EN_16: The Geometry of Quarks

From the Vibration Plane to the Baryon Table

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1. Introduction: Geometry as the Language of Matter

The Standard Model describes quarks through tables of quantum numbers.
3S+T geometry describes quarks through vibration planes.

This document adds no new hypotheses.
It only translates: from the nomenclature of the 20th century to the geometry of the 21st century.

Concept	Standard Model	3S+T Geometry
Quark	Irreducible point particle	**Standing wave in an XT, YT or ZT plane**

Concept	Standard Model	3S+T Geometry
Antiquark	Opposite charge antiparticle	**Same wave, opposite time direction**
Flavor	Quantum number with no origin	**Vibration plane + harmonic**
Charge	Postulated fractional value	**Temporal orientation of the wave**
Mass	Free parameter	**Wave frequency**
Confinement	Force increasing with distance	**Impossibility of unidirectional wave**
Family	3, unexplained	**Fundamental mode + 2 harmonics**
Collision	Probabilistic pair creation	**Temporal splitting at $t = t_0$**

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2. The Three Fundamental Planes

3S+T geometry has **three orthogonal vibration planes**.

Each plane is a **propagation channel** between a spatial dimension and time.

Plane	Coordinates	Direction	Quark	Charge
XT Plane	(x, t)	$t \to x$	u	$+\frac{2}{3}$
		$x \to t$	$\bar{u}$	$-\frac{2}{3}$
YT Plane	(y, t)	$t \to y$	d	$-\frac{1}{3}$

Plane	Coordinates	Direction	Quark	Charge
		$y \to t$	$\bar{d}$	$+\frac{1}{3}$
ZT Plane	(z, t)	$t \to z$	d	$-\frac{1}{3}$
		$z \to t$	$\bar{d}$	$+\frac{1}{3}$

There are no more planes. There cannot be. Visible matter is the combination of waves in these three planes.

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3. Harmonics: The Origin of the Three Families

Each plane admits **higher-order vibrational modes**.

Harmonic	Frequency	Family	Quarks
Fundamental mode (k=1)	ν_0	1st family	u, d
First harmonic (k=2)	$2\nu_0$	2nd family	c, s
Second harmonic (k=3)	$3\nu_0$	3rd family	t, b

Mass is not a parameter. It is the frequency of the wave.

That is why charm is more massive than up. That is why strange decays to down. That is why top does not form hadrons: its frequency is so high that it decays before it can couple.

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4. The Periodic Table of Baryons

The Standard Model presents the **octet** and **decuplet** as empirical classifications.
3S+T geometry presents them as permitted combinations of waves.

4.1 The Octet (spin 1/2)

Source: Wikipedia	Geometric Interpretation (3S+T)
	**Combinations of fundamental waves and first harmonics**

Baryon	Composition	Geometry	Mass	Origin of Mass
p	uud	**XT + XT + YT**	938 MeV	**Fundamental mode**
n	udd	**XT + YT + ZT**	940 MeV	**YT/ZT asymmetry** (δ)
Λ	uds	**XT + YT + (YT)***	1116 MeV	**One harmonic (k=2)**
Σ^+	uus	**XT + XT + (YT)***	1189 MeV	**One harmonic**
Σ^0	uds	**XT + YT + (YT)***	1192 MeV	**One harmonic (excited state)**
Σ^-	dds	**YT + ZT + (YT)***	1197 MeV	**One harmonic**

Baryon	Composition	Geometry	Mass	Origin of Mass
Ξ^0	*uss*	*XT + (YT) + (ZT)***	1315 MeV	**Two harmonics**
Ξ^-	*dss*	*YT + (YT) + (ZT)***	1321 MeV	**Two harmonics**

4.2 The Decuplet (spin 3/2)

Source: Wikipedia	Geometric Interpretation (3S+T)
	**The same geometric systems, in rotationally excited states**

Baryon	Composition	Geometry	Mass	Relation to Octet
Δ^{++}	*uuu*	**3 × XT**	1232 MeV	**Rotational excitation**
Δ^{+}	*uud*	**XT + XT + YT**	1232 MeV	**Proton excitation**
Δ^{0}	*udd*	**XT + YT + ZT**	1232 MeV	**Neutron excitation**
Δ^{-}	*ddd*	**2×YT + ZT**	1232 MeV	**No XT plane**
Σ^{*+}	*uus*	**XT + XT + (YT)***	1385 MeV	**Excitation of Σ^+**

Baryon	Composition	Geometry	Mass	Relation to Octet
Σ^{*0}	uds	**XT + YT + (YT)***	1385 MeV	**Excitation of Σ^0**
Σ^{*-}	dds	**YT + ZT + (YT)***	1385 MeV	**Excitation of Σ^-**
Ξ^{*0}	uss	*XT + (YT) + (ZT)***	1530 MeV	**Excitation of Ξ^0**
Ξ^{*-}	dss	*YT + (YT) + (ZT)***	1530 MeV	**Excitation of Ξ^-**
Ω^-	sss	*(YT) + (ZT) +* (YT/ZT)***	1672 MeV	**Three harmonics, ground state**

Key observation:
The decuplet is **not** 10 new particles.
They are the same 2 geometric configurations (proton/neutron) and their harmonic and rotational excitations.

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5. The Gell-Mann-Nishijima Formula: The Trace of Geometry

The Standard Model postulates:

$$Q = I_3 + \frac{1}{2}(B + S + C + B' + T)$$

Or, equivalently:

$$Q = \frac{2}{3}[(n_u - n_{\bar{u}}) + (n_c - n_{\bar{c}}) + (n_t - n_{\bar{t}})] - \frac{1}{3}[(n_d - n_{\bar{d}}) + (n_s - n_{\bar{s}}) + (n_b - n_{\bar{b}})]$$

This formula is not an empirical rule. It is the sum of the temporal orientations of waves in the three planes.

Plane	Orientation	Contribution to Q
XT	$t \to x$ (quark)	$+\frac{2}{3}$
XT	$x \to t$ (antiquark)	$-\frac{2}{3}$
YT/ZT	$t \to y, z$ (quark)	$-\frac{1}{3}$
YT/ZT	$y, z \to t$ (antiquark)	$+\frac{1}{3}$

Charge is not a quantum number. It is the trace of the wave's temporal orientation in the plane.

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6. Confinement: Geometry, Not Force

Why are there no free quarks?

Because a **quark** is a wave vibrating in the direction $t \to$ space. An **antiquark** is the same wave, vibrating in the direction space $\to t$.

A real wave cannot propagate only toward the past or only toward the future. Every real wave has both directions.

Therefore, when you break confinement, you do not obtain a free quark. You obtain a quark-antiquark dipole.

That dipole is a **meson**.

Meson	Composition	Geometry
π^+	$u\bar{d}$	XT ($t \to x$) + YT ($y \to t$)
π^-	$d\bar{u}$	YT ($t \to y$) + XT ($x \to t$)

Meson	Composition	Geometry
π^0	$u\bar{u}$ or $d\bar{d}$	Wave and counter-wave in the same plane

Confinement is not a force that increases with distance. It is the geometric impossibility of separating a wave from its temporal inverse direction.

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7. Collisions: Temporal Splitting, Not Creation

In a high-energy collision, at an instant $t = t_0$, the confined loop breaks.

The confined wave, which until that moment vibrated in a single temporal direction, splits:

- The component that came from $t < t_0$ toward t_0 emerges as a **quark** traveling into the future.
- The component that continues from t_0 toward $t > t_0$ emerges as an **antiquark** traveling into the future.

There is no matter creation. There is no pair annihilation. There is only the revelation of the temporal structure of a wave that was always dual.

That is why particle jets always contain quark-antiquark pairs. That is why collision energy transforms into mass: the frequency of the wave is conserved, but its confinement is broken.

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8. Summary: The Geometry of Quarks

Structure	Standard Model	3S+T Geometry
Up quark	u, charge +2 / 3	Wave in XT, direction $t \rightarrow x$

Structure	Standard Model	3S+T Geometry
Down quark	d, charge $-1/3$	Wave in YT or ZT, direction $t \to y, z$
Antiquark	Opposite charge	Same wave, opposite direction
Strange quark	s, strangeness -1	First harmonic ($k = 2$) in YT or ZT
Charm quark	c, charm $+1$	First harmonic ($k = 2$) in XT
Proton	uud	XT + XT + YT
Neutron	udd	XT + YT + ZT
Meson	$q\bar{q}$	Wave and counter-wave dipole
Confinement	Strong force	Impossibility of unidirectional wave
Collision	Pair creation	Temporal splitting at $t = t_0$
Mass	Free parameter	Wave frequency
Charge	Quantum number	Temporal orientation

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9. Conclusion: The Periodic Table of Matter

The baryon table is not a catalog of elementary particles.
It is the periodic table of wave combinations in three planes.

- **3 planes** (XT, YT, ZT)
- **2 temporal directions** ($t \to$ space, space $\to t$)
- **3 harmonics** ($k = 1, 2, 3$)
- **2 stable minimum energy configurations** (proton, neutron)

Everything else is rotational and harmonic excitations of these two configurations.

There are not 100 fundamental particles. There are 3 planes, 2 directions, 3 harmonics, and 2 stable configurations.

Nature is geometric. We only needed the right plane to see it.

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10. References

- Estrada Díaz, V. (2026). *EN_14: The 22 Internal Modes of the Nucleon*. Zenodo. DOI: 10.5281/zenodo.17172925
- Estrada Díaz, V. (2026). *EN_15: What Are Quarks*. Zenodo. 10.5281/zenodo.17172925
- Estrada Díaz, V. (2026). *EN_8: Deterministic Neutron Decay*. Zenodo. 10.5281/zenodo.17172925
- Estrada Díaz, V. (2026). *EN_18: Geometric Cosmology of the Neutron*. Zenodo. 10.5281/zenodo.17172925
- Wikipedia contributors. (2025). *Baryon*. Wikipedia, The Free Encyclopedia. https://en.wikipedia.org/wiki/Baryon
- Particle Data Group. (2024). *Review of Particle Physics*.

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