Berkelian idealism regarding properties in orthodox quantum mechanics, and implications for quantum gravity

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Planck Scale II

overview

CONTAINS PHILOSOPHICAL ARGUMENTS!

overview

In this talk:

1. the idealism of George Berkeley

2. Berkelian idealism in orthodox QM

3. implications for quantum gravity

4. conclusion

1: the idealism of George Berkeley

Bishop Berkeley (1685-1753)

esse est percipi - “to be is to be perceived”

Bishop George Berkeley (1710)

⬇

a thing exists **if and only if** it is observed

⬇

no material substance exists outside the mind:

objects are nothing but ideas in the mind of an observer

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considered to be **highly unlikely**

2: Berkelian idealism in orthodox QM

core principle: a thing exists **if and only if** it is observed

$\therefore$ Berkeley **denies** that a thing exists if not observed

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OQM **does not deny** that the quantum exists if not observed

quantum state $\leftrightarrow$ wave function $|\psi\rangle$ with $\langle\psi|\psi\rangle = 1$

completeness: a thing predicted with certainty has a counterpart in reality

no Berkelian idealism in its fullest sense!!

2: Berkelian idealism in orthodox QM

Berkelian idealism regarding properties:

a quantum 'has' a property X with quantitative value x **if and only if** the property X is measured with outcome x

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Standard Property Postulate:

a quantum 'has' a property X with value x **if and <u>only if</u>** it is in the eigenstate $|x\rangle$ of the associated operator $\hat{X}$

Projection Postulate:

if the property X is measured and the value x is obtained, **then** upon measurement the quantum is in the eigenstate $|x\rangle$

3: implications for quantum gravity

principle of curvature:
space-time is curved due to the energy of objects

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space-time is **not** a substance (aether):
therefore, it's **not** subjected to the BIRP

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at any (t, x), space-time **has** a definite curvature

❷
quanta only 'have' energy upon a measurement (BIRP)

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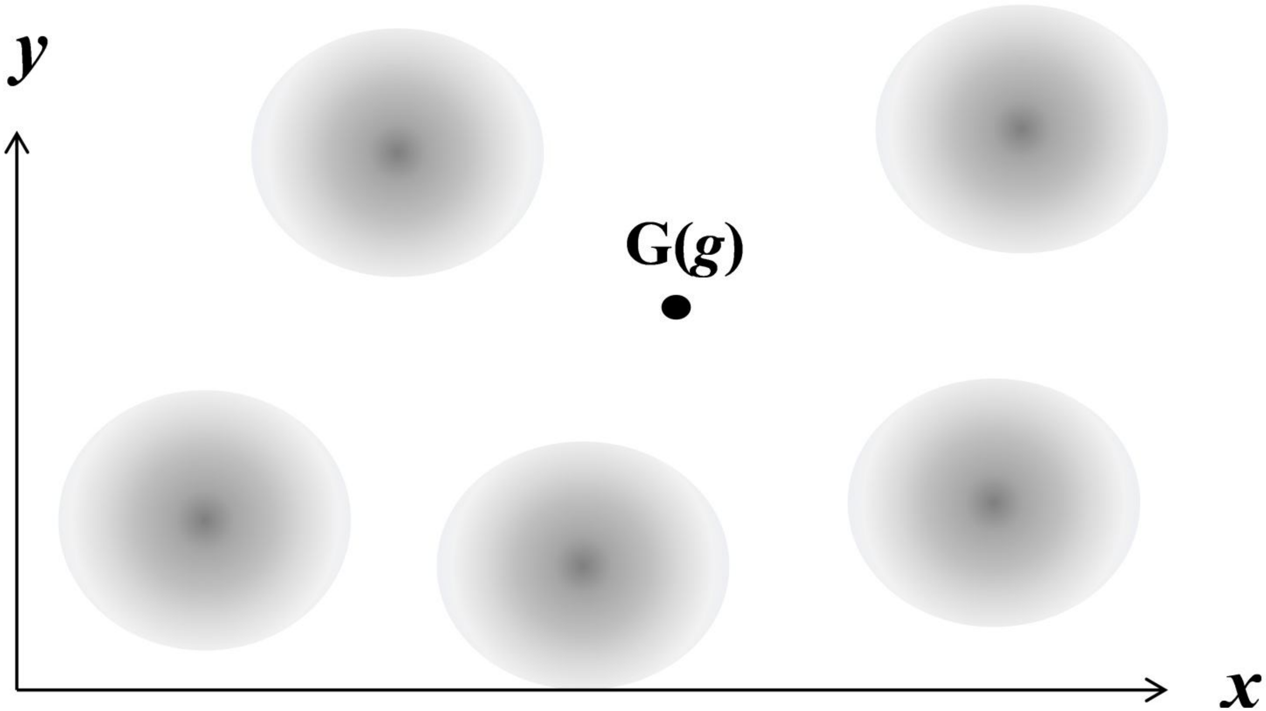
no measurement, no cause of curvature!

3: implications for quantum gravity



- the curvature G **has** a value <u>independent</u> of measurement
- without measurement, the quanta do **not** 'have' energy

∴ principle of curvature <u>cannot</u> be recontextualized in OQM

3: implications for quantum gravity

pragmatic approach to the problem:

$$G^{\mu\nu} = T(\langle p\rangle_1, \langle p\rangle_2, \langle p\rangle_3, \ldots)^{\mu\nu}$$

however:

the $\langle p\rangle_j$ refer to expected outcomes of measurements

these are not properties that the quanta 'have'

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this "solution" is <u>conceptually incoherent</u>

4: conclusion

a quantum theory of gravitation is **not possible** in any framework implying Berkelian idealism regarding properties

4: conclusion

a quantum theory of gravitation is **not possible** in any framework implying Berkelian idealism regarding properties

modus tollens:

$$\left\{ \begin{array}{l} \neg B \\ \underline{Q \Rightarrow B} \\ \neg Q \end{array} \right.$$

<u>Mahoney (1977)</u>: over 50% of scientists doesn't recognize *modus tollens* as a valid reasoning form

extra: logical from of the proof of BIRP in OQM

Berkelian idealism regarding properties:

a quantum 'has' a property X with quantitative value x

if and only if the property X is measured with outcome x

P: the quantum has property X with value x

E: the quantum is in the eigenstate $|x\rangle$ of the associated operator $\hat{X}$

M: the property X is measured with outcome x

1)	$\mathrm{P} \leftrightarrow \mathrm{E}$	(SPP)
2)	$\mathrm{E} \leftarrow \mathrm{M}$	(PP)
3)	$\neg(\mathrm{E} \wedge \neg\mathrm{M})$	(only the PP states how to get in the eigenstate)
$\therefore$	$\mathrm{P} \leftrightarrow \mathrm{M}$	(BIRP)