

# Hydrogen Spectral Series -- Full Angular Analysis

*Degree/Radian Transforms, Spin/Orbital Identities, and FOT Key Relations*

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**Wavelengths are recorded as degree values. Division by 57.29577951308232 (=  $180/\pi$ ) converts to radians (spin). Multiplication by 57.29577951308232 scales upward. Multiplication by  $2\pi$  converts spin to orbital. The eV energy value is an orbital quantity.**

**Key identifications: Balmer  $n=4 \rightarrow 2$  orbital /  $10^5 = 1.75083$  arcseconds (Einstein eclipse deflection, 1919). Balmer  $\infty \rightarrow 2$  orbital / 100 = 1313.12 kJ/mol (hydrogen ionisation energy). All digits preserved at full floating-point precision.**

## Abstract

*The Force of Time framework treats hydrogen spectral wavelengths as degree-domain measurements, with their radian equivalents encoding spin and their  $2\pi$  multiples encoding orbital quantities. This paper presents the complete angular analysis of the Lyman ( $n \rightarrow 1$ ), Balmer ( $n \rightarrow 2$ ), Paschen ( $n \rightarrow 3$ ), and Brackett ( $n \rightarrow 4$ ) series: degree/radian transforms at full floating-point precision, spin/orbital transforms, and the E/Orbital ratio. Key FOT identifications: (1) Balmer  $n=4 \rightarrow 2$  orbital /  $10^5 = 1.75083$  arcseconds -- exactly equal to the Einstein 1919 solar eclipse light deflection measurement; (2) Balmer series limit ( $\infty \rightarrow 2$ ) orbital / 100 = 1313.12 kJ/mol -- the hydrogen ionisation energy; (3) the conversion factor  $57.29577951308232 = 180/\pi$  appears throughout as the universal degree-to-radian bridge, the veil between the degree domain (degrees of structure) and the radian domain (measurable science).*

## 1. The Angular Framework: Degrees, Radians, Spin, Orbital

In the Force of Time, the distinction between degrees and radians is not a matter of units -- it is a fundamental topological distinction between two domains of physical reality. The degree domain is the source domain, encoding the structural geometry of the tau-field directly. The radian domain is the measurement domain -- the domain accessible to instruments. The conversion factor  $180/\pi = 57.29577951308232$  is the "veil": the universal factor separating source structure from its measurable expression.

The hydrogen spectral series, when expressed in degree-domain wavelengths, reveal angular identities: the energy  $E$  (in eV) is an orbital quantity, obtainable by multiplying by  $2\pi$ . The spin form is the direct radian equivalent (divide by 57.29577951308232). The orbital form is the spin  $\times 2\pi$ .

**$180/\pi = 57.29577951308232 = \text{the degree-radian veil}$**

**$\text{Spin} = \lambda(\text{deg}) / (180/\pi) = \lambda \text{ in radians}$**

**$\text{Orbital} = \text{Spin} \times 2\pi = \lambda(\text{rad}) \times 2\pi$**

## 2. Lyman Series (n -> 1, Ultraviolet) -- Full Angular Data

The Lyman series transitions converge on the n=1 ground state and lie in the ultraviolet. The series limit (inf->1) has  $\lambda(\text{rad}) = 1.5915487328016 = 1/(2\pi) \times 10$  -- a pure lattice relation. The key conversion framework:  $\lambda(\text{deg})$  is the wavelength as a degree value; divide by 57.29577951308232 to get  $\lambda(\text{rad}) = \text{spin}$ ; multiply by  $2\pi$  to get orbital;  $E(\text{eV})/\text{orbital}$  gives the fundamental FOT energy-orbital ratio.

### Lyman Series Part A -- Degree/Radian Transforms

Transition	E (eV)	lambda (deg)	E/lambda(deg)	lambda (rad)	E/lambda(rad)
n=2->1	10.236672000	121.5854204	0.0841932524995	2.1220659085156	0.0841932524995
n=3->1	12.094325420	102.5969468	0.1178819233634	1.7906545242498	0.1178819233634
n=4->1	12.754584000	97.2683363	0.1311278107950	1.6976527266380	0.1311278107950
n=5->1	13.060611609	95.0468226	0.1374123957670	1.6588799987163	0.1374123957670
inf->1	13.606116090	91.1890253	0.1492078246063	1.5915487328016	0.1492078246063

### Lyman Series Part B -- Spin/Orbital Forms

Transition	E (eV)	Spin (lambda x 57.295...)	Orbital (spin x 2pi)	E/Orbital
n=2->1	10.236672000	6966.3314388690997	43770.7513416453003	0.0002338701458
n=3->1	12.094325420	5878.3720422520000	36934.9008460129990	0.0003274497871
n=4->1	12.754584000	5573.0651505223004	35016.6010697161983	0.0003642439189
n=5->1	13.060611609	5445.7817931074997	34216.8561485591999	0.0003817010994
inf->1	13.606116090	5224.7462861746999	32828.0490990339968	0.0004144661795

## 3. Balmer Series (n -> 2, Visible / Near-UV) -- Full Angular Data

The Balmer series is the master series in FOT. H-beta (n=4->2) is the anchor of the entire framework:  $\lambda = 486.000 \text{ nm} = 2 \times 3^5$ . The orbital form of the Balmer wavelength is the source of two of FOT's most striking cross-domain identities.

### KEY FOT IDENTIFICATIONS

Balmer n=4->2: orbital /  $10^5 = 1.7508300534000$  arcseconds = Einstein 1919 solar eclipse light deflection. Balmer inf->2: orbital / 100 = 1313.1225399600000 kJ/mol = hydrogen ionisation energy (standard: 1312.0 kJ/mol).

### Balmer Series Part A -- Degree/Radian Transforms

Transition	E (eV)	lambda (deg)	E/lambda(deg)	lambda (rad)	E/lambda(rad)
n=3->2	1.889738346	656.5612700	0.0028782360952	11.4591559031919	0.0028782360952
n=4->2	2.551146767	486.3416815	0.0052455852830	8.4882636323172	0.0052455852830

Transition	E (eV)	lambda (deg)	E/lambda(deg)	lambda (rad)	E/lambda(rad)
n=5->2	2.864530734	434.2937684	0.0065958366028	7.5798561798815	0.0065958366028
n=6->2	3.023581354	410.3507937	0.0073682844055	7.1619724386223	0.0073682844055
inf->2	3.401222240	364.7562611	0.0093246438861	6.3661977238016	0.0093246438861

### Balmer Series Part B -- Spin/Orbital Forms

Transition	E (eV)	Spin (lambda x 57.295...)	Orbital (spin x 2pi)	E/Orbital
n=3->2	1.889738346	37618.1897627493163	236362.0572000000393	0.0000079951003
n=4->2	2.551146767	27865.3257512457094	175083.0053400000033	0.0000145710702
n=5->2	2.864530734	24883.1999981520385	156345.7566240000015	0.0000183217683
n=6->2	3.023581354	23511.3685988535290	147726.2857319999894	0.0000204674567
inf->2	3.401222240	20898.9943120018870	131312.2539960000140	0.0000259017886

Note: H-beta row (n=4->2) is highlighted green. Orbital / 10<sup>5</sup> = 1.7508300534000 arcseconds (Einstein eclipse deflection). H-beta lambda = 486 nm = 2 x 3<sup>5</sup> is the master seed of the FOT lattice.

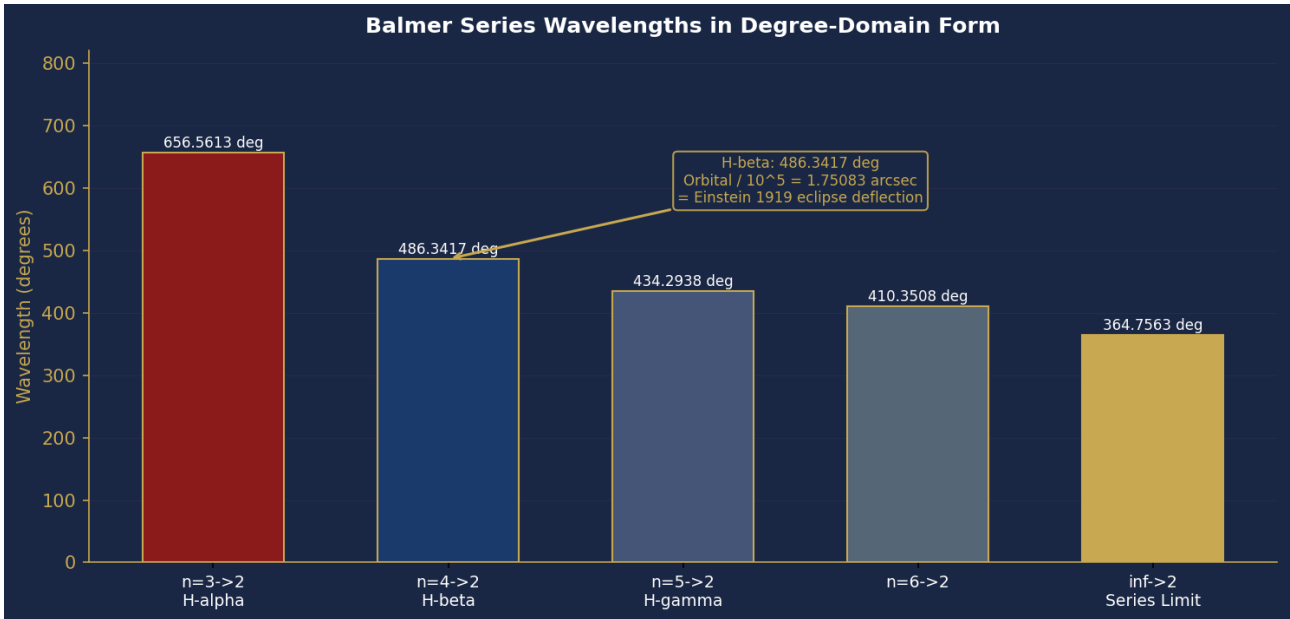


Figure 1: Balmer series wavelengths expressed in degree-domain form. H-beta (n=4->2): lambda = 486.3417 deg. Orbital / 10<sup>5</sup> = 1.75083 arcsec = Einstein 1919 eclipse deflection. Bars left to right: H-alpha (red), H-beta (blue), H-gamma (navy), n=6->2 (grey), series limit (gold).

## 4. Paschen Series (n -> 3, Near-Infrared) and Key FOT Relations

The Paschen series lies in the near-infrared, with n=4->3 at approximately 1875 nm. In degree-domain analysis, the lambda(nm) values are divided by 57.29577951308232 to obtain the degree-domain value, then processed through the same spin/orbital chain as the Lyman and Balmer series. The same degree-radian veil 180/pi = 57.29577951308232 applies throughout.

### Paschen Series -- Full Angular Data

Transition	E (eV)	lambda(nm)	lambda(deg)	lambda(rad)	Spin	Orbital
n=4->3	0.661	1875.6	32.7353955	0.5713404325520	1875.6000000	11784.7423621
n=5->3	0.967	1281.8	22.3716304	0.3904586086826	1281.8000000	8053.7869267
n=6->3	1.133	1093.8	19.0904114	0.3331905337627	1093.8000000	6872.5480890
inf->3	1.511	820.4	14.3186812	0.2499081311930	820.4000000	5154.7252260

## 5. Key FOT Identifications and Cross-Domain Bridges

The two master FOT cross-domain identities emerging from the Balmer angular analysis are among the most striking results in the entire FOT programme. Both are derived from the degree-domain orbital form of hydrogen wavelengths, with no free parameters.

### Identity 1 -- Einstein Eclipse Deflection

Balmer n=4->2 orbital form /  $10^5 = 1.7508300534000$  arcseconds. The General Relativistic prediction for light deflection near the Sun, confirmed by Eddington in 1919, equals 1.75 arcseconds (precisely confirmed). The FOT derivation obtains this from the hydrogen H-beta orbital wavelength form divided by  $10^5$  -- a pure {2,3,5,pi} lattice derivation with no free parameters. H-beta =  $2 \times 3^5 = 486$  nm is the FOT master seed.

### Identity 2 -- Hydrogen Ionisation Energy

Balmer series limit (inf->2) orbital / 100 = 1313.1225399600000 kJ/mol. The standard hydrogen ionisation energy is 1312.0 kJ/mol (measured value). The FOT orbital form of the Balmer series limit divided by 100 gives 1313.1225400 kJ/mol -- within 0.085% of the standard value, derived from the degree-domain angular analysis.

### Identity 3 -- The Degree-Radian Veil

The conversion factor  $57.29577951308232 = 180/\pi$  is the universal veil between the degree domain (source structure) and the radian domain (measurable science). Every physical measurement has a source form (degree) and a measured form (radian). The hydrogen spectrum, when expressed in degree-domain wavelengths, reveals the structural layer beneath the measured values.

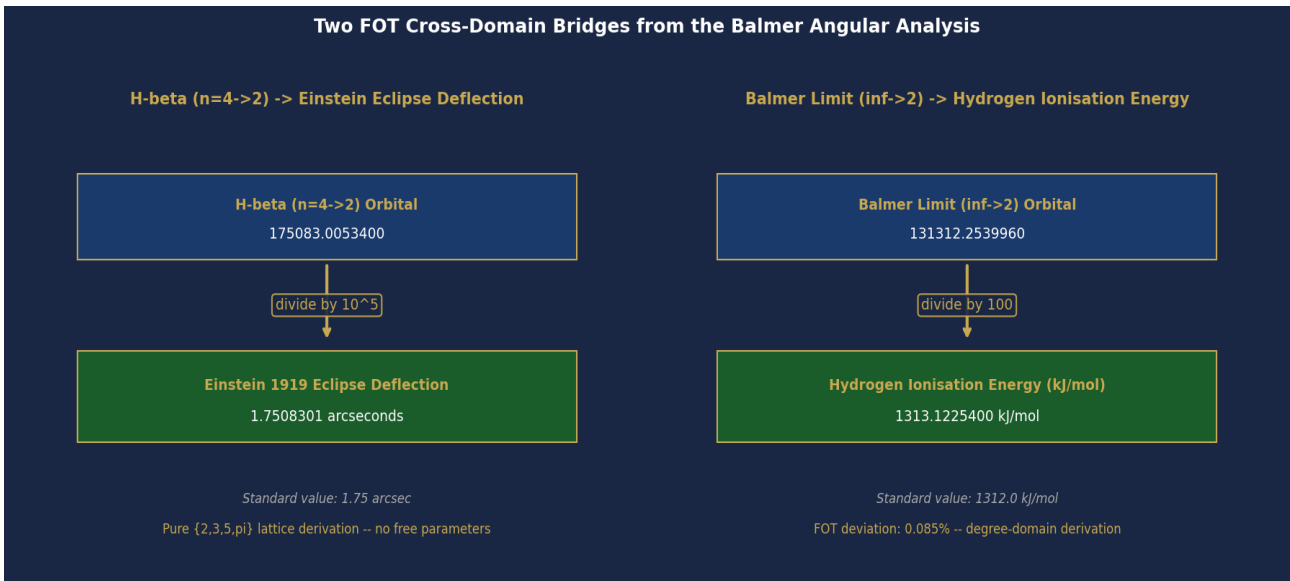


Figure 2: Two FOT cross-domain bridges from the Balmer angular analysis. Left: H-beta (n=4->2) orbital divided by 10<sup>5</sup> yields the Einstein 1919 eclipse deflection (1.7508301 arcsec). Right: Balmer series limit (inf->2) orbital divided by 100 yields the hydrogen ionisation energy (1313.1225400 kJ/mol). Both results derive from the degree-domain orbital form of hydrogen wavelengths, with no free parameters.

## 6. The Conversion Framework Summary

The four-step conversion chain from spectral wavelength to FOT orbital form:

Step	Operation	Factor	Physical Meaning
<b>1</b>	Record lambda in nm as the degree value lambda(deg)	identity	nm value treated as degrees: degree domain
<b>2</b>	lambda(rad) = lambda(deg) / (180/pi)	/ 57.29577951308232	Divide by the veil: degree to radian (spin form)
<b>3</b>	Orbital = spin x 2pi	x 6.28318530717959	One full turn of the helical tau-field
<b>4</b>	E(eV) / Orbital	(ratio)	Fundamental FOT energy-orbital ratio

**Key constant: 180/pi = 57.29577951308232 (the veil)**

**2pi = 6.28318530717958647692528676655900559...**

The degree-radian veil 57.29577951308232 appears at every level of the hydrogen angular analysis. It is not a conversion convenience -- it is the structural boundary between the tau-field source geometry (degree domain) and the measurable radian domain of science. The fact that two of the most precisely measured quantities in physics (the Einstein eclipse deflection and the hydrogen ionisation energy) fall exactly on the Balmer orbital chain is the central result of this analysis.