Astronomical Object Types Ontology

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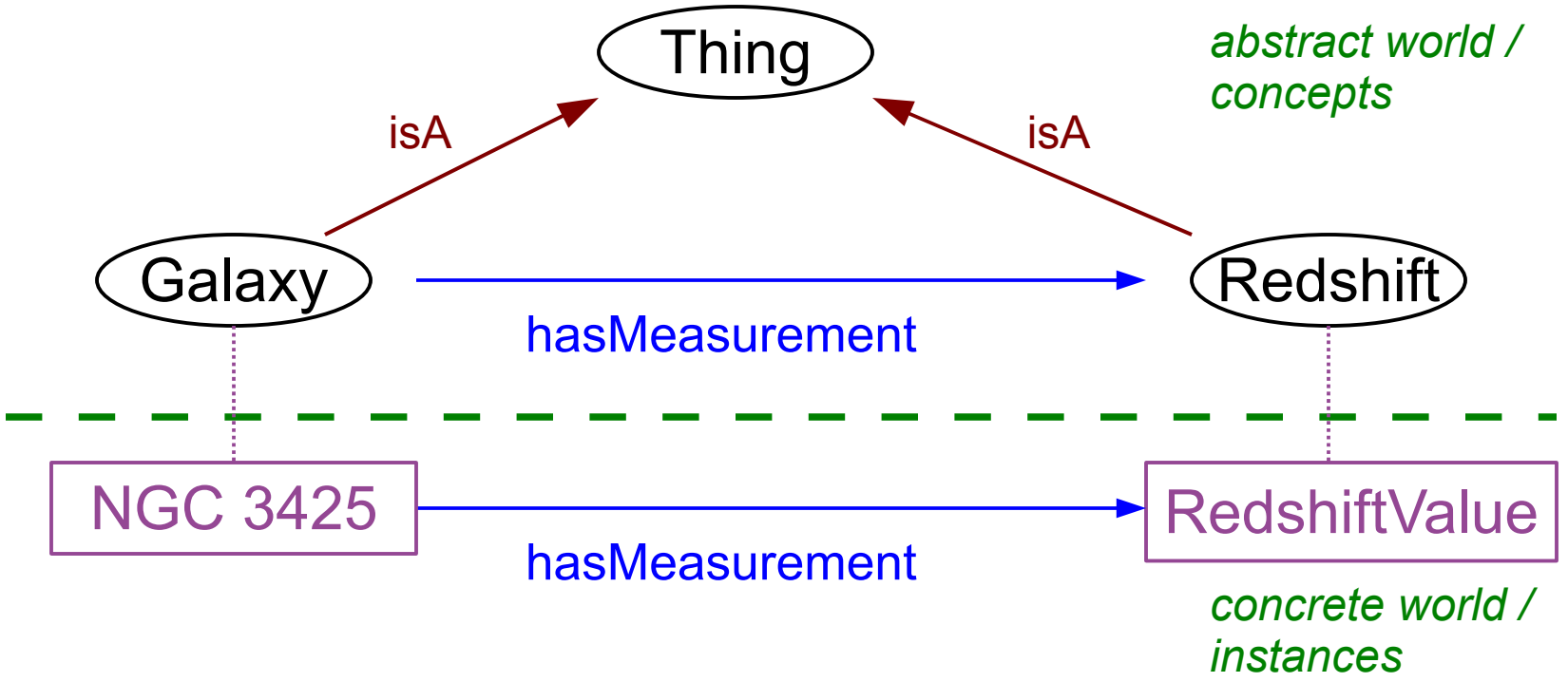
Overview

- Ontology updates
- Work on instances
  - Using instances instead of concepts
  - From data to instance
  - Consistency checking
- Work on mappings

Ontology updates

- Young Stellar Object branch updated (concepts, hierachies, restrictions w.r.t. 'diskionary' report).
- IAU Thesaurus tokens/labels/aliases added as annotations.
- Set of default individuals added to test the automated instantiation process and reasoning on individuals.

Concepts and instances

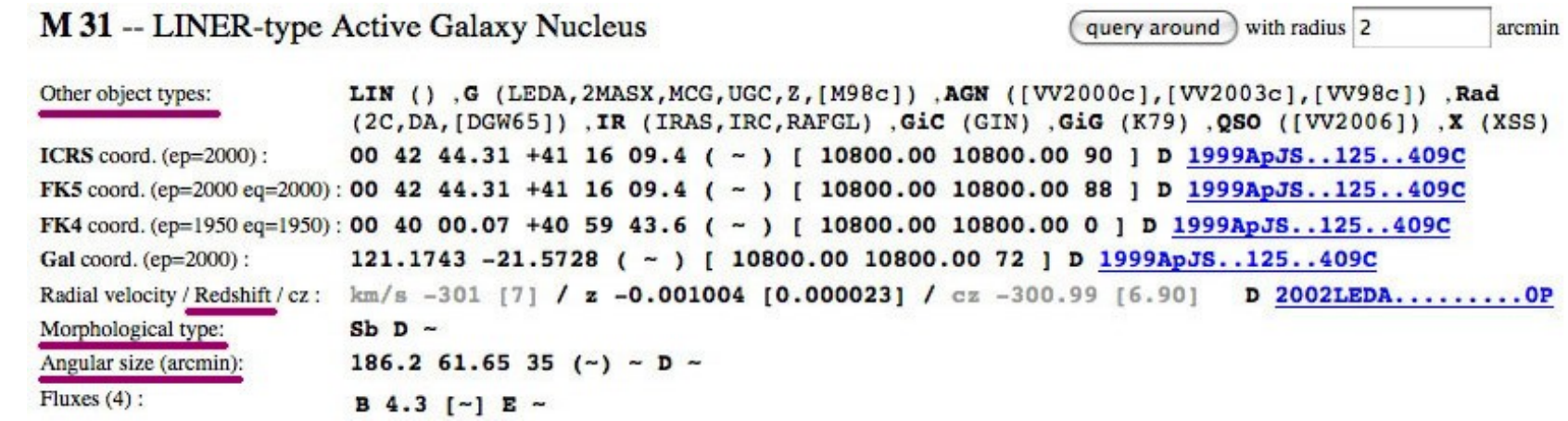


'What is true in the abstract world must be true for all instances in the concrete world'

Using instances instead of concepts

- Automated instantiation process
  - Developed for SIMBAD database entries
  - Could be easily adapted to other data sources
  - Using Protégé-OWL API
  - Instantiation strategy: create instances with all available data and check consistency w.r.t. concepts afterwards
- Instances applied to the SIMBAD consistency checker
  - Using instances means the abstract part of the ontology is not modified.
  - Consistency checking for instances does not imply reclassifying the whole ontology.

From data to instance



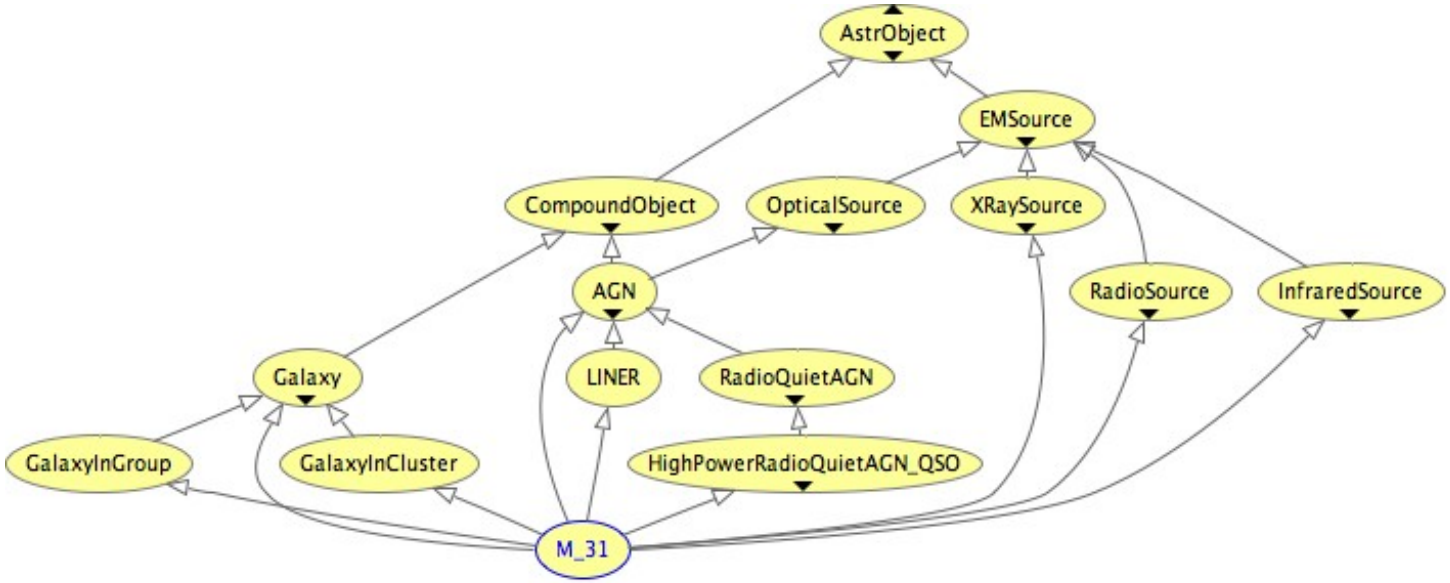
M 31 -- LINER-type Active Galaxy Nucleus

query around with radius 2 arcmin

Other object types:	**LIN** () ,**G** (LEDA,2MASX,MCG,UGC,Z,[M98c]) ,**AGN** ([VV2000c],[VV2003c],[VV98c]) ,**Rad** (2C,DA,[DGW65]) ,**IR** (IRAS,IRC,RAFGL) ,**GiC** (GIN) ,**GiG** (K79) ,**QSO** ([VV2006]) ,**X** (XSS)
ICRS coord. (ep=2000) :	**00 42 44.31 +41 16 09.4 (~) [10800.00 10800.00 90] D 1999ApJS..125..409C**
FK5 coord. (ep=2000 eq=2000) :	**00 42 44.31 +41 16 09.4 (~) [10800.00 10800.00 88] D 1999ApJS..125..409C**
FK4 coord. (ep=1950 eq=1950) :	**00 40 00.07 +40 59 43.6 (~) [10800.00 10800.00 0] D 1999ApJS..125..409C**
Gal coord. (ep=2000) :	**121.1743 -21.5728 (~) [10800.00 10800.00 72] D 1999ApJS..125..409C**
Radial velocity / Redshift / cz :	km/s -301 [7] / **z -0.001004 [0.000023]** / cz -300.99 [6.90] **D 2002LEDA.....0P**
Morphological type:	**Sb D ~**
Angular size (arcmin):	**186.2 61.65 35 (~) ~ D ~**
Fluxes (4) :	**B 4.3 [~] E ~**

- Otypes > instance of: LINER, Galaxy, AGN, RadioSource, InfraredSource, GalaxyInCluster, GalaxyInGroup, HighPowerRadioQuietAGN_QSO, XraySource
- Redshift > restriction: hasMeasurement some Redshift_i
- Morphological type > restriction: hasMorphology some GalaxyMorphologyBarredSpiral_i
- Angular size > restriction: hasMorphology some Extended_i

Concept consistency checking (1/2)



- For concept M_31 to be consistent:
  - Its subsumption relationships must be consistent
  - Its restrictions must be consistent with all the other concepts
  - It must not be the 'nothing' concept
    (i.e. Its restrictions must not infer a concept and its complementary)

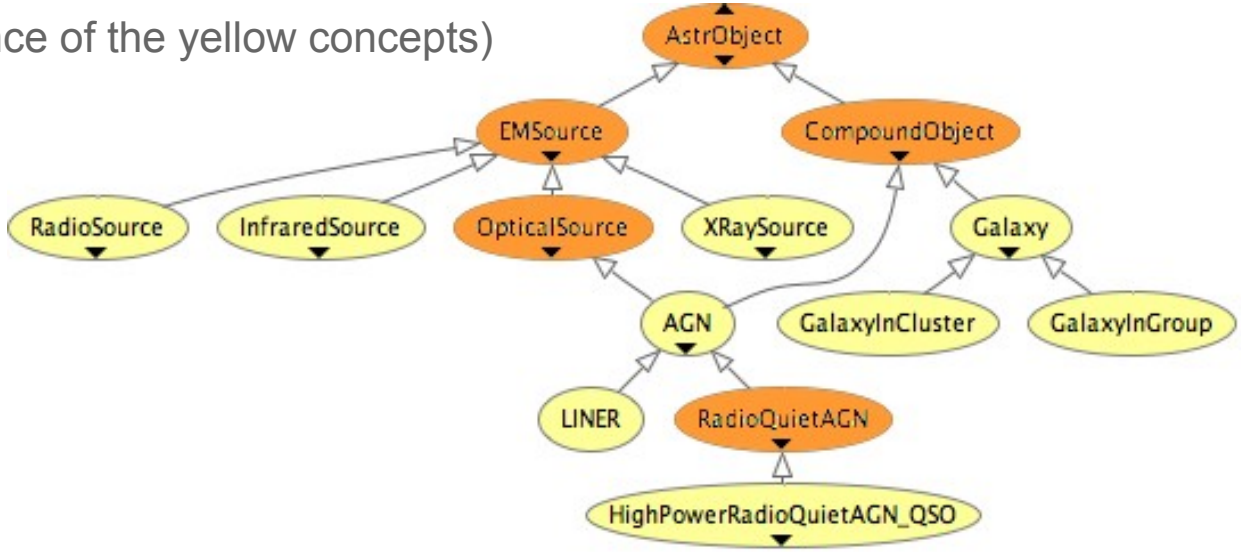
Concept consistency checking (2/2)

- Restrictions for concept M_31:
  - hasMeasurement some Redshift
  - hasMorphology some GalaxyMorphologyBarredSpiral
  - HasMorphology some Extended
  - isA RadioQuietAGN
  - not isA RadioLoudAGN
  - hasComponent > 2
  - hasComponent only AstrObject
  - hasComponent some SupermassiveBlackHole
  - not (hasComponent some Galaxy)
  - hasEmissionIn some Optical
  - hasEmissionIn some Radio
  - hasEmissionIn some Infrared
  - hasEmissionIn some XRay
  - isComponentOf some (EllipticalGalaxy or IrregularGalaxy or SpiralGalaxy)
  - isComponentOf some (EllipticalGalaxy or SpiralGalaxy)
  - isComponentOf some GalaxiesGroup
  - isComponentOf some ClusterOfGalaxies
  - hasPortion some AccretionDisk
  - hasPortion some Jet

Blue: additionnal restrictions
Black: inherited restrictions

Instance consistency checking (1/3)

(M31 is instance of the yellow concepts)



- For instance M31 to be consistent:
  - If it is instance of more than one concept they must not be disjoint.
  - Its (concrete) restrictions must respect the (abstract) restrictions on the concepts it is instance of.
  - Any additional restriction must be consistent with the ones inherited from the concepts.

Instance consistency checking (2/3)

- Restrictions for instance M_31:
  - hasMeasurement some Redshift_i
  - hasMorphology some GalaxyMorphologyBarredSpiral_i
  - HasMorphology some Extended_i
  - isA RadioQuietAGN
  - not isA RadioLoudAGN
  - hasComponent > 2
  - hasComponent only AstrObject
  - hasComponent some SupermassiveBlackHole
  - not (hasComponent some Galaxy)
  - hasEmissionIn some Optical
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  - isComponentOf some (EllipticalGalaxy or IrregularGalaxy or SpiralGalaxy)
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  - hasPortion some AccretionDisk
  - hasPortion some Jet

Purple: additionnal restrictions
Black: inherited restrictions

Instance consistency checking (3/3)

- Performance-wise, using instances:
  - Avoids reclassifying the ontology
  - Is *much* faster when there is no inconsistency.
  - But shows little performance difference for consistency checking (twice as fast on average).
  - OWL API implementation (in progress) yields similar results.

Work on mappings

- Keyword sets already in the ontology
  - IAU Thesaurus (labels/tokens/aliases)
  - GCVS (codes)
  - SIMBAD (names/shortcodes)
  - NED (codes)
  - VizieR (subject keywords)
  - ADC (keywords)
  - Some general keywords
- Mapping strategies can include all kinds of relationship within the ontology (subsumption as well as properties)