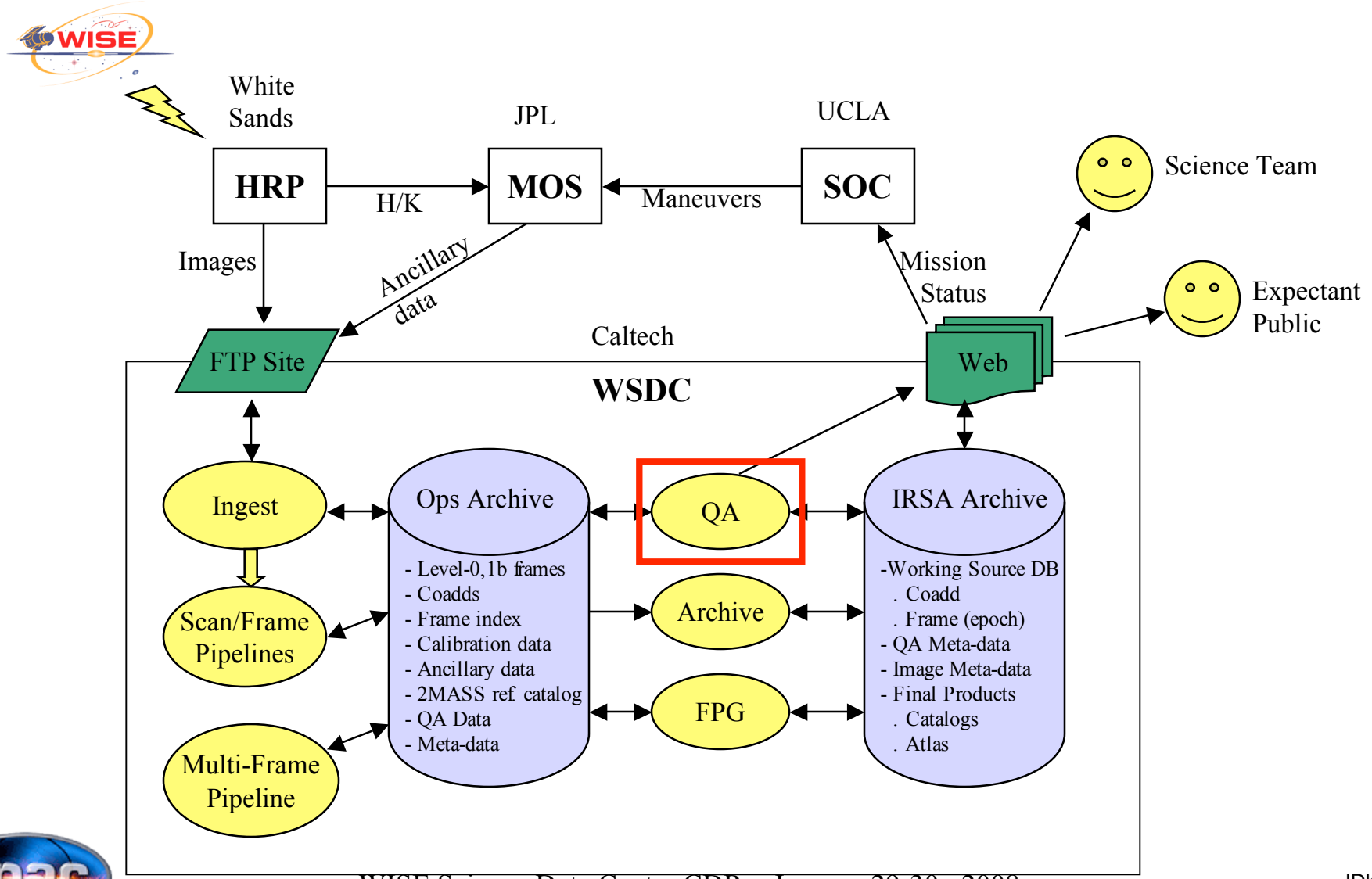
Quality Assurance

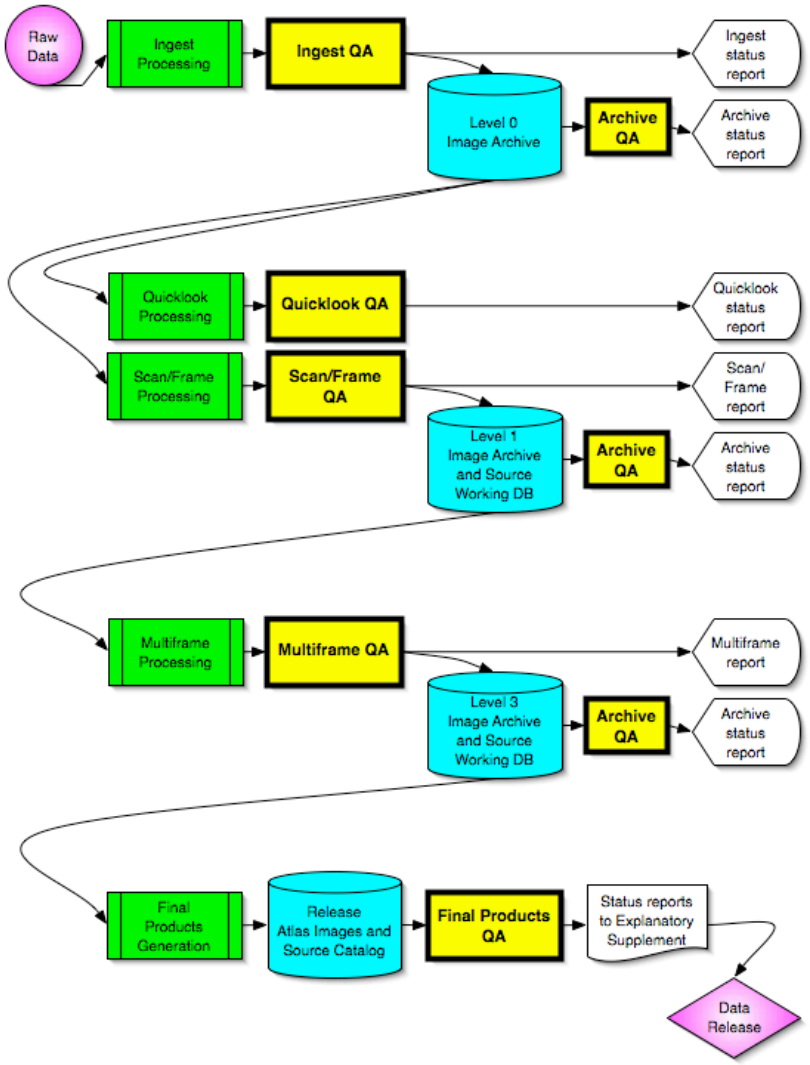
Davy Kirkpatrick
IPAC/Caltech

WSDC Functional Block Diagram



QA Block Diagram

- Quality Assurance (QA) is injected into the data processing flow at many points to monitor data quality.
- QA subsystems are shown in yellow in the WSDC flow diagram at right. These are referred to as -
  - Ingest QA
  - Quicklook QA
  - Scan/Frame QA
  - Multiframe QA
  - Archive QA
  - Final Products QA



WISE QA Philosophy

- Given large data volume and short timescale, quick and efficient QA is vital to success.
- The QA system
  - assesses data through each stage of processing,
  - identifies/flags data that may not meet WISE science requirements, and
  - alerts SOC, MOS, and WISE Science Team of these cases.
- The system must be as automated as possible, allowing the final arbiter of quality (the human reviewing the data)
  - to quickly assess and bless data meeting the specs and
  - to concentrate most of his/her time on the small fraction of data needing detailed scrutiny.
- The QA system collects summary reports from each data processing subsystem and compiles them into a single, concise report. Summaries include
  - software completion status reports,
  - statistical analyses, and
  - tabular and graphical material for use by the QA scientist.
- The goal of the QA system is
  - to compare collected parameters to metrics tied to mission science requirements and
  - to present overall results in a web-based form.

Driving Requirements

- *GENERAL QA* (L4WSDC-062): The WSDC shall perform quality analysis of all WISE science data and make reports available on a regular basis.

- *PRODUCT VALIDATION* (L4WSDC-063): The WSDC shall work with the WISE Science Team to validate that, prior to their release, the Image Atlas and Source Catalog satisfy WISE science requirements.

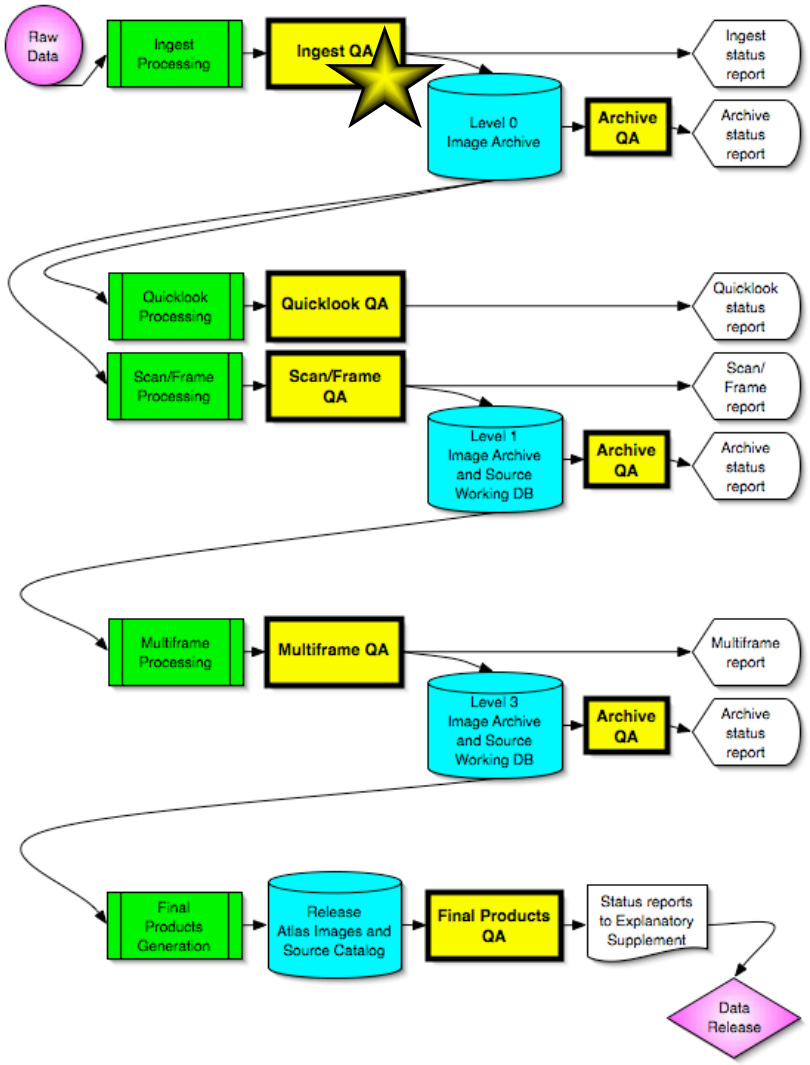
- *PRODUCT CHARACTERIZATION* (L4WSDC-064): The WSDC shall work with the WISE Science Team to characterize and document the overall data product relative to the mission requirements. This document shall be included in the WISE data product explanatory supplement.

- *QUICKLOOK QA* (L4WSDC-065): A sample of 3% of the science imaging data returned to the ground each day shall be processed in an expedited way to produce a Quicklook report that monitors the routine performance of the flight system as can be determined from the science data, and identifies problems that may require prompt action by WISE Science or Mission Operations.

- *SCAN SYNCHRONIZATION* (L4WSDC-066): The WSDC shall provide a monitor of the synchronization between flight-system and scan mirror rates to achieve and maintain required image quality as part of Quicklook QA.

Functionality: Ingest QA

- Purpose
  - To check compliance with the FITS standard.
  - To verify that all Level 0 images have been created.
  - To compare the input manifest from White Sands to the actual data received.
- Timescale:
  - Following each data transfer (up to 4 times per day).
- Action:
  - WSDC to inform MOS/EOS and SOC of status and anomalies.

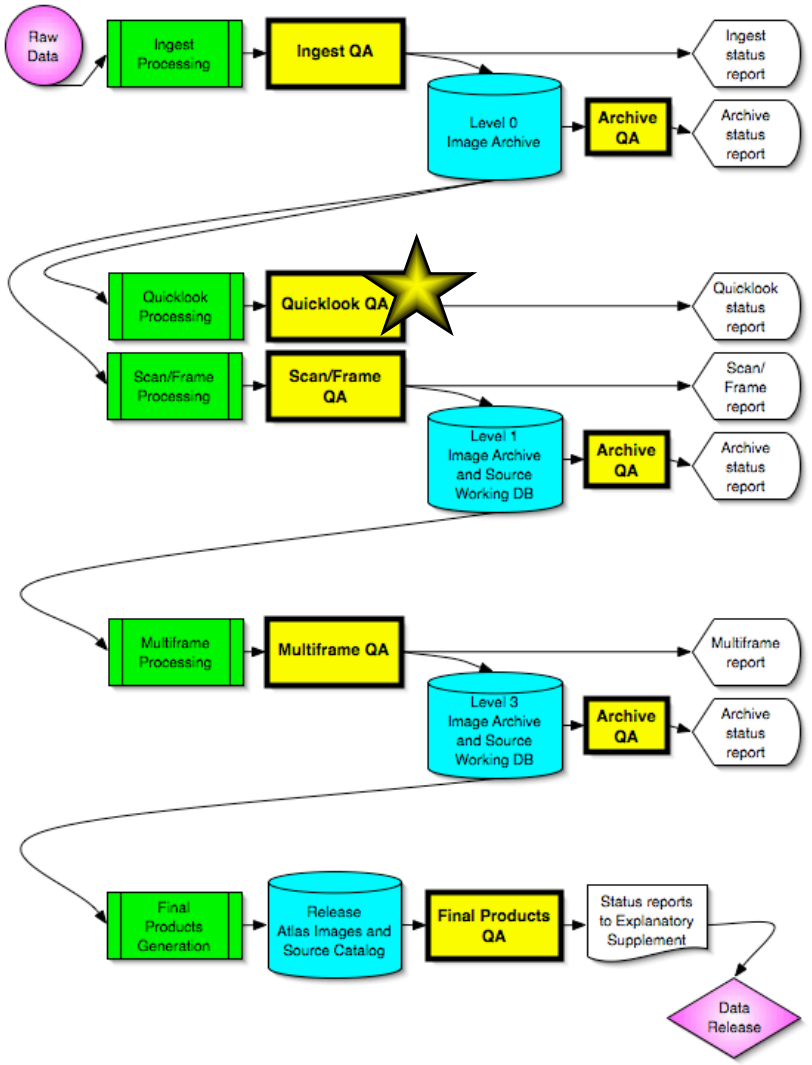


Design: Ingest QA

- Check that assembled images meet the FITS standard.
- Compare input manifest to resulting output to check for completeness.
- Verify that all Level 0 images were successfully created.
- Verify that housekeeping telemetry data and PEF (Predicted Events File) were successfully mated with the correct images.
- Summarize QA findings for MOS and SOC.

Functionality: Quicklook QA

- Purpose:
  - To check key system performance parameters (on 3% of data) for each downlink via an abbreviated processing pipeline.
- Timescale:
  - Within 24 hours of end of data transfer to WSDC.
- Action:
  - WSDC to post report to web page; SOC to review report.
  - Text based summary report e-mailed to MOS.



Design: Quicklook QA (1)

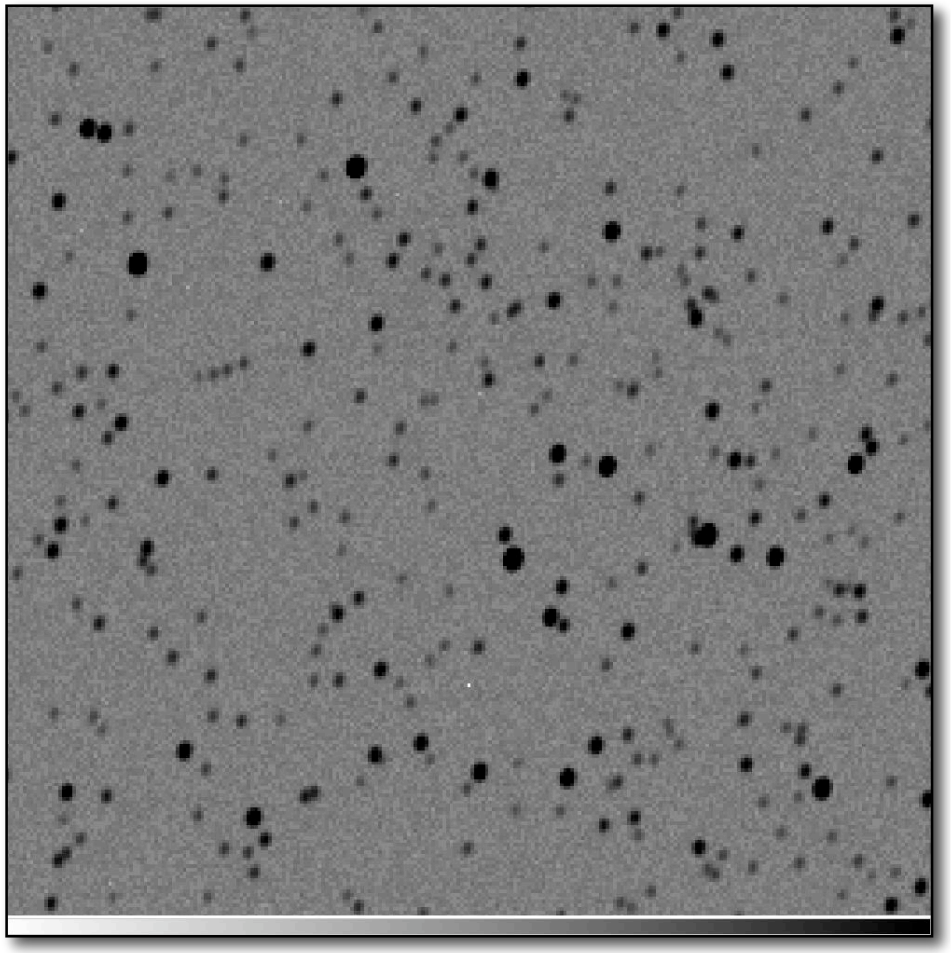
- Scan synchronization and image quality
  - Generate matrix of composite star images detected on each frame in each band, where each element is the average star image formed by combining the images of all stars in the corresponding region of the frame.
  - Measure image second moment ratios and position angles for each composite star image in the matrix.
  - Generate table and plot showing the means of these values for all frames in a half-orbit.
  - Trigger warning messages when image elongation has exceeded a predetermined threshold related to the Level 1.5 specifications for image quality. Threshold values are to be determined prior to launch using simulated image data.
- Photometric zero point and system throughput (needs ecliptic polar data for primary and secondary standard star checks.)
  - Tabulate the mean and RMS differences between a priori "true" and measured instrumental magnitudes for standard stars observed in the polar frames.
  - Generate a table and plot showing the mean and RMS of these values for each orbit.
  - Trigger a warning message if the zero point offset in any band falls outside a threshold range. The threshold range will be derived pre-launch and updated during IOC.

Design: Quicklook QA (2)

- Image backgrounds and noise (requires polar data to use as bellwethers of background level)
  - Compute the mean pixel values along with total and point-source-filtered noise values for each frame.
  - Generate a table and plot of mean pixel values and noise levels for each frame in a half-orbit and for each quadrant (for Si:As arrays) or stripe (for HgCdTe arrays).
  - Compare the measured mean pixel values and noise values in each frame to threshold values, band by band.
  - Trigger a warning message if the mean pixel values and noise values exceed predefined thresholds. These thresholds will be determined pre-launch and updated during IOC.
- Visual checks
  - Generate jpegs of a few frames in each band and check by eye. Purpose is to look for unexpected fixed pattern artifacts, odd noise signatures, and other oddities not predicted a priori.
  - Generate three-color jpegs of a few registered framesets (if possible) and check by eye.

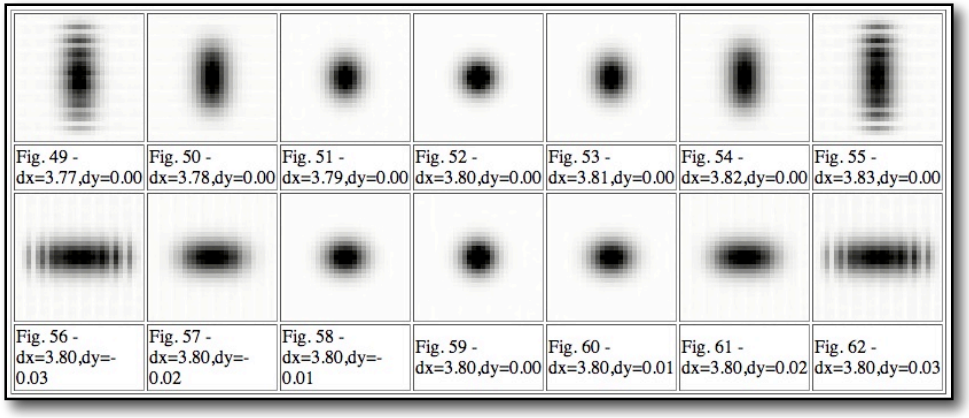
Demo of Scan Synchronization Monitor (1)

- Image quality (via PRF) will be monitored as part of standard scan/frame QA.
- Same tool will be used to support IOC task to synchronize spacecraft/scan mirror rates.
- Simulated IOC image data (with scan rate adjustments provided by Ned Wright) used to demonstrate tool.



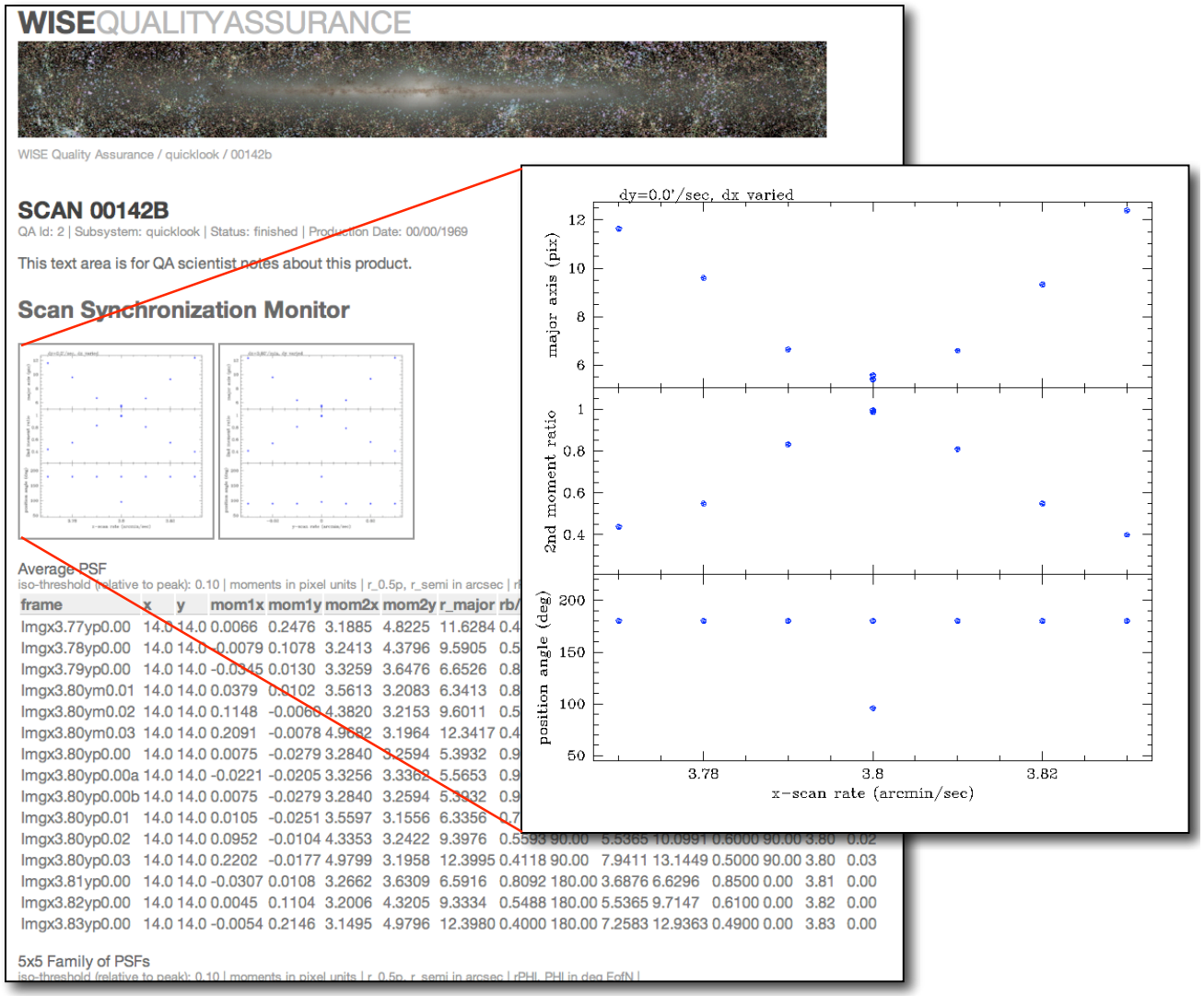
Demo of Scan Synchronization Monitor (2)

- Composite PRF generated by "stacking" high SNR point sources detected on one or more images.



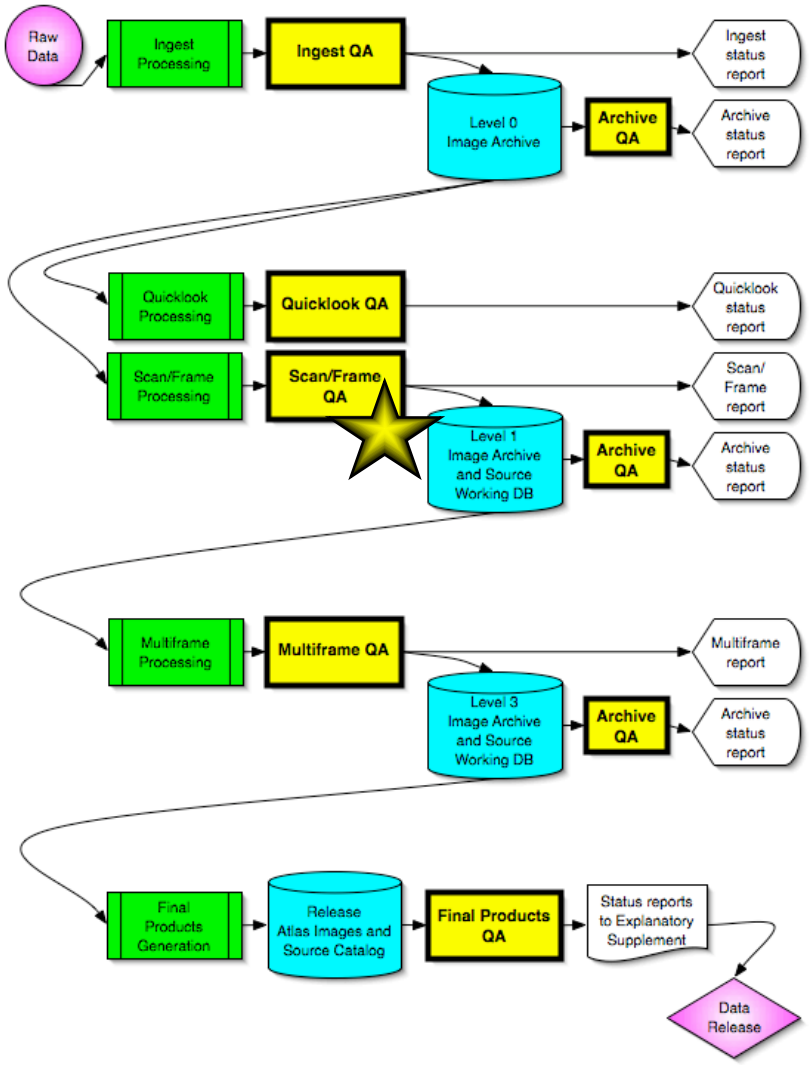
Demo of Scan Synchronization Monitor (3)

- PRF "shape" characterized and plotted as a function of frame, scan rate, etc.
- Optimal image shape occurs when scan rates are matched.
- Tool will be extended to incorporate noise pixel metric.



Functionality: Scan/Frame QA

- Purpose:
  - To check for successful completion of Scan/Frame pipeline processing.
  - To scrutinize output of processing pipeline.
  - To compare achieved performance to science metrics tied to mission science requirements.
- Timescale:
  - Within 6 days of receipt of data at IPAC.
- Action:
  - WSDC to assign quality scores to each scan and produce QA report; PI or his designee responsible for signing off.



Design: Scan/Frame QA (1)

- Summary of input data
  - Report log file and results of ingestion QA.
  - Report QA results for quicklook processing.
- Instrumental image calibration
  - If new flat fields computed, compare flat-fields to ground flats.
  - Monitor dynamic bad-pixel masks – changes in masks, # of pixels masked.
  - Flag outlying noisy frames; plot noise histograms.
  - Flag outlying point-source-filtered noisy frames; plot histograms.
- Scan synchronization
  - Monitor point source shape, scan mirror synchronization.
- Band detection statistics
  - Monitor percentage of sources seen in all bands vs. single-band missing sources, two-band missing, etc.

Design: Scan/Frame QA (2)

- Astrometric calibration
  - Plot histograms of astrometric deltas between WISE-computed and 2MASS All-Sky PSC positions; scrutinize outliers.
  - Modulo solar system object identifications, tabulate and follow up -
    - » sources (at least in W1 and W2) with no 2MASS match.
    - » 2MASS sources lacking a WISE counterpart.
- Photometric calibration, accuracy, and sensitivity
  - Monitor mean aperture photometry curves-of-growth.
  - Tabulate/plot mean/RMS differences between truth and derived photometry for standard stars in the orbit.
  - Tabulate/plot mean/RMS differences between stars in this orbit and those observed in previous overlapping orbits (trending via other Level 1 data).
  - Tabulate/plot mean photometric offsets from in-scan overlaps.
  - Plot number of objects with noted source confusion as function of galactic latitude; spot check image data for selected clean and confused sources.
  - Plot saturated star mag/flux estimates against ramp saturation flag.
  - Compare color-color diagrams for objects saturated in any band and compare against fiducial color loci to check saturated mag estimates.

Design: Scan/Frame QA (3)

- Completeness and Reliability
  - Determine fraction vs. magnitude of "truth" sources in ecliptic polar fields.
- Artifact identification -- Perform semi-automated visual spot checks of a few examples of each of the following:
  - Latents.
  - Dichroic/filter glints.
  - Diffraction spikes.
  - Bright star halo contamination.
  - Optical ghosts.
  - Electronic ghosts.
  - Non-uniform stray light.
  - Scattered light patches from bright objects.
  - Radiation hits (?).
- Frame statistics
  - Plot log(N)-log(S) and check against mean frame noise level.
  - Measure frame-to-frame overlap to assure overlap is sufficient.

Design: Scan/Frame QA (4)

- Astrophysical checks
  - Plot color-color and color-mag diagrams of "good" sources.
- Solar system object identification
  - Plot number of solar system objects vs. ecliptic latitude.
  - Perform checks to make sure that identifications include asteroids, comets, planets, and planetary satellites.
  - Inspect color-color plots of identified objects.
  - Check detection fraction vs. visual magnitude?
- QA summary
  - Report successful/unsuccessful processing completion.
  - Provide web-accessible page with tables and plots listed above.
  - Generate auto-filled QA report along with quality scores as starting point for human review.
  - Review by QA scientists to finalize report.

Scan/Frame QA Report Design (1)

Online | Ready for Review | Being Reviewed
Submitted | Ready for Cleanup | Pending Queries
Northern Nights | Southern Nights | All Nights

2MASS Final Processing QA Review Status

Night	Rev	Prod Status	Reviewer	Review Status	Other Notes
980925s	QA	archived 010926	raymond 010924	approved 011001	
980926n	QA	archived 011030	davy 011029	approved 011102	
980927n	QA	archived 020206	raymond 020206	approved ------	orig rev davy ------
980927s	QA	archived 010926	hurt 010926	approved 010928	position reconstruction problems i
980928s	QA	archived 020204	nelson 020204	approved 011001	orig rev raymond 010926
980929n	QA	archived 011031	nelson 011031	approved 011102	
980929s	QA	archived 010927	davy 010926	approved 011001	
980930n	QA	archived 011101	hurt 011101	approved 011105	
980930s	QA	archived 020207	nelson 020206	approved 011001	orig rev davy 010928
981001n	QA	archived 011030	cxu 011029	approved 011101	
981001s	QA	archived 010927	davy 010926	approved 011001	
981002n	QA	archived 011031	cxu 011029	approved 011101	
981002s	QA	archived 010927	davy 010926	approved 011001	
981003n	QA	archived 011031	cxu 011030	approved 011101	
981003s	QA	archived 010927	cxu 010926	approved 011002	
981004n	QA	archived 011030	cxu 011029	approved 011105	priority
981004s	QA	archived 010929	vandyk 010927	approved 011002	
981005n	QA	archived 011031	cxu 011030	approved 011105	
981005s	QA	archived 010927	vandyk 010926	approved 011002	
981006n	QA	archived 011031	davy 011030	approved 011105	priority
981006s	QA	archived 020206	nelson 020206	approved 011002	orig rev davy 010928
981007n	QA	archived 011031	nelson 011030	approved 011105	
981007s	QA	archived 011011	raymond 010927	approved 011015	
981008n	QA	archived 011031	cxu 011030	approved 011106	
981008s	QA	archived 020206	nelson 020206	approved 011002	orig rev raymond 010928
981009n	QA	archived 011031	cxu 011031	approved 011106	
981009s	QA	archived 020206	nelson 020206	approved 011002	orig rev davy 010928
981010n	QA	archived 011101	nelson 011031	approved 011106	
981010s	QA	archived 010928	cxu 010927	approved 010928	priority
981011n	QA	archived 011106	raymond 011102	approved 011106	
981011s	QA	archived 011002	hurt 011001	approved 011002	
981012n	QA	archived 011102	hurt 011101	approved 011106	priority
981012s	QA	archived 011002	hurt 011002	approved 011002	
981013n	QA	archived 011101	nelson 011031	approved 011106	
981014n	QA	archived 011102	hurt 011101	approved 011107	
981014s	QA	archived 011001	hurt 010927	approved 011003	
981015n	QA	archived 011105	nelson 011104	approved 011107	rerun after dropping scan 098 from
981015s	QA	archived 011003	davy 011002	approved 011003	
981016n	QA	archived 011106	nelson 011104	approved 011106	priority
981016s	QA	archived 011002	vandyk 010928	approved 011004	
981017s	QA	archived 010929	davy 010928	approved 011004	
981018s	QA	archived 011003	cxu 011002	approved 011004	
981019n	QA	archived 011102	hurt 011102	approved 011107	priority
981019s	QA	archived 011002	raymond 010928	approved 011004	
981020n	QA	archived 011102	nelson 011102	approved 011107	
981020s	QA	archived 011001	cxu 011001	approved 011004	
981021s	QA	archived 011003	davy 011003	approved 011004	
981022s	QA	archived 011002	cxu 011001	approved 011004	
981023n	QA	archived 011105	hurt 011105	approved 011107	priority
981023s	QA	archived 011003	davy 011002	approved 011004	priority
981024s	QA	archived 011003	hurt 011001	approved 011002	priority
981025s	QA	archived 011002	cxu 011001	approved 011008	
981026s	QA	archived 011003	hurt 011002	approved 011008	
981027n	QA	archived 011106	nelson 011105	approved 011106	
981027s	QA	archived 011003	davy 011003	approved 011015	
981028n	QA	archived 020205	hurt 020204	approved ------	orig rev nelson ------
981028s	QA	archived 011017	hurt 011003	approved 011018	some star halo meteor blanking art
981029n	QA	archived 011103	hurt 011102	approved 011107	
981029s	QA	archived 011004	davy 011003	approved 011009	
981030s	QA	archived 011002	hurt 011001	approved 011009	
981031s	QA	archived 011001	cxu 011001	approved 011002	
981101n	QA	archived 011106	hurt 011105	approved 011106	
981101s	QA	archived 011003	raymond 011001	approved 011015	
981102n	QA	archived 011106	hurt 011105	approved 011106	

- Modeled closely on 2MASS Nightly QA.
- Concise web-based summary with drill-down capability.

2MASS Pipeline 3 QA Report
QA Web Index
981017s

Scan Grading	Astrometry	Log File
Photometricity	Tracking/Stepping	Observers Log
Bkg/Seeing/Focus	Jumps/Airglow	V2 QA Web Pages
Galaxies	Nightly Overview	V2 QA Review

Diagnostic Plots

Zero Point Default	Seeing Shape & Ratio	Pos Reconst. Qual	Chisq/Sig Plots	Hess Plots	Galaxy Monitor
Overlaps Summary	Meteor Blanking	R1:R2 Diff Monitor	PSF/Ap Mags	In/Cross Scan Color	V2 Deltas
Sensitivity	Astrom Wander	Distortion Monitor	R1:R2 Satur Phot	Saturated Color-mags	Plot Info

Error summary

filename	line #	error type	error message
input.c	2169	scan number not in list	data in updatesit for unknown scan#75 v2 grade=0
input.c	2169	scan number not in list	data in updatesit for unknown scan#76 v2 grade=0

Return to Main Index

Last run: Wed Oct 31 15:38:25 2001

Version 010829 (3.1); more info is at SCANSCI Notes

Mail comments/bug reports to hurt@ipac.caltech.edu

Scan/Frame QA Report Design (2)

2MASS Pipeline 3 QA Report
QA Web Index
981017s

Scan Grading	Astrometry	Log File
Photometricity	Tracking/Stepping	Observers Log
Bkg/Seeing/Focus	Jumps/Airglow	V2 QA Web Pages
Galaxies	Nightly Overview	V2 QA Review

Diagnostic Plots

Zero Point Default	Seeing Shape & Ratio	Pos Reconst. Qual	Chisq/Sig Plots	Hess Plots	Galaxy Monitor
Overlaps Summary	Meteor Blanking	R1:R2 Diff Monitor	PSF/Ap Mags	In/Cross Scan Color	V2 Deltas
Sensitivity	Astrom Wander	Distortion Monitor	R1:R2 Satur Phot	Saturated Color-mags	Plot Info

Error summary

filename	line #	error type	error message
input.c	2169	scan number not in list	data in updatesit for unknown scan#75 v2 grade=0
input.c	2169	scan number not in list	data in updatesit for unknown scan#76 v2 grade=0

Return to Main Index

Last run: Wed Oct 31 15:38:25 2001

Version 010829 (3.1); more info is at SCANSCI Notes

Mail comments/bug reports to hurt@ipac.caltech.edu

2MASS Pipeline 3 QA Report
Quad Jump/Airglow/Planet Hazard
981017s

Quadrant Jump/Banding Summary

Scan#	Type	Jump counter J	Jump counter H	Jump counter Ks	Planet hzrds	Cnoise 3sig J	Cnoise 3sig H	Cnoise 3sig Ks	Cnoise(4) J	Cnoise(4) H	Cnoise(4) Ks	J Banding L hi	J Banding R hi	J Banding L lo	J Banding R lo	H Banding L hi	H Banding R hi	H Banding L lo	H Banding R lo	Ks Banding L hi	Ks Banding R hi	Ks Banding L lo	Ks Banding R lo
007	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	0	0	0	0	0	0	0	0	0	0	0
008	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	0	0	2	0	0	0	1	0	0	0	1
009	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	0	0	0	0	0	0	0	0	0	0	0
010	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	0	0	1	0	0	0	1	0	0	0	0
011	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	0	0	0	0	0	0	0	0	0	0	0
012	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	0	0	1	0	1	0	2	0	0	0	0
013	SUR	0	0	0	0	0	0	0	0.500	0.200	0.400	0	0	0	2	0	0	1	2	0	0	1	1
014	SUR	0	0	0	0	0	0	0	0.600	0.200	0.400	0	0	1	2	0	0	2	1	0	0	1	0
015	SUR	0	0	0	0	0	0	0	0.800	0.300	0.300	1	0	3	2	0	0	2	1	0	0	2	1
016	SUR	0	0	0	0	0	0	0	0.600	0.300	0.500	0	0	1	2	0	0	0	2	0	0	1	5
017	SUR	0	0	0	0	0	0	0	0.600	0.100	0.500	0	0	1	1	0	0	0	3	0	0	1	4
018	SUR	0	0	0	0	0	0	0	0.500	0.200	0.400	0	0	0	2	0	0	2	1	0	0	1	1
019	SUR	0	0	0	0	0	0	0	0.600	0.100	0.300	0	0	0	5	0	3	3	10	0	0	0	6
020	SUR	0	0	0	0	0	0	0	0.600	0.200	0.300	0	0	0	2	0	0	2	3	0	0	0	0
021	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	0	0	1	0	0	1	2	0	0	1	0
022	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	0	0	0	0	0	1	0	0	0	1	0
023	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	1	0	3	0	2	1	4	0	0	1	3
024	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	1	1	1	0	1	2	2	0	1	1	1
025	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	0	0	1	0	0	1	3	0	0	0	0
026	CAL	0	0	0	0	undf	undf	undf	undf	undf	undf	0	0	1	1	0	0	2	2	0	0	0	1
027	SUR	0	1	0	0	0	0	0	0.500	0.200	0.300	0	1	0	6	0	2	3	8	0	2	0	5
028	SUR	0	0	0	0	0	0	0	0.500	0.200	0.400	0	0	0	0	0	0	2	2	0	0	0	0

Scan/Frame QA Report Design (3)

2MASS Pipeline 3 QA Report
QA Web Index
981017s

Scan Grading	Astrometry	Log File
Photometricity	Tracking/Stepping	Observers Log
Bkg/Seeing/Focus	Jumps/Airglow	V2 QA Web Pages
Galaxies	Nightly Overview	V2 QA Review

Diagnostic Plots

Zero Point Default	Seeing Shape & Ratio	Pos Reconst. Qual	Chisq/Sig Plots	Hess Plots	Galaxy Monitor
Overlaps Summary	Meteor Blanking	R1:R2 Diff Monitor	PSF/Ap Mags	In/Cross Scan Color	V2 Deltas
Sensitivity	Astrom Wander	Distortion Monitor	R1:R2 Satur Phot	Saturated Color-mags	Plot Info

Error summary

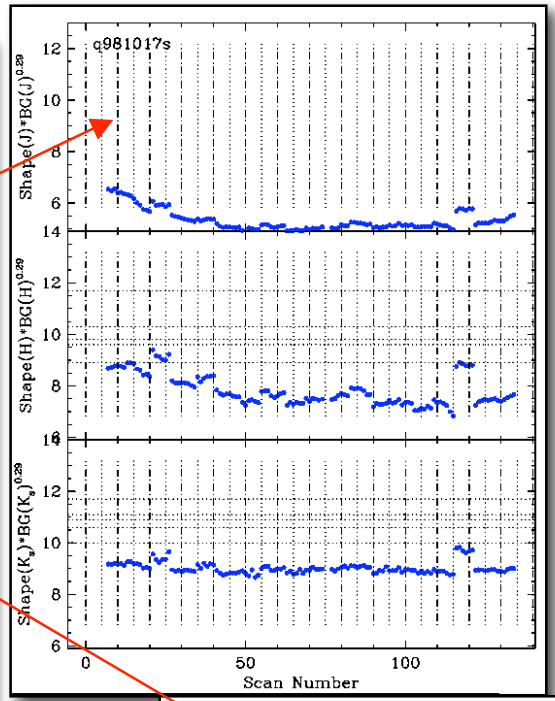
filename	line #	error type	error message
input.c	2169	scan number not in list	data in updatesit for unknown scan#75 v2 grade=0
input.c	2169	scan number not in list	data in updatesit for unknown scan#76 v2 grade=0

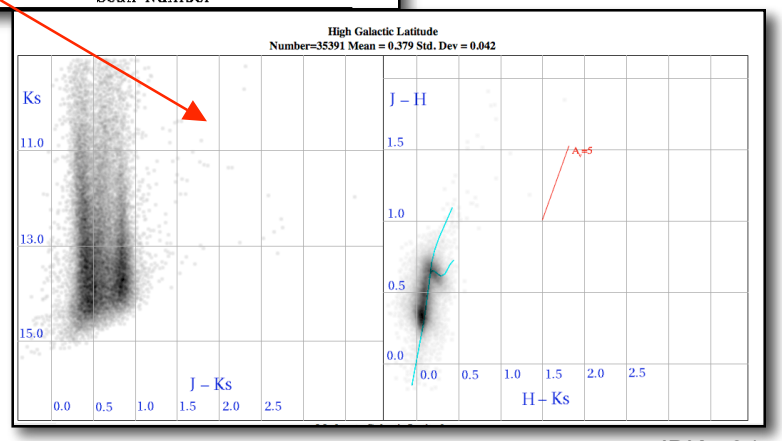
Return to Main Index

Last run: Wed Oct 31 15:38:25 2001

Version 010829 (3.1); more info is at SCANSCI Notes

Mail comments/bug reports to hurt@ipac.caltech.edu





Scan/Frame QA Report Design (4)

Online | Ready for Review | Being Reviewed
Submitted | Ready for Cleanup | Pending Queries
Northern Nights | Southern Nights | All Nights

2MASS Final Processing QA Review Status

Night	Rev		Prod Status	Reviewer	Review Status	Other Notes
980925s	QA	archived	010926	raymond 010924	approved 011001	
980926n	QA	archived	011030	davy 011029	approved 011102	
980927n	QA	archived	020206	raymond 020206	approved ------	orig rev davy ------
980927s	QA	archived	010926	hurt 010926	approved 010928	position reconstruction problems i
980928s	QA	archived	020204	nelson 020204	approved 011001	orig rev raymond 010926
980929n	QA	archived	011031	nelson 011031	approved 011102	
980929s	QA	archived	010927	davy 010926	approved 011001	
980930n	QA	archived	011101	hurt 011101	approved 011105	
980930s	QA	archived	020207	nelson 020206	approved 011001	orig rev davy 010928
981001n	QA	archived	011030	cxu 011029	approved 011101	
981001s	QA	archived	010927	davy 010926	approved 011001	
981002n	QA	archived	011031	cxu 011029	approved 011101	
981002s	QA	archived	010927	davy 010926	approved 011001	
981003n	QA	archived	011031	cxu 011030	approved 011101	
981003s	QA	archived	010927	cxu 010926	approved 011002	
981004n	QA	archived	011030	cxu 011029	approved 011105	priority
981004s	QA	archived	010929	vandyk 010927	approved 011002	
981005n	QA	archived	011031	cxu 011030	approved 011105	
981005s	QA	archived	010927	vandyk 010926	approved 011002	
981006n	QA	archived	011031	davy 011030	approved 011105	priority
981006s	QA	archived	020206	nelson 020206	approved 011002	orig rev davy 010928
981007n	QA	archived	011031	nelson 011030	approved 011105	
981007s	QA	archived	011011	raymond 010927	approved 011015	
981008n	QA	archived	011031	cxu 011030	approved 011106	
981008s	QA	archived	020206	nelson 020206	approved 011002	orig rev raymond 010928
981009n	QA	archived	011031	cxu 011031	approved 011106	
981009s	QA	archived	020206	nelson 020206	approved 011002	orig rev davy 010928
981010n	QA	archived	011101	nelson 011031	approved 011106	
981010s	QA	archived	010928	cxu 010927	approved 010928	priority
981011n	QA	archived	011106	raymond 011102	approved 011106	
981011s	QA	archived	011002	hurt 011001	approved 011002	
981012n	QA	archived	011102	hurt 011101	approved 011106	priority
981012s	QA	archived	011002	hurt 011002	approved 011002	
981013n	QA	archived	011101	nelson 011031	approved 011106	
981014n	QA	archived	011102	hurt 011101	approved 011107	
981014s	QA	archived	011001	hurt 010927	approved 011003	
981015n	QA	archived	011105	nelson 011104	approved 011107	rerun after dropping scan 098 from
981015s	QA	archived	011003	davy 011002	approved 011003	
981016n	QA	archived	011106	nelson 011104	approved 011106	priority
981016s	QA	archived	011002	vandyk 010928	approved 011004	
981017n	QA	archived	010929	davy 010928	approved 011004	
981018s	QA	archived	011003	cxu 011002	approved 011004	
981019n	QA	archived	011102	hurt 011102	approved 011107	priority
981019s	QA	archived	011002	raymond 010928	approved 011004	
981020n	QA	archived	011102	nelson 011102	approved 011107	
981020s	QA	archived	011001	cxu 011001	approved 011004	
981021s	QA	archived	011003	davy 011003	approved 011004	
981022s	QA	archived	011002	cxu 011001	approved 011004	
981023n	QA	archived	011105	hurt 011105	approved 011107	priority
981023s	QA	archived	011003	davy 011002	approved 011004	priority
981024s	QA	archived	011003	hurt 011001	approved 011002	priority
981025s	QA	archived	011002	cxu 011001	approved 011008	
981026s	QA	archived	011003	hurt 011002	approved 011008	
981027n	QA	archived	011106	nelson 011105	approved 011106	
981027s	QA	archived	011003	davy 011003	approved 011015	
981028n	QA	archived	020205	hurt 020204	approved ------	orig rev nelson ------
981028s	QA	archived	011017	hurt 011003	approved 011018	some star halo meteor blanking art
981029n	QA	archived	011103	hurt 011102	approved 011107	
981029s	QA	archived	011004	davy 011003	approved 011009	
981030s	QA	archived	011002	hurt 011001	approved 011009	
981031s	QA	archived	011001	cxu 011001	approved 011002	
981101n	QA	archived	011106	hurt 011105	approved 011106	
981101s	QA	archived	011003	raymond 011001	approved 011015	
981102n	QA	archived	011106	hurt 011105	approved 011106	

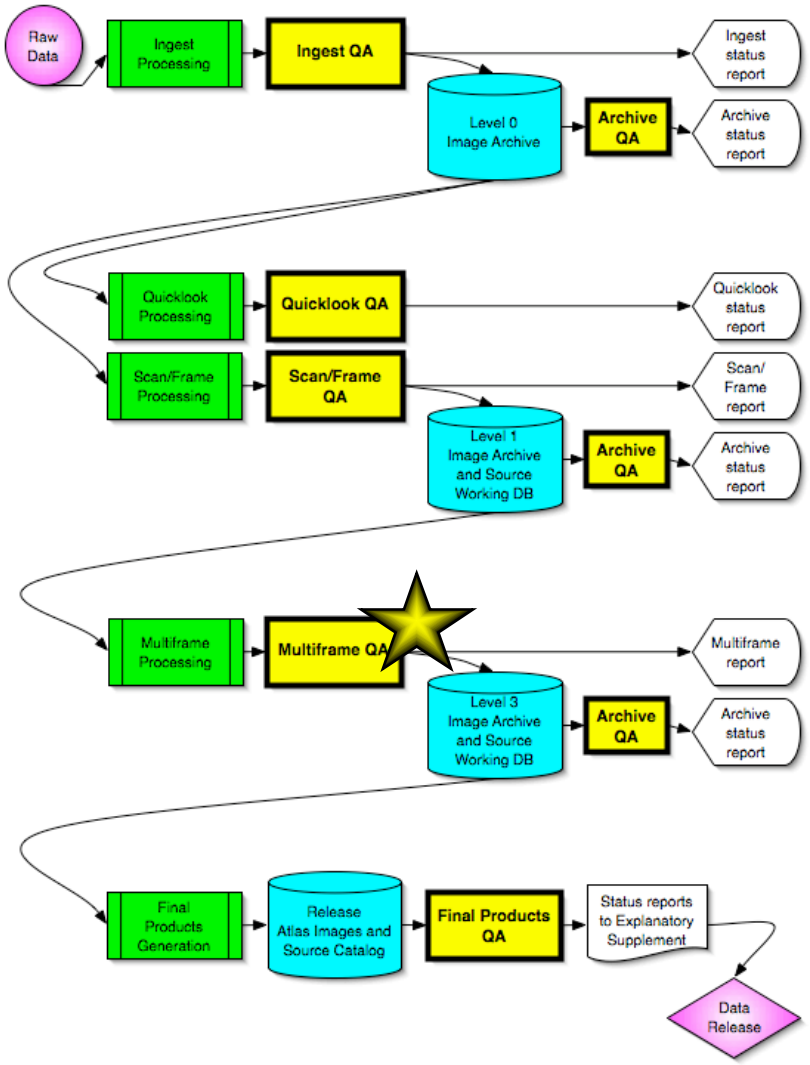
```
981017s [v3]

This night has two scans that will need to be flagged to assure that their
noted astrometric problems are factored into their final astrometric errors.


http://2massqa.ipac.caltech.edu:9000/data/2mass/1gos_v3/qa981017s/


Processing notes:
-----------------

Scans failing processing: None.

Minor planet ID's: Two low-numbered asteroids predicted and both found --

|scn|psID    |Name              |RA          |Dec       |
 014    8521 (238)       Hypatia  329.664377   -6.891632
 033    5658 (212)         Medea  331.222679   -8.601501


Photometricity:
---------------

Calibration strategy: New

CALMON overrides: None.

CALMON passes entire night with a solution in all three bands that approximates
a constant fit.

Overlaps plots: Scatter is low in all sci blocks. Biases are near zero at J
and H but are positive, though only at the 0.01 mag level, at Ks.

In summary,

      Scans      Phot. quality factor
      -------    --------------------
      013-020      1.0
      027-034      1.0
      041-048      1.0
      055-062      1.0
      069-074      1.0
      083-089      1.0
      096-102      1.0
      109-115      1.0
      122-128      1.0


Backgrounds/Coadds:
-------------------

Background plots: These all look very stable. (I love southern data!)

Meteor blanking: Scan 015 (fr 126) contains a meteor with three parallel
trails, and these were all cleaned successfully. A partial-frame meteor
in scan 016 (fr 39) is also cleaned out completely. Scan 017 (fr 124) has
two parallel meteors, only one of which is caught; the one missed is so
faint that it does not create any false sources. Scan 018 (fr 144), scan
061 (fr 243), and scan 113 (fr 253)  contain partial-frame meteors which are
successfully cleaned.

Jump Counters:  All OK

Airglow/Coadd Noise:  All OK

Marginal Airglow/Coadd Noise:  All OK


Seeing Diagnostics:
-------------------

Extensive Untracked Seeing:  All OK

Marginal Seetracker Scores:  All OK

Bad 2nd image moment ratios:  All OK


Astrometry Diagnostics:
-----------------------

Astrometric wander [blue]: The dec.dpos file for 014 vs 015 shows that RA is
displaced by 0.3" for the entire run of Decs. Interestingly, the dec.dpos files
for the two pairs on either side of this (013 vs 014 and 015 vs 016) show
delta RA's which sit perfectly on zero. Howard has looked at comparisons with
UCACr7, and it appears that both scans (014 and 015) are discrepant by about
the same amount. Both of these scans will need to be flagged so that their
final astrometric errors reflect this. This is by far the largest wander
seen on this night; all others look fine.
```

```
Global astrometry [blue]: These look fine.

Scan tracking warnings: NONE


Science Diagnostics:
--------------------

Photometric diagnostics [yellow]: Photometric sigmas show the usual families.
Chi-squared values sit very close to 1.0 for all mags. Photometric linearity
look very good except for the ~0.02 mag bias at the eastern edge of the array
for faint Ks sources. All other plots look fine.

Galaxy diagnostics [orange]: These look fine.


Quality Recommendation:
-----------------------

Sci scans:  (max score = 10; using min of fct's)

                      fct1 fct2 fct3 fct4 fct5
      Scans    Grade  phot sens see  untr airg
      -------  -----  ---------------------
      013-020   10     1.0  1.0  1.0  1.0  1.0
      027-034   10     1.0  1.0  1.0  1.0  1.0
      041-048   10     1.0  1.0  1.0  1.0  1.0
      055-062   10     1.0  1.0  1.0  1.0  1.0
      069-074   10     1.0  1.0  1.0  1.0  1.0
      083-089   10     1.0  1.0  1.0  1.0  1.0
      096-102   10     1.0  1.0  1.0  1.0  1.0
      109-115   10     1.0  1.0  1.0  1.0  1.0
      122-128   10     1.0  1.0  1.0  1.0  1.0


Cal scans:  (non-photometric = 0, photometric = 10)

      Scans    Grade  Notes
      -------  -----  -----
      007-012   10
      021-026   10
      035-040   10
      049-054   10
      063-068   10
      077-082   10
      090-095   10
      103-108   10
      116-121   10
      129-134   10


Untracked Seeing Overrides: NONE


Missing Scans:

      Scans      Notes
      -------    -----
      075-076    v2 Q=0


Version 2 Differences:
----------------------

Delta Plots [red]: Zero-points show only expected changes. PSP values show
almost no change at all. Source counts change by up to 60% but are as usual
anti-correlated with source density.

Degraded scores: NONE

Improved scores: NONE


Special Notes:
--------------

None.

SCANSCI Version 010829 (3.1) last run on Fri Sep 28 06:33:13 2001
```

Final QA grades

Functionality: Multiframe QA

- Purpose:
  - To check for successful completion of Multiframe pipeline processing.
  - To scrutinize output of processing pipeline.
  - To compare achieved performance to science metrics tied to mission science requirements.
- Timescale:
  - Within 15 days for multi-orbit pipeline with >18 coverages.
- Action:
  - For ultimate (not intermediate) coadds, WSDC to assign quality scores to each coadd and produce QA report; PI or his designee responsible for signing off.



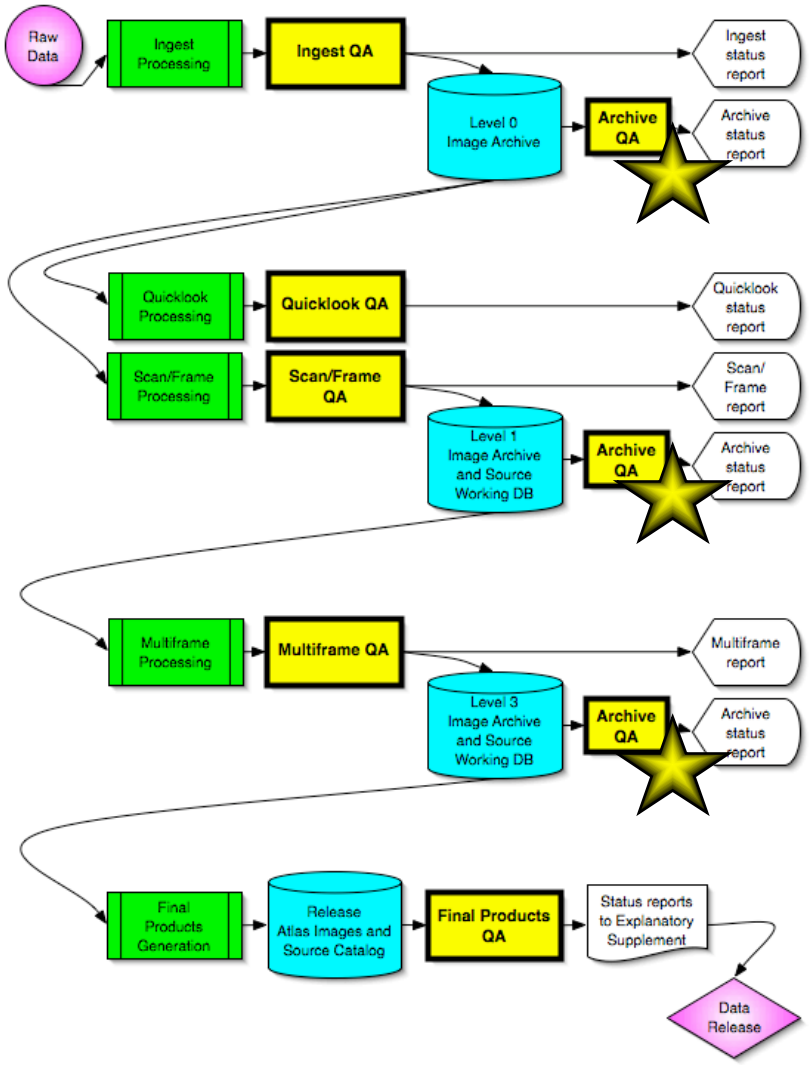
Design: Multiframe QA

Same as the Scan/Frame QA design, with the following additions/deletions:

- Summary of input data
  - Summarize QA grades for each scan considered for image stacking.
- Source characterization
  - Perform semi-automated visual checks of registered coadds.
- Astrometric calibration
  - Plot deltas with respect to 2MASS and individual scan astrometry; scrutinize sources with large deltas.
  - Plot astrometric error per axis as function of source SNR.
- Photometric calibration
  - Tabulate/plot zero-point differences for scan-to-scan overlaps.
  - Plot Level-1 photometry vs. deep coadd photometry to check for photometric self-consistency and depth of extractions.
- Artifact identification
  - Check additional artifact flagging from extra-scan info.
- No solar system object checks needed

Functionality: Archive QA

- Purpose:
  - To validate accuracy of source/metadata database loadings.
  - To verify integrity of database tables and images (using, e.g, checksums and RTB queries).
- Timescale:
  - After each database load (roughly once per week).
  - Run periodically on static tables.
- Action:
  - WSDC reports status of checks and responds to problems (in concert with IRSA, where applicable).

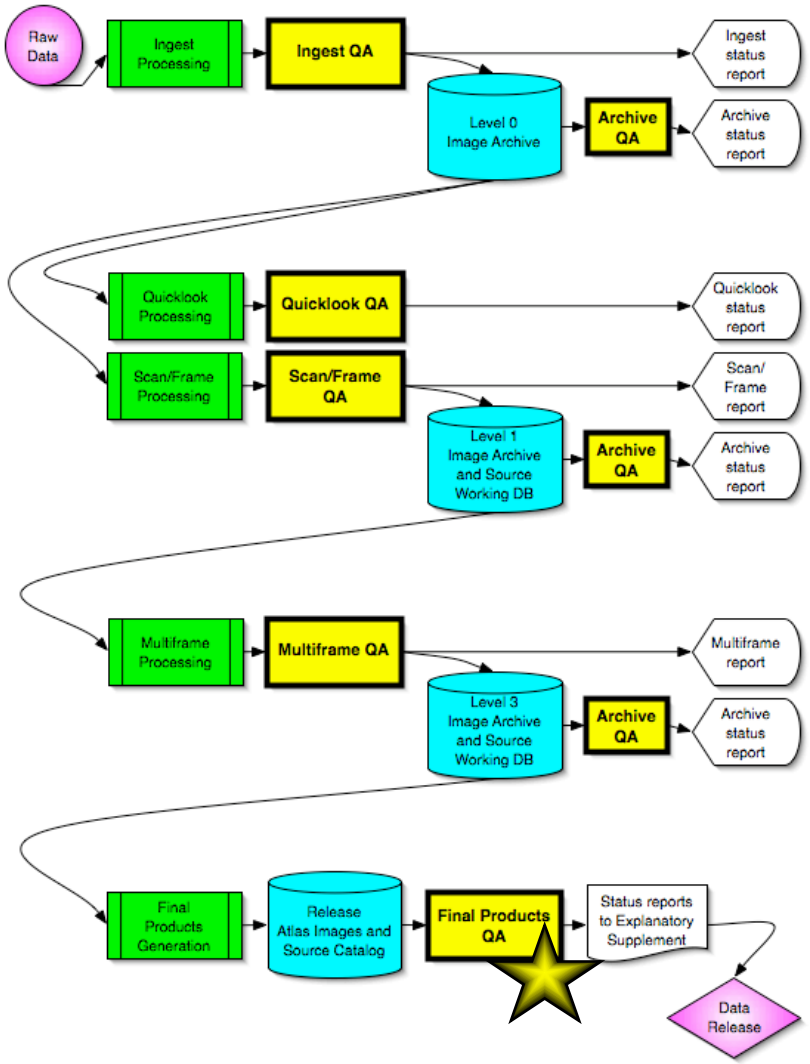


Design: Archive QA

- Perform checksums on the following:
  - Working databases.
  - Source catalogs.
  - Image archives.
  - Image metadata.
  - Any ancillary archives such as QA score archive or calibration archive.
- Perform range checking of the same databases, catalogs, and archives.
- QA summary
  - Report status of each check.
  - Provide web-accessible page with summarized results.

Functionality: Final Products QA

- Purpose:
  - To assess properties of the Atlas Images and Source Catalogs relative to mission Level 1 and 1.5 science requirements.
  - To check integrity of the products via range checking on all parameters.
  - To give overall characterization of public data products.
- Timescale:
  - After Final Product Generation but before public release.
- Action:
  - WSDC and Science Team to provide analyses; final release approval given by PI.



Design: Final Products QA (1)

- Source Catalog
  - Plot histogram of N-out-of-M (N/M) statistics for multiple epochs for internal checks of completeness and reliability; scrutinize cases with low N/M values.
  - Check photometric variability statistics; scrutinize outliers.
  - Check astrometric variability statistics (moving objects); scrutinize outliers.
  - Perform cross-correlations with other catalogs; scrutinize sources in each catalog that have no association in the other.
  - Perform range checking on all columns.
  - Using deeper Spitzer Space Telescope data at similar wavelengths (IRAC-ch1, IRAC-ch2, IRAC-ch4/IRS-blue-PU, and IRS-red-PU/MIPS-24um) and multi-repeat WISE scans at the ecliptic poles, determine completeness of catalog as a function of SNR and check with respect to science requirements.
  - Using the same data sets as above, determine reliability of catalog as a function of SNR and check with respect to science requirements.
  - Plot log(N)-log(S) against mean scan noise level or SNR.
  - Plot saturated star mag/flux estimates against ramp saturation flag.
  - Compare color-color diagrams for objects saturated in any band and compare against fiducial color loci to check saturated mag estimates.
  - Plot astrometric error per axis as function of source SNR.

Design: Final Products QA (2)

- Image Atlas (data images, depth-of-coverage mags, noise maps)
  - Confirm FITS standard.
  - Confirm that photometric zero points are correct.
  - Overlay images on outside image source data (2MASS All-Sky Atlas Images) to check astrometry.
  - Perform range checking on header values; check that pixel grid is the same for all images and all wavelengths.
  - Determine areal coverage for 8+-deep coverage areas and check against science requirement. Build up survey coverage statistics.
  - Using header info, determine epoch difference between first and last observation and check against science requirement.
  - Summarize reports of QA analyses for Explanatory Supplement.

2MASS Heritage: Final Products Analysis

	Category	Requirement	Performance
Point Source Catalog			
	Photometric sensitivity	10-σ at **15.8, 15.1, 14.3 mag** at J, H, K_s respectively for |b|>10°	met for full unconfused sky; exceeded for most of sky
	Photometric uniformity	**<4%** maximum bias in photometric zeropoint around the sky	<2% achieved
	Photometric precision	**<5%** 1-σ for bright stars unsaturated in the 1.3 s exposure	<3% achieved
	Astrometric accuracy	**<0.5″** 1-σ relative to the reference frame	<0.1″ achieved
	Completeness	**>0.99** at 10-σ sensitivity limits	met
	Reliability	**>0.9995**	0.9997 demonstrated in test areas; no known source of unreliability in excess of specification
	Bright star photometry (Read_1, *rd_flg*=1)	**<2% bias** at Read_1 saturation limit (K_s~4.0 mag) **<5% 1-σ repeatability** at Read_1 faint limit (K_s~8.0 mag) **<10% 1-σ repeatability** at Read_1 saturation limit (K_s~4.0 mag)	<4% at worst 2% achieved 2% achieved
Extended Source Catalog			
	Photometric sensitivity	**10-σ at J<15.0, H<14.2, K_s<13.5 mag**	met
	Photometric precision	**<10% 1-σ repeatability** for H<13.8 mag	7-10% achieved
	Photometric uniformity	**<10%** maximum bias around sky	<4% achieved
	Completeness	**>0.90** for |b|>30°	met
	Reliability	**>0.80** for 10°<|b|<20° **>0.99** for |b|>20°	achieved 0.93-0.95 achieved 0.992-0.995
General Survey			
	Sky coverage	**>95%**	99.998% imaged; 99.5% coverage in point sources; 98% coverage in extended source
Other Information			
	Galactic Plane performance	No Requirements	

g. PSC Bright Source Photometric Precision

The Level 1 Specifications place three requirements on saturated star photometry (specifically "Read_1" photometry).

1. **5% photometric precision for K_s=8.0 mag (meaning just above the "Read_2 - Read_1" 1.3 s exposure saturation threshold (designated by *rd_flg*=1)).**
2. **10% photometric precision for at K_s=4.0 mag (meaning just below the "Read_1" 51 ms saturation threshold (thus, also *rd_flg*=1)).**
3. **No more than 2% bias for K_s>4.0 mag**

There are no Level 1 requirements associated with sources that saturated even the 51 ms "Read_1" exposure (designated by *rd_flg*=3). These sources do have large uncertainties significantly in excess of the Level 1 Specifications for fainter sources.

i. *Bright Star Photometric Precision*

Requirements 1 and 2 are addressed in the Photometric Precision subsection (see VI.1c), which discusses uncertainties derived from repeated observation across virtually the entire flux range observed in 2MASS. The relevant diagram is reproduced in Figure 1 and shows that the uncertainty in the magnitude range 4.0<K_s [mag] <8.0 is substantially better than the 10%/5% requirements in items 1 and 2 above.

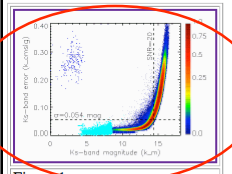


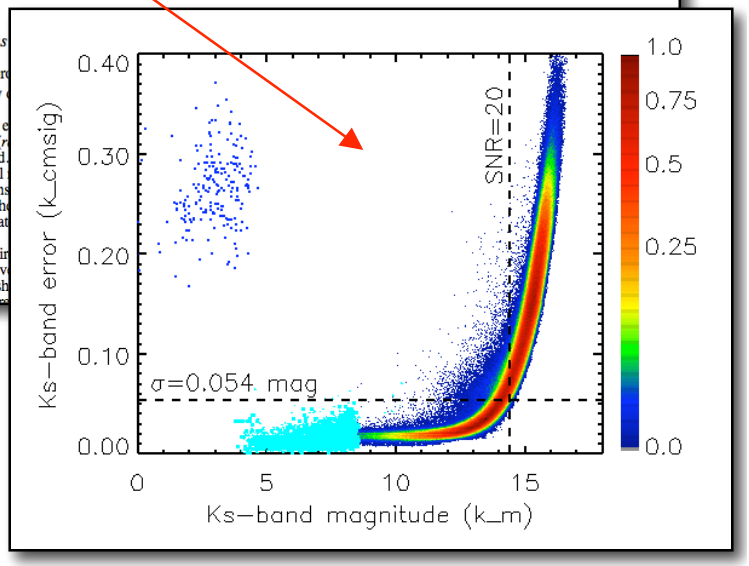
Figure 1

ii. *Bright Star Photometric Bias*

A means has not been found to rigor
mag) regime -- from internal Survey

Bias can be addressed at the "faint"
and the 51 ms Read_1 photometry (*r*
Read_2-Read_1 saturation threshold
magnitude. Figure 2 shows a typical
transition to saturated 1.3 s detections
diagrams show deviation, because th
deviation, because the singly-correlat

Although this result does not bear dir
tied to the 1.3 s frames at the crossov
linear right up to the saturation thresh



QA V&V Matrix: Scan/Frame QA

	Source Catalog														Image Atlas						
Requirement→ QA check↓	Completeness	Reliability	Characterization	Artifact Flagging	Flux Meas/Upper Limits	Flux Uncertainties	Flux Quality Flag	Phot. SNR=5 Limits	Phot. RMS Error	Saturated Photometry	Saturation Limit	Near-Moon Performance	Astrometric Measures	Astrometric Uncertainties	Astrom. RMS Error	Sky Coverage	Coverage Maps	Time Sampling	Common Pixel Grid	Photometric Calibration	FITS Standard	Image Quality
SCAN/FRAME QA												X										
Band detection stats					X																	
Source confusion vs. glat							X															
Saturation vs ramp flag										X												
Color-color plots										X												
Artifact ID checks		X		X			X															
Log(N)-log(S) plots	X																					

QA V&V Matrix: Multiframe QA

	Source Catalog															Image Atlas						
Requirement→ QA check↓	Completeness	Reliability	Characterization	Artifact Flagging	Flux Meas/Upper Limits	Flux Uncertainties	Flux Quality Flag	Phot. SNR=5 Limits	Phot. RMS Error	Saturated Photometry	Saturation Limit	Near-Moon Performance	Astrometric Measures	Astrometric Uncertainties	Astrom. RMS Error	Sky Coverage	Coverage Maps	Time Sampling	Common Pixel Grid	Photometric Calibration	FITS Standard	Image Quality
MULTIFRAME QA																						
Scan detection stats					X																	
Astr. Error vs. SNR															X							
Source confusion vs. glat							X															
Saturation vs ramp flag										X												
Color-color plots										X												
Artifact ID checks		X		X			X															
Log(N)-log(S) plots	X							X	X		X											

QA V&V Matrix: Final Products QA (1)

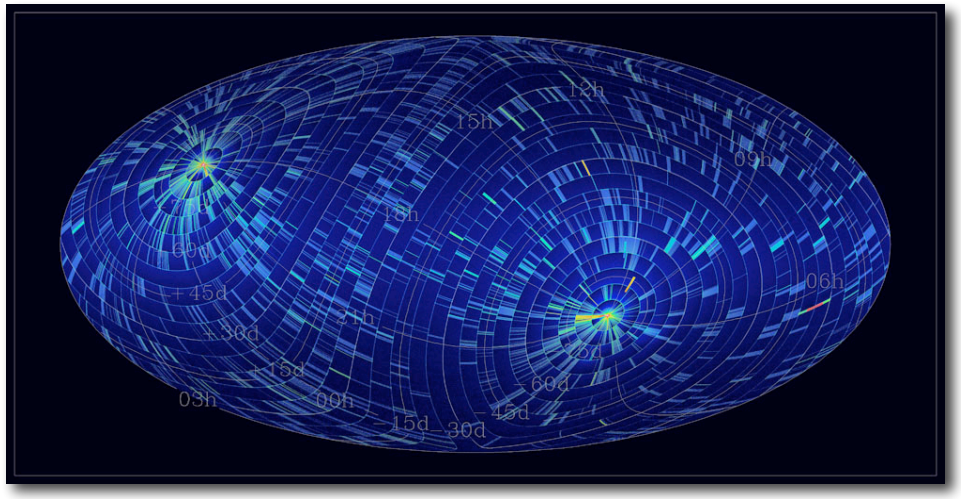
	Source Catalog														Image Atlas						
Requirement→ / QA check↓	Completeness	Reliability	Characterization	Artifact Flagging	Flux Meas/Upper Limits	Flux Uncertainties	Flux Quality Flag	Phot. SNR=5 Limits	Phot. RMS Error	Saturated Photometry	Saturation Limit	Near-Moon Performance	Astrometric Measures	Astrometric Uncertainties	Astrom. RMS Error	Sky Coverage	Coverage Maps	Time Sampling	Common Pixel Grid	Photometric Calibration	FITS Standard	Image Quality
FINAL PRODUCTS QA – Source Catalog																						
Range checking of columns					X	X	X						X	X								
Completeness via truth fields	X		X																			
Reliability via truth fields		X	X																			
Log(N)-log(S) plots								X	X		X											
Saturation vs ramp flag										X												
Color-color plots										X												
Astr. Error vs SNR															X							

QA V&V Matrix: Final Products QA (2)

	Source Catalog															Image Atlas						
Requirement→ QA check↓	Completeness	Reliability	Characterization	Artifact Flagging	Flux Meas/Upper Limits	Flux Uncertainties	Flux Quality Flag	Phot. SNR=5 Limits	Phot. RMS Error	Saturated Photometry	Saturation Limit	Near-Moon Performance	Astrometric Measures	Astrometric Uncertainties	Astrom. RMS Error	Sky Coverage	Coverage Maps	Time Sampling	Common Pixel Grid	Photometric Calibration	FITS Standard	Image Quality
FINAL PRODUCTS QA – Image Atlas																	X					
Confirm FITS standard																					X	
Phot. Zero point check																				X		
Range checking of headers; pixel grid check																			X			
Build survey coverage stats																X						
Compute epoch diff via headers																		X				

Tracking QA Results

We will maintain two tables, one for individual scans and one for coadds, that summarize QA results.



- In 2MASS we had
  - Scan Information Table for normal survey data
  - Cal Information Table for calibration data.
- These contained concise info for each scan
  - Basic scan info (e.g., ID, sky location, date)
  - Telescope telemetry (e.g., dewpoint, temperature)
  - Summarized characterizations of the data (e.g., point source shape parameters, calibration zero-points, mean source density)
  - Quality assessments and final quality scores
- Tables were useful for
  - Performing trending analyses (e.g., seeing shape vs temperature)
  - Deciding which scans to include/exclude as part of final data release.

Anomaly Response Plan (1)

During the QA process, anomalies and problems will be detected that may need response from the EOS, MOS, SOC, WSDC, or WISE Science Team.

- Ingest QA
  - Action: WSDC to inform MOS/EOS and SOC of successful ingest or anomalies via web-accessible report.
  - Tracking: (TBD) MOS/EOS and/or SOC to acknowledge receipt of anomaly report via web form; results of subsequent analyses to be archived by WSDC and made web accessible.
  - Resolution: WSDC will note anomalies on web summary pages; issues may need to be closed with MOS/EOS and/or SOC.

- Quicklook QA
  - Action: WSDC to inform MOS/EOS and SOC of Quicklook runs and anomalies via web-accessible report.
  - Tracking: MOS/EOS and/or SOC to acknowledge receipt of anomaly report via web form; results of subsequent analyses to be archived by WSDC and made web accessible.
  - Resolution: WSDC will close the issue and note it on web summary pages once parties agree that resolution has been reached

- Scan/Frame and Multiframe QA
  - Action: WSDC to report anomalies as part of the normal assigning of scan/frame QA grades. This report will be posted on the web for review by the PI and SOC.
  - Tracking: On the web summary pages, WSDC will mark reviews having outstanding issues and add subsequent analyses by WSDC or SOC to the QA review for curation.
  - Resolution: WSDC will close the issue and note it on web summary pages once the PI or designee concurs that resolution has been reached.

Anomaly Response Plan (2)

- Archive QA
  - Action: WSDC to report problems on web summary pages and to assign action items to internal WSDC or IRSA personnel via those project's ticket systems.
  - Tracking: Tracking will be handled by each project's existing ticket systems.
  - Resolution: WSDC will close issue and note it on web summary pages after concurrence of WSDC/IRSA personnel.

- Final Products QA
  - Action: WSDC to report anomalies to WSDC/IRSA via ticket systems or to SOC via e-mail.
  - Tracking: WSDC to note status of anomaly checking via ticket systems (for WSDC/IRSA-related issues) and via web summary pages.
  - Resolution: WSDC will close the issue and note it on web summary pages once the PI or designee concurs either that a solution has been found or that the anomaly should be characterized and documented for the Explanatory Supplement.

- Anomaly collection via other routes
  - Collect anomalies from WISE Science Team.
  - Collect anomalies from the astronomical community.

QA Development Schedule

- Jun 19, 2008 (version 1.0)
  - Ingest QA prototyped
  - Quicklook QA prototyped
  - Parts of Scan/Frame QA prototyped
  - Scan synch monitor in preliminary state
- Dec 17, 2009 (version 2.0)
  - v1.0 pieces matured
  - Parts of Multiframe QA prototyped
  - Archive QA prototyped
- Jul 7, 2009 (version 3.0)
  - Ingest QA, Quickook QA, Scan/Frame QA, Multiframe QA, Archive QA ready for launch
- Dec 30, 2009 (post-launch)
  - Post-launch tune-ups of the five QA subsystems above
  - Final Products QA prototyped
- Dec 20, 2010 (post-cryo)
  - Final versions of all six QA subsystems mature

Issues/Concerns

- Who is responsible for providing calibration products and tuning parameters from IOC results?
- During IOC will we be able to respond quickly enough to in-orbit differences so that processing timescales stay on schedule?
- Coordination of the parties needed to make anomaly tracking work will need the attention of upper management.

Backup Slides

IOC: QA Tasks w/ Cover On

Although some of the data acquired during IOC will be non-standard with respect to normal operational data, QA tasks will be needed on resultant data products as the integrity of both the data and the pipelines are tested. Such tests will be largely manual activities using custom software and analysis tools.

- Cover-on: Before the cover is released, the temperature of the inner shield of the aperture cover will be high enough that data in W3 and W4 should be saturated. Nonetheless, there are tests that can be made for W1 and W2 data:
  - Test Ingest QA pipeline.
  - Test those portions of the Scan/Frame QA Pipeline that monitor darks, hot pixel masks, and frame noise (for W1 and W2 only).
  - Test saturation pixel flagging (for W3 and W4 only).
  - Check noise characteristics in W1 and W2 for orbits with SAA passages to determine noise thresholds to use during routine QA.

IOC: QA Tasks w/ Cover Off

Cover-off: After the cover is ejected, a series of planned tests will evaluate the performance of the instrument to actual astronomical sources. These data will allow (a) threshold checking needed for nominal QA operations, (b) collection of inputs needed for pipeline tuning, and (b) thorough testing of the scan synchronization monitor:

- Scan Synchronization monitor
  - Test fully.
  - Derive warning thresholds for QA.
- Detector calibration
  - Derive fiducial on-orbit flats. Derive and monitor "low-frequency" flat/responsivity.
  - Derive fiducial on-orbit masks (low-response pixels + hot pixels).
- Photometric calibration initialization
  - Monitor orbit-to-orbit pole passages to check zero-point stability of standard stars.
  - Monitor photometric stability using orbit-to-orbit overlaps.
  - Verify that each standard is still appropriate for use.
  - Derive linearity correction and check (refine?) against ground calibration.
  - Check/refine saturation limits and on-board thresholds.
- Source detection initialization
  - Determine optimal SNR thresholds for detections to meet completeness requirements.
  - Set deblending parameters.
- Bright source artifact mapping
  - Set thresholds for flagging latents, diffraction spikes, dichroic glints, electronic ghosts, and optical ghosts.
- Annealling characterization
  - Check image statistics before and after anneals.
  - Check behavior of latents before and after anneals.
- Avoidance limits
  - Determine practical background limit for processing data near the Moon.
  - Determine SAA charge rate limits for W3 and W4.