



LARGE SYNOPTIC SURVEY TELESCOPE

Large Synoptic Survey Telescope (LSST)

# As-is HSC Reprocessing

Hsin-Fang Chiang, Margaret W. G. Johnson

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## Abstract

This document summarizes the status and procedures of the HSC data reprocessing campaigns done by LDF as of early Fall 2018 cycle.



## Change Record

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1	YYY-MM-DD	Unreleased.	Hsin-Fang Chiang



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# As-is HSC Reprocessing

In this document, we summarize the current status and operational processes of the Hyper Suprime-Cam (HSC) data reprocessing campaigns offered by the LSST Data Facility (LDF) as part of the Batch Production Services. We describe the service as is in the early Fall 2018 cycle, but expect the detailed procedures to evolve with the continuing development and the maturing service.

## 1 Goals

The main goal of reprocessing HSC data using LSST Science Pipelines is to generate a validation dataset for tests and integration, both scientifically and operationally, and to regularly scrutinize for any data or science issues. Besides allowing to track any quality or performance changes as the pipeline evolves, the processed dataset serves as a base set of data products with which the developers can test a specific component of the science pipelines without the need to reprocess from raw files, or to test a new tool using state-of-the-art data products.

Additionally, the reprocessing helps to stress and validate the infrastructure (both software and hardware) with current science payload, to provide feedback on operational feasibility of all current aspects of the system in use, to explore possible operational strategies, and to mature the policies and procedures of the Batch Processing Service.

Currently, the HSC reprocessing campaigns are performed at two scales: (1) the RC scale, and (2) the PDR1 scale; more details are described in §2 and §3. Recent releases of the Data Release Production (DRP) pipelines are used. In general, campaigns are characterized by their goals, inputs (data, calibrations, codes, and configurations), and cadence.

## 2 RC-scale reprocessing

The input data are the HSC “RC2” dataset, which includes 3 tracts of public data and was selected to cover a wide range of data quality and observing conditions (DM-11345). It contains about 8% of the full HSC PDR1 dataset (§3).

A calendar-based schedule is used to run a “mini-DRP” with this RC2 dataset once every two weeks. This repeated reprocessing allows continuous testing and validation of Data Release Production algorithms.

Even-number weekly stack releases, provided automatically by the LSST DM Build system and installed by John Swinbank in the designated software area on the LSST GPFS (/software), are utilized. To prepare each campaign, the operations staff (1) verifies the software release was successfully built and installed on GPFS, (2) verifies the continuous integration package `ci_hsc` can run successfully, (3) evaluates changes to the stack release compared to the last campaign, and (4) confirms resource availability on LSST batch cluster and storage. Unless otherwise agreed between the DRP and LDF teams before launching the campaign, the default algorithmic configurations are used for the pipelines, as specified in the config files or source codes in the software stack.

Currently a mini-DRP workflow includes the following top-level pipelines: `makeSkyMap.py`, `singleFrameDriver.py`, `mosaic.py`, `skyCorrection.py`, `coaddDriver.py`, and `multiBandDriver.py`. Most frontend codes exist in the `pipe_drivers` package and are based on the `ctrl_pool`-style framework. We intend to move away from the `ctrl_pool`-style framework and work towards a production system; however, the transition is blocked by the Gen3 Butler/Middleware delivery and conversion of pipelines to the new middleware framework.

To monitor and verify if runs are successful, the job status and output data products are checked. Failures are characterized and handled as described in §4.

Generated data products include single frame processing products, coaddition products, and multiband products, and, upon successful completion of a campaign, are made available through the LSST developer infrastructure at NCSA. For HSC processing campaigns, LDF currently manages derived datasets as a site file system; individuals files are managed by users. When we transition to formal production processing of LSST data, LDF will be responsible for managing the location, metadata and provenance records of each file, and production data will be centrally managed in the Data Backbone. Results of the four most recent successful runs are retained. Datasets are disposed of after they are superseded by the next campaign.

Currently, though temporarily, some QC/QA prototype pipelines from the `pipe_analysis` and `validate_drp` packages are included in the biweekly runs. The `pipe_analysis` package is not in the official stack of `lsst_distrib` and was not designed to be included in the official stack

in the first place; however, its outputs are essential for pipeline development and QA work (DMTN-074) and no replacement is available yet at time of writing. Neither `pipe_analysis` nor `validate_drp` follow the standard `pipe_base` `CmdLineTask` framework or the standard Butler usage for data IO.

How these QC/QA packages will evolve in the long term is a subject of discussions in DMLT and the QA working group (LDM-622, RFC-476). When the DM-wide QC/QA plans are clarified, we will run only the QC/QA packages blessed officially. Before such a plan exists and the packages are standardized, the operations staff will work closely with the specific pipeline owners (Table 1) for emergent issues, and remove problematic QC/QA pipelines from the campaign as necessary (also see §4). As QC output products are not as well-defined, the operations staff does not track down individual outputs until the official products are formally defined and documented, and consider the jobs done as long as no fatal errors appear. In the short term, adding automatic CI tests for any QC pipelines, such as running `pipe_analysis` in the `ci_hsc` package, can reduce obvious breakages.

### 3 PDR1-scale reprocessing

On a per request basis and as deemed necessary, LDF reprocesses the full HSC PDR1 (Public Data Release 1<sup>1</sup>) dataset with a up-to-date DRP workflow and a recent software stack. The reprocessing campaign happens approximately annually. This dataset includes 5654 raw visits in 7 bands and 3 layers (WIDE, DEEP, UDEEP). This covers 119 tracts in the sky.

With the input  $\sim 13$  times larger than the RC2 dataset, the PDR1-scale reprocessing helps identifying edge cases and bugs that do not appear in the small dataset. Developers needing more than a few tracts of data for testing algorithms also use the large processed dataset. The processed dataset is also potentially useful for PDAC testing, EPO development, or science verification activities by the commissioning team.

Software version, configurations, and other processing details that affect the scientific output products are decided between the DRP and LDF teams before the start of the run. A RC-scale run with the same setup precedes the PDR1-scale run to integrate and verify the components and configurations are nominally ready for bulk processing. Outputs of the RC-scale run allows QA work and important bug fixes before effort is spent in the large campaign. Typically,

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<sup>1</sup><https://hsc-release.mtk.nao.ac.jp/>

a few iterations are involved before the software is finalized and “frozen” for the processing campaign.

Procedures for monitoring and verifying these larger campaigns are similar to the biweekly campaigns. During the campaign, some computing and storage resources are reserved for the campaign use. Completion of these larger campaigns is announced on the LSST Community forum for broader consumption beyond the DM team. The output data products are protected against changes or disasters. Results of the two most recent successful runs are retained. Old data products are disposed before the third campaign starts.

## 4 As-is mitigation procedures in irregular scenarios

Sometimes, things don’t go as smoothly as hoped. Here we describe some common scenarios and the as-is procedures for handling the problems.

- **Weekly release is not available in the shared stack at /software: wait patiently**

If a weekly stack is not released or tagged in eups, I wait quietly; usually Josh Hoblitt (SQuaRE) would be already aware and working on it. If the weekly release has been eups-tagged successfully but the installation in the /software shared stack fails, I notify John Swinbank. Currently the LDF team is investigating using Singularity containers for the science payload; this would break the current dependency on shared stack installation.

- **Failures in building the non-official packages: file a JIRA ticket**

Until 2018-03-31, two packages, `meas_mosaic` and `pipe_analysis`, needed to be updated and built manually. If they cannot be built, for example because the unit tests of `meas_mosaic` failed, a ticket will be filed so the DRP team can fix it. Meanwhile the first processing step which does not need `meas_mosaic` could start. Since `w_2018_13`, `meas_mosaic` has been added to be part of the `lsst_distrib` weekly release. So only one package, `pipe_analysis`, needs special care.

- **Operator user errors: operator’s responsibility**

The DRP workflow in the current system implies a science workflow and there are implicit dependencies in job execution. Currently, this level of workflow is taken care of by the operator manually. If the implicit workflow is not respected, necessary inputs of



a job may not be available, so the output products would not be produced correctly, possibly without clear errors in the execution logs. It's the operator's responsibility to shepherd the workflow. Other operator errors include specifying output location improperly, overwriting files incorrectly, operator-introduced race condition, and so on. Some operations require knowledge in Butler and task framework implementations so misunderstanding of the framework can lead to mistakes as well. Many of these errors can be minimized once a real production system, including file management, is in use. The pipeline specification definition is also a design goal of the Gen3 Middleware.

- **Transient failures of the processing jobs due to hardware issues: LDF handles it**

Hardware or network glitches such as temporary file system unavailability or a faulty node can fail jobs. The operator contacts the infrastructure team and creates IHS tickets as needed. Once the system is back to stable, the same job will be re-submitted. Choosing the operational setup wisely is operator's responsibility. For example, inferior specifications in computing resource need can lead to insufficient memory, timeout, job lingering forever, or other problems.

- **Reproducible fatal errors from the pipeline: report, apply fix if available quickly**

Occasionally, the weekly stack is broken and does not allow the job to finish. The operations staff will verify if the failure is reproducible, and report to the Slack channel #dm-hsc-reprocessing for the DRP team or the specific pipeline owners (Table 1) to respond. Jira tickets containing the error messages will be filed, and the operations staff can then choose to abort the part of the campaign that depend on the data from the failed pipelines. Sometimes the bug is obvious, such as one from recent API changes or new features not caught by the standard CI tools; in this case a fix can be available quickly especially with the help of the developer who added the new feature. If a fix is available within a day, the operations staff may continue the execution using a new software version with the fix applied. If the fix is not available shortly, the operations staff may pause or cancel the campaign. (At the time of writing, no biweekly campaign has been aborted so far despite the occasional fatal bugs; developers have been helpful.)

- **Reproducible non-fatal errors from the pipeline: carry on without changes**

Errors that are not in the FATAL-level do not stop the execution. Processing continue with the same software. Currently some harmless errors appear in the logs and not all errors are carefully vetted. Only severe errors that prevent further execution of the pipelines stop a processing campaign, despite the outputs may or may not be scientifically useful. In the future, the formal QC pipelines will be helpful to provide scientific metrics of the



data products during the campaign execution, and may provide additional feedbacks on whether a campaign needs to be paused or specific inputs need to be removed. Currently, only QC metrics from the single frame processing are uploaded to the SQuaSH dashboard <sup>2</sup>; further QC metrics will be calculated and uploaded once the responsible pipelines are ready.

## A Current Science Pipelines Payload

In Table 1, we list the pipelines currently included in the biweekly campaigns (§2) and their corresponding contacts. The contact may delegate the debugging responsibility to other team members.

TABLE 1: Pipelines currently included in biweekly RC reprocessing

<b>package</b>	<b>pipeline</b>	<b>contact</b>
pipe_tasks	makeSkyMap.py	Jim Bosch
pipe_drivers	singleFrameDriver.py	Jim Bosch
pipe_drivers	skyCorrection.py	Jim Bosch
meas_mosaic	mosaic.py	Jim Bosch
pipe_drivers	coaddDriver.py	Jim Bosch
pipe_drivers	multiBandDriver.py	Jim Bosch
pipe_analysis	visitAnalysis.py	Lauren MacArthur
pipe_analysis	coaddAnalysis.py	Lauren MacArthur
pipe_analysis	colorAnalysis.py	Lauren MacArthur
pipe_analysis	compareVisitAnalysis.py	Lauren MacArthur
pipe_analysis	compareCoaddAnalysis.py	Lauren MacArthur
validate_drp	matchedVisitMetrics.py	Michael Wood-Vasey
validate_drp	validateDrp.py	Michael Wood-Vasey
validate_drp	reportPerformance.py	Michael Wood-Vasey
verify	dispatch_verify.py	Angelo Fausti

## B Stack environment variables

An example of the environment variables set up for running a HSC RC reprocessing is below.

<sup>2</sup>The metrics are uploaded to <https://squash.lsst.codes> using the `dispatch_verify.py` tool as listed in Table 1.

```
AFW_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/afw/16.0-31-gd4f69
APR_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/apr/1.5.2
APR_UTIL_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/apr_util/1.5
ASTROMETRY_NET_DATA_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/astrometry-net-data
ASTROMETRY_NET_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/astrometry-net
ASTROPY_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/astropy/2.0.1+
ASTSHIM_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/astshim/16.0-2
BASE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/base/16.0-3-g8e51
BOOST_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/boost/1.68
CFITSIO_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/cfitsio/3360.1
CMAKE_PREFIX_PATH=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pybind11
COADD_CHISQUARED_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/coadd_chisquared
COADD_UTILS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/coadd_utils
CP_PIPE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/cp_pipe/16.0+3
CTRL_EXECUTE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/ctrl_execute
CTRL_ORCA_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/ctrl_orca/16
CTRL_PLATFORM_LSSTVC_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/ctrl_platform_lsstvc
CTRL_POOL_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/ctrl_pool/16
DAF_BASE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/daf_base/16.0
DAF_BUTLER_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/daf_butler/
DAF_PERSISTENCE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/daf_persistence
DATASET=HSC RC2
DATASET_REPO_URL=https://jira.lsstcorp.org/browse/DM-11345
DISPLAY=localhost:17.0
DISPLAY_DS9_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/display_ds9
DISPLAY_FIREFLY_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/display_firefly
DISPLAY_MATPLOTLIB_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/display_matplotlib
DOXYGEN_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/doxygen/1.8.13
DYLD_LIBRARY_PATH=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/meas_mos
EIGEN_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/eigen/3.3.4.lsst
ESUTIL_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/esutil/0.6.2.5.
EUPS_DIR=/software/lsstsw/stack/eups/2.1.4
EUPS_PATH=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
EUPS_PKGR00T=https://eups.lsst.codes/stack/src
EUPS_SHELL=sh
FFTW_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/fftw/3.3.4.lsst2
```

```
FIREFLY_CLIENT_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/firefly
FLAKE8_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/flake8/3.5.0+8
GALSIM_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/galsim/1.6.0.ls
GEOM_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/geom/16.0-8-g8069
GSL_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/gsl/2.4
HEALPY_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/healpy/1.10.3.1
HISTCONTROL=ignoredups
HISTSIZE=1000
INFOPATH=/opt/rh/devtoolset-6/root/usr/share/info
IP_DIFFIM_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/ip_diffim/16
IP_ISR_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/ip_isr/16.0-7-g
JOINTCAL_CHOLMOD_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/joint
JOINTCAL_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/jointcal/16.0
LANG=en_US.UTF-8
LD_LIBRARY_PATH=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/meas_mosai
LESSOPEN=||/usr/bin/lesspipe.sh %s
LIBYAML_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/libyaml/0.1.7
LMFIT_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/lmfit/0.9.3+8
LOG4CXX_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/log4cxx/0.10.0
LOG_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/log/16.0-1-gce273f
LSST_APPS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/lsst_apps/14
LSST_DISTRIB_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/lsst_dist
LSST_LIBRARY_PATH=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/meas_mos
LSST_OBS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/lsst_obs/15.0
LS_COLORS=rs=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33;01:cd=40;33;01:or=40;31;
MANPATH=/opt/rh/devtoolset-6/root/usr/share/man::/opt/puppetlabs/puppet/share/man
MATPLOTLIB_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/matplotlib/
MEAS_ALGORITHMS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/meas_a
MEAS_Astrom_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/meas_astro
MEAS_BASE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/meas_base/16
MEAS_DEBLENDER_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/meas_de
MEAS_EXTENSIONS_ASTROMETRYNET_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/
MEAS_EXTENSIONS_CONVOLVED_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linu
MEAS_EXTENSIONS_PHOTOMETRYKRON_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
MEAS_EXTENSIONS_PSFEX_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/
MEAS_EXTENSIONS_SHAPEHSM_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux
```

```
MEAS_EXTENSIONS_SIMPLESHAPE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Li
MEAS_MODELFIT_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/meas_mod
MEAS_MOSAIC_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/meas_mosai
MINUIT2_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/minuit2/5.34.1
MPI4PY_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/mmpi4py/2.0.0+6
MPICH_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/mpich/3.2.1
MPI_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/mmpi/0.0.1+3
NDARRAY_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/ndarray/1.5.1.
NUMPY_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/numpy/1.13.1+2
OBS_BASE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/obs_base/16.0
OBS_CFHT_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/obs_cfht/16.0
OBS_COMCAM_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/obs_comCam/
OBS_CTI00M9_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/obs_ctio0m
OBS_DECAM_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/obs_decam/16
OBS_LSSTSIM_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/obs_lsstSi
OBS_MONOCAM_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/obs_monoca
OBS_SDSS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/obs_sdss/16.0
OBS_SUBARU_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/obs_subaru/
OBS_TEST_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/obs_test/16.0
OMP_NUM_THREADS=1
PATH=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/meas_mosaic/16.0-10-g
PCP_DIR=/opt/rh/devtoolset-6/root
PEP8_NAMING_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pep8_namin
PERL5LIB=/opt/rh/devtoolset-6/root/usr/lib64/perl5/vendor_perl:/opt/rh/devtoolset-6/root/usr/lib/p
PEX_CONFIG_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pex_config/
PEX_EXCEPTIONS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pex_exc
PEX_POLICY_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pex_policy/
PIPE_BASE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pipe_base/16
PIPE_DRIVERS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pipe_driv
PIPE_TASKS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pipe_tasks/
PROXMIN_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/proxmin/lsst-d
PSFEX_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/psfex/16.0+4
PYBIND11_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pybind11/2.2.
PYCODESTYLE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pycodestyl
PYFLAKES_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pyflakes/1.6.
PYKG_CONFIG_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pykg_conf
```

```
PYTEST_COV_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pytest_cov/
PYTEST_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pytest/3.2.0.ls
PYTEST_FLAKE8_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pytest_f
PYTEST_FORKED_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pytest_f
PYTEST_SESSION2FILE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/py
PYTEST_XDIST_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pytest_xd
PYTHONPATH=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/meas_mosaic/16.
PYTHON_COVERAGE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/python
PYTHON_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/python/0.0.8
PYTHON_EXECNET_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/python_
PYTHON_FUTURE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/python_f
PYTHON_MCCABE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/python_m
PYTHON_PSUTIL_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/python_p
PYYAML_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/pyyaml/3.13
QT_GRAPHICSSYSTEM_CHECKED=1
REQUESTS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/requests/2.9.
RUN_ID=DM-15517
RUN_ID_URL=https://jira.lsstcorp.org/browse/DM-15517
SCARLET_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/scarlet/lsst-d
SCIPY_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/scipy/0.0.1.lsst
SCONSUTILS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/sconsUtils/
SCONS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/scons/3.0.0.lsst
SETUP_AFW=afw 16.0-31-gd4f695684 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3
SETUP_APR=apr 1.5.2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_APR_UTIL=apr_util 1.5.4 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21
SETUP_Astrometry_NET=astrometry_net 0.67.123ff3e.lsst1+8 -f Linux64 -Z /software/lsstsw/stack3_20171
SETUP_Astrometry_NET_DATA=astrometry_net_data 8.0.0.0+40 -f Linux64 -Z /software/lsstsw/stack3_20171
SETUP_Astropy=astropy 2.0.1+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21
SETUP_Astshim=astshim 16.0-2-g0febb12+5 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/minicon
SETUP_BASE=base 16.0-3-g8e51203 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.
SETUP_BOOST=boost 1.68 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa
SETUP_Cfitsio=cfitsio 3360.lsst5 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3
SETUP_COADD_CHISQUARED=coadd_chisquared 16.0-2-g839ba83+22 -f Linux64 -Z /software/lsstsw/stack3_201
SETUP_COADD_UTILS=coadd_utils 16.0-4-g8a0f11a+6 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack
SETUP_CP_PIPE=cp_pipe 16.0+32 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21
SETUP_CTRL_EXECUTE=ctrl_execute 15.0+34 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/minicon
```



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SETUP_CTRL_ORCA=ctrl_orca 16.0-1-g9633d82+9 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_CTRL_PLATFORM_LSSTVC=ctrl_platform_lsstvc 15.0+34 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_CTRL_POOL=ctrl_pool 16.0-1-g14407aa+17 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_DAF_BASE=daf_base 16.0-4-g50d071e+6 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_DAF_BUTLER=daf_butler master-gde6ace3019 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_DAF_PERSISTENCE=daf_persistence 16.0-3-g3806c63+6 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_DISPLAY_DS9=display_ds9 16.0-2-g9d5294e+16 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_DISPLAY_FIREFLY=display_firefly 16.0-4-g03cf288+5 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_DISPLAY_MATPLOTLIB=display_matplotlib 16.0-3-gcfd6c53+14 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_DOXYGEN=doxygen 1.8.13.lsst2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_EIGEN=eigen 3.3.4.lsst1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_ESUTIL=esutil 0.6.2.5.lsst1+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_EUPS=eups LOCAL:/software/lsstsw/stack/eups/2.1.4 -f (none) -Z (none)
SETUP_FFTW=fftw 3.3.4.lsst2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_FIREFLY_CLIENT=firefly_client lsst-dev-gd3d76961fa -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_FLAKE8=flake8 3.5.0+8 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_GALSIM=galsim 1.6.0.lsst2-1-gd5e7736+1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_GEOM=geom 16.0-8-g80699e5+1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_GSL=gsl 2.4 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_HEALPY=healpy 1.10.3.lsst1+6 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_IP_DIFFIM=ip_diffim 16.0-8-g4aca173+17 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_IP_ISR=ip_isr 16.0-7-g2c7e7ec+8 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_JOINTCAL=jointcal 16.0-15-g8e16a51+1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_JOINTCAL_CHOLMOD=jointcal_cholmod master-g48cb81d145+44 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_LIBYAML=libyaml 0.1.7 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_LMFIT=lmfit 0.9.3+8 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_LOG4CXX=log4cxx 0.10.0.lsst7 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_LOG=log 16.0-1-gce273f5+6 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_LSST_APPS=lsst_apps 14.0+178 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_LSST_DISTRIB=lsst_distrib 16.0+41 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_LSST_OBS=lsst_obs 15.0+99 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_MATPLOTLIB=matplotlib 2.0.2+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_MEAS_ALGORITHMS=meas_algorithms 16.0-13-g0fce7516+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_MEAS_ASTROM=meas_astrom 16.0-10-g7547e25+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_MEAS_BASE=meas_base 16.0-11-gf9130ea+15 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_MEAS_DEBLENDER=meas_deblender 16.0-7-g37292d5+6 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
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SETUP_MEAS_EXTENSIONS_ASTROMETRYNET=meas_extensions_astrometryNet 16.0-4-g347813e+16 -f Linux64 -Z /
SETUP_MEAS_EXTENSIONS_CONVOLVED=meas_extensions_convolved 16.0-3-ga36a39f+6 -f Linux64 -Z /software/
SETUP_MEAS_EXTENSIONS_PHOTOMETRYKRON=meas_extensions_photometryKron 16.0-4-ga5d8928+6 -f Linux64 -Z /
SETUP_MEAS_EXTENSIONS_PSFEX=meas_extensions_psfex 16.0-8-gc315727+6 -f Linux64 -Z /software/lsstsw/s
SETUP_MEAS_EXTENSIONS_SHAPEHSM=meas_extensions_shapeHSM 16.0-5-g3a22acd+6 -f Linux64 -Z /software/ls
SETUP_MEAS_EXTENSIONS_SIMPLESHAPE=meas_extensions_simpleShape 16.0-5-gb3f8a4b+16 -f Linux64 -Z /soft
SETUP_MEAS_MODELFIT=meas_modelfit 16.0-11-gce733cf+7 -f Linux64 -Z /software/lsstsw/stack3_20171023/
SETUP_MEAS_MOSAIC=meas_mosaic 16.0-10-g3775aa7+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stac
SETUP_MINUIT2=minuit2 5.34.14 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21
SETUP_MPI4PY=mpi4py 2.0.0+6 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-1
SETUP_MPI=mpi 0.0.1+3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6
SETUP_MPICH=mpich 3.2.1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4f
SETUP_NDARRAY=ndarray 1.5.1.lsst1+5 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-
SETUP_NUMPY=numpy 1.13.1+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10
SETUP_OBS_BASE=obs_base 16.0-11-gfbb8ea7 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/minico
SETUP_OBS_CFHT=obs_cfht 16.0-2-gd82908a+30 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/mini
SETUP_OBS_COMCAM=obs_comCam 16.0-2-gea03357+1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/m
SETUP_OBS_CTIO0M9=obs_ctio0m9 16.0-1-g3247260+33 -f Linux64 -Z /software/lsstsw/stack3_20171023/stac
SETUP_OBS_DECAM=obs_decam 16.0-4-gb463f2d+17 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/mi
SETUP_OBS_LSSTSIM=obs_lsstSim 16.0-4-g7986501+19 -f Linux64 -Z /software/lsstsw/stack3_20171023/stac
SETUP_OBS_MONOCAM=obs_monocam 16.0-2-g379f3ce+11 -f Linux64 -Z /software/lsstsw/stack3_20171023/stac
SETUP_OBS_SDSS=obs_sdss 16.0-3-g44ea68f+31 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/mini
SETUP_OBS_SUBARU=obs_subaru 16.0-20-gb58d072b -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/m
SETUP_OBS_TEST=obs_test 16.0-4-ge3254b7+8 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/minic
SETUP_PEP8_NAMING=pep8_naming 0.4.1+3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda
SETUP_PEX_CONFIG=pex_config 16.0-3-g9645794+3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/m
SETUP_PEX_EXCEPTIONS=pex_exceptions 16.0-2-gf4e7cdd+3 -f Linux64 -Z /software/lsstsw/stack3_20171023
SETUP_PEX_POLICY=pex_policy 16.0-2-gf41ba6b+3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/m
SETUP_PIPE_BASE=pipe_base 16.0-11-g9fe0e56+7 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/mi
SETUP_PIPE_DRIVERS=pipe_drivers 16.0-4-g17aef3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack
SETUP_PIPE_TASKS=pipe_tasks 16.0-12-g85846a17 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/m
SETUP_PROXMIN=proxmin lsst-dev-g87d7c0f1bb -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/mini
SETUP_PSFEX=psfex 16.0+4 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4
SETUP_PYBIND11=pybind11 2.2.3.lsst1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-
SETUP_PYCODESTYLE=pycodestyle 2.3.1+3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda
SETUP_PYFLAKES=pyflakes 1.6.0+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.
```



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SETUP_PYKG_CONFIG=pykg_config 1.3.0+4 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda
SETUP_PYTEST=pytest 3.2.0.lsst4+1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.
SETUP_PYTEST_COV=pytest_cov 2.5.1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4
SETUP_PYTEST_FLAKE8=pytest_flake8 0.9.1+8 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/minic
SETUP_PYTEST_FORKED=pytest_forked 0.2.lsst4+1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/m
SETUP_PYTEST_SESSION2FILE=pytest_session2file 0.1.9+9 -f Linux64 -Z /software/lsstsw/stack3_20171023
SETUP_PYTEST_XDIST=pytest_xdist 1.20.1.lsst4+1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/
SETUP_PYTHON=python 0.0.8 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a
SETUP_PYTHON_COVERAGE=python_coverage 4.5.1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/min
SETUP_PYTHON_EXECNET=python_execnet 1.4.1.lsst4+1 -f Linux64 -Z /software/lsstsw/stack3_20171023/sta
SETUP_PYTHON_FUTURE=python_future 0.16.0+3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/mini
SETUP_PYTHON_MCCABE=python_mccabe 0.6.1+9 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/minic
SETUP_PYTHON_PSUTIL=python_psutil 5.4.3+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/minic
SETUP_PYYAML=pyyaml 3.13 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4
SETUP_REQUESTS=requests 2.9.1.lsst1+4 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda
SETUP_SCARLET=scarlet lsst-dev-gfdfbe1c240+1 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/mi
SETUP_SCIPY=scipy 0.0.1.lsst1+7 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.
SETUP_SCONS=scons 3.0.0.lsst1+3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.
SETUP_SCONSUTILS=sconsUtils 16.0-5-ga6f992e -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/min
SETUP_SHAPELET=shapelet 16.0-6-gf0acd13+8 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/minic
SETUP_SKYMAP=skymap 16.0-3-g6923fb6+9 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda
SETUP_SPHGEOM=sphgeom 16.0-4-g5f3a788+5 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/minicon
SETUP_SQLALCHEMY=sqlalchemy 1.2.2+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-
SETUP_STARLINK_AST=starlink_ast lsst-dev-gd6cc4e835a -f Linux64 -Z /software/lsstsw/stack3_20171023/
SETUP_SYNPIPE=synpipe 16.0-4-g7690030+17 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/minico
SETUP_TMV=tmv 0.73.lsst2+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10
SETUP_TREECORR=trecorr 3.2.3.lsst3+3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda
SETUP_UTILS=utils 16.0-6-g3610b4f+3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-
SETUP_VALIDATE_DRP=validate_drp 16.0-9-gf51232b+6 -f Linux64 -Z /software/lsstsw/stack3_20171023/sta
SETUP_VERIFY=verify 16.0-1-g0ee5b77+6 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda
SETUP_VERIFY_METRICS=verify_metrics 16.0-2-g16e3d1c+3 -f Linux64 -Z /software/lsstsw/stack3_20171023
SETUP_WCSLIB=wcslib 5.13.lsst1+2 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3
SETUP_WS4PY=ws4py 0.4.2+3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a
SETUP_XPA=xpa 2.1.15.lsst3 -f Linux64 -Z /software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10
SHAPELET_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/shapelet/16.0
SKYMAP_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/skymap/16.0-3-g
```

```
SPHGEOM_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/sphgeom/16.0-4
SQLALCHEMY_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/sqlalchemy/
SQUASH_USER=nobody
SQUASH_password=
STARLINK_AST_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/starlink_
SYNPIPE_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/synpipe/16.0-4
TMV_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/tmv/0.73.lsst2+2
TREECORR_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/treecorr/3.2.
UTILS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/utils/16.0-6-g36
VALIDATE_DRP_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/validate_
VERIFY_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/verify/16.0-1-g
VERIFY_METRICS_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/verify_
VERSION_TAG=w_2018_34
WCSLIB_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/wcslib/5.13.lsst
WS4PY_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/ws4py/0.4.2+3
XDG_RUNTIME_DIR=/run/user/34076
XDG_SESSION_ID=56101
XPA_DIR=/software/lsstsw/stack3_20171023/stack/miniconda3-4.3.21-10a4fa6/Linux64/xpa/2.1.15.lsst3
X_SCLS=devtoolset-6
```

## References

- [DMTN-074]**, Swinbank, J., 2018, *DM QA Status & Plans*, DMTN-074, URL <https://dmtn-074.lsst.io>,  
LSST Data Management Technical Note
- [LDM-622]**, Swinbank, J., 2018, *Data Management QA Strategy Working Group Charge*, LDM-622,  
URL <https://ls.st/LDM-622>