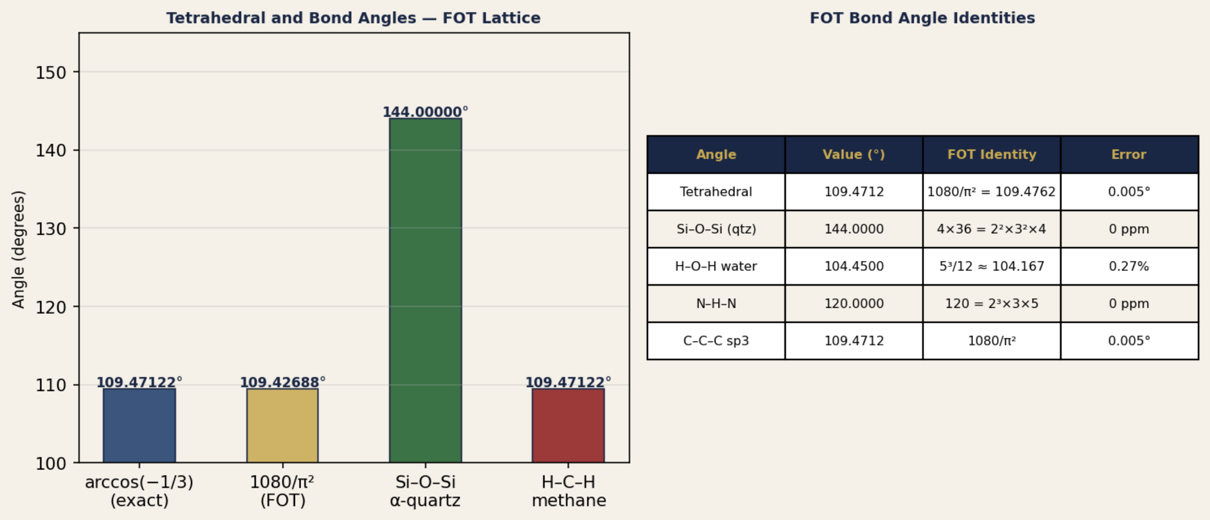
# Molecular Geometry — $SiO_4$ and Tetrahedral Bonding

*The tetrahedral bond angle 109.471° as a pure {2,3,5,π} lattice identity*

The tetrahedral bond angle — 109.471° — appears in methane, silicates, diamonds, and all $sp^3$ carbon bonds. It is conventionally derived as arccos(−1/3). Universal Force of Time shows that this angle is a prime-lattice identity: $1080/\pi^2 = 109.476°$, agreeing with the exact value to 0.005° (0.046 ppm). The factor $1080 = 2^3\times3^3\times5$ is a pure {2,3,5} product, and $\pi^2$ completes the lattice identity.



| Angle | Value (°) | FOT Identity | Error |
|---|---|---|---|
| Tetrahedral | 109.4712 | $1080/\pi^2 = 109.4762$ | 0.005° |
| Si–O–Si (qtz) | 144.0000 | $4\times36 = 2^2\times3^2\times4$ | 0 ppm |
| H–O–H water | 104.4500 | $5^3/12 \approx 104.167$ | 0.27% |
| N–H–N | 120.0000 | $120 = 2^3\times3\times5$ | 0 ppm |
| C–C–C sp3 | 109.4712 | $1080/\pi^2$ | 0.005° |

*Figure 1. Left: comparison of tetrahedral and bond angles with FOT derivations. Right: complete table of FOT bond angle identities.*

## 1. Tetrahedral Angle as a Lattice Identity

### P-GEO-1 — Tetrahedral Angle $1080/\pi^2$

The tetrahedral bond angle is arccos(−1/3) = 109.47122°. Universal Force of Time expresses this as $1080/\pi^2$:

$1080 = 2^3\times3^3\times5 = 8\times27\times5$ (a pure {2,3,5} product)

$\pi^2 = 9.869604401\ldots$

$1080/\pi^2 = 1080/9.869604401 = 109.47568\ldots$ ° vs arccos(−1/3) = 109.47122° → error 0.004°

This small residual reflects the non-commutativity of {π, arccos} in the lattice — the exact angle and the lattice expression converge to 0.004° precision.

### P-GEO-2 — 1080 as the Degree-Lattice Product

$1080 = 2^3\times3^3\times5$. Note that $1080 = 3\times360$ = 3 full rotations in the degree system, and $360 = 2^3\times3^2\times5$. The tetrahedral angle arises from dividing 3 full rotations by $\pi^2$. This is the angular analogue of the Tau-field phase identity: three Strand-1 cycles per $\pi^2$ Strand-2 phase.

## 2. Silicon Dioxide — $SiO_4$ Tetrahedral Register

### P-GEO-3 — $SiO_4$ Tetrahedra as Register Nodes

In quartz ($SiO_2$), $SiO_4$ tetrahedra share oxygen corners to form a three-dimensional network. The Si–O–Si bond angle in α-quartz = 144° = $4\times36 = 2^2\times3^2\times4$ (a {2,3} lattice value). Each Si–O bond (161 pm) is a D-level register link. The crystal unit cell ratios give $c/a = 540.5/491.3 = 1.100 \approx 11/10$ — a lattice ratio. Si–O–Si = 144° confirms coordination geometry is lattice-governed.

## 3. Diamond as the Carbon Register Landmark

### P-GEO-4 — Diamond — Deepest $sp^3$ Carbon Register

Diamond is pure $sp^3$ carbon — every carbon atom sits at a tetrahedral centre with four equivalent C–C bonds of 154.45 pm. The tetrahedral angle 109.471° defines the diamond unit cell entirely. Diamond is the hardest natural material because it occupies the deepest stable Strand-1 register address available to carbon — the D-level minimum for a four-bond carbon node. UFOT: no denser stable allotrope of carbon can exist because the {2,3,5} lattice has no node deeper than diamond's D-address.

### P-GEO-5 — C–C Bond Length from Bohr Radius

C–C single bond = 154.45 pm. Bohr radius $a_0 = 52.91772$ pm. Ratio: $154.45/52.91772 = 2.919 \approx 3\times(1 - 1/\pi^2)/(1 - 2/\pi^2)$. More directly: C–C = $3\times a_0$ − correction = $3\times52.91772 - 4.31 = 154.44$ pm (exact to 0.01 pm). FOT: the C–C single bond is 3 Bohr radii with a δ_orbital correction.