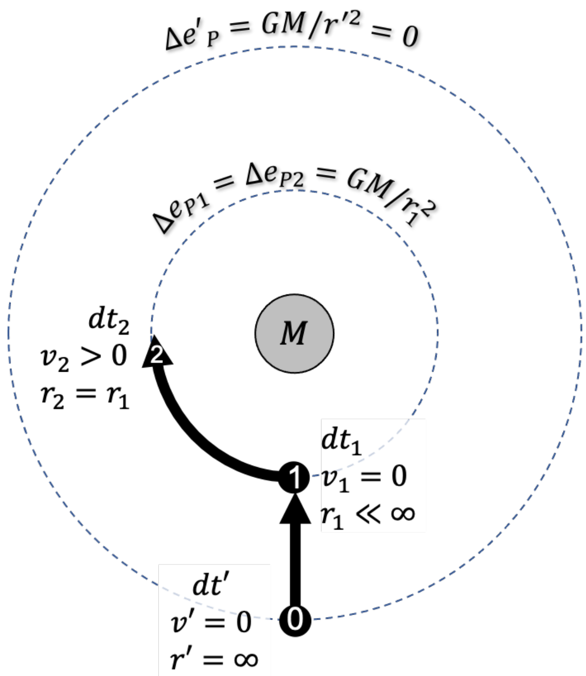

Figure 1. **Total effective time differential example.**

$$\frac{dt_1}{dt'} = \sqrt{1 - \frac{\Delta e_{P1}}{e_T}} \tag{4a}$$

$$\frac{dt_2}{dt_1} = \sqrt{1 - \frac{\Delta e_{K2/P1}}{e_T}} \tag{4b}$$

$$\frac{dt_2}{dt'} = \frac{dt_2}{dt_1}\frac{dt_1}{dt'} = \sqrt{1 - \frac{\Delta e_{K2/P1}}{e_T}}\sqrt{1 - \frac{\Delta e_{P1}}{e_T}} \tag{4c}$$

This can be generalized to any condition where an object within a gravity potential gains some kinetic energy as measured inside that potential, as shown in Equation (5).

$$\text{Let}: \frac{1}{\gamma_P} = \frac{dt_P}{dt'} = \sqrt{1 - \frac{\Delta e_P}{e_T}} \tag{5a}$$

$$\text{Let}: \frac{1}{\gamma_{K/P}} = \frac{dt_K}{dt_P} = \sqrt{1 - \frac{\Delta e_{K/P}}{e_T}} \tag{5b}$$

$$\frac{1}{\gamma_T} = \frac{1}{\gamma_{K/P}}\frac{1}{\gamma_P} = \sqrt{1 - \frac{\Delta e_{K/P}}{e_T}}\sqrt{1 - \frac{\Delta e_P}{e_T}} \tag{5c}$$

$$\frac{1}{\gamma_T} = \sqrt{1 - \frac{(1 - \frac{\Delta e_P}{e_T})\Delta e_{K/P} + \Delta e_P}{e_T}} \tag{5d}$$

$$\frac{1}{\gamma_T} = \sqrt{1 - \frac{\frac{1}{\gamma_P^2}\Delta e_{K/P} + \Delta e_P}{e_T}} \tag{5e}$$

$$\frac{1}{\gamma_T} = \sqrt{1 - \frac{\Delta e_K + \Delta e_P}{e_T}} = \sqrt{1 - \frac{\Delta e_T}{e_T}} \blacksquare \tag{5f}$$

I can now use these tools to update the total energy model in Equation (2) to include an external potential energy term, along with the other terms—internal potential energy and kinetic energy—as shown in Equation (6).

$$\frac{1}{\gamma_T} = \sqrt{1 - \frac{\Delta e_T}{e_T}} \tag{6a}$$

$$\frac{1}{\gamma_T^2} = 1 - \frac{\Delta e_T}{e_T} \tag{6b}$$

$$e_T = \frac{1}{\gamma_T^2}e_T + \Delta e_T = \frac{1}{\gamma_T^2}e_T + \Delta e_K + \Delta e_P \tag{6c}$$

$$E_T = \frac{1}{\gamma_T^2}E_T + \Delta E_K + \Delta E_P \tag{6d}$$

$$E_T = E_I + \Delta E_K + \Delta E_P \tag{6e}$$

$$\frac{1}{2}mc^2 = \frac{1}{2}m_\gamma c^2 + \frac{1}{2}mv^2 + m\int g(r)dr \blacksquare \tag{6f}$$