Theoretical Ratio of the Gravitational Force to the Electromagnetic Force between Two Electrons

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Abstract

This paper develops the theoretical ratio of the gravitational force to electromagnetic force between two electrons. I refer to this ratio as the *ggee* ratio. The $ggee_{\text{theory}}$ ratio equals the product of a factor multiplied by $alpha^2$.

The factor portion of the calculation comes from an unusual source. An underlying model posits a metaphysical structure of space and of the electron. A rational number solution to the geometry of the model leads directly to the factor. This solution emerges completely independently from the *ggee* ratio it produces. The rational factor seems to be an exact solution.

The precision of $ggee_{\text{codata}}$ depends on the precision of G. The precision of $ggee_{\text{theory}}$ depends on the precision of $alpha^2$. Using Codata values for 2018, $ggee_{\text{codata}} = 2.400610(54)E{-}43$ and $ggee_{\text{theory}} = 2.40071068266(72)E{-}43$. The theoretical value is 1.85 *sigma* greater than the Codata derived value. Based on the value of *alpha* in 1969, $ggee_{\text{theory}} = 2.4007097(72)E{-}43$. This value is also 1.85 *sigma* greater than the Codata derived value for 2018.

The gravitational constant, G, has a history of disparate value ranges. A deviation of 1.85 *sigma* may fall into an acceptable range more than would normally be the case.

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Contents

Donuts

In order to follow the *ggee* ratio calculation one needs some understanding of the underlying donut structure. The donut path depicts the dynamics of the structure in a manner that provides both a method to do computations and a suitable visual aid.

The fabric of space under this view derives from *something* and *nothing*. *Something* lacks all physical characteristics. *Something* nondestructively interacts with other *somethings* by simply canceling opposing motion when contact occurs. *Nothing* means the complete absence of anything, even the fabric of space. Concepts of *extension*, *time*, and *motion* lack meaning at this metaphysical level.

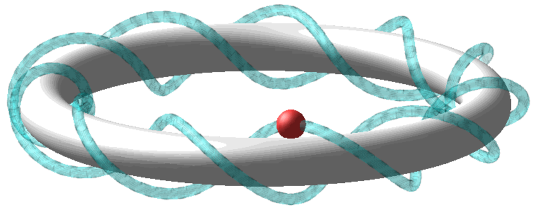

Figure 1: Basic donut chain link.

Figure 1. shows a dynamic donut path. The donut shown has 11 nodes that complete in two revolutions (because of intertwining). The red ball represents *something*. The remainder of the image serves only to help visualize the path. An animated version of this image may be seen at: http://spaceandmatter.org/dn.htm.

The illustrated donut helps us to visualize the fundamental metaphysical element. The metaphysical level is *event* and *phase* driven. This paper frequently references the number of nodes in a donut. I suggest counting the 11 nodes in Figure 1.

All events considered in this paper happen on the inside edge of the donut closest to the donut hole at the toroidal position where adjacent chain links make contact.

Objects normally travel in a straight line in the absence of an external force. The donut motion occurs in *nothing* (a complete void) which allows it to be viewed as traveling in the manner demonstrated.

The donut gains context only by reference to an assumed coordinate system. Donuts periodically contacting adjacent donuts provide the needed context. For donuts to be a stable part of the fabric of space they must be part of a chain segment. The chain segment must be connected to the fabric of space on both ends with the connecting links parallel; or, π radians out of phase.

Chain Segments

Chain segments are the strands used to create both the fabric of space and matter connected to the fabric. Chain segments provide a basis for performing calculations. Chain segments also provide a visualization of the metaphysical structure. It is useful to think of the chain segments as metaphysically real.

What is the difference between *physically real* and *metaphysically real* as they are used in this paper? *Physical reality* comes from that which our senses perceive and our languages reflect. In a physical sense we may feel we understand the meaning attached to distance (extension) and time; or, motion. The meaning of these concepts provides the basis that allows us to form a visual imagery of processes. *Metaphysical reality* may determine our physical reality, but it is removed from our direct scrutiny. This is much like trying to visualize the functional components of a combustion engine by observing its external properties.

Concepts of distance and motion are used in visualizing, understanding and evaluating metaphysical reality. These physical concepts may be considered as artificially introduced in the metaphysical realm. They are helpful and may be necessary for us to understand it. The coordinate system and the donut characteristics may also be considered as chosen to allow us to visualize metaphysical behavior. I personally find it helpful to consider the introduced view of the metaphysical realm to be real at that level. In other words, I find it to be metaphysically real and capable of being considered in a concrete manner.

A chain segment forms from connected donut links. As it is used in this paper, a chain segment connects to other chain segments on both ends. To be a chain segment means that it branches on both ends. We always consider one chain segment as being connected to two other chain segments on each end. This means that each end donut link has a total of three chain segments connected to it.

For chain segment length we count only one of the two connecting end donut links. The orientations of the connecting end donut links are considered to be parallel (either in phase; or, π radians out of phase).

We will later find that the space fabric that we think of as a vacuum develops from chain segments 138 links in length. The electron has one link missing which requires a twist in order to connect. The electron forms from a 137 link chain segment.

Rational Number Relationships

In the metaphysical realm events occur discretely. This requires rational number relationships. Parts of the donut chain solution produce irrational results. In these cases we must find the correct rational representation of the irrational relationship. This assumption yields answers that support its validity.

Contact events drive behaviors in the fabric of space. A contact event between adjacent donuts occurs at a particular location at an instant of time. Each donut has two independent motions for location and one dependent motion for timing. These motions must all synchronize in order to produce stable contact events.

Consider the time elapsed between contact events for two adjacent donuts as taking one big unit of time. This big unit of time needs to be divided into much smaller units in order for each motion to be represented by integer values of elapsed time.

This paper determines each of the three integer values for motion within the electron chain segment. We solve for the toroidal (main circle) and poloidal (outer circle) motion values in the first step of the calculation. We solve for the timing value in the second step of the calculation using values from the first step. The Least Common Multiple of these three integer time values enters directly into the calculation of the *ggee* ratio.

The first major step solves for donuts in the electron chain segment rely on the geometry of the chain segment and the behavior that happens while the electron moves through space (i.e. (n-1)(n+1)). The donut may be considered as a mechanism for handling the mathematics involved; or, it may be considered as a metaphysically real visual. I prefer the visual. These relationships produce a clearly preferred solution where the toroidal motion may be considered as 76172 (or $4 \cdot 137 \cdot 139$) and poloidal motion as 74445 (or $3 \cdot 5 \cdot 7 \cdot 709$).

The first major step synchronizes toroidal and poloidal motion so that the contact point will be revisited. We still need to synchronize the timing. Timing synchronization requires the elapsed time to be an integer value of some timing unit. Elapsed time may be viewed as the hypotenuse of a right triangle where toroidal and poloidal motion are the triangle sides.

The second major step solves for the rational approximation for the square root of $76172^2 + 74445^2$. We make use of the Least Common Multiple of integer values for the two legs and the hypotenuse (both numerator and denominator). The solution is $[(7 \cdot \cancel{7} \cdot 347 \cdot 253153)/(\cancel{3} \cdot 19 \cdot \cancel{709})]$. When combined with the electron coupling constant this produces the *ggee* ratio.

Event Probabilities

Events forge and closely synchronize the Metaphysical Realm. A synchronized view of contact events provides the means to do calculations in this realm. The donut (i.e. chain link) helps to visualize event synchronization.

Contact between the *somethings* of adjacent donut links constitute a ***contact event***. A contact event can only occur if a ***contact node*** simultaneously occurs in adjacent donuts. This requires the correct *where* and *when* for both donut links.

Visualize a toy Slinky bent completely around on itself to resemble a donut. Think of the Slinky's spiral spring as a path traveled by *something*. Define a ***donut path*** to be this spiral path.

Consider the donut as a link in a chain segment. Chain links make contact with adjacent chain links on the inside of each link. A donut works the same. Define a ***contact line*** as the part of a donut closest to the donut hole. The contact line forms the circumference of a circle that immediately surrounds the donut hole.

A *contact node* occurs at each point where the *donut path* intersects the *contact line*. The contact nodes for a donut constitute the eligible places the next event can occur. The label *"contact node"* refers to a location and instant on the donut path. At that location and instant, contact with another *something* could possibly occur.

Inverting the number of contact nodes yields the frequency with which an event occurs. Complex environments can appear to exhibit a stochastic view of the frequency. Confined environments, such as a particular chain segment, exhibit a more deterministic view of the frequency.

A *contact event* between adjacent donuts occurs when their *somethings* arrive simultaneously at connecting contact nodes located in separate donut paths.

Many conditions must be met in order for a *contact event* to occur. This may make the events seem unlikely. Remember that nothing happens until a contact event occurs however unlikely the event may seem.

Node Calculations

Node calculations rely on angles. For these calculations we ignore *extension*. Extension lacks meaning at this level, but provides a useful means for visualizing relationships. To help describe the node calculation, the donut from the *Event Probabilities* section provides a visualization.

For a node to exist the donut path traveled must eventually repeat its pattern. Consider the toroidal phase (major circular position around the center of the donut hole) and poloidal phase (minor circular position around the donut surface) of *something* at a moment in the donut path.

For visualization purposes, we choose to view our donut radii such that the *donut path* angle on the inside of the donut (i.e. *contact line*) will exactly produce the desired node count for the donut.

Define this connecting angle between donuts as the ***donut contact angle***, $\boldsymbol{\phi}$. The orientation of untwisted chain segment links differs by $\pi/2$ between adjacent links. This produces an angle of $\phi = \pi/4$ connecting two untwisted links. The angle ϕ plays a pivotal role in contact nodes, especially in twisted chain segments.

We describe radii to help visualize the donuts. The *ggee* calculation *excludes* these radii. Extension lacks meaning in the metaphysical realm, but allows us to visualize.

The major (toroidal) radius equals $\boldsymbol{R}$ measured from the center of the donut hole to the inside of the torus (the *contact line*). The major angular velocity equals $\boldsymbol{\Omega}$.

The minor (poloidal) radius equals $\boldsymbol{r}$ measured from the center of the torus ring to the surface of the torus. The minor angular velocity (poloidal) equals $\boldsymbol{\omega}$.

The major angular motion in a donut must equal the minor angular motion in a contacting donut. For identical donuts this produces the relationship:

$$\omega r = \Omega R$$

Define $\boldsymbol{p}$ as the number of *primary contact nodes* in one revolution of a donut link. For a simple untwisted chain segment this produces:

$$\omega = p\Omega \quad \text{and;} \quad pr = R$$

I suggest recounting the 11 nodes in Figure 1. and identifying where the *contact line* intersects each node next to the donut hole.

When a single link is removed from an untwisted chain segment, the remaining chain segment must be twisted in order to maintain contact. This produces a *donut contact angle* different than $\pi/4$.

Define the *target* donut contact angle as $\boldsymbol{\phi_{target}}$; and the *solution* donut contact angle as $\boldsymbol{\phi_{solution}}$. Define the difference as the *collision* angle, $\boldsymbol{\phi_{collision}}$. This section details the process used to calculate $\phi_{solution}$ for a desired primary contact node count, p; and a given target angle, ϕ_{target}.

Consider the twisted chain segment where a link is removed and twist is added. We will later find this describes the electron. Define the length of the untwisted chain segment prior to removal of a link as equal to $\boldsymbol{n}$.

The target donut contact angle for the twisted chain segment equals:

$$\phi_{target} = \frac{\pi}{4} + \frac{\pi}{2(n-1)} \tag{1}$$

This spreads the twist from the missing link over the remaining $n-1$ links. The factor 2 accounts for the midline of the contact angle.

It helps to consider ω and Ω to be revolution counts because only whole numbers can synchronize.

Let $\boldsymbol{m}$ define the number of major revolutions needed to synchronize p primary contact nodes. Thus, m provides finer gradations in the primary contact nodes.

For toroidal 'motion' the incremental unit value of Ω is:

$$\Delta\Omega = \frac{1}{mp} \tag{2}$$

For poloidal 'motion' the incremental value of $\Delta\omega_{target}$ in terms of Ω units generally is non-integer due to the need to achieve the correct donut contact angle, ϕ_{target}:

$$\Delta\omega_{target} = \frac{\tan(\phi_{target})}{mp} \tag{3}$$

Node stability determines m. In the Electron Motion Section below we find p to be a function of n:

$$p = (n-1)(n+1) \tag{4}$$

Values for Ω and $\omega_{solution}$ can be determined directly if we already know m and p. Originally, an iterative process using equation (3). A direct solution follows.

Ω equals the inverse of equation (2):

$$\Omega = mp \tag{5}$$

$\omega_{solution}$ equals the rounded inverse of equation (3):

$$\omega_{solution} = \text{round}\left[\frac{mp}{\tan(\phi_{target})}\right] \tag{6}$$

Solve for $\phi_{solution}$ using equations (5) and (6):

$$\phi_{solution} = \tan^{-1}\left[\frac{\omega_{solution}}{\Omega}\right] \tag{7}$$

The use of tangent intentionally differs between equations (3) and (7). Equation (3) relates poloidal nodes to toroidal nodes. Equation (7) relates the twist geometry.

Solve for $\phi_{collision}$ using equations (7) and (1):

$$\phi_{collision} = \left|\phi_{solution} - \phi_{target}\right| \tag{8}$$

The solution m for the electron ends up being over two orders of magnitude more stable than the next best choice. Even trying a wide range of choices for stability measures produces the same result. The accuracy of the final *ggee* calculation indicates a high level of certainty that the correct solution was found.

Node Stability Measures

We determine m by testing *node stability measures*. These measures are chosen on the basis of judgement. As such, the measures should not be considered inviolable. Fortunately, the same correct solution emerges from a wide range of choices for the measures. The stability measure factors used are:

- untwisted chain segment length — n^{-1}
- poloidal revolution count — $\omega_{solution}^{-2}$
- major toroidal revolution count — $m_{solution}^{-1}$
- collision angle — $\phi_{collision}^{-2}$

Electron Structure

The electron structure described in this paper emerges from a metaphysical understanding of how the fabric of space formed from *something* and *nothing*. The logic of the metaphysical underpinnings is not included with this paper.

Normally, objects travel in a straight line in the absence of an external force. The donut motion occurs in *nothing* (a complete void) which allows it to be viewed as traveling in the manner demonstrated.

The fabric of space consists of donut chain segments containing 138 donut links. The electron consists of a donut chain segment 137 links long. The electron chain segment is twisted because it has one fewer donut links than the fabric of space.

Donuts that form the electron chain segment have 74445 nodes that complete in four toroidal revolutions. It takes 76172 toroidal node units to synchronize with the external chain segments of space. Thus, it takes $74445 * 76172$ revolutions to be in the original position. In order to make contact donuts must synchronize time-wise as well as position-wise. This requires a rational value for the resultant vector.

This solution best aligns the angle between donuts that results from having 137 links in the electron chain segment.

The 138 and 137 chain segment lengths for space and the electron, respectively, resulted from solving a relationship. The stability of this solution exceeds the stability of the next best solution by over 2 orders of magnitude. This is the reason dimensionless numbers close to 137 have special significance in physics.

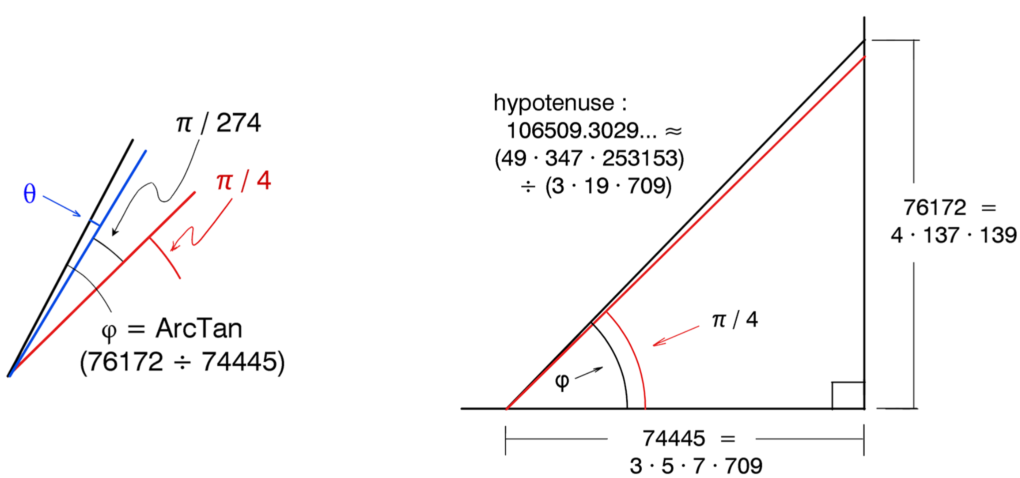

Figure 2: Components for the ggee ratio calculation.

Formula for ggee Ratio

The *ggee* ratio calculation originates from the assumption that matter slows time combined with the assumption that the mass of the electron is due entirely to its charge. A concept of drag, d, helps facilitate this analysis. Drag is the slowing of time caused by mass. Drag is considered as being in close proximity to the mass.

The rate of flow of time in close proximity to a mass is slowed by the drag. This allows us to represent the mass as creating a new flow rate of time slowed by the drag, d. For the electron this takes the form:

$$t_e = 1 - d_e \tag{9}$$

If we were to double the mass we double the drag, d. For two electrons this takes the form:

$$t_{e+e} = 1 - 2d_e \tag{10}$$

For two electrons the flow rate of time is simply multiplied to get the effect of each electron on the other.

$$t_{ee} = (1 - d_e)^2 \tag{11}$$

Expanding:

$$t_{ee} = 1 - 2d_e + {d_e}^2 \tag{12}$$

Consider Equation (12). The mass associated with two electrons attributed to charge is 2 d_e. The mass loss associated with the force of gravity is d_{e^2}. This yields the following ratio for *ggee*:

$$ggee = \frac{{d_e}^2}{2d_e} \tag{13}$$

Or:

$$ggee = \frac{d_e}{2} \tag{14}$$

What does Equation (14) mean? We consider the electron structure in answering this question. Later, we will discover that the electromagnetic coupling constant (alpha) squared balances the experimental value with the theoretical value.

Calculation of ggee Ratio

The theoretical drag, d_e, in Equation (14) separates into component factors:

$$d_e = \overset{\text{(a.)}}{\begin{bmatrix}\text{motion lost}\\ \text{for each}\\ \text{contact event}\end{bmatrix}} \overset{\text{(b.)}}{\begin{bmatrix}\text{number of}\\ \text{internal}\\ \text{contact events}\end{bmatrix}} \overset{\text{(c.)}}{\begin{bmatrix}\text{frequency of}\\ \text{internal}\\ \text{contact events}\end{bmatrix}} \overset{\text{(d.)}}{\begin{bmatrix}\text{frequency of}\\ \text{external}\\ \text{contact events}\end{bmatrix}} \quad (15)$$

Motion lost for each contact event, using equation (7):

$$1 - \cos(\phi_{collision}) \approx \frac{\phi^2_{collision}}{2} = \frac{\left[\tan^{-1}(\frac{76172}{74445}) - \frac{\pi}{4} - \frac{\pi}{274}\right]^2}{2}$$

$$= \frac{[8.08727858986336E - 11]^2}{2} \quad (15.a)$$

Number of internal contact events (two for each connection):

$$2n = 2 \cdot 137 \quad (15.b)$$

Frequency of internal contact events with both the numerator and denominator of the hypotenuse as factors (cancellations from using Least Common Multiple):

$$freq_{int} = \left[\frac{1}{3 \cdot 5 \cdot 7 \cdot 709}\right] \left[\frac{1}{4 \cdot 137 \cdot 139}\right] \left[\frac{1}{7 \cdot \cancel{7} \cdot 347 \cdot 253153}\right] \left[\frac{1}{\cancel{3} \cdot 19 \cdot \cancel{709}}\right] \quad (15.c)$$

Frequency of external contact events from 2 ends with 3 nodes in the connecting link and square of the electron coupling constant (one for each electron):

$$freq_{ext} = \frac{2}{3}\alpha^2 \quad (15.d)$$

Ratio of gravitational force to electromagnetic force between two electrons substituting equation (15) into equation (14):

$$ggee = \frac{1}{2}\left[\frac{[8.08727858986336 \times 10^{-11}]^2}{2}\right][274]\left[\frac{1}{74445}\cdot\frac{1}{76172}\cdot\frac{1}{7\cdot 347\cdot 253153\cdot 19}\right]\left[\frac{2}{3}\alpha^2\right]$$

or,

$$ggee = \left[4.50826219213487 \times 10^{-39}\right]\alpha^2 \tag{16}$$

This may be an exact relationship with precision dependent only on the computational precision and the precision of the electron coupling constant.

Chronological Comparisons of ggee Ratios

The constants below are used to calculate $ggee_{\text{codata}}$ using the relationship $ggee_{\text{codata}} = \mathrm{G} \cdot m_{\mathrm{e}} / \mathrm{c}^2 / r_{\mathrm{e}}$.

	Codata physical constants used in $ggee_{\text{codata}}$ calculation[2] [3] [4]			
	G $[m^3kg^{-1}s^{-2}]$	m_e $[kg]$	c $[ms^{-1}]$	r_e $[m]$
×	10^{-11}	10^{-31}	10^{8}	10^{-15}
1969	6.6732(31)	9.109 558(54)	2.997 925 00(100)	2.817 939(13)
1973	6.6720(41)	9.109 534(47)	2.997 924 58(1.2)	2.817 9380(70)
1986	6.672 59(85)	9.109 3897(54)	2.997 924 58	2.817 940 92(38)
1998	6.6730(10)[5]	9.109 381 88(72)	2.997 924 58	2.817 940 285(31)
2002	6.6742(10)	9.109 3826(16)	2.997 924 58	2.817 940 325(28)
2006	6.674 28(67)	9.109 382 15(45)	2.997 924 58	2.817 940 2894(58)
2010	6.673 84(80)	9.109 382 91(40)	2.997 924 58	2.817 940 3267(27)
2014	6.674 08(31)	9.109 383 56(11)	2.997 924 58	2.817 940 3227(19)
2018	6.674 30(15)	9.109 383 7015(28)	2.997 924 58	2.817 940 3262(13)

Table 1: Chronology of Selected Codata Physical Constants

	calculated	**theory calculated from α_{codata}**		**ratio**
	$ggee_{\text{codata}}$	α_{codata} [2][3][4]	$ggee_{\text{theory}}$	$\frac{ggee_{\text{theory}}}{ggee_{\text{codata}}}$
$\times$	10^{-43}	10^{-3}	10^{-43}	1
1969	2.4003(11)	7.297 351(11)	2.400 7097(72)	1.00017(46)
1973	2.3998(15)	7.297 3506(60)	2.400 7094(39)	1.00038(61)
1986	2.400 00(31)	7.297 353 08(33)	2.400 711 02(22)	1.00030(13)
1998	2.400 14(36)[5]	7.297 352 533(27)	2.400 710 659(18)	1.00025(15)
2002	2.400 57(36)	7.297 352 568(24)	2.400 710 682(16)	1.00006(15)
2006	2.400 60(24)	7.297 352 5376(50)	2.400 710 6618(33)	1.00005(10)
2010	2.400 44(29)	7.297 352 5698(24)	2.400 710 6830(16)	1.00011(12)
2014	2.400 53(11)	7.297 352 5664(17)	2.400 710 6807(11)	1.000075(46)
2018	2.400 610(54)	7.297 352 5693(11)	2.400 710 682 66(72)	1.000042(22)

Table 2: Codata Calculated versus Theory Calculated values for *ggee*

Table 1. values and Table 2. G_{codata} values come directly from legacy fundamental value tables. The *ggee* ratio values result from substituting α into equation (16).

The constant included in equation (16) is exact and does not vary. The identical constant would have emerged in 1969 had the theory been completed at that time. It is important to realize that equation (16) comes directly from theory.

The results in Table 2. may lead one to believe the theory's greatest value lies in the greatly improved precision for the gravitational constant. It does not. The precision of equation (16) and Table 2. validate the underlying metaphysical assumptions about the nature of the universe. This understanding provides the greatest value.

Table 2. does not provide backward validation of equation (16). Rather, Table 2. provides a perspective for the precision of historical values for r_e, m_e and G_{codata}.

The *ratio* column of Table 2. indicates a bias (all ratios exceed 1). The source of this possible bias has not been determined.

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4. CODATA Recommended Values of the Fundamental Physical Constants 1986, 1998, 2002, 2006, 2010, 2014, 2018. https://physics.nist.gov/cuu/Constants/
5. The 1998 Codata value for G is assumed to be 6.6730(10)... rather than 6.673(10)... as stated in the Codata constants listing.