

The Yamagishi Master Table of Classical-Physics Geometric Unpacking

— 3rd Edition: A Table That Separates Three Kinds of Number, and What the Substitution Cannot Move —

[Paper 38]

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— *From thinking to syncing.* —

ABSTRACT

This paper is a comparison table listing how representative formulas of mechanics and astrophysics look once the Yamagishi patches ($\mathbf{m} = 4\pi$, $\mathbf{G} = 4\pi$) are applied. **What the 3rd edition adds is a column of roots.** Earlier editions had only two columns — "standard form" and "after the patch" — but each row in fact mixes **three kinds of number: (i) numbers forced by geometry** (the 4π of Poisson's equation, i.e. Gauss's flux; the $4\pi^2$ of Kepler's law, i.e. angle; the $\frac{1}{2}$ of E_k , i.e. integration; the $\frac{1}{3}$ of P , i.e. isotropy in three dimensions); **(ii) choices of units** ($\mathbf{G} = 4\pi$, $\mathbf{m} = 4\pi$); **(iii) choices of configuration** ($\mathbf{M} = \mathbf{m}$, i.e. taking both point masses to be the same unit mass). **These stand side by side in one table but have different standing** (Papers 95, 86, 100). The 3rd edition then checks **whether this unit system is admissible at all.** The dimension-exponent matrix of $\mathbf{G}$, $\mathbf{m}$ and $\mathbf{c}$ in $(\mathbf{M}, \mathbf{L}, \mathbf{T})$ has determinant **1**, so the three are **dimensionally independent** and may be assigned values simultaneously. At the same time there are only three base dimensions, so **at most three quantities may be assigned, and a fourth would be a constraint rather than a convention.** The 3rd edition further lists **what the substitution cannot move**: $v_{\text{esc}}/v_{\text{orb}} = \sqrt{2}$, $kT/E_k = 2/3$, and $P = nkT$ are **identical in the standard column and in the patched column. These dimensionless ratios are the physical content; the 4π 's are units** (Paper 35, 3rd edition; Paper 113). The complete disappearance of π in the Kepler row is likewise nothing but **a forced π^2 divided by an inserted π^2 .** For $g = \frac{16\pi^2}{r^2}$ (Paper 36), excluded in the second edition, a **sharper diagnosis** is given. g is not an independent constant but a **derived quantity** $g = GM/r^2$, so once $\mathbf{G}$ and $\mathbf{M}$ are fixed it **cannot be chosen.** The expression $16\pi^2/r^2$ holds **only for a body whose mass is exactly the unit mass, and the substance of the error was using a choice of configuration as a universal law.** That GM varies by 7.4 orders of magnitude between bodies is **the symptom, not the cause.** Finally, the paper explains why $(4\pi)^n$ agrees with the sphere sequence at $16\pi^2$ but diverges at $64\pi^3$. The torus is a **direct product** (multiplicative); sphere volumes obey a **recursion of step two** that splits by parity (Paper 115), and in the Hopf bundle $S^3 \neq S^2 \times S^1$ (Papers 67, 109). **Since the generating rules differ, it is the agreement that is a signature and the divergence that is normal.** **Scope:** a list of rewritings that follow a choice of units (Layer 2). It is not a proof, and no new physical law or prediction is claimed.

Positioning of this paper (discipline): This paper offers a **structural interpretation** of established physical law. It claims neither the discovery of new physical laws nor the proof of open problems. The algebraic relations presented are substitutions into known expressions; the aim is to propose a geometric reading of them. No claim contradicting established theory is made. **The appearance of the same number in several rows is not treated as evidence of a common origin** (Papers 48, 86, 100, 115).

Note on units (important): The substitutions $m = 4\pi$, $G = 4\pi$ and the like employed here constitute a **choice of natural units**. G and $\hbar$ are dimensionful quantities whose numerical values depend entirely on the unit system. Setting $G = 4\pi$ is possible in exactly the sense that $G = 1$ (geometrised units) or $G = 6.674 \times 10^{-11}$ (SI) is possible; **physics does not determine which is "correct"**. What this paper exhibits is therefore **how the equations look once this unit system is adopted**, not a new fact about nature. The relations obtained hold in natural units, and **conversion factors are required to carry them into SI**. Whatever value this paper has lies in **making geometric structure visible**.

1. Introduction: adding a column of roots

Through the second edition the table had two columns, "standard form" and "after the patch". As a list of substitution results this is correct, but **it drops one important piece of information — which of the numbers in each row are forced by geometry, and which are the author's choice**.

For instance, the 4π of Poisson's equation $\nabla^2\Phi = 4\pi G\rho$ **cannot be chosen** (it is forced by Gauss's flux theorem; Paper 35, 3rd edition). By contrast $G = 4\pi$ **was chosen**. On the page they look like the same " 4π ", but **their standing differs**.

The 3rd edition writes this distinction into the table itself.

2. The table: formulas independent of g (valid)

The following use only $m = 4\pi$ and $G = 4\pi$, and are therefore unaffected by the withdrawal of Paper 36.

Formula	Standard form	After the patch	Source
First cosmic velocity	$v = \sqrt{GM/r}$	$v = \frac{4\pi}{\sqrt{r}}$	this paper
Second cosmic velocity	$v = \sqrt{2GM/r}$	$v = \frac{4\pi\sqrt{2}}{\sqrt{r}}$	this paper
Kepler's third law	$T^2 = \frac{4\pi^2}{GM}a^3$	$4T^2 = a^3$	Paper 28
Kinetic energy	$E_k = \frac{1}{2}mv^2$	$E_k = 2\pi v^2$	Paper 18
Momentum	$p = mv$	$p = 4\pi v$	Paper 16
$E = mc^2$	$E = mc^2$	$E = 4\pi c^2$	Paper 12
Poisson's equation	$\nabla^2\Phi = 4\pi G\rho$	$\nabla^2\Phi = 16\pi^2\rho$	Paper 35
Newtonian gravity	$F = \frac{GMm}{r^2}$	$F = \frac{64\pi^3}{r^2}$	Paper 35
Gravitational potential	$U = -\frac{GMm}{r}$	$U = -\frac{64\pi^3}{r}$	Paper 35
Gas pressure	$P = \frac{1}{3}nmv^2$	$P = \frac{4}{3}\pi nv^2$	Paper 19
Temperature	$\langle E_k \rangle = \frac{3}{2}kT$	$kT = \frac{4}{3}\pi v^2$	Paper 20

Check of the first cosmic velocity: substituting $G = M = 4\pi$ into $v = \sqrt{GM/r}$ gives $v = \sqrt{16\pi^2/r} = \frac{4\pi}{\sqrt{r}}$. The algebra is correct.

Note on F and U : Paper 35 adopts the convention of applying the patch to **both** M and m . Applying it to only one breaks $F = -dU/dr$. The table follows that convention.

Audit of sources (3rd edition): the papers referenced by this table are 12, 16, 18, 19, 20, 28 and 35, and **none of the eight discarded papers of this series (23, 24, 25, 27, 31, 33, 36, 37) appears among them**. The check left pending at the second edition — whether discarded papers had been excluded — is hereby complete.

3. Separating three kinds of number

Each row of the table above mixes **three kinds of number of different standing**.

Kind	What it is	Examples
(i) Forced	Numbers settled by geometry or analysis; no choice is available	Poisson's 4π (Gauss flux, $\text{Vol}(S^2)$); Kepler's $4\pi^2$ (the square of the angular 2π); the $\frac{1}{2}$ of E_k (result of an integration); the $\frac{1}{3}$ of P (isotropy in three dimensions); the $\frac{3}{2}$ of $\langle E_k \rangle = \frac{3}{2} kT$ (three degrees of freedom)
(ii) Choice of units	A convention fixing the numerical value of a dimensionful quantity	$G = 4\pi$; $m = 4\pi$ (fixing the unit of mass)
(iii) Choice of configuration	A specification of which system is being described ; distinct from a choice of units	$M = m$ (taking both point masses to be the unit mass)

Observation 3.1 ((ii) and (iii) are easily confused)

Setting $m = 4\pi$ fixes one unit of mass; it does **not** make every mass equal to 4π . Accordingly $F = 64\pi^3/r^2$ is not "the general form of Newtonian gravity" but **the expression for two point masses that both carry the unit mass**.

Dropping this distinction is what produces the error in g discussed below.

Corollary 3.2 (π vanishes in the Kepler row because a forced number was divided by a chosen one)

In Kepler's third law $T^2 = \frac{4\pi^2}{GM} a^3$, the $4\pi^2$ in the numerator is a **forced** number (the square of the 2π of one revolution), while the denominator $GM = 16\pi^2$ is a **chosen** one. Their ratio is

$$\frac{4\pi^2}{16\pi^2} = \frac{1}{4},$$

so π disappears entirely. This is not " π being eliminated"; it is a forced π^2 divided by an inserted π^2 . No meaning should be read into the disappearance (Paper 101).

4. Is this unit system admissible? — dimensional independence

May G , m and c be assigned values **simultaneously**? This can be checked.

Theorem 4.1 (G , m and c are dimensionally independent)

With base dimensions mass M , length L and time T , the dimension exponents of the three quantities are

$$G : (-1, 3, -2), \quad m : (1, 0, 0), \quad c : (0, 1, -1).$$

The determinant of the matrix formed by these rows is

$$\det \begin{pmatrix} -1 & 3 & -2 \\ 1 & 0 & 0 \\ 0 & 1 & -1 \end{pmatrix} = 1 \neq 0,$$

so the three are **dimensionally independent**. Choosing the units (M, L, T) appropriately therefore allows **the numerical values of G , m and c to be assigned independently and arbitrarily**.

The unit system of this table is therefore not inconsistent. Adopting $G = 4\pi$ and $m = 4\pi$ together is legitimate, and one further quantity (for instance c) may still be specified.

Corollary 4.2 (At most three may be assigned — a fourth is a constraint, not a convention)

There are only **three** base dimensions M, L, T , so at most **three** dimensionful quantities may have their values assigned independently.

Imposing a value on a fourth quantity is no longer a choice of units but a claim about nature (a constraint).

Cross that boundary and a convention turns into a prediction. Whenever the table is extended, **one must count how many degrees of freedom have already been spent**.

5. What the substitution cannot move — invariant dimensionless ratios

The two columns of the table **look different**. What, then, is the same? **The dimensionless ratios**.

Quantity	Standard column	Patched column	Agreement
$v_{\text{esc}}/v_{\text{orb}}$	$\frac{\sqrt{2GM/r}}{\sqrt{GM/r}} = \sqrt{2}$	$\frac{4\pi\sqrt{2}/\sqrt{r}}{4\pi/\sqrt{r}} = \sqrt{2}$	identical
kT/E_k	$\frac{2}{3}$	$\frac{\frac{4}{3}\pi v^2}{2\pi v^2} = \frac{2}{3}$	identical
Equation of state	$P = nkT$	$\frac{4}{3}\pi n v^2 = n \cdot \frac{4}{3}\pi v^2$	identical

Observation 5.1 (The content of the table is in the column that did not change)

The eye-catching numbers 4π , $16\pi^2$ and $64\pi^3$ are **units**, and the substitution **changes their appearance at will**. What does not move are $\sqrt{2}$, $2/3$, and the **relation $P = nkT$** .

What Paper 35 (3rd edition) said of $\alpha_G = Gm_p^2/(\hbar c) \approx 5.9 \times 10^{-39}$ holds for the table as a whole: **dimensionless quantities are invariant under a choice of units, and physics lives nowhere else** (Paper 113). **This section should be read first.**

6. A sharper diagnosis of $g = \frac{16\pi^2}{r^2}$

The second edition withdrew $g = \frac{16\pi^2}{r^2}$ (Paper 36) on the ground that **GM varies by 7.4 orders of magnitude between bodies**, and excluded the formulas depending on it (the simple pendulum and the **mgh** family).

Body	$GM \text{ [m}^3/\text{s}^2]$	$g \text{ [m/s}^2]$
Moon	4.9049×10^{12}	1.62
Earth	3.9860×10^{14}	9.82
Sun	1.3271×10^{20}	274.20

The 3rd edition supplies a structural diagnosis for that withdrawal.

Corollary 6.1 (*g* cannot be chosen, because it is derived)

g is not an independent constant but the **derived quantity** $g = GM/r^2$. Once the values of *G* and *M* are fixed, the value of *g* is **already settled**. The operation "set *g* equal to $16\pi^2/r^2$ " does not exist as a choice of units.

Indeed, adopting $G = 4\pi$ and $M = 4\pi$ makes $g = 16\pi^2/r^2$ follow automatically. The problem lies elsewhere: **that expression holds only for a body whose mass is exactly the unit mass**. In other words, **the substance of the error was to use the "choice of configuration" of §3(iii) as a universal law**.

That *GM* differs by 7.4 orders of magnitude is **the symptom by which the error surfaced, not its cause**.

On the simple pendulum: the 2π of $T = 2\pi\sqrt{L/g}$ is a **forced** number (the period of a phase). Numerical integration of $\ddot{\theta} = -(g/L)\sin\theta$ gives $T/\sqrt{L/g} = 6.283185$, agreeing with $2\pi = 6.283185$ to eight digits. **Inserting $16\pi^2$ into *g* so as to cancel that π is an operation that covers a forced structure with a choice**, and is the same error as in the Kepler corollary above.

The exclusion applies to the formula for *g*; it **does not reject the simple pendulum or *mgh* themselves**.

7. Why $(4\pi)^n$ agrees at $16\pi^2$ and diverges at $64\pi^3$

The chain $4\pi \rightarrow 16\pi^2 \rightarrow 64\pi^3$ appearing in the table is the flat-torus sequence at radius 2, $\text{Vol}(T^n_{a=2}) = (2\pi \cdot 2)^n = (4\pi)^n$.

Step	Torus (radius 2)	Sphere (radius 2)
1	$\text{Vol}(T^1) = 4\pi = 12.566$	—
2	$\text{Vol}(T^2) = 16\pi^2 = 157.914$	$\text{Vol}(S^3) = 2\pi^2 \cdot 2^3 = 157.914$ agree
3	$\text{Vol}(T^3) = 64\pi^3 = 1984.402$	$\text{Vol}(S^4) = \frac{8\pi^2}{3} \cdot 2^4 = 421.103$ diverge

Observation 7.1 (The divergence is normal; it is the agreement that is a signature)

The torus side is the volume of the **direct product** $T^n = S^1 \times \dots \times S^1$, i.e. **powers of one number**. The sphere side obeys the recursion of Paper 115, $\text{Vol}(S^n) = \frac{2\pi}{n-1} \text{Vol}(S^{n-2})$, whose **step is two**, whose coefficient changes at each stage, and which **splits by parity into two staircases**.

Since the generating rules are fundamentally different, it is unsurprising that the two sequences **part company; what requires explanation is their agreement at $16\pi^2$** . That agreement is a **signature**, not evidence of a common origin (Papers 100; 35, 3rd edition).

Furthermore, as recorded in Papers 67 and 109, **in the Hopf bundle S^3 is not $S^2 \times S^1$** . The sphere side **contains a counterexample to the product picture**. The reading "the $(4\pi)^n$ sequence and the sphere sequence are two expressions of one thing" is therefore **not available**.

On stating the radius: at radius **1** one has $\text{Vol}(T^3) = (2\pi)^3 = 8\pi^3 = 248.05$, which does not equal $64\pi^3$. The ratio $8 = 2^3$ is the volume ratio between radius **1** and radius **2**. **Whenever $(4\pi)^n$ is discussed, radius 2 must be stated explicitly.**

Personal reflection of the author (Layer 3; labelled non-scientific / no claim of mechanism)

When I first made this table I was excited that **everything had turned into powers of 4π** . But while writing the 3rd edition I realised: **they line up because I chose the units so that they would**. 4π , $16\pi^2$ and $64\pi^3$ fall into step only because I set G and m that way.

Is there then nothing in the table? No — **what remains is the numbers I could not choose**: Poisson's 4π , Kepler's $4\pi^2$, the $\frac{1}{2}$ produced by an integration, the $\frac{1}{3}$ produced by isotropy. And $\sqrt{2}$, $2/3$ and $P = nkT$ **did not budge** however I chose my units.

So what I really wanted from the 3rd edition was not a longer table but **a column saying "this one I chose / this one I could not"**. **The column I could not choose is the one that is nature**. One stops at the edge of the cliff (Paper 101).

8. Scope / Conclusion

What is shown: a list of how the formulas look under $m = 4\pi$ and $G = 4\pi$ (§2) / a division of the numbers in each row into **forced, choice of units, and choice of configuration** (§3) / that G, m, c are **dimensionally independent** (determinant 1) so that this unit system is admissible, and that **at most three** quantities may be assigned (§4) / that $\sqrt{2}$, $2/3$ and

$P = nkT$ are identical in both columns (§5) / that g cannot be chosen because it is derived, and that the substance of the error was using a choice of configuration as a universal law (§6) / and the difference in generating rule between the torus and sphere sequences (§7).

What is not shown (restraint): no proof of reduction to geometric constants — this is a list, not a proof / **no elimination of constants** — constants do not vanish, their numerical values change with the choice of units / **no g -dependent formulas** (excluded in §6, though they may return if g is supplied correctly) / **no merging of $(4\pi)^n$ with the sphere sequence** / **no meaning read into the disappearance of π in the Kepler row** / no new physical law and no prediction (Layer 2).

Through the second edition the table showed **what can be written in the same form. What the 3rd edition adds is what could be chosen and what could not.**

What makes the table striking is the tidy sequence $4\pi, 16\pi^2, 64\pi^3$ — but **that is the result of the author's choice of units.** The things in the table that **could not be chosen** — Poisson's 4π , Kepler's $4\pi^2$, the $\frac{1}{2}$, the $\frac{1}{3}$, and $\sqrt{2}, 2/3, P = nkT$ — are the quantities nature settles.

The tidy sequence is the shape of a unit system;
the numbers that refused to line up, and the ratios that would not move however hard one tried, are the physics.

Revision Record

3rd edition (August 2026): introduces a **column of roots**, dividing the numbers in each row into **forced / choice of units / choice of configuration** (§3); shows via the **dimensional independence of G, m, c** (determinant 1) that the unit system is admissible, while noting that **at most three** quantities may be assigned and a fourth becomes a constraint (§4); adds a section on the **dimensionless ratios the substitution cannot move** ($\sqrt{2}, 2/3, P = nkT$) (§5; Paper 35, 3rd edition; Paper 113); gives a structural diagnosis of $g = 16\pi^2/r^2$ as **underivable-by-choice because derived**, identifying the substance of the error as **using a choice of configuration as a universal law** (§6); explains the agreement at $16\pi^2$ and divergence at $64\pi^3$ as a **difference in generating rule** (direct product versus a step-two recursion with parity split, plus the Hopf bundle) (§7; Papers 115, 67, 109); and notes that the vanishing of π in the Kepler row is a forced number divided by a chosen one (§3). The contents of the table itself are unchanged.

2nd edition (July 2026): withdrew $g = \frac{16\pi^2}{r^2}$ from the set of patches (Paper 36 discarded) and excluded the formulas depending on it (the simple pendulum and the mgh family). Replaced the claim to "prove that all formulas reduce to

geometric constants", making explicit that this paper is **a list of substitution results**. First edition: Zenodo 10.5281/zenodo.21430234.

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