

TOPOLOGICAL AND MECHANICAL STUDY OF VORTEX FLOWS

From Toroidal Cavitation to Laminar Plasma Structures
and the Geometric Emergence of the Fine-Structure Constant (1/137)

Author	Terec Traian
Framework	Fractalon Unified Theory
Date	August 2026
Classification	Theoretical Physics • Fluid Dynamics • Magnetohydrodynamics (MHD)

Clean English edition — mathematical notation reconstructed for reliable rendering.

This edition preserves the terminology, sequence of arguments, equations, and theoretical claims of the supplied French document while correcting broken formula rendering and typography.

.

.

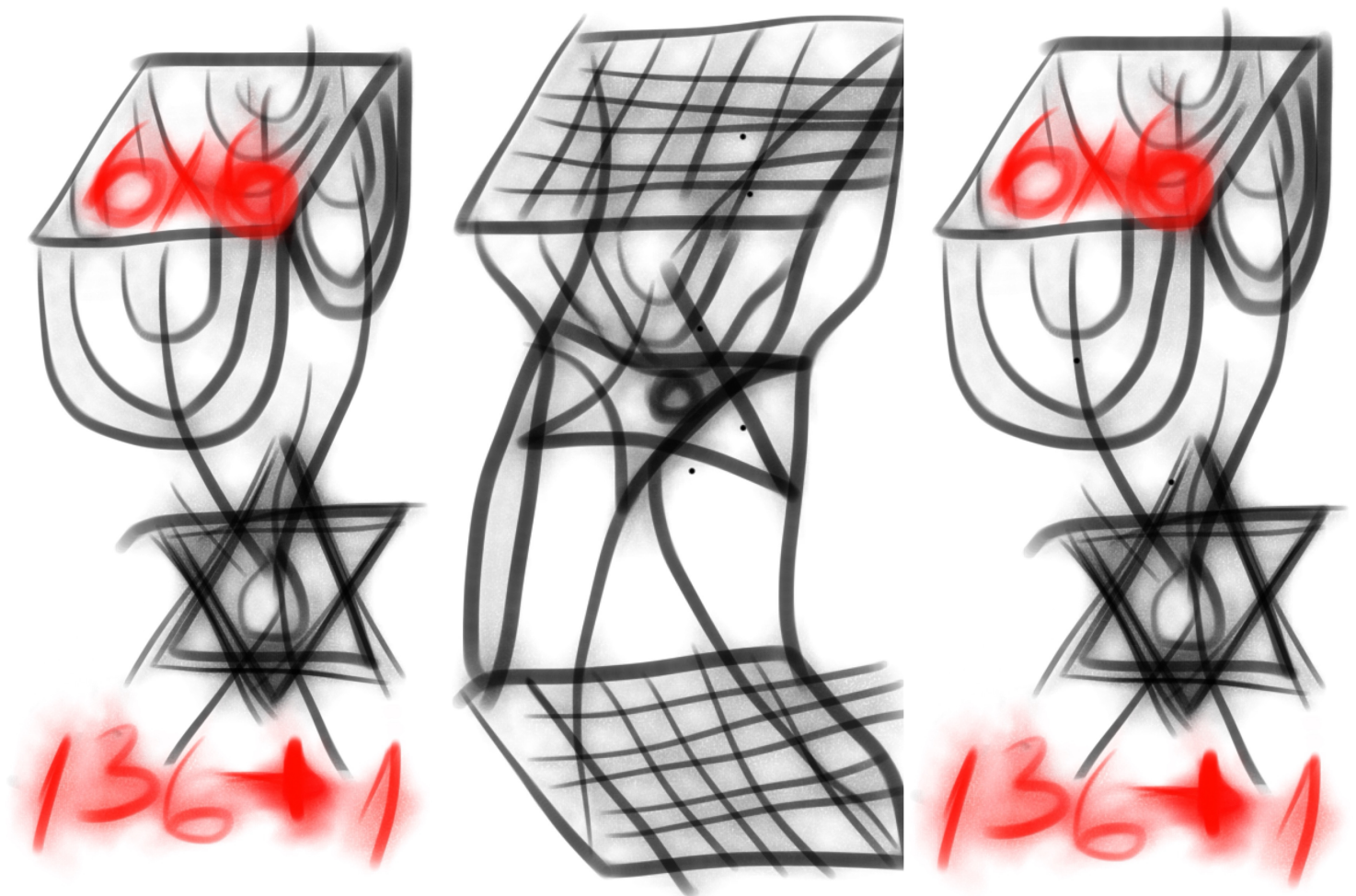
Abstract

This article examines the dynamics of highly energetic fluid structures through the lens of successive phase transitions. Starting from macroscopic cavitation in liquids, it proposes that flow asymmetries force a transition from spherical collapse toward a precessing toroidal vortex.

The same magnetohydrodynamic principles are then transposed to high-power atmospheric discharges (lightning and ball lightning), with the aim of modelling the conditions required for a stable, laminar plasma flow maintained indefinitely.

Finally, the formalism of Fractalon Theory (Part 6) is introduced, proposing a purely geometric and matrix-based derivation of the fine-structure constant, $1/137$, based on the torsional self-organization of compact flux lines at the scale of a Higgs-boson lattice.

Editorial status. The following text is an English translation and typographical reconstruction of the supplied document. Its physical propositions are presented as the author's theoretical framework; this editing process does not constitute independent experimental validation.



1. Introduction and Analogy of Energetic Phases

In classical thermodynamics, the evolution of matter is governed by inputs of kinetic and thermal energy crossing specific potential barriers (latent heats). In fluid mechanics, cavitation represents a mechanical rupture of the liquid medium: when the local static pressure p falls below the saturated vapour pressure p_v , the fluid ruptures and creates vapour cavities.

The dimensionless control parameter is the cavitation number σ :

$$\sigma = (p_{\infty} - p_v) / (\frac{1}{2} \rho U^2)$$

The transition from a neutral gas to the plasma state (ionization) constitutes the next direct stage of this energy scale. Whereas liquid cavitation is induced by a macroscopic pressure depression, gas ionization — for example in the core of a lightning discharge — results from dielectric breakdown induced by a critical electric field.

In both cases, the system is described as seeking to minimize its energetic constraints through geometric restructuring of its flow.



2. Toroidal Vortex Dynamics, Precession and Sonoluminescence

In idealized models, including the Rayleigh–Plesset equation, the collapse of a cavitation bubble is assumed to be perfectly spherical. However, in an asymmetric environment — for example near a wall or in the presence of shear gradients — the system undergoes a symmetry breaking.

1. Formation of the torus

A high-velocity liquid microjet pierces the centre of the bubble, forcing the gas pocket to curl back onto itself. The topology of the bubble therefore changes from a sphere into a vortex torus.

2. Precession mechanism

The toroidal vortex is subject to natural hydrodynamic instabilities (Widnall instabilities), induced by Kelvin waves propagating along its core. Under differential inertial effects from the surrounding medium, the main vortex axis experiences a gyroscopic torque, producing continuous precession.

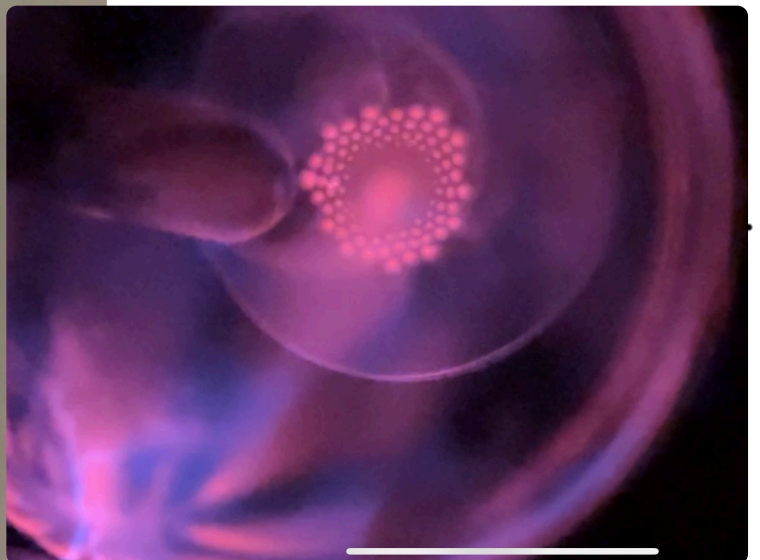
3. Application to sonoluminescence

During the ultimate compression of the torus, the internal gas undergoes extreme adiabatic heating ($T > 5000\text{ K}$), ionizing the gas into plasma. The surrounding acoustic waves act as standing waves that confine the precessing plasma donut and modulate the final photon emission associated with multi-bubble sonoluminescence.

3. Limits of Linear Discharge vs. Stabilization by a Permanent Vortex

The analysis of atmospheric electrical discharges (lightning) highlights a conflict between explosive forces and laminar structures:

- **Transient lightning.** A standard linear lightning discharge excludes a laminar flow because of its supersonic thermal expansion, the thunder shock wave, and immediate magnetohydrodynamic (MHD) instabilities such as Z-pinch, sausage, and kink instabilities.
- **Reversed double flow.** At the particle scale, the discharge core is described as containing a reversed kinematic flow: the light, free electrons are propelled in one direction, while the heavier positive ions migrate in the opposite direction. Hall interaction and the Lorentz force induce a differential helical rotation between these two charge populations.
- **Permanently powered arc.** If the energy source is stabilized indefinitely, the transient arc is proposed to transform into a continuous laminar plasma flow. By introducing a mechanical peripheral air vortex — a “giant sink” effect — centrifugal force expels cold air toward the periphery, creating a calm, low-pressure axial region. The electrical arc aligns within this region, producing a stable, laminar coexistence between the fluid vortex and the plasma channel.



• •

4. Fractalon Modelling: Geometric Emergence of 1/137

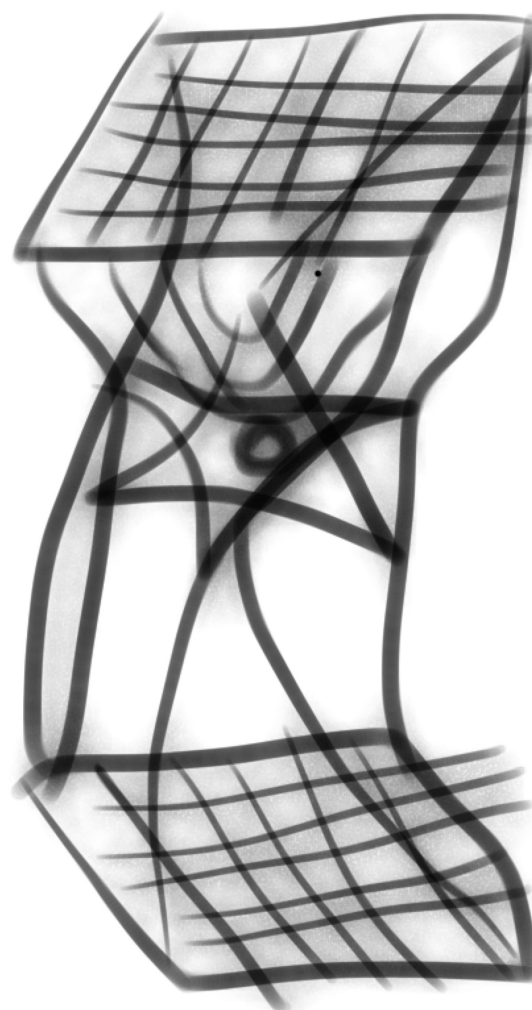
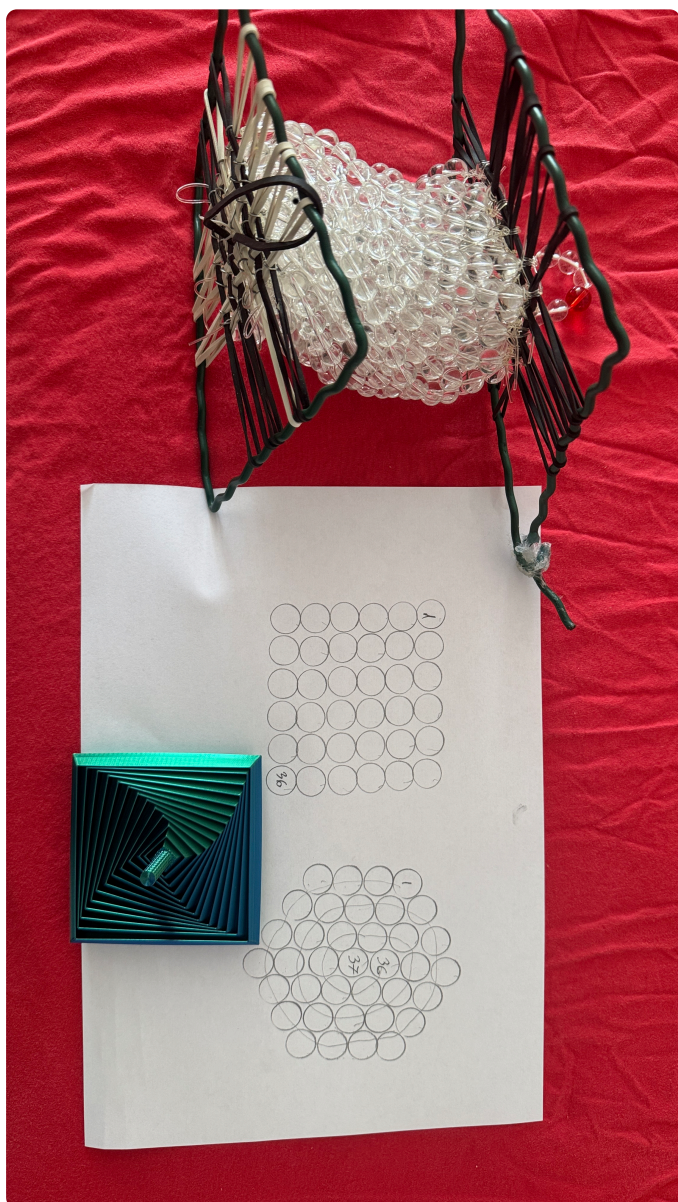
Fractalon Theory (Parts 1 and 6) proposes dispensing with abstract notions of charges and action at a distance by postulating a discrete universe composed exclusively of Higgs bosons represented geometrically as compact packings (dodecahedra or spherical structures).

Within this framework, the fundamental forces — gravity and electromagnetism — emerge solely from the self-organization rules of the lattice as the density per unit volume increases.

4.1. Discrete Torsional Flow — Rope / Strand Model

When several flux lines (rows of bosons) wind into a macroscopic laminar torsional flow resembling a rope or strand, spatial constraints impose a parallel stationary structure. As the strands touch and self-organize, they form nested square cross-section matrices following a symmetric standing-wave progression:

$$3 \times 3 \rightarrow 4 \times 4 \rightarrow 5 \times 5 \rightarrow 6 \times 6 \rightarrow 5 \times 5 \rightarrow 4 \times 4 \rightarrow 3 \times 3$$



4.2. Derivation of the Central Singularity

The total number of active material elements participating in this torsional structure is calculated through the following matrix sequence:

$$\Sigma N = (3^2) + (4^2) + (5^2) + (6^2) + (5^2) + (4^2) + (3^2)$$

$$\Sigma N = 9 + 16 + 25 + 36 + 25 + 16 + 9 = 136$$

The homogeneous central 6×6 matrix contains 36 elements. The document proposes that, in order to permit rotation and sliding of the complete torsional structure without kinematic blockage, a virtual pivot point must emerge geometrically: one empty space at the centre, the 37th position of the central matrix.

The complete system is therefore defined as:

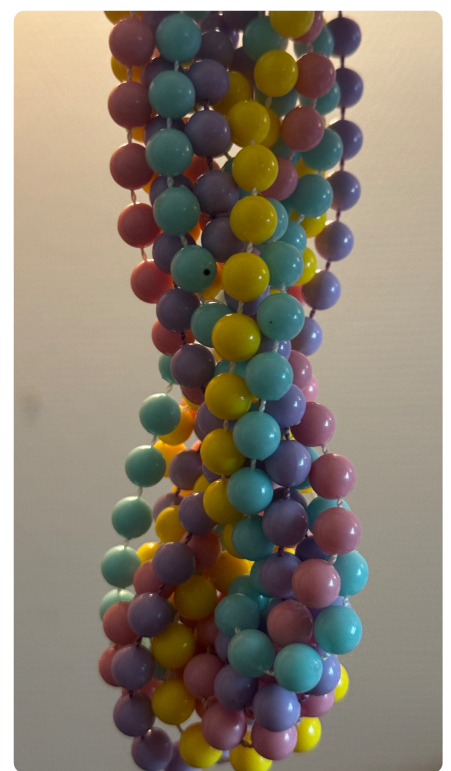
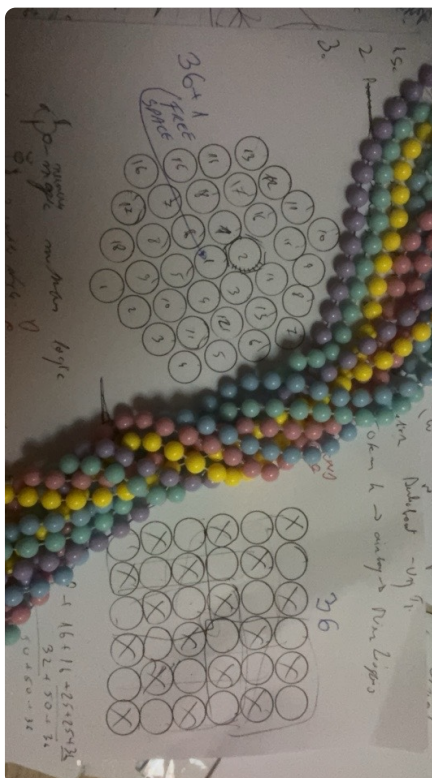
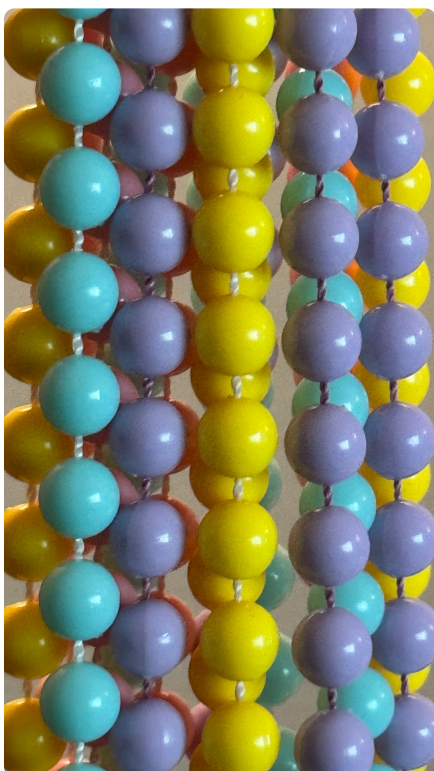
$$\text{Global Structure} = 136 \text{ (flux elements)} + 1 \text{ (central empty space)} = 137$$

3 × 3 9 strands	4 × 4 16 strands	5 × 5 25 strands	6 × 6 36 strands	5 × 5 25 strands	4 × 4 16 strands	3 × 3 9 strands
--------------------	---------------------	---------------------	---------------------	---------------------	---------------------	--------------------

Central configuration:

$$[6 \times 6] \rightarrow 36 \text{ strands} + 1 \text{ central void}$$

The symmetric count is therefore 136 flux elements plus one axial void, giving the total 137.

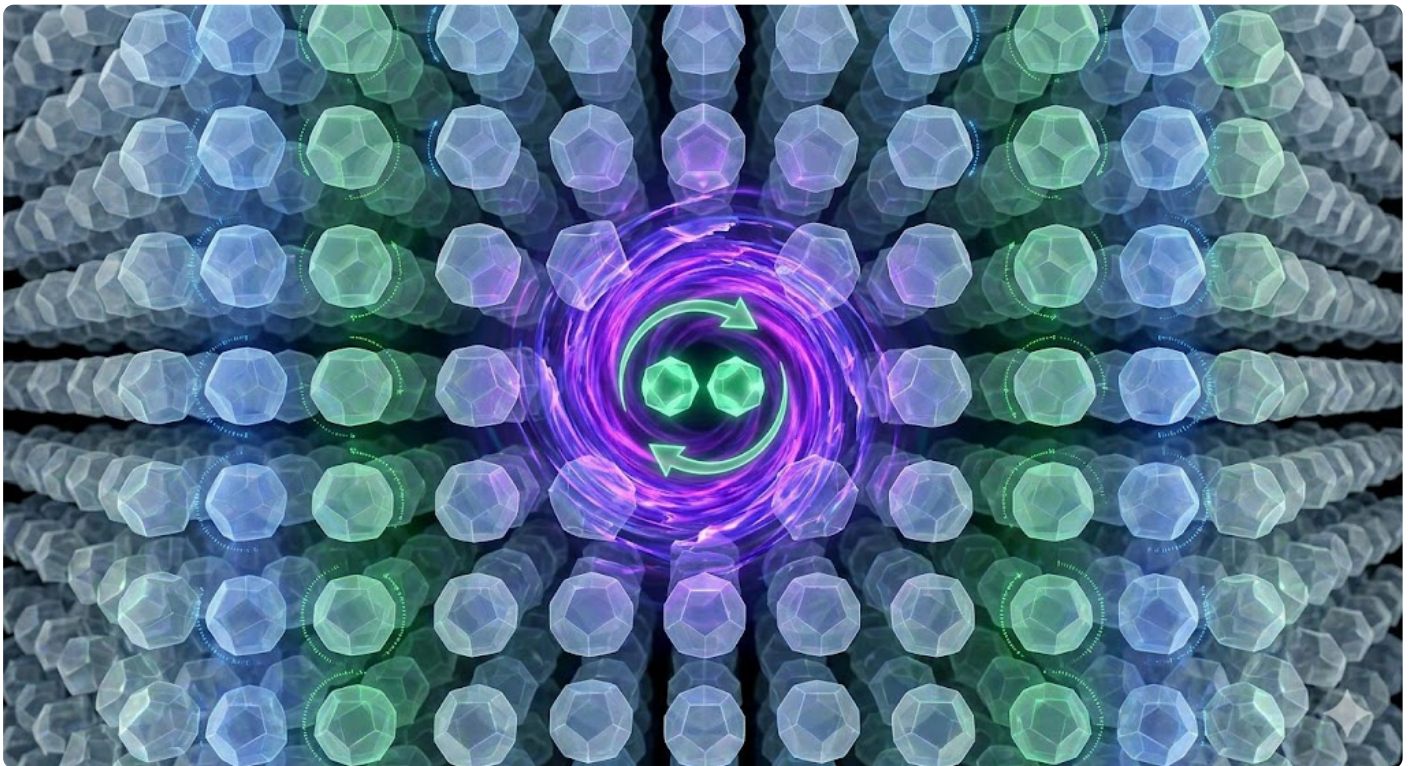


4.3. Physical Consequences and Reverse Translation

The document interprets this central void (1/137) as the pure geometric signature of the fine-structure constant α , thereby proposing that no arbitrary parameters from the Standard Model are required for this relation.

The axial void is described as creating a local region of absolute low pressure at the core of the torsional laminar flow. Because it offers no mechanical resistance, this empty space becomes the preferred channel for kinematic translation through the lattice in the direction opposite to the peripheral flow.

This direct mechanical counter-rotation mechanism is proposed to explain, in purely geometric terms, the polarization of the vacuum and the separation of charges (electron flow versus ion/plasma flow).



5. Conclusion

The comparative study of fluids and plasmas presented here proposes that toroidal vortex organization and axial laminarization are universal mechanisms for energy stabilization.

Fractalon Theory unifies these concepts by proposing that macroscopic behaviours — including the giant sink, plasma torches, and stable electrical discharges — are large-scale projections of discrete geometric packing and torsional laws within the Higgs-boson lattice.

Within this framework, the number 137 is presented as the topological key to vacuum equilibrium.

End of translated and typeset edition



Mathematical Reference Sheet

The principal mathematical relations appearing in the supplied French document are collected here with clean notation.

Cavitation number

$$\sigma = (p_{\infty} - p_v) / (\frac{1}{2} \rho U^2)$$

Torsional standing-wave sequence

$$3 \times 3 \rightarrow 4 \times 4 \rightarrow 5 \times 5 \rightarrow 6 \times 6 \rightarrow 5 \times 5 \rightarrow 4 \times 4 \rightarrow 3 \times 3$$

Total active elements

$$\Sigma N = 3^2 + 4^2 + 5^2 + 6^2 + 5^2 + 4^2 + 3^2 = 136$$

Central-vacancy relation

$$N_{\text{total}} = 136 + 1 = 137$$

Central matrix

$$6 \times 6 = 36; 36 + 1 \text{ central void} = 37 \text{ positions}$$

These expressions reproduce the mathematical content of the source document. They are not expanded with additional assumptions in this edition.