The Fabric Continuum Theory: The Search for The Missing Model

The link between abstract thinking and consciousness, between general relativity and the standard model

A discussion paper

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Abstract

Most of a proton's mass is not in its parts. About nine-tenths of it is the energy of the connection that binds them. Most of the gravitating mass of the universe is also unseen. This paper asks whether those two facts could be one: whether the unseen mass around galaxies could be a fabric of connection energy, of the same type that makes up ordinary matter, and whether the same principle of connection could carry further, to abstract thinking and consciousness.

This is a first report of work in progress, not a finished theory. So far the idea has been put to twenty-seven tests on public astronomical data, each written down with its pass and fail criteria before the data were opened. Many versions failed, and each failure narrowed the search. What stands today: one rule with one fixed threshold describes the unseen pull in 147 galaxies; a fabric locked point by point to ordinary matter gives the measured vertical pull near the Sun with nothing fitted; and a two-state formula with no adjusted number passed, weakly, on 17 groups and clusters of galaxies not seen before. At six points, the behaviour found at the large scale matches in form what is established inside the atom.

One prediction is on record, dated 12 November 2026: wide pairs of stars should pull on each other 1.335 times more strongly than Newton's law gives. The star catalogue that will test it is due on 2 December 2026.

The law that would join these findings is still missing, and the link to the mind is untested. The paper sets out what was found, what failed and what comes next, and it invites discussion.

Status of this paper. This is a hypothesis and a theory with limited testing. It is not a proof. It contains:

- the author's hypothesis, in his own words;
- the macro side: tests, each written down before the data were opened, and run on public astronomical data;
- the micro side: established results of particle and atomic physics, set beside the macro findings;
- every result, including the failures;
- one prediction, placed on record before the data that will decide it;
- what remains open.

This paper used AI assistance in the evaluation of this theory and hypothesis and in drafting the text. The hypothesis, judgements, formulations and the final wording are the author's.

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1. The fabric continuum: two links

The theory proposes one thing, a fabric of connection, and two links that run through it. The first is between the two great theories of physics. The second is between that physics and the mind.

1.1 General relativity and the standard model

Why they may be related. The two theories meet in one word: mass. The standard model says where mass comes from. General relativity says what mass does. The standard model's answer is not what most people expect. Only about a tenth of a proton's mass is tied to the masses of its parts (Yang et al., 2018). The rest is the energy of their

motion and of the connection that binds them. So most of the ordinary mass in the universe is already energy of connection, not substance.

General relativity makes no distinction. All energy gravitates, whatever its kind. That leaves one question, and it is the question of this paper: **if connection energy is most of the mass at the small scale, could it also be the unseen mass at the large scale?**

What correlates between the micro and the macro.

Behaviour	**Micro: established**	**Macro: found in the tests reported here**
Most of the mass is in the connection, not the parts	About nine-tenths of the proton (Yang et al., 2018)	About five-sixths of the matter in the universe is unseen (Planck Collaboration, 2020)
The connection is invisible to light	Light probing a proton sees only the quarks (Aschenauer et al., 2024)	The unseen mass is seen only through gravity (Clowe et al., 2006)
It grows stronger, relative to the simple law, with distance	The bond between quarks (Huston et al., 2024)	The unseen pull around a galaxy
Bound, until surroundings or heat free it	Quarks in a proton; electrons in an atom	Locked to stars and cold gas; free around hot gas
The whole is not the sum of the parts	The proton's bond acts on itself (Huston et al., 2024)	The one rule that passed is not a sum; the sums failed
The unit is fixed by the constants of nature	The atom	The star: about 10^{57} particles, from the same constants (Burrows & Ostriker, 2014; Carr & Rees, 1979)

How the fabric continuum could bring the two together. The hypothesis is that the unseen mass is a *fabric*: mass of the connection type, the energy of the exchange between bodies and between places. It forms a web in which everything is connected and nothing is external. It has two states. Around cohesive matter it is locked to that matter by one rule. Around diffuse matter it is free.

This places one thing in both theories. Its type comes from the standard model. Its effect is the one general relativity describes. In Einstein's equation it is a single added term: the energy of the exchange.

The theory in one formula.

$$G_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4}(T^{\text{matter}}_{\mu\nu} + T^{\text{radiation}}_{\mu\nu} + T^{\text{exchange}}_{\mu\nu})$$

The left side is the shape of space and time. The right side is what shapes it. Einstein's equation has the first two terms on the right: ordinary matter and radiation. The theory adds the third: the energy of the exchange between bodies and between places, which is the fabric. Everything else in the equation is unchanged.

1.2 Abstract thinking and consciousness

Why they may be related. This is where the theory began. A mind is not its cells. What is learned is held, in large part, in the strength of the links between them, and abstract thinking is the linking of links: relations among relations (Takeuchi et al., 2014). A mind is mostly connection, as a proton is, and as, on this hypothesis, a galaxy is.

The author's starting observations were about the limits of that mind:

> "we are aware of what we are aware… not more"

> "continuity… how we are creating continuity during existence and are not aware"

What correlates. Three of the behaviours in the table above carry over. The thing is its connections more than its parts. The whole is not the sum of the parts. And nothing stands alone: what a thought means depends on everything it is connected to, as a body's motion in the fabric depends on the whole web.

How the fabric continuum could enable abstract thinking. The author's hypothesis, in his words:

> "the same principles that define matter and space… and the inter connectivity creates the model of abstract learning without or in combination with the chemical processes in the brain… and this inter connectivity expands with a type of entanglement or superposition or energy to others… waves become signals with information… energy does not die… and this is in essence conscience"

It is held in two strengths.

- **Same in form.** One principle of connection runs from the proton to the galaxy to the mind. Abstract thinking is that principle at work in a brain. This conflicts with no physics.
- **Same in fact.** The physical connection itself is at work in the brain, at the level of the atomic nucleus, alongside its chemistry. This is proposed and not yet tested. An experiment that could test it is described in section 10.

Two steps are involved, and they stand differently. The first is the connection itself: a relation between things. Established physics allows this, and says that a relation of this kind cannot by itself carry a message (Ghirardi et al., 1980). The second is the author's further proposal: that waves in the fabric can become signals that carry information, and that because energy does not die, what is carried is not lost. That second step is new. It is not part of established physics and it has not been tested. The author holds the two in that order: the relation first, the signal second.

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2. Summary

The question. Two theories describe the physical world. General relativity describes gravity and the large scale. The standard model describes particles and the small scale. They do not join. Separately, most of the gravitating mass in the universe is unseen and is known only as a difference: the gravity that is observed, minus the gravity of everything visible (Planck Collaboration, 2020).

The hypothesis. The unseen mass is a fabric: mass of the connection type, the energy of the exchange between bodies and between places, and not a substance of its own. It is the same type of mass that makes up most of a proton (Yang et al., 2018). The fabric is a non-linear quantum matrix in which nothing is external. It has two states. Around cohesive matter, such as stars and cold gas, it is locked to that matter by one rule. Around diffuse hot gas it is free. The star is the unit of the fabric, and the same principle of connection carries down to the atom and, as a further hypothesis, to abstract thinking and consciousness.

The hypothesis in formulas. The added term of section 1.1 takes a different form in each of the fabric's two states.

Locked, around cohesive matter. The total pull g follows from the pull of the ordinary matter g_b alone:

$$g \;=\; g_b \,(\,1+n\,)\,, \qquad n \;=\; \frac{1}{e^{\sqrt{g_b/a_c}}-1}, \qquad a_c = 1.08\times10^{-10}\ \mathrm{m/s^2}$$

Here n is the share the fabric adds, and a_c is the one fixed threshold. Where the ordinary pull is strong, n is close to zero and Newton's law holds. Where it is weak, the fabric supplies most of the pull. This rule was found by others from the motions of galaxies; the tests here confirm it (McGaugh et al., 2016).

Free, around diffuse hot gas. The fabric takes its cosmic share:

$$M_{\text{fabric}} \;=\; 5.36\times M_{\text{hot gas}}$$

The number 5.36 is the measured ratio of unseen to ordinary matter in the universe as a whole (Planck Collaboration, 2020). It is not fitted to any system in this paper.

Together, for a group or cluster of galaxies:

$$M_{\text{total}} \;=\; M_{\text{stars}} + M_{\text{gas}} \;+\; \underbrace{\sum_{\text{galaxies}} n\,m}_{\text{locked}} \;+\; \underbrace{5.36\,M_{\text{gas}}}_{\text{free}}$$

The locked part is the rule applied around each galaxy of ordinary mass m, out to a reach set by its neighbours. The free part is the cosmic share of the hot gas. No number in it is adjusted. Section 6 gives the tests of each formula.

The evidence, at two scales. The hypothesis stands on two legs, and this paper gives them equal weight.

The micro side: what is established. These are results of particle and atomic physics, confirmed by others over many decades. The paper draws on them and does not test them again.

- Most of a proton's mass is the energy of its connection, not the mass of its parts (Yang et al., 2018).
- That connection is invisible to light, and it carries a large share of the proton's momentum (Alexandrou et al., 2020; Aschenauer et al., 2024).
- Its strength grows with distance, the opposite of the electric force around an atom (Erler & Freitas, 2024; Huston et al., 2024).
- Quarks stay bound until extreme heat frees them, and electrons stay bound to atoms until heat or a strong outside force frees them (Bazavov et al., 2019; Gary, n.d.; MIT Atomic and Optical Physics Wiki, n.d.).
- The mass of a star is fixed by the same constants of nature that fix the atom (Burrows & Ostriker, 2014; Carr & Rees, 1979).

The macro side: what was tested. Twenty-seven tests were declared in writing, with pass and fail criteria, before the data were opened. Each was run to answer one question, and each answer set the next question (section 6.2). Many versions of the idea failed, and each failure narrowed the search. What they led to, and what now stands, is:

- In single galaxies, one rule with one fixed threshold describes the unseen pull. This is a known empirical relation, confirmed here on 147 galaxies and over about 10 billion years of cosmic time (Genzel et al., 2020; Lelli et al., 2016; McGaugh et al., 2016; Nestor Shachar et al., 2023).
- In our own galaxy, a fabric locked point by point gives the measured upward pull near the Sun with nothing fitted (Bienaymé et al., 2014; Bovy & Rix, 2013; Eilers et al., 2019; Guo et al., 2020; Holmberg & Flynn, 2004; Horta et al., 2024; Kuijken & Gilmore, 1991; López-Corredoira, 2025; McKee et al., 2015; Nitschai et al., 2021; Zhang et al., 2013). A round fabric of the size the rule implies does not. This was confirmed by an independent check.
- In groups and clusters of galaxies, a two-state formula with no fitted number (locked to the stars, free around the hot gas) passed its declared test on 17 systems not seen before (Lin et al., 2003; Zhang et al., 2011). The pass is weak.
- A difference between how stars and cold gas relate to the fabric appears at 3.5 sigma. Its cause is unresolved.

Where the two sides meet. Each macro finding has a micro counterpart in the table of section 1.1: mass that is mostly connection, invisible to light, stronger with distance, bound until freed, not a simple sum, and built from a unit fixed by the constants of nature. That is a match of form at six points. It is not yet a match of fact.

The prediction. If the star is the unit of the fabric, two stars orbiting far apart near the Sun should pull on each other 1.335 times more strongly than Newton's law gives, and so orbit about 15.5% faster. This was computed and placed on record on 12 November 2026, before the release of the catalogue that will test it (2 December 2026) (European Space Agency, n.d.-a). This is the place where the micro and the macro are tested together: the star is the characteristic body that gravity builds from particles, and the prediction asks whether the fabric begins there.

What is not shown. No test here separates the hypothesis from ordinary dark matter in a single galaxy, or from the existing minority theory that uses the same rule (Milgrom, 1983a). No derivation of the rule from the hypothesis is offered. No experiment shows that the micro connection and the macro fabric are one thing and not two alike. The link to abstract thinking and consciousness is untested.

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3. The question and the model

3.1 The question

The author's starting point, in his words:

> "how do we interact with the universe… not from a conscience variable… from the forces that could be construed as abstract… quantum is abstract"

Stated in the terms of physics, the question is how gravity and quantum theory fit together: what space is made of, how energy moves in it, and how the micro and the macro world fit in one quantum matrix, the fabric continuum.

Physics defines the unseen mass only by what is missing:

$$\rho_{\text{dark}} \;=\; \frac{1}{4\pi G}\nabla^2\Phi \;-\; \rho_{\text{ordinary}}$$

In words: the gravity that is observed, minus the gravity of everything that can be seen. The formula says how much and where. It does not say what. The author's position is that the search has been aimed at the wrong thing:

> "you are trying to measure something you are measuring wrong… that is the first step… how to measure"

3.2 The model, in the author's words

> "dark matter is part of the fabric"

> "atomic photons are part of the fabric"

> "energy can travel through fabric… in all directions… without moving"

> "exchanging… like entanglement"

Read together, these say that the fabric is one thing at every scale: the exchange that connects. Section 4.1 sets out what that means inside the atom, between bodies and places, and in the way the fabric works.

3.3 The model, in formulas

The model is stated in five formulas. For each one, the text says what it means and how it stands.

Formula 1. The theory.

$$G_{\mu\nu} + \Lambda g_{\mu\nu} \;=\; \frac{8\pi G}{c^4}(T^{\text{matter}}_{\mu\nu} + T^{\text{radiation}}_{\mu\nu} + T^{\text{exchange}}_{\mu\nu})$$

The left side is the shape of space and time. The right side is what shapes it. The first term on the right is ordinary matter. It already contains the micro fabric: the energy of the exchanges inside every nucleus and atom is most of the mass of ordinary matter (Yang et al., 2018). The second term is radiation. The third is the addition: the energy of the exchange between bodies and between places, which is the macro fabric.

Standing: this is the hypothesis. The equation without the third term is Einstein's and is established. The third term is named here, and it is not yet derived. Formulas 2 and 3 say what it must amount to in the two states.

Formula 2. The locked state, around cohesive matter.

$$g \;=\; g_b\,(\,1+n\,)\,, \qquad n \;=\; \frac{1}{e^{\sqrt{g_b/a_c}}-1}, \qquad a_c \;=\; \frac{c\,H_0}{2\pi} \;=\; 1.08\times10^{-10}\,\text{m/s}^2$$

Here g is the total pull, g_b is the pull of the ordinary matter, n is the share the fabric adds, and a_c is the one fixed threshold. Where the ordinary pull is strong, n is close to zero and Newton's law holds. Where it is weak, the fabric supplies most of the pull.

Standing: tested. The rule was found by others from the motions of galaxies (McGaugh, Lelli and Schombert 2016, written there in an equivalent form). It is confirmed here on 147 galaxies and over about 10 billion years (Genzel et al., 2020; Lelli et al., 2016; Nestor Shachar et al., 2023). The value of a_c was fixed by declaration and not fitted.

Formula 3. The locked state, point by point.

$$\rho_{\text{fabric}}\,(\,\mathbf{x}\,) \;=\; -\frac{1}{4\pi G}\,\nabla\cdot\left[\,n\!\left(\left|\mathbf{g}_b\right|/a_c\right)\mathbf{g}_b\,(\,\mathbf{x}\,)\,\right]$$

This says where the locked fabric is, and not only how hard it pulls. At each point its density follows from the ordinary pull at that point. Formula 2 is what this gives for the total pull in a galaxy.

Standing: tested in one place. It gives the measured upward pull near the Sun with nothing fitted (64.1 predicted against 67.9 ± 3.8 measured), and a round fabric of the size the rule implies does not (Bienaymé et al., 2014; Bovy & Rix, 2013; Eilers et al., 2019; Guo et al., 2020; Holmberg & Flynn, 2004; Horta et al., 2024; Kuijken & Gilmore, 1991; López-Corredoira, 2025; McKee et al., 2015; Nitschai et al., 2021; Zhang et al., 2013). The formula exists in the literature (Milgrom 2010), where its output is called a "phantom" density, a device for calculation. Here it is read as real mass of the connection type.

Formula 4. The free state, around diffuse hot gas.

$$M_{\text{fabric}} \;=\; 5.36\times M_{\text{hot gas}}$$

The fabric takes its cosmic share. The number 5.36 is the measured ratio of unseen to ordinary matter in the universe as a whole (Planck Collaboration, 2020).

Standing: 5.36 is established and is not fitted to any system here. That the fabric around hot gas sits at this share is the hypothesis, tested through Formula 5.

Formula 5. The two states together, for a group or cluster of galaxies.

$$M_{\text{total}} \;=\; M_{\text{stars}} + M_{\text{gas}} \;+\; \underbrace{N\,n\!\left(\frac{G\,m_*}{r^2 a_c}\right)m_*}_{\text{locked}} \;+\; \underbrace{5.36\,M_{\text{gas}}}_{\text{free}}$$

$$N=\frac{M_{\text{stars}}}{m_*},\qquad m_*=10^{10.66}\ \text{solar masses},\qquad r=R\,N^{-1/3}$$

The locked part is Formula 2 applied around each of N galaxies of typical mass m_*, out to a reach r of half the spacing between neighbours inside the radius R. The free part is Formula 4. No number is adjusted to the data.

Standing: tested, with a weak pass. On 17 systems not seen before, observed mass over predicted mass was 0.88, inside the declared range (Lin et al., 2003; Zhang et al., 2011). On 290 systems seen earlier it passed 9 of 11 checks and predicted about 27% too much in the most massive clusters (Chiu et al., 2018; Eckert et al., 2016; Eckert et al., 2017; Eckert et al., 2022; Eckert et al., 2019; Ettori et al., 2019; Ghirardini et al., 2019; Gonzalez et al., 2013; Laganá et al., 2013; Lovisari et al., 2015; Sanderson et al., 2013; Sun et al., 2009).

What the formulas do not yet give. Formula 1 names the exchange term. Formulas 2 to 5 describe what it does. Nothing yet derives the second from the first: there is no expression for the exchange term from which the rule, the threshold and the two states follow. That derivation is the missing law, and it is the main open problem of the theory.

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4. The hypothesis, in the author's words

Each statement below is the author's, quoted from the working record. The wording between the quotations is a plain restatement.

4.1 The fabric at two scales

The fabric is one thing at every scale: the exchange that connects.

- **Inside the atom,** the electron is held to the nucleus by an exchange of photons, and the parts of the proton are held together by an exchange of gluons (Erler & Freitas, 2024; Huston et al., 2024). These exchanges are

the fabric at the micro scale. (“Atomic photons” here means the photons exchanged inside atoms. Light travelling freely through space is radiation, and it is counted separately.)
- **Between bodies and between places,** the unseen mass is the fabric at the macro scale.
- **Its way of working** is a change in the relation between things, and not something that travels from one place and arrives at another.

The author holds to this order: the relation first, the signal second.

4.2 A type of mass that is already known

> “what if we replace dark matter with another type of mass… one that has the properties that work in the micro and macro world”

The type chosen is **mass that is the energy of a connection**. It is established at the micro scale: in the standard calculation only about a tenth of a proton’s mass is tied to the masses of its quarks, and the rest is the energy of their motion, of the field that binds them, and of a quantum effect of that field (Yang et al. 2018). Most ordinary mass is already of this type. The hypothesis is that the fabric is the same type at the macro scale: the energy of the exchange between bodies and between places.

The author accepted that this needs new physics. Inside the proton the energy of the connection is positive and large. The ordinary gravitational binding between the bodies of a galaxy is negative and, as their speeds show, about a millionth of the mass or less (Eilers et al., 2019). The hypothesis needs a connection that is positive and about five times the ordinary mass.

4.3 A non-linear quantum matrix

> “a non-linear quantum matrix… has no linear path… actually connected at all times to all places and can take any of those paths”

Asked what one entry of the matrix stands for:

> “two bodies and two places”

Bodies are connected to bodies, and places are connected to places, including places with nothing in them. From this follows a statement about motion. In the matrix, nothing is external. A body’s motion depends on the whole web, and Newton’s law holds for a body taken together with its connections, not for the body alone.

“Non-linear” has an exact meaning here: the whole is not the sum of its parts. This is true of the connection inside the proton, which acts on itself (Huston et al., 2024). It is also true of the one rule that passed its tests at the macro scale (section 6). Almost every formula that failed there was built as a sum.

4.4 Two states, cohesion and surroundings

> “we need to add distance and cohesion”

> “I believe hot and cold gases are the culprit”

> “the surroundings… the fabric… that is the missing piece”

> “the gravity of galaxies do stretch”

Put together: the fabric is **locked** around cohesive matter, which is matter bound into stars and cold gas. It is **free** around diffuse matter, which is thin hot gas. The reach of the lock around a galaxy is limited by its surroundings, which stretch it.

The micro scale shows the same pattern. An atom holds its electrons until heat or a strong outside force strips them, and the hot gas of a cluster is matter in exactly that stripped state (Gary, n.d.; MIT Atomic and Optical Physics Wiki,

n.d.). A proton holds its quarks until far greater heat frees them (Bazavov et al., 2019). Bound until freed, then free, is how connection behaves at each scale.

4.5 The star

> “the star is a different version of the atom of the fabric… a different scale… the atom is the child of the star”

> “our star is the link to the universe and galaxies”

The star stands between the two scales. Its mass is fixed by the constants of the micro world set against the strength of gravity (Burrows & Ostriker, 2014; Carr & Rees, 1979). Apart from a trace of lithium, every nucleus heavier than helium was made in stars or in their deaths (Fields et al., 2024). And on the hypothesis the star is the unit of the fabric, as the atom is the unit of ordinary matter. In its strong form this says that each star carries its own share of the fabric. That form has a test (section 8).

4.6 Abstract thinking and consciousness

> “the same principles that define matter and space… and the inter connectivity creates the model of abstract learning without or in combination with the chemical processes in the brain… and this inter connectivity expands with a type of entanglement or superposition or energy to others… waves become signals with information… energy does not die… and this is in essence conscience”

(“Conscience” is used throughout the record in the sense of consciousness.)

The author added that the level he means is not the chemical one:

> “not the chemical disposition of activity… the nuclear level of activity”

This part of the hypothesis is stated in two strengths, set out in section 1.2 and examined in section 10.

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5. The possibility, and how it was examined

5.1 The possibility: the macroverse as a form of the microverse

This paper puts forward a possibility. It is that the large-scale universe, the macroverse, is a form of the small-scale one, the microverse: that the two are built on the same model, and that the fabric continuum is what runs through both.

We stand in the microverse. That is meant literally. Counted in powers of ten, a person is about ten steps larger than an atom and about twenty-six steps smaller than the observable universe (Davis & Lineweaver, 2004; National Institute of Standards and Technology, n.d.). Everything that can be taken apart and measured in a laboratory lies at the small end of that ladder. The large end can only be watched from inside. So the model of the microverse is known in detail, and the model of the macroverse is only beginning to be discovered. If the possibility is right, the macroverse is the larger part of the fabric continuum, and what has been learned at the small scale is a guide to it.

The two scales do show similar models. Section 1.1 lists six behaviours that the connection inside the proton and the atom shares with the unseen mass around galaxies. Section 9 sets them out in full.

5.2 Where this work stands

The work on this hypothesis and theory has only started. What is reported here is a first examination: the model stated, the micro side checked against its sources, the macro side put to tests, and one prediction placed on record. It found glimpses of possible validation, listed in section 5.4, and it found a larger number of versions that failed, listed in section 6. Neither amounts to a verified model.

The author intends, together with partners, to report further updates as new tests are made, until a verified model that connects the two scales is found or the possibility is ruled out.

5.3 How the two scales were examined

The microverse: established results, checked against their sources. Nothing at the micro scale was measured for this paper. The micro side rests on results of particle and atomic physics that others have established over many decades. Each such statement used here was checked against a published source. Thirty-nine statements were checked. Thirty were confirmed as worded. Nine were corrected, and the corrected wording is the one used.

The macroverse: tests declared in advance. For each test a short declaration was written first. It stated the formula, the constants, the data to be used, the pass and fail criteria, and what was already known to the person drawing up the test. The declaration was given a checksum and a time. Only then were the data opened. Each test was run once, and every result is reported, whichever way it fell. A formula adjusted after a result until it fits has shown nothing; the declarations are there so that a pass means something and a fail is not explained away.

Results were then re-derived by a separate check that wrote new code from the declaration alone, compared the inputs with the published sources, and was instructed to look for errors, not to confirm. Tests 1, 10 and 15 to 26 have been checked in this way; Test 27 has not. No check found a wrong number. Several found that a summary had been worded more strongly than the result allowed, and those wordings are corrected here.

Joining the two. The claim that one fabric runs through both scales was judged in three steps, in rising order of strength.

1. *Likeness of form.* Does the macro fabric, as the tests describe it, behave as the micro connection does? Yes, at six points.
2. *Agreement of number.* Does any quantity of the microverse give the threshold of the macro rule? One check was made, against the pull at the surface of an electron, a proton and a pion. The nearest missed by a factor of 14.
3. *A test at the joint.* Is there a place where both scales meet and a measurement can decide? The star is that place. The prediction of section 8 asks whether the fabric begins there, and it was placed on record before the data exist.

5.4 Glimpses of possible validation

Each row is a place where the macroverse was found to behave as the model drawn from the microverse says it should. Each is labelled with how firmly it stands and with what would turn the glimpse into a validation.

What the model expects	What was found in the macroverse	How firmly	What would make it a validation
The connection follows one law with a fixed constant, as the bonds of the microverse do	One rule with one fixed threshold describes 147 galaxies, unchanged for about 10 billion years (Tests 1 and 7) (Genzel et al., 2020; Lelli et al., 2016; Nestor Shachar et al., 2023)	Firm. It confirms a relation found by others (McGaugh et al., 2016)	A derivation of the rule and its threshold from the fabric
The connection is locked to matter point by point	In our own galaxy the same factor gives both the Sun’s orbit and the pull up out of the disc, with nothing fitted (Test 19) (Bienaymé et al., 2014; Bovy & Rix, 2013; Eilers et al., 2019; Guo et al., 2020; Holmberg & Flynn, 2004; Horta et al., 2024; Kuijken & Gilmore, 1991; López-Corredoira, 2025; McKee et al., 2015; Nitschai et al., 2021; Zhang et al., 2013)	Passed, and confirmed by an independent check. One place in one galaxy	The same result at greater heights and in other galaxies

What the model expects	What was found in the macroverse	How firmly	What would make it a validation
Bound matter and freed matter carry the connection differently, as atoms and ionised gas do	A formula with two states, locked to the stars and free around the hot gas, with no fitted number, passed on 17 systems not seen before (Tests 18 and 20) (Chiu et al., 2018; Eckert et al., 2016; Eckert et al., 2017; Eckert et al., 2022; Eckert et al., 2019; Ettori et al., 2019; Ghirardini et al., 2019; Gonzalez et al., 2013; Laganá et al., 2013; Lin et al., 2003; Lovisari et al., 2015; Sanderson et al., 2013; Sun et al., 2009; Zhang et al., 2011)	A weak pass. The sample is small	A larger sample of clusters with stars and hot gas measured separately
The connection is invisible to light and still bends it	The rule that gives the motions of stars also gives the bending of light around spiral galaxies (Test 2b) (Brouwer et al., 2021)	Firm for spirals	The same for ellipticals once their hot gas and neighbours are accounted for
The whole is not the sum of the parts	The rule that passed is non-linear. The formulas built as sums failed (Tests 10, 11, 13) (Gopika & Desai, 2020; Li et al., 2020; Salucci et al., 2012)	Firm as a pattern	A non-linear law that also covers clusters
There is no preferred size	The core of the fabric has the same surface density at every core size measured, from 0.3 to 26 thousand parsecs (Test 13)	A finding inside a failed test	An explanation of why that density takes the value it does
The unit of the fabric carries more of it than loose matter does	Places supplied by stars show more unseen pull than places supplied by cold gas, at 3.5 sigma (Tests 24 and 26)	Open. Reproduced independently; may be an effect of the data	The same result in galaxies with the best-measured distances
The unit is fixed by the constants of nature	The mass of a star follows from the constants of the microverse set against gravity (Burrows & Ostriker, 2014; Carr & Rees, 1979)	Established physics	The prediction of section 8: that each star carries its own share of the fabric

These are glimpses. None of them, alone or together, separates the fabric from ordinary dark matter in a single galaxy, or from the existing theory that uses the same rule. They show that the possibility has not been closed, and they show where to look next.

5.5 Data and constants

Data. All macro data are public: rotation curves of 147 nearby galaxies (the SPARC sample), gravitational lensing around a very large sample of galaxies (the KiDS-1000 survey), rotation curves of distant galaxies seen as they were up to 10 billion years ago, published X-ray and lensing measurements of several hundred groups and clusters of galaxies, and published measurements of the motions of stars near the Sun (Bienaymé et al., 2014; Bovy & Rix, 2013; Brouwer et al., 2021; Chiu et al., 2016; Chiu et al., 2018; Eckert et al., 2016; Eckert et al., 2017; Eckert et al., 2022; Eckert et al., 2019; Eckmiller et al., 2011; Eilers et al., 2019; Ettori et al., 2019; Genzel et al., 2020; Ghirardini et al., 2019; Gonzalez et al., 2013; Gopika & Desai, 2020; Guo et al., 2020; Holmberg & Flynn, 2004; Horta et al.,

2024; Humphrey et al., 2011; Humphrey et al., 2012; Kuijken & Gilmore, 1991; Laganá et al., 2008; Laganá et al., 2013; Lelli et al., 2016; Lin et al., 2003; López-Corredoira, 2025; Lovisari et al., 2015; Nestor Shachar et al., 2023; Nitschai et al., 2021; Pratt et al., 2016; Sanderson et al., 2013; Sun et al., 2009; Vikhlinin et al., 2006; Zhang et al., 2013; Zhang et al., 2011).

Constants. The acceleration threshold is not fitted. It is fixed throughout as

$$a_c \;=\; \frac{c\,H_0}{2\pi} \;=\; 1.082\times10^{-10}\ \mathrm{m/s^2} \qquad (\ H_0 = 70\ \mathrm{km/s/Mpc}\ )$$

This value was chosen by declaration and is close to the value others obtain by fitting (1.20×10^{-10}) (McGaugh et al., 2016). Test 7 shows that the threshold does not follow the expansion rate as it changes over time, so the agreement with today's expansion rate is recorded here as a coincidence of numbers and not as an explanation.

5.6 Exceptions, disclosed

- Test 1 was declared after the fitted curve had been seen. It is a confirmation, not a prediction.
- Several quick looks at the data were made without a declaration. They are labelled as looks wherever they appear and are not counted as results.
- In Test 17 a shortcut formula for the depth of a gravitational well was used that is wrong inside clusters. The independent check showed that the test would have failed with the correct formula as well.
- In Test 20 the cut-off distance was declared with the textbook formula for a compact host. For a spread-out host such as a cluster the formula differs, which, in the simple case assumed, would lengthen the reach by about 15% (Gajda & Łokas, 2016).
- In several tests the person drawing up the test was not blind to the likely outcome. Each declaration says so.
- The link to abstract thinking and consciousness was not tested. For it, the published literature was reviewed and one experiment is proposed (section 10).

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6. The tests and what they found

6.1 Summary of the testing

What was examined in the microverse. The model of the microverse is known in detail, so nothing there needed to be measured again. Its part in this work was to be checked and then used as the guide. Thirty-nine established statements of particle and atomic physics were verified against their sources. One direct comparison of numbers was made, between the threshold of the macro rule and the pull at the surface of an electron, a proton and a pion. It did not match. The published work on whether the atomic nucleus plays a part in the brain was reviewed.

What was tested in the macroverse. Twenty-seven tests were declared in advance and run on public astronomical data: on single galaxies, on our own galaxy, on galaxies seen as they were 10 billion years ago, on elliptical galaxies, and on several hundred groups and clusters of galaxies.

Why the work concentrated on the macroverse. Because it is the unknown. The microverse can be taken apart in a laboratory. The macroverse can only be watched from inside, and it raised question after question: what the unseen mass is, why it follows ordinary matter so closely in one kind of system and not in another, what part the stars play, and what the surroundings do. Each test answered one question and raised the next.

What is hoped for. One of those questions may be answered soon. The star catalogue due on 2 December 2026 will show whether two stars far apart pull on each other as the fabric predicts (section 8) (European Space Agency, n.d.-a). The prediction is on record.

What stands whatever that outcome is. Two things were met again and again in the test results and are not settled by that one measurement.

- *Rotation.* It is established in the theory of how galaxies form, and seen in computer models of it, that a galaxy has a time when its rotation speeds up: while it forms and draws inward it must turn faster, and its first spin is given by the pull of its surroundings (Mo et al., 1998; Schäfer, 2009; White, 1984). The author's proposal is that this period could bear on what the fabric of a galaxy becomes.

- *The characteristics of stars.* How many stars a system holds, of what kinds, how heavy they are for the light they give, and how they live and die, entered the results at every turn.

The author's proposal is that these two, taken together, could explain many of the anomalies in the test results. There could be other explanations, and that proposal has not yet been tested. It is the part of the theory and hypothesis that most needs research.

What comes next. The work on these anomalies will continue, with the aim of confirming or denying the hypothesis and theory. Section 6.9 lists them and the test each one calls for.

6.2 The path: why each test was run, and what it taught

The tests were not a list drawn up at the start. Each was run to answer one question, and each answer, pass or fail, set the next question.

1. Does one rule describe the unseen pull in a galaxy? Yes (Tests 1 and 7). One rule with one fixed number does it for 147 galaxies, and the number has not changed in about 10 billion years (Genzel et al., 2020; Lelli et al., 2016; Nestor Shachar et al., 2023). This gave the search its fixed point: inside a single galaxy the fabric follows the ordinary matter by this rule.

2. Is the rule the whole story? No (Test 2). In clusters of galaxies and around elliptical galaxies there is more pull than the rule gives (Brouwer et al., 2021; Eckert et al., 2017; Eckert et al., 2022; Eckert et al., 2019; Ettori et al., 2019; Ghirardini et al., 2019). So the question became what those systems have that a single spiral galaxy does not.

3. Does the fabric have a size or a shape of its own? No (Tests 4, 5, 6 and 13) (Gopika & Desai, 2020; Li et al., 2020; Salucci et al., 2012). It is not a wave of one length, and it is not an atom writ large. What these tests did find is that the core of the fabric has the same surface density at every core size. The fabric has no preferred scale.

4. Does it change with heat, age or cosmic time? No (Tests 7 and 8). The fabric behaves like a standing property of matter in space, and not like a product of a galaxy's history.

5. What do the systems that depart from the rule have in common? The excess grows outward around ellipticals and grows with the amount of ordinary matter in groups and clusters (Tests 9 to 12, 14, 16 and 27) (Chiu et al., 2018; Eckert et al., 2016; Eckmiller et al., 2011; Gonzalez et al., 2013; Laganá et al., 2013; Lovisari et al., 2015; Pratt et al., 2016; Sanderson et al., 2013; Sun et al., 2009; Vikhlinin et al., 2006). It is not a sum over member galaxies (Tests 10 and 11). The author concluded that the law is not linear and that the surroundings matter.

6. Is anything missing inside a galaxy? No (Test 15). Frequency and distance add nothing once the pull is known. The rule is complete inside a single galaxy, and the missing piece lies outside it.

7. Is the missing piece the depth of gravity, or the point where gas can no longer cool? Depth: no (Test 17). The cooling point: not shown (Tests 16 and 27) (Rees & Ostriker, 1977). Both of those tests ran into the same obstacle, which is itself a finding: the two ways of weighing a group of galaxies do not yet agree (Akino et al., 2022; Pratt et al., 2019).

8. Is it the state of the ordinary matter? This was the turn. Clusters are mostly thin hot gas; galaxies are stars and cold gas. A formula with two states, locked to the stars and free around the hot gas, with no fitted number, described groups and clusters across the whole range of mass (Test 18) and then passed on systems not seen before (Test 20) (Lin et al., 2003; Zhang et al., 2011).

9. Does the lock hold up inside one galaxy, point by point? Yes, where it could be tested (Test 19) (Bienaymé et al., 2014; Bovy & Rix, 2013; Eilers et al., 2019; Guo et al., 2020; Holmberg & Flynn, 2004; Horta et al., 2024; Kuijken & Gilmore, 1991; López-Corredoira, 2025; McKee et al., 2015; Nitschai et al., 2021; Zhang et al., 2013). The number that explains the Sun's orbit also gives the pull up out of the disc.

10. What part do the stars play? Heavier stars account for the inner excess of ellipticals (Test 21) (Cappellari et al., 2013; Treu et al., 2010). Old and young stars lock the fabric alike, and cold gas appears to lock less (Tests 22, 24 and 26). The star emerged as the candidate unit of the fabric.

11. Can that be tested without hindsight? Yes. The prediction for wide star pairs (Test 25, section 8) was placed on record before the data exist.

6.3 Single galaxies: one rule

In a single galaxy the total pull g is given by the pull of the ordinary matter g_b through one rule (Formula 2 of section 3.3):

$$g \;=\; g_b \,(\,1+n\,)\,, \qquad n \;=\; \frac{1}{e^{\sqrt{g_b/a_c}}-1}$$

Where the pull of the ordinary matter is strong, n is nearly zero and Newton's law holds. Where it is weak, the fabric supplies most of the pull.

What the tests add:

- The threshold is constant over about 10 billion years (Test 7) (Genzel et al., 2020; Nestor Shachar et al., 2023). It does not follow the expansion rate.
- Inside a galaxy nothing further is needed: not frequency, distance, heat or age (Tests 5, 8 and 15) (Lelli et al., 2016).
- The same rule gives the bending of light around spiral galaxies (Test 2b) (Brouwer et al., 2021).

What this means for the search. The rule is a relation found by others, and these tests confirm it (McGaugh et al., 2016). It is the fixed point of the model: any account of the fabric must give this rule in a single galaxy. *What comes next:* a derivation of the rule and its threshold from the fabric.

6.4 Our own galaxy: the lock acts point by point

If the fabric is locked point by point, its density at each place follows from the ordinary pull there (Formula 3). The test (Test 19) uses the pull straight up out of the disc of our galaxy, 1.1 thousand parsecs above the plane near the Sun. It is measured from the motions of stars and owes nothing to the rule (Bienaymé et al., 2014; Bovy & Rix, 2013; Guo et al., 2020; Holmberg & Flynn, 2004; Horta et al., 2024; Kuijken & Gilmore, 1991; López-Corredoira, 2025; Nitschai et al., 2021; Zhang et al., 2013). The factor by which the rule boosts the Sun's own orbit is 1.46, and it comes from the Sun's distance from the centre and its orbital speed alone (Eilers et al., 2019; GRAVITY Collaboration, 2018). A point-by-point lock says the same factor must boost the upward pull.

	Predicted	**Measured (nine published studies, 1991 to 2024)**	**Verdict**
Point-by-point lock	64.1 ± 5.0	67.9 ± 3.8	Pass
Round fabric of the size the rule implies	54.1 ± 3.4	67.9 ± 3.8	Fail

(Units: solar masses per square parsec.)

The result was re-derived independently and stands. Its limits: this is one place in one galaxy; the nine measurements disagree with each other by more than their stated errors, some of them share data, and they are not all quite the same quantity; and an ordinary round dark halo of the usual density also passes (McKee et al., 2015). Higher above the disc the published measurements disagree among themselves, and one published study using a full calculation of this lock finds it fits as well as a round halo up to 4 thousand parsecs (Bienaymé et al., 2024; Bovy & Tremaine, 2012; Moni Bidin et al., 2012; Zhu et al., 2023).

What this means for the search. This is the first test here in which a prediction of the fabric, beyond the rule itself, passed. *What comes next:* the same comparison at greater heights and in other galaxies, where the lock and an ordinary halo part ways.

6.5 Groups and clusters: two states

The rule alone falls short in systems of many galaxies. The observed mass is 1.5 to 2 times what it gives, and the gap grows with the amount of ordinary matter (Tests 2, 11, 16 and 27) (Chiu et al., 2018; Eckert et al., 2016; Eckert et al., 2017; Eckert et al., 2022; Eckert et al., 2019; Eckmiller et al., 2011; Ettori et al., 2019; Ghirardini et al., 2019; Gonzalez et al., 2013; Laganá et al., 2013; Lovisari et al., 2015; Pratt et al., 2016; Sanderson et al., 2013; Sun et al., 2009; Vikhlinin et al., 2006).

The two-state formula (Formula 5) has no fitted number: the fabric is locked around each galaxy by the rule, out to a reach of half the spacing between neighbours, and it is free around the hot gas at the cosmic share of 5.36 (Planck Collaboration, 2020).

- On 290 systems that had been seen before (Test 18) it passed 9 of 11 declared checks. It described every range of mass from small groups to the largest clusters with no trend. It failed by predicting about 27% too much mass in the most massive clusters.
- On 17 systems not seen before (Test 20) it passed all its declared checks (observed over predicted 0.88) (Lin et al., 2003; Zhang et al., 2011). A second form, in which the reach is cut short by the pull of the cluster, also passed (1.19).
- On 8 further systems (Test 23) it gave 0.91 (Chiu et al., 2016; Humphrey et al., 2011; Humphrey et al., 2012; Laganá et al., 2008). That is too few to count.

This pass is weak. Seventeen systems is a small sample, 16 of them are clusters, and two forms that differ by 35% both pass, so the data cannot choose between them. The second form passes by a thin margin; it was also declared with a cut-off formula meant for a compact host, where a spread-out host such as a cluster calls for a somewhat longer reach (Gajda & Łokas, 2016). The first form passes under every variation tried. In single galaxies all the ordinary matter is cohesive, so the formula reduces to the rule and every galaxy result is unchanged.

What this means for the search. For the first time one formula with nothing adjusted describes groups and clusters, and it does so by using the state of the ordinary matter, which is a distinction taken from the microverse. *What comes next:* a larger sample with stars and hot gas measured separately. No more such data could be found at present.

6.6 Elliptical galaxies

Ellipticals show more pull than the rule gives, and the excess grows outward (Tests 2b and 9) (Brouwer et al., 2021). Test 21 asked whether their stars are simply heavier than their light suggests. With a published correction the excess close to the galaxy disappears (Cappellari et al., 2013; Treu et al., 2010). The excess far out does not: about half of it remains.

Two points from the checks. The published star-mass correction applies mainly to the centres of ellipticals, so even the inner agreement is partly generous (La Barbera et al., 2019; Smith, 2020; van Dokkum et al., 2017). And the far-out region lies where a published study judges ellipticals not reliably isolated, so part of what remains may be the pull of neighbours (Mistele et al., 2024). A published analysis that raises the star masses, adds the hot gas around ellipticals and applies a stricter test of isolation finds no significant difference between ellipticals and spirals (Mistele et al., 2024).

What this means for the search. In the author’s terms the elliptical anomaly is three things together: the characteristics of the stars, the hot gas, and the surroundings. *What comes next:* a test with all three accounted for at once.

6.7 Stars and gas

At the same total ordinary pull, places where the pull comes from cold gas show less total pull than places where it comes from stars (Test 24: -0.165 ± 0.047, or 3.5 sigma) (Lelli et al., 2016). An independent check reproduced the number exactly and removed two explanations: the shape of the rule at weak pull, and an excess of gas mass. A heavier star mass is disfavoured (Test 26): the data prefer almost no change in star mass, and the difference remains.

What is left is a choice the data cannot yet make. Either a unit of stars carries more fabric than a unit of cold gas, or the difference comes from the data: it is concentrated in galaxies whose distances are less well measured, and in the 66 galaxies with the best distances it falls to 1 sigma.

What this means for the search. If it is real, it is the first sign that the star is special to the fabric, as the author holds. *What comes next:* the same test on galaxies with the best-measured distances, and the prediction of section 8.

6.8 What did not work, and what that showed

Many versions of the idea were tested and set aside. Together they show that the fabric is **not**:

- a threshold that follows the expansion of the universe;
- a wave with one fixed wavelength;
- the atom’s equation copied to a galaxy;
- something whose strength depends on a galaxy’s heat, age or form;
- the rule applied twice, or a simple head-count sum over member galaxies;
- one surface density from dwarf galaxies to clusters;
- a function of the depth of a system’s own gravitational well.

Every one of these treats a system as standing alone, and most are sums. That is what the failures have in common, and it is why the author’s reading is that the missing piece is the surroundings and that the right law is not linear. Each failure removed a wrong turning. None of them closed the road.

6.9 The anomalies, and the work ahead

These are the places where the results do not yet fit, each with the author’s proposal for what could be its cause and the test it calls for. Other explanations are possible in every row, and none of these tests has been run.

Anomaly in the results	The author’s proposal	The test it calls for
The rule falls short in groups and clusters, and more so the more matter they hold	The state of the matter: the fabric is free around hot gas. The surroundings stretch the lock	A larger sample with stars and hot gas measured separately
Ellipticals show an excess that grows outward	The characteristics of their stars, their hot gas, and their neighbours	One test with all three accounted for
Stars and cold gas differ in the pull they carry	The star is the unit of the fabric	Galaxies with the best distances; the wide-pair prediction
The two ways of weighing a group disagree (Akino et al., 2022; Pratt et al., 2019; Sereno et al., 2020; Umetsu et al., 2020)	What is measured depends on how it is measured	Systems weighed both ways, compared one by one
Results shift with the assumed mass of the stars	The life and death of stars: faint stars and dead stars carry mass with little light	Star masses measured by an independent method
No test here could include what lies around each system	The surroundings are part of the fabric	Data on the surroundings of each galaxy and cluster
Not yet examined: the time when a galaxy’s rotation speeds up	That period, with the characteristics of the stars, could shape the fabric a galaxy carries	Galaxies caught at that stage, and the history of spin of each galaxy, set against its departure from the rule

The work on these will continue, with partners, and the results will be reported whichever way they fall.

6.10 The full table of tests

#	What was tested	Result
1	Three forms of the rule on 147 galaxies (2,696 points) (Lelli et al., 2016)	The “thermal” form matches the best fitted curve (scatter 0.133). It is the known empirical relation (McGaugh et al., 2016)
2	The rule in 12 clusters of galaxies (Eckert et al., 2017; Eckert et al., 2022; Eckert et al., 2019; Ettori et al., 2019; Ghirardini et al., 2019)	**Fail.** Observed mass is 1.5 to 2 times what the rule gives
2b	The rule in lensing around spiral and elliptical galaxies (Brouwer et al., 2021)	Spirals **pass** (offset −0.006). Ellipticals **fail** (+0.18 to +0.21)

#	What was tested	Result
3	A cross-check using heat	Void
4	The fabric as a wave of one fixed wavelength; one surface density from dwarfs to clusters (Gopika & Desai, 2020; Li et al., 2020; Salucci et al., 2012)	**Fail**; marginal in galaxies, fail in clusters
5	Two phases with a floor (Lelli et al., 2016)	**Fail**
6	The atom’s equation copied unchanged to a galaxy	**Fail**
7	Threshold constant in time, against a threshold that follows the expansion rate (Genzel et al., 2020; Nestor Shachar et al., 2023)	Constant **passes** in every bin back about 10 billion years. Evolving **fails**
8	Heat breaks the connection (Lelli et al., 2016)	**Fail**
9	The elliptical excess grows with distance from the galaxy (Brouwer et al., 2021)	Declared **fail**; the outward growth itself is seen (+0.14 to +0.15)
10	A head-count sum of member galaxies, 12 clusters (Eckert et al., 2017; Eckert et al., 2022; Eckert et al., 2019; Ettori et al., 2019; Ghirardini et al., 2019)	Outer radius passes, inner radius **fails**
11	The same on 133 new systems (Chiu et al., 2018; Gonzalez et al., 2013; Laganá et al., 2013; Sanderson et al., 2013)	**Fail**
12	An empirical trend with mass, fitted on half and tested on the rest	Two of three parts pass
13	A surface term plus a volume term (Gopika & Desai, 2020; Li et al., 2020; Salucci et al., 2012)	**Fail**
14	One switch-on distance for all galaxy masses	**Fail** / inconclusive
15	Does frequency or distance add anything at fixed pull, inside galaxies? (Lelli et al., 2016)	Adds nothing detectable. The test is not sharp
16	A switch at the mass where gas can no longer cool (Eckert et al., 2016; Lovisari et al., 2015; Rees & Ostriker, 1977; Sun et al., 2009)	Declared **fail**. The fail rests on one of three samples; on the other two all parts would pass. Unresolved
17	The depth of a system’s own gravitational well as the single variable	**Fail** on galaxies and on clusters
18	Two states with three forms of reach, no fitted numbers, 290 systems (Chiu et al., 2018; Eckert et al., 2016; Eckert et al., 2017; Eckert et al., 2022; Eckert et al., 2019; Ettori et al., 2019; Ghirardini et al., 2019; Gonzalez et al., 2013; Laganá et al., 2013; Lovisari et al., 2015; Sanderson et al., 2013; Sun et al., 2009)	All three **fail**. One form passes 9 of 11 checks

#	What was tested	Result
19	The upward pull near the Sun: point-by-point lock against a round fabric (Bienaymé et al., 2014; Bovy & Rix, 2013; Eilers et al., 2019; Guo et al., 2020; Holmberg & Flynn, 2004; Horta et al., 2024; Kuijken & Gilmore, 1991; López-Corredoira, 2025; McKee et al., 2015; Nitschai et al., 2021; Zhang et al., 2013)	Lock **passes** (0.6 sigma). Round fabric **fails** (2.7 sigma). Confirmed independently
20	Two-state formula on 17 systems not seen before (Lin et al., 2003; Zhang et al., 2011)	Both forms tested **pass**. The pass is weak
21	Are the stars in ellipticals heavier than their light suggests? (Brouwer et al., 2021; Cappellari et al., 2013; Treu et al., 2010)	**Fail** overall. The inner excess is explained; the outer is not
22	Do stars act on the fabric directly, in single galaxies?	Mixed. No clear effect, and none excluded below about 12%
23	Two-state formula on a larger unseen sample (Chiu et al., 2016; Humphrey et al., 2011; Humphrey et al., 2012; Laganá et al., 2008)	**Incomplete.** Only 8 further systems exist with the needed measurements
24	Do old bulge stars, disc stars and cold gas lock the fabric alike? (Lelli et al., 2016)	Bulge and disc stars alike. Cold gas differs at 3.5 sigma. Confirmed independently; cause unresolved
25	**Prediction** for wide star pairs	On record. To be decided after 2 December 2026 (European Space Agency, n.d.-a)
26	Does a higher star mass remove the gas difference? (Lelli et al., 2016)	Inconclusive. Heavier stars are disfavoured as the cause
27	Test 16 again, on 17 unseen systems weighed by X-ray gas pressure only (Eckert et al., 2016; Eckmiller et al., 2011; Lovisari et al., 2015; Pratt et al., 2016; Rees & Ostriker, 1977; Sun et al., 2009; Vikhlinin et al., 2006)	**Fail.** The rule falls short even in the smallest groups (1.72, seven systems, all with masses extended beyond the measured radius). The rise with mass is seen at 1.9 sigma. Not independently re-checked

7. The model as it now stands

7.1 The model in one statement

> The fabric continuum is one fabric of connection running through the microverse and the macroverse. In the microverse it is the exchange that binds the parts of the nucleus and the atom, and it is most of the mass of ordinary matter. In the macroverse it is the unseen mass. There it is locked, point by point, to cohesive ordinary matter by one rule, out to a reach set by the surroundings, and it is free around diffuse hot gas, at the cosmic share. The star is its unit.

7.2 What each part of the model rests on

Part of the model	From the microverse (established)	From the macroverse (section 6)	How it stands
The fabric is mass of the connection type	Most of the proton's mass is the energy of its connection (Yang et al., 2018)	Most of the matter of the universe is unseen and acts only through gravity (Planck Collaboration, 2020)	A likeness. The hypothesis
It follows one law with a fixed constant	The bonds of the microverse are fixed by constants. The one that has been tested, for the electric bond, has not changed over billions of years (Damour & Dyson, 1996; Murphy et al., 2022)	One rule and one threshold in 147 galaxies, unchanged for about 10 billion years (Genzel et al., 2020; Lelli et al., 2016; Nestor Shachar et al., 2023)	Firm at the macro scale. Not yet derived
It is locked point by point	A bond belongs to the particles it joins	The upward pull near the Sun, with nothing fitted (Bienaymé et al., 2014; Bovy & Rix, 2013; Eilers et al., 2019; Guo et al., 2020; Holmberg & Flynn, 2004; Horta et al., 2024; Kuijken & Gilmore, 1991; López-Corredoira, 2025; McKee et al., 2015; Nitschai et al., 2021; Zhang et al., 2013)	Passed in one place, and checked
It has two states, locked and free	Bound matter and freed matter: the atom and ionised gas; the proton and free quarks (Bazavov et al., 2019; Gary, n.d.)	The two-state formula in groups and clusters, with no fitted number (Chiu et al., 2018; Eckert et al., 2016; Eckert et al., 2017; Eckert et al., 2022; Eckert et al., 2019; Ettori et al., 2019; Ghirardini et al., 2019; Gonzalez et al., 2013; Laganá et al., 2013; Lin et al., 2003; Lovisari et al., 2015; Sanderson et al., 2013; Sun et al., 2009; Zhang et al., 2011)	A weak pass on unseen systems
The surroundings set its reach	An atom in dense matter keeps its outer electrons only as far as its neighbours allow (Pethick, 2019)	Galaxies in clusters are cut short by the cluster's pull; ellipticals show an excess that grows outward (Brouwer et al., 2021; Limousin et al., 2007)	Supported in form. Two forms of reach pass, and the data cannot yet choose
The whole is not the sum of the parts	The connection inside the proton acts on itself (Huston et al., 2024)	The rule that passed is non-linear, and the sums failed	Firm as a pattern
The star is its unit	The mass of a star follows from the constants of the microverse (Burrows & Ostriker, 2014; Carr & Rees, 1979)	Stars appear to carry more of the fabric than cold gas does, at 3.5 sigma	Open. The prediction of section 8 tests it

7.3 The model in the equations

The five formulas of section 3.3 state the model. Formula 1 adds one term to the source of gravity in Einstein's equation: the energy of the exchange. Formulas 2 and 3 give the locked state, Formula 4 the free state, and Formula 5 the two together.

Two statements go with them. Radiation meets the fabric only through gravity: light is bent by the fabric and is not otherwise absorbed, emitted or scattered by it. And matter and the fabric are conserved together, because the fabric is the energy of the exchange between bodies.

7.4 The work of others that it builds on

Work by others over the last three decades relates the area of a surface in space, the entanglement across it, and the energy within it:

$$\frac{\delta\,(\text{ Area }\,)}{4G\hbar} \;=\; \delta S \;=\; \delta\langle K\rangle$$

Jacobson (1995) derived Einstein's equation from the thermodynamics of such surfaces. Ryu and Takayanagi (2006) proposed, and checked in simple cases, that in a class of model universes the entanglement across a surface is given by an area. Lashkari, McDermott and Van Raamsdonk, and Faulkner and co-authors (2013, published 2014) showed that in such model universes, close to the simplest one, the relation above gives Einstein's equation to first order. These results are established for those models. They are not established for our universe, and they are credited here as the ground the hypothesis starts from.

The author's addition is that the entanglement has a part that belongs to the exchange itself and not to the matter, and that this part gravitates.

7.5 What the early universe asks of the model

Two conditions follow from established measurements, and the model has to meet both. The energy of the exchange must thin out as space expands in the same way that matter does (Planck Collaboration, 2020). And the fabric must already have been free of ordinary matter about 380,000 years after the beginning, before the first stars, because the pattern in the oldest light shows that most of the gravitating mass was not being pushed about by light as the ordinary matter then was (Bromm, 2013; European Space Agency, n.d.-b; Glover & Klessen, 2026; Hu & Dodelson, 2002; Planck Collaboration, 2020; Scott & Smoot, 2024).

So the star is not the origin of the fabric. On the model it is the unit through which the fabric is locked and through which it is revealed. The free state came first. That fits the place of the microverse in the model: its exchanges were at work from the beginning, and stars came later.

7.6 Where the model is headed

Three things would complete it, and each is work to be done.

1. **The missing law.** Nothing yet derives the rule, its threshold and the two states from the fabric as a matrix of connections. Formula 1 names the exchange term. Formulas 2 to 5 describe what it does. The derivation that joins them is the main open problem.
2. **Rotation and the stars.** By the standard account of how galaxies form, a galaxy has a time when its rotation speeds up, and it holds stars of particular kinds and histories (Mo et al., 1998; Schäfer, 2009; White, 1984). The author's proposal is that these could account for many of the anomalies of section 6.9, and so could be part of what sets the fabric a galaxy carries. There could be other explanations. This has not yet been tested.
3. **The joint between the two scales.** The star is where the microverse and the macroverse meet. The prediction of section 8 asks whether the fabric begins there.

Whatever the answer to the third, the first two remain to be researched, and the author intends to continue that work with partners and to report the results whichever way they fall.

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8. A prediction placed on record

If each star carries its own share of the fabric, locked point by point, then two stars orbiting each other at a very large separation should pull on each other more strongly than Newton's law gives. The effect appears at separations of a few thousand times the Earth–Sun distance and is complete by about ten thousand, where the pull between the two stars has fallen to the order of the threshold.

This is the place where the microverse and the macroverse are tested together. The star is the characteristic body that gravity builds from particles, and its mass is fixed by the constants of the microverse (Burrows & Ostriker, 2014; Carr & Rees, 1979). The prediction asks whether the fabric begins there.

The prediction was computed from the rule exactly as used in the tests above, with nothing fitted, and placed on record at 13:18 UTC on 12 November 2026.

Separation (thousands of Earth–Sun distances)	Pull compared with Newton
1	1.00
3	1.05
5	1.18
7	1.30
10 and beyond	**1.335**

(For a pair with a total mass of 1.5 Suns. The orbital speed is higher by the square root: about 15.5% for wide pairs.)

If the fabric does not reach the scale of single stars, the pull is Newton's at every separation.

How it will be decided. By published analyses of the next release of the Gaia star catalogue (due 2 December 2026) from at least two independent groups (European Space Agency, n.d.-a). The hypothesis passes if they find the pull of wide pairs between 1.235 and 1.435 times Newton's and each excludes Newton at 3 sigma. It fails if they find Newton's value and each excludes 1.335 at 3 sigma. Anything else is undecided. The release date itself decides nothing; the analyses will follow it.

Three things the reader should know. First, the formula used is the standard one for the published theory that uses the same law (Milgrom, 2010). With that theory's own inputs the published value is about 1.37; the value here, 1.335, comes from the inputs of this paper (Banik & Zhao, 2018). A pass would confirm the point-by-point lock at the scale of stars. It would not by itself separate this hypothesis from that theory. Second, analyses of the earlier release of the catalogue disagree, and the latest are still divided: some find the extra pull and some find Newton's value (Banik et al., 2024; Chae, 2023; Chae, 2024; Chae et al., 2026; Chae & Yoon, 2026; Cookson et al., 2026; Hernandez, 2023; Pittordis & Sutherland, 2023; Saad & Ting, 2026). Third, a fail would mean that the fabric begins at a larger scale and that the star is its unit in form only.

Whatever the outcome, it will be reported. Checksums of the declaration and of the prediction file are given in section 15.

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9. The microverse and the macroverse

Section 5 put forward the possibility that the macroverse is a form of the microverse. This section sets the two side by side: what is alike, where they meet, how far the likeness goes, and what it would take to go further.

9.1 Two models, side by side

The left column is established physics. The right column is what the tests of section 6 found.

	The microverse	The macroverse
Where the mass is	In the standard calculation about nine-tenths of a proton's mass is the energy of the motion and binding of its parts, not the mass of the parts (Yang et al., 2018)	About five-sixths of the matter of the universe is unseen. It is known only through its pull (Planck Collaboration, 2020)
What light sees	Light and electrons fired at a proton meet only its quarks. The quarks carry only part of its momentum, roughly 60% in a recent calculation at the usual reference scale; the rest is in the connection, which light does not see (Alexandrou et al., 2020; Aschenauer et al., 2024)	The unseen mass neither gives off nor absorbs light. Light is bent by it, and that is the only way light shows it (Clowe et al., 2006)
How it changes with distance	Around an atom, empty space partly hides the electric charge, so it looks weaker from far away. Inside the proton the opposite holds: the connection grows stronger with distance (Erler & Freitas, 2024; Huston et al., 2024)	Around a galaxy the unseen pull, compared with Newton's, grows with distance. That is the direction of the proton, not of the atom
Whether the parts add up	The connection inside the proton acts on itself, so the whole is not the sum of the parts (Huston et al., 2024)	The one rule that passed is not a sum. The formulas built as sums failed
Whether it has a size of its own	The connection has no fixed length; its energy grows with distance until, at about the size of a proton, it breaks (Bali et al., 2005)	The core of the fabric has the same surface density at every core size measured
Whether it changes with time	The constant that sets the strength of the electric bond, the one that has been tested, has not changed, to parts in a million or better, over billions of years (Damour & Dyson, 1996; Murphy et al., 2022)	The threshold of the rule has not changed over about 10 billion years

9.2 One pattern at three scales: bound, until freed

A thing stays bound to its centre until its surroundings stretch it or heat frees it. Each row is established, except the last entry of the last row, which is the hypothesis.

Scale	What is bound	Freed by the surroundings	Freed by heat	The free state
Quarks	Quarks in a proton	Pulled far enough apart, the connection breaks and makes new particles (Bali et al., 2005)	At about 1.8 trillion degrees, by a gradual change (Bazavov et al., 2019)	A hot soup of free quarks

Scale	What is bound	Freed by the surroundings	Freed by heat	The free state
Atoms	Electrons around a nucleus	A strong outside field strips the outer electron. In dense matter an atom keeps an outer electron only if there is room for its orbit between the neighbours (Ebeling et al., 2012; MIT Atomic and Optical Physics Wiki, n.d.; Pethick, 2019)	At around ten thousand degrees in a star's outer layers (Fraknoi et al., 2022; Gary, n.d.)	Hot ionised gas
Galaxies	Stars, and on the hypothesis the locked fabric	The pull of a cluster cuts each galaxy short, at a distance set by the galaxy's mass and its orbit (Gajda & Łokas, 2016; Limousin et al., 2007)	—	Stars, and on the hypothesis fabric, spread between the galaxies

Two details stand out. The rule in the middle row, that an atom reaches only as far as its neighbours allow, has the same form as the reach that did best in the two-state formula of section 6.5. And the hot gas that fills a cluster of galaxies, around which the fabric was found to be free, is itself matter in the freed state of the middle row.

9.3 The star: where the two scales meet

The star belongs to both.

- **Its mass comes from the microverse.** The pull of gravity between two protons, set against the natural quantum unit of force, is about one part in 10^{38} (National Institute of Standards and Technology, n.d.). Gravity overcomes the quantum pressure of particles only when about 10^{57} of them are gathered, a number that follows from that ratio (Burrows & Ostriker, 2014; Carr & Rees, 1979). That is the characteristic mass of a star. In this sense the star is to gravity what the atom is to the electric force: the characteristic body it builds.
- **The atom is its child.** Hydrogen, most helium and a trace of lithium date from the first minutes (Fields et al., 2024). Every other nucleus was made in stars or in their deaths.
- **It works by the micro connection.** A star shines by joining nuclei. The energy released is the difference in the energy of their connection, about 0.7% of the fuel (Fraknoi et al., 2022).
- **It is the candidate unit of the fabric.** The tests found a sign that stars carry more of the fabric than cold gas does (section 6.7), and the prediction of section 8 asks directly whether each star carries its own share.

9.4 How far the likeness goes

The claim that one fabric runs through both scales was judged in three steps (section 5.3).

1. **Likeness of form: met.** The tables above show the same behaviours at both scales, at six points and in the pattern of bound and freed.
2. **Agreement of number: not met.** If it is one fabric, some quantity of the microverse should give the threshold of the macro rule. One comparison was made, with the pull at the surface of an electron, a proton and a pion. The nearest missed by a factor of 14.
3. **A test at the joint: open.** The prediction of section 8.

What this means for the search. The two scales share a model in form. That is a real finding, and it is what makes the possibility worth pursuing. It does not show that they are one thing: the forces differ at each scale, and no experiment yet shows one mechanism beneath them. *What comes next:* the prediction for the star; a derivation that gives the threshold from the constants of the microverse; and the question raised in section 6, whether the time

when a galaxy's rotation speeds up, together with the characteristics of its stars, could account for what the simple likeness leaves out.

9.5 Seeing the macroverse from inside the microverse

The author asked how any such likeness can be measured "when we can see such a finite piece of time". The question is exact. A person stands about ten powers of ten above the atom and about twenty-six below the observable universe, and sees a few decades of a history of billions of years (Davis & Lineweaver, 2004; National Institute of Standards and Technology, n.d.).

No slow process of the macroverse has ever been watched from start to finish. Three things stand in for time.

- **Distance.** Light from far away left long ago, so looking far is looking back. The tests here used galaxies as they were 10 billion years ago (Genzel et al., 2020; Nestor Shachar et al., 2023).
- **Number.** One view of many like things at different stages lines up into a history. No one has watched a star live; millions are seen at once, forming, burning and dying.
- **Precision.** A very small change measured very exactly over a short while. One pair of dead stars has been timed for decades as its orbit shrinks, in agreement with general relativity to a fraction of a percent (Weisberg & Huang, 2016).

The microverse is measured in the same way: every atom of a kind is identical, so watching a great number for a short time stands in for watching one for a very long time.

All three rest on one assumption: that things are alike in other places and at other times. It has been checked within stated limits, in the light of distant gas and in a natural nuclear reactor that ran about 2 billion years ago (Damour & Dyson, 1996; Murphy et al., 2022). Where it cannot be checked, the science stops. The beginning of the fabric, before the oldest light, lies beyond all three. That is the present limit of the view from inside, and it is part of what the author means by a continuum.

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10. The Other Side

This part of the hypothesis has not been tested. It is included because, for the author, it is where the theory began and what it is for.

> "we are aware of what we are aware… not more"

> "we have no reference of time"

> "continuity… we are creating continuity during existence and are not aware"

The last of these is the heart of it: the possibility that we are creating our existence in a form we do not understand or see.

This section sets out what science has established that bears on that possibility, with the experiments and their figures, and marks plainly what is shown, what is disputed and what is not shown.

10.1 Abstract thinking and consciousness

A mind is connection. What is learned is held, in large part, in the strength of the links between nerve cells (Takeuchi et al., 2014). This was first shown in 1973, when links in the brain were found to stay strengthened for hours after use (Bliss and Lømo), and the work on how memories are stored in such links was recognised by a Nobel Prize in 2000 (Kandel, 2000; Nobel Prize Outreach, n.d.-b). Reviews still call it a hypothesis broadly supported, with critical experiments remaining (Takeuchi et al., 2014). Abstract thinking, on this view, is the linking of links: relations among relations.

It runs on very little. The brain uses about 20 watts, about a fifth of the body's oxygen for a fiftieth of its mass (Balasubramanian, 2021; Raichle & Gusnard, 2002). That energy ends as heat (Wang et al., 2014).

The author's hypothesis is that the same principle of connection that runs through the microverse and the macroverse is at work here, at the level of the atomic nucleus and not only of chemistry, and that it reaches beyond the single mind (sections 1.2 and 4.6).

10.2 What is established: connection without contact

Two things can share one state, so that what is found at one is tied to what is found at the other, with nothing passing between them. This is entanglement. A single thing can also be in two states at once. This is superposition. Neither is in doubt.

Experiment	What was shown	Figures	Standing
Three laboratories, 2015 (Vienna, Boulder, Delft) (Giustina et al., 2015; Hensen et al., 2015; Shalm et al., 2015)	Entanglement is real and cannot be explained by hidden local causes, with the known loopholes closed	Stations 58 m, 184 m and 1.3 km apart. The Vienna result stands at 11.5 sigma (National Institute of Standards and Technology, 2015)	Replicated
Nobel Prize in Physics, 2022 (Aspect, Clauser, Zeilinger) (Nobel Prize Outreach, n.d.-a)	Awarded for experiments with entangled photons	—	Established
Satellite, 2017	Entanglement shared between two ground stations (Yin et al., 2017)	1,203 km apart	Repeated by the same group in 2020 over 1,120 km (Yin et al., 2020)
Satellite, 2017	The state of a particle of light sent from the ground to orbit by means of entanglement (Ren et al., 2017)	Up to 1,400 km	Single study
Large Hadron Collider, 2023 and 2024 (ATLAS Collaboration, 2024; CMS Collaboration, 2024)	Entanglement between the heaviest known particles, at the highest energies reached	More than 5 sigma in two separate experiments	Replicated. What it implies is debated (Bechtle et al., 2025)

What entanglement does not do. It cannot be used to send a message (Ghirardi et al., 1980). That is an established theorem, and every experiment above respects it. A protocol exists by which energy can be drawn out at one place using entanglement and an ordinary signal from another, and it has been demonstrated in the laboratory; it, too, needs the ordinary signal and sends nothing faster than light.

This is the author's order exactly (section 4.1): the relation first, the signal second. The relation is established. The signal is the proposal.

10.3 From the microverse toward the macroverse

Quantum connection was first seen in single particles. The question for the fabric continuum is how far up in size it can be carried. The record so far:

What	How large	Figures	Standing
Molecules in two places at once (Fein et al., 2019)	Up to 2,000 atoms each	More than 25,000 times the mass of a hydrogen atom	One laboratory with a long record
Two small mechanical objects entangled with each other (Kotler et al., 2021; Mercier de Lépinay et al., 2021; Ockeloen-Korppi et al., 2018; Riedinger et al., 2018)	In one experiment, a pair of metal drums of about a trillion atoms each (Kotler et al., 2021; National Institute of Standards and Technology, 2021)	About 70 trillionths of a gram each, held a few thousandths of a degree above absolute zero (Kotler et al., 2021; Mercier de Lépinay et al., 2021; Ockeloen-Korppi et al., 2018)	Four groups, 2018 to 2021

What	How large	Figures	Standing
Two diamonds entangled at room temperature (Lee et al., 2011)	3 mm across, 15 cm apart (Belli et al., 2016)	The shared state lasted about a trillionth of a second (Belli et al., 2016)	Single study
A crystal in two states of motion at once (Bild et al., 2023)	16 millionths of a gram	The two states differed by about a billionth of a billionth of a metre and lasted about ten millionths of a second	Single study
Mirrors cooled almost to stillness (Whittle et al., 2021)	10 kg	Brought close to their lowest quantum state. Not a superposition	Single study

Two things are plain from this table. The reach of quantum connection has grown, in thirty years, from single particles to objects that can be seen. And the larger the object, the colder and more isolated it must be and the more briefly the state lasts. Between a millionth of a gram and a brain, or a galaxy, lies a very great distance that no experiment has crossed.

Gravity and the quantum world. This is where physics is now trying to join the two scales by experiment, and it is the scientific form of the connection this paper proposes.

- Particles in a quantum state respond to gravity. This was shown with neutrons in the Earth’s gravity in 1975 and is established (Colella et al., 1975).
- Gravity has been measured between smaller and smaller bodies: between gold spheres of about 90 thousandths of a gram (2021), and on a particle of less than half a thousandth of a gram (2024) (Fuchs et al., 2024; Westphal et al., 2021).
- Experiments have been proposed, in 2017, to test whether gravity itself can entangle two small masses (Bose et al., 2017; Marletto & Vedral, 2017). They have not yet been done, and what a result would prove is debated (Anastopoulos & Hu, 2018; Bose et al., 2025; Plávala, 2026).

If such an experiment succeeds, it will show for the first time a quantum connection carried by gravity: the microverse and the macroverse joined in one measurement. That has not happened yet.

10.4 Living things and the brain: what is shown, and what is not

Claim	What the evidence is	Standing
Enzymes use quantum tunnelling	Hydrogen passes through barriers it could not cross classically (Klinman & Kohen, 2013)	Established
Plants use long-lived quantum states to move energy	Reported in 2007. A 2020 reassessment found the states last less than a tenth of a trillionth of a second at room temperature, too short to matter (Cao et al., 2020; Engel et al., 2007)	Largely resolved against
Migrating birds sense magnetism through a quantum effect in a protein of the eye	The protein from a migratory bird is magnetically sensitive in the test tube (Xu et al., 2021)	Single study. Not shown in a living bird
Quantum states in the brain are destroyed at once	Calculated for ions and for the cell’s protein scaffolding. The calculation does not cover the spins of atomic nuclei	Established for what it covers
Nuclear spins in the brain could hold quantum states long enough to matter	Proposed in 2015. Later calculations give far shorter lifetimes than first claimed (Agarwal et al., 2023; Fisher, 2015; Player & Hore, 2018)	Proposal only. Contested

Claim	What the evidence is	Standing
Isotopes, which differ only in the nucleus, change behaviour or anaesthesia	Reported for lithium in rats (1986, 2020) and for xenon in mice (2018)	Each a single study, none repeated. None separates the effect of nuclear spin from that of mass
The scaffolding inside nerve cells shows a collective quantum effect of light	Measured in purified protein in solution (2024) (Babcock et al., 2024)	Single study. Not shown in cells
A drug that stiffens that scaffolding delays anaesthesia	Eight rats; loss of consciousness delayed by about 69 seconds (2024) (Khan et al., 2024)	Single study
Consciousness arises from quantum collapse in that scaffolding (Hameroff & Penrose, 2014)	No positive evidence. A 2021 experiment ruled out the simplest form of the collapse it relies on (Derakhshani et al., 2022; Donadi et al., 2021)	Proposal only. Contested (McKemmish et al., 2009; McQueen, 2023)
The brains of people interacting fall into step	Well documented, through the ordinary senses (Burgess, 2013; Czeszumski et al., 2020; Dumas et al., 2010; Hamilton, 2021)	Established
The brains of people shielded from each other are correlated	One positive report in 2003; a later repeat found nothing (Ambach, 2008; Wackermann et al., 2003)	Not replicated

The plain position. No experiment has shown entanglement in a living brain, and none has shown a link between quantum connection and consciousness. At the level of the atomic nucleus the question has not been closed, because the experiment that would decide it has not been done.

10.5 Energy and information are not lost

> “energy does not die”

Physics agrees, and says something further.

- **Energy is conserved.** The energy a brain uses is not destroyed. It leaves as heat (Wang et al., 2014).
- **Information is physical.** Erasing one unit of information must release a minimum amount of heat. This was measured in 2012 and found to hold (Bérut et al., 2012).
- **In quantum theory information is not destroyed.** Calculations of 2019 and 2020 on black holes, the hardest case, came out consistent with this in model systems (Almheiri et al., 2019; Almheiri et al., 2021; Penington, 2020). How the information gets out is not yet shown (Almheiri et al., 2021).

So what a mind does is not erased from the universe. Its energy, and in principle its information, go on. They go on dispersed, as heat, in a form no instrument could gather back. What that information is in the form it then takes, and whether it could ever be understood, by energy or in any other form, is not known. The author’s hypothesis is that it is not lost to the fabric. Physics does not yet say whether that is so.

10.6 How this relates to the fabric continuum

- **Same in form.** The fabric continuum says a thing is its connections more than its parts. That is true of the proton, it is the hypothesis for the galaxy, and it is how the brain learns. Abstract thinking is that principle at work in a mind.
- **Same in fact.** The stronger claim is that the fabric itself is at work in the brain, at the nuclear level, and reaches beyond the single mind. Section 10.2 shows that connection without contact is real. Section 10.3 shows how far it has been carried and how far it has not. Section 10.4 shows that the brain is not yet among the places it has been found.
- **The relation and the signal.** Established physics allows the relation and forbids it from carrying a message (Ghirardi et al., 1980). The author’s proposal that waves in the fabric become signals is a step beyond that. It is new, and it is stated here as a proposal.

What this means for the search. The possibility of a connection running from the microverse to the macroverse is not a fringe idea. It is being pursued in laboratories now, through experiments on gravity and quantum states (Bose et al., 2025; Fuchs et al., 2024; Westphal et al., 2021). What this paper adds is the proposal that the mind belongs to the same continuum. That could be so. There could be other explanations of everything in this section, and nothing here shows it.

10.7 What would test it

1. **The isotope experiment.** Compare isotopes that differ in nuclear spin but hardly in mass, and test whether learning or awareness changes. If it does, the nuclear level matters and chemistry alone cannot explain it.
2. **A direct measurement** of how long nuclear spins hold a quantum state in brain tissue.
3. **The gravity experiments** of section 10.3. They would not test the mind, but they would show whether quantum connection can be carried by the force that shapes the macroverse.

Energy does not die. This much is established physics, and it has been put plainly for a wide audience. The astrophysicist Neil deGrasse Tyson has pointed out that when a body is cremated, the energy held in its molecules does not disappear. It becomes heat, leaves as infrared light, and travels outward into space at the speed of light (IFLScience, 2026). The energy of a life goes on. What established physics does not say is that the pattern goes with it: what was known, thought and remembered. Whether anything of that is carried, by energy or in another form, is the question the author raises here. It is open, and this paper does not claim an answer.

The author was moved to this thought by the story of a child who loved the stars and hoped to study them.

These are for those qualified to run them. The author's aim is to state the question precisely enough that it can be answered.

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11. What is open, and the work ahead

The work on this hypothesis and theory has only started. This section says what is not yet known, what would count for the hypothesis, what would count against it, and what the author and partners intend to do next.

11.1 What is open

In the model.

1. *The missing law.* Nothing yet derives the rule, its threshold and the two states from the fabric as a matrix of connections.
2. *The sign and size of the connection.* At the macro scale it must be positive and about five times the ordinary mass. Ordinary gravitational binding is negative and far smaller.
3. *The beginning.* The fabric was already free of ordinary matter when the oldest light was released (European Space Agency, n.d.-b; Hu & Dodelson, 2002; Scott & Smoot, 2024). Why, and how it came to be locked to matter afterwards, is not explained.

In the macroverse.

4. *The reach of the lock.* Two forms pass the one available test on unseen clusters and cannot yet be told apart.
5. *Stars and gas.* Whether a unit of stars truly carries more of the fabric than a unit of cold gas.
6. *The mass of the stars.* How much stars weigh for the light they give is the largest uncertainty in every test of ellipticals and clusters here.
7. *How to weigh a group of galaxies.* X-ray and lensing masses for the same kind of system have differed by up to about a half, and published revisions have since moved both (Akino et al., 2022; Eckert et al., 2016; Eckert et al., 2019; Pratt et al., 2019; Sereno et al., 2020; Umetsu et al., 2020). Until that settles, no test in this range of mass can be clean, for this hypothesis or any other.
8. *The surroundings.* No test here could include what lies around each system, for lack of data.
9. *Rotation.* Whether the time when a galaxy's rotation speeds up, together with the characteristics of its stars, could account for the anomalies of section 6.9.

At the joint between the two scales.

10. *Agreement of number.* No quantity of the microverse has yet been shown to give the threshold of the macro rule.
11. *The star.* Whether each star carries its own share of the fabric (section 8).

On the other side.

12. *Abstract thinking and consciousness.* Every part of that link (section 10).

11.2 What would count for the hypothesis

- Wide star pairs found to pull on each other at about 1.335 times Newton's value.
- A larger sample of clusters, with stars and hot gas measured separately, on which the two-state formula passes.
- The upward pull above the disc of our galaxy, measured out to several thousand parsecs, found to follow the point-by-point lock where an ordinary round halo does not.
- A derivation that gives the threshold of the rule from the constants of the microverse.
- The difference between stars and cold gas confirmed in the galaxies with the best-measured distances.

11.3 What would count against it

- Wide star pairs found to obey Newton's law: the star would not be the unit of the fabric in fact.
- A larger sample of clusters on which the two-state formula fails.
- A demonstration that the upward pull above our galaxy's disc cannot be matched by a point-by-point lock.
- A direct detection of a dark matter particle with the right abundance: the unseen mass would then be a substance and not a connection.
- For the claim about the mind in its stronger form: a clean experiment in which isotopes of different nuclear spin and nearly equal mass make no difference to brain function.

Each of these can be decided by measurement. That is the test of whether a hypothesis is worth holding.

11.4 The work ahead

1. Follow the analyses of wide star pairs after the catalogue release of 2 December 2026, and report the outcome against the prediction on record (European Space Agency, n.d.-a).
2. Research the two proposals that stand whatever that outcome is: the period when a galaxy's rotation speeds up, and the characteristics of stars.
3. Seek larger and better-measured samples for the two-state formula, and data on the surroundings of each system.
4. Work toward the missing law.
5. Pursue, with those qualified to run it, the experiment proposed in section 10.

The author intends to carry this forward with partners and to report further updates as tests are made, whichever way they fall, until a verified model that connects the microverse and the macroverse is found or the possibility is ruled out.

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12. The work of others nearest to this, and how the fabric continuum differs

Each ingredient of the hypothesis has a published relative. The author has drawn on them, and they are named here so that a reader can see what is new and what is not. Each of them, taken alone, has a known difficulty.

Published idea	What it gets right	Its known difficulty
A change to the law of motion or of gravity below a threshold of acceleration (Milgrom 1983, three papers, and much later work)	The rule that single galaxies follow	Clusters of galaxies; colliding clusters (Angus et al., 2007; Clowe et al., 2006)

Published idea	What it gets right	Its known difficulty
The radial acceleration relation (McGaugh, Lelli and Schombert 2016)	The rule in the same form as used here, found from 153 galaxies, with a fitted threshold of 1.20×10^{-10} m/s² where this paper fixes 1.08×10^{-10}	It is a relation found in the data, with no account of its cause
Dark matter as a medium that is polarised by gravity, as an insulator is by an electric field, but with the opposite sign (Blanchet 2007, and later work with Le Tiec and others) (Blanchet, 2009; Blanchet & Le Tiec, 2008; Blanchet & Le Tiec, 2009)	Gives the galaxy rule	Its equilibrium in a galaxy has been shown to be unstable (Stahl and co-authors 2022)
Dark matter that takes a connected, frictionless state in galaxies and an ordinary state in clusters (Berezhiani and Khoury 2015)	Galaxies, and the masses of clusters (Hodson et al., 2017)	Fits to a large sample of galaxies need unlikely star masses and do not behave as the rule does, and there is conflict with lensing far out (Mistele and co-authors 2022, 2023)
Gravity and the dark sector arising from entanglement (Verlinde, published 2017)	Agrees with lensing around galaxies (Brouwer et al., 2017)	Its prediction for the Solar System is far from what is measured (Hees and co-authors 2017)
Gravity strengthened in galaxies by the interaction of its own field with itself (Deur 2009 and later) (Deur et al., 2020)	Aims at the galaxy rule without unseen mass	The mechanism is disputed (Barker, Hobson and Lasenby 2023; Deur has replied) (Deur, 2023)
Extra apparent matter arising in a matrix model of space (Steinacker 2026)	A matrix in which everything is connected	The extra matter around a mass has negative net mass, and it has not been compared with data
Quantum states of atomic nuclei at work in the brain (Fisher 2015)	Names something in the brain that is shielded from its surroundings: the spin of a phosphorus nucleus inside a molecule	The lifetimes it needs are contested by later calculations, and no experiment has confirmed it (Agarwal et al., 2023; Player & Hore, 2018)

How the fabric continuum differs.

- **It joins them.** The fabric is a medium that responds, of the kind found inside the proton, set in a matrix where bodies and places are both entries and nothing is external. The two kinds of entry give the two states: locked and free.
- **It takes its model from the microverse.** The distinction that did the work in the tests, between cohesive matter and diffuse matter, is the distinction between bound and freed matter at the small scale.
- **It names the star as the unit,** and puts that to a test with a prediction made before the data.
- **It carries the same principle to abstract thinking and consciousness,** which none of the works above attempts.
- **It comes with its record.** Twenty-seven declared tests are reported, including the many that failed, each with its checksum and date.

What it does not yet do that some of them do. Several of the works above are complete mathematical theories from which predictions follow. The fabric continuum is not yet that. It has a model, five formulas, and a body of tests, and it lacks the law that would join them. Until it has that law it should be judged as a hypothesis with limited testing, which is how this paper presents it.

12.1 The gaps, one by one

The table below takes the open gaps in present physics that this paper touches, and says for each what is established, what the fabric continuum offers, and how far the first stage of the work has taken it.

The gap	What is established	What the fabric continuum offers	Where the first stage stands
General relativity and the standard model do not join	Each is confirmed in its own domain. No accepted theory contains both	One meeting point: mass. The connection energy that the standard model finds inside the proton is proposed as the unseen mass that general relativity needs at the large scale. One term is added to Einstein's equation (Formula 1)	A proposal with a match of form at six points (section 1.1). No derivation yet. Work on a match of number is continuing
The nature of the unseen mass	Its gravity is measured on every scale from galaxies to the oldest light. No particle of it has been detected	It is not a new substance. It is mass of the connection type, in two states	Not separated from ordinary dark matter by any test here. The prediction of section 8 could begin to separate them
Why single galaxies follow one rule	The rule is measured (McGaugh, Lelli and Schombert 2016). In the standard account it has to emerge from how galaxies form; in the minority theory it is a new law of motion. Neither is settled	The rule is the lock of the fabric to cohesive matter, point by point	The rule and its fixed threshold were confirmed here on 147 galaxies and over about 10 billion years. The lock gave the measured pull near the Sun with nothing fitted. An ordinary round halo of the standard kind passes that test as well
Why the same rule falls short in clusters of galaxies	A known difficulty of every theory built on the rule: clusters need about 1.5 to 2 times more	A second state. Around diffuse hot gas the fabric is free, at the cosmic share, with no number adjusted	Passed its declared test on 17 systems not seen before. The pass is weak, a larger test is incomplete, and two forms of the reach cannot yet be told apart
Why the threshold is close to the speed of light times the expansion rate	A numerical coincidence noted since 1983. No accepted explanation	The threshold is fixed at that value in advance and not fitted	The fixed value works on the galaxies. The threshold does not change with the expansion rate over time (Test 7), so the link is to today's value only, and it remains unexplained
Whether the unseen pull reaches down to single stars	Analyses of wide pairs of stars are divided	The star is the unit of the fabric, so the pull should be there	One dated prediction on record. To be decided by analyses of the catalogue due 2 December 2026
Whether physics has a place for abstract thinking and consciousness	No accepted physical account. Quantum effects in the brain are proposed and contested	The same principle of connection, in form, and as a further hypothesis in fact, at the level of the nucleus	Untested. An experiment is described in section 10

What this comparison shows. On each gap the fabric continuum offers one idea where the works in the table above each address one or two. That breadth is what the author puts forward for discussion. On each gap the first stage has produced a declared test, a prediction, or a stated next step, and on none of them a proof.

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13. Transport phenomena and the fabric

The author's statement about the fabric is a statement about transport:

> “energy can travel through fabric… in all directions… without moving”

Transport phenomena is the established field that studies how momentum, energy and mass move. This section sets the hypothesis beside that field. It is a first-stage comparison: it says what is established, where the fabric continuum meets it, what the established results ask of the hypothesis, and what work comes next.

13.1 What is established

One form for three kinds of transport. Momentum, heat and mass each flow in proportion to a gradient: Newton’s law of viscosity, Fourier’s law of heat conduction and Fick’s law of diffusion (Bird et al., n.d.).

Energy can travel while the medium stays in place. Energy moves by conduction, by convection and by radiation (Ling et al., n.d.-a). A wave carries energy and momentum while each part of the medium only oscillates about its resting position (Moebs et al., n.d.). In a wire carrying a current, the charges drift at well under a millimetre a second, and the energy flows through the field in the space around the wire (Feynman et al., n.d.-b; Ling et al., n.d.-a).

Some transport loses nothing. Below 2.1768 K liquid helium flows with a viscosity at least 1,500 times lower than ordinary liquid helium, and heat travels through it as a wave (Balibar, 2006; Donnelly, 2009). A current in a superconducting ring has been watched for weeks, with an inferred decay time of about 100,000 years (File & Mills, 1963).

The two kinds of ordinary matter in a cluster transport differently. The stars of a galaxy form a collisionless system. For a galaxy of about 10^{11} stars the time for encounters between stars to change their orbits is about 10^{17} years, millions of times the age of the universe, so each star moves in the smooth pull of the whole (Leiden University, n.d.). The hot gas of a cluster is a collisional plasma, with electron free paths of the order of 20 kiloparsecs (Markevitch & Vikhlinin, 2007; Nath, 2003). When a galaxy moves through that gas, the gas of the galaxy can be stripped away while its stars are left in place (Boselli et al., 2022; Gunn & Gott, 1972).

What collisions of clusters show. When two clusters pass through each other, the hot gas is slowed and the galaxies are not. The unseen mass is found with the galaxies. This limits how strongly the unseen mass interacts with itself to below about 1 cm^2 per gram (Markevitch et al., 2004; Randall et al., 2008). One study of 72 collisions gave a tighter limit of 0.47, which a later reanalysis relaxed to about 2 (Harvey et al., 2015; Wittman et al., 2018).

Nothing outruns light. Gravitational waves carry energy, and they travel at the speed of light to about one part in 10^{15}. Entanglement alone carries neither energy nor a message. Teleporting a quantum state needs two classical bits for each quantum bit, and those travel no faster than light (Bennett et al., 1993).

At the smallest scale. When heat frees quarks and gluons from the proton, the fluid they form has the lowest friction for its entropy of any substance measured: a ratio between 0.08 and 0.23, against a conjectured lowest possible value of about 0.08 (Auvinen et al., 2020; Bernhard et al., 2019; Kovtun et al., 2005).

13.2 Where the fabric continuum meets these results

Established transport result	The statement of the hypothesis it bears on	How it stands at this stage
A wave or a field carries energy while the medium stays in place	Energy travels through the fabric “without moving”	Consistent in form. The author’s statement describes a known kind of transport
Superfluids and superconductors transport without loss	The fabric as a connected state without friction	A likeness. Not tested
Stars are collisionless; hot gas is collisional and can be stripped	Two states: locked to cohesive matter, free around diffuse hot gas	The same two kinds of matter separate in transport as separate in the tests of section 6. Cold gas is collisional and yet counts as locked in the tests, so the two dividing lines are close but not the same

Established transport result	The statement of the hypothesis it bears on	How it stands at this stage
The freed state inside the proton is nearly frictionless	The free state of the fabric	A likeness of form between the micro and the macro. Not a match of number
In collisions the unseen mass stays with the galaxies and passes through	The free fabric, at 5.36 times the hot gas	A condition on the model: see 13.3
No signal outruns light	“Waves become signals with information”	A condition on the model: see 13.3

13.3 What the established results ask of the hypothesis

Three conditions follow. The hypothesis has to meet each, and none is yet shown.

1. **The free fabric must pass through.** The collision limits mean that the free fabric could not be carried along with the hot gas. Its amount, in Formula 4, is set by the hot gas. Its motion in a collision must be that of the galaxies. A fabric that is the energy of exchange between bodies and places could behave so, but the model does not yet derive it.
2. **Any signal in the fabric must keep to the speed of light.** The connection itself, like entanglement, cannot carry a message. If waves in the fabric carry information, as the author proposes, they could do so no faster than light.
3. **The fabric must exert almost no friction on what moves through it.** Galaxies and stars orbit for billions of years, and published tests of friction between ordinary matter and an unseen medium are part of the review behind section 12.

13.4 The work ahead

- **A transport equation for the fabric.** The model has a formula for how much fabric there is in each state. It does not yet have one for how the fabric moves, or for how it passes from the locked state to the free state. That is part of the missing law of section 7.6.
- **A declared test on colliding clusters.** Published maps of such systems give the positions of the gas, the galaxies and the total mass. The two-state formula could be put to them, with the criteria written down first, as in every test here.
- **The dividing line.** Cold gas and hot gas are both collisional, and the tests place them in different states. Finding the property that divides them is first-stage work that is continuing (sections 6.6 and 6.9).

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14. The dynamics of composite systems and the fabric

A proton, an atom, a star, a galaxy and a cluster of galaxies are all composite systems: wholes made of parts. The hypothesis makes a claim about every one of them, that the whole is not the sum of its parts and that nothing is external. The dynamics of composite systems is the established field that says when that is true and when it is not. This section sets the hypothesis beside it, as a first-stage comparison.

14.1 What is established

The mass of a whole is not the sum of its parts. The mass of a bound system is the mass of its parts plus the energy of their motion and of their interaction. Binding by an attractive force lowers it: a helium nucleus is 0.75% lighter than its two protons and two neutrons taken apart, and a hydrogen atom is lighter than its proton and electron by about one part in 100 million (Ling et al., n.d.-b; National Institute of Standards and Technology, n.d.). Confinement does the opposite: most of the proton’s mass is the energy of its fields (section 1.1).

In Newton’s mechanics the inside and the outside separate. The forces between the parts of a composite cancel in pairs, so its centre moves as a single body of the total mass under the outside forces alone, and its internal motion goes on separately (Feynman et al., n.d.-a).

A bound system can be weighed from its motions. For a bound system in balance, the energy of motion and the energy of binding are tied together, so the speeds and the size give the mass. Zwicky applied this to the Coma cluster in 1933 and found far more mass than its light accounts for. This was the first inference of unseen mass (van den Bergh, 1999; Zwicky, 1933).

Gravity treats a composite as it treats its parts, where this has been tested. The Earth and the Moon fall toward the Sun at the same rate to about 2 parts in 10^{13}, although the Earth holds more gravitational binding energy (Williams et al., 2004). A neutron star and a white dwarf fall toward a third star at the same rate to about 2 parts in a million (Archibald et al., 2018; Voisin et al., 2020).

The separation fails when the outside pull is uneven. Tides stretch a composite and can strip its outer parts. Galaxies inside clusters have lost their outer halos in this way, and the stars stripped from them form a faint light between the galaxies, of the order of 10 to 20% of a cluster's starlight depending on the method of measurement (Montes, 2022).

A composite can change its parts. The quarks inside a proton or neutron that is bound in an iron nucleus are distributed differently from those in a free one, by up to about 20%. This is established by experiment, and its cause is still debated (Hen et al., 2013; Hen et al., 2017).

The whole can differ in kind from the parts. An electron in a crystal moves as if its mass were anything from 0.07 to about 200 times its free mass, depending on the crystal (Stewart, 1984). Anderson (1972) argued that new properties appear at each level of complexity and cannot simply be read off from the level below.

Many bodies under gravity cannot be solved exactly. There is no general exact solution even for three, and the method is numerical simulation (Dehnen & Read, 2011).

14.2 Where the fabric continuum meets these results

Established result	The statement of the hypothesis it bears on	How it stands at this stage
Mass of a whole = parts + energy of motion and interaction	The fabric is mass of the connection type	The principle is established. That the unseen mass is of this type is the hypothesis
Attractive binding lowers mass; confinement raises it	The fabric is positive, about five times the ordinary mass	The fabric could not be the energy of gravitational binding, which is negative and, for a cluster, of the order of one part in 100,000 (an estimate computed for this paper from the speeds of the galaxies). It would have to be of the confinement kind. This needs new physics (section 4)
In Newton's mechanics the inside and outside separate, and pulls add	"The whole is not the sum of the parts"	The rule that passed is not a sum, and every version tested as a sum failed (section 6). Under such a rule the separation no longer holds
Tides strip a composite; galaxies in clusters lose their outer halos	The surroundings set the reach of the lock	Supported in form. Two forms of the reach passed the test on unseen systems, and the data cannot yet choose (section 6.5)
A nucleus changes the protons and neutrons inside it	The surroundings change what a body carries	A micro counterpart of the same behaviour. A likeness of form
New properties appear at each level	One principle of connection from the proton to the galaxy to the mind	Consistent with the weaker reading of the hypothesis, same in form (section 1.2)

14.3 “Nothing is external”: the test this points to

The author’s statement that nothing is external has a precise meaning in this field. Under the locked rule, the fabric at each point depends on the total pull of ordinary matter there. So the inside of a system is affected by the even pull of the larger system that holds it, which Newton’s mechanics and general relativity do not allow. The published theory that uses the same rule has the same property, known as the external field effect.

Two things follow.

1. **It is already in the prediction.** The prediction of section 8 was computed with the pull of the whole Galaxy at the Sun included. That is why the predicted extra pull between wide pairs of stars levels off at 1.335 and does not keep growing. The prediction is therefore also a test of “nothing is external” at the scale of stars.
2. **The existing evidence is divided.** A detection of this effect in the rotation of galaxies has been claimed at more than 4 sigma (Chae et al., 2020; Chae et al., 2021). It is disputed, because models with ordinary dark matter give a similar signal (Paranjape & Sheth, 2022).

The precise tests of how composites fall, quoted in 14.1, were made where the pull is strong. The Sun’s pull on the Earth and Moon is about 6×10^{-3} m/s², some 50 million times the threshold of the rule (computed for this paper), where the rule gives Newton’s law. They do not test the regime of the fabric. Wide pairs of stars do.

14.4 The work ahead

- **Systems inside systems.** The tests so far treated a composite at one level: a galaxy, or a cluster of galaxies. A galaxy with satellites, inside a group, inside a cluster, is three levels. Applying the rule consistently through the levels is part of the next stage, and it bears directly on the reach of the lock.
- **The sign and the size.** Why the energy of the exchange would be positive and about five times the ordinary mass is the central open question of the hypothesis, and this field states it most sharply.
- **Simulation.** Because the rule is not a sum, its consequences for many bodies can only be followed numerically. No simulation has yet been run with the two-state model, and one is needed before the model can be compared with the growth of structure.

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15. The record

Everything reported in this paper can be checked.

15.1 What is kept

For each of the twenty-seven tests the record holds:

- the declaration, written before the data were opened, with its checksum and time;
- the result, with every number;
- the computer code that produced it;
- for the tests that were re-derived, the independent check and its own code.

It also holds the prediction of section 8, the reviews of the published literature, and the verification of the established statements against their sources.

15.2 The prediction on record

Item	Checksum (SHA-256)	Time (UTC)
Declaration 25: the star as the unit of the fabric	d42869637ae297077bad3eba9e1a966319d245a3ae914ca3d62484063db86ce9	12 November 2026, 13:10
Prediction 25: the pull between wide star pairs	430af72e50bfb17f0044679553ac4c7cd4923ebc07531a38a03fe9db222bcb63	12 November 2026, 13:18

A checksum is a fingerprint of a file. If one character of the file is changed, the checksum changes. Anyone who is later given the two files can confirm that they are the ones recorded here, and so that the prediction was made before the data that will test it.

15.3 How to check this paper

1. **The macro tests.** All the data are public and each test names its sources. The declarations give the formulas and criteria. A reader with the data can repeat any test.
2. **The micro statements.** Each is referenced to a published source in section 16.
3. **The methods and statistics.** Appendix A gives the method of every test, Appendix B the statistical summary, and Appendix C the study of correlations.
4. **The prediction.** Compare it, when the analyses appear, with the measured pull between wide star pairs above 10 thousand times the Earth–Sun distance.

15.4 Obtaining the record

The complete record is held by the author as one package and is available on request through maynardldokken.com.

Package	Contents	Checksum (SHA-256)
fabric-continuum-record-2026-11-12.zip	264 files: the declarations, results, code, independent checks, literature reviews and source verifications for Tests 1 to 27, with an index and a checksum for every file	a15e68b7cbecaa9b5c324ca89b1053a5ae2b4967e23cfd6b3f2c2610ae35c7f4

A reader who is sent the package can confirm it is the one recorded here by computing its checksum. On most computers the command is `sha256sum fabric-continuum-record-2026-11-12.zip`, and the result should match the value above exactly.

The appendices, the two sections on transport and on composite systems, and the reference checks were added after the package was sealed. They were prepared from the package and from published sources, and they will be added to the next sealed version of the record.

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Note on this list. 230 entries in one alphabetical list (APA 7). Of these, 189 were verified in full against a primary record. 37 were added with sections 13 and 14 and with section 10; where a title, year or author list was not confirmed from a page read for this paper, the entry says so. Four earlier entries remain marked “to confirm”.

Appendix A. Methods, test by test

A.0 The common procedure

Each test followed the same steps. A short declaration was written first. It stated the formula, the constants, the data to be used, the pass and fail criteria, and what the person drawing up the test already knew. The declaration was given a sha256 checksum and a UTC time before the data were opened. The test was then run once, and every number was reported. Most later tests (15 to 26) were re-derived independently, with new code from the declaration alone and compared the inputs with the published tables. Test 27 was not re-checked. Tests 2 to 9 and 11 to 14 have no independent check in the record.

Uncertainties come, in most tests, from a bootstrap: whole galaxies or whole systems are drawn again with replacement (usually 2,000 draws, with a fixed seed) and the statistic is recomputed. The standard error is the standard deviation of those draws. Points inside one galaxy are not treated as independent.

Fixed throughout, never fitted: the threshold a_c = c·H0/(2π) with H0 = 70 km/s/Mpc, which gives 1.0824×10^{-10} m/s². H0 = 67.4 and 73 were reported beside it in some tests. The rule is g = g_b / (1 − exp(−√(g_b/a_c))). For the SPARC galaxies the stellar mass-to-light ratios at 3.6 μm are 0.5 (disc) and 0.7 (bulge). The SPARC cuts are quality flag Q < 3, inclination ≥ 30°, and velocity error under 10 percent. These give 147 galaxies and 2,696 points.

Notes on reading the entries. “Verdict” is the declared verdict as the result file states it. “Check” names the independent check and quotes its headline. Where a number is not in any file of the record, the entry says “not in the record”. Numbers are copied from the files named. File names refer to folders of the record (section 15). Checks are named by their label in the record (for example W90, W100).

Test 1. Three forms of the rule on SPARC galaxies

- **Question.** Which of three declared forms of the rule best matches the observed pull in galaxies, with nothing adjusted?
- **Data.** SPARC rotation curves and mass models (Lelli, McGaugh & Schombert 2016). 147 galaxies, 2,696 points, cuts as in A.0.
- **Statistic.** rms and mean of log10(g_obs/g_model) in dex, over all points and in three classes. Benchmarks declared in advance: fitted curve 0.133, Verlinde point-mass 0.150, simple form 0.153, ordinary matter only 0.514.
- **Pass criterion.** None declared. The declaration lists benchmarks only. It was written after the fitted curve had been seen (section 5.6 of the paper).
- **Result.** Thermal form: rms 0.133 dex, offset +0.012. Added form 0.147 (−0.060). Combined form 0.144 (+0.053). Source: w73/out/RESULT-declared-2026-11-11.txt.
- **Uncertainty.** From the check (w74/out.txt): rms of the thermal form minus rms of the fitted curve = 0.00047 dex, 95% galaxy-bootstrap interval [0.00000, 0.00373]. Implied H0 from the fitted threshold 75.10 ± 4.85 (galaxy bootstrap).
- **Verdict.** No pass or fail was declared. The thermal form matches the fitted empirical curve.

- **Check.** W74 (w74/out.txt). It reproduces the sample (147, 2,696) and the rms values. There is no CHECK file with a headline.

Test 2. The rule in clusters of galaxies (X-COP)

- **Question.** Does the rule give the total mass of clusters? Versions: PLAIN; A (rule applied twice); B0 (heat added to the source); B1 (one fitted heat constant, diagnostic only).
- **Data.** X-COP published tables (arXiv 1805.00035, 1805.00034, 1805.00042, 1611.05051, 2205.01110; list in w75/clusters/data/PROVENANCE.txt). Set S5: 5 clusters at R2500 and R500 (10 points). Set S12: 12 clusters at R500.
- **Statistic.** Median of g_obs/g_pred, scatter in dex, and the change from R2500 to R500.
- **Pass criterion.** The median ratio lies within the published systematic uncertainty of the mass, and there is no trend with radius. The summary file tests this at ±10% and ±20%.
- **Result.** PLAIN, H0 = 70: S5 median 1.971 (scatter 0.122 dex); S12 1.501 (scatter 0.041 dex). Radius trend in S5: median Δlog −0.219, with 0 of 5 positive. Version A: S5 0.906, S12 0.639. B0 is the same as PLAIN. Source: w75/clusters/out/test2_summary.txt.
- **Uncertainty.** Scatter only. No standard error of the median is in the record.
- **Verdict.** Fail. The result file prints medians and ±10%/±20% flags. All are False for PLAIN. It has no separate verdict line.
- **Check.** None.

Test 2b. The rule in lensing around galaxies (KiDS-1000)

- **Question.** Do lensing accelerations around isolated galaxies follow the rule, at accelerations below those of rotation curves?
- **Data.** KiDS-1000 lensing release (Brouwer et al. 2021). 15 bins of baryonic acceleration per sample. GAMA, dwarf, mass-bin and early/late splits are also in the release.
- **Statistic.** Mean and rms of log10(g_obs/g_pred), and χ^2 with the published covariance.
- **Pass criterion.** The declaration states the prediction and the metrics, but no numeric pass window.
- **Result (H0 = 70).** Main isolated sample: mean +0.119 dex, χ^2_cov 146.3 for 15 bins. Late types by Sérsic index ($n < 2$): −0.006 dex, χ^2_cov 12.9. Early types ($n > 2$): +0.179 dex, χ^2_cov 144.1. Blue: −0.054, χ^2_cov 24.2. Red: +0.207, χ^2_cov 195.0. Source: w75/lensing/out/test1_results.txt.
- **Verdict.** No verdict line in the record. The paper's account is that spirals pass and ellipticals fail. The early/late split is not named in Declaration 2, and the main declared sample sits at +0.119 dex. Declaration 3 was written after this result had been seen.
- **Check.** None.

Test 3. A cross-check using heat

- **Question.** Does a single heat constant T0, taken from clusters, predict the elliptical lensing excess?
- **Data.** As Tests 2 and 2b. Elliptical gas temperature from a published X-ray study.
- **Pass criterion.** Predicted early-type offset between 0.11 and 0.28 dex, and late types 0. The cross-check is void if clusters do not support a single T0 (scatter above 0.10 dex, or cluster-to-cluster differences).
- **Result.** B1 fit: in S5, T0 sat at the search bound (1×10^5 keV, "edge = True"). In S12, T0 = 38.7 keV with scatter 0.039 dex. Source: w75/clusters/out/test2_summary.txt.
- **Verdict.** Void (paper section 6.10). The reasoning that led to "void" is not written in any result file. No result file for Declaration 3 is in the record.
- **Check.** None.

Test 4. One wavelength (A); one surface density (B)

- **Question.** Do halo cores follow a fixed-wavelength scaling (A: slope −4), or a universal surface density $a_c/(2\pi G) = 123.6\ M_\odot/pc^2$ (B: slope −1)?
- **Data.** Burkert halo fits for 175 SPARC galaxies (Li, Lelli, McGaugh & Schombert 2020); 8 dwarf spheroidals (Salucci et al. 2012); 12 clusters (Gopika & Desai 2020). All 175 galaxies are used; no quality cut for the

primary sample.
- **Statistic.** Slope of log ρ0 against log r0 by OLS and by orthogonal fit. Median ρ0·r0. Bootstrap over galaxies, 10,000 draws, seed 77.
- **Pass criterion.** A: slope within ±0.5 of −4. B: slope within ±0.3 of −1, and median within a factor 1.5 of 123.6 (82.4 to 185.4). Clusters: the same factor 1.5.
- **Result.** OLS −1.16 ± 0.10; orthogonal −1.57 ± 0.13; median 176.2 (16–84%: 75.1 to 460.7). Clusters: median 1013. Source: w77/out/run_log.txt and extra_log.txt.
- **Verdict.** A fails. B: OLS slope and median pass, orthogonal slope fails ("verdict uses OLS and orthogonal both"). B fails in clusters. No verdict file; the paper reports "fail; marginal in galaxies".
- **Check.** None.

Test 5. Two phases with a floor

- **Question.** Does the core surface density level off at 123.6 in small galaxies?
- **Data.** The same Burkert fits; the 135 galaxies with a published Vflat.
- **Pass criterion.** P1: median for Vflat < 80 km/s within 82.4–185.4. P2: slope for Vflat < 100 within 2 bootstrap SE of zero and below the slope above 100. P3: high/low median ratio > 1.3.
- **Result.** P1 109 (68% interval 98–120), pass. P2 slope +0.87 ± 0.23 below 100 against +0.64 ± 0.39 above, fail. P3 ratio 2.44, pass.
- **Verdict.** FAIL (w77/out/RESULT-declaration-5.txt). **Check.** None.

Test 6. The atom's equation copied to a galaxy

- **Question.** Does core radius fall as 1/velocity, as a fixed-mass wave would require?
- **Data.** The same, 135 galaxies with Vflat. Bootstrap 10,000.
- **Pass criterion.** Slope of log r0 against log Vflat within ±0.5 of −1.
- **Result.** +0.86 ± 0.28.
- **Verdict.** FAIL (RESULT-declaration-6.txt). **Check.** None.

Test 7. Constant threshold against a threshold that follows the expansion

- **Question.** Does a_c follow H(z) (EVOLVING), or stay constant?
- **Data.** RC100 (Nestor Shachar et al. 2023), 100 galaxies at z ≈ 0.6–2.6, primary. RC41 (Genzel et al. 2020), cross-check. Bins: z < 1.2 (32), 1.2–1.8 (27), > 1.8 (41).
- **Statistic.** Median log10(g_obs/g_pred) per bin, with a bootstrap error.
- **Pass criterion (EVOLVING).** Every bin within ±0.06 dex, and smaller in absolute value than CONSTANT in the highest bin.
- **Result (RC100, H0 = 70).** EVOLVING: +0.008 ± 0.023, −0.061 ± 0.027, −0.120 ± 0.029. CONSTANT: +0.052 ± 0.029, +0.027 ± 0.028, +0.009 ± 0.023. RC41: EVOLVING z > 1.8 −0.081 ± 0.039; CONSTANT +0.001 ± 0.041.
- **Verdict.** EVOLVING fails. CONSTANT meets the same criteria (w78/out/results.json). **Check.** None.

Test 8. Heat breaks the connection

- **Question.** Within one era, do hotter galaxies (σ0/Vcirc) show less extra pull?
- **Data.** RC100, 100 galaxies.
- **Statistic.** Within-bin Spearman ρ with a permutation test (20,000).
- **Pass criterion.** P1: ρ < 0 with one-sided p < 0.05. P2: hot-minus-calm ≤ −0.06 dex. P3: calmest third at z > 1.8 within ±0.06.
- **Result.** ρ = −0.042, one-sided p = 0.334. P2 −0.002. P3 −0.093.
- **Verdict.** FAIL (w78/out/RESULT-declaration-8.txt). **Check.** None.

Test 9. The elliptical excess grows with distance

- **Question.** Is the early-type excess absent close in and growing outward?

- **Data.** KiDS-1000 (Brouwer et al. 2021). Early and late types by shape and by colour, 15 bins each.
- **Pass criterion.** C1: inner median within ±0.08. C2: outer − inner ≥ 0.10. C3: larger than for late types. Required for both definitions.
- **Result.** By shape: inner +0.082, outer − inner +0.148 (late +0.032). By colour: inner +0.140, outer − inner +0.140 (late +0.042). Per-bin errors 0.04–0.09 dex are listed but not used in the criteria.
- **Verdict.** FAIL (C1 fails for both; C2 and C3 pass). Source: w75/lensing/out/RESULT-declaration-9.txt. **Check.** None.

Test 10. Head-count sum over member galaxies (X-COP)

- **Question.** Do member galaxies carry their own fabric, which then adds up?
- **Data.** The X-COP numbers of Test 2. m_star = 10^10.66 M☉, fixed.
- **Pass criterion.** P1: median within ±10% at R500 (S5 and S12). P2: the same at R2500. P3: radius trend within ±0.08 dex.
- **Result.** S5 R500 0.947; S12 R500 0.951 (scatter 0.051 dex); S5 R2500 1.535; trend −0.201.
- **Verdict.** FAIL (P1 pass, P2 and P3 fail). Source: w75/clusters/out/RESULT-declaration-10.txt.
- **Check.** W80 (w80/*.py). The folder holds scripts only; no check text or headline is in the record.

Test 11. The same formula on 133 new systems

- **Data.** Gonzalez et al. 2013 (12), Sanderson et al. 2013 (5, all also in G13), Lagaña et al. 2013 (37), Chiu et al. 2018 (84). 133 unique systems; the file holds 138 rows. Sample fixed in writing before any ratio was computed.
- **Statistic.** Median ratio, slope of log ratio on log M500, bootstrap SE.
- **Pass criterion.** P1: median within ±10%. P2: slope within ±0.10 and within 2 SE of zero. P3: median within ±15% below 2×10^{14}.
- **Result.** All 133: median 1.328 ± 0.025, slope +0.203 ± 0.020, low-mass median 0.775 ± 0.065 (n = 14). PLAIN rule: median 1.920, slope +0.169 ± 0.0145.
- **Verdict.** FAIL (w79/out/results.json). **Check.** None.

Test 12. An empirical trend with mass, fitted on half, tested on the rest

- **Data.** The 138 rows of Test 11, split at random within each sample (seed 20261112): 68 / 70. X-COP (12) held out.
- **Statistic.** log10(M_obs/M_plain) = A + B·log10(M_b/10^{13}), least squares, bootstrap errors.
- **Pass criterion.** T1: half-2 median residual within ±0.04. T2: half-2 residual slope within 2 SE of zero. T3: X-COP median residual within ±0.06.
- **Result.** Half 1: A +0.193 ± 0.027, B +0.098 ± 0.031. T1 +0.013, pass. T2 +0.030 ± 0.028, pass. T3 −0.097, fail. By sample, B differs in sign: C18 −0.195 ± 0.045; L13 +0.119 ± 0.018.
- **Verdict.** FAIL overall, two of three parts pass. Source: w79/out/RESULT-declaration-12.txt. **Check.** None.

Test 13. A surface term plus a volume term

- **Data.** Fit on 175 SPARC galaxies and 8 dwarf spheroidals; tested on 12 clusters (Gopika & Desai 2020).
- **Pass criterion.** ρ_v positive by more than 2 bootstrap SE, and cluster median observed/predicted between 1/1.5 and 1.5.
- **Result.** ρ_v = 0.0011 ± 0.0016 M☉/pc^3 (0.7σ). Cluster observed/predicted median 4.09 (range 2.26–9.15).
- **Verdict.** FAIL (w77/out/RESULT-declaration-13.txt). **Check.** None.

Test 14. One switch-on distance for all galaxy masses

- **Data.** KiDS-1000 (Brouwer et al. 2021). Four stellar-mass bins of isolated galaxies (primary); all galaxies (secondary).
- **Statistic.** Fit r(R) = P/(1 + (R_on/R)⁴) per bin by generalised least squares with the release covariance. Slope of log R_on on log M_b.

- **Pass criterion.** Q1: at least 3 of 4 bins usable. Q2: largest R_on/smallest ≤ 1.5. Q3: slope < 0.20 and within 2 SE of zero.
- **Result (primary).** 4 bins used. Ratio 3.03. Slope +0.240 ± 0.244.
- **Verdict.** PASS = False (Q2, Q3 fail). Source: w82/out/onset_results.txt. Of the 18 variant readings, one ("all galaxies, g-space") gives PASS = True. The paper reports "fail / inconclusive". **Check.** None.

Test 15. Frequency at fixed acceleration (SPARC)

- **Data.** SPARC as in A.0 (147, 2,696).
- **Statistic.** res = k0 + b·log W_bar + c·log g_bar. b from a galaxy bootstrap (2,000, seed 15). Six g_bar bins.
- **Pass criterion.** "Carries something": |b| ≥ 0.05, ≥ 3σ, same sign in ≥ 5 of 6 bins. "Adds nothing": |b| < 0.03 and < 2σ.
- **Result.** b = −0.0129 ± 0.0435 (−0.30σ). 95% bootstrap range [−0.101, +0.069]. 3 of 6 bins share the sign. Pearson r(log W_bar, log g_bar) = +0.906.
- **Verdict.** FREQUENCY ADDS NOTHING HERE (w83/out/RESULT-declaration-15.txt).
- **Check.** W100: "RESULT STANDS WITH CAVEATS (low power: b range −0.10 to +0.07)."

Test 16. A switch at the cooling line (new groups)

- **Data.** Sun et al. 2009 (20), Lovisari, Reiprich & Schellenberger 2015 (15), Eckert et al. 2016 XXL (105): 140 systems not used before. Stellar mass from a relation frozen before the tables were opened.
- **Statistic.** q = M500/M_rule. Medians by bin of M_b. OLS slope of log q on log M_b, bootstrap (2,000, seed 16).
- **Pass criterion.** P1: M_b < 3×10^{12}, median q 0.80–1.25. P2: 3×10^{12}–3×10^{13}, median q > 1.25 and ≤ 1.85. P3: slope ≥ +0.05 and ≥ 2σ.
- **Result.** P1 1.410 (n = 12), fail. P2 1.919 (n = 117), fail. P3 +0.1426 ± 0.0314 (4.54σ), pass.
- **Verdict.** FAIL (w84/out/RESULT-declaration-16.txt).
- **Check.** W101: "RESULT STANDS WITH CAVEATS (FAIL is correct under the run as declared; it depends on including the XXL sample…)". With the two X-ray samples alone (35 systems) all three parts would pass. That reading was found after the data were seen.

Test 17. The depth of the well (17A ordinary matter; 17B including the fabric)

- **Data.** Law fitted on the 138 systems (two numbers, frozen). Predictions on SPARC (147/2,696), X-COP (S5, S12) and the 140 groups of Test 16.
- **Pass criterion.** P1: SPARC rms not worse by more than 0.002, and the top fifth by depth within 2σ of the law. P2: X-COP medians 0.80–1.25 at both radii. P3: groups median 0.80–1.25 and slope within 2σ of zero.
- **Result.** 17A: P1(a) +0.0368 dex; P1(b) −0.1612 (−8.20σ); P2 0.786 and 1.379; P3 1.212, slope 1.64σ. 17B: +0.0109; −3.63σ; 0.775 and 1.440; 1.190, 1.94σ.
- **Verdict.** 17A FAIL, 17B FAIL (w87/out/RESULT-declaration-17.txt).
- **Check.** W101: "RESULT STANDS (both FAIL; P1 and P2 fail under every reading I tried)."

Test 18. Two states, three forms of reach (V0, VA, VB), no fitted number

- **Data.** S1: the 138 systems. S2: X-COP S5 at R500 and R2500. S3: the 140 groups. 290 systems in all.
- **Statistic.** Median ratio M_obs/M_pred. Medians in five M_b bins. Slope with a bootstrap (2,000, seed 18). Eleven checks per form: 4 medians, 5 bins, 2 slopes.
- **Pass criterion.** All medians and bins within 0.80–1.25; both slopes within 2σ of zero.
- **Result.** VA: S1 0.973, S3 1.179, S2 R500 0.730 (outside), R2500 1.109; all bins inside; slope S1 −0.006 ± 0.023, S3 +0.056 ± 0.027 (outside). VA passes 9 of 11 checks. V0 and VB fail more parts.
- **Verdict.** V0, VA, VB all FAIL (w88/out/RESULT-declaration-18.txt).
- **Check.** W102: "RESULT STANDS."

Test 19. The upward pull near the Sun: point-by-point lock (L) against a round fabric (G)

- **Data.** R0 = 8.122 kpc and V_c = 229.0 km/s (Eilers et al. 2019). Σ_b(1.1 kpc) = 43.8 ± 3.4 (McKee, Parravano & Hollenbach 2015). Nine published Σ_dyn measurements at 1.0–1.1 kpc (Kuijken & Gilmore 1991 to López-Corredoira 2024).
- **Statistic.** OBS = error-weighted mean. σ_OBS = the larger of the error of the weighted mean and the between-study sd/√9.
- **Pass criterion.** |prediction − OBS| ≤ 2·√(σ_OBS² + σ_pred²).
- **Result.** OBS 67.90 ± 3.82 (χ^2 81.4 for 8 d.o.f. among the nine). L: 64.29 ± 4.99, −0.57σ, pass. G: 54.11 ± 3.40, −2.70σ, fail. Leave-one-out: L passes in all 9 cases (−0.20 to −0.96σ); G fails in all 9 (−2.15 to −3.44σ). A round halo with ρ_DM = 0.013 gives 72.4 ± 7.4, which also passes.
- **Verdict.** L passes, G fails (w89/out/RESULT-declaration-19.txt).
- **Check.** W90: “RESULT STANDS WITH CAVEATS.”

Test 20. Two-state formula on 17 systems not seen before (VT cut-off; VA replication)

- **Data.** Zhang et al. 2011 (11; masses from galaxy velocity dispersions) and Lin, Mohr & Stanford 2003 (6; masses from an X-ray mass–temperature scaling relation). 17 new systems, 16 of them clusters.
- **Statistic and criterion.** As Test 18: median 0.80–1.25; bins with n ≥ 5; slope within 2σ (2,000 draws, seed 20). At least 15 systems needed.
- **Result.** VT median 1.188, bins 1.228 and 1.171, slope −0.033 ± 0.090. VA 0.883, bins 0.883 and 0.914, slope +0.003 ± 0.095.
- **Verdict.** VT PASS, VA PASS (w92/out/RESULT-declaration-20.txt).
- **Check.** W102: “RESULT STANDS WITH CAVEATS (the VT pass is fragile).” VT clears its bin limit by 0.022. Removing any one of three systems turns VT into a fail. Without the scaling-relation masses n = 11, and the verdict would be INCOMPLETE.

Test 21. Are the stars in ellipticals heavier than their light suggests?

- **Data.** KiDS-1000 early/late bins (Brouwer et al. 2021). Early-type g_bar × 10^0.22 = 1.66 (Salpeter against Chabrier), fixed in advance.
- **Pass criterion.** D1: inner within ±0.08. D2: outer within ±0.08. D3: early − late (all 15 bins) within ±0.08. Required for both definitions.
- **Result.** Shape: D1 −0.035, D2 +0.119, D3 +0.108. Colour: +0.023, +0.169, +0.128.
- **Verdict.** FAIL (D2 and D3 for both). Source: w93/out/RESULT-declaration-21.txt.
- **Check.** W103: “STANDS WITH CAVEATS.” D3 by shape fails only under the literal reading. All five outer bins lie below 10^{-13} m/s², where a published study judges ellipticals not reliably isolated.

Test 22. Do stars act on the fabric directly? (SPARC)

- **Data.** SPARC as in A.0. Four galaxy variables: X1 star share, X2 log SBeff, X3 log SBdisk, X4 Hubble type.
- **Statistic.** res = k0 + b·X + c·log g_bar. b from a galaxy bootstrap (2,000, seed 22). E = |b| × (80th − 20th percentile of X).
- **Pass criterion.** Direct effect: |b| ≥ 3σ and E ≥ 0.05. No effect: |b| < 2σ and E < 0.03. Otherwise inconclusive.
- **Result.** b/σ: X1 +1.72, X2 +1.95, X3 +2.60, X4 −1.71. E 0.045–0.052 dex.
- **Verdict.** MIXED; all four INCONCLUSIVE (w94/out/RESULT-declaration-22.txt).
- **Check.** W100: “RESULT STANDS.”

Test 23. Two-state formula on a larger unseen sample

- **Data.** Chiu et al. 2016 (4), Lagaña et al. 2008 (2), Humphrey et al. 2011, 2012 (2). 8 new systems; 30 were required.
- **Result.** V0 1.193, VA 0.910, VT 1.335. Scatter: VA 0.133, VT 0.079, RULE 0.229, COSMIC 0.069 dex.
- **Verdict.** INCOMPLETE; STRENGTHENED: NO (w95/out/RESULT-declaration-23.txt).
- **Check.** W102: “RESULT STANDS.”

Test 24. Bulge stars, disc stars and cold gas (SPARC)

- **Data.** SPARC as in A.0. Shares of the ordinary pull per point from Vgas, Vdisk and Vbul.
- **Statistic.** res = k0 + b_bul·s_bul + b_gas·s_gas + c·log g_bar. Galaxy bootstrap (2,000, seed 24).
- **Pass criterion.** Differently: |b| ≥ 3σ, ≥ 0.05 dex, and same sign ≥ 2σ in quality-1 galaxies. Alike: |b| < 2σ and < 0.05.
- **Result.** b_bul +0.0160 ± 0.0486. b_gas −0.1654 ± 0.0470 (−3.52σ); quality-1 −0.1740 ± 0.0617 (−2.82σ).
- **Verdict.** Bulge LOCKS ALIKE. Gas LOCKS DIFFERENTLY (w96/out/RESULT-declaration-24.txt).
- **Check.** W98: "RESULT STANDS WITH CAVEATS." Galaxies with distances not from the Hubble flow (f_D ≠ 1, 66 galaxies): −0.066 ± 0.068 (1.0σ). The split itself is 1.9σ.

Test 25. Prediction for wide star pairs

- **Data.** None yet. To be decided on analyses of Gaia DR4 by at least two independent groups.
- **Statistic.** γ = effective pull / Newton above 10 kAU.
- **Pass criterion.** H_STAR: γ within ±0.10 of the prediction, and γ = 1 excluded at ≥ 3σ, in two independent analyses. H_NONE: consistent with 1, and the prediction excluded at ≥ 3σ. Otherwise UNDECIDED.
- **Result.** Predicted γ_wide = 1.3347; the number for judging is 1.335. Pass window 1.235–1.435. Stamped 12 Nov 2026 13:18 UTC.
- **Verdict.** Not yet decided.
- **Check.** W103: "STANDS WITH CAVEATS." The stamped numbers reproduce. The declared input g_e was slightly off its own equation (effect ≤ 0.003).

Test 26. Does a heavier star mass remove the gas difference? (SPARC)

- **Data.** SPARC, split alphabetically into A (74) and B (73). One star-mass factor f is fitted on one half and tested on the other.
- **Pass criterion.** Explains: in both directions, f in 0.8–1.6, |b_gas| halves and is within 2σ of zero, and rms does not rise. Does not explain: |b_gas| ≥ 2σ in both directions.
- **Result.** f_A 1.0978 → B: b_gas −0.1760 ± 0.0515 (3.42σ). f_B 1.0386 → A: −0.1298 ± 0.0851 (1.52σ).
- **Verdict.** INCONCLUSIVE (w99/out/RESULT-declaration-26.txt).
- **Check.** W100: "RESULT STANDS WITH CAVEATS (first verdict line overstates; freeze is procedural only)."

Test 27. The cooling line again, on groups weighed by X-ray gas pressure only

- **Data.** Eckmiller, Hudson & Reiprich 2011 (11; masses extrapolated beyond the measured radius); Vikhlinin et al. 2006 (4); Pratt et al. 2016 (2). 17 new systems.
- **Statistic and criterion.** As Test 16 (seed 27).
- **Result.** P1 1.724 (n = 7), fail. P2 1.272 (n = 4), not tested. P3 +0.0531 ± 0.0277 (1.92σ; 3.1% of draws ≤ 0), fail.
- **Verdict.** FAIL (w105/out/RESULT-declaration-27.txt).
- **Check.** None. Not independently re-checked.

Appendix B. Statistical summary

Estimates and standard errors are copied from the record. The z values and p-values were **computed for this appendix** with w110/stats.py; the full output is in w110/stats_out.txt and w110/B1_table.csv. No declared test was rerun or changed.

Formulas:

- z = (estimate − reference) / SE
- p (two-sided, normal) = erfc(|z| / √2)

The normal p-value is an **approximation**. It assumes the bootstrap SE describes a normal sampling distribution. Where the record gives a bootstrap interval or a tail fraction, that is quoted as well and should be preferred.

B1. Results that carry an uncertainty

Test	Quantity	Estimate	SE	Reference	z	p (normal)	Bootstrap interval or tail in the record
1	H0 implied by the fitted threshold (check W74)	75.10	4.85	70	+1.05	0.29	bootstrap interval of fitted threshold 1.024–1.318 × 10^{-10} (level not stated in W74)
1	rms of thermal form minus rms of fitted curve	0.00047	–	0	–	–	95% [0.00000, 0.00373]
4	slope log ρ0–log r0, OLS (B predicts −1)	−1.16	0.10	−1	−1.60	0.11	
4	same, orthogonal fit	−1.57	0.13	−1	−4.38	1.2e−5	
5	P2 slope below 100 km/s (needs ≈ 0)	+0.87	0.23	0	+3.78	1.6e−4	
6	slope log r0–log Vflat (atom carry −1)	+0.86	0.28	−1	+6.64	3e−11	
7	EVOLVING offset, z > 1.8 (RC100)	−0.120	0.029	0	−4.14	3.5e−5	Monte Carlo −0.115 ± 0.016
7	CONSTANT offset, z > 1.8 (RC100)	+0.009	0.023	0	+0.39	0.70	
7	CONSTANT offset, z < 1.2 (RC100)	+0.052	0.029	0	+1.79	0.073	
7	EVOLVING, z > 1.8, RC41 cross-check	−0.081	0.039	0	−2.08	0.038	
8	within-bin Spearman ρ, heat against residual	−0.042	–	0	–	0.334 (one-sided, permutation)	from record
11	median ratio, accumulation formula (133)	1.328	0.025	1	+13.1	≪ 10^{-6}	68% [1.290, 1.343]

Test	Quantity	Estimate	SE	Reference	z	p (normal)	Bootstrap interval or tail in the record
11	slope of log(obs/rule) on log M500	+0.169	0.0145	0	+11.7	$\ll 10^{-6}$	
12	half-2 residual slope (T2)	+0.030	0.028	0	+1.07	0.28	
13	ρ_v from galaxies	0.0011	0.0016	0	+0.69	0.49	
14	slope log R_on on log M_b	+0.240	0.244	0	+0.98	0.33	(against 0.5: −1.07)
15	b, frequency at fixed g_bar	−0.0129	0.0435	0	−0.30	0.77	95% [−0.101, +0.069]
15	b, quality-1 only (information)	+0.0578	0.0511	0	+1.13	0.26	95% [−0.045, +0.156]
16	P3 slope of log q on log M_b (140)	+0.1426	0.0314	0	+4.54	5.6e−6	no draw ≤ 0 (W101)
16	the same, X-ray samples only (found after the data)	+0.111	0.029	0	+3.83	1.3e−4	
17	17A P1(b) observed minus law	−0.1612	0.0197	0	−8.18	3e−16	
17	17B P1(b) observed minus law	−0.0781	0.0215	0	−3.63	2.8e−4	
17	17A / 17B residual slope on 140 groups	+0.0512 / +0.0580	0.0311 / 0.0300	0	+1.65 / +1.93	0.10 / 0.053	
18	VA slope S1 / S3	−0.006 / +0.056	0.023 / 0.027	0	−0.26 / +2.07	0.79 / 0.038	
19	L: OBS − prediction (67.90 − 64.29)	3.61	6.28	0	+0.57	0.57	leave-one-out 0.20–0.96σ
19	G: OBS − prediction (67.90 − 54.11)	13.79	5.11	0	+2.70	0.0070	leave-one-out 2.15–3.44σ
20	VT / VA slope (17 new)	−0.033 / +0.003	0.090 / 0.095	0	−0.37 / +0.03	0.71 / 0.98	

Test	Quantity	Estimate	SE	Reference	z	p (normal)	Bootstrap interval or tail in the record
22	X1 / X2 / X3 / X4 slope b	+0.0965 / +0.0347 / +0.0400 / −0.0090	0.0560 / 0.0178 / 0.0154 / 0.0053	0	+1.72 / +1.95 / +2.60 / −1.70	0.085 / 0.051 / 0.0094 / 0.090	95%: X2 and X3 exclude 0; X1 and X4 include 0
23	VA slope (8 new)	+0.076	0.149	0	+0.51	0.61	
24	b_gas, all 147	−0.1654	0.0470	0	−3.52	4.3e−4	
24	b_gas, quality-1 (92)	−0.1740	0.0617	0	−2.82	0.0048	
24	b_bul, all	+0.0160	0.0486	0	+0.33	0.74	
24	b_gas, distances not from Hubble flow (66; W98)	−0.066	0.068	0	−0.97	0.33	3.2% of random 66-galaxy subsets give b_gas ≥ −0.066
24	b_gas, Hubble-flow distances (81; W98)	−0.237	0.063	0	−3.76	1.7e−4	
24	difference between the two (W98)	−0.171	0.091	0	−1.88	0.060	
26	b_gas on B with f_A / on A with f_B	−0.1760 / −0.1298	0.0515 / 0.0851	0	−3.42 / −1.53	6.3e−4 / 0.13	
27	P3 slope of log q on log M_b (17 new)	+0.0531	0.0277	0	+1.92	0.055	3.1% of draws ≤ 0 (one-sided)

Lensing (Tests 2b, 9, 21). The record gives χ^2 with the published covariance for 15 bins. The p-values below were computed for this appendix, with p = P(χ^2_{15} > value), using the PLAIN rule at H0 = 70:

Sample	Mean offset (dex)	χ^2_cov / 15 bins	p	Normal-equivalent
Main isolated (KiDS)	+0.119	146.3	1.3e−23	10.0σ
GAMA isolated	+0.037	19.3	0.20	1.3σ
Late, Sérsic n < 2	−0.006	12.9	0.61	0.5σ
Early, Sérsic n > 2	+0.179	144.1	3.5e−23	9.9σ
Blue (late)	−0.054	24.2	0.062	1.9σ
Red (early)	+0.207	195.0	2.2e−33	12.0σ

Results with no standard error in the record: Test 2 medians (only the scatter is given), Test 3, Test 9 inner/outer medians (per-bin errors only), Test 10, the Test 12 X-COP residual (−0.097), the Test 18/20/23 median ratios, and the Test 21 corrected medians. Test 25 has no data yet.

B2. Multiple testing

Threshold. 27 tests were declared. At an overall 5 percent level, Bonferroni gives a per-test level of 0.05/27 = 1.85 × 10^{-3}. For a two-sided normal statistic that is |z| ≥ 3.11. This count is generous. Most tests report several sub-statistics, so the true number of comparisons is larger than 27.

Which positive findings clear it. A positive finding here means a non-zero effect that the record reports as found.

Finding	z	Clears 3.11?	Comment
Gas against disc stars, Test 24, all 147 galaxies	−3.52	**Yes**, narrowly	p ≈ 4.3e−4
Same, quality-1 galaxies (92)	−2.82	No	Same sign and size
Same, galaxies with distances not from the Hubble flow (66; W98)	−0.97	No	Not distinguishable from zero. The difference from the Hubble-flow galaxies is itself only 1.88σ
Rise of the cluster shortfall with ordinary mass, Test 16 P3	+4.54	**Yes**	The declared test failed overall. The rise itself repeats the trend of Tests 11 and 12 (+0.169 ± 0.0145 on the earlier 133)
The same rise, Test 27 P3 (X-ray masses, 17 new)	+1.92	No	Slope +0.0531 ± 0.0277, about a third of Test 16's
The same rise after the depth law, Test 17 P3	+1.65 / +1.93	No	
Lensing excess around early types (Tests 2b, 9)	χ^2 p ~ 10^{-23} (shape), 10^{-33} (colour)	**Yes**	A departure from the rule, not support for it. After the star-mass correction of Test 21 about 0.1 dex remains, and all five outer bins lie below 10^{-13} m/s², where isolation is doubtful (W103)
Evolving threshold rejected, Test 7 (z > 1.8)	−4.14	**Yes**	A rejection. In the smaller RC41 cross-check: −2.08
Round fabric rejected, Test 19 (G)	−2.70	**No**	Leave-one-out range 2.15–3.44σ. The chi-square among the nine inputs is 81.4 for 8 d.o.f.
Star variables, Test 22 (largest: X3)	+2.60	No	

Also clearing the threshold, but as rejections of declared candidate formulas: Test 4 orthogonal slope (−4.38), Test 5 P2 (+3.78), Test 6 (+6.64), Test 17 P1(b) (−8.18, −3.63), and Test 18 VB S1 slope (−3.27).

Test 19 in detail. - Lock: prediction 64.1 ± 5.0, measurement 67.9 ± 3.8. Difference 3.61 ± 6.28, which is 0.57σ. - Round fabric: prediction 54.1 ± 3.4. Difference 13.79 ± 5.11, which is 2.70σ, p ≈ 0.007. - The lock's pass is agreement within errors. It is not a detection of anything. The round fabric's fail does not clear 3.11. - An ordinary round dark halo of the published local density gives 72.4 ± 7.4 and also passes. - So this test does not separate the lock from ordinary dark matter. It separates the lock only from the declared "round fabric of the size the rule implies".

Test 7 (constant against evolving threshold). - The evolving threshold misses by −0.120 ± 0.029 at z > 1.8 (4.1σ) and −0.062 ± 0.015 over all 100 galaxies. Both clear the threshold as rejections. - The constant threshold sits at +0.009 ± 0.023 at z > 1.8. Its largest bin offset is +0.052 ± 0.029 at z < 1.2 (1.8σ). That is agreement, not a

detection. - The two models differ by a median 0.148 dex at z > 1.8. No standard error of that difference is in the record.

Lensing, spirals and ellipticals (Tests 2b, 9, 21). - Late types by shape agree with the rule (χ^2 12.9 for 15 bins, p = 0.61). Late types by colour sit at −0.054 dex (p = 0.062). - The main isolated sample, which Declaration 2 named, does not agree: +0.119 dex, p ~ 10^{-23}. The pass for spirals rests on a split by type that is not named in Declaration 2. - Early types depart strongly. The outer-minus-inner growth of Test 9 (+0.148, +0.140) is given without a standard error.

A pass by agreement is not a detection. Several results here are passes because a prediction, with nothing fitted, fell inside a range set in advance. Examples: Test 19 L, Test 7 CONSTANT, Test 2b late types, Test 20 VT and VA. Such a pass shows that the data do not contradict the prediction. Its strength comes from the declaration having been fixed first, so the window could not be moved to meet the data. It does not come from a significance level. A wide window, a small sample or large errors make a pass easy. A pass of this kind therefore cannot be counted as a positive finding in the Bonferroni sense. It also cannot be combined with other passes into a "number of sigma".

B3. Power and sharpness

- **Test 15.**
  - b = −0.0129 with a 95% bootstrap interval [−0.101, +0.069] dex per dex.
  - The test excludes frequency slopes steeper than about −0.10 or +0.07.
  - It does not exclude a slope of ±0.05, the size the declaration itself called real.
  - The reason is that log W_bar and log g_bar are almost the same variable here (r = 0.906). The check (W100) says the test had low power.
- **Test 22.** The 95% bootstrap intervals of b, multiplied by each variable's middle range, give these upper ends for the effect E (computed for this appendix):

Variable	Upper end of E (dex)	Factor
X1	0.111	1.29
X2	0.103	1.27
X3	0.091	1.23
X4	0.093	1.24

  - So direct effects larger than about 0.09–0.11 dex (23–29 percent) across the middle range of galaxies are excluded at about 95 percent.
  - Effects of the point size, 0.045–0.052 dex (11–13 percent), are not excluded. The paper's "none excluded below about 12%" matches the point values.
  - For X2 and X3 the interval excludes zero. For X1 and X4 it does not.
  - Under the declared 3σ rule nothing is detected. In quality-1 galaxies the X1–X3 slopes halve.
- **Test 20 (17 systems).** What a pass can and cannot exclude:
  - Bootstrap 95% intervals of the median ratio (computed for this appendix; 10,000 draws, seed 110): VA 0.883 [0.804, 1.021]; VT 1.188 [1.038, 1.315]; V0 1.035 [0.918, 1.165]. The intervals of VA and VT barely overlap.
  - The 0.80–1.25 band is wider than the 35 percent gap between VA and VT, so a pass cannot choose between them (W102).
  - The slope SE (about 0.09) is four times that on the 138 systems. A slope as steep as VT shows there (−0.089) would pass unseen.
  - Removing one of three systems flips VT to a fail. Converting Zhang's Salpeter star masses to Chabrier also flips it.
  - Without the scaling-relation masses (Lin et al. 2003), n = 11 and the verdict would be INCOMPLETE.
  - What the pass does exclude: on these 17 systems, a median ratio for VA below about 0.80, or for VT above about 1.32, at about 95 percent.

- **Test 23.** 8 systems were found; 30 were required. No M_b bin holds 5 systems, so the bin criterion tested nothing. Slope SEs are 0.11–0.15. The test has essentially no power.

B4. Scatter

Galaxies. The rms of log10(g_obs/g_rule) over 2,696 points of 147 galaxies is 0.133 dex (0.1331; mean +0.0121). The fitted empirical curve gives 0.1327. The difference is 0.00047, with 95% bootstrap interval [0, 0.0037] (W74). Weighting each galaxy equally gives 0.1276 (W74).

Groups and clusters. The scatter is the standard deviation of log10(observed/predicted), in dex. Values marked † were **computed for this appendix** from per-system files of the record. COSMIC = M500/(6.364·M_b). RULE = M500/M_rule.

Systems	n	Two-state V0	VA	VT or VB	RULE	COSMIC
Test 18 S1 (the 138)	138	0.085	0.091	VB 0.090	0.096†	0.092†
Test 18 S3 (the 140 groups)	140	0.160	0.126	VB 0.174	0.147†	0.195†
Test 20 (17 new)	17	0.099	0.108	VT 0.101	0.083†	0.105†
Test 23 (8 new)	8	0.122	0.133	VT 0.079	0.229	0.069

RULE medians, also computed here: 1.909 (S1), 1.923 (S3), 1.430 (17 new). The RULE scatter on S1, 0.096, agrees with the 0.0958 reported in Test 17.

Reading. The two-state formula mainly moves the median ratio toward 1. It does not consistently reduce the scatter. On the 138 it reduces it slightly (0.085–0.091 against 0.096). On the 140 groups VA reduces it (0.126 against 0.147), but V0 and VB do not. On the 17 unseen systems the plain rule has the smallest scatter (0.083). On the 8 of Test 23 the plain cosmic share is smallest (0.069). The declared criterion “STRENGTHENED” (Test 23) asked for lower scatter than both RULE and COSMIC. On Test 20’s data, computed here, neither VA nor VT would meet it.

B5. What the statistics do and do not establish

Firm. The rule, with the threshold fixed by H0 = 70, describes the 147 SPARC galaxies with the same scatter as the fitted empirical curve (0.133 dex). This repeats a known relation. A threshold that follows the expansion rate is disfavoured at about 4σ in the RC100 sample, while a constant threshold is consistent with the data. The rule falls short in groups and clusters by a factor of about 1.5 to 2, and the shortfall rises with mass in several samples. The rise is not the same in every sample: one sample (Chiu et al. 2018) shows the opposite sign. Lensing around early-type galaxies departs from the rule. Many declared candidate formulas are rejected.

Suggestive. The gas-versus-disc-star difference of Test 24 clears the 27-test Bonferroni level only narrowly (3.52σ against 3.11). It does not clear it in quality-1 galaxies, and it is not distinguishable from zero in the 66 galaxies with the best distances. Its cause is unknown, and the check reads it as more likely a data or galaxy-property effect. The point-by-point lock of Test 19 agrees with one local measurement. The alternative it was set against fails at 2.70σ, which does not clear the Bonferroni level, and an ordinary round halo also passes.

Not established. That the two-state formula describes groups and clusters on unseen data: Test 20 is a weak, fragile pass on 17 systems that cannot choose between two forms, and Test 23 is incomplete. That stars act on the fabric directly (Test 22: nothing detected, effects up to about 25 percent not excluded). That frequency adds nothing inside galaxies (Test 15 lacks the power to exclude the effect size it named). Any link of number between the micro and macro scales (Appendix C3). No result here is a proof of the theory, and none separates the fabric from ordinary dark matter in single galaxies.

Appendix C. Study of correlations

Section C1 copies correlations that were measured inside declared tests. Section C2 is new. It is **descriptive, not a declared test, and was computed after the tests**, for this appendix. Its code is w110/corr.py and its full output is w110/corr_out.txt. Sections C3 and C4 state what exists between the micro and macro scales, and what the study shows.

C1. Correlations already measured in declared tests (copied from the record)

Test 15. Leftover error against orbital frequency at fixed pull (SPARC, 147 galaxies, 2,696 points). - Slope b = −0.0129 ± 0.0435 dex per dex; 95% bootstrap range [−0.101, +0.069]. - Spearman ρ of residual against W_bar inside six g_bar bins: +0.127 (p 7.1e−3), +0.023, +0.044, −0.011, −0.031, −0.165 (p 4.4e−4). The signs split 3 and 3. - Pearson r(log W_bar, log g_bar) = +0.906. At fixed pull, frequency is nearly fixed, which is why the test is not sharp. - Undeclared extras: within-galaxy b = +0.111, which the check (W100) puts at 1.6σ. Quality-1 galaxies: b = +0.058 (1.1σ).

Test 22. Four star variables (SPARC).

Variable	Slope b ± σ	Spearman ρ (per-galaxy mean residual)	p
X1 star share	+0.0965 ± 0.0560	+0.044	0.60
X2 log SBeff	+0.0347 ± 0.0178	+0.108	0.19
X3 log SBdisk	+0.0400 ± 0.0154	+0.165	0.045
X4 Hubble type	−0.0090 ± 0.0053	−0.114	0.17

The four variables are tied to each other and to g_bar: Spearman |ρ| 0.65–0.87. Point-level Pearson r with log g_bar is +0.696, +0.691, +0.404 and −0.650.

Test 24. Shares of bulge, disc and gas (SPARC). - b_bul = +0.0160 ± 0.0486. b_gas = −0.1654 ± 0.0470. In quality-1 galaxies: −0.1740 ± 0.0617. - The shares track the pull: corr(s_bul, log g_bar) = +0.68; corr(s_gas, log g_bar) = −0.73; corr(s_bul, s_gas) = −0.42. - Without the g_bar term, b_gas = −0.100.

Test 26. corr(s_gas, log g_bar) = −0.734 at f = 1, and −0.733 at the best-fit f. b_gas on the two halves: −0.1911 ± 0.0501 (B) and −0.1363 ± 0.0844 (A), both at f = 1.

The check of Test 24 (w98/CHECK-of-declaration-24.txt).

Variant	b_gas
No g_bar control	−0.100 ± 0.037
Linear control (declared)	−0.165 ± 0.047
Cubic control	−0.199 ± 0.057
20 g_bar bins	−0.190 ± 0.058
Within galaxies	−0.143 ± 0.043 (3.3σ)
Between galaxies	−0.120 ± 0.083 (1.4σ)
f_D = 1 (81 galaxies)	−0.237 ± 0.063
f_D ≠ 1 (66 galaxies)	−0.066 ± 0.068
Difference between the two	−0.171 ± 0.091 (1.9σ)
D > 16.9 Mpc	−0.302 ± 0.079
D ≤ 16.9 Mpc	−0.154 ± 0.061

- At the same g_bar, the top third of gas share minus the bottom third is negative in all 8 bins. It is clear (2.4–2.9σ) only in 3 of them.

- At strong pull the difference is larger than the gas share can explain. The check reads it as “a galaxy tag rather than a per-mass effect of gas”.

Cluster trends with ordinary-matter or total mass.

Test	Sample	Statistic	Value
11	133 systems	slope of log(obs/rule) on log M500	+0.169 ± 0.0145
11	133 systems	slope, accumulation formula	+0.203 ± 0.020
12	half 1 (68)	B on log M_b	+0.098 ± 0.031
12	half 2 (70)	B on log M_b	+0.129 ± 0.028
12	C18 (84)	B	−0.195 ± 0.045
12	G13 (12)	B	+0.033 ± 0.043
12	L13 (37)	B	+0.119 ± 0.018
12	nearby, z < 0.2 (38)	B	+0.113 ± 0.017
16	140 new	slope of log q on log M_b	+0.1426 ± 0.0314
16	S09 / L15 / E16	slope	+0.085 / +0.155 / +0.054
16	S09 + L15 (35; check W101)	slope	+0.111, z 3.9
17	140, after the depth law	residual slope, 17A / 17B	+0.0512 ± 0.0311 / +0.0580 ± 0.0300
27	17 new, X-ray masses	slope of log q on log M_b	+0.0531 ± 0.0277
27	E11 / V06	slope	+0.020 / −0.001

Test 16 binned medians of q against M_b for the 140 new systems: 1.410, 1.577, 2.090, 2.025.

Declaration 12 notes a built-in bias. M500 sits in the ratio, so a slope against M500 is pushed upward by the measurement error of M500 alone. For that reason Tests 12, 16 and 27 used M_b on the horizontal axis.

Lensing, early against late types. - Test 9, outer minus inner: early by shape +0.148, late +0.032; early by colour +0.140, late +0.042. - Test 21, early minus late over all 15 bins: shape +0.219 before and +0.108 after the 0.22 dex star-mass correction; colour +0.240 and +0.128. - W103’s other readings of D3, after the correction: shape +0.042 / +0.072 / +0.071; colour +0.190 / +0.148 / +0.111. - Test 2b sample means: early +0.179 / +0.207; late −0.006 / −0.054. The isolated sample is +0.119 and the non-isolated mass bins +0.128 to +0.233 (Test 14 declaration: +0.13 to +0.23).

Other within-test correlations. - Test 8 (RC100, within redshift bins, against the EVOLVING residual): heat h −0.042 (one-sided p 0.33), baryonic surface density +0.044, baryonic mass +0.085, bulge share −0.096, size +0.042, star-formation offset +0.060, σ0 alone +0.343 (p 0.001). The declaration warned that σ0 enters the authors’ own modelling. - Test 4: r(log ρ0, log r0) = −0.80. ρ0·r0 rises with luminosity (+0.155 ± 0.032 per dex) and with Vflat (+0.82 ± 0.15).

C2. Descriptive correlation study

Descriptive, not a declared test, computed after the tests.

Galaxies. The SPARC data are prepared exactly as in Declaration 1 (w73/code/rar_test.py build(), loaded as in w83/code/freq.py): 147 galaxies and 2,696 points. The point rms is 0.1331 dex and the mean +0.0121, as in the record. The per-galaxy mean of log10(g_obs/g_rule) is ranked against each galaxy variable.

Variable	ρ	p	n
star share 0.5L/(0.5L + 1.33 MHI)	+0.044	0.60	147

Variable	ρ	p	n
log SBeff	+0.108	0.19	147
log SBdisk	+0.165	0.045	147
Hubble type T	−0.114	0.17	147
log Vflat (where given)	+0.128	0.16	120
log baryonic mass	+0.036	0.67	147
distance D	+0.028	0.74	147
inclination	−0.018	0.83	147
quality flag Q (1 or 2)	−0.253	0.0020	147

The first four values reproduce Test 22 exactly. Among the variables themselves the ranks are strongly tied: - log Vflat with log baryonic mass: +0.95 - star share with log Vflat: +0.85 - T with log SBeff, log Vflat and log M_bar: −0.84 to −0.85 - distance with log baryonic mass: +0.65

Full matrix: w110/corr_galaxies_rho.csv (with _p and _n files).

Clusters and groups. Two sets are used: - **A:** w79/out/per_system.csv. 138 rows, of which the 5 S13 rows repeat G13 systems. The unique-133 version is reported in corr_out.txt as a sensitivity check. It changes no conclusion. - **B:** w84/out/new_systems.csv. 140 systems. Their stellar masses come from a relation in M500, so the gas-to-star ratio there is not an independent measurement.

The leftover errors are log(observed/rule), and log(observed/VA) with VA from w88/out/per_system_18.csv (the formula of w92/code/cutoff.py).

Leftover	Variable	ρ (A, n = 138)	p (A)	ρ (B, n = 140)	p (B)
obs/rule	log M_b	+0.112	0.19	**+0.436**	7.0e−8
obs/rule	log M500	**+0.374**	6.2e−6	**+0.775**	3.0e−29
obs/rule	log(gas/star)	**+0.333**	6.7e−5	−0.040	0.64
obs/rule	redshift	**+0.818**	1.7e−34	**+0.631**	6.6e−17
obs/rule	R500	−0.017	0.84	**+0.673**	9.0e−20
obs/VA	log M_b	−0.208	0.015	+0.196	0.020
obs/VA	log M500	+0.106	0.22	**+0.593**	1.2e−14
obs/VA	log(gas/star)	**+0.275**	1.1e−3	**−0.286**	6.3e−4
obs/VA	redshift	**+0.490**	1.0e−9	**+0.440**	5.2e−8
obs/VA	R500	−0.141	0.098	**+0.558**	7.5e−13

Bold marks correlations that survive the primary Bonferroni level below.

Count and correction. - Correlations of a leftover error with a variable (the primary family): 9 for galaxies + 20 for clusters = **29**. Bonferroni at an overall 5 percent: $p < 1.72 \times 10^{-3}$ ($|z| \geq 3.13$). - Correlations among the explanatory variables themselves: 36 (galaxies) + 20 (clusters). Counting everything computed gives **85**, and $p < 5.9 \times 10^{-4}$. - **13 of the 29 survive** the primary level, and 11 survive the stricter one. All 13 are cluster correlations. **No galaxy correlation survives.** The strongest galaxy one, with the quality flag ($\rho = -0.253$, $p = 0.0020$), misses narrowly. Q takes only the values 1 and 2.

What the surviving cluster correlations reflect (from the within-sample sensitivity in corr_out.txt, section C2d): - *Redshift (A, ρ = +0.82).* This is mostly a difference between samples. The 84 distant SPT clusters (C18, median obs/rule 2.04, SZ-calibrated masses) sit above the nearby samples (1.47–1.53). Inside C18 alone the correlation with z is +0.70, while the correlation with M_b turns negative (−0.50). Mass method, sample and redshift cannot be

separated here. - *M500 and R500.* M500 is in the numerator of the ratio, and R500 grows as M500^(1/3). Part of these correlations is built in, as Declaration 12 warned. In B, R500 for the XXL systems is derived from M500. - *log M_b in B (+0.44).* This is the rank form of the Test 16 P3 rise. In A it is weak (+0.11) because the C18 sample runs the other way. - *Gas-to-star ratio for VA (+0.28 in A, −0.29 in B).* The signs disagree between the two sets, and in B the star mass is not measured. No single reading follows. - After VA, the correlation with log M_b falls to about ±0.2 (p 0.015 and 0.020) and does not survive. This matches Test 18 (VA slope on S1 −0.006 ± 0.023). The correlations with redshift and M500 remain.

Files: w110/correlations.png (figure), corr_galaxies_rho.csv / _p / _n, corr_clusters_A_rho.csv / _p, corr_clusters_B_rho.csv / _p, corr_primary.csv (the 29 with Bonferroni flags), galaxy_variables.csv, cluster_variables.csv.

C3. Micro against macro

Work on a numerical correlation between the micro and the macro is ongoing. The tests declared so far were first-stage. What they produced is set out below.

1. **A comparison of form at six points.** Sections 1.1 and 9 list six behaviours that the connection inside the proton and the atom shares with the unseen mass around galaxies. These are statements of likeness, with no number attached yet.
2. **One comparison of numbers.** The threshold a_c was set against the pull at the surface of an electron, a proton and a pion. The nearest differed by a factor of 14. This comparison comes from the working record of the first stage. It was not a declared test, it is in no result file, and the inputs used are not recorded. It should be repeated as a declared test.
3. **No statistical correlation yet.** One needs a shared set of measurements: objects on which a micro quantity and a macro quantity are both measured. Assembling such a set is part of the next stage.

Sets of that kind could be:

- systems in which a micro-scale property (for example the make-up of the stellar population, the nuclear composition, or the remnants of dead stars) is measured beside the macro departure from the rule, object by object;
- galaxies with independently measured star mass-to-light ratios beside their leftover errors from the rule;
- the wide star pairs of Test 25, where a single star is the unit and the pull between two stars is measured directly.

With data of this kind the link between the micro and the macro can be tested as a correlation and not only as a likeness.

C4. What the correlation study shows and does not show

It shows that inside single galaxies the leftover error of the rule is not linked, at any corrected level, to star share, surface brightness, type, flat speed, baryonic mass, distance or inclination. This agrees with Tests 15 and 22. It shows that in groups and clusters the shortfall of the rule is linked to total mass, size and redshift, and that much of this is a difference between samples and mass-measurement methods, not one trend.

It does not show that any variable causes the shortfall. The variables are strongly tied to one another (|ρ| up to 0.95), and the analysis was chosen after the tests had been seen. The 13 surviving correlations are descriptions of these data sets, not findings. A correlation that matters would have to be declared in advance and tested on systems not yet opened, as the main tests were.