The AMI 2.0 metadata ecosystem: new design principles and features

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What is AMI?

- AMI (ATLAS Metadata Interface) is a generic ecosystem for metadata:
  - Primitives for metadata extraction and processing
  - Heterogenous and distributed database connectivity
  - High level tools for selecting data by metadata criteria

- The ecosystem has development kits for:
  - Developing JAVA business objects (server-side)
  - Developing metadata-oriented Web applications (client-side)

- AMI is designed for:
  - Scalability, evolutivity and maintainability

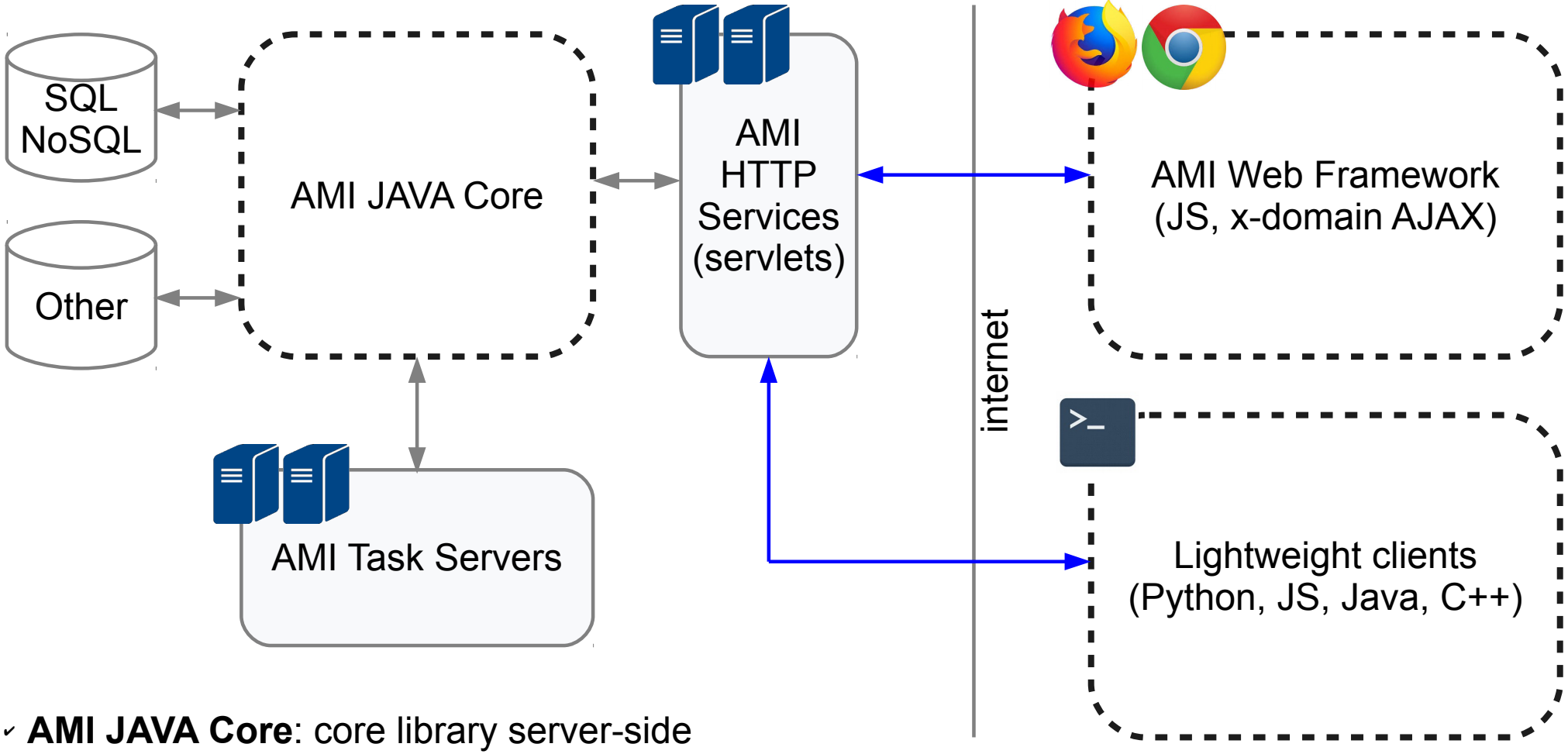
History of AMI

- AMI is mature ecosystem of more than 18 years of existence
- Originally developed for the ATLAS experiment at CERN
  - 2000 → Metadata bookkeeping for the Liquid Argon (LAr) calorimeter
  - 2001-2016 → ATLAS software release management (TagCollector)
  - 2006-ongoing → AMI provides the ATLAS official dataset discovery tool
  - 2015-ongoing → parameter definition for dataset processing (AMI-Tags)
  - …

Used by the ATLAS production system

- Development of AMI 2.X started in 2015 for:
  - Simplifying deployment
  - Avoiding subsystem entanglements
  - Improving maintainability and performance
- Since 2017, AMI 2.X is used by:
  - ATLAS (migration ongoing)
  - ROSETTA (Institut de Planétologie et d'Astrophysique de Grenoble)

Overview of the AMI ecosystem

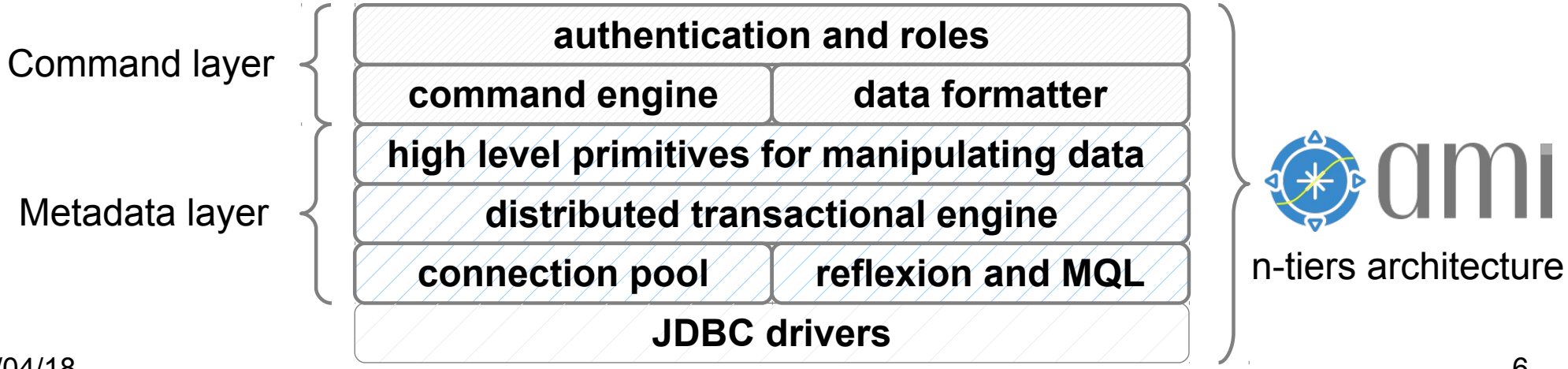


- **AMI JAVA Core**: core library server-side
- **AMI HTTP Services**: AMI Commands (proprietary) or REST API
- **AMI Task Server**: aggregating and processing metadata
- **AMI Web Framework**: developing metadata-oriented Web applications
- **Lightweight clients**: accessing AMI from anywhere

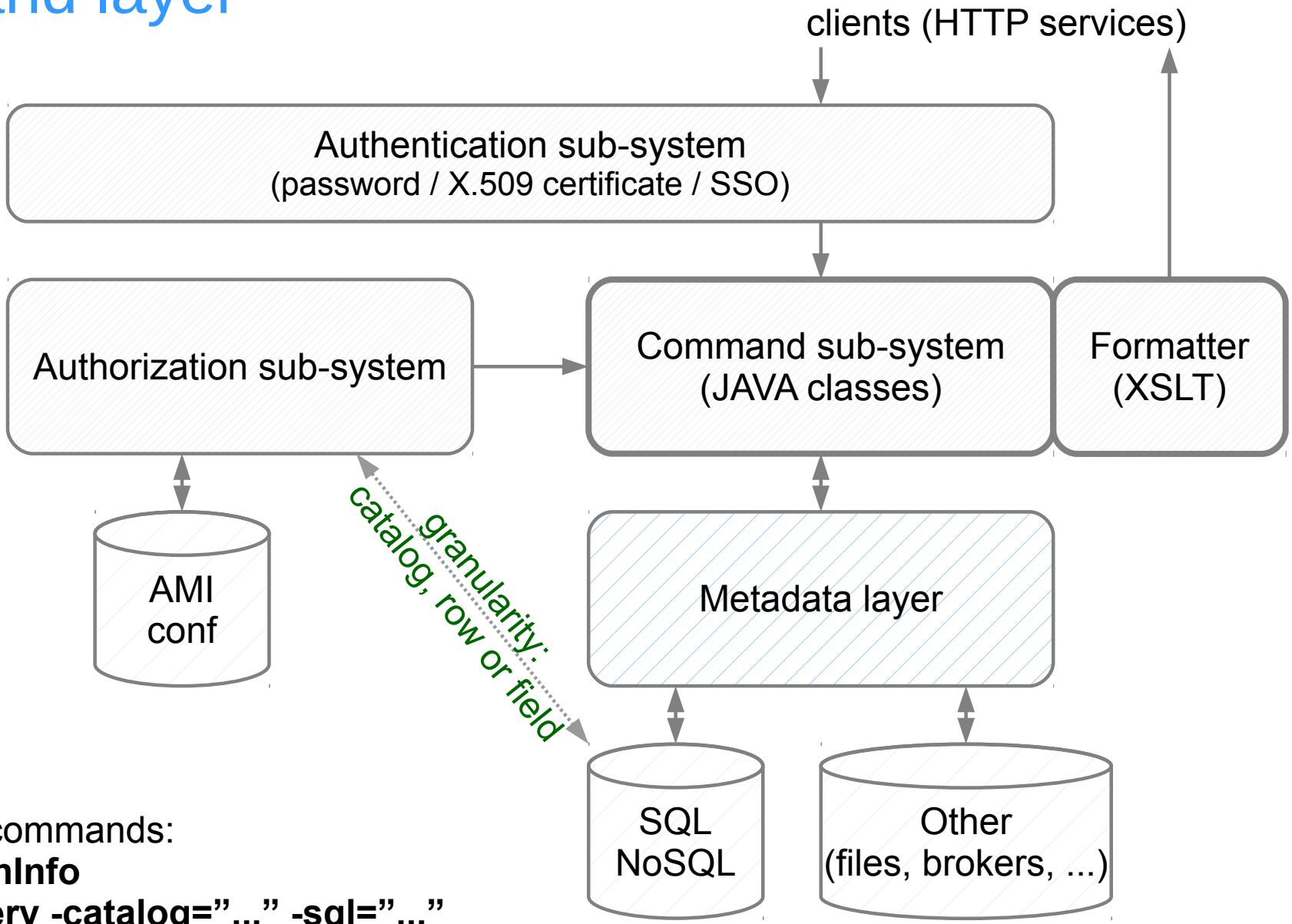
AMI JAVA Core

AMI JAVA Core features

- AMI JAVA Core is the central part of the AMI ecosystem
- Main features:
  - Authentication and authorizations
  - Command engine (~100 generic commands, ~500 ATLAS-specific commands)
    - Metadata queries (trivial [SQL, MQL] or more complex, read or write), experiment-specific commands, service administration, ...
  - High level primitives for manipulating data
    - DB rowsets, JSON documents, XML documents, remote access, ...
  - Metadata Query Language (MQL) and Structured Query Language (SQL)



Command layer



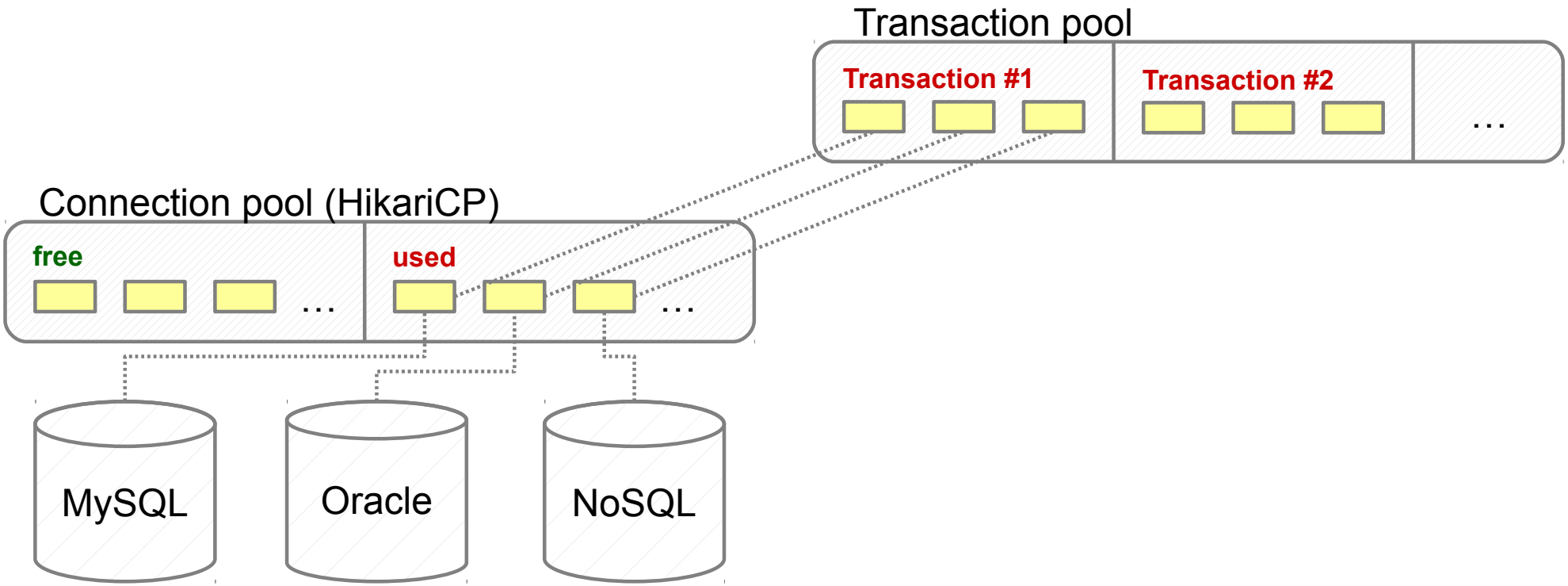
Example of commands:

GetSessionInfo

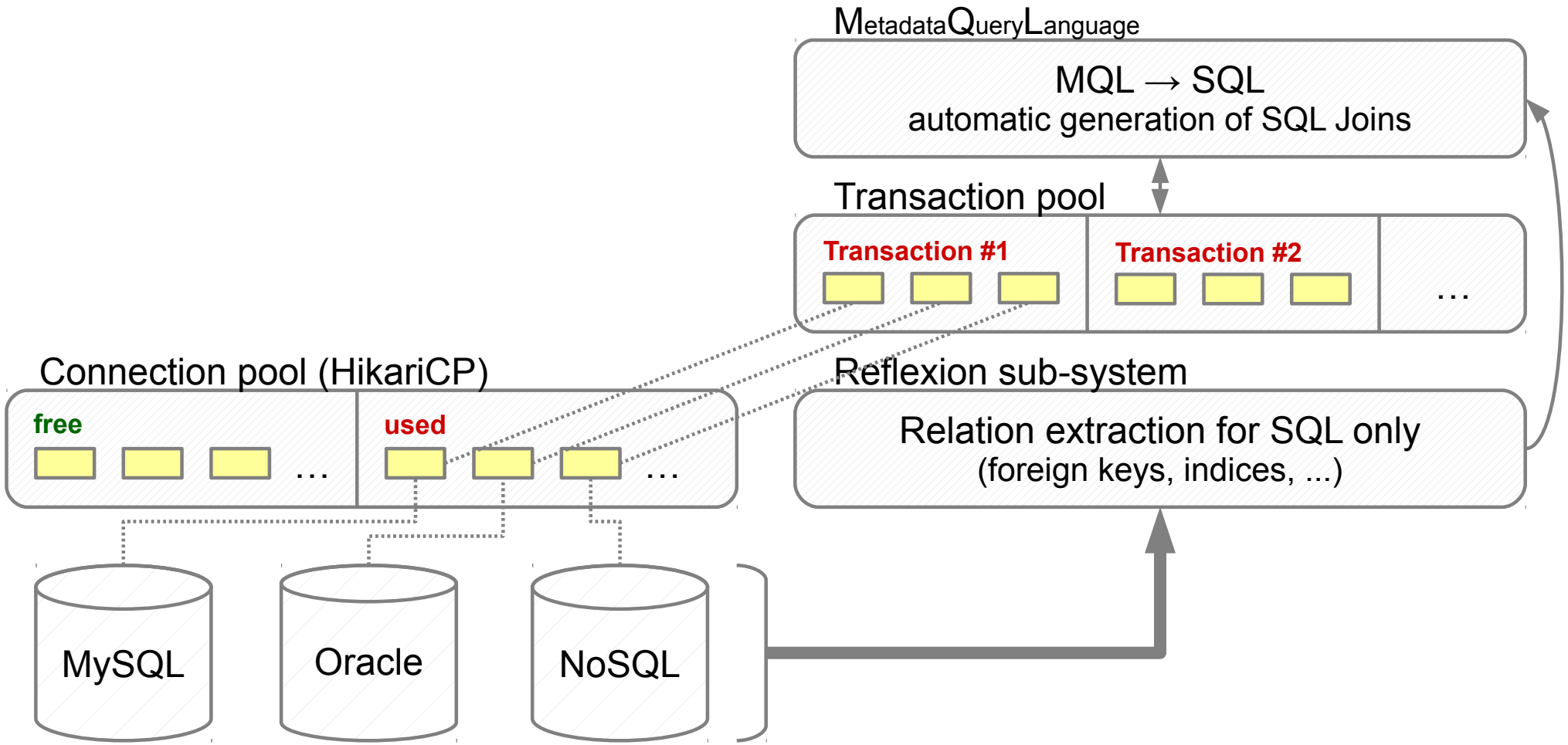
SearchQuery -catalog="..." -sql="..."

GetDatasetInfo -logicalDatasetName="..." (for ATLAS, getting detailed dataset info)

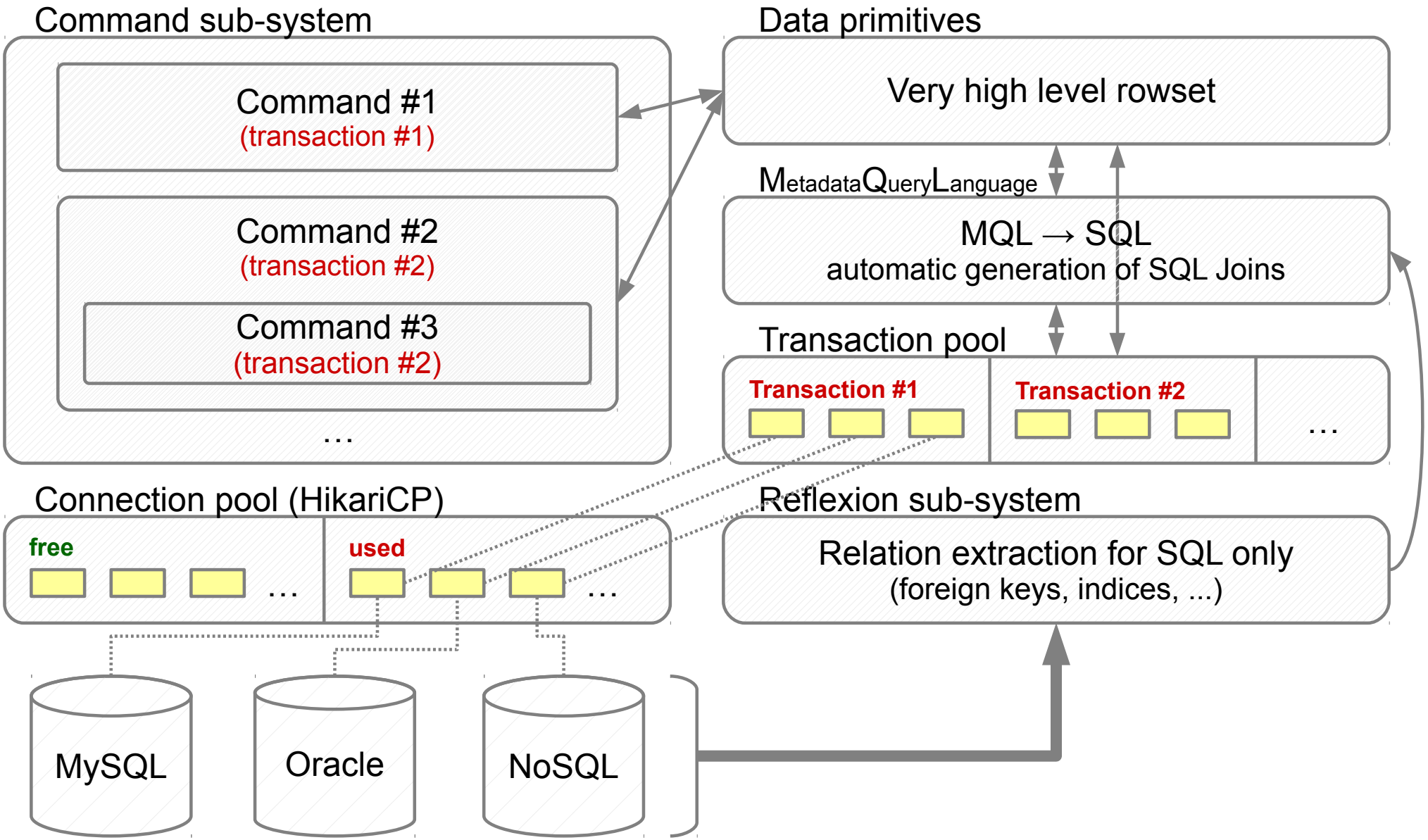
Metadata layer



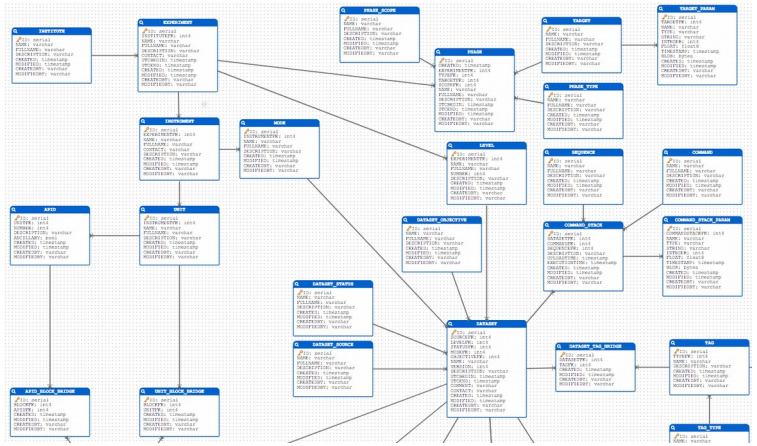
Metadata layer



Metadata layer



More about MQL



- MQL is a kind of SQL without **FROM** clause nor join
- It makes it possible to build queries without (precisely) knowing relations
- Joins are automatically generated from the reflexion sub-system info

- MQL turns DB-oriented point of view to metadata-oriented point of view
- When there are cycles in relations, there is a dedicated syntax to apply path constraints
- Example:

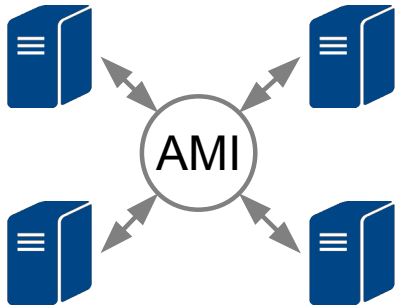
```
SELECT BLOCK.ID
WHERE BLOCK_PARAM.NAME='foo'
  AND DATASET.NAME{BLOCK.DATASETFK}='bar'
```

MQL to SQL

```
SELECT `BLOCK`.`ID`
FROM `BLOCK`
WHERE (`BLOCK`.`ID` IN
        (SELECT `BLOCK`.`ID`
         FROM `BLOCK`,
              `BLOCK_PARAM`
         WHERE `BLOCK_PARAM`.`NAME` = 'foo'
           AND (((`BLOCK_PARAM`.`ID`,
                  `BLOCK`.`ID`) IN
                 (SELECT `BLOCK_PARAM`.`ID`,
                         `BLOCK`.`ID`
                  FROM `BLOCK_PARAM`,
                       `BLOCK`
                  WHERE `radardb`.`BLOCK_PARAM`.`BLOCKFK` = `radardb`.`BLOCK`.`ID`))))
      AND `BLOCK`.`ID` IN
        (SELECT `BLOCK`.`ID`
         FROM `BLOCK`,
              `DATASET`
         WHERE `DATASET`.`NAME` = 'bar'
           AND (((`DATASET`.`ID`,
                  `BLOCK`.`ID`) IN
                 (SELECT `DATASET`.`ID`,
                         `BLOCK`.`ID`
                  FROM `BLOCK`,
                       `DATASET`
                  WHERE `radardb`.`BLOCK`.`DATASETFK` = `radardb`.`DATASET`.`ID`)))))
```

AMI Task Server

AMI Task Server features



for instance
4 AMI Task Servers

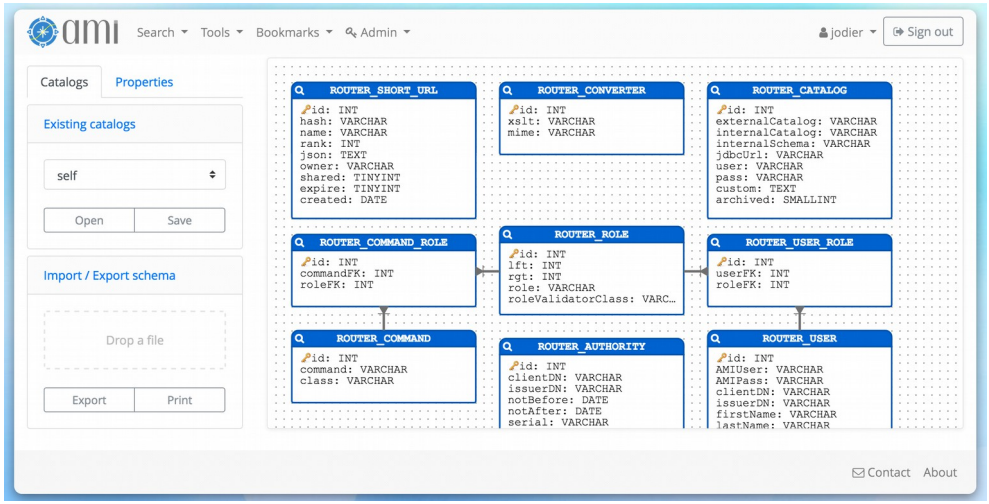
- The AMI Task Server is used for:
  - Extracting metadata from primary sources (pull mode)
  - (Re)Processing metadata
  - Storing metadata in AMI
- It can run any kind of tasks (shell, python, java, ...)
- When needed, it can benefit from the AMI Java Core library
- Main features:
  - Kind of super CRON
  - Web interfaces and monitoring
  - The AMI Task Server is distributed
  - Mutual exclusion mechanism between tasks
  - Priority lottery scheduler for avoiding starvation (not real time)
  - One shot tasks

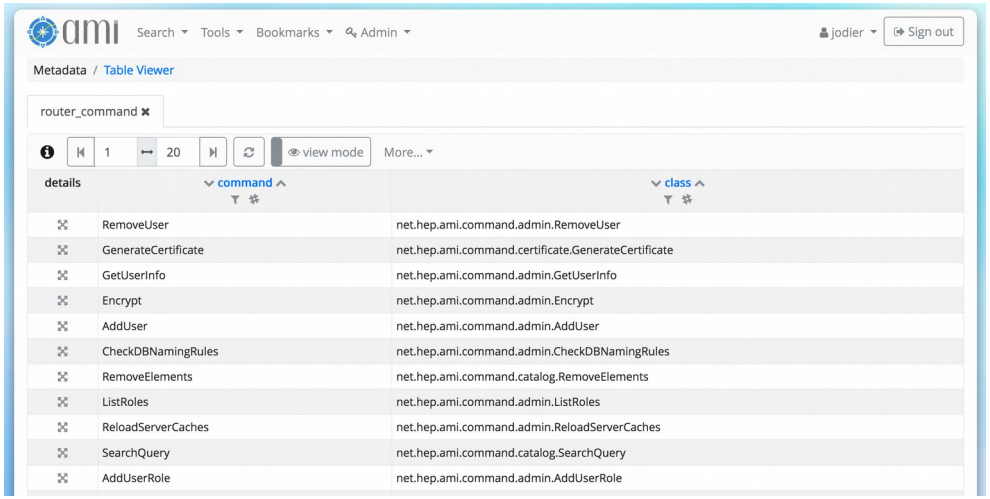
In ATLAS:
- Metadata extraction from Tier0 (real data)
- Metadata extraction from ProdSys (simulated data, reprocessing)
- ActiveMQ messages from RUCIO (data placement)
- ~50 other tasks

AMI Web Framework

AMI Web Framework (AWF)

- A Web framework for designing metadata-oriented applications
- AWF can be used without the AMI Java HTTP Service
  - Server-side, libraries AMIMini{PHP,Python,JAVA} can easily bridge AWF to existing services
- AWF is based on standard technologies:
  - JS6 (transpiled to JS5), CSS3, HTML5
  - JQuery, Twitter Bootstrap 4
  - AMI-Twig (a JavaScript homemade version of the Twig template engine)





Features and patterns

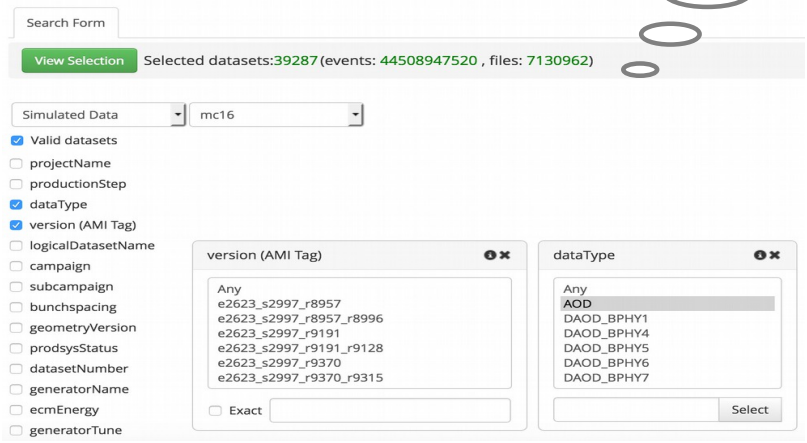
- Authentication
- URL router, short URLs
- Object paradigm (emulated)
- Sub-applications and reusable graphic controls
- Centralized resource live cycle management (CSS, JS, JSON, xml, Twig files; AMI sub-applications; AMI controls)
- Wizards for generating sub-application and control skeletons
- MVC pattern:
  - Model → AMI commands
  - View → TWIG templates
  - Controller → classes ami.SubApp, ami.Control (JavaScript)

Default controls and applications

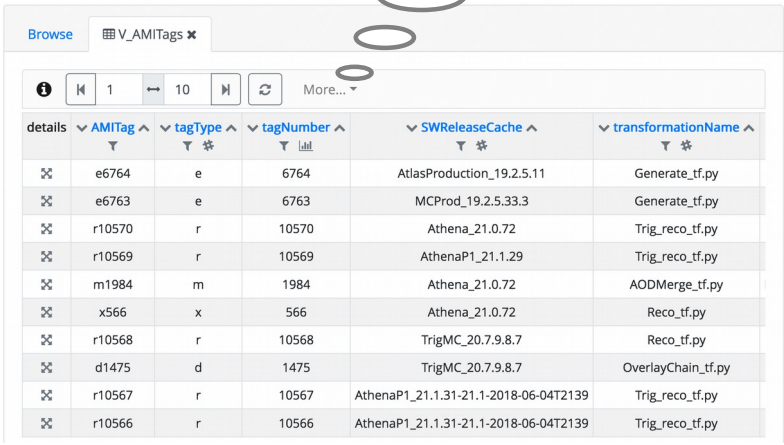
- Controls can be embedded in external Web pages such as wikis
  - See details in poster session
- Applications are generally built by assembling controls
- Main available controls:
  - Dialog boxes
  - Controls for searching (Google-like Search, Criteria Search, …)
  - Controls for displaying (Schema Viewer, Tab, Table, Element Info, …)
  - Controls for annotating entities (WhiteBoard, …)
- Main available applications:
  - Basic CMS
  - AMI command interpreter
  - Admin Dashboard and Monitoring
  - Schema Viewer, Table Viewer, Simple Search, Criteria Search, Search Modeler, …

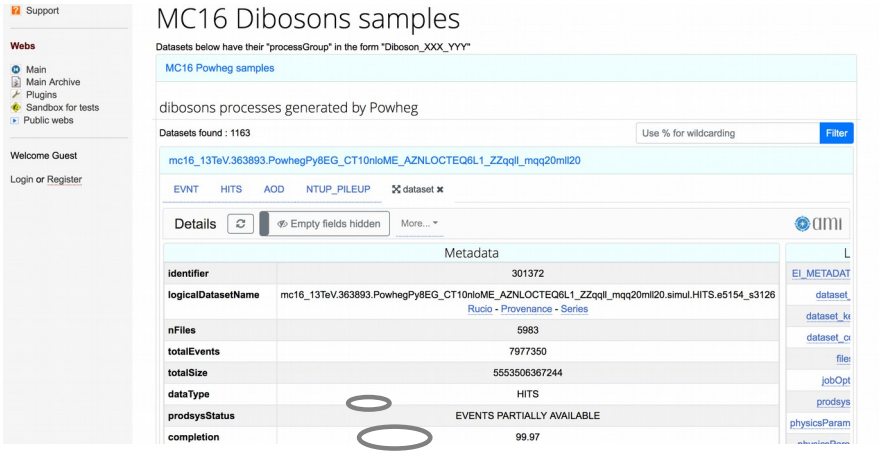
Screenshots

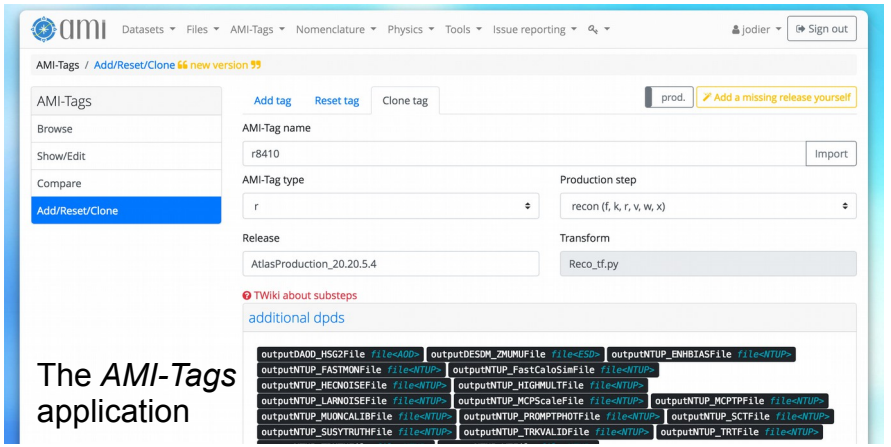
Searching ATLAS datasets by criteria



Displaying search results in AMI







The *AMI-Tags* application

A control embedded in a wiki and connected to the central AMI service

This control executes the **GetDatasetInfo** command

Conclusion

Conclusion

- AMI is mature metadata ecosystem of more than 18 years of existence
- Originally developed for the ATLAS experiment:
  - i) Official dataset discovery tool (millions of datasets, billions of files). ii) Used by the ATLAS production system (parameter definition for dataset processing [= AMI-Tags]). …
- AMI version 2 released this year, web site soon available
- AMI Java Core
  - High level server-side JAVA library for processing metadata
    - i) High level primitives for manipulating metadata. ii) Metadata Query Language. iii) datasource connectivity.
- AMI HTTP Services + lightweight clients
  - AMI commend service (proprietary), REST interface
- AMI Task Server
  - Distributed system for extracting, processing and storing metadata
- AMI Web Framework
  - For developing metadata-oriented Web applications and graphic controls

Questions?