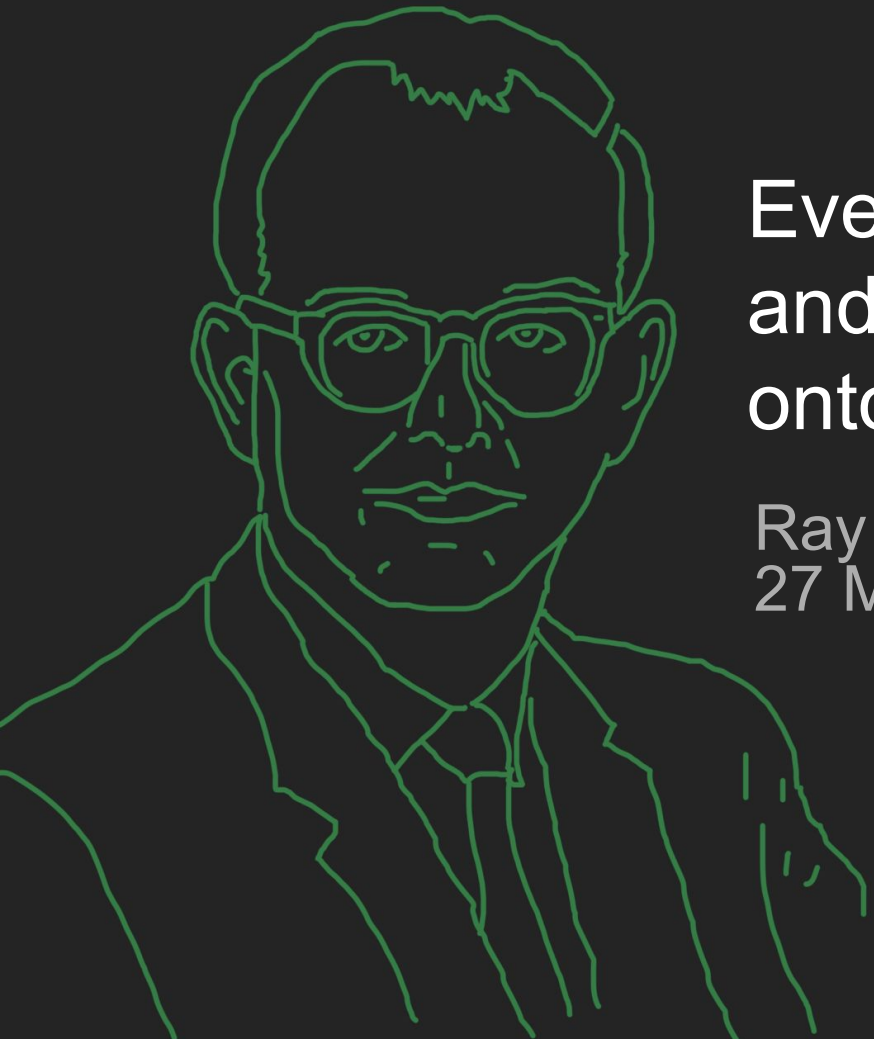

Everettian quantum mechanics and the problem of ontological extravagance

Ray Å. Pedersen
27 March 2025

Pre-introduction

What's EQM?

Pre-introduction

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[Other versions of QM]

[Everettian QM]

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Deterministic evolution of Ψ + a stochastic collapse principle

Everettian QM

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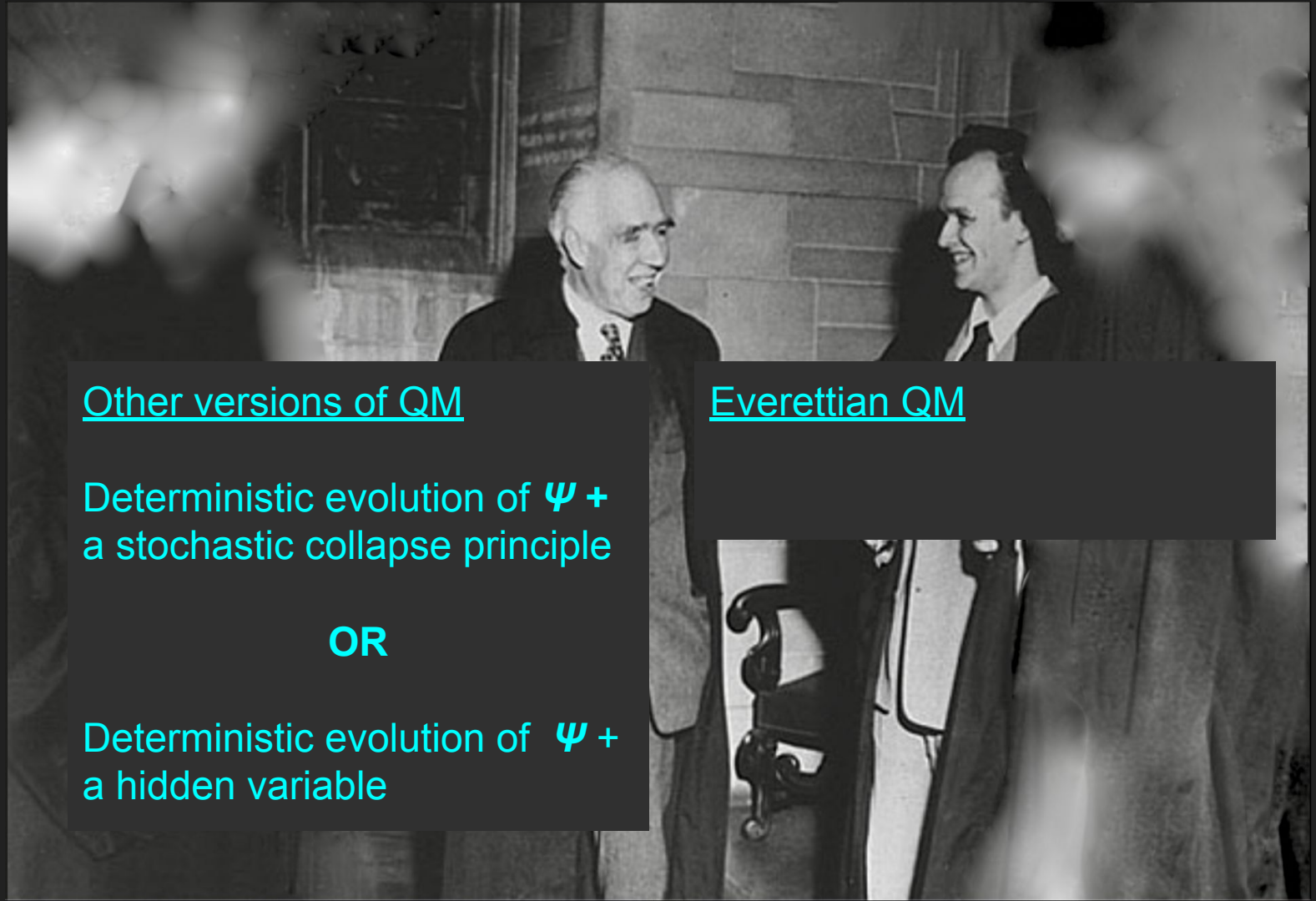

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OR

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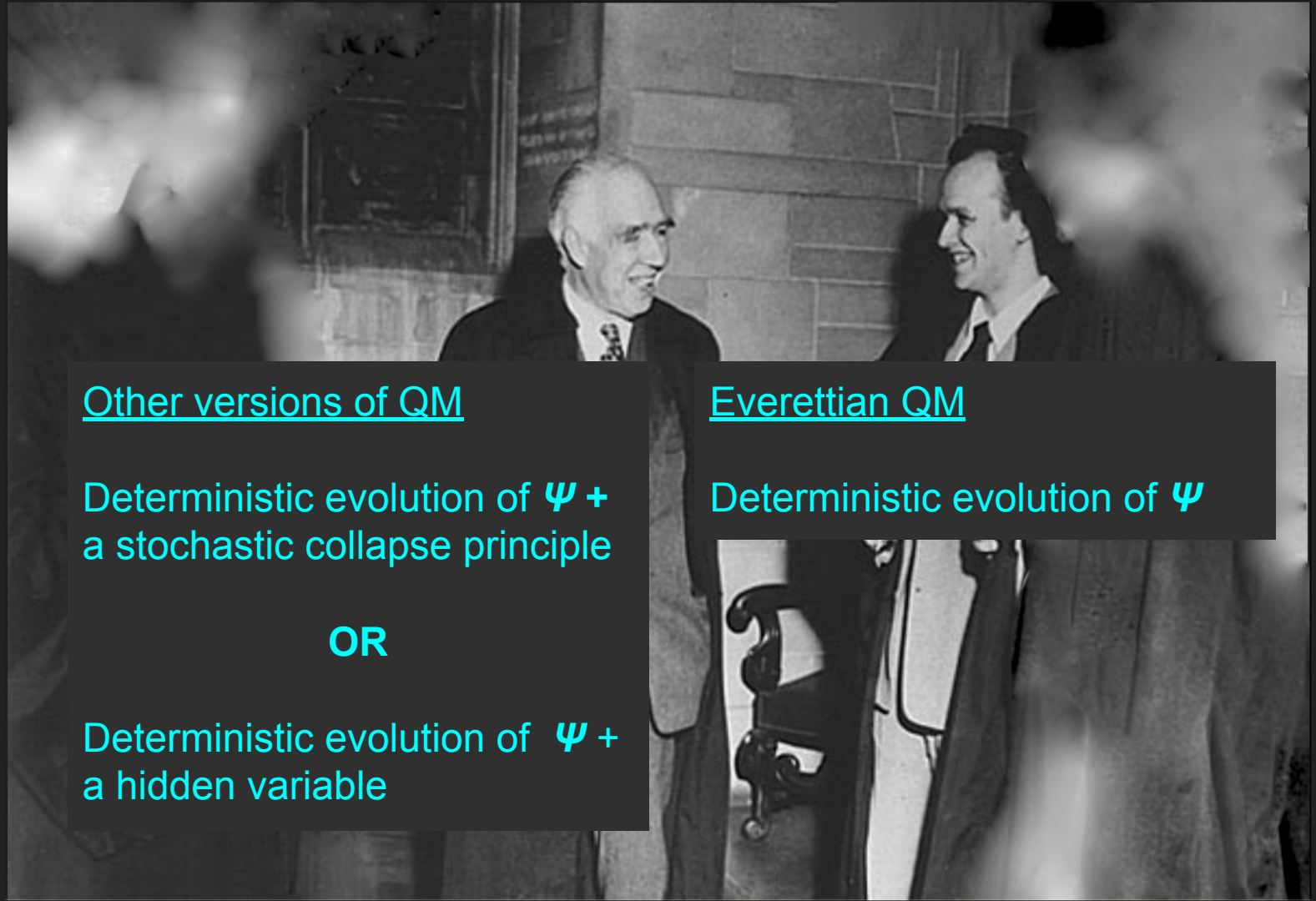

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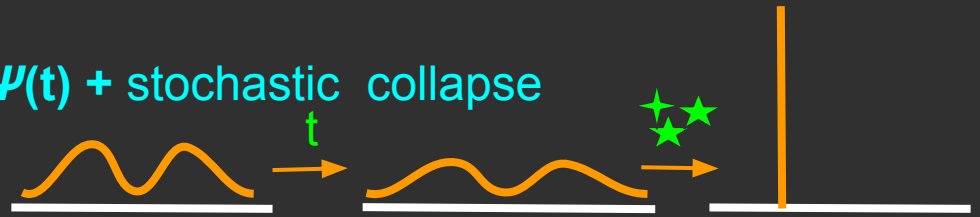

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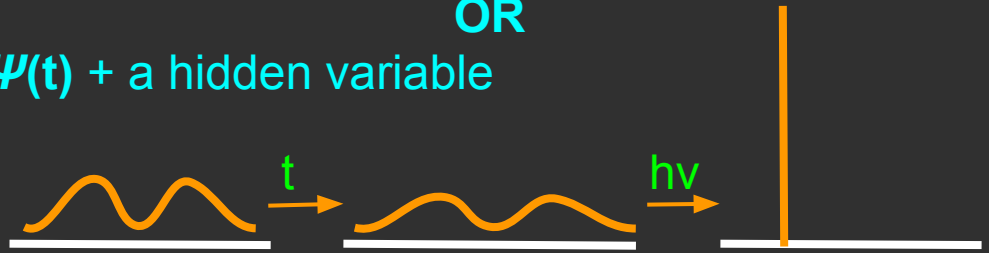
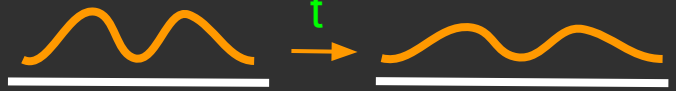


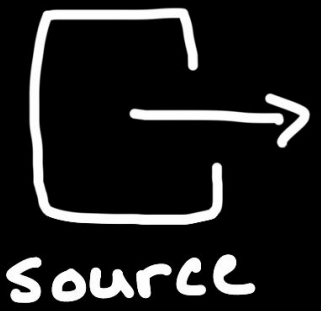
Everettian QM

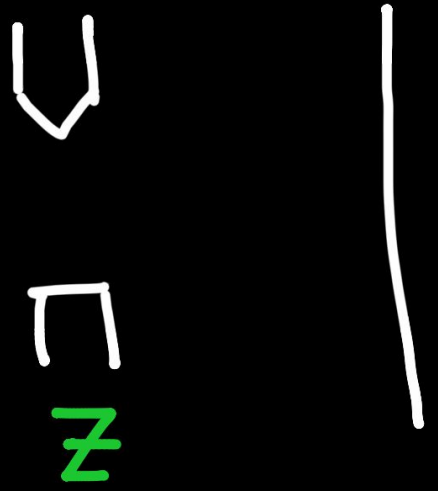
Ψ(t)



A simpler case: the Stern-Gerlach Experiment

(1921)





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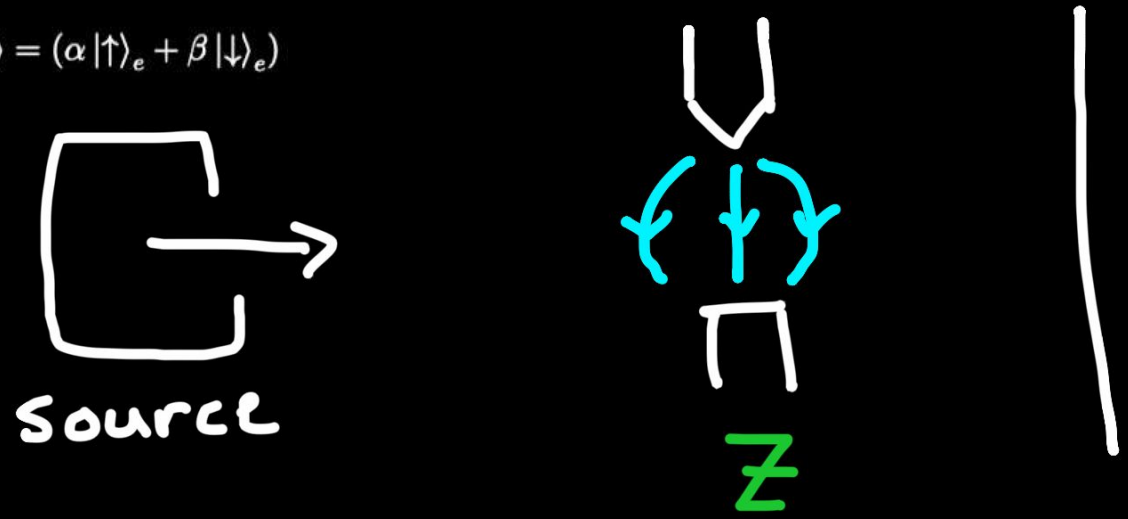
$$|\Psi\rangle = (\alpha\,|\uparrow\rangle_e + \beta\,|\downarrow\rangle_e)$$



$$F_z = \frac{\partial}{\partial z}(\vec{\mu}\cdot\vec{B}) \simeq \mu_s \frac{\partial B_z}{\partial z}$$ [1]

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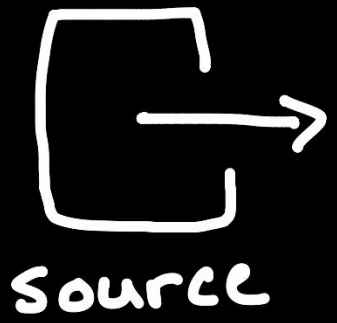

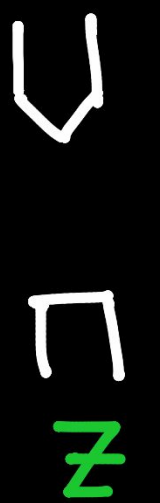

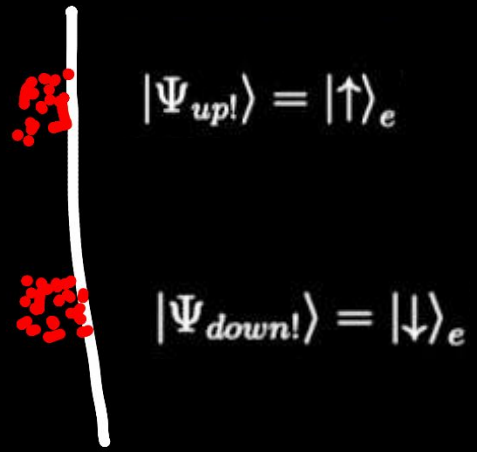

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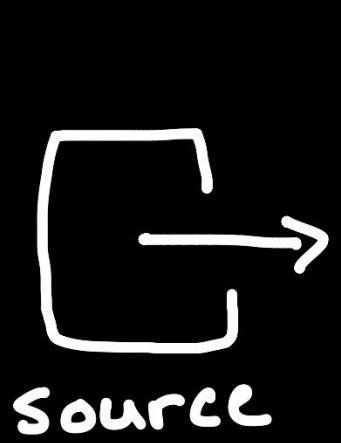

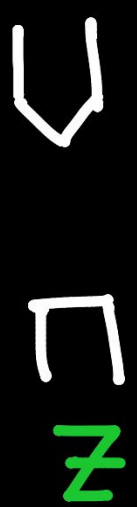

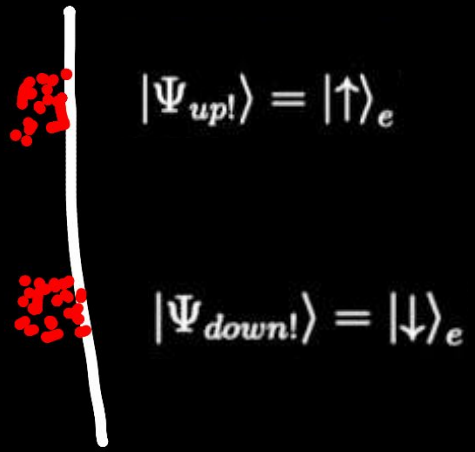

For each electron…

either $|\Psi\rangle = (\alpha\,|\uparrow\rangle_e + \beta\,|\downarrow\rangle_e) \longrightarrow |\Psi_{up!}\rangle = |\uparrow\rangle_e$

or $|\Psi\rangle = (\alpha\,|\uparrow\rangle_e + \beta\,|\downarrow\rangle_e) \longrightarrow |\Psi_{down!}\rangle = |\downarrow\rangle_e$

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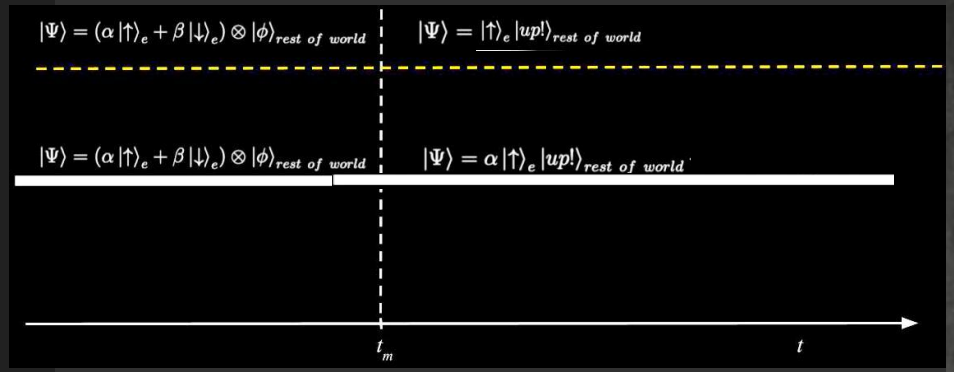
Other versions of QM



Everettian QM

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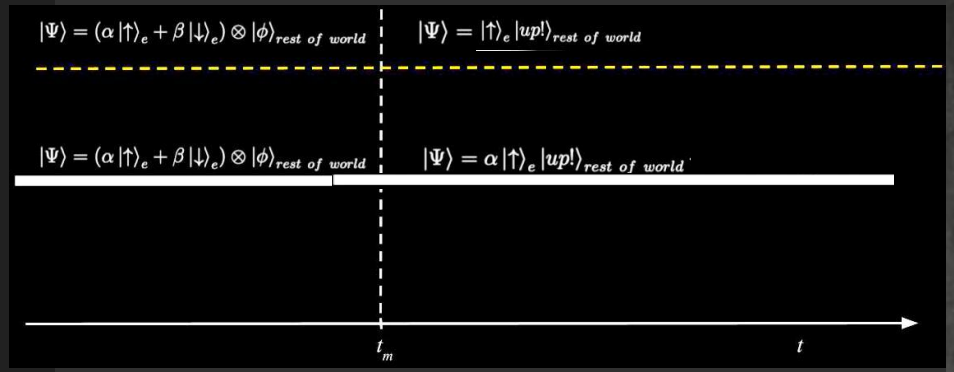

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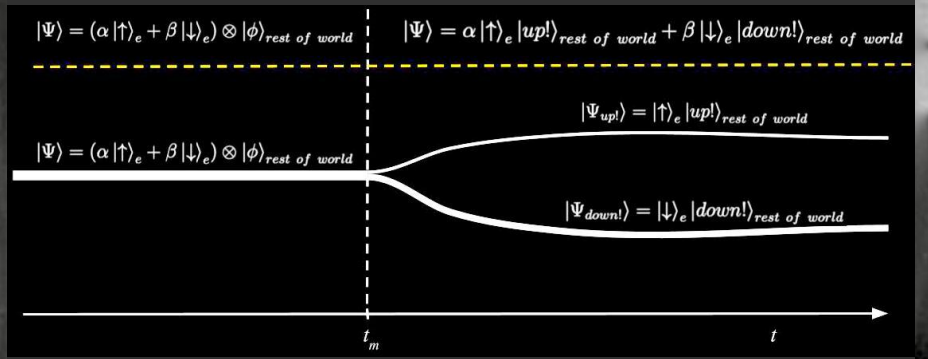

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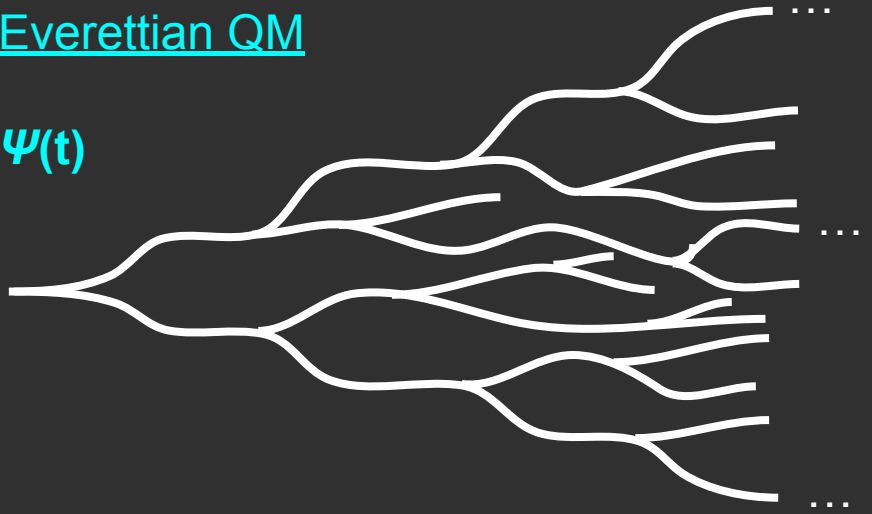

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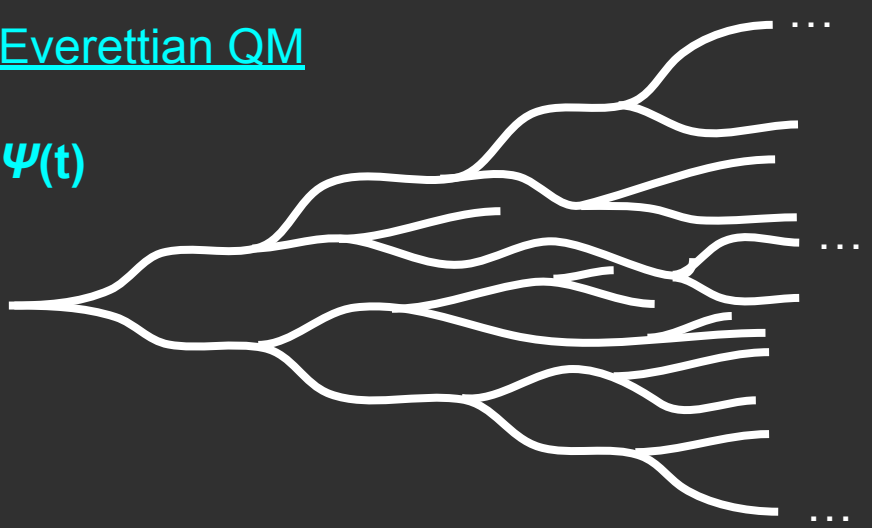

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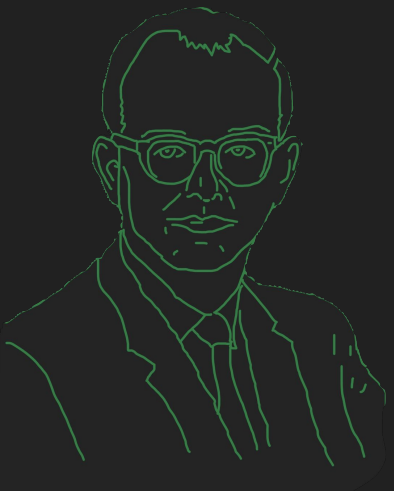
EQM: Quantum mechanics without a collapse postulate *and* without a hidden variable.



Introduction

EQM: Quantum mechanics without a collapse postulate *and* without a hidden variable,

but with a (costly!) commitment to *many worlds*.

Introduction

I’m interested in the questions over

(1) *why* it is that everyone’s not an Everettian, and

(2) how Everettians can learn from the answer to the first question.

Introduction

“vulgar”
(Albert, 1992: 115)

Introduction

“It nevertheless appears that the more ‘extravagant’ understanding, namely that of many worlds, is the one whose basic ontology is clearest and which provides the logically sharpest solution to the measurement problem” (Marchildron, 2011: 361)

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The extravagance of EQM is a major drawback.
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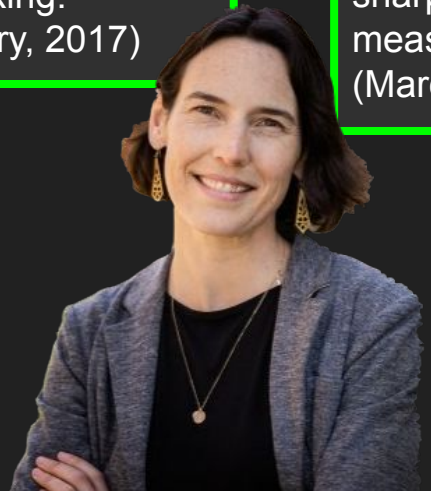

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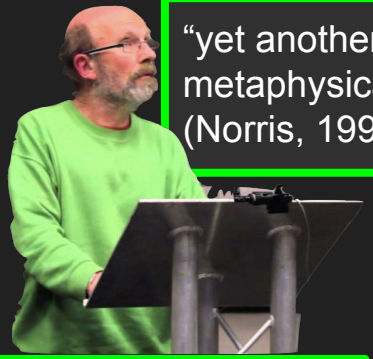

"yet another back of wacky metaphysical extravagance." (Norris, 1999: 315)

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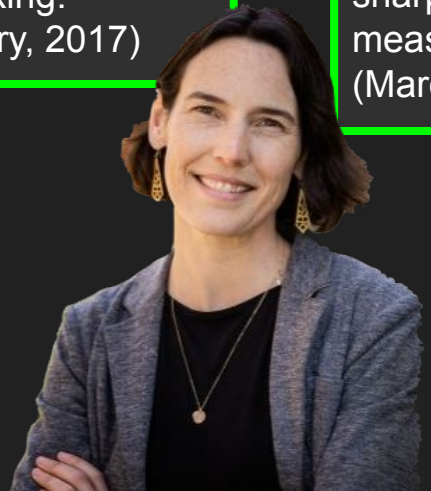

Outline

I. The incredulous stare, version 1: displeasure with excess
II. The incredulous stare, version 2: classical divergence
III. The state of play
IV. Are these norms justified?
V. What's the Everettian to do?

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“I do not know how to refute the incredulous stare.”

Attributed to David Lewis.

Excess

Sceptic: Isn't it still a bit uncomfortable for you that you're arguing that all these other worlds exist but that there's no possible way to observe one of them?

Author: Not especially. Our best current theory of physics (a) predicts that they exist and (b) explains why we can't normally see them... In any case, we see this sort of thing a lot in science. We can't directly observe a dinosaur, or a quark, or a quasar, or the interior of the sun, but that doesn't stop us taking them seriously.

Sceptic: In most of those cases, it's just happenstance that we can't make the observation. If we were properly situated in space and time, we'd be able to.

Author: Well, if we were properly situated in the multiverse, we'd be able to see other worlds.

Sceptic: How can you know that?

Author: My best theory of physics tells me so. How do you know that you'd be able to see dinosaurs or quasars if you were appropriately situated? (Wallace, 2012: 104)

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On the abundance of galaxies

“<u>We</u> don’t tend to assume that cosmological theories are *a priori* more or less likely to be true according to how many galaxies they postulate… Generally in physics, we try to keep our number of postulates, and the complexity of our theories, as low as possible.”
(Wallace 2012: 105).

Necessary worlds?

“The Everett(?) theory... [is] simply be the pilot-wave theory without trajectories... Now it seems to me that **this multiplication of universes is extravagant, and serves no real purpose in the theory, and can simply be dropped without repercussions**" (Bell: 133)

	Comparative
Ontic Abundance	**COMPARATIVE ONTIC ABUNDANCE.** For any two theories T_A and T_B that have identical explanatory and predictive power, we ought to prefer the theory with more modest commitments to unobservable objects.

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An absolute criterion?

"If you say, 'Ockham's razor rules out the Everett interpretation', you're not really making just one more application of a tried and tested philosophical principle. **You're appealing to a new principle–that we should reject theories according to which the Universe exceeds some threshold size**—and that principle doesn't have any independent motivation."

(Wallace, 2012: 105, emphasis mine)

	Absolute	Comparative
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A taxonomy of simplicity norms

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Scales for the application of these norms

Local

For intra-community judgements

Many Worlds Interpretation conference in Tel Aviv, 2022

Global

For inter-community judgements

Xavier conference on the foundations of quantum mechanics, 1962

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personal

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How to weigh these isn't obvious, and it may just come down to personal preference.

A taxonomy of simplicity criteria: Global application

Even if they're justified, arguments from parsimony can neither condemn nor vindicate EQM.

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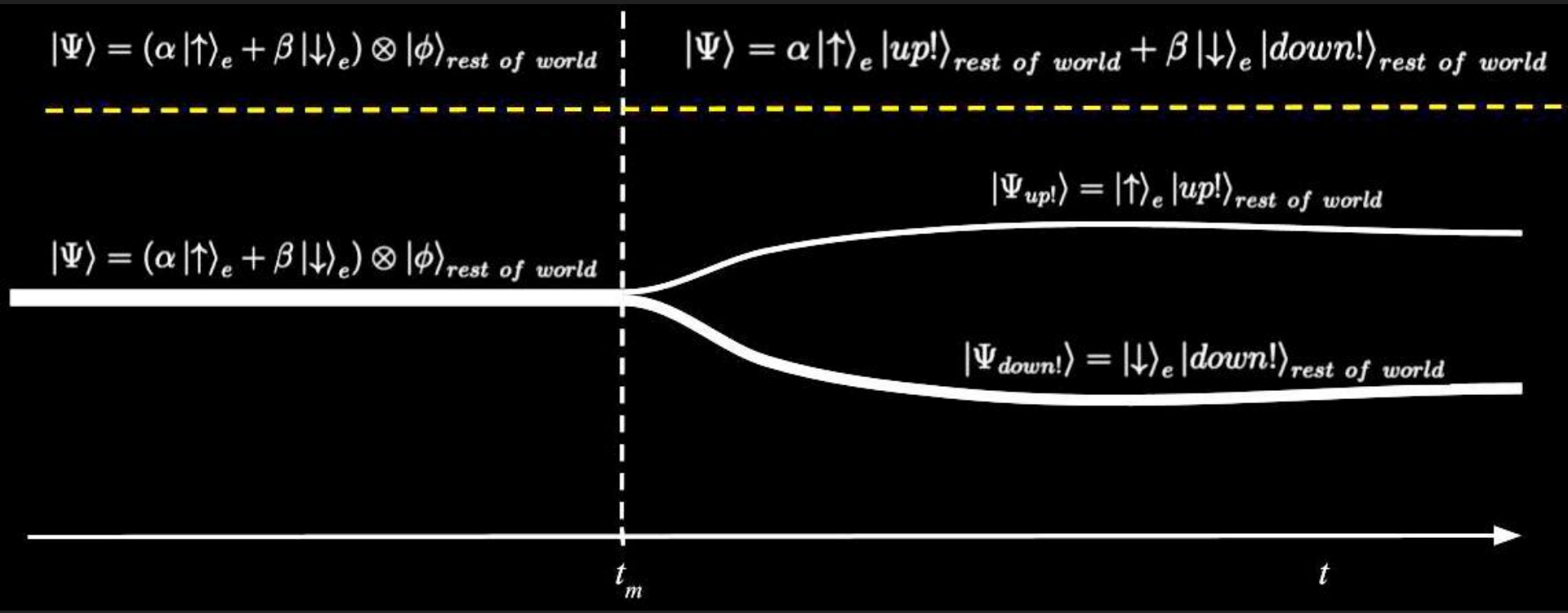
Reality according to EQM is unexpected.



“I do not know how to refute the incredulous stare.”

Attributed to David Lewis.

The minimal divergence norm

"Insofar as we have two or more empirically adequate scientific theories–two theories that both accurately predict the phenomena that we observe–we ought to choose the one that minimizes the difference between the way the theory says the world is and the way the world appears to be."

(Emery 2017: 565)

The minimal divergence norm

According to the minimal divergence norm (MDN), we ought to prefer theories that deviate least from the manifest image, or the way we generally perceive the world to be.

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This spells trouble for EQM, which says there much more to reality than what the manifest image says.

What’s the manifest image?

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- Surely this varies agent-to-agent!

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- Surely this is theory-laden!

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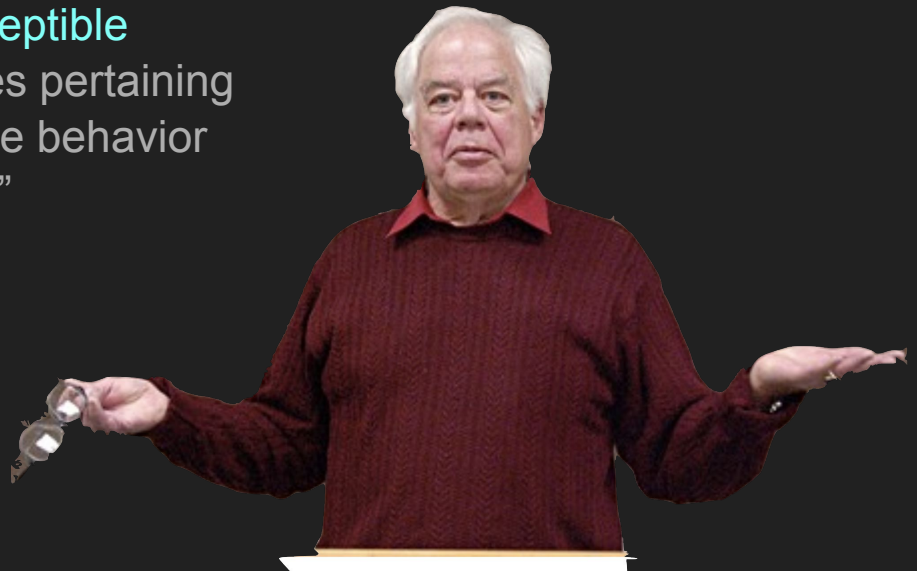
- Surely this is theory-laden!

There's no unique MI!

What's the manifest image?

"The conceptual framework which I am calling the manifest image… does *not* include, namely that which involves the postulation of imperceptible entities, and principles pertaining to them, to explain the behavior of perceptible things."

(Sellars 1963: 6-7)



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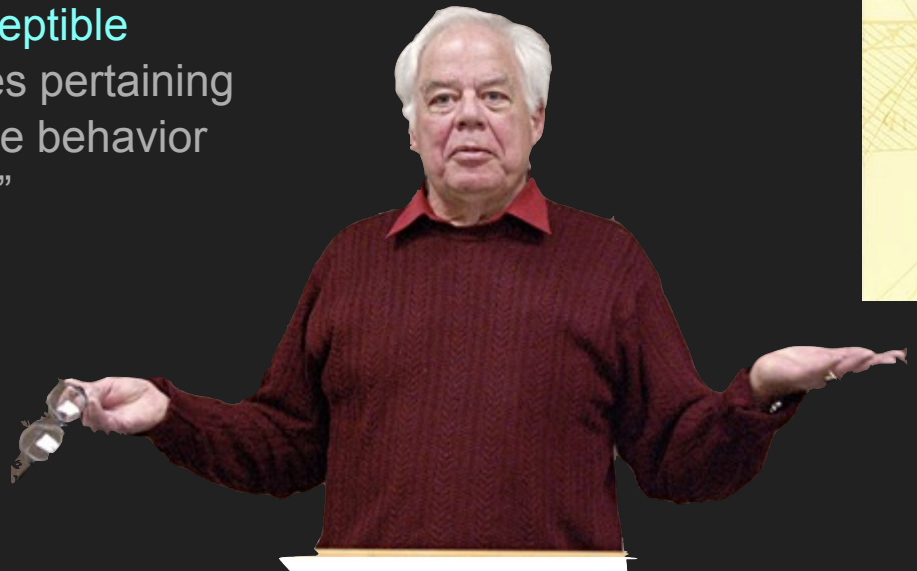

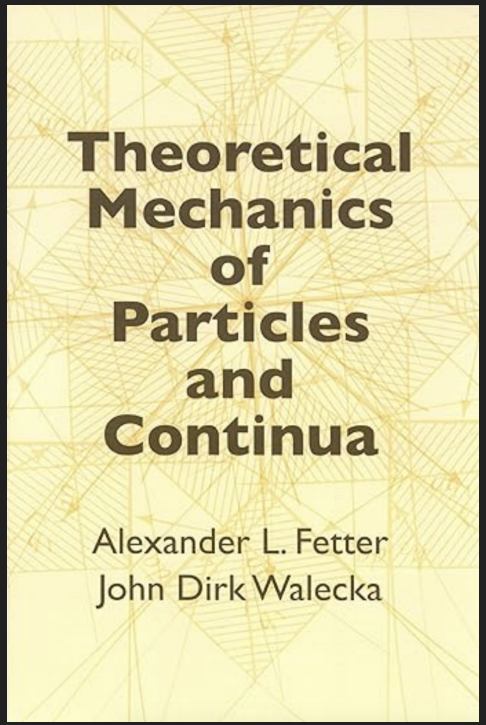

Two worries arise.

1. **Unobservable entities in classical mechanics.**

2. **Contingency.**

1. Unobservable entities in classical mechanics

The problem: Classical mechanics makes use of all sorts of theoretical entities that are unobservable, such as point particles and fields, that decisively are not part of the manifest image!

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Reply: Classical mechanics is a mere idealized representation of the world. Detecting the real-world counterparts to the objects of the theory should be sufficient to dissolve this worry; we can (often) readily observe the sorts of systems that we use classical mechanics to model.

2. Contingency

The problem: Of all of the available theories, why look to proximity to ontology-according-to-classical-mechanics as a guide to our metaphysical theory choice? After all, that the body of theory that we call classical mechanics is our classical mechanics is a highly contingent matter.

2. Contingency

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Reply: For concerns relating to the divergence between their ontic commitments and those of the Everettian, the differences between the various formulations are probably negligible. Classical mechanics is an excellent candidate for this role because it is the predecessor theory to quantum mechanics.

Toward a modest conservatism

It is in our best interest to make modest modifications to our ontological commitments to help us avoid taking on unnecessary ontic commitments.

This is not to say that our ontic commitments will not shift as our best scientific theories evolve.

We should just employ a prudent conservatism about such matters.

COMPARATIVE CLASSICAL DIVERGENCE.

For any two theories T_A and T_B that have identical explanatory and predictive power, we ought to prefer the theory that minimizes the difference between the way the theory says the world is and the way classical mechanics says the world is.

ABSOLUTE CLASSICAL DIVERGENCE.

We ought to accept some theory *T* only if the difference between the way *T* says the world is and the way classical mechanics says the world is falls below some threshold amount.

(Updated) taxonomy of simplicity considerations

	Absolute	**Comparative**
Ontic abundance	We ought to accept any theory T only if theory T ontologically commits us to fewer than n unobservable objects.	For any two theories T_A and T_B that have identical explanatory and predictive power, we ought to prefer the theory with more modest commitments to unobservable objects.
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- It’s difficult to know how to definitively apply comparative ontic abundance and comparative postulate abundance to either condemn or vindicate many-worlds ontologies

- It’s not yet clear whether we should accept *any* of these norms.

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For any two theories T_A and T_B that have identical explanatory and predictive power, we ought to prefer the theory with a more economical set of postulates.

Compare this to an analogous norm in scientific inquiry.

Scientists and metaphysicians s both seek to understand

what the world is like,

so shouldn't they share methodologies?

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1. Simpler theories stand a stronger chance of confirmation. (They're easier to work with.)
2. Historically, more complex theories tend to be replaced by simpler theories. (Eg, replace circular orbits + epicycles with elliptical orbits.)

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(This norm fails to have any normative punch!)

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In the case of metaphysics, however, there is (once again) no relevant notion of confirmation.

It's not obvious that this norm should apply either.

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Observation: We tend to prefer metaphysical theses that do not wildly contradict our common sense. (Emery 2017)

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There's no reason to think that CCD privileges theories that are more likely to be *true.*

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There's no real sense in which there's global progress in metaphysics.

But, surely individual research communities build on existent work over time.

Lakatos-inspired *hard core metaphysics*?

Lakatos’s hard core

The protective belt surrounds the core; this involves peripheral commitments and can change over time.

The hard core cannot change. It provides the identity conditions for the community.

Lakatos's hard core

This account:
1. describes research programs and how they operate, and
2. tells us when research programs are degenerating.

The protective belt surrounds the core; this involves peripheral commitments and can change over time.

The hard core cannot change. It provides the identity conditions for the community.

Hard core metaphysics

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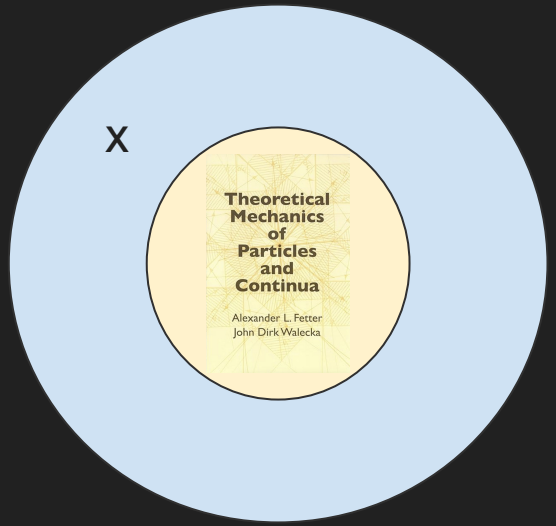
Research communities within metaphysics can be defined by their hard cores–the ontic commitments of their predecessor theories.



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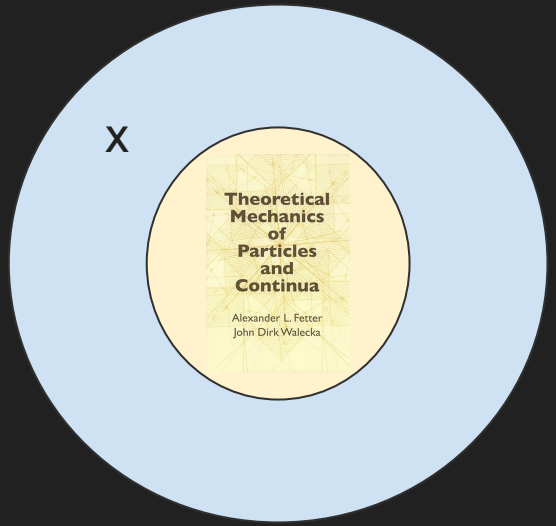

By minimizing the distance between the set of ontic commitments of the shared predecessor theory and the new metaphysical theories, research communities will avoid committing themselves to unnecessary ontology.

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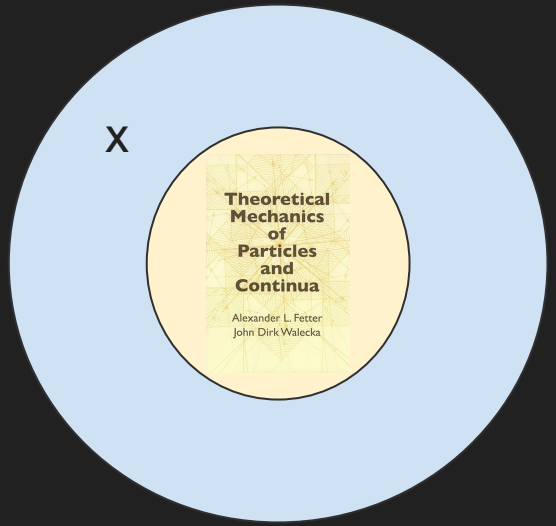

It's not that this norm helps us select theories that are *more likely to be True*, but this norm helps us more carefully explore possibility space within research programs.

Hard core metaphysics: is this too dogmatic?

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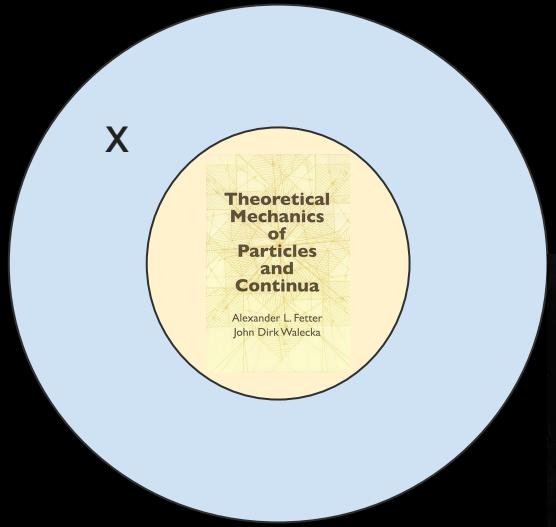

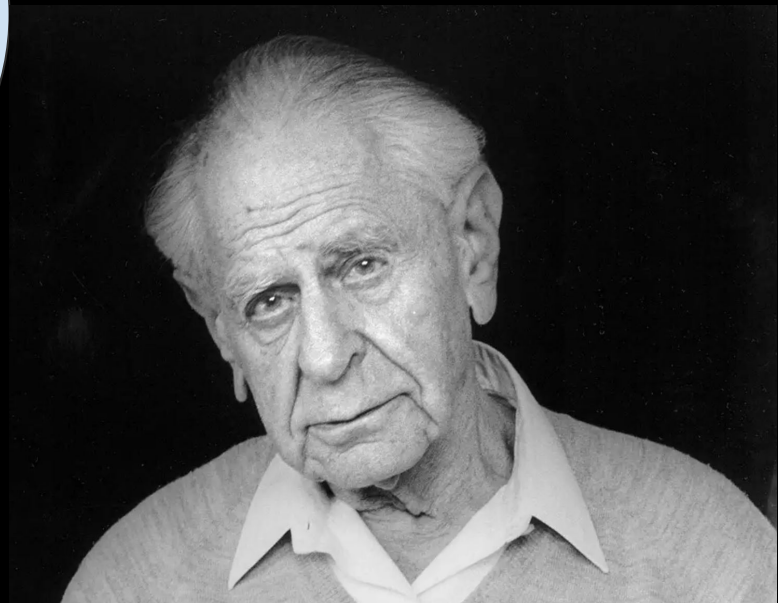

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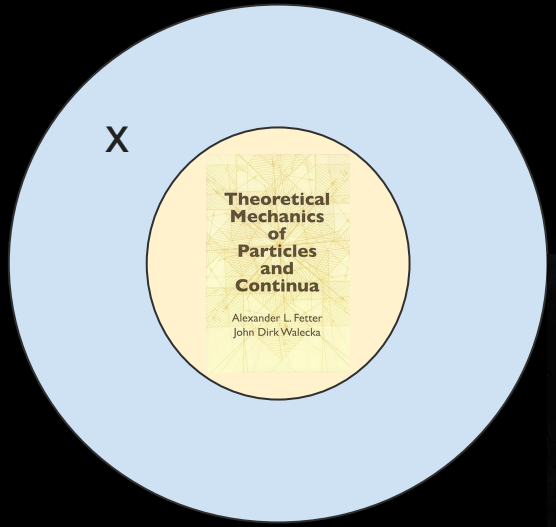
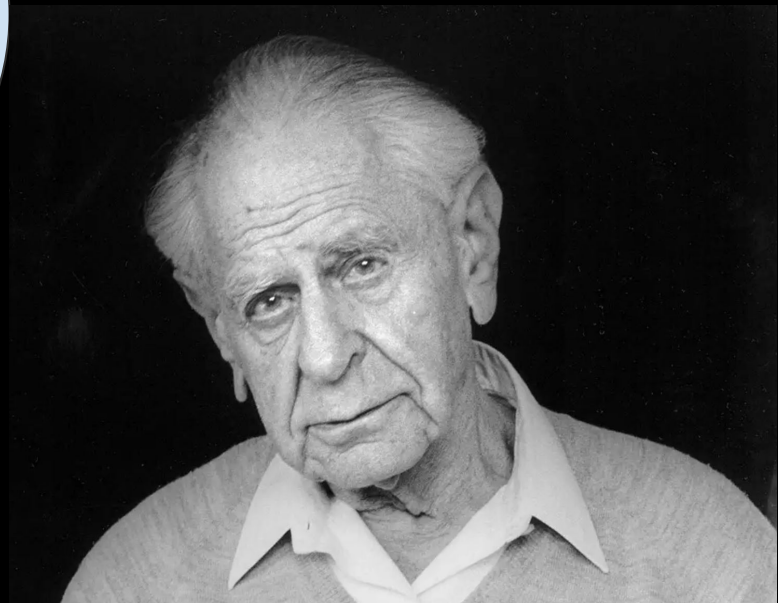


I don’t think so.



Outline

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Seek to minimize classical divergence.

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Classical mechanics → 

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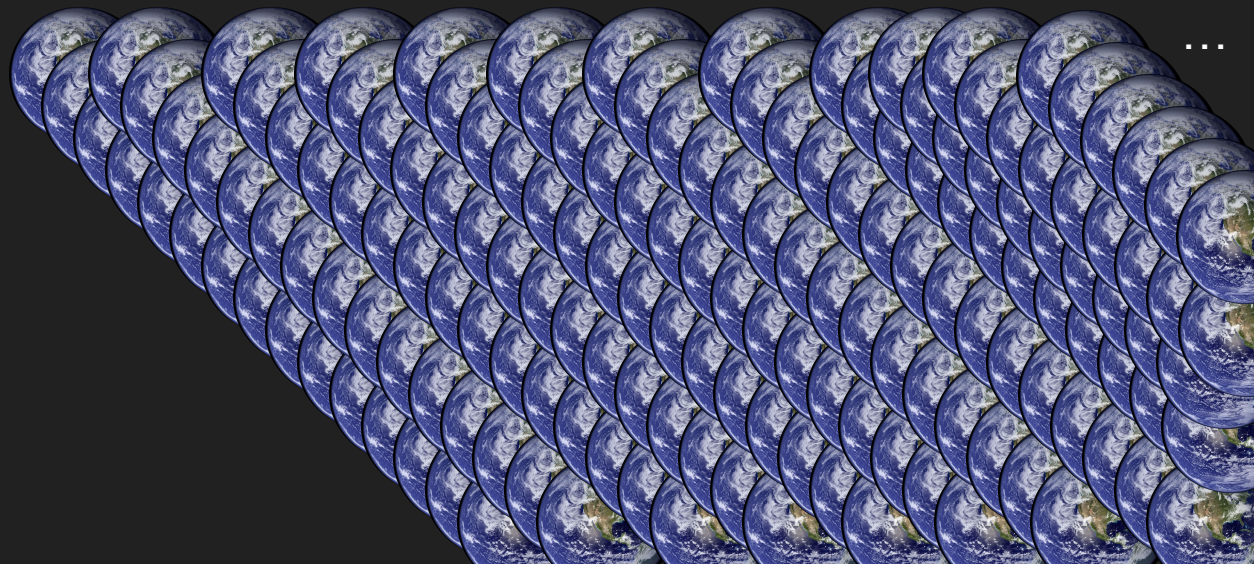
Orthodox (Oxford) EQM → 

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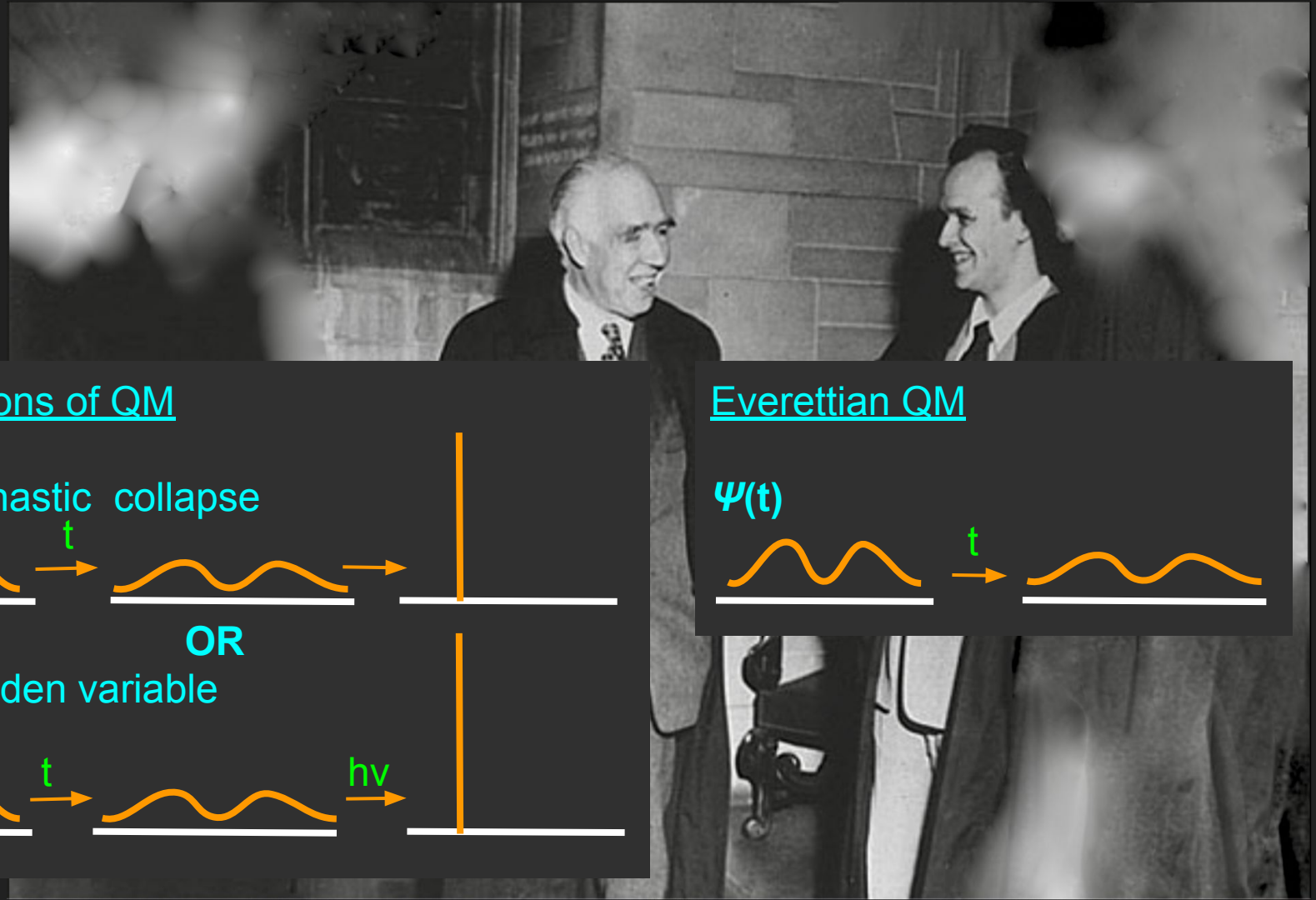
Other versions of QM → 



Other versions of QM

Ψ(t) + stochastic collapse

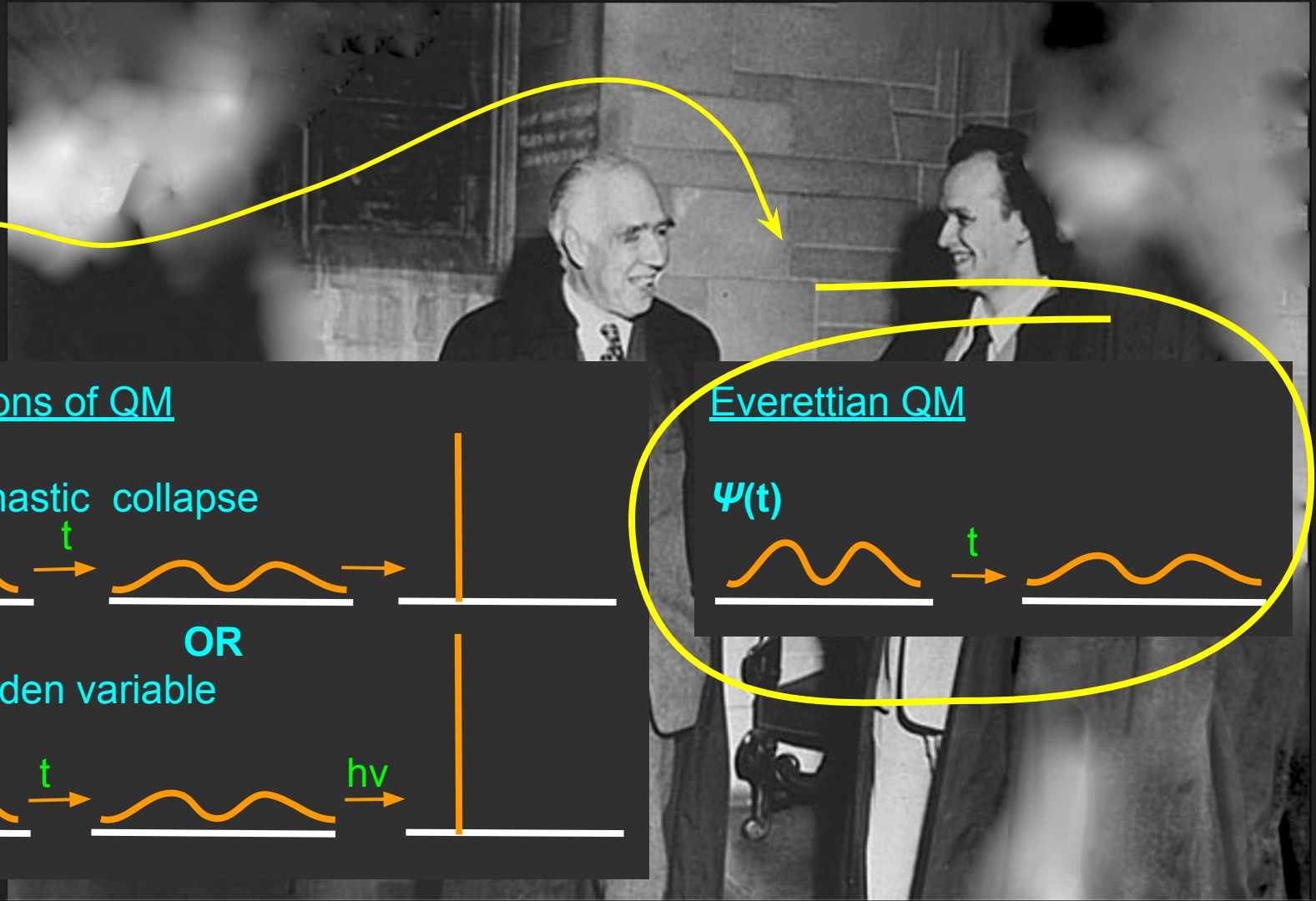
OR

Ψ(t) + a hidden variable

Everettian QM

Ψ(t)

We can get this for less if we can do EQM without many worlds.



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thanks.

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