Straightforward Derivation of E = mc^2

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The equivalence of mass and energy is a direct consequence of the variation of mass with velocity. That mass varies with velocity according to the Lorentz factor γ is a consequence of special relativity, but it does not depend on the bizarre notions of space and time associated with that theory. Relational optics also infers such a relationship under the assumption that the transformation law for momentum is the same for matter as for light [See *Universe without Space and Time*, p. 112]. The famous equation E = mc^2 can be derived simply by using Newton's second law with the Lorentz factor to calculate the kinetic energy imparted to a mass. The kinetic energy so calculated manifests itself as an increase in inertial mass. The procedure for calculating the change in kinetic energy is outlined on pages 139-140 of *Universe without Space and Time*. The mathematical details are filled in below.

$$p = \frac{m_0\, v}{\sqrt{1 - \frac{v^2}{c^2}}} \; ; \; v = \frac{p}{\sqrt{m_0^2 + \frac{p^2}{c^2}}}$$

$$F = \frac{dp}{dt} = \frac{d(\gamma m_0 v)}{dt} ; \; \gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$dE = F dx = \frac{dp}{dt}\, dx = v\, dp = \frac{p\, dp}{\sqrt{m_0^2 + \frac{p^2}{c^2}}} = \frac{½ d(p^2)}{\sqrt{m_0^2 + \frac{p^2}{c^2}}} = \frac{\frac{c^2}{2}\, dz}{\sqrt{m_0^2 + z}} \; ; z = \frac{p^2}{c^2}$$

$$E = \int_0^{KE} dE = \int_0^{\frac{p^2}{c^2}} \frac{\frac{c^2}{2}\, dz}{\sqrt{m_0^2 + z}} = c^2 \sqrt{m_0^2 + \frac{p^2}{c^2}} - m_0 c^2 = c^2 \sqrt{m_0^2 + \frac{\gamma^2\, m_0^2 v^2}{c^2}} - m_0 c^2$$

$$= \gamma m_0 c^2 - m_0 c^2 = m_0 c^2 \left(1 + ½\, \frac{v^2}{c^2} + \ldots\right) - m_0 c^2 = ½ m_0 v^2 + \ldots$$