Sloan Digital Sky Survey
Quarterly Progress Report
Third Quarter 2001

November 7, 2001

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1. OBSERVATION STATISTICS

1.1 Summary

By the end of Q3, we had imaged 99% of the three Southern Stripes that constitute the Southern Survey and obtained 66% of the spectra of the objects in the Southern Survey that we plan to target for spectroscopy. We anticipate finishing the Southern Survey in Q3-2002 as planned. We also made significant progress toward obtaining repeated images of the Southern Equatorial Stripe, which is the primary goal of the survey of the Southern Equatorial Stripe. These repeated images will enable us to detect objects whose luminosity or position changes on time scales of a few days to a few years, and the addition of these images will allow us to detect objects that are 1.5 to 2 magnitudes fainter than can be detected in a single image. Progress on the survey of the Southern Equatorial Stripe is measured by the mean number of times that this stripe is imaged. The image category of "Good minus Unique" was created to provide a metric for this phase of the survey. "Good" consists of the imaging area that meets survey requirements after processing and calibration. "Unique" is the subset of "Good" imaging area after the area of duplicated strip-to-strip overlaps and repeated observations has been removed. "Unique" area is the metric that is used to describe our progress on the Northern and Southern surveys. To date, we have obtained 366 square degrees of "Good minus Unique" imaging area on the Southern Equatorial Stripe. When this is compared to its footprint of 270 square degrees, it follows that we have already imaged some parts of the Southern Equatorial Stripe more than three times.

While the cumulative areas of the Southern Survey and Southern Equatorial Survey are ahead of the baselines for these surveys, our accomplishments during Q3 did not meet the incremental baseline goals for Q3. In addition, we did not meet the baseline goals for the Survey of the Northern Galactic Cap during this period. This is not surprising, since only a small piece of the Northern Galactic Cap is visible in July and by September that piece is essentially unobservable. We shut down for maintenance and improvements from June 29 to August 6 and the resumption of meaningful observations was delayed by the southwest monsoons until August 21. Thus the summer shutdown and the monsoons eliminated all of the July dark run and most of the August dark run. In September, we actually exceeded our imaging and spectroscopy goals, although the totals for the quarter did not meet our goals. While poor seeing was a major cause of our disappointing performance, a careful examination of our operations efficiency during the good seeing in Q3 shows that our efficiency did not meet the baseline efficiency goals. We are now concentrating on reducing our inefficiency and this is discussed in some detail in sections 2 and 4. A more extensive discussion of our performance for Q3 is given in the remainder of this section and section 2.

In Q3, we made good progress in automating the accounting for data collected and for evaluating mountain operations performance. Files are computed automatically (with some hand-fixes); they now form the basis for our reporting. The progress graphs are now updated at the end of each observing run and posted on the SDSS website; from www.sdss.org, click on Survey Ops. We are also making progress in creating similar graphs that will be updated automatically as data is processed and loaded into the operational database. The history of imaging to date, for each of the three surveys, is posted at: http://www-sdss.fnal.gov:8000/skent/imgHistory.html. The history of spectroscopy is posted at: http://www-sdss.fnal.gov:8000/skent/specHistory.html.

1.2 Q3 Imaging

We obtained 286 square degrees of new imaging data, corresponding to 63% of our incremental baseline goal for imaging in Q3-2001. As noted earlier, we suspended observations between June 29 and August 6 for maintenance and improvements and when we attempted to resume operations on August 10, the southwest summer monsoon season delayed meaningful observations until August 21. During that evening, we were able to carry out imaging for a total of 5.1 hours; 3.3 hours of this time yielded useful imaging data. Unfortunately, the seeing was not suitable for imaging for the remainder of the dark run, which ended on August 28. The seeing conditions improved significantly in September and we accomplished our baseline goal for imaging in September.

Table 1.2 Imaging Survey Progress in Q3-2001

	Imaging Area Obtained (in Square Degrees)			
	Q3-2001		Cumulative through Q3	
	Baseline	Actual	Baseline	Actual
North Survey[1]	78	47	2384	2099
Southern Survey[1]	132	84	635	738
Southern Equatorial Stripe[2]	246	155	246	366

1. “Unique” area
2. “Good minus Unique” area

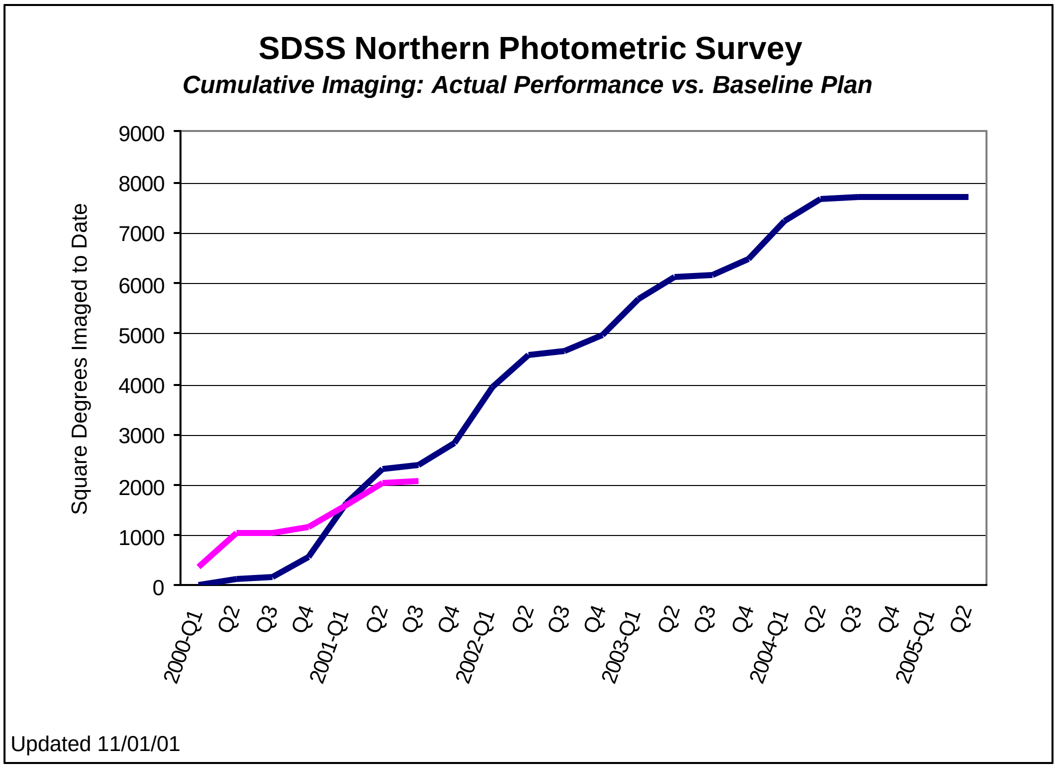

Figure 1.1. Imaging Progress against the Baseline Plan – Northern Survey

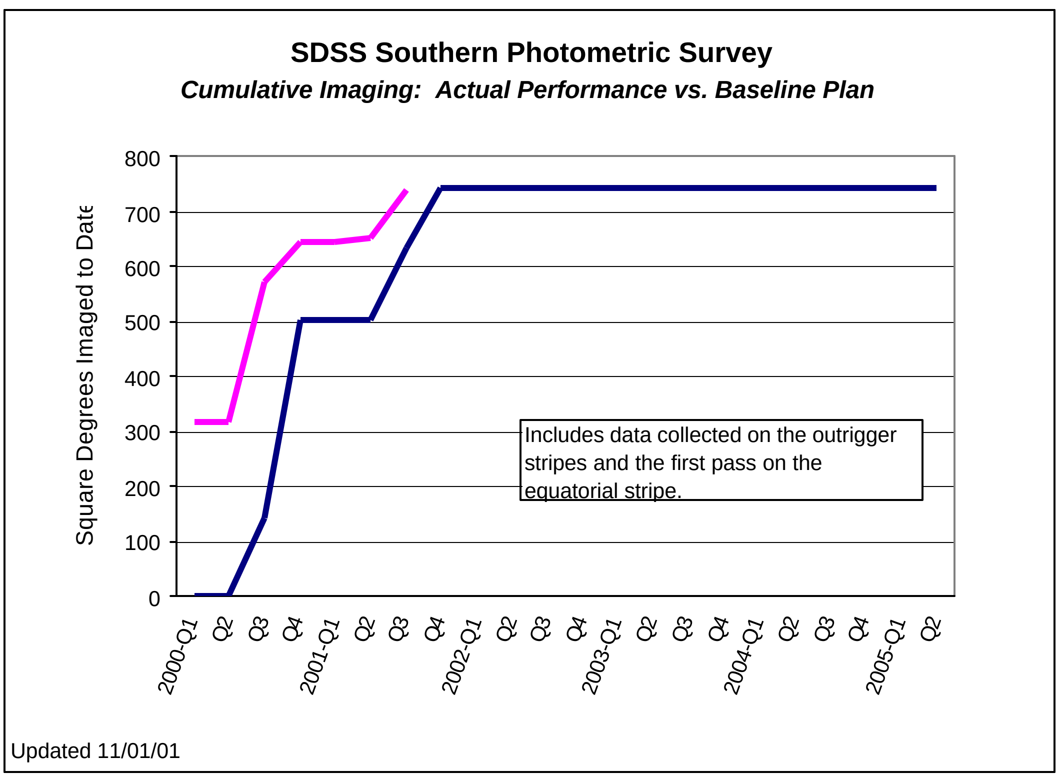

Figure 1.2. Imaging Progress against the Baseline Plan – Southern Survey

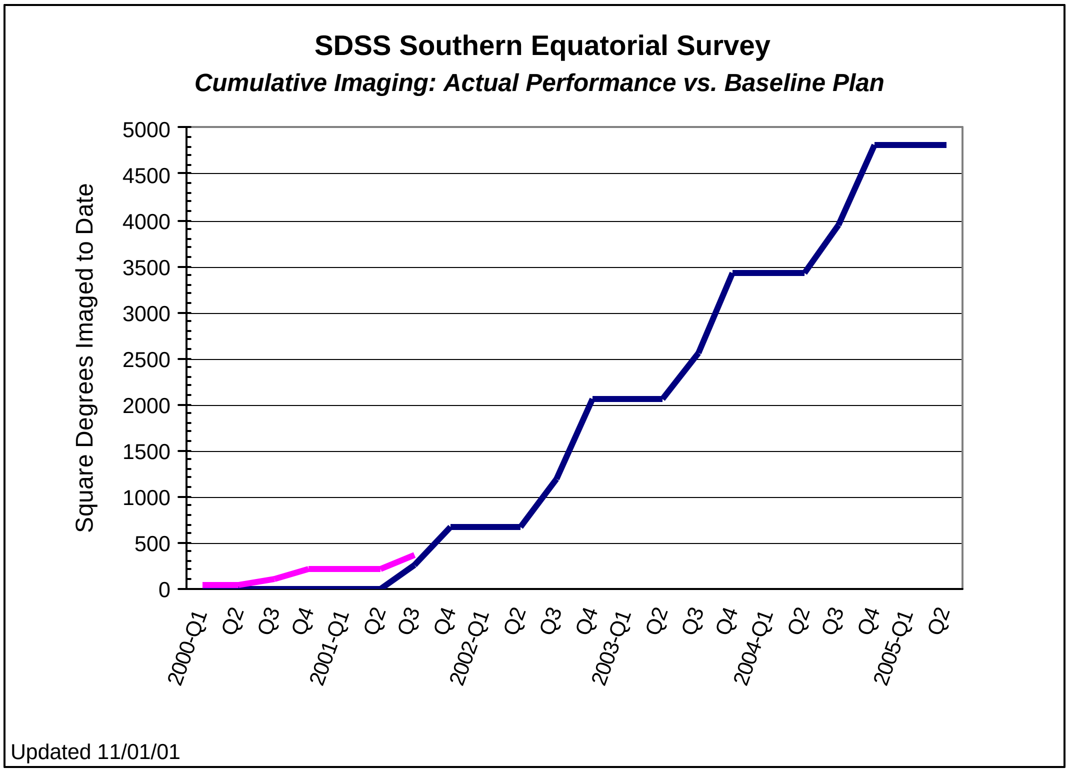

Figure 1.3. Imaging Progress against the Baseline Plan – Southern Equatorial Survey

The August dark run did not provide much insight into the causes of our inefficiency because we obtained so little imaging data. The much better seeing conditions in September allowed us to obtain a much better understanding of the causes of our inefficiency. We can generate two simple statistics from our time tracking data that can provide some insight into the extent of our inefficiency. The ratio of the time for science imaging (22.6 hours in Q3) to the sum of the science imaging time and setup for imaging (33.9 hours in Q3) is a good measure of observing efficiency. The five-year baseline plan established this ratio to be 0.86. During Q3, it was only 0.67. Thus, our efficiency for observations relative to the baseline was 77% in Q3. A second useful statistic is the mean rate at which survey quality imaging data was acquired during Q3. We define this as the sum of the areas of survey quality imaging data for each survey obtained in Q3 (286 square degrees) divided by the time expended on science imaging (22.6 hours). For Q3 this was 12.7 square degrees/hour. The baseline defined this to be 18.6 square degrees/hour. The difference between the actual and the baseline consists of imaged area that did not meet survey requirements and imaged area that did not contribute to the survey goals. The ratio of these two rates is 68%. The product of these two statistics is 53% and this shows that there is considerable room for improvement. We have recognized for some time that the inefficiency of our observations is a major impediment to reaching our baseline goals for imaging. We describe the causes of our inefficiencies and their impact on the useful hours of observation in further detail in section 2.

1.3 Q3 Spectroscopy

We observed a total of 43 plates during Q3, corresponding to about 27,000 spectra. This number of plates was 71% of our baseline goal for Q3. We were able to do this well only because we were able to obtain survey quality spectra when the sky was cloudy and also when the moon was up. We define the time during which the moon is up and the sun is more than 15 degrees below the horizon as gray time. We define the time during which the moon is below the horizon and the sun is more than 15 degrees below the horizon as dark time. The baseline plan is based on the available dark time. Observations during gray time or when the sky is cloudy are limited to spectroscopy and are inherently less efficient. Nevertheless, we are able to make good use of this time.

Table 1.3 summarizes the amount of spectroscopic data obtained during Q3 compared to the baseline projection. We report progress on spectroscopy in terms of the number of plates that were observed and declared done during the quarter. The successful observation of a plate will typically yield 640 unique spectra.

Table 1.3 Spectroscopic Survey Progress in Q3-2001

	Number of Plates Observed			
	Q3-2001		Cumulative through Q3	
	Baseline	Actual	Baseline	Actual
North	10	2	206	204
South	28	31	95	97
Southern Equatorial	20	10	20	10
Total plates	58	43	321	311

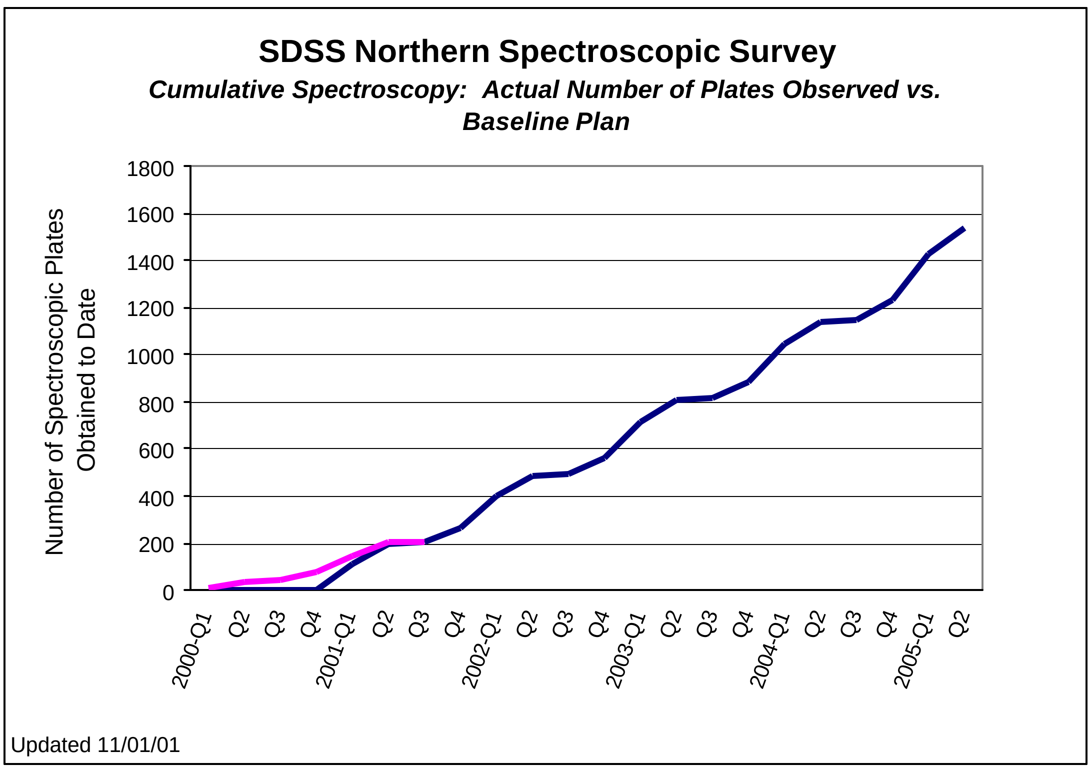

Figure 1.4. Spectroscopic Progress against the Baseline Plan – Northern Survey

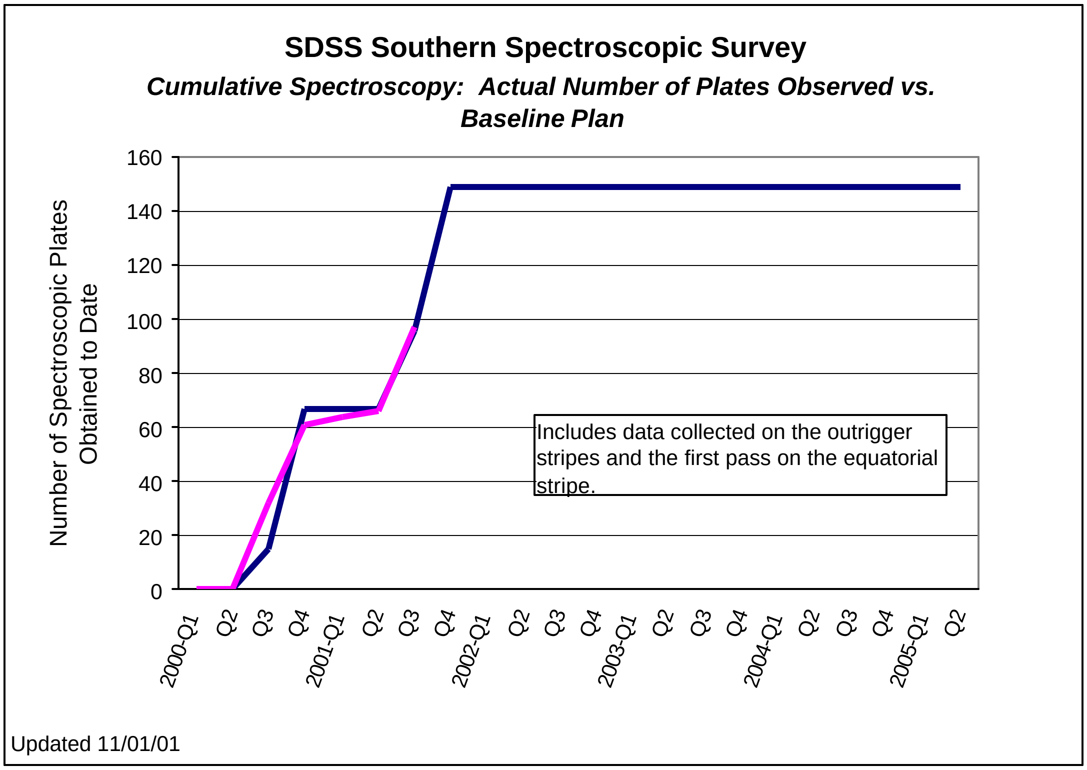

Figure 1.5. Spectroscopic Progress against the Baseline Plan – Southern Survey

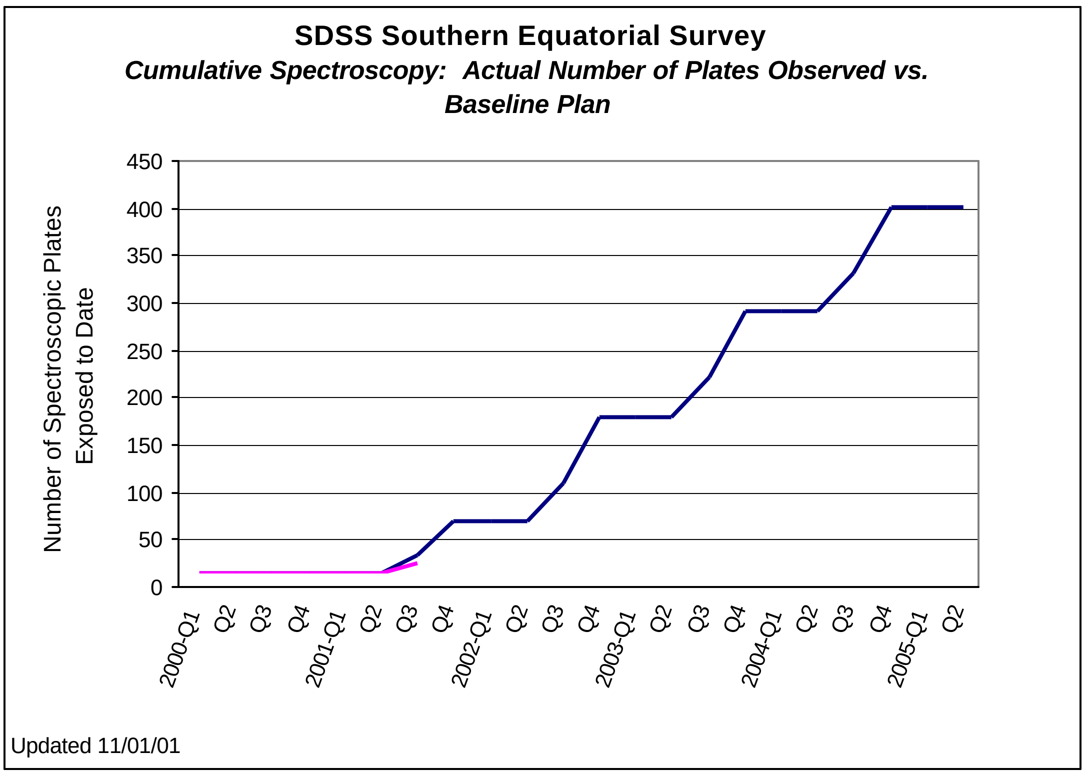

Figure 1.6. Spectroscopic Progress against the Baseline Plan – Southern Equatorial Survey

The efficiency of our spectroscopic observations during good seeing conditions in September fell below our baseline goals. During Q3, the total time spent making spectroscopic observations, after excluding the time for cartridge changes, setup, and calibration, was 46.9 hours, compared to the baseline expectation of 40.5 hours. The difference was not due to better weather, but due to the use of gray time for spectroscopy. This time is also used for critical engineering and calibration tests. It is important to note that we did not include observations during gray time in the baseline plan because we were not certain that such observations would produce survey quality data. We have now shown that we can make survey quality spectroscopic observations during gray time. These observations will help us to reach and perhaps exceed our baseline goals for spectroscopy. Nevertheless, we must improve our efficiency. The mean time that was expended to obtain survey quality spectra for a plate was 65.4 minutes, whereas the baseline allocates only 45 minutes. While most of this difference was due to the fact that some of the observations were made during unfavorable conditions, there are steps that we can take to reduce this time. The time spent making cartridge changes, setting up for spectroscopy, and taking calibrations was 39.5 minutes for each plate in Q3, whereas the baseline plan allows 25 minutes for these steps. It is important to note that the observers typically change cartridges in less time than the baseline plan allows for this step. Therefore, we are evaluating ways to reduce the setup time and the calibration time in order to come much closer to the baseline plan for these steps. While we expect to improve the efficiency of our spectroscopic observations, we now plan to use gray time for spectroscopic observations. Unfortunately, gray time is not useful for imaging and we must improve the efficiency of imaging if we are to reach our imaging goals. As in the case of imaging inefficiency, we have identified many of the causes of spectroscopic inefficiency and these are described in sections 2 and 4.

1.4 Status of Photometric Telescope Secondary Patches

In Q3, we completed 27 secondary patches for the Northern Survey. As noted earlier, the opportunity to observe the North Galactic Cap in Q3 was very limited and thus very few new patches were obtained. While all of the secondary patches for the Southern Survey had already been obtained before Q3 began, the time that was photometric was also used to make repeat observations of some of the patches for the Southern Survey. A summary of the PT patches that have been observed and classified is shown in Table 1.4. The categories used in the table are defined as follows. Total Patches consist of all of the patches that have been observed since the PT baffling was improved and the PT CCD cleaned to remove a contaminating film from the CCD surface. Unique Patches consist of the number of patches under the current patch layout system that have been successfully observed without regard to overlap. This criterion is analogous to the "unique" criteria for imaging data. Patches classified as "Done, verified" have been successfully observed at APO and their quality verified after data processing at Fermilab.

Table 1.4 Summary of Unique Secondary Patches Progress in Q3-2001

	Cumulative through Q3
Unique Patches	
"Done, verified"	746
"Done, not verified"	78
Old patches available	41
Total Patches	865
Total number required	1545
Percent observed (exclusive of old patches)	53%

In addition to the patches that have successfully completed data processing, there are currently 78 patches that have been observed and declared “good” at APO, but that still require data processing confirmation. These patches are classified as “Done, not verified”. (These patches were successfully processed in October.) There are also 41 patches that were observed earlier, but that need to be re-observed under the current layout scheme. These patches are of sufficiently good quality, and their positions close enough to that in the current layout, that re-observing these patches has been given lower priority relative to observing new patches. These patches are classified as “Old patches available.” The total number of patches noted in table 1.4 sums these various categories to present the gross number of secondary patches observed to date.

While the fraction of sky with good patches is greater than the fraction of sky that we have successfully imaged, some patches are still needed for parts of the Northern Galactic Cap that have been successfully imaged. It is important to note that patches can be observed whenever the sky is photometric, while imaging requires that the sky be photometric and the seeing be less than 1.5 arcseconds rms. Because this second requirement is very restrictive, the fraction of time that one can obtain good patches is much greater than the fraction of time that survey quality imaging data can be obtained. We expect to obtain all of the missing patches before the end of Q2-2002. Once we have reached that state, the acquisition of good patches will remain comfortably ahead of the imaging survey.

2. OBSERVING EFFICIENCY

2.1. Improved Time Tracking Tools

In order to address the problems causing observing efficiency and data collection rates to fall below the baseline, we need accurate information on the efficiency of operations, and in particular, how time spent on each observing activity compares with the time allocated in the baseline. Relevant information includes the time spent on routine observing tasks, and time lost to weather, problems, and other engineering tasks. Previous efforts at time tracking required constant attention by the observers and often did not provide the information needed. In Q3, we modified the observing software to include and produce information needed for time tracking. We also utilized our existing logging mechanism (the "murmur log") as a collection point for time tracking data. Finally we developed tools to extract this information and create reports that summarize time usage in a manner useful for comparison with baseline values. We first started using the new tools during the August run, and made a number of improvements in September based on operating experience. These tools are proving quite useful and were used to generate the performance statistics for this report. They have also exposed a number of problems that need attention.

2.2. Overview of Observing Efficiency in Q3

Table 2.1 summarizes the breakdown of observing time in Q3-2001 according to the categories used to prepare the baseline projection. These numbers came from the new tracking system. The hours add up to a bit more than the number of scheduled dark hours because some of the setup & calibration time, and some of the spectroscopy time, were undertaken in moonlight conditions.

Table 2.1. Comparison of Q3-2001 Efficiency Measures to the Baseline

	August Run			September Run		
Category	Baseline	Dark	Dark+gray	Baseline	Dark	Dark+gray
Total time (hrs)	101:23	101:23	141:18	116:11	116:11	161:17
Imaging fraction	0.27	0.21	0.17	0.27	0.43	0.31
Spectro fraction	0.63	0.73	0.70	0.63	0.48	0.59
Weather	0.50	0.31	0.30	0.50	0.53	0.59
Uptime	0.90	0.89	0.90	0.90	0.98	0.98
Imaging efficiency	0.86	0.62	0.62	0.86	0.67	0.67
Spectro efficiency	0.65	0.60	0.61	0.65	0.59	0.63
Operations	0.90	0.93	0.94	0.90	0.93	0.94

The Q3 baseline assumes that 27% of the available time will be allocated to imaging and 63% will be allocated to spectroscopy. In practice, weather and atmospheric seeing conditions drive the allocation of time spent imaging and doing spectroscopy. In August, conditions suitable for imaging were less than forecast in the baseline; in September, they were greater. While we monitor the fraction of time spent in imaging and spectroscopy operations, we do not use this data to adjust our observing plan to meet the baseline split. Rather, our strategy continues to be "image whenever conditions are suitable", since we are behind in our meeting our imaging goals and conditions suitable for imaging are rare.

The baseline assumes that weather conditions will allow useful observations 50% of the time in Q3. In fact, the weather in August was only suitable for observing 30% of the time. September was much better than August and was in reasonable agreement with the baseline for "dark" hours (53% actual vs. 50% baseline). When the dark and gray hours are combined for September, the time that weather was suitable for observations was 59%. Better weather during gray time helped us to increase the numbers of plates observed in September, which helped offset the poor performance in August.

Equipment uptime, which is a measure of system availability when conditions are suitable for observing, met the baseline goals in August and greatly exceeded the goals in September. Although we are meeting our baseline goal of 90% uptime, we realize that doing consistently better than this will help us catch up with our overall imaging and spectroscopy goals. We are encouraged by the September performance and will continue to set a high priority on improving system reliability.

2.3. Efficiency of Imaging Operations

The greatest problem highlighted by the time tracking results is the imaging efficiency. The baseline assumes that a typical imaging night consists of two imaging runs totaling 5.8 hours. The breakdown of imaging time includes 15 minutes of focus and rotator tweaks, 32 minutes of ramp up and ramp down time, and 5 hours of science time, for an efficiency of 0.86. According to this baseline, an average run consists of 0.4 hours of setup and ramp time and 2.5 hours of science time. In September, an average run consisted of 0.83 hours of setup and ramp time, and only 1.45 hours of science time, for an efficiency of 0.64. The inefficiency cost us 5:40 in science imaging time in September, and 1:15 in August.

We have identified two important contributors to the imaging inefficiency: the time it actually takes to set up an imaging run is much longer than specified in the baseline, and the length of each run is significantly shorter than that specified in the baseline, so less science data is taken for each imaging setup. The problem is compounded because the two factors are multiplicative.

The baseline allocates 15 minutes at the beginning of each run to verify telescope pointing and bring the telescope into focus. In practice, both of these operations are taking much longer than expected. With regard to pointing, we have had problems with the reliability of telescope pointing and to compensate, the observers have been allowing a significant amount of time prior to the start of a scan to correct for any pointing problem that may exist. When no problems exist, the imaging scan simply starts early over an area previously observed or outside the survey area. Hence, the imaging data obtained counts towards the gross but not "unique"; it only counts towards the baseline goal if the scan is within the footprint of the southern equatorial stripe. Recognizing that the time taken to correct the pointing at the beginning of a run could be reduced to zero if the pointing were made reliable, we put significant effort into understanding and resolving the pointing problem in Q3. This effort is described in section 4.4. As of this writing, we are guardedly confident that the changes made will allow us to eliminate the time previously allocated for potential pointing and rotator corrections.

With regard to focus, the telescope often starts so far out of focus that the current procedures for correcting the focus are inefficient. Although some time will always be required to tweak the focus at the beginning of a run, we are working on two fronts to significantly reduce the time required to focus the telescope. First, we are improving the focus software so that it will be more effective when the telescope is far from focus, and second, we are improving our initial estimate of telescope focus by developing correlations between the telescopes temperature and the focus value. The latter will allow the observers to predict initial focus position based on telescope structure temperature, and the former will provide improved software to achieve final focus faster.

In order to meet the baseline, we must not only reduce the setup time for each imaging run, we must also increase the length of the science portion of each run. At present, the priority for imaging scans is driven by the need for imaging data to provide contiguous areas for efficient spectroscopic tiling, rather than on which stripes can be imaged most efficiently on a given night. This strategy often results in short imaging scans that have a small yield-to-setup-time ratio. As the amount of observed imaging area increases, the imaging strategy will evolve to more equally satisfy the requirements for both imaging and tiling efficiency.

2.4. Efficiency of Spectroscopic Operations

Spectroscopic efficiency is also a serious problem: each plate is effectively taking 11 minutes longer than expected by the baseline, which effectively cost us approximately 6 plates in Q3.

There is room for improvement in both field acquisition and calibration. To improve the field acquisition, we are developing procedures for obtaining good initial estimates of the scale and focus using the temperature for which the plate was drilled, the actual temperature, the airmass for which the plate was drilled, and the actual airmass. We are also considering possible improvements to the Guider so that it can converge more quickly on a field. To improve calibration time, we are beginning to explore the use of heavily binned reads for calibrations frames. Finally, we may be able to further reduce the time it typically takes to calibrate a set of observations in marginal conditions by changing where in the sequence of observations we take the initial calibration frame: if the initial set of flats and arcs are taken after the first science exposure instead of before, we reduce the chance of needing to take another set after the last science exposures is competed. This requires a change in observing software and the QA tools used at the mountain to ascertain the quality of spectroscopic data; therefore, these improvements may take one or two observing runs to fully implement.

2.5. Summary of Efficiency Observations

Although poor weather contributed to our inability to meet the baseline goals for Q3, we were also hampered by inefficiencies in our operation. The most important among these are setup and calibration times for both imaging and spectroscopy. In each case, we have identified specific problem areas and are developing plans and procedures to deal with them. Finally, we are not limiting our improvement efforts to only to those areas where we are falling behind the baseline. An example of this is equipment uptime. Although our total equipment uptime in Q3 exceeded baseline goals, we are still actively working to further improve reliability because high equipment uptime maximizes the use of available science time.

3. OBSERVING SYSTEMS

The annual summer shutdown occurred as scheduled during Q3. The month of July and the first week of August were devoted to maintenance and improvements tasks on the imaging camera, the 2.5-m and photometric telescopes, and the telescope enclosure. We also continued work to improve the thermal environment around the telescope and implemented measures to better control and manage operations software changes.

3.1. The Instruments

A significant amount of maintenance work was performed on the imaging camera during the summer shutdown. In particular, we may have solved the intermittent problem with the u3 chip that was reported in the Q1-2001 report. During the shutdown, a series of tests indicated that the problem with the u3 chip was likely associated with the signal electronics and not the device. We replaced all of the major signal-processing electronics for u3 and carefully examined and checked continuity to the CCD pins from the preamp connector. Subsequent tests and use indicate that the performance of the u3 chip is now fine, so we are guardedly optimistic that the problem has been solved.

In addition to troubleshooting the u3 problem, a number of other camera maintenance tasks were performed. Of the more notable, we:

1. Fixed a thermal short on the trailing astrometric dewar caused by improper latching of the camera T-bars;
2. Fabricated and installed a new umbilicus for the camera;
3. Installed a remote switch to issue a cold boot signal to the camera “executive micro”, which now makes it unnecessary to ever power cycle the camera;

4. Fixed the dropped pixel problems in dewars 1 and 2 that were being caused by fiber problems (a dirty fiber and a badly seated fiber respectively);
5. Improved the electrical isolation of the camera when mounted to the telescope, although improved electrical isolation is still required on the instrument latches that hold the camera to the telescope;
6. Installed a pull-up resistor on the signal-bias board for the g1 chip. We now have all chips working properly for Apache Wheel scans and have checked with SITe, the chip manufacturer, to be certain that there is no danger working this way.

By the end of the summer shutdown, the camera was ready to observe in a much improved state; the only serious problem remaining is the latch isolation, but this should not be a danger if the camera is taken off the telescope when it is not in use, which is the current design desideratum.

Very little maintenance work was done on the spectrographs. During the summer shutdown, spectrograph maintenance work consisted mainly of pumping down the camera dewars.

3.2. Thermal Work

We continued our work to improve the thermal environment around the telescope, and to improve the thermal performance of the telescope itself. During the third quarter, we:

1. Hired a contractor to install the commercial refrigeration unit that we purchased in Q2. The unit was installed on the west wall of the 2.5m telescope enclosure, above the overhead door. Remaining work includes paint touch-up.

2. Conducted a series of airflow measurements in the lab to quantify the effectiveness of the primary mirror ventilation system, and in particular the geometry of the ventilation tubes near the inner face of the primary mirror. In the original design, the vent tubes in the mirror cell were fitted with small discs intended to force ventilation air into good thermal contact with the mirror face. A section of mirror cell, of similar geometry to the 2.5m primary, was purchased from Steward Mirror Laboratory for these tests. Tests made with and without the discs indicated that the discs offer no measurable improvement in performance. Since the discs complicate the removal/installation of the primary mirror and they offer no noticeable improvement in performance, we decided to remove the discs when the primary mirror was removed for re-aluminization.

The largest remaining thermal project is to investigate the replacement of the inefficient Glentec power servo amplifiers that run the telescope. The electrical engineer assigned to lead this project made no progress in Q3 because he is also responsible for the telescope slip detection system; all of his available effort went into slip detection in Q3. With slip detection in the final stages of acceptance testing, prototype work will begin on the amplifier project in Q4.

3.3. The Photometric Telescope

During the summer shutdown, the Photometric Telescope (PT) was disassembled and its primary mirror aluminized at Sunspot. The mirror received a good coating and was safely re-installed into the telescope. New transmission filters were also installed during the shutdown. Plots of several relevant parameters, as a function of time, have been made for each of the five filters. There are no significant differences between before-and-after FWHMs for any of the filters.

We have had on-going problems with the PT filter wheel controller and some effort went into troubleshooting this while the PT was disassembled. Micro-switches and a power transistor on the filter wheel were replaced during the shutdown but did not fix the problem. In Q4, we will install a new control circuit to replace the existing one; it is now the most likely suspect.

To improve the efficiency of PT operations, we contracted with a vendor to install a powered winch to automate the opening and closing of the lower PT dome shutter. The winch was installed and tested, but we experienced trouble with the system in September and reverted back to manual mode. The vendor has been contacted and is scheduled to return to the observatory to fix the winch.

The PT was ready for operation on August 9, but didn't actually begin taking data until August 21 due to poor weather. The PT has been taking survey quality data since.

3.4. Operations Software

During Q3, we were hampered by a number of observing software problems that affected observing efficiency. The most notable of these is a communications problem between the telescope motion control computers that results in axis motion aborts. We are putting significant effort into debugging this, but have yet to find the cause of the problem. Indeed, we have allowed an exemption to our "no-changes-during-an-observing-run" policy to allow MCP code changes during the observing run; we are adding diagnostics to help solve this problem.

We had a systematic 15 arcsec pointing offset throughout Q3 that affected observing efficiency; the offset prevented guide stars from immediately landing on guide star fibers, which adversely affected setup time. Joint troubleshooting by the developers and observers identified a correlation between the pointing offset and the pointing model being used. Once recognized, the observers' were able to deal with the offset procedurally while we continued to pursue the problem. We eventually found that the instrument block used for the engineering camera, used to take pointing models, was not being set correctly. The observers implemented a new procedure and early evidence indicates that the 15 arcsec pointing problem has been solved. Improved pointing reliability is critical to improving both imaging and spectroscopic efficiency.

Finally, we implemented stricter controls to limit the number of software changes per month to only those necessary to meet data quality or efficiency requirements. A software-planning meeting was scheduled for late September but had to be cancelled. It was replaced with a series of phone-cons between the observers' program developers, the observers, and management to review the list of outstanding Problem Reports (PRs) and prioritize the work to be done. The SDSS Problem-Reporting database was modified to make it easier to identify and track approved changes and bug fixes. The objective is to limit the number of software changes the observers have to learn and understand, and to make sure that development effort is being applied where it will have the most benefit in terms of data quality and operating efficiency.

3.5. Status of Engineering Tasks Scheduled for Q3

Table 3.1 reports the status of the more significant engineering tasks that were scheduled for completion in Q3-2001.

Table 3.1. Status of Engineering Tasks Scheduled for Q3-2001

Task	Responsible	Driver	Priority	Status
Aluminize PT primary mirror	Leger	Data quality	High	100%
Install enclosure refrigeration unit	Klaene	Efficiency*	High	100%
Complete camera maintenance/repairs	Gunn	Data quality	High	100%
Re-cable and organize MCP/TPM VME crate	Leger	Reliability	High	100%
Install new PT filters and quantify performance	Gunn	Data quality	High	100%
Troubleshoot/repair PT filter wheel controller	Brinkmann	Efficiency	High	100%
Install new instrument latch controller	Federwitz	Equip prot.	High	100%
Design/fab/install M2 radiation shield	Carey	Data quality	High	100%
Complete M1 cell ventilation tests	Carey	Data quality	High	100%
Resolve cartridge concentricity questions	Leger	Efficiency	High	50%
Develop PM program for telescope systems	Leger	Reliability	High	25%
Design/fab/install secondary latch improvements	Gunn	Equip prot.	High	25%
Develop/implement inst. change interlocks	Anderson	Equip prot.	High	10%
Procure and install emergency closing generator	Leger	Equip prot.	High	5%
Design/fab improved plug plate QA fixture	Carey	Efficiency	Medium	100%
Finish implementation of slip detection system	Czarapata	Equip prot.	Medium	95%
Design/fab improved plug plate drilling fixture	Carey	Efficiency	Medium	0%

*Also affects data quality.

The status of the incomplete tasks is as follows:

- Cartridge concentricity measurements were suspended during the summer shutdown and superseded by weather and telescope problems in September. Now scheduled for Q4.
- The slip detection system was installed late in Q3 and is undergoing testing. We want more operating experience before integrating the system into observing operations.
- The preventive maintenance program for the telescopes is under development. Many procedures have been developed and implemented, but there is more work to be done.
- A conceptual design has been prepared for the emergency-closing generator, but a more detailed plan is required before the project is approved. We expect to have the detailed plan ready for approval in November and the system installed in December.
- Conceptual design work to improve the camera secondary latches is underway; we expect the project to be completed in late January 2002.
- Work on the instrument change interlocks was delayed pending the availability of personnel to program the necessary changes into the interlock PLC. Programming work is now underway; we anticipate initial implementation and testing in early December.
- Work on the improved plug plate drilling fixture has been postponed until 2002. We diverted these resources to conduct the primary mirror vent tube flow measurements.

3.6 Engineering Tasks Scheduled for Q4

Table 3.2 lists the more significant engineering tasks that are scheduled for completion in Q4-2001. It should be noted that the list does not include the monthly plug plate drill runs or numerous documentation tasks. Tasks marked with asterisks are carry-over tasks from Q3.

Table 3.2. Engineering Tasks Scheduled for Q4

Task	Responsible	Driver	Priority
Complete cartridge concentricity questions*	Leger	Efficiency	High
Develop PM program for telescope systems*	Leger	Reliability	High
Procure / install emergency closing generator*	Leger	Equip prot.	High
Fabricate secondary latch improvements*	Gunn	Equip prot.	High
Develop/implement inst. change interlocks*	Anderson	Equip prot.	High
Design enclosure stair upgrade	Carey	Safety	High
Aluminize 2.5m primary mirror	Leger	Data quality	High
Develop method to remove set in science fibers	Owen	Reliability	High
Assess Holloman scattered light sensitivity	Rockosi	Data quality	High
Procure and install humidity sensor in enclosure	Gillespie	Equip prot.	Medium
Finish implementation of slip detection system*	Czarapata	Equip prot.	Medium
Develop requirements for cloud camera upgrade	Gunn	Reliability	Medium

In re-prioritizing our work to focus on efficiency and reliability, we have postponed several projects that were scheduled for completion in 2001. These will be re-prioritized and scheduled as part of the planning process for 2002.

4. DATA PROCESSING AND DISTRIBUTION

4.1 Data Processing

Two new people were hired at Fermilab to support SDSS data processing operations: a data analyst and an associate scientist.

Two terabyte disk servers were installed and are now in use: sdssdp8 and sdssdp9. Six more of these were delivered late in the quarter and are being installed, along with a pair of machines to hold our software product disks.

All imaging and spectro data are processed, and the following drilling deadlines were met:

- August 2001: chunk 21+22 (47 plates)

While we made reasonable progress in achieving the goals stated in the Q2-2001 report, we fell short in some areas, and in particular in implementing changes to support photo v5_3 validation. This was due largely to deploying resources from this effort to work on higher priority tasks related to telescope operations. The status of Q2 goals is as follows:

1. Implement strong authentication at Fermilab. This was not done, as an incompatibility was discovered between our batch queue software (LSF) and the strong authentication software (Kerberos). The Fermilab Computing Division is testing a new version of LSF that addresses this problem.

2. Finish a collaboration data release.
   - chunk catalog archive server (imaging) -- done
   - staging catalog archive server -- in progress
   - chunk catalog archive server (spectro) -- done

- chunk data archive server -- not done

3. Complete photo v5_3 validation by October 1
   - Implement data model changes for "weak lensing" shape parameters -- not done
   - Implement changes to astrom methodology -- done
   - Use better flats, generated from "oblique" scans -- flats not provided
   - Change photometric calibration procedures to reduce the problem to a set of "delta zero points" to simplify the eventual transformation to a true AB system while not confusion target selection algorithms and parameters -- not done
   - Satisfy existing testbed and regression tests -- not done.

4. Reprocess all spectro data with v4_7 of spectro 2d -- done, with rerun 14

The following data processing goals have been established for Q4-2001:

- Keep current with all imaging, mt, and spectro data.
- Produce files for the October, November, and December drilling runs
- Implement and validate photo v5_3 changes to the pipelines, opdb, and sx.
- Implement the opdb on a Linux machine, reliability testing, and make it operational.
- Implement automation of database updates
- Launch the reorganized "collaboration" web pages
- Change photometric calibration procedures to reduce the problem to a set of "delta zero points"to simplify the eventual transformation to a true AB system while not confusing target selection algorithms and parameters.
- Implement strong authentication at FNAL.

4.2. Data Distribution

The status of goals stated in the Q2 report is as follows:

1. Continue to support the EDR -- done;
   The collaboration between the SDSS and STScI is working well, and we are refining our log and reporting system to monitor database use. For one month of the quarter, we had the following access:
   - EDR Catalog Archive Server: In the month of September 2001, there were 5,279 queries run, and up to 13 concurrent sessions.
   - EDR Data Archive Server:
     In a four-week period during September and October 2001, there were 36,580 queries and 133,524 data files transferred.
   - EDR skyServer:
     In the four-month period since the EDR skyServer became public, June through September 2001, it served about two million hits and 700 thousands page views, via 50 thousand sessions. About 4% of these were to the Japanese sub-web and 3% to the German sub-web. The educational projects received about 8% of the traffic, or about 250 page views per day. Figure 4.1 shows skyServer traffic since June 2001.

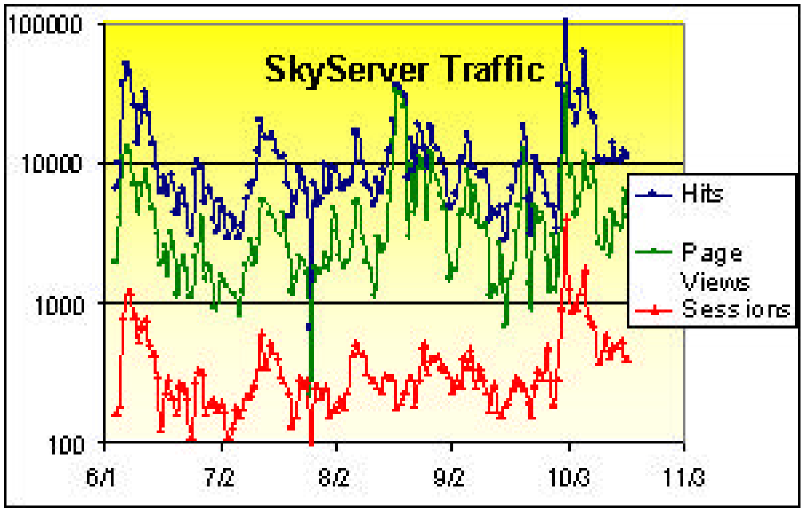

Figure 4.1. skyServer Traffic since the Early Data Release.

1. All of the public Sloan imagery has now been ingested into Virtual Sky. One may access VS-Sloan from: http://www.virtualsky.org/themes.

2. Load data for the collaboration release -- done for the Chunk Catalog Archive Server, as noted above.
   - Chunk Catalog Archive Server
     In the month of September 2001, there were 776 queries run and up to 6 concurrent sessions.

4) sx v2_4 improvements:
   - integrate ProxList server – not done
   - rewrite major parser elements to address long-standing bugs -- not done
   - modifications to accommodate data model changes – not done
   - incorporate tiling and target selection information – not done
   - handle best/all/target classifications for reruns – not done

The following data distribution goals have been established for Q4:

- Implement the following sx v2_4 improvements:
  - best/target/all rerun selection
  - mask objects
  - tiling information
  - ProxList integration
  - upgrade segment class to include start,end mu
  - implement target and tile chunk
  - reintroduce java query tool
  - implement photo v5_3 parameters
  - implement 64-bit flag fix, to include constants
  - fix MACROs in the parser (rerun, fieldID, etc.)
  - add photo z
- Make the six new disk servers and the products/NIS servers operational;
- Load and operate data servers for the collaboration;

- Implement all schema in SQLServer;
- Design and implement archive usage reports;
- Distribute tapes of EDR and Chunk data to collaborators in Japan and Germany.

5. SURVEY PLANNING

5.1 Observing Aids

Several programs used to aid in observing were updated.

1. HoggPT is a program that processes the data from the Photometric Telescope in near real time and provides feedback on the photometric quality of a night. The algorithm for analyzing the cloud camera images was improved so the background is now subtracted much better. The new filters installed in the PT will require new values for the "b" terms to be computed and inserted in the code.

2. The plate inventory database tracks which plates have been observed. Several small changes were made at the request of the observers to display additional information about plates being observed. A more robust backup procedure was implemented. A goal to automate the feedback of results from data processing was not met - this process is still done by hand. Data processing does not yet automatically generate all the information needed.

3. The patch database tracks the Photometric Telescope observing program. The database code was restructured to make it more maintainable and a more robust backup procedure has been implemented. Only small feature enhancements were made.

Several programs are in various stages of development to aid in planning observations.

1. The plate layout program determines the exact parameters to be used for designing new plates. This program is relatively stable. One change was made to allow it to work with lower priority plates now being designed for the southern hemisphere.

2. The plate planning program helps decide which areas of sky should be imaged next in order to maximize plate availability at all times during the night. This program has been upgraded to the point that it can now allow predicting when plates will be needed months in advance and for what locations in the sky.

5.2 Target Selection

Two significant changes were made to this code. First, the QSO code was changed so it is now more efficient at selecting quasars in the redshift range $z > 2$ where the code had previously been excessively conservative at avoiding objects with colors similar to ordinary stars. Second, the target selection code was modified to allow selecting objects with different parameter cuts in order to begin designing plates for the Southern Equatorial Survey.

Enough of the main southern survey area has now been observed in both imaging and spectroscopy that there are gaps in the supply of available plates. Consequently, the first set of plates for the Southern Equatorial Survey were designed and drilled. These plates are designed with modified algorithms that are used for testing the target selection algorithms, for calibrating photometric redshifts, and for other scientific programs. These plates are assigned lower priority than the main survey plates and thus are only observed when no main survey plates are available.

Overall, there was one round of drilling in this quarter creating 47 plates.

6. COST REPORT

The approved SDSS project budget for 2001 consisted of two parts: $4,000K for ARC funded expenses, and $1,909K for Fermilab, US Naval Observatory (USNO), and Los Alamos National Laboratory (LANL) expenses, which are paid by these institutions and counted as in kind contributions. Actual ARC funded expenses in Q3 were $839K against a baseline of $911K. We now forecast that ARC-funded expenses will be less than $3,400K for the year, thereby saving at least $600K for expenses in future years. The ARC funded budget is summarized in Table 6.1, which compares actual expenses against the baseline. A more complete table comparing actual to baseline performance is included as an attachment to this report.

As noted in previous reports, final third quarter expenses were not available for all of the institutional budgets at the time this report was prepared, due to variations in the timeliness of the accounting systems for the various institutions performing work for the SDSS. In these instances, third quarter expenses have been estimated to the best of our ability. The reported expenses will be revised as final invoices are received from the supported institutions.

Table 6.1. ARC-Funded 3rd Quarter Expenses and Forecast for 2001 ($K)

	2001 – 3rd Quarter		2001 - Total	
Category	Baseline Budget	Actual Expenses	Baseline Budget	Current Forecast
1.1. Survey Management	106	90	274	220
1.2. Collaboration Affairs	0	0	0	0
1.3. Survey Operations				
1.3.1. Observing Systems	269	205	1,095	956
1.3.2. Data Processing and Distribution	166	162	696	648
1.3.3. Survey Coordination	0	0	0	0
1.3.4. Observatory Support	330	362	1,320	1,317
1.4. ARC Corporate Support	40	19	167	88
Sub-total	911	839	3,553	3,230
1.5. Management Reserve	124	0	447	170
Total	1,036	839	4,000	3,400

6.1. First and Second Quarter Adjustments

ARC-funded Q1 and Q2 expenses have been adjusted from that reported in the Q2 progress report to reflect revised costs reported by several institutions. Actual Q1 expenses decreased by $47K, while Q2 expenses increased by $18K. The net change was a decrease of $29K. There were no adjustments in the in-kind contribution for these two quarters.

6.2 Third Quarter Performance - In-kind Contributions

The sum of in-kind contributions for the third quarter was $560K against the baseline forecast of $492K, and was provided by Fermilab, Los Alamos, and USNO. Fermilab provided support for the data acquisition system at APO, the software programs used by the observers to operate the telescopes and instruments (the "Observers' Programs"), and the data processing systems at Fermilab as agreed. The Fermilab in-kind contribution for Observing Systems Support was higher than forecast for three reasons. First, more effort was required on slip detection in Q3 than forecast. Second, Fermilab provided unanticipated support to refine and fabricate printed circuit boards to replace wire-wrap prototype boards (an effort to improve reliability). Third, Fermilab provided unanticipated support to update as-built drawings and assist engineers with developing shop drawings based on conceptual designs. The additional support is expected to last through the end of the calendar year and the Q4 forecast has been revised to reflect this.

Variations from the baseline for survey management and observers' program support were described in the 2001-Q1 report and a revised forecast was presented; actual Q3 expenses were in line with the revised forecast. Los Alamos provided programming support for the Telescope Performance Monitor as required, but stopped providing PT observing support at the end of Q2. This was according to plan, since PT observing operations are now performed by the 2.5m telescope observers. Accordingly, the total level of support provided by LANL was less than anticipated when the baseline budget was prepared. USNO provided support as required for the software systems they provided and now maintain, but as previously reported, these systems are mature and stable and so the required level of support is less than was anticipated when the baseline was prepared; USNO activity continues to focus on quality assurance testing.

6.3. Third Quarter Performance – ARC Funded Expenses

The sum of ARC-funded expenses for the second quarter was $839K, which is $72K below the second-quarter budget of $911K.

Survey management costs as a whole were $16K below the Q3 baseline. Expenses related to the Office of the Project Scientist were lower than anticipated. Also, JHU was unable to provide the level of pipeline testing and validation support anticipated in Q3. The level of testing support will remain low until mid-December, and the Q4 forecast has been adjusted to reflect this. For the year, survey management costs are forecast to be $54K below the baseline budget. We anticipate that the budget for the Project Scientist, and the budgets for software testing and validation at JHU and UW, will be underspent for the year.

Observing Systems costs were below the second quarter budget by $64K. The budget to support the work associated with improving the thermal environment around the telescope is held in the ARC budget for Observing Systems Support. Costs incurred in the third quarter were associated with the installation of the new enclosure refrigeration unit and testing to improve airflow through the primary mirror. For the year, thermal improvements costs will be significantly less than budgeted. A portion of the unspent funds allocated for thermal improvement work has been moved forward into Q4 to cover remaining improvement costs. The Fermilab budget for Observing Systems support was slightly overspent because ARC-funded salary costs for an additional mechanical technician at APO were not included in the baseline plan. The need for this additional support was determined after the baseline budget was prepared. The UW budget for Observing Systems support was underspent in part because funds budgeted for a new primary mirror shipping container and wind baffle cover tarp were not needed. The Princeton budget for Observing Systems was underspent because funds budgeted for a spectroreflectometer, and for an upgrade to the secondary mirror support system, were not spent. We identified a commercially built reflectometer that met our needs and whose cost could be shared with the 3.5m telescope operation, and the design work for the mirror support upgrade has been postponed pending further analysis to determine need. We are reconsidering whether this work needs to be done. The UC budget for Observing Systems appears to be overspent due to the addition of funds to support the Imaging Scientist. These funds were transferred from the ARC Corporate account and do not reflect an increase in the budget, but only a re-allocation of funds.

Data Processing and Distribution costs were $4K below the third quarter budget. Travel costs for Fermilab personnel and support costs for UC personnel were both below baseline estimates. These were partially offset by an increase in personnel costs at Princeton and Johns Hopkins.

Observatory Support costs were $32K above the baseline budget for Q3. The Observatory Support budget appears overspent in Q3 because in addition to actual expenses, it includes encumbrances for Q4-2001 expenses for the housekeeping contract, NSO services, telephone maintenance, etc. Final expenses will be adjusted as encumbrances are converted to costs. In fact, this is part of the reason for the large adjustment in Q1 expenses, as noted in section 6.1. With regard to Q3 expenses, salary costs were as expected. The cost of items such as utilities, supplies, repairs and maintenance, and equipment varied up and down from the budget, but not to unexpected levels. For the year, the Observatory Support budget is forecast to be within 1% of the baseline.

ARC Corporate Support costs were $21K below the third quarter budget. Funds are held in the ARC Corporate account and distributed evenly throughout the year to support personnel replacement costs. In addition, funds are held in the ARC Corporate Support budget under the category "Additional Scientific Support" to provide for additional scientific support when needed to work on specific problems or areas of concern. This budget is also spread evenly throughout the year in the baseline plan. These funds were not needed in the third quarter and we do not anticipate they will be needed through the remainder of the year; therefore, we have removed from the forecast.

No management reserve funds were distributed in the third quarter. The management reserve has been reduced to $170K to cover any unforeseen expenses that might be accrued in Q4-2001. Unspent funds from the management reserve will be available for covering expenditures in future years.

7. PUBLICATIONS

The Angular Clustering of Galaxy Pairs
ApJ submitted - Leopoldo Infante, et al.

Sloan Digital Sky Survey: Early Data Release
AJ submitted - Chris Stoughton, et al.

Evidence for Reionization at z ~ 6: Detection of a Gunn-Peterson Trough in a z=6.28 Quasar
AJ submitted – Robert H. Becker, et al.

L Dwarfs Found in Sloan Digital Sky Survey Commissioning Data II. Hobby-Eberly Telescope Observations
AJ accepted - D. Schneider, et al.

A Survey of z > 5.8 Quasars in the Sloan Digital Sky Survey I: Discovery of Three New Quasars and the Spatial Density of Luminous Quasars at z~6
AJ accepted - Xiaohui Fan, et al.

KL Estimation of the Power Spectrum Parameters from the Angular Distribution of Galaxies in Early SDSS Data
ApJ submitted - Alexander S. Szalay, et al.

The 3D Power Spectrum from Early SDSS Angular Clustering
ApJ submitted - Scott Dodelson, et al.

The Angular Correlation Function of Galaxies from Early SDSS Data
ApJ submitted - Andrew Connolly, et al.

The Angular Power Spectrum of Galaxies from Early SDSS Data
ApJ submitted - Max Tegmark, et al.

Spectroscopic Target Selection for the Sloan Digital Sky Survey: The Luminous Red Galaxy Sample
AJ accepted - Daniel Eisenstein, et al.

New insights on the Draco dwarf spheroidal galaxy from SDSS: a larger radius and no tidal tails
AJ accepted - M. Odenkirchen, et al.

Galaxy Clustering in Early SDSS Redshift Data
ApJ submitted -Idit Zehavi, et al.

The Ghost of Sagittarius and Lumps in the Halo of the Milky Way
ApJ submitted - Heidi Newberg, et al.

The u'g'r'i'z' Standard Star System
AJ submitted - J Allyn Smith, et al.

Analysis of Systematic Effects and Statistical Uncertainties in Angular Clustering of Galaxies from Early SDSS Data
ApJ submitted - Ryan Scranton, et al.

Solar System Objects Observed in the Sloan Digital Sky Survey Commissioning Data
AJ submitted - Zeljko Ivezic, et al.