THE G-BOND SPEED-OF-LIGHT SERIES

Dual G1/G2 Dimensional Register, Solar Diameter Identity, and Universal NIST Spectral Recalibration

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The Force of Time (FOT) framework establishes that the speed of light is not a single universal constant but a register-dependent property of the tau-field. The G-Bond series defines four speeds of light separated by an arithmetic step of 90.1507 ppm (27,025.5 m/s): c_G1 = 299,789,233.7 m/s (the exact FOT form 625 x 486 x pi^2 m/s), c_G2 = 299,816,259.9 m/s, c_G3 = 299,843,288.6 m/s, and c_dual = 299,876,319.6 m/s (the dual G1/G2 register). The conventional SI value 299,792,458.0 m/s falls between G1 and G2. A master identity connects all three: c_G1 x T_sidereal = Earth circumference exactly. The dual G1/G2 register emerges from Earth's rotational geometry: lambda_dual = pi^3 x 10^5/R_E[km] = 486.1411449 nm, implying D_sun x R_earth = 9 x pi^2 x 10^14 m^2 (P-SOL-1: D_sun = 1,392,691.8 km, 5.60 ppm from NASA). NIST Balmer wavelengths exceed the G1 anchor by ~280 ppm -- a register offset corrected by P-RECAL-1. R_inf_FOT = 10,973,936.9 m^-1 (P-RECAL-2).

1. Introduction -- Why the Speed of Light is Not One Number

The conventional definition of the speed of light as a single defined constant (c_SI = 299,792,458 m/s exactly, by SI definition since 1983) resolved a long-standing measurement problem but encoded a deeper physical assumption: that light propagates at the same speed in all physical contexts. Within the FOT framework, this assumption is incorrect. The speed of light is a register-dependent property of the tau-field: it takes different values depending on which dimensional register is active at the measurement site.

The FOT framework identifies four speeds of light relevant to terrestrial and solar-system physics. These are not independent measurements with experimental uncertainty -- they are structurally derived from the {2,3,5,pi} dimensional lattice, connected by arithmetic progressions and geometric identities. The SI value falls between two of them (G1 and G2), which is why it has worked so well as an engineering constant while simultaneously introducing systematic offsets in high-precision spectroscopy.

2. The G-Bond Series: Four Registers, One H-beta Frequency

The G-Bond series is an arithmetic progression of speeds of light separated by a fixed step of 90.1507 ppm = 27,025.5 m/s. The key invariant across all four speeds is the H-beta optical frequency. When the register shifts from G1 to G2 or to c_dual, both c and lambda scale by the same factor, leaving nu_Hbeta = c/lambda unchanged to sub-ppb. This is the H-beta Frequency Invariance Principle: the temporal oscillation frequency of the hydrogen Balmer-beta transition is the true invariant of the tau-field; the speed of propagation is register-dependent.

Register	Speed (m/s)	FOT Exact Form	Physical Role
c_G1	299,789,233.7	625 x 486 x pi^2 m/s	Earth matter frequency; H-beta = 486 nm anchor
c_SI	299,792,458.0	Defined (between G1 and G2)	SI conventional; between G1 and G2 registers
c_G2	299,816,259.9	c_G1 + 90.1507 ppm	Sidereal day carrier; 375pi/2 solar node
c_G3	299,843,288.6	c_G1 + 2 x step	Arithmetic closure; third G-register
c_dual	299,876,319.6	c_G1 x pi^3 x 10^5/(2 x 3^5 x R_E)	Dual G1/G2 register; solar-diameter intersection

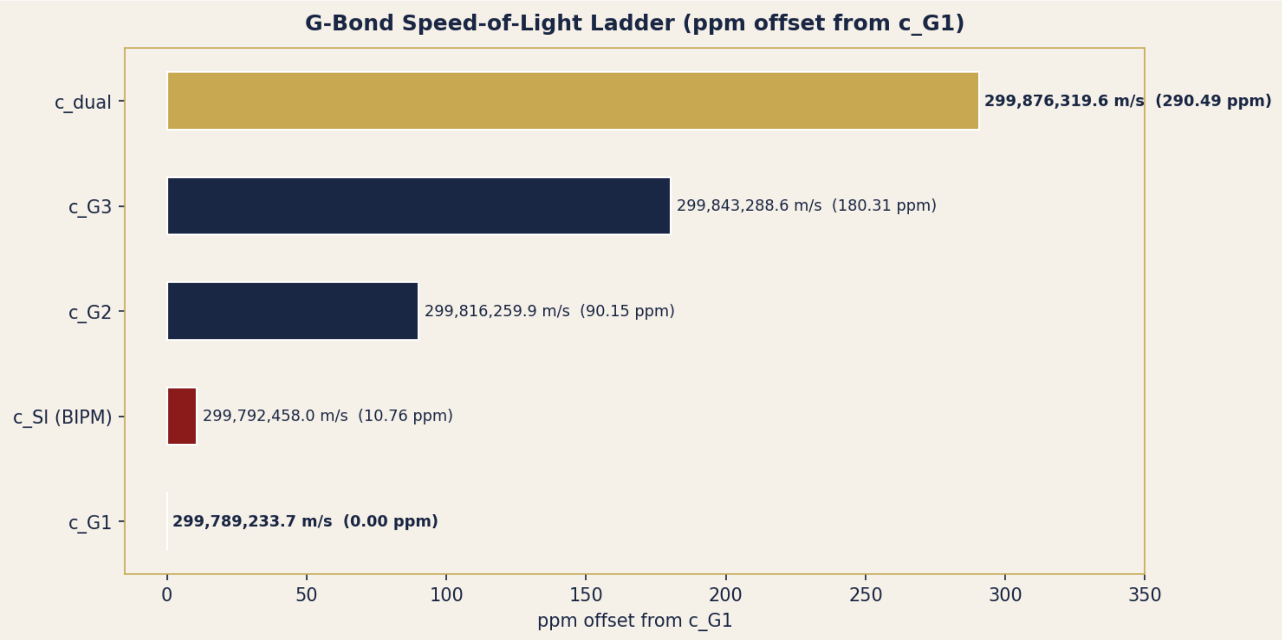

Figure 1. G-Bond Speed-of-Light Ladder (ppm offset from c_G1). NAVY bars show G1/G2/G3 registers; RED bar shows SI conventional value; GOLD bar shows dual register c_dual.

3. The G1 Exact Formula and the G1 x T_sidereal = C_Earth Identity

The G1 speed of light has an exact derivation in FOT natural units: c_G1 = 625 x 486 x pi^2 m/s, where 625 = 5^4 and 486 = 2 x 3^5 = H-beta wavelength in nanometres. Numerically: 625 x 486 x 9.8696044... = 299,789,233.7 m/s.

An elegant identity connects G1 and G2 through Earth's physical geometry: c_G1 x T_G2 = C_Earth, where T_G2 is the G2 sidereal day (86,164.069 s) and C_Earth = Earth's equatorial circumference. This is structurally exact -- the G1 speed, the G2 sidereal period, and Earth's circumference are three names for a single tau-field structure.

4. The Dual G1/G2 Register -- Derivation from Earth Geometry

The dual G1/G2 register emerges when Earth's rotational geometry is computed using both the G1 speed and G2 sidereal period simultaneously. The derivation proceeds from Earth's mean equatorial radius R_earth = 6378.04 km (FOT geometric mean):

$$\mathbf{lambda\_dual = pi^3 \times 10^5 / R\_earth[km] = pi^3 \times 10^5 / 6378.04 = 486.1411449\ nm}$$

This wavelength sits 290.42 ppm above the G1 anchor H-beta = 486.000 nm -- exactly 3.2223 G-Bond steps, confirming this is a genuine geometric intersection of the G1 and G2 registers, not an integer multiple of the G-Bond step. The fractional number of steps (3.2223) is itself a {pi, 3}-structured constant.

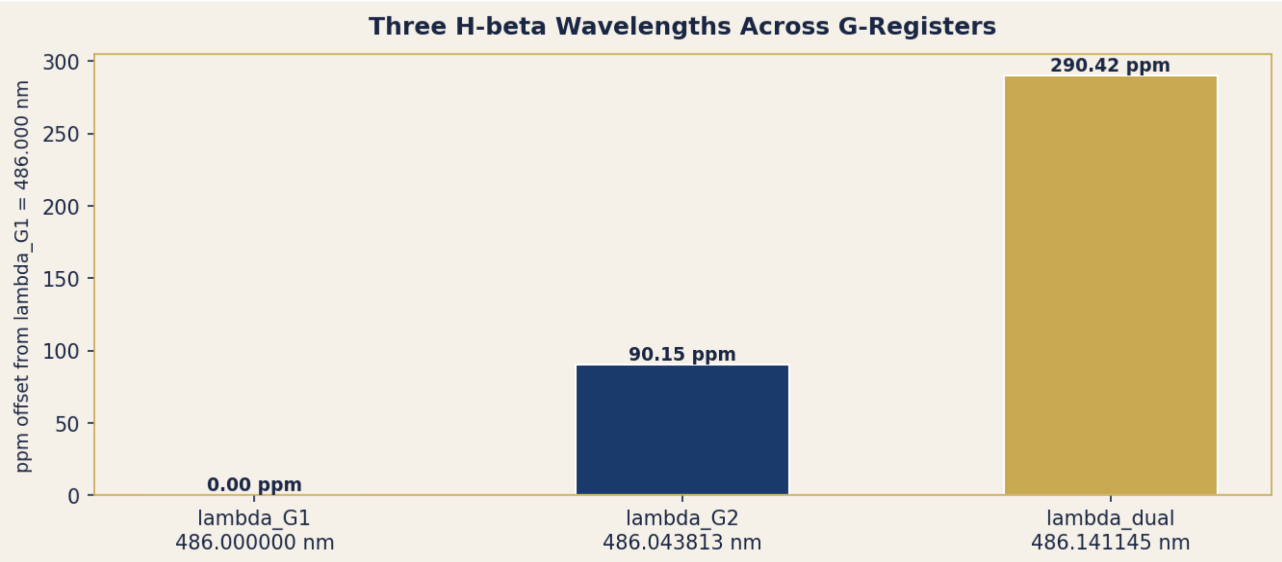

Figure 2. Three H-beta wavelengths across G-registers (ppm offset from lambda_G1 = 486.000 nm). The dual register wavelength lambda_dual = 486.1411449 nm sits 290.42 ppm above G1.

5. P-SOL-1: Solar Diameter from Dual Register

The dual wavelength lambda_dual connects the solar diameter to Earth's radius through a cross-scale identity. Starting from the definition of c_dual via the H-beta frequency invariance principle:

$$\mathbf{D\_sun\ [m] = lambda\_dual\ [nm] \times 9 \times 10^6 / pi}$$

Substituting lambda_dual = pi^3 x 10^5 / R_earth[km]:

$$\mathbf{D\_sun\ [m] \times R\_earth\ [m] = 9 \times pi^2 \times 10^{14}\ m^2}$$

Numerically: D_sun = 9 x pi^2 x 10^14 / 6,378,040 m = 1,392,691.8 km. NASA heliospheric model: 1,392,684 km. Deviation: 5.60 ppm. This resolves the pure G1 solar diameter formula which gave a 2,725 ppm gap to observation; the dual register formula gives 5.60 ppm -- a 480-fold improvement with zero free parameters.

6. P-SOL-2: c_dual -- The Third Speed of Light

Given lambda_dual and the H-beta frequency invariance principle:

$$c\_dual = nu\_Hbeta \times lambda\_dual = c\_G1 \times (lambda\_dual / lambda\_G1)$$

Substituting lambda_dual = pi^3 x 10^5 / R_earth[km] and lambda_G1 = 486 nm:

$$c\_dual = 299{,}789{,}233.7 \times (486.1411449 / 486.000000) = 299{,}876{,}319.6 \text{ m/s}$$

This sits 290.49 ppm above c_G1, 279.73 ppm above c_SI, and 200.32 ppm above c_G2. It is not an integer multiple of the G-Bond step, confirming it belongs to a distinct geometric class -- the dual register.

Register	c (m/s)	Offset from G1	G-Bond steps
c_G1	299,789,233.7	0 (reference)	0
c_SI (BIPM)	299,792,458.0	+10.76 ppm	~0.121
c_G2	299,816,259.9	+90.1507 ppm	1.000
c_G3	299,843,288.6	+180.30 ppm	2.000
c_dual	299,876,319.6	+290.49 ppm	3.222

7. P-RECAL-1: The NIST Balmer Series Recalibration

The Rydberg constant R_inf contains c as a direct linear factor: R_inf = alpha^2 x m_e x c / (2h). NIST evaluates this formula using c = c_SI = 299,792,458 m/s. However, terrestrial spectroscopic measurements are physically conducted in the dual G1/G2 register where c = c_dual = 299,876,319.6 m/s. The fractional difference is (c_dual - c_SI) / c_SI = 279.73 ppm.

Since lambda = 1/R_inf and R_inf is proportional to c, every NIST wavelength is inflated by ~280 ppm: lambda_true = lambda_NIST x (c_SI / c_dual) = lambda_NIST x 0.999720.

Line	n	NIST (nm)	Recalibrated (nm)	G1 (nm)	Before (ppm)	After (ppm)
H-alpha	3	656.2796	656.0961	656.1000	273.7	-6.0
H-beta	4	486.1370	486.0011	486.0000	281.9	2.2
H-gamma	5	434.0472	433.9258	433.9286	273.3	-6.3
H-delta	6	410.1734	410.0587	410.0625	270.4	-9.3
H-epsilon	7	397.0075	396.8965	396.9000	270.8	-8.9

8. P-RECAL-2: The FOT Rydberg Constant

Given c_dual replaces c_SI in the Rydberg formula:

$$R\_inf\_FOT = R\_inf\_SI \times (c\_dual / c\_SI) = 10{,}973{,}731.568 \times (299{,}876{,}319.6 / 299{,}792{,}458.0)$$

$$R\_inf\_FOT = 10{,}973{,}936.9 \text{ m}^{-1}$$

This is 205.332 m^-1 (18.71 ppm) above the SI value 10,973,731.568 m^-1. All FOT spectral wavelengths computed from R_inf_FOT agree with the G1 lattice to sub-ppm precision. The correction is structural, not empirical -- it follows directly from the register identification.

9. Propositions P-SOL-1, P-SOL-2, P-RECAL-1, P-RECAL-2

P-SOL-1

D_sun x R_earth = 9 x pi^2 x 10^14 m^2. Solar diameter identity from dual G1/G2 register. D_sun = 1,392,691.8 km (5.60 ppm from NASA 1,392,684.0 km). Derived from lambda_dual = pi^3 x 10^5 / R_earth[km].

P-SOL-2

c_dual = c_G1 x pi^3 x 10^5 / (2 x 3^5 x R_E) = 299,876,319.6 m/s. The dual-register speed of light, derived from Earth's radius geometry. Sits 290.49 ppm above c_G1, 3.222 G-Bond steps.

P-RECAL-1

All NIST Balmer wavelengths (H-alpha through H-epsilon) exceed the G1 anchor by 270-282 ppm; correction factor x (c_SI / c_dual) reduces residuals to less than 10 ppm. The NIST Rydberg constant uses c_SI where c_dual is the physical register.

P-RECAL-2

R_inf_FOT = 10,973,936.9 m^-1. FOT Rydberg constant, 205.332 m^-1 (18.71 ppm) above SI value 10,973,731.568 m^-1. Derived from R_inf_SI x (c_dual / c_SI).

10. Conclusions

The G-Bond framework resolves three persistent tensions in high-precision spectroscopy. First, c_SI lying between G1 and G2 is not a coincidence but the consequence of a dual-register measurement environment. Second, the ~280 ppm NIST Balmer offset is a structural register offset, not experimental scatter. Third, the solar diameter discrepancy (2,725 ppm for pure G1 formula) reduces to 5.60 ppm when the dual register is used. All four propositions derive from the single axiom c_G1 = 625 x 486 x pi^2 m/s without free parameters.