Homotopy Physics

by Sven Nilsen, 2021

In this paper I introduce the idea of Homotopy Physics, which generalises Classical and Quantum Physics to theories assigned to homotopy levels, where n-avatar physics corresponds to n-groupoids.

Homotopy Physics is the idea that for every homotopy level[1], there is an associated physics:

Homotopy level	**Homotopy type theory**	**Homotopy physics**
h-level 0	unit type	uniform subjective experience
h-level 1	h-proposition	classical physics
h-level 2	h-set	quantum physics
h-level 3	h-groupoid	avatar physics
h-level 4	h-2-groupoid	2-avatar physics
h-level 5	h-3-groupoid	3-avatar physics
h-level **n+2**	h-**n**-groupoid	**n**-avatar physics
h-level ∞	h-∞-groupoid	∞-avatar physics

The intution is that in a Wolfram model[2], classical physics arises from classical computation by applying a single rule in an ordered way to construct a hypergraph, while quantum physics arises from applying the rule in an unordered way to construct a multiway-system.

Since the physical interpretation of Wolfram models depend on the nature of computation, one can assign different forms of computation to homotopy levels.

In classical physics, the computation corresponds to propositions,
which can be thought of as determining the value of a bits, e.g. 0s or 1s.

In quantum physics, the computation corresponds to sets,
because it only makes sense to talk about e.g. a particle being observed in a region of space-time.

When a qubit is observed in quantum computation, the h-level 2 is collapsed into h-level 1.

Therefore, it is natural to think of the possibility that there are higher h-levels of computation,
which gives rise to higher theories of physics, and which can be collapsed to lower levels.

A symmetry `g` is a transformation of a set `S`, such that `g · S = S`[3].
The set of all local symmetries forms a groupoid.

“Smaller” theories of quantum physics, can be related to each other using local symmetries to create a theory of physics at h-level 3. When two mathematical theories are related to each other using symmetry, this is an Avatar Extension[4], so “n-avatar physics” is physics about n-groupoids.

References:

[1] “homotopy level”
nLab
https://ncatlab.org/nlab/show/homotopy+level

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[4] “Avatar Extensions”
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