

# Perspectives on the Universe

Graham Priest

June 23, 2020

# A Perspective on Things

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## 2.1 One or Many?

# The Universe

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- The standard view: one universe,  $V$

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*There are diverse distinct concepts of set, each instantiated in a corresponding set-theoretic universe, which exhibit diverse set-theoretic truths. Each such universe exists independently in the same Platonic sense that proponents of the universe regard their universe to exist.*

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- There is no unique universe: there is a plurality of such

# The Universe of Pluriverses

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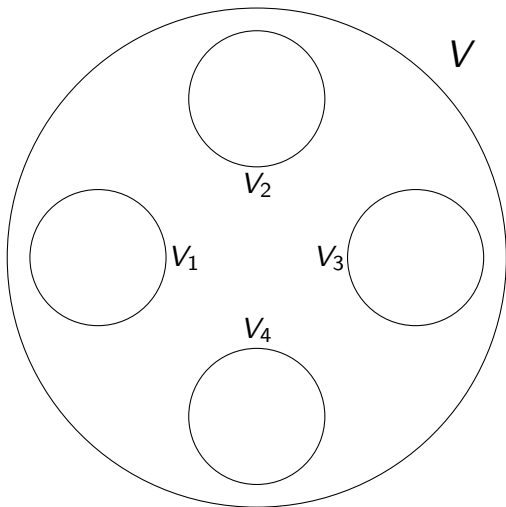
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## 2.2 Enter Perspectivalism

# Perspectivalism

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- What is perspectivalism?

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- What is perspectivalism?
- ‘Such and such a joke is funny’ is not true/false *simpliciter*

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- What is perspectivalism?
- ‘Such and such a joke is funny’ is not true/false *simpliciter*
- What is so is ‘Such and such a joke is funny *wrt a certain sense of humour*’

# Perspectivalism of?

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## ■ Local vs global perspectivalism

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- Local vs global perspectivalism
- Nietzsche
- Jainism

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- Local vs global perspectivalism
- Nietzsche
- Jainism
- What are perspectives perspectives *of*?

# Perspectives on $\mathfrak{U}$

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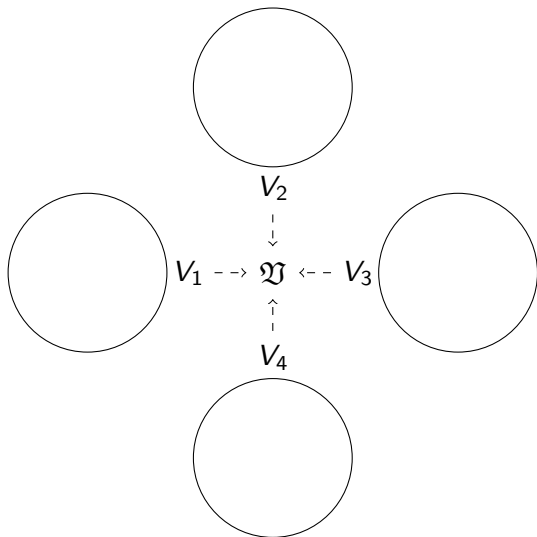
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- $\mathfrak{U}$  is the mathematical object which is the totality of all collections (though it has no intrinsic structure)

# Absoluteness

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- Some claims are absolute (hold on every universe)

# Absoluteness

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- Some claims are absolute (hold on every universe)
  
- Some claims are not

# Universes within Universes

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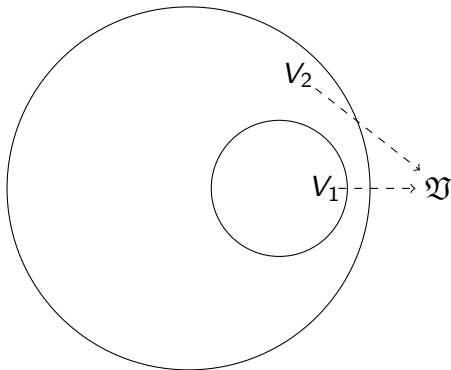
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■ And so?

## 2.3 Changing the logic (not the Subject)

*The background idea of the multiverse, of course, is that there should be a large collection of universes, each a model of (some kind of) set theory. There seems to be no reason to restrict inclusion only to ZFC models, as we can include models of weaker theories  $ZF$ ,  $KP^-$ ,  $KP$ , and so on, perhaps even down to second-order number theory, as this is set-theoretic in a sense. At the same time, there is no reason to consider all universes in the multiverse equally, and we may be simply more interested in the parts of the multiverse consisting of universes satisfying very strong theories, such as  $ZF$  plus large cardinals.*

# The Comprehension Principle [CP]

- The paraconsistent logic  $LP$  is a generalisation of classical logic

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# The Comprehension Principle [CP]

- The paraconsistent logic  $LP$  is a generalisation of classical logic
- So every classical  $ZFC$  model is an  $LP$  model

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- The paraconsistent logic  $LP$  is a generalisation of classical logic
- So every classical  $ZFC$  model is an  $LP$  model
- But there are (non-trivial)  $LP$  models which are models of all the theorems of  $ZFC$  plus:
  - $\exists x \forall y (y \in x \equiv A(y))$

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- Hence, moving to  $LP$  *expands* the pluriverse

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  - $\exists x \forall y (y \in x \equiv A(y))$
- Hence, moving to  $LP$  *expands* the pluriverse
- Illegitimate perspectives?

## 3.1 Mathematics (Pl.)

# Mathematical Monism

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## ■ Mathematical monism

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- Mathematical monism
- ... and the pluriverse
- ... and paraconsistent logic



# Mathematical Pluralism

- Mathematical pluralism

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- Mathematical pluralism
  - paraconsistent set theory

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  - paraconsistent set theory
  - paraconsistent topology

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- Mathematical pluralism
  - paraconsistent set theory
  - paraconsistent topology
  - intuitionistic smooth infinitesimal analysis

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  - paraconsistent set theory
  - paraconsistent topology
  - intuitionistic smooth infinitesimal analysis
  - Heyting Arithmetic plus Church's Thesis

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  - intuitionistic smooth infinitesimal analysis
  - Heyting Arithmetic plus Church's Thesis
- Note 1: this is not to claim that all such mathematics are equally rich, interesting, etc.

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  - Heyting Arithmetic plus Church's Thesis
- Note 1: this is not to claim that all such mathematics are equally rich, interesting, etc.
- Note 2: we are talking here about *pure* mathematics

## 3.2 The Real Pluriverse



# Non-Classical Universes

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- Some non-classical universes:

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- Some non-classical universes:
  - set theoretic axioms of *ZFC* but intuitionist logic

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- Some non-classical universes:
  - set theoretic axioms of *ZFC* but intuitionist logic
  - set theory based on the notion of a spread

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- Some non-classical universes:
  - set theoretic axioms of *ZFC* but intuitionist logic
  - set theory based on the notion of a spread
  - fuzzy set-theory based on Łukasiewicz continuum-valued logic

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  - set theory based on the notion of a spread
  - fuzzy set-theory based on Łukasiewicz continuum-valued logic
  - set-theory based on a relevant logic

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  - set theoretic axioms of *ZFC* but intuitionist logic
  - set theory based on the notion of a spread
  - fuzzy set-theory based on Łukasiewicz continuum-valued logic
  - set-theory based on a relevant logic
  - set theory based on quantum logic

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  - set theoretic axioms of *ZFC* but intuitionist logic
  - set theory based on the notion of a spread
  - fuzzy set-theory based on Łukasiewicz continuum-valued logic
  - set-theory based on a relevant logic
  - set theory based on quantum logic
- a mathematician may well not be interested in all the universes

## 3.3 ~~The~~ Structure of the Pluriverse



# The Plurality of Universes

- each universe,  $\mathfrak{U}$ , has its own logic,  $L_{\mathfrak{U}}$ .

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# The Plurality of Universes

- each universe,  $\mathfrak{U}$ , has its own logic,  $L_{\mathfrak{U}}$ .
- write  $\mathfrak{U} \Vdash A$  to mean that  $A$  holds in  $\mathfrak{U}$ .

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- each universe,  $\mathfrak{U}$ , has its own logic,  $L_{\mathfrak{U}}$ .
- write  $\mathfrak{U} \Vdash A$  to mean that  $A$  holds in  $\mathfrak{U}$ .
- $\Sigma_{\mathfrak{U}} = \{A : \mathfrak{U} \Vdash A\}$  is closed under  $L_{\mathfrak{U}}$ .

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- each universe,  $\mathfrak{U}$ , has its own logic,  $L_{\mathfrak{U}}$ .
- write  $\mathfrak{U} \Vdash A$  to mean that  $A$  holds in  $\mathfrak{U}$ .
- $\Sigma_{\mathfrak{U}} = \{A : \mathfrak{U} \Vdash A\}$  is closed under  $L_{\mathfrak{U}}$ .
- set theorists may investigate each  $\Sigma_{\mathfrak{U}}$

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- each universe,  $\mathfrak{U}$ , has its own logic,  $L_{\mathfrak{U}}$ .
- write  $\mathfrak{U} \Vdash A$  to mean that  $A$  holds in  $\mathfrak{U}$ .
- $\Sigma_{\mathfrak{U}} = \{A : \mathfrak{U} \Vdash A\}$  is closed under  $L_{\mathfrak{U}}$ .
- set theorists may investigate each  $\Sigma_{\mathfrak{U}}$
- they will also investigate the properties of and relations between different universes.

# The Plurality of Universes

## Perspectives on the Universe

Graham Priest

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- set theorists may investigate each  $\Sigma_{\mathfrak{U}}$
- they will also investigate the properties of and relations between different universes.
- using what set-theoretic structure?

*The multiverse perspective ultimately provides what I view as an enlargement of the theory/metatheory distinction. There are not merely two sides for this distinction, the object theory and the metatheory, but rather there is a vast hierarchy of metatheories. Every set-theoretic context, after all, provides in effect a meta-theoretic background for the models and theories that exist in that context, a model theory for the models and theories one finds there. Every model of set theory provides an interpretation of second-order logic, for example, using the sets and predicates existing there.*

# Hamkins (ctd.)

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*Yet, a given model of set theory  $M$  may itself be a model inside a larger model of set theory  $N$ , and so what was previously the absolute set-theoretic background, for the people living inside  $M$ , becomes just one of the possible models of set theory, from the perspective of the larger model  $N$ . Each meta-theoretic context becomes just another model at the higher level. In this way, we have theory, metatheory, metametatheory and so on, a vast hierarchy of possible set-theoretic backgrounds.*



# A Universal Perspective

- any universe which contains the universe(s) in question may be used to study it (them)

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- any universe which contains the universe(s) in question may be used to study it (them)
- a sub-universe may have a different internal logic to the super-universe

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- any universe which contains the universe(s) in question may be used to study it (them)
- a sub-universe may have a different internal logic to the super-universe
- different super-universes may attribute different properties/relations to sub-universes

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- including the relation  $\mathcal{U} \Vdash A$

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- any universe which contains the universe(s) in question may be used to study it (them)
- a sub-universe may have a different internal logic to the super-universe
- different super-universes may attribute different properties/relations to sub-universes
- including the relation  $\mathcal{U} \Vdash A$
- But the perspective provided by each super-universe is equally legitimate

*To put the matter in general terms, if we become interested in relations among particular theories or systems,  $S_1, S_2, \dots, S_n$ , then we need a perspective—theory, structure—from which we can refer to  $S_1, S_2, \dots, S_n$ , at once, so to speak, and we need some account of the relations between theories of systems  $S_1, S_2, \dots, S_n$ . But we do not need a single foundational theory that accommodates every possible mathematical theory, or every possible logic...*

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## 3.4 Relativism

# Relativism and Self-Refutation

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- relativism and self-refutation



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- relativism and self-refutation
- mathematical pluralism is not self-refuting

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- relativism and self-refutation
- mathematical pluralism is not self-refuting
- the claim that there is only a pluriverse does seem to be self-refuting

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- relativism and self-refutation
- mathematical pluralism is not self-refuting
- the claim that there is only a pluriverse does seem to be self-refuting
- perspectivalism is a reply to this objection

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- mathematical pluralism is not self-refuting
- the claim that there is only a pluriverse does seem to be self-refuting
- perspectivalism is a reply to this objection
- but is perspectivalism about the pluriverse self-refuting?

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- mathematical pluralism is not self-refuting
- the claim that there is only a pluriverse does seem to be self-refuting
- perspectivalism is a reply to this objection
- but is perspectivalism about the pluriverse self-refuting?
- no.

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... such is my perspective on matters