Resolved Questions in Physics

Academy of Science and Arts · Potentum Physics Observatory

Prelude: The Completion of Foundations

From its origins in observation and curiosity, physics has advanced toward an ever more exact description of nature. The term *resolved question* designates a domain whose governing equations and constants have been verified to predictive accuracy across all known experiments. Modern physics rests upon a small set of universal constants that define the structure of space, time, energy, and matter.

Among these, the speed of light in vacuum (c), Planck's constant (h), Newton's gravitational constant (G), Boltzmann's constant (k_B), and the elementary charge (e) serve as the keystones of measurement and theory. Each corresponds to a closure of mystery: c fixes the limit of signal propagation; h quantizes action; G sets the scale of gravitation; k_B connects energy and temperature; and e anchors the quantization of charge. Collectively they enable all modern computation of natural phenomena.

Table 1 — Fundamental Physical Constants (Representative Values)

Speed of light, c	$2.99792458 \times 10^{8}\ \mathrm{m\,s^{-1}}$
Planck constant, h	$6.62607015 \times 10^{-34}\ \mathrm{J\,s}$
Gravitational constant, G	$6.67430 \times 10^{-11}\ \mathrm{m^3\,kg^{-1}\,s^{-2}}$
Boltzmann constant, k_B	$1.380649 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
Elementary charge, e	$1.602176634 \times 10^{-19}\ \mathrm{C}$
Fine-structure constant, α	$7.2973525693 \times 10^{-3}$
Electron–proton mass ratio, m_e/m_p	$5.446170214 \times 10^{-4}$

These constants form the metrological base of the International System of Units. Every quantitative statement in physics ultimately traces back to them. Their stability across cosmological time and laboratory conditions constitutes one of the deepest confirmations of the uniformity of natural law.

Newton's three laws of motion, formalized in the *Principia* (1687), resolved the dynamics of macroscopic bodies. Momentum conservation, energy conservation, and the inverse-square law of gravitation allowed precise prediction of planetary motion and terrestrial mechanics. In the Lagrangian and Hamiltonian formulations, these principles were later expressed as variational symmetries—mathematical closure under transformation.

Noether's theorem (1918) gave this structure a universal rationale: every continuous symmetry of nature corresponds to a conservation law. Temporal symmetry yields energy conservation; spatial homogeneity yields momentum conservation; and rotational invariance yields angular-momentum conservation. Mechanically, the world is complete: the equations of motion are fully determined once the potential energy is known.

Thermodynamics extended these principles to systems of many particles. The Zeroth through Third Laws, established between 1850 and 1900, resolved the nature of temperature, heat, and entropy. The identification of heat with microscopic motion, and the introduction of the Boltzmann constant as a bridge between microscopic and macroscopic quantities, unified mechanics and energy. Statistical mechanics then provided a probabilistic interpretation of entropy, closing the conceptual circle between order, randomness, and energy exchange.

Maxwell's unification of electricity and magnetism in the 1860s produced one of the most complete theories in science. The four field equations predict electromagnetic waves with speed c, immediately connecting light with electromagnetism. Every electrical and optical technology arises from these relations, verified to one part in 10^{12} in precision tests.

Einstein's special relativity (1905) resolved the paradox of invariant light speed, deriving time dilation and mass–energy equivalence $E = mc^2$. General relativity (1915) extended this to gravitation, describing it as curvature of spacetime—confirmed by gravitational waves and black-hole imaging.

Quantum mechanics resolved the atomic realm. Planck's quantization of energy, Schrödinger's wave equation, and Dirac's relativistic spinor formulation jointly describe electrons, nuclei, and radiation. Atomic stability, spectral lines, and chemical bonding are all fully explained within this framework. Quantum electrodynamics (QED) subsequently refined the picture, predicting the electron's anomalous magnetic moment to 13 significant figures, making it the most precisely tested theory in history.

Mendeleev's periodic system found its theoretical completion in quantum mechanics. Electron orbitals (s, p, d, f) correspond to quantized angular momenta and radial nodes of the atomic wavefunction. The Pauli exclusion principle explains the structure and repetition of chemical properties across periods. No stable element below $Z = 118$ remains unaccounted for, marking the effective closure of atomic classification.

Spectroscopy provided the decisive bridge between theory and observation. The Balmer and Rydberg series demonstrated that atomic emissions follow a simple mathematical law, later derived from Bohr's quantized model and ultimately from quantum mechanics itself. Laboratory spectra, stellar lines, and nebular emissions share identical patterns: the universe and the laboratory obey the same physics.

Table 2 — Periodic Table and Spectral Anchors (Representative Lines)

Element	Principal Optical Line (nm)	Transition Series
Hydrogen	656.28	Hα, Balmer
Helium	587.56	Singlet–Triplet
Sodium	589.00	D_1–D_2 doublet
Oxygen	630.03	Forbidden [O I]
Iron	532.80	Fe I multiplet

These lines serve as universal yardsticks in astrophysical diagnostics, defining stellar temperatures, compositions, and motions. Their precision across cosmological scales stands as one of the most complete verifications of physical law.

Astrophysics represents the synthesis of all previous domains. Stellar structure is explained by hydrostatic equilibrium, nuclear fusion, and radiative transport. The Hertzsprung–Russell diagram relates luminosity and temperature across stellar classes (O–M), all modeled quantitatively by known physics.

Nuclear fusion, governed by quantum tunneling and strong-force cross-sections, resolves the energy source of stars. Observed neutrino fluxes and helioseismic data confirm the theoretical predictions within a few percent.

Einstein's general relativity governs large-scale structure and cosmic expansion. The detection of gravitational waves (LIGO, 2015) and direct imaging of black-hole shadows (EHT, 2019) verified predictions made a century earlier. The cosmic microwave background, mapped with precision better than 0.1%, fixes cosmological parameters such as the Hubble constant, matter density, and dark-energy fraction.

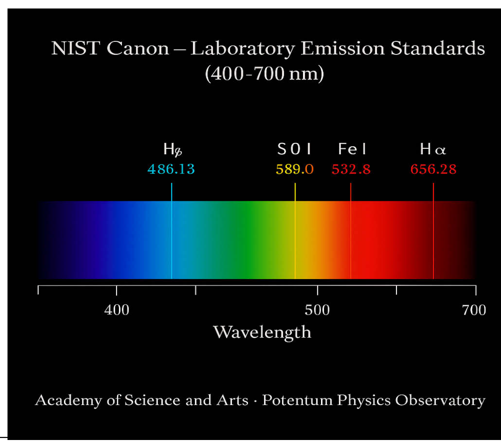


Plate 1 — Stellar Spectroscopy Reference Spectrum

At cosmic scale, physics achieves closure across 60 orders of magnitude in length and 40 in time. From Planck time (10^{-43} s) to the age of the universe ($\sim 10^{17}$ s), every tested domain conforms to the established laws. Remaining questions—quantum gravity, dark matter, and dark energy—reside beyond this horizon of resolution, but within its framework the physical world stands as one continuous, verified structure.

For four centuries, humanity has pursued the resolution of nature's questions. "What moves the planets?" asked Newton. "What carries light?" asked Maxwell. "What limits speed?" asked Einstein. "What makes matter stable?" asked Bohr and Schrödinger. Each of these inquiries was answered not by miracle but by mathematics—by geometry gaining motion, by motion gaining form.

By the beginning of the twenty-first century, the catalogue of resolution appeared complete. Every measurable constant had been fixed; every stable element identified; every celestial mechanism mapped. Physics, in its classical sense, had reached a terminus of predictability. The remaining riddles—dark matter, dark energy, unification, and consciousness—seemed to stand outside experiment, waiting.

It is here that **Geometric Algebra** reopened the path. In Hestenes' rotors, the old division between vector and spinor dissolved: geometry itself began to move. Electric and magnetic fields were recognized as dual aspects of one bivector structure; space and time as orientations of a single multivector field. Where Newton saw point masses and Einstein saw curvature, Geometric Algebra saw orientation—the inner grammar of reality written in rotations and reflections.

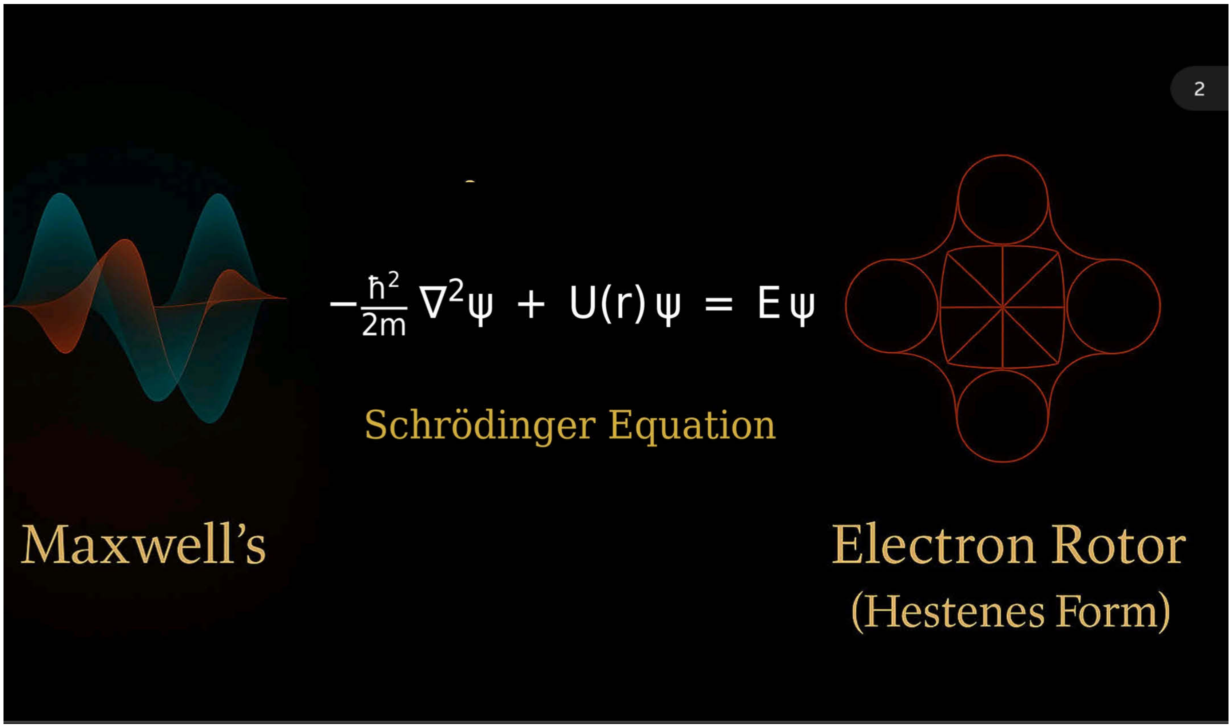
From this algebraic foundation emerged **Potentum Physics**, the modern restoration of natural philosophy. It extends resolution beyond measurement into structure, showing that the constants of physics are not arbitrary: they are the closure coefficients of reciprofluxive geometry. Each constant—c, h, G, α—corresponds to a limit where extrofluxion and introfluxion balance; each atom is a geometry sustained by reciprocal flux.

Thus the resolved questions of physics become the resolved forms of geometry. Spectral lines, once empirical fingerprints, are now understood as harmonic intersections of conjugate rotors. The periodic table, once a chemical taxonomy, is revealed as the lattice of closure symmetries permitted by the algebra. Astrophysical spectra, once distant light, are now read as the same interfluxions extended through cosmic scale.

In this recognition, science turns from accumulation to comprehension. The age of answers gives way to the age of understanding—a re-entry of meaning into measurement. The constants stand not as limits but as harmonies; the universe is resolved not into stillness but into coherence.

The task before the Academy is therefore not to replace physics, but to complete it—to translate its resolved equations into the what we may now Create as our kingdom of Heaven on Eartth.

Hence begins the Potentum Era—the Renewal of Natural Philosophy.



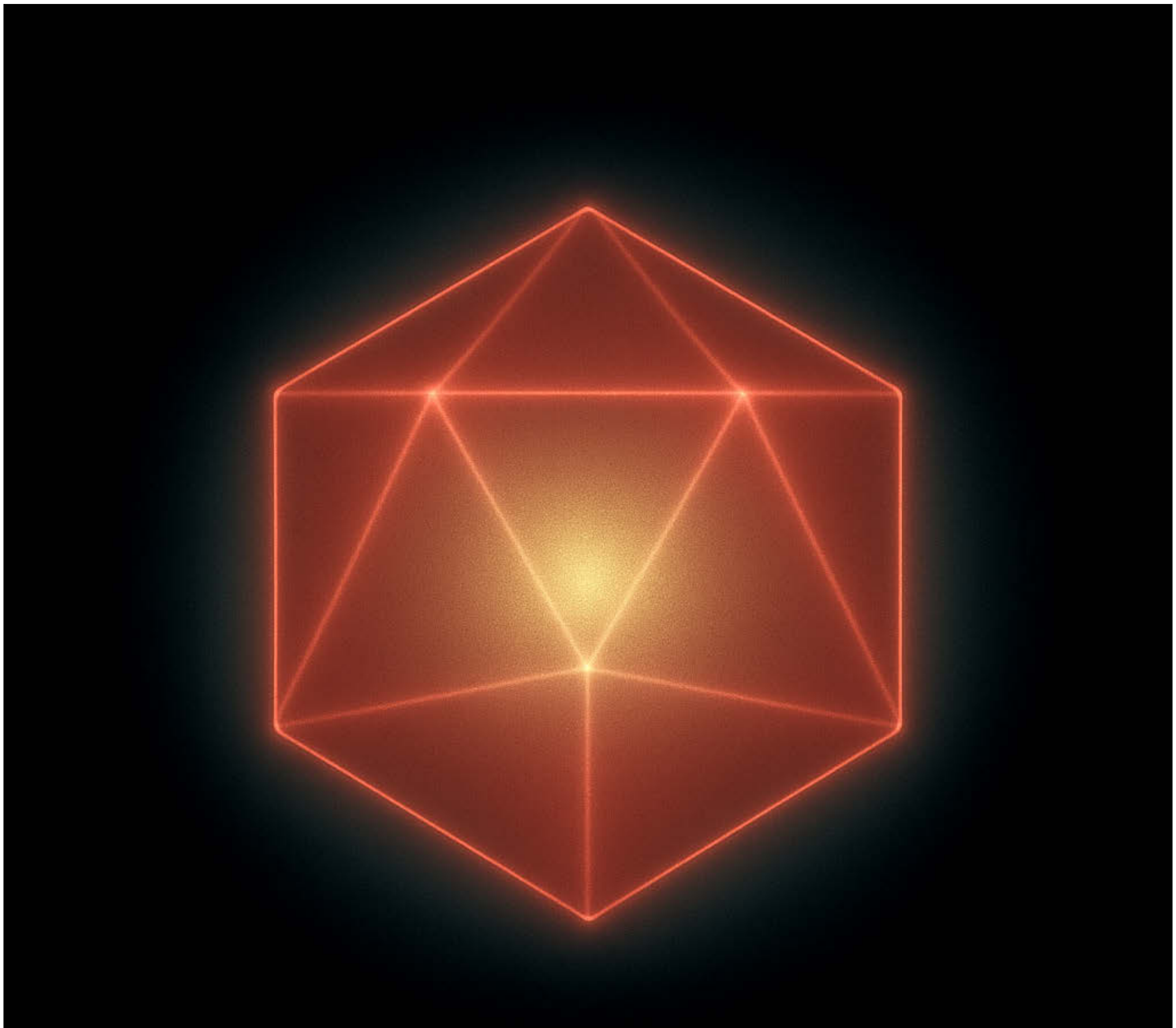


Plate IV — Iron (Fe) Nucleus

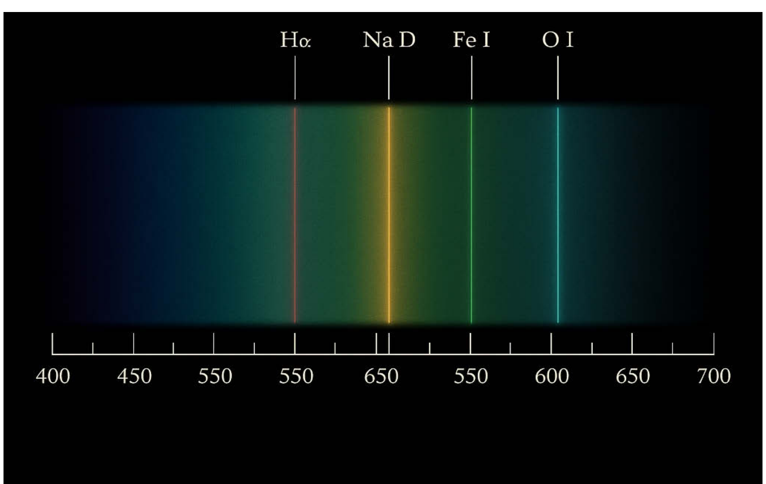


Plate V — NIST Ticks + Interfluxion Overlay