the weak correspondence principle

a new intertheory relation in physics based on Rosaler's empirical reduction

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Outline

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brief intro

what do I do

- I'm fascinated by the idea of a world with repulsive gravity
- repulsive gravity is incompatible with modern interaction theories
- I work on new physics consistent with repulsive gravity
- experiments at CERN to (dis-)prove repulsive gravity resume 11/'21

why

if repulsive gravity exists, **then** there is a very simple foundational theory for physics that applies to all basic interactions: the EPT[a]

[a] M.J.T.F. Cabbolet, *Ann. Phys.* **522**, 699-738 (2010); **523**, 990-994 (2011), **528**, 626-627 (2016)

big open question

does the EPT **correspond** to what we know about basic interactions?

the strong correspondence principle

accepted view on 'correspondence to existing knowledge'

a new theory corresponds to existing knowledge about interactions **if and only if** it corresponds to modern interaction theories

the correspondence principle renamed

- what physicists call 'correspondence', I call 'strong correspondence'
- a new theory T **corresponds strongly** to an earlier theory T' *if and only if* T reduces formally to T'

definition

a new theory T **reduces formally** to an existing T' *if and only if* T' emerges from T by applying some limiting procedure.[a]

[a] Joshua Rosaler, *Topoi* **34**, 325–338 (2015)

the strong correspondence principle

strong correspondence in a pseudo-mathematical "equation"

$$\lim_{\alpha \to 0} T = T' \qquad \text{for a parameter } \alpha \text{ of } T \tag{1}$$

or

$$\lim_{\beta \to \infty} T = T' \qquad \text{for a parameter } \beta \text{ of } T \tag{2}$$

important

whether or not a new theory T corresponds strongly to an existing theory T' can be established **purely** from the mathematical formulation of T and the mathematical formulation of T'

the strong correspondence principle

accepted view on correspondence in a widely accepted Sollsatz

every new theory in physics **must** satisfy the strong correspondence principle, i.e. **must** correspond strongly to the modern interaction theories

consequence

this Sollsatz puts an enormous constraint on foundational research:

- QED is a set of computational rules formalized in QFT
- QFT must emerge from any new theory postulated to underlie QED
- one is then practically forced to start with QFT

the problem

the EPT is an abstract physical theory determined by

1. a mathematical foundation T for the EPT with language $\mathcal{L}(T)$
   - e.g. ZF
2. the **language** $\mathcal{L}(EPT)$ of the EPT:
   - $\mathcal{L}(EPT)$ is $\mathcal{L}(T)$ extended with constants and relations
3. the **axioms** of the EPT:
   - formal axioms for the constants and relations
   - process-physical axioms
4. the **inference rules** of the EPT:

$$\Sigma_{EPT} \vdash_T \Psi \tag{3}$$

5. the **interpretation rules** of the EPT
   - give physical meaning to constants and relations of the EPT

the problem

abstractness of the EPT

1. let ZF be the mathematical foundation for the EPT
2. let Φ be an abstract constant that refers to a material object
3. Φ satisfies the formal axiom $\exists\alpha : \alpha = \Phi$
4. then mathematically, Φ is a set whose elements are not specified
5. **it must be clear from the typography to which object Φ refers**

example

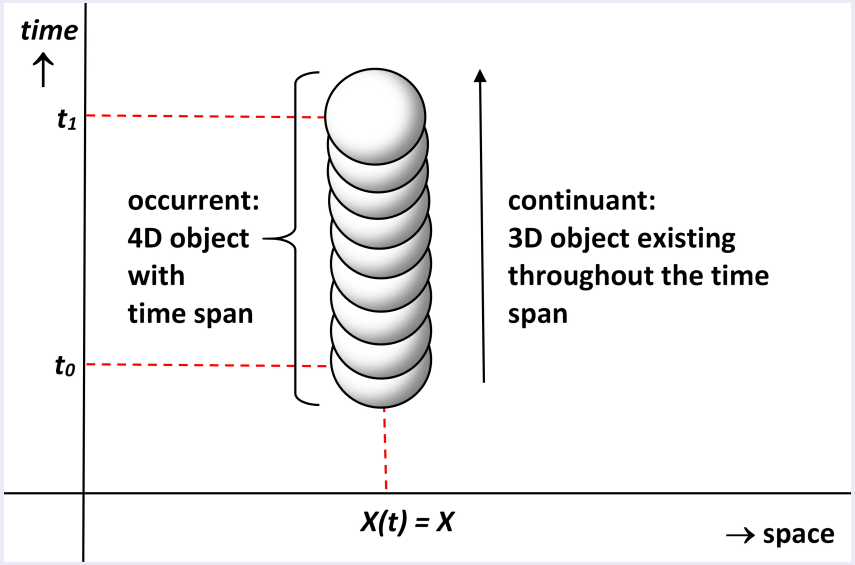
- the abstract constant ${}^{EP}\varphi_{24}^{15}$ refers to *the extended particlelike phase quantum created at the* 15^{th} *degree of evolution in the* 24^{th} *process from the* 15^{th} *to the* 16^{th} *degree of evolution*
- it looks cumbersome, but mathematically ${}^{EP}\varphi_{24}^{15}$ is **just a set**

the problem

what can you do at that degree of abstractness

$\mathcal{L}(EPT)$ is suitable for the description of elementary processes:

1. abstract constants refer to **occurrents** instead of **continuants**



2. axioms can describe a generic elementary process:
   - $\mathbb{E}\Phi_0$
   - $\Phi_0 \rightarrow \Phi_i$
   - $\Phi_i : \Phi_0 \rightarrow \Phi^*$

   etc: a process in terms of discrete transitions between occurrents

the problem

why the EPT cannot ever satisfy the SCP

- physical objects are referred to by **abstract constants** of the EPT
- there is no limiting procedure that can be applied to the EPT: the abstract constants are not functions of parameters α or β

$$\lim_{\alpha \to 0} \mathrm{EPT}$$

$$\lim_{\beta \to \infty} \mathrm{EPT}$$

- the EPT **cannot possibly** correspond to existing knowledge about interactions in the sense of strong correspondence

solution

definition

a **set-theoretic model** of the EPT is a structure for the EPT specified in a language $\mathcal{L}(M)$ with interpretation function $I : \mathcal{L}(EPT) \rightarrow \mathcal{L}(M)$, such that

1. every abstract constant $\Phi \in U_{EPT}$ is interpreted as a concrete constant $I(\Phi)$ in the universe $|M|$ of individuals of M;
2. every n-ary relation R of the EPT is interpreted as an n-ary relation $I(R)$ on $|M|$ such that

$$\langle \Phi_1, \ldots, \Phi_n \rangle \in R \Leftrightarrow \langle I(\Phi_1), \ldots, I(\Phi_n) \rangle \in I(R) \tag{4}$$

3. for each of the seven axioms $A^1_{EPT}, \ldots, A^7_{EPT}$ of the EPT, its interpretation $I(A^j_{EPT})$ is true in M:

$$M \models I(A^j_{EPT}) \tag{5}$$

solution

so ...

- the interpretation $I(\Phi)$ of abstract constants referring to occurrents translates to **states of massive systems** in the RF of an observer
- a model of the EPT translates to **a model of an elementary process in the temporal evolution of a massive system**, in which the system interacts with its environment
- predictions of the model can be tested experimentally

solution

definition

a **categorical model of the EPT** is a (small) category $\mathscr{C}$ such that

1. the objects of $\mathscr{C}$ are set-theoretic models M of the EPT;
2. the arrows of $\mathscr{C}$ are structure isomorphisms $T : M \to M'$.

general idea

- a model M is a model of the EPT in a RF of one observer;
- a structure isomorphism corresponds to a coordinate transformation;
- intra-model predictions are derived from a single model M
- inter-model predictions are derived from two models M, M'

solution

empirical reduction

a theory T **reduces empirically** to a theory T' *if and only if* T reproduces the empirically successful predictions of T'.[a]

[a] Joshua Rosaler, *Topoi* **34**, 325–338 (2015)

weak correspondence principle

the EPT **corresponds weakly** to a modern interaction theory T' *if and only if* the EPT has a categorical model $\mathscr{C}$ that reduces empirically to T'

solution

important

- observations on systems are reproduced by intra-model predictions
- relativity is reproduced by inter-model predictions
- no need to reproduce the mathematical structure of modern physics
- one only needs to reproduce the successful predictions

unifying scheme

The EPT is a **unifying scheme** if and only if the EPT corresponds weakly to both GR and QED. The EPT is a **grand unifying scheme** (GUS) if and only if the EPT corresponds weakly to GR, QED, QCD, and EW.

conclusions

1. there is nothing wrong with developing a theory that is intended to correspond strongly to theories of modern physics
2. there **is** something wrong with the Sollsatz that every new theory must correspond strongly to theories of modern physics
3. to prove that the EPT corresponds to knowledge of interactions,
   - no need to prove strong correspondence to interaction theories: theories are underdetermined by experiment!
   - proving weak correspondence to successful predictions is enough
4. is the widespread acceptance of this Sollsatz perhaps the root cause of the stalemate in the foundations of physics in past decades?

thank you for your attention