

Do you see what I see?
Joint observation in Barbourian universe

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Outline

Introduction - context

Time in a timeless universe

Barbour's Platonía

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Problem of joint observers in Platonía

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Introduction - context

- ▶ Gratitude, thanks, limitations
- ▶ Project of time in timeless physics
- ▶ Restarted from original approach

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Remark

A generalised flow of time *fulfills the following*:

1. *worldlines have a linear order of now-points;*
2. *past and present now-points are ontologically definite;*
3. *it has a relation (or set) of now-points on worldlines respecting ontological definiteness.*

Barbour Branching Configurations with observers, [4]

- ▶ Mirrored Branching Continuations [3],
- ▶ Attempted to reconstruct the gFoT only as a result of the introduction of observers.

BBC with observers

Definition (Platonica)

We call \mathcal{P} **Platonica**, the set of all configurations c .

Definition (Transitions)

Any two configurations $c, c' \in \mathcal{P}$ form a **direct transition** $c \approx_d c'$ iff $\forall c'' \in \mathcal{P} : \Delta(c, c') \leq \Delta(c, c'')$.

There is a **transition** $c \approx c'$ iff there is a chain of direct transitions $c_1 \approx_d c_2 \approx_d \dots \approx_d c_n$ such that $c_1 = c$ and $c_n = c'$.

Definition (Directly successive)

Two configurations $c, c' \in \mathcal{P}$ are **directly successive** $c < c'$ iff $c \approx_d c'$ and $c \in \Psi(c')$. Where $\Psi(c)$ denotes the set of possible preceding configurations based on time capsules from c .

Two configurations $c, c' \in \mathcal{P}$ are **successive**, denoted $c \ll c'$ iff there is a chain of directly successive configurations $c_1 < c_2 < \dots < c_n$ such that $c_1 = c$ and $c_n = c'$.

Definition (Barbour history)

A **Barbour history** h is a set of configurations $c_1, \dots, c_n \in \mathcal{P}$ totally ordered by $<$.

Definition (Barbour structure)

1. The ordering $<$ is dense.
2. The relation $<$ is transitive.
3. The relation $<$ is antisymmetric.
4. Every lower bounded chain in \mathcal{P} has an infimum in \mathcal{P} .
5. Every upper bounded chain in \mathcal{P} has a supremum in every *history* that contains it.
6. (PCP) For any lower bounded chain $C \in h_1 - h_2$ there exists a configuration $c \in \mathcal{P}$ such that c is maximal in $h_1 \cap h_2$ and $\forall c' \in C \ c < c'$.

Definition (Observer in BBC)

An observer at configuration c , \mathcal{O}_c is an observer that can use only the evidence available to him at c .

Definition (Observer valuation in BBC)

For given \mathfrak{M} , c and observer \mathcal{O}_c and evidences h_i , such that $E \subseteq h_i$, a formula φ is true for \mathcal{O}_c iff for every h_i it holds that $\mathfrak{M}, c, h_i \models \varphi$.

Theorem (Observer time asymmetry in BBC)

For any observer \mathcal{O}_c , if she is part of at least two histories, there exists at least one well-formed formula about the future that she cannot attribute any truth value.

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Definition (Observer valuation in BBC)

For given \mathfrak{M} , c and observer \mathcal{O}_c and evidences h_i , such that $E \subseteq h_i$, a formula φ is true for \mathcal{O}_e iff for every h_i it holds that $\mathfrak{M}, c, h_i \Vdash \varphi$.

Theorem (Observer time asymmetry in BBC WHAT ?!)

For any observer \mathcal{O}_c , if she is part of at least two histories, there exists at least one well-formed formula about the future that she cannot attribute any truth value.

Theorem (BBC can contain generalised flow of time)

There exist models of BBC that contain generalised flow of time.

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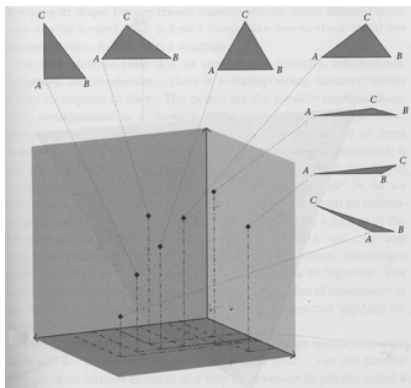
Problem of joint observers in Platonia

Back to the drawing board

- ▶ From configurations to point-states
- ▶ Construct observers and then time
- ▶ Ask whether it still is Barbour and makes any sense

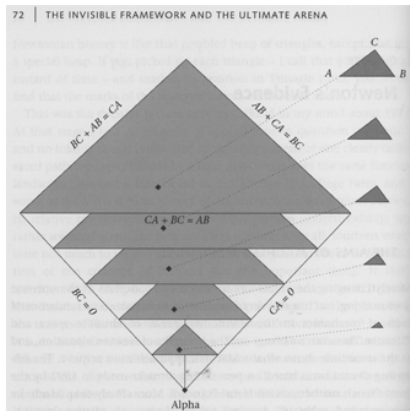
Triangle land [1]

- ▶ Three objects in the world (A, B, C)
- ▶ Only properties are their relative distances (AB, BC, AC) measured in \mathbb{R}



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Primitives

Definition (Measurement)

A ontological quantification of properties of the objects of our world.

Example (Measurement in Triangle land)

Distances between the objects A, B, C.

Primitives

Definition (Point-state)

A point-state p is the set of measurement results relating the point-state to all point-states.

Example (Point-state in Triangle land)

A point-state p_A is $\{ 'A', AB, AC \}$.

Primitives - questions

- ▶ Why not point-events?
- ▶ Why **point**-states?
- ▶ Why is there 'A'?

Configuration

Definition (A complete set of point-states)

The set of point-states that contains all the point-states that are part of any point-states measurements.

Example (Complete set in Triangle land)

Would be $\{p_A, p_B, p_C\}$, i.e.:

$\{\{ 'A', AB, AC \},$

$\{ 'B', BA, BC \},$

$\{ 'C', CA, CB \}\}$.

Configuration

Definition (A consistent set of point-states)

The set of point-states where the mutual measurements between the point-states are equal.

Example (Consistent set in Triangle land)

Would be $\{p_A, p_B\}$ where:

- ▶ $AB = BA$

Configuration

Definition (State/Configuration)

A consistent and complete set of point-states for the given set of measurements.

Example (Configuration in Triangle land)

Would be $\{p_A, p_B, p_C\}$ where:

- ▶ $AB = BA$
- ▶ $BC = CB$
- ▶ $AC = CA$

Configurations - questions

- ▶ Why start out with sets?
- ▶ Why should configurations be complete?
- ▶ Why should they be consistent?

Definition (World/Platonia)

The set of all possible configurations for the given set of measurements.

Example (World in Triangle land)

Would be \mathbb{R}^3 configurations for the distances in AB, BC, CA.

Platonia - questions

- ▶ Why all possible measurements?

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Time capsules [1]

Specific configurations that are consistent with each other and describe a process.

Triangle land revisited

- ▶ Three objects in the world (A, B, C)
- ▶ Only properties are their relative distances (AB, BC, AC) in \mathbb{R}
- ▶ ?

Triangle land revisited - questions

- ▶ A specific type of objects, "records", different from the original objects?
- ▶ Are records just interpretations of the distances between the objects?
- ▶ Are records given by configurations, i.e. extrinsic to the configuration?

Triangle land revisited

- ▶ Three objects in the world (A, B, C) and new objects (A', B', C')
- ▶ Only properties are their relative distances (AB, BC, AC, AA', ...) in \mathbb{R}
- ▶ Non measurable relation of objects ("law")

Record

Definition (Record)

A measurable property of point-states relating the point-state to another point-state through a set of "laws".

Example (Records in Triangle land)

- ▶ "Law": $A'B'$, $B'C'$, $C'A'$ are previous relations of AB , BC , CA of a diminishing triangle.
- ▶ Thus $A'B'-AB$, $B'C'-BC$, $C'A'-CA$ are records.

Time capsule

Definition (Time capsule)

A configuration, where all the records are consistent, i.e. all the "laws" are consistent.

Example (Time capsules in Triangle land)

- ▶ $A'B'$, $B'C'$, $C'A'$ are less than AB , BC , CA respectively.

Time capsules - questions

- ▶ Are laws mere interpretation of point-state relations?

Observer

Definition (Observer)

A set of records in a time-capsule.

Example (Observers in Triangle land)

- ▶ $\{A'B'-AB, B'C'-BC\}$

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Observation in Platonia

- ▶ The observers are part of the same configuration.
- ▶ Thus are limited to records in the configuration.
- ▶ Both observers are in the same configuration.

Observation in Platonia - questions

- ▶ Can the observers disagree if they are part of the same configuration?
- ▶ Should observers transcend configurations?

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