

THE CONSTANTS OF PHYSICS AND MATHEMATICS

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Thursdays starting September 28 through October 19 for four sessions | 10:00 a.m. - noon
IN-PERSON AT NSK | LECTURE | MAXIMUM 50

Overview

Nature is always surprising but fundamentally consistent. Throughout history, particularly from the 17th century, scientists have proposed physical laws that attempt to capture how nature behaves. Outstanding examples include Isaac Newton's laws of motion and gravitation, James Clerk Maxwell's equations of electromagnetism, and Edwin Hubble's law of galaxy recession. These laws are expressed mathematically but become more than mathematical identities by the inclusion of mysterious numbers, numbers that can only be determined by experiment or observation. These are the constants of physics.

We cannot explain (yet) why these constants have the numerical values that we find, but we can show that our universe would be very different if any of these constants had a significantly different value.

A handful of numbers, many known in the ancient world, occur throughout mathematics and the sciences. Some are natural numbers, such as zero and 1. Others are almost as familiar, such as π , pi, the square root of 2, and the golden ratio. A couple, the square root of -1, i , and Euler's number, e , are hardly known to the general public but are ubiquitous in mathematics, science, engineering, statistics, and elsewhere. And another, infinity, ∞ , is not really a number.

We will explore the origin and significance of the special numbers that appear repeatedly in science and see what they mean, how they appear in nature, and how they combine with one another. High school math is sufficient to understand these remarkable concepts.

Weekly Schedule

Week	Topic	Week	Topic
WEEK 1	Newton's gravitational constant, G The speed of light, c Planck's constant, \hbar Boltzmann's constant, k Planck units	WEEK 2	Atomic particle masses, m_p , m_n , m_e The electric charge, e Avogadro's constant, N_A The fine structure constant, α Hubble's constant, H_0 Einstein's cosmological constant, Λ
WEEK 3	Zero, 1, The square root of 2, Pi, π , The square root of -1, i , Euler's number, e	WEEK 4	The golden ratio, φ Euler's constant gamma, γ To infinity and beyond