Wavefunction as a Concrete Object

Paul Tappenden - 1st December 2023

paulpagetappenden@gmail.com

Wavefunction as
a Concrete Object

«

The wave function is taken as the basic physical entity

»

Hugh Everett III
1957

This paper proposes to regard pure wave mechanics as a complete theory.

It postulates that a wave function [...] supplies a complete mathematical model for every isolated physical system. [...]

It further postulates that every system that is subject to external observation can be regarded as part of a larger isolated system.

is a wave function
an abstract mathematical model
or a
concrete physical entity
?
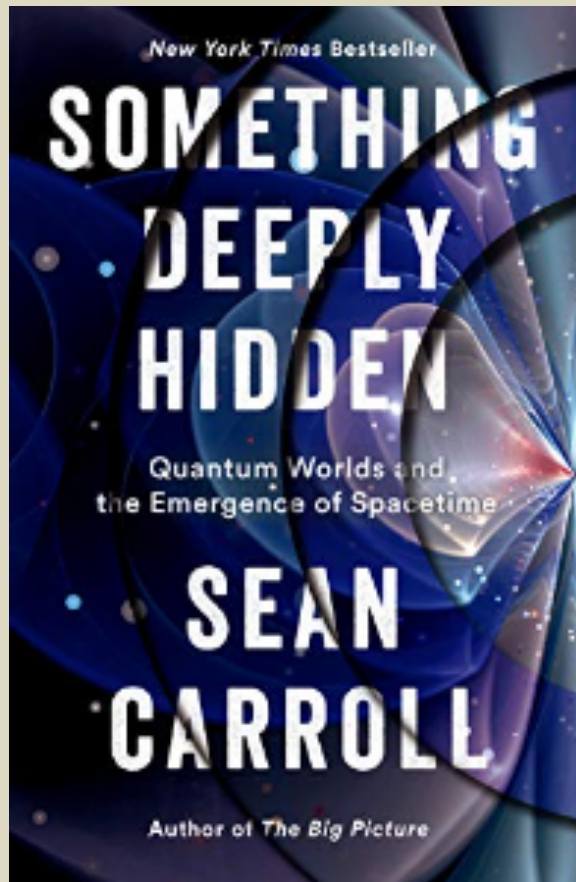
What the World Is Made Of… A quantum wave function
p.49

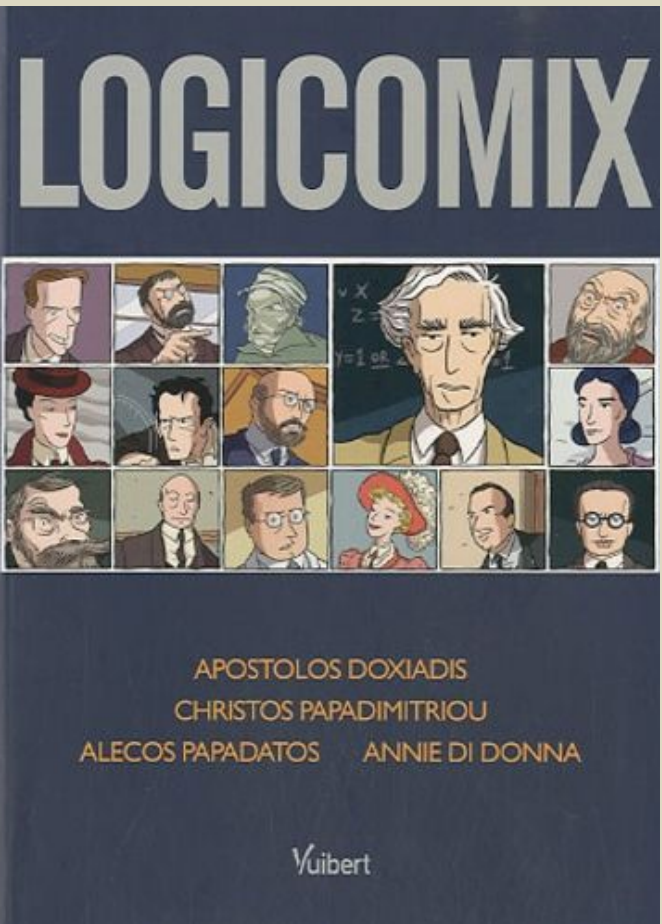**wave functions are superpositions of different possibilities**
p.64

Wave functions may be real, but they're undeniably abstract
p.79

our **concrete** world is undeniably abstract
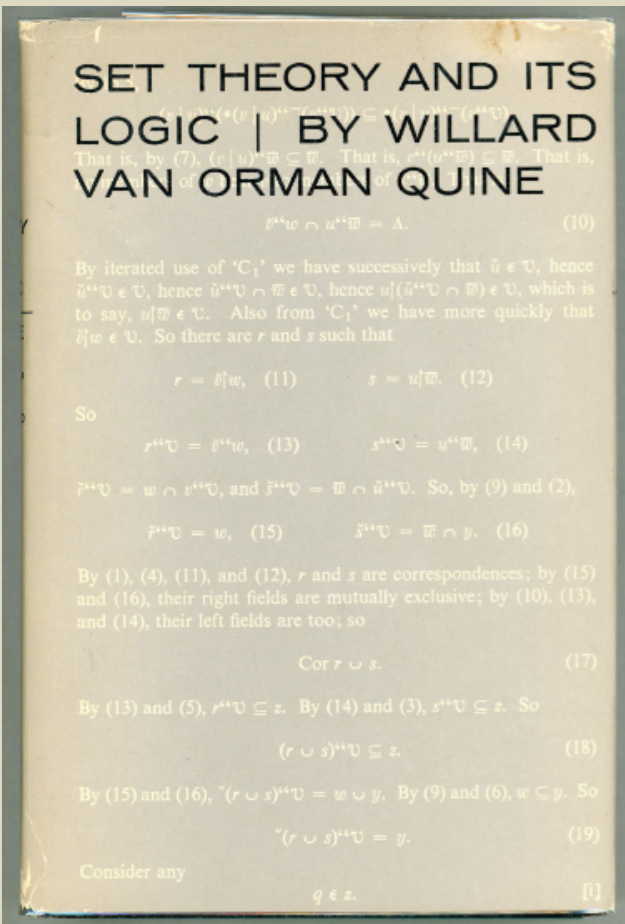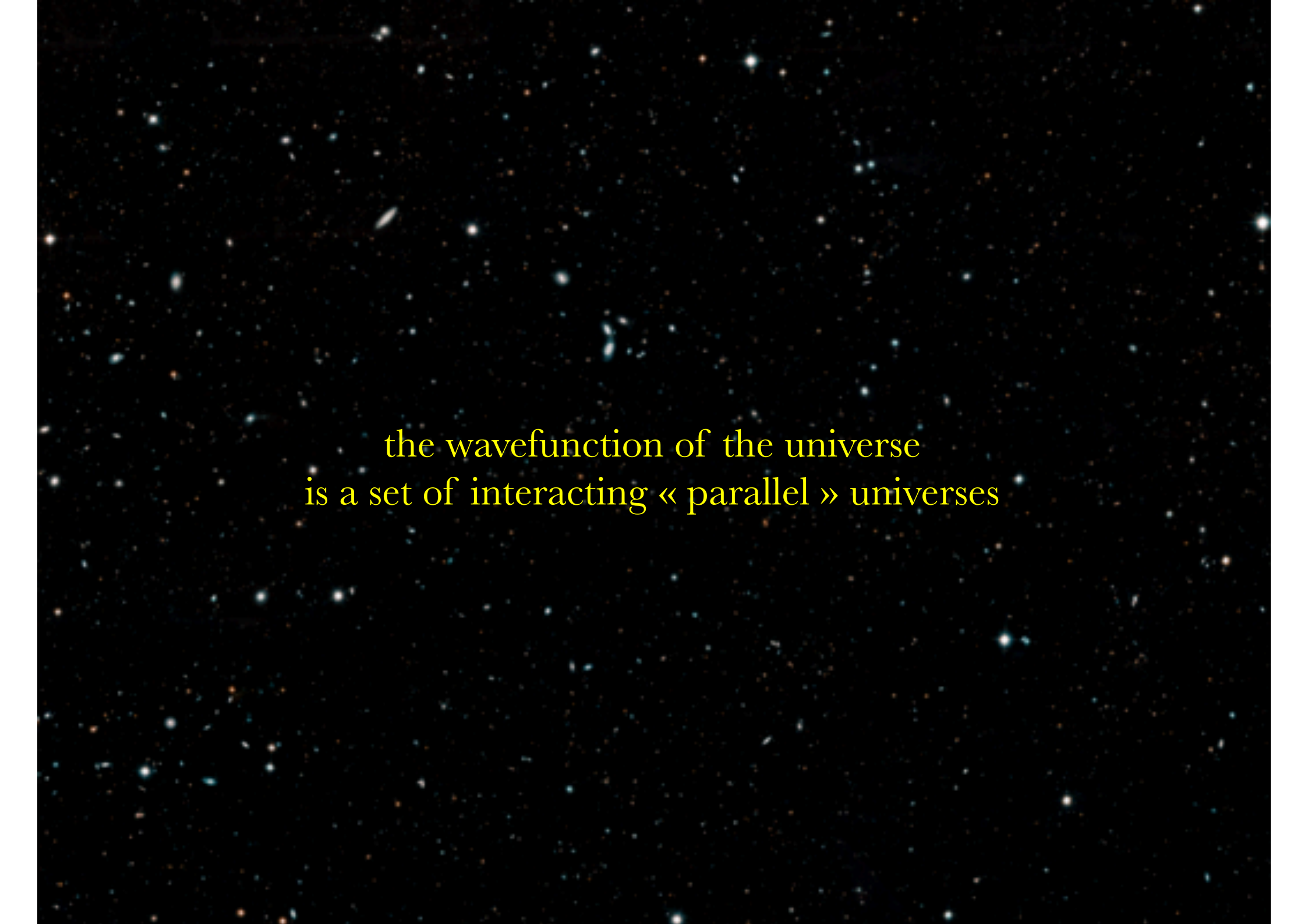and made of possibilities?
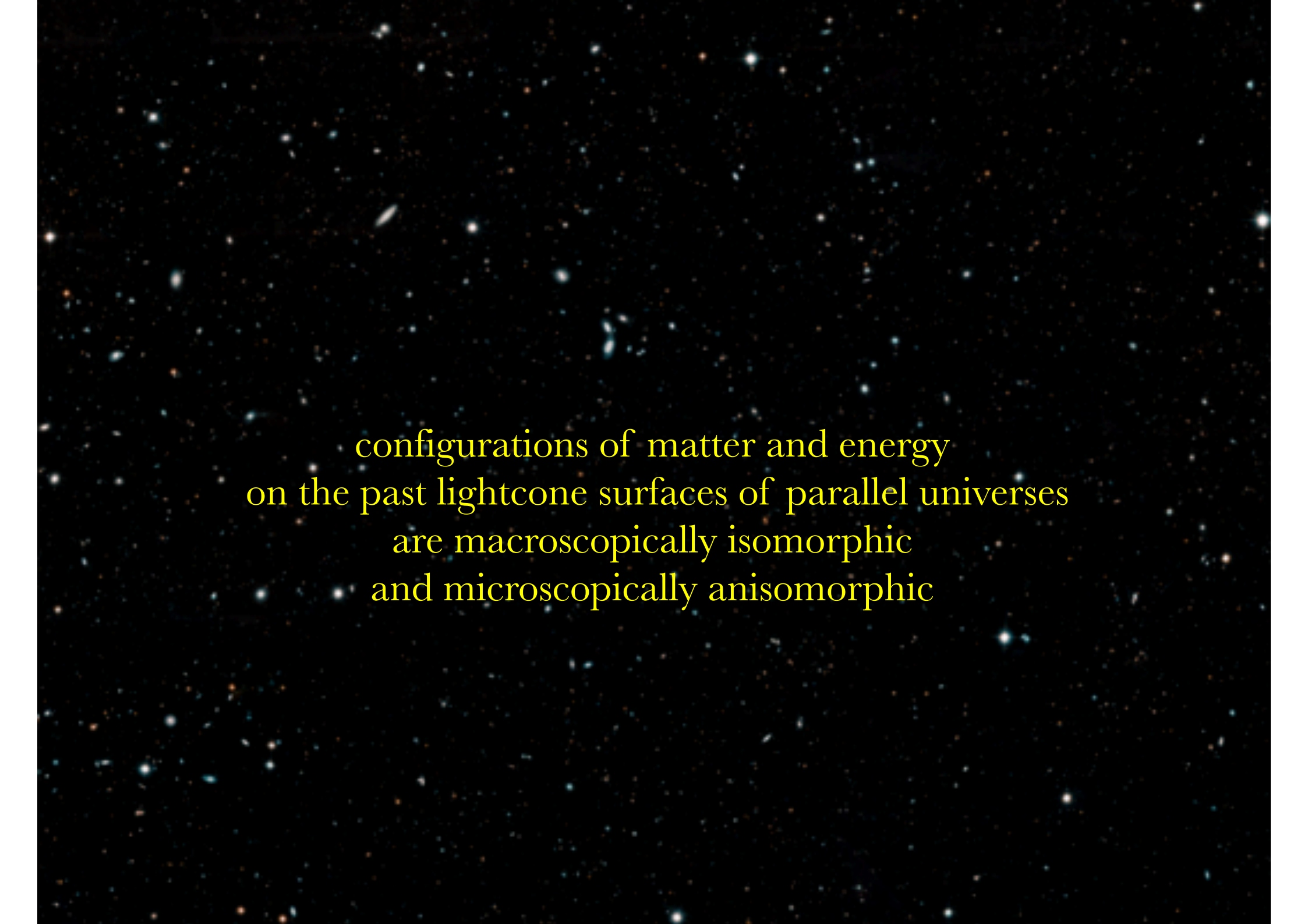HELP !

set theory to the rescue !

LOGICOMIX

APOSTOLOS DOXIADIS

CHRISTOS PAPADIMITRIOU

ALECOS PAPADATOS   ANNIE DI DONNA

Vuibert

Boole
Cantor
Frege
Hilbert
Russell
Peano
Poincaré
Gödel
Von Neumann
Turing

SET THEORY AND ITS LOGIC | BY WILLARD VAN ORMAN QUINE

That is, by (7), $(r \mid u)``\overline{w} \subseteq \overline{w}$. That is, $r```(u``\overline{w}) \subseteq \overline{w}$. That is,

$$\overline{v}``w \cap u``\overline{w} = \Lambda. \qquad (10)$$

By iterated use of 'C₁' we have successively that $\hat{u} \in \mathcal{U}$, hence $\hat{u}``\mathcal{U} \in \mathcal{U}$, hence $\hat{u}``\mathcal{U} \cap \overline{w} \in \mathcal{U}$, hence $u|(\hat{u}``\mathcal{U} \cap \overline{w}) \in \mathcal{U}$, which is to say, $u|\overline{w} \in \mathcal{U}$. Also from 'C₁' we have more quickly that $\hat{v}|w \in \mathcal{U}$. So there are r and s such that

$$r = \hat{v}|w, \quad (11) \qquad\qquad s = u|\overline{w}. \quad (12)$$

So

$$r``\mathcal{U} = \hat{v}``w, \quad (13) \qquad\qquad s``\mathcal{U} = u``\overline{w}, \quad (14)$$

$\check{r}``\mathcal{U} = w \cap v``\mathcal{U}$, and $\check{s}``\mathcal{U} = \overline{w} \cap \hat{u}``\mathcal{U}$. So, by (9) and (2),

$$\check{r}``\mathcal{U} = w, \quad (15) \qquad\qquad \check{s}``\mathcal{U} = \overline{w} \cap y. \quad (16)$$

By (1), (4), (11), and (12), r and s are correspondences; by (15) and (16), their right fields are mutually exclusive; by (10), (13), and (14), their left fields are too; so

$$\text{Cor } r \cup s. \qquad (17)$$

By (13) and (5), $r``\mathcal{U} \subseteq z$. By (14) and (3), $s``\mathcal{U} \subseteq z$. So

$$(r \cup s)``\mathcal{U} \subseteq z. \qquad (18)$$

By (15) and (16), $\check{}(r \cup s)``\mathcal{U} = w \cup y$. By (9) and (6), $w \subseteq y$. So

$$\check{}(r \cup s)``\mathcal{U} = y. \qquad (19)$$

Consider any

$$q \in z. \qquad [1]$$

the wavefunction of the universe
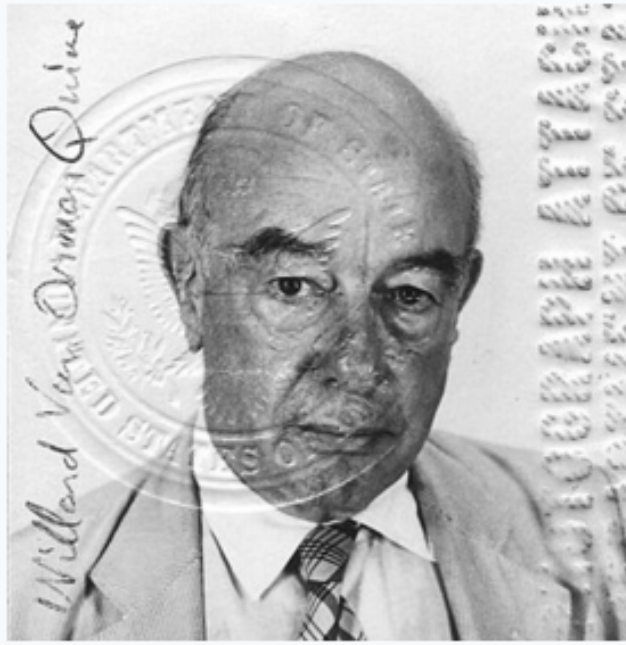is a set of interacting « parallel » universes

configurations of matter and energy
on the past lightcone surfaces of parallel universes
are macroscopically isomorphic
and microscopically anisomorphic

an observer's *environmental* universe
is a set of interacting *elemental* universes

Willard Van Orman Quine

none of the utility of class theory is impaired
by counting an individual
its unit class
the unit class of that unit class
and so on
as one and the same thing

Set Theory and Its Logic
2nd edition, p. 31
1969

an *elemental* universe is a Quine atom

a set which is its own sole element

it's not an abstract set

it's a concrete set

Concrete Sets

the hypothesis

**a set of Quine atoms has all and only
the properties which its elements share
other than those logically excluded**

**excluded properties include
number of elements
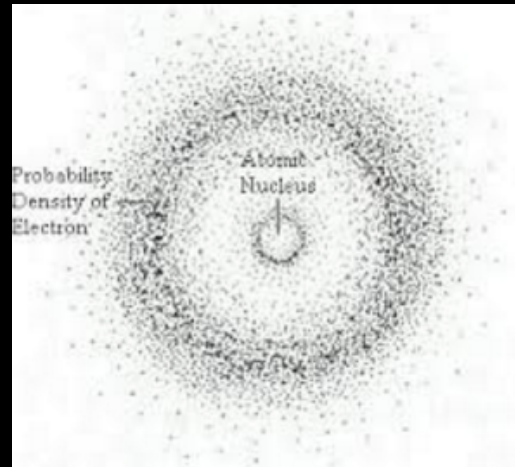value-definiteness**

sets of sets of Quine atoms are abstract
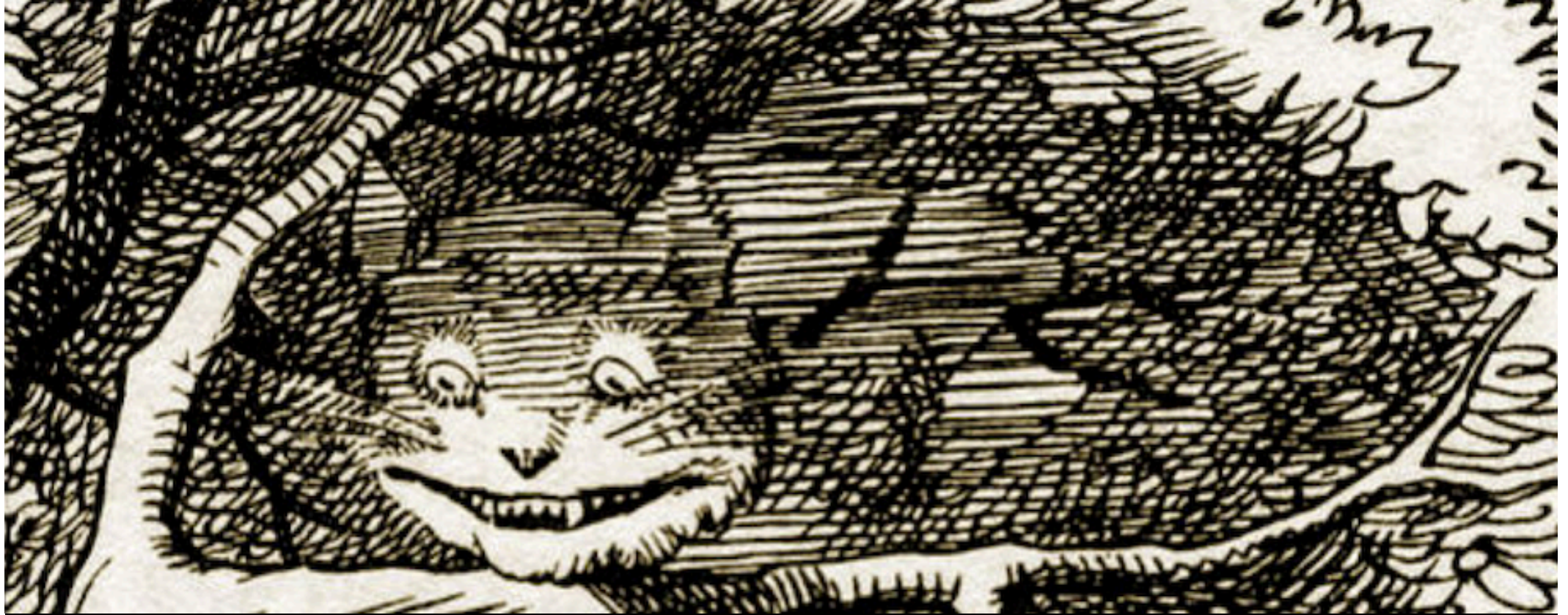
a single *environmental* electron
is a set of *elemental* electrons which are Quine atoms

each following a different trajectory
in an *elemental* universe which is a Quine atom
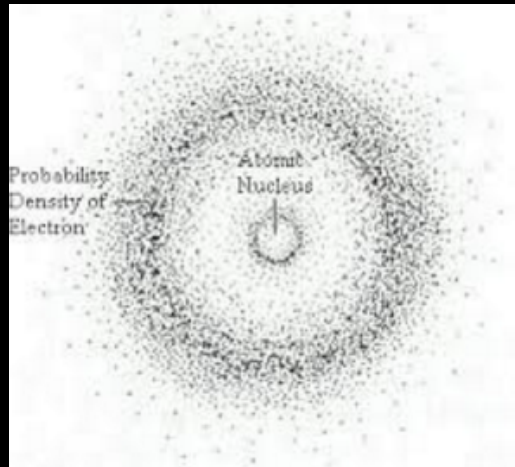
**an *environmental* electron cloud
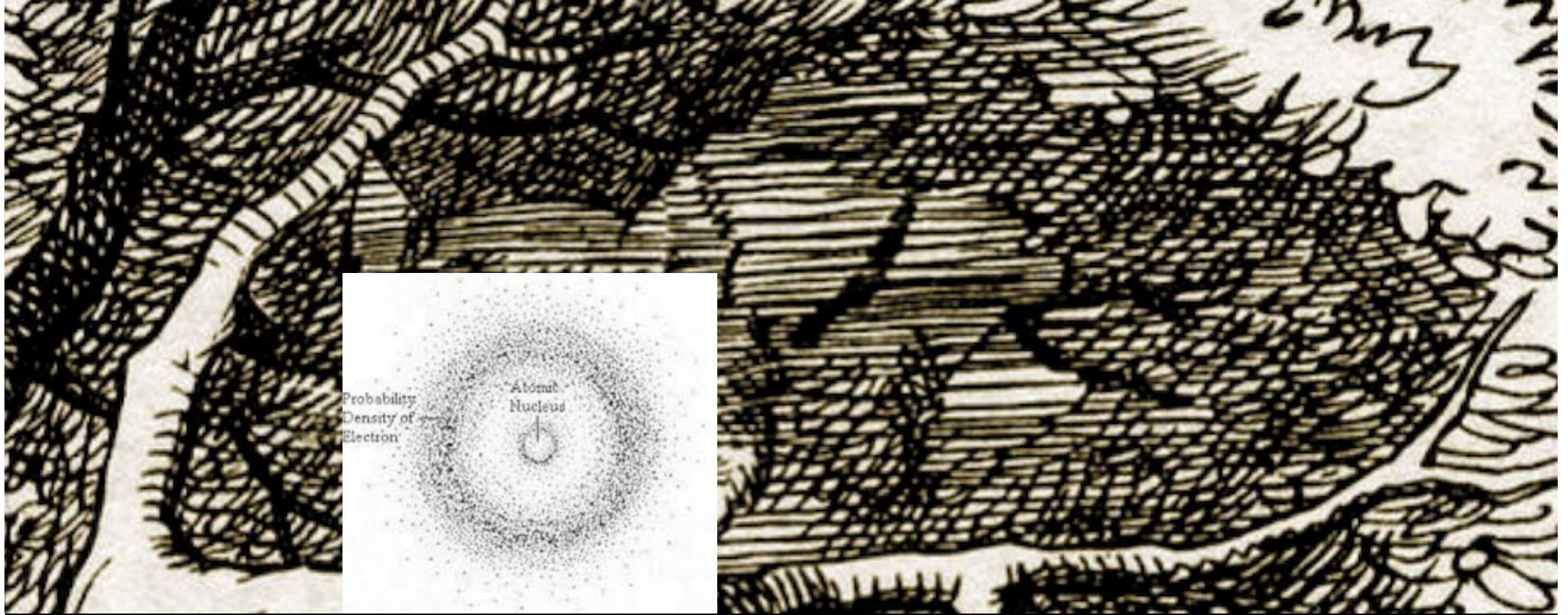is a set of *elemental* electrons**

**probability density for a region in the cloud
is a subset measure on the set of *elemental* universes
which is the observer's universe**

**it's the measure of the subset of *elemental* universes where
elemental electrons are located at parallel *elemental* regions**
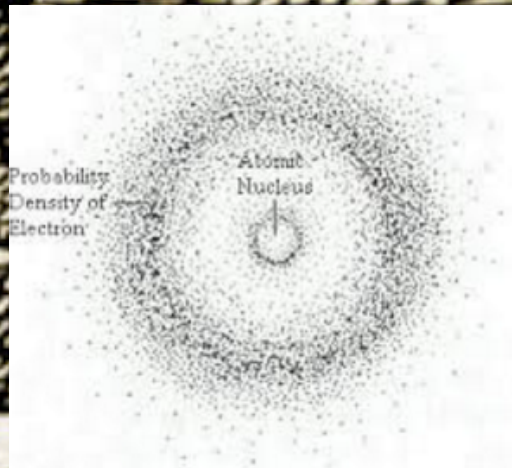
on measuring the cloud
Alice splits into observers observing
environmental electrons
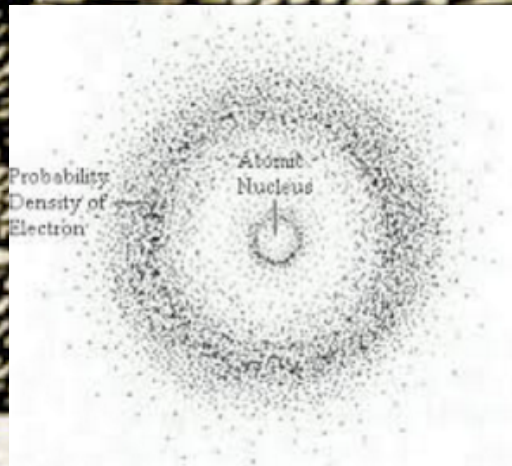in different regions

Probability
Density of
Electron

Atomic
Nucleus

she splits because her *environmental* body
is a set of *elemental* bodies which partitions into subsets
that are the *environmental* bodies of observers
making different observations

the subset measure of each downstream Alice's universe
relative to Alice's universe
is the probability that Alice will be an observer
observing an electron in each downstream region

phase arises via interactions between *elemental* universes

PHYSICAL REVIEW X **4**, 041013 (2014)

Quantum Phenomena Modeled by Interactions between Many Classical Worlds

Michael J. W. Hall,[1] Dirk-André Deckert,[2] and Howard M. Wiseman[1,*]

arXiv: 1402.6144

Quantum Mechanics as Classical Physics
Author(s): Charles T. Sebens
Source: *Philosophy of Science*, Vol. 82, No. 2 (April 2015)

arXiv: 1403.0014

Quantum mechanics as a deterministic theory of a continuum of worlds

Kim Joris Boström ✉

Quantum Studies: Mathematics and Foundations **2**, 315–347 (2015) | Cite this article

arXiv: 1410.5653

« Many Interacting Worlds »

but
Many Interacting Worlds
lacks *environmental* superposition
because observers inhabit individual universes
not sets of universes

Louis de Broglie, Solvay 1927

a wave in configuration space needs configurations

A Set-Theoretic Metaphysics for Quantum Mechanics

an observer's universe is a set of interacting parallel universes
decoherence is its partitioning
into macroscopically anisomorphic subsets
arXiv: 2309.14004