Sloan Digital Sky Survey II

2007 FIRST QUARTER REPORT

January 1, 2007 – March 30, 2007

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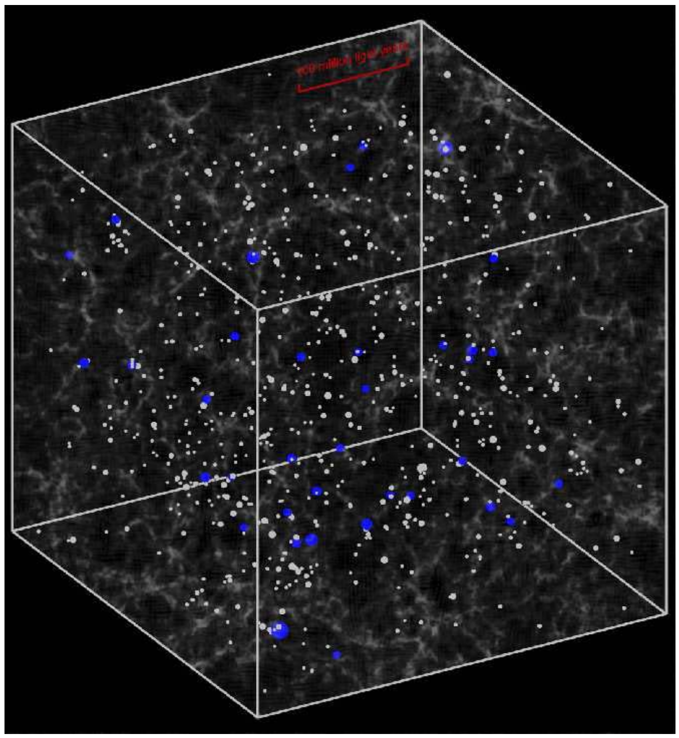
Q1 PERFORMANCE HIGHLIGHTS

- We obtained 124 square degrees of new SEGUE imaging data, against a baseline goal of 535 square degrees. We completed a total of 30 SEGUE plates (17 bright and 13 faint, corresponding to 43 plate-equivalents). This is roughly equivalent to completing 15 SEGUE tiles, against a baseline goal of 21 tiles. Progress was hampered by weather.
- We completed 57 Legacy spectroscopic plates against a baseline goal of 86 plates (66%); again, progress was hampered by weather. Consistent with our baseline plan, no new Legacy imaging data were obtained.
- We released an initial version of Data Release 6 (DR6) to the collaboration on February 9, 2007. DR6 contains all survey-quality Legacy and SEGUE data obtained through June 2006. The public release is scheduled to occur on or before June 30, 2007.
- We recorded over 23.8 million hits on our SkyServer interfaces and processed over 1.8 million SQL queries. We also transferred over 9.5 terabytes of data through the Data Archive Server interfaces.
- Q1 cash operating expenses were $952K against a baseline budget of $1,150K, excluding management reserve. In-kind contributions were $166K against anticipated contributions of $190K. No management reserve funds were expended.
- The spring SDSS Collaboration Meeting was held March 29-31, 2007 at Drexel University in Philadelphia, Pennsylvania. The meeting was hosted by Drexel and attended by approximately 100 participants representing 45 institutions. Two days of presentations were followed by one day of working group meetings in parallel with a 2-day SEGUE meeting.

1. SOME RECENT SCIENCE RESULTS

The following description, with graphics, briefly highlights some of the scientific work accomplished during the reporting interval (bearing in mind that efforts often spill over into other quarters). Unlike the list of publications given in Exhibits 3 and 4, the topic selected here is by no means comprehensive, nor even representative, of the science being undertaken by the SDSS collaboration. The short science description nevertheless augments our reporting of activities in SDSS-II.

Distant quasars live in massive dark matter halos



The SDSS has dramatically increased the known number of distant quasars. Princeton graduate student Yue Shen and his collaborators have used the SDSS quasar map to make the first high-precision measurement of the clustering of the most distant quasars, those seen during the first 2 billion years of cosmic history (redshift greater than three). They show that these ultra-luminous beacons, believed to be powered by gas falling into supermassive black holes, are clustered much more strongly than “normal" galaxies at the same redshifts, and much more strongly than quasars seen at smaller distances (and thus later times). When combined with theoretical models, the strong clustering implies that the quasars reside at the centers of very massive halos of dark matter. The illustration above, based on a simulation by Princeton astronomer Paul Bode, shows a numerical simulation of the distribution of dark matter in the early universe, 1.6 billion years after the Big Bang. Gray-colored filamentary structure shows the general distribution of dark matter, and small white circles mark concentrated halos of dark matter more massive than 3 trillion times the mass of the sun. (For comparison, the dark matter halo of the Milky Way galaxy is about 1 trillion times the mass of the sun.) Larger blue circles mark the most massive halos, more than 7 trillion times the mass of the sun. The strong clustering of quasars in the SDSS sample demonstrates that they reside in these rare, very massive halos, linking the growth of the most massive black holes to the growth of the most massive dark matter concentrations.

References:

1. Clustering of High Redshift (z > 2:9) Quasars from the Sloan Digital Sky Survey, by Yue Shen et al. 2007, The Astronomical Journal, 133, 2222

2. SURVEY PROGESS

The period of accounting for this report includes three observing runs spanning the period from January 8 through March 25 2007.

2.1. Legacy Survey

Table 2.1 compares the imaging and spectroscopic data obtained against the Legacy baseline plan. No new Legacy imaging data was obtained in 2007-Q1.

Table 2.1. Legacy Survey Progress in 2007-Q1

	2007-Q1		Cumulative through Q1	
	Baseline	Actual	Baseline	Actual[1]
Legacy Imaging (sq. deg)	0	0	7808	7577
Legacy Spectroscopy (tiles)	86	57	1456	1450

Due to poor weather conditions, we fell short of the Q1 baseline goal for obtaining new spectroscopic data. We completed 57 plates against a baseline goal of 86. Fortunately, we came into the quarter ahead of the cumulative baseline, which softened the impact of the marginal yield in Q1. Through the end of Q1, we have completed 1450 plates, which is within 1% of the cumulative goal of 1456 plates.

The following graphs show progress against the baseline plan. Figure 2.1 shows historical progress against the baseline plan for the Legacy Survey. Figure 2.2 shows progress on the spectroscopic survey. In order to provide a better view of progress against plan, the axis scales on Figure 2.2 have been adjusted to show progress made since July 2005, the start of SDSS-II operations.

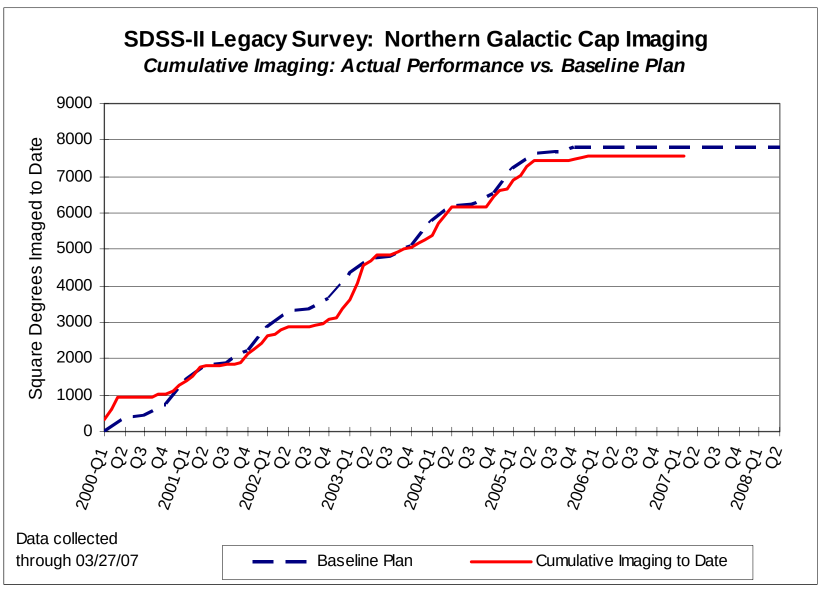


Figure 2.1. Imaging Progress against the Baseline Plan – Legacy Survey

[1] When the baseline plan for SDSS-II was prepared, we estimated that the total area to be imaged was 7808 "footprint" square degrees. We "closed the gap" in the imaging footprint at the end of June 2006 and declared the imaging survey to be complete. At that time, the actual area imaged was 7561 square degrees. Since then, and as time and conditions permit, we plan to continue obtaining small amounts of imaging data in order to fill in small missing areas on stripes 23 and 33. We obtained an additional 16 square degrees of imaging data in 2006-Q4, which increased the total area imaged to 7577 square degrees.

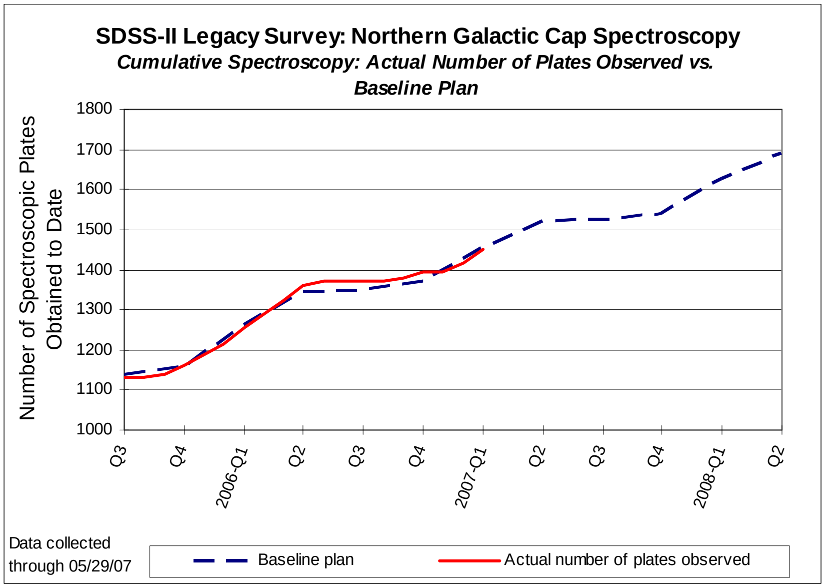


Figure 2.2. Spectroscopic Progress against the Baseline Plan – Legacy Survey

2.2. SEGUE Survey

SEGUE imaging data were obtained under photometric conditions during the February and March observing runs. No imaging data were obtained in January, as weather in that month was unusually poor.

For the quarter, we obtained a total of 124 square degrees of new SEGUE imaging data against a baseline goal of 535 square degrees. Data were obtained on stripes 205, 1374, 1406, and 1458.

A total of 30 SEGUE plates (17 bright and 13 faint, corresponding to 43 plate-equivalents) were completed. This is roughly equivalent to completing 15 SEGUE tiles, against a baseline goal of 21 tiles. Recall that a SEGUE tile is considered complete when the faint and bright plate combination for a field is observed. Our observing strategy is arranged to complete plate pairs in roughly the same time frame, in order to maximize the scientific usefulness of each plate pair. However, given the many factors that affect observing operations (atmospheric conditions, available time, etc.), it is not always efficient to complete plates in "pair combinations." Therefore, we have elected to separately report progress in terms of the number of bright and faint plates completed, as opposed to combined bright/faint plate pairs (i.e., SEGUE tiles).

Table 2.2 compares SEGUE progress against the baseline plan. The SEGUE Survey is ahead of the baseline in imaging due to the acquisition of SEGUE data in prior to July 2005, when commissioning and proof-of-concept observations were made. Prior to this quarter, we had been ahead of the baseline for spectroscopy for the same reason. However, due to marginal weather conditions, we are now even with the baseline for bright plates and have fallen slightly behind the baseline for faint plates.

Table 2.2. SEGUE Survey Progress in 2007-Q1

	2007-Q1		Cumulative through Q1	
	Baseline	Actual	Baseline	Actual
SEGUE Imaging (sq. deg)	535	126	2367	3121
SEGUE Spectroscopy (bright plates)	21	17	106	105
SEGUE Spectroscopy (faint plates)	21	13	106	95

Figure 2.3 shows the current SEGUE layout and progress map, as of March 31, 2007. The plot can be found online at: http://home.fnal.gov/~yanny/fut/layout.html

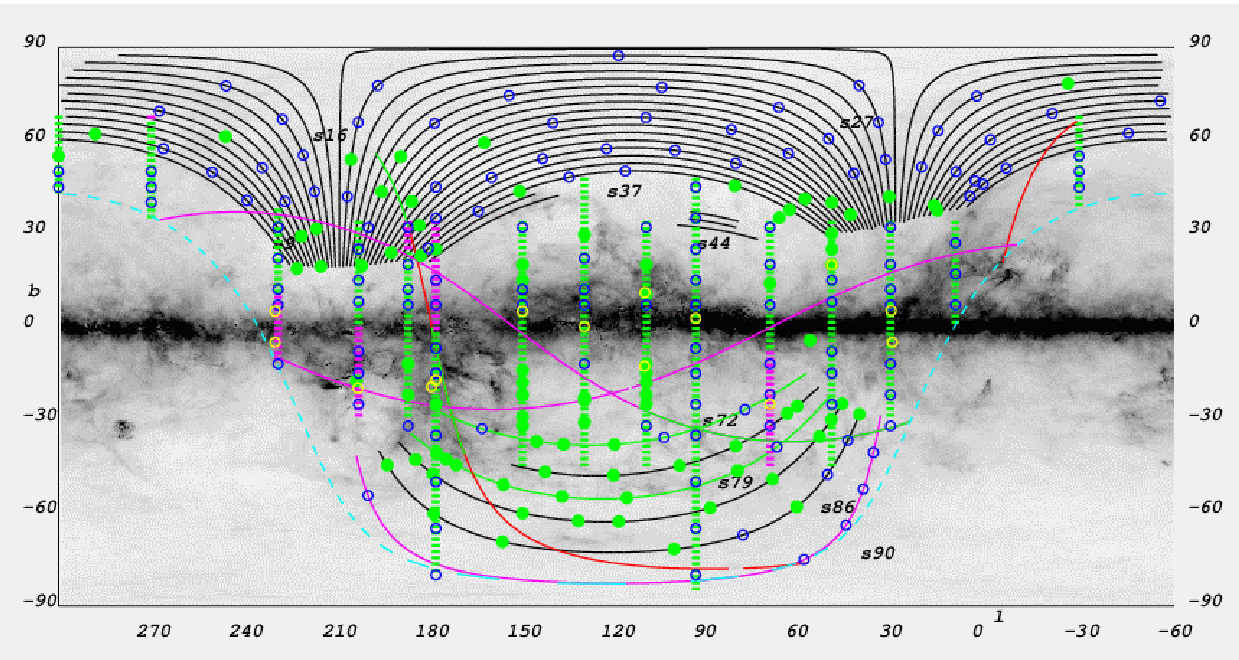


Figure 2.3. SEGUE imaging sky coverage and plate layout (as of March 31, 2007).

The following graphs illustrate SEGUE progress against the baseline plan. The imaging graph presents a straightforward comparison of imaging progress against plan. The spectroscopy graph shows the rate at which we have completed bright and faint plates separately.

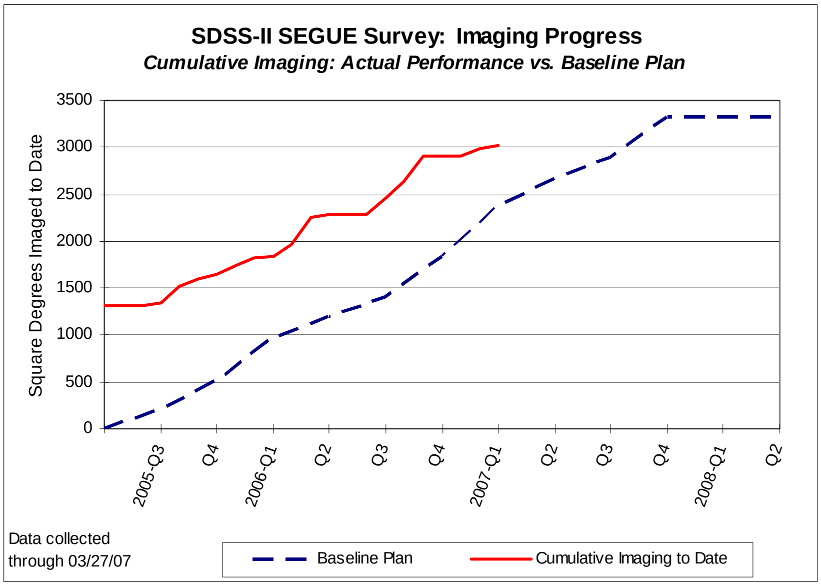


Figure 2.4. Imaging Progress against the Baseline Plan – SEGUE Survey

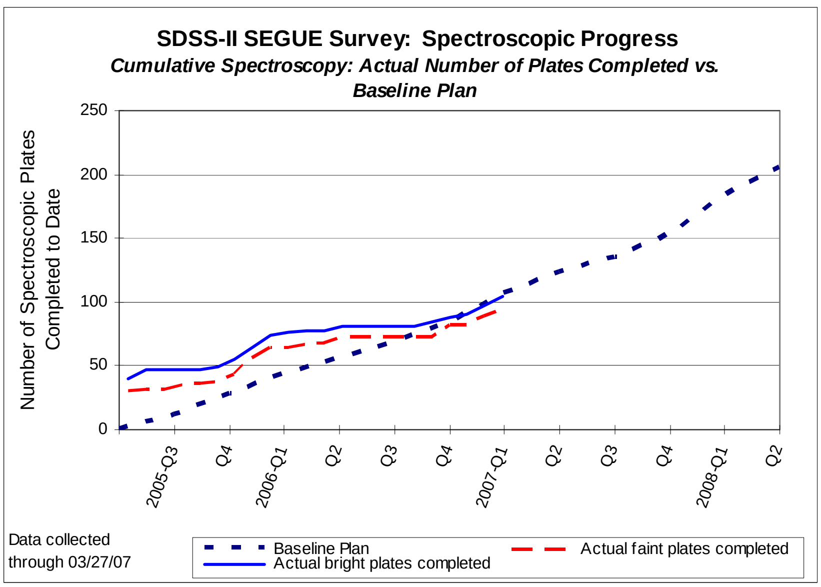


Figure 2.5. Spectroscopic Progress against the Baseline Plan – SEGUE Survey

The USNO-1m observing program in support of SEGUE continued at a reduced schedule due to the relocation last year of the observer for this program. In Q1, we obtained 3 nights of data during a 6-night observing run. Depending on the level of observing support available, we should be able to schedule two week-long USNO-1m observing runs in support of SEGUE in Q2 (one in May and another in June).

In addition to supporting observing operations, the SEGUE team was involved in several other activities:

- Process and analysis is underway on low latitude algorithm plates that have been observed.

- In conjunction with the SDSS-II collaboration meeting at Drexel University at the end of March 2007, SEGUE held a group meeting on March 31 and April 1. This meeting was attended by 30 active collaborators and covered all aspects of SEGUE: target selection, early science results, remaining calibration to-dos, status of the survey, preparations for DR6 public release. It was a very productive session.

- Work proceeded on a SEGUE public web page (to be released prior to public DR6) and a (collaboration accessible) SEGUE wiki for exchange of figures and data.

Work planned for 2007-Q2 includes the following:

- Implementing and vetting SEGUE data that will be included in the DR6 public release. DR6 will be the first release that includes SEGUE imaging data, as well as stellar parameter estimates.

- Continued development work to improve the stellar velocity accuracy for SEGUE (reducing residuals from +/15 km/s to +/- 5 km/s), in an attempt to get the improvement completed in time for the DR6 public release.

2.3. Supernova Survey

In accordance with the observing plan, no new supernova data were obtained. Work this quarter focused on continued processing and analysis of fall 2006 supernova data. Data originally processed through the on-mountain data processing at APO were reprocessed in the data processing factory at Fermilab.

2.4. Photometric Telescope

We observed 17 secondary patch sequences with the Photometric Telescope (PT) in Q1. Of these, nine were deemed survey quality after processing and eight were declared bad. The PT also observed 31 manual target sequences for the SEGUE program over this time period; of these, 21 were deemed survey quality after processing and 10 were declared bad.

3.0 OBSERVING EFFICIENCY

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

3.1. Weather

The weather category reports the fraction of scheduled observing time that weather conditions are suitable for observing. Table 3.1 summarizes the amount of time lost to weather and Figure 3.1 plots the fraction of suitable observing time against the baseline forecast. Averaged over the quarter, the fraction of available observing time was much worse than predicted in the baseline plan. By month, weather conditions in January were only suitable for observing 13% of the time, which severely hampered progress. Conditions in February were better, with 50% of the available time suitable for observing. Observable weather in March was right around the 60% baseline.

Table 3.1. 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	413	261	37%	60%
Dark & Gray Time	598	374	37%	60%

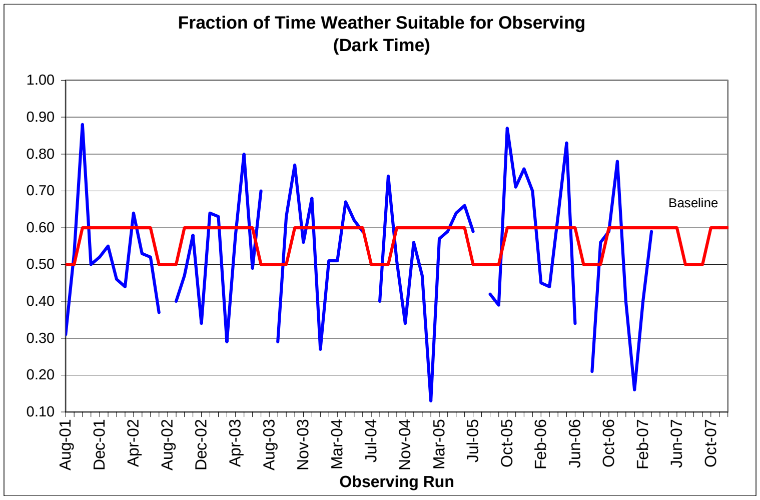


Figure 3.1. Percentage of Time Weather Suitable for Observing

3.2. System Uptime

System uptime measures the availability of equipment when conditions are suitable for observing. We averaged 99% uptime against a baseline goal of 90%. Table 3.2 summarizes the total amount of time lost to equipment or system problems and Figure 3.2 plots uptime against the baseline goal.

Table 3.2. 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	413	3	99%	90%
Dark & Gray Time	598	3	99%	90%

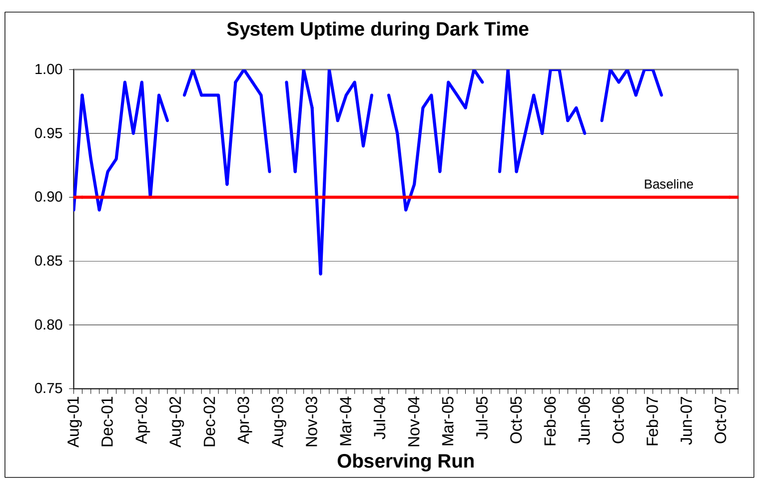


Figure 3.2. System Uptime

3.3. Imaging Efficiency

Imaging efficiency in February and March averaged 75% against a baseline goal of 86%. January's weather conditions prohibited successful imaging.

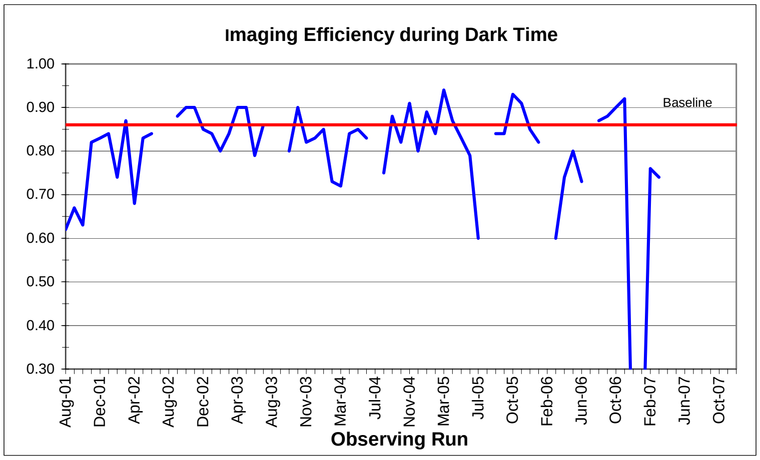


Figure 3.3. Imaging Efficiency

3.4. Spectroscopic Efficiency

Spectroscopic efficiency is derived by assessing the time spent performing various activities associated with spectroscopic operations. Table 3.3 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 exceeded baseline goals; average efficiency in Q1 was 67% against the baseline goal of 64%.

Table 3.3. Median Time for Spectroscopic Observing Activities

Category	*Baseline*	*Run starting Jan*	*Run starting Feb*	*Run starting Mar*
Instrument change	10	6	5	5
Setup	10	8	9	7
Calibration	5	5	5	6
CCD readout	0	3	3	3
Total overhead	25	22	22	21
Science exposure (assumed)	45	45	45	45
Total time per plate	70	67	67	66
Efficiency	0.64	0.67	0.67	0.68

Figure 3.4 shows that efficiency is trending upward in recent months due to a slight reduction in the amount of time spent in setup.

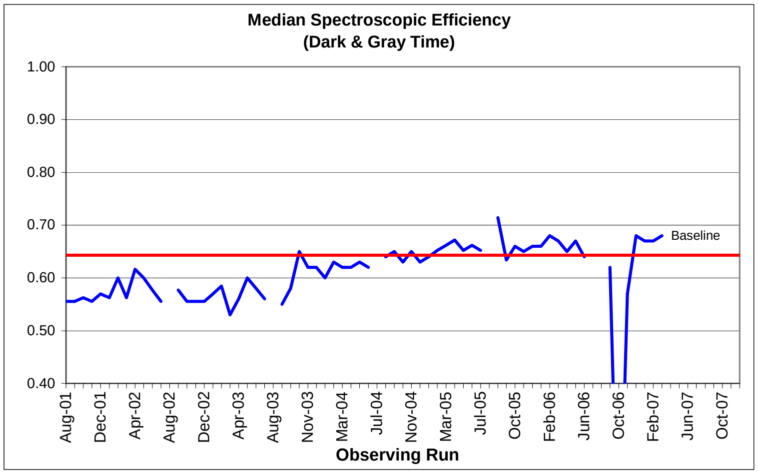


Figure 3.4. Spectroscopic Efficiency

4. OBSERVING SYSTEMS

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

4.1. The Instruments

The imaging camera and spectrographs worked reasonably well throughout the quarter. We had one exceptionally cold night in January that affected voltages on two of the imager CCDs. We have seen this problem in the past when temperatures dip below our normal operating range. CCD operation returned to normal when temperatures increased.

In previous reports, we described reliability problems with the operation of the spectrograph LN2 autofill system and our ongoing effort to troubleshoot and fix the system. In Q1, we discovered a faulty ground through the quick disconnect units on the LN2 fill lines. Cleaning the connectors improved the ground connection and the autofill system has been working well since the cleaning. We are guardedly optimistic that we have finally found the underlying source of the problem. To prevent future problems, we added periodic cleaning of the connectors to the preventive maintenance list.

4.2. The 2.5m Telescope

The following list highlights some of the more notable engineering work performed on the 2.5m telescope and supporting systems during the quarter. Beyond the normal repair and maintenance activities, we were primarily concerned with documentation and new hire integrations.

1) To improve safety and system reliability, a new set of ODH sensors were installed in the telescope enclosure. We had tested one of the new units during Q1 and initial operating experience suggests that the new units should improve the stability and reliability of the ODH system.

2) We have located a new flow meter for the spectrograph purge system and are testing it to determine stability under APO operating conditions. We intend to upgrade the purge system during the summer shutdown.

3) We plan to install a second humidity sensor in the collimator mirror area of each spectrograph during the summer shutdown. We currently have humidity sensors in the central optics area that have been functional for several months.

4) Documentation work continues and we have started to convert hard copy drawings to electronic format for improved documentation access.

5) The ET project required an enclosure near the 2.5-m telescope that would meet current and future needs. This was accomplished with the fabrication of a new enclosure mounted atop the imager doghouse, which also removed a potential trip hazard from the 2.5-m telescope floor.

6) We continued monitoring the output of the imaging camera ion pump with a data logger and saw several transient vacuum spikes that we do not believe to be real, given the very rapid vacuum rise and recovery times reported by the pump. We intend to replace the ion pump during the 2007 summer shutdown, to eliminate these false readings.

7) We purchased and installed a new CCD camera in the Cloud Camera, which replaced a much older and very problematic unit. We also purchased a second unit for the spares pool.

8) The control valve in the Latch Booster Pump housing failed during the quarter. Given the nature of the pump assembly, it was more cost-effective to replace the entire unit. A second unit was purchased as well and placed into the spares inventory.

9) We experienced an unusually large number of burned-out quartz lamps on the Flat Field system. Three quartz lamps failed in as many days. Although the quartz lamp assemblies are rather inexpensive, the failures occurred during nighttime operations and resulted in lost observing time while the failed lamps were replaced. The engineering team inspected power supplies and cabling and found nothing amiss. Since replacing the lamps, we have not had further problems. We are still not sure what caused the lamp failures.

10) The controller for the X-Y stage on the Imager Calibrator failed during the quarter. A spare has been ordered and will be installed when it arrives.

11) We experienced problems with the altitude fiducial system early in the quarter, which was fixed by re-aligning the fiducial read-head.

12) We completed the implementation of the instrument change interlock system. The system has been partially implemented for several years, but was not being used in full production mode due to a number of small problems related to the instrument lift pendant and instrument lift velocity interlocks. Through testing and debugging, all remaining problems were found and fixed and the system rigorously tested by the day and night staffs before being declared production-ready.

13) In early March, we were plagued with a series of rotator servo aborts. The aborts occurred when the rotator was being moved at tracking speeds and the rotator angle was near 251 degrees. Thorough testing of the servo system, along with a careful analysis of the TPM data files, determined that the aborts were being caused by unnecessarily low motor current limits imposed

by the interlock system. The current limits were increased slightly, to more reasonable levels, and the aborts have ceased.

4.3. The Photometric Telescope

No significant work was performed on the PT during the quarter, and there were no problems encountered during observing operations.

4.4. Operations Software and the Data Acquisition System

Very minor changes were made to the observing software. During testing and implementation of the instrument change interlocks, we realized that the status of the instrument ID and imaging camera "saddle-mounted" switches was no longer being reported. Because we do not use the power umbilical lift, we had decided to remove the umbilical tower control software as part of the upgrade. In doing so, we overlooked the fact that the instrument ID and saddle-mounted switch status was being returned in the "Umbil" keyword status block. We re-enabled the status block in a new piece of code, which made the switch status available once again. This change is documented in PR6930.

Work on the data acquisition system (DA) included the following:

- Increased the stack sizes for various tasks on the DA boards in an attempt to reduce the frequency of the intermittent board hangs.
- Provided instructions for replacing Vigra MMI-250 video cards with MVME2302/Peritek VCQ-M cards. These were successfully used at APO as part of a test of such an exchange.
- Sent working MVME5500 and MVME2302/VCQ-M boards to APO to be added to the spares pool.
- Modified the DA TCC code so that it no longer clears the internal buffer of telescope position updates when a "slewing" update is received. This was a result of PR6084 which reported that frame header values for the telescope position were being set to nonsense values when the telescope started slewing before the DA had finished the readout of an exposure.
- Restored the TCC simulator program to working order for testing telescope position message handling at the teststand.
- Moved the Fermilab teststand from WH8 to FCC3. Returned obsolete boards to PREP.
- Completed the handoff of support of the DA upgrade from the development team to APO staff.

5. DATA PROCESSING AND DISTRIBUTION

5.1. Data Processing

5.1.1. Software Development and Testing

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

Development work continued at Princeton on the spectroscopic pipeline, the photometric pipeline, and photometric calibration. Development work on the co-addition of the Southern stripe runs continued at several institutions. With regard to the spectroscopic pipeline, a significant amount of code development and testing was completed on the updated version of the spectroscopic pipeline, idlspec2d_v5. The intent is to use this version of the software to reprocess all survey-quality spectroscopic data for inclusion into Data Release 6.

Work continues by the JINA-MSU team on the SEGUE Stellar Parameter Pipeline, formerly named the Stellar Atmosphere Pipeline. The SEGUE Stellar Parameter Pipeline (SSPP) continues to evolve slightly, with new versions being mirrored for testing and verification of code at FNAL.

Highlights of Q1 progress include:

- Acquisition of high-resolution calibration spectra at various 8m-10m telescopes is now completed. These data will be used for first-pass validation of the SSPP pipeline parameters. All data have been reduced and analyzed. We now have the tools needed to proceed onto several papers that involve these high-resolution comparisons.
- Completed addition of the UW "Hammer" program, which provides spectral classifications for late type stars from SDSS spectroscopy. Did not complete the anticipated "hot extension" but hope to do so in the near future.
- Extended several techniques for parameter estimates in the SSPP, including the determination of the alpha element Mg. Currently engaged in testing of the resulting alpha elements by comparison with their values from the high-resolution spectroscopy mentioned above. Tests initiated on confidence of [Mg/Fe] as a function of S/N.
- An active effort is underway to complete and submit the three basic papers that comprise a description of the SSPP and its validation, roughly on the same timescale as the DR6 release. In any case, these papers will be sent to astro-ph upon submission to the journals, so the information is in the public's hands as soon as possible.

In the early part of Q2 we plan to freeze a version of the SSPP for the DR6 public release. Additional planned activities include:

- Submission of several papers describing the operation of the SSPP, and its validation via globular cluster observations and high-resolution observations.
- Incorporation of methods to evaluate parameter estimate errors as a function of S/N, taking advantage of a recently completed SDSS spectroscopic noise model.
- Development of a Wiki page for receiving public comment on problems / suggestions for future revisions of the SSPP, once science applications are initiated.

5.1.2. Data Processing Operations at APO

No data were processed at APO during Q1 as we were not collecting new supernova data.

5.1.3. Data Processing Operations at Fermilab

There were no major problems or development efforts related to the processing of imaging data this quarter. We processed 7 legacy imaging runs, 25 SEGUE runs, and 29 supernova runs.

Developers of the spectroscopic pipeline have made a several improvements to the pipeline since the version used to process the data we currently distribute, including the correction of bugs that impact the science from SEGUE data. Although the spectroscopic data in DR6 released to the collaboration includes only data processed by the older version, we plan to reprocess all spectroscopic data using the new pipeline for inclusion in the public release of DR6. We began testing and integration of the new version into data processing operations at Fermilab in Q1, and will finish this integration and reprocess the data in Q2.

We continued migration of our archive of data on tape to new media. Our current projected finish date is in mid-July.

One of our older nodes used for data processing suffered a major disk failure of its RAID arrays. We are continuing to restore the data that was on these disks, either by restoration from tape backup or regeneration. More recently acquired nodes have disk configuration for which comparable hardware failures would be less severe; we are considering reconfiguration of the other older nodes.

Other data processing related tasks we completed included modification of our use of IDL in the production pipeline to use precompiled IDL code (which allows us to perform processing on additional nodes without requiring additions IDL licenses), improved backups of supernova data, and upgrading of several data processing products to allow their use on 64-bit architecture machines.

5.2. Data Distribution

Data distribution activities were focused on supporting existing releases and preparing for Data Release 6 (DR6). The DR6 public release is scheduled to occur on or before June 30, 2007.

5.2.1. Data Usage Statistics

Through March, the general public and astronomy community have access to the EDR, DR1, DR2, DR3, DR4, and DR5 through the DAS and SkyServer interfaces. In addition, the collaboration has access to a preliminary version of DR6, and the Runs DB. The SDSS helpdesk, established at Fermilab, continues to respond to user questions or to system problems reported by users. On average, the helpdesk responds to 1-2 requests per day for help or information.

Figure 5.1 plots the number of web hits we receive per month through the various SkyServer interfaces. In Q1 we recorded 23.9 million hits, compared to 15.1 million hits in 2006-Q4 and 22.6 million hits in 2006-Q3.

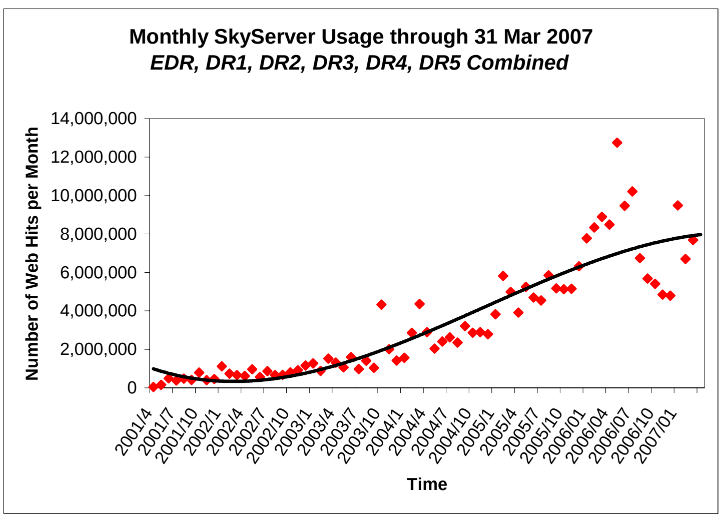


Figure 5.1. SkyServer usage per month, for all public releases combined.

Figure 5.2 shows the total number of SQL queries executed per month. We executed 1.9 million queries in Q1, compared to 1.8 million queries in 2006-Q4 and 4.2 million queries in 2006-Q3.

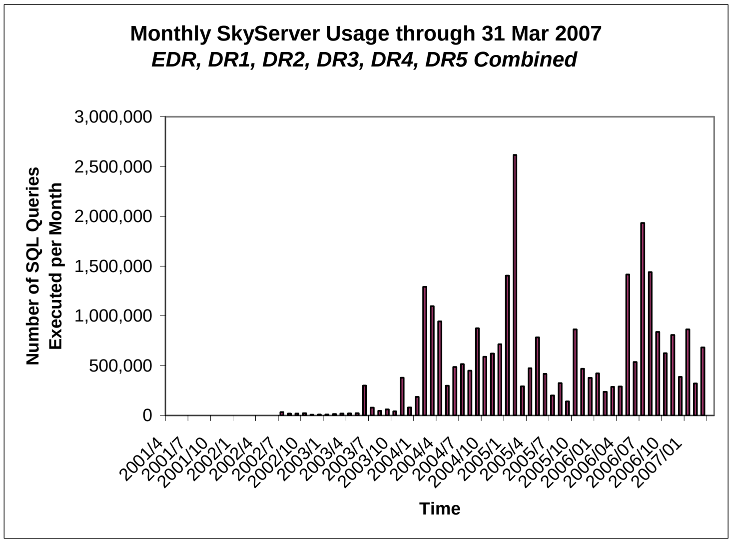


Figure 5.2. SkyServer usage, measured by the number of SQL queries submitted per month.

Through March 31, 2007, the SkyServer interfaces have received over 235 million web hits and processed over 26 million SQL queries. Over the past three months, the SkyServer sites received an average of 8 million hits and processed just over 622,000 SQL queries per month.

Figure 5.3 shows the volume of data transferred monthly from the DAS through the rsync server. A total of 4.2 TB of data were transferred via rsync in Q1, compared to 3.0 TB in 2006-Q4. As we have seen in the past, the volume of data transferred varies significantly from month to month.

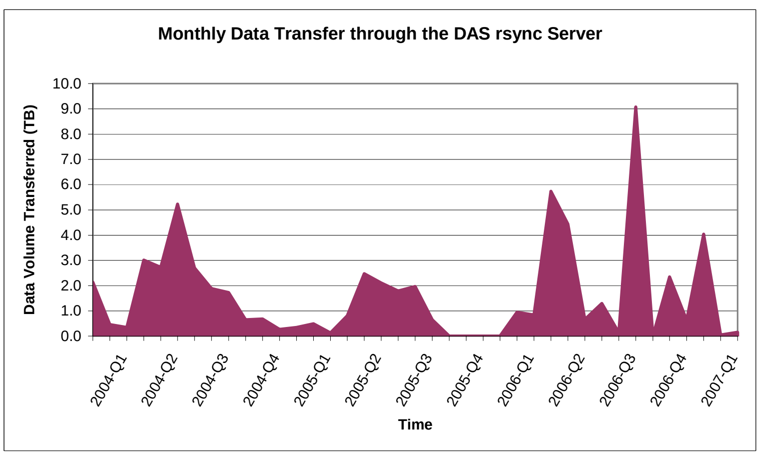


Figure 5.3. Monthly volume of data transferred via the DAS rsync Server.

Figure 5.4 shows the volume of data transferred monthly through the DAS web interface. A total of 5.3 TB of data were transferred via the web interface in Q1, compared to 16.8 TB in 2006-Q4.

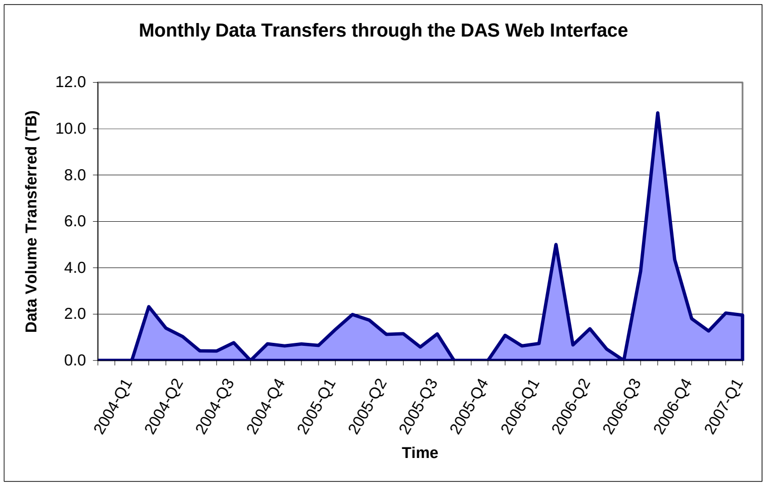


Figure 5.4. Monthly volume of data transferred via the DAS web interface.

Figure 5.5 shows the total volume of data transferred from the DAS through the two access portals combined. In addition to showing total volume transferred, the stacked-area chart shows the fraction transferred via each method (rsync vs. web interface). Historically, the majority of data transfers have been made using rsync, suggesting that rsync is the preferred transfer method for large data transfers. In Q1 the volume of data transferred through the interfaces was comparable: 45% of the data transferred was via the rsync interface and 55% was via web.

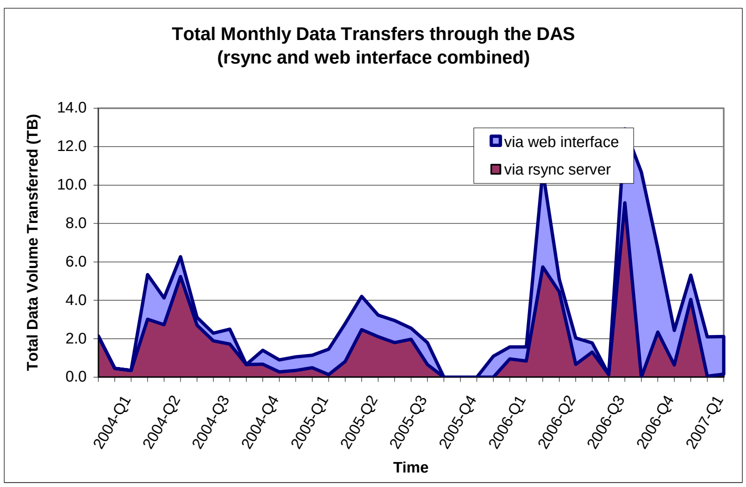


Figure 5.5. Total monthly volume of data transferred via the DAS

5.2.2. Data Release 6

On February 9, we announced the availability of preliminary versions of the DR6 DAS and CAS to the SDSS collaboration. DR6 includes approximately 6.5% more Legacy survey imaging than DR5 and essentially 'completes the footprint', with 8520 square degrees of imaging data. DR6 also includes approximately 20% more spectra than DR5, including a total of 1.2M spectra (counting duplicate and SEGUE spectra). In addition, for the first time, early SEGUE imaging is released in a searchable CAS format database, parallel to the main DR6 database.

DR6 contains many improvements over prior releases, including additional tables in the CAS (e.g., stellar atmospheric parameters, including [Fe/H], log g, and Teff estimates for stars), improved calibration of photometric data, and improved support of SEGUE data. The preliminary version of DR6 released to the collaboration included spectro data processed with version 4 of the idlspec2d pipeline (idlspec2d_v4). In Q2, we plan to reprocess all spectroscopic data with version 5 of this pipeline. Version 5 includes significant improvements in scattered light correction, sky fiber outputs, and spectrophotometric calibration. After appropriate testing, we will replace the existing v4 reductions with the new v5 reductions in time for the public release.

5.2.3. Data Archive Server

There were no significant activities related to the Data Archive Server (DAS) in Q1, nor were there any significant hardware problems affecting data accessibility. The majority of efforts associated with DAS were related to providing general support for data distribution operations.

5.2.4. Catalog Archive Server

Work on the Catalog Archive Server (CAS) included addressing problem reports, preparing for the DR6 data load, and providing general support for data distribution operations.

A total of eight problem reports filed through the SDSS Problem-Reporting Database were fixed and closed, including two filed as critical/high (one against CAS and one against CasJobs).

The majority of CAS work focused on getting ready for DR6. In preparation for DR6, we migrated to the latest version of Microsoft SQL Server (SQL2005), which required a number of code changes to accommodate new or modified features in the SQL Server application.

The following list highlights some of the more significant changes required to support loading DR6 imaging and spectroscopic data:

- replaced spHtm_C#.sql and spHtmCSharp.sql, and SphericalHtm.ddl with Spatial.ddl
- updated LoadSpecObj DTS package with 4 new columns in SpecObjAll
- removed GrantAccess from x*schema*.txt files
- fixed bug with spSkyQASupport.sql
- replaced fHtmToNormalForm calls in spRegion and spBoundary with C# equiv fHtmRegionToNormalFormString
- fixed SEGUE stripedefs problem and fRegionFromString bug
- fixed problem with FK deletion for schema sync, tagged DR6_20
- added fix for problem with fGetNearbyTiledTargetsEq
- replaced fGetObjectsEq with zone version (renamed the original to fGetObjectsEqHTM)
- tested and ran Ap7Mag table and functions patch

In addition, the following changes were required to support the loading of SEGUE data into the CAS:

- fixed bug causing infinite loop in spBoundarySegment
- attempted to fix bug causing an infinite loop in spBoundaryHole; debugging is still underway, with the problem narrowed down to the fRegionConvexToArcs function.
- finished segueDR6 patch that set mode=2 for all objects in the patch.
- created and copied a version of the DR6 data load (MySkyServerDR6) to JHU for use in testing and development.

The development team at JHU and the production team at Fermilab worked closely throughout the quarter to prepare DR6 for collaboration release. A significant amount of troubleshooting and bug fixing was required to successfully complete the database load, due partly to issues associated with the migration from SQL2000 to SQL2005, and partly to nuances associated with DR6 data model and schema changes.

To support data distribution operations, five new database servers were ordered and incorporated into the production system at Fermilab. Three of the new servers will be used to support DR6 and two will replace older aging machines.

6. SURVEY PLANNING

6.1. Observing Aids

Several programs are used to aid in planning and carrying out observations; no changes were made to these in Q1.

6.2. Target Selection

For this quarter, 96 plates were designed and drilled in three drilling runs. Of these, 30 were for the Northern survey area, 33 were for the normal exposure SEGUE plates, 33 were for double length exposure SEGUE plates.

6.3. Survey Planning

The software that is used to track survey progress is also used to prepare monthly observing plans. Two new plots are now being made that combine the legacy and Segue programs for comparing the cumulative imaging and spectroscopic data against their respective baselines. These plots provide a better measure of overall survey efficiency than the four separate comparisons being made previously.

7. EDUCATION AND PUBLIC OUTREACH

In Q1, the SDSS EPO Coordinator assisted with SDSS activities at the joint American Astronomical Society/American Association of Physics Teachers meeting in Seattle in January 2007. In particular, she provided support for the workshop on using SDSS data in the classroom. She also spent about 18 hours at the SDSS exhibit booth answering questions and gathering information about how the SDSS web sites are used in high school and college classrooms.

The EPO Coordinator attended the SDSS Collaboration meeting at Drexel University in March 2007. She gave a “machine gun” talk on E/PO on the sdss.org web site and urged members of the collaboration to report events. She also brought 400 copies of the SDSS bookmark to the meeting and these were taken home by collaboration members for use in E/PO.

Funding was received from the M. J. Murdock Charitable Trust to support two high school teachers to do SDSS follow-up observations at the University of Washington’s Manastash Ridge Observatory (MRO) during the summers of 2007 and 2008. One proposal, written by MRO Assistant Director Chris Laws, involves observations of RR Lyra candidates that were derived from the SDSS database. The other, written by MRO Director Julie Lutz, involves observations of both known symbiotic stars and some candidates derived from the SDSS database. The orientations of the teachers for their summer projects will begin in April.

The EPO Coordinator continued follow-up work with some high school and college teachers (community college and 4-year schools) who had been trained on the SDSS SkyServer education activities in June 2006. In particular, she worked with Cheryl Niemela, a high school teacher at Rogers High School in

Puyallup who is offering an Astronomy 101 class for University of Washington credit at her school. Ms. Niemela used the SDSS exercise on stellar spectral types with students in her Astronomy 101 class.

Finally, we continued updating and streamlining the features on the sdss.org/education web page.

EPO activities in the coming quarter include the following:

- The EPO Coordinator will offer the "Sloan Digital Sky Survey for Kids" educator workshop in the late spring, probably on the University of Washington campus. The audience will be teachers of grades 6-10.
- During this quarter, we will begin planning future SDSS-related events and workshops at the summer American Association of Physics Teachers meeting and the Astronomical Society of the Pacific meeting in September.
- The EPO Coordinator, with others from the University of Washington, have started a SDSS database project on identifying objects that might be planetary nebulae in the halo of the Milky Way Galaxy. Candidate objects will be investigated by undergraduate assistants.
- We will be working with high school teachers and undergraduates on SDSS follow-up projects involving observations at Manastash Ridge Observatory.

8. COST REPORT

The operating budget that the Advisory Council accepted and the Board of Governors approved for SDSS-II activities during the period January 1 through December 31, 2007 consists of $720K of anticipated in-kind contributions from Fermilab, the University of Chicago (UC), the Johns Hopkins University (JHU), the University of Washington (UW), and the Joint Institute for Nuclear Astrophysics (JINA); and $4,857K for ARC-funded cash expenses.

Table 8.1 shows actual cost performance for ARC-funded cash expenses in Q1. More complete tables comparing actual to baseline performance are included in the appendices of this report. Appendix 1 compares cash expenses to the budget and presents the revised cash forecast for 2007. Appendix 2 compares actual in-kind contributions to the budget and presents the revised in-kind forecast for 2007.

8.1. Q1 Performance - In-kind Contributions

The sum of in-kind contributions in Q1 was $166K against the baseline budget of $190K and was provided by Fermilab, UW, and Michigan State University (MSU) for JINA, as follows:

- Fermilab provided support for survey management, data processing and data distribution activities. Effort was also provided to support oversight and planning, and development work for the SEGUE and Supernova projects. The level of effort provided to support data processing and distribution operations was as anticipated.
- JHU provided support for the development, loading and hosting of the databases associated with the CAS, CasJobs, and SkyServer. The amount of effort provided was as anticipated. However, expenses for first quarter were not posted due to a new accounting system and the timing of budget approval. First quarter expenses were accrued and will post in the second quarter results.
- No support was provided by USNO in Q1; no support was required.
- UW contributed the overhead associated with the plate drilling operation as anticipated.
- MSU provided support for the SEGUE project, including continued work on the SEGUE Stellar Parameter Pipeline (SSPP). The level of effort provided was as anticipated.

Table 8.1. Q1 Cash Expenses and Forecast for 2007 ($K)

Category	2007 – 1st Quarter Baseline Budget	2007 – 1st Quarter Actual Expenses	2007 Operations Budget Total *(for the period Jan-Dec 2007)* Baseline Budget	2007 Operations Budget Total *(for the period Jan-Dec 2007)* Current Forecast
1. Survey Management	96	85	477	512
2. Survey Operations				
2.1. Observing Systems	160	161	693	677
2.2. Observatory Operations	433	383	1,732	1,716
2.3. Data Processing	192	147	722	719
2.4. Data Distribution	171	116	491	514
2.5. ARC Support for Survey Ops	22	1	41	22
3. New Development				
3.1. SEGUE Development	42	25	151	142
3.2. Supernova Development	0	0	0	0
3.3. DA Upgrade	0	0	0	0
3.4. Photometric Calibration	23	14	94	84
4. ARC Corporate Support	11	20	44	74
Sub-total	1,150	952	4,457	4437
5. Management Reserve	103	0	410	410
Total	1,253	952	4,856	4,870

8.2. Q1 Performance – ARC Funded Cash Expenses

ARC-funded expenses were $952K, or $198K (17%) below the budget of $1,150K, before management reserve.

Survey Management costs were $85K against a budget of $96K. Expenses for the Director, Project Scientist, EPO Coordinator, Public Information Officer, FNAL project management support staff, and Collaboration Affairs were less than anticipated. Expenses for the ARC Business Manager and ARC Office of the Secretary/Treasurer were as anticipated. Actual expenses for the University of Chicago project management office and ARC Public Affairs office were higher than anticipated. The Q2-Q4 forecast includes the costs to support additional staff in the FNAL project management office. Overall the revised forecast for Survey Management expenses is $512K, or $35K (7%) above the baseline budget of $477K.

Observing Systems costs were $161K against a budget of $160K. UW costs were less than budgeted. Fermilab and Princeton expenses were in reasonable agreement with the budget. ARC Expenses were greater than anticipated due to personnel expenses for an observer which was planned as part of the NMSU budget. The observer will join the NMSU staff in the third quarter. For the year, the revised forecast for Observing Systems expenses is $654K, or $39K (6%) below the baseline budget of $693K.

Observatory Support costs were $383K against a budget of $433K. Salaries were slightly below the budget forecast for the quarter, in part stemming from delays in staff recruiting. Travel expenses, operations and miscellaneous expenses were also below budget, as were capital equipment purchases. Besides the effects of staffing, the overall under run in the quarter can be attributed to the normal delays of setting up encumbrances for the long-term service contracts, and the delays in planned and budgeted purchases of large capital items that will occur in later quarters. For the year, the forecast for Observatory Support expenses is $1,716K, or $16K (1%) below the baseline budget of $1,732K.

Data Processing costs were $147K against a budget of $192K. Actual expenses at Fermilab were below budget. Actual expenses at Princeton and University of Chicago were higher than anticipated. For the year, the revised cost forecast for Data Processing is $719K, or $3K below the baseline budget of $722K.

Data Distribution costs were $116K against a budget of $171K. Fermilab expenses were slightly higher than budget. JHU expenses and ARC Support for Data Distribution were lower than budgeted. For the year, the cost forecast for Data Distribution is $514K or $21K (5%) above the baseline budget of $491K.

Minimum expenses were incurred against the ARC accounts holding funds for additional Survey Operations support (specifically, Additional Scientific Support and Observers' Research Support). Unspent Q1 funds from the Observers' Research Support budget and the Additional Scientific Support budget have not been carried forward in the forecast. The baseline budget for Q2-Q4 should adequately meet needs in both of these areas. As a result, we predict that actual expenses will be substantially less than budgeted. Overall, the revised forecast for Survey Operations support is $22K, or $19K (48%) below the baseline budget of $48K.

Expenses associated with development work for the SEGUE Survey were $25K against a budget of $42K. Expenses for development work at Princeton were less than budget. Expenses to support software development work at Ohio State were in reasonable agreement with the budget. Expenses for development work at University of California Santa Cruz were less than budgeted due to a graduate student not scheduled to begin work until 3rd quarter. Planned expenses have been carried forward in the forecast.

Expenses associated with photometric calibration efforts at Princeton were in $14K against a budget of $23K. For the year, the revised forecast is $84, or $10K (10%) below the baseline budget of $94K.

Miscellaneous ARC corporate expenses (i.e., audit fees, bank fees, petty cash, and APO trailer rentals) were $20K against a budget of $11K. For the year, the revised forecast is $74K against the baseline budget of $44K. The increase reflects the addition of the capital improvement expenses for a bobcat which will be offset by savings in observatory support costs.

8.3. Q1 Performance - Management Reserve

No management reserve funds were expended in Q1. Unspent management reserve has been carried forward into Q2-Q4.

9. PUBLICATIONS

In Q1, there were 9 papers based on SDSS data that were published by members of the SDSS collaboration. There were also 7 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.

Exhibit 1. CY2007 Cash Budget Forecast (in $000s)

SDSS-II CY2007 Budget Forecast

(as of 30-Apr-2007)

		Inst	Qtr 1 Jan-Mar Approved Baseline Budget	Qtr 1 Jan-Mar Actual Expenses	Qtr 1 Jan-Mar Variance (%)	Qtrs 2-4 Apr-Dec Approved Baseline Budget	Qtrs 2-4 Apr-Dec Apr-2007 Forecast	Qtrs 2-4 Apr-Dec Variance (%)	CY2007 Total Approved Baseline Budget	CY2007 Total Apr-2007 Forecast	CY2007 Total Variance (%)
OPERATIONS BUDGET - CASH EXPENSES											
1.0 Survey Management											
SSP-221	ARC Secretary/Treasurer	ARC	2,495	2,335	6%	9	9	-2%	11,500	12	0%
SSP-234	ARC Business Manager	ARC	16,505	15,988	3%	52	53	-1%	68,700	69	0%
SSP-246	PU Office of the Project Scientist	PU	3,350	241	93%	69	69	0%	72,825	70	4%
SSP-248	FNAL Support for Survey Management	FNAL	14,400	13,413	7%	43	67	-55%	57,600	80	-40%
SSP-267	UC Support for Survey Management	UC	14,000	16,272	-16%	65	65	0%	78,850	81	-3%
SSP-270	UW Support for EPO Coordinator	UW	11,160	9,759	13%	37	35	4%	47,750	45	6%
SSP-274	PU Support for EPO (NSF REU)	PU	0	0	---	0	18	---	0	18	---
SSP-291a	ARC Support for Public Affairs	ARC	7,500	17,737	-136%	8	8	0%	15,500	26	-66%
SSP-291b	ARC Support for Spokesperson	ARC	2,500	1,489	40%	8	8	0%	10,000	9	10%
SSP-291c	ARC Support for Collaboration Affairs	ARC	16,000	2,403	85%	48	53	-9%	64,000	55	14%
SSP-291i	ARC Support for Public Information Officer	ARC	7,650	4,065	47%	23	23	0%	30,600	27	12%
SSP-291k	ARC Support for Young Astronomers Travel Fund	ARC	0	1,700	---	0	0	---	0	2	---
SSP-291L	ARC Support for EPO Webmaster and Teacher	ARC	0	0	---	20	20	0%	19,875	20	0%
	Survey Management Sub-total		**95,560**	**85,402**	11%	**381,640**	**427**	-12%	**477,200**	**512**	-7%
2.0 Survey Operations											
2.1 Observing Systems											
SSP-231	UW Observing Systems Support	UW	37,850	29,832	21%	121	127	-4%	159,100	157	2%
SSP-232	PU Observing Systems Support	PU	11,420	11,702	-2%	38	38	0%	49,300	50	-1%
SSP-242	FNAL Observing Systems Support	FNAL	88,650	91,398	-3%	279	290	-4%	368,000	381	-4%
SSP-261	FNAL Data Acquisition System Support	FNAL	7,325	6,133	16%	20	20	-2%	27,300	27	3%
SSP-291d	ARC Observing Systems Support	ARC	15,000	22,216	-48%	74	42	44%	89,000	64	28%
	Observing Systems Sub-total		160,245	161,281	-1%	532	516	3%	692,700	677	2%
2.2 Observatory Support											
SSP-235	NMSU Site Support	NMSU	433,064	382,537	12%	1,265	1,299	-3%	1,697,984	1,682	1%
SSP-272	JHU Support for APO Site Management	JHU	0	0	---	34	34	---	34,272	34	---
	Obseratory Support Sub-total		433,064	382,537	12%	1,299,192	1,333,464	-3%	1,732,256	1,716,001	1%
2.3 Data Processing											
SSP-240	FNAL Software and Data Processing Support	FNAL	146,520	97,642	33%	369	411	-11%	515,800	508	1%
SSP-238	PU Software and Data Processing Support	PU	39,925	41,955	-5%	119	119	0%	159,200	161	-1%
SSP-239	UC Software and Data Processing Support	UC	5,400	7,675	-42%	42	42	0%	47,100	49	-5%
	Data Processing Sub-total		191,845	147,272	23%	530	572	-8%	722,100	719	0%
2.4 Data Distribution											
SSP-268	FNAL Data Distribution Support	FNAL	96,350	110,489	-15%	250	276	-10%	346,400	386	-11%
SSP-237	JHU Data Archive Development and Support	JHU	24,675	5,710	77%	70	123	-74%	95,000	128	-35%
SSP291M	ARC Support for Data Distribution	ARC	50,000	0	100%	0	0	---	50,000	0	100%
	Data Distribution Sub-total		171,025	116,199	32%	320	398	-24%	491,400	514	-5%
2.5 ARC Support for Survey Operations											
SSP91f	ARC Additional Scientific Support	ARC	18,130	500	97%	9	9	0%	27,130	10	65%
SSP91h	ARC Observers' Research Support	ARC	3,500	0	100%	11	12	-14%	14,000	12	14%
	Data Distribution Sub-total		21,630	500	98%	20	21	-8%	41,130	22	48%
	Survey Operations Sub-total		**977,809**	**807,790**	17%	**2,701,777**	**2,840,331**	-5%	**3,679,586**	**3,648,121**	1%

Exhibit 1. CY2007 Cash Budget Forecast (continued)

SDSS-II CY2007 Budget Forecast
(as of 30-Apr-2007)

		Inst	Qtr 1 Jan-Mar Approved Baseline Budget	Qtr 1 Jan-Mar Actual Expenses	Qtr 1 Jan-Mar Variance (%)	Qtrs 2-4 Apr-Dec Approved Baseline Budget	Qtrs 2-4 Apr-Dec Apr-2007 Forecast	Qtrs 2-4 Apr-Dec Variance (%)	CY2007 Total Approved Baseline Budget	CY2007 Total Apr-2007 Forecast	CY2007 Total Variance (%)
OPERATIONS BUDGET - CASH EXPENSES											
3.0 New Development											
3.1 SEGUE Survey Development											
SSP-138	PU SEGUE Software Development	PU	23,085	13,658	41%	71	71	0%	93,755	84	10%
SSP271	OSU Scientific Support	ARC	10,470	10,962	---	19	18	-3%	29,000	29	0%
SSP273	UCSC Scientific Support	ARC	8,765	0	---	20	28	45%	28,460	28	0%
SSP-268	FNAL Data Distribution Support	FNAL	0	0	---	0	0	---	0	0	---
	SEGUE Development Sub-total		42,320	24,620	42%	109	117	-8%	151,215	142	6%
3.2 Supernova Survey Development									0	0	---
	No allocation		0	0	---	0	0	---	0	0	---
	Supernova Development Sub-total		0	0	---	0	0	---	0	0	---
3.3 Data Acquisition System Upgrade											
	No allocation		0	0	---	0	0	---	0	0	---
	DA Upgrade Sub-total		0	0	---	0	0	---	0	0	---
3.4. Photometric Calibration Development											
SSP-138	PU Photometric Calibration Development	PU	23,085	13,658	41%	71	71	0%	93,755	84	10%
	Photometric Calibration Sub-total		23,085	13,658	41%	70,670	70,670	0%	93,755	84,328	10%
	New Development Sub-total		**65,405**	**38,277**	41%	**180**	**188**	-5%	**244,970**	**226**	8%
4.0 ARC Corporate Support											
SSP291e	ARC Corporate Support	ARC	11,300	20,282	-79%	33	30	8%	43,800	50	-15%
SSP291g	ARC Capital Improvements	ARC	0	0	---	0	24	---	0	24	---
	ARC Corporate Support Sub-total		**11,300**	**20,282**	-79%	**32,500**	**53,500**	-65%	**43,800**	**74**	-68%
Cash Budget Sub-total			**1,150,074**	**951,751**	17%	**3,295**	**3,509**	-6%	**4,445,556**	**4,460**	0%
5.0 Management Reserve		ARC	102,500	0	100%	308	410	-33%	410,000	410	0%
TOTAL CASH BUDGET			**1,252,574**	**951,751**	24%	**3,603**	**3,919**	-9%	**4,855,556**	**4,870**	0%

Exhibit 2. CY2007 In-Kind Contribution Forecast (in $000s)

SDSS-II CY2007 Budget Forecast

(as of 30-Apr-2007)

			Qtr 1 Jan-Mar			Qtrs 2-4 Apr-Dec			CY2007 Total		
		Inst	Approved Baseline Budget	Actual Expenses	Variance (%)	Approved Baseline Budget	Apr-2007 Forecast	Variance (%)	Approved Baseline Budget	Apr-2007 Forecast	Variance (%)
OPERATIONS BUDGET: IN-KIND											
1.0 Survey Management											
SSP-248	FNAL Support for Survey Management	FNAL	34,740	27,455	21%	106	85	20%	140,350	112	20%
	Survey Management Sub-total		**34,740**	**27,455**	21%	**106**	**85**	20%	**140,350**	**112**	20%
2.0 Survey Operations											
2.1 Observing Systems											
SSP-231	UW Observing Systems Support	UW	15,000	15,000	0%	45	45	0%	60,000	60	0%
	Observing Systems Sub-total		15,000	15,000	0%	45	45	0%	60,000	60	0%
2.3 Data Processing											
SSP-239	UC Software and Data Processing Support	UC	4,815	0	100%	14	14	0%	19,260	14	25%
SSP-240	FNAL Software and Data Processing Support	FNAL	84,550	88,959	-5%	257	257	0%	341,600	346	-1%
SSP-269	MSU SEGUE Software Development and Support	MSU	0	0	---	0	0	---	0	0	---
	Data Processing Sub-total		89,365	88,959	0%	271	272	0%	360,860	360	0%
2.4 Data Distribution											
SSP-237	JHU Data Archive Development and Support	JHU	10,750	0	100%	39	50	-28%	49,500	50	0%
SSP-268	FNAL Data Distribution Support	FNAL	13,900	19,159	-38%	42	42	0%	56,200	61	-9%
	Data Distribution Sub-total		24,650	19,159	22%	39	92	-137%	105,700	111	-5%
	Survey Operations Sub-total		**129,015**	**123,118**	5%	**355**	**408**	-15%	**526,560**	**531**	-1%
3.0 New Development											
3.1 SEGUE Survey Development											
SSP-237	JHU Data Archive Development and Support	JHU	10,750	0	100%	11	22	-100%	21,500	22	0%
SSP-269	MSU SEGUE Software Development and Support	MSU	15,625	15,625	0%	16	16	0%	31,250	31	0%
	SEGUE Development Sub-total		26,375	15,625	41%	26	37	-41%	52,750	53	0%
	New Development Sub-total		**26,375**	**15,625**	41%	**26**	**37**	-41%	**52,750**	**53**	0%
TOTAL IN-KIND CONTRIBUTIONS			**190,130**	**166,198**	13%	**461**	**530**	-15%	**719,660**	**696**	3%
TOTAL OPERATING BUDGET (Cash and In-kind)			**1,442,704**	**1,117,949**	23%	**4,064**	**4,449**	-9%	**5,575,216**	**5,567**	0%

Exhibit 3. Papers from within the SDSS Collaboration

1. New Close Binary Systems from the SDSS-I (Data Release Five) and the Search for Magnetic White Dwarfs in Cataclysmic Variable Progenitor Systems. AJ Accepted – Nicole Silvestri

2. The Hercules-Aquila Cloud. ApJL 657:89 (2007) – V. Belokurov, et al.

3. On the Spectral Evolution of Cool, Helium-Atmosphere White Dwarfs: Detailed Spectroscopic and Photometric Analysis of DZ Stars. ApJ Accepted – Patrick Dufour

4. HI Selected Galaxies in the Sloan Digital Sky Survey I: Optical Data. AJ Submitted – Andrew West, et al.

5. The Sloan Digital Sky Survey Quasar Catalog. IV. Fifth Data Release. AJ Accepted – D. P. Schneider

6. SDSS Standard Star Catalog for Stripe 82: the Dawn of Industrial 1% Optical Photometry. AJ Submitted – Zelklo Ivezic, et al.

7. On the Variability of Quasars: A Link Between Eddington Ratio and Optical Variability? MNRAS Accepted - Brian C. Wilhite, et al.

8. Estimating stellar atmospheric parameters from SDSS/SEGUE spectra. A&A 467:1373(2007) - P. Re Fiorentin, et al.

9. Exploring the Variable Sky with Sloan Digital Sky Survey. AJ Submitted - Branimir Sesar, et al.

Exhibit 4. Publications Based on Public Data

1. A Systematic Search for High Surface Brightness Giant Arcs in a Sloan Digital Sky Survey Cluster Sample. ApJ 660:1176 (2007) – Juan Estrada, et al.

2. Discovery of An Unusual Dwarf Galaxy in the Outskirts of the Milky Way. ApJL 656:136 (2007) – M. Irwin, et al

3. The Properties of Jovian Trojan Asteroids Listed in SDSS Moving Object Catalog 3. MNRAS Accepted – G. Szabo, et al.

4. Searching for rotating galaxy clusters in SDSS and 2dFGRS. ApJ 662:236 (2007) – Ho Seong Hwang, et al.

5. The ultraluminous and hyperluminous infrared galaxies in the Sloan Digital Sky Survey, 2dF Galaxy Redshift Survey and 6dF Galaxy Survey. MNRAS 375:115 (2007) – Ho Seong Hwang, et al.

6. SDSS Galaxy Clustering: Luminosity & Color Dependence and Stochasticity. PRD Submitted – Molly Swanson, et al.

7. The discovery of two extremely low luminosity Milky Way globular clusters. ApJL Submitted – S. Koposov, et al.