

# Rubin Observatory

Vera C. Rubin Observatory  
Data Management

## Characterization Metric Report: Science Pipelines Version 21.0.0

Jeff Carlin

DMTR-281

Latest Revision: 2020-12-09



## Abstract

This brief report describes measurements of interest that were carried out for release v21.0.0 of the Science Pipelines. The report for the previous version can be found in [DMTR-251].

## Change Record

Version	Date	Description	Owner name
	2020-12-02	First Draft	Jeff Carlin
1.0	2020-12-09	Document issued. DM-27237	Jeff Carlin

*Document source location:* <https://github.com/lstt-dm/DMTR-281>

## Contents

<b>1 Summary of performance metrics</b>	<b>1</b>
<b>2 Photometric Performance</b>	<b>2</b>
<b>3 Astrometric Performance</b>	<b>3</b>
<b>4 Ellipticity Correlations</b>	<b>5</b>
<b>5 Computational Performance</b>	<b>5</b>
<b>A References</b>	<b>5</b>
<b>B Acronyms</b>	<b>6</b>

# Characterization Metric Report: Science Pipelines Version 21.0.0

In this Report, we characterize the performance of the Rubin Observatory Science Pipelines Version 21.0.0. We illustrate the performance via metrics that are measured on the HSC-RC2 dataset. RC2 consists of 3 tracts of data taken from the HSC-SSP survey, and selected to provide a means of testing various “pathological” cases (e.g., difficult astrometric solutions, seeing too small to provide a well-sampled PSF, difficult fields for deblending, and large galaxies, among others). These three tracts each contain between 112–149 visits split between the HSC-G, HSC-R, HSC-I, HSC-Z, and HSC-Y (*grizy*) filters. The `validate_drp` scripts were run on these tracts to derive the photometric, astrometric, and shape metrics that are reported here. We exclude the three astrometry metrics (AM3, AD3, and AF3) that concern residuals on 200-arcminute scales, since neither the handful of CCDs in the `validation_data_hsc` dataset nor the individual tracts of RC2 span large enough spatial scales to enable these measurements.

For comparison, we provide the [SRD](#) required “design” value of each metric as defined in the Science Requirements Document [LPM-17]. For context, the [SRD](#) does not place any constraints on *y*-band for these Key Performance Metrics (KPMs). For the photometric metrics, there are only specifications for *g*, *r*, and *i*. In the case of the ellipticity correlation metrics, there are specs only for *r* and *i*. The *y*-band measurements are of interest primarily for historical tracking.

Some KPMs (AF1, AD1) involve thresholds that are different for “design”, “minimum”, and “stretch” specifications. The metrics in this report are all compared to the “design” thresholds. The assessment of these KPMs would be different if evaluated against different thresholds.

## 1 Summary of performance metrics

Metrics are typically monitored on a dashboard hosted by SQuaSH (Science Quality System Harness; described in [SQR-009]). Here we show an example of this dashboard displaying ~ 6 months of measurements for a few metrics. These measurements are for tract 9813, as measured in the *r*-band filter (HSC-R). The astrometry (two upper panels) and ellipticity (lower right plot) metrics have remained roughly the same since the Version 20.0.0 release in late June, 2020. Likewise, all of the astrometry metrics summarized in Section 3 are similar to, or

slightly better than, the Version 20.0.0 values. Note, however, that there is a large increase in the photometric repeatability metric in late June – this can also be seen in the photometric KPMs summarized in Section 2. This happened because shortly after the release of version 20.0, we began using FGCM [1] for photometric calibration instead of jointcal. In general, FGCM is optimized for survey self-calibration with multiple exposures overlapping in space and time, and is not optimized for individual isolated tracts as in the RC2 dataset. Thus, while FGCM is likely to enable much better overall survey calibration, at RC2 scales it may offer little improvement compared to jointcal. Nonetheless, we expect the photometry metrics to continue to improve as we understand the effects of implementing FGCM in the Science Pipelines.

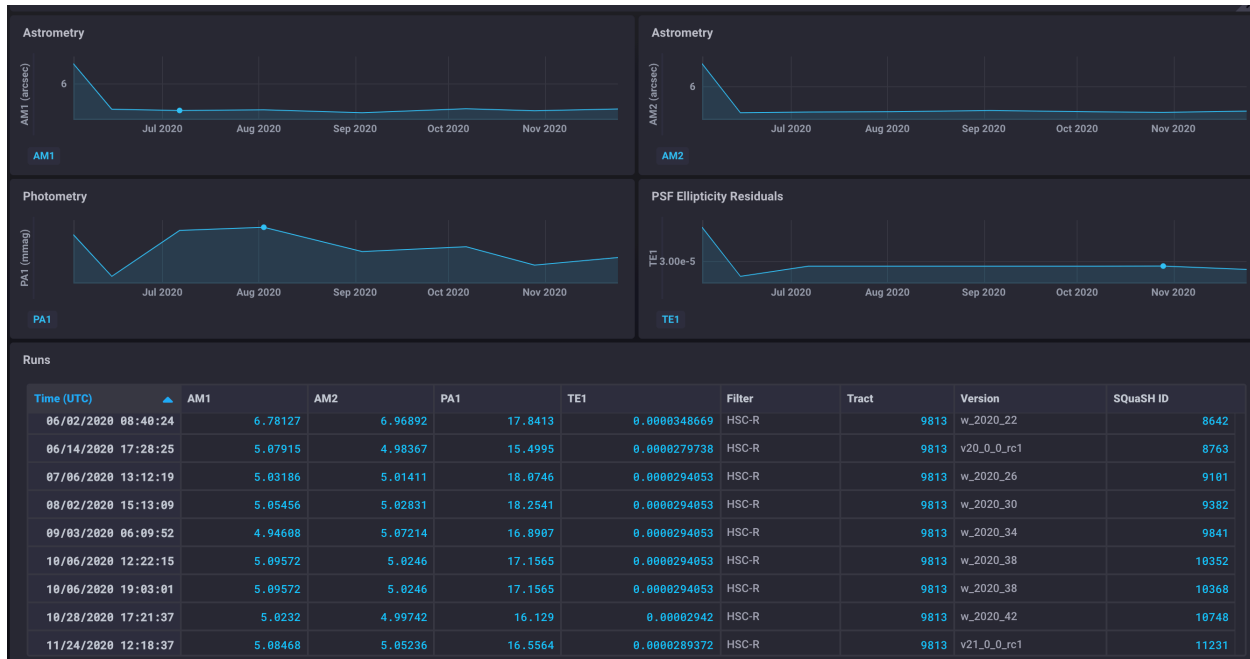


FIGURE 1: SQuaSH dashboard showing the past four months of metric measurements from the RC2 dataset. This view shows the metrics for tract 9813 in the HSC-R filter. The degraded performance in the photometry metrics after late June was due to the introduction of a new photometric calibration method known as FGCM, replacing jointcal. The metrics have continued to improve since the introduction of FGCM (but are still slightly worse than previous results using jointcal), as our understanding of FGCM's effects on the pipeline outputs evolves.

## 2 Photometric Performance

These photometric performance metrics are defined in LSS-REQ-0093 (LSE-29) and Table 14 of LPM-17.

Any entries left blank are those for which we do not have data in the given filter for that dataset.

Metric	Unit	SRD Re- quirement - Design	Release 20 Value (RC2)	Release 21 Value (RC2)	Comments
PA1: <i>u</i>	mmag	$\leq 7.5$	—	—	No data
PA1: <i>g</i>	mmag	$\leq 5.0$	12.7	13.8	
PA1: <i>r</i>	mmag	$\leq 5.0$	14.1	14.7	
PA1: <i>i</i>	mmag	$\leq 5.0$	14.0	14.7	
PA1: <i>z</i>	mmag	$\leq 7.5$	11.6	11.8	
PA1: <i>y</i>	mmag	$\leq 7.5$	13.5	14.3	
PF1: <i>u</i>	%	$\leq 20$	—	—	No data
PF1: <i>g</i>	%	$\leq 20$	28.6	31.1	
PF1: <i>r</i>	%	$\leq 10$	31.1	33.0	
PF1: <i>i</i>	%	$\leq 10$	31.7	33.7	
PF1: <i>z</i>	%	$\leq 20$	13.2	14.1	
PF1: <i>y</i>	%	$\leq 10$	16.6	17.6	
PA2: <i>u</i>	%	$\leq 22.5$	—	—	No data
PA2: <i>g</i>	%	$\leq 15$	27.9	29.0	
PA2: <i>r</i>	%	$\leq 15$	29.8	30.1	
PA2: <i>i</i>	%	$\leq 15$	29.7	31.6	
PA2: <i>z</i>	%	$\leq 22.5$	25.5	26.4	
PA2: <i>y</i>	%	$\leq 22.5$	29.6	29.2	

### 3 Astrometric Performance

The following metrics are defined following LSR-REQ-0094 [LSE-29] and Table 18 of LPM-17.

Metric	Unit	SRD Re- quirement - Design	Release 20 Value (RC2)	Release 21 Value (RC2)	Comments
AM1: <i>u</i>	mas	$\leq 10$	—	—	No data
AM1: <i>g</i>	mas	$\leq 10$	4.9	4.8	

Metric	Unit	SRD Re- quirement – Design	Release 20 Value (RC2)	Release 21 Value (RC2)	Comments
AM1: <i>r</i>	mas	≤ 10	5.2	5.2	
AM1: <i>i</i>	mas	≤ 10	4.5	4.4	
AM1: <i>z</i>	mas	≤ 10	4.8	4.9	
AM1: <i>y</i>	mas	≤ 10	6.7	6.6	
AF1: <i>u</i>	%	≤ 10	—	—	No data
AF1: <i>g</i>	%	≤ 10	0.4	0.5	
AF1: <i>r</i>	%	≤ 10	1.4	1.3	
AF1: <i>i</i>	%	≤ 10	0.5	0.5	
AF1: <i>z</i>	%	≤ 10	0.5	0.4	
AF1: <i>y</i>	%	≤ 10	2.8	3.1	
AD1: <i>u</i>	mas	≤ 20	—	—	No data
AD1: <i>g</i>	mas	≤ 20	5.9	6.0	
AD1: <i>r</i>	mas	≤ 20	7.4	7.4	
AD1: <i>i</i>	mas	≤ 20	5.7	5.8	
AD1: <i>z</i>	mas	≤ 20	6.7	6.6	
AD1: <i>y</i>	mas	≤ 20	11.3	10.8	
AM2: <i>u</i>	mas	≤ 10	—	—	No data
AM2: <i>g</i>	mas	≤ 10	5.0	5.0	
AM2: <i>r</i>	mas	≤ 10	6.4	5.0	
AM2: <i>i</i>	mas	≤ 10	4.4	4.4	
AM2: <i>z</i>	mas	≤ 10	5.0	5.0	
AM2: <i>y</i>	mas	≤ 10	6.8	6.8	
AF2: <i>u</i>	%	≤ 10	—	—	No data
AF2: <i>g</i>	%	≤ 10	0.5	0.6	
AF2: <i>r</i>	%	≤ 10	1.1	1.1	
AF2: <i>i</i>	%	≤ 10	0.7	0.6	
AF2: <i>z</i>	%	≤ 10	0.5	0.4	
AF2: <i>y</i>	%	≤ 10	2.7	2.8	
AD2: <i>u</i>	mas	≤ 20	—	—	No data
AD2: <i>g</i>	mas	≤ 20	5.7	6.0	
AD2: <i>r</i>	mas	≤ 20	6.8	6.9	
AD2: <i>i</i>	mas	≤ 20	5.7	5.8	



Metric	Unit	SRD Re- quirement – Design	Release 20 Value (RC2)	Release 21 Value (RC2)	Comments
AD2: <i>z</i>	mas	$\leq 20$	6.0	5.9	
AD2: <i>y</i>	mas	$\leq 20$	10.6	10.5	

## 4 Ellipticity Correlations

The following metrics are defined following LSR-REQ-0097 [LSE-29] and Table 27 of LPM-17.

Metric	Unit	SRD Re- quirement – Design	Release 20 Value (RC2)	Release 21 Value (RC2)	Comments
TE1: <i>u</i>	—	$\leq 2 \times 10^{-5}$	—	—	No data
TE1: <i>g</i>	—	$\leq 2 \times 10^{-5}$	$1.4 \times 10^{-5}$	$1.3 \times 10^{-5}$	
TE1: <i>r</i>	—	$\leq 2 \times 10^{-5}$	$2.0 \times 10^{-5}$	$2.1 \times 10^{-5}$	
TE1: <i>i</i>	—	$\leq 2 \times 10^{-5}$	$1.1 \times 10^{-5}$	$9.2 \times 10^{-6}$	
TE1: <i>z</i>	—	$\leq 2 \times 10^{-5}$	$1.6 \times 10^{-5}$	$1.7 \times 10^{-5}$	
TE1: <i>y</i>	—	$\leq 2 \times 10^{-5}$	$9.3 \times 10^{-6}$	$9.2 \times 10^{-6}$	
TE2: <i>u</i>	—	$\leq 1 \times 10^{-7}$	—	—	No data
TE2: <i>g</i>	—	$\leq 1 \times 10^{-7}$	$3.7 \times 10^{-7}$	$3.6 \times 10^{-7}$	
TE2: <i>r</i>	—	$\leq 1 \times 10^{-7}$	$1.0 \times 10^{-6}$	$9.5 \times 10^{-7}$	
TE2: <i>i</i>	—	$\leq 1 \times 10^{-7}$	$2.5 \times 10^{-6}$	$1.8 \times 10^{-6}$	
TE2: <i>z</i>	—	$\leq 1 \times 10^{-7}$	$5.0 \times 10^{-7}$	$5.4 \times 10^{-7}$	
TE2: <i>y</i>	—	$\leq 1 \times 10^{-7}$	$1.2 \times 10^{-6}$	$1.1 \times 10^{-6}$	

## 5 Computational Performance

Computational performance metrics were not re-measured for this release.

## A References

- [1] Burke, D.L., Rykoff, E.S., Allam, S., et al., 2018, *AJ*, 155, 41 (arXiv:1706.01542), doi:10.3847/1538-3881/aa9f22, ADS Link
- [2] **[DMTR-251]**, Carlin, J., 2020, *Characterization Metric Report: Science Pipelines Version 20.0.0*, DMTR-251, URL <http://dmtr-251.lsst.io>
- [3] **[LSE-29]**, Claver, C.F., The LSST Systems Engineering Integrated Project Team, 2017, *LSST System Requirements (LSR)*, LSE-29, URL <https://ls.st/LSE-29>
- [4] **[SQR-009]**, Fausti, A., 2017, *The SQuaSH metrics dashboard*, SQR-009, URL <https://sqr-009.lsst.io>
- [5] **[LPM-17]**, Ivezić, Ž., The LSST Science Collaboration, 2018, *LSST Science Requirements Document*, LPM-17, URL <https://ls.st/LPM-17>

## B Acronyms

Acronym	Description
DM	Data Management
DMTR	DM Test Report
FGCM	Forward Global Calibration Model
HSC	Hyper Suprime-Cam
LPM	LSST Project Management (Document Handle)
LSE	LSST Systems Engineering (Document Handle)
LSR	LSST System Requirements; LSE-29
PSF	Point Spread Function
SQuaSH	Science Quality Analysis Harness
SRD	LSST Science Requirements; LPM-17