

Data Release Production WIP F16 Release Notes



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These *draft* notes cover the major updates made by Data Release Production to the LSST stack since release 12 (Winter/Extra 2016). Please add material here which should ultimately be incorporated into the notes accompanying the Fall 2016 release.

Major Functionality and Interface Changes

Add a measurement extension which performs Kron photometry

The KronFluxAlgorithm measures the flux in an elliptical aperture as defined by [Kron \(1980\)](#). The plugin is not enabled by default, but may be switched on by requesting `ext_photometryKron_KronFlux` in measurement configuration.



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Package version tracking and checking ("stack provenance")

A package version tracking and checking capability has been included in the stack and integrated with the `CmdLineTask` system. This keeps track of what versions of packages are being used in order to prevent the user from unwittingly processing data with multiple, subtly different, versions of the code. This provides a provisional implementation of a provenance tracking system: it is essential for short-term use, but will be rendered obsolete before we move to operations. A [more detailed description](#) of this system is available on the LSST Community Forum.




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ngmix-based measurement


Erin Sheldon's [ngmix](#) has been integrated with the LSST codebase: it can be installed as package [ngmix](#), and [meas_extensions_ngmix](#) package provides an interface between it and the LSST measurement framework. At time of writing, these packages are purely optional, and have not been included in any of the standard Science Pipelines top-level packages (`lsst_apps`, `lsst_distrib`). Currently, we provide an [ngmix](#)-based plugins for approximating the PSF and for fitting sources using a mixture of Gaussians in both single frame and forced measurement.





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Multiband coadd processing now saves metadata

Metadata describing the operations of algorithms within the [multiband coadd processing framework](#) is now correctly persisted along with their outputs.



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"Mosaic" calibration

The `meas_mosaic` package for performing simultaneous astrometric calibration across multiple overlapping exposures has been ported from Hyper Suprime-Cam. While this is an essential capability for LSST, we do not expect `meas_mosaic` itself to survive to operations: it is slated for replacement by [Jointcal](#). However, `meas_mosaic` provides an essential point of comparison for Jointcal, and is a key capability until Jointcal is fully available.



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Disabled oversampling in PSFEx

Experiments with Hyper Suprime-Cam have established that oversampling does not work well in PSFEx. It has therefore been disabled in the default configuration used for LSST.



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Add support for the HSC I2 filter

This filter is now defined in the `obs_subaru` camera package.



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Multiband coadd processing does not select flagged bands as reference

The algorithm used to select the reference band in multi-band coadd processing has been updated to avoid bands with certain user-specified flags set. By default, these flags include the source having an interpolated centre, or errors detected with PSF, Kron or CModel fluxes.



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Renamed the "afterburner" system to `CatalogCalculation`

The "afterburner" system the stack in the previous (v12) release; it provides a capability to run algorithms akin to our regular measurements, but which only take inputs from catalogs (i.e. not pixel data). To avoid ambiguity, this system has been renamed `CatalogCalculation`.



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Centroid position checker

Centroid finding measurement algorithms were updated to ensure that the centroids they find fall within the `Footprint` being centroided. If not, the returned value is forced to correspond to the position of the most significant peak within the `Footprint`, and a flag is set to indicate the error.



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Added ability to run `ctrl_pool` processes without a batch system

The option `--batch-type none` (or `None`) runs the command in your process as normal. This means that e.g. the `pipe_drivers` calibration scripts need not rely on MPI.



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HSC R2 filter

The `obs_subaru` package now includes support for the R2 filter on Hyper Suprime-Cam.



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Added DirectMatchTask

The new `DirectMatchTask` matches sources against a reference catalog without performing any rotation, offset or WCS fitting. This provides a simpler and less error-prone option for matching sources for quality assessment. The `MeasureMergedCoaddSourcesTask` has been modified to make use of this new `DirectMatchTask`.



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Added `--show history=config.foo.bar`

You can now specify a command line argument `--show history=config.foo.bar` to see where configuration parameter `foo.bar` is set and overridden (the leading `config.` is optional). The output may not be very intuitive, but it is what `pex_config` provides and is sometimes just what you need. N.B. pipe to `cat` to turn off colourization (or investigate `lsst.pex.config.history.Color`).



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frame defaults to None when creating a new Display

When using the `afw.display` system to create a new `Display` object, the `frame` argument is now optional: it will default to `None` if not specified.




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Attribute access to Display objects is passed through to the underlying implementation

Some `afw.display` device types may provide implementation-specific functionality. This may now be accessed directly through the `Display` object, which will delegate to implementation-specific methods, if they exist, when a non-standard method is called on the `Display`.

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New fitter for astrometric distortions.

A new fitter task, `meas.astrom.FitSipDistortionTask` has been added that will eventually replace the current fitter, `meas.astrom.FitTanSipWcsTask`. The new fitter should be more robust and certainly uses a better-motivated algorithm, but it has not yet received enough testing to be used as the default and hence must be enabled explicitly. When running `processCcd.py`, this can be done with the following config file:


```
from lsst.meas.astrom import FitSipDistortionTask
config.charImage.astrometry.wcsFitter.retarget(FitSipDistortionTask)
config.calibrate.astrometry.wcsFitter.retarget(FitSipDistortionTask)
```


The new fitter is not compatible with `meas.astrom.ANetAstrometryTask`.

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Unified exposure metadata

Exposures now contain a new `VisitInfo` object that contains useful information about the overall visit (none of it specific to the individual CCD), including the exposure time, date and ID, boresight position and airmass. See [Unified exposure metadata](#) for more information.

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Convenient access to catalog metadata

It is now possible to read the metadata, length and schema of a catalog through a Butler interface without loading the whole catalog. For example, given a particular data ID (`dataId`) and catalog dataset type (`someCatalog`), one can run:

```
butler.get("someCatalog_schema", dataId)
butler.get("someCatalog_len", dataId)
butler.get("someCatalog_md", dataId)
```



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Return a `PropertyList` when reading FITS headers

`lsst.afw.image.readMetadata` now returns a `PropertyList`, which maintains the intrinsic ordering of the header keywords in the FITS file it is reading. Previous versions used a `PropertySet`, which is unordered and hence lost this information.



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Measurement without deblending

The deblender sometimes runs into trouble with cluster galaxies, leading to inaccurate fluxes. To mitigate, we can now provide measurements performed without any deblending having taken place. To activate this functionality, specify the measurement plugins to be run without deblending in the `undeblender` registry attached to the measurement class (this is analogous to the `plugins` registry used when performing measurement on deblended sources). By default, no undeblended measurement is performed. This functionality is available in both forced and single-frame measurement.



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Warp then match when building PSF-matched coadds

`WarpAndPsfMatchTask` has been updated so that, by default, it will first warp inputs to the coadd projection and then perform PSF matching; this is the reverse of its previous behaviour. The new behaviour is preferable, but a configuration option makes it possible to revert to the old method on request.



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Reduce galaxy “shredding” when deblending

If galaxies have substructure, such as face-on spirals, the process of identifying peaks can “shred” the galaxy into many pieces. The templates of shredded galaxies are typically quite similar because they represent the same galaxy. We try to identify these “degenerate” peaks by looking at the inner product (in pixel space) of pairs of templates. If they are nearly parallel, we only keep one of the peaks and reject the other. This behaviour is enabled by the `removeDegenerateTemplates` option to `SourceDeblendConfig`; by default, it is disabled.



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Bug Fixes

Corrected configuration dictionary comparisons

Resolved a bug whereby comparison of (intrinsically unordered) configuration dictionaries incorrectly compared their ordering rather than just their contents. This led to unexpected failure of re-runs due to incorrectly identified “mismatched configurations”.



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Correct CModel table schema units

Units for the time field changed from seconds to second to comply with the Astropy convention.



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Restore capability of calculating temporary local backgrounds in source detection

Our `SourceDetectionTask` provides the optional capability of fitting and temporarily removing a local background before detecting sources. This capability was accidentally disabled in the X/W16 release (v12); it has now been restored. It is disabled by default.



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Resolve a memory error in convolution

A memory handling error could cause our convolution code to generate incorrect results on some platforms (problems observed on OS X when the code is built without optimization; no errors seen on Linux, or when building with `-O2` or `-O3` on OS X). This appears to originate in the [Boost Generic Image Library](#), an external dependency of the LSST stack. We have been unable to isolate the problem in Boost, but have worked around it for our particular use case.



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Patched GalSim to raise an exception in some error conditions

On certain error conditions, [GalSim](#), a third party package used by the LSST stack, generates an assertion failure which is hard for our code to handle appropriately. LSST's version of GalSim has been patched to raise a more appropriate exception instead. This change has been [submitted](#) for inclusion in GalSim itself.



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Ensure star selector results are reproducible

Resolved an issue whereby the star selection could change depending on the number of CPU cores in use.



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Single frame measurement exploits multiple CPU cores

Resolved an issue whereby the `SingleFrameDriverTask` failed to use more than one CPU core regardless of configuration.



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Fix typo in CoaddSrcTransformTask

A typo which rendered `CoaddSrcTransformTask` inoperable was resolved. In the process, the tests for this task were significantly upgraded to avoid a repeat of this, or other, problems.



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Do not write duplicate AR_NAME headers when persisting data

When persisting objects to FITS, we were incorrectly writing duplicate `AR_NAME` headers. This has been resolved.



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Be more rigorous about units when persisting angles

We now correctly write `TUNIT` headers describing the units used when storing angles, and are more careful about checking units when reading them.



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Infinite recursion in afw table

A bug has been discovered in the afw table library which could lead to infinite recursion. While the ultimate cause of the bug is still under investigation, a temporary workaround has been put in place to mitigate its impact.



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Fixed a division by zero error in measurement of aperture corrections

Attempting to calculate an aperture correction for a measurement of zero flux would previously result in an unhandled division by zero.



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Fix dataset lookup in multibandDriver.py

The multiband driver script was previously checking for the existence of the pre-calexp version of the coadd. This is not guaranteed to exist if the coadds were built using the driver scripts (where there is no need to persist both the pre-calexp and calexp versions) and it is only the calexp coadds that are used in the multiband tasks, so it is the calexp version whose existence should be checked for in **multibandDriver.py**.



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Fix incorrect definition of mask when building fringe frames

The code in pipe_drivers to construct fringe frames, `FringeTask`, was incorrectly using a mask *plane* when in fact a mask *bit* was required. This has now been corrected.



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it.

Fix failures in MPI-based processing

Resolved an issue whereby the ctrl_pool distributed processing middleware was unable to transmit large volumes of data over MPI due to a limitation of the Python 2.x "pickle" system.




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it.

Fix failure to retrieve optimizer state when fitting DoubleShapeletPsf


Resolved an issue whereby the optimizer state was being read incorrectly, which could lead to fitting failures.


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Build & Code Improvements


Migration from Boost to standard library equivalents


Continuing work started in the previous release, we have audited the stack for use of the [Boost](#) libraries. Where possible, Boost has been replaced with C++11 standard library equivalents.


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Properly log warnings in ObjectSizeStarSelector

Previously, non-fatal NumPy warnings of the form `RuntimeWarning: invalid value encountered in less` could appear on the console, but not be caught and logged anywhere. It was therefore easy to miss problems arising when running the algorithm. These warnings are now ingested into the LSST logging system, and are hence recorded properly.

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Unit tests for colorterm framework

A set of unit tests have been written which properly exercise the colorterm framework which was adapted from [Hyper Suprime-Cam](#) in the S15 cycle.

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FlagHandler accessible from Python

The FlagHandler system for efficiently and safely setting flags corresponding to measurement algorithm failures on source records is now accessible from Python. Previously, it was only available for use in C++ code.



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Exact image comparison utility code

The `assertImagesEqual` and `assertMaskedImagesEqual` methods have been added to LSST's test cases. These provide explicit mechanisms for checking for exact equality of image data.



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Add integration test for stellaricity of sources used to measure PSF

Added a test to the `ci_hsc` package to monitor the fraction of sources used to model the PSF in when processing a CCD image and ensure that the vast majority of them are ultimately classified as stars. This provides an automated check that we are not inadvertently estimating the PSF based on extended objects.



[DM-6051](#) - Jira project doesn't exist or you don't have permission to view it.

Use CatalogCalculation to handle aperture corrections

The `CatalogCalculation` facility was added to the stack in the previous (v12) release (where it was referred to as "afterburners"); it provides a capability to run algorithms akin to our regular measurements, but which only take inputs from catalogs (i.e. not pixel data). This has now been used to clean up the logic used to apply aperture corrections within our regular data processing flow. This old method for handling aperture corrections was a persistent source of bugs and confusion: these should be avoided by the new approach.



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Builds are now optimized by default

Following an RFC, `sconsUtils` was updated to enable optimization by default.




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[DM-7010](#) - Jira project doesn't exist or you don't have permission to view it.


Fixed a build failure of `mpi4py` on some versions of Mac OS X


Added extra logic to ensure we target a version of the OS X SDK which is compatible both with the version of Mac OS installed and the Python interpreter in use.


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Centralised Butler datasets

Butler dataset definitions which are common to multiple cameras have been consolidated in a central location in `daf_butlerUtils` rather than being repeated in each camera package.

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 [DM-7677](#) - Jira project doesn't exist or you don't have permission to view it.

Order in which SConscript files are read is configurable

The `sconsUtils` build system now reads `SConscript` files, which describe the build, in a user configurable order. This makes it possible to specify that some components of a package must be built before others.

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Ndarray is now an external package

The `ndarray` package in the LSST stack now installs vanilla upstream version 1.3.0.



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[DM-7519](#) - Jira project doesn't exist or you don't have permission to view it.

SpherePoint now available

The SpherePoint class allows locations on the celestial (or any other) sphere to be represented and manipulated without the coordinate-system complications associated with Coord.



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