



# Consciousness and the implicate order

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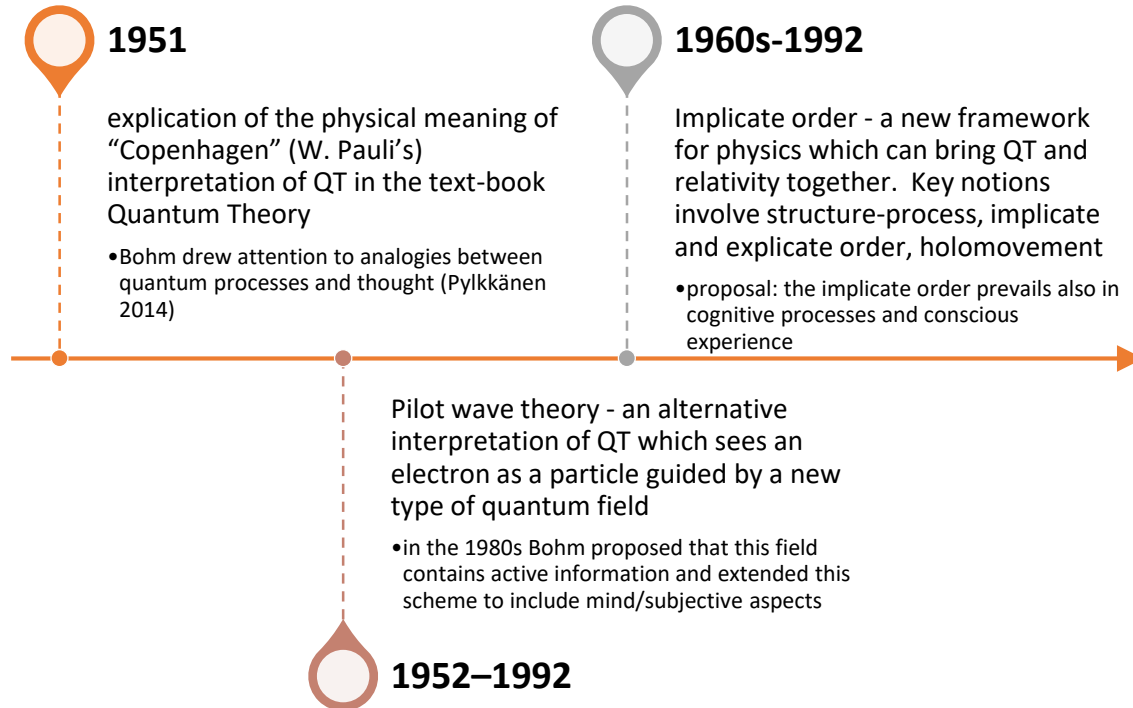
“Expansions of Quantum Physics towards Consciousness”  
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# Bohm, Quantum Mechanics and the mind

- The physicist-philosopher David Bohm (1917-1992) developed many different (yet interrelated) approaches to quantum theory (and to modern physics more generally)
  - applied physics-inspired ideas to understand mind/cognition/consciousness
  - sometimes even made use of his ideas about the mind when developing theories about matter!
    - cf. Plotnitsky: Bohm as a Hegelian, vs. Bohr as a Kantian)



# Bohmian quantum approaches and their relevance to mind



# The pilot wave theory (de-Broglie-Bohm, "hidden variables", causal interpretation, ontological interpretation...)

- Active information at the quantum level can be seen as a primitive mind-like quality
  - it could serve as a bridge between matter and mind/consciousness (mental causation)
  - cf. Beck and Eccles

# Here: focus upon the implicate order

- In the 1960s Bohm (with Hiley) began to develop a more general framework for physics in which one could unite quantum theory and relativity
  - the implicate order framework
- Bohm, D. (1980) *Wholeness and the Implicate Order*. Routledge.
- Pylkkänen, P. (2007) *Mind, Matter and the Implicate Order*. Springer.

# Bohm's early ideas on order / structure

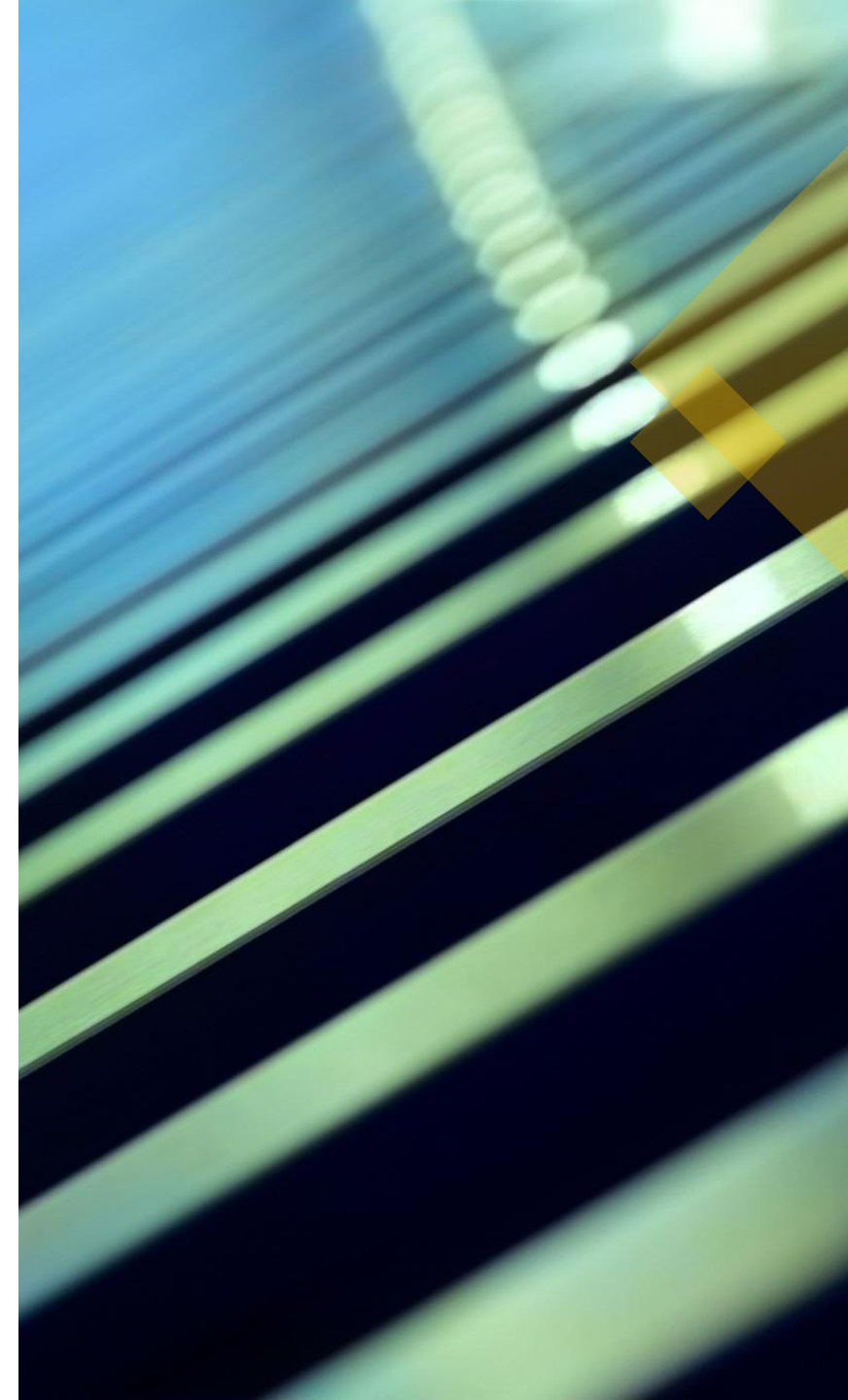
We should give up the notion of continuous space-time as fundamental and replace it by the notion of space-time as a discrete structural process.

"structural process" refers to a set of "spacelike" elements.

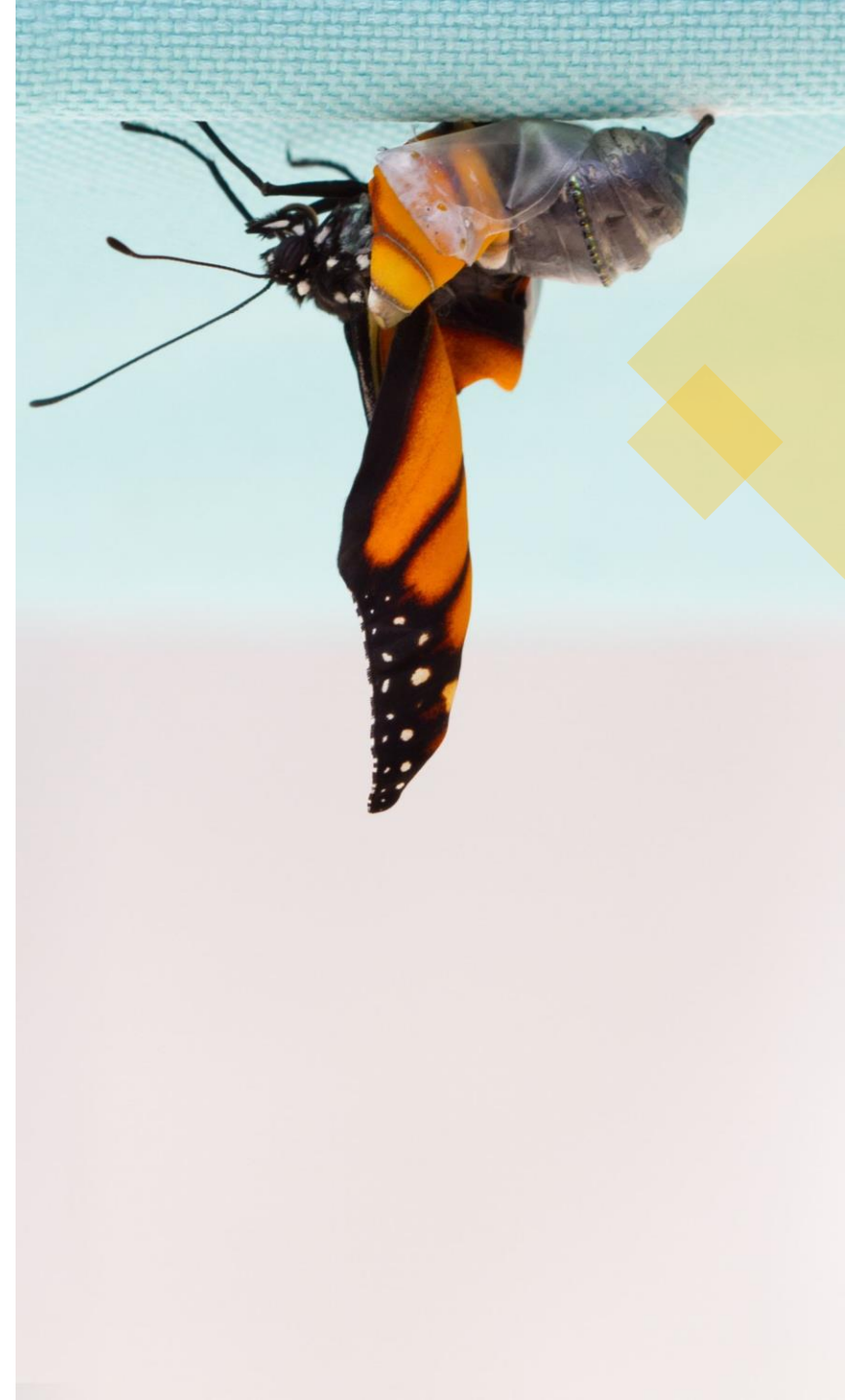
these are discrete structures which undergo discrete or discontinuous changes as they move and unfold in a process of development.



Continuous space-time can then be seen as an abstraction from the underlying discrete structural process (Bohm 1965c).



- Note that one here uses the word “process” to refer not to a continuous change but rather to a discrete, step-by-step change.
  - the word “process” is based on the verb “to proceed”, which means “to step forward”.
  - it originally thus refers to a particular kind of movement, which goes step by step, with one step following another (Bohm 1976, pp. 40–41).
- This is the sense in which Bohm uses the word process here, which perhaps makes the term “discrete structural process” easier to grasp.



# Implicate order - summary

In both everyday experience and classical physics we are accustomed to the explicate order of separate things in space-time.

Bohm: the holistic features of quantum theory and relativity call attention to another kind of order, the implicate order, as the fundamental order of the universe.

- implicate order here means that the whole is in some sense dynamically contained or enfolded in each region, so that reality is “holomovement”.
- the existence of things in the explicate order is sustained in a constant process of unfoldment and re-enfoldment




Usually there is a great deal of relative independence between things

- but: there are situations (such as those involving quantum non-locality) where the holistic features of the implicate order reveal themselves.

Unfoldment need not be completely deterministic

- thus the implicate order provides a framework in which also radical emergence can occur
- Prigogine vs. Bohm



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- In Bohm's pilot wave interpretation of QT, the quantum field containing active information can be seen as living in an implicate order (multidimensional configuration space)
    - The field guides/in-forms the particle, which latter lives in the explicate order.

# Need for new notions of order



Bohm contrasts implicate order with the generally accepted *mechanistic order* in physics.

relativity and QT both challenge the mechanistic order, but their basic concepts directly contradict each other



Needed: a new theory that starts from what R & QT have in common: *undivided wholeness*.

but: we need *new notions of order* appropriate to undivided wholeness.

these can best be illustrated with models and analogies.

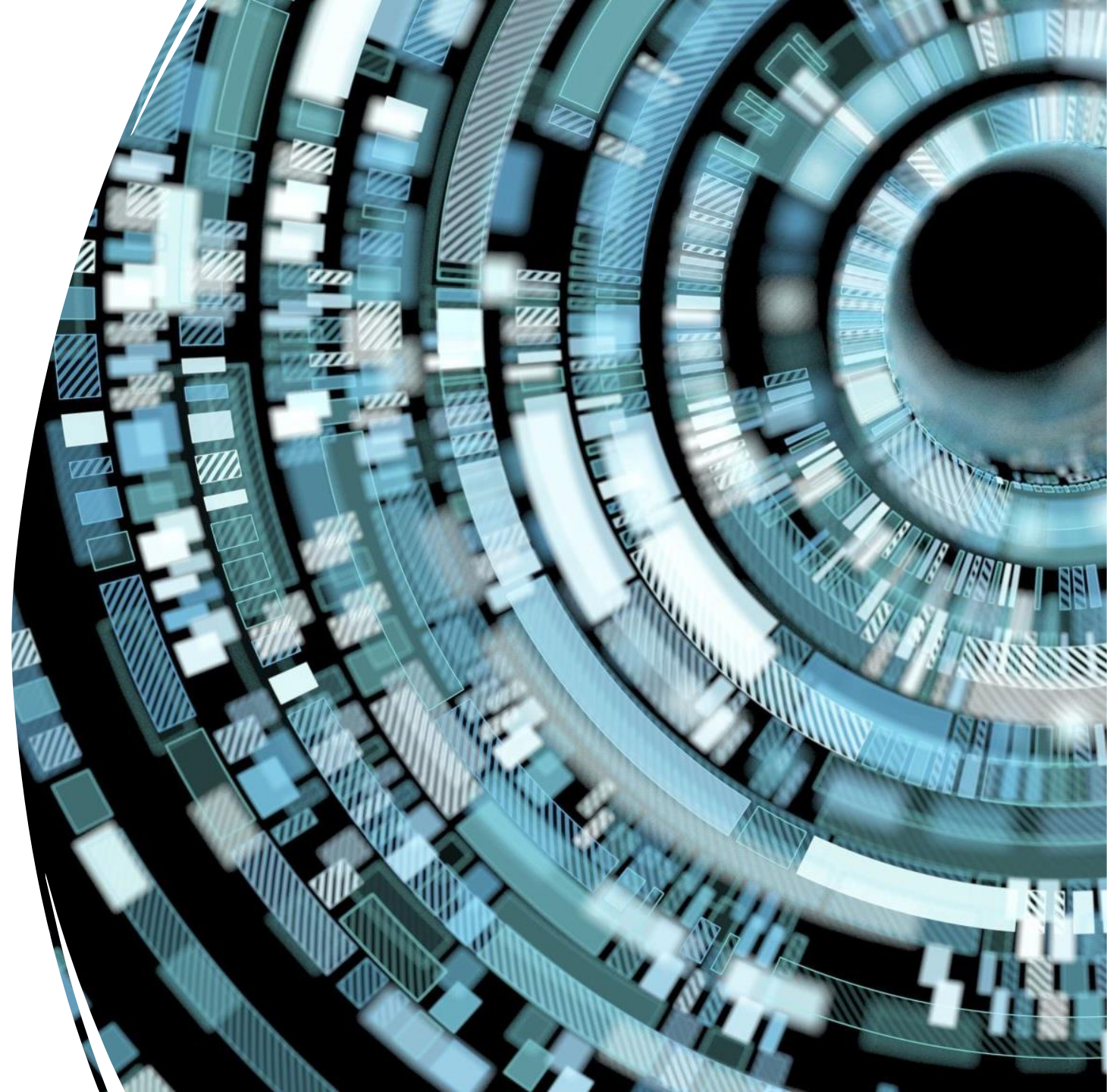


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- Note: these models and analogies are mechanical
    - but: they are meant to illustrate holistic principles
    - once you understand the holistic principle, throw away the mechanical model
      - cf. Wittgenstein tells us to "kick the ladder" at the end of *Tractatus*

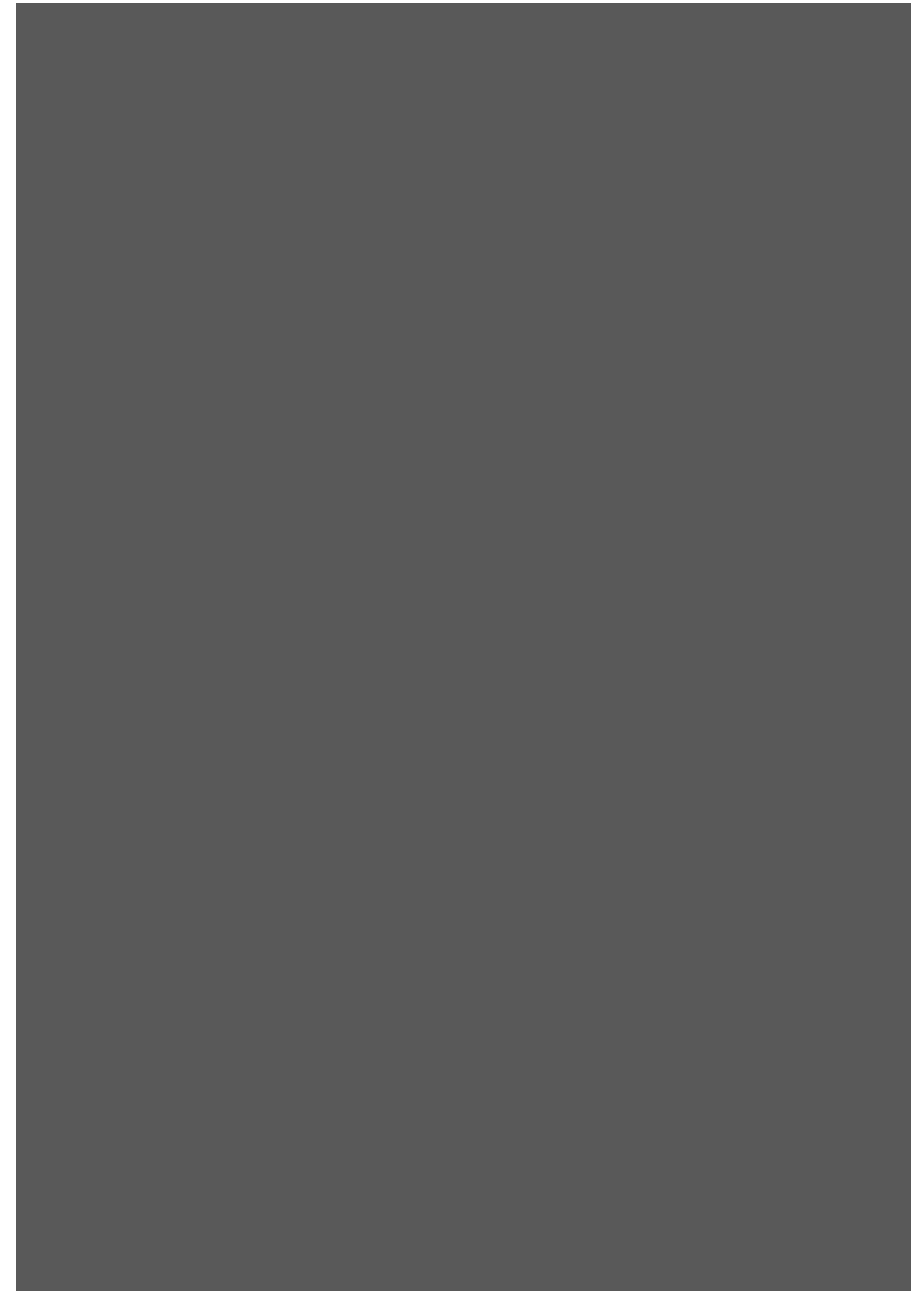
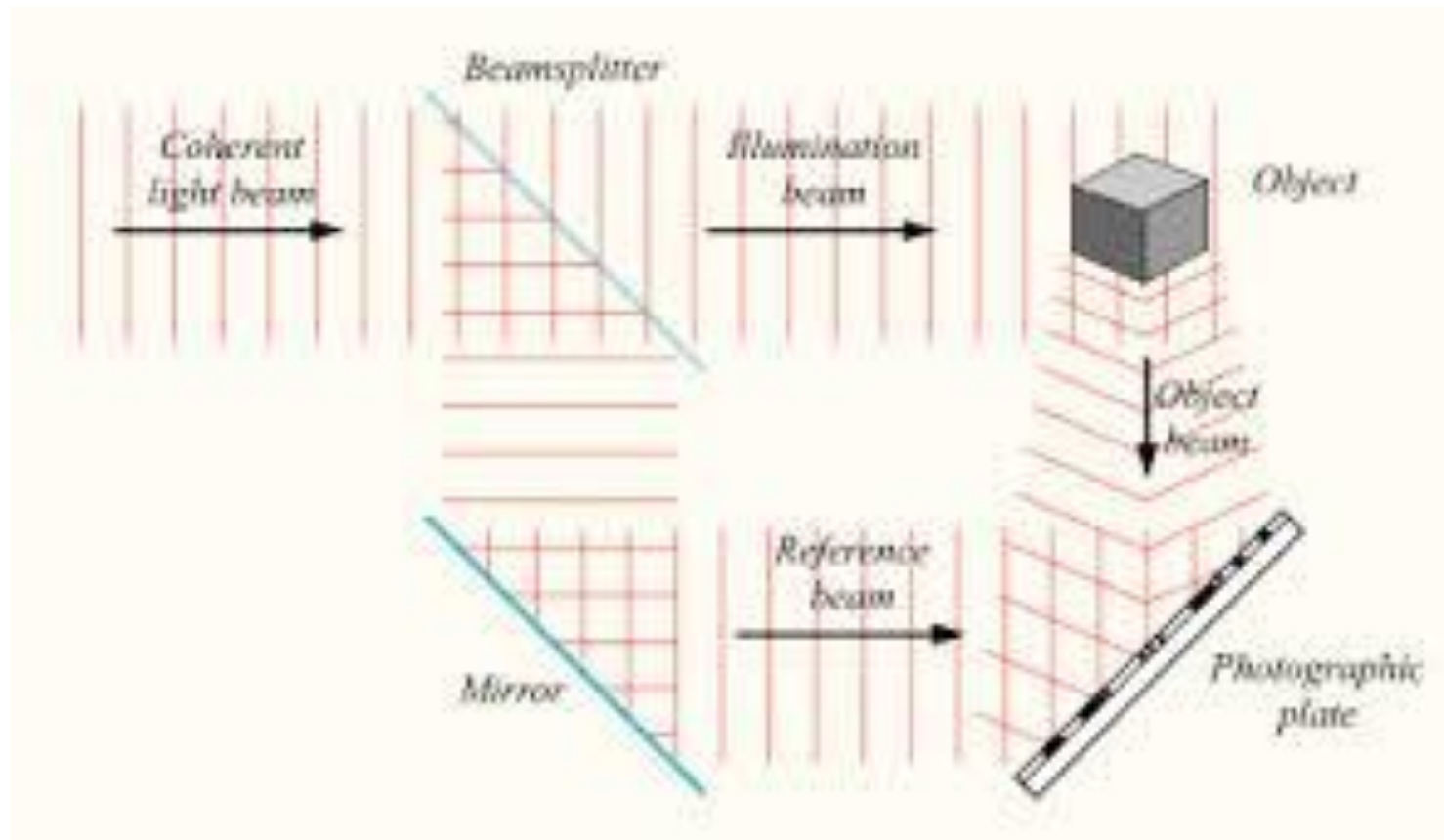
# 1st analogy: Hologram, the part enfolds the whole

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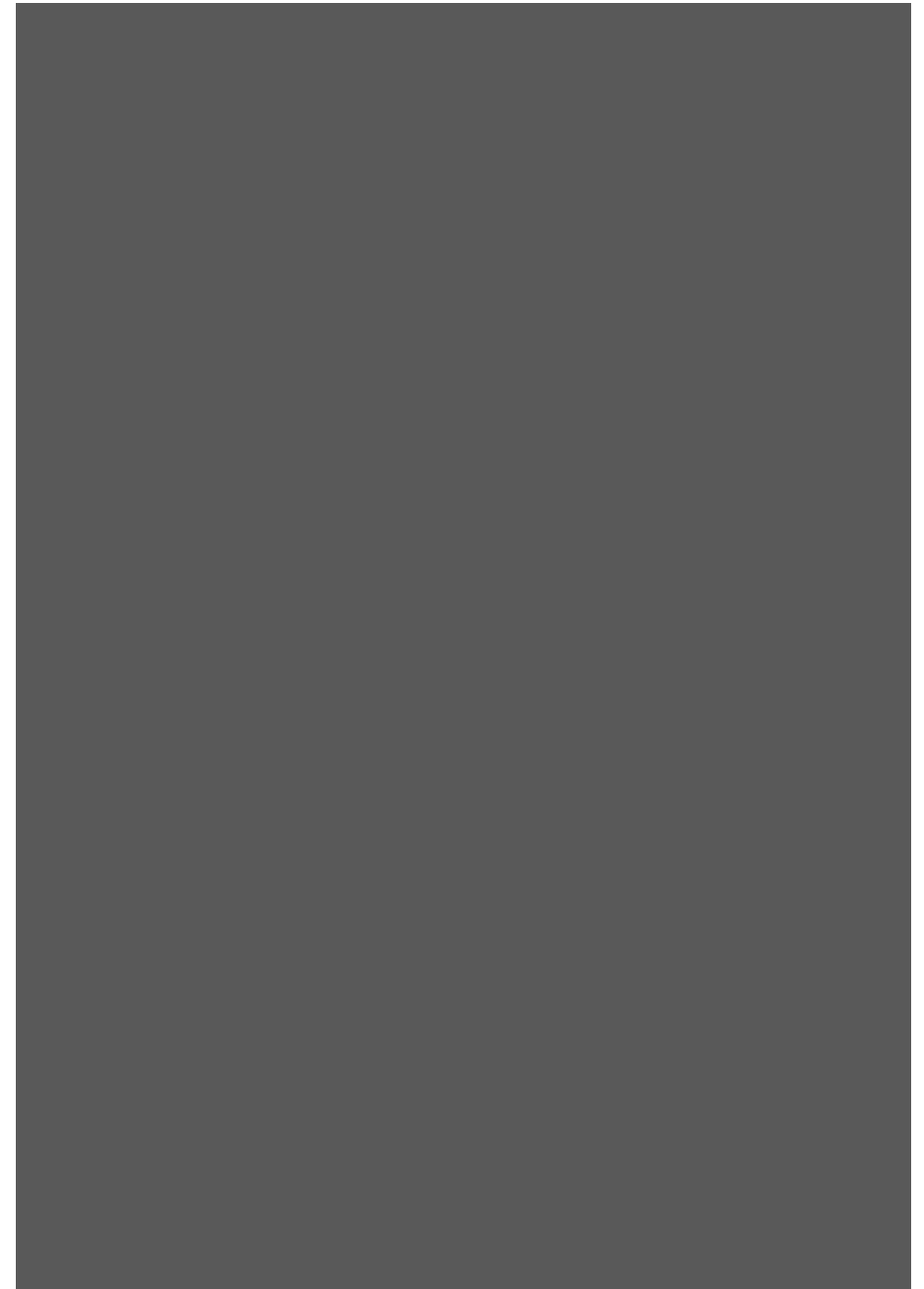
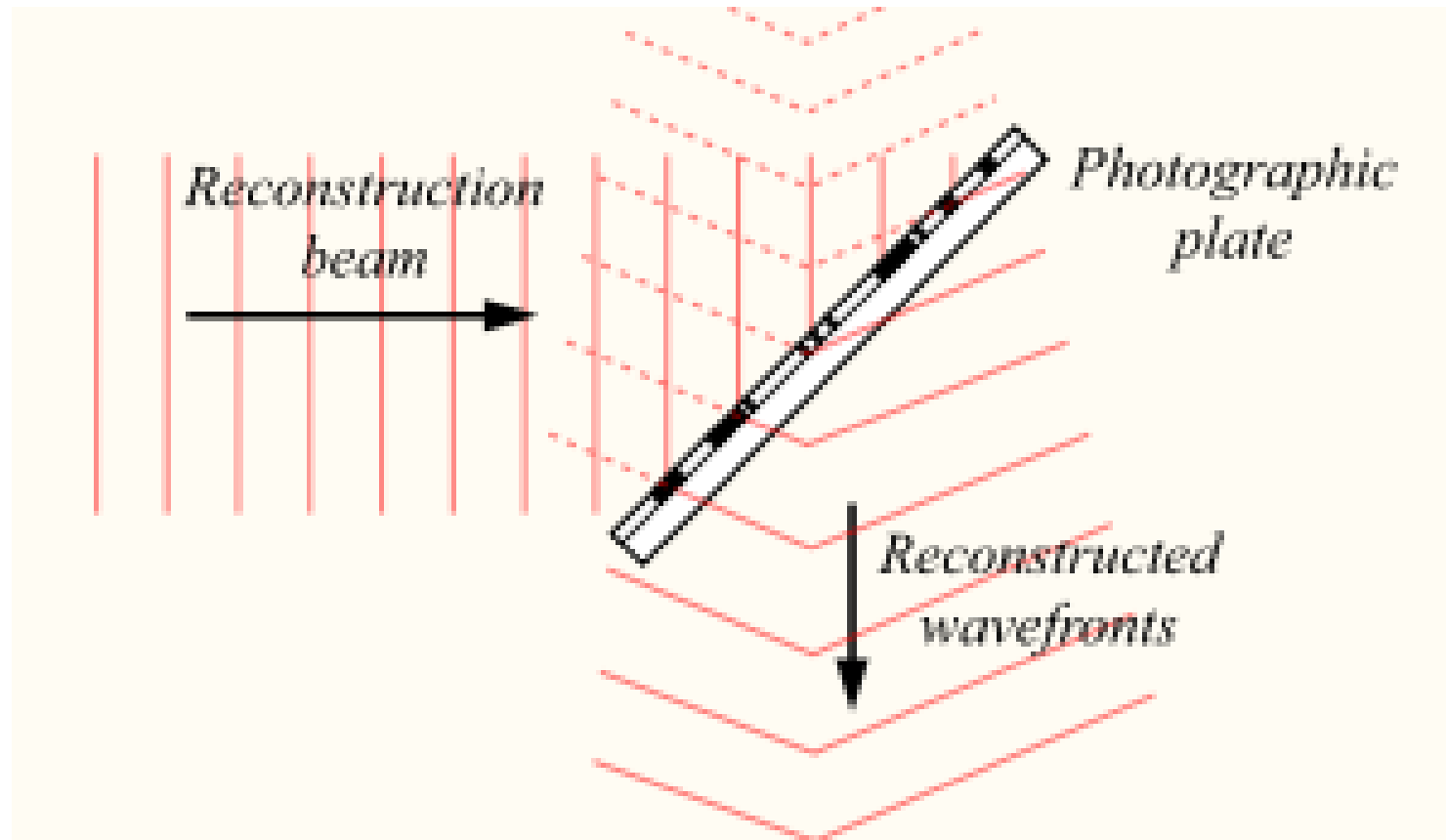
- In a hologram, each part contains information about a whole object.
  - the form & structure of the entire object is *enfolded* within each region of a photographic plate.
  - shine light on any region & this form & structure are *unfolded*, to give a recognizable image of the whole object



# Making a hologram



# Reconstructing the image



# Implicate & explicate order

A new notion of order is involved: the implicate order

In terms of the implicate order one may say that everything is enfolded into everything.

This contrasts with the explicate order now dominant in physics:

- things are unfolded, each thing lies only in its own particular region of space (& time) & outside regions belonging to other things.



## 2nd analogy: ink-in-fluid

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Device: two concentric glass cylinders

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There is viscous fluid (e.g. glycerine) between them

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Outer cylinder is turnable very slowly -> negligible diffusion of viscous fluid

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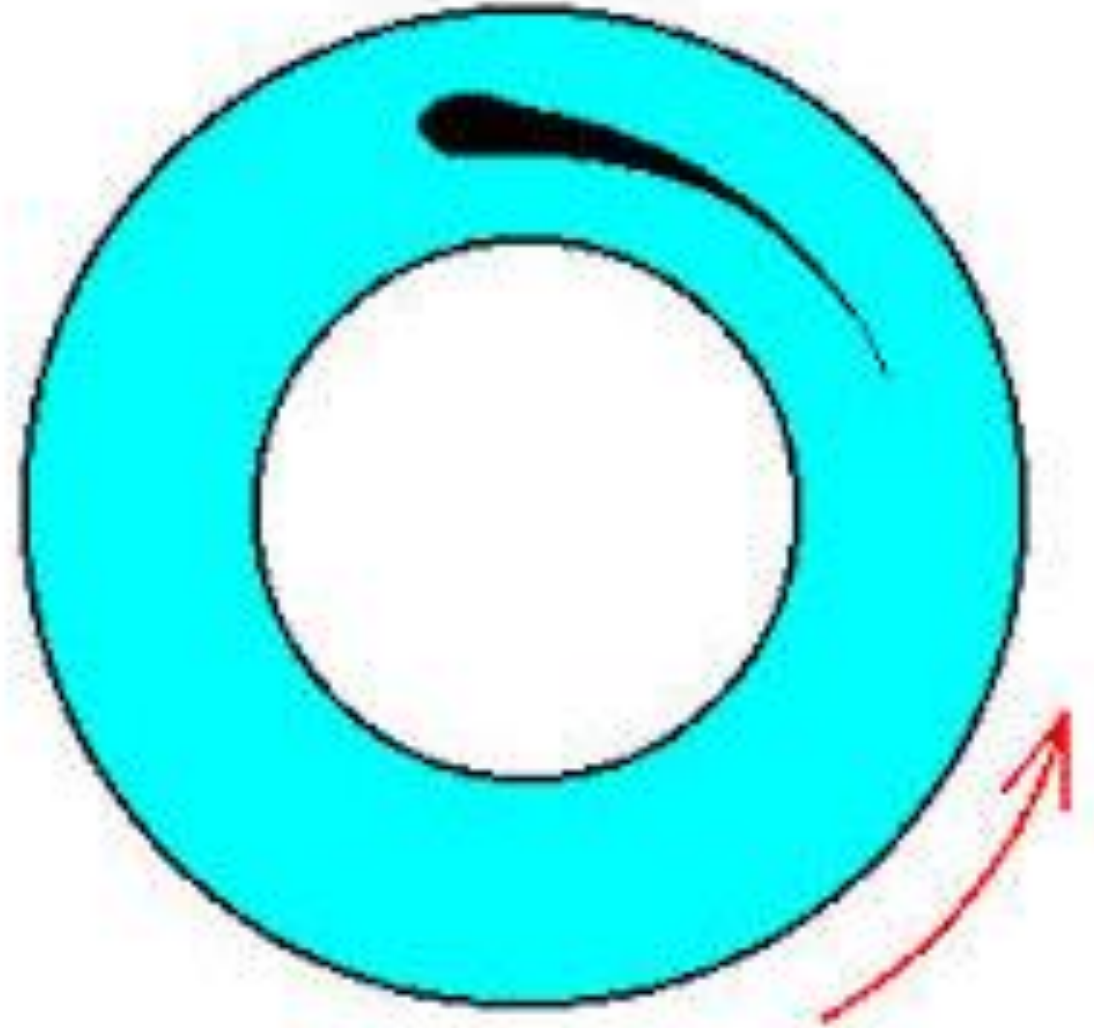
Droplet of insoluble ink is placed in fluid & outer cylinder is turned.

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Droplet is drawn out into fine thread-like form, eventually becomes invisible.

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When turned in opposite direction thread-form draws back & suddenly becomes visible -> original droplet!



# Concepts & principles

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***Enfoldment*** and ***unfoldment***

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***Implicate*** and ***explicate*** order

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An ***ensemble of elements*** (e.g. droplet consisting of ensemble of ink particles)

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Ensembles of elements ***enfolded together*** & yet ***distinguishable***





## Non-intrinsic IO

Any order (e.g. a set of droplets arranged along a line) which you can enfold and unfold.

But: it is not intrinsically implicate because, you can make it all "explicate" in one moment.

Intrinsically  
implicate  
order

An order all of which  
cannot be made  
explicate at one  
moment



An abstract background on the left side of the slide, consisting of numerous thin, overlapping, wavy lines in various shades of blue and green, creating a sense of depth and movement.

# Let's make an intrinsically implicate order

Insert droplet A and turn cylinder  $n$  times

Insert droplet B at same place, turn  $n$  times, etc.

When reversed, in general only one of ensembles will unfold at a time, rest are enfolded

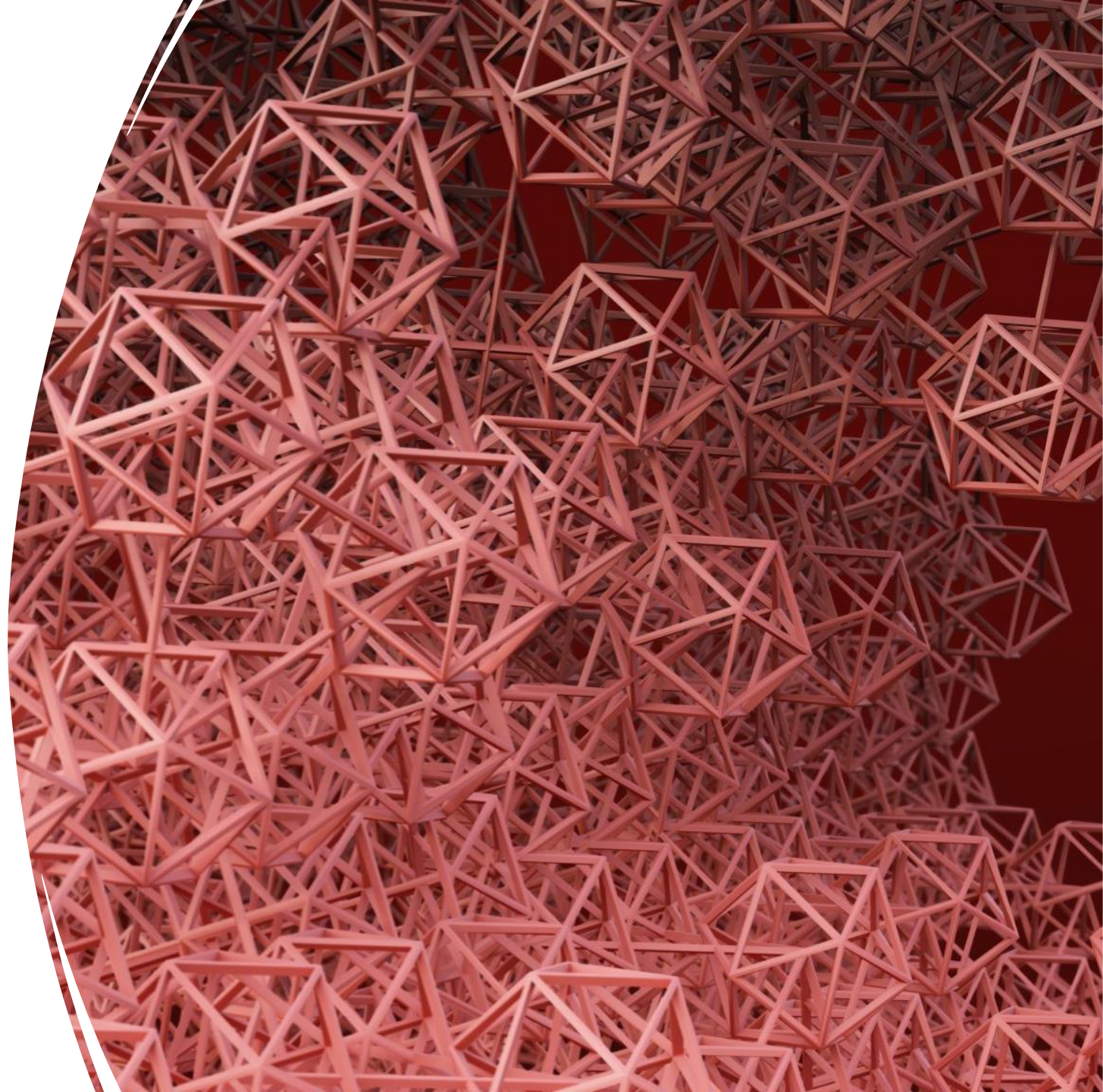
*An order which cannot all be made explicate at once -> Complementarity!*


- Nevertheless *real* (revealed as successive droplets become visible)
- Cf. Wheeler: time is nature's way of preventing everything from happening at once.

# The mark of the implicate order:

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Co-presence of elements at  
different degrees of enfoldment





# You can model the classical domain

Now you can play "Newtonian God" and put in the droplets as you please

Put them in so that when you turn back you'll see "particles" coming out obeying laws of classical physics

- "moving" independently in straight lines
- or along curved paths mutually related & dependent, *as if* a force of interaction between them.

# You can model the quantum domain

- Or: play "Quantum God" and put in the droplets & arrange the fluid so that when you turn back you'll see "particles" coming out obeying laws of QT
  - making discontinuous quantum jumps
  - exhibiting non-locality
  - obeying the mathematics of wave motion (wave-particle duality)





# The basic claim

- The implicate order gives generally a much more coherent account of the quantum properties of matter than the traditional mechanistic order



# Consciousness

Let's now consider  
conscious experience in the  
implicate order framework

# Matter and Consciousness

Bohm: consciousness, just like matter can be understood in terms of the implicate order

- matter and consciousness have in common the same order
- this suggests that they may have a common ground

”Neutral monism” or ”double aspect monism”

Conscious experience is a natural phenomenon!

# Descartes - > Bohm?

Descartes on the  
order in which  
thoughts exist

Descartes: thoughts do not exist in an order of extension and separation (i.e. some kind of space)

They exist rather in a different order, in which *extension and separations have no fundamental significance.*

But: these have no fundamental significance in the implicate order!

Descartes  
anticipated that  
consciousness has  
to be understood  
in terms of  
something like the  
implicate order!

# Examples of IO in consciousness



Pribram's holographic theory of neural memory

"Time consciousness" (listening to music, visual experience of movement etc)

Thinking (feelings, will...)

The ordinary static sensory experiences (explicate order) are abstracted from an underlying dynamic implicate order

Piaget's research on "infant consciousness"

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- Also: Hawking's research on black holes (the information paradox) has led to speculations that we live in a holographic universe, in which three-dimensional space is some kind of illusion.

# Neural holography?

- Pribram: activating "holographic" record of brain suitably creates a pattern of nervous energy constituting a partial experience similar to that which produced the "hologram" in the first place.
  - if sensory data is being attended to, response of memory fuses with sensory nervous excitation

# The field nature of conscious experience

-> an overall experience in which memory, logic & sensory activity combine into a single unanalysable whole. (cf Kant!)

- *naturalizing Kantian phenomenology via holography*
- *“reason”, “understanding” and “perception” fuse in an interference pattern*





# Beyond mechanism



THE HOLOGRAPHIC MODEL  
SUGGEST THAT IMPLICATE  
ORDER IS CENTRAL IN  
NEURAL PROCESSES



BUT: EVEN THE  
HOLOGRAPHIC MODEL  
IMPLIES MECHANISTIC  
RESPONSES



CRUCIAL CLAIM  
OF "QUANTUM-MIND":  
CONSCIOUS EXPERIENCE  
GOES BEYOND THESE



CONSIDER LISTENING TO  
MUSIC AS EXAMPLE

# Bohm on musical experience

Involves simultaneous presence & activity of *reverberations* of notes

direct & immediately felt sense of movement, flow & continuity

Reverberations are not memories but *active transformations* of what came earlier

- sense of original sounds, emotional responses, bodily sensations, incipient muscular movements etc.



One can obtain a direct sense of how a sequence of notes is enfolding into many levels of consciousness

at a given moment, transformations flowing out of many such enfolded notes interpenetrate & intermingle to give rise to an immediate & primary feeling of movement.



*This activity in consciousness constitutes a striking parallel to the activity of implicate order in general*

# The mark of the implicate order

- Co-presence of elements at different degrees of enfoldment



Direct  
perception of  
implicate  
order

- In music an enfolded order is sensed immediately as the presence together of many different but interrelated degrees of transformations of tones & sounds.
  - in listening to music one is *directly perceiving* an implicate order.

- The implicate order offers a new way to think about the phenomenal structure of experience (generalise to other sensory modalities)
  - possible to criticize "classical" models of "time consciousness" (e.g. Van Gelder, Dainton) in the implicate order framework (Pylykänen 2007, ch 5)



# Wooden iron...

- The implicate order also allows us to make sense of Husserl's view of time consciousness which involves "perceiving the past" (wooden iron)
  - "past" elements can exist in the present as enfolded structures



# References

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Van Gulick, Robert, "Consciousness", *The Stanford Encyclopedia of Philosophy* <http://plato.stanford.edu/archives/sum2004/entries/consciousness>



# Forthcoming articles

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Hiley, B.J. & Pylkkänen, P. “Can quantum mechanics solve the hard problem of consciousness?” Submitted to (S. Gao, ed.) *Consciousness and Quantum Mechanics* (Oxford University Press).

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Pylkkänen, P. “Is the Brain Analogous to a Quantum Measuring Apparatus?” Submitted to Wuppuluri & A. Grayling eds. *Words and Worlds: Use and Abuse of Analogies and Metaphors within Sciences and Humanities*. Berlin: Springer Synthese Library .