Sloan Digital Sky Survey
Quarterly Progress Report
Second Quarter 2005

August 4, 2005

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Q2 PERFORMANCE HIGHLIGHTS

- We obtained 536 square degrees of imaging data against a baseline goal of 413 square degrees (130%).
- We completed 107 standard survey plates and five SEGUE plates. Converting these to plate-equivalents, we completed 113 plate-equivalents against our baseline goal of 117 plates (97%).
- Weather was exceptionally good for a change. On average, weather was suitable for observing 63% of the time. We had many nights during the quarter in which conditions were favorable for imaging. This was particularly true in June; we devoted a full 71% of the June dark time to imaging.
- June 30 marked the end of the observing period for the SDSS project. Through June 30, the "footprint" area of sky covered by imaging was 8171 square degrees for the primary survey (combining the North survey area and three outrigger in the South) and 1262 square degrees for the SEGUE program. When other area covered by calibration runs and other special runs is added in, the SDSS-I footprint area is approximately 10,000 square degrees. In addition, a total of 1585 unique "tiles" were observed with spectroscopic plates, including 1122 for the primary survey area, 68 for SEGUE, and 395 for the Southern spectroscopic program plus other special plates. If one counts each fiber as being a spectrum of a unique piece of sky, the survey obtained approximately 1 million spectra.
- Data Release 4 was made available to the public on June 29, 2005, slightly ahead of the schedule defined in the SDSS Data Distribution Plan. The imaging data covers 6670 “footprint” square degrees and contains 180 million unique objects. The spectroscopic data covers 4681 square degrees and contains 849,920 spectra, including the spectra for 565,715 galaxies, 76,483 quasars.
- Q2 cash operating expenses were $714K against a baseline budget of $872K, excluding management reserve. In-kind contributions were $336K against anticipated contributions of $345K. No management reserve funds were expended in Q2.
- Two of our collaboration members were recognized for their outstanding contributions to the fields of astronomy and cosmology. Robert Lupton was awarded the Maria and Eric Muhlmann Award for 2005 by the Astronomical Society of the Pacific. The award is given for recent significant observational results made possible by innovative advances in astronomical instrumentation, software, or observational infrastructure. The ASP cited Robert’s central role in the development of software for the SDSS. In June, Jim Gunn was awarded the 2005 Cosmology Prize of the Peter Gruber Foundation, in recognition of “his central contributions to the theoretical, observational and instrumental development of modern cosmology.” The official citation further recognizes that Jim “has set the highest standards for the

field and provided the ideas and the data to inspire new generations of cosmologists." We congratulate Robert and Jim on these prestigious awards.

- The University of Portsmouth (Institute of Cosmology and Gravitation) was the host institution for the SDSS Collaboration meeting in Portsmouth June 18 - 20. This meeting was well attended, including by some of the partners new for SDSS-II. Planning sessions were held for SEGUE and Supernova, which helped familiarize some of the partners with these operational elements of SDSS-II.
- On June 29 we received official word from the NSF that we would be fully funded for SDSS-II. This event was already anticipated in Q1, but the official notification allowed us to formally constitute, and begin, SDSS-II as of 1 July.

1. SURVEY PROGESS

1.1. Q2 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 536 square degrees of imaging data, or 130% of our baseline goal of 413 square degrees.

Table 1.1. Imaging Survey Progress in Q1-2005

	Imaging Area Obtained (in Square Degrees)			
	Q2-2005		Cumulative through Q2	
	Baseline	Actual	Baseline	Actual
Northern Survey[1]	413	536	7642	7433
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.

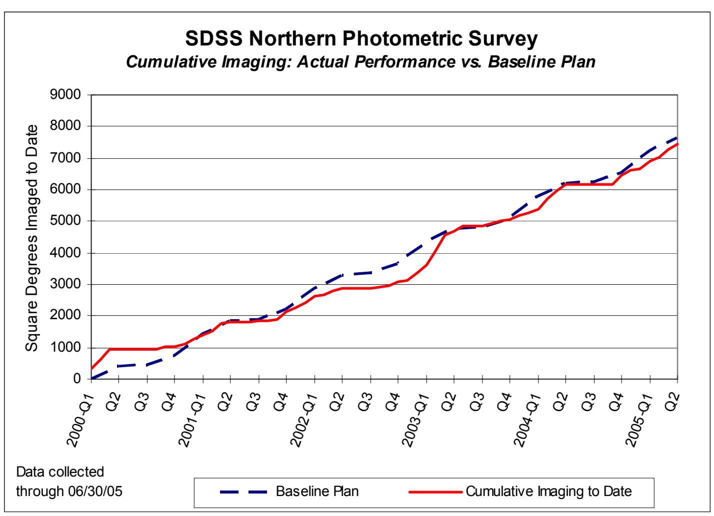

Figure 1.1. Imaging Progress against the Baseline Plan – Northern Survey

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

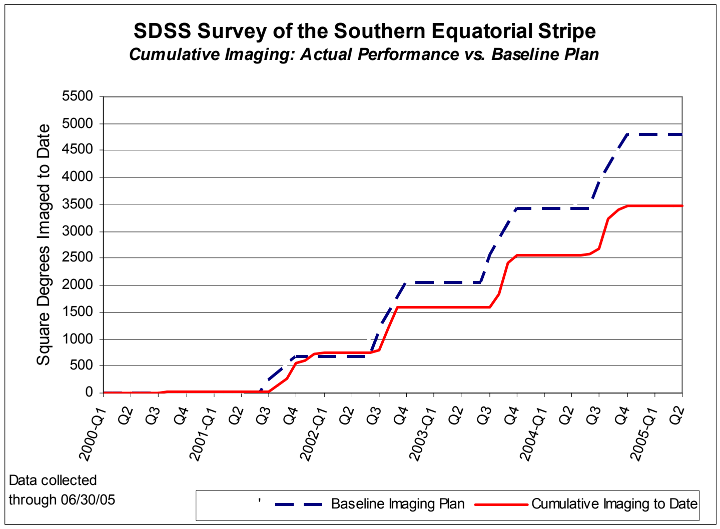

Figure 1.2. Imaging Progress against the Baseline Plan – Southern Equatorial Survey

1.3. Q2 Spectroscopy

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

We completed 112 spectroscopic plates in Q2; 107 were standard survey plates and five were SEGUE plates. One of the SEGUE plates required a longer exposure time 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 113 plate-equivalents against the baseline goal of 117 plates (97%).

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.

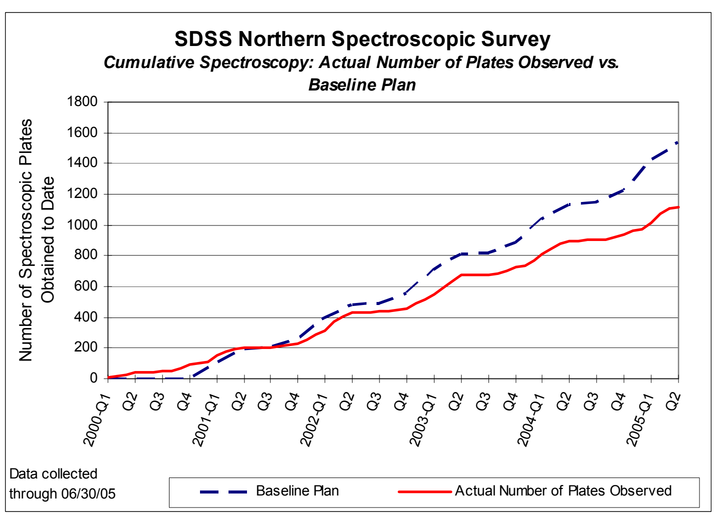

Figure 1.3. Spectroscopic Progress against the Baseline Plan – Northern Survey

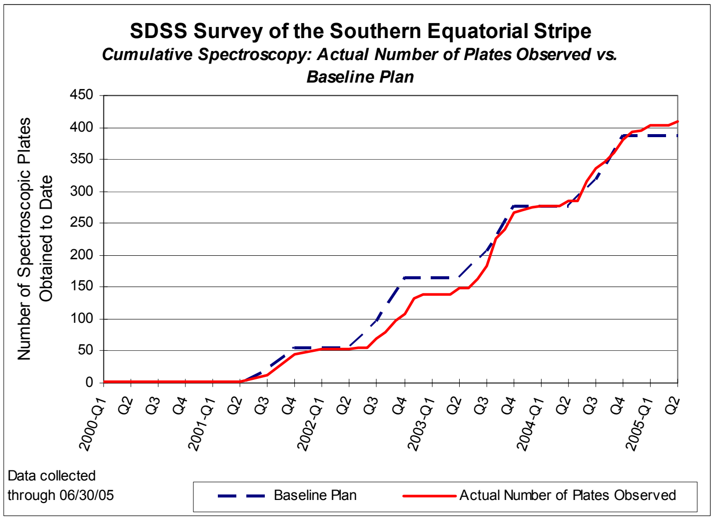

Figure 1.4. Spectroscopic Progress against the Baseline Plan – Southern Equatorial Survey

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 Q2 met or exceeded the baseline forecast in all three months and were particularly favorable for imaging in June.

Table 2.1. Potential Observing Hours Lost to Weather in Q2

Observing Condition	Total hours potentially available for observing	Total hours lost to weather	Fraction of time suitable for observing	Baseline Forecast
Dark Time	313	117	63%	60%
Dark & Gray Time	421	159	62%	---

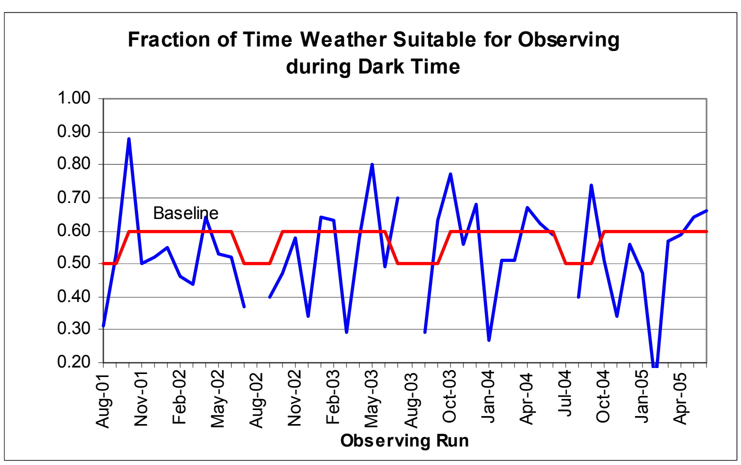

Figure 2.1. Percentage of Time Weather Suitable for Observing

2.2. System Uptime

System uptime measures the availability of equipment when conditions are suitable for observing. We averaged 98% 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 Q2

Observing Condition	Total hours potentially available for observing	Total hours lost to problems	System Uptime	Baseline Forecast
Dark Time	313	7	98%	90%
Dark & Gray Time	421	8	98%	---

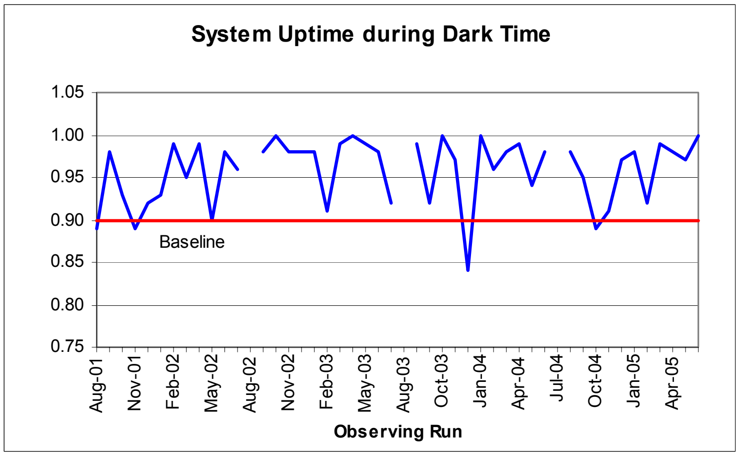

Figure 2.2. System Uptime

2.3. Imaging Efficiency

Imaging efficiency averaged 83% against a baseline goal of 86%. Imaging efficiency in May and June was slightly lower than normal due to shorter than average imaging run lengths; the shorter runs were necessary to fill in remaining areas in the imaging footprint. Fortunately, the better than average weather allowed us to complete a large number of the short runs. We completed 11 imaging runs in May and 29 imaging runs in June.

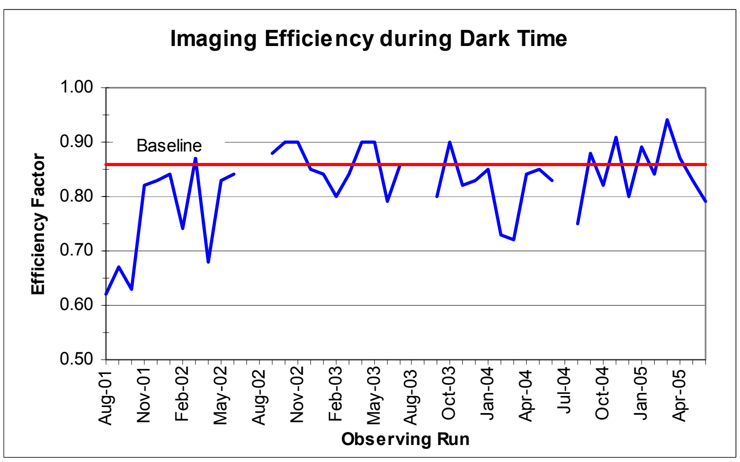

Figure 2.3. Imaging Efficiency

2.4. Spectroscopic Efficiency

Spectroscopic efficiency is derived by assessing the time spent performing various activities associated with spectroscopic operations. Table 2.3 provides the median time, by dark run, for various overhead activities associated with spectroscopic operations. Units for all categories are minutes except for efficiency, which is given as the ratio of baseline science exposure time (45 minutes) to total time required per plate. Using these measures, spectroscopic efficiency averaged 66% against the baseline goal of 64%.

Table 2.3. Median Time for Spectroscopic Observing Activities

Category	*Baseline*	*Run starting Mar 29*	*Run starting Apr 28*	*Run starting May 30*
Instrument change	10	4	4	4
Setup	10	9	11	10
Calibration	5	6	6	6
CCD readout	0	3	3	3
Total overhead	25	22	24	23
Science exposure (assumed)	45	45	45	45
Total time per plate	70	67	69	68
Efficiency	0.64	0.67	0.65	0.66

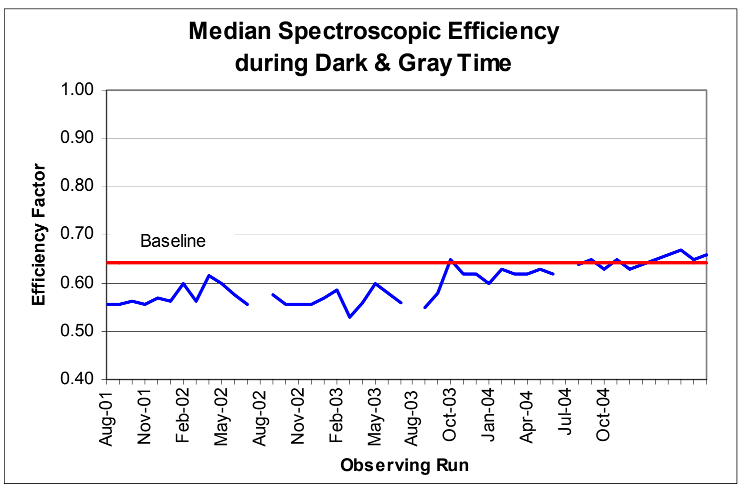

Figure 2.4. Spectroscopic Efficiency

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 continue to see occasional spikes in the reported value for the imaging camera vacuum; this problem has been noted and described in previous progress reports. We suspect a faulty cable or controller and will address this during the summer shutdown.

The observers obtained a full set of calibration measurements on the imaging camera CCDs during the quarter. The measurements were made whenever weather conditions precluded normal observing operations. The data will be used to monitor CCD and filter performance and possible degradation over time.

The spectrograph system worked reasonably well throughout the quarter. There were a few problems with the spectro crate in the DA system. On several occasions, the spectro system ended up in a “hung” state; rebooting the spectro crate quickly restored normal operation. As of this writing, the cause of the spurious ”hangs” has not been determined. We had one instance in which the CCDs on Spectrograph 2 (SP2) warmed up unexpectedly, due to a lack of liquid nitrogen (LN2) cooling. Rebooting the camera controller on SP2 restored the LN2 autofill process, but the spectrograph camera vacuum had to be pumped to a suitable level before cooling could commence. Finally, due to fluctuating spring temperatures, we found it necessary to adjust spectrograph focus often. Spectrograph focus is checked daily as part of the afternoon checkout and adjusted as necessary to correspond to anticipated nighttime operating temperatures. The daily inspection and adjustment process implemented by the observers has significantly increased spectroscopic observing efficiency.

3.2. The 2.5m Telescope

There were a few minor, but no significant, problems with the 2.5m telescope or its subsystems. We replaced a faulty windbaffle servo amplifier that started causing altitude drive problems in mid-June. Dirty contacts caused the instrument lift to stop working one night; swapping the pendant with the spare resulted in no downtime. Contacts were cleaned and the original pendant put back into operation the following night. One of the neon flat-field lamps burned out during observing operations one night; the observers replaced the lamp, but we lost approximately 30 minutes of science time in the process.

The following list highlights the more significant engineering and maintenance activities completed in Q2:

1) We developed a new enclosure system for the M2 Galil controller. We also purchased an additional spare Galil controller that will allow Galil interchanges by observer staff for both the M1 and M2. The availability of the spare controller reduces replacement time of a failed controller from one day to less than one hour. The new M2 system was installed and successfully tested during the June bright time.

2) We experienced some problems with the operation of the imager calibrator’s X-Y table. Through investigation and troubleshooting, we have determined that a new encoder system and lead screw are necessary to eliminate the problem. We have scheduled this work for the summer shutdown.

3) During the April bright time, we hosted the second ET project observing run. The SDSS engineering interaction with the ET team was very positive. During the feasibility tests, we identified some issues associated with plugging operations for the ET plates; we anticipate that these will be readily addressed during future feasibility tests.

4) We have located a spectral lamp vendor in Albuquerque who is willing to co-develop a neon/argon spectral lamp that will fit into our existing lamp housings. To date, we have received and tested two prototype lamp assemblies. We hope to finish refining the lamp design over the summer shut down.

5) During the extended June bright time, we accomplished the following:
   - Installation of a new enclosure rollup door threshold. We have yet to experience a true monsoon downpour in order to fully test the effectiveness of this new threshold, but the threshold worked well for the couple of minor storms that we have experienced.
   - Cleaned, inspected and re-lubed the 2.5m telescope azimuth drive bearing. The inspection showed normal wear and we are confident that the bearing will work well through SDSS II operations.
   - Installed the first stage of the axes encoder moth ejector system.

6) The LN2 autofill sensor for #8 imager dewar failed. We built a bypass timer circuit that allows the dewar to be filled at the appropriate times. This will remain in place until we get the imager into the clean room for repairs during the summer shutdown.

7) We built a new set of telescope wind baffle removal wheels. These should eliminate the need to move the wind baffle over gravel in order to stow it.

8) During this quarter we discovered that the wind baffle altitude drive control amplifier had been malfunctioning intermittently. We determined this to be to cause of sporadic axis aborts during slewing movements. The amplifier was replaced with a spare and the system is now functioning properly. We plan to test and troubleshoot the original amplifier during the summer shutdown.

9) We determined that a minor re-design of the instrument lift pendant will be necessary to eliminate sporadic speed control switch failures we have been experiencing. This is scheduled as a summer shutdown task.

Planned work for the coming summer shutdown includes re-aluminizing the 2.5-meter and PT primary mirrors; cleaning and re-lubricating the rotator and telescope azimuth drive bearings, and a number of smaller preventive maintenance tasks. We also plan to cross-train our on-the-mountain technical staff during telescope disassembly and reassembly, in an effort to increase the depth of our knowledge pool.

3.3. The Photometric Telescope

The Photometric Telescope (PT) worked well throughout the quarter. We did experience a vacuum leak in the PT camera dewar, which we traced to a leak in the ion pump canister wall. We removed the ion pump and have been operating without it until we have a chance to replace it this summer.

We purchased a new Cryotiger closed-cycle refrigerator for installation during the summer shutdown. The new unit will replace the existing unit, which is nearing the end of its useful life.

3.4. Operations Software and the Data Acquisition System

We had a minor problem with the DA at the beginning of the quarter. Backplane communication errors in one of the DA crates terminated user iop sessions and killed file servers; rebooting the three DA crates and file servers brought the system back on line. It is not clear what caused the problem, but there were several subsequent nights in which it was necessary to reboot the spectro crate and restart the servers.

We started seeing an increase in problems associated with tapes drives in the quarter. Recovery procedures were executed and no data was lost. The current set of drives is nearing end-of-expected-life and would be replaced with new tape drives were it not for the DA upgrade. The plan for the DA upgrade, scheduled for installation during the summer shutdown, includes replacing tape drives with a file server and removable hard disks.

Work on observing software was very minor in Q2 and consisted of bug fixes and minor upgrades to IOP associated with the imager calibration procedure.

Work continued on the DA upgrade, in preparation for the planned summer installation. New hardware has been received, including new Linux computers to replace the existing “host” machine at APO, and MVME5500 PowerPC single-board computers to replace obsolete MVME167 boards. Orders are out for other hardware components, such as SCSI interface modules to maintain backward-compatibility, and a new file server that will be used to archive data at APO in preparation for transfer to Fermilab via the internet. In Q2, the DA team continued porting software to run on the new Linux / VxWorks platform. The test stand at Fermilab was modified to include the new hardware and simulated test data run was through the old and new systems. Comparison tests have shown a few differences in the outputs from the two systems;

troubleshooting and debugging to understand and resolve the differences is on-going. In addition to modifying the system that acquires data from the instruments, the code that archives the data is being revised. In the existing system, the Archiver writes data to two sets of tapes simultaneously. In the new system, the Archiver will write data to a Linux file server. From here, data will be immediately available for on-the-mountain data processing for the Supernova program. Data will also be staged for online shipment to Fermilab for production data processing, and long-term archiving in the Fermilab Enstore tape robot. Finally, a backup copy of all newly-acquired data will be written to removable hard drives. As of this writing, a significant amount of progress has been made on the new DA system, but a significant amount of work remains. Remaining work including extensive end-to-end testing of the new system and revision of the observers' programs (IOP, SOP, and MOP) and other key observing support programs (e.g. the Telescope Performance Monitor, TPM) to run on a Linux operating system and connect and communicate with the new DA system underpinnings. Nonetheless, we remain committed to finishing the remaining work in time to successfully complete the installation and commissioning of the new system during the summer shutdown.

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 Q2.

A technical paper describing the image deblending algorithm used in the Photometric Pipeline was prepared and submitted to the Astronomical Journal for publication. At high galactic latitude, approximately 25% of objects between 17^{th} and 23^{rd} magnitude are deblended children. The deblending algorithm identifies child objects, conserves flux, and handles data where more than one band is available. The algorithm is reasonably fast and runs without human intervention.

A technical paper describing the Photometric Telescope Pipeline, MTPIPE, was prepared and submitted to the Astronomical Journal for publication. MTPIPE is the pipeline used to process data from the Photometric Telescope and the USNO 1-meter telescope as part of the photometric calibration process. In addition to describing the pipeline, the paper describes the transformation equations that convert photometry on the USNO 1-meter u'g'r'i'z' system to photometry on the SDSS 2.5-meter ugriz system and the results of various validation tests of the MTPIPE software.

4.1.2. Data Processing Operations

Data processing operations continue to run very smoothly. In Q2, we processed data from 43 imaging runs, 112 spectroscopic plates, and 89 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.

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, DR3, and DR4 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 5.24 TB were transferred in Q2, compared to 960 GB in Q1. The increase in May and June is due to a large number of rsync data transfers by a single institution.

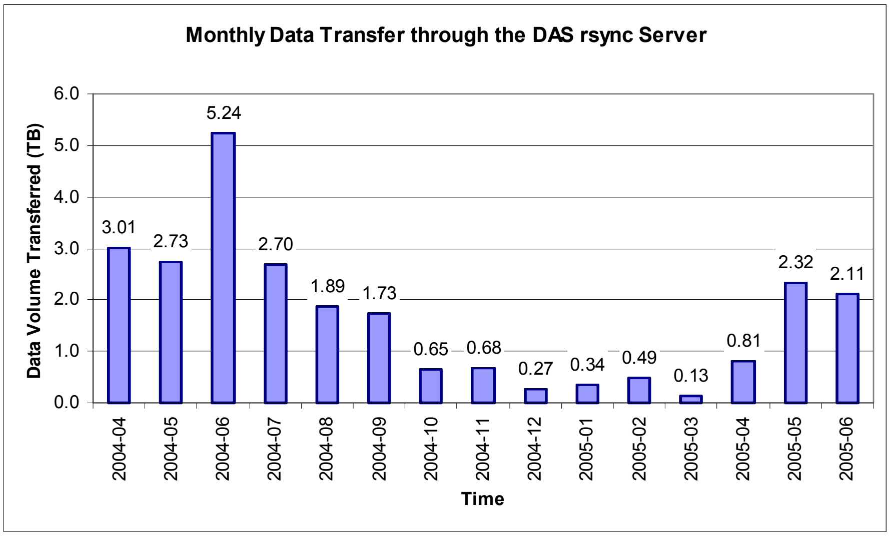

Figure 4.1. Monthly data transfer through the DAS rsync Server

Figure 4.2 shows the volume of data transferred monthly through the DAS web interface. We have seen a significant increase in the volume of data transferred in the last four months, when compared to the previous eight months.

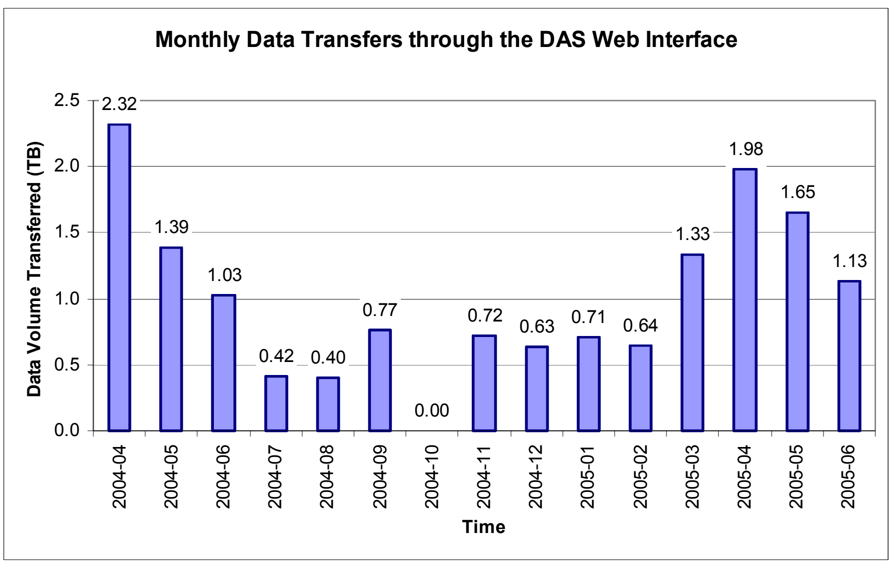

Figure 4.2. Monthly data transfer through the DAS web interface

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 12.7 million web hits, compared to 14.6 million web hits in Q1 and 8.5 million hits in 2004-Q4. Through June 30, 2005, the SkyServer interfaces have received a total of 92 million web hits and processed over 15.1 million SQL queries. As the graph shows, the rate at which the user community is accessing SDSS data continues to grow.

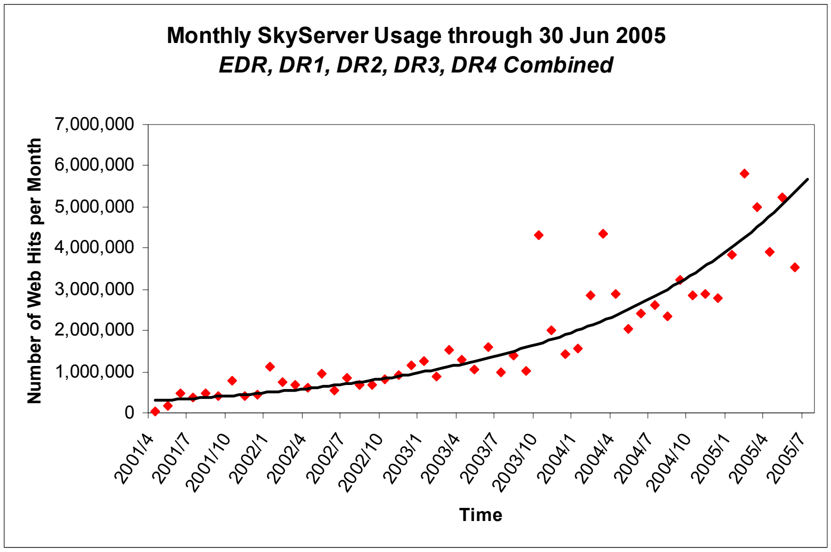

Figure 4.3. SkyServer usage per month, for all public releases combined.

Figure 4.4 shows the total number of SQL queries executed per month. We recorded 1.6 million queries in Q2, compared to 4.3 million queries in Q1 and 1.93 million queries in 2004-Q4. As reported last quarter, the spike in February was due to machine-generated queries. Usage over the past quarter was slightly below that of recent quarters. We expect an increase in Q3 as the public begins to access DR4.

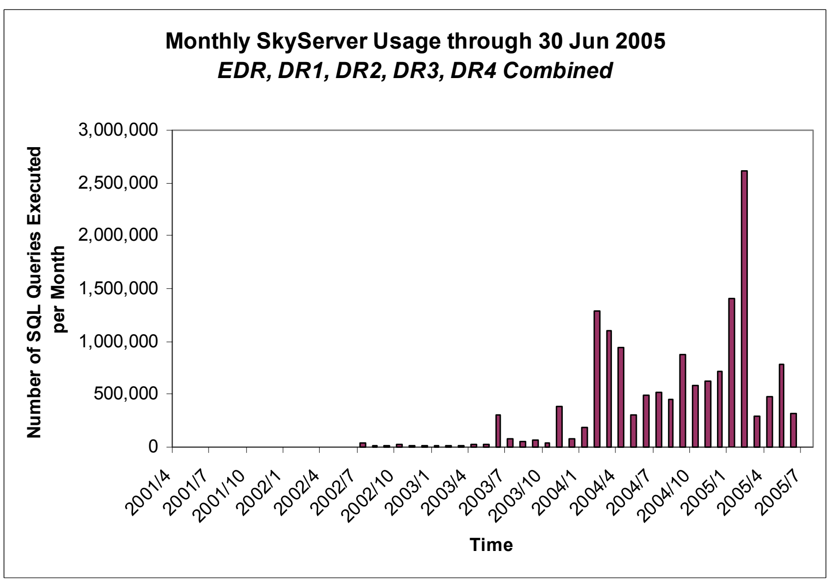

Figure 4.4. SkyServer usage, measured by the number of SQL queries submitted per month.

4.2.2. Data Release 4

Data Release 4 (DR4) was released to the public on June 29, 2005. DR4 contains an imaging catalog of 180 million objects covering a footprint area of 6,670 square degrees. It also contains 849,920 spectra, including approximately 565,700 galaxy spectra. The data release contents are described on the DR4 web site, which is accessible through www.sdss.org. The public release satisfies our commitment to release DR4 as specified in the SDSS Archive Distribution Plan to the Astronomy Community.

In addition to standard survey data, DR4 contains spectroscopic data from 276 “extra” and “special” plates. The bonus data come from the following plate observations:

- 61 "extra" plate/MJD combinations which are repeat observations of 52 distinct main survey plates,
- 206 distinct "special" plates, which are observations of spectroscopic targets, mostly in the southern galactic cap, which were selected by the collaboration for a series of specialized science programs. Some of these plates are outside of the DR4 imaging area); and
- 9 "extra-special" plates, which were repeat observations of "special" plates.

Prior to the public release, a few changes were made to the DR4 data set. Testing and evaluation by members of the collaboration resulted in the reclassification of 6,076 objects in the spectral database. Mostly, these changes were reassignments of objects flagged as “unknown” spectral classes to other spectral classes, or in some cases to new spectral classes and redshifts. In addition, there were some instances in which objects were re-classified as “unknown.”

Additional preparations for the public release included updating web pages to describe the DR4 data set, updating documentation to include the “extra” and “special” plates, and testing and where necessary fixing the various links and interfaces associated with DR4.

A technical paper describing DR4 has been prepared and submitted to The Astrophysical Journal Supplement Series (ApJ Supplements) for publication. The paper, “The Fourth Data Release of the Sloan Digital Sky Survey”, has also been posted on astro-ph with the number astro-ph/0507711.

4.2.3. Data Archive Server

The Data Archive Server (DAS) and its associated interfaces continue to be stable. The DAS is currently serving up all survey quality data collected through June 2004 to the general public, and all data collected through June 2005 to the collaboration.

Work in Q2 included copying files and configuring links to access the “extra” and “special” plates associated with the DR4 release. Extensive testing of the new links was performed to verify that everything was in place and working properly prior to public release.

4.2.4. Catalog Archive Server

Work associated with the Catalog Archive Server (CAS) focused on finishing the DR4 data load and preparing for the June public data release.

After the initial versions of BestDR4 and TargDR4 were loaded and made available to the collaboration, further development took place to incorporate the “extra” and “special” plates previously described. Incorporating the additional plates required modifications to the software that loads data into the database (sqlLoader), and the software that merges the newly loaded data, computes indices, nearby objects, etc (the FINISH step). Code modifications were completed and tested by the JHU development team and integrated into the production operation by members of the data distribution operations team at Fermilab. Comma-separated value (CSV) files were created for each new “extra” and “special” plate, the data was loaded into the database, and then the FINISH step run against the expanded database. Problems encountered during data loading and the running of the FINISH step were debugged and fixed.

In addition to dealing with the “extra” and “special” plates, new procedures were developed and added to sqlLoader to allow us to more easily remove and replace data on a single plate, or set of plates. The new scripts were successfully tested and implemented into the production operation.

Finally, a new table, photoAuxAll, was added to the database that contains errors and covariances for the right ascension and declination as well as galactic coordinates for all objects.

5. SURVEY PLANNING

5.1. Observing Aids

Several programs are used to aid in planning and carrying out observations. No software changes were made. All patches for the SEGUE program are now loaded into the patch database.

5.2. Target Selection

For this quarter, 82 plates were designed and drilled in one drilling run. Of these, 51 were for the Northern survey area, 20 were for the normal exposure SEGUE plates, and 11 were for double length exposure SEGUE plates.

5.3. Survey planning

The software that is used to track survey progress that is contained in this report is also used to prepared monthly observing plans. 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. Given that SDSS-II is now fully-funded, the closeout plan will not be executed. A portion of the funds approved for the project closeout will be re-allocated to cover the effort associated with preparing and loading the final year of SDSS data into databases in preparation for the DR5 release. The cost forecast to complete this work includes $224K in ARC-funded expenses, $30K in anticipated in-kind contributions, and $25K in management reserve. The remainder of the cash portion of the approved closeout budget, $224K, will be carried forward to pay down unpaid invoices.

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

Table 6.1. Q2 Cash Expenses and Forecast for 2005 ($K)

Category	2005 – 2nd Quarter Baseline Budget	2005 – 2nd Quarter Actual Expenses	2005 Operations Budget Total (for the period Jan-Jun 2005) Baseline Budget	2005 Operations Budget Total (for the period Jan-Jun 2005) Actual Expenses	Revised Closeout Cost Forecast (*Jul-Sep*)
1.1. Survey Management	60	34	119	74	9
1.2. Collaboration Affairs	5	2	10	2	8
1.3. Survey Operations					
1.3.1. Observing Systems	157	89	312	168	0
1.3.2. Data Processing & Dist.	191	138	391	277	202
1.3.3. Survey Coordination	0	0	0	0	0
1.3.4. Observatory Support	409	426	819	794	0
1.4. ARC Corporate Support	48	25	90	38	0
Sub-total	872	714	1,739	1,354	224
1.5. Management Reserve	50	0	100	0	25
1.6. Capital Improvements	0	0	0	0	0
Total	922	714	1,839	1,354	249

6.1. Q2 Performance - In-kind Contributions

The sum of in-kind contributions was $336K against the baseline forecast of $345K 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. Effort was also provided to support planning and preparations for the SEGUE and Supernova projects. The level of effort provided was in close agreement to that anticipated.

Los Alamos provided programming and maintenance support for the Telescope Performance Monitor, and planning support for the SDSS-II SEGUE program. The level of effort provided was in close agreement to that anticipated.

USNO provided support as required for the astrometric pipeline and other software systems they maintain. Again, the level of effort provided was in close agreement to that anticipated.

6.2. Q2 Performance – ARC Funded Expenses

ARC-funded expenses in Q2 were $714K, or $158K (18%) below the second quarter budget of $872K, excluding management reserve.

Survey management costs were $34K against a budget of $60K. Actual support costs for the Project Scientist, ARC Business Manager, and Public Information Officer were less than anticipated. Support costs for the Director and Project Manager were in agreement with the budget. No charges were incurred against the budget for Public Affairs; funds had been budgeted for AAS meeting expenses, but since the project did not have a formal presence at the June meeting, these funds were not expended. For the six months of operations ended June 30, actual Survey Management expenses were $74K, or $45K (38%) 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. Expenses in Q2 were associated with page charges for a technical paper.

For the six months of operations ended June 30, actual expenses were $2K against a budget of $8K. Unspent funds have been carried forward into Q3 to cover anticipated page charges for three technical papers.

Observing Systems costs were $89K against a budget of $157K. Actual UW costs were significantly less than budgeted; as in Q1, 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 in agreement with the budget. Funds set aside in the ARC Observing Systems Support account for additional engineering support and unanticipated hardware expenses were not needed. For the six months of operations ended June 30, actual Observing Systems expenses were $168K, or $144K (46%) below the baseline budget.

Data Processing and Distribution costs were $138K against a budget of 191K (-28%). Fermilab and UC expenses for data processing and operations support were in line with expectations. Princeton and JHU expenses were less than forecast. Fermilab expenses associated with data distribution support were also less than anticipated. Several new file servers and web servers were purchased in Q2 to support data distribution operations; however, due to delays in the actual delivery dates, costs for these purchases will show up in the July accounting reports. The budgeted funds for these purchases have been carried forward into the Q3 budget. For the six months of operations ended June 30, actual Data Processing and Distribution expenses were $277K, or $114K (29%) below the baseline budget.

Observatory Support costs were $426K against a budget of $409K (4%). Quarterly salary expenses were in line with expectations. The remaining categories of observatory operating expenses ended the quarter with a mixture of overruns and under runs, which largely cancel out over the course of the year. For the six months of operations ended June 30, actual Observatory Support expenses were $794K, or $25K (3%) below the baseline budget.

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 higher than budgeted for the quarter; a significant number of the observers elected to attend the final SDSS collaboration meeting. No charges were incurred against the Additional Scientific Support fund. For the six months of operations ended June 30, actual Corporate Support expenses were $38K against a baseline budget of $90K. The large variance is due primarily to the lack of charges against the Additional Scientific Support fund.

6.3. Revised Closeout Cost Forecast

Full funding for SDSS-II had not been secured when the CY2005 budget was prepared and approved in October 2005. Therefore, the approved budget covered normal operating expenses for the first six months of the year (January through June) and anticipated closeout costs during the period July through November. The approved budget for project closeout activities is $671K; the budget includes $448K to cover cash expenses and $223K in anticipated in-kind contributions from Fermilab.

On June 29, 2005, the funding goals for SDSS-II were met, which allowed SDSS-II operations to commence on July 1. Full funding for SDSS-II means that we will not execute all aspects of the project closeout plan at this time. As a result, the scope of work associated with SDSS-I closeout has been refined and the closeout budget forecast revised downward to meet reduced closeout needs.

The revised closeout plan covers those activities associated with preparing and loading the final year's worth of data into the Data Archive Server and Catalog Archive Server in preparation for the final SDSS-I data release, Data Release 5 (DR5). The work to prepare the data and load the appropriate databases will be completed by September 30, 2005. The revised closeout budget includes funds to cover data distribution work at Fermilab and The Johns Hopkins University.

The revised closeout plan also provides funds to cover management and oversight for DR5 preparations, carry-over technical page charges, and effort associated with closing SDSS-I cost accounts and preparing final project reports. The budget provides support for the ARC Business Manager and SDSS Project Manager. It also provides $8K for technical page charges and $5K to cover expenses associated with an independent audit of final SDSS costs.

The revised budget for closeout activities is $274K. It includes $224K to cover anticipated cash expenses, $30K in anticipated in-kind contributions from Fermilab, and $25K in management reserve. The remainder of unspent closeout budget funds will be carried forward to pay down unpaid invoices, once final SDSS invoices have been received and paid, and final project costs known.

6.4. Management Reserve

No management reserve funds were expended in Q2. Management reserve for DR5 preparation work and SDSS-I closeout activities is set at $25K, or roughly 10% of the revised closeout budget. The remainder of the unspent management reserve will be used to pay down unpaid invoices, once final SDSS invoices have been received and paid, and final project costs known.

7. PUBLICATIONS

In Q2, there were 27 papers based on SDSS data that were published by members of the SDSS collaboration. There were also 26 papers published by individuals outside of the collaboration, using publicly available data. Exhibit 3 lists papers published by members of the SDSS Collaboration; Exhibit 4 lists papers published by individuals outside of the SDSS collaboration.

At the time of this writing, there are 777 published refereed papers that include 'SDSS' or 'Sloan' in their title and/or abstract. These papers have been cited a total of 20,966 times, including 40 papers cited more than 100 times and 104 papers with 50 or more citations. In addition, there are 1018 un-refereed papers with "SDSS" or "Sloan" in the title and/or abstract.

8. SDSS-II DEVELOPMENT WORK

8.1. Progress on the SEGUE Project

Table 8.1 summarizes SEGUE data observed and processed in Q2. SEGUE imaging data was obtained during photometric conditions when the NGC was not observable. This yielded a total of approximately 196 square degrees of SEGUE imaging, including the difficult-to-reach (at other times of the year) stripes at low Galactic longitude (stripes 1020 at l=10 degrees and 1062 at l=31 degrees).

SEGUE spectroscopic observing was obtained during non-photometric conditions when Legacy NGC plates were unobservable. A total of 6 SEGUE plates (5 bright and 1 faint, corresponding to about 7 plate equivalents) were completed.

The SEGUE spectroscopy obtained this quarter were mostly designed with the SEGUE target selection v3_1 code. One plate pair 2174/2185 targeted the known globular M13, providing calibration feedback for the parameter estimation code.

To date, SEGUE has obtained approximately 1300/3500 square degrees of imaging and approximately 76/400 plates towards its baseline goal.

Table 8.1. Details on SEGUE data observed and processed (Apr 1-Jun 30, 2005)

Spectroscopy

Plate / MJD
2056/53463 (Apr 3, 2005)
2174/53521
2181/53524
2185/53532
2184/53534
2183/53536 (Jun 15, 2005)
Total: 6 plates, 7 plate equivalents

Imaging:

Run 5384 Strip 1020S 111 fields = 20 sq deg
Run 5392 Strip 290N 84 fields = 16 sq deg
Run 5396 Strip 1020N 180 fields = 34 sq deg
Run 5403 Strip 1140S 300 fields = 56 sq deg
Run 5409 Strip 1062N 110 fields = 20 sq deg
Run 5415 Strip 1062N 80 fields = 15 sq deg
Run 5416 Strip 1140N 190 field = 35 sq deg
Total: 196 square degrees of SEGUE imaging

The SEGUE project team held a technical meeting at Fermilab May 13-15th, with attendance by about 15 interested SEGUE participants. The meeting included a review of the SEGUE project and algorithms, and a useful discussion of what remained to be accomplished.

SEGUE also held a one day meeting in conjunction with the SDSS Collaboration meeting, held in Portsmouth, where the survey footprint and target selection algorithms were discussed by approximately 20 SEGUE collaborators.

8.2. Progress on the Supernova Project

During this quarter, we ordered and received at Fermilab a new compute cluster dedicated to rapid Supernova (SN) processing that will be shipped to APO in early August, before the start of the 2005 SN observing run in September. The frame subtraction pipeline continued to undergo extensive modification from the version used in Fall 2004, primarily incorporating better remapping and using more astrometric, PSF, and mask information from PHOTO to reduce the number of framesub processing steps. Work also was underway on modifying the frame subtraction pipeline to be able to handle co-added stripe 82 template data, since this should improve the S/N for supernova detection. In addition, a new veto catalog of stars was constructed from the stripe 82 database. Work was begun with a summer student on revising and improving the `handscan' environment for human inspection of supernova candidates, replacing the ds9 interface with a web-based interface using gif images. Work was also begun on code to do color selection and real-time lightcurve fitting of Type Ia supernovae; this will be incorporated into the processing and used as an aid in assigning candidates for follow-up spectroscopy.

Exhibit 1. CY2005 Cash Budget Forecast

SDSS CY2005 Budget Forecast as of July 31, 2005 (*in $000s*)

		Qtr 1	Qtr 2	Qtr 3		CY2005 Operations Sub-Total		Closeout Cost		CY2005 Total	
		Jan-Mar	Apr-Jun	Jul-Sep		(Jan-Jun 2005)		Forecast		Forecast	
		Actual Expenses	Actual Expenses	Baseline Budget	31-Jul-05 Forecast	(Q1-2 Baseline)	Actual Expenses	Baseline Budget	31-Jul-05 Forecast	Baseline Budget	31-Jul-05 Forecast
ARC-FUNDED BUDGET											
1.1 Survey Management											
SSP21	ARC Secretary/Treasurer	3	2	2	0	6	5	5	0	11	5
SSP34	ARC Business Manager	13	9	21	8	30	22	35	8	65	30
SSP46	PU Office of the Project Scientist	.02	.4	36	0	12	.4	36	0	47	
SSP48	FNAL Support for Survey Management	5	7	3	2	17	12	3	2	20	13
SSP67	UC Support for Survey Management	15	13	2	0	29	28	3	0	32	28
SSP91a	ARC Support for Public Affairs	0	0	0	0	12	0	0	0	12	0
SSP91i	ARC Support for Public Information Officer	4	2	0	0	13	7	0	0	13	7
	Sub-total	40	34	63	9	119	74	82	9	201	83
1.2 Collaboration Affairs											
SSP91c	ARC Support for Collaboration Affairs	1	2	5	8	10	2	5	8	15	10
	Sub-total	1	2	5	8	10	2	5	8	15	10
1.3.1 Observing Systems											
SSP42	FNAL Observing Systems Support	34	42	34	0	86	76	34	0	120	76
SSP61	FNAL Observing Programs and DA Support	0	.1	0	0	0	.1	0	0	0	
SSP31	UW Observing Systems Support	33	36	0	0	146	68	0	0	146	68
SSP32	PU Observing Systems Support	11	12	0	0	25	23	0	0	25	23
SSP91d	ARC Observing Systems Support	.5	.4	0	0	55	1	0	0	55	1
	Sub-total	78	89	34	0	312	168	34	0	346	168
1.3.2 Data Processing and Distribution											
SSP40	FNAL Software and Data Processing Support	13	22	13	0	28	35	13	0	42	35
SSP68	FNAL Data Distribution Support[1]	30	27	29	152	98	57	39	152	136	208
SSP38	PU Software and Data Processing Support	20	20	19	0	64	40	19	0	82	40
SSP39	UC Software and Data Processing Support	11	10	0	0	21	20	0	0	21	20
SSP37	JHU Data Archive Development and Support[1]	57	50	11	50	162	107	11	50	172	157
SSP33	UC Operations Support	9	9	0	0	19	18	0	0	19	18
	Sub-total	139	138	72	202	391	277	81	202	472	479
1.3.4 Observatory Support											
SSP35	NMSU Site Support	368	426	197	0	819	794	197	0	1,016	794
	Sub-total	368	426	197	0	819	794	197	0	1,016	794
1.4 ARC Corporate Support											
SSP91e	ARC Corporate Support	11	16	4	5	28	27	14	5	42	32
SSP91f	ARC Additional Scientific Support	0	0	0	0	56	0	0	0	56	0
SSP91h	ARC Observers' Research Support	2	9	0	0	6	11	0	0	6	11
	Sub-total	14	25	4	5	90	38	14	5	104	43
SUBTOTAL		641	714	375	224	1,739	1,354	413	224	2,153	1,578
SSP91g	Capital Improvements	0	0	0	0	0	0	0	0	0	0
SSP91	Management Reserve	0	0	20	25	100	0	35	25	135	25
TOTAL ARC-FUNDED BUDGET		641	714	395	249	1,839	1,354	448	249	2,288	1,603

Exhibit 2. CY2005 In-Kind Contribution Forecast

SDSS CY2005 Budget Forecast as of July 31, 2005 (*in $000s*)

		Qtr 1	Qtr 2	Qtr 3		CY2005 Operations Sub-Total		Closeout Cost		CY2005 Total	
		Jan-Mar	Apr-Jun	Jul-Sep		(Jan-Jun 2005)		Forecast		Forecast	
		Actual Expenses	Actual Expenses	Baseline Budget	31-Jul-05 Forecast	(Q1-2 Baseline)	Actual Expenses	Baseline Budget	31-Jul-05 Forecast	Baseline Budget	31-Jul-05 Forecast
IN -KIND CONTRIBUTION											
1.1 Survey Management											
SSP48	FNAL Support for Survey Management	40	38	40	15	81	78	65	15	146	93
	Sub-total	40	38	40	15	81	78	65	15	146	93
1.3.1 Observing Systems											
SSP42	FNAL Observing Systems Support	44	49	63	0	101	93	63	0	164	93
SSP58	LANL Observing Systems Support	44	25	0	0	55	69	0	0	55	69
SSP61	FNAL Observers' Programs and DA Support	0	0	0	0	7	0	0	0	7	0
	JPG Observing Systems Support	0	0	0	0	5	0	0	0	5	0
	Sub-total	88	74	63	0	168	162	63	0	231	162
1.3.2 Data Processing and Distribution											
SSP40	FNAL Software and Data Processing Support	246	200	81	0	401	446	81	0	482	446
SSP68	FNAL Data Distribution Support	4	13	10	15	20	17	14	15	34	32
SSP57	USNO Software and Data Processing Support	10	10	0	0	33	20	0	0	33	20
	Sub-total	260	223	91	15	454	483	95	15	548	498
TOTAL IN-KIND CONTRIBUTION		387	336	195	30	702	723	223	30	925	753
TOTAL BUDGET		1,028	1,050	590	279	2,542	2,077	671	279	3,213	2,356

Exhibit 3. Papers from within the SDSS Collaboration

1. Inada, N., Oguri, M., Keeton, C. R., Eisenstein, D. J., Castander, F. J., Chiu, K., Hall, P. B., Hennawi, J. F., Johnston, D. E., Pindor, B., Richards, G. T., Rix, H. R., Schneider, D. P., and Zheng, W. 2005, Discovery of a Fifth Image of the Large Separation Gravitationally Lensed Quasar SDSS J1004+4112, Publications of the Astronomical Society of Japan, 57, L7.

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5. Willman, B., Dalcanton, J. J., Martinez-Delgado, D., West, A. A., Blanton, M. R., Hogg, D. W., Barentine, J. C., Brewington, H. J., Harvanek, M., Kleinman, S. J., Krzesinski, J., Long, D., Neilsen, E. H., Nitta, A., and Snedden, S. A. 2005, A New Milky Way Dwarf Galaxy in Ursa Major, Astrophysical Journal, 626, L85.

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Exhibit 4. Publications Based on Public Data

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