Semiclassical stars(i.e. stars described by the semiclassical Einstein field equation) are made rigorous and extended what coexists with it via a new renormalization that's perturbative multiplication rather than perturbative addition. I found epistemological and ethical limits of experimentally detecting such stars for the case when there are any fermions on the stars, and this has supported a duality between fermions and bosons. I develop a multiverse theory from an operator that adds back fermions in the codomain, and suggest it will look like an hourglass when the new universe (i call the saved point universe) does start this way, then constructed a category of stuff in the universe. I showed the domain and codomain of the category coincides under extension. I interpreted hausdorff locally convex vector spaces as matter here. I developed a new formula for the stress energy tensor linking it to the Hamiltonian which also suggests some matrix scaled is the reason we don't get to see the saved point universe starting as it places bosons in where there should be fermions. I develop a new construction for symmetries such that it's locally presentable and is generalized at universal algebra level yet still suited under AQFT philosophy. I postulated huge existence dependant on stars and AQFTs under a universe where only stars exist, then postulated a huge similarity between what coexists with stars and AQFTs, and postulated an adjunction between this theory together with symmetries to AQFT together with symmetries. I connected the improved Haag Kasler 2-functor (i.e. a functor that works for AQFT that is actually a stack) deeper to AQFT philosophy. I also made a rigorous version of black hole light rings defined based on its shape, and constructed a quadrant from it which summarises the metaphysics, and hypothesised objects "unaffected" by black holes. I constructed the local to global version of what coexists with stars. I named this theory SUSACF (Semiclassical Universe Stellar Algebraic Causal Fermionically, pronounced sus-saf).

SUSACF: A proposed multiverse theory from a unification of causal fermion systems, locally covariant QFTs, and semiclassical stars

Or Like That[1*]

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Keywords: Semiclassical stars, Stress energy tensor and Hamiltonian, multiverse theory, hourglass, Haag Kasler stacks

1 Introduction

1.1 Introduction

The case for plugging in semiclassical stars(i.e. stars described by the semiclassical Einstein field equation) [2] spacetime for causal fermion systems (i.e. a central object where other major objects emerge) [22] manifold is not studied which this paper does and derive results relevant to ethics of detecting such stars. [2]'s main result (i.e. claim that some things exist if star solutions to the semiclassical Einstein field equation exists) is not rigorous which this paper makes rigorous and so, it has differential equations motivations. Additionally, perturbative renormalization techniques haven't considered multiplication rather than sole addition of a perturbation which this paper considers such to extend such result of [2]. Connecting to ethics of such stars(boson-fermion distinction is a major thing leading such problems), even though bosons emerge from fermions in causal fermion systems [44], a duality between them two has been an open problem which this paper give major insights to solving in open problem 3.2.1. Next, the current framework for AQFT, and causal fermion systems hasn't been connected to a multiverse theory which is fixed as well, but this paper introduce such a theory from definition 2.1.4 deriving it from existing operators in causal fermion systems then make a relevant category with it using AQFT philosophy, then study simplifying extension properties of it in corollary 3.2.9. We do not know why another universe doesn't start now but this paper shows in theorem 3.3.1 that it's because of some matrix scaled by the imaginary unit. Theorem 3.3.1 additionally derive a new formula between stress energy tensor, and the Hamiltonian in AQFT.

Next, there has been major problems around symmetries and AQFTs. Improved Haag Kasler 2-functor (i.e. a functor that works for AQFT that is actually a stack) [4] doesn't map to the category of algebra of observables Alg. We don't yet know what happens when symmetries related to Haag Kasler style 2-functor, spacetime, and what keeps the new universe not coming approach nothingness, and how it relates to symmetries related to AQFTs. Since Alg is central to the AQFT philosophy, this is problematic. In physical postulate 3.3.4, we fix this by getting a map to Alg and additionally, I incorporate symmetries and what's relevant to this theory. Symmetries aren't general to the level of universal algebra and they're not locally presentable. However, this paper generalizes them well and shows they're locally presentable in construction 2.2.3.

Following rigor and associated elegance of semiclassical stars, they haven't been in AQFT literature and this paper extensively connects what's relevant to AQFT with semiclassical stars. Black hole light rings aren't rigorous yet which this paper defines based on their shape in definition 2.1.7. We do not know what it will look like when a new universe does start but this paper argues it will be an hourglass. An additional universe with only stars isn't studied yet but this paper defines it as a corporeal universe in definition 2.2.4, then uses it in definition 2.2.3 which is used in physical postulate 2.2.5. I specifically set a deep existence dependence between some AQFTs and what coexists with stars in physical postulate 2.2.5 under certain conditions, then suggest deep similarity in physical postulate 2.2.7. It's easy to check these postulates are argued from established physics theories under certain philosophy from the paper.

I propose to name this new unified theory as Semiclassical Universe Stellar Algebraic Causal Fermionically (SUSACF (pronounced sus-saf)).

1.2 preliminaries (general)

Informal definition 1.2.1: The following equations are called Polyakov approximation

$$\langle \hat{T}_{rr} \rangle = -F \frac{l_P^2 \psi^2}{8\pi}$$

$$\langle \hat{T}_{tt} \rangle = F \frac{l_P^2 e^{2\phi}}{8\pi} \left[2\psi'(1-C) + \psi^2(1-C) - \psi C' \right]$$

$$\langle \hat{T}_{\theta\theta} \rangle = \frac{\langle \overline{T}_{\varphi\varphi} \rangle}{\sin^2 \theta} = -(2F + rF') \frac{l_P^2 r^2}{16\pi} (1-C) \psi^2$$

[1] but notations from [2] are used (i.e. ψ for gravitational redshift function and r for radial coordinate. For the purpose of this paper, knowledge of other notations is unnecessary given they're built up on these two)

Definition 1.2.2. Quantum killing lie derivatives are defined as follows:

Let (M, g) be globally hyperbolic. Given a Killing vector field Z on (M, g), we define δ_Z to be the operator

$$\bigcup_{\mathcal{O}\in\mathcal{K}(M,g)} \mathcal{M}(\mathcal{O}) \to \mathcal{M}(M)$$

with domain

$$\operatorname{dom}(\delta_Z) = \left\{ f \in \mathcal{M}(\mathcal{O}) : \mathcal{O} \in \mathcal{K}(M,g), \lim_{t\to 0} \frac{1}{t}\left(\pi_t^Z(f) - f\right) \text{ exists as an element of } \mathcal{M}(M) \right\}$$

and with values given by

$$\delta_Z(f) = \lim_{t\to 0} \frac{1}{t}\left(\pi_t^Z(f) - f\right).$$

[3, section 6]

Let C be an arbitrary category and let X be an object of C for which all finite powers of X also exist in C.

Definition 1.2.4. Setting

$$O_X = \coprod_{n>0} C\left(X^n, X\right),$$

a subset $Cl \subseteq O_X$ is called a clone of operations over the object X if it contains all projections $\pi_i : X^n \longrightarrow X$ and is closed under composition, i.e., writing Cl_n for those elements of Cl that lie in $C\left(X^n, X\right)$, given $f \in Cl_n$ and $f_1, \ldots, f_n \in Cl_k$, the composite $f\left(f_1, \ldots, f_n\right)$ is in Cl_k. [9, def 3.1]

Definition 1.2.5

A Lawvere theory consists of a small category $\mathcal{L}$ with (necessarily strictly associative) finite products and a strict finite-product preserving identity-on-objects functor

$$P : \aleph^{\mathrm{op}} \to \mathcal{L}$$

($\aleph$ denotes a skeleton of the category of finite sets and all functions between them).

A map of Lawvere theories from $\mathcal{L}$ to $\mathcal{L}'$ is a (necessarily strict finite-product preserving) functor from $\mathcal{L}$ to $\mathcal{L}'$ that commutes with the functors I and P. [9, def 2.2]

Definition 1.2.6. A set of algebraic operations on a fixed set S is a concrete clone on S if it contains all (component) projections $S_n \to S$ and is closed under composition.

Example 1.2.7. A concrete clone is an abstract clone [8].

Definition 1.2.8: A light ring is a null geodesic in a spacetime $\mathcal{M}$ such that there exist at least two commuting Killing vectors in $\mathcal{M}$ [13, section 2].

Informal definition 1.2.9: Boson stars are stars made out of scalar particles or mixture of fermions and bosons [25, page 166].

Definition 1.2.10. Paraconsistent logic is a type of logic where two contradictory statements can be true at the same time i.e. both statements p and not p may be true [34].

1.3 preliminaries (stacks related)

Definition 1.3.1 A 2-functor $\overline{\mathbf{C}(-)} : \mathbf{Loc} \to \mathbf{Cat}^{\perp}$ is called a net domain if it satisfies the following properties:

(1) For all $M \in \mathbf{Loc}$, the underlying category of $\overline{\mathbf{C}(M)}$ is thin, i.e. there exists at most one morphism between every two objects.

(2) For all $M \in \mathbf{Loc}$ and all causally convex open subsets $V \subseteq M$, the orthogonal functor

$$\iota_V^M = \overline{\mathbf{C}\left(\iota_V^M\right)} : \overline{\mathbf{C}(V)} \to \overline{\mathbf{C}(M)}$$

is a full orthogonal subcategory inclusion $\overline{\mathbf{C}(V)} \subseteq \overline{\mathbf{C}(M)}$.

(3) For all $M \in \mathbf{Loc}$ and all causally convex open subsets $V_1, V_2 \subseteq M$, if there exists a morphism $U_1 \to U_2$ in $\overline{\mathbf{C}(M)}$ from $U_1 \in \overline{\mathbf{C}(V_1)} \subseteq \overline{\mathbf{C}(M)}$ to $U_2 \in \overline{\mathbf{C}(V_2)} \subseteq \overline{\mathbf{C}(M)}$, then $U_1 \in \overline{\mathbf{C}(V_1 \cap V_2)} \subseteq \overline{\mathbf{C}(M)}$. [4, definition 4.6]

Definition 1.3.2. Let $\overline{\mathbf{C}(-)} : \mathbf{Loc} \to \mathbf{Cat}^{\perp}$ be a strict 2-functor. For each causally convex open cover $\mathcal{U} = \{U_i \subseteq M\}$ of an object $M \in \mathbf{Loc}$, we define the category $\mathbf{C}(\mathcal{U})$ by the following generators and relations description:

- An object in $\mathbf{C}(\mathcal{U})$ is a pair (i, U) consisting of an index i of the cover and an object $U \in \mathbf{C}\left(U_i\right)$.

- The morphisms in $\mathbf{C}(\mathcal{U})$ are generated by the following two types of generators:

(i) For every i and every morphism $g : U \to U'$ in $\mathbf{C}\left(U_i\right)$, there exists a morphism

$$(i, g) : (i, U) \longrightarrow (i, U') .$$

(ii) For every i, j such that $U_{ij} \neq \varnothing$ and every $V \in \mathbf{C}\left(U_{ij}\right)$, there exists a morphism

$$\varphi_{ij,V} : \left(j, \iota_{U_{ij}}^{U_j}(V)\right) \longrightarrow \left(i, \iota_{U_{ij}}^{U_i}(V)\right) .$$

These generators are required to satisfy the following relations:

(r1) For all i and all composable morphisms $g : U \to U'$ and $g' : U' \to U''$ in $\mathbf{C}\left(U_i\right)$,

$$(i, g') \circ (i, g) = (i, g'g) .$$

For all i and all $U \in \mathbf{C}(U_i)$,

$$(i, \mathrm{id}_U) = \mathrm{id}_{(i,U)}.$$

(r2) For all i, j with $U_{ij} \neq \varnothing$ and all morphisms $h : V \to V'$ in $\mathbf{C}(U_{ij})$, the diagram commutes.

(r3) For all i and all $U \in \mathbf{C}(U_{ii}) = \mathbf{C}(U_i)$,

$$\varphi_{ii,U} = \mathrm{id}_{(i,U)}\,.$$

For every $M \in \mathbf{Loc}$ and every causally convex open cover $\mathcal{U} = \{U_i \subseteq M\}$, we define an orthogonal functor

$$j_{\mathcal{U}} : \overline{\mathbf{C}(\mathcal{U})} \longrightarrow \overline{\mathbf{C}(M)}.$$

Definition 1.3.3. As defined in [4, Definition 3.1] the 2-functor

$$HK : \mathbf{Loc}^{op} \to \mathbf{CAT}$$

assigns to each manifold M the category $HK(M) := AQFT(COpen(M))$.

This leads to

$$j_{\mathcal{U}!} : \mathcal{HK}^{\mathcal{C}}(\mathcal{U}) \to \mathcal{HK}^{\mathcal{C}}(M)$$

with

$$j_{\mathcal{U}!} \dashv j_{\mathcal{U}}^{*}.$$

[4, definition 4.3–proposition 4.4]

From [4, definition 4.17], an object A is in $\mathcal{HK}_C(M)$ if the A-component of the counit

$$(\epsilon_{\mathcal{U}})_A : j_{\mathcal{U}!} j_{\mathcal{U}}^{*}(A) \xrightarrow{\cong} A$$

is an isomorphism.

Define

$$\mathcal{HK}_C^{\dagger} : \mathbf{Loc} \to \mathbf{Pr}^L,$$

assigning to each $M \in \mathbf{Loc}$ the category $\mathcal{HK}_C(M)$ and to each morphism $f : M \to N$ the left adjoint $f_!$ (the operadic left Kan extension).

Let $\overline{\mathbf{C}(-)} : \mathbf{Loc} \to \mathbf{Cat}^{\perp}$ be a net domain. The improved Haag-Kastler-style pseudo-functor is defined as the adjoint

$$\mathcal{HK}_{\overline{\mathbf{C}}} := \mathcal{HK}_{\overline{\mathbf{C}}}^{\dagger\dagger} : \mathbf{Loc}^{\mathrm{op}} \longrightarrow \mathbf{Pr}^R.$$

[4, definition 4.30]

This functor is essentially surjective because it's a stack under [4, assumption 4.23], which we assume throughout the paper [4, theorem 4.25]. Definition 1.3.4. Let us consider two objects from the functor category

$$\mathfrak{L}_M, \mathfrak{R}_M \in \mathrm{Fun}(\mathbf{C}(M), \mathbf{T})$$

and two parallel morphisms

$$\tilde{r}_1^M, \tilde{r}_2^M : \mathfrak{R}_M \Rightarrow \mathrm{F}_M(\mathfrak{L}_M)$$

in $\mathrm{Fun}(\mathbf{C}(M), \mathbf{T})$.

We define the object

$$\mathfrak{A}_M := \mathrm{colim}_{\mathbf{Alg}} \left(\mathrm{F}_M(\mathfrak{R}_M) \overset{r_1^M}{\underset{r_2^M}{\rightrightarrows}} \mathrm{F}_M(\mathfrak{L}_M) \right) \in \mathrm{Fun}\left(\mathbf{C}(M), \mathbf{Alg}_{\mathrm{uAs}}(\mathbf{T})\right),$$

by taking the colimit (i.e. coequalizer) in $\mathrm{Fun}\left(\mathbf{C}(M), \mathbf{Alg}_{\mathrm{uAs}}(\mathbf{T})\right)$, where r_1^M, r_2^M denote the adjuncts of $\tilde{r}_1^M, \tilde{r}_2^M$ with respect to the free-forget adjunction $\mathrm{F}_M \dashv \mathrm{U}_M$.

We also have $\mathfrak{A}_M \in \mathrm{HK}_{\overline{\mathbf{C}}}(M)$.

Throughout this paper, this will be what we call an AQFT.

It is mentioned in the text between [4,definition 2.11] and [4, definition 2.12] that they do not use fully general form of stacks. However, that is a problem as all [15], [4], and [16] are using definitions of stacks that work but are all different. Hence, to unify, I will be using the definition of stacks and prestacks in full generality as the following.

Definition 1.3.5 [16, definition 5.5.4.1]. For an object o in an ∞-category C and S a collection of morphisms, o is S-local if for every morphism $s : X \to Y$ belonging to S, composition with s induces an isomorphism

$$\mathrm{Map}_C(Y, Z) \to \mathrm{Map}_C(X, Z)$$

in the homotopy category of spaces.

Definition 1.3.6. [16, Definition 6.2.2.6]

Let $\mathcal{C}$ be a (small) ∞-category equipped with a Grothendieck topology. Let S be the collection of all monomorphisms $U \to j(\mathcal{C})$ which correspond to covering sieves $e_{\mathcal{C}}^{(0)} \subseteq e_{j(\mathcal{C})}$.

An object $\mathcal{F} \in \mathcal{P}(\mathcal{C})$ is a sheaf if it is S-local. We let $\mathrm{Shv}(\mathcal{C})$ denote the full subcategory of $\mathcal{P}(\mathcal{C})$ spanned by S-local objects.

Theorem 1.3.7: The presheaf $\mathcal{E}^{fam}$ on the site of families of manifolds is a stack [15, Theorem 1.2].

Definition 1.3.8 [19, definition 1.1.3 and definition 1.1.14]. A deformation context is a pair $(\Upsilon, \{E_\alpha\}_{\alpha\in\Upsilon})$, where Υ is a presentable ∞-category and $\{E_\alpha\}_{\alpha\in\Upsilon}$ is a set of objects of the stabilization $\mathrm{Stab}(\Upsilon)$.

Let $(\Upsilon, \{E_\alpha\}_{\alpha\in\Upsilon})$ be a deformation context. A formal moduli problem is a functor

$$X : \Upsilon^{\mathrm{sm}} \to \mathcal{S}$$

satisfying the following pair of conditions:

(a) The space $X(*)$ is contractible (here $*$ denotes a final object of Υ).

(b) Let

$$A' \longrightarrow B'$$

$$\downarrow \quad \phi$$

$$A \longrightarrow B$$

be a diagram in Υ^{sm}. If this is a pullback diagram and ϕ is small, then $X(\sigma)$ is a pullback diagram in $\mathcal{S}$.

Note that formal moduli problems are sheaves because the pullback condition is equivalent to the descent condition.

Example 1.3.9 [19, definition 1.1.16]. Let $(\Gamma, \{E_\alpha\}_{\alpha\in T})$ be a deformation context, and let $A \in \Gamma$ be an object.

Let

$$\mathrm{Spec}(A) : \Gamma^{\mathrm{sm}} \to \mathcal{S}$$

be the functor corepresented by A, which is given on small objects of Γ by the formula

$$\mathrm{Spec}(A)(B) = \mathrm{Map}_\Gamma(A, B).$$

Then $\mathrm{Spec}(A)$ is a formal moduli problem.

1.4 preliminaries (causal fermion systems)

Definition 1.4.1: The spin inner product $\prec | . \succ_x$ is given by

$$\prec u, v \,|\, \succ_{x = -\langle u|xv\rangle_H}$$

(for all $u, v \in S_x := x(H) \subset H$; S_x is the spin space with H as defined in definition 1.4.3). [22]

Construction 1.4.2. Let (M, g) be a Lorentzian manifold. Let

$$\gamma : T_xM \to L(S_xM)$$

for spinor bundle (in spin geometry sense) S_xM with

$$\gamma(u)\gamma(v) + \gamma(v)\gamma(u) = 2g(u,v)\mathbb{1}_{S_xM}$$

being Clifford multiplication, then write it as Dirac matrices γ^j.

The Dirac operator D is defined by

$$D := i\gamma^j \nabla_j : C^\infty(M, SM) \to C^\infty(M, SM).$$

Given a real parameter $m \in \mathbb{R}$, the Dirac equation is

$$(D - m)\psi = 0.$$

On smooth sections with spatially compact support (i.e. wave functions whose restriction to any Cauchy surface is compact), one has

$$(\psi|\phi)_m = 2\pi \int_N \prec\!\psi \,|\, \gamma(\nu)\phi\!\succ_x d\mu_N(x),$$

where N is any Cauchy surface and ν its future-directed normal. As [23] cited, $\prec\!\psi \,|\, \gamma(\nu)\phi\!\succ_x$ is in the sense of [27] rather than definition 1.4.1. Form the completion to get the Hilbert space $(H_m, (.|.)_m)$. [23]

Definition 1.4.3. Given a separable complex Hilbert space H with scalar product $\langle.|.\rangle_H$ and a parameter $n \in \mathbb{N}$, we let $F \subset L(H)$ be the set of all self-adjoint operators on H of finite rank, which have at most n positive and at most n negative eigenvalues. F is called the local correlation operator. [22]

Definition 1.4.4a. Choose a closed subspace $H \subset H_m$. The induced scalar product on H is denoted by $\langle.|.\rangle_H$. There is the technical difficulty that the wave functions in H are in general not continuous, making it impossible to evaluate them pointwise. For this reason, we introduce an ultraviolet regularization on the length scale ε, described mathematically by a linear regularization operator

$$R_\varepsilon : H \to C^0(M, SM).$$

[23]

we Definition 1.4.4b. Evaluating the regularization operator at a spacetime point $x \in M$ gives the regularized wave evaluation operator $K_\varepsilon(x)$,

$$K_\varepsilon(x) = R_\varepsilon(x) : H \to S_x M.$$

We also take its adjoint (with respect to the Hilbert space scalar product $\langle .|. \rangle_H$),

$$(K_\varepsilon(x))^* : S_x M \to H.$$

Multiplying $\Psi_\varepsilon(x)$ by its adjoint gives the operator

$$F_\varepsilon(x) := -(K_\varepsilon(x))^* K_\varepsilon(x) : H \to H,$$

referred to as the local correlation operator at the spacetime point x.

Varying the spacetime point, we obtain a mapping

$$F_\varepsilon : M \to F \subset L(H),$$

where F denotes all symmetric operators of rank at most four with at most two positive and at most two negative eigenvalues. [23]

Definition 1.4.5: Given $x \in F^{\text{reg}}$ (a local correlation operator with the maximum possible rank called a regular local correlation operator) denote the image of x by $I := x(H)$.

Throughout section 1.4 starting from this definition, n^* will denote the adjoint of n with respect to the spin inner product for any n.

Consider I as a $2n$-dimensional Hilbert space with the scalar product induced from $\prec | . \succ_H$ and let J be its orthogonal complement for Hilbert space H. Take $H = I \oplus J$ then

$$L(H, I) = L(I, I) \oplus L(J, I).$$

Now define

$$R_x(\psi) := \psi^\dagger x \psi = \psi^* \psi$$

for an operator ψ in $L(H, I)$ and

$$R_x : L(I, I) \oplus L(J, I) \to F,$$

and the adjoint of ψ is denoted $\psi^\dagger$. [24, equation 3.2–3.7] Theorem 1.4.6. Define

$$R_x^{\text{symm}} := R_x|_{\text{Symm}(S_x)\oplus L(J,S_x)} : \text{Symm}(S_x) \oplus L(J, S_x) \to \mathcal{F}$$

where

$$\text{Symm}(S_x) := \{A \in \mathcal{L}(S_x) \mid A = A^*\}.$$

Then Ω_x is an open subset $R_x^{\text{symm}}(W_x)$ of F^{reg} for an open neighborhood W_x of $(0, \text{id}_{S_x}) \in \text{Symm}(S_x) \oplus L(J, S_x)$ and spin space S_x i.e. I equipped with $\prec|.\succ : S_x \times S_x \to \mathbb{C}$, a spin inner product in the sense of definition 1.4.1. [24, theorem 3.2]

Definition 1.4.7. Let

$$V_x := \text{Symm}(S_x) \oplus L(J, S_x) \quad \text{and} \quad X := x|_{S_x}.$$

Let $\pi_x y|_{S_y} : S_y \to S_x$ and

$$\phi_x(y) = \left(X^{-1}\pi_x y|_{S_x}\right)^{-\frac{1}{2}} X^{-1}\pi_x y.$$

Define the equivalence relation

$$(x, v, x') \sim (y, w, y')$$

iff $x = y$ and

$$\left(\phi'_x \circ (\phi'_y)^{-1}\right)' |_{\phi'_y(x)}\, w = v.$$

Now define the tangent bundle

$$TF^{\text{reg}} := \bigsqcup_{x' \in F^{\text{reg}}} \Omega_{x'} \times V_{x'} \times \{x'\}.$$

The canonical projection is given by

$$\pi : TF^{\text{reg}} \to F^{\text{reg}}, \quad \pi\left([x, \mathbf{v}, x']\right) = x.$$

For every $x \in F^{\text{reg}}$ the tangent space at x is defined by

$$T_x F^{\text{reg}} := \pi^{-1}(x).$$

[24]

Theorem 1.4.8.

Consider a smooth curve

$$\gamma : (-\delta, \delta) \to F^{\mathrm{reg}}, \quad \gamma(0) = x.$$

Let

$$\psi(\tau) := \phi_x \circ \gamma(\tau)$$

with

$$T_x^{\mathscr{S}} \mathcal{F}^{\mathrm{reg}} := \{-\psi^* \psi_0 - \psi_0^* \psi \mid \psi \in \mathrm{Symm}(S_x) \oplus L(J, I)\} \subseteq \mathscr{S}(H).$$

Here $\mathscr{S}(H)$ is the space of self-adjoint Hilbert-Schmidt operators on the Hilbert space.

Then

$$g_x : T_x^{\mathscr{S}} \mathcal{F}^{\mathrm{reg}} \times T_x^{\mathscr{S}} \mathcal{F}^{\mathrm{reg}} \to \mathbb{R}, \quad g_x(A, B) := \mathrm{tr}(AB)$$

defines a Fréchet-smooth Riemannian metric on F^{reg}. [24, theorem 3.12]

Definition 1.4.9. A flow on $\mathcal{F}$ is a smooth map

$$F : \mathcal{D} \to \mathcal{F}$$

that satisfies

$$F_0(x) = x$$

for all $x \in \mathcal{F}$ and

$$F_{\tau'}(F_\tau(x)) = F_{\tau' + \tau}(x)$$

for all $\tau \in \mathcal{D}_x$ and $\tau' \in \mathcal{D}_{F_\tau(x)}$. [40, pg 134–135]

$$\rho_\tau = (F_\tau)_* (f_\tau \rho)$$

for pushforward $(F_\tau)_*$. [40, equation 5.1]

Consider a function $b : F \to \mathbb{R}$ and a vector field v on F. Let $F_\tau := F(\tau, \cdot)$. ρ is a Borel measure on the local correlation operator $\mathcal{F}$ and

$$f : (-\delta, \delta) \times \mathcal{F} \to \mathbb{R}^+$$

is smooth.

$$F : (-\delta, \delta) \times \mathcal{F} \longrightarrow \mathcal{F}$$

is smooth as well. [40, pg 116]

2 basic setups

2.1 Making existing astrophysics things rigorous and foundational implications

This section makes stellar configurations and black hole light rings rigorous. It also introduces a new universe as a basic implication.

I will be formalising the statement "...a minimal deformation of the Polyakov approximation inside the central core is sufficient to produce regular ultracompact stellar configurations." as stated in [2]. This will be called the primary strpoly postulate and I will be showing its foundational nature in the next sections.

Firstly, given "...central core of radius $r_{\text{core}} \ll R$ around $r = 0$, with R being the radius of the star." [2], we can interpret it as the following.

Definition 2.1.1. Take a stellar configuration (ultracompact solution of the semiclassical Einstein field equation

$$G_{ab} = 8\pi \langle T_{ab} \rangle_\omega$$

for Hadamard state ω as in [3, equation 7.2]). Then, take an areal radius induced by the stellar configuration R. We define the stellar Polyakov core (strpoly core) as

$$\int := \{r \in (0, r_{\text{core}})\}$$

for some $r_{\text{core}} < R$.

Next, let's define stellar configurations which will be really central.

Definition 2.1.2. A stellar configuration is an ultracompact solution of the semiclassical Einstein field equation (see definition 2.1.8 for ultracompact).

Primary Stellar-Polyakov (Primary Strpoly) postulate: There exists some deformation h such that if h is applied to variables in the Polyakov approximation (because [2] proved it only for $F = 1/r^2$ from the Polyakov approximation, this will similarly be just a deformation $1/(r^2 + h)$ inside a strpoly core $\int$), there exists a stellar configuration.

We will use the postulate in later sections. Now, let me state this very obvious yet very deep theorem.

Theorem 2.1.3. The Dirac equation in construction 1.4.2 holds for a Lorentzian manifold (M, g_{uv}) where g_{uv} is a stellar configuration. We pick M such that M is maximally extended.

Proof: This is an obvious application of construction 1.4.2. _Indeed, this theorem has significant epistemological and ethics-of-experimental implications. Looking at the Dirac equation

$$(i\gamma^j \nabla_j - m)\psi = 0,$$

let's do some interpretation. Now, recall that γ^j maps T_xM to S_xM.

I argue that semiclassical stars, if measurable, must be a fermion-free boson star under classical logic and reasonable astronomy. Cause suppose for contradiction that there is a fermion on a boson star. Notice the fermion is part of S_xM as that's what the canonical physical interpretation of S_xM is. Then, predict reasonable astronomical events happen to change the fermion (e.g. collision) which we interpret as the subtraction of m to the change in (the ∇_j component) the map.

This is a reasonable interpretation indeed, subtracting from γ^j stuffs means reducing the value of the output in S_xM after we twist some interpretation first i.e. rather than interpreting m solely as the mass, we interpret it as any logical real parameter (i.e. any observables on the fermion). This is forced by standard interpretations of subtraction and this interpretation indeed makes more sense because the math is more general.

Note that even if we twist the interpretation, it would be logical that the Dirac equation still should be motivated because it's used to derive other important stuff in [22].

A stellar configuration which is as equipped in T_xM exists (because the stellar configuration is a metric tensor) as heavily dependant on the input i.e. the domain of γ^j being T_xM, then we subtract m caused by reasonable astronomical events (e.g. collision) and now, if we ever measure it, it would be interpreted as adding the ψ after (by the canonical interpretation of ψ) so, we get zero by Dirac equation.

Now, notice it's the entire map with the entire domain T_xM which disappears if it's changed and m is subtracted when we measure. This is catastrophic, take the vectors from T_xM, then map it to fermions and we're done, the operator from vectors(such as the 4-momentum) to fermions is zero by the same interpretation of the Dirac equation.

This is obviously problematic for our survival if our 4-momentum vector maps to what we're made out of (i.e. fermions) in this way. Hence, if measurable, it should be a fermion-free star like I said which works for the majority of ethics.

Definition 2.1.4a. Let $K_\varepsilon(x)$, F_ε, and $F_\varepsilon(x)$ be in the sense of definition 1.4.4 but derived from the Hilbert space induced by theorem 2.1.3 in the sense of construction 1.4.2.

Then K_ε is called the saviour while $F_\varepsilon(x)$ is called the saviour point, and F_ε is called the saved point universe.

Let me show how to have some physical interpretation of this. Recall the Hilbert space scalar product

$$(\psi|\phi)_m = 2\pi \int_N \prec\!\psi \,|\, \gamma(\nu)\phi\!\succ_x d\mu_N(x)$$

used.

Now, we see ψ as the wavefunction "alone" in the right hand side and as the wavefunction is interpreted as measurement, that would be interpreted as measurement of nothing. This is a forced interpretation if we accept the canonical interpretation that it's the measurement of whatever it comes with. It's logical to interpret nothing here as level 5 nothing in the sense of [28] as we can't stay without laws of physics if we're studying physics. Interpret

$$2\pi \int_N \prec\!\psi \,|\, \gamma(\nu)\phi\!\succ_x d\mu_N(x)$$

as summing up everything that destroys us completely i.e. $\prec\!\psi \,|\, \gamma(\nu)\phi\!\succ_x$ is the destroyer. To explain why, it makes sense to first have an intuition on $\gamma(v)\phi$ as "measuring γ stuffs in the future" which is vague but works. Then, notice, the only way it's logical that measuring γ and measuring nothing coincides is when the star isn't fermion free which is as explained before. To explain why this coincides, (1) i will explain why bosons can't be such, (2) i will explain why they must be fermions. For (1), assume for contradiction the disappearance can also be when the star has bosons on it. Then, both fermions and bosons would not exist, giving an empty universe. But wait, that's a trivial case with no physical source to study so, that works under the philosophy that it shouldn't be trivial. Hence, it must be associated with fermions solely. For (2), fermions don't practically exist at all because of majority ethics again, and under the philosophy that we can study them experimentally so, it coincides with nothingness. So this coincides with what I said before i.e. being a semiclassical star with a fermion because it's the only way to pair up with nothing, hence, that's the interpretation of the integrand.

Next, recall

$$F_\varepsilon(x) := -(K_\varepsilon(x))^* K_\varepsilon(x) : H \to H.$$

We interpret this as an hourglass because of the following diagram.

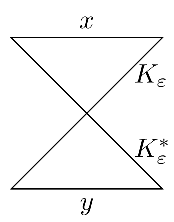

Fig. 1

Now, I argue this is the right diagram representing the relation

$$\boxed{\langle y, K_\varepsilon x\rangle = \langle K_\varepsilon^* y, x\rangle \quad \forall x \in \mathcal{D}(T),\ y \in \mathcal{D}(K_\varepsilon^*)}$$

Next and most importantly, the intersection between line of x and line of y symbolize the composition

$$(K_\varepsilon(x))^* K_\varepsilon(x) : H \to H \propto F_\varepsilon(x)$$

because it's composition in the sense that one of the lines crosses first (corresponds to applying a map), then the other line crosses.

Since it's a point, we call it the saviour point.

Now recall

$$F_\varepsilon : M \to L(H).$$

We interpret this as a universe (it's logical to call this a universe as quantum stuffs and spacetime working (represented by H and M) together signifies laws of a universe) emerging from or at least being associated to the point because of its perceived association with $F_\varepsilon(x)$.

Definition 2.1.4b. Let R_x^{symm} and g_x be as in theorem 1.4.6 and theorem 1.4.8 but instead of deriving them from a general F^{reg}, derive them from the saviour point universe F_ε.

Then R_x^{symm} shall be called the attractive glass and g_x shall be called the valuing saved universe map.

Definition 2.1.5: Define the category of saviour point universe stuff (SPUS) where objects are subsets of F_ε, and morphisms are isometric embeddings between M and (N, TN).

M and N are finite dimensional Riemannian submanifolds of F_ε equipped with valuing saved point universes, and TN denotes the tangent bundle of N.

Now define

$$M = (a, b] \times \mathfrak{V} \times H[E]^\ell$$

that's also a submanifold where $(a, b] \subset \mathbb{R}$, $\mathfrak{V} \subseteq \mathrm{clos}(V) \subset E$, and

$$H[E]^\ell = (\mathbb{R} \times E)^\ell$$

where E is Hausdorff locally convex.

All are defined such that $(a, b] \times \mathfrak{V} \times H[E]^\ell$ is open. Next, I argue to interpret Hausdorff locally convex vector spaces as matter. Recall that a locally convex topological vector space is convex, balanced, and absorbing. Matter should be convex since convexity is seen as a line and we can connect any two distant particles to form a line. Matter is balanced by conservation principles. And matter absorbs as you can merge matter with other matter to form a larger matter. Lastly, matter is Hausdorff because interpreting each point as particles, you can think of two different sets containing two different particles. So, M will be just "matter stuff" since it's built with Hausdorff locally convex vector spaces.

From [11, pg 10], we note that mass, spin, and observer's inclination affect the shape of the photon sphere (i.e. the circlipse from [11, equation 5]). Next, we note from [11, figure 1] that the diameter d_ϕ is in units of microarcseconds (μas) so, it's in angular units.

Notice from [11, pg 6–7] that angular coordinates relate to screen coordinates in a way that's proportional to M. Concluding from that, we say the radii in the paper are real functions f_1, f_2, f_3 of spin and observer's inclination, and are proportional to M.

Easily, reformulate spin and mass as objects in the algebras of observable O_1, O_2, the camera's orientation as the proper orthochronous Lorentz group $SO^+(1,3)$, and observer's inclination as a vector in the tangent bundle of the state space v.

Definition 2.1.6: For some functions f_1, f_2, f_3, a circlipse of a polar coordinate angle ϕ is a weakly geodesically convex curve C such that

$$d_\phi(C) = f_1(O_1, v) + \sqrt{f_2(O_1, v)^2 \cos^2(\phi - \theta) + f_3(O_1, v)^2 \sin^2(\phi - \theta)}$$

where θ represents an element of $SO^+(1,3)$.

The functions $f_3(O_1, v), f_2(O_1, v), f_1(O_1, v)$ are proportional to O_2. d_ϕ is a convex set that is also a function which we interpret as the diameter.

Definition 2.1.7: A black hole light ring is a circlipse such that the union of all the diameters of it contains an event horizon.

Definition 2.1.8: A solution to the semiclassical Einstein field equation is called ultracompact if it has a light ring.

2.2 Random setups for section 3

This section introduce symmetries, corporeal universe, and deformation AQFTs which will be used in section 3.

Remark 2.2.1. As cited in [6, remark 6.10], notice the category of C* algebras $CAlg$ is locally presentable so, it is an object of Pr^R.

Definition 2.2.2: Let $CAlg$ be the category of C* algebras, Alg_σ be the category of infinitary algebras, and Law be Lawvere theories.

Define the category $Clones\_KillAlg$ as the comma category of the product

$$Alg_\sigma \times Law \times CAlg \downarrow (\mathcal{C} \times \mathcal{L} \times \mathcal{A})$$

in the sense of [7, definition 0.3] where $\mathcal{C}$ are all objects of $CAlg$, $\mathcal{A}$ all objects of Alg_σ, and $\mathcal{L}$ all objects of Law.

Construction 2.2.3: Quantum killing lie derivatives can be embedded into a locally presentable category constructed via definition 2.2.2.

Proof: Notice smooth maps form a clone C_n^m via polynomials and chain rule. Then, by [9, prop 3.4, proof], we get a Lawvere theory $L_{CL(n,m)}$.

For a Lawvere theory L, the category $Lex(L, Set)$ is locally presentable (take the evaluation functor at 1,

$$ev_1 : Lex(L, Set) \to Set, \quad M \mapsto M(1)$$

and a left adjoint

$$F : Set \to Lex(L, Set)$$

by

$$F(X)(n) := X^n.$$

It's easy to check $F \dashv ev_1$ is monadic via Beck's monadicity theorem and there is a standard result that it follows $Lex(L, Set)$ is equivalent to Set^A.

It follows from Gabriel-Ulmer duality that L is locally presentable and hence, we successfully embedded smooth maps (which include local flows and their isomorphisms).

Recall a quantum killing lie derivative from the preliminaries,

$$\delta_Z(f) = \lim_{t \to 0} \frac{1}{t} \left(\pi_t^Z(f) - f \right).$$

We have already embedded the π_t^Z, rest are easy to embed to locally presentable categories (operations as comma category with the infinitary algebras (it preserves local presentability by [7, prop 1.57]), f as C* algebras) leaving us with definition 2.2.2 (notice product categories and comma categories preserve local presentability from [7]). ____1. Law is defined based on an identity on objects. Since symmetries involve staying invariant and identity make things stay invariant, this makes sense. Additionally, its choice of finite products preserving property is interpreted as products to expand to get more symmetries.

2. Symmetries are usually defined as invariant under some properties and algebras are similarly often defined to be closed (i.e. invariant) under given properties so, infinitary algebras make sense.

3. The comma category is just defined so that the symmetries start mapping to each other.

Lastly, the C^*-algebra category there is just an AQFT constraint on symmetries. It still make sense because every C^*-algebra has an approximate identity which works just like the identity for many cases that we care about, and hence, still supports the invariant property of symmetries.

The construction is relative to this interpretation.

Definition 2.2.4. A corporeal universe is the set $g_{uv} \cup \omega$ for all $\omega \in Alg$ for the category of algebras of observables Alg such that if $\omega \in Alg$ then ω exists if g_{uv} exists.

Though a corporeal universe looks simple mathematically, it has huge physical motivation. It is a hypothetical universe. In fact, it might even have significant experimental relevance that I suggest phenomenalogists explore this area with a more concrete definition of it being just the space of only stars. It is definitely gripping to consider what happens when we live in a universe with only stars and nothing else, what we can do in it experimentally is interesting though we can't really test yet. Though what was intended was just stars, it's physically reasonable that if we have stars in a universe then we can perform our measurements of the observables. It is corporeal in the sense that there's just concrete stars (and observables that are forced to exist if stars do), no other objects hence the name. See section 3.2 for further exploration of this universe. The construction is relative to this interpretation again.

Definition 2.2.5 define the category of deformation $AQFTs$ as $dfAQFT$ where objects are $m \in Loc \times Alg$, and functors are $f(m)$ for a real functor f.

3 core of the theory

3.1 A new way of renormalization, and its implications

We often regularize divergences by adding a renormalization factor h to the denominator. However, this misses what we can see when we don't wanna add but multiply. Here the following is very helpful if we wanna do that.

Define $K \neq 0$ such that for all $r \geq 0$, and h in a strpoly core, we have $rK = (r + h)K$. This section uses K to renormalize and derive related deformation theoric things.

The main motivation of this is to introduce a new way of perturbative renormalization where we don't add an h but just time it by K to get similar results. Additionally, it's intuitive to see how timing with something, just like adding something, increases the value to "shift" it from the singularity and hence should work just like it. This can be used for a lot of heuristic results.

Open problem 3.1.1: Since I only work with [2], it feels likely there might be such similar cases throughout the work of phenomenonlogists where there's only the case of adding being explored so the multiplicative version is left which I leave for whoever is interested to explore. This new philosophy of allowing multiplying to renormalize rather than solely adding open a lot of new spaces.

Definition 3.1.2: a radial coordinate r is called self if $r = rK$.

The reason I used to name it self is it's self in the sense that it works by timing K with it so, in some sense, it take out K to make itself. Since it leads to a perturbation $(r + h)K$, it's named analogous to [5] where we get self forces from perturbations.

Looking back at the Polyakov approximations (informal definition 1.2.1), you can see it's easy to put ψF together by elementary algebraic manipulations. Recall ψ is defined as the radial derivative of the gravitational redshift function $\sqrt{g_{ttA}/g_{ttB}}$ in static spacetime. If it's constant giving a derivative of zero then we're done regularizing. Else, applying the quotient rule for derivatives, we get $\sqrt{g_{ttB}}^2$ on the denominator and it's timed with F i.e. timed with r^2 on the denominator. From here it's easy to see below follows under the philosophy of multiplying to renormalize (as it'll be well defined, use the same argument as in [2]).

Secondary Strpoly postulate: A deformation $K\sqrt{g_{ttB}} = \sqrt{g_{ttB}}$ is there iff stellar configurations exist.

It's easy to see that typical perturbative renormalization wouldn't work through elementary algebraic manipulations.

For Secondary Strpoly postulate, the philosophy used to derive it i.e. multiplicative renormalization is really just a perturbative renormalization extended for multiplication.

Corollary 3.1.3: h is added to r, or K is timed with g_{uv} or H for Hamiltonian H iff stellar configurations exist (equivalently, we may replace H with t for time since the Hamiltonian generates it).

Proof: This follows directly by recalling g_{tt} can be broken down into time t and g_{uv} then applying Secondary Strpoly postulate plus Primary Strpoly postulate. ______________We notice [19, page 5] talks about formal moduli problems relating to "gluing" which may be interpreted as formal moduli problems being sheaves.

Definition 3.1.4: Let Γ be a locally presentable category such that r, (H or time evolution t), and g_{uv} are subsets of Γ. Let $(\Gamma, \{E_\alpha\}_{\alpha \in T})$ be a deformation context. The notation $\text{Spec}(A)$ will be just as in definition 1.3.9. Take $K \in \Gamma$ such that r, (H or time evolution t), and g_{uv} are subsets of K, the formal moduli problem $\text{Spec}(K)$ is called a stelloppoaqft.

Stelloppoaqft is a word that's shorthand for "stellar opponents of AQFTs" which makes sense if you read section 3.2.

Note that because formal moduli problems deform, this is just deformations of r, H, and g_{uv} but now sheaves.

3.2 Further analysis of what's in the saved point universe and stelloppoaqfts

This subsection extensively relates stelloppoaqfts to AQFTs, and finds less noticeable properties related to the saved point universe.

Open problem 3.2.1. Throughout section 1.3, we act as if fermions and bosons are completely distant. However, the theory is much deeper when we consider their interconnectedness. Clearly, it's highly plausible from our results that semiclassical stars are fermion-free boson stars because otherwise, we won't be able to detect them without starting a new universe, and it's useful to focus on the case where we can detect them. However, the thing is, semiclassical stars are just the same stars we see fermions on except that they're described by a different (i.e. semiclassical) theory which contradict the result that they're fermion-free. So, this suggests that the fermions we see might be acting like bosons in "disguise" and this goes to the philosophy of their duality. Since [41, pg 22] suggested discussion on the meaningfulness of distinguishing fermions and bosons, this supports the philosophy that it's not indeed meaningful (because fermions are some kinds of boson in "disguise"(i.e. fermions become bosons when the theory is upgraded)) otherwise, we can't detect without issues. This leaves an open problem on developing the part of this theory where the fermions are not meaningfully distinguished from bosons. Additionally, we assumed particles are either bosons or fermions so, there left a case where that's not true extending it via [26]

Definition 3.2.2. A match in the colosseum between AQFTs and stelloppoaqfts (which I combine to mcolossaqfts-mcolosstelloppo) is the set of AQFTs (an AQFT in the sense of definition 1.3.4) and stelloppoaqfts in the corporeal universe.

Definition 3.2.3. A mcolossaqfts-mcolosstelloppo is said to be in the antechamber (of the colleseum) if the law of explosion does not hold (paraconsistent logic) and it is said to be in the mcolossaqfts-mcolosstelloppo battle arena if the law of explosion does hold.

The contradiction can be heuristically viewed as "fighting" hence the names.

Informal statement 3.2.4 (informal shapeshifter attack postulate). AQFTs and stelloppoaqfts are similar in interaction in some way if we drop the local to global condition for stelloppoaqfts.

This is argued because for AQFTs (I mentioned in section 1.3 what we mean by AQFT throughout this paper, I strongly request the reader to read it first if not done yet), there is spacetime and observables (focus on it being part of $HK_{\overline{C}}$) as the domain and the codomain. We will restrict back to it being just the first statement of corollary 3.1.3 applied as this is what's meant by dropping the local to global condition (i.e. it's no longer a stelloppoaqft) and it is more concrete. g_{uv} and r should correspond to Loc (as they're also part of spacetime) for AQFTs, and H which is an observable should correspond to Alg in AQFT. Physically speaking, when we do an experiment and look at our math, we solely wanna take the observables (as they're the only thing we can measure so, should be the main relevance for experiments) so, all observables are treated the same in that sense of solely checking if they're observables for necessity and to check if our rules of spacetime follows, we just see if it's in spacetime mainly so, all spacetime are treated in that sense. This is forced under the "simplified for experiment" philosophy. So we can conclude AQFTs and stelloppoaqfts are the same in that conditions of checking spacetime plus experiments practicality. The statement is mathematically ill defined but we will get to formalizing it shortly after in physical postulate 3.2.7. Also, just in case the argument for the statement looks to make sense but weaker, I got another argument for their similarity. For the AQFT, inside the coequalizer, there is free unital algebras i.e. algebras with no relations. Hence, it's logical to interpret the colimit as interacting with the algebras with no relations. Now I argue the stelloppoaqfts with local to global stuff dropped similarly interact with no relations. Firstly, look at H in Alg, it's just too uninteresting to have any relations because there's only one variable. Second, the relationship between the metric tensor and radial coordinate r is mainly through the spherically symmetric case, and as argued in [32] through texts such as "There are two ways that one might interpret the epistemological significance of this: on the one hand, we might say that symmetries are associated with unavoidable redundancy in our descriptions of the world, while on the other hand we might maintain that symmetries indicate a limitation of our epistemic access - there are certain properties of objects, such as their absolute positions, that are not observable" suggesting symmetries reflect epistemological limit rather than reality so, the relationship between g_{uv} and r can be negligible under the philosophy that values reality hence another major similarity. The story is that when stelloppoaqfts aren't local to global to form a formal moduli problem, they "become friends with" AQFT i.e. commute under composition but however, when they both get local to global, they become "jealous" of each other and start attacking. Aside from that attack, here's another attack they do before I make the statement rigorous.

Physical postulate 3.2.5 (Landmine Style Attack postulate). $\nexists\,\mathrm{Spec}(n)$ for stelloppoaqfts $\mathrm{Spec}(n)$ iff $\nexists\,\mathbb{A}$ for AQFT $\mathbb{A}$ in a battle arena of mcolossaqfts-mcolosstelloppo. Outside a mcolossaqfts-mcolosstelloppo, one direction of the statement still hold i.e. stelloppoaqfts don't exist without AQFTs.

If $\mathrm{Spec}(n)$ doesn't exist, by corollary 3.1.3, stars don't exist and since there're no stars and hence no algebra of observables (the universe will become empty as the only thing existing are gone, there's nothing left for observables) which make having an AQFT impossible. Conversely, there's nothing to quantize if there's no AQFT and since the stars are described at a quantum level, they can't exist. It's a creepy style attack in the sense that $\mathrm{Spec}(n)$ makes itself "explode" stopping to exist just like a landmine just to "attack" the AQFT stopping it to exist too.

So, we will be focusing on formalizing what we mean by dropping the local to global condition of Spec(n).

Definition 3.2.6a. A broken cuber is a chain

$$Alg \xrightarrow{f_1} Loc \xrightarrow{g_1} df AQFT$$

or a chain

$$Loc \xrightarrow{f_2} Alg \xrightarrow{g_2} df AQFT \ .$$

Fig. 2

Note this is just the same intuition of deforming g_{uv}, r, and H placed in their respective category, hence stelloppoaqfts with local to global intuition dropped. It is called a broken cuber metaphorically because like a cuber deforming a cube, it deforms and the cube is broken in the sense that it has no local to global property.

Assumption 3.2.6b. I assume

$$g_2 \circ f_2 = g_1 \circ f_1 := g \circ f.$$

This is because it doesn't matter which way it comes in, we only care if it's a broken cuber for this specific case and either ways of having it deformed works.

Proposition 3.2.6c. The first part of corollary 3.1.3 (i.e. h is added to r, or K is timed with g_{uv} or H) holding implies having applied $g \circ f$ as in definition 3.2.6a.

Proof: This is obvious, we have the objects exactly as in corollary 3.1.3 and then them being deformed exactly like there in definition 3.2.6a. ___Now we're ready for our old attack formalised.

Physical postulate 3.2.7 (shapeshifter attack postulate): The following diagram commutes.

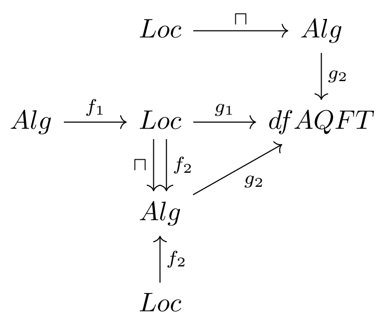

Fig. 3

Where $\sqcap$ is an AQFT. This is really just informal postulate 3.2.4 but now rigorous. The whole diagram can be seen as both $\sqcap$ and the broken cubers stuff reaching $df AQFT$ is the same which represents their similarity in interaction.

Proposition 3.2.8a. Let X, E, F be Hausdorff locally convex vector spaces. For $k \in \mathbb{N} \cup \{\infty\}$ and $U \subseteq E$ non-empty open, let $C^k(U, F)$ denote the set of all k-times continuously differentiable maps $U \to F$. $V \subseteq E$ is non-empty open, and $\mathfrak{V} \subseteq E$ is contained in the closure of V in E with $V \subseteq \mathfrak{V}$. $H[E]^\ell$ is $(\mathbb{R} \times E)^\ell$ as in definition 2.1.5. Let

$$M = (a, b] \times \mathfrak{V} \times (\mathbb{R} \times E)^\ell.$$

Define a C^k map $\psi_m : U \subset M \to (-\infty, 0] \times X$ as $m = \psi_m^{-1}(t, z)$. Notice we need to extend ψ_m^1 to $\widetilde{\psi_m^1} : \mathbb{R} \times X \to U$ with an open domain because of properties of C^k maps according to definitions in [20]. Take a valuing saved point universe g in the domain of a functor in SPUS, define

$$d\psi_{(t,z)}^{-1} := D_m \widetilde{\psi}_m^{-1}(t, z)$$

where D_m denotes the directional derivative.

Let

$$Y_1 := u \in \mathbb{R} \times X, \quad Y_2 := v \in \mathbb{R} \times X,$$

$$\Phi(x)(Y_1, Y_2) := g_{\psi^{-1}(x)}\big(d\psi_x^{-1} Y_1, d\psi_x^{-1} Y_2\big),$$

where g is a valuing saved point universe that is in M.

Recall the functors from definition 2.1.5, let ϕ be such a functor with domain M. Let $-\infty \leq a < \tau < b < \infty$ be fixed. Define

$$\mathcal{C}^k_{\mathfrak{U}}(U, F) := \big\{ f \in C^k(U, F) \mid \text{for each } \ell = 0, 1, \ldots, k,\ \mathrm{d}^\ell f \text{ extends to a continuous map } \operatorname{Ext}(f, \ell) : \mathfrak{U} \times H^\ell \to F \big\},$$

where $\mathrm{d}^\ell f$ denotes the ℓ-th Bastiani differential of f.

Then:

(1) $(a, b] \times \mathfrak{V} \times H[E]^\ell$ is diffeomorphic to a subset of the tangent bundle of a Riemannian manifold.

(2) Define

$$\mathcal{C}^k_{\mathfrak{V}}((a, b) \times V, F) := \mathcal{C}^k_{(a,b] \times \mathfrak{V}}((a, b) \times V, F).$$

There exist linear (extension) maps

$$\mathcal{E}_{a,\tau,b}(E, V, \mathfrak{V}) : \mathcal{C}^k_{\mathfrak{V}}((a, b) \times V, F) \to \mathcal{C}^k_{\mathfrak{V}}((a, \infty) \times V, F)$$

such that the restriction

$$\mathrm{Ext}(\mathcal{E}_{a,\tau,b}(E,V,\mathfrak{V})(\Phi),\ell)\restriction(a,b]\times\mathfrak{V}\times H[E]^{\ell}=\mathrm{Ext}(\Phi,\ell).$$

Proof: Check ($T_mM \cong \mathbb{R}\times X$) via the fact (which is easy to verify through the direct definition of diffeomorphism) that ($d\psi_m$) is an isomorphism, and given the fact that ($\psi^{-1}\big((-\infty,0]\times\mathfrak{V}\big)\subset M$), we conclude the first claim of the proposition. Now we verify that (Φ) here is (f) as in [33, Theorem 1] (i.e. ($\Phi\in\mathcal{C}^k_{(a,b]\times\mathfrak{V}}((a,b)\times V,F)$)), which proves the remaining parts of this proposition by [33, Theorem 1]. Since (ψ^{-1}) is (C^k) up to ($t=0$), ($d\psi^{-1}$) is (C^{k-1}) up to ($t=0$). (Φ) is continuous in (x) (since (g) and (ψ^{-1}) are continuous), and bilinear in ((Y_1,Y_2)) for fixed (x) (because ($g_{\psi^{-1}(x)}$) is bilinear). Thus, by [33, Lemma 2], it is bounded, hence continuous. Define [$\Psi(t,z)=\big(\psi^{-1}(t,z),d\psi^{-1}*(t,z),d\psi^{-1}*(t,z)\big),$] and [$B\big(\psi^{-1}(t,z),d\psi^{-1}*(t,z),d\psi^{-1}*(t,z)\big)(u,v):=g_m\big(d\psi^{-1}*(t,z)u,d\psi^{-1}*(t,z)v\big)$.] Note that ($\Phi(t,z)=B(\Psi(t,z))$). ($\Psi$) is ($C^{k-1}$) because ($d\psi^{-.1}$) is ($C^{k-1}$) and ($\psi^{-1}$) is ($C^k$).

It is easy to see that (B) is (C^k). We conclude the proof by applying the chain rule, which implies that the composition ($B(\Psi(t,z))$) is (C^k) [33, Corollary 1]. _Given the relation between the tangent bundle of a Riemannian manifold and (M), we conclude that (M) is similar to some codomain (N) of the functor of a SPUS. Thus, both the domain and codomain in the functors of Proposition 2.1.5 are similar to subsets of ((N,TN)), and it is logical to interpret (N) as spacetime, as it is what we associate with the whole universe. The functors of Definition 2.1.5 are interpreted as functors between regions of spacetime and their velocities together (since tangent bundles are usually interpreted as velocities) involving matter. Hence, unlike our Lorentzian universe, the saved point universe is Riemannian. I interpret (ψ) as a map from some matter to negative values related to matter, because ($(-\infty,0)$) consists of negative values. Thus, (ϕ) is interpreted as giving values to matter stuff. .

Conjecture 3.2.8b. Both $\mathcal{E}_{a,\tau,b}(E,V,\mathfrak{V})$ and $\mathrm{Ext}(\Phi,\ell)$ are linear differential operators.

Notice that Φ is basically defined with matter stuff (i.e. ψ-stuff) giving values to matter via the valuing saved point universe. Recall

$$\mathcal{C}^k_{\mathfrak{U}}(U,F):=\big\{f\in C^k(U,F)\mid \text{for each } \ell=0,1,2,\ldots,k,$$
$$\mathrm{d}^{\ell}f \text{ extends to a continuous map } \mathrm{Ext}(f,\ell):\mathfrak{U}\times H^{\ell}\to F\big\}.$$

Now, since for $\mathcal{C}^k_{(a,b]\times\mathfrak{V}}((a,b)\times V,F)$, the corresponding $\mathrm{Ext}(\Phi,\ell)$ has domain $(a,b]\times\mathfrak{V}\times H^{\ell}$ we interpret it as matter stuffs still. This is because

1.the codomain is coherent with matter as it just comes fromΦwhich is matter 2.The domain is coherent with matter as well. It contains changes in matter i.e.$d^e ll\Phi$and it's made out of matter as$\mathfrak{V}$ and $H^e ll$are defined from Hausdorff locally convex vector spaces.

Alternative interpretations break the simplicity of the logic that matter comes from matter. Now the linear property of $\mathrm{Ext}(\Phi, \ell)$follows from its deep interpretation remaining to be matter and that's physically equivalent to another thing that's also interpreted as matter i.e. the stress energy tensor. Because expectation value are linear, the expectation value of the stress energy tensor is linear and since that's physically equivalent to $\mathrm{Ext}(\Phi, \ell)$, it follows that it's linear as well. Now, the stress energy tensor in other sense is also matter which is physically equivalent to $\mathcal{E}_{a,\tau,b}(E, V, \mathfrak{V})$which can be interpreted as matter for similar reasons to$\mathrm{Ext}(\Phi, \ell)$. Because the stress energy tensor is defined as functional derivative of relative Cauchy evolution, the stress energy tensor is differential and hence, because $\mathcal{E}_{a,\tau,b}(E, V, \mathfrak{V})$is also physically equivalent, it should be differential as well.

Corollary 3.2.9.

$$\begin{aligned}
&\mathrm{Ext}(\mathcal{E}_{a,\tau,b}(E, V, \mathfrak{V})(\Phi), \ell) \restriction_{(a,b]\times\mathfrak{V}\times H[E]^\ell} \\
&\quad= \mathrm{Ext}(\mathcal{E}_{a,\tau,b}(E, V, \mathfrak{V})(\Phi) \restriction_{(a,b]\times\mathfrak{V}\times H[E]^\ell}, \ell) \restriction_{(a,b]\times\mathfrak{V}\times H[E]^\ell} \\
&\quad= \mathrm{Ext}(\Phi, \ell) \\
&\quad= \mathrm{Ext}(\mathcal{E}_{a,\tau,b}(E, V, \mathfrak{V})(\Psi), \ell) \restriction_{(a,b]\times\mathfrak{V}\times H[E]^\ell} \\
&\quad= \mathrm{Ext}(\Psi, \ell).
\end{aligned}$$

$$\Psi(x)(Y_1, Y_2) := w_{\psi^{-1}(x)}\big(d\psi_x^{-1}Y_1, d\psi_x^{-1}Y_2\big),$$

for the metric tensor w of the codomain of a SPUS.

Proof: Note that these are linear differential operators by Conjecture 3.2.8. The equality

$$\mathrm{Ext}(\mathcal{E}_{a,\tau,b}(E, V, \mathfrak{V})(\Phi), \ell) \restriction_{(a,b]\times\mathfrak{V}\times H[E]^\ell} = \mathrm{Ext}(\mathcal{E}_{a,\tau,b}(E, V, \mathfrak{V})(\Phi) \restriction_{(a,b]\times\mathfrak{V}\times H[E]^\ell}, \ell) \restriction_{(a,b]\times\mathfrak{V}\times H[E]^\ell}$$

holds because of Peetre's theorem on linear differential operators. Since $(a, b] \times \mathfrak{V} \times H[E]^\ell$ is an open set, for any $x_0 \in (a, b] \times \mathfrak{V} \times H[E]^\ell$, there exists a neighborhood of x_0 entirely contained within $(a, b] \times \mathfrak{V} \times H[E]^\ell$. Because differentiation is a local operation—meaning the derivative $\partial^\alpha\Phi$ at x_0 depends only on the values of Φ in an arbitrarily small neighborhood of x_0—the derivative of the restriction is identical to the derivative of the original function at that point.

Next,

$$\mathrm{Ext}(\mathcal{E}_{a,\tau,b}(E,V,\mathfrak{V})(\Phi)\restriction_{(a,b]\times\mathfrak{V}\times H[E]^\ell},\ell)\restriction_{(a,b]\times\mathfrak{V}\times H[E]^\ell}=\mathrm{Ext}(\Phi,\ell)=\mathrm{Ext}(\mathcal{E}_{a,\tau,b}(E,V,\mathfrak{V})(\Psi),\ell)\restriction_{(a,b]\times\mathfrak{V}\times H[E]^\ell} \tag{1}$$

holds because of Proposition 3.2.8, and because the restriction coincides with pullback through the functor of a SPUS. Since the functor is an isometric embedding, the pullback equals Ψ. Lastly, $\mathrm{Ext}(\Phi,\ell) = \mathrm{Ext}(\mathcal{E}_{a,\tau,b}(E,V,\mathfrak{V})(\Psi),\ell)\restriction_{(a,b]\times\mathfrak{V}\times H[E]^\ell}= \mathrm{Ext}(\Psi,\ell)$ holds by [33, Theorem 1]. Interpreting the corollary, $\mathrm{Ext}(\Phi,\ell) = \mathrm{Ext}(\Psi,\ell)$ suggests that valuing saved point universes applied to matter are the same when extended, giving huge insights about functors of a SPUS.

Open Problem 3.2.10. Even though we use formal moduli problems throughout this paper, [45, page 13] suggests that they are insufficient for AQFT philosophy, and since we want to apply AQFT philosophy, it would be good if anyone could generalize them.

3.3 interesting specific cases

The first specific case will be the case where among what is deformed within corollary 3.1.3, the thing deformed is the time or Hamiltonian. In theorem 3.3.1, I provide the relation between the stress energy tensor and the time/Hamiltonian to suggest the relation to matter when time is changed. However, even though that's the mathematical motivation, the physical motivation will be quite different and even deeper than it.

Theorem 3.3.1. Define such that $T(t)$ and $T(s)$ are classical time-evolution maps on the real symplectic space of solutions, and t, s are reals. Take a real linear map $K : S \to \mathcal{H}$ where $\mathcal{H}$ is a Hilbert space and S the space of smooth, real solutions to the Klein–Gordon equation with compact support on a Cauchy surface and ϕ_1, ϕ_2 elements of S (context: algebraic quantum field theory). $\langle ., .\rangle$ denotes the complex Hilbert space inner product and A the two point function. Take metric

$$\epsilon = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}.$$

For

$$T_{\lambda\lambda} = T_{uv}(\lambda, y)\frac{dx^u}{d\lambda}\frac{dx^v}{d\lambda},$$

and polar coordinates Ω and λ where γ is the plane the modular Hamiltonian is associated with, the following hold

$$\langle K\phi_1, e^{-i(t-s)h}K\phi_2\rangle\left(\mathbb{I} - e^{-2\pi\int d\Omega\int_0^{\gamma(\Omega)} d\lambda\,\lambda^{d-1}\frac{\gamma(\Omega)-\lambda}{\gamma(\Omega)}T_{\lambda\lambda}}\right)\big(T(t)\phi_1, T(s)\phi_2\big) = (i\epsilon).$$

Proof: Check

$$A(\phi_1, \phi_2) = (\text{symmetric}) + \tfrac{i}{2} a'(\phi_1, \phi_2) = \mathrm{Re}\langle K\phi_1, K\phi_2\rangle + i\,\mathrm{Im}\langle K\phi_1, K\phi_2\rangle = \langle K\phi_1, K\phi_2\rangle$$

from [12, proposition 3.1], and [12, equation 3.25]. Now, substitute [12, eqs. (3.41)–(3.43)] and recall the relation between time and Hamiltonian to get

$$A\big(T(t)\phi_1, T(s)\phi_2\big) = \big\langle K(T(t)\phi_1), K(T(s)\phi_2)\big\rangle = \big\langle U(t)K\phi_1, U(s)K\phi_2\big\rangle$$

$$= \big\langle K\phi_1, U(t)^* U(s) K\phi_2\big\rangle = \big\langle K\phi_1, e^{-i(t-s)h} K\phi_2\big\rangle.$$

Then, isolate the two point function

$$A = (i\epsilon)\left(\mathbb{I} - e^{-\mathbb{K}}\right)^{-1}$$

from [29, equation 2.62]. Then, substitute the modular Hamiltonian $\mathbb{K}$ from [30, equation 3.26] giving us

$$\langle K\phi_1, e^{-i(t-s)h} K\phi_2\rangle = (i\epsilon)\left(\mathbb{I} - e^{-2\pi \int d\Omega \int_0^{\gamma(\Omega)} d\lambda\, \lambda^{d-1} \frac{\gamma(\Omega)-\lambda}{\gamma(\Omega)} T_{\lambda\lambda}}\right)^{-1} \big(T(t)\phi_1, T(s)\phi_2\big).$$

Now the theorem follows from simply moving a component to the other side. Time for interpretation of the theorem. First, notice that similar to stuff we define back in section 2.1, polar coordinates λ, Ω together can be interpreted as an hourglass. This is because for an hourglass, we visualise

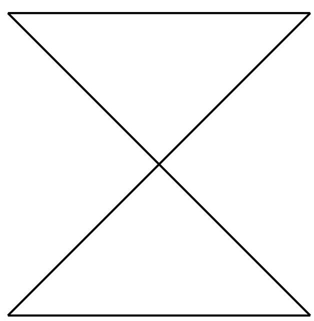

Fig. 4

Let's say the top side is the radial coordinate of Ω. The angle between the top side and upper right is the angle of Ω. The upper right and the lower left together represent the overall of Ω. Similarly, for the reflection, the bottom side is interpreted as the radial coordinate of λ while lower right and upper left are interpreted as the overall λ. An hourglass specifically keeps them symmetric suggesting how they go together. The factor

$$-2\pi \int d\Omega \int_0^{\gamma(\Omega)} d\lambda\, \lambda^{d-1} \frac{\gamma(\Omega)-\lambda}{\gamma(\Omega)} T_{\lambda\lambda}$$

suggests matter and the polar coordinates together in an expression of integral so, it's interpreted as summing up polar coordinates and matter. Now, applying it to $\big(T(t)\phi_1, T(s)\phi_2\big)$ is interpreted as applying to particles moving in time which is standard. Next, interpret $\langle K\phi_1, e^{-i(t-s)h}K\phi_2\rangle$ as the Hilbert space of particles and time. Putting them all together,

$$\langle K\phi_1, e^{-i(t-s)h}K\phi_2\rangle \left(\mathbb{I} - e^{-2\pi \int d\Omega \int_0^{\gamma(\Omega)} d\lambda\, \lambda^{d-1} \frac{\gamma(\Omega)-\lambda}{\gamma(\Omega)} T_{\lambda\lambda}} \right) \big(T(t)\phi_1, T(s)\phi_2\big)$$

is Hilbert space together with an hourglass of fermions. The hourglass exactly specifies all the ambiguity forcing the interpretation to be that if ϕ_1, ϕ_2 were fermions rather than bosons, the saved point universe would start (because of the association with fermions and hourglass for a new universe). This interpretation is forced if we wanna connect this equation to our hourglass multiverse theory. Moving in time suggests it happens in some of the time. This strongly supports eternalism as if it were fermions, the new universe surely is there happening in either future or past (it can go back in past as by the interpretation of negative sign part of oriented area). Because of the other hand side, it's interpreted that $(i\epsilon)$ is the stuff causing all these making sure bosons exist there and not starting a saved point universe.

The next specific case we will be exploring will be the case of black hole light rings as in definition 2.1.7 and the specific formulations of stelloppoaqfts. We define a black hole light ring to exist. We recall that a circlipse is a weakly geodesically convex C such that

$$d_\phi(C) = f_1(O_1, v) + \sqrt{f_2(O_1, v)^2 \cos^2(\phi - \theta) + f_3(O_1, v)^2 \sin^2(\phi - \theta)}.$$

Now, $\sin^2(\phi - \theta)$, and $\cos^2(\phi - \theta)$ are interpreted as leaving a choice for ϕ to depend on while $f_2(O_1, v)^2, f_3(O_1, v)^2$ are interpreted as leaving a choice for O_1 to depend on canonically. So, together, they can be visualised as a diagram of a quadrant where v goes in one direction while ϕ in the other direction. Now, I construct a quadrant by picking matter for a type of O_1 (it makes more sense because matter is the one being intended first in the original pre-formalized paper for O_2 i.e. in [11] and O_2 is related to the stuff here) and picking levels of nothing to go for ϕ. To describe the diagram, there will be "typical matter" i.e. general relativity stress energy tensor stuffs in the first top of the quadrant while in the second top of the quadrant, there is "extra stuffs from renormalized stress energy tensor" which are stuffs like quantum fluctuations. Basically, the top first quadrant will be interpreted as physical sources, and working within the suggested philosophy of [35, Pg 3] where everything (not literal everything) emerges from quantum fluctuations, the top second quadrant will be interpreted as potential for physical sources since it's associated with quantum fluctuations. So, as the quadrants increase in the right direction, it becomes more foundational. Next, the bottom quadrants will be interpreted as pulling down the corresponding quadrants to higher levels of nothingness so, as the quadrants increase in downward direction, the level of nothingness gets higher. We got a symmetry since a quadrant is symmetric. This quadrant is obviously interesting because it seperates what exists and what comes first hierarchically. I argue that this interpretation is forced because physical sources are really central to the theory and $(f_3(O_1, v)^2, f_2(O_1, v)^2)$ can be interpreted as physical sources as physical sources are observables. Next, $(\cos^2(\phi - \theta), \sin^2(\phi - \theta)$ must be interpreted as nothingness because nothingness will exist for us to deal complicating its study further even if we don't interpret that way and additionally, we may interpret subtracting θ from the angle as subtracting everything needed leaving nothing because of the major association between angles and transformations. Now, to generalize this quadrant, and make it more precise, let's give a relevant example of a stelloppoaqft.

Theorem 3.3.2. Let $OAlg$ be the category of unital (non self-adjoint) operator algebras with unital completely contractive maps as morphisms. Let z be a non-completely-contractive algebra. Let Z be any algebraic combination under multiplication and exponents of z such that Z is contained inside the union of all circlipse. Define $g(Z) = z$ for all z, Z. Let L_n be the operator as in [36, Pg 4]. Take L_n of $ISPP_u$ (the operator of taking isomorphic copies I, the operator of taking subalgebras S, the operator of taking direct products P, and the operator of taking ultraproducts P_u) of the set $\mathcal{Y}(A, \mathcal{Z})$ and denote it K_1 where A denotes a subset of the algebras of observables and $\mathcal{Z}$ denotes a subset of Z such that we define $z \in \eta \in K_1$ implies $z \in K_1$ for all η.

Within the conventions of [31, page 667], an Abelian A-group is any Abelian group G in which A embeds. Define the abelian Q-group of the real numbers equipped with multiplication and addition $(\mathbb{R}, +, \times)$ where Q is the rationals equipped with multiplication and addition. Then take $ISPP_u$ of $(\mathbb{R}, +, \times)$ denoting it K_2. The product category $OAlg \times K_1 \times K_2 \times Law$ is locally presentable, and for some $A \in OAlg \times K_1 \times K_2 \times Law$, spec$(A)$ is a stelloppoaqft. Law denote Lawvere theories.

Proof: Note that quasivarieties are locally presentable from [7] and note that $ISPP_u$ of the stuffs here make up a quasivariety from [37] so, K_1, K_2 are locally presentable because the operator L_n of a quasivariety is a quasivariety from a main result in [36]. The local presentability of $OAlg$ follows from a main theorem in [21] so, $OAlg \times K_1 \times K_2 \times Law$ is locally presentable since Law is locally presentable as argued in construction 2.2.3. It's easy to verify time evolution is a morphism in $OAlg$

from basic algebraic properties of it. Recall that $L_n(\mathcal{M})$ is the class of all algebras G such that:

$$\text{For every } n\text{-generated subalgebra } A \text{ of } G\text{, the congruence class } a/\theta_A \quad (a \in A)$$

is an algebra belonging to $\mathcal{M}$. Pick G and A with $(\mathcal{Z}, z) \subseteq A$. So, $(\mathcal{Z}, z) \in \theta_A$, and hence, z/θ_A is an algebra belonging to $ISPP_u(A, Z)$. It follows $z \in A \subseteq G \in K_1$ so, $z \in G \in K_1$ hence, by our definition, $z \in K_1$ for all z.

Let $U(t) = e^{itH}$ be the relationship between the Hamiltonian and the unitary group. Notice $\{e^{itH} \mid t \in \mathbb{R}\} \in Z$ for real $\mathbb{R}$ because e, i, t are complex numbers and it's argued to be in the union of all circlipses because recall that $U(t)$ is a geodesic from [38]. It's weakly geodesically convex because take small enough t_1, t_2 and define a curve

$$\gamma(s) = e^{i((1-s)t_1+st_2)H}, \quad s \in [0,1],$$

this geodesic lies entirely in it and connects it to it. Because t_1, t_2 are small, the minimality of the geodesic is satisfied. Now simply define d_ϕ such that $d_\phi(\{e^{itH} \mid t \in \mathbb{R}\})$ make $\{e^{itH} \mid t \in \mathbb{R}\}$ a circlipse. So, $g(\{e^{itH} \mid t \in \mathbb{R}\}) = H$ and it's easy to verify that H is a type of z from this. Hence, $H \in K_1$. Obviously, K_2 contains the radial coordinate because the radial coordinate is real. Using the same argument as in construction 2.2.3, *Law* contains smooth maps so, it contains g_{uv}. Since $OAlg \times K_1 \times K_2$ contains r, H, g_{uv}, and time evolution, the proposition follows. ―――――I argue that the interpretation fits the picture of the quadrant in a more generalized way and this supports properties of a black hole. For laws, since it's part of CloneskillAlg, it supports some symmetries so it generalizes the symmetry of the quadrant. For Oalg, its identity (since unital) further supports the symmetry and the inequality in definition of its completely contractive map is interpreted as when objects near black holes spaghettify, stretching, hence, one becomes longer. It generalizes to stretching beyond spaghettification (e.g. stretching of time i.e. time dilation, photons stretching in wave frequency). Next, a coordinate group is defined in [31, pg 668] and [31, theorem 1.36] suggests the elements of$ISPP_u$ of$(R, +,)$(i.e. the smallest quasivariety containing $(R, +,))$ are coordinate groups. So, interpreting coordinate groups in relation to coordinates which feels standard, becomes more related to the quadrant since there are coordinates on the quadrant in the sense that we move in directions to change stuff just like in coordinates. That's the justification for K_2, for K_1, the$L_n$operator is seen as simply adding H into$K_1$and I propose a hypothetical astrophysical object interpreted by z. Since$z$is not completely contractive i.e. $z$is not stretched, the hypothetical object will be defined as not being affected by stretching properties of black holes.Next, the following are examples of reasons we include some stuffs contained in algebras of observables when forming a quasivariety forK_1: (1)to account for matter associated with the black hole such as hawking radiation which are observables. (2)to account for possible z that are observables. (3)to account for observables associated with quasinormal modes [39]. The isomorphisms in$ISPP_u$are canonically interpreted to account for similar stuffs while products and ultraproducts are interpreted as ways it's made sure we can't detect z. An example of how products and ultraproducts work that way would be when a type of z exists but there is also another type of z distant from the first type with a property such that it blocks all the ways we can detect it so, when interacted via products or ultraproducts, the properties get merged and hence we can't detect the first z as well. Since K_1 is interpreted near black hole, the property $z \in /eta \in K_1$ implies$z \in K_1$is interpreted as a property that if η is in K_1, because $z \in \eta$ is still in the black hole and K_1 is about being near black hole, stuffs $z \in \eta$ will still be near black hole, and hence, it will be inK_1. The interpretation is relative to the construction.

Proposition 3.3.3. Define a new limit operations(notice that this is different from standard notation of calculus limits and this is an entirely new operation as defined despite same notation) where $\lim a \to b \quad O = \mathfrak{D}$ is given as for all $d \in \mathfrak{D}$, with the same notations in definition 1.4.9, $\rho_\tau = (F_\tau)_*(f_\tau \rho)$ is computed for the exponent$F_\tau = F_\tau^d$ and $O \in \rho$ implies d is isomorphic to$a$, and $a \subset f(b)$ where f denotes the set of algebraic combinations under addition and multiplication such that elements are at least an element of b and an element of the algebras of observables. Then, letΦ be the nullity element as in [42]. Let$\emptyset$be the empty set. Let HK be the improved Haag Kasler style 2-functor and let $x/\cong$ be the isomorphism class in the domain of HK of all x such that x is isomorphic to $CloneskillAlg$. Let $\mathcal{E}^f am$be as in theorem 1.3.8. Let $(i\epsilon)$ be as in theorem 3.3.1. Let$k$ be the coordinate group i.e. an element of$ISPP_u$of $(R, +,)$. Then,

(1)$x/\cong$ is nonempty. (2)In classical logic, we can't define the existence of $D := \lim [\![\lim HK \restriction x/\cong \to i\epsilon]\!] \to (\Phi, k) \quad i\epsilon$because of contradictions (3)In classical logic, we can't define the existence of$L := \lim [\![\lim \mathcal{E}^{fam} \to (\emptyset, k) \quad i\epsilon]\!] \to (\Phi, k) \quad i\epsilon$ because of contradictions.

Proof: (1) follows because the codomain of HK contains locally presentable categories and $CloneskillAlg$is locally presentable so, by essential surjectivity of the improved Haag Kasler style 2 functor, there exists such an x. (2) and (3) follows because$f(b)$ here is the nullity elements by axioms defined in [42, section 2.1] for both cases and a (i.e. $HK \restriction x/\cong$for (2) and $\mathcal{E}^f am$ for (3)) can't be in the nullity element obviously without contradictions. ———Because of this contradiction, it's nesscessy to work in paraconsistent logic because the thing I constructed must exist for the physical theory to make sense. Let's interpret the limit operation. Though not the same, the intuition is similar to analysis limits. $a \subset f(b)$ is interpreted as "a is close to b" because it's close in the sense that $f$is associated with observables and observables are concrete stuffs (so, close to us), and we can do a lot with observables physically which indicates intimacy and the way$f$is constructed indicates a gets together with b algebraically together with observables. Next, it's canonical that the flow is interpreted as how much the measure is moved from definition since these are about dynamics so, computing$F_\tau = F_\tau^d$ is interpreted as adding $d$amount of force and Oin ρ implies$O$ is being the object that's moved. Since this implies d isomorphic to$a$, it's interpreted that it pulls as motion to make sure d is close as a is close.

physical postulate 3.3.4. This postulate is formulated under paraconsistent logic, so we can define $L$and$D$. Let $\sqcap$ be an AQFT. Then, there is an adjunction between the multiplication $\sqcap \times CloneskillAlg$ and a functor with domain as the direct product $\mathfrak{f} : L \otimes D \to Alg$. One may reduce $\sqcap \times CloneskillAlg$to $\Delta^i t_W \times CloneskillAlg$for modular unitary group $\Delta^i t_W$ associated with a wedge W under the assumptions of [43, theorem 2.3].

The map $\mathfrak{f}$ fixes the problem that the improved Haag Kasler style 2-functor looks too detached from AQFT philosophy because it doesn't map to Alg by incorporating it in a map with codomain Alg.

We pick $i\epsilon$for both$b$ in D and Lbecause (think of the relation between this and the adjunction) by theorem 3.3.1, it represents matter being controlled not to start a universe which we interpret as physical source relevant to the multiverse theory as other configurations, if applied may start a new universe. It approaching $(\emptyset, k)$then again approaching (Φ, k) is interpreted as just like our described quadrant, it can go down because interpreting $\emptyset$as nothing is standard and Φmay be interpreted as a higher level of nothing because of its "absorbing" axioms. Because nothingness may go beyond mathematics/physics, it absorbs in the sense that getting with it takes stuff out of mathematics/physics as well. Adding k makes it more visualisable as the quadrant because of its coordinate nature. For D and L,note that they're both stacks (as a in this case are stacks and a is isomorphic to d i.e. it with motion) first after the motion is applied which is our first similarity and argument for adjunction as the AQFT is argued to have descent condition as [4, pg 46] suggested that was the goal and [4, pg 47] proved it. So, $L$and Dtogether make up symmetries (as suggested by$HK \restriction x/\cong$) and spacetime stuffs (extended by$\mathcal{E}^{fam}$) and mapping it to Alg make its intuition sound exactly like an AQFT with symmetries suggesting the adjunction. What I'm saying is they're meant to be the same objects described in different theories (with only theory based differences like the addition of quadrants and matter controlling$i\epsilon$). The reduction to $\Delta^i t_W$because [43, theorem 2.3] links it to what's canonically interpreted as symmetries. This is the postulate that links our theory to existing physics. Open problem 3.3.5. The corporeal universe, despite being interesting, is understudied(so, i recommend studying) in this paper especially in the antechamber. I find the antechamber especially interesting because physical postulate 3.2.5 doesn't hold so, we can see the physical implications when stelloppoaqfts don't exist for AQFTs and vice versa. Additionally, it would be useful to see a version of physical postulate 3.3.4 in the antechamber as it's already paraconsistent so, it makes it sound suited for the antechamber.

4 conclusion and discussion

The result that stars exist iff certain objects exist has been made rigorous and extended via the new introduced philosophy of multiplicative renormalization. There is a discussion left on comparing this to traditional perturbative renormalization: which one is more fundamental sheerly? Is it standard perturbative renormalization because the multiplicative renormalization is defined via addition, or is it the multiplicative renormalization because it can do what standard renormalization can't do which might replace it? Additionally, it's left open to apply this to other parts of phenomenology work which might give insights to the question. We also give a much more general version of symmetries i.e. $CloneskillAlg$, and it is useful due to its local presentability. A corporeal universe with only stellar configurations is introduced and I mentioned it is understudied so, there is a whole pack of philosophies to be developed there. It is found that detecting semiclassical stars is ethically and epistemologically problematic unless they have no fermions on them so, this leaves a debate on whether to risk detecting them, and it's been found even if everything collapsed due to wrong detection, a new universe can start fixing it back but it hasn't been clear whether the new universe is just as good as ours. Next, stelloppoaqfts(i.e. what must exist if stars do) and AQFTs are "attacking" eachother through making one disappear if inside a battle in the colleseum or if stelloppoaqfts don't get the local to global merit, through mimicing one another too. There's an ethical question on whether to let them attack as that's their nature, or try to avoid such colleseum and unfair merit. There left nesscessity to explore the case where fermions are just disguising to be bosons for more perspectives on the theory. It's found that $i\epsilon$ is what's keeping us to not start the saved point universe which leaves discussion on power status of such a simple construction. It's additionally found that the metric of functors of SPUS are the same when applied to certain things after extension which gives insights on simplicity of the saved point universe unlike ours. A quadrant is constructed where the further you go right, the more foundational it gets and the further you go down, the more it becomes empty. This is suggested by the case of black hole light rings and generalized by a case of a stelloppoaqft.This asks: what is the best position on the quadrant? Lastly, it's postulated where as objects with symmetries in this theory work with the theory's quadrant i.e. go downward in the quadrant, it's adjacent to symmetries and AQFT together.

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Declarations

Ethical Approval

Not applicable. This research does not involve human participants or animals.

Competing Interests

The author declares a close friendship with Chips from the acknowledgement section and an ex close friendship (used to be a friendship when their contributions were made) with Mia Theint Thu from the acknowledgement section.

Author Contributions

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References

[1] J. Arrechea, C. Barceló, R. Carballo-Rubio, L.J. Garay, Phys. Rev. D 104, 084071 (2021)

[2] J. Arrechea, C. Barceló, R. Carballo-Rubio, L.J. Garay, Sci. Rep. 12, 15958 (2022)

[3] L.E. Labuschagne, W.A. Majewski, A von Neumann algebraic approach to Quantum Theory on curved spacetime, arXiv:2503.14107 [math-ph]

[4] M. Benini, A. Grant-Stuart, A. Schenkel, Haag-Kastler stacks, arXiv:2404.14510 [math-ph]

[5] S. Detweiler, B.F. Whiting, Phys. Rev. D 67, 024025 (2003)

[6] I. Di Liberti, J. Rosický, Theory Appl. Categ. 38, 17 (2022)

[7] J. Adámek, J. Rosický, Locally Presentable and Accessible Categories (Cambridge University Press, Cambridge, 1994)

[8] nLab, “Clones,” https://ncatlab.org/nlab/show/clones (accessed 27 Sept 2025)

[9] M. Behrisch, S. Kerkhoff, J. Power, Electron. Notes Theor. Comput. Sci. 286, 5 (2012)

[10] V. Cardoso, A. Lemos, M. Marques, A.S. Miranda, E. Berti, Phys. Rev. D 90, 044069 (2014)

[11] S.E. Gralla, A. Lupsasca, D.P. Marrone, Phys. Rev. D 102, 124004 (2020)

[12] B.S. Kay, R.M. Wald, Ann. Phys. (N.Y.) 207, 49 (1991)

[13] P.V.P. Cunha, C.A.R. Herdeiro, Gen. Relativ. Gravit. 50, 42 (2018)

[14] A. Schwarz, J. Math. Phys. 51, 015201 (2010)

[15] K.İ. Berktav, Turk. J. Math. 48, 673 (2024)

[16] J. Lurie, Higher Topos Theory (Princeton University Press, Princeton, 2009)

[17] nLab, "(∞,1)-sheaves," https://ncatlab.org/nlab/show/$(\infty, 1) - sheaves(ncatlab.orginBing)(accessed 3 Nov 2025)$

[18] nLab, "(infinity,1)-presheaf," https://ncatlab.org/nlab/show/(infinity,1)-presheaf-presheaf) (accessed 4 Nov 2025)

[19] J. Lurie, Derived Algebraic Geometry X: Formal Moduli Problems, unpublished manuscript, Harvard University (5 Nov 2011)

[20] H.H. Keller, Differential Calculus in Locally Convex Spaces, Lecture Notes in Mathematics, Vol. 417 (Springer, Berlin, 1974)

[21] A. Chirvasitu and I. Thompson, "Local presentability and monadicity of forgetful functors for operator algebraic categories," arXiv:2507.23152 [math.CT], 2025.

[22] F. Finster, The Continuum Limit of Causal Fermion Systems, Fundamental Theories of Physics, Vol. 186 (Springer, Cham, 2016)

[23] F. Finster, "Causal Fermion Systems: Classical Gravity and Beyond," in The Sixteenth Marcel Grossmann Meeting, ed. R. Ruffini, G. Vereshchagin (World Scientific, Singapore, 2023), pp. 661–678

[24] F. Finster, M. Lottner, Ann. Glob. Anal. Geom. 60, 313 (2021)

[25] P. Jetzer, Phys. Rep. 220, 163 (1992)

[26] nLab authors: Parastatistics. Available at: https://ncatlab.org/nlab/show/parastatistics (accessed 23 February 2026).

[27] H. Baum, Bull. Pol. Acad. Sci. Math. 33, 165 (1985)

[28] R.L. Kuhn, Skeptic 18, 34 (2013)

[29] M.B. Fröb, Relating the modular Hamiltonian to two-point functions, arXiv:2501.09669 [math-ph]

[30] H. Casini, E. Testé, G. Torroba, Modular Hamiltonians on the null plane and the Markov property of the vacuum state, J. Phys. A: Math. Theor. 50, 364001 (2017). https://doi.org/10.1088/1751-8121/aa7eaa

[31] E. Yu. Daniyarova, A. A. Mishchenko, V. N. Remeslennikov, and A. V. Treier, "On Algebraic-Geometric and Universal Theories of Abelian Groups," J. Math. Sci. 262, 660–690 (2022).

[32] Brading, K., Castellani, E. (eds.): Symmetries in Physics: Philosophical Reflections. Cambridge University Press, Cambridge (2003). https://doi.org/10.1017/CBO9780511535253

[33] M. Hanusch, Can. J. Math. 75, 170 (2023)

[34] nLab authors: Paraconsistent logic. In: nLab. https://ncatlab.org/nlab/show/paraconsistent+logic (accessed Feb 13, 2026)

[35] Baumann, D., Green, D., Joyce, A., Pajer, E., Pimentel, G.L., Sleight, C., Taronna, M. (2022). Snowmass White Paper: The Cosmological Bootstrap. arXiv preprint arXiv:2203.08121.

[36] Budkin, A.I.: The operator $\mathrm{L}_n onquasivarietiesofuniversalalgebras.SiberianMathematicalJournal60, 565\breve{}571(201$

[37] G. Grätzer and H. Lakser, "A note on the implicational class generated by a class of structures," *Can. Math. Bull.* **16**, (1973), 603–605.

[38] Durán, C.E., Mata-Lorenzo, L.E., Recht, L. (2003). Metric geometry in homogeneous spaces of the unitary group of a C-algebra. Part I. Minimal curves. Advances in Mathematics, 184*(2), 342–366.

[39] Chung, A. K. W., Quasinormal mode frequencies and gravitational-wave observables, Phys. Rev. D 110, 064019 (2024)

[40] Kleiner, J.: Dynamics of Causal Fermion Systems. Dissertation, University of Regensburg (2017).

[41] De Haro, S., Cinti, E.: Dualities in Physics. Cambridge University Press, Cambridge (2026). https://doi.org/10.1017/9781009203845. Preprint available at arXiv:2509.15866

[42] Anderson, J.A.D.W., Völker, N., Adams, A.A.: Perspex Machine VIII: Axioms of Transreal Arithmetic. In: Latecki, L.J., Mount, D.M., Wu, A.Y. (eds.) Vision Geometry XV. Proceedings of SPIE, vol. 6499, pp. 64990J. Society of Photo-Optical Instrumentation Engineers (SPIE), Bellingham (2007). https://doi.org/10.1117/12.698153

[43] Brunetti, R., Guido, D., Longo, R.: Group Cohomology, Modular Theory and Space-Time Symmetries. Rev. Math. Phys. 7(1), 57–71 (1995). https://doi.org/10.1142/S0129055X95000050

[44] Dappiaggi, C., Finster, F., Oppio, M.: Linear bosonic quantum field theories arising from causal variational principles. Lett. Math. Phys. 112, 38 (2022). https://doi.org/10.1007/s11005-022-01534-1

[45] Benini, M., Schenkel, A.: Operads, homotopy theory and higher categories in algebraic quantum field theory. Encyclopedia of Mathematical Physics, 2nd edn. arXiv:2305.03372 [math-ph] (2023). https://doi.org/10.48550/arXiv.2305.03372