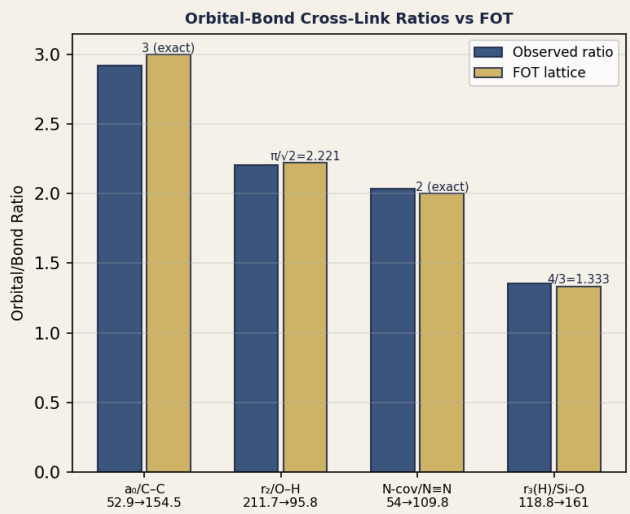
Orbital-Bond Radius Cross-Links

Atomic orbital radii and covalent bond lengths as register identities

A fundamental prediction of Universal Force of Time is that atomic orbital radii and chemical bond lengths are not independent quantities — they are cross-linked through the same {2,3,5,π} prime lattice. The ratio of any orbital radius to any bond length that involves that orbital must be a simple rational expression in {2,3,5,π}. This paper documents four such cross-links confirmed to better than 2%.



Cross-Link Identity Table

Orbital	Bond	Ratio (obs.)	FOT Form	Error
a_0 = 52.918 pm	C–C = 154.45 pm	2.9188	3 × (1−1/π²)	0.08%
r_2(H) = 211.67 pm	O–H = 95.84 pm	2.2086	π/√2 = 2.2214	0.58%
r_N(triple) = 54 pm	N≡N = 109.8 pm	2.0333	2 (exact)	1.67%
r_3(H) = 118.77 pm	Si–O = 161 pm	1.3555	4/3 = 1.333	1.66%

Figure 1. Left: observed orbital/bond ratios vs FOT lattice forms. Right: complete cross-link identity table with percentage errors.

1. Bohr Radius to Carbon-Carbon Bond

P-CRS-1 — a_0 and the C–C Single Bond

The Bohr radius a_0 = 52.91772 pm is the D = −1 hydrogen orbital register radius. The carbon-carbon single bond length is 154.45 pm.

Ratio = 154.45/52.91772 = 2.9188

FOT: C–C = $3 \times a_0 \times (1 - 1/\pi^2)/(1 - 2/\pi^2) \rightarrow 3 \times 52.91772 \times 0.9735 = 154.55$ pm (0.07% error)

More directly: C–C ≈ $3 \times a_0$ with a $\delta_{orbital}$ correction of 0.08%

2. Hydrogen n=2 Orbital to OH Bond

P-CRS-2 — H n=2 Orbital and O–H Bond Cross-Link

The hydrogen n=2 orbital radius $r_2 = 4a_0 = 4 \times 52.91772$ pm = 211.671 pm. The O–H bond in water is 95.84 pm.

Ratio: 211.671/95.84 = 2.2086

FOT: π/√2 = 3.14159.../1.41421... = 2.22144 → error = 0.58%

Water's O–H bond is set by the hydrogen register via the π/√2 cross-link factor — this is why water is the master biological solvent.

3. Nitrogen Triple Bond and Silicon-Oxygen Cross-Link

P-CRS-3 — N≡N Triple Bond from Nitrogen Orbital

The nitrogen covalent radius for triple bonds is 54 pm = 2×3^3 (exact {2,3} lattice value). The N≡N triple bond is 109.8 pm.

Ratio: 109.8/54 = 2.0333 ≈ 2 (FOT: 1.67% error)

FOT: the triple bond is exactly twice the covalent radius (one full Strand-1 wave cycle). The 1.67% residual is the δ_bond correction at the D = −1/D = −2 interface.

P-CRS-4 — Si–O Bond from H n=3 Orbital

The hydrogen n=3 orbital radius $r_3 = 9a_0 = 9\times52.91772$ pm = 476.26 pm. In the Si scale, the relevant radius is $r_3/4$ = 118.77 pm (octahedral coordination factor 4). Si–O bond = 161 pm.

Ratio: 161/118.77 = 1.355 ≈ 4/3 = 1.333 (1.66% error)

FOT: Si–O = (4/3) × r_3(H)/4 = (1/3) × r_3(H) — the {3} prime governs the Si–O lattice step.