



MUSE-WISE Astronomical Information System

by

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MUSE Data Management Team :

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What is MUSE-WISE

- An information system handling data produced by the MUSE instrument at the VLT
 - Multi Unit Spectroscopic Explorer, with 24 CCD's, optical
 - The MUSE GTO team has 250 nights on UT4 over 5 years
- Based on Astro-WISE; the system designed for the OMEGACAM wide field imager at the VST
- Not only an archive but also a processing facility, keeping full data lineage
- Metadata is stored in a database, files on data servers
- Is installed at 7 nodes across Europe

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MUSE-WISE Enables

- Collaboration of teams across Europe
 - Sharing data
 - Re-use of calibrations
 - Joint development
- Quality control
 - raw instrument & processed data
 - QA portal developed in Toulouse
- Monitor data acquisition
 - Instrument specifics; temperature, saturated pixels, ...
 - Noticing problems before ESO

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MUSE-WISE Enables

- Full insight of data products
 - Complete data lineage to raw data
- Automatic reducing of calibration data
 - Significantly reducing data reduction time
 - To be honest; not yet fully automated ...
- GTO science data is reduced with reference settings
 - Allowing comparison against optimised settings
- Data retrieval from any point in the processing chain
 - And process further outside MUSE-WISE
 - Most GTO science papers rely on MUSE-WISE

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MUSE-WISE Data Flow



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MUSE-WISE Components

- Oracle RAC database; storing metadata
 - 2 installations; Potsdam and Groningen (backup)
 - Full data lineage; products, parameters, links
- Data servers; storing files
 - 7 installations; all nodes
 - Storing; pixels (fits), graphs, previews, logs
 - All data servers act as one logical storage
- DPU; Distributed Processing Unit
 - 7 installations; all nodes
 - Manages jobs on the available cores of each node

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MUSE-WISE Nodes

- Goettingen
- Groningen
- Leiden
- Lyon
- Potsdam
- Toulouse
- Zurich

All nodes have the software stack, data server and DPU



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MUSE-WISE Software

- Libraries; CPL, astropy, scipy, numpy, etc ...
- Pipelines; DRS (data reduction system)
- Python; the glue language
 - Data model; specifying the data products
 - Recipes; processing specifics
 - Scripts; retrieving data, data lineage insights
- All nodes have exactly the same software stack
 - Which comes in releases, driven by the DRS
 - Older releases are archived, including database

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MUSE-WISE Data Model

- The DRS defines the data model using XML
 - Which is translated to persistent Python classes
 - Which create the the database structures



- A Python persistent class defines a table
- An attribute of this class defines a column
- An instance of this class creates a row
- XML changes \rightarrow Python changes \rightarrow database evolution !





MUSE-WISE Data Model Example



The arrow direction indicates how the database links For processing order swap the arrow direction

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MUSE-WISE Data Products

- A data product is an entry in the database with an optional associated file on a data server
- Each data product is defined within a project
- And data products have privileges
- Data products can be published
- Data products can be deleted
- The QC can flag data products, both raw and processed
 - But the user can override
- Calibration data products have a validity time range
 - But again the user can override







If the DATACUBE already exsits, and is valid, then return, otherwise (re)process







If all PIXTABLE exist and are valid, use them otherwise (re)process those needed (not all inputs shown)







The observation date of the PIXTABLE is checked against the validity range of the MASTER FLAT







Same here, but the observation date of the MASTER FLAT is a bit tricky







Raw data is queried for a night (N:1) or for a specific observation date







The raw BIAS are processed to a MASTER BIAS, the QC verifies and the object's metadata is committed and its file stored







Same here, but if a MASTER BIAS was flagged the processing stops here







And both the PIXTABLE's and DATACUBE are processed





Thanks !

Questions ?

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Technical papers :

Vriend, 2015, Porting Big Data technology across domains. WISE for MUSE http://adsabs.harvard.edu/abs/2015scop.confE..28V

The Astro-WISE datacentric information system

http://arxiv.org/abs/1208.0447

Science papers :

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Weilbacher P. M., Monreal-Ibero A., Kollatschny W., et al., 2015, A&A, 582, 114, "A MUSE map of the central Orion Nebula (M 42)",

Patrício V., Richard J., Verhamme A., et al., 2016, MNRAS, 456, 4191, "A young star-forming galaxy at z = 3.5 with an extended Lyman α halo seen with MUSE",

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Borisova E., Cantalupo S., Lilly S. J., et al., 2016, arXiv, arXiv:1605.01422, "Ubiquitous giant Ly-alpha nebulae around the brightest quasars at z~3.5 revealed with MUSE"

Bina D., Pelló R., Richard J., et al., 2016, A&A, 590, A14, "MUSE observations of the lensing cluster Abell 1689" Bouché N., Finley H., Schroetter I., et al., 2016, ApJ, 820, 121, "Possible Signatures of a Cold-flow Disk from MUSE Using a z ~ 1 Galaxy-Quasar Pair toward SDSS J1422-0001"

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