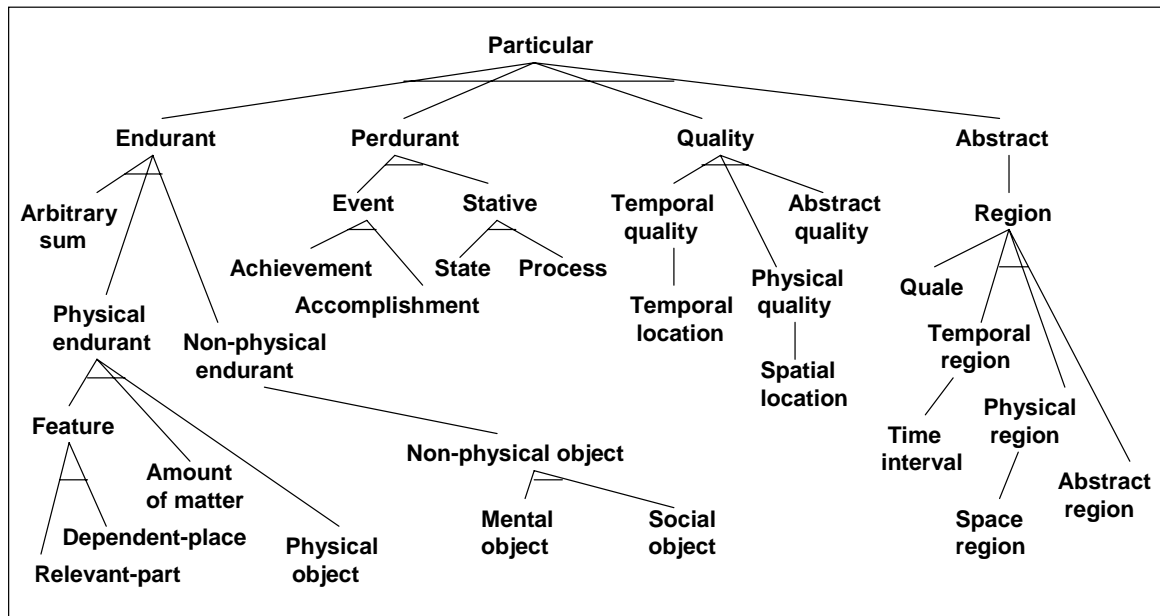


## Particular-OS

// Metadata

Name	Particular-OS
Keywords	Endurant, Physical object, Perdurant, Achievement, State, Quality, Region, Time interval, has for part, is the quality location of, participates in during
Creation date	September 18 <sup>th</sup> , 2008
Last modification date	April 12 <sup>th</sup> , 2009
Revisions made in v1.1	<ul style="list-style-type: none"> <li>- The concepts depending on the concept Agentive have been removed and added in the sub-ontology Agentive &amp; Artefact-OS.</li> <li>- The signature of the relations of participation (e.g. <i>has for participant during</i>, <i>has for total participant during</i>, <i>has for constant participant</i>) has been modified in order to allow Particulars (in general) to participate in Perdurants.</li> <li>- The relation <i>has for constant part</i> (inverse of <i>is a constant part of</i>) has been added.</li> </ul>
Has contributor	Gilles Kassel
Used ontology engineering methodology	OntoSpec
Is of type	Foundational ontology
Natural language	English
Has ontology language	OntoSpec
Has formality level	Semi-informal
Ressource locator	<a href="http://www.laria.u-picardie.fr/IC/site/IMG/pdf/Particular-OS.pdf">http://www.laria.u-picardie.fr/IC/site/IMG/pdf/Particular-OS.pdf</a>
Version	1.1
Number of concepts (classes)	35
Number of relations (properties)	86
Description	<p>This ontology is an OntoSpec specification of the DOLCE (Descriptive Ontology for Linguistic and Cognitive Engineering) ontology; <a href="http://www.loa-cnr.it/DOLCE.html">http://www.loa-cnr.it/DOLCE.html</a>) defined by researchers at the LOA (Laboratory for Applied Ontology, Trento, Italia; <a href="http://www.loa-cnr.it">http://www.loa-cnr.it</a>). Both the translation mechanism and the notations used by the semi-informal language OntoSpec are presented in the paper: <i>Kassel, 2005, Integration of the DOLCE top-level ontology into the OntoSpec methodology</i>, available at: <a href="http://hal-archives-ouvertes.fr/hal-00012203">http://hal-archives-ouvertes.fr/hal-00012203</a>.</p>

// Rigid concepts



## Particular, **PT**

### Meta-properties

PARTICULAR is RIGID (+**R**). PARTICULAR is NOT CARRYING AN IDENTITY CRITERION (-**I**). PARTICULAR is NOT CARRYING A COMMON UNITY CRITERION (-**U**). PARTICULAR is NON-EXTERNALLY-DEPENDENT (-**D**). PARTICULAR is NON-EMPTY. ABSTRACT, ENDURANT, PERDURANT and QUALITY is a non-trivial partition of PARTICULAR.

## Abstract, **AB**

### Meta-properties

ABSTRACT is RIGID (+**R**). ABSTRACT is NOT CARRYING AN IDENTITY CRITERION (-**I**). ABSTRACT is NOT CARRYING A COMMON UNITY CRITERION (-**U**). ABSTRACT is NON-EXTERNALLY-DEPENDENT (-**D**). ABSTRACT is NON-EMPTY.

### Properties

[EP/SL] An ABSTRACT is a PARTICULAR. [Ad3a'; EP/VR] An ABSTRACT has for parts only ABSTRACTS. [Ad3b; EP/VR] An ABSTRACT is a part of only ABSTRACTS. [Ad5a; EP/NMC] Every ABSTRACT is part of itself. [Ad8a'; EP/NMC] Every ABSTRACT1 which is not a part of an ABSTRACT2 is such that at least one ABSTRACT3 exists which is a part of ABSTRACT1 and which does not overlap with ABSTRACT2.

### Comment

[CIT] [Masolo *et al.*, 2003, p. 10] "Abstracts possess no causal power while concretes do."  
 [CIT] [Masolo *et al.*, 2003, p. 18] "The main characteristic of abstract entities is that they do not have spatial nor temporal qualities, and they are not qualities themselves."

## Region, **R**

### Meta-properties

REGION is RIGID (+**R**). REGION is SUPPLYING AN IDENTITY CRITERION (+**O**). REGION has ANTI-UNITY (~**U**). REGION is NON-EXTERNALLY-DEPENDENT (-**D**).

REGION is NON-EMPTY. ABSTRACT REGION, PHYSICAL REGION and TEMPORAL REGION *is a non-trivial partition of* REGION.

**Properties**

[EP/SL] A REGION is an ABSTRACT. [EP/NSIC] Two REGIONS are the same iff they have the same parts. [EP/VR] A REGION *has for part* only REGIONS.

**Quale**

**Meta-properties**

QUALE is RIGID (+**R**). QUALE is CARRYING AN IDENTITY CRITERION (+**I**). QUALE is NON-EXTERNALLY-DEPENDENT (-**D**). QUALE is NON-EMPTY.

**Properties**

[EP/SLD] A QUALE is a REGION which *is an atomic part of* a REGION.

**Abstract region, AR**

**Meta-properties**

ABSTRACT REGION is RIGID (+**R**). ABSTRACT REGION is CARRYING AN IDENTITY CRITERION (+**I**). ABSTRACT REGION has ANTI-UNITY (~**U**). ABSTRACT REGION is NON-EXTERNALLY-DEPENDENT (-**D**). ABSTRACT REGION is NON-EMPTY.

**Properties**

[EP/SL] An ABSTRACT REGION is a REGION. [EP/VR] An ABSTRACT REGION *has for part* only ABSTRACT REGIONS. [**Ad60b**’; EP/VR] An ABSTRACT REGION *is the quality location of* only ABSTRACT QUALITIES *during* a TIME INTERVAL.

**Comment**

[EX] An example of ABSTRACT REGION is the (conventional) value of 1 Euro.

**Physical region, PR**

**Meta-properties**

PHYSICAL REGION is RIGID (+**R**). PHYSICAL REGION is CARRYING AN IDENTITY CRITERION (+**I**). PHYSICAL REGION has ANTI-UNITY (~**U**). PHYSICAL REGION is NON-EXTERNALLY-DEPENDENT (-**D**). PHYSICAL REGION is NON-EMPTY.

**Properties**

[EP/SL] A PHYSICAL REGION is a REGION. [EP/VR] A PHYSICAL REGION *has for part* only PHYSICAL REGIONS. [**Ad59b**’; EP/VR] A PHYSICAL REGION *is the quality location of* only PHYSICAL QUALITIES *during* a TIME INTERVAL.

**Comment**

[EX] Examples of PHYSICAL REGIONS are the physical space, an area in the colour spectrum, 80kg.

**Space Region, S**

**Meta-properties**

SPACE REGION is RIGID (+**R**). SPACE REGION is CARRYING AN IDENTITY CRITERION (+**I**). SPACE REGION has ANTI-UNITY (~**U**). SPACE REGION is NON-EXTERNALLY-DEPENDENT (-**D**). SPACE REGION is NON-EMPTY.

**Properties**

[EP/SL] A SPACE REGION is a PHYSICAL REGION. [EP/VR] A SPACE REGION *has for part* only SPACE REGIONS. [EP/VR] A SPACE REGION *is the quality location of* only SPATIAL LOCATIONS.

## Temporal region, **TR**

### Meta-properties

TEMPORAL REGION is RIGID (+**R**). TEMPORAL REGION is CARRYING AN IDENTITY CRITERION (+**I**). TEMPORAL REGION has ANTI-UNITY (~**U**). TEMPORAL REGION is NON-EXTERNALLY-DEPENDENT (-**D**). TEMPORAL REGION is NON-EMPTY.

### Properties

[EP/SL] A TEMPORAL REGION is a REGION. [EP/VR] A TEMPORAL REGION *has for part* only TEMPORAL REGIONS. [EP/VR] A TEMPORAL REGION *is the quality location of* only TEMPORAL QUALITIES.

### Comment

[EX] Examples of TEMPORAL REGIONS are the time axis, 22 June 2002, one second.

## Time interval, **T**

### Meta-properties

TIME INTERVAL is RIGID (+**R**). TIME INTERVAL is CARRYING AN IDENTITY CRITERION (+**I**). TIME INTERVAL has ANTI-UNITY (~**U**). TIME INTERVAL is NON-EXTERNALLY-DEPENDENT (-**D**). TIME INTERVAL is NON-EMPTY.

### Properties

[EP/SL] A TIME INTERVAL is a TEMPORAL REGION.

## Endurant, continuant, **ED**

### Meta-properties

ENDURANT is RIGID (+**R**). ENDURANT is NOT CARRYING AN IDENTITY CRITERION (-**I**). ENDURANT is NOT CARRYING A COMMON UNITY CRITERION (-**U**). ENDURANT is NON-EXTERNALLY-DEPENDENT (-**D**). ENDURANT *partially generically spatially depends on* PERDURANT. ENDURANT is NON-EMPTY. ARBITRARY SUM, NON-PHYSICAL ENDURANT and PHYSICAL ENDURANT *is a non-trivial partition of* ENDURANT.

### Properties

[EP/SL] An ENDURANT, or “CONTINUANT”, is a PARTICULAR. [EP/VR] Every ENDURANT *has for part* only ENDURANTS *during* a TIME INTERVAL. [**Td15a**’; EP/ER] Every ENDURANT *is present at* at least one TIME INTERVAL. [**Ad14**’; EP/NMC] For every ENDURANT1 which *is present at* the same TIME INTERVAL of an ENDURANT2 and which *is not a part of* the ENDURANT2 *during* this TIME INTERVAL, there exists an ENDURANT3 such that the ENDURANT3 *is a part of* the ENDURANT1 *at* a TIME INTERVAL and the ENDURANT3 does not *overlap with* the ENDURANT2 *at* that TIME INTERVAL. [**Ad16**’; EP/NMC] Every ENDURANT which *is present at* a TIME INTERVAL *is a part of* itself *during* that TIME INTERVAL. [**Ad35**’; EP/ER] Every ENDURANT *participates in* at least one PERDURANT *during* at least one TIME INTERVAL. [**Td1a**’; EP/NMC] No ENDURANT *constitutes* itself *during* a TIME INTERVAL. [**Td6**’; EP/NMC] No ENDURANT *participates in* itself *during* a TIME INTERVAL. [EP/VR] An ENDURANT *is constantly specifically constituted by* only ENDURANTS.

### Comment

[SA] ENDURANTS are divided into PHYSICAL ENDURANTS and NON-PHYSICAL ENDURANTS according to whether or not they have direct spatial qualities. [CIT] [Masolo *et al.*, 2003, p. 15] “Endurants are *wholly* present (i.e., all their proper parts are present) at any time they are present.” [CIT] [Masolo *et al.*, 2003, p. 16] “Endurants can “genuinely”

change in time, in the sense that the very same endurant as a whole can have incompatible properties at different times.”

### Arbitrary sum, **AS**

#### Meta-properties

ARBITRARY SUM is RIGID (+**R**). ARBITRARY SUM is SUPPLYING AN IDENTITY CRITERION (+**O**). ARBITRARY SUM has ANTI-UNITY (~**U**). ARBITRARY SUM is NON-EXTERNALLY-DEPENDENT (-**D**). ARBITRARY SUM is NON-EMPTY.

#### Properties

[EP/SL] An ARBITRARY SUM is an ENDURANT. [EP/NSIC] Two ARBITRARY SUMS are the same iff they are the sum of the same entities. [EP/ER] Every ARBITRARY SUM *has for part* at least one ENDURANT *during* a TIME INTERVAL.

#### Comment

[EX] An example of ARBITRARY SUM is a left foot plus a car.

### Non-Physical endurant, **NPED**

#### Meta-properties

NON-PHYSICAL ENDURANT is RIGID (+**R**). NON-PHYSICAL ENDURANT is NOT CARRYING AN IDENTITY CRITERION (-**I**). NON-PHYSICAL ENDURANT is NOT CARRYING A COMMON UNITY CRITERION (-**U**). NON-PHYSICAL ENDURANT is EXTERNALLY-DEPENDENT (+**D**). NON-PHYSICAL ENDURANT *mutually specifically constantly depends on* ABSTRACT QUALITY. [**Ad74**] NON-PHYSICAL ENDURANT *one-sided constantly depends on* PHYSICAL ENDURANT. NON-PHYSICAL ENDURANT is NON-EMPTY.

#### Properties

[EP/SL] A NON-PHYSICAL ENDURANT is an ENDURANT. [**Ad12a'**; EP/VR] A NON-PHYSICAL ENDURANT *has for parts* only NON-PHYSICAL ENDURANTS *during* a TIME INTERVAL. [**Ad12b'**; EP/VR] A NON-PHYSICAL ENDURANT *is part of* only NON-PHYSICAL ENDURANTS *during* a TIME INTERVAL. [**Ad22a'**; EP/VR] A NON-PHYSICAL ENDURANT *has for constituents* only NON-PHYSICAL ENDURANTS *during* a TIME INTERVAL. [**Ad22b'**; EP/VR] A NON-PHYSICAL ENDURANT *constitutes* only NON-PHYSICAL ENDURANTS *during* a TIME INTERVAL. [**Ad41ab'**; EP/VR] A NON-PHYSICAL ENDURANT *has for qualities* only ABSTRACT QUALITIES.

### Non-Physical object, **NPOB**

#### Meta-properties

NON-PHYSICAL OBJECT is RIGID (+**R**). NON-PHYSICAL OBJECT is NOT CARRYING AN IDENTITY CRITERION (-**I**). NON-PHYSICAL OBJECT is NOT CARRYING A COMMON UNITY CRITERION (-**U**). NON-PHYSICAL OBJECT is EXTERNALLY-DEPENDENT (+**D**). NON-PHYSICAL OBJECT is NON-EMPTY. MENTAL OBJECT and SOCIAL OBJECT *is a non-trivial partition of* NON-PHYSICAL OBJECT.

#### Properties

[EP/SL] A NON-PHYSICAL OBJECT is a NON-PHYSICAL ENDURANT. [EP/VR] Every NON-PHYSICAL OBJECT *has for part* only NON-PHYSICAL OBJECTS *during* a TIME INTERVAL.

#### Comment

[SA] NON-PHYSICAL OBJECTS are divided into SOCIAL OBJECTS and MENTAL OBJECTS according to whether or not they are generically dependent on a community of agents.

### Mental object, **MOB**

#### Meta-properties

MENTAL OBJECT is RIGID (+**R**). MENTAL OBJECT is NOT CARRYING AN IDENTITY CRITERION (-**I**). MENTAL OBJECT is NOT CARRYING A COMMON UNITY CRITERION (-**U**). MENTAL OBJECT is EXTERNALLY-DEPENDENT (+**D**). [Ad71] MENTAL OBJECT *one-sided specifically constantly depends on* AGENTIVE PHYSICAL OBJECT. MENTAL OBJECT is NON-EMPTY.

#### Properties

[EP/SL] A MENTAL OBJECT is a NON-PHYSICAL OBJECT.

#### Comment

[EX] Examples of MENTAL OBJECTS are a percept, a sense datum.

### Social object, **SOB**

#### Meta-properties

SOCIAL OBJECT is RIGID (+**R**). SOCIAL OBJECT is NOT CARRYING AN IDENTITY CRITERION (-**I**). SOCIAL OBJECT is NOT CARRYING A COMMON UNITY CRITERION (-**U**). SOCIAL OBJECT is EXTERNALLY-DEPENDENT (+**D**). SOCIAL OBJECT is NON-EMPTY. AGENTIVE SOCIAL OBJECT and NON-AGENTIVE SOCIAL OBJECT *is a non-trivial partition of* SOCIAL OBJECT.

#### Properties

[EP/SL] A SOCIAL OBJECT is a NON-PHYSICAL OBJECT.

#### Comment

[SA] SOCIAL OBJECTS are divided into AGENTIVE SOCIAL OBJECTS and NON-AGENTIVE SOCIAL OBJECTS whether or not they have intentions, beliefs and desires.

### Physical endurant, **PED**

#### Meta-properties

PHYSICAL ENDURANT is RIGID (+**R**). PHYSICAL ENDURANT is NOT CARRYING AN IDENTITY CRITERION (-**I**). PHYSICAL ENDURANT is NOT CARRYING A COMMON UNITY CRITERION (-**U**). PHYSICAL ENDURANT is NON-EXTERNALLY-DEPENDENT (-**D**). PHYSICAL ENDURANT *mutually specifically spatially depends on* PHYSICAL QUALITY. PHYSICAL ENDURANT is NON-EMPTY. AMOUNT OF MATTER, FEATURE and PHYSICAL OBJECT *is a non-trivial partition of* PHYSICAL ENDURANT.

#### Properties

[EP/SL] A PHYSICAL ENDURANT is an ENDURANT. [Ad11a'; EP/VR] A PHYSICAL ENDURANT *has for parts* only PHYSICAL ENDURANTS *during* a TIME INTERVAL. [Ad11b'; EP/VR] A PHYSICAL ENDURANT *is part of* only PHYSICAL ENDURANTS *during* a TIME INTERVAL. [Ad19'; EP/NMC] Every PHYSICAL ENDURANT which *is a part of* another PHYSICAL ENDURANT *at* a TIME INTERVAL *is spatially included in* this other PHYSICAL ENDURANT *during* that TIME INTERVAL. [Ad21a'; EP/VR] A PHYSICAL ENDURANT *has for constituents* only PHYSICAL ENDURANT *during* a TIME INTERVAL. [Ad21b'; EP/VR] A PHYSICAL ENDURANT *constitutes* only PHYSICAL ENDURANTS *during* a TIME INTERVAL. [Ad28'; EP/NMC] Every PHYSICAL ENDURANT which *constitutes* another

PHYSICAL ENDURANT *during* a TIME INTERVAL *temporarily spatially coincides with* this other PHYSICAL ENDURANT *during* the TIME INTERVAL. [Ad40ab'; EP/VR] A PHYSICAL ENDURANT *has for qualities* only PHYSICAL QUALITIES. [Ad50'; EP/ER] Every PHYSICAL ENDURANT *has for quality* at least one SPATIAL LOCATION. [Td16a'; EP/NMC] Every PHYSICAL ENDURANT which *is present at* a TIME INTERVAL *is present in* at least one SPACE REGION *at* that TIME INTERVAL.

#### **Comment**

[CIT] [Masolo *et al.*, 2003, p. 22] “Within physical endurants, we distinguish between *amounts of matter*, *objects*, and *features*. This distinction is mainly based on the notion of unity we have discussed and formalized in [Gangemi *et al.* 2001].”

### **Amount of matter, M**

#### **Meta-properties**

AMOUNT OF MATTER is RIGID (+R). AMOUNT OF MATTER is SUPPLYING AN IDENTITY CRITERION (+O). AMOUNT OF MATTER has ANTI-UNITY (~U). AMOUNT OF MATTER is NON-EXTERNALLY-DEPENDENT (-D). AMOUNT OF MATTER is NON-EMPTY.

#### **Properties**

[EP/SL] An AMOUNT OF MATTER is a PHYSICAL ENDURANT. [EP/NSIC] Two AMOUNTS OF MATTER are the same iff they have the same parts.

#### **Comment**

[CIT] [Masolo *et al.*, 2003, p. 23] “The common trait of *amounts of matter* is that they are endurants with no unity (according to [Gangemi *et al.*, 2001], none of them is an essential whole). Amounts of matter – “stuffs” referred to by mass nouns like “gold”, “iron”, “wood”, “sand”, “meat”, etc. – are mereologically invariant, in the sense that they change their identity when they change some parts.”

[EX] Examples of AMOUNTS OF MATTER are some air, some gold, some cement.

### **Feature, F**

#### **Meta-properties**

FEATURE is RIGID (+R). FEATURE is NOT CARRYING AN IDENTITY CRITERION (-I). FEATURE is NOT CARRYING A COMMON UNITY CRITERION (-U). FEATURE is EXTERNALLY-DEPENDENT (+D). [Ad70] FEATURE *one-sided generically constantly depends on* NON-AGENTIVE PHYSICAL OBJECT. FEATURE is NON-EMPTY. DEPENDENT-PLACE and RELEVANT-PART *is a non-trivial partition of* FEATURE.

#### **Properties**

[EP/SL] A FEATURE is a PHYSICAL ENDURANT. [EP/ER] Every FEATURE *has for host* at least one PHYSICAL ENDURANT.

#### **Comment**

[CIT] [Masolo *et al.*, 2003, p. 23] “Typical examples of features are “parasitic entities” such as holes, boundaries, surfaces, or stains, which are generically constantly dependent on physical objects (their host). All features are essential holes, but, as in the case of objects, no common unity criterion may exist for all of them. However, typical features have a topological unity, as they are singular entities. Some features may be *relevant parts* of their host, like a bump or an edge, or *places* like a hole in a piece of cheese, the underneath of a table, the front of a house, which are not parts of their host.”

[CIT] [Masolo *et al.*, 2003, p. 23] “It may be interesting to note that we do not consider body parts like heads or hands as features: the reason is that we assume that a hand can be detached from its host (differently from a hole or a bump), and we assume that in this

case it retains its identity. Should we reject this assumption, then body parts would be features.” [EX] Examples of FEATURES are a hole, a gulf, an opening, a boundary.

### Dependent-place

#### Meta-properties

DEPENDENT-PLACE is RIGID (+**R**). DEPENDENT-PLACE is NOT CARRYING AN IDENTITY CRITERION (-**I**). DEPENDENT-PLACE is NOT CARRYING A COMMON UNITY CRITERION (-**U**). DEPENDENT-PLACE is EXTERNALLY-DEPENDENT (+**D**).

#### Properties

[EP/SL] A DEPENDENT-PLACE is a FEATURE.

#### Comment

[CIT] Comment from DOLCE-Lite.owl: “A feature that is not part of its host, like a hole in a piece of cheese, the underneath of a table, the front of a house, or the shadow of a tree.”

### Relevant-part

#### Meta-properties

RELEVANT-PART is RIGID (+**R**). RELEVANT-PART is NOT CARRYING AN IDENTITY CRITERION (-**I**). RELEVANT-PART is NOT CARRYING A COMMON UNITY CRITERION (-**U**). RELEVANT-PART is EXTERNALLY-DEPENDENT (+**D**).

#### Properties

[EP/SL] A RELEVANT-PART is a FEATURE.

#### Comment

[CIT] Comment from DOLCE-Lite.owl: “A feature that is a relevant part of its host, like a bump or an edge.”

### Physical object, object, **POB**

#### Meta-properties

PHYSICAL OBJECT is RIGID (+**R**). PHYSICAL OBJECT is SUPPLYING AN IDENTITY CRITERION (+**O**). PHYSICAL OBJECT is not CARRYING A COMMON UNITY CRITERION (-**U**). PHYSICAL OBJECT is NON-EXTERNALLY-DEPENDENT (-**D**). PHYSICAL OBJECT is NON-EMPTY. AGENTIVE PHYSICAL OBJECT and NON-AGENTIVE PHYSICAL OBJECT *is a non-trivial partition of* PHYSICAL OBJECT.

#### Properties

[EP/SL] A PHYSICAL OBJECT, or “OBJECT”, is a PHYSICAL ENDURANT.

[EP/NSIC] Two PHYSICAL OBJECTS are the same iff they have the same spatial location at the same time.

#### Comment

[CIT] [Masolo *et al.*, 2003, p. 23] “The main characteristic of objects is that they are endurants with unity. However, they have no *common* unity criterion, since different subtypes of objects may have different unity criteria. Differently from aggregates, (most) objects change some of their parts while keeping their identity, they can have therefore *temporary parts*.”

### Perdurant, occurrent, **PD**

#### Meta-properties



PERDURANT is RIGID (+**R**). PERDURANT is EXTERNALLY-DEPENDENT (+**D**). PERDURANT *mutually specifically constantly depends on* TEMPORAL QUALITY. PERDURANT *inversely partially generically spatially depends on* ENDURANT. PERDURANT is NON-EMPTY. EVENT and STATIVE is a *non-trivial partition of* PERDURANT.

### Properties

[EP/SL] A PERDURANT, or “OCCURRENT”, is a PARTICULAR. [**Ad2a'**; EP/VR] A PERDURANT *has for parts* only PERDURANTS. [**Ad2b'**; EP/VR] A PERDURANT *is a part of* only PERDURANTS. [**Ad5b'**; EP/NMC] Every PERDURANT *is part of* itself. [**Td15b'**; EP/ER] Every PERDURANT *is present at* at least one TIME INTERVAL. [**Ad8b'**; EP/NMC] Every PERDURANT1 which *is not a part of* a PERDURANT2 is such that there exists at least one PERDURANT3 which *is a part of* PERDURANT1 and which does not *overlap with* PERDURANT2. [**Ad23a'**; EP/VR] A PERDURANT *has for constituents* only PERDURANTS *during* a TIME INTERVAL. [**Ad23b'**; EP/VR] A PERDURANT *constitutes* only PERDURANTS *during* a TIME INTERVAL. [**Ad34'**; NMC] For every PERDURANT *present at* a TIME INTERVAL there exists at least one ENDURANT which *participates in* the PERDURANT *during* that TIME INTERVAL. [**Ad39ab'**; EP/VR] A PERDURANT *has for qualities* only TEMPORAL QUALITIES. [**Ad49'**; EP/ER] Every PERDURANT *has for quality* at least one TEMPORAL LOCATION. [**Td1b'**; EP/NMC] No PERDURANT *constitutes* itself *during* a TIME INTERVAL.

### Comment

[SA] PERDURANTS are divided among STATIVES and EVENTS according to whether they hold of the mereological sum of two of their instances, *i.e.* if they are cumulative or not. [CIT] [Masolo *et al.*, 2003, p. 15] “Perdurants [...] just extend in time by accumulating different temporal parts, so that, at any time they are present, they are only *partially* present, in the sense that some of their proper temporal parts (e.g., their previous or future phases) may be not present.”

[CIT] [Masolo *et al.*, 2003, p. 16] “Perdurants cannot change [...] since none of their parts keeps its identity in time.”

[CIT] [Masolo *et al.*, 2003, p.24] “They can have temporal parts or spatial parts. For instance, the first movement of (an execution of) a symphony is a temporal part of it. On the other side, the play performed by the left side of the orchestra is a spatial part. In both cases, these parts are occurrences themselves.”

## Event, **EV**

### Meta-properties

EVENT is RIGID (+**R**). EVENT is NOT CARRYING AN IDENTITY CRITERION (-**I**). EVENT is NOT CARRYING A COMMON UNITY CRITERION (-**U**). EVENT is EXTERNALLY-DEPENDENT (+**D**). EVENT is ANTI-CUMULATIVE. EVENT is NON-EMPTY. ACCOMPLISHMENT and ACHIEVEMENT is a *non-trivial partition of* EVENT.

### Properties

[EP/SL] An EVENT is a PERDURANT.

### Comment

[SA] EVENTS are divided among ACHIEVEMENTS and ACCOMPLISHMENTS whether they are atomic or not.

## Accomplishment, **ACC**

### Meta-properties

ACCOMPLISHMENT is RIGID (+**R**). ACCOMPLISHMENT is NOT CARRYING AN IDENTITY CRITERION (-**I**). ACCOMPLISHMENT is NOT CARRYING A COMMON UNITY CRITERION (-**U**). ACCOMPLISHMENT is EXTERNALLY-DEPENDENT (+**D**). ACCOMPLISHMENT is ANTI-CUMULATIVE. ACCOMPLISHMENT is ANTI-ATOMIC. ACCOMPLISHMENT is NON-EMPTY.

**Properties**

[EP/SLD] An ACCOMPLISHMENT is an EVENT which is not ATOMIC.

**Comment**

[EX] Examples of ACCOMPLISHMENTS are a conference, an ascent, a performance.

**Achievement, ACH**

**Meta-properties**

ACHIEVEMENT is RIGID (+**R**). ACHIEVEMENT is NOT CARRYING AN IDENTITY CRITERION (-**I**). ACHIEVEMENT is NOT CARRYING A COMMON UNITY CRITERION (-**U**). ACHIEVEMENT is EXTERNALLY-DEPENDENT (+**D**). ACHIEVEMENT is ANTI-CUMULATIVE. ACHIEVEMENT is ATOMIC. ACHIEVEMENT is NON-EMPTY.

**Properties**

[EP/SLD] An ACHIEVEMENT is an EVENT which is an ATOM.

**Comment**

[EX] Examples of ACHIEVEMENTS are reaching the summit of K2, a departure, a death.

**Stative, STV**

**Meta-properties**

STATIVE is RIGID (+**R**). STATIVE is NOT CARRYING AN IDENTITY CRITERION (-**I**). STATIVE is NOT CARRYING A COMMON UNITY CRITERION (-**U**). STATIVE is EXTERNALLY-DEPENDENT (+**D**). STATIVE is NON-EMPTY. STATIVE is CUMULATIVE. PROCESS and STATE *is a non-trivial partition of* STATIVE.

**Properties**

[EP/SL] A STATIVE is a PERDURANT.

**Comment**

[EX] A sitting is STATIVE since the sum of two sittings is still a sitting. [SA] STATIVES are divided among STATES and PROCESSES according to homeomerichity.

**Process, PRO**

**Meta-properties**

PROCESS is RIGID (+**R**). PROCESS is NOT CARRYING AN IDENTITY CRITERION (-**I**). PROCESS is NOT CARRYING A COMMON UNITY CRITERION (-**U**). PROCESS is EXTERNALLY-DEPENDENT (+**D**). PROCESS is CUMULATIVE. PROCESS is ANTI-HOMEOMEROUS. PROCESS is NON-EMPTY.

**Properties**

[EP/SL] A PROCESS is a STATIVE.

**Comment**

[CIT] [Masolo *et al.*, 2003, p. 24] “*running* is classified as a process since there are (very short) temporal parts of a running that are not themselves runnings.”

[EX] Examples of PROCESSES are running, writing.

**State, ST**

**Meta-properties**

STATE is RIGID (+**R**). STATE is NOT CARRYING AN IDENTITY CRITERION (-**I**). STATE is NOT CARRYING A COMMON UNITY CRITERION (-**U**). STATE is EXTERNALLY-DEPENDENT (+**D**). STATE is CUMULATIVE. STATE is HOMEOMEROUS. STATE is NON-EMPTY.

#### **Properties**

[EP/SL] A STATE is a STATIVE.

#### **Comment**

[EX] Examples of STATES are being sitting, being open, being happy, being red.

### Quality, Q

#### **Meta-properties**

QUALITY is RIGID (+**R**). QUALITY is NOT CARRYING AN IDENTITY CRITERION (-**I**). QUALITY is EXTERNALLY-DEPENDENT (+**D**). QUALITY is NON-EMPTY. ABSTRACT QUALITY, PHYSICAL QUALITY and TEMPORAL QUALITY *is a non-trivial partition of* QUALITY.

#### **Properties**

[EP/SL] A QUALITY is a PARTICULAR. [**Td15c'**; EP/ER] Every QUALITY *is present at* at least one TIME INTERVAL. [EP/ER] Every QUALITY *is a quality of* exactly one PARTICULAR. [**Td8'**; EP/NMC] No QUALITY *is a quality of* itself.

#### **Comment**

[CIT] [Masolo *et al.*, 2003, p. 16] “Qualities can be seen as the basic entities we can perceive or measure: shapes, colours, sizes, sounds, as well as weights, lengths, electrical charges.”

[CIT] [Masolo *et al.*, 2003, p. 16] “Qualities *inhere* to entities: every entity (including qualities themselves) comes with certain qualities, which exist as long as the entity exists.”

[CIT] [Masolo *et al.*, 2003, p. 16] “No two particulars can have the same quality, and each quality is *specifically constantly dependent* on the entity it inheres in: at any time, a quality can’t be present unless the entity it inheres in is also present.”

[CIT] [Masolo *et al.*, 2003, p.17] “Each quality type has an associated quality space with a specific structure. For example, lengths are usually associated to a metric linear space, and colours to a topological 2D space.”

[CIT] [Masolo *et al.*, 2003, p. 18] “Since no parthood is defined, qualities are neither endurants nor perdurants, although their persistence conditions may be similar, in certain cases, to those of endurants or perdurants.”

### Abstract quality, AQ

#### **Meta-properties**

ABSTRACT QUALITY is RIGID (+**R**). ABSTRACT QUALITY is NOT CARRYING AN IDENTITY CRITERION (-**I**). ABSTRACT QUALITY is EXTERNALLY-DEPENDENT (+**D**). [**Ad69**] ABSTRACT QUALITY *mutually specifically constantly depends on* NON-PHYSICAL ENDURANT. ABSTRACT QUALITY is NON-EMPTY.

#### **Properties**

[EP/SL] An ABSTRACT QUALITY is a QUALITY. [**Ad41aa'**; EP/VR] An ABSTRACT QUALITY *has for qualities* only ABSTRACT QUALITIES. [**Ad41b**; EP/EVR] An ABSTRACT QUALITY *is a quality of* only ABSTRACT QUALITIES or NON-PHYSICAL ENDURANTS. [**Ad48**; EP/ER] Every ABSTRACT QUALITY *is a quality of* exactly one NON-PHYSICAL ENDURANT. [**Ad60a'**; EP/VR] An ABSTRACT QUALITY *has for quality location* only ABSTRACT REGIONS *during* a TIME INTERVAL. [**Ad62b'**; EP/NMC] Every ABSTRACT QUALITY *which is present at* a

TIME INTERVAL *has for quality location* at least one ABSTRACT REGION *during* that TIME INTERVAL.

**Comment**

[EX] The value of an asset is an example of ABSTRACT QUALITY.

**Physical quality, PQ**

**Meta-properties**

PHYSICAL QUALITY is RIGID (+**R**). PHYSICAL QUALITY is NOT CARRYING AN IDENTITY CRITERION (-**I**). PHYSICAL QUALITY is EXTERNALLY-DEPENDENT (+**D**). [Ad68] PHYSICAL QUALITY *mutually specifically spatially depends on* PHYSICAL ENDURANT. PHYSICAL QUALITY is NON-EMPTY.

**Properties**

[EP/SLD] A PHYSICAL QUALITY is a QUALITY which directly inheres to PHYSICAL ENDURANTS. [Ad40aa'; EP/VR] A PHYSICAL QUALITY *has for qualities* only PHYSICAL QUALITIES. [Ad40b; EP/EVR] A PHYSICAL QUALITY *is a quality of* only PHYSICAL QUALITIES or PHYSICAL ENDURANTS. [Ad47; EP/ER] Every PHYSICAL QUALITY *is a quality of* exactly one PHYSICAL ENDURANT. [Ad59a'; EP/VR] A PHYSICAL QUALITY *has for quality location* only PHYSICAL REGIONS *during* a TIME INTERVAL. [Ad62a'; EP/NMC] Every PHYSICAL QUALITY which *is present at* a TIME INTERVAL *has for quality location* at least one PHYSICAL REGION *during* that TIME INTERVAL. [Td16b'; EP/NMC] Every PHYSICAL QUALITY which *is present at* a TIME INTERVAL *is present in* at least one SPACE REGION *at* that TIME INTERVAL.

**Comment**

[EX] Examples of PHYSICAL QUALITIES are the weight of a pen, the colour of an apple.

**Spatial location, SL**

**Meta-properties**

SPATIAL LOCATION is RIGID (+**R**). SPATIAL LOCATION is NOT CARRYING AN IDENTITY CRITERION (-**I**). SPATIAL LOCATION is EXTERNALLY-DEPENDENT (+**D**). SPATIAL LOCATION is NON-EMPTY.

**Properties**

[EP/SL] A SPATIAL LOCATION is a PHYSICAL QUALITY. [Ad61'; EP/VR] A SPATIAL LOCATION *has for quality location* only SPACE REGIONS *during* a TIME INTERVAL.

**Temporal quality, TQ**

**Meta-properties**

TEMPORAL QUALITY is RIGID (+**R**). TEMPORAL QUALITY is NOT CARRYING AN IDENTITY CRITERION (-**I**). TEMPORAL QUALITY is EXTERNALLY-DEPENDENT (+**D**). [Ad67] TEMPORAL QUALITY *mutually specifically constantly depends on* PERDURANT. TEMPORAL QUALITY is NON-EMPTY.

**Properties**

[EP/SLD] A TEMPORAL QUALITY is a QUALITY which directly inheres to PERDURANTS. [Ad39aa'; EP/VR] A TEMPORAL QUALITY *has for qualities* only TEMPORAL QUALITIES. [Ad39b; EP/EVR] A TEMPORAL QUALITY *is a quality of* only TEMPORAL QUALITIES or PERDURANTS. [Ad46; EP/ER] Every TEMPORAL QUALITY *is a quality of* exactly one PERDURANT. [Ad55'; EP/ER] Every TEMPORAL

QUALITY *has for quality location* at least one TEMPORAL REGION. [EP/ER] A TEMPORAL QUALITY *has for quality location* only TEMPORAL REGIONS.

**Comment**

[EX] Examples of TEMPORAL QUALITIES are the duration of World War I, the starting time of the 2000 Olympics.

Temporal location, **TL**

**Meta-properties**

TEMPORAL LOCATION is RIGID (+**R**). TEMPORAL LOCATION is NOT CARRYING AN IDENTITY CRITERION (-**I**). TEMPORAL LOCATION is EXTERNALLY-DEPENDENT (+**D**). TEMPORAL LOCATION is NON-EMPTY.

**Properties**

[EP/SL] A TEMPORAL LOCATION is a TEMPORAL QUALITY. [**Ad53'**; EP/VR] A TEMPORAL LOCATION *has for quality location* only TIME INTERVALS.

// Non-rigid concept

Atom, **At**

**Meta-properties**

ATOM is NON-RIGID (-**R**). ATOM is NOT CARRYING AN IDENTITY CRITERION (-**I**). ATOM is NOT CARRYING A COMMON UNITY CRITERION (-**U**). ATOM is NON-EXTERNALLY-DEPENDENT (-**D**).

**Properties**

[**Dd16'**; EP/NSMC] an ATOM x is a PARTICULAR such that there does not exist y such that y *is a proper part of* x.

// Binary relations

Depends constantly and specifically on, **SD**

**Properties**

[EP/DDR & DRR] An ENDURANT, a PERDURANT or a QUALITY *depends constantly and specifically on* an ENDURANT, a PERDURANT or a QUALITY. [**Dd69**; EP/NSMC] x *depends constantly and specifically on* y iff necessarily x *is present at* a t and y *is present at* every t such that x *is present at* t.

Has for host

**Properties**

[EP/DR & RR] A FEATURE *has for host* a PHYSICAL OBJECT. [EP/SL] x *has for host* y implies that x *depends constantly and specifically on* y. [EP/IVL] *Has for host* mutually implies *is the host of*.

Depends spatially and specifically on, **SD<sub>s</sub>**

**Properties**

[**Dd78**; EP/NSMC] x *depends spatially and specifically on* y iff necessarily there exists at least one t and one s such that x *is present in* s at t and y *is present in* s at t for every s and t such that x *is present in* s at t.

Depends spatially, specifically and partially on, **PSD<sub>s</sub>**

**Properties**

[Dd79; EP/NSMC] *x depends spatially, specifically and partially on y* iff necessarily there exists at least one t and one s such that *x is present in s at t* and for every s and t such that *x is present in s at t*, there exists at least one s' such that *s' is a proper part of s* and *y is present in s' at t*.

Depends spatially, specifically, partially and inversely on, **P<sup>-1</sup>SD<sub>s</sub>**

**Properties**

[Dd80; EP/NSMC] *x depends spatially, specifically, partially and inversely on y* iff necessarily there exists at least one t and one s such that *x is present in s at t* and for every s and t such that *x is present in s at t*, there exists at least one s' such that *s is a proper part of s'* and *y is present in s' at t*.

Has for part, **P<sub>inv</sub>**

**Properties**

[EP/DDR & DRR] An ABSTRACT or a PERDURANT *has for part* an ABSTRACT or a PERDURANT. [EP/IVL] *Has for part* mutually implies *is a part of*.

Has for atomic part

**Properties**

[EP/SLD] *x has for atomic part y* iff *x has for part y* and not *y is an ATOM*. [EP/IVL] *Has for atomic part* mutually implies *is an atomic part of*.

Has for proper part, **PP<sub>inv</sub>**

**Properties**

[EP/SLD] *x has for proper part y* iff *x has for part y* and not *y has for part x*. [EP/IVL] *Has for proper part* mutually implies *is a proper part of*.

Has for boundary

**Properties**

[EP/SL] *x has for boundary y* implies that *x has for proper part y*. [EP/IVL] *Has for boundary* mutually implies *is a boundary of*.

Has for constant part

**Properties**

[EP/DR & RR] An ENDURANT *has for constant part* an ENDURANT. [EP/NSMC] *x has for constant part y* iff *x is present at at least one t* and *y is a part of x during each t such that x is present at that t*. [EP/IVL] *Has for constant part* mutually implies *is a constant part of*.

Has for constant participant

**Properties**

[EP/DR & RR] A PERDURANT *has for constant participant* a PARTICULAR. [Dd63; EP/NSMC] *x has for constant participant y* iff at least one t exists such that *x is present at t* and *y participates in x during each t such that x is present at t*. [EP/IVL] *Has for constant participant* mutually implies *Participates constantly in*.

Is the life of, **If**

**Properties**

[EP/DR & RR] a PERDURANT *is the life of* a PARTICULAR. [Dd68; EP/NSMC] *x is the life of y iff x is the sum of the z such that y participates totally in z.* [EP/SL] *x is the life of y implies that x has for constant participant y.* [EP/IVL] *Is the life of mutually implies has for life.*

Has for total constant participant

**Properties**

[EP/DR & RR] A PERDURANT *has for total constant participant* a PARTICULAR. [EP/IVL] *Has for total constant participant mutually implies is a total constant participant in.*

Has for temporary participant

**Properties**

[EP/DR & RR] A PERDURANT *has for temporary participant* a PARTICULAR. [Dd63; EP/NSMC] *x has for temporary participant y iff at least one t exists such that x is present at t and y participates in x during at least one t such that x is present at t.* [EP/IVL] *Has for temporary participant mutually implies Participates temporary in.*

Has for total temporary participant

**Properties**

[EP/DR & RR] A PERDURANT *has for total temporary participant* a PARTICULAR. [EP/IVL] *Has for total temporary participant mutually implies is a total temporary participant in.*

Has for quality location

**Properties**

[EP/DR & RR] A TEMPORAL QUALITY *has for quality location* A TEMPORAL REGION. [EP/IVL] *Has for quality location mutually implies is the quality location of.*

Has for quale, **ql<sub>inv</sub>**

**Properties**

[EP/NSC] *x has for quale y iff x has for quality location y and y is a QUALE.* [EP/IVL] *Has for quale mutually implies is the quale of.*

Has for quality, **qt<sub>inv</sub>**

**Properties**

[EP/DDR & RR] A QUALITY, an ENDURANT or a PERDURANT *has for quality* a QUALITY. [EP/MIL] *Has for quality mutually implies is a quality of.*

Has for temporal quale, **ql<sub>t</sub><sub>inv</sub>**

**Properties**

[EP/DDR & RR] A PERDURANT, an ENDURANT or a QUALITY, *has for temporal quale* A TIME INTERVAL. [EP/IVL] *Has for temporal quale mutually implies is a temporal quale of.*

Is a constant part of, **CP**

**Properties**

[EP/DR & RR] An ENDURANT *is a constant part of* an ENDURANT. [Dd25; EP/NSMC] *x is a constant part of y iff y is present at at least one t and x is a part of y during each t*

such that *y* is present at that *t*. [EP/IVL] *Is a constant part of* mutually implies *has for constant part*.

Is a part of, **P**

**Properties**

[Ad1; EP/DDR & DRR] An ABSTRACT or a PERDURANT *is a part of* an ABSTRACT or a PERDURANT. [Ad6; EP/NMC] *x is a part of y* implies that if *y is a part of x* then *x* is equal to *y*. [Ad7; EP/NMC] *x is a part of y* implies that if *y is a part of z* then *x is a part of z*. [EP/IVL] *Is a part of* mutually implies *has for part*.

Is a proper part of, **PP**

**Properties**

[Dd14; EP/SLD] *x is a proper part of y* iff *x is a part of y* and not *y is a part of x*. [EP/IVL] *Is a proper part of* mutually implies *has for proper part*.

Is a boundary of

**Properties**

[EP/SL] *x is a boundary of y* implies that *x is a proper part of y*. [EP/IVL] *Is a boundary of* mutually implies *has for boundary*.

Is an atomic part of, **AtP**

**Properties**

[Dd17; EP/SLD] *x is an atomic part of y* iff *x is a part of y* and *x* is an ATOM. [EP/IVL] *Is an atomic part of* mutually implies *has for atomic part*.

Is a spatial part of, **P<sub>s</sub>**

**Properties**

[EP/DR & RR] A PERDURANT *is a spatial part of* a PERDURANT. [Dd55; EP/SLD] *x is a spatial part of y* iff *x is a part of y* and *x* is a PERDURANT and *x temporally coincides with y*.

Is a temporal part of, **P<sub>t</sub>**

**Properties**

[EP/DR & RR] A PERDURANT *is a temporal part of* a PERDURANT. [Dd54; EP/SLD] *x is a temporal part of y* iff *x is a part of y* and *x* is a PERDURANT and for each *z* such that *z is a part of y* and *z is temporally included in x* then *z is a part of x*.

Is a quality of, **qt**, is inherent-in

**Properties**

[Ad38; EP/DR & DRR] A QUALITY *is a quality of* a QUALITY, an ENDURANT or a PERDURANT. [Ad42; EP/NMC] *x is a quality of y* implies that if *y is a quality of z* then *x is a quality of z*. [EP/IVL] *Is a quality of* mutually implies *has for quality*.

Is a direct quality of, **dqt**

**Properties**

[Dd28; EP/SLD] *x is a direct quality of y* iff *x is a quality of y* and there does not exist *z* such that *x is a quality of z* and *z is a quality of y*. [Ad43; EP/NC] *x is a direct quality of y* implies that if *x is a direct quality of y'* then *y* is equal to *y'*.



Is a temporal quale of, **ql<sub>T</sub>**

**Properties**

[EP/DR & DRR] A TIME INTERVAL is a temporal quale of a PERDURANT, an ENDURANT or a QUALITY. [Dd35; EP/NSMC] *t* is a temporal quale of *x* iff *t* is a temporal quale of the endurant *x* or *t* is a temporal quale of the perdurant *x* or *t* is a temporal quale of the quality *x*. [EP/IVL] *Is the temporal quale of* mutually implies *has for temporal quale*.

Is a temporal quale of an endurant, **ql<sub>T,ED</sub>**

**Properties**

[Dd31; EP/NSMC] *t* is a temporal quale of an endurant *x* iff *x* is an ENDURANT and *t* is the sum of the TIME INTERVAL *t'* such that *x* participates in a PERDURANT *y* during *t'*.

Is a temporal quale of a perdurant, **ql<sub>T,PD</sub>**

**Properties**

[Dd30; EP/NSMC] *t* is a temporal quale of a perdurant *x* iff *x* is a PERDURANT and there exists at least one *z* such that *z* is a TEMPORAL LOCATION and *z* is a quality of *x* and *t* is the quale of *z*.

Is a temporal quale of a physical quality or an abstract quality, **ql<sub>T,PQ∨AQ</sub>**

**Properties**

[Dd33; EP/NSMC] *t* is a temporal quale of a physical quality or an abstract quality *x* iff *x* is a PHYSICAL QUALITY or an ABSTRACT QUALITY and there exists at least one *z* such that *x* is a quality of *z* and *t* is a temporal quale of the endurant *z*.

Is a temporal quale of a quality, **ql<sub>T,Q</sub>**

**Properties**

[Dd34; EP/NSMC] *t* is a temporal quale of a quality *x* iff *t* is a temporal quale of the temporal quality *x* or *t* is a temporal quale of the physical quality or the abstract quality *x*.

Is a temporal quale of a temporal quality, **ql<sub>T,TQ</sub>**

**Properties**

[Dd32; EP/NSMC] *t* is a temporal quale of a temporal quality *x* iff *x* is a TEMPORAL QUALITY and there exists at least one *z* such that *x* is a quality of *z* and *t* is a temporal quale of the perdurant *z*.

Is atomic during, **At**

**Properties**

[EP/DR & RR] An ENDURANT is atomic during a TIME INTERVAL. [Dd22; EP/NSMC] *x* is atomic during *t* iff there does not exist *y* such that *y* is a proper part of *x* during *t*.

Is constantly specifically constituted by, **SK**

**Properties**

[Dd96; EP/NSMC] *x* is constantly specifically constituted by *y* iff necessarily *x* is present at at least one *t* and *y* constitutes *x* during each *t* such that *x* is present at *t*.

Is present at, **PR**

**Properties**

[EP/DDR & RR] An ENDURANT, a PERDURANT or a QUALITY *is present at a TIME INTERVAL*. [Dd40; EP/NSMC] *x is present at t* iff at least one  $t'$  exists such that  $t'$  *is the temporal quale of x* and  $t$  *is a part of*  $t'$ . [Td17; EP/NMC] *x is present at t* implies that *x is present at every*  $t'$  *such that*  $t'$  *is a part of*  $t$ .

Is spatio-temporally included in,  $\subseteq_{ST}$

**Properties**

[Dd46; EP/NSMC] *x is spatio-temporally included in y* iff there exists at least one  $t$  such that *x is present at t* and *x is spatially included in y during each t* such that *x is present at t*.

Spatio-temporally coincides with,  $\approx_{ST}$

**Properties**

[Dd50; EP/SLD] *x spatio-temporally coincides with y* iff *x is spatio-temporally included in y* and *y is spatio-temporally included in x*.

Is temporally included in,  $\subseteq_T$

**Properties**

[Dd42; EP/NSMC] *x is temporally included in y* iff there exists at least one  $t$  and one  $t'$  such that  $t$  *is a temporal quale of x* and  $t'$  *is a temporal quale of y* and  $t$  *is a part of*  $t'$ .

Is temporally properly included in,  $\subset_T$

**Properties**

[EP/SL] *Is temporally properly included in* implies *is temporally included in*. [Dd43; EP/NSMC] *x is temporally properly included in y* iff there exists at least one  $t$  and one  $t'$  such that  $t$  *is a temporal quale of x* and  $t'$  *is a temporal quale of y* and  $t$  *is a proper part of*  $t'$ .

Temporally coincides with,  $\approx_T$

**Properties**

[Dd48; EP/SLD] *x temporally coincides with y* iff *x is temporally included in y* and *y is temporally included in x*.

Is the host of

**Properties**

[EP/DR & RR] A PHYSICAL OBJECT *has for host* a FEATURE. [EP/IVL] *Is the host of* mutually implies *has for host*.

Is the maximal participant of, **mpc**

**Properties**

[EP/DR & RR] an ENDURANT *is the maximal participant of* a PERDURANT. [Dd66; EP/NSMC] *x is the maximal participant of y* iff *x is the sum of the z* such that *z participates totally in y*.

Is the maximal physical participant of, **mppe**

**Properties**

[EP/DR & RR] a PHYSICAL ENDURANT *is the maximal physical participant of* a PERDURANT. [Dd67; EP/NSMC] *x is the maximal physical participant of y* iff *x is the sum of the z* such that *z participates totally in y* and *z is a PHYSICAL ENDURANT*.

Is the quality location of

**Properties**

[EP/DR & RR] A TEMPORAL REGION *is the quality location of* A TEMPORAL QUALITY. [EP/IVL] *Is the quality location of* mutually implies *has for quality location*.

Is the quale of, **ql**

**Properties**

[EP/NSMC] *x is the quale of y* iff *x is the quality location of y* and *x is a QUALE*. [Ad54; EP/NMC] *x is the quale of y* implies that if *x' is the quale of y* then *x is equal to x'*. [EP/IVL] *Is the quale of* mutually implies *has for quale*.

Overlaps with, **O**

**Properties**

[EP/DDR & DRR] An ABSTRACT or a PERDURANT *overlaps with* an ABSTRACT or a PERDURANT. [Dd15; EP/NSMC] *x overlaps with y* iff at least one *z* exists such that *z is a part of x* and *z is a part of y*.

Participates constantly in, **PC<sub>C</sub>**

**Properties**

[EP/DR & RR] An ENDURANT *participates constantly in* a PERDURANT. [Dd63; EP/NSMC] *x participates constantly in y* iff at least one *t* exists such that *y is present at t* and *x participates in y during each t* such that *y is present at t*. [EP/IVL] *Participates constantly in* mutually implies *has for constant participant*.

Has for life

**Properties**

[EP/DR & RR] An ENDURANT *has for life* a PERDURANT. [Dd68; EP/NSMC] *x has for life y* iff *y is the sum of the z* such that *x participates totally in z*. [EP/SL] *x has for life y* implies that *x participates constantly in y*. [EP/IVL] *Has for life* mutually implies *is the life of*.

Is a total constant participant in

**Properties**

[EP/DR & RR] An ENDURANT *is a total constant participant in* a PERDURANT. [EP/LSD] *x is a total constant participant in y* iff *x participates constantly in y* and *x participates totally in y*. [EP/IVL] *Is a total constant participant in* mutually implies *has total constant participant*.

Participates temporary in, **PC<sub>C</sub>**

**Properties**

[EP/DR & RR] An ENDURANT *participates temporary in* a PERDURANT. [Dd63; EP/NSMC] *x participates temporary in y* iff at least one *t* exists such that *y is present at t* and *x participates in y during at least one t* such that *y is present at t*. [EP/IVL] *Participates temporary in* mutually implies *has for temporary participant*.

Is a total temporary participant in

**Properties**

[EP/DR & RR] An ENDURANT *is a total temporary participant in a PERDURANT*.  
[EP/LSD] *x is a total temporary participant in y iff x participates temporary in y and x participates totally in y*. [EP/IVL] *Is a total temporary participant in mutually implies has total temporary participant*.

Participates totally in, **PC<sub>T</sub>**

**Properties**

[EP/DR & RR] An ENDURANT *participates totally in a PERDURANT*. [Dd65; EP/NSMC] *x participates totally in y iff at least one t exists such that t is a temporal quale of y and x participates totally in y during t*.

Temporally overlaps with, **O<sub>T</sub>**

**Properties**

[Dd52; EP/NSMC] *x temporally overlaps with y iff there exists at least one t and one t' such that t is a temporal quale of x and t' is a temporal quale of y and t overlaps with t'*.

// Ternary relations

Constitutes during, **K**

**Properties**

[Ad20; EP/DR1 & DR2 & R3] An ENDURANT or a PERDURANT *constitutes an ENDURANT or a PERDURANT during a TIME INTERVAL*. [Ad24; EP/NMC] *x constitutes y during t implies that y does not constitutes x during t*. [Ad25; EP/NMC] *x constitutes y during t implies that if y constitutes z during that t, then x constitutes z during also that t*. [Ad26a; EP/NMC] *x constitutes y during t implies that x is present at that t*. [Ad26b; EP/NMC] *x constitutes y during t implies that y is present at that t*. [Ad27; EP/NSMC] *x constitutes y during t iff x constitutes y during every t' such that t' is a part of t*. [Ad29; EP/NMC] *x constitutes y during t implies that if y' is a part of y during t then there exists at least one x' such that x' is a part of x during t and x' constitutes y' during t*. [EP/IVL] *Constitutes during mutually implies has for constituent during*.

Constitutes directly during, **DK**

**Properties**

[Dd95; EP/SLD] *x constitutes directly y during t iff x constitutes y during t and there does not exist z such that x constitutes z during t and z constitutes y during t*.

Depends spatially and specifically on during, **SDt<sub>s</sub>**

**Properties**

[Dd88; EP/NSMC] *x depends spatially and specifically on y during t iff x depends spatially and specifically on y and x is present at t*.

Has for constituent during, **K<sub>inv</sub>**

**Properties**

[EP/DR1 & DR2 & R3] An ENDURANT or a PERDURANT *has for constituent an ENDURANT or a PERDURANT during a TIME INTERVAL*. [EP/IVL] *Has for constituent during mutually implies constitutes during*.

Has for part during, **P<sub>inv</sub>**

### Properties

[EP/R1 & R2 & R3] An ENDURANT *has for part* an ENDURANT *during* a TIME INTERVAL. [EP/IVL] *Has for part during* mutually implies *is a part of during*.

Has for proper part during, **PPinv**

### Properties

[EP/SLD] *x has for proper part y during z* iff *x has for part y during t* and not *y has for part x during t*. [EP/IVL] *Has for proper part during* mutually implies *is a proper part of during*.

Has for boundary during

### Properties

[EP/SL] *x has for boundary y during z* implies that *x has for proper part y during z*. [EP/IVL] *Has for boundary during* mutually implies *is a boundary of during*.

Has for atomic part during, **PPinv**

### Properties

[EP/SLD] *x has for atomic part y during z* iff *x has for part y during t* and *y* is an ATOM. [EP/IVL] *Has for atomic part during* mutually implies *is an atomic part of during*.

Has for participant during, **PCinv**

### Properties

[EP/R1 & R2 & R3] A PERDURANT *has for participant* a PARTICULAR *during* a TIME INTERVAL. [EP/IVL] *Has for participant during* mutually implies *participates in during*.

Has for total participant during

### Properties

[EP/R1 & R2 & R3] A PERDURANT *has for total participant* a PARTICULAR *during* a TIME INTERVAL. [Dd64; EP/NSMC] *x has for total participant y during t* iff for every *z* such that *z is a part of x* and *z is present at t*, *z has for participant x during t*. [EP/IVL] *Has for total participant during* mutually implies *participates totally in during*.

Has for quality location during

### Properties

[EP/DR1 & DR2 & R3] A PHYSICAL QUALITY or an ABSTRACT QUALITY *has for quality location* a PHYSICAL REGION or an ABSTRACT REGION *during* a TIME INTERVAL. [EP/IVL] *Has for quality location during* mutually implies *is the quality location of during*.

Has for quale during, **qlinv**

### Properties

[EP/NSMC] *x has for quale y during z* iff *x has for quality location y during t* and *y* is a QUALE. [EP/IVL] *Has for quale during* mutually implies *is the quale of during*.

Has for spatial quale during, **qlsinv**

### Properties

[EP/DR1 & R2 & R3] A PHYSICAL ENDURANT, a PHYSICAL QUALITY or a PERDURANT, *has for spatial quale* a SPACE REGION *during* a TIME INTERVAL. [EP/IVL] *Has for spatial quale during* mutually implies *is a spatial quale of during*.

Is a part of during, **P**

**Properties**

[Ad10; EP/R1 & R2 & R3] An ENDURANT *is a part of* an ENDURANT *during* a TIME INTERVAL. [Ad13; EP/NMC] *x is a part of y during t* implies that if *y is a part of a z during t* then *x is a part of that z during t*. [Ad17a; EP/NMC] *x is a part of y during t* implies that *x is present at that t*. [Ad17b; EP/NMC] *x is a part of y during t* implies that *y is present at that t*. [Ad18; EP/NMC] *x is a part of y during t* implies that for each *t'* such that *t' is a part of t*, *x is a part of y during t'*. [EP/IVL] *Is a part of during* mutually implies *has for part during*.

Is a proper part of during, **PP**

**Properties**

[EP/SLD] *x is a proper part of y during t* iff *x is a part of y during t* and not *y is a part of x during t*. [EP/IVL] *Is a proper part of during* mutually implies *has for proper part during*.

Is a boundary of during

**Properties**

[EP/SL] *x is a boundary of y during z* implies that *x is a proper part of y during z*. [EP/IVL] *Is a boundary of during* mutually implies *has for boundary during*.

Is an atomic part of during, **PPinv**

**Properties**

[EP/SLD] *x is an atomic part of y during z* iff *x is a part y during t* and *x is an ATOM*. [EP/IVL] *Is an atomic part of during* mutually implies *has for atomic part*.

Coincides with during,  $\equiv_t$

**Properties**

[Dd24; EP/SLD] *x coincides with y during t* iff *x is a part of y during t* and *y is a part of x during t*.

Is the quality location of during

**Properties**

[EP/DR1 & DR2 & R3] a PHYSICAL REGION or an ABSTRACT REGION *is the quality location of* A PHYSICAL QUALITY or an ABSTRACT QUALITY *during* a TIME INTERVAL. [EP/IVL] *Is the quality location of during* mutually implies *has for quality location during*.

Is the quale of during, **ql**

**Properties**

[EP/NSMC] *x is the quale of y during t* iff *x is the quality location of y during t* and *x is a QUALE*. [Ad65; EP/NMC] *x is the quale of y during t* implies that *y is present at t*. [Ad66; EP/NSMC] *x is the quale of y during t* iff *x is the quale of y during every t'* such that *t' is a part of t*. [EP/IVL] *Is the quale of during* mutually implies *has for quale during*.

Is a spatial quale of a physical endurant during, **qls,PED**

**Properties**

[Dd36; EP/NSMC] *s is a spatial quale of a physical endurant x during t* iff x is a PHYSICAL ENDURANT and there exists at least one z such that z is a SPATIAL LOCATION and *z is a quality of x and s is a quale of z during t*.

Is a spatial quale of a perdurant during,  $ql_{s,pd}$

**Properties**

[Dd38; EP/NSMC] *s is a spatial quale of a perdurant x during t* iff x is a PERDURANT and there exists at least one z such that *z is the maximal physical participant of x and s is a spatial quale of the physical endurant z during t*.

Is a spatial quale of a physical quality during,  $ql_{s,pq}$

**Properties**

[Dd37; EP/NSMC] *s is a spatial quale of a physical quality x during t* iff x is a PHYSICAL QUALITY and there exists at least one z such that *x is a quality of z and s is a spatial quale of the physical perdurant z during t*.

Is present in at, **PR**

**Properties**

[EP/DR1 & R2 & R3] A PHYSICAL ENDURANT, a PHYSICAL QUALITY or a PERDURANT *is present in* a SPACE REGION *at* a TIME INTERVAL. [Dd41; EP/NSMC] *x is present in s at t* iff *x is present at t* and at least one *s'* exists such that *s' is the spatial quale of x during t and s is a part of s'*. [Td18; EP/NMC] if *x is present in s at t* then *x is present at t*.

Is spatio-temporally included in during,  $\subseteq_{ST,t}$

**Properties**

[Dd47; EP/NSMC] *x is spatio-temporally included in y during t* iff *x is present at t* and *x is spatially included in y during each t'* such that *t' is an atomic part of t*.

Spatio-temporally coincides with during,  $\approx_{ST,t}$

**Properties**

[EP/SL] *x spatio-temporally coincides with y during t* implies *x is spatio-temporally included in y during t*. [Dd51; EP/NSMC] *x spatio-temporally coincides with y during t* iff *x is present at t* and *x temporally spatially coincides with y during each t'* such that *t' is an atomic part of t*.

Is spatially included in during,  $\subseteq_{s,t}$

**Properties**

[Dd44; EP/NSMC] *x is spatially included in y during t* iff there exists at least one *s* and one *s'* such that *s is a spatial quale of x during t and s' is a spatial quale of y during t and s is a part of s'*.

Is spatially properly included in during,  $\subset_{s,t}$

**Properties**

[EP/SL] *Is spatially properly included in during* implies *is spatially included in during*. [Dd45; EP/NSMC] *x is spatially properly included in y during t* iff there exists at least one *s* and one *s'* such that *s is a spatial quale of x during t and s' is a spatial quale of y during t and s is a proper part of s'*.

Spatially coincides with during,  $\approx_{s,t}$

**Properties**

[Dd49; EP/SLD] *x spatially coincides with y during t* iff *x is spatially included in y during t* and *y is spatially included in x during t*.

Is the binary sum of, +

**Properties**

[Dd18; EP/NSMC] *z is the binary sum of x and y* iff *z is such that every w which overlaps with z either overlaps with x or y*.

Is the binary constant sum of,  $+_{te}$

**Properties**

[Dd26; EP/NSMC] *z is the binary constant sum of x and y* iff *z is such that every w which overlaps with z during every t either overlaps with x or y during that t*.

Is a spatial quale of during,  $ql_s$

**Properties**

[EP/R1 & DR2 & R3] A SPACE REGION is a spatial quale of a PHYSICAL ENDURANT, a PHYSICAL QUALITY or a PERDURANT, during a TIME INTERVAL. [Dd39; EP/NSMC] *s is a spatial quale of x during t* iff *s is a spatial quale of the physical endurant x during t* or *s is a spatial quale of the physical quality x during t* or *s is a spatial quale of the perdurant x during t*. [EP/IVL] *Is a spatial quale of during* mutually implies *has for spatial quale during*.

Overlaps with during, **O**

**Properties**

[EP/R1 & R2 & R3] An ENDURANT overlaps with an ENDURANT during a TIME INTERVAL. [Dd21; EP/NSMC] *x overlaps with y during t* iff at least one *z* exists such that *z is a part of x during t* and *z is a part of y during t*.

Participates in during, **PC**

**Properties**

[Ad33; EP/R1 & R2 & R3] A PARTICULAR participates in a PERDURANT during a TIME INTERVAL. [Ad36a; EP/NMC] *x participates in y during t* implies that *x is present at that t*. [Ad36b; EP/NMC] *x participates in y during t* implies that *y is present at that t*. [Ad37; EP/NMC] *x participates in y during t* implies that *x participates in y during each t'* such that *t' is a part of t*. [Td7; EP/NMC] *x participates in y during t* implies that *y does not participate in x during t*. [EP/IVL] *Participates in during* mutually implies *has for participant during*.

**Comment**

[EX] A person, which is an ENDURANT, may participate in a discussion, which is a PERDURANT. A person's life is also a PERDURANT, in which a person participates throughout its all duration.

Participates totally in during, **PC<sub>T</sub>**

**Properties**

[EP/R1 & R2 & R3] A PARTICULAR participates totally in a PERDURANT during a TIME INTERVAL. [Dd64; EP/NSMC] *x participates totally in y during t* iff for every *z*



such that *z is a part of y* and *z is present at t*, *x participates in z during t*. [EP/IVL]  
*Participates totally in during* mutually implies *has for total participant during*.

Spatially overlaps with during,  $O_{s,t}$

**Properties**

[Dd53; EP/NSMC] *x spatially overlaps with y during t* iff there exists at least one *s* and one *s'* such that *s is a spatial quale of x during t* and *s' is a spatial quale of y during t* and *s overlaps with s'*.