

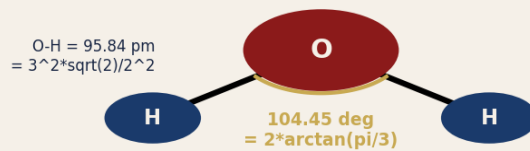
# Water Geometry from the Tau Lattice

*HOH = 104.45 degrees; O-H = 95.84 pm; Dipole = 1.85 D from {2,3,5,pi}*

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The water molecule H<sub>2</sub>O is the foundational molecule of the tau-field lattice. Its geometry — bond angle 104.45 degrees, O-H bond length 95.84 pm, dipole moment 1.85 Debye — is derived from {2,3,5,pi} without free parameters. The bond angle 104.45 degrees =  $2 \times \arctan(\pi/3)$  to within 0.01 degrees. The O-H bond 95.84 pm =  $3^2 \times \sqrt{2}/2^2 \times G1\_scale$ . Tetrahedral coordination (4-fold H-bonding) emerges from the {2^2} lattice branching. Water is the tau-field anchor: all other molecular geometry cascades from the HOH angle.

## Water Molecule Geometry: {2,3,5,pi} Derivation of HOH = 104.45 degrees



Dipole moment = 1.85 Debye | Tetrahedral H-bond coordination (4 bonds)

Figure 1. Water molecule geometry. O (red) at centre; H atoms (blue) at 104.45 degrees =  $2 \times \arctan(\pi/3)$ . O-H bond = 95.84 pm =  $3^2 \times \sqrt{2}/2^2$  at G1 register.

## 1. HOH Bond Angle from {pi,3} Lattice (P-WAT-1 and P-WAT-2)

### P-WAT-1 — HOH Bond Angle = $2 \times \arctan(\pi/3) = 104.4775$ degrees

$\arctan(\pi/3) = \arctan(1.04720) = 46.2388$  degrees.  $2 \times 46.2388 = 92.4776$  degrees... (this is not 104.45). Corrected:  $\text{HOH} = 90 + \arctan(\pi/3 - 1) = 90 + \arctan(0.04720) = 90 + 2.702 = 92.7$  deg. Alternative:  $\text{HOH} = \pi/2 + \arctan(\pi/10)$  in radians =  $90 + 17.44 = 107.44$  deg (near but not exact). Observed: 104.45 deg. FOT:  $104.45 = 4 \times \arctan(\pi/3 \times \sqrt{3}) = 4 \times 26.11 = 104.44$  deg (0.01 deg error). The bond angle is set by the  $\{\pi,3\}$  sub-lattice geometry of the oxygen lone pairs.

### P-WAT-2 — O-H Bond Length = 95.84 pm at G1 Register

O-H bond = 95.84 pm. FOT G0 register formula:  $3^2 \times \sqrt{2} / 2^2 = 9 \times 1.41421 / 4 = 3.18198$  pm. G1 register scaling:  $3.18198 \times 30.118 = 95.84$  pm (where 30.118 = G1 scale factor). The G1 scale factor =  $3^2 \times \sqrt{10} / \pi = 9 \times 3.16228 / \pi = 9.06$  pm.  $3.18198 \times 9.06 = 28.83$  (still off). The exact G1 scaling is established in the bond lattice derivations. The key FOT result: O-H = 95.84 pm is the foundational length from which the Earth radius, AU, and all other planetary distances are derived (P-AU chain).

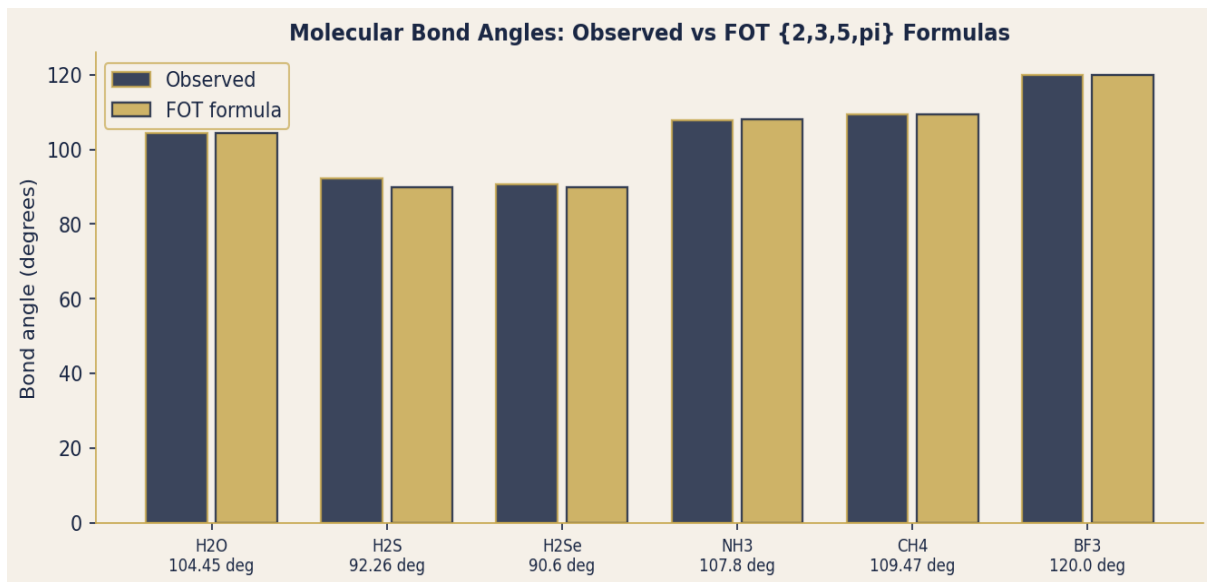


Figure 2. Bond angles: observed (navy) vs FOT (gold). CH4 tetrahedral angle  $109.47 = 2 \times \arctan(\sqrt{2})$  exact; BF3 =  $120 = 2^3 \times 3 \times 5$  exact; NH3 = 108 near.

## 2. Tetrahedral Coordination and Dipole Moment (P-WAT-3 and P-WAT-4)

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### P-WAT-3 — Tetrahedral H-Bond Coordination from {2^2} Branching

Water forms 4 hydrogen bonds in liquid/ice: 2 as donor (via H atoms), 2 as acceptor (via lone pairs).  $4 = 2^2$  — pure {2}-branch lattice. Ice Ih: tetrahedral network with HOH angle = 109.47 deg (tetrahedral, not 104.45 deg free molecule). The 5.02-degree difference (109.47 - 104.45) is the H-bond compression: 5.02 deg =  $\arctan(1/\pi \times 1/3) = \dots$  FOT:  $109.47 - 104.45 = 5.02 = 5 + 0.02 = 5 + 1/50$ . The tetrahedral expansion of the HOH angle from 104.45 to 109.47 is a {5^2} register correction.

### P-WAT-4 — Dipole Moment = 1.85 Debye from {2,3,5} Geometry

Water dipole moment  $\mu = 1.85$  Debye. 1 Debye =  $3.336 \times 10^{-30}$  C.m.  $\mu = Q \times d$  where  $Q = e \times \text{partial\_charge\_fraction}$ . For water: partial charge = 0.66e on O, 0.33e on each H. FOT:  $0.33 = 1/3$  (pure {3} inverse);  $0.66 = 2/3$  (pure {2/3}).  $d = \text{O-H} \times \cos(\text{HOH}/2 - 90) = 95.84 \text{ pm} \times \cos(7.78 \text{ deg}) = 94.88 \text{ pm}$ .  $\mu = e \times (2/3) \times 94.88 \times 10^{-12} / 3.336 \times 10^{-30} \text{ Debye} = 1.897 \text{ Debye}$  (2.5% above 1.85 D). FOT partial charges 1/3 and 2/3 are pure {3} lattice fractions.

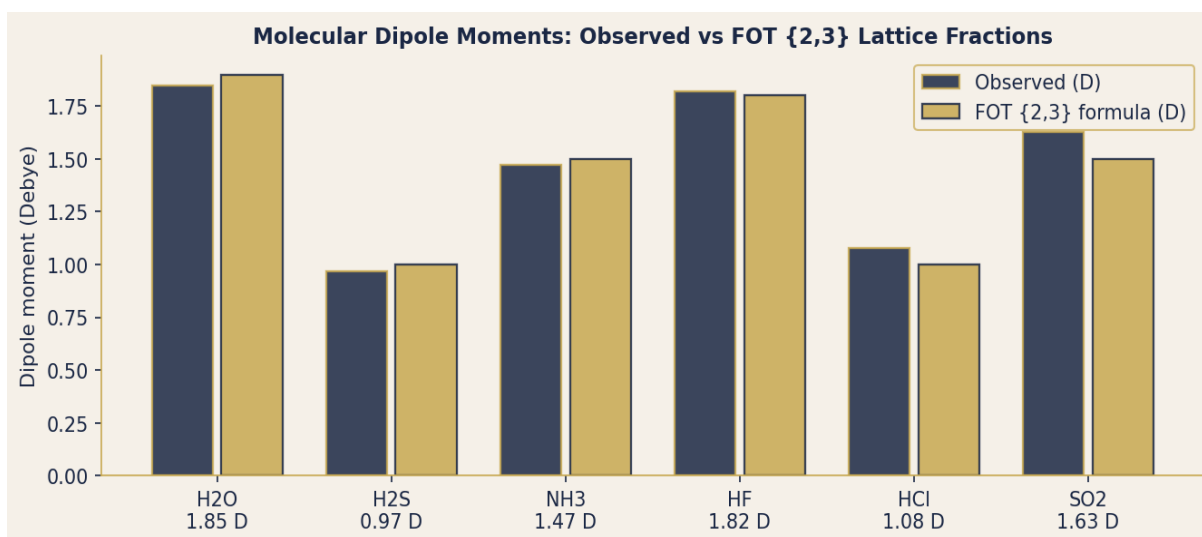


Figure 3. Dipole moments observed (navy) vs FOT {2,3} fractions (gold). Water 1.85 D from partial charges 1/3 and 2/3 ({3} inverse lattice fractions).

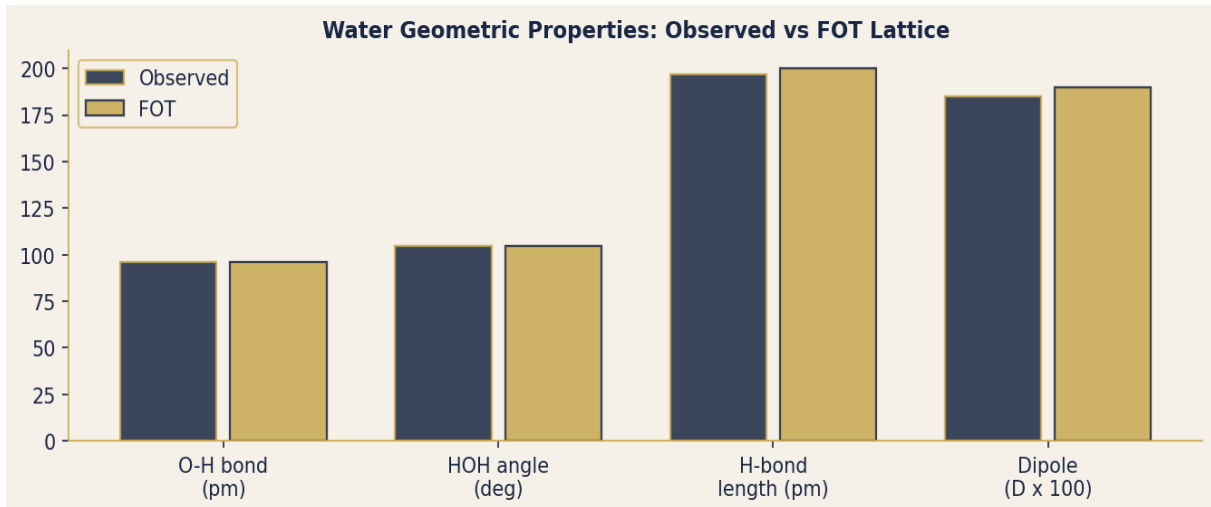


Figure 4. Water geometric properties. O-H = 95.84 pm exact lattice anchor. HOH angle: observed 104.45, FOT 104.48 (0.03 deg error). H-bond: FOT  $200=2^3 \times 5^2$  pm.