



Data Management System Verification, Validation and Characterization

Leanne Guy, Jeff Carlin, Wil O'Mullane

CCR1
2024-10-XX



Charge questions DM

1. Completed the required scope: [Status Overview](#), [Verification detail \(Jeff/Leanne\)](#),
2. Construction completeness criteria well-defined: [1a,1b - Completeness](#)
3. Met the requirements detailed and documented: [Verification detail](#)
4. design, technical, and operational documentation: [Documentation](#)
5. Plans for transition to operations complete: [in the overview](#)
6. - 10 are for LSSTCam

Overview of Data Management System Vision

Raw Data: 20TB/night



Sequential 30s images covering the entire visible sky every few days



Access to proprietary data and the Science Platform require Rubin data rights



Prompt Data Products

- Alerts incl. science, template and difference image cutouts
- Catalogs of detections incl. difference images, transient, variable & solar system sources
- Raw & processed visit images (PVIs), difference images

60s

24h

80h



via Alert Streams

via Prompt Products

via Image Services

via Data Releases

Data Release Data Products

Final 10yr Data Release:

- Images: 5.5 million x 3.2 Gpixels
- Catalog: 15PB, 37 billion objects

Community Brokers

Rubin Data Access Centres (DACs)

USA (USDF)
Chile (CLDF)
France (FRDF)
United Kingdom (UKDF)

Independent Data Access Centers (IDACs)

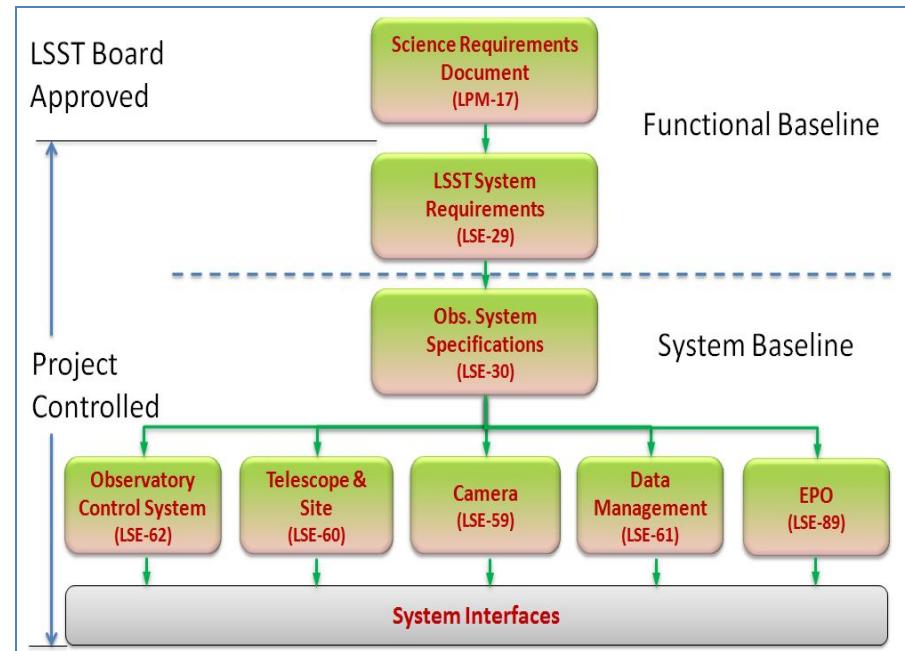


Rubin Science Platform

Provides access to LSST Data Products and services for all science users and project staff.

DM High level approach to Verification

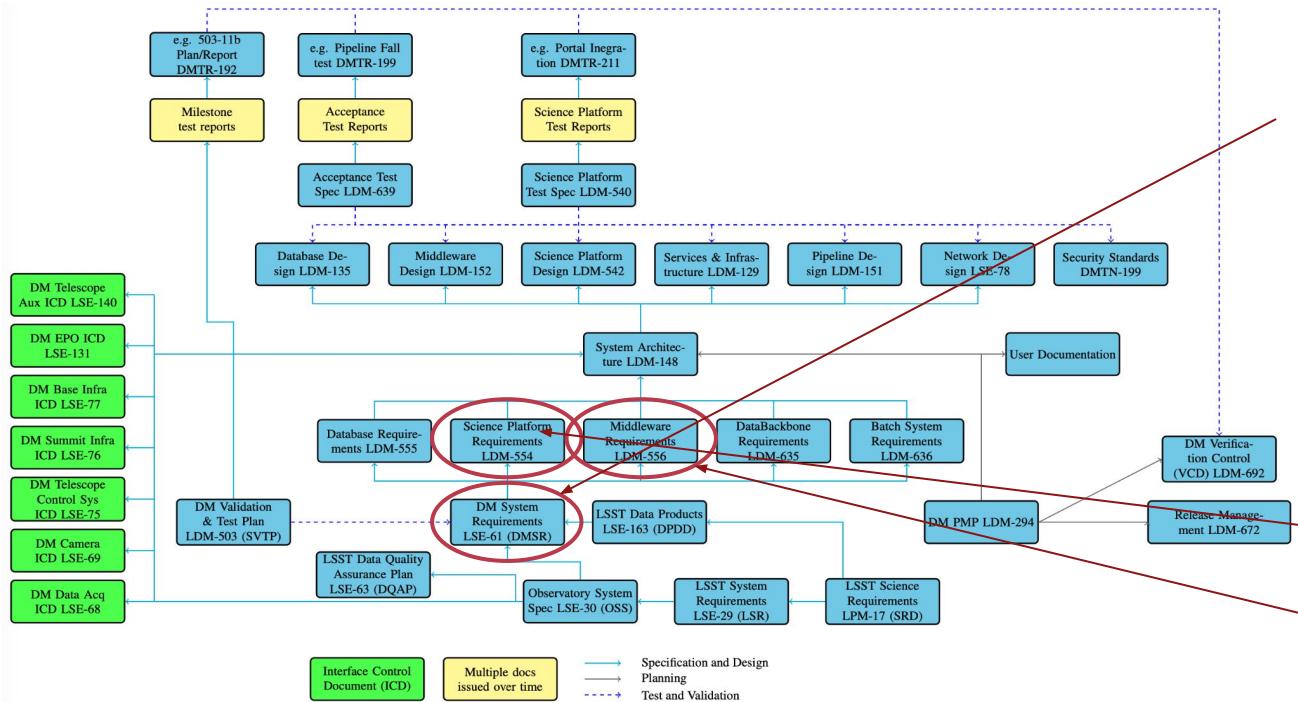
- DM follows the overall Verification Approach and Architecture presented by Holger Drass (Lead Systems Engineer) in the [System Verification](#) session
- DM verifies requirements detailed in the [Data Management System Requirements \(DMSR\) LSE-61](#) via a series of Acceptance Test Campaigns that have been carried out over the course of several years





Data Management Verification **Verification Guiding Documents**

Acceptance Testing carried out around three high-level DM requirements documents



LSE-61: DM System

Requirements

And two additional
flowed down
requirements documents:

- LDM-540: Science Platform
- LDM-556: Middleware

DM System Acceptance Testing Specifications

- [LDM-639](#): LSST Data Management Acceptance Test Specification – the detailed acceptance test specification for the LSST Data Management System, auto-generated from Jira.
- [LDM-752](#): DM Science Verification document: – Captures the content and details of all DM Verification Elements categorized in the Science sub-component.
- [DMTN-091](#): Test Datasets for Scientific Performance Monitoring

Requirements Prioritization & Completion Status

- We have been verifying and validating as much of DM as possible in advance of commissioning and operations using precursor and simulated datasets, operations rehearsals & data challenges and the early science DP program.
- We regard the system as being successfully completed when all **236** of the high level requirements placed upon it – [LSE-61 – the Data Management System Requirements](#) – have been verified.
- The DM System Requirements ([LSE-61](#)) prioritizes requirements:
 - **57** priority 1a requirements - must be met to enter commissioning (*Rubin First Photon (2025-Mar-31)*)
 - **118** priority 1b requirements - must be met to enter operations. (*Start of SV Surveys (2025-Aug-13)*)
 - **55** priority 2 requirements - should be done to enter Operations; but waiver likely to be granted if not met," i.e., we could enter Operations without this, for first 3 years (*Start of SV Surveys (2025-Aug-13)*)
 - **6** priority 3 requirements – overall capability/efficiency/ease of use/etc., may be reduced but science will not critically suffer if not done." Could enter operations without this requirement fulfilled, (*Start of SV Surveys (2025-Aug-13)*)

DM Completion Status

Priority 1a: Must be demonstrated to be working before the start of the commissioning period

Milestone: LDM-503-19a: All 1a DM requirements verified, Rubin First Photon (31-Mar-2025)

Status: 46% Fully or Partially Verified, 53% In Verification.



Priority 1b: Must be demonstrated to be working before the start of the observing

Milestone: LDM-503-19: All 1a,1b DM requirements verified, Start of SV Surveys (2025-Aug-13)

Status: 13% Fully or Partially verified, 86% In Verification.



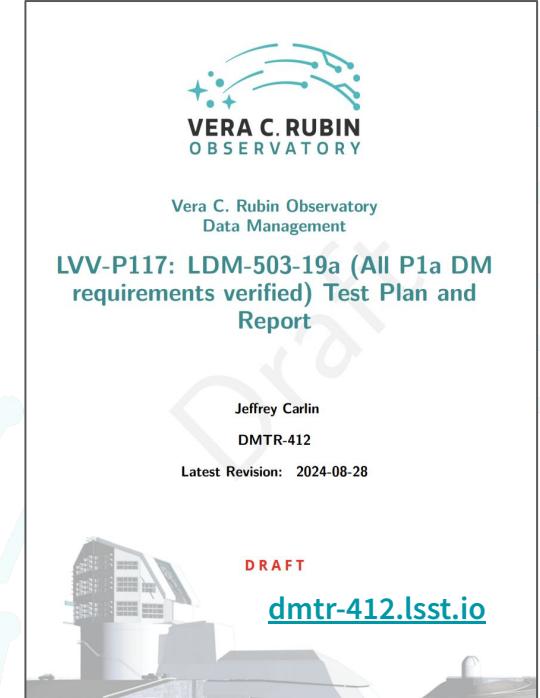
Priority 2: Should be done to enter Operations; but waiver likely to be granted if not met.

Status: 6% Fully Verified. Expect to complete more prior to the start of operations in mid-2025 with the remainder in the first 3 years of operations.



DM readiness for on-sky commissioning

- DM aims to complete verification of all P1a requirements prior to LSSTCam on sky.
- Most functionality is delivered and verified with precursor or simulated data, remainder will use ComCam on-sky data
- Verification campaign LVV-P117 mapped to milestone **LDM-503-19a : All P1a DM requirements verified** in progress. Builds on many earlier verification campaigns
 - Networks and Facility
 - Image processing and calibration
 - Data quality reports
 - Data archiving and access
 - Computation of performance metrics
 - EFD



P1a Verification – Detailed Summary

1. Data Products (21):

- 8 *complete*: camera visualization, raw image acquisition/assembly, PVIs (basic calibration), reporting
- 13 *incomplete*: metadata, WFSs/guiders, embargo, exposure catalog, reporting, calibration data products, provenance

2. Productions (4):

- 1 *complete*: data ID uniqueness
- 3 *incomplete*: dataset associations, reporting, calibrations

3. Software (15):

- 12 *complete*: precursor data, source detection, photoCalib, CBP coords, DMS initialization, data ingestion, pipeline execution, production orchestration/monitoring/fault tolerance, task specification/configuration
- 3 *incomplete*: data products access, pipeline construction

4. Facilities (13):

- 3 *complete*: camera test data archive, catalog queries and export
- 10 *incomplete*: archive and summit facilities and their reliability, transformed EFD, networking

5. Performance (3):

- 1 *complete*: astrometry
- 2 *incomplete*: photometry, EFD queries

Code for most science performance metrics implemented and tested, performance specs will be assessed in commissioning.

P1a Verification – Detailed progress

ReqId	% Complete
DMS-REQ-0024	100
DMS-REQ-0030	100
DMS-REQ-0033	100
DMS-REQ-0043	100
DMS-REQ-0060	100
DMS-REQ-0072	100
DMS-REQ-0075	100
DMS-REQ-0078	100
DMS-REQ-0097	100
DMS-REQ-0156	100
DMS-REQ-0292	100
DMS-REQ-0296	100
DMS-REQ-0297	100
DMS-REQ-0299	100
DMS-REQ-0302	100
DMS-REQ-0303	100
DMS-REQ-0304	100
DMS-REQ-0305	100
DMS-REQ-0306	100
DMS-REQ-0315	100
DMS-REQ-0351	100

Complete (or
nearly
complete)

ReqId	% Complete
DMS-REQ-0360	100
DMS-REQ-0372	100
DMS-REQ-0395	100
DMS-REQ-0158	67
DMS-REQ-0298	67
DMS-REQ-0282	50
DMS-REQ-0359	33

ReqId	% Complete
DMS-REQ-0003	0
DMS-REQ-0018	0
DMS-REQ-0020	0
DMS-REQ-0059	0
DMS-REQ-0061	0
DMS-REQ-0096	0
DMS-REQ-0101	0
DMS-REQ-0102	0
DMS-REQ-0130	0
DMS-REQ-0132	0
DMS-REQ-0155	0
DMS-REQ-0066	0
DMS-REQ-0068	0
DMS-REQ-0069	0
DMS-REQ-0168	0
DMS-REQ-0171	0
DMS-REQ-0176	0
DMS-REQ-0185	0
DMS-REQ-0186	0
DMS-REQ-0265	0

ReqId	% Complete
DMS-REQ-0266	0
DMS-REQ-0289	0
DMS-REQ-0293	0
DMS-REQ-0309	0
DMS-REQ-0316	0
DMS-REQ-0358	0
DMS-REQ-0394	0
DMS-REQ-0402	0
DMS-REQ-0404	0

Incomplete

P1b Verification – Detailed Summary

Verified (15):

- Source injection, difference exposures, zeropoints, PSF, base facility and archive locations, forced-source catalog, coadded images, background modeling, flux measurements, HiPS maps

Remaining (102):

- Data availability and performance of access tools, UI, bulk download, image access
- catalog (Source, Object, DIASource, DIAObject) measurements, image characterization, coadd types, provenance, astrometric model, shape measurements, (DIA)Source-Object association
- prompt products production and availability, variability characterization, alerts, DIASource precovery, Solar System objects
- monochromatic flats, illumination correction, fringe frames
- reporting, publishing predicted visits, EPO images, HiPS services/maps, MOC maps, special programs, query performance, pipeline completeness/performance, software architecture, networking, DACs

P1b Verification – Detailed progress, part 1

Complete (or
nearly complete)

ReqId	% Complete
DMS-REQ-0009	100
DMS-REQ-0010	100
DMS-REQ-0029	100
DMS-REQ-0047	100
DMS-REQ-0070	100
DMS-REQ-0178	100
DMS-REQ-0187	100
DMS-REQ-0268	100
DMS-REQ-0278	100
DMS-REQ-0327	100
DMS-REQ-0334	100
DMS-REQ-0347	100
DMS-REQ-0369	100
DMS-REQ-0379	100
DMS-REQ-0390	100
DMS-REQ-0382	50
DMS-REQ-0380	33

Incomplete

ReqId	ReqId	ReqId	ReqId
DMS-REQ-0002	DMS-REQ-0164	DMS-REQ-0277	DMS-REQ-0341
DMS-REQ-0004	DMS-REQ-0165	DMS-REQ-0279	DMS-REQ-0346
DMS-REQ-0008	DMS-REQ-0166	DMS-REQ-0280	DMS-REQ-0353
DMS-REQ-0032	DMS-REQ-0170	DMS-REQ-0281	DMS-REQ-0354
DMS-REQ-0034	DMS-REQ-0172	DMS-REQ-0283	DMS-REQ-0355
DMS-REQ-0042	DMS-REQ-0173	DMS-REQ-0284	DMS-REQ-0356
DMS-REQ-0052	DMS-REQ-0174	DMS-REQ-0285	DMS-REQ-0357
DMS-REQ-0062	DMS-REQ-0175	DMS-REQ-0287	DMS-REQ-0361
DMS-REQ-0063	DMS-REQ-0180	DMS-REQ-0291	DMS-REQ-0362
DMS-REQ-0065	DMS-REQ-0181	DMS-REQ-0294	DMS-REQ-0374
DMS-REQ-0052	DMS-REQ-0182	DMS-REQ-0300	DMS-REQ-0376
DMS-REQ-0062	DMS-REQ-0183	DMS-REQ-0301	DMS-REQ-0377
DMS-REQ-0063	DMS-REQ-0188	DMS-REQ-0308	DMS-REQ-0383
DMS-REQ-0065	DMS-REQ-0189	DMS-REQ-0310	DMS-REQ-0384
DMS-REQ-0074	DMS-REQ-0190	DMS-REQ-0311	DMS-REQ-0385
DMS-REQ-0077	DMS-REQ-0191	DMS-REQ-0312	DMS-REQ-0386
DMS-REQ-0090	DMS-REQ-0193	DMS-REQ-0313	DMS-REQ-0387
DMS-REQ-0094	DMS-REQ-0194	DMS-REQ-0314	DMS-REQ-0388
DMS-REQ-0098	DMS-REQ-0196	DMS-REQ-0318	DMS-REQ-0389
DMS-REQ-0099	DMS-REQ-0197	DMS-REQ-0319	DMS-REQ-0398
DMS-REQ-0100	DMS-REQ-0267	DMS-REQ-0322	DMS-REQ-0399
DMS-REQ-0103	DMS-REQ-0269	DMS-REQ-0324	DMS-REQ-0400
DMS-REQ-0106	DMS-REQ-0271	DMS-REQ-0328	DMS-REQ-0401
DMS-REQ-0160	DMS-REQ-0272	DMS-REQ-0331	DMS-REQ-0403
DMS-REQ-0161	DMS-REQ-0274	DMS-REQ-0333	DMS-REQ-0405
DMS-REQ-0162	DMS-REQ-0275	DMS-REQ-0336	DMS-REQ-0406
DMS-REQ-0163	DMS-REQ-0276		

P2 Verification – Detailed Summary

Verified (4):

- DIAForcedSource, Best-seeing and PSF-matched coadds, base wifi

(DMS-REQ-0317, 0330, 0335, 0352)

Remaining (50):

- Denormalizing databases, per-pixel metadata, SSOBJECTS, faint DIASOURCES/variables, DIAForcedSource, photo-z, data product regeneration, extended LSB object detection, all-sky visualizations, DR characterization, Special Programs processing, Alert stream performance, User-generated (Level 3) data products, query logging, federation with external catalogs, image retrieval performance

(DMS-REQ-0022, 0046, 0119, 0120, 0121, 0122, 0123, 0124, 0125, 0126, 0127, 0128, 0131, 0167, 0197, 0270, 0273, 0286, 0288, 0290, 0295, 0307, 0317, 0320, 0321, 0325, 0326, 0329, 0330, 0332, 0335, 0337, 0338, 0339, 0340, 0342, 0343, 0344, 0345, 0348, 0349, 0350, 0352, 0365, 0366, 0367, 0373, 0375, 0378, 0381, 0391, 0392, 0393, 0396, 0397)

P3 Verification – Detailed progress

ReqId	% Complete
DMS-REQ-0323	0
DMS-REQ-0363	0
DMS-REQ-0364	0
DMS-REQ-0368	0
DMS-REQ-0370	0
DMS-REQ-0371	0

5 of the requirements are related to access to previous/older Data Releases

1 related to Solar System objects

DM System Acceptance Testing – the process

- Define [Test Plan](#) and related [Test Cycle](#) (populated with Test Cases) – identify new DM milestones achieved and plan for a campaign
- Write the test scripts for Test Cases
 - If needed, consult with, e.g., DM-SST for clarification/definition
- Execute tests, recording results and attaching related artifacts (archived in [github repo](#))
- For all passing tests, request sign-off from product owner – “Do the tests we have executed demonstrate that we have fully met the requirement?”
 - If issues are encountered along the way, file Jira tickets
 - If product owner/primary stakeholder is not convinced, file tickets for further work, and flag test for inclusion in future campaign
- Transition Verification Elements from “In Verification” to “SE Review” (i.e., requesting review and formal sign-off from Systems Engineering)
- Issue a test report (DMTR-XXX) detailing results (example: [DMTR-401](#))



Data Management Verification

DM Verification in the LVV Jira Project

SMARTBEAR Zephyr Scale

Test Cases Test Cycles **Test Plans** Reports

+ New Folder Q ...

+ New Test Plan Delete

Search... Filters

All test plans (111)

- Camera (2)
- Services (39)**
 - DBB Services (1)
 - LSP Services (7)
 - Offline Services
 - Prompt Services (4)
 - IT Services (1)
- Software Products (9)
- Infrastructure (0)
- Acceptance (7)
- Interfaces

Continuous testing over several years to incrementally verify functionality as delivered at key DM milestones

1 - 39 ▾ of 39

+ New Test Plan		Delete	Search...	Filters
Key	Name	Status		Status
LVV-P117	LDM-503-19a (All P1a DM requirements verified)	APPROVED		COMPLETED
LVV-P107	LDM-503-16a: Science Pipelines Fall 2022 Release Test Plan	COMPLETED		COMPLETED
LVV-P106	Data Management Acceptance Test Campaign, Fall 2023	COMPLETED		COMPLETED
LVV-P99	Data Management Acceptance Test Campaign 1	COMPLETED		COMPLETED
LVV-P96	LDM-503-14: DM readiness for Science Verification	DRAFT		COMPLETED
LVV-P92	LDM-503-15a: Science Pipelines Fall 2021 Release	COMPLETED		COMPLETED
LVV-P91	LDM-503-RSPb (Science Platform ready for Science Verification)	DRAFT		COMPLETED
LVV-P90	LDM-503-EFDb: Replication of Summit EFD to USDF	APPROVED		COMPLETED
LVV-P83	LDM-503-17a: Science Pipelines Final Release	DRAFT		COMPLETED
LVV-P82	LDM-503-13a: Science Pipelines Fall 2020 Release	COMPLETED		COMPLETED
LVV-P80	LDM-503-RSPa: RSP on the Interim Data Facility (IDF) is ready for DP0.2	APPROVED		COMPLETED
LVV-P79	LDM-503-14a: RSP redeployed on the Interim Data Facility (IDF), ready for DP0.1	COMPLETED		COMPLETED
LVV-P78	DM-503-EFDA: EFD on Summit for M1/M3	COMPLETED		COMPLETED
LVV-P77	LDM-GEN3: Gen 3 Butler Acceptance Testing	COMPLETED		COMPLETED
LVV-P76	LDM-503-11a: ComCam OPS Readiness	COMPLETED		COMPLETED
LVV-P75	Qserv Scalability Testing 50	DRAFT		COMPLETED
LVV-P73	Network Acceptance Test Campaign 1	DRAFT		COMPLETED
LVV-P72	DM Acceptance Testing, Operations Rehearsal #2	COMPLETED		COMPLETED
LVV-P71	Science Pipelines Release 20.0.0 Acceptance Test Campaign	COMPLETED		COMPLETED
LVV-P70	LDM-503-xxx: Access to Processed HSC Public Data in the LSP	DRAFT	?	COMPLETED

Data Management Verification

Generating Reports



Each Test Campaign produces a Test Report (DMTR-XXX) that contains the verification tickets and includes the following elements:

- Summary of requirements being verified
- Description of the specific verification requirements and mapping to verification elements
- Test procedure definitions & personnel
- Success criteria for each element
- Test results
- Non-Compliance assessment
- Recommendations
- Summary

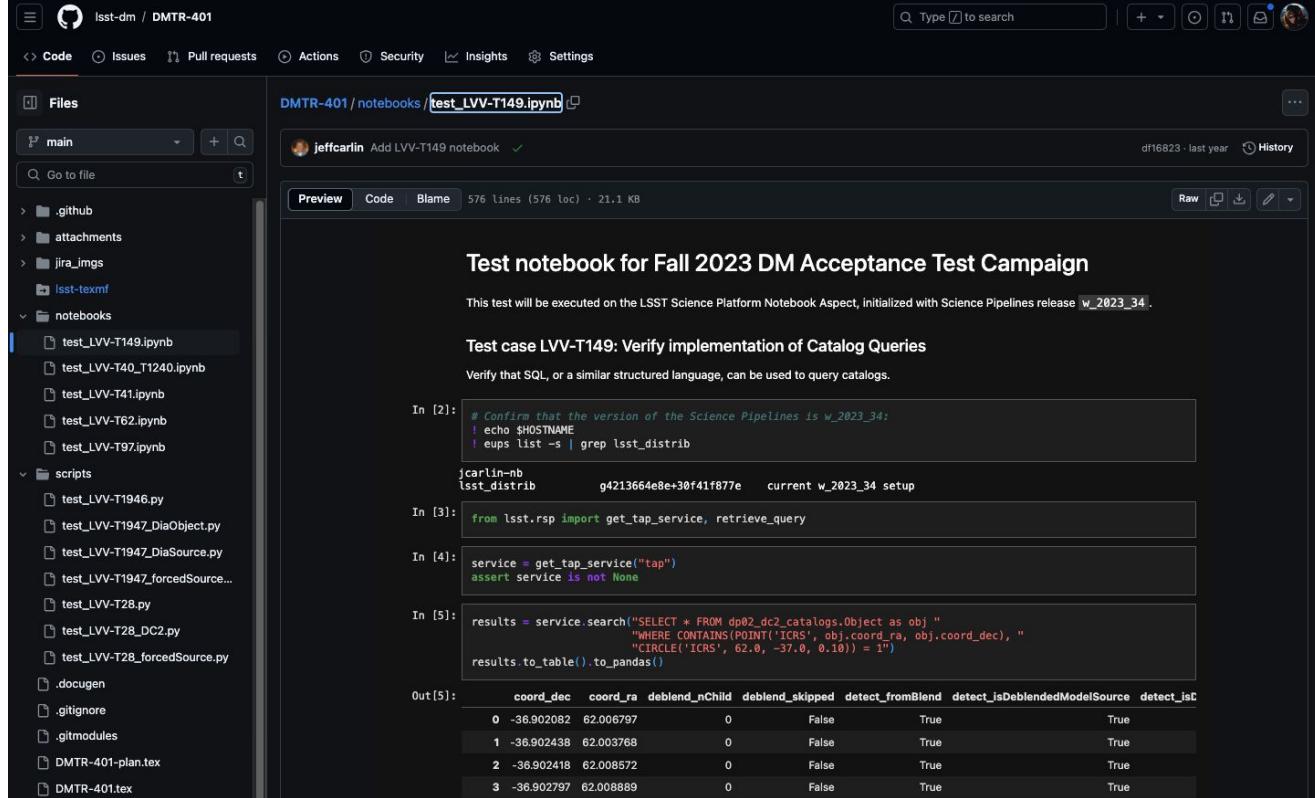
DMSR-level Verification Reports and Artefacts

List of reports that contribute to requirement completion

- [DMTR-201](#): Fall 2019 Pipelines Release Acceptance Test Campaign - HSC/DC2 data **Complete**
- [DMTR-261](#): Science Pipelines Release 20.0.0 Acceptance Test Campaign - HSC/DC2 data **Complete**
- [DMTR-231](#): DM Acceptance Testing, Operations Rehearsal #2 – Focus on pipeline algorithms, network and observing facility infrastructure, and some basic camera and data backbone functionalities **Complete**
- [DMTR-241](#): Network Acceptance Test Campaign ... **Work done, formal verification In Progress**
- [DMTR-331](#): EFD Test campaign to show USDF replication. **Complete**
- [DMTR-371](#): Data Management Acceptance Test Campaign 1 – DP0.2 & AuxTel data products, RSP at the IDF and USDF. **Complete**
- [DMTR-381](#): RSP Test Campaign based on DP0.2 RSP services: : IVOA-compatible image metadata services and image services in the API Aspect, and the addition to the Portal Aspect of specific search capabilities, for ObsCore image metadata searches in an ObsTAP service. **Complete**
- [DMTR-401](#): Data Management Acceptance Test Campaign, Fall 2023 : Data Preview 0.2 (DESC DC2 simulated data reprocessed using the LSST Science Pipelines, AuxTel imaging and camera test-stand data. **Complete**
- [DMTR-412](#): LDM-503-19a (All P1a DM requirements verified): Readiness for on-sky observing, pipelines, infrastructure, summit, USDF, data access **In Progress**

Data Management Verification

Reports with test code in Github



The screenshot shows a GitHub repository interface for the LSST Data Management team. The repository is named 'lsst-dm / DMTR-401'. The 'Code' tab is selected, showing a list of files. One file, 'test_LVV-T149.ipynb', is highlighted. The notebook preview shows a title 'Test notebook for Fall 2023 DM Acceptance Test Campaign' and a section 'Test case LVV-T149: Verify implementation of Catalog Queries'. It includes a command-line snippet to check the Science Pipelines version and several code cells in Python using the lsst.rsp library to interact with a database and verify search results.

```

# Confirm that the version of the Science Pipelines is w_2023_34:
! echo $HOSTNAME
! ups list -s | grep lsst_distrib

jcarlin@lsst_distrib: g4213664e8e+30f41f877e current w_2023_34 setup

from lsst.rsp import get_tap_service, retrieve_query

service = get_tap_service("tap")
assert service is not None

results = service.search("SELECT * FROM dp02_dc2_catalogs.Object as obj "
                        "WHERE CONTAINS(POINT('ICRS', obj.coord_ra, obj.coord_dec), "
                        "CIRCLE('ICRS', 62.0, -37.0, 0.10)) = 1")
results.to_table().to_pandas()

coord_ra    coord_dec  deblend_nChild  deblend_skipped  detect_fromBlend  detect_isDeblendedModelSource  detect_isD
0   -36.902082  62.006797          0      False        True        True
1   -36.902438  62.003768          0      False        True        True
2   -36.902418  62.008572          0      False        True        True
3   -36.902979  62.008889          0      False        True        True

```

These test notebooks also provide good examples of how to use the system

Example notebook for a Requirement Verification

[test_LVV-T40_T1240.ipynb](#) (Jeff Carlin)

Related requirements attached here

Test notebook for Fall 2023 DM Acceptance Test Campaign

This test will be executed on the LSST Science Platform Notebook Aspect, initialized with Science Pipelines release `w_2023_37`.

Test case LVV-T40: Verify implementation of Generate WCS for Visit Images

Verify that Processed Visit Images produced by the AP and DRP pipelines include FITS WCS accurate to specified **astrometricAccuracy** over the bounds of the image.

Test case LVV-T1240: Verify implementation of minimum astrometric standards per CCD

Verify that each CCD in a processed dataset had its astrometric solution determined by at least **astrometricMinStandards = 5** astrometric standards.

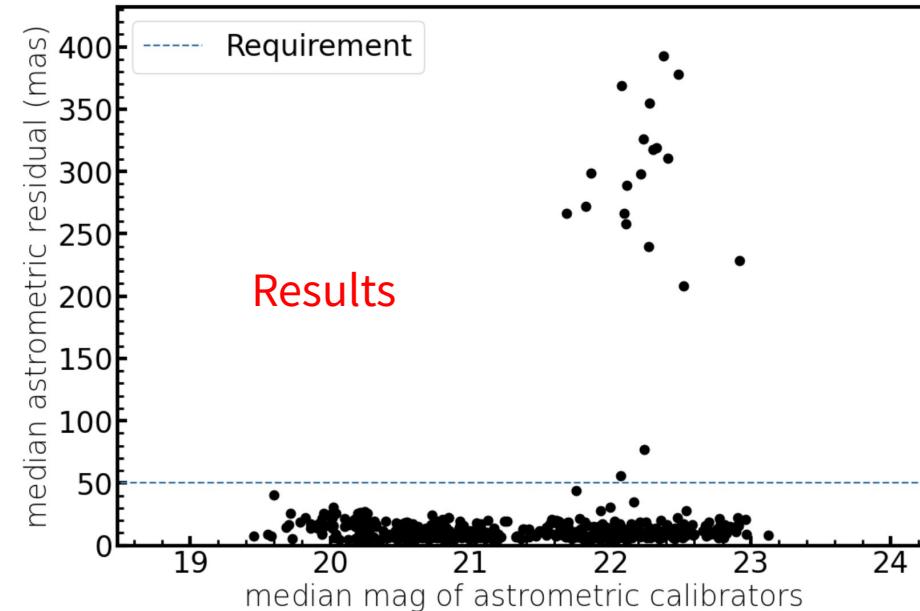
Discussion:

For this test we interpret the requirement to mean that the *absolute* astrometry (as compared to an external reference source of "truth" such as Gaia DR3) should meet the specified accuracy. Thus the verification will be done by comparing to Gaia DR3 (note, however, that the HSC-RC2 data were astrometrically and photometrically calibrated to PanSTARRS-1).

More examples:

[test_LVV-T41.ipynb](#), [test_LVV-T43.ipynb](#)

Conclusions



It seems that the fields with large astrometric residuals when compared to Gaia were calibrated using faint stars. These may be deep exposures, so that many Gaia objects saturate, or some other similar effect. Because of this small fraction of fields, the test for LVV-T40 technically does not pass. Given that this may be due to a lack of Gaia reference catalog objects, and not due to a deficiency in DM algorithms, we consider the result of this test a "Pass".

Example notebook for a Requirement Verification

Example notebook showing verification using output metrics and plots generated w/ analysis_tools during pipeline execution

```
[3]: did_tract = {'instrument': 'HSC', 'tract': 9615, 'skymap': 'hsc_rings_v1'}
metric_extract = butler.get('objectTable_tract_gaia_dr3_20230707_match_metrics', collections=collection, dataId=did_tract)
Last executed at 2024-07-26 16:25:23 in 2.75s
```

Print the metrics to the screen:

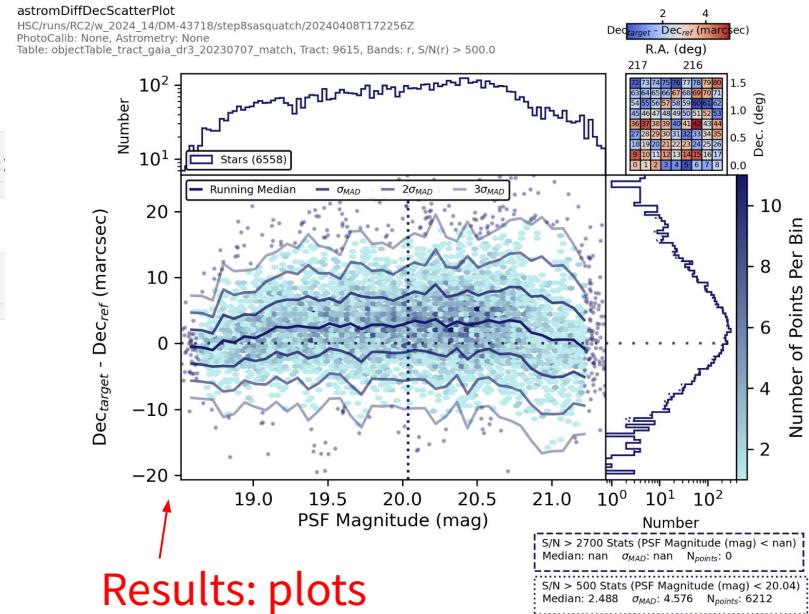
```
[4]: for met in metric_extract['astromDiffMetrics']:
    print(met)
```

```
Last executed at 2024-07-26 16:25:24 in 3ms
g_AA1_RA_coadd: 2.0720035990962056 mas
g_AA1_sigmaMad_RA_coadd: 3.9528699053073817 mas
g_AA1_Dec_coadd: 2.1020925280446074 mas
g_AA1_sigmaMad_Dec_coadd: 4.2956679236301225 mas
g_AA1_tot_coadd: 5.493056562887971 mas
g_AA1_sigmaMad_tot_coadd: 3.793806140098986 mas
r_AA1_RA_coadd: 2.7016732019546903 mas
r_AA1_sigmaMad_RA_coadd: 4.486308187317577 mas
r_AA1_Dec_coadd: 2.43938085821016 mas
r_AA1_sigmaMad_Dec_coadd: 4.6040264407679645 mas
r_AA1_tot_coadd: 6.287467219279792 mas
r_AA1_sigmaMad_tot_coadd: 4.0832584132899745 mas
i_AA1_RA_coadd: 3.5153549447386463 mas
i_AA1_sigmaMad_RA_coadd: 4.2785401891194565 mas
i_AA1_Dec_coadd: 3.2812940278903464 mas
i_AA1_sigmaMad_Dec_coadd: 4.4554776145788155 mas
i_AA1_tot_coadd: 6.912862180664823 mas
i_AA1_sigmaMad_tot_coadd: 4.038805204978894 mas
```

Results: metric values

Conclusions:

We have demonstrated that the astrometric residuals relative to the Gaia reference catalog are well below the required threshold of 50 mas in both RA and Dec. Additionally we have shown the metrics and plots that are produced by analysis_tools each time the DRP pipeline is executed. Thus the result of this test is a "Pass".



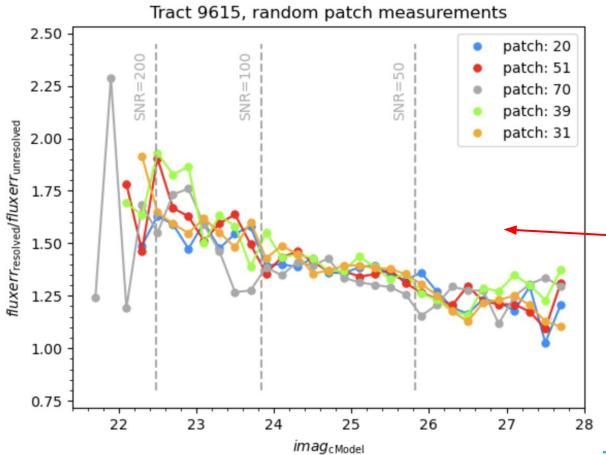
Example notebook for a Requirement Verification

Example notebook showing verification using extensive calculation within the notebook

To measure this, we will work on the `objectTable_tract` tables, executing the following steps for each patch:

- Apply a signal-to-noise (SNR) cut to select only bright sources. (Default: SNR > 100)
- Select isolated objects based on the "detect_isIsolated" flag.
- Select galaxies and stars based on their "refSizeExtendedness" values.
- Select only galaxies with diameters less than 10 arcsec (based on their moments-based trace sizes).
- Bin the flux error values for (separately) selected bright, isolated stars and galaxies into magnitude bins.
- Calculate the ratio of the median flux errors in each bin for resolved sources (galaxies) vs. unresolved (stars).
- Report summary statistics aggregating the magnitude-binned ratios, and return these statistics (mean, median, stdev, etc. over all magnitude bins for the patch).

Detailed description



Results: plots

```
In [2]: def res_source_patch(objtab, binsize=0.5, magmin=18.0, magmax=28.0, snrcut=100.0):
    """Calculate the ResSource metric for each patch in a tract-level objectTable.

    Parameters
    ----------
    objtab : pandas `DataFrame`
        The objectTable_tract to calculate metrics over.
    binsize : float (default: 0.5)
        Binsize for magnitude bins in which to calculate statistics.
    magmin : 'float' (default: 18.0)
        Minimum magnitude to include in the statistics.
    magmax : 'float' (default: 28.0)
        Maximum magnitude to include in the statistics.
    snrcut : 'float' (default: 100.0)
        Minimum signal-to-noise to include in statistics.

    Returns
    -------
    results_tab : Astropy `Table`
        Table with per-patch statistics for the resolved-to-unresolved flux ratio.
    ....
    # i-band SNR (9-pixel aperture Fluxes):
    snr = objtab['i_ap09Flux'] / objtab['i_ap09FluxErr']

    # Cut down to only objects meeting the SNR cut:
    objtab = objtab[snr < snrcut]
    results_tab = Table()

    for patch in np.unique(objtab['patch']):
        # Extract only the patch of interest:
        objtab_tmp = objtab[objtab['patch'] == patch]

        # Calculate i-band magnitudes:
        img = (objtab_tmp['i_cModelFlux'].values*u.nJy).to(u.ABmag)

        # trace radius from HSM moments
        # 0.168 arcsec/pixel; the 2.0 factor is radius-->diameter
        itrace_diam = 0.168*2.0*np.sqrt((objtab_tmp['shape_xx']) + (objtab_tmp['shape_yy']))/2

        # Pick objects with diameters less than 10 arcsec:
        oksize = (itrace_diam < 10.0)

        # Select isolated objects:
        iso = (objtab_tmp['detect_isIsolated'] > 0.5)
        # Select extended objects:
        gx = (objtab_tmp['refSizeExtendedness'] > 0.6)

        # Extract the flux errors and magnitudes for isolated stars and galaxies:
        flux_err_isostars = objtab_tmp[iso & gx]['i_cModelFluxErr']
        img_isostars = img[iso & gx]

        flux_err_isogx = objtab_tmp[iso & gx & oksize]['i_cModelFluxErr']
        img_isogx = img[iso & gx & oksize]

        # Calculate statistics in magnitude bins for both flux errors:
        bins = np.arange(magmin, magmax, binsize)

        # Use binned_statistic to calculate mean within each bin
        isostars_binned_median = binned_statistic(img_isostars, flux_err_isostars, bins=bins, statistic='median')
        isogx_binned_median = binned_statistic(img_isogx, flux_err_isogx, bins=bins, statistic='median')

        isostars_binned_count = binned_statistic(img_isostars, flux_err_isostars, bins=bins, statistic='count')
        isogx_binned_count = binned_statistic(img_isogx, flux_err_isogx, bins=bins, statistic='count')

        rms = np.sqrt(np.nanmean((isogx_binned_median.statistic/isostars_binned_median.statistic)**2))
        std = np.nanstd(isogx_binned_median.statistic/isostars_binned_median.statistic)
        median = np.nanmedian(isogx_binned_median.statistic/isostars_binned_median.statistic)
        mean = np.nanmean(isogx_binned_median.statistic/isostars_binned_median.statistic)

        if len(results_tab) == 1:
            results_tab['patch'] = [patch]
            results_tab['mean'] = [mean]
            results_tab['median'] = [median]
            results_tab['rms'] = [rms]
            results_tab['std'] = [std]
            results_tab['nstar'] = [np.sum(isostars_binned_count.statistic)]
            results_tab['ngx'] = np.sum(isogx_binned_count.statistic)
        else:
            results_tab.add_row([patch, mean, median, rms, std,
                                np.sum(isostars_binned_count.statistic),
                                np.sum(isogx_binned_count.statistic)])
    return results_tab
```

...now implemented as code

DM Middleware Status

P1a



P1b



P2



Remaining:

- Repository merging, subsetting, upload, layering (working with external hardware), DataUnit update, config dump, storage elision, repos in VOSpace, reading persisted data, metadata merging, Notebook access to batch outputs, remote I/O, EFD queries, metadata association, reading raw images, composite datasets, aliases to catalog selections/queries, publish to microservices, filename invariance, output staging, filter by data quality/config, metadata lookup, provenance

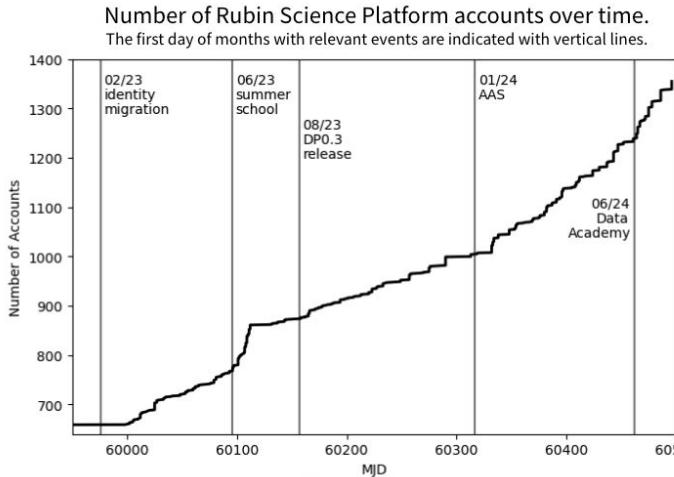


Data Management Verification

DM Science Platform Status

All requirements

- █ Fully Verified: 34/236 (14.4%)
- █ In Verification: 202/236 (85.6%)



Verification on summit using RSP

```

[LVV-T2732] - StarTracker Pointing and
Tracking Test - Slew and Settle - TMA
Tracking Jitter Validation

Requirements:
  • All the MT components should be enabled.
  • Need the notebooks_vandy module installed.

Please, see the README file for the requirements to run this notebook.

Setup
[ ]:
test_case = "LVV-T2732"
test_exec = "LVV-EXXXX"

az_grid = [225, 135, 45, -45]
el_grid = [25, 35, 45, 55, 65, 75]

# 101 - Wide Camera
# 102 - Narrow Camera
# 103 - Fast Camera (DIMM)
camera_sal_indexes = [101, 102, 103]
exposure_times = [5., 4., 6.] # s
base_msg = f"(test_case) {test_exec}:"

number_of_exposures = 3
n_offsets = 5
offset_size = 3.5 # degrees
track_time = 32.

```

Prepare Notebook

Start with importing libraries:



Vera C. Rubin Observatory
Data Management

LDM-503-RSPa: RSP on the Interim
Data Facility (IDF) is ready for DP0.2
Test Plan and Report

Gregory Dubois-Felsmann

DMTR-381

Latest Revision: 2023-01-18



Performance Characterization

Scientific Performance

Science Pipelines releases are accompanied by a Characterization Metric Report that tracks the evolution of the Science Performance Metrics (DMS-REQ-359/360/362, OSS-REQ-0387/0388/0403)

DMTR-431

Characterization Metric Report: Science Pipelines Version 27.0.0

DETAILS

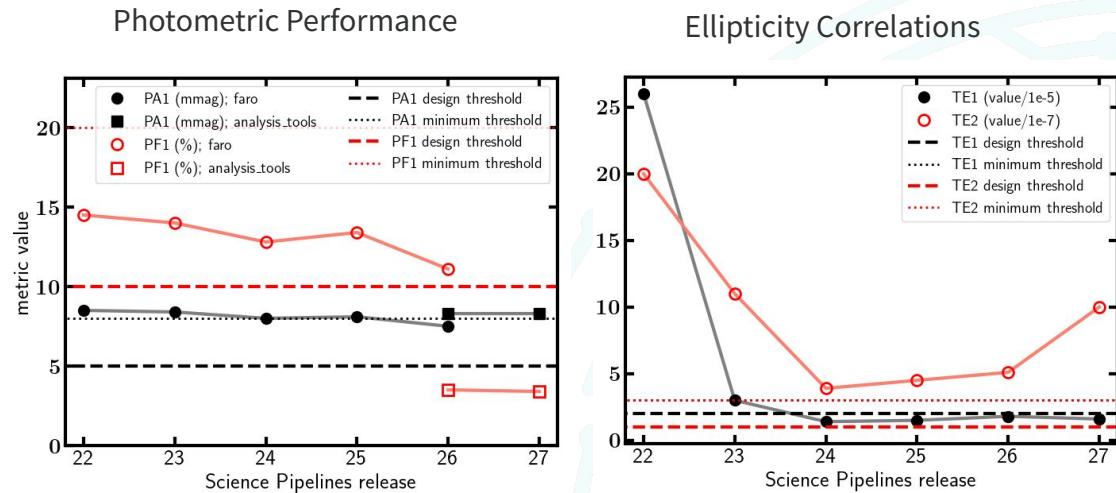
This brief report describes measurements of data quality metrics that were carried out for release v27.0.0 of the LSST Science Pipelines. The report for the previous version can be found in [DMTR-421].

- Jeff Carlin
- Updated 2 months ago (2024-08-08)
- Created 5 months ago (2024-06-05)

DMTR-431 Public <https://github.com/lsst-dm/DMTR-431>

Characterization Metric Report: Science Pipelines Version 27.0.0

TeX 0 ⭐ 0 0 0 1 Updated on Aug 8

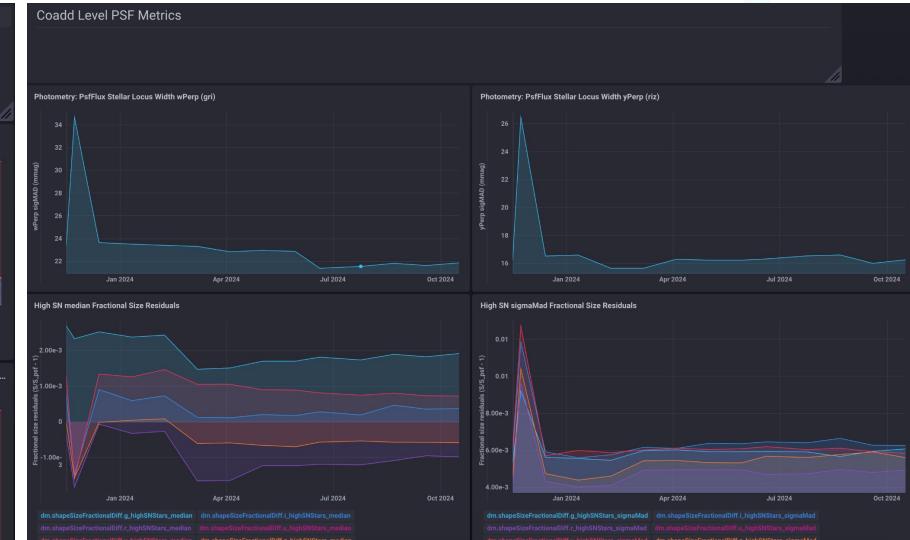
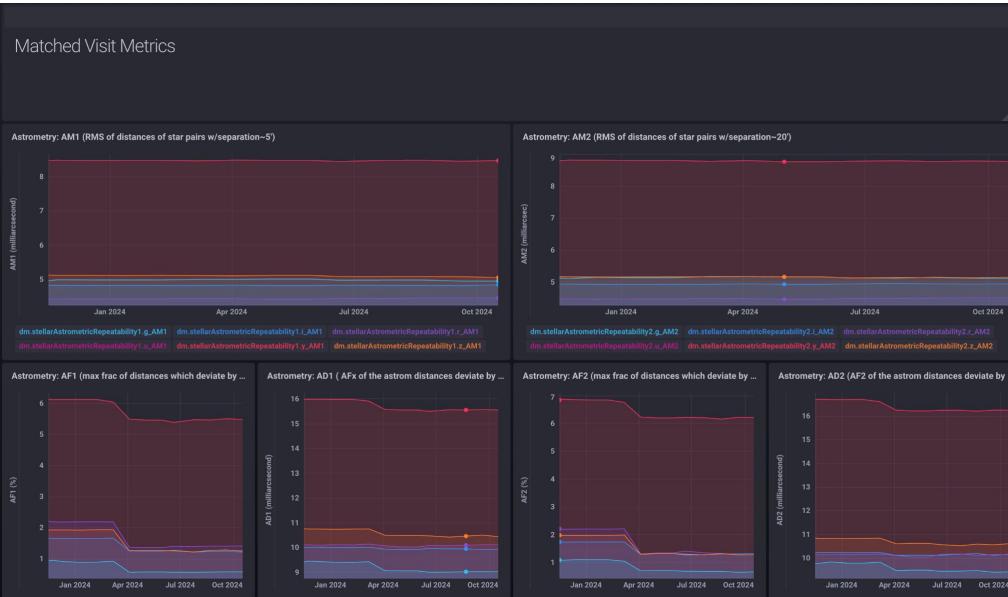


Performance Characterization

Scientific Performance

Science Performance Metrics are measured during monthly reprocessing of a medium-sized dataset, and dispatched to a dashboard for monitoring to identify potential issues.

Matched Visit Metrics



DM Science Validation

- Validation is carried out in parallel to Verification and not just at the end
- DM-SST has carried out studies to assess the performance of the system and propose changes to improve the scientific output during construction
- Data Previews and Early Science Program are providing early feedback on the scientific usability of the DM data products and services by the community so that we can make adjustments and improvements before the survey starts

DM Science Team Studies

- [DMTN-049: A Roadmap to Photometric Redshifts for the LSST Object Catalog](#)
- [DMTN-065: Data Management for LSST Special Programs](#)
- [DMTN-068: Lossy Compression WG Report](#)
- [DMTN-086: Next-to-the-Database Processing Use Cases](#)
- [DMTN-102: LSST Alerts: Key Numbers](#)
- [DMTN-107: Options for Alert Production in LSST Operations Year 1](#)
- [DMTN-155: Interim Model for Community Support](#)
- [DMTN-231: Detection Efficiencies for diaSources.](#)
- [DMTN-248: Options for Alert Packets](#)

Science Validation

Rubin Data Previews

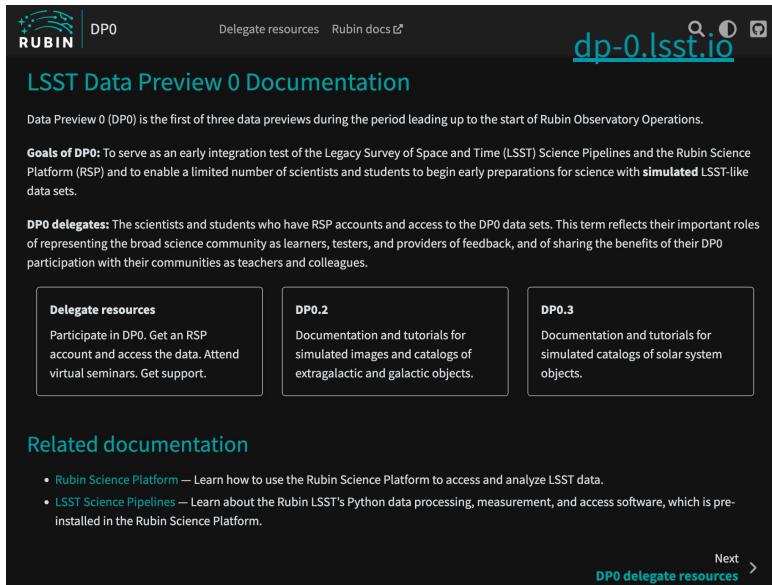
Rubin Observatory Operations will prepare both the community and itself by providing early data for science through a series of shared-risk Data Previews (DPs)

Data Previews lead deliberately to Operations readiness through the systematic addition of data products and users at each stage.

- Three planned Data Previews:
 -  DP0 - based on simulated datasets - **Complete July 2023**
 - DP1 - based on ComCam data - **June 2025**
 - DP2 - Science-grade LSSTCam Commissioning data - **~Mid 2026**
- Two DP0 data sets are currently available via the RSP:
 - DP0.2 - reprocessed DC2 data (dp0-2.lsst.io)
 - DP0.3 - Solar System catalogs (dp0-3.lsst.io)
- Currently supporting hundreds of active RSP users
 - This will ramp up to support all users by start of operations.
 - Space is available; visit dp0.lsst.io to get an RSP account.

Science Validation

Science Platform in Use



RUBIN DPO Delegate resources Rubin docs ↗ dp0.lsst.io

LSST Data Preview 0 Documentation

Data Preview 0 (DPO) is the first of three data previews during the period leading up to the start of Rubin Observatory Operations.

Goals of DPO: To serve as an early integration test of the Legacy Survey of Space and Time (LSST) Science Pipelines and the Rubin Science Platform (RSP) and to enable a limited number of scientists and students to begin early preparations for science with simulated LSST-like data sets.

DPO delegates: The scientists and students who have RSP accounts and access to the DPO data sets. This term reflects their important roles of representing the broad science community as learners, testers, and providers of feedback, and of sharing the benefits of their DPO participation with their communities as teachers and colleagues.

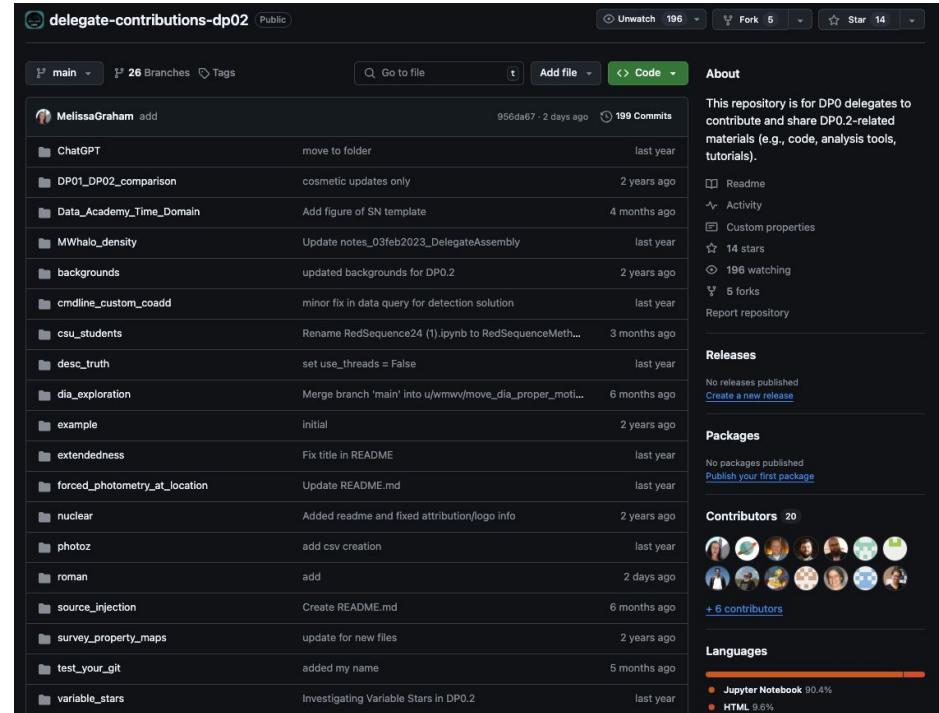
Delegate resources Participate in DPO. Get an RSP account and access the data. Attend virtual seminars. Get support.	DP0.2 Documentation and tutorials for simulated images and catalogs of extragalactic and galactic objects.	DP0.3 Documentation and tutorials for simulated catalogs of solar system objects.
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Related documentation

- Rubin Science Platform — Learn how to use the Rubin Science Platform to access and analyze LSST data.
- LSST Science Pipelines — Learn about the Rubin LSST's Python data processing, measurement, and access software, which is pre-installed in the Rubin Science Platform.

Next >
[DP0 delegate resources](#)

Science Platform in use for the Data Preview Program.
Operations and Community delivered analyses



delegate-contributions-dp02 Public

main 26 Branches Tags Go to file Add file Code

MelissaGraham add move to folder 956da67 - 2 days ago 199 Commits

ChatGPT cosmetic updates only 2 years ago

DP01_DP02_comparison Add figure of SN template 4 months ago

Data_Academy_Time_Domain Update notes_03feb2023_DelegateAssembly last year

MWhalo_density updated backgrounds for DP0.2 2 years ago

backgrounds minor fix in data query for detection solution last year

cmdline_custom_coadd Rename RedSequence24 (1).ipynb to RedSequenceMeth... 3 months ago

csu_students set use_threads = False last year

desc_truth Merge branch 'main' into u/wmwv/move_dia_proper_moti... 6 months ago

dia_exploration initial 2 years ago

example Fix title in README last year

extendedness Update README.md last year

forced_photometry_at_location Added readme and fixed attribution/logo info 2 years ago

nuclear add csv creation last year

photoz add 2 days ago

roman Create README.md 6 months ago

source_injection update for new files 2 years ago

survey_property_maps added my name 5 months ago

test_your_git Investigating Variable Stars in DP0.2 last year

variable_stars

About This repository is for DPO delegates to contribute and share DP0.2-related materials (e.g., code, analysis tools, tutorials).

Readme Activity Custom properties 14 stars 196 watching 5 forks Report repository

Releases No releases published Create a new release

Packages No packages published Publish your first package

Contributors 20 + 6 contributors

Languages Jupyter Notebook 90.4% HTML 9.6%

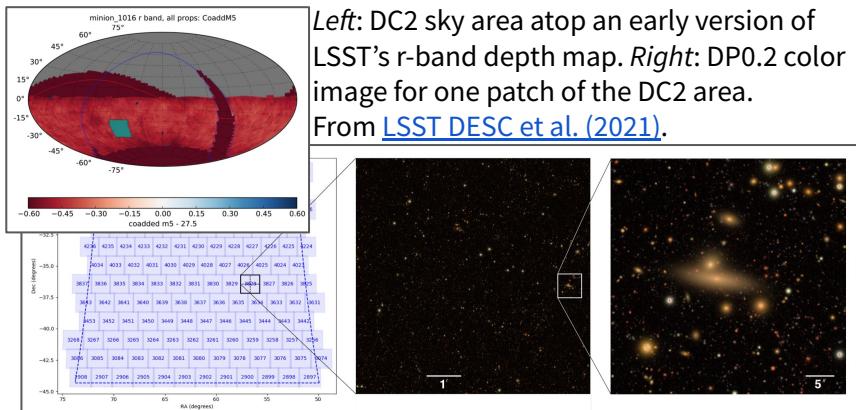
Science Validation

Data Previews Support Community Science

Simulated data in the same format - and made accessible via the same tools - as the future real data, to help scientists prepare.

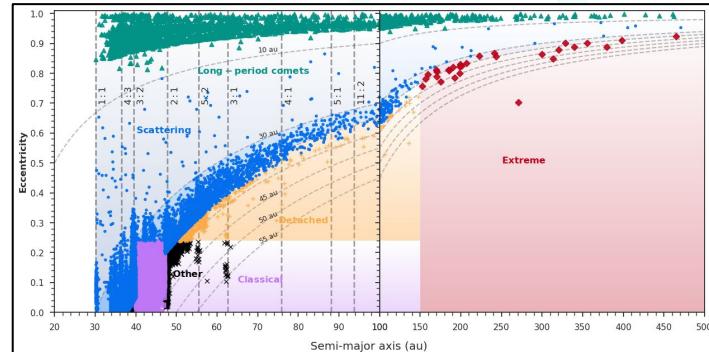
DP0.2: Galactic & extragalactic dataset

- Simulated LSST-like images (300 deg², 5 years) from the DESC's Data Challenge 2 (DC2; [arXiv:2101.04855](https://arxiv.org/abs/2101.04855)) includes clusters, galaxies, SNIa, and stars (10% variable).
- Processed visit (PVIs), coadded, and difference images.
- Catalogs of SNR>5 detections and forced photometry.



DP0.3: Solar System dataset

- Simulated LSST-like catalogs for moving objects includes Solar System objects and interstellar objects.
- Catalogs are simulated at 1 and 10 years of the LSST.
- Catalog data products include LSST detections and derived orbital elements.



Above: Recreation of Figure 8 from [Bernardinelli et al. \(2022\)](#) with DP0.3.



Performance Characterization

Community Science Performance - DP0

Over 50 Rubin scientists gave flash talks for DP0.1 or DP0.2; these are just a few of their slides.