PART IV –CRITICAL REVIEW: ARE QWST DERIVATIONS CREDIBLE?

IV.1 – Introduction: Analyzing the Derivations

In any theoretical framework, a critical concern is whether the system relies on arbitrarily tuned parameters or operates within a tightly constrained framework based on consistent conceptual principles. Many physical models employ loosely tuned parameters—essentially adjustable knobs—that offer flexibility but can undermine internal consistency. In contrast, QWST derives its fundamental constants from a small set of interdependent parameters, rigorously constrained within the conceptual foundation. Its mathematical derivations are exceptionally tight; even minor adjustments result in rapid error increases, underscoring the precision of the equations. Moreover, these parameters arise consistently from the foundational principles of quantum wavespace, rather than from arbitrary adjustments. This stands in contrast to many physical models, where conceptually inconsistent ideas are often introduced to justify arbitrary tuning. Part IV forms the essential bridge between the foundational equations of Part I and the comprehensive derivations detailed in Parts V–IX.

Traditionally, constants such as the Rydberg constant, Planck's constant, the fine-structure constant, and electron charge are treated as empirically determined parameters, accepted as fundamental but lacking deeper explanatory foundations. Remarkably, QWST predicts these constants naturally and precisely from foundational wave-structure parameters such as the nucleon radius (r_0), core wave energy-density (P_0), and the speed-of-light boundary condition (C). Each constant emerges not as an isolated value but as a natural resonance condition deeply embedded within wave mechanics.

It is important to emphasize that we, the authors, approach this material as engineers, not theoretical physicists. However, aided significantly by modern artificial intelligence tools and computational analysis, we have rigorously evaluated the original derivations, confirming their internal consistency, mathematical accuracy, and logical coherence. Our goal is not to assert definitive conclusions, but rather to introduce these derivations to the broader scientific community, encouraging further examination, validation, or refinement.

We highlight the credibility of QWST's derivations to inspire further scrutiny and refinement by the scientific community. The intention is not to assert definitive conclusions but to establish a firm theoretical basis that encourages new approaches for further investigation into the quantum phenomena underlying the fabric of our universe. We believe that further exploration, particularly leveraging today's computational resources, could profoundly impact fields ranging from quantum mechanics to fusion energy research.

Table of Fundamental Constants Comparing Emprical and Derived Values

Constant	Symbol	Empirical Value	Calculated Value (QWST)	Significance to Physics
Nucleon Radius (C-sphere)	r_0	*Fundamental QWST constant*	$6.60724060118 \times 10^{-16}\, m$	¼ wavelength of quantum wavespace.
Max (Mass-) Energy Density	M_E	*Fundamental QWST constant*	$5.8211 \times 10^{18}\, kg/m^3$	Maximum (mass-) energy density in nucleon cores.
Max Energy Density	P_0	*Fundamental QWST constant*	$5.15851475 \times 10^{35}\, Pa$	Maximum energy density in nucleon cores.
Nucleon Energy	E_N	*Fundamental QWST constant*	$2.2628 \times 10^{-10}\, J$	Total energy in a nucleon.
Nucleon Stabilization	g_Σ	*Fundamental QWST constant*	980.6650	Governs stability and energy exchange thresholds.
Fine Structure Constant	α^{-1}	137.0360	137.0360	Determines strength of electromagnetic interactions.
Planck Constant	h	$6.626070 \times 10^{-34}\, J \cdot s$	$6.626070 \times 10^{-34}\, J \cdot s$	Links energy and frequency in quantum mechanics.
Rydberg Constant	R_∞	$1.097373 \times 10^{7}\, 1/m$	$1.097373 \times 10^{7}\, 1/m$	Characterizes atomic spectral line spacing.
Bohr Radius	a_0	$5.291772 \times 10^{-11}\, m$	$5.291814 \times 10^{-11}\, m$	Fundamental atomic orbital size.
Nucleon Mass	m_n	$1.672622 \times 10^{-27}\, kg$	$1.678487 \times 10^{-27}\, kg$	QWST Mass derived from wave structure.
Electron Charge (electrostatic)	e	$1.602177 \times 10^{-19}\, C$	$1.602177 \times 10^{-19}\, C$	Defines strength of electromagnetic interactions.
Electron Ionization Energy	E_I	$13.6000\, eV$	$13.5991\, eV$	Ionization thresholds in hydrogen-like atoms.
Electron Mass	m_e	$9.109384 \times 10^{-31}\, kg$	$9.104232 \times 10^{-31}\, kg$	Determines electron dynamics and stability.
Gravitational Constant	G	$6.6743 \times 10^{-11}\, \frac{m^3}{\mathrm{kg} \cdot \mathrm{s}^2}$	$6.6720 \times 10^{-11}\, \frac{m^3}{\mathrm{kg} \cdot \mathrm{s}^2}$	Determines gravitational force.

The empirical and derived values of the fundamental constants are extremely close—or exact in several cases—demonstrating that QWST is both conceptually and mathematically robust. The following chapters from the original manuscript (*PPNU*) describe the fundamental constant derivations in detail. Additional constant derivations based on the principles of QWST are included as "Selected Investigations", demonstrating the wealth of material that can be analyzed based on the original work.

Table of Fundamental Constants: Dependency Analysis

Symbol	Constant	Dependency	Free/ Derived	Derived From:
f_0	Basic Frequency of Quantum Wavespace	N/A (alternate r_0)	—	C, r_0
C	Speed of Light	primary	—	*Standard physics*
r_0	Nucleon Radius (C-sphere)	primary	free	*Fundamental QWST constant*
R_0	Wavespace Boundary	secondary	—	C, r_0, P_0, g_Σ
M_E	Max (Mass) Energy Density	N/A (alternate $P0$ N/A (alternate P_0)	—	*Fundamental QWST constant (alternate)*
P_0	Max Energy Density	primary	free	*Fundamental QWST constant*
E_N	Nucleon Energy	primary	derived	r_0 , P_0
E_e	Electron Energy	primary	derived	r_0 , P_0
g_Σ	Nucleon Stabilization	primary	free	*(wave geometry)*
α^{-1}	Fine Structure Constant	primary (wave geometry derivation)	derived	*(wave geometry)*
h	Planck Constant	primary	derived	C, r_0, P_0
R_∞	Rydberg Constant	Primary (electron photon threshold)	derived	r_0, g_Σ
a_0	Bohr Radius	secondary	—	r_0, P_0
m_n	Nucleon Mass	primary	derived	r_0 , P_0
e	Electron Charge (electrostatic)	primary	derived	r_0, P_0, α
EiE_I	Electron Ionization Energy	secondary	—	r_0, g_Σ, P_0
m_e	Electron Mass	primary	derived	$C, P_0, r_0, g_\Sigma, (\alpha^{-1})$
G	Gravitational Constant	primary (boundary loss effects)	derived	$M_E, C, r_0, g_\Sigma, R_0$
A, B, D	Wave geometry placeholders	N/A (dimensionless placeholders)	—	*(wave geometry)*

Sensitivity Analysis: Variation of Free Parameters vs. Average Error of Constants

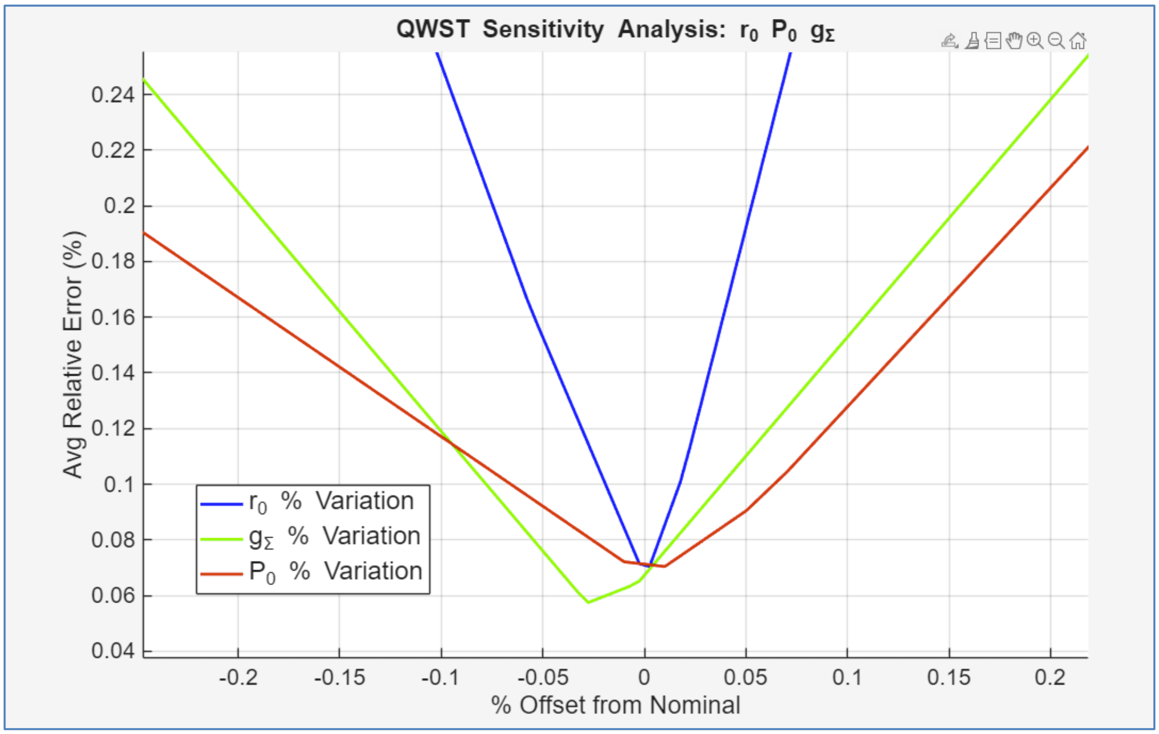
The table above lists key relationships developed from QWST. A common concern in any unified theory is whether it relies on numerous "adjustable knobs" to fit data artificially. However, QWST employs only a small set of free parameters (highlighted in blue):

1. r_0 = (nucleon radius) $\sim 0.8\ fm$ matching known proton-radius data.
2. P_0 = (maximum energy density in nucleon) is $\sim 10^{35}\ Pa$ corresponding to pressures required for fusion.

3. g_{Σ} = (nucleon stabilization ratio) is a unique QWST constant; one fixed, it yields consistent results with known nuclear energy and pressures.

The plot shown below compares how extremely small percentage changes (±0.2% on the x-axis) in each of three key QWST parameters—r_0 (blue), g_{Σ} (green), and P_0 (red)—affect the average relative error (y-axis) across multiple derived physical constants (Planck's constant, electron mass, Rydberg constant, etc.). Each curve is generated by varying only one parameter at a time while holding the others fixed at their nominal QWST values.

A sharp minimum for each curve with steep error slopes outside the narrow range of optimum parameter values, demonstrates that QWST is **tightly constrained**: very small deviations from the optimum lead to a noticeable increase in error.



Sensitivity of the "flex" parameters of Quantum Wavespace Theory. The V-shaped curves demonstrate that the principal constants are tightly constrained, and do not act as adjustment "knobs".

In short, QWST's ability to accurately reproduce a wide range of fundamental physical constants using only a handful of free parameters is not the result of arbitrary tuning— it directly reflects the strength and internal consistency of its conceptual framework. This over-constrained nature, where a few core parameters yield many significant and precise predictions, provides compelling evidence that QWST will yield useful results when further examined with HPC models and empirical analysis.