Equation of the Universe

Atomic Bonding

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Equation of the Universe — Core Theory (Rev 3.44 or later)

§0 — Introduction

0.1 Definition

Bonding is the stable equilibrium established when two atomic structures enter a shared geometric and phase-compatible configuration. Within the EOTU framework, a bond is not an abstract force acting at a distance and it is not a probabilistic overlap of undefined orbitals. It is a resolved structural state in which the participating nuclei and electron shells settle into an admissible separation that minimizes the full proton–electron and electron–electron constraint of the combined system.

0.2 Conditions Required

An isolated atom is already a closed equilibrium between its nucleus and its participating electron regions. When a second atom approaches, that equilibrium is not preserved unchanged. The two atomic structures interact as a coupled system, and the bond length is the center-to-center separation at which the combined configuration reaches a new stable closure. Bonding therefore represents a geometric re-closure of two atomic systems into a single admissible equilibrium rather than the attachment of one atom onto another.

For the light elements, bonding follows shell structure directly. Shell 1 governs the simplest diatomic cases, while shell 2 governs the principal bonding behavior from lithium through neon. The characteristic bond lengths in this range arise from the resolved shell radii together with the two wavelength levers that control atomic interaction: the proton–electron wavelength term and the electron–electron wavelength term. The first supplies the linear loading contribution of the nuclei on the shared electron structure, while the second supplies the geometric constraint imposed by electron separation within the combined bond.

Bond length is therefore not assigned independently for each molecule. It is generated from a fixed structural grammar. The shell radius sets the available bonding scale, the proton loading shifts the equilibrium inward, and the valid electron interaction count shifts the equilibrium outward. The observed diatomic separation is the balance point of these opposing structural contributions. In this form, bonding length becomes a derived atomic consequence of shell geometry rather than an isolated chemical parameter.

The light-element sequence already shows this structure clearly. Hydrogen establishes the shell-1 equilibrium. Lithium establishes the shell-2 anchor as the first element whose bonding is governed by the second shell. Nitrogen marks the strongest shell-2 compaction point, not as a special exception, but as the equilibrium point where the combined loading and electron constraint reach their maximum balance. From that point, the rest of the diatomic sequence is a direct consequence of the same structural rule.

Bonding therefore has a single meaning within the framework: it is the stable shared closure of two atomic structures at an allowed separation. The task of the bonding section is to derive that separation from shell radius, proton participation, and electron constraint so that each bond length follows from the same first-principal construction.

§1 – Foundational Definitions

- Coherent Phase Packet (CPP): Fundamental oscillating unit of the EOTU lattice.
- θ is the intra-cycle phase parameter of the King recurrence (not recorded in Constellus).
- Phase Tag (Φ_{cpp}): Fixed phase offset defined at freeze-out; one of {0, π/2, π, 3π/2}.
- Z is the **fabric property impedance** = 376.730313412 Ω
- Constellus Snapshot Ledger: Record of local CPP state changes at end of each King cycle.
- CMB spectral-distortion limits: $|\varepsilon-1| \leq 1.7\times10^{-5}$ (μ/y era) for the Zero-Phase baseline
- Fine-structure constant stability: $\Delta\alpha/\alpha$ constrained to $\lesssim 10^{-5}$ on cosmological baselines.
- Baryonic / Dark-Matter Ratio $\sigma = \sin(0.42\pi) \approx 0.968583$
- $\lambda_k = 2.809321648 \times 10^{-20}$ m (first principle derivation)

1.1 Conversion factors

- $1\ L_0 = 0.001797965855$ fm
- 1 fm $= 556.1837316\ L_0$
- 1 Å $= 100{,}000$ fm $= 55{,}618{,}373.16\ L_0$

1.2 Editorial note on spreadsheet

1.3 Key Derived Factors

These values were derived from ionization energy and first principal values in a separate document

- Shell 1 (radius) = $S_1 = 29{,}447{,}706\ L_0$ (derived)
- Shell 2 (radius) = $S_2 = 105{,}124{,}156\ L_0$ (derived)
- Shell 3 (radius) = $S_3 = 121{,}091{,}309\ L_0$ (derived)
- Shell 4 (radius) = $S_4 = 153{,}576{,}343\ L_0$ (derived)your r
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- Proton-Electron lambda = $\lambda_{pe} = \lambda_p * \lambda_e = 1836 * 816 * 1{,}498{,}176\ L_0$ (derived)
- Electron-Electron lambda= $\lambda_{ee} = \lambda_e * \lambda_e = 816 * 816 = 665{,}856\ L_0$ (derived)
- Proton-Proton lambda= $\lambda_{pp} = \lambda_p * \lambda_p = 1836 * 1836 = 3{,}370{,}896\ L_0$ (derived)

§2 – Diatomic Bonding Rules

Nitrogen is not the center — it is the **maximum entropy equilibrium point**

$$d = r_{atom} + \sum(p\text{-}e) + \sum(e\text{-}e \text{ valid pairs})$$

Where:

- p–e = linear term
- e–e = geometric constraint count

working bonding formula is:

$$d = d_0 - N_{pe}\lambda_{pe} + (N_{ee,S1} + N_{ee,S2} + N_{ee,S3})\lambda_{ee}$$

With constants:

$$d_0 = 58{,}895{,}412, \;\; \lambda_{pe} = 1{,}498{,}176, \;\; \lambda_{ee} = 665{,}856$$

For H-C Hydrogen-Carbon example:

$$N_{pe} = 3, N_{ee,S1} = 6, N_{ee,S2} = 6, N_{ee,S3} = 0$$

2.1 Bonding length for shell 1

2.2 Bonding length for shell 2

Bonding length = Anchor – proton Contribution + electron contribution

2.2.1 Lithium Anchor value:

$$Li_{calc} = 148{,}603{,}268 \text{ (based on loading)}$$

2.2.2 Counting Proton contributions

Counting connection between electron and protons based on the number of protons in each element's nucleus.

$$P = N * Z * \lambda_{pe}$$

Where N = 4 (Li, Be), 12 (B), 16 (C, N, O, F, Ne)

Appendix A – Derived values

A.1 Shell 1 Derivation

Solving for r based on proton wavelength

$$r_p = \frac{(2n+1)\pi - \delta}{k_p}$$

Substitute $k_p = 2\pi/\lambda_p$:

$$r_p = ((2n+1)\pi - \delta)\frac{\lambda_p}{2\pi}$$

Now substitute $\delta = \frac{2\pi}{3}$:

$$r = \left((2n+1)\pi - \frac{2\pi}{3}\right)\frac{\lambda_p}{2\pi} = \left((2n+1) - \frac{2}{3}\right)\frac{\lambda_p}{2} = \left(2n + \frac{1}{3}\right)\frac{\lambda_p}{2}$$

$$\boxed{r_p = \left(n + \frac{1}{6}\right)\lambda_p}$$

The fractional term $\frac{1}{6}\ \lambda_p$ arises directly from the 120° triad phase offset when substituted into the closure

For $n = 16038, \quad \lambda_p = 1836\ L_0 = 117{,}504$ cells

$$r = \left(16038 + \frac{1}{6}\right)117{,}504 = 16038 \cdot 117{,}504 + \frac{1}{6} \cdot 117{,}504$$

$$r = 1{,}884{,}633{,}600 + 19{,}584 = 1{,}884{,}653{,}184 \text{ cells}$$

$$\boxed{r_{\text{cells}} = 1{,}884{,}653{,}184 \times 10^9 \text{cells} \ = \ 29{,}447{,}706\ L_0}$$

Observed: $a_0 = 1{,}884{,}653{,}184 \times 10^9$ cells

A.2 Shell 2 derivation

Lithium sets the shell 2 distance being the first element with electrons in shell 2. It forms a square with the nucleus and therefore the distance between can be calculated from the bonding length for lithium

$$S_2 = 2\ S_1\ \text{Sin}(45) = 2\ (29{,}447{,}706)\ \sqrt{2}$$

$$29{,}447{,}706 * 2 * \sqrt{2}$$

Measured: 148,668,007 / $\sqrt{2}$ = 105,124,156 L_0

A.3 Shell 3 derivation

Sodium is the first element occupying shell 3. The sodium diatomic separation therefore defines the shell-3 anchor. The bonding geometry follows the same square-equilibrium relation used for lithium:

$$d_{Na_2} = \sqrt{2}\, S_3$$

Solving for the shell radius gives:

$$S_3 = \frac{d_{Na_2}}{\sqrt{2}}$$

Using the measured sodium diatomic bonding distance:

$$S_3 = \frac{171{,}248{,}971}{\sqrt{2}} = 121{,}091{,}309\, L_0$$

A.4 Shell 4 derivation

Potassium is the first element occupying shell 4. The potassium diatomic separation therefore defines the shell-4 anchor. The same square-equilibrium relation applies:

$$d_{K_2} = \sqrt{2}\, S_4$$

Solving for the shell radius gives:

$$S_4 = \frac{d_{K_2}}{\sqrt{2}}$$

Using the measured potassium diatomic bonding distance:

$$S_4 = \frac{217{,}189{,}747.1898}{\sqrt{2}} = 153{,}576{,}343.0421\, L_0$$

Appendix Y – Anchoring Bonds

Protium (H_2) bond length

The H-H bond is in perfect equilibrium between protons and electrons with equal separation between all for components, creating a perfect square between them. Therefore, we can use the following formula.

$$d = \sqrt{2}\ S_1$$

$$d_H = 2(\sin 45°)\ S_1 = \left(\sqrt{2}\right)(29{,}447{,}706) = 41{,}645{,}345\ L_0$$

Measured H-H (0.741 A): $41{,}235{,}488\ L_0$

$$\frac{41{,}645{,}345 - 41{,}235{,}488}{41{,}235{,}488} \approx 0.994\%$$

Helium (He_2) bond length

Helium is 2 extra protons and 2 extra electrons so nucleon number = 4. The equilibrium is exactly 4 times that of the H-H equilibrium. The protons are the dominant equalizers

$$d_E = 4 * 2(\sin 45°)\ S_1 = 4 * \left(\sqrt{2}\right)(29{,}447{,}706) = 4 * 41{,}645{,}345 = 166{,}581{,}380\ L_0$$

$$Li_{BL} = 105{,}124{,}156 * \sqrt{2} = 148{,}668{,}007.1482\ L_0$$

$$Li_{calc} = 148{,}603{,}268 \text{ (based on loading)}$$

Measured: $165{,}200{,}000\ L_0$

$$\frac{166{,}581{,}380 - 165{,}200{,}000}{165{,}200{,}000} * 100 \approx 0.8362\ \%$$

Helium **does not form a normal chemical bond**, but it *does* form a very weak van der Waals dimer. Measured equilibrium separation:

$$\boxed{d_{\mathrm{He_2}} \approx 2.97\ \text{Å}}$$

Convert to your L_0scale Using your coherence length:

$$R_{\text{cells}} \approx \frac{2.97 \times 10^{-10}}{2.809321648 \times 10^{-20}} \approx 1.057 \times 10^{10}$$

$$R_{L_0} \approx \frac{1.057 \times 10^{10}}{64} \approx 165{,}200{,}000\ L_0$$

Lithium (Li_2) bond length

$$d = 2(\sin 45°)\, S_2 = \sqrt{2}\, S_2 = \left(\sqrt{2}\right)(105{,}124{,}156) = 148{,}668{,}007$$

Measured: 148,668,007 L_0

$$\frac{148{,}668{,}007 - 148{,}668{,}007}{148{,}668{,}007} \approx 0.00\%$$

Nitrogen (N_2) bond length

$$d_N = \left(2 - \sqrt{2}\right) S_2$$

$$d_N = \ 2(1 - \sin 45°)\, S_2 \ = \left(2 - \sqrt{2}\right)(105{,}124{,}156) \approx 61{,}580{,}305\ L_0$$

Measured 61,069,013 L_0

$$\frac{61{,}580{,}305 - 61{,}069{,}013}{61{,}069{,}013} \approx 0.84\%$$

Sodium (Na_2) bond length

$$d = 2(\sin 45°)\, S_3 = \sqrt{2}\, S_3 = \left(\sqrt{2}\right)(105{,}124{,}156) = 148{,}668{,}007$$

Measured: 171,248,971 L_0

$$\frac{148{,}668{,}007 - 171{,}248{,}971}{171{,}248{,}971} \approx 0.00\%$$