Existential Propositions

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In this paper I argue for using the Excluded Middle for non-Existence as basis for propositions in Type Theoretic Existential Philosophy. This creates a logical foundation for understanding unitary physical laws and unobservables.

In the field of theoretical physics[1], there is a deep intuition that information is preserved.
For example, there is a debate whether black holes emit the information that is contained within[2].
This intuition comes from quantum mechanics[3], which states that physical laws are unitary[4].

I think it is a good idea to use Type Theory as a basis for Existential Philosophy[5]. My motivation is to bridge the gap between Path Semantical Quality[6] and the difference between Analytic[7] and Continental Philosophy[8], using Seshatism vs Platonism[9] to formalize mathematical stereotypes[10].

Conservation of information in physics seems relevant for Type Theoretic Existential Philosophy.

Existential Propositions (EP) uses the following assumption in Intuitionistic Logic[11] (IPL):

$$\forall\ x\ \{\ \neg\neg x \vee \neg x\ \}$$

This assumption is called “Excluded Middle for non-Existence”.

My argument is divided into 3 parts:

1. Definition of cross equality
2. Cross equality is equivalence in EP, but not in IPL
3. Interpretation of cross equality as unitary physical laws

1. Definition of cross equality

Cross equality is defined as following:

$$a =\times= b \iff (a \Rightarrow \neg\neg b) \wedge (b \Rightarrow \neg\neg a) \qquad \text{Cross equality}$$

$$a == b \iff (a \Rightarrow b) \wedge (b \Rightarrow a) \qquad \text{Normal equality}$$

Notice the similarity between cross equality and normal equality.

2. Cross equality is equivalence in EP, but not in IPL

Equivalence[12] is a binary relation that is reflexive, symmetric and transitive:

$$a =\times= a \qquad \text{Reflexivity}$$

$$a =\times= b \Rightarrow b =\times= a \qquad \text{Symmetry}$$

$$a =\times= b \wedge b =\times= c \Rightarrow a =\times= c \qquad \text{Transitivity (in EP, but not in IPL)}$$

3. Interpretation of cross equality as unitary physical laws

Under transitivity of implication, there is no necessity of equality.

a == b	∧	b == c	=>	a == c	Normal equality transitivity
a => b	∧	b => c	=>	a => c	Implication part

The implication part is tautological in IPL, therefore normal equality transitivity is trivial.

Therefore, from the perspective of Existential Philosophy, there is no reason to believe that normal implication transitivity tells something about why physical laws should be unitary.

However, when looking at the implication part of cross equality, something strange happens:

a =×= b	∧	b =×= c	=>	a =×= c	Cross equality transitivity
a => ¬¬b	∧	b => ¬¬c	=>	a => ¬¬c	Implication part

It seems intuitively that `¬¬b => b` should occur,
but this is not possible, since EP only assumes `∀ x { ¬¬x ∨ ¬x }`.

Interpreted in terms of theoretical physics, `b` is an unobservable[13] (an unobserved phenomena).

The trick is that the following normal path[14] only holds in EP, but not in IPL:

∴ eq_transitivity[eqnn_to_crosseq] => crosseq_transitivity

∵ eq_transitivity : (a == b) ∧ (b == c) => (a == c)
∵ eqnn_to_crosseq : (¬¬a == ¬¬b) => (a =×= b)
∵ crosseq_to_eqnn : (a =×= b) => (¬¬a == ¬¬b) provable in EP, but not in IPL
∵ crosseq_transitivity : (a =×= b) ∧ (b =×= c) => (a =×= c)
∵ inv(eqnn_to_crosseq) <=> crosseq_to_eqnn

The function `eqnn_to_crosseq` is partial, so the normal path uses `=>` instead of `<=>`.

The function `crosseq_transitivity` can be defined using following proof:

∵ crosseq_transitivity
∴ eq_transitivity[eqnn_to_crosseq]
∴ eqnn_to_crosseq · eq_transitivity · (inv(eqnn_to_crosseq) · fst, inv(eqnn_to_crosseq) · snd)
∴ eqnn_to_crosseq · eq_transitivity · (crosseq_to_eqnn · fst, crosseq_to_eqnn · snd)

Therefore, it is necessary for the implication part of cross equality that there is an equivalence.

Interpreted in terms of theoretical physics,
cross equality in EP models the logical foundation of unitary physical laws.

With other words, unitary physical laws are necessary in the presence of causality through unobservables.

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