### ISSUE 438: proposal to replace E18 IsA E92 and E4 IsA E92 with properties

The sig reviewed the HW by MD on classes and properties affected by declaring E18 IsA E92 NOT to be the case. The classes and properties reviewed were [E18 Physical Thing](#_E18_Physical_Thing), [E92 Spacetime Volume](#_E92_Spacetime_Volume), [E93 Presence](#_E93_Presence), [P161 has spatial projection](#_P161_has_spatial), P156 occupies (is occupied by), [P195 had presence](#_P195_was_a), [P196 defines](#_P196_defines_(is).

In yellow are marked some properties that may have an added spatiotemporal formalization about the presence of parts. These are P8, P12, P110, P111, P112, P113

### E18 Physical Thing

Subclass of: [E72](#_E72_Legal_Object) Legal Object

[E92](#_E91_Co-Reference_Assignment) Spacetime Volume

Superclass of: [E19](#_E19_Physical_Object) Physical Object

[E24](#_E24_Physical_Man-Made_Thing) Physical Human-Made Thing

[E26](#_E26_Physical_Feature) Physical Feature

Scope Note: This class comprises all persistent physical items with a relatively stable form, human-made or natural.

Depending on the existence of natural boundaries of such things, the CIDOC CRM distinguishes the instances of E19 Physical Object from instances of E26 Physical Feature, such as holes, rivers, pieces of land etc. Most instances of E19 Physical Object can be moved (if not too heavy), whereas features are integral to the surrounding matter.

An instance of E18 Physical Thing occupies not only a particular geometric space at any instant of its existence, but in the course of its existence it also forms a trajectory through spacetime, which occupies a real, that is phenomenal, volume in spacetime. We include in the occupied space the space filled by the matter of the physical thing and all its inner spaces, such as the interior of a box. For the purpose of more detailed descriptions of the presence of an instance of E18 Physical Thing in space and time it can be associated with its specific instance of E92 Spacetime Volume by the property *P196 defines (is defined by).*

The CIDOC CRM is generally not concerned with amounts of matter in fluid or gaseous states, as long as they are not confined in an identifiable way for an identifiable minimal time-span.

Examples:

* + - the Cullinan Diamond (E19) (Scarratt and Shor, 2006)
    - the cave “Ideon Andron” in Crete (E26) (Smith, 1844-49)
    - the Mona Lisa (E22) (Mohem, 2006)

In First Order Logic:

E18(x) ⊃ E72(x)

E18(x) ⊃ E92(x)

Properties:

[P44](#_P44_has_condition_(condition of)) has condition (is condition of): [E3](#_E3_Condition_State) Condition State

[P45](#_P45_consists_of_(is incorporated in) consists of (is incorporated in): [E57](#_E57_Material) Material

[P46](#_P46_is_composed_of (forms part of)) is composed of (forms part of): [E18](#_E18_Physical_Thing) Physical Thing

[P49](#_P49_has_former_or current keeper (i) has former or current keeper (is former or current keeper of): [E39](#_E39_Actor) Actor

[P50](#_P50_has_current_keeper (is current ) has current keeper (is current keeper of): [E39](#_E39_Actor) Actor

[P51](#_P51_has_former_or current owner (is) has former or current owner (is former or current owner of): [E39](#_E39_Actor) Actor

[P52](#_P52_has_current_owner (is current o) has current owner (is current owner of): [E39](#_E39_Actor) Actor

[P53](#_P53_has_former_or current location ) has former or current location (is former or current location of): [E53](#_E53_Place) Place

[P59](#_P59_has_section_(is located on or w) has section (is located on or within): [E53](#_E53_Place) Place

[P128](#_P128_carries_(is_carried by)) carries (is carried by): [E90](#_E90_Symbolic_Object) Symbolic Object

[P156](#_P156_occupies_(is) occupies (is occupied by): [E53](#_E53_Place) Place

P196 defines (is defined by) : E92 Spacetime Volume

### E92 Spacetime Volume

Subclass of: [E1](#_E1_CRM_Entity) CRM Entity

Superclass of: [E4](#_E4_Period) Period

[E93](#_E93_Presence) Presence

Scope note: This class comprises 4 dimensional point sets (volumes) in physical spacetime (in contrast to mathematical models of it) regardless their true geometric forms. They may derive their identity from being the extent of a material phenomenon or from being the interpretation of an expression defining an extent in spacetime. Intersections of instances of E92 Spacetime Volume, E53 Place and E52 Timespan are also regarded as instances of E92 Spacetime Volume. An instance of E92 Spacetime Volume is either contiguous or composed of a finite number of contiguous subsets. Its boundaries may be fuzzy due to the properties of the phenomena it derives from or due to the limited precision up to which defining expression can be identified with a real extent in spacetime. The duration of existence of an instance of E90 Spacetime Volume is its projection on time.

Examples:

* the extent in space and time of the Event of Caesar’s murder
* where and when the carbon 14 dating of the "Schoeninger Speer II" in 1996 took place
* the spatio-temporal trajectory of the H.M.S. Victory from its building to its actual location
* the extent in space and time defined by a polygon approximating the Danube river flood in Austria between 6th and 9th of August 2002

In First Order Logic:

E92(x) ⊃ E1(x)

Properties:

[P10](#_P10_falls_within_(contains)) falls within (contains): [E92](#_E91_Co-Reference_Assignment) Spacetime Volume

[P132](#_P132_overlaps_with) spatiotemporally overlaps with: [E92](#_E91_Co-Reference_Assignment) Spacetime Volume

[P133](#_P133_is_separated_from) spatiotemporally separated from: [E92](#_E91_Co-Reference_Assignment) Spacetime Volume

[P160](#_P160_(Px5)_) has temporal projection(is temporal projection of): [E52](#_E52_Time-Span) Time-Span

[P161](#_P161_(Px6)_) has spatial projection (is spatial projection of): [E53](#_E53_Place) Place

### E93 Presence

Subclass of: [E92](#_E92_Spacetime_Volume) Spacetime Volume

Scope note: This class comprises instances of E92 Spacetime Volume, whose temporal extent has been chosen in order to determine the spatial extent of a phenomenon over the chosen time-span. Respective phenomena may, for instance, be historical events or periods, but can also be the diachronic extent and existence of physical things. In other words, instances of this class fix a slice of another instance of E92 Spacetime Volume in time.

The temporal extent of an instance of E93 Presence typically is predetermined by the researcher so as to focus the investigation particularly on finding the spatial extent of the phenomenon by testing for its characteristic features. There are at least two basic directions such investigations might take. The investigation may wish to determine where something was during some time or it may wish to reconstruct the total passage of a phenomenon’s spacetime volume through an examination of discrete presences. Observation and measurement of features indicating the presence or absence of a phenomenon in some space allows for the progressive approximation of spatial extents through argumentation typically based on inclusion, exclusion and various overlaps.

In First Order Logic:

E93(x) ⊃ E92(x)

Properties:

[P164](#_P164_(Px9)_is) during (was time-span of): [E52](#_E52_Time-Span) Time Span

[P166](#_P166_was_a) was a presence of (had presence): [E92](#_E91_Co-Reference_Assignment) Space Time Volume

[P167](#_P167_was_at) at (was place of): [E53](#_E53_Place) Place

P195 was a presence of (had presence): E18 Physical Thing

### P8 took place on or within (witnessed) (no discussion)

Domain: [E4](#_E4_Period) Period

Range: [E18](#_E19_Physical_Object) Physical Thing

Quantification: many to many (0,n:0,n)

Scope note: This property describes the location of an instance of E4 Period with respect to an instance of E19 Physical Object.

P8 took place on or within (witnessed) is a shortcut of the more fully developed path from ‘E4 Period’ through ‘P7 took place at’, ‘E53 Place’, ‘P156i is occupied by’, to ‘E18 Physical Thing’

It describes a period that can be located with respect to the space defined by an E19 Physical Object such as a ship or a building. The precise geographical location of the object during the period in question may be unknown or unimportant.

For example, the French and German armistice of 22 June 1940 was signed in the same railway carriage as the armistice of 11 November 1918.

Examples:

* the coronation of Queen Elizabeth II (E7) *took place on or within* Westminster Abbey (E19)

In First Order Logic:

P8(x,y) ⊃ E4(x)

P8(x,y) ⊃ E18(y)

### P12 occurred in the presence of (was present at) (no discussion)

Domain: [E5](#_E5_Event) Event

Range: [E77](#_E77_Persistent_Item) Persistent Item

Superproperty of: [E5](#_E5_Event) Event. [P11](#_P11_had_participant_(participated_i) had participant (participated in): [E39](#_E39_Actor) Actor

[E7](#_E7_Activity) Activity. [P16](#_P16_used_specific_object (was used ) used specific object (was used for): [E70](#_E70_Thing) Thing

[E9](#_E9_Move) Move. [P25](#_P25_moved_(moved_by)) moved (moved by): [E19](#_E19_Physical_Object) Physical Object

[E11](#_E11_Modification) Modification. [P31](#_P31_has_modified_(was modified by)) has modified (was modified by): [E18](#_E24_Physical_Man-Made_Thing) Physical Thing

[E63](#_E63_Beginning_of_Existence) Beginning of Existence. [P92](#_P92_brought_into_existence (was bro) brought into existence (was brought into existence by): [E77](#_E77_Persistent_Item) Persistent Item

[E64](#_E64_End_of_Existence) End of Existence. [P93](#_P93_took_out_of existence (was take) took out of existence (was taken out of existence by): [E77](#_E77_Persistent_Item) Persistent Item

[E79](#_E79_Part_Addition) Part Addition.[P111](#_P111_added_(was) added (was added by): [E18](#_E18_Physical_Thing) Physical Thing

[E80](#_E80_Part_Removal) Part Removal.[P113](#_P113_removed_(was) removed (was removed by): [E18](#_E18_Physical_Thing) Physical Thing

Quantification: many to many, necessary (1,n:0,n)

Scope note: This property describes the active or passive presence of an E77 Persistent Item in an E5 Event without implying any specific role.

It documents known events in which an instance of E77 Persistent Item was present during the course of its life or history. For example, an object may be the desk, now in a museum on which a treaty was signed. The E53 Place and E52 Time-Span where and when these events happened provide us with constraints about the presence of the related E77 Persistent Item in the past. Instances of E90 Symbolic Object, in particular information objects, are physically present in events via at least one of the instances of E18 Physical Thing carrying them. Note, that the human mind can be such a carrier. A precondition for a transfer of information to a person or another new physical carrier is the presence of the respective information object and this person or physical thing in one event.

Examples:

* Deckchair 42 (E19) *was present at* The sinking of the Titanic (E5)

In First Order Logic:

P12(x,y) ⊃ E5(x)

P12(x,y) ⊃ E77(y)

### P46 is composed of (forms part of)(no discussion)

Domain: [E18](#_E18_Physical_Thing) Physical Thing

Range: [E18](#_E18_Physical_Thing) Physical Thing

Subproperty of:

Superproperty of:[E19](#_E19_Physical_Object) Physical Object. [P56](#_P56_bears_feature) bears feature (is found on): [E26](#_E26_Physical_Feature) Physical Feature

Quantification: many to many (0,n:0,n)

Scope note: This property associates an instance of E18 Physical Thing with another instance of Physical Thing that forms part of it.

Component elements, since they are themselves instances of E18 Physical Thing, may be further analysed into sub-components, thereby creating a hierarchy of part decomposition. An instance of E18 Physical Thing may be shared between multiple wholes, for example two buildings may share a common wall. This property does not specify when and for how long a component element resided in the respective whole. If a component is not part of a whole from the beginning of existence or until the end of existence of the whole, the classes E79 Part Addition and E90 Part Removal can be used to document when a component became part of a particular whole and/or when it stopped being a part of it. For the time-span of being part of the respective whole, the component is completely contained in the place the whole occupies.

This property is intended to describe specific components that areindividually documented, rather than general aspects. Overall descriptions of the structure of an instance of E18 Physical Thing are captured by the *P3* *has note* property.

The instances of E57 Material of which an item of E18 Physical Thing is composed should be documented using *P45* *consists of (is incorporated in)*.

Examples:

* the Royal carriage (E22) *forms part of* the Royal train (E22)
* the “Hog’s Back” (E24) *forms part of* the “Fosseway” (E24)

In First Order Logic:

P46(x,y) ⊃ E18(x)

P46(x,y) ⊃ E18(y)

P46(x,y) ⊃ P132(x,y)

P46(x,y) ⊃ (∃uzw)[E93(u) ∧ P195 (x,u) ∧ E52(z) ∧ P164(u,z) ∧ E93(w) ∧ P195 (y,w) ∧

P164(w,z) ∧ P10(w,u)]

### P110 augmented (was augmented by) )(no discussion)

Domain: [E79](#_E79_Part_Addition) Part Addition

Range: [E24](#_E24_Physical_Man-Made_Thing) Physical Human-Made Thing

Subproperty of: [E11](#_E11_Modification) Modification. [P31](#_P31_has_modified_(was_modified_by)) has modified (was modified by): [E18](#_E24_Physical_Man-Made_Thing) Physical Thing

Quantification: many to many, necessary (1,n:0,n)

Scope note: This property identifies the E24 Physical Human-Made Thing that is added to (augmented) in an E79 Part Addition.

Although a Part Addition event normally concerns only one item of Physical Human-Made Thing, it is possible to imagine circumstances under which more than one item might be added to (augmented). For example, the artist Jackson Pollock trailing paint onto multiple canvasses.

Examples:

* the final nail-insertion Event (E79) *augmented* Coffin of George VI (E24)

In First Order Logic:

P110(x,y) ⊃ E79(x)

P110(x,y) ⊃ E24(y)

P110(x,y) ⊃ P31(x,y)

### P111 added (was added by) )(no discussion)

Domain: [E79](#_E79_Part_Addition) Part Addition

Range: [E18](#_E18_Physical_Thing) Physical Thing

Subproperty of: [E5](#_E5_Event) Event. [P12](#_P12_occurred_in) occurred in the presence of (was present at):[E77](#_E77_Persistent_Item) Persistent Item

[E7](#_E7_Activity) Activity.[P16](#_P16_used_specific_object_(was_used_) used specific object (was used for):[E70](#_E70_Thing) Thing

Quantification: many to many, necessary (1,n:0,n)

Scope note: This property identifies the E18 Physical Thing that is added during an E79 Part Addition activity

Examples:

* the insertion of the final nail (E79) *added* the last nail in George VI’s coffin (E18)

In First Order Logic:

P111(x,y) ⊃ E79(x)

P111(x,y) ⊃ E18(y)

P111(x,y) ⊃ P12(x,y)

P111(x,y) ⊃ P16(x,y)

### P112 diminished (was diminished by) )(no discussion)

Domain: [E80](#_E80_Part_Removal) Part Removal

Range: [E24](#_E24_Physical_Man-Made_Thing) Physical Human-Made Thing

Subproperty of: [E11](#_E11_Modification) Modification. [P31](#_P31_has_modified) has modified (was modified by): [E18](#_E24_Physical_Man-Made_Thing) Physical Thing

Quantification: many to many, necessary (1,n:0,n)

Scope note: This property identifies the E24 Physical Human-Made Thing that was diminished by E80 Part Removal.

Although a Part removal activity normally concerns only one item of Physical Human-Made Thing, it is possible to imagine circumstances under which more than one item might be diminished by a single Part Removal activity.

Examples:

* the coffin of Tut-Ankh-Amun (E22) *was* *diminished by* The opening of the coffin of Tut-Ankh-Amun (E80)

In First Order Logic:

P112(x,y) ⊃ E80(x)

P112(x,y) ⊃ E24(y)

P112(x,y) ⊃ P31(x,y)

### P113 removed (was removed by) )(no discussion)

Domain: [E80](#_E80_Part_Removal) Part Removal

Range: [E18](#_E18_Physical_Thing) Physical Thing

Subproperty of: [E5](#_E5_Event) Event. [P12](#_P12_occurred_in) occurred in the presence of (was present at):[E77](#_E77_Persistent_Item) Persistent Item

Quantification: many to many, necessary (1,n:0,n)

Scope note: This property identifies the E18 Physical Thing that is removed during an E80 Part Removal activity.

Examples:

* the opening of the coffin of Tut-Ankh-Amun (E80) *removed* The mummy of Tut-Ankh-Amun (E20,E22)

In First Order Logic:

P113(x,y) ⊃ E80(x)

P113(x,y) ⊃ E18(y)

P113(x,y) ⊃ P12(x,y)

### P132 spatiotemporally overlaps with)(no discussion)

Domain: [E92](#_E91_Co-Reference_Assignment) Spacetime Volume

Range: [E92](#_E91_Co-Reference_Assignment) Spacetime Volume

Superproperty of:

[E4](#_E4_Period) Period.[P9](#_P9_consists_of_(forms_part_of)) consists of (forms part of): [E4](#_E4_Period) Period

[E92](#_E91_Co-Reference_Assignment) Spacetime Volume.[P10](#_P10_falls_within_(contains)) falls within (contains): [E92](#_E91_Co-Reference_Assignment) Spacetime Volume

Quantification: many to many (0,n:0,n)

Scope note: This symmetric property associates two instances of E92 Spacetime Volume that have some of their extents in common. If only the fuzzy boundaries of the instances of E92 Spacetime Volume overlap, this property cannot be determined from observation alone and therefore should not be applied. However, there may be other forms of justification that the two instances of E92 Spacetime Volume must have some of their extents in common regardless of where and when precisely.

If this property holds for two instances of E92 Spacetime Volume then it cannot be the case that P133 also holds for the same two instances. Furthermore, there are cases where neither P132 nor P133 holds between two instances of E92 Spacetime Volume. This would occur where only an overlap of the fuzzy boundaries of the two instances of E92 Spacetime Volume occurs and no other evidence is available.

.

Examples:

* the “Urnfield” period (E4*) spatiotemporally overlaps with* the “Hallstatt” period (E4)

In First Order Logic:

P132(x,y) ⊃ E92(x)

P132(x,y) ⊃ E92(y)

P132(x,y) ⊃ P132(y,x)

P132(x,y) ⊃ ¬P133(x,y)

### P133 is spatiotemporally separated from)(no discussion)

Domain: [E92](#_E91_Co-Reference_Assignment) Spacetime Volume

Range: [E92](#_E91_Co-Reference_Assignment) Spacetime Volume

Quantification: many to many (0,n:0,n)

Scope note: This symmetric property associates two instances of E92 Spacetime Volume that have no extents in common. If only the fuzzy boundaries of the instances of E92 Spacetime Volume overlap, this property cannot be determined from observation alone and therefore should not be applied. However, there may be other forms of justification that the two instances of E92 Spacetime Volume must not have any of their extents in common regardless of where and when precisely.

If this property holds for two instances of E92 Spacetime Volume then it cannot be the case that P132 also holds for the same two instances. Furthermore, there are cases where neither P132 nor P133 holds between two instances of E92 Spacetime Volume. This would occur where only an overlap of the fuzzy boundaries of the two instances of E92 Spacetime Volume occurs and no other evidence is available.

Examples:

* the “Hallstatt” period (E4) *is spatiotemporally separated from* the “La Tène” era (E4)
* Kingdom of Greece (1831-1924) (E92) *is spatiotemporally separated from* Ottoman Empire (1299-1922) (E92)
* The path of the army of Alexander (335-323 B.C.) (E92) *is spatiotemporally separated from* the Mauryan Empire (E92)

In First Order Logic:

P133(x,y) ⊃ E92(x)

P133(x,y) ⊃ E92(y)

P133(x,y) ⊃ P133(y,x)

P133(x,y) ⊃ ¬P132(x,y)

### P156 occupies (is occupied by) )(no discussion)

Domain: [E18](#_E18_Physical_Thing) Physical Thing

Range: [E53](#_E53_Place) Place

Subproperty of: P157i is at rest relative to (provides reference space for).

Subproperty of: P53 has former or current location (is former or current location of)

Quantification: one to one (0,1:1,1)

Scope note: This property describes the largest volume in space, an instance of E53 Place, that an instance of E18 Physical Thing has occupied at any time during its existence, with respect to the reference space relative to the physical thing itself. This allows for describing the thing itself as a place that may contain other things, such as a box that may contain coins. In other words, it is the volume that contains all the points which the thing has covered at some time during its existence. The reference space for the associated place must be the one that is permanently at rest (*P157 is at rest relative to)* relative to the physical thing. For instances of E19 Physical Objects it is the one which is at rest relative to the object itself, i.e. which moves together with the object. For instances of E26 Physical Feature it is one which is at rest relative to the physical feature itself and the surrounding matter immediately connected to it. Therefore there is a 1:1 relation between the instance E18 Physical Thing and the instance of E53 Place it occupies. We include in the occupied space the space filled by the matter of the physical thing and all its inner spaces.

This property implies the fully developed path from E18 Physical Thing through *P196 defines, E92 Spacetime Volume*, *P161 has spatial projection*, E53 Place. However, in contrast to *P156 occupies,* the property *P161 has spatial projection* does not constrain the reference space of the referred instance of E53 Place.

In contrast to *P156 occupies*, for the property *P53 has former or current location* the following holds:

* It does not constrain the reference space of the referred instance of E53 Place.
* It identifies a possibly wider instance of E53 Place at which a thing is or has been for some unspecified time span.
* If the reference space of the referred instance of E53 Place is not at rest with respect to the physical thing found there, the physical thing may move away after some time to another place and/or may have been at some other place before. The same holds for the fully developed path from E18 Physical Thing through *Pxxx defines, E92 Spacetime Volume*, *P161 has spatial projection*, E53 Place.

In First Order Logic:

P156(x,y) ⊃ E53(y)

P156(x,y) ⊃ E18(x)

P156 (x,y) = [E18(x) ∧ E53(y) ∧ P196(x,z) ∧ P161(z,y) ∧ P157(y,x)]

### P161 has spatial projection (is spatial projection of)

Domain: [E92](#_E92_Spacetime_Volume) Spacetime Volume

Range: [E53](#_E53_Place) Place

Quantification: one to many, necessary, dependent (1,n:1,1)

Scope note: This property associates an instance of an instance of E92 Spacetime Volume with an instance of E53 Place that is the result of the spatial projection of the instance of the E92 Spacetime Volume on a reference space.

In general there can be more than one useful reference space (for reference space see *p156 occupies* and *p157 is at rest relative to*) to describe the spatial projection of a spacetime volume, for example, in describing a sea battle, the difference between the battle ship and the seafloor as reference spaces. Thus it can be seen that the projection is not unique.

The spatial projection is the actual spatial coverage of a spacetime volume, which normally has fuzzy boundaries except for instances of E92 Spacetime Volumes which are geometrically defined in the same reference system as the range of this property are an exception to this and do not have fuzzy boundaries. Modelling explicitly fuzzy spatial projections serves therefore as a common topological reference of different spatial approximations rather than absolute geometric determination, for instance for relating outer or inner spatial boundaries for the respective spacetime volumes.

In case the domain of an instance of *P161 has spatial projection* is an instance of E4 Period, the spatial projection describes all areas that period was ever present at, for instance, the Roman Empire.

This property is part of the fully developed path from E18 Physical Thing through *P196 defines, E92 Spacetime Volume*, *P161 has spatial projection*, which in turn is implied by *P156 occupies (is occupied by)*

This property is part of the fully developed path from E4 Period through *P161 has spatial projection*, E53 Place, *P89 falls within (contains)* to E53 Place, which in turn is shortcut by *P7took place at (witnessed.)*

Example:

The Roman Empire *P161 has spatial projection* all areas ever claimed by Rome.

In First Order Logic:

P161(x,y) ⊃ E92(x)

P161(x,y) ⊃ E53(y)

### P195 was a presence of (had presence)

Domain: [E93](#_E93_Spacetime_Snapshot) Presence

Range: E18 Physical Thing

Quantification: (1,1 : 0,n)

Scope note: This property associates an instance of E93 Presence with the instance of E18 Physical Thing of which it represents a temporal restriction (i.e.: a time-slice) of the thing’s trajectory through spacetime. In other words, it describes where the instance of E18 Physical Thing were or moved around within a given time-span. Instantiating this property constitutes a necessary part of the identity of the respective instance of E93 Presence.

This property is a shortcut of the fully developed path from E18 Physical Thing through *P196 defines,* E92 Spacetime Volume, *P166 was a presence of (had presence),* E93 Presence.

In First Order Logic:

P195(x,y) ⊃ E93(x),

P195(x,y) ⊃ E18(y),

P195(x,y) = (∃z)[E9(z) ∧ P196 (y,z) ∧ P166(z,x)]

**P196 defines (is defined by)**

Domain: [E18](#_E18_Physical_Thing) Physical Thing

Range: E92 Spacetime Volume

Quantification: one to one, necessary (1,1:0,1)

Scope note: This property associates an instance of E18 Physical Thing with the instance of E92 Spacetime Volume that constitutes the complete trajectory of its geometric extent through spacetime at all times of the existence of the instance of E18 Physical Thing.

Note that an instance of E18 Physical Thing not only occupies a particular geometric space at any instant of its existence, but in the course of its existence it also forms a trajectory through spacetime, which occupies a real, that is phenomenal, volume in spacetime, i.e., the instance of E92 Spacetime Volume this property associates with. This real spatiotemporal extent of an instance of E18 Physical Thing is regarded to be unique to it, due to all its details and fuzziness; its identity and existence depends uniquely on the identity of the instance of E18 Physical Thing, which defines it by its very existence. It constitues a phenomenal spacetime volume as defined in CRMgeo (Doerr and Hiebel 2013).

We include in this spacetime volume the space filled by the matter of the physical thing and all its inner spaces at any time of their existence, such as the interior of a box. Physical things consisting of aggregations of physically unconnected objects, such as a set of chessmen, occupy a finite number of individually contiguous subsets of this spacetime volume equal to the number of objects that constitute the set and that are never connected during its existence.

In First Order Logic:

P196(x,y) ⊃ E18(x)

P196(x,y) ⊃ E92(y)