

3-31-2010

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Recommended Citation

Allori, Valia, "On Wave Function Monism in Spontaneous Collapse Theories" (2010). *Faculty Peer-Reviewed Publications*. 486.

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On Wave Function Monism in Spontaneous Collapse Theories

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January 30, 2009
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Introduction

- orthodox quantum mechanics = only Schrodinger wave function
- wave function monism ?
- NO: the measurement problem.
- Bell's alternatives
 - either the wave function is complete or it evolves differently
 - BM
 - GRW

Introduction

- GRW and orthodox quantum mechanics
 - wave function monism?
 - in GRW: different evolution equation...
- Questions:
 - 1- Is monistic GRW possible?
 - no
 - 2- Is it reasonable/desirable?
 - no

Monistic GRW

- David Albert's view
- physical space = configuration space dimension $M=3N$.
- problems:
 - account of the false belief that we live in a 3-d space
 - account of macro properties

The Impossibility of Strict Monism: 3d space

- $\Psi(q)$, q in R^M
- $\Psi(q) = \Psi(q_1, \dots, q_N)$, q_i in R^3 ?
- Not enough resources:
 - already assume that the configuration can be divided as such= there are 3d particles!
- gap:
 - a map (from configuration to 3d space) is needed

The Impossibility of Strict Monism: Macro Properties

- observables as physical properties
 - the eigenstate--eigenvalue rule
- monistic GRW:
 - infinite tails
 - no definite properties
- gap:
 - a map (from configuration to 3d space) is needed

Rule One: the Hamiltonian

- $H = \nabla_q^2 + V(q)$, q in \mathbb{R}^M
- empirical fact: $V(q) = \sum_{i < j} V(|q_i - q_j|)$,
 $q = (q_1, \dots, q_N)$, q_i in \mathbb{R}^3
 - this ensures us of the appearances of the world as 3 dimensional

Rule Two: Supervenience

- new rule:
 - particle x is in region R' iff the proportion of the total square amplitude of x 's wave function which is associated with points in R is greater than or equal to $1-p$
- it maps macro with micro talk

Practical Rules

- Both rules are not additional ontologies
- Rather, they are just practical rules

The Alternatives: Local Beables and Primitive Ontology

- John Stuart Bell and local beables in GRW
- local beables as an ontological rule
- primitive ontology = local beable in 3d space
- monistic GRW = GRW0
 - no primitive ontology

GRWf

- Bell:
 - "flashes" = space-time events corresponding to localization events of the wave function
- GRWf
- $F_{[0,t]} = \{(x_1, t_1), (x_2, t_2), \dots, (x_i, t_i), \dots\}$

GRWm

- Ghirardi:
 - mass density $M^{\Psi} = M^{\Psi}(x, t)$ in 3d space
- GRWm

The General Structure of Fundamental Physical Theories

- mechanical explanation:
 - space-time
 - trajectories of the primitive ontology in it
- examples:
 - Newtonian mechanics
 - Bohm's theory
 - GRWf and GRWm
- Common structure: (X, f)

The Two Approaches Compared

- What is Wrong with GRWf and GRWm?
 - 1-The Status of the Wave Function
 - wave function as a law
 - Objections:
 - 1-time evolution
 - reply: quantum cosmology
 - 2-degrees of reality
 - replies:
 - nominalism
 - not strong enough
 - non existence of the wave function

The Two Approaches Compared

- What is Wrong with GRWf and GRWm?
 - 2- artificiality
 - Begging the question
 - 3-Simplicity
 - misleading
 - against Occam's razor
 - 4-Redundancy
 - begging the question

The Two Approaches Compared

- What is Wrong with GRW0?
 - 1- Radicality
 - GRW0 is even more radical than the brain-in-a-vat scenario ...
 - 2-The Hamiltonian Rule
 - Hamiltonian --> 3d
 - or
 - 3d --> Hamiltonian???

The Two Approaches Compared

- 3-The Supervenience Rule
 - GRWf and GRWm:
 - clear ``mechanism of explanation''
 - GRW0:
 - addition of rules because "they work"

The Two Approaches Compared

- 4-The Mind-Body Problem
 - GRWf and GRWm:
 - The mind-body problem can be left out
 - GRW0:
 - !!!!!



Why not Both?

- The “mixed” view???
 - monism is appealing because for its ontological simplicity
 - primitive ontology is appealing because of its explanatory simplicity
- the mixed view complicates both!