

A New Solution to Einstein's Infinite Mass Challenge Based on Maximum Frequency*

Espen Gaarder Haug
Norwegian University of Life Sciences

November 6, 2016

Abstract

In 1905, Einstein presented his famous relativistic mass energy equation $\frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}$. When v approaches c , the expression containing the moving mass approaches infinity. Einstein interpreted this in the following way: since one needs an infinite amount of energy to accelerate even a small mass to the speed of light, it would appear that no mass can ever reach the speed of light. In this paper, we present a new solution to the infinite mass challenge based on combining special relativity with insights from Max Planck and maximum frequency. By doing this we show that there is an exact limit on the speed v in Einstein's formula. This limit is only dependent on the Planck length and the reduced Compton wavelength of the mass in question. This also gives us a limit on the maximum relativistic Doppler shift that is derived and discussed.

Key words: Relativistic mass, maximum frequency, maximum speed, Planck length, Planck mass, relativistic Doppler shift.

1 A Maximum Frequency and a Maximum Velocity for Mass?

Einstein [1, 2] gave the following relativistic energy mass formula:

$$E = \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}. \quad (1)$$

Further, Einstein commented on his own formula

This expression approaches infinity as the velocity v approaches the velocity of light c . The velocity must therefore always remain less than c , however great may be the energies used to produce the acceleration¹

Einstein's argument is that the mass will become infinite as v approaches c and this means that we would need an infinite amount of energy to accelerate even an electron to the speed of light. Here we will combine Einstein's special relativity with insight from Max Planck [3, 4] and show that there is another possible solution to the infinite mass challenge. The relativistic mass relationship can be derived from a two-sided Einstein relativistic Doppler shift. Assume a mass is sending out two energy beams. These beams have a frequency of f_{ab} and f_{ba} as observed from the mass sending them out, and further $f_{ab} = f_{ba}$ as observed from this frame. From another frame moving at speed v relative to this mass, based on the relativistic Doppler shift, one will observe these frequencies to be

$$\hat{f}_a = f_a \frac{(1-\frac{v}{c})}{\sqrt{1-\frac{v^2}{c^2}}} \quad (2)$$

and

*Thanks to Victoria Terces for helping me edit this manuscript and thanks to Alan Lewis for useful tips on how to do high accuracy calculations in Mathematica.

¹This quote is taken from page 53 in the 1931 edition of Einstein's book *Relativity: The Special and General Theory*. English translation version of Einstein's book by Robert W. Lawson.

Assume, for example, an electron, which has a frequency (amount of counter-strikes per second, clock frequency) as observed from its rest-frame equal to $f_1 = \frac{c}{\lambda_e} \approx 7.7634 \times 10^{20}$. Next assume this electron is accelerated to its maximum velocity relatively to the laboratory frame and that it is traveling towards the laboratory frame. The frequency as observed from the laboratory frame is then given by

$$\begin{aligned} f_2 &\approx f_1 2 \frac{\bar{\lambda}_e}{l_p} \\ f_2 &\approx \frac{c}{\lambda_e} 2 \frac{\bar{\lambda}_e}{l_p} \approx 2 \frac{c}{l_p} \end{aligned} \quad (8)$$

That is the maximum relativistic Doppler shift, which again is directly related to the maximum velocity of masses that will “turn” a non-Planck-frequency into the Planck frequency. This is just another way of looking at how a subatomic particle will become a Planck mass when accelerated to its maximum velocity. As the Planck frequency is the very collision point of indivisible particles (the point where the photons changes direction), this also means the Planck frequency is invariant as observed from any reference frame.

Still no one has been able to observe the Planck frequency, or a Planck mass, or the maximum velocity described in this paper “directly”. The maximum velocity for any known subatomic particle is far above that achieved at the LHC.

3 Summary and Conclusion

In this paper we have assumed that there is a maximum two-sided Doppler shift frequency of $\hat{f} = 2 \frac{c}{l_p}$. Based on this, we have found the maximum speed that fundamental particles can take. At this maximum speed any fundamental particle will have reached a relativistic mass equal to the Planck mass. We expect the Planck mass to be highly unstable and burst into energy within a Planck second. If this is the case, then we do not need an infinite amount of energy to accelerate particles to the speed of light, as they will become Planck masses (standing still for an instant), and then they will burst into pure energy traveling at the speed of light.

To deny that such a maximum velocity just below the speed of light exists, one must assume there is no limitations to the shortness of the wavelength and no limit on the maximum frequency in relativistic Doppler shift. The maximum velocity gives a limit on the maximum relativistic Doppler shift equal to the Planck frequency $2 \frac{c}{l_p}$. It also gives a relativistic mass limit equal to the Planck mass, and most importantly, it gives strong evidence towards the concept that the Planck mass is the same as observed from any reference frame. This because the maximum velocity of a Planck mass is zero. However, the Planck mass only exists when it is at rest and in that regard, it only exists for an instant. The Planck mass is the turning point of photons, being the point at which photons collide and change direction.

References

- [1] A. Einstein. Ist die trägheit eines körpers von seinem energieinhalt abhängig? *Annalen der Physik*, 323(13):639–641, 1905.
- [2] A. Einstein. *Relativity: The Special and the General Theory*. Translation by Robert Lawson (1931), Crown Publishers, 1916.
- [3] M. Planck. Ueber das gesetz der energieverteilung im normalspectrum. *Annalen der Physik*, 4, 1901.
- [4] M. Planck. *The Theory of Radiation*. Dover 1959 translation, 1906.
- [5] E. G. Haug. *Unified Revolution: New Fundamental Physics*. Oslo, E.G.H. Publishing, 2014.
- [6] E. G. Haug. The Planck mass particle finally discovered! Good bye to the point particle hypothesis! *www.viXra.org*, 2016.
- [7] E. G. Haug. The gravitational constant and the Planck units. a simplification of the quantum realm. *Forthcoming: Physics Essays Vol 29, No 4*, 2016.
- [8] B. Fixler, G. T. Foster, J. M. McGuirk, and M. A. Kasevich. Atom interferometer measurement of the Newtonian constant of gravity. *Science*, 315, 2007.
- [9] S. Schlamminger. A fundamental constant: A cool way to measure big G. *Nature*, 510, 2014.
- [10] G. Brumfiel. LHC by the numbers. *News: Briefing, Nature, Published online 9 September*, 2008.