

# VERSF

## in plain language

How the proposed picture of reality  
connects to the mathematics



What if the world we see begins with patterns we cannot?

An illustrated journey through the ideas behind VERSF.  
No physics background needed.

Keith Taylor • 11 October 2026

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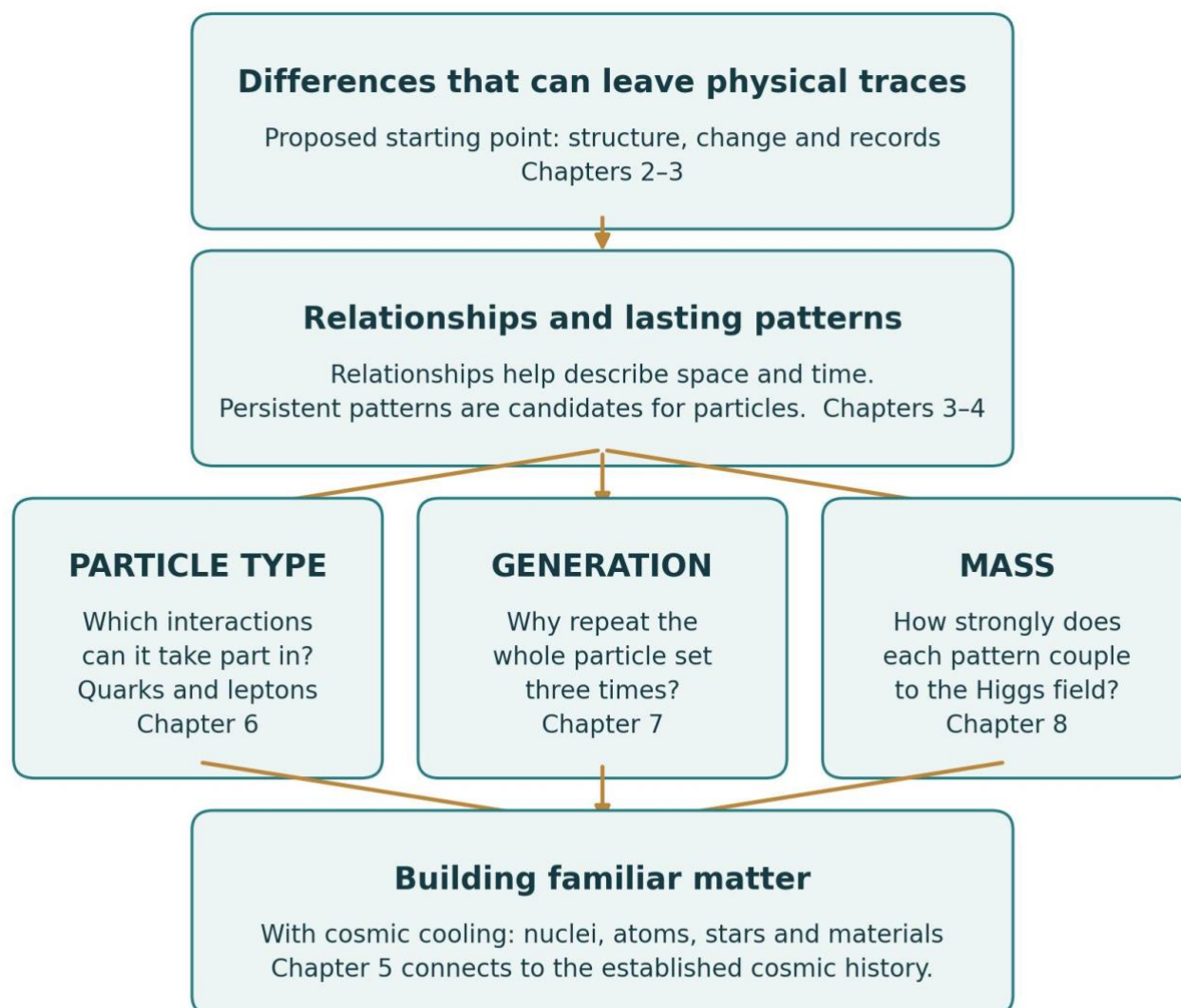
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# The whole picture before the details

VERSF asks whether space, time, particles and forces can arise from the organisation of one more basic system. This guide follows that proposed explanation, then introduces the mathematics used to investigate it. Three levels matter throughout: observations tell us what nature does; a VERSF proposal suggests why; a calculation establishes what follows from specified rules and assumptions. These levels should not be confused.



Arrows connect questions and calculations; they are not a timetable or a claim that every link is proved.

*Read down the map, then across the three particle questions. Particle type, generation and mass describe different features of the same particle.*

Keep three questions in view. What allows a pattern to persist? What makes it a particular particle? What sets its mass and interactions? The tools below answer parts of these questions: geometry measures differences between possible patterns, stability tests persistence, and response calculations measure what happens when a pattern is disturbed.

# 1 Start with the world around you

Hold a cup in your hand. It has a shape, it resists your fingers, it occupies a place, and it has a history. It was made, used and perhaps chipped. A picture of reality needs to explain how there can be things with these properties at all.



*A familiar cup brings the questions together: matter, shape, resistance, place and history.*

We can work backwards. The cup is made of atoms, tiny arrangements containing electrons and a central nucleus. The nucleus contains protons and neutrons, which contain quarks. But listing smaller ingredients leaves another question: why do those ingredients exist, and why do they behave in these particular ways?

## The familiar cosmic story

The hot Big Bang account describes an early universe that was much hotter and denser than today. As it expanded and cooled, conditions allowed particles to combine into increasingly lasting structures. Much later came stars, planets and objects like your cup. This account is supported by evidence including the universe's expansion, its leftover early light and the abundance of light elements.

It does not provide a settled explanation of the ultimate origin of everything. Nor does saying "particles emerged" explain why nature has these particle types, masses and interactions. Those are among the deeper questions VERSF is trying to address.

## The VERSF question

Could space, time, particles and forces be connected expressions of a more basic organisation? VERSF explores a picture in which distinguishable structure, the changes it can undergo and the lasting traces of those changes help explain the world we experience.

Chapters 1–5 connect the proposed foundations to the familiar cosmic story. Chapters 6–8 then ask what this picture says about real particles: their different roles, their three generations and their unequal masses. The remaining chapters explain the tools used to calculate and test those claims.

## A few ordinary meanings

A particle, such as an electron, need not be a tiny solid ball. An interaction is how physical things affect one another. A field assigns a physical quantity throughout a region, as a weather map assigns a temperature to each place. Energy is a measurable quantity carried by motion, fields and other physical arrangements; it can be transferred or converted. A model supplies rules for calculating their behaviour.

The origin story below presents VERSF's proposed interpretation. Specific calculations support particular steps under stated assumptions; a complete derivation of our universe is still the goal. The guide will show where the mathematical work fits into that goal.

## 2 From underlying possibility to a difference that lasts

### What does VERSF mean by the void

Start by setting aside the picture of empty space. An empty room already has distances, directions and time passing. In the foundational VERSF account used here, the void names the proposed ground of possibility before those familiar features are defined. It is not a dark room, a hidden gas or a reservoir into which energy can be poured.

This is the deepest starting point of the proposal: what makes a structured reality possible at all? It is a philosophical starting point, with stated assumptions. The void paper explicitly leaves the physical origin of the first differentiation open.

### Why a difference matters

Imagine a page with no marks and then a page with two different marks. With the second page, there is something to distinguish and a relationship to describe. "Distinguishable" simply means that alternatives can, in principle, be told apart by an appropriate physical process. It does not require a person looking.

The page only illustrates the idea of a difference. A real page already has space and matter, so it cannot show how the void becomes structured. The step VERSF needs to explain is precisely how a ground with no such structure can support the first physical distinction. Giving that step a name does not yet explain its mechanism.

### A changing difference and a kept difference

Move a finger through the air and then press it into soft clay. Both involve change, but the clay can retain a trace. That gives us an everyday picture of the distinction between change and a physical record of change.



*A touch ends, but its impression remains. A record is a physical trace.*

VERSF calls the keeping of a physical distinction commitment. No intention is implied. Its cosmology distinguishes changes that can be undone, called ticks, from commitments that leave an irreversible record, called bits. Irreversible here means that restoring the original situation would require

recovering changes dispersed into the surroundings, beyond the physical limits being considered. A tick is not a second; a bit here names a committed distinction.

A record can later be damaged or erased; “kept” does not mean indestructible. What matters is that a trace has entered the physical history and that recovering the earlier situation is constrained by the whole process, including the surroundings.

### Where entropy enters

Entropy concerns how many detailed possibilities fit what we know about a system, and how those possibilities are distributed. “The cards are mixed” allows many more arrangements than “the cards are in this exact order”. Recording an outcome narrows the alternatives compatible with that record, while making the record can change the surroundings too. VERSF uses entropy to analyse these changes; entropy is a quantity to calculate, not a substance.

This gives the story its first problem to solve: how can differences become physical, and which of them can leave lasting consequences? The admissibility and record calculations later in the guide address parts of that problem.

## 3 How space and time enter the story

### Relationships before a ready made map

A railway map tells you which stations connect, even when the drawing gives poor distances. Connections and measured distance are related ideas, but they are not the same thing. This helps us imagine asking about relationships before assuming a complete map of space.



*Connections tell us which routes are possible. Measuring their lengths asks a further question.*

VERSF asks whether places and distances could arise from relationships between physical distinctions, rather than be a ready-made stage. Its cosmology proposes that accumulating lasting records increases the spatial extent that can be physically distinguished. The papers call this unfolding. This is meant to describe physical space; the “spaces of possibilities” introduced later are mathematical maps and serve a different purpose.

This is a proposed physical connection, not a consequence of merely counting things. A pile of receipts does not create extra space. The theory must supply rules relating its particular physical commitments to distances, volume and observations. Later chapters explain why geometry and a measuring rule are needed.

## **A history gives change a direction**

Imagine a trail of footprints. The marks let later events retain evidence of earlier ones. In VERSF's proposed account, accumulated irreversible commitments provide the basis for physical history and for the direction we call past to future.

Ordinary clocks measure time by comparing repeating processes. The deeper VERSF question is how anything like a clock becomes possible in the first place. Its cosmology gives a rule linking the accumulation of lasting records to elapsed time. Counting records alone does not tell us how many seconds have passed.

## **Where the Big Bang belongs**

In this account, the Big Bang is associated with a change from reversible patterns to widespread irreversible commitment. On larger scales, the model then admits a description in terms of space, time and expansion. A change in collective behaviour is called a phase transition. Water forming ice illustrates how new organisation can appear, although it does not explain this proposed cosmic transition.

In the proposed stage where patterns form but their changes can still be undone, there is already more structure than in the featureless void. These are different steps in the explanation. VERSF still needs to explain the physical connections from the void, through those changing patterns, to the expanding universe.

## **What does before mean here**

At this foundational level, "before" means underlying in the explanation, rather than a date on an earlier cosmic clock. We should not imagine the void waiting for billions of years, getting hotter, or finally deciding to change.

The aim is to explain how a universe acquires a physical history and spatial organisation. To connect this proposal to the observed universe, VERSF must recover the hot, expanding history that cosmological evidence describes. The origin picture and that observational task belong together.

# **4 Why different particles and forces could appear**

## **A lasting thing can be an organised process**

Watch a whirlpool. Water moves through it, yet a recognisable pattern persists for a while. A guitar string offers a second example: the same string can support different organised vibrations. These pictures help us imagine physical identity arising from a pattern and its behaviour.



*The water changes while the whirlpool remains recognisable. An analogy for persistence through organisation.*

VERSF explores whether different organisations of the same underlying system can behave as different particles. A fold names structured differentiation, rather than a crease in a material sheet. A mode is a particular pattern of change. A resonance is a response that is especially strong at a particular rhythm. These words identify features to calculate; none by itself establishes that a pattern is an electron or a quark.

The proposal is not that electrons are water vortices or vibrating guitar strings. A successful particle account must explain the actual properties of electrons, quarks and the other particles, including how they interact. The pattern must reproduce those measured properties.

### **Why some patterns last**

A pattern can be disturbed, reorganised or broken apart. The theory needs to explain which changes are possible and how difficult they are. Think of a ball settled in a bowl: small nudges and large pushes can have different consequences.

This is where ridges, basins and stability enter the story. They help describe how one organisation can remain recognisable while another fades or changes. When conditions change, the patterns that can persist or be produced may change too. We must calculate this rather than assume every pattern survives.

### **Why more than one kind**

One guitar supports more than one note because its rules allow different organised motions. Similarly, VERSF asks which patterns its rules allow, which are genuinely different and which physical properties distinguish them. Modes and eigenvalues are tools for answering those questions. An eigenvalue is not automatically a particle mass; its meaning depends on the calculation.

### **Why particles must be able to affect one another**

Separate persistent patterns would not yet explain an interacting world. The theory also needs to describe how a change in one part affects the surrounding organisation and other patterns. That is where the field and force calculations enter.

To calculate an interaction, VERSF must compare the pattern at neighbouring parts of the model, identify a meaningful change, and calculate the response. Transport supplies the comparison rule; holonomy checks it around a closed route. Chapters 12–13 explain these ideas. Chapters 14–17 ask which patterns respond and by how much. This is the route from organisation towards a force strength.

Gravity adds the question of how spatial and temporal relationships respond to physical organisation. VERSF seeks a shared foundation for that response and particle physics. The gauge calculations later in this guide address specific interaction questions; they are not a complete derivation of gravity or of every particle.

## 5 From early patterns to the world in your hand

### Cooling changes what can stay together

Imagine trying to build a house of cards on a vigorously shaking table. Slow the shaking and arrangements that kept falling apart may survive. In the early universe, energetic encounters could break apart bound structures. Cooling made lasting combinations possible.

Cooling means that the typical energy of encounters decreases. Bound structures that were repeatedly broken apart can then survive. In the established cosmic history, quarks became bound into protons and neutrons. During the first few minutes, some joined into light atomic nuclei. Around 380,000 years later, electrons could remain bound to nuclei, forming neutral atoms. Making particles and assembling them into atoms are different stages.

### Larger structures become possible

Gravity gathered gas into stars and galaxies. Stars produced many heavier elements, and stellar processes spread enriched material. Later generations of stars and planets formed from it. On planets, atoms could join into molecules and materials. The familiar cup is one late arrangement of ingredients with a long cosmic history.



*Everyday matter has a cosmic history. This illustration is not a scale drawing or a timetable.*

VERSF seeks to explain the underlying particle patterns, interaction rules and space-and-time behaviour. The known sequence of cosmic assembly gives that ambition concrete requirements.

### The whole proposed picture

Start with the proposed ground of possibility. Ask how distinguishable structure can arise and how some changes become lasting physical commitments. Ask how those relationships support space and time, which organised patterns behave as particles, and how they affect one another. Then follow what those ingredients can build as cosmic conditions change.

This order of explanation matters. First establish what the proposed system contains and can do. Then show that some of its patterns have the properties of particles and interactions. Finally ask whether

those ingredients reproduce the observed cosmic history. The later universe provides tests of the earlier claims; an appealing origin story alone is not enough.

### **Where to go next**

The next three chapters fill in the particle picture. Chapter 6 explains the different particle roles. Chapter 7 explains the three-generation argument. Chapter 8 works through the quark mass-ratio grid, including the assumptions behind its numbers.

Chapters 9–11 then explain how arrangements, stability and geometry make those questions calculable. Chapters 12–17 connect comparisons, loops, modes, symmetry and records to physical responses. Chapters 18–19 explain comparison with measurements and take stock of the results.

### **What remains to be connected**

The sources used here do not yet provide one completed calculation from the featureless void to the full observed universe. They offer an origin proposal and mathematical investigations of particular links. The cosmology paper reports comparisons with expansion-related observations while leaving further tests of cosmic structure growth open. The first differentiation and several bridges to final particle and force predictions remain research problems.

Keep three questions in view: What makes this particle a particular kind? Why are there three versions of the same kind? What determines how much mass each version has? The mathematical tools should earn their place by helping answer these questions.

## 6 What makes one particle different from another

An electron is not simply a lighter quark. Particle types differ in which interactions they take part in. A charge measures how a particle participates in a particular interaction. Electric charge governs electromagnetic behaviour; other interactions have their own kinds of charge. Mass is a separate property, associated with resistance to acceleration and rest energy. It is not the same as weight, which depends on gravity.

### The repeated pattern in the particle list

The table groups matter particles by role. Each column is a generation: another set with the same basic roles but different masses. Charges use the proton's electric charge as +1, so an electron has  $-1$  and a quark can have a fractional value. "Up" and "down" are names, not directions. Quark "colour" is also a label, not a visible colour.

| Particle role                             | Generation 1      | Generation 2  | Generation 3 |
|-------------------------------------------|-------------------|---------------|--------------|
| Up-type quark<br>Electric charge $+2/3$   | up                | charm         | top          |
| Down-type quark<br>Electric charge $-1/3$ | down              | strange       | bottom       |
| Charged lepton<br>Electric charge $-1$    | electron          | muon          | tau          |
| Neutral lepton<br>Electric charge 0       | electron neutrino | muon neutrino | tau neutrino |

The strong interaction binds quarks into particles such as protons; quarks carry its colour charge, while leptons do not. Electromagnetism acts on electric charge and helps hold atoms together. The weak interaction allows particle transformations, including some radioactive decays. Neutrinos are electrically neutral leptons with weak interactions. The table names them by their weak-interaction partners; the states with definite masses are mixtures of those labels.

### Same role does not mean same mass

Ordinary atoms use first-generation electrons and up and down quarks. The heavier generations appear in energetic processes and their unstable members decay into lighter particles. "Generation" therefore does not mean an earlier or later era of the universe. An electron, muon and tau share their electric charge and basic roles, despite their very different masses.

VERSF's proposed explanation follows that distinction. The way a pattern connects to the interaction structure determines its role. The way it couples to the mass-producing structure determines its mass. Keeping the same role does not require keeping the same coupling strength.

## Why VERSF needs the whole set

In the census calculation, a particle species is a distinct physical role in a completed, consistent record. “Completed” means that the required connections and consistency conditions are satisfied. It does not mean a person has observed the particle, or that the particle can never decay.

The argument begins with paired weak-interaction roles and a three-way colour branch. Together they provide the quark side. The calculation then checks whether that side can stand alone. It cannot: under the stated premises, its quantum bookkeeping is inconsistent. Adding the colourless lepton roles supplies the minimal completion. This is why the proposed derivation seeks quarks and leptons together.

The technical word for this consistency failure is an anomaly. Here it means that rules which work at one stage of the description cannot all remain true in the quantum theory. It is closer to an account that cannot balance than to an unusual experimental event. Anomaly cancellation is an established requirement of particle physics; VERSF uses it inside its proposed explanation of which roles must exist.

## Where the Higgs enters

The theory describes charged matter using two kinds of mathematical component, called left-handed and right-handed. These are technical labels, not little hands or two halves of a ball. The weak interaction treats them differently. In the usual Higgs mechanism, an allowed connection between them supplies a mass. The VERSF census identifies the required partner roles; explaining the strength of their Higgs connection is the separate mass problem.

A field and a particle are related but different ideas. A Higgs particle is a particular excitation of the Higgs field, rather as a ripple is a disturbance of water. The analogy is limited: the Higgs field is not a liquid. Photons, gluons and the weak W and Z particles are associated with the other interactions. They are not additional entries in the matter-family table.

## What the census does and does not give

Under the VERSF attachment and consistency premises, the calculation returns the minimal familiar particle package. The electric-charge pattern is a consistency result known since 1989, which the VERSF rules reproduce rather than discover. This explains how the roles fit together within the framework; it does not obtain their masses just by counting them. The generation argument and the mass calculation are the next two steps.

Nor is the mass of an ordinary object simply the sum of its quark masses. Much of a proton’s or neutron’s mass comes from the energy of the strong interaction inside it. The quark mass ratios in Chapter 8 concern the individual quark mass parameters, not the full mass of the bound proton.

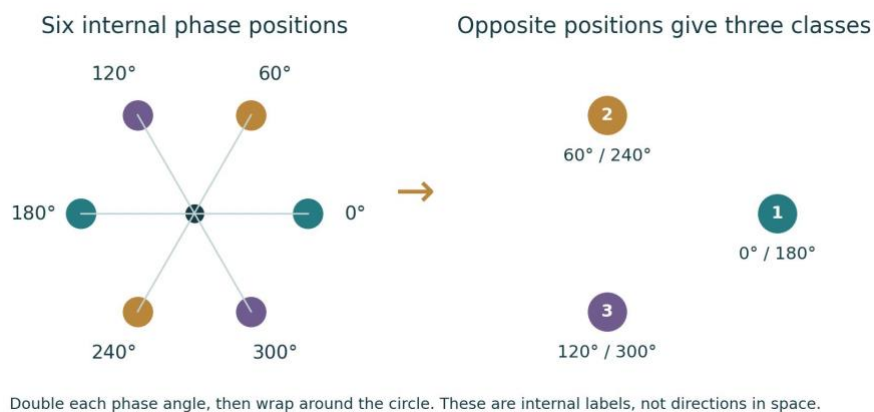
*Sources: The Generation and Species Census Theorem in VERSF (SC-1), Sections 1 to 3; The Yukawa Hierarchy Theorem, charge versus completion-density distinction.*

## 7 Why the pattern repeats three times

A generation repeats the particle roles listed in Chapter 6. Why three repetitions? SC-1 combines a three-part structure inherited from earlier VERSF work with a separate classification into three families. Its key assumption is that these two groups of three correspond. The steps below explain both the counting and what the counting leaves unproved.

### How six internal positions can give three classes

SC-1 uses an earlier VERSF construction with a centre and six surrounding positions. This guide takes that construction as an input, rather than deriving its selection here. One selected pattern has six phase positions. Phase means position within a repeating cycle, like the angle on a dial. These internal labels are not six particles or six locations in ordinary space.



*The same colour marks a pair that becomes indistinguishable under the specified angle-doubling rule. The diagram shows the rule's result, not six particles turning into three.*

The selected rule doubles each phase angle. Zero stays zero; 180 degrees becomes 360 degrees, which is back at zero. Each of the other opposite pairs also ends at the same angle, leaving three classes. The notation  $Q(z) = z^2$  expresses this rule in the paper. The rule follows under its specified assumptions; simply choosing a rule because it yields three would explain nothing.

### Why three classes become three generations

The census takes over from an earlier VERSF calculation the statement that there are three independent layers for completing the physical record. Each layer requires its own complete, internally consistent particle package. The VERSF census paper (SC-1) assumes that these three layers correspond to the three family classes described above. Given that assumption, its uniqueness proposition shows that the matching is fixed up to relabelling; no further choice remains. The proposition does not prove the assumption itself. That identification remains an open bridge in the argument.

“Unique up to relabelling” means that renaming the three families leaves the same matching; it does not mean the identification has been proved. The conclusion still depends on the inherited layers and the assumed correspondence. Neither three spatial directions nor three quark colours supplies that missing argument. Even a successful count would leave a further question: why do the three generations have different masses?

*Source: The Generation and Species Census Theorem in VERSF (SC-1), Section 5. The three-layer structure is inherited; its identification with the three family classes is a stated, still-open premise. Uniqueness up to relabelling holds only once that premise is assumed.*

## 8 How the quark mass ratios are calculated

The starting question is simple: if particles are enduring patterns in one underlying system, why should some patterns have much more mass than others? VERSF is trying to explain the differences from the way those patterns are organised. The ratios are the numerical test of that idea.

### 1. A particle must maintain a distinct pattern

In the VERSF picture introduced earlier, a particle is not a tiny piece of material added to the universe. It is a pattern that remains distinguishable within the underlying system. Its internal relationships must fit together consistently. The papers call this requirement closure. Here, closure means satisfying those relationships; it does not mean putting the particle inside a physical shell.

This makes the pattern's organisation physically important. How does it hold together? What changes are possible without losing its identity? How strongly does the underlying structure resist those changes? These are questions VERSF can try to calculate before assigning a particle a mass.

### 2. The same charge can conceal a different organisation

Down, strange and bottom quarks have the same electric charge and basic interaction roles. VERSF proposes that charge reads one aspect of their structure, while mass reads another. A change in the second aspect can therefore alter mass without altering charge. This is why repeating the particle roles across generations need not repeat their masses.

The hierarchy paper describes the mass-related difference as anchoring: how strongly a pattern is tied into the underlying structure. This is not an anchor holding it still in space. It is a proposed measure of its structural connection. Stronger anchoring is proposed to mean greater mass, but deriving that connection remains part of the work.

### 3. Turn "anchoring" into something we can calculate

The closure-response work makes this idea more specific. Disturb the underlying structure slightly and calculate its resistance. Different changes can meet different resistance, just as bending and stretching the same material need not be equally easy. Then work out which of those responses each particle can access through its own connections.

VERSF proposes that the response available through those connections determines the particle's coupling to the Higgs field. The usual Higgs mechanism then supplies the mass. The aim is to explain the coupling numbers, rather than simply enter their measured values. The mathematical link from the underlying response to the Higgs coupling is still conditional.

### 4. Why the numerical recipe has these ingredients

The ratio papers investigate how tightly the pattern is confined, how much of the structure remains available to contribute, and how many allowed connections contribute. Those are proposed ways to quantify the organisation and access just described. They motivate the confinement factor, the fraction  $1/12$  and the factor 3 in the example that follows.

A ratio compares two masses, so the common Higgs scale cancels and the relative couplings remain. But the physical story does not, by itself, establish the numerical recipe. The next pages separate what is calculated from the structure from what is inherited or still assumed.

## **Following the bottom-to-strange calculation**

### **1. A factor for how tightly the pattern is confined**

The earlier VERSF localisation calculation describes how tightly a pattern is confined as one moves between generations. Its geometry supplies a rate of change,  $8/3$ . The mass construction uses twice that rate in an exponential rule, giving about 207.13. An exponential rule describes repeated multiplication; its mathematical shorthand here is  $e^{(16/3)}$ .

This is the origin of the large number, but not a complete derivation of a mass ratio. The geometry supplies  $8/3$ ; the extra factor of two that turns it into  $16/3$  still needs a physical justification. The quark calculation inherits this rule from the charged-lepton work. It does not independently prove it.

### **2. A fraction for how much can contribute**

The calculation also uses a network with a central point and six surrounding points. Its links describe the proposed structure, not seven little particles inside a quark. When the network is disturbed, it has different possible patterns of response. The calculation assigns a response value of 2 to the relevant pattern and a total of 24 to the network. Comparing them gives  $2 \div 24 = 1/12$ .

The paper interprets this fraction as what remains available to contribute after the structure has met the requirements for maintaining itself. An everyday comparison is a household budget: the total income is not the amount left after regular commitments. Crucially, the fraction  $1/12$  is calculated from the specified network before looking at particle masses. Its mathematical origin is firmer than the unfinished connection from that network to physical mass.

### **3. Three possible contributions**

The proposed structure has three independent allowed ways to contribute at this stage. The bottom-to-strange rule counts all three, so it multiplies by 3. Counting the available ways and proving that all three contribute to this particular mass ratio are different tasks. The second task remains open.

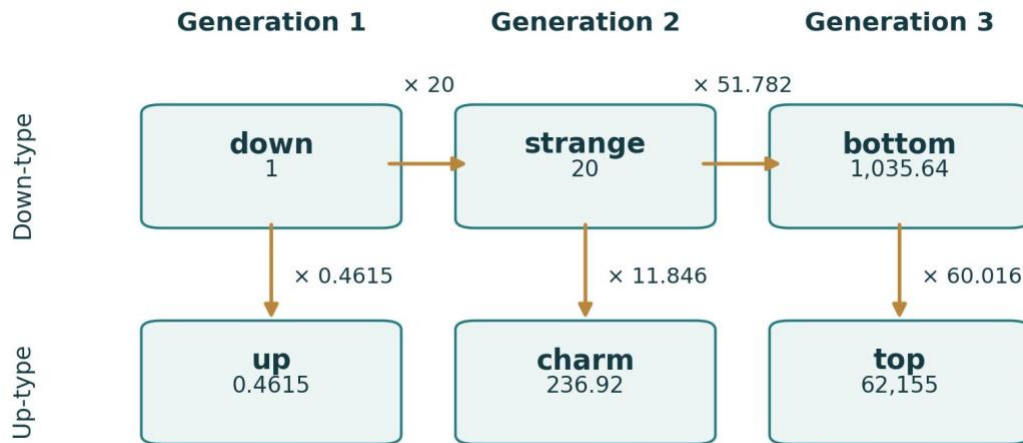
## **Putting those ingredients together**

$$207.13 \times 1/12 \times 3 \approx 51.78$$

So the proposed bottom entry is about 52 times the strange entry. That number has a traceable recipe: confinement factor  $\times$  available fraction  $\times$  number of contributions. It is a conditional result: the arithmetic follows, but the physical assumptions behind two of those ingredients still need to be established.

## How the other quarks enter the picture

The diagram puts the six entries together, with down set to 1 as a reference. The arrows are multipliers. These are the later MCHY-1C paper's proposed relative coupling values, before the conversion required to compare physical quark masses on the same footing.



Conditional coefficient grid before energy-scale conversion. Down = 1 is the chosen reference.

Read across the top row first, then follow each downward arrow. Values are rounded; the entry for the top quark is 62,155.

## Where do the remaining arrows come from?

Down to strange: the factor 20 is supplied by a separate calculation used by the paper. The network argument above does not derive it. Strange to bottom: the factor 51.78 is the worked example on the previous page.

Down to up: the proposed rule uses the seven-part structure in the expression  $(7 - 1) \div (2 \times 7 - 1)$ , giving 6/13, about 0.462. Knowing that there are seven parts does not explain why this particular expression should determine a mass ratio. That choice still needs independent justification.

The later assembly obtains charm/strange by multiplying 6/13 by 77/3, giving 11.846. The next multiplier is the square root of 77/3: about 5.066, a number which gives 77/3 when multiplied by itself. This gives top/bottom = 60.016. The rule builds the numerical pattern; why the underlying physics must choose this rule remains to be established.

With the arrows supplied, charm follows as  $20 \times 11.846 \approx 236.92$ . Explaining the arrows is harder. Why is up lighter than its partner, while charm and top are heavier than theirs? VERSF proposes unequal access to the underlying response; calculating that access remains unfinished.

## What has been achieved?

This is a connected numerical proposal, with some ingredients calculated from a specified structure. It is not yet a complete derivation of every ratio. The remaining assumptions must be justified, and the values converted to a common energy scale for comparison with measured masses.

Sources: *The Yukawa Hierarchy Theorem*, Sections 4–6; *The Conditional Quark Mass-Ratio Grid*, Sections 3–7 and 10–11; *Quark Mass Ratios from Fold-Selective Accessibility*, Sections 1 and 17–19; *The Closure-Operator Yukawa Construction*; *The Microscopic Closure-Hessian and Full Yukawa Evaluation Theorem in VERSF (MCHY-1)*, Sections 37–38. The grid uses its later conditional assembly.

## 9 How can one underlying system make different things?

Chapter 8 proposed that organisation and access determine mass. To test that idea, we must specify an arrangement precisely and calculate its allowed changes. The next three chapters build that description: first the possible arrangements, then their stability, then a way to measure differences between them.

### Picture a screen

A screen can show a face, a tree or a moving wave. It does not need a different kind of screen for each image. The differences come from how its parts are arranged and how that arrangement changes.



*The same kind of screen supports very different images through different arrangements of its parts.*

This helps picture an ambition within VERSF: to explain different physical structures through differences in underlying organisation. The screen is only an analogy. It gives us a starting question: what must we describe if we want to work out how an organised pattern behaves?

### First, describe the whole arrangement

On a mixing desk, one complete choice of slider settings is one arrangement. Change a slider and you have another. The technical word for a complete arrangement is configuration.

In VERSF, an arrangement can specify neighbouring states, the links comparing them, currents describing flows or transfers, and records left by earlier events. The model must say what each represents. Changing a link while holding its current fixed need not give the same answer as allowing both to change. “The structure responds” is therefore incomplete until we say what is varied and what is held fixed.

### What does a “fold” contribute to the picture?

Folding paper changes relationships within one sheet without adding a new material. That is the limited point of the fold analogy. VERSF must replace this picture with variables and rules specifying its physical pattern. A drawn fold does not yet specify its charge, its mass or its allowed changes. Those are outputs the construction must earn.

## Which changes are actually allowed?

A lamp may let you adjust brightness and colour separately. Each independent control is called a degree of freedom. The collection of possible settings is called state space or configuration space. This is a space of possibilities; it need not mean extra directions in the room.

Not every arrangement we can imagine is necessarily allowed by the model. Admissibility means meeting its rules. VERSF's Physical Admissibility Framework proposes limits on the distinctions a physical system can support and constraints on turning a distinction into a lasting record. Think of the difference between drawing a building and showing that it can be built.

## Why VERSF needs these ideas

They turn “there is an underlying pattern” into questions we can answer: What specifies it? What can change? What must stay fixed? Without those answers, we cannot calculate whether the pattern lasts or how it responds when disturbed.

# 10 Why do the papers describe hills, valleys and ridges?

A proposed particle pattern must remain recognisable long enough to have a physical role. The landscape picture helps formulate that stability question; a valley alone does not identify a particular quark.

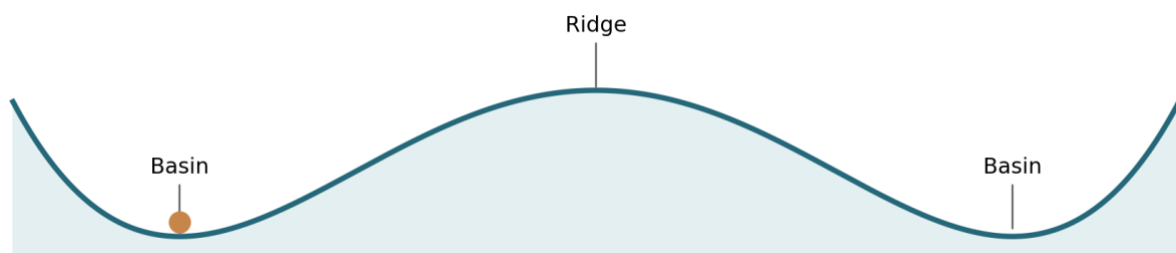
## The question behind the picture

Some arrangements may be easier to reach than others. Some may last; others may quickly change. VERSF needs a way to describe those differences. A landscape is a picture of how a chosen quantity varies from one possible arrangement to another.

## Imagine a ball in a bowl

Nudge the ball slightly and it tends to return towards the bottom. Push it far enough and it might leave the bowl. The shape helps us picture a pattern that can withstand small disturbances.

Now imagine two bowls separated by a raised crest. That crest is a ridge. It helps us picture why moving within one region might be easy while reaching another requires a larger change. A basin is the region leading towards a particular resting place under the movement rule being considered.



*A schematic landscape: two basins separated by a ridge. The height must be defined by the particular model.*

## What do the heights stand for?

They must stand for something specified in the calculation. Height might represent energy: a larger number means more energy in that arrangement. In another picture it could represent probability, meaning how likely an outcome is. The earlier VERSF papers also use entropy landscapes.

Entropy concerns how possibilities are distributed and, in suitable settings, how many detailed arrangements fit the same broad description. There are many ways for a deck of cards to look shuffled and few ways for it to be perfectly ordered. The card example gives the basic idea; the calculation supplies the precise definition.

These different landscapes must be read differently. A low point on an energy map is not automatically a low point on an entropy map. VERSF has to say what the height represents before drawing conclusions from the picture.

## Two useful words: slope and curvature

Gradient is the mathematical name for the steepest increase of the chosen quantity. Curvature of the landscape describes how its slope changes. A gently rounded bowl and a sharply curved bowl react differently to a nudge. When the landscape represents energy, this helps us calculate resistance to a small disturbance.

## Why VERSF needs these ideas

VERSF needs both a landscape and a rule for change. The landscape can reveal whether small disturbances stay near one arrangement or lead towards another. The change rule determines the actual motion and its speed. Together they address persistence and transitions; a valley drawn on its own neither predicts a lifetime nor identifies a particle.

# 11 Why is a space of possibilities called “geometry”?

The mass calculation compares different organisations and their responses. Geometry supplies a consistent way to measure those differences without confusing a change of labels with a change of physics.

## Geometry is about relationships as well as shapes

Suppose a lamp has a brightness control and a colour control. You can draw a map of its settings: move right to increase brightness and up to change colour. The map describes possible states of the lamp, not places where the lamp can stand.



*Brightness and colour give two independent ways to change a lamp's state.*

VERSF uses this kind of reasoning for more complicated arrangements. A point can stand for a whole state. A direction can stand for a particular way to change it. This lets the calculation compare possibilities without listing every one separately.

### **How big is the difference?**

A one-step change on a brightness dial and a one-step change on a colour dial are not automatically comparable. We need a rule for measuring differences. The technical name for such a local measuring rule is a metric.

In one VERSF calculation, the question may be how easily two states can be told apart. In another, it may be how much energy a change requires. Those are different questions. A tiny change can be easy to detect without being expensive to produce.

### **Coordinates and basis: the labels and the controls**

Coordinates are the numbers used to locate a state on the map. A basis is a set of independent changes from which other changes can be built. For our lamp, brightness and colour provide two useful controls. Another description could use combinations of them without changing the lamp.

A manifold is a space that can be described in local map patches, much as an atlas describes different parts of the Earth. In VERSF, those patches may describe possible arrangements rather than parts of physical space. The word helps mathematicians handle complicated spaces using manageable local descriptions.

### **Simplify carefully**

A projection retains part of a description, as a shadow keeps width but loses depth. A quotient groups descriptions of the same physical situation so that they are counted once. Celsius and Fahrenheit illustrate how different numbers can describe one temperature. These operations have different risks: a projection can lose physical information; a quotient should remove only the equivalences the model justifies.

Why VERSF needs this: some differences in a calculation are meaningful and others come only from the way we describe things. Removing the wrong difference could erase a real effect. Keeping duplicate descriptions could make one effect appear to be several.

### **The purpose**

The result is a language for calculating a small disturbance without depending on arbitrary labels. This is needed in Chapter 8's mass programme and in the force calculations that follow. We next ask how separately described neighbouring parts can be compared consistently.

## **12 How do we compare neighbouring parts?**

### **Watch ripples meet on water**

Where two sets of ripples meet, a crest meeting a crest makes a larger rise. A crest meeting a trough can partly or completely cancel it. Phase describes where a wave is within its repeating cycle. Their relative phases help determine how the waves combine.



*Overlapping ripples evoke how waves reinforce or cancel according to their relative phase.*

The relationship between phases matters for waves. Contributions can reinforce one another or partly cancel, depending on how they line up. VERSF's calculations need to keep track of comparable relationships in the underlying states.

### **Now give each dial a different zero mark**

Imagine neighbouring dials whose zero marks have been drawn in different places. You cannot compare their written angles until you know how their reference marks relate. A difference in the numbers might come from the hands or merely from the markings.

### **Link, connection and transport**

A link joins neighbouring places in a mathematical model. It can carry a rule for comparing what is described at one place with what is described at the next. A connection is the local comparison rule. Transport means following that rule along a route.

The thing being compared might be a phase or an orientation. Transport therefore need not mean that a piece of matter is physically travelling. In VERSF's link calculations, it tells us how to relate neighbouring parts of the proposed field description.

### **Gauge freedom: change the markings, keep the relationship**

Moving a dial's zero mark changes the written angle even if the hand does not move. If the comparison instructions are updated consistently, the underlying relationship is preserved. Gauge freedom is the more general mathematical version of this freedom to change local references.

Gauge invariant means unchanged by those permitted reference changes. VERSF needs this distinction so that a change of labels is not mistaken for a physical effect. The calculations seek relationships that survive the choice of description.

### **Why the order can matter**

Rotate a book about its long edge, then about its short edge. Reversing the order generally gives a different final orientation. Rules for which order matters are called non-Abelian; rules for which it does not are Abelian. Strong and weak interactions use order-sensitive mathematics. VERSF must therefore preserve the order of its relevant comparisons.

The purpose: transport lets VERSF connect local descriptions consistently. Gauge freedom helps separate what actually changed from what was merely renamed. We can then ask what happens when the comparisons lead all the way back to the starting point.

## 13 What can a round trip reveal?

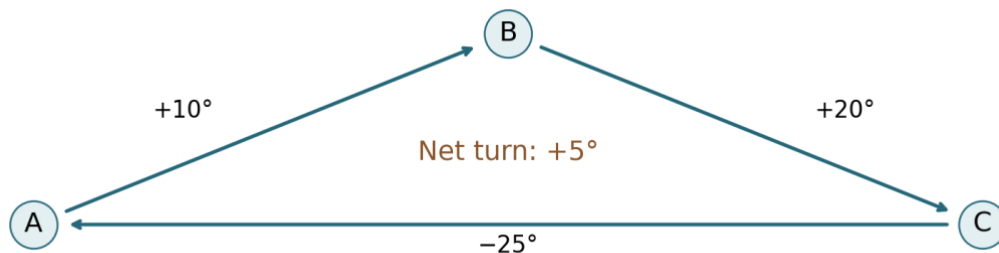
### The idea behind holonomy

Follow a sequence of comparison instructions around a loop and return to the starting point. Does the compared state return unchanged? The net transformation after that round trip is called holonomy. It can be no change at all, or it can leave a mismatch.

### Try a simple dial example

Imagine three places, A, B and C, with an instruction for comparing a hand from one place to the next. Going from A to B adds ten degrees. From B to C adds twenty. From C back to A subtracts twenty-five. The complete loop leaves a five-degree turn.

This is an invented example. Its comparison instructions contain more than differences between three dial labels: label differences alone would cancel around the loop. The five-degree remainder represents extra structure in the connections. Consistently changing each dial's zero mark cannot remove it. That is why a closed loop can reveal more than a comparison of two written angles.



*Follow A to B to C to A. The three comparison instructions leave a five-degree turn.*

### What VERSF uses it for

A recent VERSF calculation examines small triangular loops. It combines the comparisons around each loop and then combines several loops in a particular alternating pattern. This tests whether the model retains information about the direction of a small phase change.

That is a more precise question than “does the structure remember something?” The calculation identifies a particular comparison and works out whether changing the underlying pattern changes its result.

### Why a simpler record might miss the difference

Picture a hand pointing to the right. Tilt it a little upwards or a little downwards. Its horizontal shadow has the same length in both cases. The shadow tells you something about the hand but loses which way it tilted.

The VERSF calculation encounters a similar loss. Keeping only one part of the mathematical description can hide opposite phase changes. Retaining the fuller loop comparison reveals a distinction that the simpler summary misses. The next question is whether the physical recording process keeps that distinction too.

## Curvature: the local mismatch

When such comparisons are made around sufficiently small loops, the mismatch reveals what is called the curvature of the connection. Here, curvature is about the comparison rule; it need not mean that a material surface is visibly bent.

The loop tells VERSF which field change is present, independently of arbitrary local labels. To obtain an interaction strength, it must then calculate the response associated with that change. The next chapters separate the possible response patterns and use symmetry to simplify that calculation. Detecting a mismatch and explaining its physical cost are different steps.

# 14 Which patterns of change belong together?

## Listen to a guitar string

A plucked string can move in several organised patterns at once. Describing those patterns helps us understand its sound. We do not have to treat every moving point as an entirely separate event.



*A string can support several organised patterns of vibration. The painted waves are illustrative.*

VERSF faces a similar problem. A change in its underlying arrangement may contain several simpler patterns. To understand the result, we need to separate those patterns and find out how the system responds to each.

## Mode: a pattern of change

A mode is one organised pattern. Imagine six small platforms joined by springs. They might all move upwards together, or alternate with one up and the next down. These are different patterns, even though the same platforms take part.

## Operator and matrix: the rule and its table

An operator is a mathematical rule acting on what we describe. A matrix is a table of numbers that can represent such a rule. For the platforms, the table could tell us how much restoring force appears at each platform when another is moved a little.

## Eigenvector and eigenvalue: the pattern and the multiplier

Usually the rule mixes an input pattern into a different output pattern. An eigenvector is a special nonzero pattern that comes back in the same proportions. Its overall size can change, but the proportions within the pattern are preserved.

For example, a mathematical rule might turn the pair of numbers 1 and 2 into 3 and 6. The second pattern is three times the first, so three is the eigenvalue for that pattern. This example illustrates a multiplier; it is not a particle calculation. In a physical calculation, the number's meaning and units depend on the rule being used.

### The VERSF connection

The gauge-work calculation studies six linked changes with hexagonal symmetry. Fourier analysis separates their combined behaviour into regular patterns, like separating a chord into notes. Under the paper's assumptions, selected patterns are assigned roles in describing the strong interaction and the linked electromagnetic and weak interactions. This assignment needs a physical justification as well as a mathematical decomposition.

The same distinction appeared in Chapter 8: knowing an allowed pattern is not the same as knowing its mass contribution. Here the target is an interaction strength. The calculation needs the physical resistance associated with each relevant pattern, plus the rule converting that resistance into a coupling.

### Two extra words you may see

Spectrum means the collection of eigenvalues. Degeneracy means that different independent patterns share an eigenvalue. The purpose of all this vocabulary is to separate "which pattern?" from "how much response does it produce?"

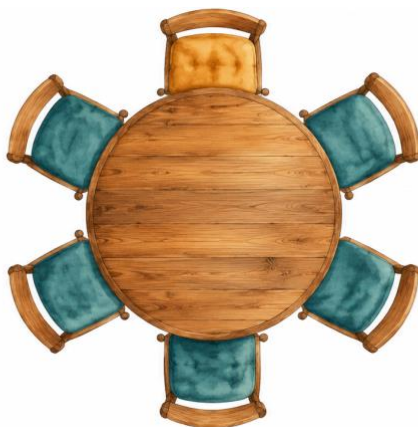
## 15 Why can thirty-six answers reduce to four?

### A small calculation can still contain many questions

With six linked parts, we could move each one in turn and examine the response of all six. That gives six times six, or thirty-six entries in a table. But some entries may have to agree because the setup treats them in the same way.

### Picture six seats around a round table

Choose one of six equally spaced seats. Another seat can be the chosen seat itself, one place away, two places away or opposite. Turning the whole arrangement does not create a new kind of relationship.



*From the highlighted seat, the relationships are self, one seat away, two seats away and opposite.*

This is symmetry: a change of viewpoint or arrangement that preserves the relevant structure. A regular hexagon has rotational and mirror symmetries. In the paper's notation, that set of symmetries is called  $D_6$ .

### **What the VERSF calculation gains**

For the specified symmetric setup, responses related by a rotation or reflection must agree. The calculation also requires reciprocity: exchanging which part is disturbed and which response is read gives the same paired coefficient. The thirty-six entries then fall into four types. This is a conditional simplification of the response table, not a claim that every physical system has only four responses.

The four types describe response on the changed part itself, on a neighbour, two steps away and opposite. This does not guess the four numbers. It tells the underlying calculation which numbers it needs to supply.

### **Why this matters**

VERSF is trying to explain the response from its rules. Reducing thirty-six apparently separate questions to four makes that task more specific. Those four answers can then be combined to give the responses of the organised patterns described in the previous chapter.

The reduction holds for the symmetric setup being considered. If some parts are prepared differently, the same simplification cannot simply be assumed. A balanced table and a table carrying an uneven load need not respond alike.

### **Representation: how does a change act on this kind of thing?**

Rotate your viewpoint and an arrow's written direction changes. A temperature reading does not change in that way. Representation is the mathematical name for how a symmetry acts on the particular kind of object being described.

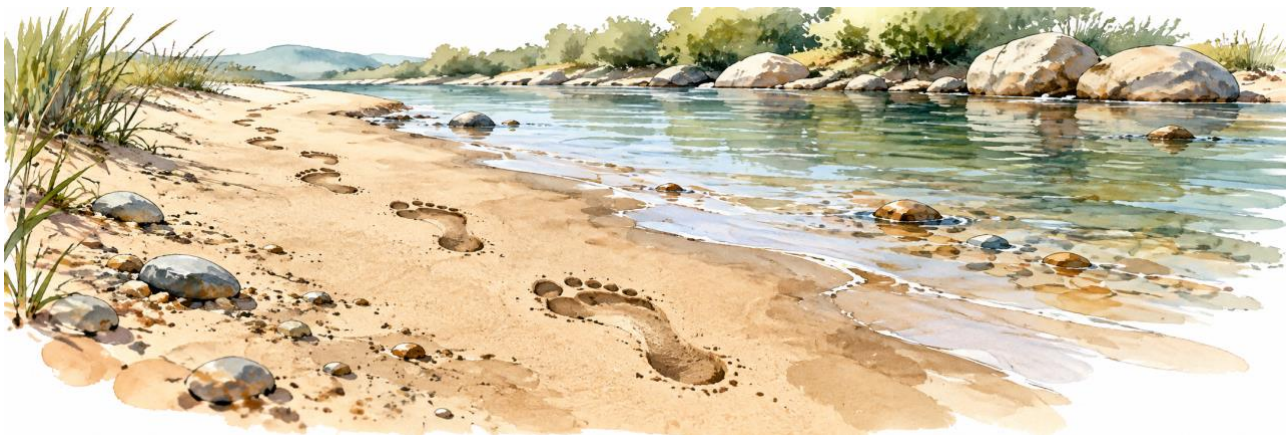
VERSF needs this because different kinds of physical structure need not respond identically. A common starting rule may need contributions that depend on the kind of structure involved. The recent work derives a definite starting set of four numbers under its assumptions, while leaving further physical identification and corrections to be established.

This gives a concrete sequence: calculate four independent response numbers, combine them into the patterns of Chapter 14, then connect the relevant patterns to interaction strengths. Symmetry reduces the work; it does not supply the four numbers or prove their physical interpretation.

## **16 Why does a theory of forces talk about records?**

### **A footprint does not need a reader to exist**

A footprint in mud is a physical trace. It can remain even when nobody sees it. This is the everyday sense of a record that matters here: information retained in a physical arrangement, not necessarily a note written by a person.



*A physical trace can remain even when nobody is there to read it.*

A calculated difference can matter experimentally only if it has physical consequences that can in principle be distinguished. VERSF's recording programme asks which differences survive its proposed process of making records. An instrument reading is one example of a physical record, but the concept also includes traces made without an instrument or observer.

### **History, commitment and Fact**

A history is a sequence of changes. Commitment is the term used for making a distinction retained under the model's recording rule. A completed, kept distinction is called a Fact in these papers. This connects to Chapter 2: a tick describes reversible change, while a bit describes an irreversible commitment. A Fact is the physical distinction kept through that commitment. These terms concern physical records, not a person deciding that something is true.

The connection to forces is a research question: what do the surrounding fields do when such a record is made? The configuration-dynamics paper studies proposed connections between recording events, brief changes in motion and later field behaviour. That is why records appear alongside field calculations.

### **A receipt cannot tell you the whole journey**

A delivery receipt says the parcel arrived. A route log can also say where the van went and in which order. Both are records, but they answer different questions.

Coarse-graining means replacing detail with a summary. If a VERSF calculation needs the order or direction of changes, a summary that drops that information cannot supply it. The loop example in Chapter 13 asks exactly this kind of question: did the final record preserve the difference the underlying calculation could detect?

### **How much can the record tell us?**

Covariance asks whether two recorded quantities tend to rise and fall together. Fisher information asks how much the statistics of possible records change when an underlying parameter changes slightly. If two different underlying changes produce exactly the same record statistics, those records cannot tell them apart. These tools test what the proposed recording process preserves.

But a sensitive thermometer does not tell you how much energy a heater used. Likewise, showing that a record detects a change does not automatically establish the physical cost of producing that change. The recent VERSF papers keep these questions separate.

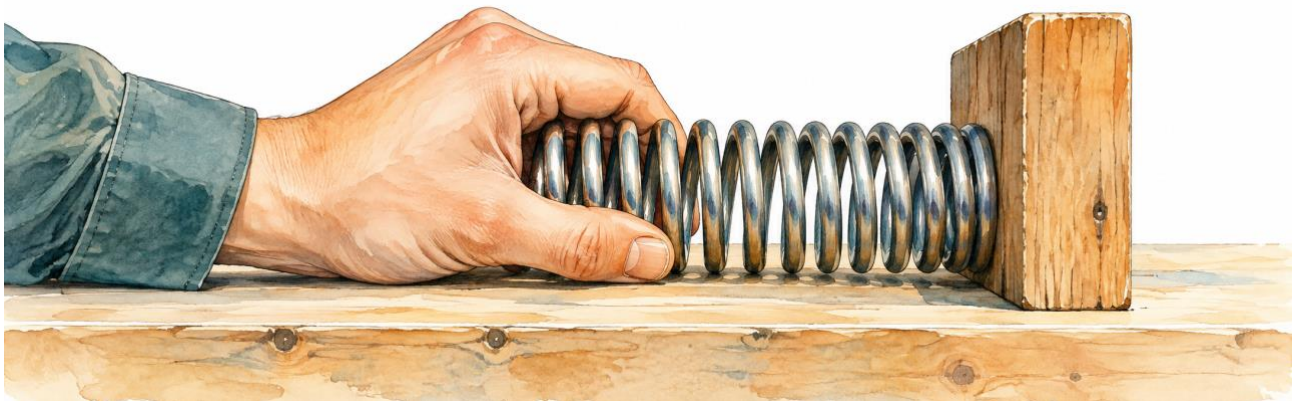
## The purpose

The sequence is now clearer: the loop detects a distinction in the mathematical description; the record analysis tests whether a physical trace can retain it; the work calculation asks what producing the change costs. Each answers a different question. A force prediction needs the links between them, not merely three separate calculations.

# 17 How strongly does the structure resist change?

## Push a spring

A stiff spring pushes back strongly when compressed. A soft spring moves more easily. Stiffness describes how strongly the restoring force changes as the spring is displaced. Physical work is energy transferred by a force acting through a distance; compressing a spring is one example.



*Push the spring and it resists. A response calculation asks how much resistance a change produces.*

VERSF's force calculations need an equivalent quantitative question: when the specified field pattern changes a little, what is the physical response? Knowing the pattern's geometry does not yet supply that answer.

## Derivative and Hessian: measure the response

A derivative measures how one quantity changes as another is varied. For a spring, we might ask how much extra restoring force accompanies an extra millimetre of compression.

A spring's energy rises as it is compressed. The first derivative tells us the slope of that rise; the second tells us how quickly the slope itself changes, which gives the stiffness. For several linked changes, a Hessian collects these second derivatives into a table. VERSF must specify what it differentiates: the Hessian of an energy describes energetic resistance; the Hessian of a statistical score describes that score.

## Let the other parts move too

Imagine a spring attached to a sliding support. Push the spring with the support held still. Then repeat with the support free. These are different experiments: movement of the support can change how much resistance you feel.

Clamped means the other parts are held fixed. Relaxed means the permitted parts are allowed to settle. VERSF calculations need to say which applies. Otherwise two different responses might be mistaken for conflicting answers to the same question.

## Schur complement: account for the hidden adjustment

An auxiliary is an additional quantity tracked in a calculation; a bath is the interacting environment. Some quantities can adjust while we disturb the part we care about. In a suitable small-change energy calculation, the Schur complement gives the resistance left after these adjustments. It combines the direct resistance with the effect of the other parts responding.

Think: “What resistance do we feel after the other parts have adjusted?” That is the useful idea. The precise calculation has conditions, but it is not equivalent to simply ignoring those other parts.

### A few related words

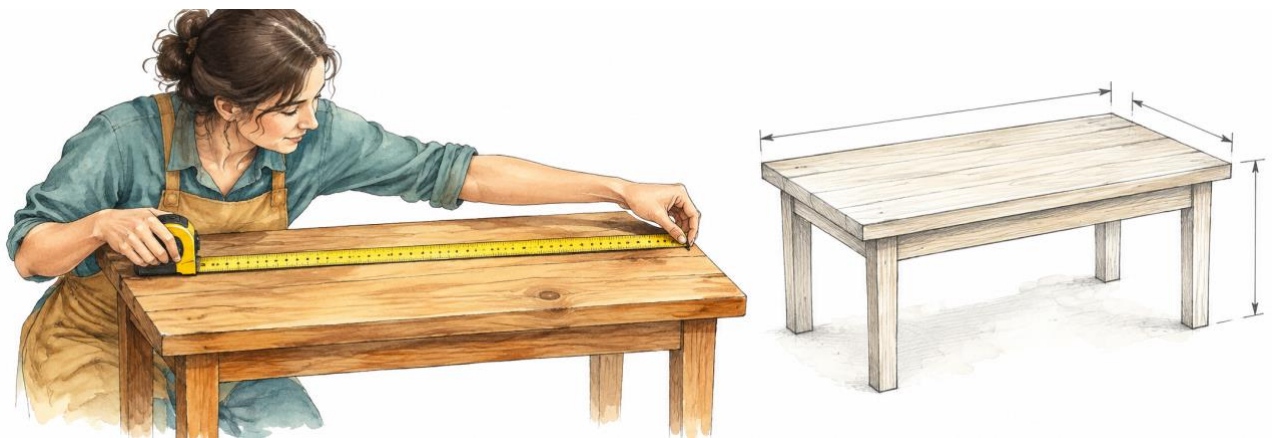
Compliance asks how far something moves for a given applied force. Screening describes a reduction of the relevant effective response. A positive energetic stiffness means a small change costs energy in this calculation. A zero response needs interpretation: it could mean a harmless change of labels or a real motion that costs nothing at the level of detail being calculated.

This is the quantitative counterpart of the anchoring discussion in Chapter 8: which response does a particle or field actually experience after the allowed surroundings have adjusted? The mass and force programmes use response calculations for different physical outputs. Neither can identify a mathematical stiffness with an observed quantity without deriving the connecting rule.

## 18 How does a calculation become a prediction?

### The numbers need a meaning

Suppose two people measure a table and report different numbers because one used inches and the other centimetres. Their disagreement is easily resolved. But if one measured the table’s length and the other its weight, converting units will not make them the same measurement.



*A prediction and a measurement must describe the same property using compatible scales.*

VERSF faces both issues. It must fix the measuring conventions, and it must establish that the calculated quantity is the physical quantity it wants to predict.

### Source-derived: the rules supply the answer

In these papers, the source means the underlying model and how it has been prepared. Source-derived means calculated from those rules. If an observed answer is used to choose an unknown setting, the result is fitted or calibrated using that observation. That may be useful, but it is different from predicting the answer independently.

## **Normalisation and coefficients: agree on the measuring system**

Normalisation sets scales and conventions. Some changes merely alter how a quantity is written, like changing units. But an unknown conversion between a VERSF result and physical work is a missing physical input, not something fixed by choosing units. A coefficient is a multiplier in an equation; a coupling specifies an interaction's strength in that equation's convention.

The recent VERSF gauge papers seek coefficients in the mathematical description of the force fields. Those coefficients have a defined relationship to couplings. A larger coefficient does not necessarily mean a stronger interaction: the relationship has to be read from the equation.

## **Action: describe a whole possible history**

Energy describes an important property of a state. Action is a different quantity assigned to an entire possible history. A useful picture is scoring a complete route rather than a single place. Physical equations can be obtained by examining how that score changes when the route is varied slightly. In the papers, connecting a record calculation to an action calculation therefore requires a real mathematical link.

## **Resolution and comparison scale**

A regulator makes a calculation manageable, for example by representing it on a finite grid. Refinement asks what happens when that representation becomes more detailed. The answer should behave consistently in the appropriate limit.

A probe with higher energy can reveal different detail, so the effective interaction strength used to describe its result can differ. This dependence on energy scale is called running; it is not change with calendar time. Matching connects descriptions where both apply. A VERSF number and an experimental number must refer to compatible scales and conventions before their difference is meaningful.

## **The purpose**

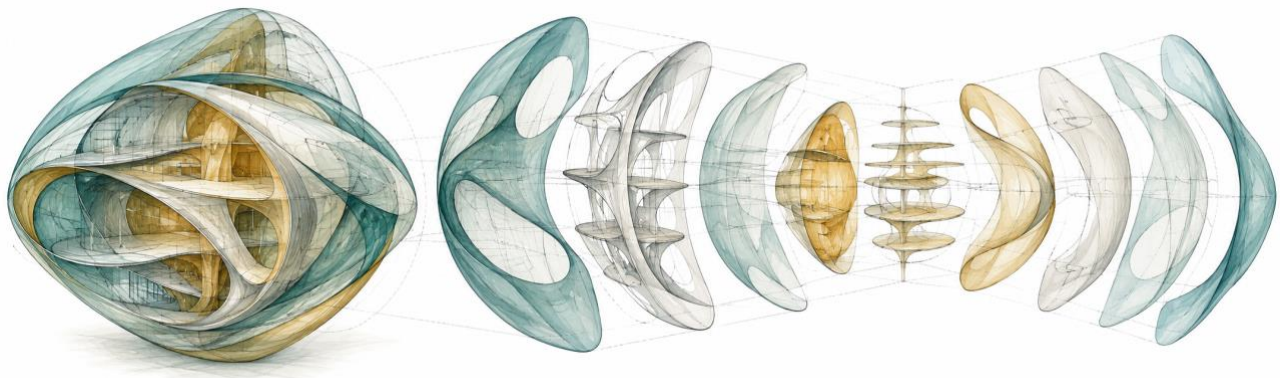
A prediction requires a complete connection: from the underlying rules, through the calculated response, to a clearly defined observation. An exact answer to one part is valuable, but it does not automatically complete all the other parts.

# **19 Read the difficult sentence in small steps**

## **Here is the kind of sentence you may meet**

“Compute the reduced curvature Hessian on the physical quotient.”

That looks forbidding because it compresses several instructions into a few words. Open it up and the intended task becomes more familiar:



*Revealing the layers helps us understand a complex whole. A visual metaphor for reading the calculation in stages.*

- Identify the field changes revealed by the loop comparisons.
- Set aside changes that merely rename the same physical situation.
- Allow the other permitted parts of the model to adjust.
- Calculate the remaining response to a small disturbance.

Why do this in VERSF? Because the resulting physical response is one proposed route to calculating the numbers that govern interaction strengths.

### **The main words, in one glance**

Configuration: an arrangement.

Metric: a rule for measuring differences.

Transport: follow a comparison rule from place to place.

Holonomy: the net transformation after a closed round trip.

Mode: an organised pattern of change.

Eigenvalue: the multiplier for a pattern preserved by a rule.

Record: information retained in a physical arrangement.

Hessian: a table describing how a chosen quantity curves locally.

Normalisation: fix the scales and conventions for comparison.

### **Bring the particle story back together**

The census asks which particle roles form a consistent set. The generation argument asks why that set repeats three times; SC-1 still assumes the required identification. The mass programme asks why the repetitions have unequal Higgs couplings. These are connected tasks, but no one calculation supplies all three answers.

### **What the calculations have produced**

CLSN-1 tests the relative sizes of the strong and two electroweak gauge couplings. At very high energy, its fixed pattern comes within about 2.5% after one common conversion factor is allowed. Think of a drawing with correct proportions but an undetermined scale. The overall conversion remains about a factor of two from the starting value.

SGRI-1 removes that common factor and the choice of comparison energy within its approximation. Using measured electromagnetic and strong strengths, its improved calculation predicts the weak mixing angle to within about 1.7%; the simpler calculation misses by about 3%. This angle describes how electromagnetic and weak descriptions are related. It is a test using two measured inputs, not an independent prediction of all force strengths. Explaining the common conversion and remaining corrections from the underlying rules remains essential.

# Sources by chapter

The titles below identify the papers behind the guide's VERSF claims. Everyday analogies illustrate those claims; they are not additional derivations. Chapter references use this guide's numbering.

## Chapters 1 to 5 Foundations and cosmic history

The Void Before Everything: Why the Simplest Pre-Cosmic State Is Pure Potential, opening argument; Before the Big Bang: An Information-Theoretic Origin of the Universe (BCB-and-the-Big-Bang), Sections 3–4 and 16. These are the “void paper” and “cosmology paper”. The established cooling and assembly sequence is described in NASA Science, Overview of the Universe ([science.nasa.gov/universe/overview/](https://science.nasa.gov/universe/overview/)), and CERN, The early universe ([home.cern/science/physics/early-universe](https://home.cern/science/physics/early-universe)).

## Chapters 6 to 8 Particle roles and mass ratios

The Generation and Species Census Theorem in VERSF (SC-1), Sections 1 to 3 and Section 5; The Yukawa Hierarchy Theorem; The Conditional Quark Mass-Ratio Grid, Sections 10–11; Quark Mass Ratios from Fold-Selective Accessibility; The Closure-Operator Yukawa Construction; The Microscopic Closure-Hessian and Full Yukawa Evaluation Theorem in VERSF (MCHY-1), Sections 37–38. The inline notes identify the specific assumptions and numerical branch used.

## Chapters 9 to 11 Arrangements and geometry

The Physical Admissibility Framework, opening sections; Entropy Foundations (file Entropy-Foundations(1)), Sections 1–2 and 6; Configuration Dynamics, Refinement Geometry and Record-Conditioned Curvature Response in VERSF (RCHS-35). The last title is the “configuration-dynamics paper” mentioned in the guide.

## Chapters 12 to 16 Comparisons and recorded patterns

Realised-Record  $m=3$  Comparison-Holonomy Test (7 October 2026); The Physical Changing Link Source Representation Resolved History Metric and Gauge Normalisation Closure Attempt in VERSF (CLSN-1); Source-Derived Gauge Work and Curvature Response in VERSF (SGW-1); and the Configuration Dynamics paper above. These supply the loop, symmetry, mode and record examples. Standard mathematical background: David Tong, Gauge Theory, Section 2.1.3; Gilbert Strang, MIT OpenCourseWare 18.06SC, Eigenvalues and Eigenvectors.

## Chapters 17 to 19 Response and numerical tests

Source-Derived Gauge Work and Curvature Response in VERSF (SGW-1), for the response reduction; CLSN-1, for the high-energy gauge pattern and common conversion; The Scale and Common Normalisation Free Gauge Relation in VERSF (SGRI-1), for the relation between measured strengths and the weak-mixing-angle comparison. The particle recap refers back to the sources for Chapters 6–8.