ESO's approach as (Open) Science Data Provider

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PUNCH4NFDI workshop, 11 Feb. 2021



European Southern Observatory in a nutshell

- Inter-governmental organisation supported by 16 member states
- builds and operates state-of-the-art ground-based astronomical facilities
- ~1/2 of the astronomical community world-wide are involved
- most productive (ground-based) Observatory worldwide



Superb Sites and Telescopes

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Versatile Instrument Suite



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Large & Diverse Communities



Mandate: ESO Science Policy

- Monitor the long term evolution of instruments
 - instrument health
- Produce Data Products
- Jaia Products
 remove instrumental signatures
 calibrate in physical units
- Deliver

i R content calibration and cata products ricta wand public lata through the Science Archive Facility

lines and repues (and increase their accuracy over time)

- the community helpdesk
 - in their quest to generate Advanced Data Products





ESO data products stewardship

In-house generation of Data Products (IDPs)

- > enabled through standardized acquisition and quality control
 - near-real time quality control process ensures certified master calibrations
- un-attended processing w/ certified pipelines, process is QC'ld
- goal: science grade data for all popular instrument modes ("Level 1")

External Data Products (EDPs)

- provided by public surveys and large programs (deliverables)
- programs selected by their high legacy value
- most use dedicated (non-ESO) user-pipes (eg CASU)
- goal: advanced products (wide, deep, merged catalogs, "Level 2/3")
- > perspective: community/expert centers *at large* contribute EDPs
 - quality assurance: published datasets
 - Acknowledgement: by DOI



Formalization: ESO Phase 3 validation and curation

ESO Phase 3 process enables

Preparation, submission, validation and ingestion of science data products for storage in the ESO Science Archive Facility (SAF), and subsequent publication to the scientific community.

ESO Science Data Product Standard is required for coherence of EDPs and IDPs in the Science Archive

www.eso.org/sci/observing/phase3/p3sdpstd.pdf

- defines format, meta-data, keywords, quality descripto processing provenance
- generally derived from "VO" standards
- some SDPS innovations
 - multi-epoch photometry (su
 - processing provenance
 - 3D/IFU cubes (KMOS, MUSE
 - sub-mm/radio maps (ALMA/AF

European Organisation for Astronomical Research in the Southern Hemisphere Programme: Directorate of Operations (DOO) Project/NP: Archive Science Group ESO Science Data Products Standard Document Number: ESO-044286 iment Version: 6 CDE)



Access: ESO Data Portal

http://archive.eso.org/scienceportal



The purpose of this page is to help you to learn:

- 1. how to compose URLs to interact with the different ESO science archive services, either programmatically or via tools;
- 2. how to construct queries to interrogate the various database tables of the ESO science archive, using ADQL and TAP;
- 3. how to put it all together and script your access to the ESO science archive, using the pyvo python module.

If some terms in this page are not familiar to you, please read the overview page first.

In this page: [open] click here to read the page description...

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Data Volume



Extremely Large Telescope – relatively small (science) data

100 m 80 m 20 m PUNCH4NFDI workshop, 11 Feb. 2021

120 m



Innovations and Challenges

ESO endorses EOSC

ESO partners w/ ESCAPE (before ASTERICS)

- > ESCAPE: European Science Cluster of Astronomy & Particle physics ESFRI (EC-funded H2020 project)
- machine/deep learning applied to the ESO Science Archive

ML/DL Applications

- * Machines learn stellar parameters just by looking at many spectra" (Sedaghat et al., 2021, MNRAS 501, 6062-6041)
- "DeepThought": astro-semantic text processing
 - to find "similar" astronomy papers on arXiv: <u>opensupernova.org/deepthought</u>
 to help peer review of observing proposals (Kerzendorf et al.)
- Weather Nowcast/Forecast (w/ Microsoft/MetricArts)
- Biggest Challenge: integrate ELT and VLT operations, Ind. 4.0
 - \succ find and exploit synergies (lean operations)
 - high performance operations
 - remotely controlled operations



Backup Material



Research cycle Astronomy





Data Flow System: Scheme







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