# Finding the Planck Length Independent of Newtons Gravitational Constant and the Planck Constant
# The Compton Clock Model of Matter

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It is assumed by modern physics that the Planck length is a derived constant from the Newton's gravitational constant, the Planck constant and the speed of light, $l_p = \sqrt{\frac{G\hbar}{c^3}}$. This was first discovered by Max Planck in 1899. We suggest a way to find the Planck length independent of any knowledge of the Newton's gravitational constant or the Planck constant, but still dependent on the speed of light (directly or indirectly).

## I. INTRODUCTION

In 1899, Max Planck [1, 2] introduced what he called the 'natural units': the Planck mass, the Planck length, the Planck time, and the Planck energy. He derived these units using dimensional analysis, assuming that the Newton gravitational constant, the Planck constant, and the speed of light were the most important universal constants. The Max Planck formula for the Planck length is given by

$$l_p = \sqrt{\frac{G\hbar}{c^3}} \tag{1}$$

in other words, it seems like we need to know the Newton's gravitational constant $G$ and the Planck constant $\hbar$ and the speed of light $c$ to find the Planck length. It has therefore been assumed that the Planck length is a derived constant and that Newton's gravitational constant is a more fundamental constant, a view we will challenge here.

## II. PLANCK LENGTH INDEPENDENT OF $G$ AND $\hbar$

First find the reduced Compton wavelength of an electron by Compton scattering. The reduced Compton frequency is then given by

$$f_C = \frac{c}{\bar{\lambda}_e} \tag{2}$$

where $f_C$ stands for the reduced Compton frequency, and $\bar{\lambda}_e$ is the reduced Compton wavelength of the electron.

Further the Cyclotron frequency is linearly proportional to the reduced Compton frequency. Doing a cyclotron experiment, one can find out that the reduced Compton frequency ratio between the proton and the electron. For example [3] measured it to be about

$$\frac{\frac{c}{\bar{\lambda}_P}}{\frac{c}{\bar{\lambda}_e}} = \frac{f_{C,P}}{f_{C,e}} = 1836.152470(76) \tag{3}$$

Well, [3] measured the Proton electron mass ratio this way, but the reduced Compton frequency is only a deeper aspect of mass, that recently have also been more or less confirmed by experimental research. And theoretically it is no surprise that $\frac{f_{C,P}}{f_{C,e}} = \frac{m_P}{m_e}$. We simply claim a simpler and deeper way to express mass is through the reduced Compton frequency in matter, see [4].

Next from the Schwarzschild metric [5, 6] solution of the Einstein field equation [7] we have the well-known formula for the Schwarzschild radius

$$r_s = \frac{2GM}{c^2} \tag{4}$$

Haug [4] has recently pointed out that the Schwarzschild radius also is equal to twice the reduced Compton frequency of the gravity object over a time period of one Planck second, multiplied by the Planck length. That is, we must have

$$\frac{r_s}{2} = \frac{2GM}{c^2} = f_C t_p l_p = \frac{c}{\bar{\lambda}} \frac{l_p}{c} l_p = \frac{l_p^2}{\bar{\lambda}} \tag{5}$$

This means the Schwarzschild radius contains the Planck length. Still, is there a way to extract this without knowing the mass and the Newton's gravitational constant? Haug [8] has recently shown that the Schwarzschild radius can be measured in a series of ways with no knowledge of the mass size or the Newton's gravitational constant. For example the Schwarzschild radius of the earth can be found from the gravitational acceleration field, the speed of light and the radius of the earth

$$\frac{r_s}{2} = \frac{gR^2}{c^2} \tag{6}$$

where $g$ is the gravitational acceleration and $R$ is the radius of the gravity object. For smaller size objects we can find the Schwarzschild radius using a Cavendish apparatus, it is given by

$$r_s = \frac{L4\pi^2 R^2 \theta}{c^2 T^2} \tag{7}$$

where $L$ is the distance between the small balls and $R$ is the distance center to center between the small and large ball. $T$ is the natural resonant oscillation period of a torsion balance, $\theta$ is the deflection angle of the balance. This is somewhat different than the known use of a Cavendish apparatus used to find the weight of the Earth or to find $G$, where one need to know the mass size (weight) of the lead balls. Again, we do not need to know the mass size in normal sense nor do we need to know anything about Newton's gravitational constant to find the Schwarzschild radius .

So, in practice, take a clump of matter, divide it in two and makes two balls of it. Place the two "identical" balls in the Cavendish apparatus. In addition one need two much smaller balls. By measuring $T$, $L$, $R$ and $\theta$ we known the Schwarzschild radius of the large balls in the apparatus. Assume we measure a Schwarzschild radius off $7.43 \times 10^{-28}$ meter.

Next, we find the reduced Compton frequency of an electron, it is

$$f_{C,e} = \frac{c}{\bar{\lambda}_e} \approx 7.76 \times 10^{20} \tag{8}$$

Next, we use the cyclotron to find the reduced Compton frequency of a Proton

$$f_{C,P} = \frac{c}{\bar{\lambda}_e} \times 1836.15247 \approx 1.42549 \times 10^{24} \tag{9}$$

Next, we break the large balls up in pieces and count the number of protons in it. Or alternatively we can pack a known amount of atoms together in a ball, and kept track of the number of protons. This is at least in theory possible. Assume we count approximately $5.97864 \times 10^{26}$ protons in the mass, that we next divide in two. The reduced Compton frequency is additive for a larger mass, so based on the proton count we must have that the reduced Compton frequency in each of the large balls must be approximately

$$\begin{aligned} f_C &= 1.42549 \times 10^{24} \times \frac{1}{2} \times 5.97864 \times 10^{26} \\ &\approx \frac{1}{2} \times 8.52249 \times 10^{50} \end{aligned} \tag{10}$$

Remember the Schwarzschild radius we measured was $7.43 \times 10^{-28}$ m. To find the Planck length we can use the following formula

$$l_p = \sqrt{\frac{1}{2}\frac{r_s}{f_C}c} \tag{11}$$

this gives us

$$l_p = \sqrt{\frac{1}{2}\frac{r_s}{f_C}c} \approx \sqrt{\frac{7.43 \times 10^{-28}}{8.52249 \times 10^{50}}c} \approx 1.616 \times 10^{-35} \text{ m}$$

This also means the Planck length always is the square root of half the Schwarzschild radius times the reduced Compton wavelength of the mass

$$l_p = \sqrt{\frac{1}{2} r_s \bar{\lambda}} \tag{12}$$

The whole method requires no knowledge of traditional mass size measures, that also means no knowledge of the Planck constant $\hbar$, and no knowledge of the Newton's gravitational constant $G$.


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[2] Max Planck. *Vorlesungen über die Theorie der Wärmestrahlung.* Leipzig: J.A. Barth, p. 163, see also the English translation "The Theory of Radiation" (1959) Dover, 1906.

[3] R.S. Van Dyck, F.L. Moore, D.L. Farnham, and P.B. Schwinberg. New measurement of the proton-electron mass ratio. *International Journal of Mass Spectrometry and Ion Processes*, 66.

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[5] K. Schwarzschild. Über das gravitationsfeld eines massenpunktes nach der einsteinschen theorie. *Sitzungsberichte der Deutschen Akademie der Wissenschaften zu Berlin, Klasse fur Mathematik, Physik, und Technik*, page 189, 1916.

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[7] Albert Einstein. Näherungsweise integration der feldgleichungen der gravitation. *Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften Berlin*, 1916.

[8] E. G. Haug. Gravity without newton's gravitational constant and no knowledge of mass size. *preprints.org*, 2018.