

# Chapter 1

## Calculation of the Gravitational Constant from SI Constants

## 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 ( $G = 6.674 \times 10^{-11} \text{ m}^3/(\text{kg} \cdot \text{s}^2)$ ) confirms this fundamental reinterpretation of gravity.

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## 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:**  $c = 1/\sqrt{\mu_0\epsilon_0}$  (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:**

$$G = \frac{\ell_P^2 \times c^3}{\hbar} \quad (1.1)$$

**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)

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

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

## 1.3 Step-by-Step Calculation

### 1.3.1 Given SI Constants

### 1.3.2 Numerical Calculation

Step 1: Planck length squared

$$\ell_P^2 = (1.616 \times 10^{-35})^2 \quad (1.2)$$

$$= 2.611 \times 10^{-70} \text{ m}^2 \quad (1.3)$$

Step 2: Speed of light cubed

$$c^3 = (2.998 \times 10^8)^3 \quad (1.4)$$

$$= 2.694 \times 10^{25} \text{ m}^3/\text{s}^3 \quad (1.5)$$

Step 3: Calculate numerator

$$\ell_P^2 \times c^3 = 2.611 \times 10^{-70} \times 2.694 \times 10^{25} \quad (1.6)$$

$$= 7.035 \times 10^{-45} \text{ m}^5/\text{s}^3 \quad (1.7)$$

Step 4: Division by  $\hbar$

$$G = \frac{7.035 \times 10^{-45}}{1.055 \times 10^{-34}} \quad (1.8)$$

$$= 6.674 \times 10^{-11} \text{ m}^3/(\text{kg} \cdot \text{s}^2) \quad (1.9)$$

## 1.4 Result and Verification

### Perfect Agreement

Calculated result:

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

Experimental value (CODATA):

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

**Agreement:** Exact up to rounding errors!

## 1.5 Dimensional Analysis

### 1.5.1 Unit Verification

$$\left[ \frac{\ell_P^2 \times c^3}{\hbar} \right] = \frac{[\text{m}]^2 \times [\text{m/s}]^3}{[\text{J} \cdot \text{s}]} \quad (1.12)$$

$$= \frac{[\text{m}]^2 \times [\text{m}]^3 / [\text{s}]^3}{[\text{kg} \cdot \text{m}^2 / \text{s}^2] \times [\text{s}]} \quad (1.13)$$

$$= \frac{[\text{m}]^5 / [\text{s}]^3}{[\text{kg} \cdot \text{m}^2 / \text{s}]} \quad (1.14)$$

$$= \frac{[\text{m}]^5 / [\text{s}]^3 \times [\text{s}]}{[\text{kg} \cdot \text{m}^2]} \quad (1.15)$$

$$= \frac{[\text{m}]^5 / [\text{s}]^2}{[\text{kg} \cdot \text{m}^2]} \quad (1.16)$$

$$= \frac{[\text{m}]^3}{[\text{kg} \cdot \text{s}^2]} \quad \checkmark \quad (1.17)$$

The dimensions perfectly match those of the gravitational constant!

## 1.6 Physical Interpretation

### 1.6.1 What does this formula mean?

- $\ell_P^2$ : 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
$\mu_0, \varepsilon_0$ 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:**

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

**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!**