Sloan Digital Sky Survey
Quarterly Progress Report
Second Quarter 2004

September 8, 2004

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Q2 PERFORMANCE HIGHLIGHTS

- We obtained 950 square degrees of new imaging data on the Northern Galactic Cap (NGC) against a baseline goal of 434 square degrees (219%).
- We completed 86 spectroscopic plates on the NGC against a baseline goal of 93 plates (92%).
- We obtained 7 plate-equivalents on the Southern Equatorial Stripe. The baseline plan did not forecast observing on the Southern Equatorial Stripe in Q2.
- Weather was in close agreement with the baseline forecast, which helped substantially with our observing yield.
- Observatory operations ran smoothly during the quarter. There were no major system problems.
- All data acquired during the quarter were promptly processed and calibrated. In fact, all data collected to date has been processed and calibrated. The DP factory continues to operate smoothly.
- We released DR3 to the collaboration on May 27. DR3 contains 5,282 square degrees of imaging data (141 million objects) and 528,640 spectra (including 374,730 galaxies). DR3 is available to the collaboration through both the DAS and CAS interfaces. We are on schedule to release DR3 to the general public in early October 2004 in accordance with the approved Data Distribution Plan.
- Through the end of June, the public SkyServer had received 48.4 million web hits and executed 5.5 million SQL database queries. In Q2, we averaged 2.2 million web hits and 577,000 SQL queries per month. Data archive use continues to be heavy, with no unscheduled downtime on our public database system.
- Q2 cash operating expenses were $777K against a baseline budget of $840K (-8%), excluding management reserve. In-kind contributions were $319K against anticipated contributions of $453K (-30%). The APO road improvement project was completed in Q1, but expensed in Q2. Final cost was $43K against an estimated cost of $40K. No management reserve funds were expended.

1. SURVEY PROGESS

1.1 Summary

We observed primarily on the Northern Galactic Cap, with a small amount of spectroscopic data collected on the Southern Equatorial Stripe. On the Northern Galactic Cap, we obtained 950 square degrees of new "unique" imaging data against a baseline goal of 434 square degrees. We also completed 86 plates on the Northern Galactic Cap against a baseline goal of 93 plates, and 7 plate-equivalents on the Southern

Equatorial Stripe against a baseline goal of zero plates. Plate-equivalents are reported to account for the longer exposure times required on special southern program plates. Finally, we spent 6 hours of observing time acquiring Apache Wheel data and 1 hour on an oblique scan.

On average, weather in Q2 was comparable to the baseline forecast. Weather was suitable for observing 63% of the time, compared to the baseline forecast of 60%. Overall, we lost 113 potential observing hours to poor weather. We also lost 8.5 potential observing hours to equipment problems.

1.2 Q2 Imaging

Table 1.1 compares the imaging data obtained against the baseline projection.

Table 1.1. Imaging Survey Progress in Q2-2004

	Imaging Area Obtained (in Square Degrees)			
	Q2-2004		Cumulative through Q2	
	Baseline	Actual	Baseline	Actual
Northern Survey[1]	434	950	7655	7476
Southern Survey[1]	0	0	745	738
Southern Equatorial Stripe[2]	0	0	3430	2755

1. "Unique" area
2. "Good minus Unique" area.

The following graphs show progress against the imaging goals for the Northern Galactic Cap and the Southern Equatorial Stripe. The full set of graphs is available on the SDSS website.

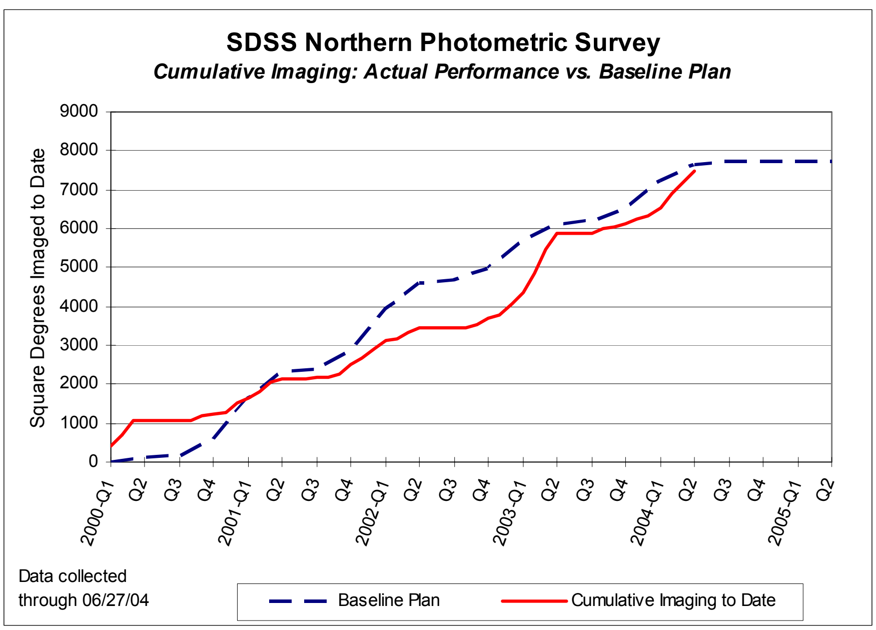


Figure 1.1. Imaging Progress against the Baseline Plan – Northern Survey

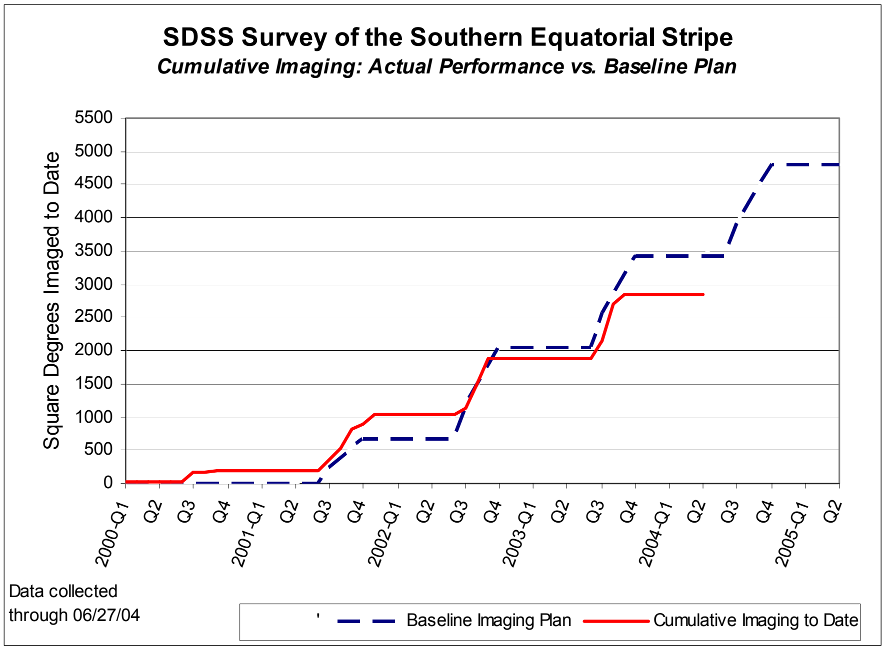


Figure 1.2. Imaging Progress against the Baseline Plan – Southern Equatorial Survey

1.3 Q2 Spectroscopy

Spectroscopic progress is reported in terms of the number of plates observed and declared done during a quarter. Each plate typically yields 640 unique spectra. In Q2, we completed a total of 90 physical plates, of which 4 were special plates associated with the Southern Equatorial Stripe program. Some of the special plates require longer exposure times than standard survey plates. In order to compare progress against the baseline, we apply a scale factor to these plates to determine the number of standard survey plates that would have been observed in the same amount of time. Through this accounting, we would have completed 7 standard-survey plates in the amount of time it took us to complete the four special plates. Combining these 7 "plate-equivalents" with the 86 standard-survey plates observed, we completed a total of 93 plate-equivalents against the baseline goal of 93 plates.

The following graphs show spectroscopic progress against the baseline goal for each survey region. Progress is reported in plate-equivalents for the special program plates, which allows for a direct comparison with baseline goals.

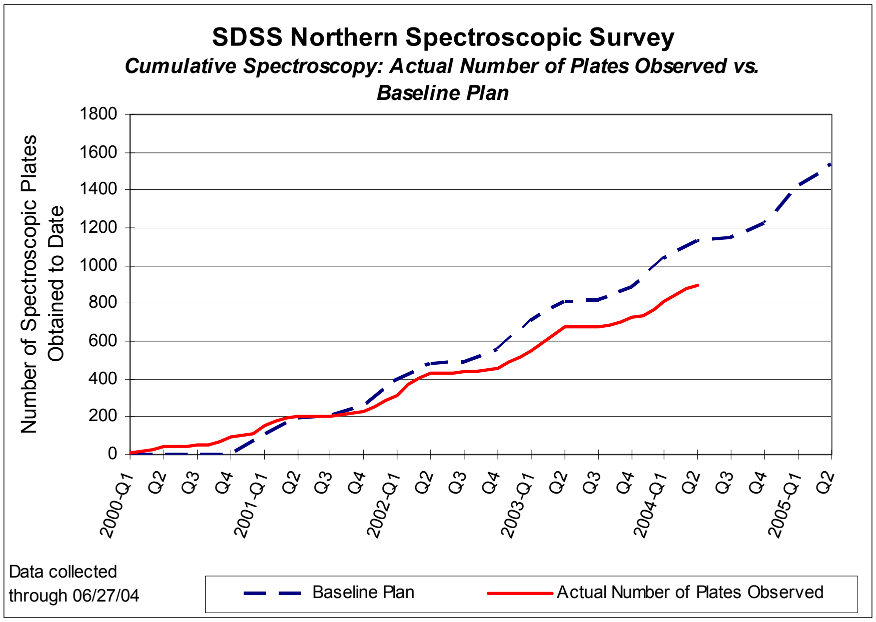


Figure 1.3. Spectroscopic Progress against the Baseline Plan – Northern Survey

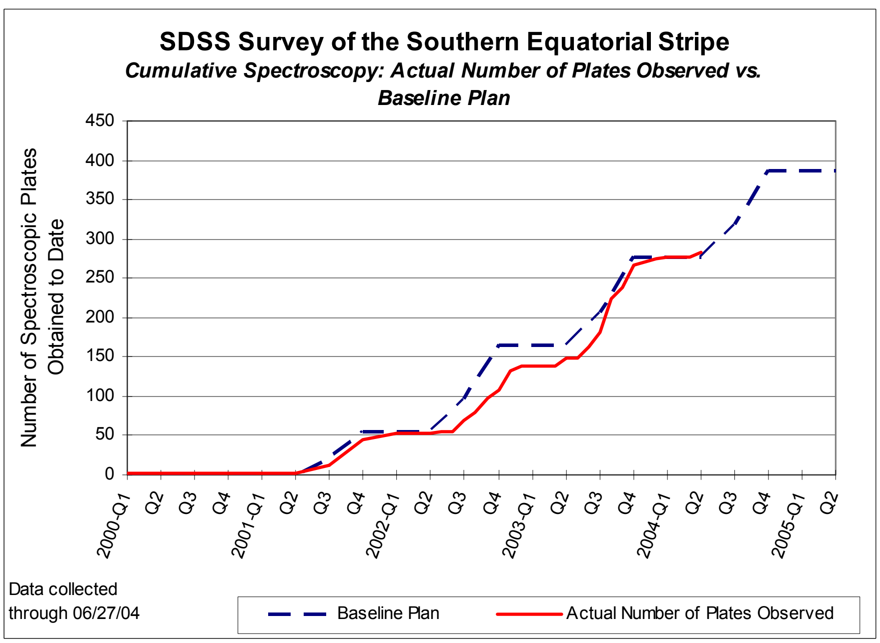


Figure 1.4. Spectroscopic Progress against the Baseline Plan – Southern Equatorial Survey

2.0 OBSERVING EFFICIENCY

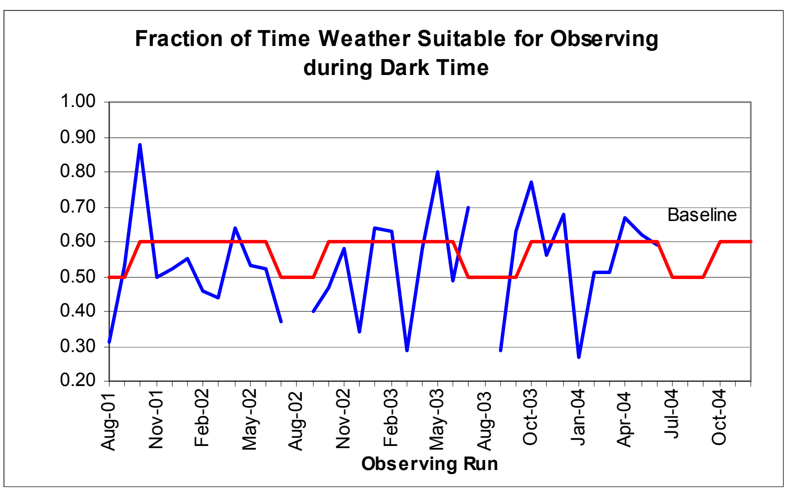
Table 2.1 summarizes the breakdown of observing time in 2004-Q2 according to the categories used to prepare the baseline projection.

Table 2.1. Comparison of Efficiency Measures to the Baseline

Category	Baseline	April Dark	April Dark + gray	May Dark	May Dark + gray	June Dark	June Dark + gray
Total time (hrs)	April:	115:09	153:06				
	May:			99:21	125:12		
	June:					96:10	126:25
Imaging fraction	0.27	0.38	0.34	0.34	0.30	0.35	0.34
Spectro fraction	0.63	0.48	0.48	0.55	0.57	0.55	0.57
Weather	0.60	0.67	0.62	0.62	0.61	0.59	0.52
Uptime	0.90	0.99	1.00	0.94	0.95	0.98	0.96
Imaging efficiency	0.86	0.84	0.84	0.85	0.85	0.83	0.83
Spectro efficiency	0.65	0.67	0.67	0.69	0.66	0.66	0.65
Operations	0.90	0.97	0.96	0.96	0.96	0.96	0.94
Hours lost to problems		0:36	8:38	6:25	6:25	1:31	4:26
Hours lost to weather		37:52	57:32	37:28	48:28	38:30	56:36

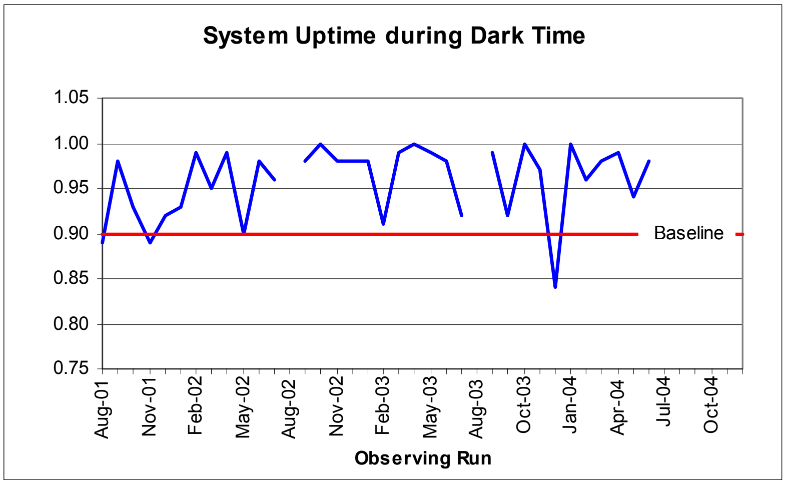
2.1. Weather

The weather category reports the fraction of scheduled observing time that weather conditions were suitable for observing. In Q2, weather was in agreement with the baseline forecast. The overall fraction of time suitable for observing in Q2 was 63%; our baseline expectation is 60%.



2.2. System Uptime

System uptime measures the availability of equipment when conditions are suitable for observing. We averaged 97% uptime in Q2 against a baseline goal of 90%. Uptime performance over time is shown in the following graph.

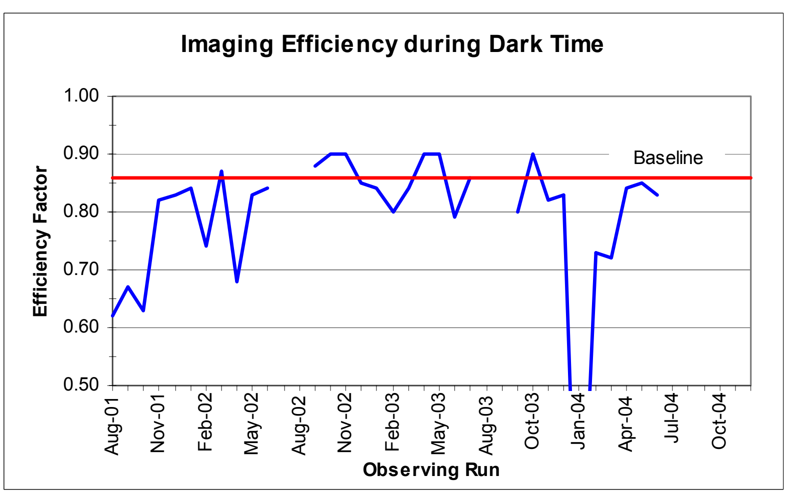


Although we exceeded our baseline uptime goal, we did lose approximately 8.5 hours of observing time to system problems. The most significant problem that resulted in lost observing time was associated with the warm-up of the blue camera (b1) CCD in spectrograph #1 that occurred when a system-requested nitrogen fill was ignored. Shortly before the fill request was initiated, system control had been taken over by a member of the APO engineering team in order to do some system troubleshooting. As a result, the system-generated autofill request was missed and the CCD warmed above normal operating temperature. To ensure there was no contamination on the face of the CCD, it was necessary to fully warm the CCD, pump down the system, and re-cool the CCD. This operation took nearly all night and by the time the system was ready for observing, poor weather had moved in and prevented the observers from opening the telescope. Procedures have been implemented to ensure that such a circumstance cannot happen again.

We also experienced a number of smaller problems that caused difficulty during observing operations but did not result in lost observing time, due to the skill and ability of the observing staff to quickly diagnose problems and implement quick work-arounds.

2.3. Imaging Efficiency

The imaging efficiency ratio provides a measure of observing efficiency and is defined as the ratio of science imaging time to the sum of science imaging time plus imaging setup time. The baseline plan established the imaging efficiency ratio to be 0.86; average imaging efficiency in Q2 was slightly below the baseline at 0.84.



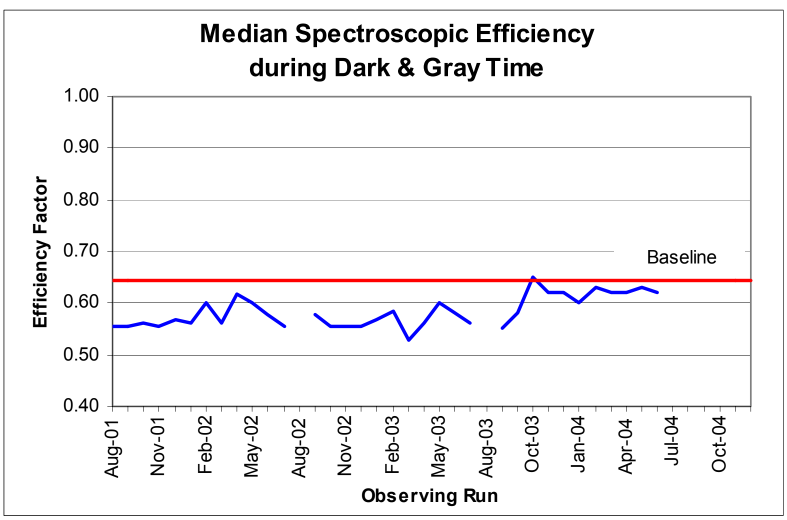
2.4. Spectroscopic Efficiency

Spectroscopic efficiency is derived by assessing the time spent performing various activities associated with spectroscopic operations. Table 2.2 provides the median time, by dark run, for various overhead activities associated with spectroscopic operations. Units for all categories are minutes except for efficiency, which is given as the ratio of baseline science exposure time (45 minutes) to total time required per plate. Using these measures, spectroscopic efficiency averaged 62% in Q2 against the baseline goal of 64%.

Table 2.2. Median Time for Spectroscopic Observing Activities

Category	*Baseline*	*Run starting Apr 8*	*Run starting May 9*	*Run starting Jun 7*
Instrument change	10	4	4	7
Setup	10	14	13	12
Calibration	5	6	6	6
CCD readout	0	3	3	3
Total overhead	25	27	26	28
Science exposure (assumed)	45	45	45	45
Total time per plate	70	72	71	73
Efficiency	0.64	0.62	0.63	0.62

The following graph shows spectroscopic efficiency over time.



3. OBSERVING SYSTEMS

In addition to addressing the problems described in Section 2.2, we addressed a number of additional issues and completed a number of planned engineering tasks and preventive maintenance activities.

The spectroscopic guider system failed to operate during shakedown testing for the May run. After several hours of troubleshooting and debugging, it was discovered that a required file on the guider Macintosh computer had been corrupted. It is still not clear what caused the file corruption or when exactly it occurred; fortunately, the problem has not re-occurred.

A lightning strike occurred near the observatory in late June, near the end of the dark run. While not a direct hit to any observatory structure, the strike caused the following problems that interrupted operations:

- The ad3 FOXI in the camera refused to send data until it was power cycled.
- The VCQ VME display cards for the spectrographs and PT stopped working. A spare unit was installed but found to be dead as well. Additional spare cards were sent from Fermilab via overnight mail and installed in the system.
- The spectrograph DA stopped responding to the watcher, which caused the watcher servers to crash. Rebooting the crate and sdsshost restored the DA and watcher.

After all systems were made functional, bias measurements were made with all of the instruments. The data indicate that the strike did not impose any permanent damage on any SDSS instruments or systems.

3.1. The Instruments

In early April, we discovered the source of spurious stray light that was affecting data quality, particularly in spectrograph 2. Sections of the material intended to form a light-tight seal between cartridge slitheads and the spectrographs had come off on three of the nine cartridge assemblies. The material was replaced and the problem mitigated. Periodic inspection of the material has been added to the preventive maintenance program.

A spectrograph CCD electronics test set was designed, fabricated and implemented in May. The system will allow us to better test and troubleshoot components associated with the spectrograph cameras and data acquisition system. The system includes a box to test the spectrograph microprocessor and aux boards from the control chassis, though we did not implement any way to test the secondary LN2 system. There is also a saddlebag setup for testing power distribution signals and the bus receiver, sig-bias and preamp/clock-driver boards. The system was used to successfully check out a full set of circuit boards, including taking a test frame with SOP and the spectrograph DA.

Work was done on the imager calibration system, in preparation for planned summer shutdown activities. Through testing we discovered that the micrometer on the imager monochromator was broken. The unit was sent to Japan, where the JPG promptly repaired the unit and returned it to APO.

3.2. The 2.5m Telescope

This quarter's engineering work was predominately consumed by responding to system problems and work in preparation for the coming summer engineering shut-down. The following summarizes the various projects, tasks and activities performed during this quarter.

- Testing determined that, under certain circumstances, the imaging camera doghouse (the enclosure used to store the imaging camera) can become an Oxygen Deficiency Hazard (ODH). In addition, the doghouse meets the criteria for a confined space. Accordingly, new signs have been installed on the doghouse identifying the area as a confined space and potential ODH environment. New procedures were put into place to control access and mitigate or reduce the level of oxygen depletion when access is required.

- We began work on the M1 Galil enclosure upgrade. We employed the PC board fabrication capacity we developed at APO in Q1 to create new PC boards and connection setups. The new design minimizes space requirements and increases the robustness of the cabling and connectors between the controller, its amplifiers and the actuators. The new system also incorporates a modular design to make maintenance easier. Installation of the new system is scheduled for the summer shutdown.

- Work began on a moth ejector system for the altitude and azimuth axes encoders. During moth season, moths land on the drive disk and get run over by the drive encoders, causing problems in the telescope drive system. The moth ejector system utilizes a pulse of air directed at the contact point between the encoder capstans and their axes drive surfaces. Installation will occur in the Q3.

- Larger pneumatic control valves were installed on the altitude and azimuth axes brakes to increase air flow rate. This was done to ensure proper control of these brake systems at low ambient temperatures. An additional benefit is improved control of the azimuth brake at all temperatures.

- Due to its weight, the windbaffle isolation transformer is causing cracks in the lower level floor of the 2.5m telescope enclosure. A one-half inch thick aluminum plate was installed between the transformer and the floor in order to better distribute the weight.

- We began experiencing noise problems that appeared to be associated with the “sig/bias” boards for the R2 spectrograph camera. Testing determined that the problem was associated with preamps located inside the camera dewar; these are inaccessible until summer shutdown.

- A major spectrograph light leak was discovered at the beginning of the quarter. The light leak was traced to gaps in the bottom of cartridges #6, #7, and #8. A short-term fix was applied to seal the gaps. During the summer shutdown, all cartridges will be examined and permanent repairs made.

- The “Snoopy House” enclosure for the imager calibrator was finished and calibrator testing was conducted. A series of problems associated with the calibrator were discovered during system testing. The monochromator micrometer adjustment and the manual adjustment for the X-Y stage both required repairs. A slew of additional problems were found to be caused by faulty optical-digital converters. These were replaced, the actuators repaired, and by quarter’s end the system was working properly. The system will be used to conduct imager calibration tests during the summer.

- Spectrograph focus problems occurred during the quarter. Testing indicates that components associated with the B1 camera may be moving with telescope position. During the coming summer shutdown, we plan to disassemble the unit to find and correct the problem.

- The power supply for the PT flat field lamps failed and was replaced. The failure appears to be associated with system aging.

- The M2 Galil daughter board was replaced after it was discovered that one of its ICs was failing to deliver the required voltages to the Piezo controller.

- The astigmatism actuator controller was given a major upgrade when its interior plumbing was reworked. The system is now more robust and will be much easier to service in the future.

- The LN2 auto-fill lines between the intermediate and primary dewars on the imager were upgraded from Teflon hose to stainless steel braided lines. This was done to repair leaks caused by longitudinal cracking in the Teflon lines.

- A major step forward in completing the spare parts inventory was accomplished with the spare parts conference held at APO. A web-based database system has been initiated and physical locations of parts have been linked to this database. Identification of additional spare parts needed has begun.

- Preliminary work has been conducted to determine the cost of insulating the bottom of the telescope pier in order to eliminate possible seasonal telescope tilting due to temperature differentials across the pier. Utilizing a tilt meter provided by Fermilab, the telescope azimuth axis was shown to be off its vertical axis by 45 arcs to the east-northeast.

- In May, the #2 altitude Glentek amplifier exhibited a voltage offset that produced a torque in the #2 altitude motor, consequently producing an upward drift on the altitude axis when the axis was commanded to stop. One of the spare amplifiers was installed and the system promptly returned to normal operation. We have not been able to determine the cause of the failure in the original amplifier. Fortunately, there is a second spare Glentek amp on hand, while we continue to troubleshoot the problem with the original amplifier.

- We experienced collimation problems with the 2.5m telescope primary mirror (M1) during the quarter. Unfortunately, we do not have an adequate means of determining precisely where M1 is located, which in turn hampers our ability to determine which direction to move M1 for proper collimation. Therefore, when M1 is removed in late August for re-aluminization, pads will be installed to facilitate measuring M1 position with depth micrometers. Also, upon replacement of M1 into the PSS after re-aluminization, we will perform a complete three-axis physical collimation and, in conjunction with installation of the new micrometer pads, establish a set of collimation measurements for future reference.

- The power supply in the counterweight controller failed during the quarter. The spare controller was installed and the original repaired, tested, and placed back into the spares inventory. The cause of the failure is not clear; we suspect it may simply be system aging.

- As the warm weather approached the altitude fiducial system became problematic. Tests confirmed that the gap between the altitude fiducials and read head had decreased to below its acceptable limit. To preclude this problem in the future, we plan to fabricate a new read head bracket that will reference the read head position relative to the altitude drive disk. This will follow the design of the new azimuth read head bracket that was installed during the past year and solved a similar problem on the azimuth fiducial system. The new altitude bracket will be fabricated and installed in Q3.

- During a scheduled PM inspection of the plugging station, we discovered fraying on the lift actuator cable. Subsequent analysis determined that the pulleys used in the cable system are undersized for the cable being used. The existing cables have been in the system for several years, so for the short-term, a new cable was ordered and installed. However, to prevent future problems, we are redesigning the system to incorporate larger pulleys. Redesign work has already started, with the new system scheduled for installation in the third quarter.

- Work began on an azimuth motor removal system, which will be used to aid in the azimuth motor bearing replacement that will occur during summer shut-down. We also identified a grinding vendor who can regrind the motor shafts after new bearings are installed onto the shafts. Fabrication of a grinding fixture is required and so a PO was issued to begin this work.

- The flexible couplings for the spectrograph collimation mirror actuators were redesigned to eliminate collimation mirror positioning problems. The new couplings have been fabricated and will be installed during the summer shut-down.

3.3. The Photometric Telescope

There are no significant problems to report with the Photometric Telescope (PT). We observed patches for the standard program and continued experimenting with using the PT for follow-up observations of new supernova discoveries. Summer shutdown work will include re-aluminizing the PT primary mirror and performing miscellaneous PM activities.

3.4. Operations Software and the Data Acquisition System

There were no problems with the data acquisition system that prevented us from acquiring data. We continue to have occasional problems with the PTVME link, but existing workarounds keep these problems from affecting our ability to collect data. A permanent solution to this problem will be incorporated into the planned DA upgrade.

Regarding the DA upgrade, we held a DA upgrade workshop in June that brought together the original system designers, the APO computer systems manager, members of the observing and engineering teams, and project management. The purpose of the meeting was to review system reliability and maintainability; the principal concerns are system aging and component obsolescence. We also discussed new system requirements associated with possible operations beyond mid-2005. As a result of the workshop, three potential upgrade options were identified and preliminary work plans developed:

- Option A involves replacing the Motorola MVME167 boards in the DA system with MVME177 boards. The 167 boards are no longer available; 177s are expected to be available for a couple more years. The advantage of this option is that it requires no software modifications; the disadvantage is that it merely postpones the obsolescence and parts availability concern by a couple of years.
- Option B involves replacing the 167 boards with VME PCs. Some new code will be required to emulate some of the 167 functions on the new platform; however, if the majority of the existing DA software ports to the new platform, as we expect it should, this option greatly improves system maintainability and eliminates obsolescence concerns.
- Option C involves replacing the 167s with Linux PCs. The disadvantage of this option is that it requires a complete rewrite of the DA system code on the Linux platform. The advantage is that the system may be more maintainable for a longer period, given that more developers know Linux and C than VxWorks.

All three options include provisions for possibly replacing the existing tape drives with hot-swappable disk drives.

At this point, given resource and technical concerns, we believe the most practical and economical option is Option B. Therefore, during Q3, we intend to purchase a modest amount of hardware to understand whether existing software ports easily to the new platform. The results of this effort will help us properly scope the level of effort required to implement Option B and identify the resources required to complete the work. If software portability proves to be an issues, we will work on scoping out the next best alternative.

All observing software remains under formal version control and all changes are reviewed and approved before work is done. The following work was done on observing software in Q2:

- The Telescope Control Computer (TCC) was updated to improve guide camera error reporting;
- Several minor changes were made to IOP and SOP. A new scrolling display provides an option for viewing 2x2 decimated images of the camera chips; this allows the observers to see the whole chip on the display monitors. New guider code was implemented that recognizes, records, and automatically disables dead guide fibers.
- The Telescope Performance Monitor (TPM) ChannelArchiver was relocated from the computer “sdsshost” to “sdsscommish.” Reducing the load on sdsshost has been an ongoing effort, as sdsshost is the primary computer used for observing operations.
- New code was implemented for the M2 Galil controller, which is part of the M2 mirror control system. The new M2 code outputs piezo data to the TMP (via the Galil's auxiliary port) and the TPM displays the new data.
- Several minor bug fixes were made on various pieces of observing software as required.

3.5. APO Operations and Facility Improvements

On 6/15, a small forest fire broke out at the top of Dog Canyon, about 2 miles west of the observatory. Local firefighting teams brought the fire under control within the same day. Nonetheless, this was a bit too close for comfort. Figure 3.1 shows the location of the fire relative to the 2.5m telescope enclosure; the photograph was taken from the steps of the photometric telescope enclosure.

Figure 3.1. Dog Canyon forest fire on June 15, 2004, as seen from APO.

DIMM development/testing/characterization continued, as did imager calibrator work. Science papers by SDSS Observers were accepted for publication, and an overall mountain QA plan was implemented. The APO road was resurfaced, and lightning damage was sustained by several SDSS and site systems, mostly minor. The installation of the 10 Mb/sec internet service started. Several staff attended the DA meetings at FNAL, and some presented papers at the SPIE meeting. Finally, the observatory hosted a 10-year anniversary of the 3.5-m telescope.

4. DATA PROCESSING AND DISTRIBUTION

4.1. Data Processing

4.1.1. Pipeline Development and Testing

No changes were made to the photometric pipeline in Q2. The spectroscopic pipeline, idlspec2d, is undergoing revision to provide sky-subtracted spectra and improved spectrophotometry. Incorporating the new code requires a data model change, as well as revisions to the pipeline, Spectro1D, and the Catalog

Archive Server (CAS). In the spirit of providing data to the collaboration in a timely manner and meeting our commitments for public data releases, we will forego implementing the data model change until after DR3 is released to the public and DR4 is released to the collaboration. Once new data model changes are approved and implemented, new versions of the spectroscopic pipelines, as well as the CAS, will be delivered to the DP factory for acceptance testing and validation. Once validated, all spectro data collected to date will be re-processed through the new pipelines. We anticipate this will occur in early 2005.

The astrometric pipeline is mature and stable; no major upgrades or changes are foreseen. New "Known Objects" files for SEGUE stripes are being prepared for the fall observing season. Several koTycho2 files have been delivered to the observers at APO to enable the scans to be set up with "skippy." koTycho2 and koUcac files will be prepared for all SEGUE stripes in Q3.

A preliminary all-sky UCAC catalog was completed and delivered to SDSS late in Q2. In Q3, the UCAC Known Objects SDSS product will be updated. At that point, UCAC reference stars will be available for all of the SDSS Survey area, and areas previously reduced (astrom pipeline) against the Tycho-2 catalog will be re-reduced against UCAC.

4.1.2. Data Processing Operations

In Q2 we processed all newly acquired imaging data, as well as data from 90 spectroscopic plates and 34 unique PT patches. In addition to processing new data, we are 100% finished with data processing for DR3 and DR4.

The median turnaround time to process data remains at approximately 13 days (including calibrations) for imaging data, 1-2 day for spectroscopic data, and 5 days for PT data. Overall, the factory data processing operation continues to work very smoothly.

A current snapshot of data volume obtained and processed can be found on-line. Imaging history is summarized at http://das.sdss.org/skent/runHistory.html; spectroscopy history is summarized at http://das.sdss.org/skent/specHistory.html; and target and tile runs are summarized at http://das.sdss.org/targetlink/target.html .

Over the past two quarters, we have brought a number of new computers online as part of the on-going factory upgrade project. In the Q1 report, we noted problems with hard drive controller cards that were affecting system reliability. The suspect cards were placed by new cards provided by the hardware vendor. Subsequent testing indicates that the new cards solved the problems previously seen. The new machines are now in regular production use. Through Q2, we have installed new disk servers, retired aged servers, and increased data storage capacity by 20 terabytes (TB), to a total of 65 TB.

A new version of the imaging QA tool, runQA, was delivered by Princeton to the DP factory late in Q1. It was tested and validated by the DP factory, and placed into production use in Q2. Details on the improvements to the quality tool were provided in the Q1 report.

In Q1, we implemented weekly QA phone-cons between the DP factory, mountaintop operations, and project management. The emphasis is on identifying and chasing down data quality problems quickly, and putting into place new tests to promptly catch problems should they reoccur. In addition to the phone-cons, the DP factory began issuing daily reports summarizing the data processing results for data collected in the previous night. These reports quickly convey the status of new data and identify areas of concern that require action on the part of the observing or engineering staffs.

Data processing group goals for the coming quarter (Jul-Sep 2004) include the following:

1. Keep current on all new data collected;
2. Prepare data for DR4. By one month after the data distribution team defines the data set for DR4, prepare all input files and have the DAS interface operational.
3. Confirm that the "new" automated QA procedures work, before the beginning of data collection in August.
4. Port the software infrastructure to the Long Term Support version of Linux.
5. Reduce the number of problem reports (PRs) to under 30 in categories we are responsible for, before the start of data collection in August.
6. Prepare hardware purchasing plans for FY2005.

4.2. Data Distribution

4.2.1. Data Usage Statistics

Data Release 2 (DR2) was made available to the general public on March 15, 2004. Details may be found in the Q1 report. In Q2, the data volume transferred from the DAS by the user community averaged 2.2 TB per month. These data transfers occurred through the rsync server.

Figure 4.1 shows DR2 usage since the public release through the SkyServer professional astronomer and general public interfaces. The graph shows the cumulative number of data rows returned as a result of SQL queries submitted by users, as well as the approximate volume of data returned.

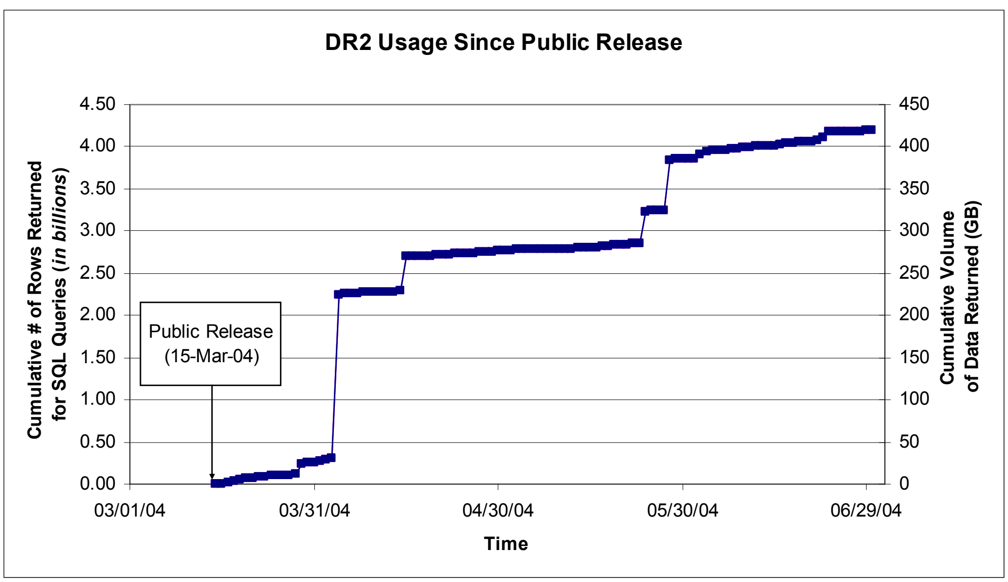


Figure 4.1. DR2 usage through the general public and astronomer SkyServer interfaces.

To date, the general public and the astronomy community have access to the Early Data Release (EDR), Data Release 1 (DR1), and DR2. Through June 30, 2004, the various SkyServer interfaces have received a total of 48.3 million web hits and have processed over 5.5 million SQL queries on the EDR, DR1 and DR2 data sets. The rate at which the user community is accessing SDSS data continues to grow, as shown in Figure 4.2, which plots the number of web hits we receive per month through the various SkyServer interfaces.

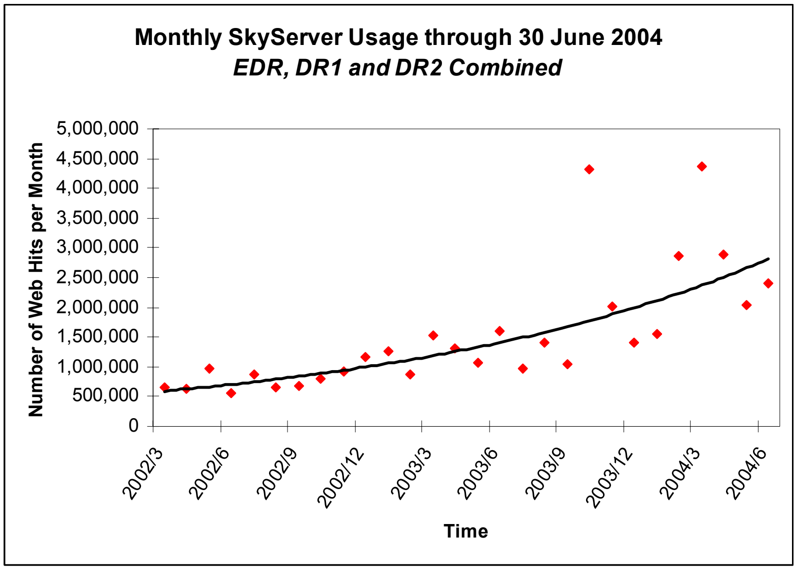


Figure 4.2. SkyServer usage per month, for all public releases combined.

We also measure usage by the number of SQL queries executed. Figure 4.3 shows the total number of SQL queries executed per month through the various interfaces. We have seen a significant increase in the number of SQL queries submitted and have noticed that the complexity of queries is increasing, suggesting that users are becoming more familiar with SQL and its capabilities to extract information from the CAS.

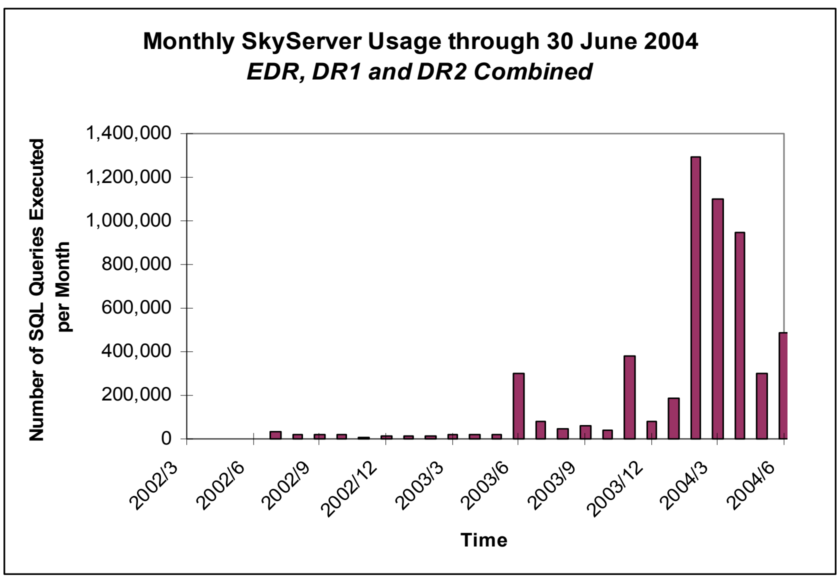


Figure 4.3. SkyServer usage, measured by the number of SQL queries submitted per month.

4.2.2. Data Release 3

While preparing DR2 for public release, we also worked on DR3 for the collaboration. Links were updated to provide the collaboration with data access through the DR3-DAS. A key recommendation from the March 2004 CAS review was that DR3 be loaded using the same data model that was used for DR2. By keeping the data model unchanged, we could focus on making the loading process more robust. Heeding this advice, we loaded DR3 using the same data model and database loading software that was used for DR2. At the completion of loading, the DR3-DAS and DR3-CAS were tested to ensure data integrity. Web interfaces and documentation was updated to reflect changes associated with the new data set. Table 4.1 summarizes the sky coverage of DR3 and shows the incremental increase in data between DR2 and DR3.

Table 4.1. Data Release 3 contents and comparison with DR2

	DR2 Contents	*DR3 Contents*	*Increment*
Imaging			
Footprint area (sq deg)	3,324	5,282	1,958
Imaging catalog (unique objects, in millions)	88	141	53
Data volume (TB)			
Images	5.0	6.0	1.0
Catalogs (DAS, FITS format)	0.7	1.2	0.5
Catalogs (CAS, SQL database)	1.4	2.3	0.9
Spectroscopy			
Spectroscopic area (sq deg)	2,627	4,188	1,561
Spectroscopic catalog			
Total spectra	367,360	528,640	161,280
Galaxies	260,490	374,767	114,277
Quasars (redshift < 2.3)	32,241	45,260	13,019
Quasars (redshift > 2.3)	3,791	5,767	1,976
Stars	34,998	50,369	15,371
M stars and later	13,379	20,805	7,426
Sky spectra	18,767	26,819	8,052
Unknown	3,694	4,853	1,159
Data volume (GB)			
Calibrated spectra	27	41	14
Spectra, redshifts, line measurements	73	110	37

Collaboration use of DR3 has been moderate to date. Figure 4.4 graphs collaboration use of the DR3-CAS since the late-May release date, in terms of the cumulative volume and rows of data returned.

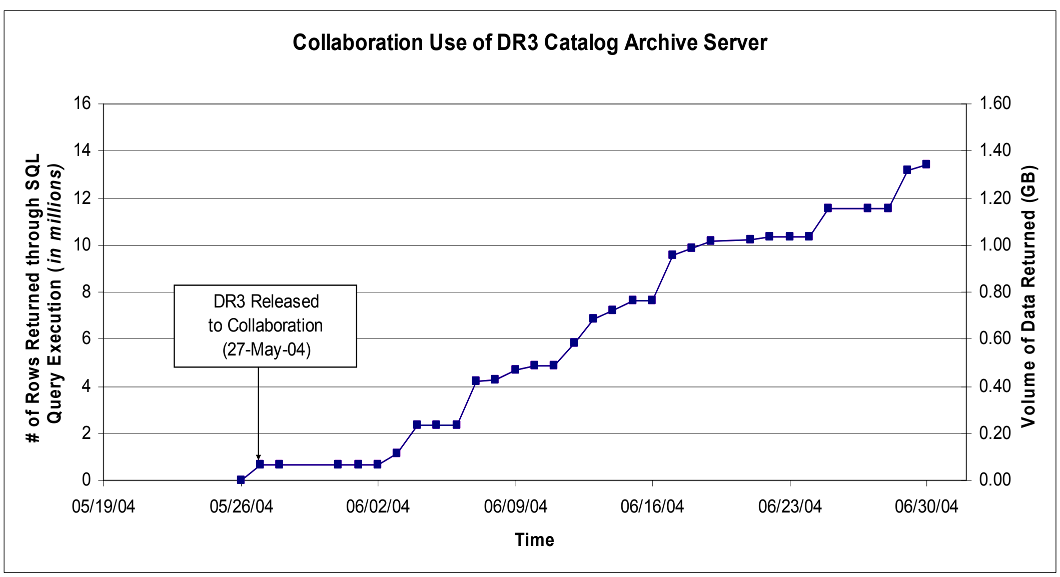


Figure 4.4. DR3-CAS use by the SDSS collaboration.

In preparation for the public release of DR3, we continue to update the "Known Problems" page of the DR3 web site to document problems uncovered by members of the collaboration. We have also started working on the DR3 paper, which will document the contents of the DR3 public release. At this point, we do not anticipate making any significant changes to the DR3-DAS, DR3-CAS, or SkyServer interfaces for the public release. The public will simply be given access to the version currently being used by the collaboration.

4.2.3. Data Release 4 Preparations

All survey quality imaging data collected through July 2004, with the exception of repeat scans on the southern equatorial stripe, will be included in DR4. The DR4 public release is scheduled for July 2005. We intend to load the DR4 data set and make it available to the collaboration by the fall of 2004, to provide as long a proprietary period as possible for collaboration members.

DR4 loading will commence in Q3. We will finalize the DR4 runs and plates lists, modify the database loading machines to reflect the DR4 load, and begin the loading process. As of this writing, we anticipate loading DR4 with the same data model used for DR2 and DR3. Doing so will get the data to the collaboration in the shortest time possible.

4.2.4. Data Archive Server

The Data Archive Server (DAS) and its associated interfaces continue to be stable and reliable. The DAS is currently serving up the DR1 and DR2 to the public; and DR1, DR2, and DR3 to the collaboration.

No significant changes were made to the DAS in Q2, other than to update links to point to the DR3 data. We continue to monitor the integrity of data spinning on the DAS file server. There were no file corruption problems and there was no unscheduled downtime in Q2.

In Q1, we reported on the implementation of a new web farm at Fermilab to further improve DAS reliability and system performance. The web farm was made fully operational in Q2. It provides a front-end load balancer and two back-end machines for data distribution.

4.2.5. Catalog Archive Server

The bulk of the work in Q2 was associated with supporting DR2 public hosting and the DR3 data load and release to the collaboration. A 3-way web cluster was set up and tested on the DR2 SkyServer at JHU. The goal is to improve load-balancing on the SkyServer front-end. Debugging work continued on the Sector and Match table code. When complete, the code will be run on the DR2-CAS and DR3-CAS. DR3 work included loading and validating the data, setting up web access, updating documentation, and updating and testing the image cutout service. In addition, several minor enhancements, documentation updates, and bug fixes were made to CasJobs. Enhancements included auto-deleting temp files after one week and adding the ability to create and call stored procedures and functions in MyDB. Bug fixes addressed a problem with FITS output and a rounding problem. Finally, design work began on a CasJobs command line interface.

A planning meeting was held at JHU in May to review the current status of the CAS and agree on the work plan for the coming six months. Participants included members of the development team at JHU, the operations team at Fermilab, and project management. Improvements to the loading process were discussed, such as breaking up the monolithic sqlLoader "finish" step into multiple steps to make it easier to monitor progress. This will also provide the ability to easily restart the "finish" operation should problems occur, without having to either start over or manipulate the "finish" step by hand. This change was approved in the spirit of improving production operation robustness. We also agreed on the scheme for reconfiguring and renaming the CAS production hardware at Fermilab, as part of the CAS hardware plan development. Finally

we considered developing test suites that would improve regression testing of future code changes, and improved error checking during the loading process.
In May, the responsibility for supporting and maintaining the CAS computer hardware at Fermilab was transferred to the Core Services and Infrastructure (CSI) group in the Fermilab Computing Division. The CSI group maintains Windows computer systems for other Fermilab departments and experiments and has extensive expertise in this area. Their support will enhance the reliability of the CAS production operation.

In June, we temporarily transferred the public hosting of DR2 to JHU, which allowed the CSI group to reconfigure all of the CAS production machines at Fermilab. All machines were brought up to date with the same version of the operating system and the latest security patches. The reconfigured cluster is now ready to support data loading for DR4 and beyond.

In May, we added the CAS production computers at Fermilab to two on-line support systems at Fermilab: the Next Generation Operations (NGOP) system and the Remedy Action Request System (Remedy). These two systems are used in combination at Fermilab to monitor, report, and track problems with computer hardware and software, in addition to other types of equipment and systems. We added the CAS machines to the NGOP system, which now automatically pings all CAS machines in the SDSS cluster and submits pre-defined SQL queries to the CAS front-end web servers. The ping verifies that all machines are on-line and available. The queries result in an end-to-end system test that verifies that machines are working properly and queries are successfully executed in the expected amount of time. If a ping fails or a query result does not meet pre-defined acceptance criteria, NGOP automatically creates a Remedy helpdesk ticket. We have configured the Remedy system so that when a helpdesk ticket is created, an e-mail alert is automatically sent to a distribution list notifying key people of the system fault. At the same time, the system starts paging individuals on the CAS support on-call list. Implementation of this system will result in a faster response to system problems, which translates directly to improved system uptime.

5. SURVEY PLANNING

5.1. Observing Aids

Several programs are used to aid in planning and carrying out observations. No changes were made in Q2.

5.2. Target Selection

For this quarter, 75 plates were designed and drilled in three drilling runs. Of these, 66 were for the Northern survey area, 5 were for the low-redshift galaxy program on the Southern equatorial stripe, and 4 were test plates for the SEGUE program that are observable during a gap between the Northern and Southern survey areas. Of those plates in the Northern survey area, 50 were located in the area of the "gap" that is the highest priority for observing, while 16 were in the northern part of the survey area that is outside the "gap". These northern areas are observed only when the gap itself is not visible.

Plate storage at APO continues to be tight. We have a sufficiently large backlog of plates that we are now juggling incoming plates with outgoing plates that have already been observed. At present we continue to maintain that balance. The number of plates drilled this quarter is lower than previously on that account.

5.3. Survey planning

The software that is used to track survey progress that is contained in this report is also used to prepared monthly observing plans. Additional improvements were made to automatically create imaging observation plans for the SEGUE observing program. A couple of SEGUE scans were included in the observing program this spring for observing at times when the North Galactic Cap was not visible, although none of the scans were actually executed.

6. COST REPORT

The operating budget that the Advisory Council approved for the year 2004 consists of $1,806K of in-kind contributions from Fermilab, US Naval Observatory (USNO), Los Alamos National Laboratory (LANL), and the Japan Participation Group (JPG); and $3,400K for ARC funded expenses.

Table 6.1 shows the actual cost performance by project area for ARC-funded cash expenses in Q2. A more complete table comparing actual to baseline performance is included as an attachment to this report.

Table 6.1. ARC-Funded 2nd Quarter and Forecast for 2004 ($K)

	2004 – 2nd Quarter		2004 – Total	
Category	Baseline Budget	Actual Expenses	Baseline Budget (Nov 2003)	Current Forecast
1.1. Survey Management	72	50	294	293
1.2. Collaboration Affairs	4	1	16	12
1.3. Survey Operations				
1.3.1. Observing Systems	178	145	648	573
1.3.2. Data Processing & Dist.	162	171	593	660
1.3.3. Survey Coordination	0	0	0	0
1.3.4. Observatory Support	380	390	1,522	1,553
1.4. ARC Corporate Support	44	21	176	84
Sub-total	840	777	3,248	3,175
1.5. Management Reserve	40	0	152	152
1.6. Capital Improvements	0	43	0	43
1.7. SDSS-II Expenses	0	0	0	19
Total	880	777	3,400	3,370

6.1. Q2 Performance - In-kind Contributions

The sum of in-kind contributions for the second quarter was $316K against the baseline forecast of $453K and was provided by Fermilab, Los Alamos, and the U.S. Naval Observatory (USNO).

Fermilab provided telescope engineering and maintenance support, and the data processing systems at Fermilab, as agreed. Details of Q2 in-kind contributions are as follows:

- The level of in-kind engineering support at APO was less than the baseline forecast because the engineer who serves as the SDSS Telescope Engineer became involved in another Fermilab astrophysics project in Q1. As a result, his level of support for the SDSS project has been reduced from 100% to 50%. As we reported in Q1, we have reviewed engineering needs at APO and available resources and conclude that we can properly complete engineering projects and maintain telescope systems with the reduced level of support.
- The level of in-kind support for Software and Data Processing was less than the baseline forecast. The level of effort provided was consistent with the baseline forecast. Total Q2 expenses are less than the forecast because equipment expenses that we had anticipated accruing in Q2 were actually accrued and expensed in Q1.

Los Alamos provided programming support for the Telescope Performance Monitor, testing support in preparation of DR2, and work on an open star cluster project related to calibration efforts. The level of in-kind infrastructure support provided in Q2 was slightly less than the baseline forecast.

USNO provided support as required for the astrometric pipeline and other software systems they maintain. Q2 activities focused on quality assurance testing, support for observing operations and completion of the preliminary all-sky UCAC catalog. As reported in Q1, the value of in-kind support was lower than the baseline because the baseline did not properly reflect the lower level of anticipated support in 2004. The total anticipated level of support that the USNO will provide in 2004 is 0.5 FTE. The forecast for the remainder of the year has been revised downward accordingly.

JPG provided technical support for the SDSS imaging camera. They repaired the broken imaging camera monochromator and returned it to APO in time for early July calibration measurements. They also measured spare SDSS filters stored in Japan, for signs of aging. In Q3, Dr. Mamoru Doi will travel to APO to measure the filter response curves for the imaging camera as part of our ongoing QA and instrument monitoring program. The value of JPG's in-kind contribution for Q2 was not reported in time for inclusion in this report. It is anticipated that the Q3 report will include the value of JPG's contributions for Q2 and Q3.

6.2. Q2 Performance – ARC Funded Expenses

The sum of ARC-funded expenses for the first quarter was $777K, or $63K (8%) below the second quarter budget of $840K, excluding management reserve.

Survey management costs were $22K (31%) below the Q2 budget. Travel and office support expenses related to the Office of the Project Scientist were significantly lower than anticipated. Expenses related to ARC Support for Public Affairs were also significantly lower than anticipated. ARC Business Manager expenses appear to be higher than budgeted. As reported last quarter, salary costs were accrued but not expensed in Q1; they have been expensed in Q2. When SSP34 Q1 and Q2 expenses are combined, the total cost over two quarters is in very close agreement with the forecast. Fermilab Support for Survey Management exceeded the baseline budget. Charges for hardware purchases associated with data distribution activities were charged against this account in Q2. In the future, a new SSP account will be established to properly budget for and track these costs. Regarding the forecast for Q3-4, we have revised upward the budget for Project Scientist support. The baseline budget allocated a portion of summer salary support to SSP46 and held a portion of salary support in ARC Corporate Account SSP91f. We have since re-allocated all of the support from SSP91f to SSP46. This adjustment, in combination with the carry-forward of unspent Q1-2 funds, increases the Q3-4 forecast for Project Scientist Support (SSP46). For the year, the revised forecast for Survey Management is $293K, which is within $1K of the baseline budget.

The budget for Collaboration Affairs provides for Working Group travel and technical page charges and is held in an ARC corporate account. Q2 expenses covered page charges for one technical paper. A portion of the unspent funds have been moved forward into subsequent quarters. As a result, the forecast for the year for Collaboration Affairs is $12K, or $4K (27%) below the baseline budget of $16K.

Observing Systems costs were $9K (5%) above the Q2 budget. The Fermilab budget for Observing Systems Support was overspent by $11K (30%). Unanticipated Q2 expenses included components for a new moth ejector system, components to upgrade the telescope altitude and azimuth brake assemblies, and cabling for light baffle removal rigging. The UW Observing Systems Support budget is under spent. The level of available engineering support was lower than anticipated; therefore salary expenses were lower than budgeted. Princeton expenses were in close agreement with the budget. Funds from the ARC Observing Systems Support account were used to cover the vertical mill usage fee; the vertical mill is used in the production of plug plates. Funds are also budgeted in the account to cover the cost of repairs or other unanticipated engineering needs that might arise over the course of the year; these funds were not required in

Q2. For the year, the revised forecast for Observing Systems is $573K, or $75K (11%) below the baseline budget of $648K.

Data Processing and Distribution expenses were $9K (5%) above the Q2 budget. SSP40 expenses exceeded the baseline budget allocation by $7K (16%). Personnel and database server costs were slightly higher than budgeted. Princeton Q2 expenses appear overspent, but as reported in Q1, the baseline budget allocated 50% salary support for one the Princeton staff members, with the remaining 50% held in an ARC corporate account for additional scientific support. A review of support needs in Q1 determined that the level of salary support at Princeton needed to be increased and so we re-allocated funds from SSP91f to SSP38 to cover the required increase. JHU expenses for data distribution support were slightly lower than anticipated. Salary costs were accrued but not invoiced in Q2; we will see these charges in Q3 and have carried forward the unspent funds to cover the expense. For the year, the forecast for Data Processing and Distribution is $660K, or $67K (11%) above the baseline budget of $593K.

Observatory Support expenses were $10K (3%) above the baseline forecast. Salary costs for the new part-time observer were not in the baseline budget. In addition, NMSU accrues vacation salary as it is earned and pays it back when vacations are taken. Since there is little vacation time taken in Q2, salary expenses are artificially higher than budgeted. As in past years, we expect this imbalance to correct itself later in the year as observatory personnel take their vacation time. For the year, the forecast for Observatory Support is within 2% of the baseline budget of $1,522K.

Miscellaneous ARC corporate expenses (i.e., audit fees, bank fees, petty cash, and APO trailer rentals) were as expected. A few final expenses associated with the March 2004 CAS Review were covered under the ARC corporate account; funds for such reviews are included in the baseline budget. Modest charges were incurred against the observers' development fund in Q2; unspent funds have been carried forward into Q3-4.

Finally, as previously noted, we re-allocated funds held in the ARC account for Additional Scientific Support, SSP91f, to SSP38 and SSP46; $19K of unallocated funds remains in the account. We also re-allocated funds held in the ARC account for Observing Systems Support, SSP91d, to SSP35, SSP40, and SSP91i; $62K of unallocated funds remains in the account. Re-allocation of funds from the ARC holding accounts allows us to meet changing project needs without tapping into the management reserve.

6.3. Capital Improvements

The APO road improvement project was completed near the end of Q1, but the invoice was received and paid in Q2. The road improvement project was not included in the 2004 budget approved by the Advisory Council in October 2003, but was subsequently approved as a Capital Improvement project by the ARC Board of Governors. The cost of the project was split evenly between the SDSS project and 3.5m telescope operations. The estimated cost to the SDSS was $40K; actual final cost was $43K.

6.4. SDSS-II Expenses

We have begun incurring costs associated with development work for the SDSS-II project, which if funded will extend SDSS operations beyond mid-2005. Expenses incurred in Q2 were exceptionally minor (~$30). Year-to-date expenses total $11K. Nearly all expenses incurred through Q2 have been associated with travel to attend the science reviews we held for the Segue and Supernovae programs. For the year ending December 31, 2004, we forecast SDSS-II expenses to reach $19K.

6.5. Management Reserve

No management reserve funds were expended during Q2. Unspent management reserve funds have been carried forward into Q3-4.

7. PUBLICATIONS

There are 595 published refereed papers to date that include 'SDSS' or 'Sloan' in their title and/or abstract. 239 of these papers have been published in the last year. These papers have been cited a total of 10,232 times, including 12 papers cited more than 100 times, and 34 additional papers cited between 50 and 100 times. One third of the citations have been in the last year. The York et al (2000) paper has been cited 476 times, which puts it in the top several hundred astronomy papers of all time.

In addition, there have been 760 un-refereed papers (e.g., lots of AAS abstracts!) with 'SDSS' or 'Sloan' in the title and/or abstract.

The following papers were published in Q2:

North-south asymmetry and the local hole
MNRAS Submitted - Jon Loveday, et al

XMM-Newton Observations of the Extremely Low Accretion Rate Polars SDSSJ155331.12+551614.5 and SDSSJ132411.57+032050.5
Paula Szkody, et al

Calibrating Photometric Redshifts of Luminous Red Galaxies
MNRAS submitted - Nikhil Padmanabhan, et al

Efficient Photometric Selection of Quasars from the Sloan Digital Sky Survey: 100000 $z<3$ Quasars from Data Release One
ApJS submitted - Gordon T. Richards, et al

Photometric Redshifts of Quasars II. Improved Redshifts and Redshift Probabilities
ApJS submitted - Michael A. Weinstein, et al

Cross-correlation of CMB with large-scale structure: weak gravitational lensing
PRD accepted - Christopher M. Hirata, et al

Discovery of New Ultracool White Dwarfs in the Sloan Digital Sky Survey
ApJL submitted - Evalyn Gates, et al

Cataclysmic Variables from SDSS III. The Third Year
AJ accepted - Paula Szkody, et al

The Lyman-alpha Forest Power Spectrum from the Sloan Digital Sky Survey
ApJ submitted - Patrick McDonald, et al

A Survey of $z>5.7$ Quasars in the Sloan Digital Sky Survey III: Discovery of Five Additional Quasars
AJ accepted - Xiaohui Fan, et al

Dust Reddening in SDSS Quasars
AJ accepted - Philip Hopkins, et al

SDSS galaxy bias determination from halo mass-bias relation and its cosmological implications
PRD submitted – U. Seljak, et al

Publications Based on Public Data

Star Formation in Close Pairs Selected from the Sloan Digital Sky Survey
MNRAS submitted – B. Nikolic, et al

Empirical Modeling of the Stellar Spectrum of Galaxies
AJ submitted – Cheng Li, et al

New Colour-transformations for the Sloan Photometry and Revised Metallicity Calibration and Equations for Photometry and Parallax Estimation
PASA accepted – S. Karaali, et al

The Mass Function of Void Galaxies in the SDSS Data Release 2
ApJ submitted - D. Goldberg, et al

The Clustering of Active Galactic Nuclei in the Sloan Digital Sky Survey
ApJ accepted – David Wake, et al

The Environment of Low Surface Brightness Galaxies
A&A accepted – S. Rosenbaum, et al.

Theoretical Isochrones in Several Photometric Systems II. The Sloan Digital Sky Survey ugriz System
A&A accepted – Leo Girardi, et al

Gravitational Lensing Magnification without Multiple Imaging
ApJ submitted – Charles Keeton, et al

The Cosmic Evolution of Low-Luminosity Radio Sources from the SDSS DR1
MNRAS accepted - Lee Clewley, et al

Optical and Infrared Color Distributions In Nearby Early-Type Galaxies and the Implied Age and Metallicity Gradients
ApJ submitted – Hong Wu, et al

Detections of the 2175 Å Dust Feature at 1.4z 1.5 from the Sloan Digital Sky Survey
ApJ 609:589 (2004) – Junfeng Wang, et al

A Helium White Dwarf of Extremely Low Mass
ApJL accepted – James Liebert, et al

What drives the Balmer extinction sequence in spiral galaxies? Clues from the Sloan Digital Sky Survey
A&A accepted - G. Stasinska, et al

Observational constraints on Cosmic Strings: Bayesian Analysis in a Three Dimensional Parameter Space
PRD Brief Reports submitted - Levon Pogosian, et al

A Halo Approach to the Evaluation of the Cross-Correlation between the SZ Sky and Galaxy Survey
A&A accepted - Yan Qu, et al

Candidate Type II Quasars from the Sloan Digital Sky Survey: II. From Radio to X-Rays
AJ submitted - Nadia L. Zakamska, et al

A New Catalog of Clusters of Galaxies selected from the Spectroscopic Sample of the SDSS
Chris Miller, et al

SDSS CY2004 Budget Forecast as of August 1, 2004 (*in $000s*)

		Qtr 1 Jan-Mar			Qtr 2 Apr-Jun			Qtrs 3-4 Jul-Dec			CY2004 Budget Forecast		
		Approved Budget	Actual Expenses	Variance (%)	Approved Budget	Actual Expenses	Variance (%)	Approved Budget	Aug 2003 Forecast	Variance (%)	Approved Budget	Aug 2003 Forecast	Variance (%)
ARC-FUNDED BUDGET													
1.1 Survey Management													
SSP21	ARC Secretary/Treasurer	2	2	-8%	3	2	-32%	6	7	18%	12	11	-2%
SSP34	ARC Business Manager	14	10	-31%	15	19	27%	29	29	2%	58	58	1%
SSP46	PU Office of the Project Scientist	8	1	-86%	8	.2	-98%	43	71	64%	59	72	23%
SSP48	FNAL Support for Survey Management	9	12	35%	9	14	52%	18	18	0%	36	44	22%
SSP67	UC Support for Survey Management	14	12	-17%	14	12	-12%	50	50	na	79	74	-5%
SSP91a	ARC Support for Public Affairs	8	2	-80%	16	0	-100%	0	12	na	24	14	-44%
SSP91i	ARC Support for Public Information Officer	7	4	-51%	7	2	-66%	13	14	12%	27	20	-26%
	Sub-total	63	42	-33%	72	50	-31%	158	201	27%	294	293	0%
1.2 Collaboration Affairs													
SSP91c	ARC Support for Collaboration Affairs	4	2	-52%	4	1	-83%	8	9	13%	16	12	-27%
	Sub-total	4	2	-52%	4	1	-83%	8	9	13%	16	12	-27%
1.3.1 Observing Systems													
SSP42	FNAL Observing Systems Support	37	62	67%	37	48	30%	75	75	0%	149	185	24%
SSP61	FNAL Observing Programs and DA Support	5	1	-81%	8	3	-67%	11	11	0%	23	14	-39%
SSP31	UW Observing Systems Support	72	66	-8%	72	57	-21%	144	136	-6%	288	259	-10%
SSP32	PU Observing Systems Support	15	10	-35%	13	12	-7%	31	31	0%	59	53	-10%
SSP91d	ARC Observing Systems Support	29	6	-79%	47	24	-49%	53	32	-40%	128	62	-52%
	Sub-total	157	145	-8%	178	145	-18%	313	284	-9%	648	573	-11%
1.3.2 Data Processing and Distribution													
SSP40	FNAL Software and Data Processing Support	27	48	77%	47	54	16%	54	54	0%	128	156	22%
SSP38	PU Software and Data Processing Support	43	56	30%	39	47	23%	66	84	28%	148	188	27%
SSP39	UC Software and Data Processing Support	11	9	-11%	11	10	-9%	21	21	0%	42	40	-5%
SSP37	JHU Data Archive Development and Support	62	65	3%	57	51	-12%	120	126	5%	240	241	1%
SSP33	UC Operations Support	9	8	-4%	9	9	1%	17	17	0%	35	34	-1%
	Sub-total	152	186	22%	162	171	5%	278,500	303	9%	593	660	11%
1.3.4 Observatory Support													
SSP35	NMSU Site Support	380	384	1%	380	390	3%	761	779	2%	1,522	1,553	2%
	Sub-total	380	384	1%	380	390	3%	761	779	2%	1,522	1,553	2%
1.4 ARC Corporate Support													
SSP91e	ARC Corporate Support	15	10	-33%	22	17	-24%	25	27	7%	62	54	-13%
SSP91f	ARC Additional Scientific Support	19	0	-100%	19	0	-100%	65	19	-71%	102	19	-82%
SSP91h	ARC Observers' Research Support	3	0	-100%	3	4	33%	6	8	33%	12	12	0%
	Sub-total	37	10	-73%	44	21	-53%	96	54	-44%	176	84	-52%
SUBTOTAL		793	769	-3%	840	777	-8%	1,607	1,620	1%	3,248	3,175	-2%
SSP91j	SDSS-II Related Expenses	0	10	---	0	.03	---	0	9	---	0	19	---
SSP91g	Capital Improvements	0	0	0%	0	43	---	0	0	---	0	43	---
SSP91	Management Reserve[1]	40	0	-100%	40	0	-100%	72	152	111%	152	152	0%
TOTAL ARC-FUNDED BUDGET		833	769	-8%	880	777	-12%	1,679	1,772	6%	3,400	3,370	-1%

SDSS CY2004 Budget Forecast as of August 1, 2004 (*in $000s*)

		Qtr 1 Jan-Mar			Qtr 2 Apr-Jun			Qtrs 3-4 Jul-Dec			CY2004 Budget Forecast		
		Approved Budget	Actual Expenses	Variance (%)	Approved Budget	Actual Expenses	Variance (%)	Approved Budget	Aug 2003 Forecast	Variance (%)	Approved Budget	Aug 2003 Forecast	Variance (%)
IN -KIND CONTRIBUTION													
1.1 Survey Management													
SSP48	FNAL Support for Survey Management	47	42	-12%	47	41	-13%	96	96	0%	191	179	-6%
	Sub-total	47	42	-12%	47	41	-13%	96	96	0%	191	179	-6%
1.3.1 Observing Systems													
SSP42	FNAL Observing Systems Support	66	50	-25%	66	52	-22%	135	104	-23%	267	206	-23%
SSP58	LANL Observing Systems Support	55	59	7%	55	40	-28%	112	46	0%	222	144	-35%
SSP61	FNAL Observers' Programs and DA Support	13	5	-61%	13	2	-87%	26	20	-23%	52	27	-49%
	JPG Observing Systems Support	0	0	0%	0	0	0%	0	0	---	0	0	---
	Sub-total	134	114	-15%	134	93	-31%	273	170	-38%	541	377	-30%
1.3.2 Data Processing and Distribution													
SSP40	FNAL Software and Data Processing Support	259	293	13%	239	167	-30%	444	405	-9%	941	866	-8%
SSP57	USNO Software and Data Processing Support	33	16	-50%	33	14	-57%	67	36	-46%	133	67	-50%
	Sub-total	291	310	6%	271	181	-33%	511	442	-14%	1,074	933	-13%
TOTAL IN-KIND CONTRIBUTION		473	465	-2%	453	316	-30%	880	708	-19%	1,806	1,489	-18%
TOTAL BUDGET		1,306	1,234	-6%	1,334	1,093	-18%	2,558	2,481	-3%	5,206	4,859	-7%

Notes

1) Management Reserve is controlled by the SDSS Director.