

EN_25: Rigorous Framework of Confined Waves and Atomic Structure

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1. General Principle of Confined Wave Stability

Any stable confined wave must satisfy:

$$\Delta\phi_{\text{total}} = 2\pi n, \quad n \in \mathbb{Z}^+$$

Conditions:

1. The phase must close exactly.
2. There must be no phase accumulation ($\Delta\phi(t) = 0$).
3. Stability is independent of external forces; it depends solely on the wavelength of the wave itself.

Direct consequence:

The equivalent projective radius of any confined wave is:

$$R_{ved} = \frac{n\lambda}{2\pi}$$

where $\lambda = h / (mc)$ for a particle of mass m .

2. Application to the Proton

- Confinement in 3 spatial dimensions.
- Stable existence throughout all time T ($dt' = 0$).
- Exact contour closure for total stability.

Result:

$$n = 4 \quad \Rightarrow \quad R_p = \frac{4\lambda_p}{2\pi}$$

- The proton satisfies the exact integer $\rightarrow$ stable.
- The free neutron has $n = 4 + \delta \rightarrow$ phase drift $\rightarrow$ decays over time $\tau \approx 877$ s.

Interpretation:

The number 4 is not arbitrary; it is **the minimum integer compatible with three-dimensional stability without angular degeneracy.**

3. Electron and First Atomic Orbital

Stability condition of the electron:

$$R_{ved} = \frac{n\lambda_e}{2\pi}$$

- First stable orbital: $n = 137$
- This automatically determines:
 - Orbital radius
 - Minimum energy
 - Exact contour closure

Minimum energy:

$$E_{\min} = \frac{hc}{\lambda_e} = \frac{hc}{2\pi R_{ved}} \cdot n$$

- Coincides with the observed minimum energy (~ 13.6 eV for hydrogen)

- Higher orbitals: $n > 137 \rightarrow$ larger radii and energies $\rightarrow$ decreasing relative stability
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4. Method to Determine the Subsequent Orbitals

1. Take $n_{\min}$ (first stable orbital, 137).
2. Increment $n_i = n_{\min} + 1, n_{\min} + 2, \dots$
3. Calculate radii and energies:

$$R_{ved}^{(i)} = \frac{n_i \lambda_e}{2\pi}, \quad E_i = \frac{hc}{2\pi R_{ved}^{(i)}} \cdot n_i$$

4. Evaluate stability: longer contours $\rightarrow$ lower rigidity $\rightarrow$ lower relative stability.
 5. This generates **the complete hierarchy of orbitals and energies** without probabilistic postulates.
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5. Autonomous Confinement and Bosonic Condensates

- Each wave has its own λ and contour R_{ved} , independent of the nucleus.
 - For bosons, multiple waves can share the same minimum contour state $\rightarrow$ **Bose-Einstein condensate**.
 - Cooper pairs: $L_{\text{Cooper}} = 2 \cdot n \cdot \lambda_e \rightarrow$ maximum stability based on exact closure, not nuclear interaction.
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6. Molecules as Bound States

- Electrons from different atoms can form **combined contours**.

- Bonding condition:

$$\sum_i n_i \lambda_i = 2\pi R_{ved}^{mol}$$

- Each n_i integer ensures **exact closure**.
- Bond hierarchy: more rigid contours $\rightarrow$ more stable bonds.
- Explains single, double, and triple bonds geometrically.

7. Summary of the Conceptual Framework

Concept	Geometric Basis	Consequence
Proton	3D, $n=4$, $dt'=0$	Absolute stability
Neutron	3D, $n=4+\delta$	Temporal decay
Electron	Orbital $n=137$	Minimum energy, exact closure
Higher orbitals	$n>137$	Increasing energies, decreasing stability
Cooper pairs	$k=2$, exact closure	Superconductivity, collective stability
Bosonic condensates	Shared n , independent R_{ved}	Coherent macroscopic state
Molecules	Combined contours, $\sum n_i \lambda_i = 2\pi R_{ved}$	Stable chemical bonds

Unifying principle:

Any stable confined wave must close its contour exactly at an integer n . From this, radii, energies, stability, and the

hierarchy of bound states are deduced—from elementary particles to molecules and condensates.

8. Conclusion

1. **Universal deterministic framework:** No probabilities, no ad hoc postulates.
 2. **Constructive method:** From λ , n , R_{ved} , and E are determined.
 3. **Unification of phenomena:** Proton, electron, Cooper pairs, condensates, molecules $\rightarrow$ same principle of confined waves.
 4. **Orbital basis:** Exact integer n = orbital number $\rightarrow$ natural hierarchy of energies and radii.
 5. **Future applicability:** Enables study of new bound states and predictability of atomic and molecular structures.
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