INCOMPLETE DRAFT FROM MAY 14, 2017. FIRST PUBLISHED MAY 7, 2024.

The PAVIS Hypothesis: Reinterpreting Physics As Virtual Instantiation Software

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May 14, 2017

Abstract

The PAVIS hypothesis in a nutshell is that the most fundamental components of physics are neither locations in spacetime nor pure states of particles, but dynamic, software-like rules that instantiate both space and matter only to the degree to which information-creating processes (observers) invest enough mass-energy to provide a particular level of detail. These proposed deep rules of physics thus operate very similarly to the virtual instantiation software of computers models, which obtain phenomenal efficiency by avoiding investments of computation until required by an observer. For physics, investments of mass-energy play the same role as computation for creating the level of detail that an observer process requires in a given situation. The particle pair creation operator of quantum mechanics is an example of one of these virtual instantiation rules, although its detailed structure and relationship to other rules has never been elaborated. If valid, the the PAVIS hypothesis requires a massive restructuring of all of physics, since implies that many of the most profound symmetries of physics are in fact simply extremely convincing high-fidelity, local-only, variable-duration illusions created in context by virtual instantiation rules. PAVIS also implies a much deeper relationship between continuous mathematics and physics, one in which the algorithmic aspects of continuous mathematics become in effect a more refined and fundamental aspect of physics.

Summary

1 Introduction . . . **2**
2 Proposed PAVIS Papers . . . **3**
3 No Turtles, Just Rules . . . **3**
4 Continuum Math as Deep Physics **3**
5.1 Mandelbrot and the Anthropic Principle . . . 3
5 Mandelbrot as Multiverse . . . **3**
6 Space-Matter Duality . . . **3**
7 Pure States as Multiplying Infinities . . . **3**
8 Dirac's Lost Positron Insight . . . **3**
9 Particles as Space Creation Solitons . . . **3**
10 Wave Collapse as Deep Physics . . . **3**
11 Focus Obscuration Hypothesis . . . **3**
12 Top-Down Uncertainty Resolution . . . **4**
12.1 Maximum Humility Computation 4
13 V2H Scale Matching . . . **4**
13.1 Minimality Plus Atomicity . . . 4

13.2 The Standard Model as Optimal V2H 4
13.3 The Planck Overshoot 5
14 Context and Causality 6
15 Particle-Space Symmetry Breaking 6
16 REF: Earlier Versions of Abstract and Intro 6
16.1 First Abstract, 2017-04-10 . . . 6
16.2 Final Expansion of 2017-04-10 Abstract] 7
16.3 ADAM and EVE 9

1 Introduction

The most fundamental components of the universe are not particle states, but software-like rules that create whatever level of detail an observer chooses to observe. The pair creation rule of quantum mechanics is an explicit example of one of these rules. These Particles As Virtual Instantiation Software (PAVIS) rules enable persistent binding of small packets of mass-energy by imposing on them halves of conserved quantity pairs that are themselves the products of other PAVIS rules. It is these persistent, information-rich packets of conservation-rule-bound mass-energy that we interpret as particles. The level of spacetime detail visible for any such packet depends on the level of additional unbound mass-energy that an observer chooses to devote to creating that detail.

This process is entirely virtual in the sense that a more detailed version of spacetime itself is created locally and only temporarily through the addition of those free mass-energy resources, though the information record created by this process persists and becomes part of a universally shared definition of causal history. The overall PAVIS instantiation process is similar to Mandelbrot set instantiation, except that PAVIS rules converge for the most part towards smoothness rather than additional detail.

The implications of the PAVIS hypothesis are profound and include the following:

- Wave packets are real, while pure particle states are abstractions that exist only as unobtainable limits of dynamic instantiation processes that become exponentially more costly as the limits are approached.
- All of quantum gravity and string theory are "overshoots" that are neither fundamental nor particularly insightful.
- Most of the defining functionality of the fundamental rule set was uncovered 40 years ago with the creation of the Standard Model.
- The amazing frame symmetries of special relativity collapse under the PAVIS hypothesis into a single "fastest time" frame, in which all moving frames are simulated with almost perfect fidelity. This fastest time frame is the rest frame in which mass-energy has sat unaccelerated since the beginning of the universe.
- All other SR frames are virtual, and always operate more slowly than the cosmic rest frame, while still retaining the amazing causal symmetries first identified by Einstein.
- The SR illusion is incredibly high fidelity, but is not quite perfect; there should exist at least one subtle but testable path by which an observer can determine that they are not in the cosmic rest frame.
- The possibility of a block universe disappears, and is replaced by a single literally universal (but inaccessible) "now" state. This shared "now" state also becomes the fabric of curved space in general relativity.
- The entire domain of quantum gravity and string theory disappears.

Additionally, the fermion particle family turns out to be a "side effect" of local multi-stage construction of Lorentzian spacetime, with each fermion type being a bar of mass-charge resonance locked soliton-style at a phase boundary between ordinary XYZ space and a momentum-like space.

2 Proposed PAVIS Papers

So far, proposed papers include [1] and [2], with other in queue. Two very interesting papers that Google Scholar found are [3] and [4], both of which remarkably seem to take the creation-annihilation operator as a fundamental operation by which a quantum model can be simplified. I've downloaded both (2017-05-13) and will be taking a much closer look at them.

3 No Turtles, Just Rules

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4 Continuum Math as Deep Physics

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5 Mandelbrot as Multiverse

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5.1 Mandelbrot and the Anthropic Principle

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6 Space-Matter Duality

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7 Pure States as Multiplying Infinities

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8 Dirac's Lost Positron Insight

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9 Particles as Space Creation Solitons

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10 Wave Collapse as Deep Physics

text

11 Focus Obscuration Hypothesis

If you exist as an observation-capable entity within a universe that is largely virtual in nature, how then do you determine the deeper nature of that world?

This turns out to be a truly intriguing epistemological question. By the nature of virtualization, the very components of that are not the most fundamental will nonetheless emerge as the most sharply defined whenever additional resources are focused on them to help discern their precise structures. This is precisely because they are focus dependent: As you attempt to understand your universe more precisely, you necessarily invest more resources in observing some detail of it. In the case of our universe, this situation ends in such *reductiones ad absurdum* as infinitely precise locations in spacetime and infinitely precise quantum particle states, neither of which can truly exist without violating quantum mechanics and mass-energy conservation.

Conversely, this same distraction effect implies features that experimentation tends to focus *away* from as "ephemeral" or "difficult to quantify" are more likely to reflect non-virtual that underly the much more visible dynamic outcomes. Virtuality will by its nature tend to blur these non-virtual clues out in ways that make them smoother and harder to discern against a backdrop of more detailed virtual effects.

If we live in a PAVIS universe, then the two most likely examples of virtualization obscuring and distracting away from more fundamental non-virtual physics are the paired issues of *quantum observation* and *wave function collapse*. ...

12 Top-Down Uncertainty Resolution

Virtuality works by creating a large-scale fabric of low to very-low resolution maps of the vast majority of some abstract space, but in such a way that at any given region or moment in time, it is always possible to elaborate a subsection of that fabric to much greater levels of detail. This process is also capable of taking place at many different scales within that region, which is to say that the the virtualization process much be *recursive* or *fractal* in nature.

12.1 Maximum Humility Computation

Top-down uncertainty resolution also has powerful implications for how results are computed with ubits. The first premise of ubit computation is that all computation begins with ubits set to the *least* known state. This simple rule only works if context and cross-space information networking ensure preservation and conveyance of any changes to that unknown state. However, with those assurances in place, the use of ubits with "maximal ignorance" translates into an exceptionally efficient computing architecture. This is because ubits are used in a maximally economical fashion overall. From a "storage" perspective, at allows as few ubits as possible to representing as much of the v-verse as possible. From a "computation" perspective it avoids one of the most wasteful of computation strategies, which is over specifying precision in ways that are guaranteed not to contribute to final result.

13 V2H Scale Matching

For any smoothly defined virtualization process there will be no specific limit on how finely grained the resulting elaboration can become. However, it is important to note at the same time that there will exist some level of granularity at which the virtual elaboration produces structures that correspond roughly one-to-one in complexity with their corresponding ubit representations. Larger v-side constructions will be non-atomic composites of smaller units, just as molecules are composites of atoms, while finer-grained v-side constructions will require *uvectors* — vectors of ubits for expressing higher-precision real numbers on the h-side — that also increase ubit use.

13.1 Minimality Plus Atomicity

As one would expect, the most important clue that a v-world property is close to this optimal v2h level is *minimality plus atomicity* (mpa). *Minimality* means the property can only have one of a small number of very similar values, with those properties lacking any obvious way to be grouped into small subgroups. Binary values such as spin up and spin down are perhaps the ideal example of minimality. *Atomicity* means that this set of properties are being expressed within a structure that cannot be subdivided into still smaller components without losing those properties entirely. An example of minimality from chemistry of minimality would be one molecule of a crystal.

13.2 The Standard Model as Optimal V2H

Identifying the experimental location of this optimum *v2h scale match* is important for gaining a better understanding of the EVE rule set, since it is only at the roughly one-to-one level of v2h that the quantities and behaviors we see in the v-world will correspond closely to quantities and behaviors controlled by EVE rules.

Somewhat paradoxically given events of the past 40 years, the optimal v2h level of physics understanding is not a future goal yet to be obtained. It is almost the Standard Model of particle physics, which in the 1970s achieved a level of understanding of quantum-level particle properties that has remained incredibly robust and predictive to this day. The effectiveness of the Standard Model implies that the v2h sweet spot for deciphering EVE is roughly at the same size and time scales at which well-known and stable particles interact. For space,

INCOMPLETE DRAFT FROM MAY 2017. FIRST PUBLISHED MAY 2024

this is in the order of nucleon diameters, or $10^{-15}m$.

If $v2h\ = 10^{I}-15m$, the implication is that this is the level at which under most circumstances space and matter part ways and become respectively part of the universal fabric of exchanged causal information (space) and localized persistent captures of mass-energy (particles). Further elaboration below this scale remains both meaningful and extremely useful for predicting further details of how our universe works. However, if PAVIS is true, it also means that these further elaborations will be increasing pure virtual, and thus meaningful only within extremely localized and narrow regions of the universe as whole. This is especially true for issues such as deciphering the motions of quarks with a nucleon. While such motions are as "real" as one wishes to invest energy to make them, the average nucleon under PAVIS simply will not operate by default in that fashion. Instead, simpler, lower ubit-count processes will enable to nucleons to "figure out" the envelope of behaviors they need to exhibit and engage in in order to be fully compatible with those more detailed elaborations, without actually computing them directly.

A simple example of why this is not just a matter of two exactly equivalent views of the same issue is the spin of protons and neutrons. When calculated by using spatially detailed models of quarks and gluons, ensuring that nucleons have an overall spin of $\frac{1}{2}$ becomes remarkably difficult. If however protons and neutrons are interpreted as relatively simple combinations of no more than a handful of EVE rules, spin remains a primary characteristic of those simpler rules, and the complexities of subdivision literally never arise for ordinary low-energy nucleon interactions.

13.3 The Planck Overshoot

If $v2h\ = 10^{I}-15m$ is the optimal region for deciphering and detailing EVE, what then is the Planck domain into which much of the last 40 years of physics research has gone in attempts to unify gravity with other three interactions of the Standard Model?

The simplest and most frank answer is that if PAVIS is true, then attempts to define gravity as a quantum phenomenon are example of extreme overshoot, specifically of virtually instantiating phenomena that rarely if ever occur within the overall fabric of our v-verse. Actual quantum gravity may be so costly in terms of ubits (real mass-energy) that it literally cannot exist within our v-verse, and so cannot impact its fabric.

The reason this can happen is that in the PAVIS model gravity is not a force in the same sense of the other three rule-defined forces, but a modification of the multi-scale space-particle symmetry exchange that defines space in our universe. Or stated another way, gravity really is geometry, just as Einstein first described it, rather than a first-order quantum effect. It is the geometry of the EVE subset that deals with the breakdown, reformation, and overall integration of mass-energy into particles and what we call space.

In recent years, the idea that space itself is an aspect of quantum information connections has emerged. The first critical insight was the holographic universe concept of Witten, which enabled a new information-first perspective on how the universe could interact with itself. This thread of thought has progressed to exploration of the idea that space may itself be an aspect of quantum entanglement.

There is however a truly huge scale divide between the scales typically chosen for exploring this issue. Both quantum gravity and string theories focus on scales that are 20 orders of magnitude finer in detail than the nucleon level of detail, which entails that such massive levels of ubit resources that the very gravitational stability of the universe quickly comes into doubt. It has been noted that of all the curious "just right" parameter setting of physics that seem to support the anthropic principle hypothesis, this precious balancing of negative and positive

INCOMPLETE DRAFT FROM MAY 2017. FIRST PUBLISHED MAY 2024

mass-energy contributions required to keep the universe relatively flat is the most remarkable and least plausible of them.

The resolution is surprisingly simple: Move the scale of "typical" spatial granularity up to the $v2h \ = 10^{I}-15m$, that is, up to roughly the same level as proton and neutron diameters. In an efficiently structured v-verse, even that level of detail would not be typical of the majority of space. A well-structured v-verse might for example have individual ubits representing light years of volume in the deepest and most empty supervoids of the universe. However, the main implication of $v2h \ = 10^{I}-15m$ would be that the types of hot thermal matter that we humans care about most, space only approximates a continuum down to about the size of protons and neutrons. Even more specifically, the volumes within nucleons would not necessarily be Lorentzian space at all, since they would reflect EVE rules that operate right at the boundary of the particle-space breakdown, and so may contain "incomplete" version of both.

An example of incomplete space-particle breakdown within nucleons would be the containment of quarks, and a complementary but unrecognized need to modify the "typical" space within the nucleon to achieve that containment. This possibility is discussed elsewhere in this paper as part of the mechanism by which fermions achieve persistence, specifically as topological boundary solitons trapped between the indefinitely expansive Lorentzian space of our v-verse and a much more localized, momentum-like space that exists only within the wave packet region of the fermion.

14 Context and Causality

... The role context and causality: keeping large granularity in sync with smaller ...

15 Particle-Space Symmetry Breaking

... Wave packets are combination of space and particles in which the symmetries between the two are locally unbroken. The integral of all possible histories ...

16 REF: Earlier Versions of Abstract and Intro

16.1 First Abstract, 2017-04-10

Abstract:

Whether naturally occurring or artificially created, the physics of our universe can be vastly simplified if it is assumed to be a simulation program executing on a vast but finite computing substrate with finite resources and independent time flow. The simplifications stem from the ability of such a program to create extremely high fidelity *virtual instantiations* when provided with sufficient memory and processing power, which within our universe appear as mass-energy. Without exception, all physical and mathematical processes that approach infinitesimal or infinite limits become instances of *smooth-limit rule sets*, that is, program modules that converge towards highly linear behaviors when pushed to create finer or larger levels of detail. Such smooth-limit modules can be contrasted to *fractal-limit rule sets* such as the Mandelbrot set, which instead creates unlimited additional complexity when pushed to extreme limits. The overall interpretation of special relativity, quantum mechanics, spacetime, and particle physics are all profoundly impacted by the assumption that their experimentally observed limits are virtual and thus resource-dependent in nature. In special relativity, frames and foliations retain their deeply astonishing symmetry of temporal interchangeability, but only the universal rest frame as defined by deep space clocks that have never undergone acceleration since the big bag are close to the "real" hardware of mass-energy and causality, with all other frames becoming extremely high fidelity simulations running at slower rates on within that singular real frame. The concept of "now" becomes universal and the future determined only by prediction from it, while the block universe ceases to be a vi-

INCOMPLETE DRAFT FROM MAY 2017. FIRST PUBLISHED MAY 2024

able concept. Quantum uncertainty become nothing more than a lack of available memory per entity at the lowest levels of the simulation, guided by a program that ensure "fit" of the low fidelity parts to the higher (more mass-energy) parts. Spacetime itself, with all of its deeply complex geometry and rotation relationships, becomes a set of computational relationships that calculate additional detail only as needed, and without any preexistence of mathematical abstractions such as real or irrational numbers, which only emerge incrementally as smooth limits to modules given sufficient resources. Finally, particle physics become a set of rules whose total program complexity was largely captured 40 years ago by the Standard Model, with unification of gravity becoming a red herring based on the false assumption that space is granular only at the Planck limit. Quantum gravity is a red herring primarily because there exist multi-scale quantum strategies that can create the same smooth space behavior that we observe experimentally, but do so at literally order orders of magnitude of orders of magnitude higher efficiency in their use of implied memory and computational resource.

16.2 Final Expansion of 2017-04-10 Abstract]

Abstract:

The central premise of this paper is that our understanding of fundamental physics can be vastly simplified and made deeper by assuming that physics is a form of software that executes on a vast but finite computing substrate. In terms of its implications for understanding physics in new ways, the origins of this substrate are less important than how it uses its times, memory, and execution capacity, all of which are independent of out universe. This postulated physics simulator achieves exceptional memory and computational efficiency by always using memory and computation to represent the least level of detail possible, adding more resources to create additional "virtual" detail only as needed to capture the outcomes of more complex interactions. Our understanding special relativity, quantum mechanics, spacetime, and particle physics are all impacted in specific ways by this assumption. The main features of the physics-as-software hypothesis are outlined, and a number of specific implications and approaches are then explored.

Introduction:

Physics has a long and rich history of using various philosophical principles as general guidance both theorizing and experimenting, with varying levels of success. An example is Western civilization's millennia-long fascination with the four classical Greek elements of earth, water, air, fire, and aether. While this presumed principle arguably helped lead in time to the scientific identification of a much larger set of chemical elements, it also vastly slowed the process by misdirection attention away from the less obvious details of what really made an element unique and indivisible.

A more current and structured equivalent to such guiding principles for trying to decipher complex problems is a "heuristic," that is, a general rule that has either proven useful in the past or for various reasons is speculated will be efficient for exploring problem spaces in the future.

The central premise of this paper is that our understanding of fundamental physics can be vastly simplified and made deeper by assuming a very specific heuristic with exceptionally broad implications, which is this: Fundamental physics is a form of software that executes on a vast but finite naturally-occurring computing substrate. In terms of its implications for understanding physics in new ways, the origins of this substrate are less important than how it uses its times, memory, and execution capacity, all of which are independent of out universe, the software in this postulated physics simulator achieves exceptional memory and computational efficiency by using memory and computation to represent the least level of detail possible, adding more resources to create additional "virtual" detail only as needed to capture the outcomes of more complex interactions. Our understanding special relativity, quantum mechanics, spacetime, and particle physics are all impacted in specific ways by this assumption. The main features of the physics-as-software hypothesis are outlined, and a number of specific implications and approaches are then explored.

Subsection: Deciphering A Naturally Occurring Computing Architecture

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Subsection: Limit Examples from Physics

Simplifications to fundamental physics arise from the ability of such a program to replace concepts such as locating point-like particles in real space with rule sets that, with only a few bytes of information, enable such locations to be approximated only to the degree needed by actual circumstance. In contrast, experimental implementation of such point-like concepts entail catastrophically high memory and execution costs, costs that show up in our universe in the extreme energy levels required by high-end particle accelerators. In this model, all physical and mathematical processes that approach infinitesimal or infinite limits are instances of *smooth-limit rule sets*, that is, program modules that converge towards highly linear behaviors when pushed to create finer or larger levels of detail. Such smooth-limit modules can be contrasted to *fractal-limit rule sets* such as the Mandelbrot set, which instead creates unlimited additional complexity when pushed to extreme limits. Interpreting much of observed physics as "virtual instantiations" of such rule sets profoundly impacts the underlying reality and by making much of it simply elaboration of much simpler programming rules. In special relativity, frames and foliations retain their deeply astonishing symmetry of temporal interchangeability, but only one frame, the "universal rest frame" as defined by deep space clocks that have never undergone acceleration since the big bag, is sufficiently close to the "real" hardware of our universe to be considered real. All other frames become extremely high fidelity simulations running at slower rates within that single real frame, which also becomes the singular fabric of curved space in general relativity. The concept of "now" becomes universal and the future determined only by prediction from the single real frame, and the block universe ceases to be a viable concept. Quantum uncertainty become little more than a lack of available memory per entity at the lowest levels of the simulation, with rules that create classical details (including space itself) only when such parts become entangled. Spacetime, with all of its deeply complex geometry and rotation relationships, becomes a set of computational relationships that emerge incrementally as smooth limits when given sufficient resources. Finally, particle physics become a set of rules whose total program complexity was largely captured 40 years ago by the Standard Model, with unification of gravity becoming a red herring based on the false assumption that space is granular only at the Planck limit. Quantum gravity is replaced by a multi-scale quantum entanglement strategy that create the same smooth space behavior, but literally order orders of magnitude of orders of magnitude higher efficiency. This last point implies that the holographic model of space as entangled quantum effects is conceptually correct, but off in scale by about 20 orders of magnitude due to its incorrect focus on Planck limits. The real entanglement takes place at roughly the same size scale (in our universe) as baryons, meaning that despite their irregularity and seeming randomness, it is ordinary, relatively high granularity fermionic and bosonic matter and energy that create the seemingly infinitesimal smoothness of virtual spacetime. This argues that ordinary thermal matter and spacetime are an important and unrecognized instance of a broken quantum symmetry, and should be analyzed jointly from just that perspective, with for example electric and color charges in particle physics becoming broken but deeply intertwined sym-

INCOMPLETE DRAFT FROM MAY 2017. FIRST PUBLISHED MAY 2024

metries of time and the three spatial dimensions.

16.3 ADAM and EVE

(From a 2017-04-16 email to Roger Duncan)

Since the fundamental theme of the hypothesis is that *rules* are the only real physics, with particles (and many, many other things) becoming just variable-energy instantiations of those rules, PAVIS captures the critical concept better. A pavis is also a shield that covers (and so masks) the entire body, so it's also not too bad as an image for virtualization.

ADAM (All Data, All Mass) still nicely locks down the idea even if the computing substrate behaves very differently from what we are accustomed to, it's still right there in front of us and part of us, not some weird abstraction in a totally different universe.

EVE becomes "Efficient Virtualization Ensemble." Using "ensemble" better captures that EVE really is like rule-based software, with a finite number or rules, and with each rule being relatively simple in form. Each such rule deals with a particular aspect of physics virtualization.

Summary:

Paper Title: "The PAVIS Hypothesis: Physics As Virtual Instantiation Software"

PAVIS = ADAM + EVE

PAVIS = Physics As Virtual Instantiation Software

The PAVIS hypothesis is that both physics and real mathematics are convergent-at-infinity limits created by exceptionally efficient software-like rules that execute on an immense but finite supply of "universal bits" (u-bits). These bits appear to us as mass-energy.

ADAM = All Data, All Mass

ADAM is the immense but finite substrate of computational "hardware" upon which PAVIS operates. It is composed of universal bits (u-bits) that play very diverse roles in our physics.

EVE = Efficient Virtualization Ensemble

EVE is the "software" (finite set of rules) that defines both our physics and our continuum mathematics, with continuum mathematics becoming essentially a more abstracted form of physics. The full ensemble of virtualization rules economically transforms concentrations of u-bits into variable-duration, variable-fidelity, convergent-only-at-infinite-cost physics concepts that include particles, space itself, classical time, relativistic physics, and quantum physics. Ordinary information (i-bits) stabilize certain types of u-bit instantiations, such as thermal matter, and enables them to endure and remain well-located for long periods of time.

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