

The Yamagishi Classical Mechanics Reformulation — 2nd Edition: how Newtonian mechanics reads under $m = 4\pi$, and four corrections to the geometric labels — [Paper 26]

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ABSTRACT

We substitute the Yamagishi mass patch $m = 4\pi$ into the basic equations of Newtonian mechanics. **First:** Newton's second law becomes $F = 4\pi a$. **Second:** momentum and kinetic energy become $p = 4\pi v$ and $E_k = \frac{1}{2}mv^2 = 2\pi v^2$. **Third:** substituting $G = 4\pi$ and $m = 4\pi$ into $U = -\frac{GMm}{r}$ gives $U = -\frac{16\pi^2 M}{r}$. **Fourth:** the work integral returns the change in kinetic energy.

Position of the 2nd edition: All of the algebra in this paper is correct — each result is a substitution into a known expression, and no error was found on verification. The second edition corrects **four inaccuracies in the geometric labels** (Section 6). It also shows that $E_k = 2\pi v^2$ agrees exactly with the corrected temperature of Paper 20, $kT = \frac{4}{3}\pi v^2$ (Section 5), providing independent support for that correction.

Scope of this paper: This paper offers a **structural interpretation** of existing physical law. It does not claim the discovery of new physical laws or the proof of open problems. **Note on units:** Substitutions such as $m = 4\pi$ are a **choice of natural units**. G and $\hbar$ are dimensionful; their numerical values depend entirely on the unit system. Setting $G = 4\pi$ is legitimate in exactly the same sense as setting $G = 1$ (geometric units) or $G = 6.674 \times 10^{-11}$ (SI); **physics does not single out one of these as "correct."** What this paper exhibits is therefore **how the equations look in this unit system**, not a new fact about nature. The relations obtained hold in natural units and **require conversion factors when transported to SI**.

Introduction

Mass as an empirical scalar

Since Newton's *Principia* (1687), classical mechanics has taken the mass m as an empirically given scalar.

The $n = 2$ uniqueness theorem and the patch $m = 4\pi$

By the $n = 2$ uniqueness theorem, the mass parameter is set to the area of the unit sphere, $m = \text{Vol}(S^2) = 4\pi$. This paper substitutes that value throughout classical mechanics and records how the equations read.

Newton's second law under $m = 4\pi$

Proposition (Yamagishi equation of motion)

Under $m = 4\pi$, Newton's second law reads

$$F = 4\pi a$$

Momentum and kinetic energy

Momentum ($p = 4\pi v$)

$$p = mv = 4\pi v$$

Kinetic energy ($E_k = 2\pi v^2$)

$$E_k = \frac{1}{2}(4\pi)v^2 = 2\pi v^2$$

Gravitational potential energy

Proposition (Toroidal potential form)

Substituting $G_{\text{geom}} = 4\pi$ and $m = 4\pi$ into $U = -\frac{GMm}{r}$:

$$U = -\frac{(4\pi)M(4\pi)}{r} = -\frac{16\pi^2 M}{r}$$

Work

For $F = 4\pi a$ with $a = v \frac{dv}{dx}$:

$$W = \int (4\pi a) dx = 4\pi \int_{v_1}^{v_2} v dv = 2\pi(v_2^2 - v_1^2) = \Delta E_k$$

i.e. the work equals the **change** in kinetic energy (the work–energy theorem).

Consistency with the 2nd edition of Paper 20

The kinetic energy $E_k = 2\pi v^2$ obtained here **independently supports the corrected temperature of Paper 20**.

Applying the standard equipartition theorem $\langle E_k \rangle = \frac{3}{2} k_B T$:

$$kT = \frac{2}{3} E_k = \frac{2}{3} \cdot 2\pi v^2 = \frac{4}{3} \pi v^2$$

This **agrees exactly** with the corrected result $kT = \frac{4}{3} \pi v^2$ of Paper 20 (verified numerically at $v = 0.5, 1, 2, 3.7$).

The first edition of Paper 20 had $kT = \frac{4}{3} \pi v^3$, with one extra factor of v . **The framework of this paper can never yield v^3** : starting from $E_k = 2\pi v^2$, equipartition gives v^2 . In this sense the present paper provides **independent corroboration** that the correction to Paper 20 was in the right direction.

[2nd Edition] Four corrections to the geometric labels

The algebra of this paper — $F = 4\pi a$, $p = 4\pi v$, $E_k = 2\pi v^2$, $U = -16\pi^2 M/r$ — is **correct throughout**. Each is a substitution into a definition, and verification found no error. What requires correction is the **interpretive labelling**.

Correction 1: $E_k = 2\pi v^2$ is not "the area of a 2D cross-section"

The first edition called $E_k = 2\pi v^2$ "the area of a 2D phase cross-section in velocity space". **The factor of 2 does not match**: the area of a circle of radius v is

$$\pi v^2 \neq 2\pi v^2.$$

$2\pi v^2$ is **twice** that area, so the label "cross-sectional area" does not hold. It is withdrawn; what remains is the **algebraic expression $E_k = 2\pi v^2$** .

Correction 2: the patch is applied selectively

The first edition substituted $G = 4\pi$ and $m = 4\pi$ into $U = -\frac{GMm}{r}$ to obtain $U = -\frac{16\pi^2 M}{r}$, but left M untouched.

If $m = 4\pi$ is a universal patch it should apply to M as well, giving

$$U = -\frac{(4\pi)(4\pi)(4\pi)}{r} = -\frac{64\pi^3}{r}.$$

The first edition gave no ground for applying the patch to one mass and not the other.

Two readings are possible: (a) $m = 4\pi$ is a **normalisation of the unit mass**, so not every mass equals 4π (in which case retaining M is right, but " $m = 4\pi$ " means only "choose m as the unit mass"); or (b) the patch is universal and the expression should read $-64\pi^3/r$. **This paper adopts (a)**, but the first edition did not state the choice.

Correction 3: the lower limit of the work integral

The first edition wrote $W = 4\pi \int v dv = 2\pi v^2$, dropping the lower limit. Correctly,

$$W = 2\pi(v_2^2 - v_1^2),$$

and $W = 2\pi v^2$ holds only if $v_1 = 0$. Work is the **change** in kinetic energy, not the kinetic energy itself. Corrected in Section 4.1.

Correction 4: language of "proof"

The first edition stated that it **proves** force to be "a geometric rendering flux", and that it answers "why objects resist motion and why they gravitate". **These claims are withdrawn.**

Substituting $m = 4\pi$ into $F = ma$ to obtain $F = 4\pi a$ is **substitution and naming**; it does not explain the origin of inertia or gravitation. Setting $m = 7$ would give $F = 7a$ with equal justification. What this paper performs is **a rewriting consequent on a choice of units**.

Explicit Scope

- **What this paper establishes:** that adopting $m = 4\pi$ lets the basic equations of mechanics be written $F = 4\pi a$, $p = 4\pi v$, $E_k = 2\pi v^2$, $U = -16\pi^2 M/r$. **These are algebraic facts.** In addition, that $E_k = 2\pi v^2$ is consistent with the second edition of Paper 20 (Section 5).
- **What it does not establish:** (i) the origin of inertia or gravitation; (ii) any mechanical role for 4π beyond substitution; (iii) a geometric area reading of E_k (the factor of 2 does not match).
- **Value of this paper:** the claims are modest, but it serves as **a consistency check that independently supports the correction to Paper 20**. This role was absent from the first edition.

Conclusion

Adopting $m = 4\pi$ and $G = 4\pi$, the basic equations of Newtonian mechanics read $F = 4\pi a$, $E_k = 2\pi v^2$ and $U = -\frac{16\pi^2 M}{r}$. **The algebra is correct throughout.**

The second edition corrects four points: the "area" label on E_k , the non-application of the patch to M , the missing lower limit in the work integral, and the language of "proof".

It also confirms that $E_k = 2\pi v^2$ agrees exactly with $kT = \frac{4}{3}\pi v^2$ from the second edition of Paper 20, and that the framework here cannot produce the v^3 of that paper's first edition.

References

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