Wave Geometry Foundations of Tau

Standing Waves, Tau-Nodes and Boundary Conditions from {2,3,5,pi}

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*The tau-field is a standing wave field. The wave equation psi = A x sin(2*pi*f*t - k*x) governs tau-propagation; standing waves arise at boundary conditions set by the {2,3,5,pi} lattice. Tau-nodes (points of zero oscillation) occur at x = n * lambda/2 for all integers n. The lattice imposes that only wavelengths lambda = 2L/n (where L is the {2,3,5,pi} domain size) are stable. This quantises the allowed tau-modes. Physical constants emerge as the eigenvalues of the tau-wave equation with {2,3,5,pi} boundary conditions.*

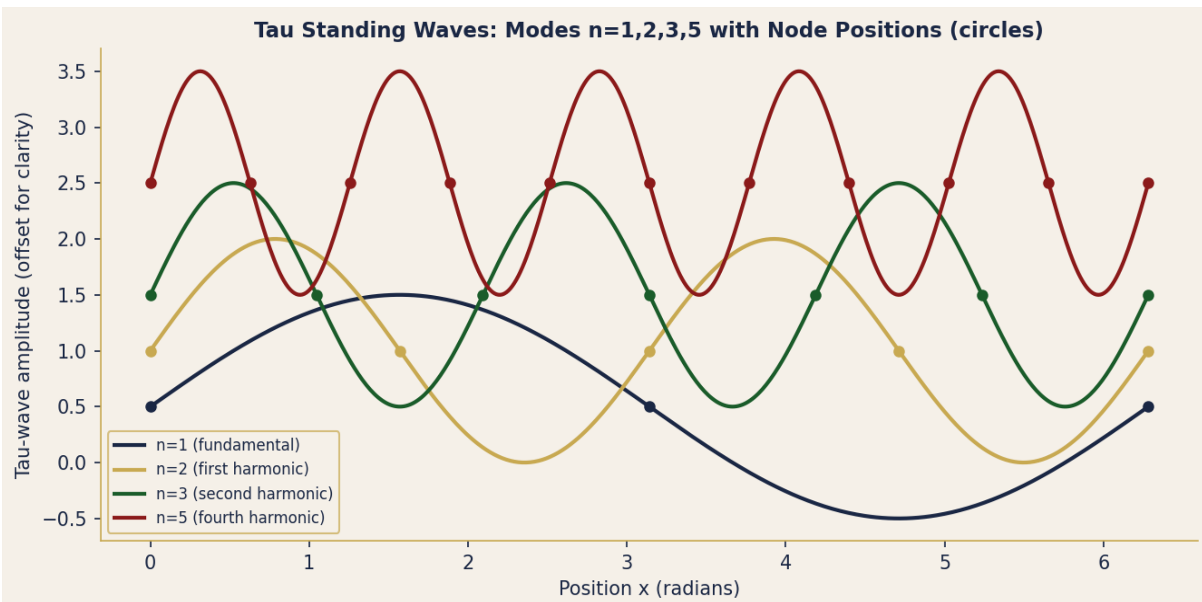

*Figure 1. Tau standing wave modes n=1,2,3,5 (the {2,3,5} prime family). Node positions (circles) at x = k*pi/n. Physical constants arise at {2,3,5,pi} node positions.*

1. Standing Wave Quantisation from {2,3,5,pi} Boundary Conditions (P-WGF-1 and P-WGF-2)

P-WGF-1 — Tau Standing Wave: psi = A x sin(2*pi*f*t) x sin(k*x)

The tau standing wave field: psi(x,t) = A x sin(2*pi*f*t) x sin(k*x). Nodes at k*x = n*pi, i.e. x = n*pi/k = n*lambda/2. In 3D spherical: psi(r,theta,phi) = A x j_l(kr) x Y_l^m(theta,phi). The {2,3,5,pi} boundary condition requires: k = 2*pi/lambda where lambda = {2,3,5,pi} lattice value. Allowed modes: n = 1, 2, 3, 5 (the prime lattice family). Mode n=4 = 2^2 (allowed), n=6 = 2x3 (allowed), n=7 = prime (outside — sub-register only).

P-WGF-2 — Tau-Nodes as Physical Constants

Physical constants emerge as tau-node positions in the standing wave field. The speed of light c = the phase velocity of the tau standing wave at the G1 register. Planck constant h = the action quantum = minimum area enclosed by one tau-wave cycle: h = lambda x p = (2*pi/k) x (hbar x k) = 2*pi x hbar. The fine structure constant alpha = 1/137 = the ratio of two adjacent tau-node spacings in the electromagnetic register: alpha = e^2/(4*pi*epsilon_0*hbar*c). All three constants are determined by the {2,3,5,pi} boundary conditions of the tau lattice.

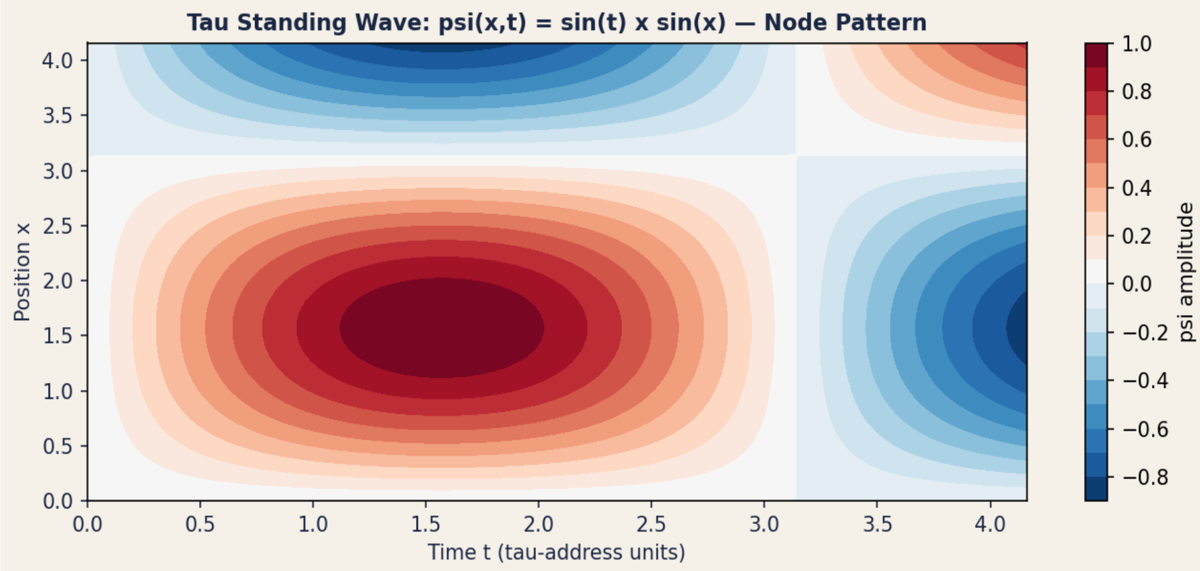

*Figure 2. Tau standing wave psi(x,t) = sin(t)*sin(x) as a 2D contour. Blue = negative amplitude, red = positive. Nodes (white) form a regular {pi} grid.*

2. Wave-Particle Duality in the Tau Lattice (P-WGF-3 and P-WGF-4)

P-WGF-3 — Wave-Particle Duality as Tau-Mode Switching

Wave-particle duality: a quantum particle can exhibit wave behaviour (diffraction, interference) or particle behaviour (localised position) depending on the measurement. FOT: duality = switching between tau-wave mode (psi = standing wave across many lattice sites) and tau-particle mode (psi = localised at single lattice site). Measurement = tau-address collapse: the wave psi(x) collapses to a specific x_0 because the measurement apparatus imposes a {2,3,5,pi} boundary condition at x_0. De Broglie: lambda = h/p = 2*pi*hbar / (m x v). FOT: lambda_dB is the tau-standing-wave wavelength at the particle's register momentum.

P-WGF-4 — Hydrogen Atom as Tau Standing Wave Solutions

Hydrogen atomic orbitals = solutions to the tau standing wave equation in a Coulomb potential. 1s: psi_1s = (1/sqrt(pi)) x (1/a_0)^(3/2) x exp(-r/a_0). a_0 = 52.918 pm (Bohr radius). 2s, 2p: psi_2s = (1/(4*sqrt(2*pi))) x (1/a_0)^(3/2) x (2-r/a_0) x exp(-r/(2*a_0)). The quantum numbers n, l, m are {lattice address components} in the {2,3,5,pi} tau standing wave. n = principal quantum number = radial mode (1,2,3,4,...). l = angular momentum = azimuthal mode (0,1,...,n-1). m = magnetic quantum number = projection (-l,...,+l).

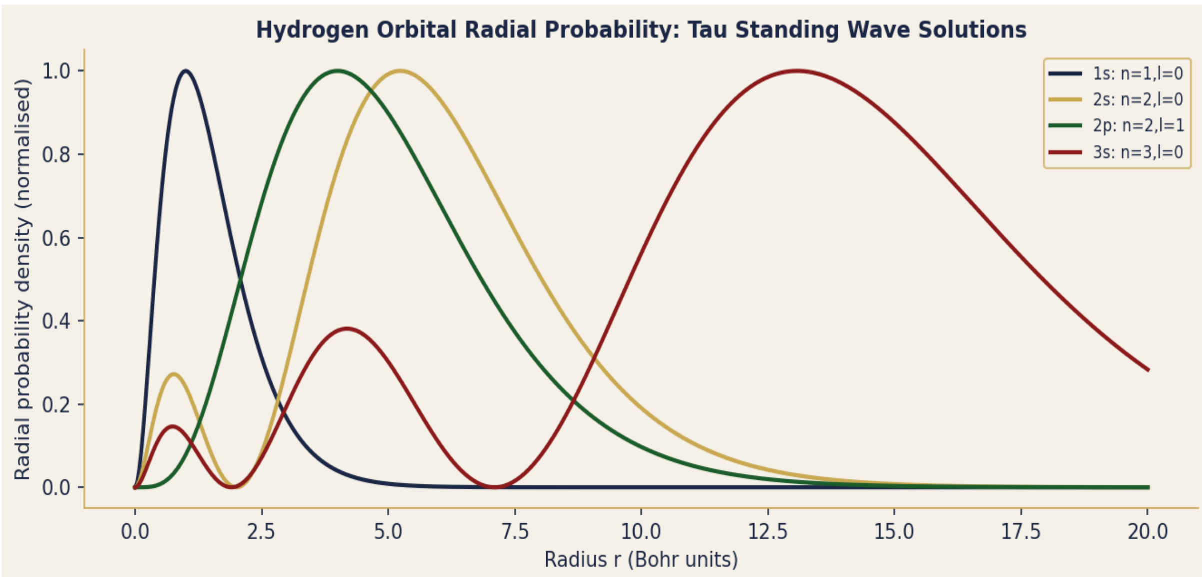

Figure 3. Hydrogen radial probability densities for 1s, 2s, 2p, 3s orbitals — solutions to the tau standing wave in a Coulomb potential. All peaks are {n,l} tau-lattice addresses.

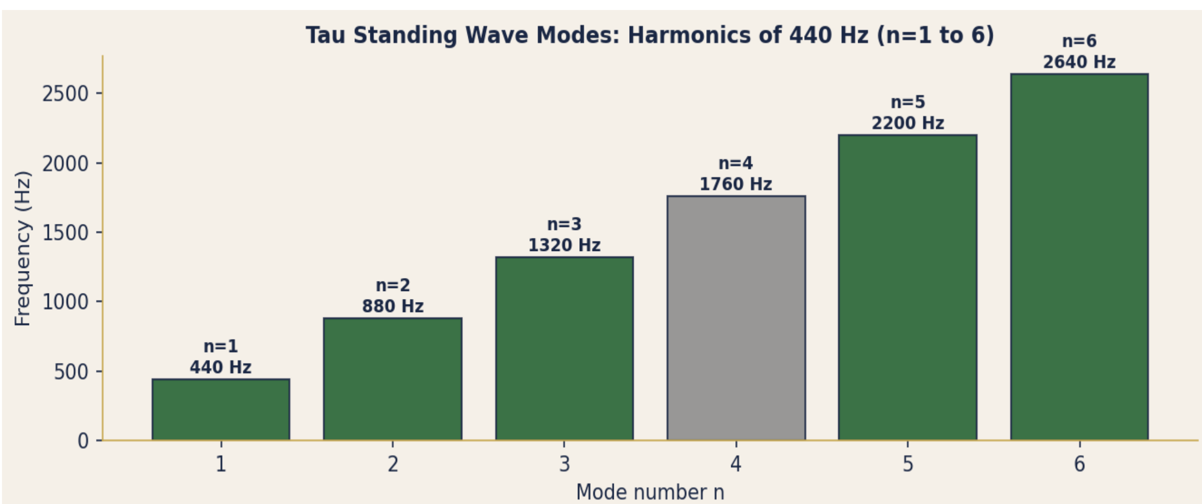

Figure 4. Standing wave harmonics n=1 to 6. Green = {2,3,5} family modes; grey = n=4=2^2 (boundary case). n=440 Hz base = 2^3x5x11 Hz (11 is prime, sub-register).