Leibniz-Institut für Astrophysik Potsdam

AIP

GEFÖRDERT VOM

Bundesministerium für Bildung und Forschung

German Astrophysical GAVO Virtual Observatory

Provenance Webapp for RAVE

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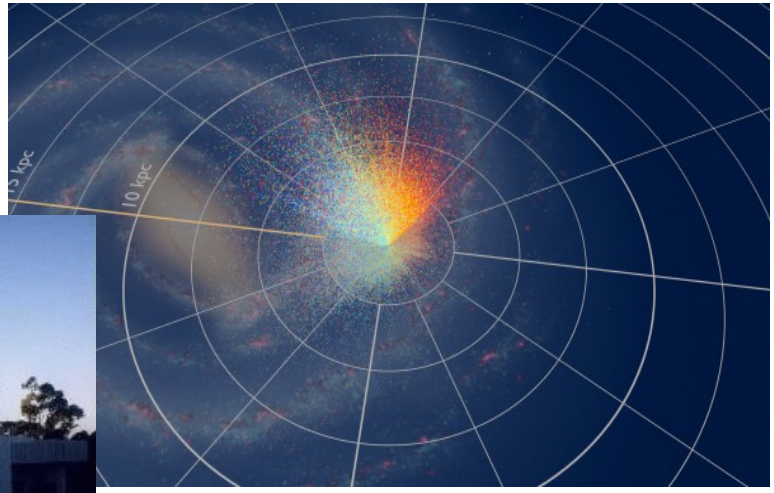
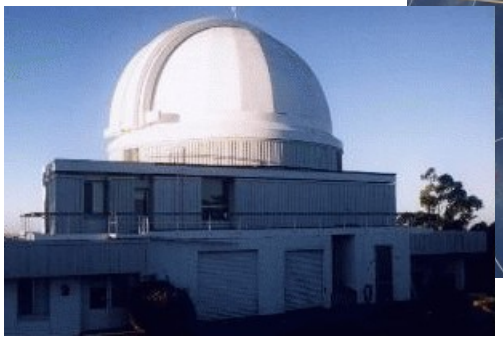
RAVE Survey - example use case

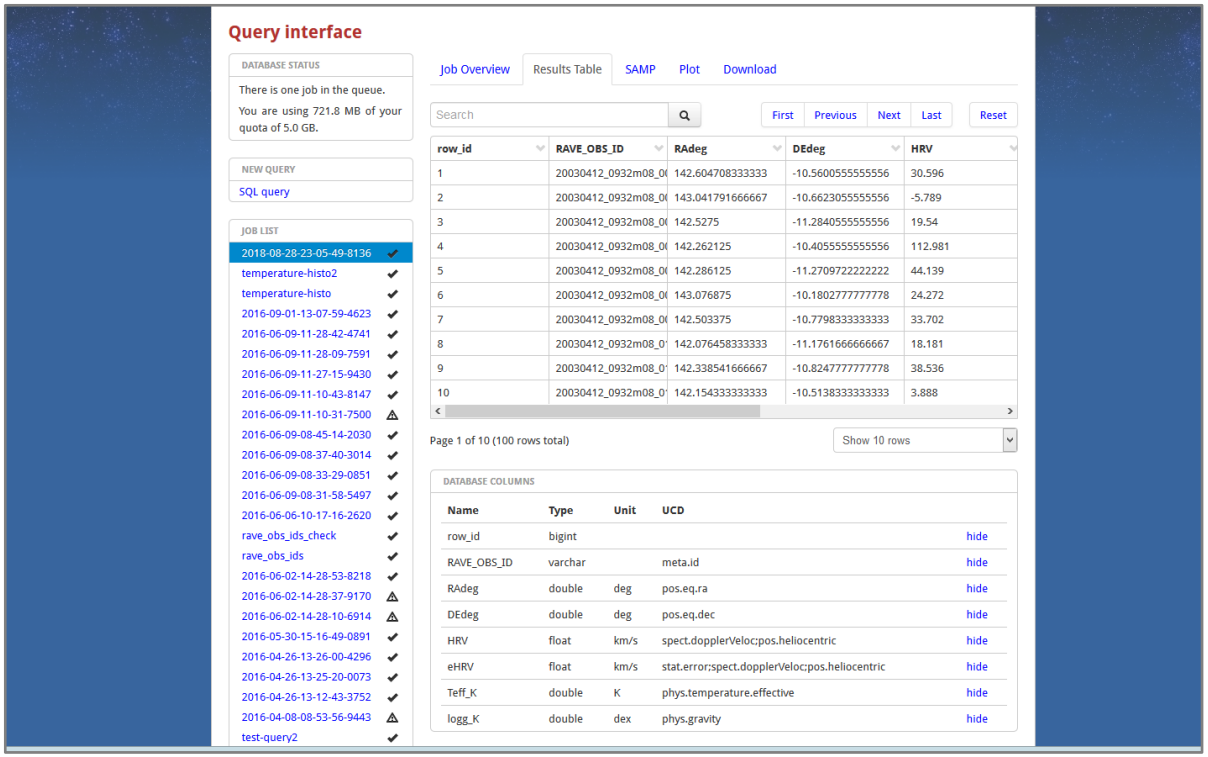
- Radial Velocity Experiment, ~ 500,000 spectra of stars observed at Anglo-Australian Observatory
- spectra processed with RAVE pipeline (workflow):
  - different calibration steps, combining and splitting files, generating radial velocities, stellar properties, cross-matching with other catalogues
- data release: mainly tables with stellar properties





RAVE Survey - example use case

- Example data table (from querying the RAVE database)



RAVE: Basic use cases

- Get overview of all processing steps
  - workflow/ActivityDescription
  - list of activities/activityDescriptions
- Graph representation (visualisation) of these steps
  - possible with ProvStore, if provided in W3C serialization format
- Provide detailed information for individual observations
  - given a unique identifier for an entry in the published RAVE DR5 table, return file names and locations of intermediate and raw files, how they are linked with each other

RAVE: Advanced use cases

- Who created the stellar_parameters-table?
  - i.e.: get the agent associated with this entity, thus: retrieve details for this entity
- Where do the values in column Teff_K come from? In which paper are the methods described? The uncertainties?
  - errors are in additional columns "e..."-something
- Are intermediate files (spectrum png/ascii) for a given obsId available? How could I get them?
  - Or: who do I need to ask for them?
  - Need: permission/accessibility flag, contact details
  -

RAVE: Advanced use cases (continued)

- How are values (for a given star) changing for each data release? What's the difference in processing?
  - First part can be answered with published data alone, provenance only needed for second question.
- Are there multiple observations of the same star?
  - If the derived heliocentric radial velocity differs more than the error bars suggest: what was causing this difference? (Which processing step(s)?)
- What is the coverage of this survey? Compare intended/actual coverage for studies of completeness/selection effects.
  - Needs additional information on failed fibers per field

Webapp for RAVE provenance

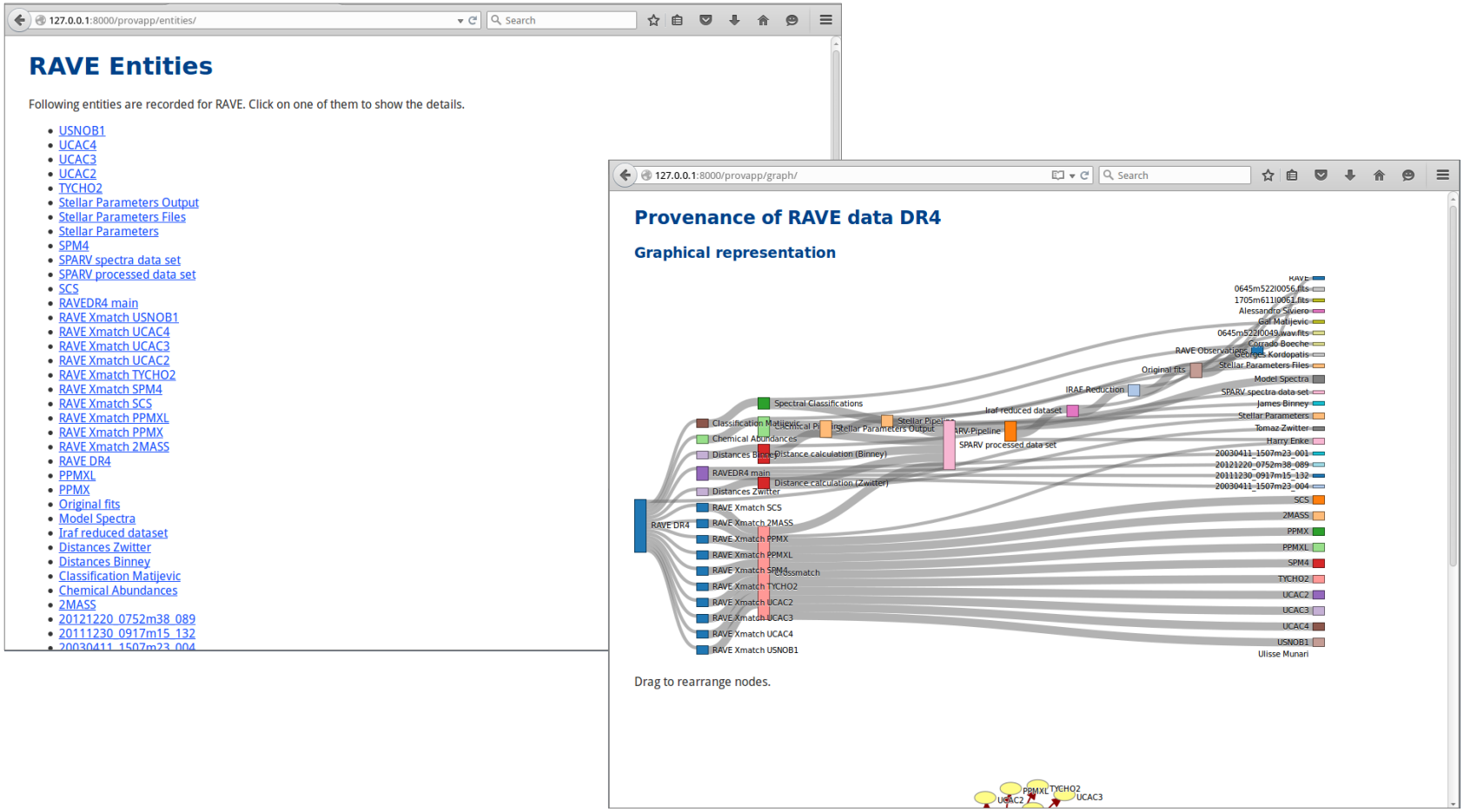
- Testing how to implement the data model
- Simple setup using Django Framework with SQlite3 database
- Define classes “as is”, main provenance classes, one DB table for each:
  - **entity**
  - **activity**
  - **agent**
  - used -- foreign keys to activity, entity
  - wasGeneratedBy -- foreign keys to entity, activity
  - wasAssociatedWith -- foreign keys to entity, agent
  - hadMember -- foreign keys to entities (one with type collection)
  - wasDerivedFrom -- foreign keys to entities

RAVE Provenance webapp

- Django web application (Python)
- Prototype for implementing IVOA ProvenanceDM
- Features:
  - implementation of main classes as Django models -> DB tables
  - list all instances of a class (Rest API)
  - show details for a single object (Rest API)
  - ProvSAP access for retrieving provenance for given id
  - serialisation of provenance information, IVOA and W3C versions
  - visualisation of provenance using javascript

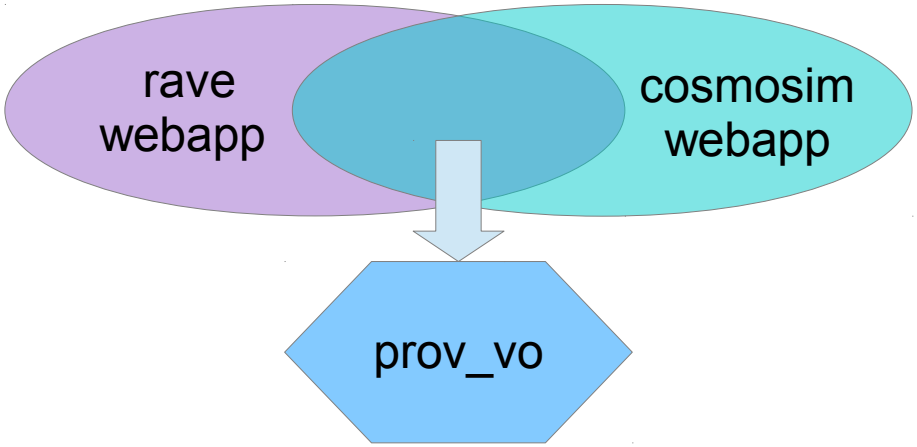
https://github.com/kristinriebe/provenance-rave
https://escience.aip.de/provenance-rave

Webapp for RAVE provenance



django-prov_vo

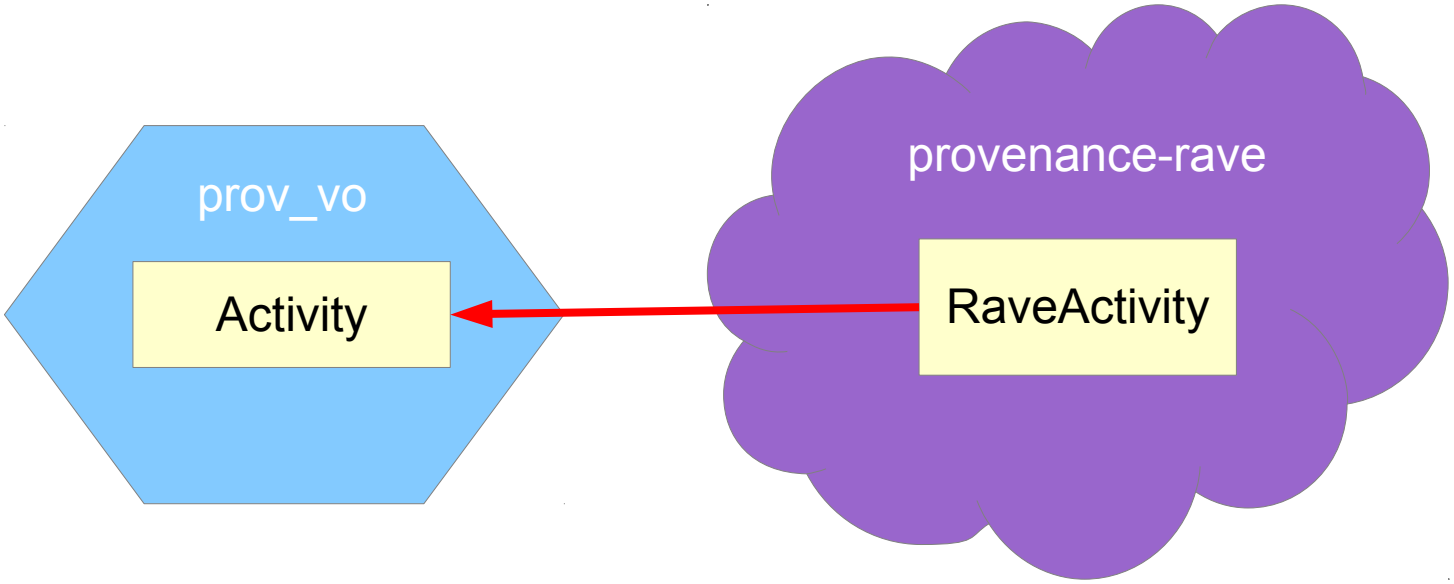
- Basic provenance implementation now (mostly) separated from RAVE-specific attributes etc.
- => reusable package „django-prov_vo“ (~ abstract classes)



- => all project specific attributes, extensions can be stored in the main app,
  => common provenance implementation can be the same for each webapp

django-prov_vo

- classes in RAVE webapp inherit from basic classes
- e.g.: class RaveActivity(prov_vo.models.Activity)
- still work in progress



ProvSAP - definition

- Interface for retrieving serialized provenance description for a given entity/activity/agent ID
- GET request with main parameter “ID”
- **Parameters:**

required

- **ID** *(of entity, activity or agent, can occur multiple times)*
- **DEPTH** *(= 1,2,... or ALL)*
- **RESPONSEFORMAT** *(PROV-N, PROV-JSON, PROV-XML, PROV-VOTable)*

optional

- DIRECTION *(= BACK or FORTH)*
- MEMBERS *(include members of collections)*
- ~~STEPS *(include steps of activityFlows)*~~
- AGENT *(explore relations beyond agent)*
- MODEL *(= IVOA or W3C)*

DIRECTION affects only:

- Used
- WasGeneratedBy
- WasDerivedFrom
- WasInformedBy

AGENT – rename?

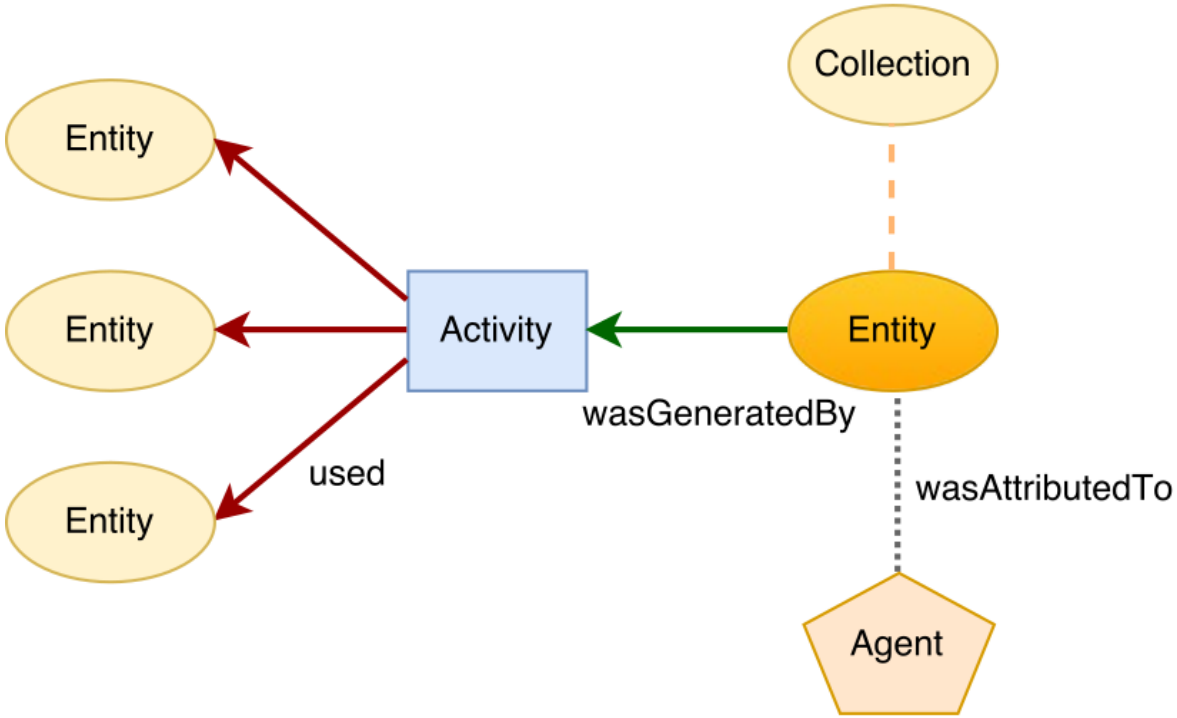
- EXPLORE_AGENT
- TRACK_AGENT
- AGENT=STOP, AGENT=EXPLORE

ProvSAP - Parameters

- **ID**
  - Identifier for an activity, entity or agent
- **RESPONSEFORMAT**
  - = format of the response
  - one of the W3C serialization formats (PROV-JSON, PROV-N, PROV-XML) or PROV-VOTable
- **DEPTH**
  - How much of the provenance graph shall be retrieved?
  - Everything (DEPTH=ALL) or just the most recent processing steps?
  - DEPTH=1: go exactly 1 “relation” backwards
  - DEPTH=ALL: services may also restrict to a max. depth instead (HTTP 302 redirect to DEPTH=<MAXDEPTH>)

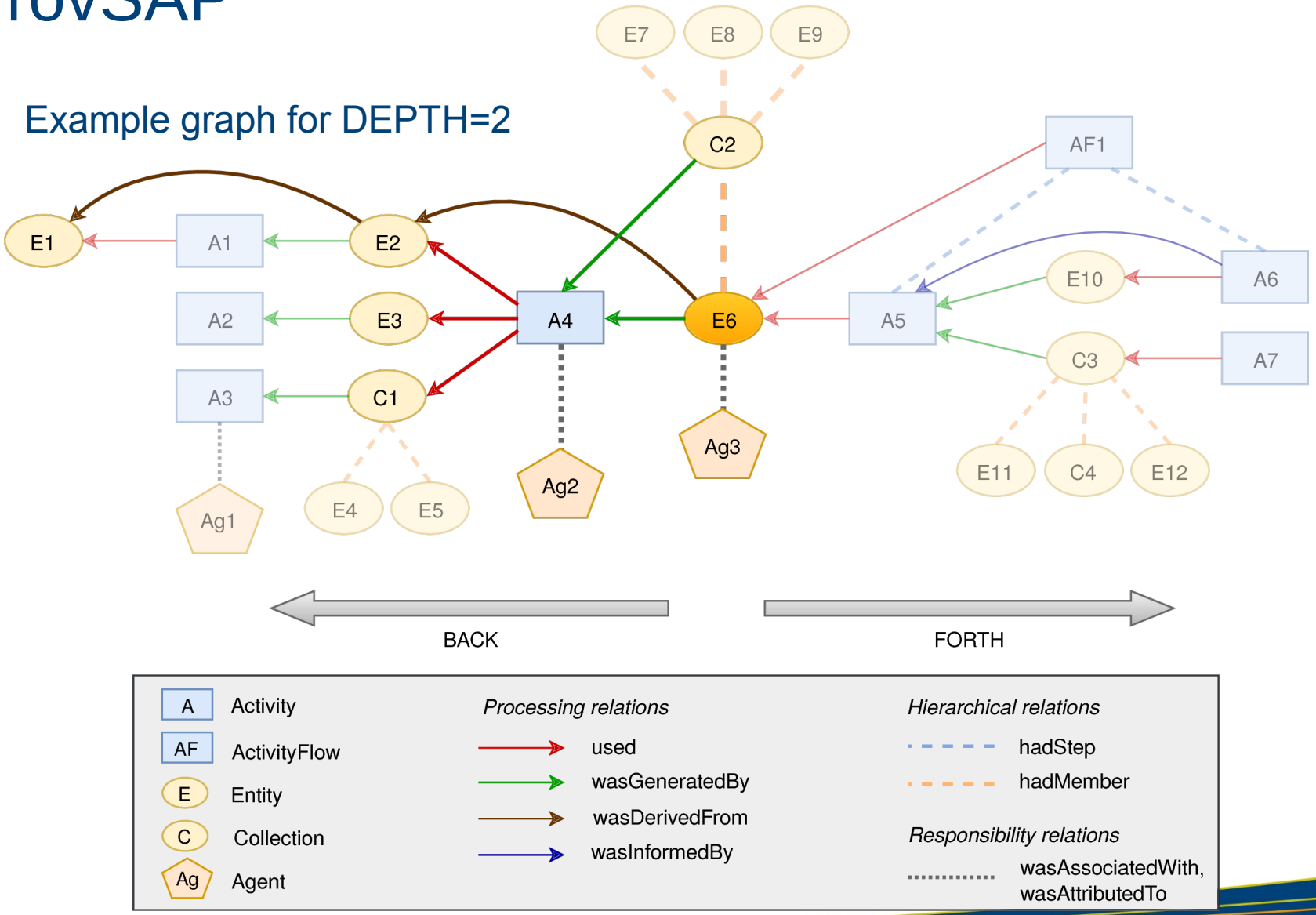
ProvSAP – Parameter DEPTH

- Example graph with DEPTH=2



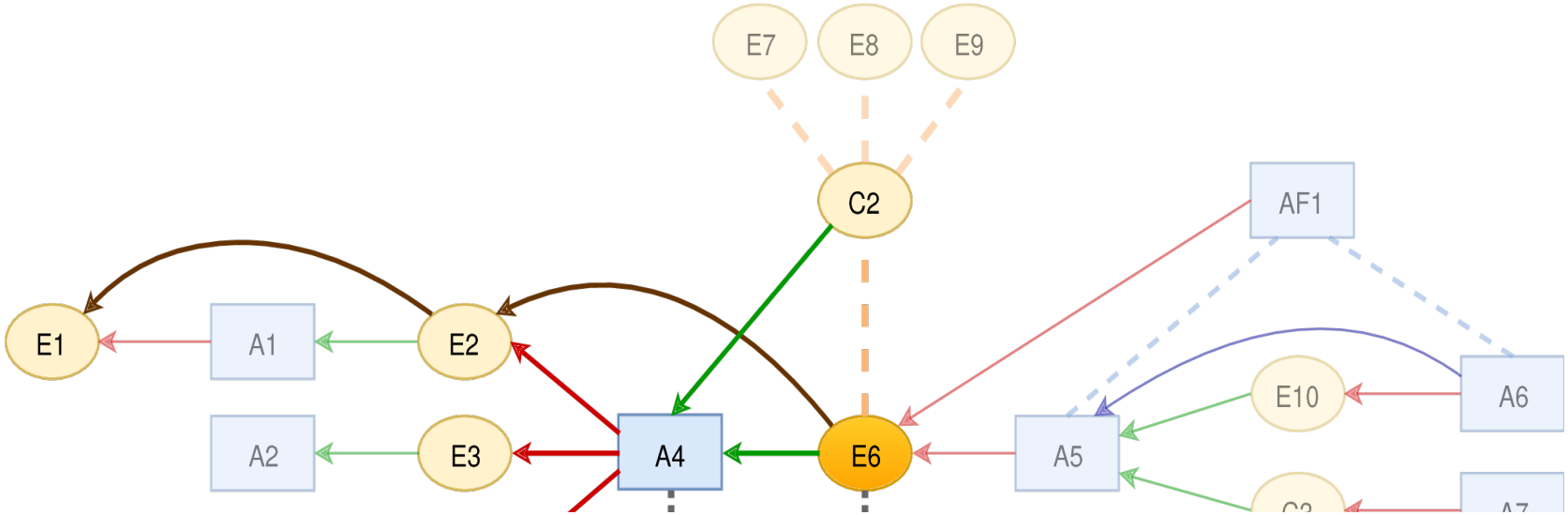
ProvSAP

- Example graph for DEPTH=2



ProvSAP

- Derivation, Information = short-cut relations
- Proposal:
  - redefine DEPTH=1: always go the next entity in the graph
    - (stop at agent and collections, if AGENT=false, MEMBERS=false)



ProvSAP parameters

- DIRECTION = BACK or FORTH
  - Allow to track provenance forward, i.e. find out which processes used an image, which outputs were produced etc.
  - Use cases
    - pipeline development
    - bug tracking
  - Only affects the processing relations:
    - Used
    - WasGeneratedBy
    - WasDerivedFrom
    - WasInformedBy
    - Because FORTH/BACK makes not much sense for e.g. hadMember or wasAttributedTo relations; thus the hierachical/responsibility relations are always tracked, independent of DIRECTION

ProvSAP parameters

- MEMBERS, STEPS = true/<u>false</u>
  - Collection groups entities together
    => hadMember relationship
- If tracking members of collections by default, a lot of data is returned
- => always follow the relations “up” (to the “container”), but only follow the “children”, if MEMBERS=true

ProvSAP parameters

- AGENT = true/<u>false</u>
  - Usually stop tracking when an agent is reached,
    but maybe want to know which other activities/entities an agent was involved with?
  - => allow tracking the agent further, using AGENT=true
- Discussion:
  - AGENT = false may be misleading
  - Better ideas?
    - EXPLORE_AGENT = true/false
    - TRACK_AGENT = true/false
    - AGENT = STOP/EXPLORE

ProvSAP parameters

- MODEL:
  - Allow to choose between IVOA and W3C serialization
  - IVOA:
    - directly map the classes to JSON, VOTable, …
    - => more direct representation of the data model classes
    - For exchange in the VO
    - To be used with VO tools, e.g. for loading into a ProvTAP service for further querying
  - W3C:
    - rename and restructure classes and attributes to produce W3C compatible serialization
    - For exchange with the world outside of the VO
    - For usage with W3C tools (e.g. ProvStore)

ProvSAP implementation

- Live version for RAVE:
  - https://escience.aip.de/provenance-rave
- Decoupled django-prov_vo package as reusable web app:
  - https://github.com/kristinriebe/django-prov_vo

    and an extra package for the VOSI resources (availability/capabilities):
  - https://github.com/kristinriebe/django-vosi

ProvSAP implementation

- Implemented all parameters from the draft
- Recursive tracking of the relations
- Each visited node of the provenance graph is returned only once (It's a graph, not a tree → loops possible!)
- Allows W3C compatible serialization (model=W3C)
- Formats: PROV-N or PROV-JSON

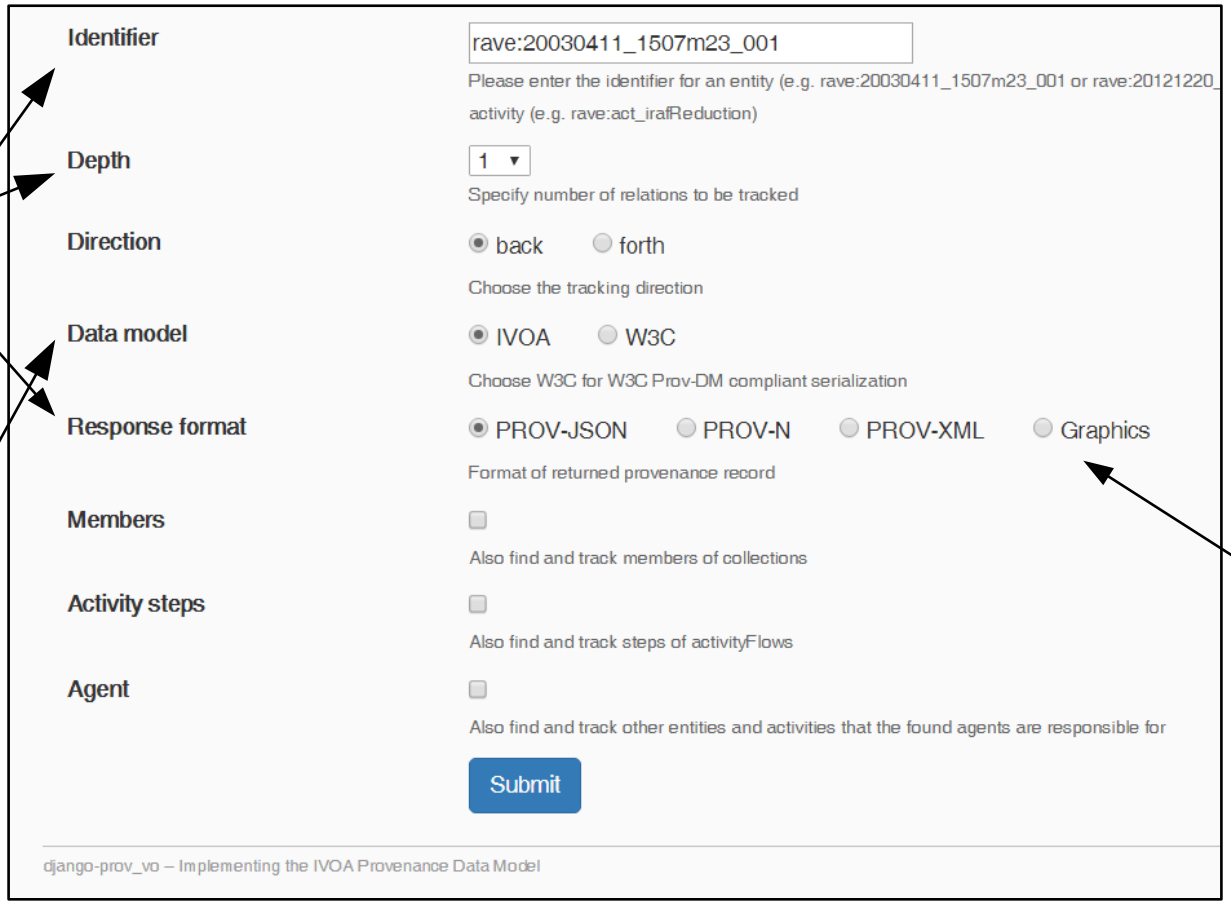
- Additionally:
  - Visualization of provenance (Javascript)
    - option RESPONSEFORMAT=GRAPH
  - Web form for nice user interface

ProvSAP webform (prev. called: ProvDAL)

mandatory parameters

new parameter

additional option



Automatically generates the ProvSAP GET request URL: https://escience.aip.de/provenance-rave/provapp/provdal/?ID=rave:20121220_0752m38_089&DEPTH=1&RESPONSEFORMAT=PROV-JSON&DIRECTION=BACK&MODEL=IVOA&MEMBERS=false&STEPS=false&AGENT=false

Summary

- RAVE survey of stellar spectra as use case for provenance
- Many example questions to be answered by provenance
- Simple prototype implementation of the W3C/VO data model is possible (but didn't try with a significant fraction of the data)
- ProvSAP implementation works in principle, some details need to be decided:
  - really allow querying for agent or activity as well?
  - always walk the graph until an end node or the next entity is reached?
  - keep both, IVOA and W3C serialisation?

Questions?