

# Levels of reality in ISO 15926 and Shell's Downstream Data Model

Matthew West

Reference Data Architecture and  
Standards Manager



# Abstract

ISO 15926 is designed to support engineering applications and covers physical and functional levels of reality. Shell's Downstream Data Model uses ISO 15926 as a foundation and includes some intentionally constructed objects. Both are 4 dimensionalist. The levels of reality in these ontologies are presented, and the 4 dimensionalist analysis of levels of reality is examined.

A problem faced with 3 dimensional analysis is the coincidence of objects, and whether apparently coincident objects really are different or the same. A 4 dimensional analysis sees objects as being different if they have different spatio-temporal extents. Objects at different levels of reality can be seen to have different spatio-temporal extents, with objects at higher levels of reality being states of objects at lower levels of reality, with it being possible to construct a complete chain from the lowest level of reality to the highest that applies. Interestingly this gives a non-reductionist account of reality, whereas 4 dimensionalism is sometimes claimed to be reductionist in nature.

# Contents

- Context
- An introduction by example
- Levels of reality in 3D and 4D
- What makes a level of reality?

# Some context...

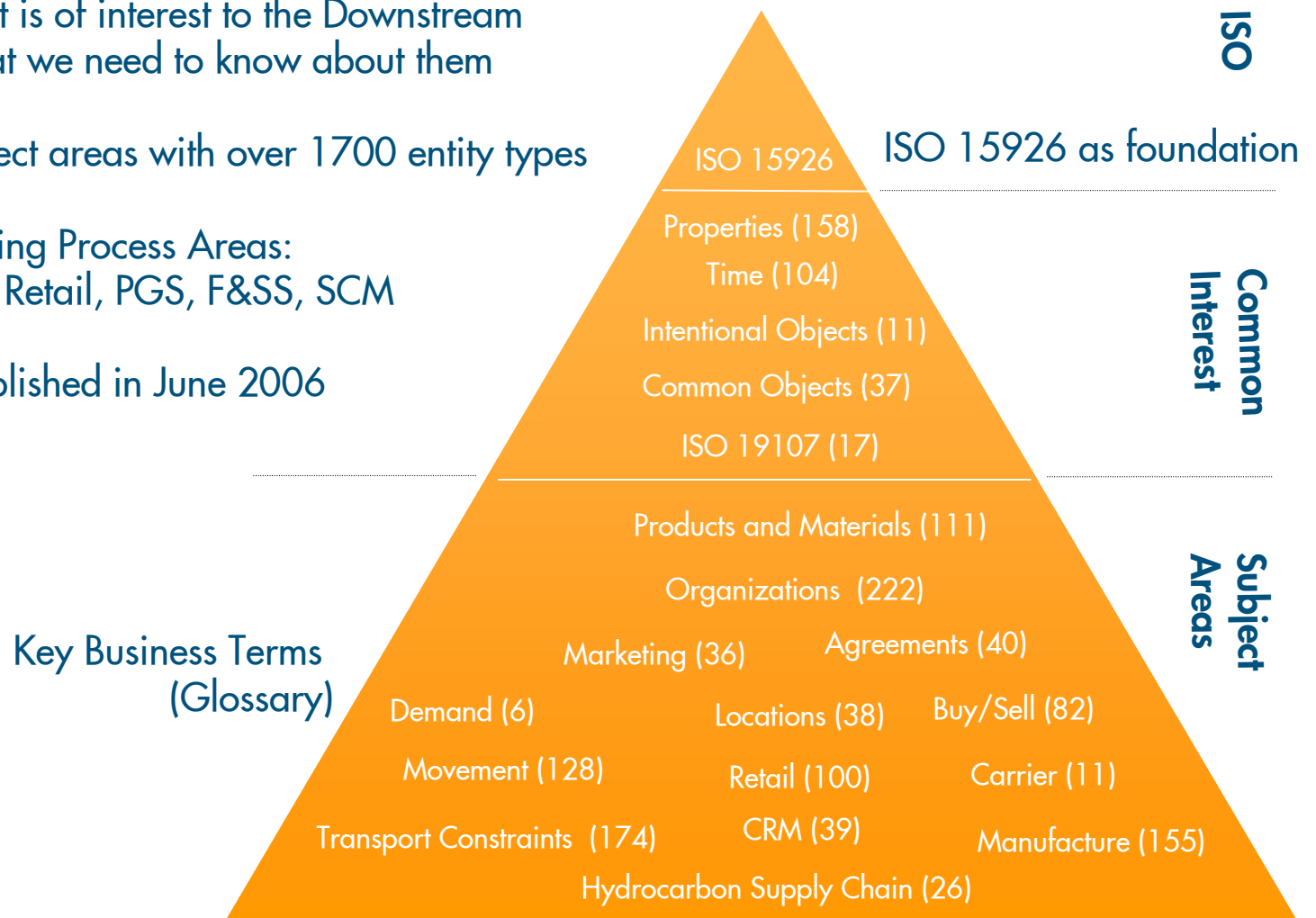
- I'm an engineer...
  - Chemical Engineering and Informatics
  - Take “science” and do something useful with it
- Interest in ontology?
  - About the nature of things...
  - Organizing data around the nature of the things the data represents works well
- Motivation for ISO 15926
  - Managing the engineering data for process plants through out their life
  - In particular the handing over of process plant design data from Design Contractor to Plant Owner Operator
- Reference Data Architecture and Standards
  - A companies reference data reflects the ontology of its business

# ISO 15926

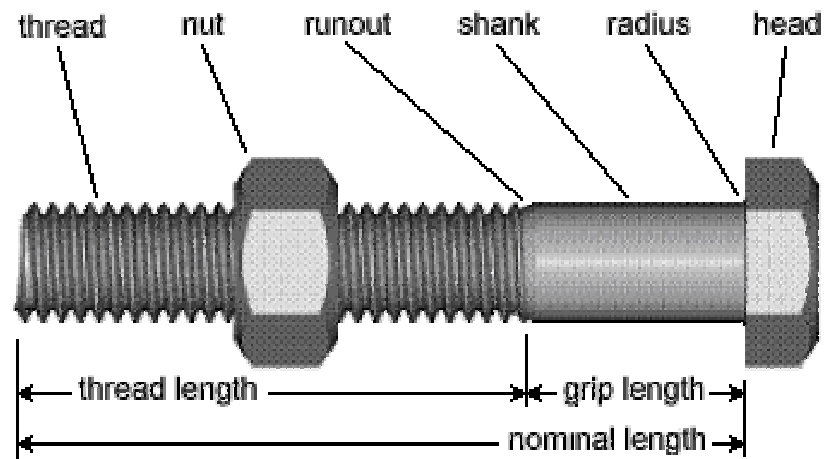
- ISO 15926 – an ISO standard data model/upper ontology
  - Integration of lifecycle data for process plants
- ISO 15926 is 4 dimensionalist with extensionalism
  - Perdurantist (space time extensions) rather than stage theory (lots of 3D slices)
  - Classes also extensional (i.e. membership does not change)
- The data model can be seen as both an upper ontology and a meta-ontology
  - 201 entity types
- There is an additional Reference Data Library
  - c15,000 classes, rising to c50,000
- It has been used to exchange engineering data for \$multi-billion engineering projects
- Norway requires its use by oil companies to report their production figures from their North Sea operations

# What is the Downstream Data Model?

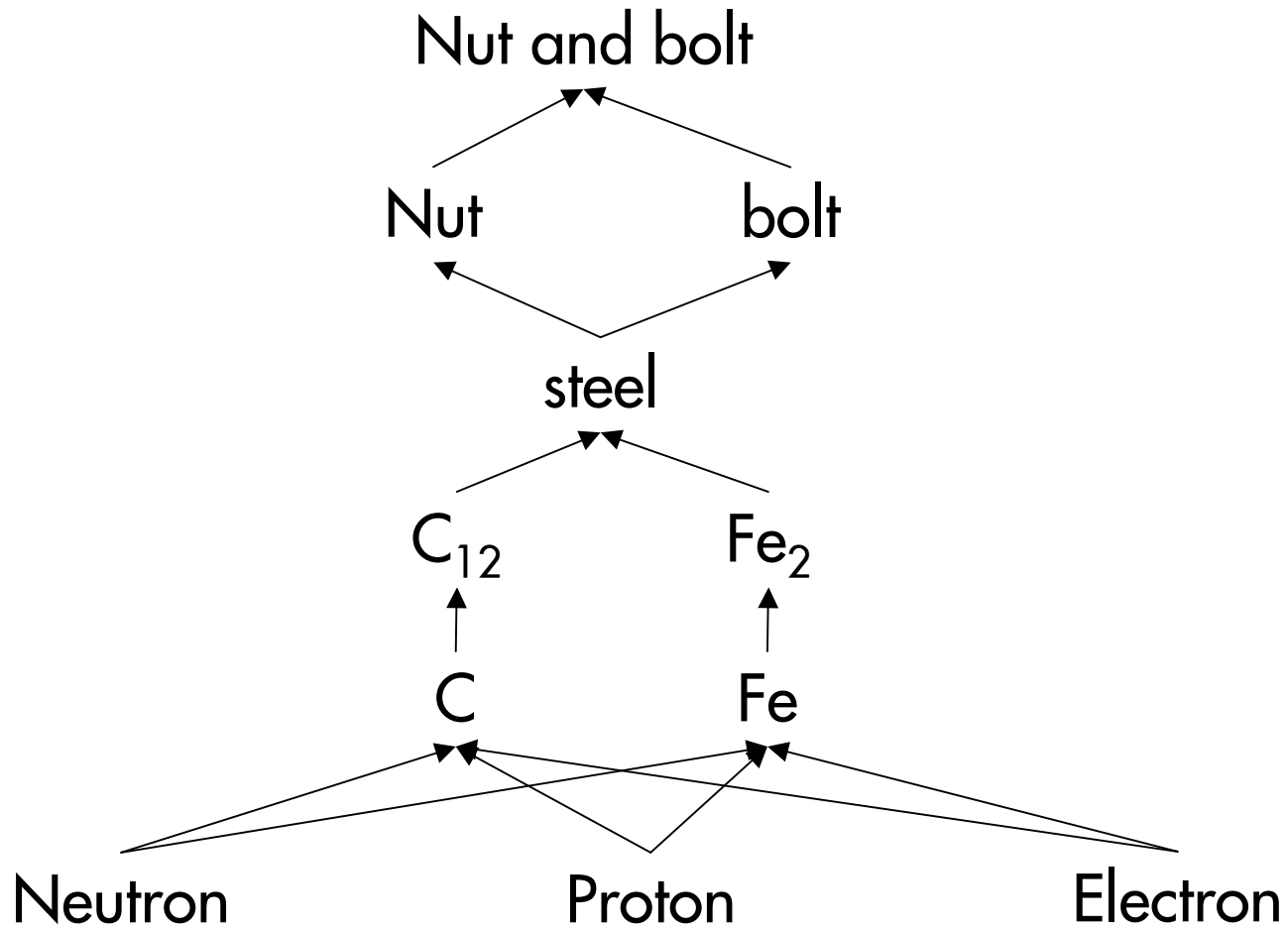
- The Downstream Data Model (DDM) is the standard catalogue of what is of interest to the Downstream business and what we need to know about them
- Contains 20 subject areas with over 1700 entity types
- Covers the following Process Areas: StBC, LSC, MSD, Retail, PGS, F&SS, SCM
- DDM V2 was published in June 2006



# A nut and bolt fastener



# Arrangement of...

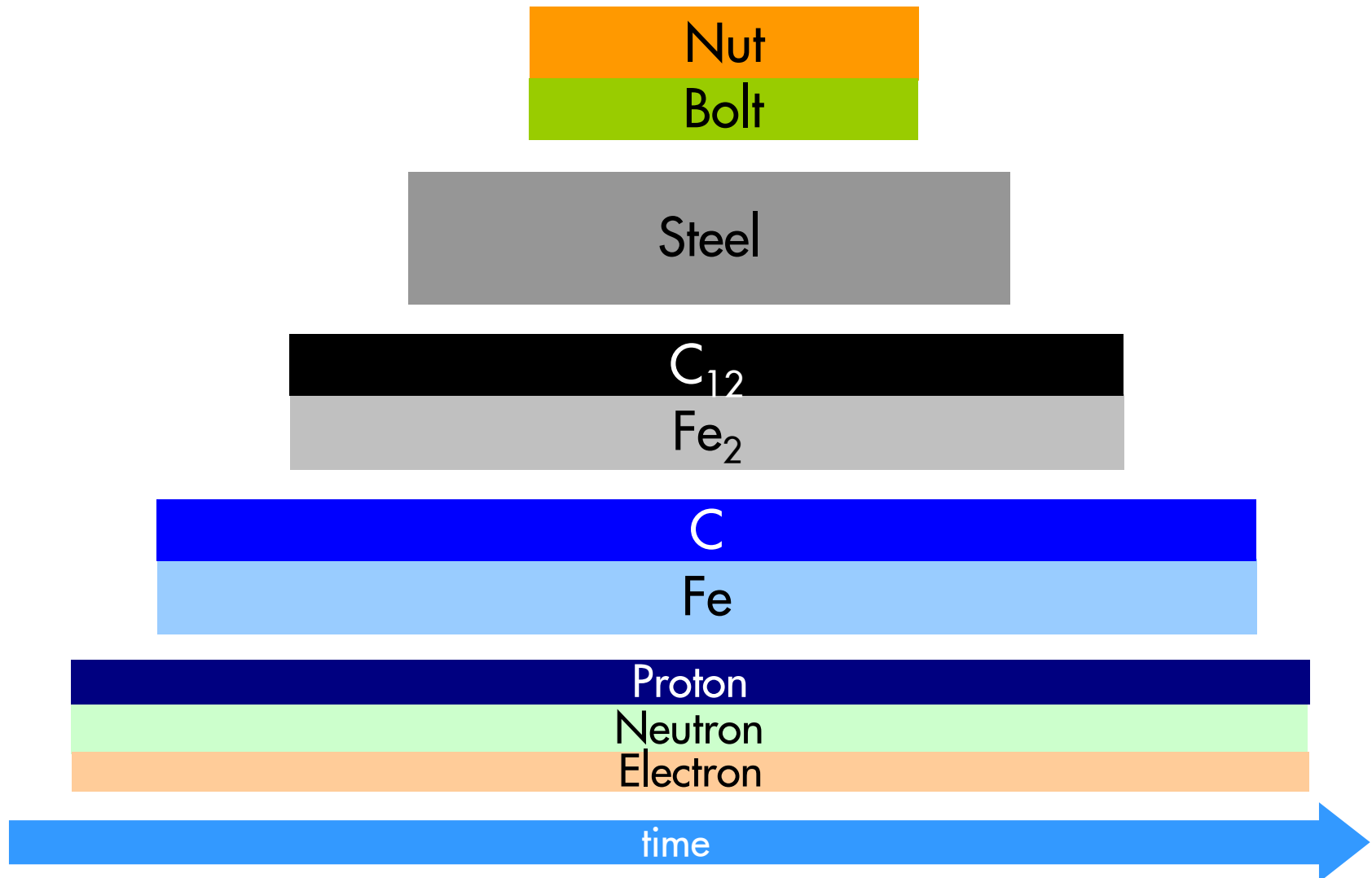




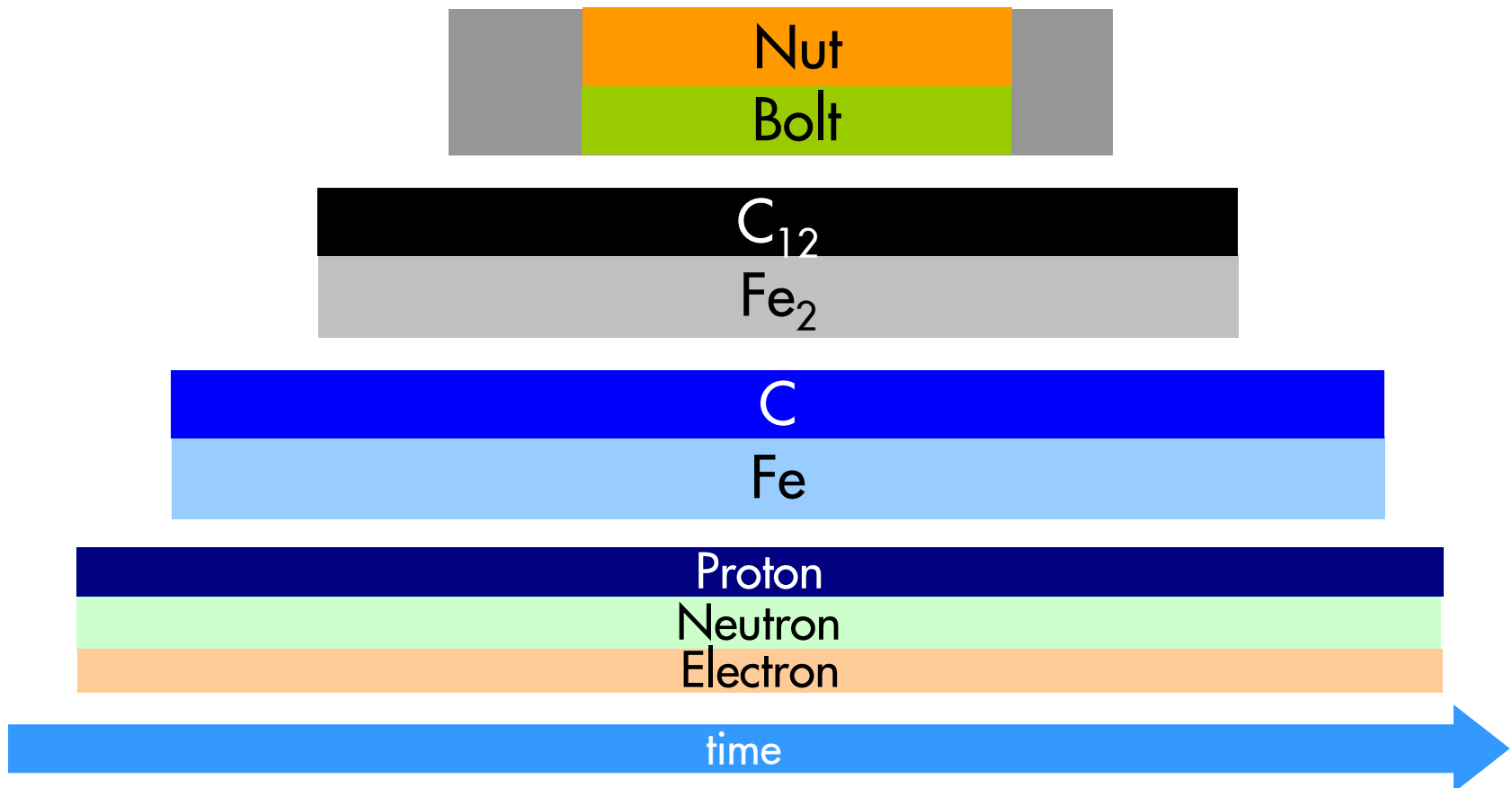
# A Challenge to 4 Dimensionalists

- Most 4 dimensionalists adopt extensionalism as well, whereby if two objects are coincident, they are the same object.
- Therefore, surely a 4 Dimensionalist must be reductionist too, because all the levels of “made out of” are coincident and so all that is left is the bottom most substrate out of which everything else is made?

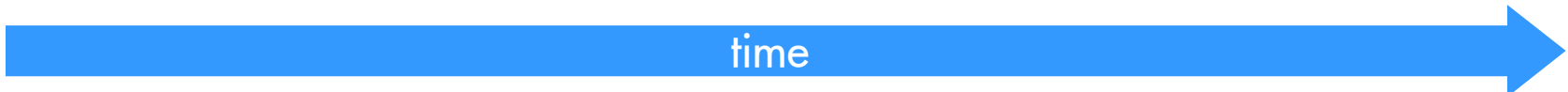
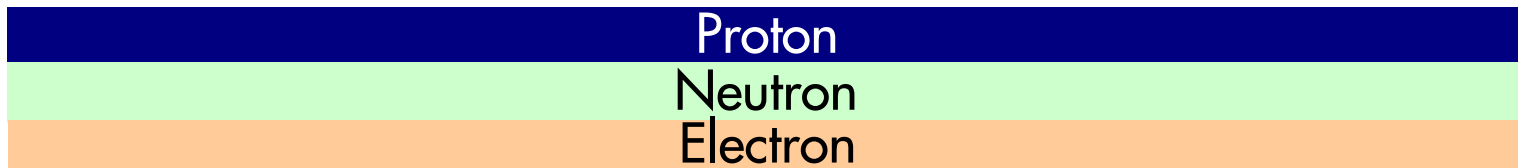
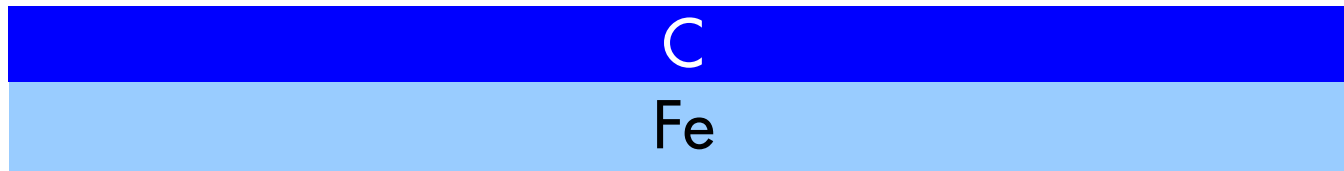
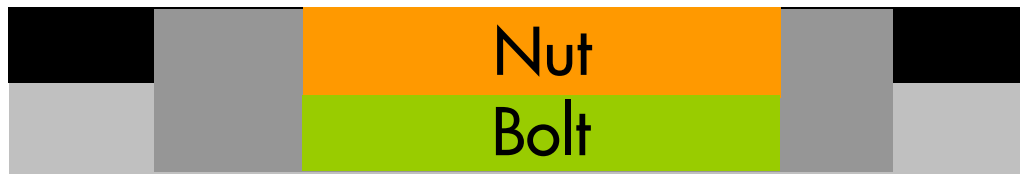
# Arrangement of...



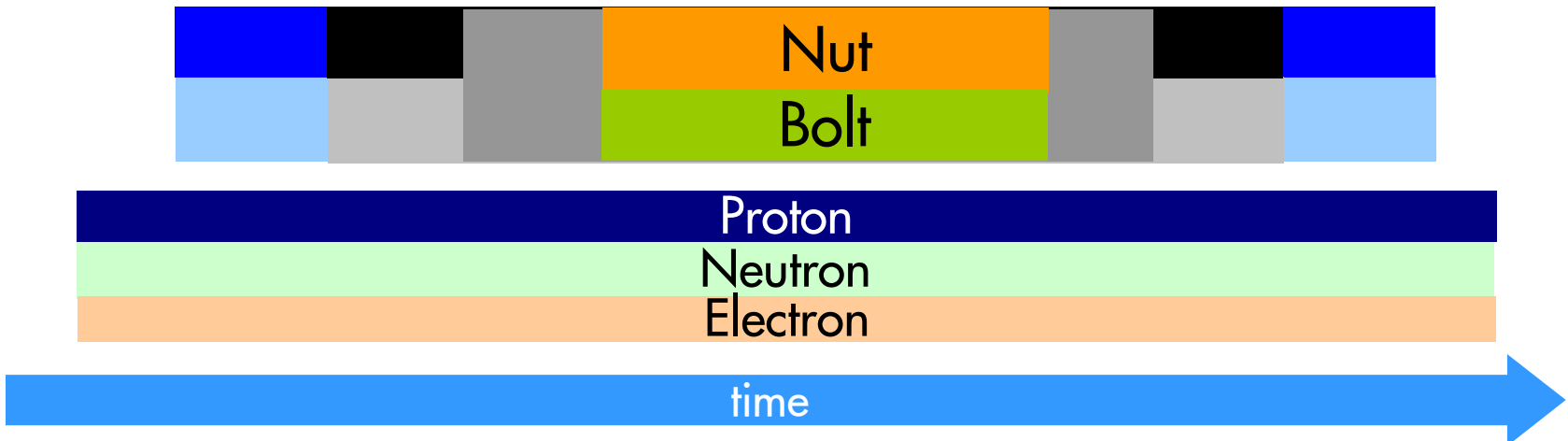
# Made out of...



# Made out of...

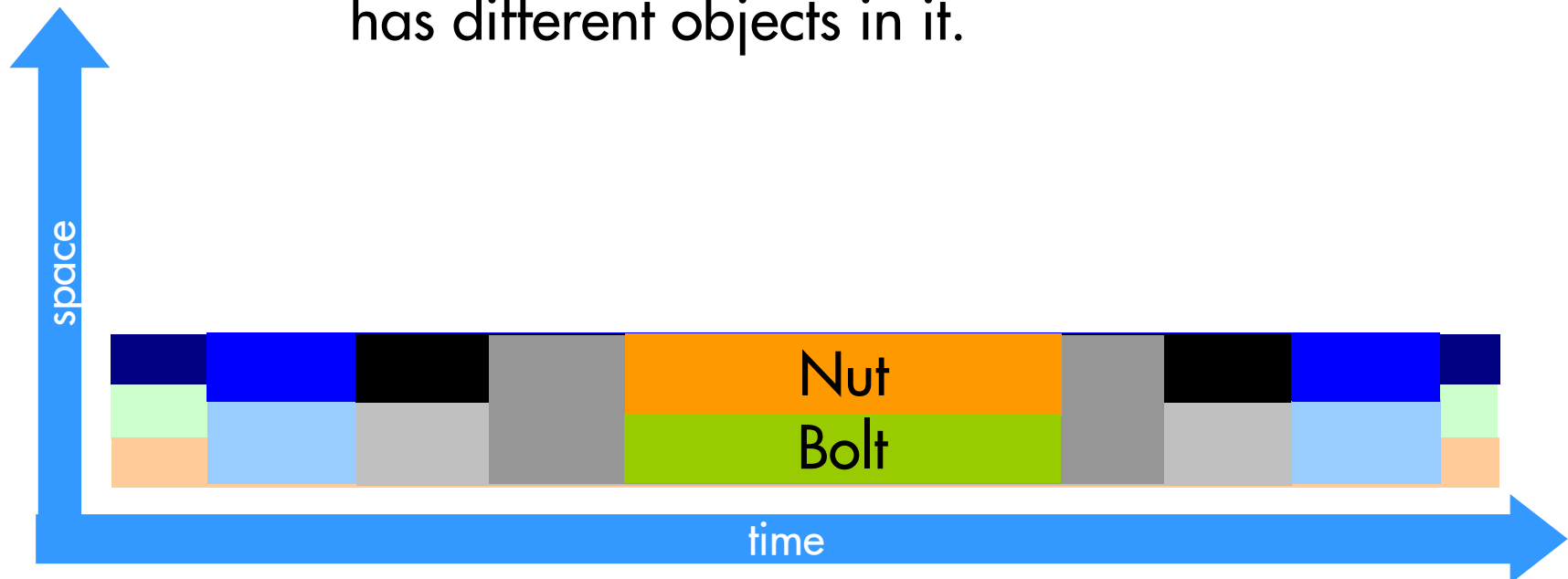


# Made out of...



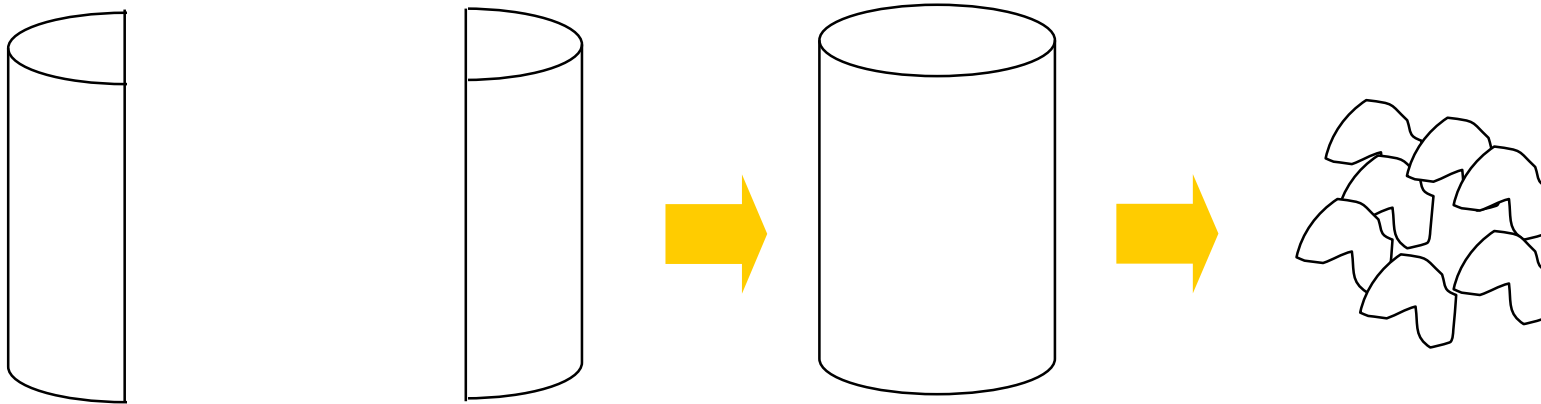
# Each level is a state of the underlying substrate

Now you can see that because each level has a different spatio-temporal extent than its substrate, each level has different objects in it.



# What about the vase made from two pieces of clay?

Neither the clay nor the pot exists as one piece before the two parts are brought together or after the vase is smashed.



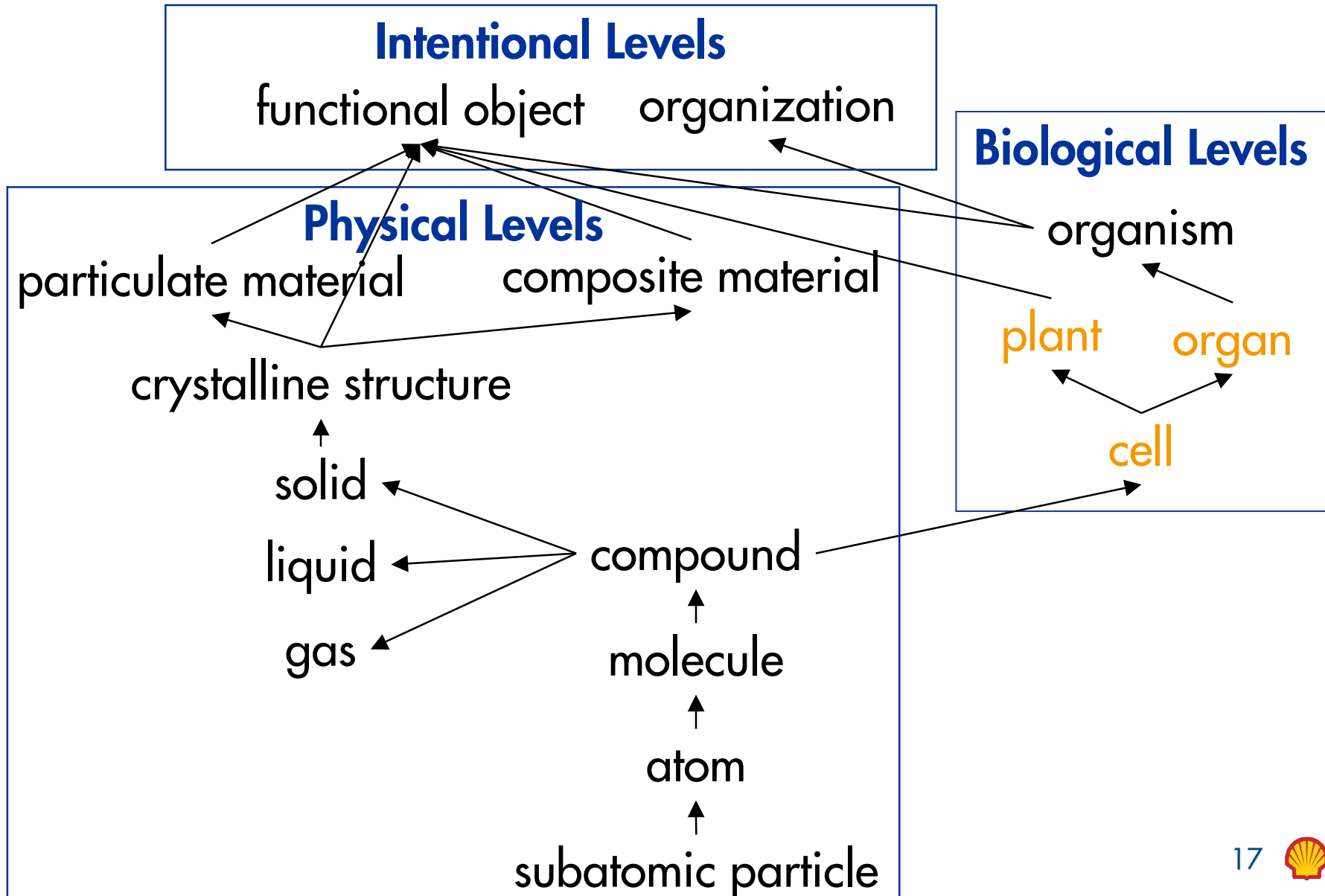
So there is one object that is both the vase and the piece of clay it is made from – so being at different levels of reality does not require a different object under 4 dimensionalism.

# A Challenge to 3 Dimensionalists

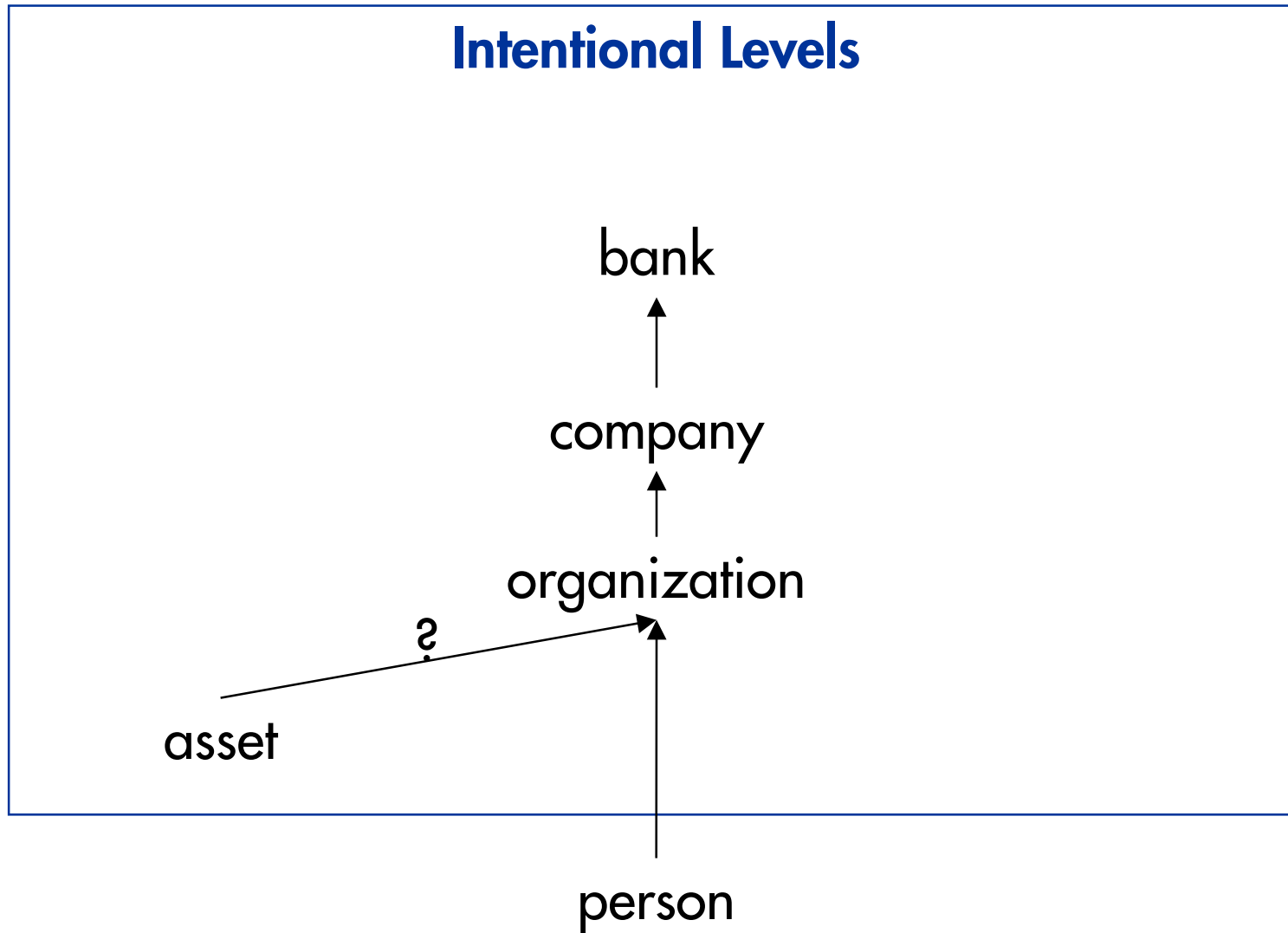
- Since you allow objects to be coincident, what is your basis for deciding whether apparently coincident objects are the same or different, or the same or different levels?



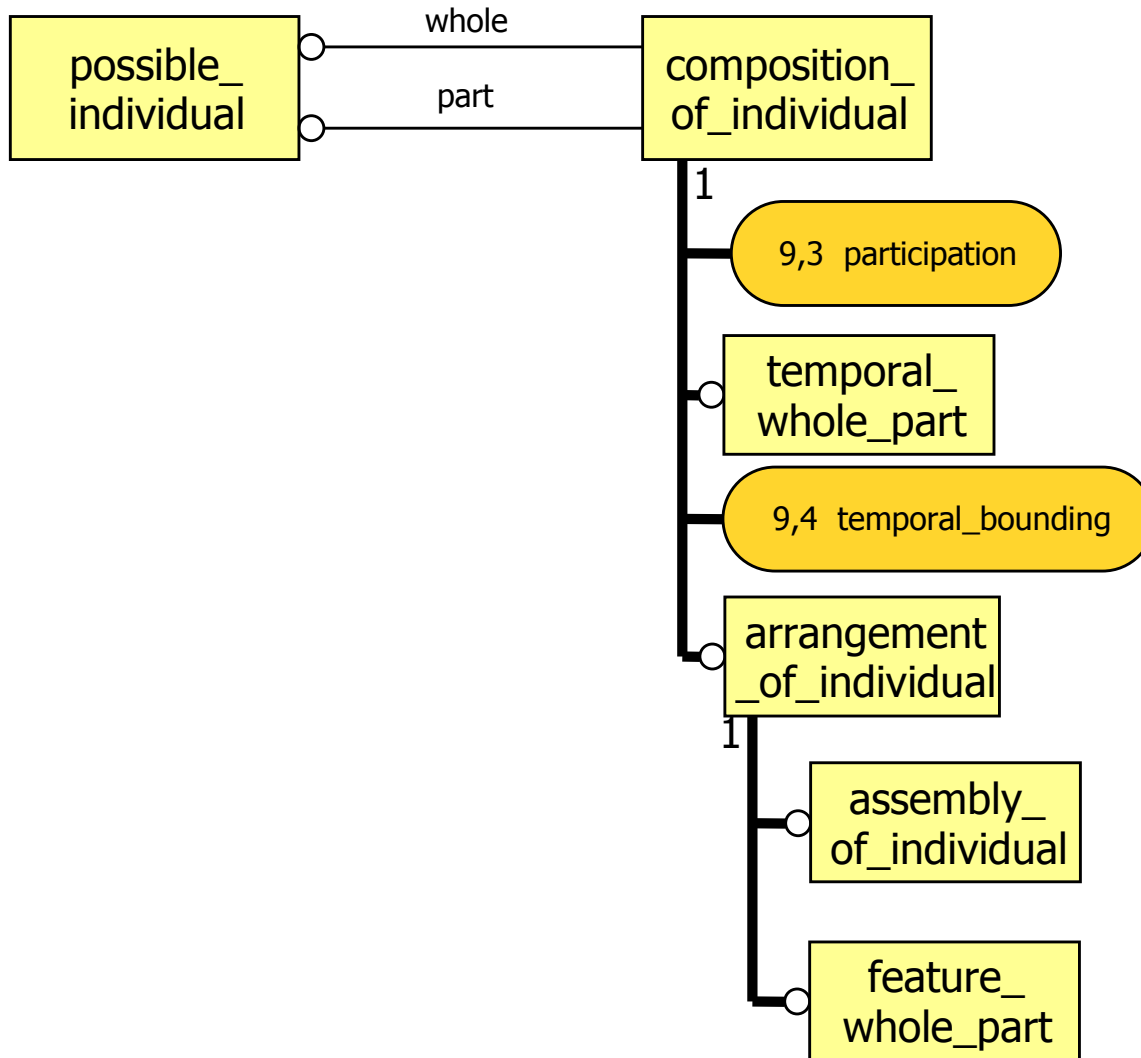
# Levels of Reality in ISO 15926



# Additional levels of reality in Shell's Downstream Data Model



# Different sorts of composition



# Some questions about levels of reality

- What is it that allows one to determine that entities are at different levels of reality?
  - Just being part of something and of a different type does not seem to be enough.
  - Arrangement to give something that is more than the sum of the parts is at least necessary
  - Is that enough?
  - It seems to me that properties at different levels are somehow very different. But what is different enough?
- What does 4 dimensionalism with extensionalism add to the discussion?
  - It allows you to determine when entities are (possibly) different, a prerequisite for different levels.
  - However, being different does not give you enough to define a different level. It is the categories that are at different levels rather than individuals.
- Is intentionality alone sufficient to determine different levels (in the intentional layer)?
  - It would seem so.

