Chapter 1

Calculation of the Gravitational Constant from SI Constants

The T0-Theory: Emergence of G from Spacetime Geometry

Complete derivation without experimental input values

Abstract

This work presents the new insight that the gravitational constant G is not a fundamental constant of nature but is calculable from other SI constants: $G = \ell_P^2 \times c^3/\hbar$. The central innovation of the T0-Theory is that G emerges from the geometry of spacetime, analogous to $c = 1/\sqrt{\mu_0\varepsilon_0}$ in electrodynamics. All SI constants prove to be different projections of an underlying dimensionless geometry. The perfect agreement between calculated and experimental values ($G = 6.674 \times 10^{-11}$ $\mathrm{m}^3/(\mathrm{kg} \cdot \mathrm{s}^2)$) confirms this fundamental reinterpretation of gravity.

Contents

1.1 The Fundamental T0-Insight

New Paradigm Shift

From the T0 perspective, ALL SI constants are merely "conversion factors"!

- In natural units: $G = 1$, $c = 1$, $\hbar = 1$ (exactly)
- SI values are only different descriptions of the same geometry
- The true physics is dimensionless and geometric

Analogue to: $c = 1/\sqrt{\mu_0 \varepsilon_0}$ (electromagnetic structure)
Now also: $G = f(\hbar, c, \ell_P)$ (geometric structure)

1.2 The Fundamental Formula

G from SI Constants

Gravitational constant as an emergent quantity:

$$\boxed{G = \frac{\ell_P^2 \times c^3}{\hbar}} \tag{1.1}$$

Where all constants are in SI units:

- $\ell_P = 1.616 \times 10^{-35}$ m (Planck length)
- $c = 2.998 \times 10^{8}$ m/s (Speed of light)
- $\hbar = 1.055 \times 10^{-34}$ J·s (Reduced Planck constant)

1.3 Step-by-Step Calculation

1.3.1 Given SI Constants

Constant	Value	Unit
Planck length ℓ_P	1.616×10^{-35}	m
Speed of light c	2.998×10^{8}	m/s
Reduced Planck constant $\hbar$	1.055×10^{-34}	J·s

Table 1.1: SI Constants (from T0 perspective: conversion factors)

1.3.2 Numerical Calculation

Step 1: Planck length squared

$$\ell_P^2 = (1.616 \times 10^{-35})^2 \tag{1.2}$$
$$= 2.611 \times 10^{-70}\ \mathrm{m}^2 \tag{1.3}$$

Step 2: Speed of light cubed

$$c^3 = (2.998 \times 10^8)^3 \tag{1.4}$$
$$= 2.694 \times 10^{25}\ \mathrm{m}^3/\mathrm{s}^3 \tag{1.5}$$

Step 3: Calculate numerator

$$\ell_P^2 \times c^3 = 2.611 \times 10^{-70} \times 2.694 \times 10^{25} \tag{1.6}$$
$$= 7.035 \times 10^{-45}\ \mathrm{m}^5/\mathrm{s}^3 \tag{1.7}$$

Step 4: Division by $\hbar$

$$G = \frac{7.035 \times 10^{-45}}{1.055 \times 10^{-34}} \tag{1.8}$$
$$= 6.674 \times 10^{-11}\ \mathrm{m}^3/(\mathrm{kg} \cdot \mathrm{s}^2) \tag{1.9}$$

1.4 Result and Verification

Perfect Agreement

Calculated result:

$$G_{\text{calculated}} = 6.674 \times 10^{-11}\ \mathrm{m}^3/(\mathrm{kg} \cdot \mathrm{s}^2) \tag{1.10}$$

Experimental value (CODATA):

$$G_{\text{experimental}} = 6.67430 \times 10^{-11}\ \mathrm{m}^3/(\mathrm{kg} \cdot \mathrm{s}^2) \tag{1.11}$$

Agreement: Exact up to rounding errors!

1.5 Dimensional Analysis

1.5.1 Unit Verification

$$\left[\frac{\ell_P^2 \times c^3}{\hbar}\right] = \frac{[\mathrm{m}]^2 \times [\mathrm{m/s}]^3}{[\mathrm{J \cdot s}]} \tag{1.12}$$

$$= \frac{[\mathrm{m}]^2 \times [\mathrm{m}]^3/[\mathrm{s}]^3}{[\mathrm{kg \cdot m^2/s^2}] \times [\mathrm{s}]} \tag{1.13}$$

$$= \frac{[\mathrm{m}]^5/[\mathrm{s}]^3}{[\mathrm{kg \cdot m^2/s}]} \tag{1.14}$$

$$= \frac{[\mathrm{m}]^5/[\mathrm{s}]^3 \times [\mathrm{s}]}{[\mathrm{kg \cdot m^2}]} \tag{1.15}$$

$$= \frac{[\mathrm{m}]^5/[\mathrm{s}]^2}{[\mathrm{kg \cdot m^2}]} \tag{1.16}$$

$$= \frac{[\mathrm{m}]^3}{[\mathrm{kg \cdot s^2}]} \quad \checkmark \tag{1.17}$$

The dimensions perfectly match those of the gravitational constant!

1.6 Physical Interpretation

1.6.1 What does this formula mean?

- ℓ_P^2: Planck area - fundamental geometric scale
- c^3: Third power of the speed of light - relativistic dynamics
- $\hbar$: Quantum character - smallest action

G arises from the combination of geometry, relativity, and quantum mechanics!

1.6.2 Analogy to the electromagnetic constant

Electromagnetism	**Gravitation**
$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$	$G = \frac{\ell_P^2 \times c^3}{\hbar}$
emergent from EM vacuum	emergent from spacetime geometry
μ_0, ε_0 fundamental	$\ell_P, c, \hbar$ fundamental

Table 1.2: Parallel between electromagnetic and gravitational constants

1.7 The New T0-Insight

Fundamental Paradigm Shift

Traditional physics:

- G is a fundamental constant of nature
- Must be determined experimentally
- Unexplained origin

T0-Physics:

- G is emergent from other constants
- Calculable from first principles
- Origin: Geometry of spacetime

All SI constants are merely different projections of the underlying dimensionless T0-geometry!

1.8 Practical Consequences

1.8.1 For Experiments

- **G-measurements** serve to verify the T0-Theory
- **Precision experiments** can search for deviations from the T0 prediction
- **New calibrations** become possible

1.8.2 For Theoretical Physics

- **Unification:** One constant less in the standard model
- **Quantum gravity:** Natural connection between $\hbar$ and G
- **Cosmology:** New insights into the structure of spacetime

1.9 Summary

The Revolutionary Insight

Gravitational constant is not fundamental:

$$G = \frac{\ell_P^2 \times c^3}{\hbar} = 6.674 \times 10^{-11}\ \mathrm{m}^3/(\mathrm{kg} \cdot \mathrm{s}^2) \tag{1.18}$$

Key statements:

- G follows from the geometry of spacetime
- All SI constants are conversion factors
- The true physics is dimensionless (T0)
- Perfect experimental agreement

This is the breakthrough of the T0-Theory!