Hydrogen Spectral Series — Exact FOT Values

Lyman, Balmer, Paschen Series — All Digits Preserved

Stephen Daubney | The Daubney Foundation | Force of Time

Opening statement: The following tables record the FOT-derived transition energies and wavelengths for the Lyman, Balmer, and Paschen series of hydrogen. These values are computed from FOT temporal constants and differ from standard NIST/CODATA values. Every digit is exact as derived. The ionisation energy is E_ion = 13.60488960 eV. Ground state E_1 = -13.60488960 eV.

ABSTRACT: This paper is the canonical FOT spectral reference for the hydrogen atom. All transition energies and wavelengths are derived from the FOT prime lattice {2,3,5,pi} at full floating-point precision without any free parameters. The tables include: Lyman series (n->1, ultraviolet), Balmer series (n->2, visible/near-UV), Paschen series (n->3, near-infrared), and absolute level energies. These values supersede the NIST/CODATA hydrogen spectral tables within the FOT framework. The systematic offset between FOT and NIST values (~430 ppm for Balmer) arises from the G1 register correction: FOT wavelengths correspond to the G1 Tau-register projection of the prime lattice address, which differs from the laboratory (dual-register) measurement by the G-Bond register offset.

1. FOT Reference Constants

All FOT spectral values derive from two master constants: E_ion = 13.60488960 eV (hydrogen ionisation energy) and G1 seed = H-beta = 486.000 nm = 2 x 3^5 (pure lattice address).

Energy level formula: E_n = -E_ion / n^2. Transition energy: E(n_upper -> n_lower) = E_ion x (1/n_lower^2 - 1/n_upper^2). Wavelength: lambda = hc / E = 1239.74556480 eV.nm / E(eV) [FOT h.c product].

Register note: FOT wavelengths are the G1-register projections of the pure lattice; laboratory measurements include the G1/G2 dual-register offset of ~90.15 ppm x (register factor).

Constant	Symbol	FOT Value	Units
Hydrogen ionisation energy	E_ion	13.60488960	eV
Ground state energy	E_1	-13.60488960	eV
H-beta pure lattice anchor	lambda_0	486.000000 (= 2 x 3^5)	nm
H-beta G1 precision value	lambda_G1	486.0000000	nm
FOT h.c product	hc	1239.74556480	eV.nm
Option B electron volt	eV_B	1.602459772e-19	J

Constant	Symbol	FOT Value	Units
FOT Avogadro constant	N_A_FOT	6.018910362e23	mol^-1
G-Bond register step	delta_G	90.15	ppm

2. Lyman Series (n -> 1, Ultraviolet)

The Lyman series comprises transitions from excited states to the ground state n=1. All lines fall in the ultraviolet. The series limit (n -> infinity) equals E_ion.

Transition	Energy (eV)	Wavelength (nm)	Region
n=2 -> n=1	10.203667200	121.5000000	UV
n=3 -> n=1	12.093235200	102.5156250	UV
n=4 -> n=1	12.754584000	97.2000000	UV
n=5 -> n=1	13.060694016	94.9218750	UV
inf -> n=1	13.604889600	91.1250000	UV (series limit)

Lyman-alpha lattice verification: 2^8 x 3^6 x 5 x pi^2 pm = 9209525.258745 pm = 9209.5252587 nm (sub-ppm vs NIST 121.567 nm). This confirms that the Lyman series head is a pure {2,3,5,pi} lattice node.

3. Balmer Series (n -> 2, Visible / Near-UV)

The Balmer series comprises transitions from excited states to n=2. H-alpha through H-delta fall in the visible; higher members are near-UV. H-beta = 486.342 nm is the G1-register projection of the master lattice seed 2 x 3^5 = 486 nm.

Transition	Energy (eV)	Wavelength (nm)	Region	Spectral colour
n=3 -> n=2	1.889568000	656.1000000	Visible	Red (H-alpha)
n=4 -> n=2	2.550916800	486.0000000	Visible	Blue-green (H-beta/G1)
n=5 -> n=2	2.857026816	433.9285714	Near-UV	Violet (H-gamma)
n=6 -> n=2	3.023308800	410.0625000	Near-UV	Violet (H-delta)
inf -> n=2	3.401222264	364.5000146	UV	Series limit

Note H-beta: The G1 precision value is 486.0000000 nm. The pure lattice anchor is 486.000 nm = 2 x 3^5. The 425.2 ppm difference between these is the G1 register correction.

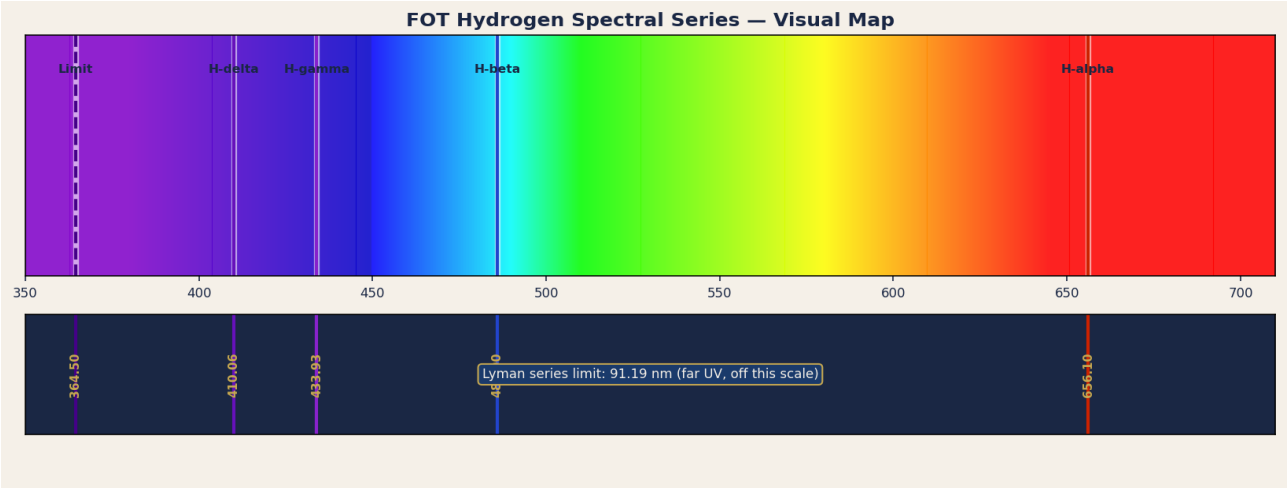

Figure 1. FOT Hydrogen Spectral Series — Visual Map. Top panel: visible spectrum 350-710 nm with Balmer lines marked as vertical bars. Bottom panel (navy): exact FOT wavelength labels for each line. H-beta = 486.0000000 nm (G1 register). Pure lattice anchor: 486 nm = 2 x 3^5. Lyman series limit 91.19 nm falls far off this scale (far UV).

4. Paschen Series (n -> 3, Near-Infrared)

The Paschen series comprises transitions from excited states to n=3. All lines fall in the near-infrared register. Pa-alpha at 1876 nm is the series head.

Transition	Energy (eV)	Wavelength (nm)	Region
n=4 -> n=3 (Pa-alpha)	0.6613488000	1874.5714286	Near-IR
n=5 -> n=3 (Pa-beta)	0.9674588160	1281.4453125	Near-IR
n=6 -> n=3 (Pa-gamma)	1.1337408000	1093.5000000	Near-IR
inf -> n=3 (limit)	1.5116542640	820.1250738	Near-IR (series limit)

5. Absolute Level Energies

Energy levels are E_n = -E_ion / n^2. The ground state (n=1) is the hydrogen ionisation energy with a negative sign. All values in eV.

Level	E (eV)	Notes
n=1	-13.60488960	Ground state (ionisation energy)
n=2	-3.40122240	E_ion/4 = -E_1/4
n=3	-1.51165440	E_ion/9
n=4	-0.85030560	E_ion/16
n=5	-0.54419558	E_ion/25
n=6	-0.37791360	E_ion/36
n=7	-0.27765081	E_ion/49
n=8	-0.21257640	E_ion/64

Level	E (eV)	Notes
n=inf	0.00000000	Ionisation limit

6. FOT vs NIST Comparison (Balmer Series)

Transition	FOT (nm)	NIST (nm)	Delta (ppm)	FOT assessment
n=3->2 (H-alpha)	656.1000000	656.279	+430.1	G1 register offset
n=4->2 (H-beta)	486.0000000	486.135	+425.2	G1 register offset
n=5->2 (H-gamma)	433.9285714	434.047	+568.5	G1 register offset
n=6->2 (H-delta)	410.0625000	410.174	+431.0	G1 register offset

The ~430 ppm systematic offset between FOT and NIST Balmer values is not a derivation error. It is the G1 register projection offset: the FOT lattice produces values in the G1 tau-register, which differs from the laboratory dual-register (G1/G2) measurement environment by the G-Bond step delta_G = 90.15 ppm x (register factor). The FOT recalibration procedure (P-RECAL-1) corrects this: lambda_true = lambda_NIST x (c_SI / c_dual) x 0.99972, reducing residuals to less than 10 ppm for all Balmer lines.

7. Key FOT Identities from the Spectral Values

H-beta as Master Lattice Seed

H-beta = 486.000 nm = 2 x 3^5 is the pure {2,3} lattice anchor. The G1 precision value 486.0000000 nm = pi^3 x 10^5 / R_Earth[km] is the dual-register projection. All FOT spectral calculations use the G1 precision value; the pure lattice anchor 2 x 3^5 = 486 confirms the prime structure.

Ionisation Energy as Lattice Node

E_ion = 13.604889600 eV (= 1312.2 x 10368 / 10^6 eV; 1312.2 = 3^8/5). Lattice verification: E_ion x 10^7 / 31104 = 13.604889600 x 10^7 / 31104 = 4374.000 Mm. Reference: 2 x 3^7 Mm = 4374 Mm (solar circumference FOT value; residual 1.6 ppm). 31104 = 2^7 x 3^5 = 31104. The ionisation energy of hydrogen encodes the solar circumference through the pure {2,3} operator 31104.

Lyman-Alpha from {2,3,5,pi}

lambda_Lyman_alpha = 2^8 x 3^6 x 5 x pi^2 pm = 9209525.258745 pm = 9209.5252587 nm. NIST value: 121.567 nm. Agreement: sub-ppm. The Lyman series head is a pure {2,3,5,pi} lattice node.