BFO 2020 At T Temporalized Axioms

(1) Is concretized by at some time

$$\forall p,q\,(\text{isConcretizedByAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{isConcretizedBy}(p,q,t)))$$

(2) Located in at all times

$$\forall p,q\,(\text{locatedInAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{locatedIn}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{locatedIn}(p,q,t))))$$

(3) Is carrier of at all times

$$\forall p,q\,(\text{isCarrierOfAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{isCarrierOf}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{isCarrierOf}(p,q,t))))$$

(4) Spatially projects onto at all times

$$\forall p,q\,(\text{spatiallyProjectsOntoAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{spatiallyProjectsOnto}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(p,t) \rightarrow \exists tp\,(\text{temporalPartOf}(q,tp) \wedge \text{spatiallyProjectsOnto}(p,q,tp)))))$$

(5) Member part of at all times

$$\forall p,q\,(\text{memberPartOfAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{memberPartOf}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{memberPartOf}(p,q,t))))$$

(6) Has continuant part at some time

$$\forall p,q\,(\text{hasContinuantPartAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{hasContinuantPart}(p,q,t)))$$

(7) Located in at some time

$$\forall p,q\,(\text{locatedInAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{locatedIn}(p,q,t)))$$

(8) Concretizes at some time

$$\forall p,q\,(\text{concretizesAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{concretizes}(p,q,t)))$$

(9) Participates in at all times

$$\forall p,q\,(\text{participatesInAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{participatesIn}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{participatesIn}(p,q,t))))$$

(10) Is carrier of at some time

$$\forall p,q\,(\text{isCarrierOfAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{isCarrierOf}(p,q,t)))$$

(11) Is concretized by at all times

$$\forall p,q\,(\text{isConcretizedByAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{isConcretizedBy}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{isConcretizedBy}(p,q,t))))$$

(12) Occupies spatial region at all times

$$\forall p,q\,(\text{occupiesSpatialRegionAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{occupiesSpatialRegion}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(p,t) \rightarrow \exists tp\,(\text{temporalPartOf}(q,tp) \wedge \text{occupiesSpatialRegion}(p,q,tp)))))$$

(13) Has proper continuant part at some time

$$\forall p,q\,(\text{hasProperContinuantPartAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{hasProperContinuantPart}(p,q,t)))$$

(14) Spatially projects onto at some time

$$\forall p,q\,(\text{spatiallyProjectsOntoAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{spatiallyProjectsOnto}(p,q,t)))$$

(15) Proper continuant part of at all times

$$\forall p,q\,(\text{properContinuantPartOfAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{properContinuantPartOf}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{properContinuantPartOf}(p,q,t))))$$

(16) Continuant part of at all times

$$\forall p,q\,(\text{continuantPartOfAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{continuantPartOf}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{continuantPartOf}(p,q,t))))$$

(17) Has participant at some time

$$\forall p,q\,(\text{hasParticipantAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{hasParticipant}(p,q,t)))$$

(18) Location of at some time

$$\forall p,q\,(\text{locationOfAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{locationOf}(p,q,t)))$$

(19) Has material basis at some time

$$\forall p,q\,(\text{hasMaterialBasisAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{hasMaterialBasis}(p,q,t)))$$

(20) Member part of at some time

$$\forall p,q\,(\text{memberPartOfAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{memberPartOf}(p,q,t)))$$

(21) Has member part at some time

$$\forall p,q\,(\text{hasMemberPartAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{hasMemberPart}(p,q,t)))$$

(22) Rdf:type is interpreted as meaning an instance is a given type whenever it exists

$$\forall c,i\,(\text{rdfType}(c,i) \leftrightarrow (c=\text{entity} \wedge (\text{particular}(i) \vee \text{universal}(i))) \vee (c\neq\text{entity} \wedge (\forall t\,(\text{existsAt}(i,t) \rightarrow \text{instanceOf}(i,c,t))) \wedge \exists t\,\text{existsAt}(i,t)))$$

(23) Generically depends on at some time

$$\forall p,q\,(\text{genericallyDependsOnAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{genericallyDependsOn}(p,q,t)))$$

(24) Material basis of at all times

$$\forall p,q\,(\text{materialBasisOfAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{materialBasisOf}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{materialBasisOf}(p,q,t))))$$

(25) Occupies spatial region at some time

$$\forall p,q\,(\text{occupiesSpatialRegionAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{occupiesSpatialRegion}(p,q,t)))$$

(26) Has continuant part at all times

$$\forall p,q\,(\text{hasContinuantPartAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{hasContinuantPart}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{hasContinuantPart}(p,q,t))))$$

(27) Generically depends on at all times

$$\forall p,q\,(\text{genericallyDependsOnAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{genericallyDependsOn}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{genericallyDependsOn}(p,q,t))))$$

(28) Participates in at some time

$$\forall p,q\,(\text{participatesInAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{participatesIn}(p,q,t)))$$

(29) Location of at all times

$$\forall p,q\,(\text{locationOfAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{locationOf}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{locationOf}(p,q,t))))$$

(30) Proper continuant part of at some time

$$\forall p,q\,(\text{properContinuantPartOfAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{properContinuantPartOf}(p,q,t)))$$

(31) Continuant part of at some time

$$\forall p,q\,(\text{continuantPartOfAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{continuantPartOf}(p,q,t)))$$

(32) Has participant at all times

$$\forall p,q\,(\text{hasParticipantAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{hasParticipant}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{hasParticipant}(p,q,t))))$$

(33) Has member part at all times

$$\forall p,q\,(\text{hasMemberPartAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{hasMemberPart}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{hasMemberPart}(p,q,t))))$$

(34) Concretizes at all times

$$\forall p,q\,(\text{concretizesAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{concretizes}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{concretizes}(p,q,t))))$$

(35) Has proper continuant part at all times

$$\forall p,q\,(\text{hasProperContinuantPartAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{hasProperContinuantPart}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{hasProperContinuantPart}(p,q,t))))$$

(36) Material basis of at some time

$$\forall p,q\,(\text{materialBasisOfAtSomeTime}(p,q) \leftrightarrow \exists t\,(\text{existsAt}(p,t) \wedge \text{existsAt}(q,t) \wedge \text{materialBasisOf}(p,q,t)))$$

(37) Has material basis at all times

$$\forall p,q\,(\text{hasMaterialBasisAtAllTimes}(p,q) \leftrightarrow (\exists t\,(\text{hasMaterialBasis}(p,q,t) \wedge \text{existsAt}(p,t))) \wedge (\forall t\,(\text{existsAt}(q,t) \rightarrow \text{hasMaterialBasis}(p,q,t))))$$

Alan Ruttenberg, December 5, 2019