Sloan Digital Sky Survey

Quarterly Progress Report
First Quarter 2005

May 20, 2005

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Q1 PERFORMANCE HIGHLIGHTS

- We obtained 448 square degrees of new imaging data against a baseline goal of 691 square degrees (65%).
- We completed 82 standard survey plates and 14 SEGUE plates. Converting these to plate-equivalents, we completed 103 plate-equivalents against our baseline goal of 195 plates (53%).
- Once again, weather significantly reduced our observing yield. On average, weather was suitable for observing 41% of the time. February was particularly poor; only one-eighth of the time scheduled for observing had suitable weather conditions.
- Operations ran smoothly and there were no major system problems. All data acquired in Q1 have been processed. Plug plates continue to be designed, fabricated, and delivered to APO in a timely fashion.
- The "Target" version of DR4 was made available to the SDSS collaboration on April 15. The collaboration has had access to the DAS and to the "Best" version of DR4 since December 22. The public release of DR4 is scheduled for June 27, 2005, slightly ahead of the schedule.
- Q1 cash operating expenses were $641K against a baseline budget of $837K, excluding management reserve. In-kind contributions were $402K against anticipated contributions of $357K. No management reserve funds were expended in Q1.
- One of our observers, Pete Newman, left the project on February 15 for a new position overseas. Pete joined the observing staff in March 2001 and was with us for nearly four years. Pete's efforts helped improve the efficiency and effectiveness of observing operations at APO and his diligence helped ensure the quality of data collected. We wish Pete all the best and continued success in his new position.

1. SURVEY PROGESS

1.1. Q1 Imaging

Table 1.1 compares the imaging data obtained against the revised baseline projection for the North Galactic Cap[1] and against the established baseline projection for the South and Southern Equatorial Stripe. We collected 448 square degrees of imaging data, or 65% of our baseline goal of 691 square degrees.

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[1] The revised baseline projection was described in the 2004-Q4 Progress Report.

Table 1.1. Imaging Survey Progress in Q1-2005

	Imaging Area Obtained (in Square Degrees)			
	Q1-2005		Cumulative through Q1	
	Baseline	Actual	Baseline	Actual
Northern Survey[1]	691	448	7229	6897
Southern Survey[1]	0	0	745	738
Southern Equatorial Stripe[2]	0	0	4808	3485

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

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

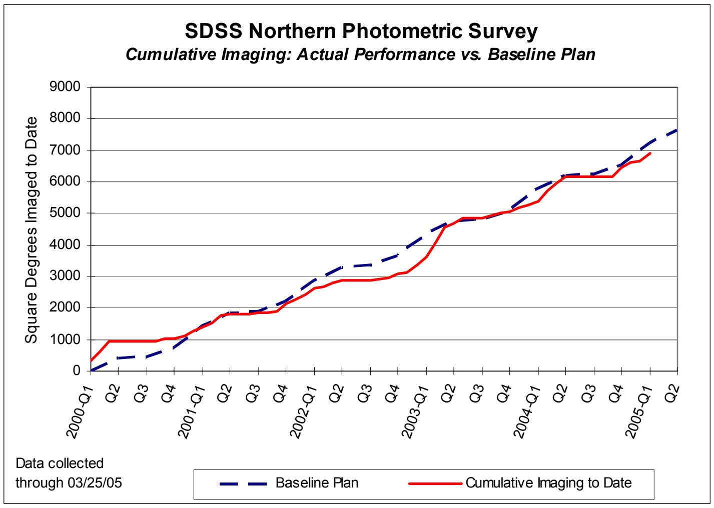

Figure 1.1. Imaging Progress against the Baseline Plan – Northern Survey

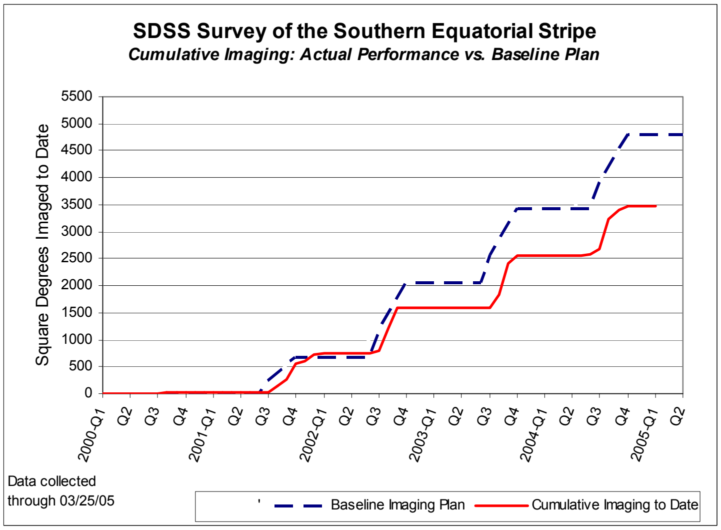

Figure 1.2. Imaging Progress against the Baseline Plan – Southern Equatorial Survey

1.3. Q1 Spectroscopy

Spectroscopic progress is reported in terms of the number of plates observed and declared done during a quarter. Each plate typically yields 640 unique spectra.

We completed 96 spectroscopic plates in Q1; 82 were standard survey plates and fourteen were SEGUE plates. Some of the SEGUE plates required longer exposure times than the standard plates, so it is necessary to convert the number of physical plates observed into plate-equivalents to measure progress against the baseline. In these terms, we completed 103 plate-equivalents against the baseline goal of 195 plates (53%).

The following graphs show spectroscopic progress against the baseline goal for each survey region. Progress is reported in plate-equivalents for the special program plates, which allows for a direct comparison with baseline goals. Details on the SEGUE plates are provided in Section 8.

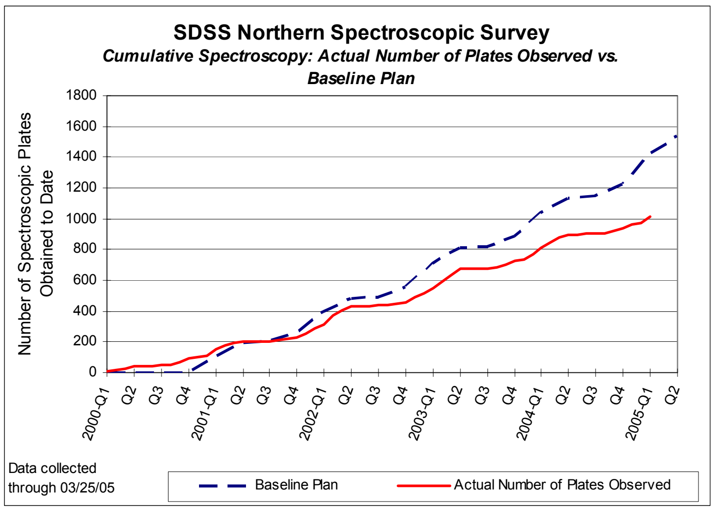

Figure 1.3. Spectroscopic Progress against the Baseline Plan – Northern Survey

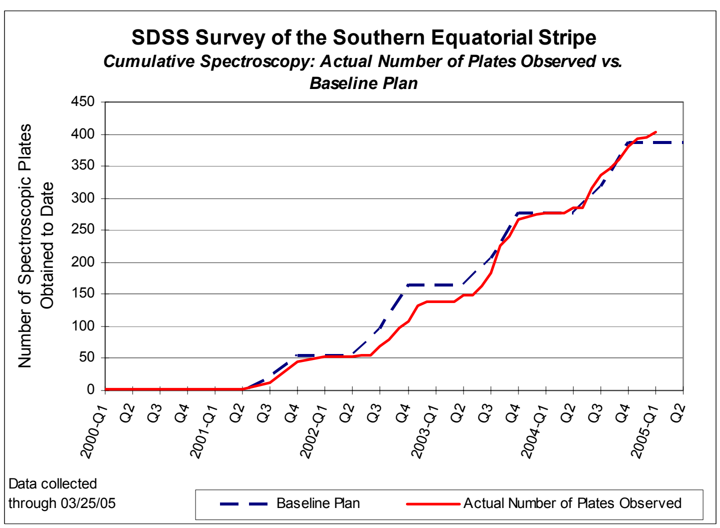

Figure 1.4. Spectroscopic Progress against the Baseline Plan – Southern Equatorial Survey

1.4. Photometric Telescope Secondary Patches

Figure 1.5 shows the status of secondary patches observed and processed through May 19, 2005. As the figure shows, all of the necessary secondary patches in the revised footprint area for the Northern Galactic Cap (the area bounded by Stripes 10 and 37) have been observed and processed. Thus, the planned program for obtaining secondary patches is complete.

Although the planned program is complete, we will continue to use the Photometric Telescope (PT) on a regular basis. When imaging with the 2.5m telescope, the PT will be used to measured extinction coefficients. We also anticipate observing additional secondary patches in sparsely-populated areas as necessary to improve photometric calibration; and occasionally re-observing patches as part of our quality assurance program.

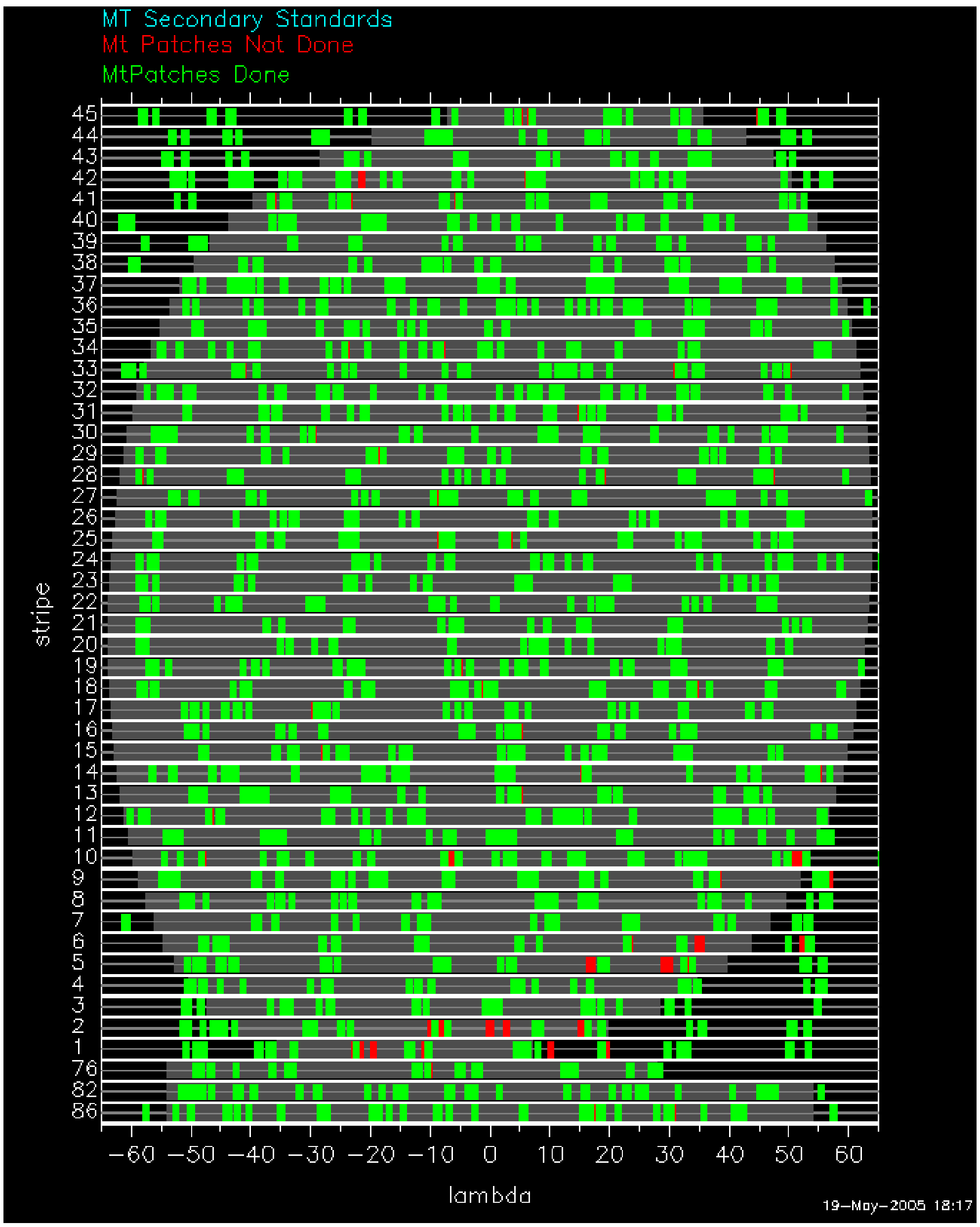

Figure 1.5. Secondary Patches overlaid on the SDSS Footprint

2.0 OBSERVING EFFICIENCY

Observing efficiency is summarized according to the categories used to prepare the baseline projection.

2.1. Weather

The weather category reports the fraction of scheduled observing time that weather conditions were suitable for observing. Table 2.1 summarizes the amount of time lost to weather and Figure 2.1 plots the fraction of suitable observing time against the baseline forecast. Weather conditions in February were particularly poor, when weather conditions were suitable for observing during only one-eighth of the scheduled observing time.

Table 2.1. Potential Observing Hours Lost to Weather in Q1

Observing Condition	Total hours potentially available for observing	Total hours lost to weather	Fraction of time suitable for observing	Baseline Forecast
Dark Time	416	244	41%	60%
Dark & Gray Time	622	367	41%	---

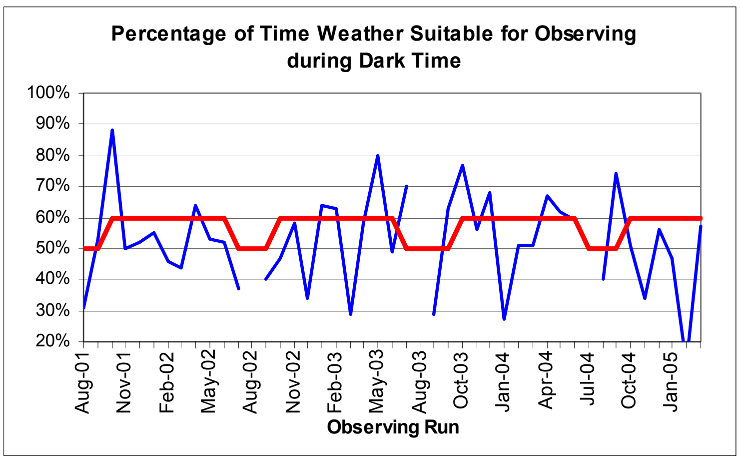

Figure 2.1. Percentage of Time Weather Suitable for Observing

2.2. System Uptime

System uptime measures the availability of equipment when conditions are suitable for observing. We averaged 96% uptime against a baseline goal of 90%.

Table 2.2 summarizes the total amount of time lost to equipment or system problems and Figure 2.2 plots uptime against the baseline goal.

Table 2.2. Potential Observing Hours Lost to Problems in Q1

Observing Condition	Total hours potentially available for observing	Total hours lost to problems	System Uptime	Baseline Forecast
Dark Time	416	16	96%	90%
Dark & Gray Time	622	18	97%	---

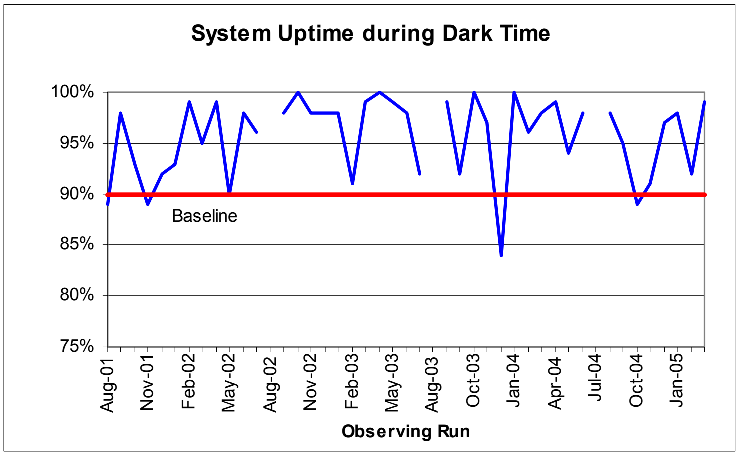

Figure 2.2. System Uptime

2.3. Imaging Efficiency

The imaging efficiency factor is defined as the ratio of imaging science time to the sum of imaging science time plus setup time. For the quarter, imaging efficiency averaged 89% against a baseline goal of 86%. Imaging efficiency in March was exceptional, when the observers achieved an imaging efficiency of 0.94, a new high.

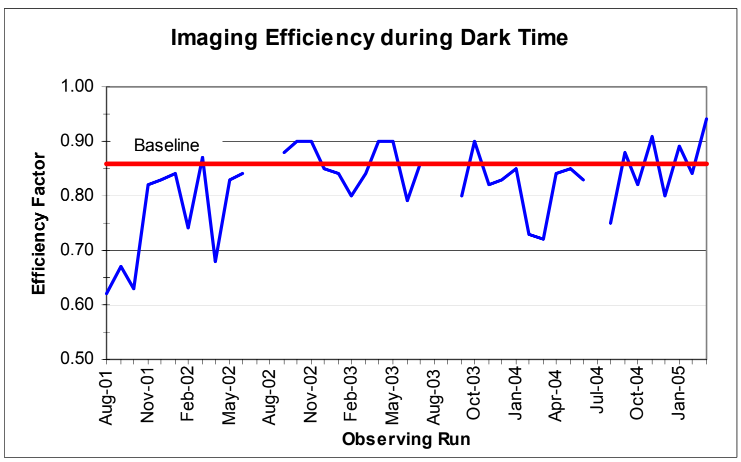

Figure 2.3. Imaging Efficiency

2.4. Spectroscopic Efficiency

Spectroscopic efficiency is defined as the ratio of spectroscopic science time to the sum of spectroscopic science time plus overhead. Overhead includes time associated with instrument change, setup, and calibration; and CCD readout. For the quarter, spectroscopic efficiency averaged 65% against the baseline goal of 64%. Figure 2.4 plots spectroscopic efficiency against the baseline goal.

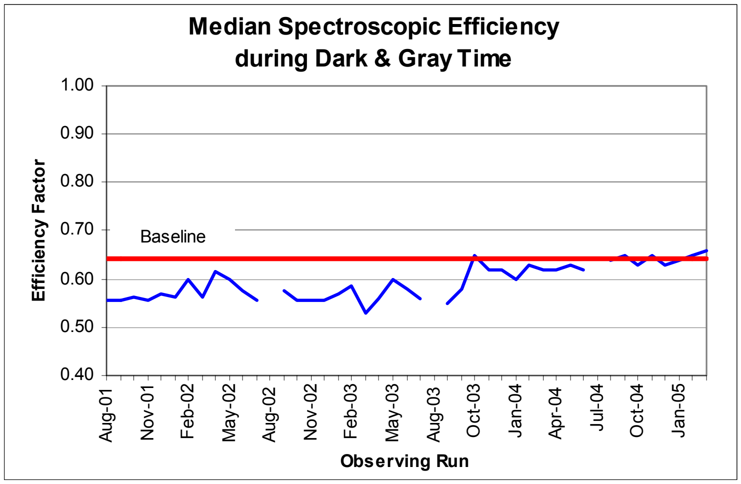

Figure 2.4. Spectroscopic Efficiency

3. OBSERVING SYSTEMS

Observing systems includes the instruments, telescopes, computers and various sub-systems that support observing operations at APO.

3.1. The Instruments

The imaging camera worked well throughout the quarter. We are still seeing occasional spikes in the reported value for the imaging camera vacuum; this problem has been noted and described in previous progress reports. Evidence still suggests that the problem lies in the ion pump or its controller, as opposed to a vacuum leak in the imager. Unless the problem becomes more severe, we will not initiate repairs before the summer shutdown.

There were minor mechanical problems with the spectrographs. In January, the shutter in spectrograph #1 failed to operate properly; the problem was fixed by reseating a connector. In March, we had a minor problem with the spectro data acquisition system that was fixed via system reboots.

Operationally, the observers have become quite adept at determining, prior to nighttime operations, when and to what extent to refocus the spectrographs, based on anticipated nighttime operating temperatures. Their proactive approach has increased operating efficiency.

3.2. The 2.5m Telescope

There were no significant problems with the 2.5m telescope or its subsystems in Q1. The following list highlights some of the more significant engineering and maintenance activities completed in the quarter:

1) After further re-design and modifications, we settled on a design for the "Holloman" light baffles that allows both easy access to the flat-field lamps and more convenient removal procedures during major structural work on the telescope. The baffles prevent stray light from Holloman Air Force Base from reaching the secondary mirror and, in turn, affecting data quality.

2) We discovered earlier in the year that the cable pulleys for the plug station were improperly sized for the diameter of the lifting cable used in the system. This caused minor fraying in the cable, which if left uncorrected could lead to a potentially unsafe situation. We re-designed the lifting

mechanism to incorporate a larger diameter sheave and pulley arrangement. We also eliminated all cable splices. The upgrade has been in place and working satisfactorily for over two months.

3) A significant portion of the quarter was devoted to preparation work for the installation of the feasibility tests for the Exoplanet Tracker (ET) project. An optical bench, interferometer, and thermal enclosure were installed in the "pit" of the telescope azimuth cone area and made operational for the feasibility tests conducted during the March bright time.

4) We had installed a new M2 thermal radiation shield in Q4. Subsequent data analysis found that the shield's thermal performance was unsatisfactory and a physical examination identified thermal shorts between the aluminum plates comprising the shield assembly. We removed the aluminized material originally positioned between the plates and substituted Volara foam sheeting. The shield was re-installed onto the telescope and preliminary results indicate that the modification has improved thermal performance substantially.

5) Upon inspection, we discovered that the contact discs for the telescope bump switches are detaching themselves from their bodies and causing erroneous bump signals. We are in the process of re-designing the switches; we anticipate installing the new switches during the summer shutdown.

6) We started to install a valve in the instrument lift hydraulic system, to aid in diagnosing the cause of an occasional, uncontrolled minor upward drift in the instrument lift ram during imager change operations. During the valve installation, we decided to change the mounting orientation of the hydraulic pressure accumulator from horizontal to vertical. After bleeding the system, the drift in the ram disappeared. It appears that a small air bubble had been trapped in the fluid side of the accumulator when mounted in the horizontal position. Once mounted vertically, the bubble was able to escape during system bleeding. Thus, remounting the accumulator in a vertical orientation successfully fixed a long-standing safety and equipment protection concern.

7) A new set of static counterweights was installed to balance the telescope in altitude for our instrument combinations; the new counterweights were required to offset the increased weight of the new M2 radiation shield discussed earlier.

8) In an effort to monitor the thermal environment inside the spectrographs, we mapped the various thermal sensor locations and modified the software package, "specMech", to read and record the sensors. At quarter's end, the code was in the process of being tested and debugged.

3.3. The Photometric Telescope

The Photometric Telescope (PT) worked well throughout the quarter. In previous reports, we noted the existence of a fiber on the filter of the PT CCD. During maintenance work in Q1, the fiber was removed.

We continue to have problems with the Cryotiger closed-cycle refrigerator used to cool the PT CCD. Over the past year, we have had both our main and spare units refurbished by the vendor, with only moderate success. Upon further discussion with the vendor's engineering department, we learned that the compressors are nearing the end of their useless life, which may explain the growing number of problems we have had of late. We are in the process of ordering a new compressor, which we intend to install during the summer shutdown.

Through a detailed analysis of the PT dome shutter slit control circuit, we discovered that a 2-amp load was being applied across the slit motor when the system was shut down. Further investigation revealed several other shortcomings in the control circuit wiring. The control circuit system was rewired, and overheating problems due to amperage draws across supposedly de-energized motors have been resolved.

A set of UV LEDs were installed on the PT flat-field lamp system. The new lamps will be used once a month to calibrate the UV response of the PT's CCD.

3.4. Operations Software and the Data Acquisition System

Work on observing software consisted of bug fixes and minor upgrades to improve operating efficiency. The following work was done on observing software in Q1:

- A new version of iop (v3_143_0a) was delivered and successfully tested on the sky under imaging and spectroscopy modes. The new version is built on the latest version of astrom, which allows goStare commands executed by the imager calibration code to work well with nighttime goDrift commands.
- The specMech code, which controls mechanical components of the spectrographs was modified to begin reading and recording outputs from temperature and humidity sensors mounted internally in the spectrographs. The code was delivered to the observers for testing, but failed acceptance testing. Code fixes will be implemented and the code re-tested in Q2.

We experienced several minor problems with the DA system. We still have occasional problems with the PTVME link. In most cases, the observers execute procedural work-arounds that allow us to quickly recover and resume operations. In Q1, we had more serious problems with the PTVME link that were eventually traced to a faulty PTVME board; replacing the faulty board with one from the spares pool solved the problem. We also had a problem with the portion of the DA system associated with the spectrographs that resulted in "blue-screened" monitors for the spectrograph #1 outputs. Rebooting the SP1 DA crate several times fixed the problem. We have not been able to determine the source of the problem, but fortunately the problem has not re-occurred.

Work is actively underway on the DA upgrade. Orders for new hardware have been placed. New PCs running Linux will replace obsolete workstations that are costly to maintain. New Motorola MVME5500 PowerPC control cards will replace obsolete MVME167 control cards. A team of four computer professionals at Fermilab are working on migrating existing DA code to the new platform. In Q1, they resurrected and tested the DA simulator at Fermilab. They also successfully emulated PTVME link functionality in software, which means that the PTVME link hardware that has given us problems over the past several years will not be a present in the new system. Finally, they began porting the code that runs on the existing MVME167 platform to the new PowerPC platform and porting existing astroline and astroda code to run on Linux.

4. DATA PROCESSING AND DISTRIBUTION

4.1. Data Processing

4.1.1. Pipeline Development and Testing

No changes were made to the photometric or spectroscopic pipelines in Q1.

In past reports, we have discussed the Apache Wheel program, and in particular, collecting Apache Wheel data with the 2.5m telescope and imaging camera. "Apache Wheel" imaging scans run perpendicular to the main scans; they are obtained by driving the telescope at several times sidereal rate, while substantially binning the camera. The Apache Wheel data are designed to tie the imaging stripes together photometrically. In Q1, scientists at Princeton were successful in getting Apache Wheel data through the photometric pipeline, after dealing with a number of difficult book-keeping issues for these very non-standard frames. The next step is to incorporate the photometry from these runs into 'ubercalibration', which carries out photometric calibration by forcing overlapping runs to give consistent photometry of objects in common.

Work also continues on the co-adding of data obtained through repeated scans on the Southern Equatorial Stripe. Efforts in Q1 focused on getting the photometric pipeline to process co-added data. Working closely together, individuals at Princeton and Fermilab have come up with a scheme to use the results of the photometric pipeline on individual scans to identify stars appropriate for determination of the Point Spread Function. Initial tests show that the results are quite good (i.e., the photometry of the co-added image is consistent with that of single scans at the 1-2% level); they are continuing to work to "industrialize" the code to handle unusual situations gracefully.

4.1.2. Data Processing Operations

Data processing operations continue to run very smoothly. In Q1, we processed data from 10 imaging runs, 96 spectroscopic plates, and 108 unique PT patches. Quality assurance tests were performed on the imaging data and the results posted on the runQA web page. Quality assurance inspections were made on the spectroscopic data and the results summarized on the spectro QA web page.

In addition to processing data and preparing for data releases, data processing personnel are involved with the implementation and testing of data reduction software for the SEGUE program; and in the development, installation and commissioning of the Supernova data reduction system at APO. Work performed in these areas is discussed in Section 8.

4.2. Data Distribution

4.2.1. Data Usage Statistics

To date, the general public and astronomy community have access to the EDR, DR1, DR2, and DR3 through the DAS and SkyServer interfaces. Figure 4.1 shows the volume of data transferred monthly from the DAS through the rsync server. A total of 960 GB were transferred in Q1, compared to 930 GB in Q4. Historically, monthly data transfers via the rsync server are characterized by numerous small transfers and one or two large transfers by institutions apparently transferring much if not all of the data set. Over the past six months, we have seen a reduction in the number of large transfers.

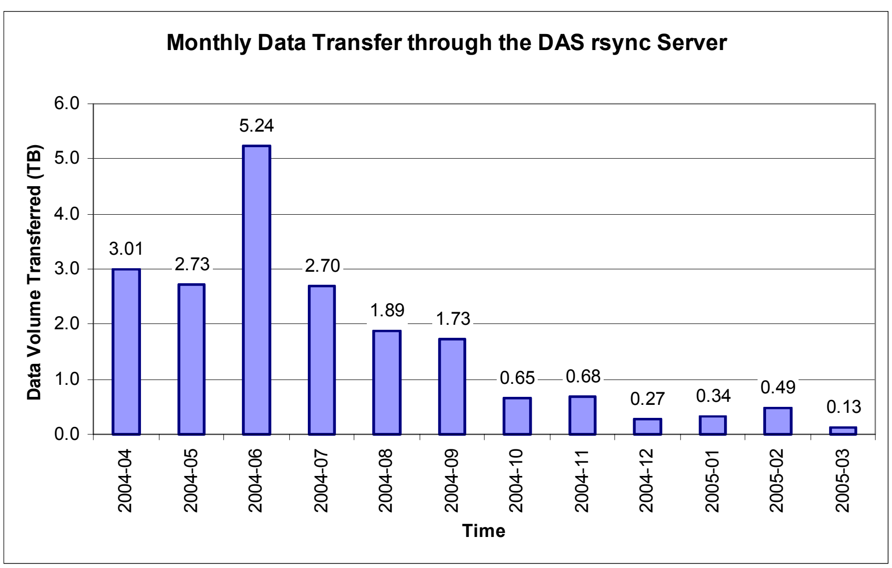

Figure 4.1. Monthly data transfer through the DAS rsync Server

Figure 4.2 shows the volume of data transferred monthly through the DAS web interface. Over the past six months, data transfer volume has averaged approximately 0.7 TB per month. In March, the volume of data transferred was nearly double the monthly average. We are currently looking into the reason for the large increase. It should be noted that logging was disabled in October 2004. While the actual volume of data transferred during that month is unknown, it was certainly more than zero.

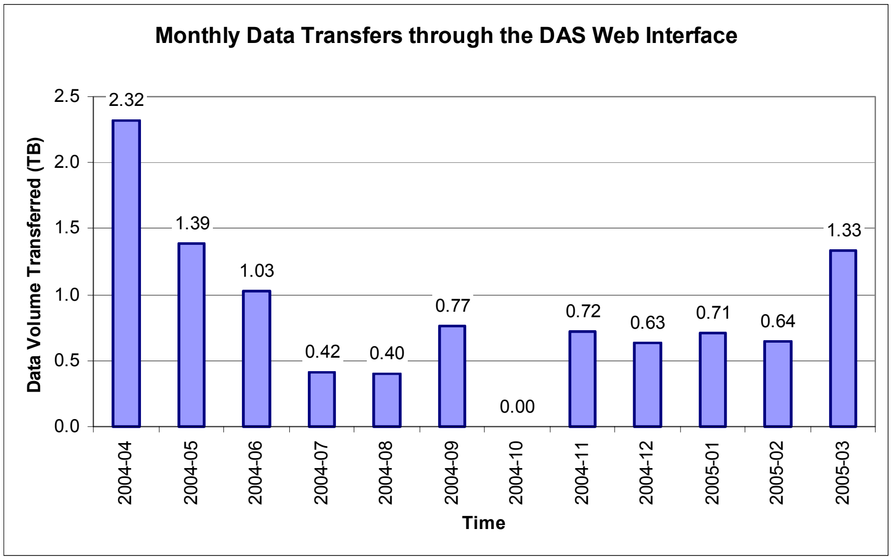

Figure 4.2. Monthly data transfer through the DAS web interface

Figure 4.3 plots the number of web hits we receive per month through the various SkyServer interfaces. In Q1 we recorded a total of 14.6 million web hits, compared to 8.5 million hits in 2004-Q4 and 8.2 million hits in Q3. Through March 31, 2005, the SkyServer interfaces have received a total of 80 million web hits and processed over 13.6 million SQL queries. As the graph shows, the rate at which the user community is accessing SDSS data continues to grow.

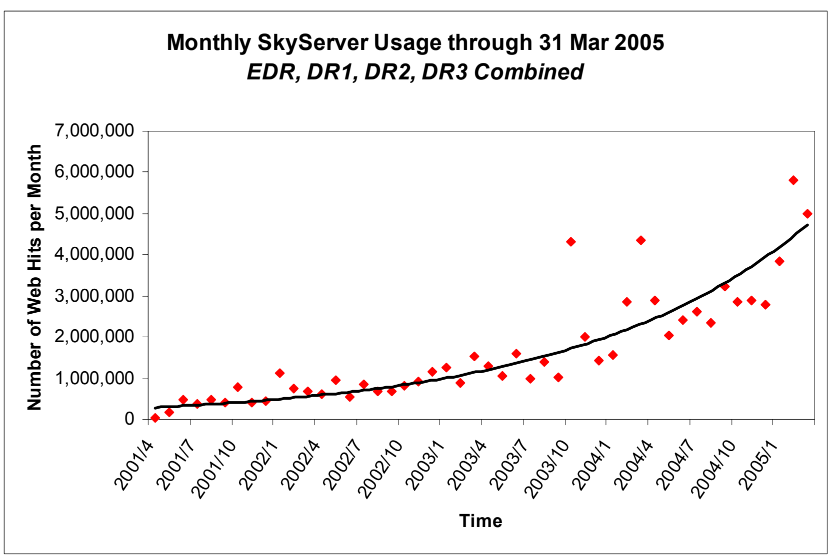

Figure 4.3. SkyServer usage per month, for all public releases combined.

Figure 4.4 shows the total number of SQL queries executed per month. We recorded 4.3 million queries in Q1, compared to 1.93 million queries in 2004-Q4 and 1.84 million in Q3. Looking at the graph, one notices a significant increase in the number of SQL queries received and processed in February. In mid-February, we started receiving approximately 170,000 SQL queries per day; the queries were emanating primarily from two scientific organizations. From the first, we were receiving machine-generated SQL queries at the rate of several times per second. From the second, we were receiving machine-generated queries of order 3,000 per day, each of which executed in 0.1 seconds and returned one row of data. Given the rates at which these queries were being received and serviced, server response time was drastically reduced. To alleviate the reduction in performance, and to ensure that other user queries weren't being blocked by those generated by automated systems, we implemented an online procedure that limits queries to six per minute from a single IP address. The procedure allows large organizations and systems to still crawl through the dataset, albeit at a slower rate and not at the expense of system response time to regular users.

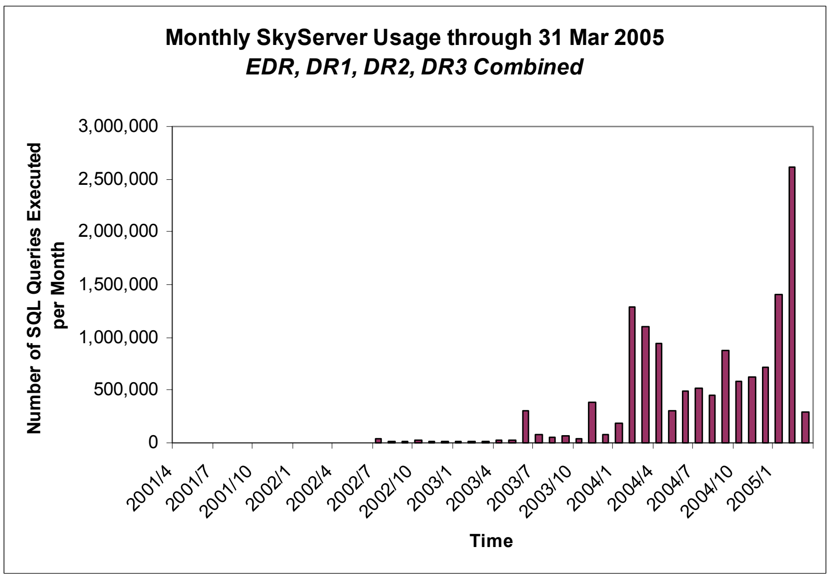

Figure 4.4. SkyServer usage, measured by the number of SQL queries submitted per month.

4.2.2. Data Release 4 Preparations

As reported last quarter, the DR4-DAS and the "Best" version of the DR4-CAS were released to the SDSS collaboration in December. In early April, we released the "Target" version of the DR4-CAS to the collaboration. Work associated with preparing the Target version is discussed in Section 4.2.4.

We are on schedule to release DR4 to the public on June 27, 2005; our planned release date is slightly ahead of the scheduled release date of July 2005 defined the approved data distribution plan.

4.2.3. Data Archive Server

The Data Archive Server (DAS) is currently serving up the DR1, DR2 and DR3 data sets to the public and collaboration; and DR4 to the collaboration. The DAS remains for the most part highly reliable. There were no file corruption problems in Q1. There was a period of several days during Q1 in which DAS access through the "wget" interface was unavailable. The problem was traced to a combination of hardware failures and a lack of consistency in operating system versions, the latter of which led to system instability within the networked cluster of computers serving the DAS. Faulty hardware components were promptly replaced and a systematic upgrading of the operating system (OS) on all machines in the cluster, to the same OS version, was completed. There have been no further problems with the interface since the repairs and upgrades were made. Moreover, we fully expect that running the same version of the OS on all machines in the cluster will further increase system reliability and stability.

4.2.4. Catalog Archive Server

Work on the CAS was associated with finishing the Target version of the DR4 load. Prior to initiating the Target load, we spent a significant amount of time on CAS loading infrastructure improvements. We verified and validated the schema and data model used for the DR4 load; and tested and refined the "finish" step of the CAS loading process. We developed a number of software tools that allow us to quickly synchronize new schema changes with those used for earlier data loads and validate schema and data model changes implemented in new versions of the sqlLoader code. We measured and recorded the time required to complete various elements of the loading operation. Knowing the nominal time required for various steps to execute allows us to more quickly confirm that operations are proceeding normally, and to identify anomalies requiring attention. Finally, we implemented more stringent version control and configuration management procedures. All code changes, regardless of complexity, are now checked into the CVS repository and all loading operations are now performed using tagged versions of the sqlLoader code.

With the data model and schema verified, we ran the "finish" step of the loading process on the DR4 "Target" load. It took a significant amount of time to get the "finish" step to run uninterrupted from start to finish. During the process, a number of bugs and discrepancies were found and fixed. Although time-consuming, the process was necessary to establish a stable, documented version of the sqlLoader code in our production environment.

By the end of the quarter, we had completed the DR4 Target load and made it available to the collaboration for use and testing prior to the planned late-June public release.

In parallel with the database loading effort by the production group, development work and testing continued at JHU on the code to integrate sector computations and "match" tables into the database. Development and testing was completed and a development version of the DR3 CAS upgraded to contain these additional computations and tables. As these code and schema changes were not ready in time for the DR4 production load, they will be incorporated into the version of the sqlLoader that will be used to load DR5.

5. SURVEY PLANNING

5.1. Observing Aids

Several programs are used to aid in planning and carrying out observations. No software changes were made. Plates for the new ET program are being saved in the plate inventory database but have priority 0 so they are not visible to the observers during normal observing. Patches for the SEGUE program are being loaded into the patch database.

5.2. Target Selection

For this quarter, 42 plates were designed and drilled in one drilling run. Of these, 33 were for the Northern survey area and 9 were drilled for the ET program. Of those plates in the Northern survey area, all were located in the area of the "gap" that is the highest priority for observing.

5.3. Survey Planning

The software that is used to track survey progress that is contained in this report is also used to prepare monthly observing plans. No significant changes were made this quarter.

6. COST REPORT

The operating budget that the Advisory Council approved for the year 2005 consists of $702K of in-kind contributions from Fermilab, US Naval Observatory (USNO), Los Alamos National Laboratory (LANL), and the Japan Participation Group (JPG); and $1,839K for ARC funded expenses. The operating budget covers the period January 1 through June 30, 2005.

The Advisory Council also approved a closeout budget in the event that SDSS-II was not fully funded. The closeout budget consists of $223K of anticipated in-kind contributions from Fermilab; and $448K for ARC-funded expenses.
Table 6.1 shows actual cost performance by project area for ARC-funded cash expenses in Q1. A more complete table comparing actual to baseline performance is included as an attachment to this report. The attachment also shows the current forecast for closeout costs.

Table 6.1. Q1 Cash Expenses and Forecast for 2005 ($K)

	2005 – 1st Quarter		2005 Operations Budget Total *(for the period Jan-Jun 2005)*	
Category	Baseline Budget	Actual Expenses	Baseline Budget (Nov 2004)	Current Forecast
1.1. Survey Management	58	40	119	100
1.2. Collaboration Affairs	5	1	10	13
1.3. Survey Operations				
1.3.1. Observing Systems	154	78	312	269
1.3.2. Data Processing & Dist.	169	139	391	453
1.3.3. Survey Coordination	0	0	0	0
1.3.4. Observatory Support	409	368	819	773
1.4. ARC Corporate Support	41	14	90	44
Sub-total	837	641	1,739	1,652
1.5. Management Reserve	50	0	100	50
1.6. Capital Improvements	0	0	0	0
Total	887	641	1,839	1,702

6.1. Q1 Performance - In-kind Contributions

The sum of in-kind contributions was $402K against the baseline forecast of $357K and was provided by Fermilab, Los Alamos, and the U.S. Naval Observatory (USNO).

Fermilab provided survey management support, telescope engineering and maintenance support, and data distribution support as agreed. The level of effort provided to support data processing operations was greater than anticipated. Some of the additional effort was associated with preparations and planning for the proposed SDSS-II SEGUE and Supernova programs.

Los Alamos provided programming support for the Telescope Performance Monitor and continued working on the preparation of a technical paper documenting the Photometric Telescope data reduction pipeline, MTPIPE. The level of effort provided was slightly greater than anticipated when the budget was prepared. Some of the additional effort was associated with planning for the proposed SDSS-II SEGUE program.

USNO provided support as required for the astrometric pipeline and other software systems they maintain.

6.2. Q1 Performance – ARC Funded Expenses

ARC-funded expenses in Q1 were $641K, or $196K (31%) below the first quarter budget of $837K, excluding management reserve.

Survey management costs were $40K against a Q1 budget of $58K. Support costs for the Project Scientist, Spokesperson, and Project Manager were less than anticipated. No charges were incurred against the budget for Public Affairs; funds had been budgeted for AAS meeting expenses, but since the project will not have a formal presence at the June meeting, these funds will remain unspent. For the year, the forecast for Survey Management is $100K, or $19K (19%) below the baseline budget.
The budget for Collaboration Affairs provides for Working Group travel and technical page charges and is held in an ARC corporate account. Minimal expenses were incurred in Q1, with unspent funds carried forward in anticipation with page charges associated with technical papers currently under preparation. For the year, the forecast for Collaboration Affairs is $13K against the baseline budget of $10K.

Observing Systems costs were $78K against a budget of $154K. Actual UW costs were significantly less than budgeted; the amount of UW engineering and technical effort required to support on-going operations was less than anticipated when the budget was prepared. Actual Fermilab and Princeton hardware expenses were slightly less than budgeted. Funds set aside in the ARC Observing Systems Support account for additional engineering support and unanticipated hardware expenses were not needed. For the year, the forecast for Observing Systems is $269K, or $43K below the baseline budget of $312K.

Data Processing and Distribution costs were $139K against a budget of 169K (-18%). Fermilab and UC expenses were in line with expectations. Princeton and JHU expenses were substantially less than the baseline. For the year, the forecast for Data Processing and Distribution is $773K, or $46K (6%) below the baseline budget of $819K.

Observatory Support costs were $368K against a Q1 budget of $409K (-10%). One of our observers, Pete Newman, left the project in Q1 for another position overseas. His last night of observing was February 8 and his last day with us was February 15. His departure resulted in a reduction in Q1 salary costs. Other observatory operating expenses were in line with expectations. For the year, the forecast for Observatory Support is $773K, or $46K (6%) below the baseline budget of $819K.

Miscellaneous ARC corporate expenses (i.e., audit fees, bank fees, petty cash, and APO trailer rentals) were as expected. Charges against the Observers' development fund were also as expected. No charges were incurred against the Additional Scientific Support fund and the forecast going forward has been revised downward. For the year, the forecast for ARC Corporate Support has been reduced from $90K to $44K.

6.3. Management Reserve

No management reserve funds were expended in Q1. Management reserve for the remainder of the year has been reduced from $100K to $50K.

7. PUBLICATIONS

There were 54 refereed papers published in Q1 that include 'SDSS' or 'Sloan' in their title and/or abstract; 70% of these were written by people outside the SDSS collaboration, indicating that the broader astronomical community is making good use of the public data releases.

Exhibit 3 lists papers published in Q1 by members of the SDSS Collaboration using proprietary data. Exhibit 4 lists papers published by individuals outside of the SDSS collaboration, using public data.

Through March 30, 2005, there are 738 published refereed papers that include 'SDSS' or 'Sloan' in their title and/or abstract. These papers have been cited a total of 19,217 times, including 34 papers cited more than 100 times and 91 papers with 50 or more citations. In addition, there are 980 un-refereed papers with "SDSS" or "Sloan" in the title and/or abstract.

8.0. SDSS-II DEVELOPMENT WORK

8.1. Progress on the SEGUE Project

SEGUE observing occurred during non-photometric conditions when Legacy NGC plates were not available or unobservable. SEGUE observing focused on spectroscopy; there were no SEGUE imaging scans in Q1.

A total of 14 SEGUE plates were completed (6 bright plates and 8 faint plates, corresponding to about 22 plate equivalents as seguefaint plates are of longer exposure).

The SEGUE spectroscopic plates were designed with version 3_0 of the SEGUE target selection code. One faint plate (2079) on the main sequence of a known cluster, NGC 2420, provided valuable calibration feedback for the parameter estimation code.

To date, SEGUE has obtained approximately 1050/3900 square degrees of imaging and approximately 70/400 plates (100/600 plate equivalents) towards its baseline goal.

Progress on refining the SEGUE target selection and parameter analysis continued in 2005Q1. Changes to the target selection included incorporating high proper motion targets from the American Museum of Natural History Museum Lepine and Shara catalog. Progress, which is continuing, on the parameter analysis included accounting for the effects of saturated Calcium absorption in cooler stars, which resulted in the mis-estimation of metal-rich stars ([Fe/H] > -1).

8.2. Progress on the Supernova Project

During this quarter, SN work proceeded on a variety of fronts, including:

- implementation of post-processing pipelines to do final photometry of supernovae;
- development of an improved version of the frame subtraction pipeline including improved remapping and inclusion of PSF information from PHOTO and a bug fix to enable us to detect supernovae at lower signal to noise;
- development of code to insert artificial SNe into the data stream to monitor detection efficiency and gauge photometric errors;
- specification of needs for on-mountain and off-mountain compute processing;
- initial work on a stripe 82 database that will contain a veto catalog of variable sources and catalog of calibration stars;
- specification of development work for the website that will be used for manual inspection of SN candidates;
- a study of SN detection efficiency and photometric accuracy under moony conditions, based on Fall 2004 data; coordination of spectroscopic follow-up proposals being submitted by collaborators in the US, Europe, and Japan; and
- benchmark testing of compute processors to be selected for on-mountain processing.

Exhibit 1. CY2005 Cash Budget Forecast

SDSS CY2005 Budget Forecast as of April 30, 2005 (*in $000s*)

		SDSS Operations		SDSS Closeout		CY2005 Forecast without closeout costs		Closeout Cost	
		Qtr 1 Jan-Mar Actual Expenses	Qtr 2 Apr-Jun 29-Apr-05 Forecast	Qtr 3 Jul-Sep 29-Apr-05 Forecast	Qtr 4 Oct-Dec 29-Apr-05 Forecast	(Q1-2 Baseline)	29-Apr-05 Forecast	Baseline Budget	29-Apr-05 Forecast
ARC-FUNDED BUDGET									
1.1 Survey Management									
SSP21	ARC Secretary/Treasurer	3	3	2	2	6	6	5	4
SSP34	ARC Business Manager	13	16	20	15	30	29	35	35
SSP46	PU Office of the Project Scientist		7	64	0	12	7	36	64
SSP48	FNAL Support for Survey Management	5	9	3	0	17	14	3	3
SSP67	UC Support for Survey Management	15	15	2	1	29	29	3	3
SSP91a	ARC Support for Public Affairs	0	0	0	0	12	0	0	0
SSP91i	ARC Support for Public Information Officer	4	11	0	0	13	15	0	0
	Sub-total	40	60	91	17	119	100	82	108
1.2 Collaboration Affairs									
SSP91c	ARC Support for Collaboration Affairs	1	12	5	0	10	13	5	5
	Sub-total	1	12	5	0	10	13	5	5
1.3.1 Observing Systems									
SSP42	FNAL Observing Systems Support	34	54	34	0	86	88	34	34
SSP61	FNAL Observing Programs and DA Support	0	0	0	0	0	0	0	0
SSP31	UW Observing Systems Support	33	101	0	0	146	134	0	0
SSP32	PU Observing Systems Support	11	12	0	0	25	22	0	0
SSP91d	ARC Observing Systems Support		25	0	0	55	25	0	0
	Sub-total	78	191	34	0	312	269	34	34
1.3.2 Data Processing and Distribution									
SSP40	FNAL Software and Data Processing Support	13	15	11	0	28	28	13	11
SSP68	FNAL Data Distribution Support[1]	30	124	30	10	98	184	39	10
SSP38	PU Software and Data Processing Support	20	30	19	0	64	50	19	19
SSP39	UC Software and Data Processing Support	11	11	0	0	21	21	0	0
SSP37	JHU Data Archive Development and Support[1]	57	65	31	0	162	152	11	0
SSP33	UC Operations Support	9	9	0	0	19	17	0	0
	Sub-total	139	253	90	10	391	453	81	39
1.3.4 Observatory Support									
SSP35	NMSU Site Support	368	405	186	0	819	773	197	186
	Sub-total	368	405	186	0	819	773	197	186
1.4 ARC Corporate Support									
SSP91e	ARC Corporate Support	11	16	4	10	28	28	14	14
SSP91f	ARC Additional Scientific Support	0	10	0	0	56	10	0	0
SSP91h	ARC Observers' Research Support	2	4	0	0	6	6	0	0
	Sub-total	14	30	4	10	90	44	14	14
SUBTOTAL		641	951	411	37	1,739	1,652	413	387
SSP91g	Capital Improvements	0	0	0	0	0	0	0	0
SSP91	Management Reserve	0	50	20	15	100	50	35	35
TOTAL ARC-FUNDED BUDGET		641	1,001	431	52	1,839	1,702	448	422

Exhibit 2. CY2005 In-Kind Contribution Forecast

SDSS CY2005 Budget Forecast as of April 30, 2005 (*in $000s*)

		SDSS Operations		SDSS Closeout		CY2005 Forecast without closeout costs		Closeout Cost	
		Qtr 1 Jan-Mar Actual Expenses	Qtr 2 Apr-Jun 29-Apr-05 Forecast	Qtr 3 Jul-Sep 29-Apr-05 Forecast	Qtr 4 Oct-Dec 29-Apr-05 Forecast	(Q1-2 Baseline)	29-Apr-05 Forecast	Baseline Budget	29-Apr-05 Forecast
IN -KIND CONTRIBUTION									
1.1 Survey Management									
SSP48	FNAL Support for Survey Management	40	44	40	26	81	84	65	66
	Sub-total	40	44	40	26	81	84	65	66
1.3.1 Observing Systems									
SSP42	FNAL Observing Systems Support	52	40	65	0	101	92	63	65
SSP58	LANL Observing Systems Support	44	33	0	0	55	77	0	0
SSP61	FNAL Observers' Programs and DA Support	0	2	0	0	7	2	0	0
	JPG Observing Systems Support	0	0	0	0	5	0	0	0
	Sub-total	96	76	65	0	168	172	63	65
1.3.2 Data Processing and Distribution									
SSP40	FNAL Software and Data Processing Support	246	192	80	0	401	438	81	80
SSP68	FNAL Data Distribution Support	10	10	10	3	20	20	14	14
SSP57	USNO Software and Data Processing Support	10	13	0	0	33	23	0	0
	Sub-total	266	215	90	3	454	481	95	94
TOTAL IN-KIND CONTRIBUTION		402	335	195	29	702	737	223	225
TOTAL BUDGET		1,043	1,336	626	81	2,542	2,439	671	647

Exhibit 3. Publications from Within the SDSS Collaboration

1. Tramposch, Jonica, Homer, Lee, Szkody, Paula, Henden, Arne, Silvestri, Nicole M., Yirak, Kris, Fraser, Oliver J., & Brinkmann, J. 2005, SDSS J210014.12+004446.0: A New Dwarf Nova with Quiescent Superhumps?, Publications of the Astronomical Society of the Pacific, 262

2. Goto, Tomotsugu 2005, 266 E+A galaxies selected from the Sloan Digital Sky Survey Data Release 2: the origin of E+A galaxies, Monthly Notices of the Royal Astronomical Society, 937

3. Oguri, Masamune, Inada, Naohisa, Hennawi, Joseph F., Richards, Gordon T., Johnston, David E., Frieman, Joshua A., Pindor, Bartosz, Strauss, Michael A., Brunner, Robert J., Becker, Robert H., Castander, Francisco J., Gregg, Michael D., Hall, Patrick B., Rix, Hans-Walter, Schneider, Donald P., Bahcall, Neta A., Brinkmann, Jonathan, & York, Donald G. 2005, Discovery of Two Gravitationally Lensed Quasars with Image Separations of 3" from the Sloan Digital Sky Survey, Astrophysical Journal, 106

4. Goldberg, David M., Jones, Timothy D., Hoyle, Fiona, Rojas, Randall R., Vogeley, Michael S., & Blanton, Michael R. 2005, The Mass Function of Void Galaxies in the Sloan Digital Sky Survey Data Release 2, Astrophysical Journal, 643

5. Zehavi, Idit, Eisenstein, Daniel J., Nichol, Robert C., Blanton, Michael R., Hogg, David W., Brinkmann, Jon, Loveday, Jon, Meiksin, Avery, Schneider, Donald P., & Tegmark, Max 2005, The Intermediate-Scale Clustering of Luminous Red Galaxies, Astrophysical Journal, 22

6. Abazajian, Kevork, Adelman-McCarthy, Jennifer K., Agueros, Marcel A., Allam, Sahar S., Anderson, Kurt S. J., Anderson, Scott F., Annis, James, Bahcall, Neta A., Baldry, Ivan K., Bastian, Steven, Berlind, Andreas, Bernardi, Mariangela, Blanton, Michael R., Bochanski, John J., Jr., Boroski, William N., Brewington, Howard J., Briggs, John W., Brinkmann, J., Brunner, Robert J., Budava'ri, Tama's, Carey, Larry N., Castander, Francisco J., Connolly, A. J., Covey, Kevin R., Csabai, Istva'n, Dalcanton, Julianne J., Doi, Mamoru, Dong, Feng, Eisenstein, Daniel J., Evans, Michael L., Fan, Xiaohui, Finkbeiner, Douglas P., Friedman, Scott D., Frieman, Joshua A., Fukugita, Masataka, Gillespie, Bruce, Glazebrook, Karl, Gray, Jim, Grebel, Eva K., Gunn, James E., Gurbani, Vijay K., Hall, Patrick B., Hamabe, Masaru, Harbeck, Daniel, Harris, Frederick H., Harris, Hugh C., Harvanek, Michael, Hawley, Suzanne L., Hayes, Jeffrey, Heckman, Timothy M., Hendry, John S., Hennessy, Gregory S., Hindsley, Robert B., Hogan, Craig J., Hogg, David W., Holmgren, Donald J., Holtzman, Jon A., Ichikawa, Shin-ichi, Ichikawa, Takashi, Ivezic', Zeljko, Jester, Sebastian, Johnston, David E., Jorgensen, Anders M., Juric', Mario, Kent, Stephen M., Kleinman, S. J., Knapp, G. R., Kniazev, Alexei Yu., Kron, Richard G., Krzesinski, Jurek, Lamb, Donald Q., Lampeitl, Hubert, Lee, Brian C., Lin, Huan, Long, Daniel C., Loveday, Jon, Lupton, Robert H., Mannery, Ed, Margon, Bruce, Marti'nez-Delgado, David, Matsubara, Takahiko, McGehee, Peregrine M., McKay, Timothy A., Meiksin, Avery, Me'nard, Brice, Munn, Jeffrey A., Nash, Thomas, Neilsen, Eric H., Jr., Newberg, Heidi Jo, Newman, Peter R., Nichol, Robert C., Nicinski, Tom, Nieto-Santisteban, Maria, Nitta, Atsuko, Okamura, Sadanori, O'Mullane, William, Owen, Russell, Padmanabhan, Nikhil, Pauls, George, Peoples, John, Pier, Jeffrey R., Pope, Adrian C., Pourbaix, Dimitri, Quinn, Thomas R., Raddick, M. Jordan, Richards, Gordon T., Richmond, Michael W., Rix, Hans-Walter, Rockosi, Constance M., Schlegel, David J., Schneider, Donald P., Schroeder, Joshua, Scranton, Ryan, Sekiguchi, Maki, Sheldon, Erin, Shimasaku, Kazu, Silvestri, Nicole M., Smith, J. Allyn, Smolcic', Vernesa, Snedden, Stephanie A., Stebbins, Albert, Stoughton, Chris, Strauss, Michael A., SubbaRao, Mark, Szalay, Alexander S., Szapudi, Istva'n, Szkody, Paula, Szokoly, Gyula P., Tegmark, Max, Teodoro, Luis, Thakar, Aniruddha R., Tremonti, Christy, Tucker, Douglas L., Uomoto, Alan, Vanden Berk, Daniel E., Vandenberg, Jan, Vogeley, Michael S., Voges, Wolfgang, Vogt, Nicole P., Walkowicz, Lucianne M., Wang, Shu-i., Weinberg, David H., West, Andrew A., White, Simon D. M., Wilhite, Brian C., Xu, Yongzhong, Yanny, Brian, Yasuda, Naoki, Yip, Ching-Wa, Yocum, D. R., York, Donald G., Zehavi, Idit, Zibetti, Stefano, & Zucker, Daniel B. 2005, The Third Data Release of the Sloan Digital Sky Survey, Astronomical Journal, 1755

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10. Homer, Lee, Szkody, Paula, Chen, Bing, Henden, Arne, Schmidt, Gary D., Fraser, Oliver J., Saloma, Karla, Silvestri, Nicole M., Taylor, Hilda, & Brinkmann, J. 2005, XMM-Newton and Optical Follow-up Observations of Three New Polars from the Sloan Digital Sky Survey, Astrophysical Journal, 929

11. Hoyle, Fiona, Rojas, Randall R., Vogeley, Michael S., & Brinkmann, Jon 2005, The Luminosity Function of Void Galaxies in the Sloan Digital Sky Survey, Astrophysical Journal, 618

12. Schmidt, Gary D., Szkody, Paula, Homer, Lee, Smith, Paul S., Chen, Bing, Henden, Arne, Solheim, Jan-Erik, Wolfe, Michael A., & Greimel, Robert 2005, Unraveling the Puzzle of the Eclipsing Polar SDSS J015543.40+002807.2 with XMM and Optical Photometry/Spectropolarimetry, Astrophysical Journal, 422

13. Ivezic', Zeljko, Vivas, A. Katherina, Lupton, Robert H., & Zinn, Robert 2005, The Selection of RR Lyrae Stars Using Single-Epoch Data, Astronomical Journal, 1096

14. Goto, Tomotsugu 2005, Do star formation rates of galaxy clusters depend on mass? Blue/late-type fractions and total star formation rates of 115 galaxy clusters as a function of cluster virial mass, Monthly Notices of the Royal Astronomical Society, L6

15. Eisenstein, Daniel J., Blanton, Michael, Zehavi, Idit, Bahcall, Neta, Brinkmann, Jon, Loveday, Jon, Meiksin, Avery, & Schneider, Don 2005, The Small-Scale Clustering of Luminous Red Galaxies via Cross-Correlation Techniques, Astrophysical Journal, 178

16. Bernardi, Mariangela, Sheth, Ravi K., Nichol, Robert C., Schneider, D. P., & Brinkmann, J. 2005, Colors, Magnitudes, and Velocity Dispersions in Early-Type Galaxies: Implications for Galaxy Ages and Metallicities, Astronomical Journal, 61

Exhibit 4. Publications Based on Public Data

1. Shirata, Akihito, Shiromizu, Tetsuya, Yoshida, Naoki, & Suto, Yasushi 2005, Galaxy clustering constraints on deviations from Newtonian gravity at cosmological scales, Physical Review D, 064030.

2. Beltra'n, Mari'a, Garci'a-Bellido, Juan, Lesgourgues, Julien, Liddle, Andrew R., & Slosar, Anze`e 2005, Bayesian model selection and isocurvature perturbations, Physical Review D, 063532.

3. Kewley, Lisa J., Jansen, Rolf A., & Geller, Margaret J. 2005, Aperture Effects on Star Formation Rate, Metallicity, and Reddening, Publications of the Astronomical Society of the Pacific, 227.

4. Stalin, C. S. & Srianand, R. 2005, Long-term optical photometric monitoring of the quasar SDSS J153259.96-003944.1, Monthly Notices of the Royal Astronomical Society, 308.

5. Georgantopoulos, I. & Georgakakis, A. 2005, X-ray bright optically inactive galaxies in XMM-Newton/Sloan Digital Sky Survey fields: more diluted than absorbed?, Monthly Notices of the Royal Astronomical Society, 131.

6. Me'nard, Brice & Dalal, Neal 2005, Revisiting the magnification of type Ia supernovae with SDSS, Monthly Notices of the Royal Astronomical Society, 101.

7. Hirashita, Hiroyuki, Nozawa, Takaya, Kozasa, Takashi, Ishii, Takako T., & Takeuchi, Tsutomu T. 2005, Extinction curves expected in young galaxies, Monthly Notices of the Royal Astronomical Society, 1077.

8. Pandey, Biswajit & Bharadwaj, Somnath 2005, A two-dimensional analysis of percolation and filamentarity in the Sloan Digital Sky Survey Data Release One, Monthly Notices of the Royal Astronomical Society, 1068.

9. Brown, Warren R., Geller, Margaret J., Kenyon, Scott J., & Kurtz, Michael J. 2005, Discovery of an Unbound Hypervelocity Star in the Milky Way Halo, Astrophysical Journal, L33

10. Plionis, M., Basilakos, S., Georgantopoulos, I., & Georgakakis, A. 2005, XMM-Newton Observations of Optically Selected Sloan Digital Sky Survey Clusters, Astrophysical Journal, L17

11. van Dokkum, P. G., Kriek, M., Rodgers, B., Franx, M., & Puxley, P. 2005, Gemini Near-Infrared Spectrograph Observations of a Red Star-forming Galaxy at z=2.225: Evidence of Shock Ionization Due to a Galactic Wind, Astrophysical Journal, L13

12. Stiavelli, M., Djorgovski, S. G., Pavlovsky, C., Scarlata, C., Stern, D.,Mahabal, A., Thompson, D., Dickinson, M., Panagia, N., & Meylan, G. 2005, Evidence of Primordial Clustering around the QSO SDSS J1030+0524 at z=6.28, Astrophysical Journal, L1

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14. Wu, Hong, Shao, Zhengyi, Mo, H. J., Xia, Xiaoyang, & Deng, Zugan 2005, Optical and Near-Infrared Color Profiles in Nearby Early-Type Galaxies and the Implied Age and Metallicity Gradients, Astrophysical Journal, 244.

15. Mitchell, Jonathan L., Keeton, Charles R., Frieman, Joshua A., & Sheth, Ravi K. 2005, Improved Cosmological Constraints from Gravitational Lens Statistics, Astrophysical Journal, 81.

16. Bauer, A. E., Drory, N., Hill, G. J., & Feulner, G. 2005, Specific Star Formation Rates to Redshift 1.5, Astrophysical Journal, 89.

17. Keeton, Charles R., Kuhlen, Michael, & Haiman, Zolta'n 2005, Gravitational Lensing Magnification without Multiple Imaging, Astrophysical Journal, 559.

18. Hatziminaoglou, E., Pe'rez-Fournon, I., Polletta, M., Afonso-Luis, A., Herna'n-Caballero, A., Montenegro-Montes, F. M., Lonsdale, C., Xu, C. K., Franceschini, A., Rowan-Robinson, M., Babbedge, T., Smith, H. E., Surace, J., Shupe, D., Fang, F., Farrah, D., Oliver, S., Gonza'lez-Solares, E. A., & Serjeant, S. 2005, Sloan Digital Sky Survey Quasars in the Spitzer Wide-Area Infrared Extragalactic Survey (SWIRE) ELAIS N1 Field: Properties and Spectral Energy Distributions, Astronomical Journal, 1198.

19. Trentham, Neil, Sampson, Leda, & Banerji, Manda 2005, The galaxy luminosity function from M_R=-25 to M_R=-9, Monthly Notices of the Royal Astronomical Society, 783.

20. Zhou, Hong-Yan, Wang, Ting-Gui, Dong, Xiao-Bo, Li, Cheng, & Zhang,Xue-Guang 2005, The Hybrid Nature of 0846+51W1: a BL Lac Object with a Narrow Line Seyfert 1 Nucleus, Chinese Journal of Astronony and Astrophysics, 41.

21. Oh, S. Peng & Furlanetto, Steven R. 2005, How Universal is the Gunn-Peterson Trough at z~6?: A Closer Look at the Quasar SDSS J1148+5251, Astrophysical Journal, L9

22. Dong, Xiao-Bo, Zhou, Hong-Yan, Wang, Ting-Gui, Wang, Jun-Xian, Li, Cheng, & Zhou, You-Yuan 2005, Partially Obscured Quasars in the Sloan Digital Sky Survey Early Data Release, Astrophysical Journal, 629

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25. de Vries, W. H., Becker, R. H., White, R. L., & Loomis, C. 2005, Structure Function Analysis of Long-Term Quasar Variability, Astronomical Journal, 615

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