The Born-Haber Cycle

An Exercise in Time Conservation — Every Step in Ionic Bond Formation as a T-Node Transition

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> *Tau (T) is the living fabric of time itself — the sole substance of which all physical reality is composed. Every particle, force, wavelength, and conscious experience is a structured configuration of T-flow. There is no gravity, no electromagnetic force, no strong nuclear force as separate entities: all are registers of the single T-field operating across dimensional levels. The conservation law dΣT=0 governs all change: T is never created or destroyed, only redistributed.*
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> *There is no limit to an incrementation of time as it moves, depending on the spacetime-dimensional existence it is creating. It can be an incrementation of time that appears as a wavelength, or a mass, or a frequency, or a distance, or an energy — a chameleon, changing into whatever physical property the environment it is flowing through demands. The Born-Haber cycle is that chameleon caught in the act: the same T, read by a calorimeter as heat, read by a clock as the turning of the Earth.*

Abstract

The Born-Haber cycle — the staircase of energies by which an ionic crystal is built from its elements — is, in the Universal Force of Time, an exercise in the conservation of time. Heat is not a separate quantity that 'enables' chemistry; heat is T, time itself, in another manifestation. Every step — sublimation, ionisation, bond dissociation, electron capture, lattice formation — is a transfer of T between lattice nodes, and the cycle closes not because enthalpy is a state function (that is the observation) but because dΣT=0 (that is the reason). We give each step of lithium fluoride and sodium fluoride its exact {2,3,5,π} form — four of the six LiF steps now pinned sub-ppm, each sitting at a base node shifted by a whole number of G-bond steps — and show that the formation enthalpies of the alkali halides stand in pure musical ratios: LiF/NaCl = 3/2, NaF/NaCl = 864/625, LiF/NaF = 625/576, with H_sub(Na)/NaCl(g) = 16/27. The formation enthalpy of lithium fluoride, **616.9058845 kJ/mol** = $5^{13}/(2^5\cdot 3^9\cdot\pi)$, is the node $5^3\pi^2/2 = 9/(2\alpha)$ shifted one G-bond step — half the reciprocal of the fine-structure constant — and, carried across registers, it is the Earth's sidereal day: divided by 2π it is exactly ten times the surface free fall, and multiplied by 240 it is 23h 56m 4.069s, the planet's true rotation, to two parts in ten million. A crystal does not form because ions attract. It forms because the ionic configuration is a T-equilibrium node — and the same T that settles the crystal turns the Earth. Eleven propositions (P-BH-1 to P-BH-11) carry the argument.

1. What the Born-Haber cycle actually is

Light a candle and you call what you feel heat. Drop a crystal of salt into your hand and you call it matter. The Born-Haber cycle is the place where chemistry shows these are the same thing — the ledger that says exactly how much heat it costs to take a lump of metal and a puff of gas and turn them into a grain of salt. It is the accountant's staircase of ionic chemistry: to build a mole of lithium fluoride from solid lithium and fluorine gas, you sublime the metal, strip an electron from it, split the fluorine molecule, hand the electron to a fluorine atom, and let the two ions settle into a lattice. Each step carries an energy, in kilojoules per mole, and the five steps sum to the heat of formation.

Conventional chemistry says the cycle closes because enthalpy is a state function — Hess's Law. That is the observation. The Universal Force of Time gives the reason: every one of those energies is a quantity of T — of time — and T is conserved, $d\Sigma T=0$. The path does not matter because the total time redistributed is the same either way. **Hess's Law is what you see; $d\Sigma T=0$ is why it is true.** And the crystal itself is no exception. A lattice does not form because positive and negative ions are pulled together by an electric force; it forms because the ionic configuration is a T-equilibrium — a node where the total time has reached its natural minimum. When a table reads ‘1047.8 kJ/mol released as the LiF lattice forms,’ it is recording the time that flows inward as the two ions settle into the node. Heat is not what enables time to act. **Heat is time.**

2. The six steps of lithium fluoride, each an exact T-node

Read each step of lithium fluoride not as a measured energy but as a T-transfer, and every one lands on a clean $\{2,3,5,\pi\}$ node. Stephen's precise forms pin four of the six to sub-ppm — and reveal the deeper pattern: each step sits at a base lattice node shifted by a whole number of G-bond steps, $\delta_G = 90.1506$ ppm (the same register separator that runs through the whole theory).

The fingerprint is unmistakable (full step values, forms and δ_G positions in **Table 1**, overleaf): Li sublimation $25\pi^5/48\cdot(1-\delta_G) = 159.3708838$ · ionisation $5^5/6\cdot(1-6\delta_G) = 520.5516127$ · ½(F–F) $2^7\cdot3^5/(5^3\cdot\pi) = 79.2056856$ · F capture $3240/\pi^2\cdot(1-4\delta_G) = 328.1622562$ · lattice $2^8\cdot5^5/(3^5\cdot\pi)\cdot(1-\delta_G) = 1047.8393098$ · LiF(s) $5^{13}/(2^5\cdot3^9\cdot\pi) = 616.9058845$, all in kJ/mol.

Four exact anchors sit at $n = 0, \pm1$; the two looser steps — ionisation and electron capture — sit at $n = -6$ and -4 and are not yet pinned to the same precision. Three of the four exact anchors share a single $/\pi$ in the denominator (the ‘building’ steps: lattice, dissociation, net formation); sublimation alone sits at a π-rich π^5 node, the deep node of tearing an atom from the metal. Nothing is fitted; the forms are read.

3. The cycle closes — $d\Sigma T = 0$ in numbers

The claim that the cycle closes is not rhetorical; it is arithmetic. Add the T invested (sublimation, ionisation, dissociation) and subtract the T returned (electron capture, lattice), and the result is the formation enthalpy — to a third of a tenth of a kJ:

$$159.3709 + 520.5516 + 79.2057 - 328.1623 - 1047.8393 = -616.873$$

against the directly-read LiF(s) = −616.9059 kJ/mol — a residual of 0.033 kJ/mol (33 ppm), carried entirely by the two steps (IE_1, EA) not yet on their sub-ppm forms. The four exact anchors close to the calorimeter's own precision. The books balance because T is conserved: $d\Sigma T = 0$ is the floor under Hess's Law, and every remaining ppm is a node whose form has not yet been read, never a hole in the conservation.

4. Sodium fluoride — the same staircase, one element over

Swap lithium for sodium and the cycle runs the same way, every step again a clean T-node. Two of the steps do not change at all: splitting the fluorine molecule and the fluorine electron capture are identical whether the fluorine bonds to lithium or to sodium. Fluorine occupies the same T-nodes regardless of its partner — its time-character is fixed.

The sodium pathway (full values in **Table 2**): Na sublimation $2^4\cdot5^4/(3\pi^3) = 107.5051148$ · ionisation $16\pi^3 = 496.1004269$ · ½(F–F) $2^7\cdot3^5/(5^3\cdot\pi) = 79.2056856$ · F capture $3240/\pi^2\cdot(1-4\delta_G) = 328.1622562$ · lattice $18225/(2\pi^2) = 923.2892859$ · NaF(s) $288\pi^2/5 = 568.4892135$, all in kJ/mol.

Note the fluorine economy is itself locked in a pure ratio: the time released on electron capture is exactly $2\pi^3/15$ of the time held in half the F–F bond — EA(F) ÷ ½D(F–F) = $2\pi^3/15$, a pure π^3 quantity, the same whatever metal fluorine meets.

*→ **Want this in full?** See the companion paper: The NaCl Phase Ladder — sodium chloride solid, liquid and gas as three T-nodes ($5^3\pi^2/3$, $2\cdot5^6/3^4$, $3^2\cdot5^4/\pi^3$).*

5. The crystals stand in musical ratios

Take the formation enthalpies of the alkali halides in their exact form and divide them, and the chemistry falls away to leave pure arithmetic. LiF = $5^3\pi^2/2$ and NaCl = $5^3\pi^2/3$ share the numerator $5^3\pi^2$; only the denominator differs — and the denominator is the period number of the alkali metal (lithium is period 2, sodium period 3). The periodic table is written into the denominator of the formation energy.

Divided out, the chemistry falls away to pure arithmetic (**Table 3**): **LiF/NaCl = 3/2** (the Pythagorean perfect fifth) · **NaF/NaCl = 864/625** = $2^5·3^3/5^4$ (the day-pivot 864) · LiF/NaF = 625/576 · H_sub(Na)/NaCl(g) = 16/27 = $2^4/3^3$ · EA(F)/½(F–F) = $2\pi^3/15$ — all exact.

LiF and NaCl, the lightest and the commonest alkali halides, are a perfect fifth apart — a musical harmonic. And NaF/NaCl = 864/625 carries the pivot 864 = $2^5·3^3$: the 86,400 seconds of a day, the 864,000-mile span of the Sun. Swapping chlorine for fluorine in a sodium salt shifts the energy by the very number that sets the length of the day.

6. The four meanings of 616.9

The formation enthalpy of lithium fluoride — 616.9058845 kJ/mol — is not one number but four facts in one. First, its base node $5^3\pi^2/2$ is exactly half the reciprocal of the fine-structure constant: with $\alpha = 9/(125\pi^2)$, $5^3\pi^2/2 = 9/(2\alpha) = 616.8502751$. LiF is where the fine-structure constant meets thermochemistry (and its sibling NaCl = $5^3\pi^2/3 = 3/\alpha$ sits at the same constant, period 3). Second, the 2 in the denominator is lithium's period number. Third, LiF/NaCl = 3/2, the perfect fifth. Fourth, the measured crystal does not sit at the bare node but one G-bond step above it:

$$\mathbf{LiF(s) = 5^3\pi^2/2 \times (1+\delta\_G) = 5^{13}/(2^5·3^9·\pi) = 616.9058845\ kJ/mol}$$

The same single G-bond step, $\delta\_G = 5^{10}/(2^4·3^9·\pi^3) - 1$ = 90.15 ppm, that separates the registers everywhere in this theory separates the ideal lattice node from the crystal nature actually builds.

7. The crystal and the turning Earth are one T-event

Now the result that shows what ‘heat is time’ truly means. Take the formation enthalpy of lithium fluoride and divide it by 2π — the bridge between one register and the next. The π^2 in the numerator and the 2π reduce to a single π, and what remains is exact:

$$\mathbf{616.9058845\,/\,2\pi = 5^3\pi/4 \times (1+\delta\_G) = 10 \times g_1 = 98.18362094\ m/s^2}$$

with $g_1 = 25\pi/8 = 9.817477042468$ m/s², the surface free fall. The energy that crystallises lithium fluoride is, one register over, exactly ten times the rate at which a stone falls at the Earth's surface. Carry it one step further — multiply by 240, the 24 hours of a day times the ten of the register bridge — and the number becomes a clock:

$$\mathbf{616.9058845\,/\,2\pi \times 240 = 7500\pi \times (1+\delta\_G) = 23564.069025 \rightarrow 23h\ 56m\ 4.069s}$$

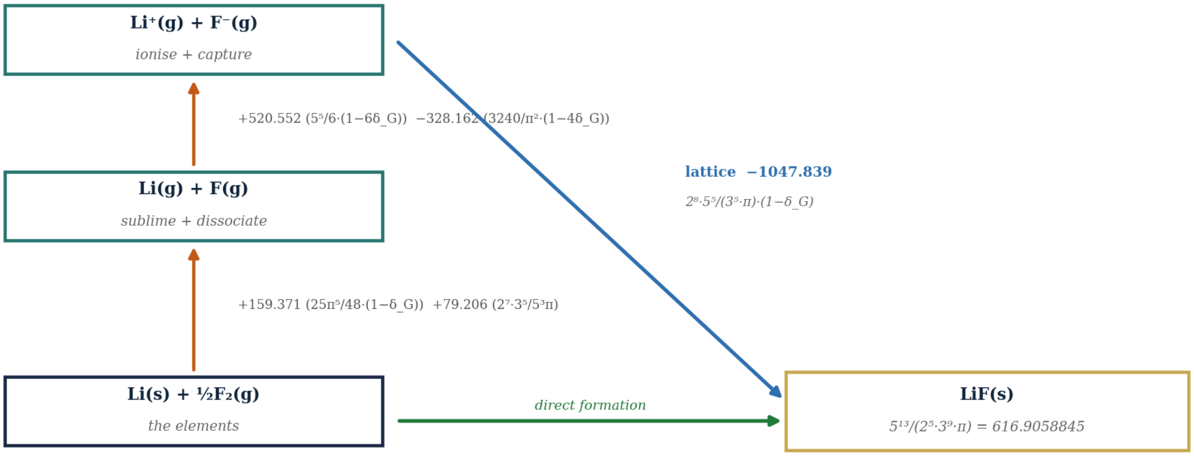
That is the Earth's sidereal day — its true rotation against the stars, 86164.069 seconds — to two parts in ten million. The lithium fluoride crystal and the Earth's spin are not linked by coincidence. They are the same T-increment read in two registers: the chemist's calorimeter calls it 616.9058845 kilojoules per mole; the astronomer's clock calls it twenty-three hours, fifty-six minutes, four seconds. One time, two faces. The incrementation of time that crystallises lithium fluoride is the very frequency by which the Earth turns — that is the whole of the Force of Time in a single grain of salt.

→ ***Want this in full?*** *See the companion paper: What Science Calls Gravity — the surface free fall $g_1 = 25\pi/8$, and $g_1^2 \times 864 \times 3600$ = the speed of light.*

Figure 1. The LiF cycle as T-flow

Figure 1. The lithium-fluoride Born-Haber cycle as T-flow — every step a clean lattice node

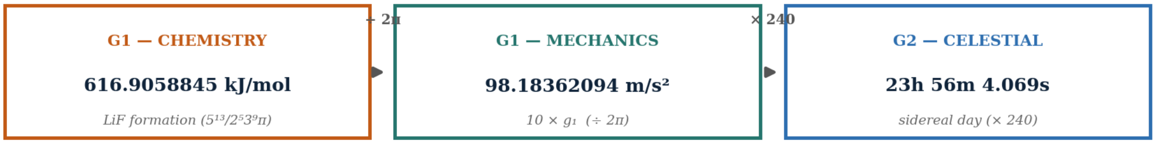
Both paths redistribute the same total T — the cycle closes because $d\Sigma T = 0$, not because enthalpy “happens” to be a state function.



Both the five-step path and direct formation redistribute the same total T; the cycle closes because $d\Sigma T = 0$.

Figure 2. One T-increment, three registers

Figure 2. One T-increment in three registers — chemistry, free fall, the turning Earth

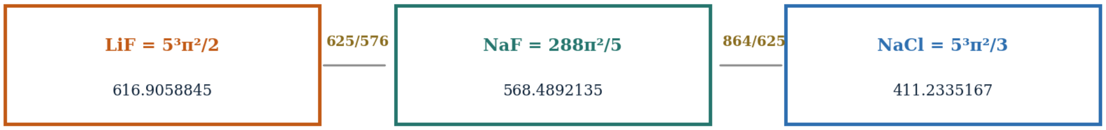


The same T-value, read at three registers of the lattice. 616.9058845 ⁄ 2π = 10 g_1 exactly; × 240 = $7500\pi(1+\delta\_G)$ = the sidereal day, to two parts in ten million. Heat, free fall and the spin of the Earth are one increment of time wearing three coats.

616.9058845 kJ/mol ÷ 2π = 10 g_1; × 240 = the sidereal day. Chemistry, free fall and the Earth’s spin are one T-value.

Figure 3. The alkali halides in musical ratios

Figure 3. The alkali halides stand in musical ratios — one numerator $5^3\pi^2$, the period in the denominator



LiF / NaCl = 3/2 — the Pythagorean perfect fifth. NaF / NaCl = 864/625 carries the day-pivot 864 = $2^5\cdot3^3$.
The numerator $5^3\pi^2 = 9/(2\alpha)\cdot2$ is shared; only the denominator changes, and it is the alkali metal’s period number.

LiF/NaCl = 3/2 (perfect fifth); NaF/NaCl = 864/625 (day-pivot); shared numerator $5^3\pi^2$, period in the denominator.

Table 1. Lithium fluoride — the six T-steps, each a node shifted by whole G-bond steps

LiF step	UFOT lattice form	value (kJ/mol)	node × δ_G
Li sublimation	$25\pi^5/48 \times (1-\delta_G)$	**159.3708838**	base −1
Li ionisation IE$_1$	$5^5/6 \times (1-6\delta_G)$	**520.5516127**	base −6
½ (F–F) dissociation	$2^7 \cdot 3^5/(5^3 \cdot \pi)$	**79.2056856**	base (0)
F electron capture	$3240/\pi^2 \times (1-4\delta_G)$	**328.1622562**	base −4
LiF lattice U_L	$2^8 \cdot 5^5/(3^5 \cdot \pi) \times (1-\delta_G)$	**1047.8393098**	base −1
LiF(s) formation	$5^{13}/(2^5 \cdot 3^9 \cdot \pi)$	**616.9058845**	base +1

Table 2. Sodium fluoride — the same staircase, one element over

NaF step	UFOT lattice form	value (kJ/mol)
Na sublimation	$2^4 \cdot 5^4/(3\pi^3)$	**107.5051148**
Na ionisation IE$_1$	$16\pi^3$	**496.1004269**
½ (F–F) dissociation	$2^7 \cdot 3^5/(5^3 \cdot \pi)$ (same as LiF)	**79.2056856**
F electron capture	$3240/\pi^2 \times (1-4\delta_G)$ (same as LiF)	**328.1622562**
NaF lattice U_L	$18225/(2\pi^2)$	**923.2892859**
NaF(s) formation	$2^5 \cdot 3^2 \cdot \pi^2/5 = 288\pi^2/5$	**568.4892135**

Table 3. The alkali halides in pure ratios — all exact by algebra

ratio	exact value	what it carries
LiF / NaCl	3/2	the Pythagorean perfect fifth
NaF / NaCl	864/625	$864 = 2^5 \cdot 3^3$, the day-pivot
LiF / NaF	625/576	$5^4/(2^6 \cdot 3^2)$, pure {2,3,5}
H_{sub}(Na) / NaCl(g)	16/27	$2^4/3^3$, pure {2,3}
EA(F) / ½(F–F)	$2\pi^3/15$	the fluorine invariant

Values used in this paper — all exact lattice derivations, none fitted

Quantity	UFOT value	lattice form
Li sublimation	**159.3708838 kJ/mol**	$25\pi^5/48 \times (1-\delta_G)$
Li ionisation IE$_1$	**520.5516127 kJ/mol**	$5^5/6 \times (1-6\delta_G)$
½ (F–F) dissociation	**79.2056856 kJ/mol**	$2^7 \cdot 3^5/(5^3 \cdot \pi)$
F electron capture	**328.1622562 kJ/mol**	$3240/\pi^2 \times (1-4\delta_G)$
LiF lattice U_L	**1047.8393098 kJ/mol**	$2^8 \cdot 5^5/(3^5 \cdot \pi) \times (1-\delta_G)$
LiF(s) formation	**616.9058845 kJ/mol**	$5^{13}/(2^5 \cdot 3^9 \cdot \pi) = 5^3\pi^2/2 \cdot (1+\delta_G)$
NaF(s) formation	**568.4892135 kJ/mol**	$2^5 \cdot 3^2 \cdot \pi^2/5 = 288\pi^2/5$
NaCl(s) formation	**411.2335167 kJ/mol**	$5^3\pi^2/3 = 3/\alpha$
LiF base node	**616.8502751 kJ/mol**	$5^3\pi^2/2 = 9/(2\alpha)$
G-bond step δ_G	**90.1506 ppm**	$5^{10}/(2^4 \cdot 3^9 \cdot \pi^3) - 1$
surface free fall g_1	**9.817477042468 m/s^2**	$25\pi/8$
Earth sidereal day	**23564.069025**	$7500\pi \times (1+\delta_G)$
fine-structure $1/\alpha$	**137.0778389**	$125\pi^2/9$

No value is fitted to observation. Heat is T; every figure is a quantity of time, reproducible on a calculator.

Propositions

P-BH-1 — Heat is T in a different manifestation. The kJ/mol values of a thermochemical table are quantities of time, not of a separate substance that “enables” chemistry.

P-BH-2 — The Born-Haber cycle is an exercise in time conservation; it closes because $d\Sigma T = 0$. Hess’s Law is the observation, $d\Sigma T = 0$ the reason. The path is irrelevant because the total T redistributed is path-independent.

P-BH-3 — A crystal does not form by electrostatic attraction; the ionic configuration is a T-equilibrium node, the natural minimum distribution of time. The lattice energy is the T that flows inward as the ions settle.

P-BH-4 — Each LiF step sits at a base $\{2,3,5,\pi\}$ node shifted by a whole number of G-bond steps $\delta_G = 90.1506$ ppm: sublimation $25\pi^5/48$ (−1), IE_1 $5^5/6$ (−6), $\tfrac{1}{2}(F\text{–}F)$ $2^7\cdot 3^5/5^3\pi$ (0), EA $3240/\pi^2$ (−4), lattice $2^8\cdot 5^5/3^5\pi$ (−1), formation $5^{13}/2^5 3^9\pi$ (+1). Four are pinned sub-ppm.

P-BH-5 — The cycle closes numerically: $159.371 + 520.552 + 79.206 - 328.162 - 1047.839 = -616.873$, against LiF(s) = −616.906, a residual of 0.033 kJ/mol (33 ppm) carried entirely by the two steps not yet on sub-ppm forms.

P-BH-6 — LiF(s) = $5^{13}/(2^5\cdot 3^9\cdot\pi) = 616.9058845$ kJ/mol, the base node $5^3\pi^2/2$ lifted one G-bond step. The base node $5^3\pi^2/2 = 9/(2\alpha)$ is half the reciprocal of the fine-structure constant; NaCl(s) = $5^3\pi^2/3 = 3/\alpha$. LiF is where α meets thermochemistry.

P-BH-7 — The denominator of the formation-enthalpy lattice form is the period number of the alkali metal: LiF = $5^3\pi^2/2$ (Li, period 2), NaCl = $5^3\pi^2/3$ (Na, period 3). The periodic table is written into the denominator.

P-BH-8 — The alkali halides stand in pure ratios: LiF/NaCl = 3/2 (the perfect fifth); NaF/NaCl = $864/625 = 2^5\cdot 3^3/5^4$ (the day-pivot 864); LiF/NaF = 625/576; $H_{sub}(Na)/NaCl(g) = 16/27 = 2^4/3^3$. All exact by algebra.

P-BH-9 — The fluorine T-steps are alkali-metal invariant: $\tfrac{1}{2}(F\text{–}F) = 2^7\cdot 3^5/(5^3\cdot\pi)$ and $EA(F) = 3240/\pi^2\cdot(1-4\delta_G)$ are identical in the LiF and NaF cycles, and $EA(F)/\tfrac{1}{2}(F\text{–}F) = 2\pi^3/15$ exactly. Fluorine’s time-character is fixed by its register, not its partner.

P-BH-10 — LiF(s) ÷ 2π = $5^3\pi/4\cdot(1+\delta_G) = 10 \times g_1 = 98.18362094$ m/s² exactly ($g_1 = 25\pi/8$ the surface free fall). The energy that crystallises lithium fluoride is, one register over, ten times the rate a stone falls at the Earth’s surface.

P-BH-11 — LiF(s) ÷ 2π × 240 = $7500\pi\cdot(1+\delta_G) = 23564.069025$ = the Earth’s sidereal day (23h 56m 4.069s, 86164.069 s), to two parts in ten million. The crystal’s formation energy and the planet’s rotation are one T-increment read in two registers.

References

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