Quarterly SDSS Operations Report

April 12, 2000 - July 3, 2000

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Data Collected and Observing Efficiency

An Appendix to the Q1 Report provided a spreadsheet that projects the rate of data acquisition (square degrees and plates) for the survey. This baseline enables our actual progress to be evaluated.

Imaging

In Q2 we acquired 317 deg^2 that were stuffed into the database. One run contains a rich cluster of stars, which has slowed down processing. When stuffed, this will add another 156 deg^2. The quantity 317 deg^2 has been corrected for repeated scans of the same area of sky, but has not been corrected for overlap between adjacent stripes. Considered in the same way, the baseline Q2 2000 calls for 154 deg^2 to have been obtained. In Q2 2001, the baseline calls for 711 deg^2 due to better efficiency.

We have not yet determined what fraction of the data that have been stuffed into the database are deemed to meet survey image-quality and photometric standards, but it is evident that if only 50% of the area of the scans do, then we have met the baseline projection. We do know that 62% of all of the scans stuffed meet the revised image quality requirements of 1.5 arcseconds or better.

Spectroscopy

In Q2 30 plates were exposed and processed that certainly meet, or likely will be found to meet, the necessary quality to enable extraction of redshifts at the survey's specified level of completeness.

The baseline calls for zero plates, since the official start of spectroscopic operations is Q1 of 2001. The baseline projection for Q2 of 2001 is 82 plates. The comparison of 30 to 82 is not so unfavorable because we are still refining the efficiency of spectroscopic operations. Seven other plates were attempted in Q2 but were underexposed; with experience we can avoid such underexposure. This indicates that, a year from now, we require a factor of 82/37 = 2.2 increase in throughput to meet the baseline rate of spectroscopic progress.

The following table gives summary statistics of time usage, identical in format to Table 1 of the Q1 report. Essentially no time was lost to equipment failures in Q2. The final dark run (23 June - 2 July) resulted in no new data, either spectroscopic or imaging, due to bad luck with the weather, but some time was used for engineering tests. Averaged over the quarter. The total time lost to weather during this entire second quarter, 38%, was consistent with our baseline projections.

Dark Run	24 April - 10 May	23 May - 7 June	23 June – 2 July
Total dark hours in run	115	95	60
Hours lost to clouds	15.4	36.5	51
Engineering time	1.0	3.5	9
Net hours for science	98.6	55.0	0
Science imaging	33.9	0.0	
Commis. imaging	7.6	-	
Science spectroscopy	13.0	27.0	
Commis. spectroscopy	-	-	
Hrs collecting sky data	54.5	27.0	0
Hours collecting sky data/net hours for science	55%	49%	n/a

Science and Commissioning Highlights

This quarter marked the transition from active commissioning of the SDSS on-site operations to routine observing. Smooth operations on the mountain requires bug-free running of a large amount of interlocking software and hardware, and much of Q1 was spent ironing out these problems. Although we are not completely free of troubles at this time, in Q2 things ran smoothly enough that most of the clear dark time on the mountain was spent on observing, rather than discovering and diagnosing problems.

Much work was done on improving observing efficiency. For example, we have clarified the criteria and decision-making steps by which we switch between imaging and spectroscopy. We have also developed a quick-look spectroscopic reduction package, which runs immediately after each spectroscopic exposure is completed, thus allowing the observers to determine whether the net exposure meets our signal-to-noise ratio requirements.

In this quarter we scanned over a region of sky with deep images from the Hubble Space Telescope as a way to check our star/galaxy classification. We scanned a southern region of our survey area that has existing astrometric calibration; the analysis of these data confirm that we are meeting the survey astrometric requirements.

Among the exciting SDSS science results of this quarter: Xiaohui Fan (Princeton) and collaborators used imaging data taken in March to spectroscopically identify a luminous $z = 5.80$ quasar, the most distant one yet by far. This discovery was widely reported in the popular media, including a prominent article in the New York Times. The total number of high-redshift ($z > 3.5$) quasars discovered thus far in SDSS data is over 150. Don Schneider (Penn State) found a close pair of quasars at $z = 4.25$ in SDSS imaging data, implying that quasars at high redshift are strongly clustered. In addition, several workers have studied the structure of the Galactic halo with SDSS data, giving photometric evidence for a thick disk (Chen et al.), and tidal streams.

Papers Submitted or Published in Q2 Include:

Discovery of a Close Pair of z=4.25 Quasars from the Sloan Digital Sky Survey
AJ submitted – D. P. Schneider

The Structure of the Galactic Halo Implied by RR Lyrae Candidates Found in Sloan Digital Sky Survey Commissioning Data
AJ submitted - Z. Ivezic

The Discovery of a Luminous z=5.80 Quasar from the Sloan Digital Sky Survey
AJ, 120 --, 2000 - X. Fan

Five High-Redshift Quasars Discovered in Commissioning Imaging Data of the Sloan Digital Sky Survey
AJ accepted - W. Zheng

Weak Lensing with SDSS Commissioning Data: The Galaxy-Mass Correlation Function to 1/h Mpc
AJ accepted - P. Fischer

The Missing Link: Early Methane ("T") Dwarfs in the Sloan Digital Sky Survey
ApJ Lett, accepted - S.K. Leggett

Identification of A-colored Stars and Structure Halo of the Milky Way from SDSS Commissioning Data
AJ, 540, ---, 2000 - B. Yanny

The Discovery of a Second Field Methane Brown Dwarf from Sloan Digital Sky Survey Commissioning Data
ApJ, 531:L61-65, 2000 March - Z. Tsvetanov

L Dwarfs Found in the Sloan Digital Sky Survey Commissioning Imaging Data
AJ, 119:928-935, 2000 - X. Fan

High-Redshift Quasars Found in Sloan Digital Sky Survey Commissioning Data II: The Spring Equatorial Stripe
AJ, 119:1-11, 2000 - X. Fan

The Low-Resolution Spectrograph of the Hobby-Eberly Telescope.II. Observations of Quasar Candidates from the Sloan Digital Sky Survey
PASP, 112:6-11, 2000 January - D. P. Schneider

The SDSS had a significant presence at the American Astronomical Society meeting held in Rochester, NY, June 4 - 8. Several poster papers giving recent science results were presented. An exhibit booth was staffed that included a demonstration of the science database, a working model of the fiber plugging system with a plug plate, and a display of redshift cone diagrams. In preparation for distribution at the meeting, a booklet had been prepared titled "Science and Technology 1999 – 2000" that summarizes the papers published or in preparation within the past year. Finally, a special session was secured at the forthcoming AAS meeting (January 2001 in San Diego) that will highlight scientific results from the SDSS.

Operations Readiness Review

A review of Observing Systems and Observatory Support was held at Apache Point Observatory April 25 – 27. It was chaired by J. Crocker with a team of reviewers from external observatory and operational venues. The reviewers were given a documentation package, heard oral presentations from the technical staff, watched actual survey operations, and interviewed many of the operational staff. The report of the panel made a number of recommendations, among which are: 1) the cadre of Observers should be increased to at least 6.5 FTE, and a Lead Observer position should be established; 2) the "minimum accomplishments for survey success" needs to be defined (as a complement to the projected baseline progress); 3) the project needs to prioritize the task list. This was the first of two operations readiness reviews; the second will review Data Processing and Distribution. The review will be held at Fermilab on July 20-21, and will be chaired by Sidney Wolff.

Our responses to these recommendations are:

1. A Lead Observer and a Deputy Lead Observer have been appointed from the current group of Observers (Scot Kleinman and Dan Long, respectively). Their new job definitions are being developed. The lead observer will serve half-time as an observer and the reminder of his effort will be dedicated to provide an effective interface between the project leadership and the observing operation. NMSU has been authorized to maintain the regular observing staff at 6 FTEs, exclusive of the lead observer position, which is a new position. In addition, another part-time Observer is being contributed from Los Alamos National Laboratory. Thus if the in-kind contribution is considered as a bonus, the total number of FTE Observers will be 7.0 once the open positions are filled. While two of the current observing team are leaving the project, they will be replaced with three new hires, for which job announcements have been published.

2. We are proposing specific minimum acceptable accomplishments in units of square degrees of sky covered and number of plates. This still provides a focus for discussion of the minimum accomplishments, which define the survey as a success. The impact of this minimum on the scientific programs will be evaluated by the Working Groups, a process that will include discussions of modifications to the survey strategy as a corollary response.

3. The hardware tasks planned for observing systems have been identified placed in priority order and scheduled. Fifty percent of the time of the engineering staff is allocated to maintenance and unplanned repairs. The remainder is allocated to the prioritized, scheduled task list.

Highlights of SDSS Operations at APO

The efficiency of operations improved as a consequence of hardware and software becoming more robust, operational procedures becoming more mature, and relatively good observing conditions up until May 30. The recent half of the May/June dark run and all of the June/July dark runs were lost to weather.

In this quarter the testing of changes was restricted to the shakedown period, which helped provide a more stable base of operational software during the dark runs. New tape drives were installed in the data acquisition system, which gave far fewer problems than the older units they replaced, among a number of other improvements.

Improvements and repairs to the 2.5-meter telescope enclosure air-handling systems continued during the quarter. The telescope environment is now routinely controlled for dust, humidity, and temperature during the day.

On May 11 - 12 a team of four safety professionals from other observatories and laboratories conducted a review of the APO safety program. This entailed a detailed review of the APO Site Safety Plan, plus an audit of the site, with observations of and interviews with operations staff. A report has been issued, which largely commends the APO safety program, while making specific recommendations on improvements to safety equipment, procedures, documentation, and communications.

A forest fire started 11 May as close as four miles northeast of APO, which consumed more than 10,000 acres before containment. The observatory was fortunately upwind of the fire, but for several days, the observatory was on high alert for evacuation of personnel, and our standing procedures for site fire protection and evacuation were reviewed. In June, the monsoon rains began early, mitigating the risk of fire. In coordination with Forest Service and the National Solar Observatory, plans were developed to clear and burn log piles and other wood slash around the Sunspot/APO area. This controlled-burn program will be conducted by the Forest Service in July, during the rainy season and while the telescopes at APO and Sunspot are shut down for their annual engineering overhauls.

Observing Systems

One major uncertainty that we must resolve is definition of the achievable image quality. The telescope/camera combination has never yielded the image quality expected from the design and the claimed quality of the optics as delivered by the vendors. It certainly appears that one major problem is that the seeing is not as consistently good as the early surveys suggested it might be. However, even when the seeing is superb the image quality over the camera array has been substantially poorer than we expected. This is not always the case, as we have learned recently. Rather than clarifying the issue, these results further confuse us.

We are in the midst of adopting a course of action in which we will temporarily relax the scientific requirement for image quality from 1.2 arcseconds to 1.5 arcseconds. We have operationally already done this by using this as a condition for imaging. We need to evaluate the consequences for quasar target selection (expected to be the most demanding issue) before making a final decision. In the meantime, we will conduct several studies to attempt to identify the source of the problem. These will including thermal studies to investigate thermal distortions to the optics and adverse effects on local seeing, and a measurement of the optical figures of the secondary mirror and the common Gascoigne corrector using the absolute profilometer at Lick Observatory.

The second major problem is with the photometric system. A very large number of small problems had to be solved before the Photometric Telescope (PT) could consistently be used for observations. Reliable observations began only in the first quarter. The photometric system, which was supposed to be finished two years ago, is just now nearing completion, and there are significant, though easily solved, problems with the software, as it exists now. We have been working with a system that works but is not of nearly the consistency and accuracy we require for the survey in the long term. These issues will be resolved by the end of the summer. We are hopeful that the ad hoc system we have been using is good enough that we will not have to repeat the spectroscopic observations acquired this spring.

Improvements to Observing Efficiency:

1. A new piece of software has been written, which will allow rotational alignment of the camera during 'ramp-up' before data taking begins. This will have a dramatic effect on imaging efficiency, especially for short scans.

2. A major component of the spectroscopic efficiency is the acquisition and determination of the rotational 'attitude' of the guide fibers, which has recently been fixed by the addition of collars with specific rotational orientation. The full calibration of these is not yet complete. Another component is the accuracy of pointing, but there has not been enough time for the regular acquisition of pointing models for each run.

3. All of the hardware for enhancing the speed of instrument change is finished and almost all of it has been installed and tested. We are waiting currently on software development.

Observing Systems tasks Completed or Well Under Way:

1. Telescope-windscreen bumpers: Design finished, parts finished, first two bumpers assembled; install and test mid-July.

2. Pointing error diagnosis: Data taken and analyzed, fix designed and implemented and tested to the extent weather allowed in July run. The problem was hysteresis in the elevation encoders when moving rapidly; we now calibrate them every 15 degrees when slewing. We will apply the same fix to azimuth even though the problem has not shown there.

3. Spectroscopic corrector housing/handling fixture design is finished and roughly half the parts are in the shop. Installation in August.

4. Optics testing: Secondary and common corrector were removed from the 2.5-m telescope on 5 July. They were shipped to the Lick Observatory for profilometry measurements on 10 July. The profilometer measurements will be completed by the end of July. The optics will be back at APO by 5 August.

5. Optics thermal monitoring. Imaging data with thermal camera was obtained, and is ready to be analyzed. Preliminary recording thermometer network on primary and secondary mirrors installed early in the June-July run. Unfortunately no useful data have been obtained because of weather.

6. Lightning protection grounding for telescope and fixed enclosure finished. Final installation of fiber isolation for all external paths into the enclosure except power will be finished in July. Yet to be done is improved grounding of movable part of enclosure when closed.

7. Early lightning warning. We have subscribed to a service, which monitors local lightning activity, and it appears to be accurate and timely. We are still looking into local electric field measurement.

Data Processing in Q2 2000

All of the processable data that have been acquired have been run at least once through the pipelines. Moreover, extensive re-processing of older data with newer versions of the pipelines was begun in this quarter (and is on-going). The reprocessing is being done on one of the high-throughput farms (a set of 26 processors with extension disk and tape storage). Since this required moving the PHOTO pipeline from a Silicon Graphics operating system to a LINUX operating system there were problems but they have been resolved.

The speed of processing was slowed because of a number of problems. Among these were the difficulties encountered by the astrometric pipeline in handling scans obtained at high declination (due to tracking problems in the telescope); bias level changes in column 1 that required special code to be developed; intermittent noise in the u2 CCD (such runs are rejected); and dropped pixels in the spectroscopic data (a problem that is thought to be fixable in software).

Due to the large number of bug fixes and other improvements in the photometric pipeline it was deemed sensible to re-process all of the viable runs with the new code. Ten runs to date are scheduled. An incorrectly set tuning parameter for calibration in the photometric pipeline was discovered.

We have made progress in the general plan to automate the running of the pipelines, i.e., to have little if any human intervention in the stages between the pipelines. An important element of this is to quantify data quality in a reliable and transparent way, both locally (specific to one run) and globally (inter-comparison of independently calibrated runs).

The primary SIRTF field was scanned and processed, but still needs to be properly calibrated. This field will be observed by the SIRTF infrared satellite early in its mission, and all data made publicly available.

The Groth field (a piece of sky with extensive imaging done by the Hubble Space Telescope) was scanned. Comparison of the SDSS and HST images has shown us that our star-galaxy separation is 95% correct to fainter than 22nd magnitude.

Data Distribution

The automated data transmissions are currently the primary means of data distribution to collaboration members wanting large amounts of the data, and will continue until the SX provides access to all data.

After the processing of each run is completed, Fermilab copies these data to a disk available to all collaborators. From here Fermilab transmits a subset of the data files to any collaborating institution that requests it. Fermilab announces what is available and when the transfer will take place approximately one day in advance. Each institution selects a standard subset of files to receive, which are then transferred to a disk on their own machines.

The automated data transmissions have been performed since October of 1999, with continual improvements in transfer rate, error handling, and automation. The system is now quite robust and transmissions are regularly made by various members of the data processing team. No further major changes or improvements beyond greater automation are planned.

This process is limited by available bandwidth between Fermilab and the collaborating institutions. Fermilab is able to distribute all data products for a full night's run to the University of Chicago within well under 24 hours, for instance. The same is not true of all institutions, many of which have slower connections and thus must request smaller subsets of the data products.

Work on complete automation of the transfers continues. At the present, some options and logging for the batch system are still left to the operator. The default command options are automatically generated and logged and the operator enters the commands by hand with the option of changing them.

SDSS Project Financial Report

Executive Summary

This report presents the state of the SDSS project budget at the end of the second quarter of 2000 and provides an updated forecast for the remainder of the calendar year. The SDSS project budget consists of two parts; $1,848K for Fermilab, US Naval Observatory (USNO), and Los Alamos National Laboratory (LANL) expenses, which are paid by Fermilab, LANL and the USNO and are counted as in kind contributions, and $3,700K for ARC funded expenses. The current forecast of ARC funded expenses for 2000 is $3,718K after applying the entire contingency in the approved budget. The ARC funded portion of the budget is summarized in Table 1 and presented in detail in

Appendix 1. Both tables compare second quarter expenses and the current forecast against the baseline. It should be noted that while some second quarter costs are based on actual invoices submitted to ARC, many are based on less formal input from institution SSP managers and budget officers and in one case on estimated expenses. In particular, final June costs for the science archive effort at Johns Hopkins were not available when this report was prepared; therefore, June expenses for this activity were estimated.

Table 1. 2000 Budget Status – ARC-Funded 2nd Quarter Expenses and Proposed Forecast ($K)

	2000 – 2nd Quarter		2000 - Total	
Category	Baseline	Actual Expenses	Baseline	Forecast
Project Management & Science Direction	64	88	244	307
Observing Systems	240	229	1,074	1,162
Data Processing and Distribution	170	181	686	761
Observatory Support	296	343	1,185	1,195
ARC – Corporate Expenses	32	61	139	271
Capital Improvements	0	0	0	22
Sub-total	802	902	3,328	3,718
Undistributed Contingency	71	0	372	0
Total	873	902	3,700	3,718

Second Quarter Performance

Fermilab, LANL, and the USNO provided the agreed upon level of effort throughout the quarter and both plan to provide the same level of effort for the remainder of 2000. Fermilab also provided the data acquisition system at APO and data processing systems at Fermilab as agreed.

The sum of ARC-funded expenses for the second quarter was $902K. This is $100K above the second-quarter baseline, without contingency, of $802K. Second quarter expenses were higher than the baseline for the following reasons. First, project management costs exceeded the baseline because the SDSS Director had requested additional management support from JHU to assist with the readiness review at Apache Point and the preparation of project reports. This overrun was anticipated at the beginning of the quarter and described in the first quarter report. Second, several new scope requests were approved for additional hardware and personnel support at the observatory, thereby resulting in a cost overrun of the Observatory Support budget. Third, second quarter expenses for Princeton software and data processing support exceeded the baseline by 30% due to late invoicing of salary costs that were actually incurred in the first quarter. This budget was under spent in the first quarter and when the first and second quarter expenses are summed, the budget is on track with the baseline through the second quarter. Therefore, the apparent overrun in the second quarter does not have an impact on the total budget for 2000. Finally, ARC corporate expenses exceeded the baseline for a number of reasons. Costs of an SDSS booth at the June AAS and the operational readiness review held at APO between April 25-27 were charged to the corporate account; since these items were not included in the baseline budget they will contribute to the overrun of the ARC corporate budget. Since booths are costs planned for future AAS meetings, the ARC corporate budget in future years will be increased to provide for these costs and the 5-year Survey Operations budget will be revised. In addition, a change was made in the way the project will be billed by the University of Washington for the use of the milling machine used to manufacture spectroscopic plug plates. This change created a cost increase in the ARC Corporate budget and a corresponding cost reduction in the University of Washington budget for observing systems support. The change has no impact on the total budget for 2000, although it contributes to the apparent overrun of the ARC Corporate budget in the second quarter. In summary, projected cost savings in the third quarter will largely offset the $46K cost increase in Observatory Support. Cost savings in the first quarter Princeton software development budget offset the $20K increase in the second quarter. The remaining $34K constitutes an actual cost increase for the quarter.

Year 2000 Budget Forecast

The current forecast for CY2000 is $391K above the baseline, without contingency. This is less than the forecast overrun presented in the first quarter report because the construction of the engineering support building and the acquisition of the phone system upgrade at APO have been deferred in response to concerns by the SDSS Advisory Council. The Advisory Council was concerned that the cost of these capital improvements would have to be paid for with funds contributed to the project by new partners if the work was started in 2000. These funds can also be used to pay the unpaid construction bills from 1996-97. The SDSS Director will develop a new plan for funding these capital improvements that does not require the use of funds contributed by new partners.

Table 2 outlines the distribution of projected costs contributing to the forecast increase. By applying the entire contingency in the approved 2000 budget, the current forecast exceeds the ARC funded baseline by $18K.

Table 2. Increases in the 2000 Budget, by Category

Item	Projected Cost ($K)
ARC corporate expenses	130
Telescope and instrument support	88
Project management support	63
Data processing and distribution support	75
APO engineering support building design	22
Observatory site support	10
APO dedication	8
ARC personnel	(6)
Subtotal	390
Contingency/reserve adjustment	(372)
Forecast overrun of the 2000 budget	18

1) Difference in sum due to rounding.

The following sections discuss second quarter performance and provide details regarding proposed changes to the forecast budget. The sections are organized according to the project Work Breakdown Structure (WBS).

Project Management and Science Direction

The ARC funded budget for Project Management and Science Direction provided for the travel and miscellaneous expenses incurred by the Director, the Technical Director, the Spokesperson, and the Head of Science Direction. It also provides for salary support and other expenses for the Spectroscopic Scientist at the University of Pittsburgh and the editor of the project reports at JHU. The budget is distributed among Princeton, the University of Chicago, the Johns Hopkins University, the University of Washington and the University of Pittsburgh. Second quarter expenses were 38% over the baseline for this period because of the previously forecast increase in the JHU costs for the editor of the project reports, as described in the first quarter report. The Director requested additional support from the editor to assist with the review of Observing Systems at APO and the preparation of several sponsor reports during the second quarter. This work has been completed and no further support for project management will be requested from JHU beyond June 2000. With the exception of the JHU budget, the forecast for all other project management support is on track with the baseline and no additional cost increases are expected this year.

Observing Systems

Observing Systems includes engineering, maintenance, and support for the 2.5-m telescope, photometric telescope, telescope instruments, and plug plate operations at APO. It also includes plug plate production. The budget for Observing Systems includes ARC funded support provided by Princeton, the University of Chicago, the Johns Hopkins University, and the University of Washington. Fermilab provides the telescope engineer and two technicians at APO as an in kind contribution and ARC pays for the materials, services, and travel expenses incurred by the telescope engineer and the technicians.

The telescope and instrument engineering costs are projected to be $88K higher than the baseline budget. This is slightly below the $95K forecast overrun projected in the first quarter report and demonstrates that the forecast for the year is relatively unchanged from last quarter. The increased cost in this category was for equipment protection and small changes to the 2.5 m telescope and the instruments, which corrected deficiencies uncovered during the last quarter of 1999 and the first two quarters of 2000. We have offset costs for this previously unplanned work by prioritizing the remaining work and deferring some of it to 2001 when appropriate. We will continue this practice to hold the forecast at its present level.

The second quarter expenses for telescope and instrument engineering were 5% below the baseline. The UW observing systems budget appears under spent by 30%. This is largely due to a change in the way the project will be billed for the use of the vertical milling machine used to manufacture spectroscopic plug plates. $24K had been included in the University of Washington budget to cover this use fee, but a change in the billing procedure now has these charges being invoiced directly against the ARC Corporate budget. This change will require moving funds for these charges from the UW budget to the ARC corporate budget when budget amendments are processed after third quarter results are known.

The first quarter report noted the possibility of sending the secondary mirror and common corrector lens to Lick Observatory for profilometer measurements during the summer 2000 shutdown. We did determine that the seeing requirement of 1.2 arcseconds could not be met consistently. This has been attributed to three possible causes: poorer than expected seeing at the APO site, heat sources in the telescope and the lower level enclosure which create very local distortions of the seeing, and optics which do not meet the technical requirements. Each of these possibilities is being investigated. We elected to proceed with the profilometer measurements since they were necessary to characterize the quality of the optical surfaces. Since the best time to do these measurements is during the summer shutdown that began on July 6, the common corrector and the secondary mirror were shipped to Lick Observatory a few days after July 6. The measurements will be completed in July and the components will be shipped to APO during the first week of August. We expect to receive a final report on these measurements by late August. The projected cost for these measurements, including shipping and transportation, is $33K. $5K will be added to the UW observing systems support budget for engineering and fixture fabrication; $28K will be added to the ARC Corporate budget to cover shipping and measurement costs. The Director authorized the use of undistributed contingency to fund this work.

Princeton engineering costs in the second quarter were in reasonable agreement with the baseline. Fermilab engineering costs exceeded the second quarter baseline as expected due to the large under run in the first quarter. Work that had been planned but not completed in the first quarter was completed in the second quarter and the costs incurred as anticipated. For the year, the Fermilab observing systems forecast is 16% over the baseline to cover the additional items enumerated in the first quarter report. University of Chicago expenses associated with observing systems support were below the baseline, due largely to the fact that not all charges were applied against the budget by the end of the quarter. Adjustments will be made when all charges are in and the second quarter results become final. Expenses associated with JHU support for observing systems and photometric telescope commissioning were in close agreement with their respective budgets.

Data Processing and Distribution

Data processing and distribution includes pipeline and data processing development and support, development and support of the Science Archive (SX), and development of the photometric calibration system. The following sections discuss budget performance and revised forecasts for each of these areas.

Pipeline Development and Data Processing Support

The ARC budget for pipeline development is spread among Fermilab, Princeton, and the University of Chicago and supports the salaries for the developers at Chicago and Princeton and the travel and supplies expenses at Chicago, Fermilab, and Princeton. The salaries of developers at Fermilab are supported by an in-kind contribution from Fermilab. Fermilab provides the cost of the data processing effort as an in-kind contribution.

Actual second quarter expenses for the ARC-funded effort at Fermilab were in close agreement with the baseline. We propose to add an ARC funded position at Fermilab to provide software development and observing support. This new position will be a 3-year appointment, with the individual spending roughly 50% of his/her time supporting the development and maintenance of observing programs and 50% as a 2.5-m telescope observer. We expect to fill this position on October 1; therefore we project an increase of approximately $19K to the ARC-funded budget for Fermilab in the fourth quarter of 2000. Overall, this 3-year appointment will result in a forecast increase of $249K to the ARC-funded portion of the 5-year Survey Operations budget. We note that the committee that reviewed Observing Systems recommended that the SDSS add this position in order to improve the efficiency of operations at APO.

Princeton expenses for data processing support exceeded the second quarter baseline by $20.4K as a result of salary costs for February and March not being charged to this account until June. Since these costs were not reported in the first quarter, first quarter expenses appeared under spent when compared to the baseline as noted in the first quarter report. Summing together the first and second quarter expenses now results in expenses through June that are on track with the baseline. The result is that the apparent overrun in the second quarter has no impact on the total budget for 2000. Second quarter University of Chicago expenses for software and data processing support were on track with the baseline.

Data Archive Development and Support

The budget for data archive development and support covers the effort at JHU to develop the Science Archive database. June expenses for the second quarter were not available when this report was prepared, so June expenses were estimated by extrapolating actual April and May expenses. Using this approach, second quarter expenses appear within 3% of the baseline budget. Second quarter numbers will be adjusted once actual June expenses are made available.

The baseline budget for the JHU effort in 2000 is $167K and the current forecast is $208K. $17K of the forecast increase was requested by the Head of Science Archive Development in the first quarter and approved by the Director. The details were presented in the first quarter report. The remaining $15K of the forecast increase will provide for an orderly replacement of one of the two computer scientists, who will be leaving in February 2001. The Head of Science Archive Development has identified an individual with the correct skills and experience to fill the position that will be vacated in 2001. Since this individual is available, the decision was made to offer the person a job beginning in October. Thus ARC will be supporting three developers in the last quarter of 2000 and most of the first quarter of 2001. The overlap will result in a forecast increase of roughly $30K to the 5-year Survey Operations budget.

Photometric System Definition

Photometric system definition tasks in the second quarter included commissioning and operation of the Photometric Telescope and development of the primary standard star system. The baseline JHU budget for Photometric Telescope commissioning in 2000 was $204K; the current forecast is $231K. The increase is due to previously unreported costs incurred in 1999 as discussed in the first quarter report. Second quarter expenses were $46K against the second quarter baseline of $43K.

The baseline budget for the JHU effort to develop the photometric calibration system is $45K; the current forecast is $43K. Second quarter expenses were $5.5K against a baseline of $14.8K. The budget appears under spent due to the delay in receiving bills from JHU; these numbers will be revised when actual costs become available.

Through the end of June 2000, the University of Michigan provided a post-doc to work on the photometric calibration effort. The baseline 2000 budget for this effort is $33K; the current forecast is also $33K. Second quarter expenses were $16.5K against a baseline of 14K. This second quarter cost increase is offset by the under spent budget in the first quarter. The work by the post-doc is complete and no additional costs will be incurred, although we do expect some small residual charges in July that did not get into the U-Michigan system in time for the June accounting period. These additional charges are factored into the current forecast.

In addition to the ARC funded JHU effort on the photometric calibration system and the Fermilab in-kind support for the development of the photometric pipeline, a second, independent effort will be started at Princeton and the Institute for Advanced Study. Since photometric calibration is on the critical path for providing calibrated imaging data for target selection and the testing and verification of the imaging pipelines, it was decided by the Director and the Technical Director to increase the level of effort. A new agreement is being initiated with the Institute for Advanced Study to participate in this activity. The IAS will provide personnel as an in-kind contribution to the SDSS and the SDSS will provide $8.6K to support travel and the cost of incidental supplies. Additionally, the Princeton software support budget will be augmented by $6.2K to support travel and incidental supplies on this effort as well. These amounts are included in the current 2000 forecast and are funded by the use of undistributed contingency.

Observatory Support

The baseline observatory support budget for 2000 was $1,185K; the current forecast is $1,195K. Second quarter costs were $343K against a baseline of $296K. The $46K overrun can be attributed to the following expenses that have been approved by the SDSS Director based on need.

Table 3. Observatory Support Budget Add-ons ($K)

Item	Add-on Expenses ($K)
Additional technician support	12.0
Observer travel to Feb FNAL meeting	10.0
Housekeeping contract increase	8.0
Lightning surge suppressor system	6.3
Security/safety cameras	4.3
Other miscellaneous	6.0
Total	46.6

Miscellaneous costs include FedEx shipping costs that exceeded the baseline budget, electricity costs for the new HVAC system running higher than budgeted, and miscellaneous costs for shop cabinets and Observer workstations.

It is anticipated that third quarter observatory support expenses will be below the baseline and largely offset the overrun in the second quarter. The observing staff is in “summer mode” so overtime usage will be minimal. Since overtime is budgeted evenly throughout the year in the baseline plan, salary costs charged against the budget in the third quarter will be below the baseline. Additionally, vacation time taken by NMSU staff is paid out of previously encumbered funds and will not be charged directly against the third quarter budget. It is estimated that these factors will result in a third quarter cost savings in excess of $50K, which will offset the second quarter cost increase.

Fourth quarter expenses are expected to follow the baseline with the exception of two items. First, additional funds may be necessary to cover the cost of observer travel to Fermilab for meetings with the data processing group. This travel was not in the baseline budget and results in a forecast increase of $15K. Second, salary costs will be increased by an estimated $27K to augment the SDSS observing team to seven members and to adjust the salaries of the designated Lead Observer and Deputy. The $27K forecast increase includes benefits and MTDC. The increase in the size of the observer team from six to seven is being done in order to create the Lead Observer and Deputy Lead Observer positions. The addition of a lead observer was one of the major recommendations made by the committee that reviewed Observing Systems and Observatory Support between April 25-27, 2000. They noted that the observing group was too small and that a leader and a deputy were needed to establish communication between the observing group, project management, and the engineering staff during the daytime.

Summing these items together results in a forecast increase of $42K against the Q2-4 Observatory Support budget of $888.8K. This budget, along will all others, will be amended after the third quarter results are reported and first quarter construction budgets closed. At that time, we will have a more accurate view of Q2-3 expenses, a more accurate projection of the fourth quarter forecast, and a clear understanding of our remaining contingency.

ARC Corporate Expenses

Corporate-level expenses cover such items as audit and insurance expenses, CD’s for limited data distribution, and aluminizing costs for the 2.5-m telescope primary mirror. The current ARC forecast is $170K against a baseline budget of $40K. In addition to the items planned for in the baseline, the items shown in Table 4 have been added to the ARC Corporate budget and collectively sum to the $130K forecast.

Table 4. ARC-Corporate Budget Add-ons

Item	Projected Cost ($K)
Lick profilometer measurements	28
UW vertical mill usage fee	24
APO petty cash and cleaning (Q3-4)	24
APO observer workstations	12
Enclosure rail shroud	10
Readiness review at APO	10
Audits and insurance	9
AAS meeting expenses	7
AAS expenses (graphics)	5
Total	**130**

Capital Improvements

The two capital improvements proposed in the first quarter report have been deferred until funds are raised for this purpose. This will reduce the previously forecast overrun in the 2000 budget by $476K. Although these projects have been deferred, the design of the engineering support building was completed. We now have an accurate cost estimate for the work and we are in a position to solicit bids and award a contract for the construction of the building once funds are available and approval is granted by the Advisory Council. We will incur costs of $22K in the third quarter for the design work for the support building.

Contingency

The baseline budget contained $372K in undistributed contingency.   Applying the entire contingency to the current forecast results in a projected overrun of $18K against the baseline budget of $3,700K. It is clear that we will have to monitor costs closely and work very hard to bring the project in on budget for 2000. The costs for any new work will have to be offset by deferring currently planned work.