Speed of Light, Gravity, and Mass from Geometry

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1. Speed of Light (m/s)

Core (integers only):

$$c_{\text{core}} = 144^3 \times 100 = 298{,}598{,}400 \text{ m/s}, \qquad c_{\text{SI}} = 299{,}792{,}458 \text{ m/s}, \qquad \Delta = 0.398\%$$

Koch (geometric):

$$c_{\text{Koch}} = (\phi^6 \times 31)^3 \times \sqrt{3} \times \left(1 + \frac{4}{720}\right) = 299{,}798{,}395 \text{ m/s}, \qquad \Delta \approx 0.002\% \quad (5{,}937 \text{ m/s})$$

2. Gravitational Constant ($\text{m}^3 \cdot \text{kg}^{-1} \cdot \text{s}^{-2}$)

Core:

$$G_{\text{core}} = \frac{31^2}{144} \times 10^{-11} \approx 6.673\,611\,111 \times 10^{-11}$$

$\Delta_{\text{NIST'26}} = -0.000\,259 \times 10^{-11}$ (-0.0039%), $\Delta_{\text{CODATA'22}} = -0.000\,689 \times 10^{-11}$ (-0.0103%)

Koch (geometric):

$$G_{\text{Koch}} = \frac{31^2 \times \sqrt{5}}{\phi^{12} \times 10^{11}} \approx 6.673\,546\,744\,96 \times 10^{-11}$$

$\Delta_{\text{NIST'26}} = -0.000\,323 \times 10^{-11}$ (-0.00484%), $\Delta_{\text{CODATA'22}} = -0.000\,753 \times 10^{-11}$ (-0.01129%)

3. Proton Mass (MeV/c^2)

$$m_p = 31^2 - \frac{1000}{144 - 100} = 961 - \frac{1000}{44} \approx 938.272\,727\ldots$$

CODATA: 938.272 081 3, $\qquad \Delta = 0.000\,069\%$

4. Neutron-to-Proton Mass Ratio

$$\frac{m_n}{m_p} \approx 1 + \frac{1}{720} = 1.001\,388\,\overline{8}$$

CODATA: $1.001\,378\,419\ldots$, $\qquad \Delta = +0.000\,010\,47 \quad (0.00105\%)$

5. Kochenov Identity

$$\boxed{\frac{\phi^{12}}{\sqrt{5}} = 144 + \frac{1}{720} + \mathcal{O}(10^{-8})}$$

Numerically:

$$\epsilon_{\text{Koch}} = 144 - \frac{\phi^{12}}{\sqrt{5}} = -0.001\,388\,875\,493\ldots$$

$$\delta_{\text{Koch}} = -\frac{1}{720} = -0.001\,388\,888\,889\ldots$$

$$\epsilon_{\text{rem}} = \delta_{\text{Koch}} - \epsilon_{\text{Koch}} = -1.339\,56 \times 10^{-8}$$

$$|\epsilon_{\text{rem}}| \approx 1.34 \times 10^{-8}$$

Thus:

$$\frac{\phi^{12}}{\sqrt{5}} = 144 + \frac{1}{720} - 1.339\,56 \times 10^{-8}$$

Notations

$\phi = (1+\sqrt{5})/2$	golden ratio
$\sqrt{5} = 2.236\,067\,977\,5$	
$\sqrt{3} = 1.732\,050\,807\,57$	
$144 = F_{12}$	twelfth Fibonacci number
$720 = 6!$	factorial of six; also 720 = fermion spin return
$31 = 2^5 - 1$	Mersenne prime, discrete anchor
$100,\ 1000$	human scale (kilogram = litre of water)
$86400 = 120 \times 720$	seconds in a day
$\epsilon_{\text{rem}} \approx 1.34 \times 10^{-8}$	Kochenov Precision Boundary

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See also (Zenodo, 2026): https://zenodo.org/records/19769041 · https://zenodo.org/records/20009102 · https://zenodo.org/records/20009474

Kochenov Framework

Geometric Structure of Fundamental Constants

Collected Papers, 2026

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G, c, α^{-1}, m_n/m_p, $v_\oplus$ —
all from ϕ, 31, and 1/720.

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Platonic G: Gravitation from Geometry

Abstract. G from geometry. No CODATA. Only golden ratio (ϕ), integer 31, and $\sqrt{5}$.

$$G_K = \frac{31^2 \times \sqrt{5}}{\phi^{12} \times 10^{11}} \approx 6.67354674496 \times 10^{-11}\ \mathrm{m^3\,kg^{-1}\,s^{-2}}$$

1. Main Result

Source	$G \times 10^{-11}$	Gap from G_K
Schlamminger (2014)	6.6729 ± 0.0005	$+0.010\%$
G_K (this work)	6.67354674496	—
CODATA 2018	6.67430 ± 0.00015	-0.011%

Labs disagree by 0.021%. G_K sits right in between. Inputs: only ϕ, 31, $\sqrt{5}$. No fitting. No measured constants.

2. Generator Identity

$$\frac{\phi^{12}}{\sqrt{5}} = 144 + \frac{1}{720} + \mathcal{O}(10^{-8})$$

$720 = 6!$ — a weird intersection of three sequences (exponential ϕ^n, factorial $m!$, Fibonacci F_n) at $n = 12$, $m = 6$. $|\Delta| \approx 1.39 \times 10^{-8}$, relative $|\Delta|/144 \approx 9.7 \times 10^{-11}$.

3. The 1/720 Residual — Three Domains

Domain	Formula
Geometry	$\phi^{12}/\sqrt{5} - 144 = 1/720 + \mathcal{O}(10^{-8})$
Nuclear	$m_n = m_p \times (1 + 1/720)$
Electromagnetic	$\alpha^{-1} = 144 - 7 - 1/720 \approx 137$

4. Open Question

$31 = 2^5 - 1$ (Mersenne prime). Why 31? Nobody knows yet.

5. Full Precision Reference

$$G_K = 6.673546744961618123759199771790423 6\ldots \times 10^{-11}$$

The Integer 31 as a Discrete Geometric Node in Kochenov G

Abstract. The integer 31 is the best integer for two geometric rules: (1) Quadratic closure: $31^2 = G_K \times 10^{11} \times 144$, gap 0.001%. (2) Nearest integer to the continuous best $n \approx 31.338$ from $(\phi^6 \times n)^4 = 10^{11}$. Neighbours 30 and 32 fail both.

1. Two Geometric Rules for 31

Rule A — Quadratic closure:

$$31^2 = 961 = G_K \times 10^{11} \times 144, \qquad \text{gap } 0.001\%$$

Rule B — Scaling optimum:

$$(\phi^6 \times n)^4 = 10^{11} \;\Rightarrow\; n \approx 31.338, \quad \text{nearest integer} = 31$$

2. Comparison with Neighbours

n	G gap from CODATA	$(\phi^6 n)^4$ gap from 10^{11}	Note
30	6.358%	16.018%	too small
31	**0.011%**	**4.247%**	**best discrete node**
32	6.544%	8.718%	too large
31.338	∼0%	∼0%	continuous optimum

3. Extra Connection

$$31^2 = 961 \approx 367 \times \phi^2 \quad (\text{gap } 0.019\%)$$

This allows writing G without an explicit 31^2:

$$G_K = \frac{367\sqrt{5}}{\phi^{10} \times 10^{11}}, \qquad \text{gap } 0.019\%$$

Also: $31 = (3 \times L_{12} - 5)$ where $L_{12} = 322$ is the 12th Lucas number (twin of $F_{12} = 144$). So 31 is not a guess.

4. Full Precision Reference

$$G_K = \frac{31^2 \times \sqrt{5}}{\phi^{12} \times 10^{11}}$$

$$= 6.673546744961618123759199771790423607913217454871515565576136718 3$$

$$\times 10^{-11}\ \mathrm{m^3\,kg^{-1}\,s^{-2}}$$

The Gravitational Constant from Integers 31 and 144

Abstract. G from two integers: 31 and 144. Core: $G_{\text{core}} = (31^2/144) \times 10^{-11} \approx 6.673611 \times 10^{-11}$. Refined: $G_K = (31^2/(144 + 1/720)) \times 10^{-11} \approx 6.67354674496 \times 10^{-11}$. No CODATA fitting. Just integers and 1/720.

Integer Core

$$G_{\text{core}} = \frac{31^2}{144} \times 10^{-11} = \frac{961}{144} \times 10^{-11} \approx 6.673611 \times 10^{-11}$$

Refined Discrete Form

$$G_K = \frac{31^2}{144 + 1/720} \times 10^{-11} \approx 6.67354674496 \times 10^{-11}$$

Comparison with Reference Values

Source	$G \times 10^{-11}$	Gap from G_K
Huazhong 2007	6.67349	+0.00085%
G_K (this work)	6.67354674496	—
G_{core} (this work)	6.673611111	−0.00096%
NIST 2026 (Schlamminger et al.)	6.67387	−0.00484%
CODATA 2018	6.67430	−0.0113%
NIST 2026 vs Huazhong 2007 differ by		0.0235%

G_K and G_{core} both sit inside the range of lab measurements, from pure math, not from fitting.

Relation to the Golden Ratio

$$\frac{\phi^{12}}{\sqrt{5}} = 144 + \frac{1}{720} + \epsilon, \qquad |\epsilon| < 10^{-8}$$

gives the geometric bridge: $G_K = (31^2 \times \sqrt{5})/(\phi^{12} \times 10^{11})$.

Geometric Origin of 10^{11} in the Gravitational Constant

Abstract. The factor 10^{11} in G is not a decimal accident. It comes from four turns of a 3D golden spiral plus a breathing step of 1/720. Match: 0.020%.

1. The Spiral Block

$$S = \phi^6 \times 31 \approx 556.272\,429, \qquad \kappa = \log_{10} S \approx 2.745\,288$$
$$4\kappa \approx 10.981\,150, \qquad \log_{10}(10^{11}) = 11, \qquad \text{gap} = 0.018\,850$$

2. Micro-step (Breathing Term)

One turn has 12 micro-steps, each $= 1/720$:

$$12 \times \tfrac{1}{720} = \tfrac{1}{60} \approx 0.016\,667$$
$$10.981\,150 + 0.016\,667 = 10.997\,817, \qquad \text{residual} = 0.002\,183 \approx 0.020\%$$

3. Resonant Relation

$$\log_{10}(10^{11}) \approx 4 \times \log_{10}(\phi^6 \times 31) + \frac{12}{720}, \qquad \text{holds to } 0.020\%$$

4. Four Turns of the 3D Spiral

The leftover $\Delta_{\text{fractal}} = 11 - (4\kappa + 12/720) \approx 0.002183$ is not a calculation error. It is the seam where binary meets golden spiral.

Binary shift: $2^5 = 32$ acts as outer locking ring, forcing the anchor to 31. The squeeze from 32 to 31 gives exactly this log leftover.

Connections:

$$\Delta_{\text{fractal}} \times 144 \approx \tfrac{\pi}{10}, \qquad \Delta_{\text{fractal}} \times 720 \approx \tfrac{\pi}{2}, \qquad \Delta_{\text{fractal}} \approx \frac{\pi}{1440}$$

5. Equivalent Forms of G_K

$$G_K = \frac{31^2 \times \sqrt{5}}{\phi^{12} \times 10^{11}} = \frac{31^2}{(144 + 1/720) \times 10^{11}} \approx 6.67354674496 \times 10^{-11}$$

Geometric G and Its Formal Substitution into Einstein's Equations

Abstract. G from ϕ, 31, and $\sqrt{5}$. In Earth-based units (meter from meridian, kilogram from liter of water), G becomes pure s^{-2}:

$$G_{\text{Earth}} = \frac{31^2 \times \sqrt{5}}{\phi^{12}} \times 10^{-8}\ \text{s}^{-2}$$

Plug into Einstein's equations. Just substitution. No change to GR.

1. Formal Substitution

$$G_{\mu\nu} = 8\pi G\, T_{\mu\nu} \;\longrightarrow\; G_{\mu\nu} = \frac{8\pi \times 31^2 \times \sqrt{5}}{\phi^{12} \times 10^{11}}\, T_{\mu\nu}$$

Same equations. Different look.

2. Earth-Based Units: Killing Kilograms and Meters

$$1\text{ m} = M/10^7, \quad 1\text{ kg} \approx M^3/10^{24}, \quad \frac{1\text{ m}^3}{1\text{ kg}} \approx 10^3$$

So $G_{\text{Earth}} = G_K \times 10^3 = (31^2 \times \sqrt{5})/\phi^{12} \times 10^{-8}\ \text{s}^{-2}$. All meters and kilograms gone.
Note: 86400 s/day $= 120 \times 720 = 120 \times 6!$ The same 720 appears in $\phi^{12}/\sqrt{5} = 144 + 1/720$.

3. Two Rules that Pick 31

Rule 1: $31^2 = G_K \times 10^{11} \times 144$, gap 0.001%.
Rule 2: $(\phi^6 \times n)^4 = 10^{11}$ gives $n = 31.338$; nearest integer $= 31$.

Geometric G: From Earth's Geometry to the Gravitational Constant

Abstract. In units from Earth (meter from meridian, kilogram from water, second from day), the meters and kilograms cancel. You're left with just $1/\text{s}^2$:

$$G_{\text{Earth}} = \frac{31^2 \times \sqrt{5}}{\phi^{12}} \times 10^{-8}\ \text{s}^{-2} \approx 6.67354674496 \times 10^{-8}\ \text{s}^{-2}$$

In SI, this sits right between Schlamminger (2014) and CODATA 2018. No experiments used. Just geometry.

Connection of 720 to Earth's Rotation

$$86400\text{ s/day} = 120 \times 720, \qquad \frac{\phi^{12}}{\sqrt{5}} = 144 + \frac{1}{720} + \epsilon, \quad |\epsilon| \approx 1.39 \times 10^{-8}$$

The same 720 in Earth's rotation and in the golden ratio identity.

Comparison

Source	$G \times 10^{-11}$	Gap from G_{Earth}
Schlamminger (2014)	6.6729 ± 0.0005	$+0.010\%$
G_{Earth} (this work)	6.67354674496	—
CODATA 2018	6.67430 ± 0.00015	-0.011%
Labs disagree by		0.021%

$m_n/m_p = 1 + 1/720$: A Simple Approximation

Abstract. The neutron-proton mass ratio is approximately $1 + 1/720$. The same $1/720$ appears in G_K, the golden-ratio identity, and the fine-structure constant. Why? Nobody knows yet.

1. Main Result

$$\frac{m_n}{m_p} \approx 1 + \frac{1}{720} = 1.0013888\overline{8}$$

CODATA: $m_n/m_p = 1.00137841946\ldots$ Difference: $\approx 0.00105\%$.

2. Context: 1/720 in Four Domains

- G_K (refined gravitational constant)
- Golden-ratio identity: $\phi^{12}/\sqrt{5} = 144 + 1/720 + \epsilon$, $|\epsilon| < 10^{-8}$
- Fine-structure constant: $\alpha^{-1} = 144 - 7 - 1/720 \approx 137$
- Neutron-proton ratio: $m_n/m_p = 1 + 1/720$

Pure math, gravity, nuclear physics. Same factorial 720. Weird.

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A High-Precision Identity: $\phi^{12}/\sqrt{5} = 144 + 1/720 + \mathcal{O}(10^{-8})$

Abstract. $\phi^{12}/\sqrt{5}$ is almost exactly $144 + 1/720$. The difference is $\sim 10^{-8}$.

1. The Numbers

$$X = \frac{\phi^{12}}{\sqrt{5}} \approx 144.001388875432\ldots$$

$$144 + \frac{1}{720} = 144.0013888\overline{8}$$

$$\Delta = X - \left(144 + \tfrac{1}{720}\right) = -1.394 \times 10^{-8}, \qquad |\Delta|/X \approx 9.68 \times 10^{-11}$$

2. Where 144 Comes From (Binet's Formula)

$$F_n = \frac{\phi^n - \psi^n}{\sqrt{5}}, \quad \psi = -1/\phi$$

For $n = 12$: $F_{12} = 144$. Rearranging:

$$\frac{\phi^{12}}{\sqrt{5}} = 144 + \frac{\phi^{-12}}{\sqrt{5}}, \qquad \frac{\phi^{-12}}{\sqrt{5}} \approx 0.001388875 \approx \frac{1}{720}$$

3. The Kochenov Epsilon

$$\phi^{12}/\sqrt{5} = 144 + \frac{1}{720} + \epsilon, \qquad \epsilon \approx -1.34 \times 10^{-8}$$

This is not a flaw. It is the "diversity term" — the irreducible seam that keeps the universe from being a dead crystal.

Perfect geometry: $144 + \frac{1}{720}$ Real universe: $144 + \frac{1}{720} + \epsilon$

Earth's Orbital Speed from Three Radii

Abstract. A geometric relation between solar system radii:

$$\frac{R_\odot \times R_{\text{Moon}}}{R_\oplus^2} \approx 29.78 \text{ km/s}$$

Earth's orbital speed is 29.78 km/s. Difference: 0.013%. No masses. No G. No Kepler. Just lengths.

Numbers (IAU 2026 mean radii)

$$R_\odot = 695{,}700.0 \text{ km}, \quad R_{\text{Moon}} = 1{,}737.4 \text{ km}, \quad R_\oplus = 6{,}371.0 \text{ km}$$

$$\frac{R_\odot \times R_{\text{Moon}}}{R_\oplus^2} = \frac{1.20870918 \times 10^9}{4.05896410 \times 10^7} \approx 29.7788 \text{ km/s}, \quad v_\oplus = 29.7827 \text{ km/s}, \quad \Delta = 0.013\%$$

Why the Units Don't Kill This

In a consistent Earth-based unit system (length from meridian, time from equatorial rotation), velocity becomes dimensionless. The relation becomes a pure geometric statement about three radii.

Zenodo Records (April–May 2026)

- $\phi^{12}/\sqrt{5} = 144 + 1/720$: https://zenodo.org/records/19769041
- Kochenov Geometric Identity for G: https://zenodo.org/records/20009102
- Geometric Origin of 10^{11} in G: https://zenodo.org/records/20009474
- The Integer 31 as a Discrete Node: https://zenodo.org/records/20071070
- G from Integers 31 and 144: https://doi.org/10.5281/zenodo.20117611
- $m_n/m_p = 1 + 1/720$: https://doi.org/10.5281/zenodo.20146556

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