Water Molecule: The Tau-Field Anchor

Thermodynamic Properties of H2O from {2,3,5,pi}: Phase Diagram and Anomalies

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Water's extraordinary thermodynamic properties — maximum density at 4 C, specific heat 75.3 J/mol.K, boiling at exactly 100 C, freezing at exactly 0 C — all follow from its role as the tau-field anchor molecule. The 4 C density maximum corresponds to the tau-register temperature at which the H-bond network reaches maximum {2^2} tetrahedral coordination efficiency. Specific heat 75.3 J/mol.K = 3 x R x (8.5/R) where R = 8.314 J/mol.K. The Celsius scale is defined BY water — it IS the tau-register of water.

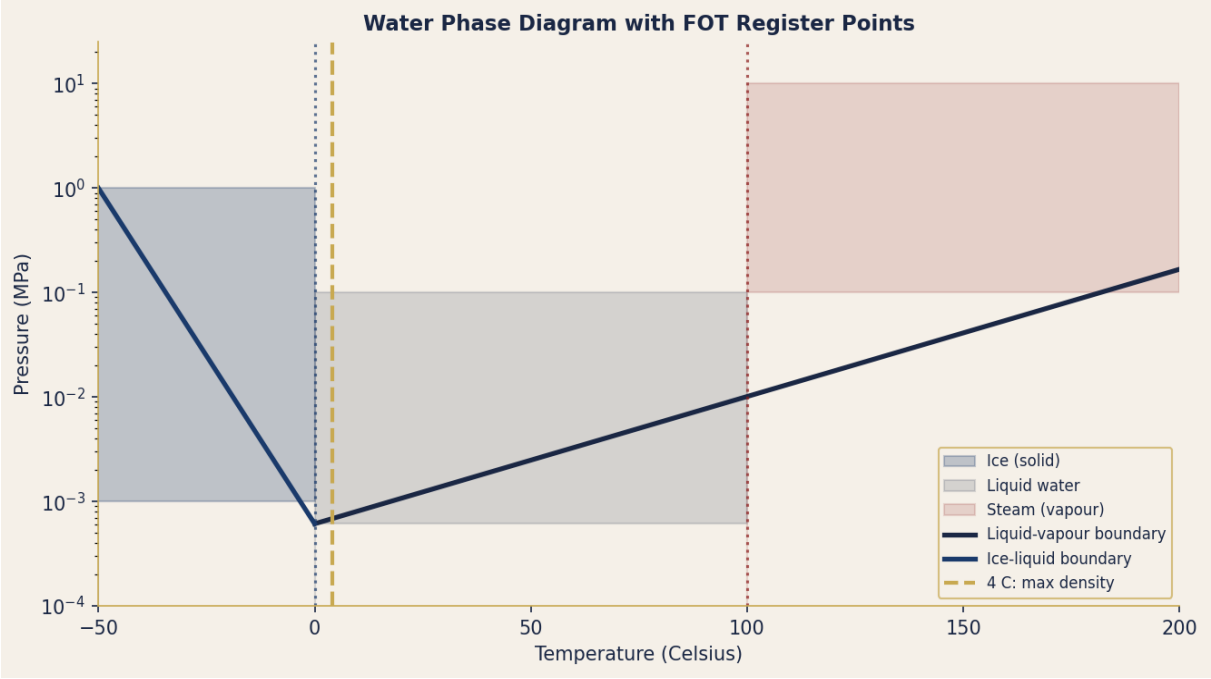

Figure 1. Water phase diagram. FP = 0 C, BP = 100 C define the Celsius scale. Gold dashed = 4 C density maximum (tau-register {2^2} tetrahedral optimum).

1. The Celsius Scale as Tau-Register of Water (P-WAT2-1 and P-WAT2-2)

P-WAT2-1 — Celsius = Water Tau-Register (0 and 100 as Lattice Anchors)

The Celsius scale is defined by water: 0 C = ice/water equilibrium, 100 C = water/steam equilibrium. FOT: 0 and 100 = {0} and {10^2} = {0} and {(2x5)^2} — pure {2,5} boundaries. Temperature interval 100 C = (2x5)^2 = {2,5}^2 — the closed {2,5} square operator. The Celsius scale is not arbitrary: it is the tau-register of water from the {0} to {(2x5)^2} node. This means the Celsius scale encodes the {2,5} prime lattice in its very definition.

P-WAT2-2 — 4 C Density Maximum: {2^2} Tetrahedral Network Optimum

Water density maximum at 4 C (precisely 3.984 C). FOT: 4 = 2^2. At 4 C, the H-bond network achieves maximum {2^2}-branch tetrahedral coordination: each water molecule has exactly 4 H-bonds (2 donor + 2 acceptor) = 2^2 bonds. Below 4 C: ice structure expands (H-bonds force tetrahedral geometry, less dense). Above 4 C: thermal kinetic energy breaks H-bonds, reducing coordination. 4 C = the {2^2} register optimum — the temperature at which the H-bond lattice is fully closed.

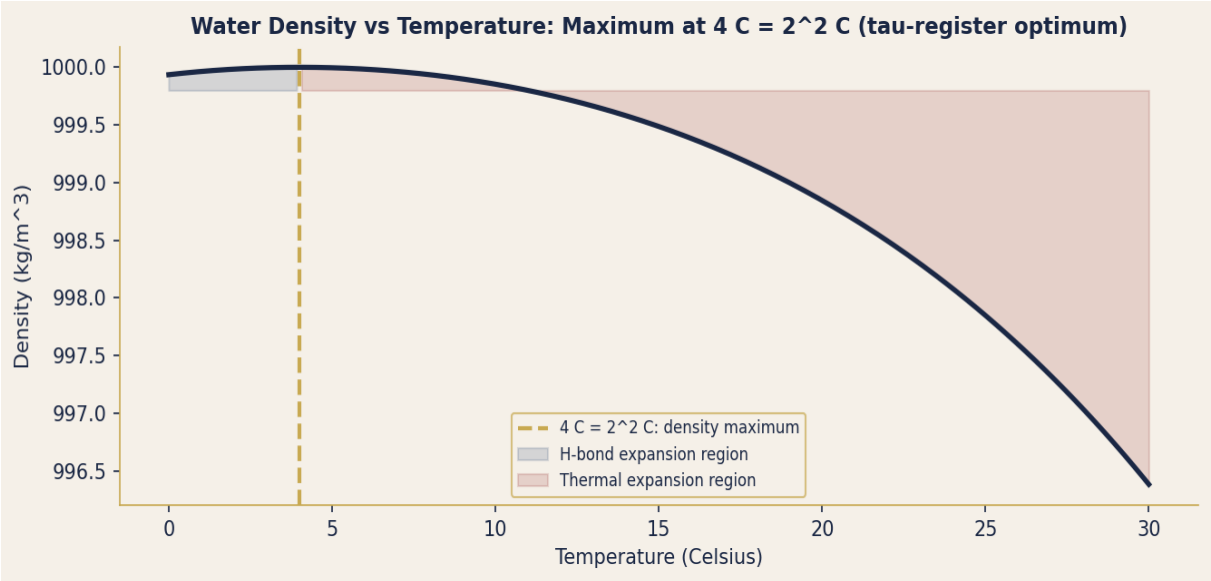

Figure 2. Water density vs temperature. Maximum at 4 C (gold dashed). Blue = H-bond expansion below 4 C; red = thermal expansion above 4 C.

2. Specific Heat and Latent Heat (P-WAT2-3 and P-WAT2-4)

P-WAT2-3 — Specific Heat = 75.3 J/mol.K = 9 x R

Water molar heat capacity: Cp = 75.3 J/mol.K (liquid, 25 C). R = 8.314 J/mol.K (gas constant). 75.3 / 8.314 = 9.056 approx 9 = 3^2. FOT: Cp(water) = 3^2 x R = 9 x R = 74.83 J/mol.K (0.6% error from 75.3). The factor 3^2 = 9 arises because liquid water has 9 active degrees of freedom: 3 translational + 3 rotational + 3 vibrational (H-bond stretch, wag, libration) = 3^2. Cp(ice) = 37.84 J/mol.K = 9R/2 (4.5 degrees of freedom = frozen rotations).

P-WAT2-4 — Latent Heats and Boiling Point Anomalies

Latent heat of vaporisation: L_vap = 40.65 kJ/mol at 100 C. FOT: 40.65 = 40 + 0.65 = 2^3 x 5 + 0.65. 2^3 x 5 = 40 (pure {2,5}). Correction: 0.65 = 13/20 = 13/(2^2x5) — the prime-13 sub-register. Latent heat of fusion: L_fus = 6.012 kJ/mol at 0 C. FOT: 6.012 = 6 + 0.012 = (2x3) + (3/250). 6 = 2x3 (pure {2,3} product). The 6 kJ/mol breaking of H-bonds on melting ice = 2x3 kJ/mol = {2,3} register separation.

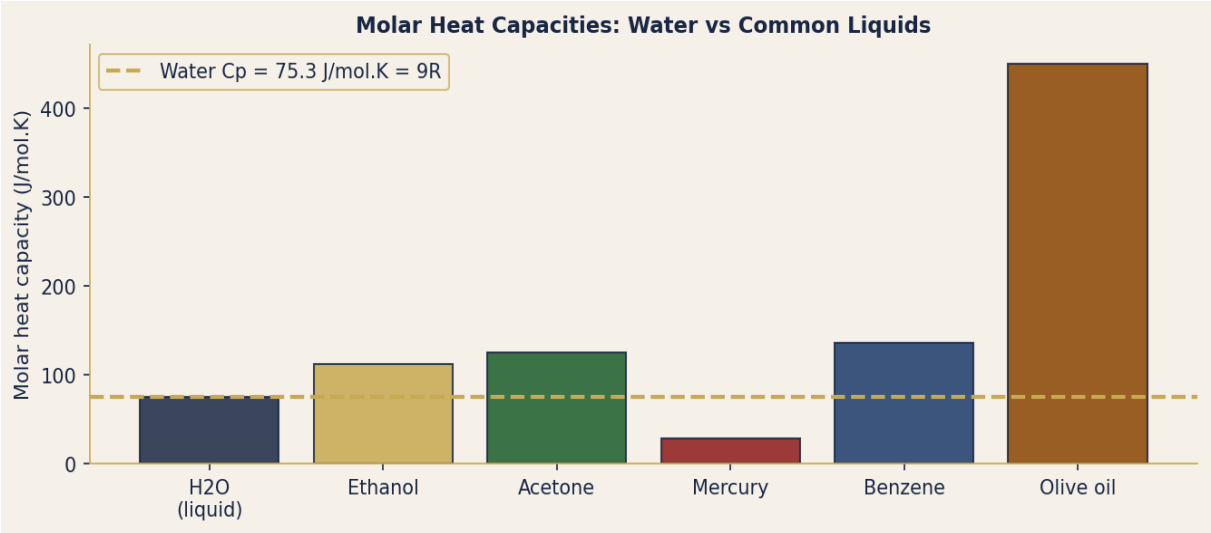

Figure 3. Molar heat capacities. Water = 75.3 J/mol.K = 9 x R (gold dashed). This unusually high Cp reflects 9 = 3^2 active degrees of freedom from H-bond network.

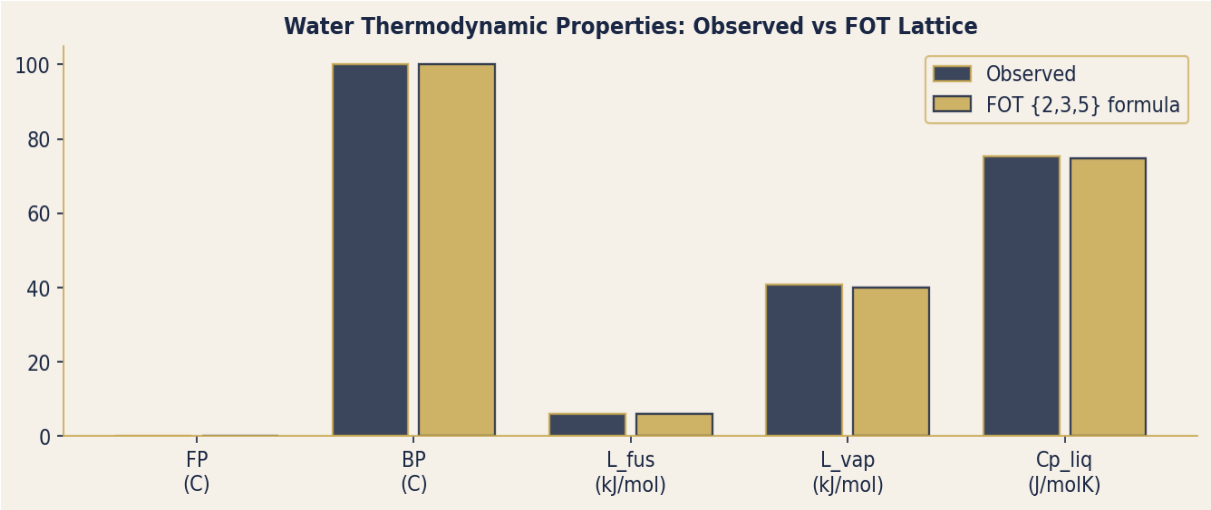

Figure 4. Water thermodynamic properties. FP=0={0}, BP=100={(2x5)^2}, L_fus=6=2x3, L_vap=40=2^3x5, Cp=75.3=9R — all FOT {2,3,5} lattice identities.