

Sloan Digital Sky Survey II
2007 THIRD QUARTER REPORT
July 1, 2007 – September 30, 2007

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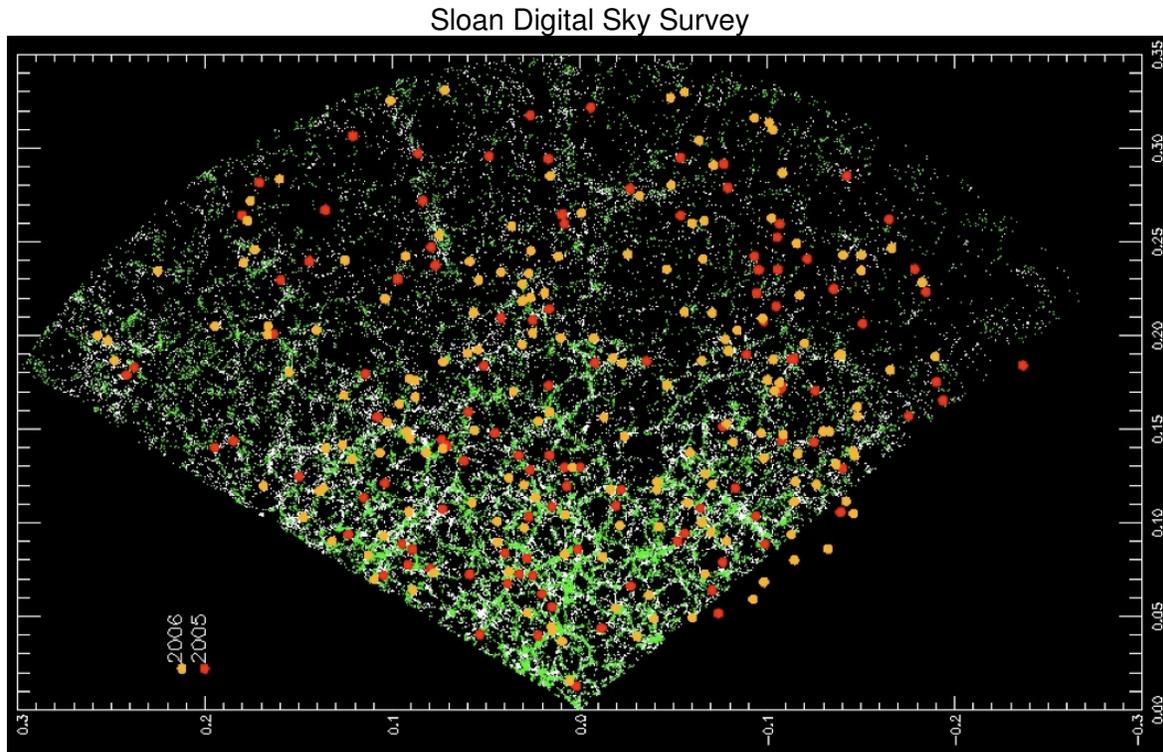
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Q3 PERFORMANCE HIGHLIGHTS

- We obtained 14 square degrees of new SEGUE imaging data, against a baseline goal of 215 square degrees. We completed a total of 16 SEGUE plates (9 bright and 7 faint, corresponding to 23 plate-equivalents). This is roughly equivalent to completing 8 SEGUE tiles, against a baseline goal of 12 tiles.
- We recorded over 22 million hits on our SkyServer interfaces and processed over 3.6 million SQL queries. We also transferred over 14.4 terabytes of data through the Data Archive Server interfaces.
- The Annual Report for the NSF was completed in July. We also met with the NSF program officers on August 3rd to present our annual status report.
- We changed the last night of observations to July 14, 2008 instead of June 30, 2008.
- We changed the DR7 public release date to no later than December 1, 2008. Based on our current project timeline we forecast a release date of October 31, 2008.
- We completed the summer shutdown work at APO which included extensive preventive maintenance activities.
- Q3 cash operating expenses were \$1,205K against a baseline budget of \$1,228K, excluding management reserve. In-kind contributions were \$159K against anticipated contributions of \$167K. No management reserve funds were expended.

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.

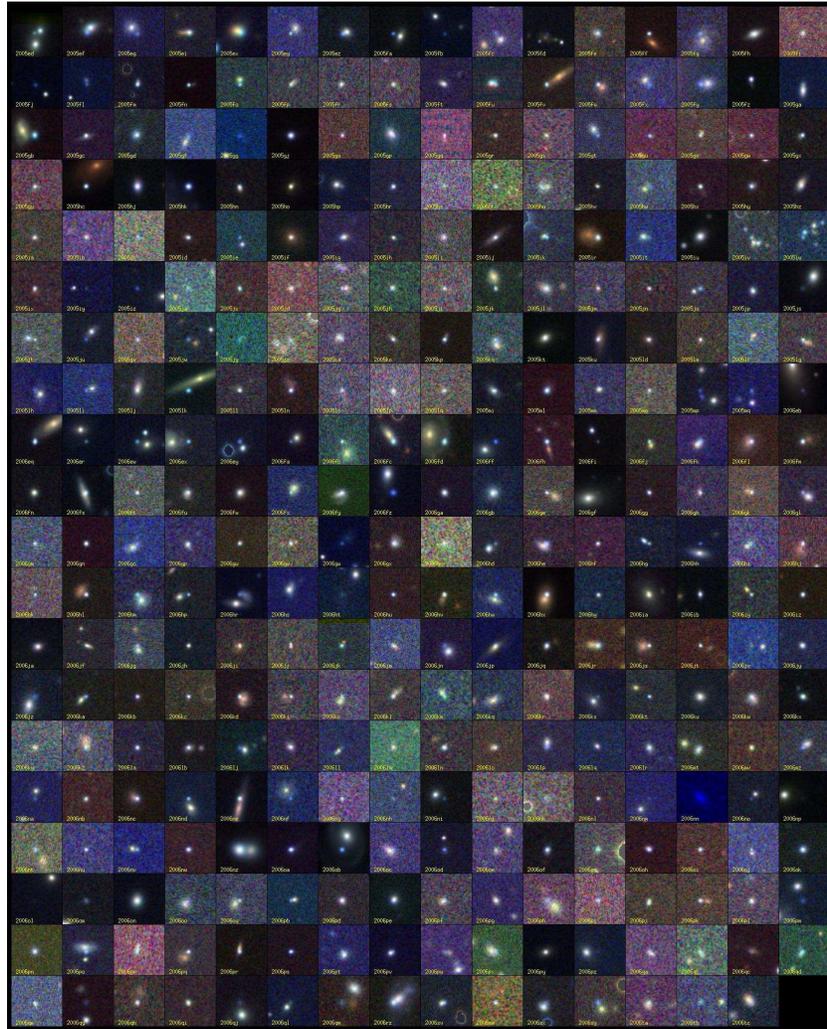


Mapping the Universe with Supernovae

Type Ia supernovae are produced by the thermonuclear explosions of white dwarf stars. At its peak, a supernova explosion can outshine the entire galaxy (typically containing billions of stars) in which it resides. Because the intrinsic luminosities of Type Ia supernovae can be well calibrated, their apparent brightnesses can be used to infer their distances, and thereby to map the expansion of the cosmos over time.

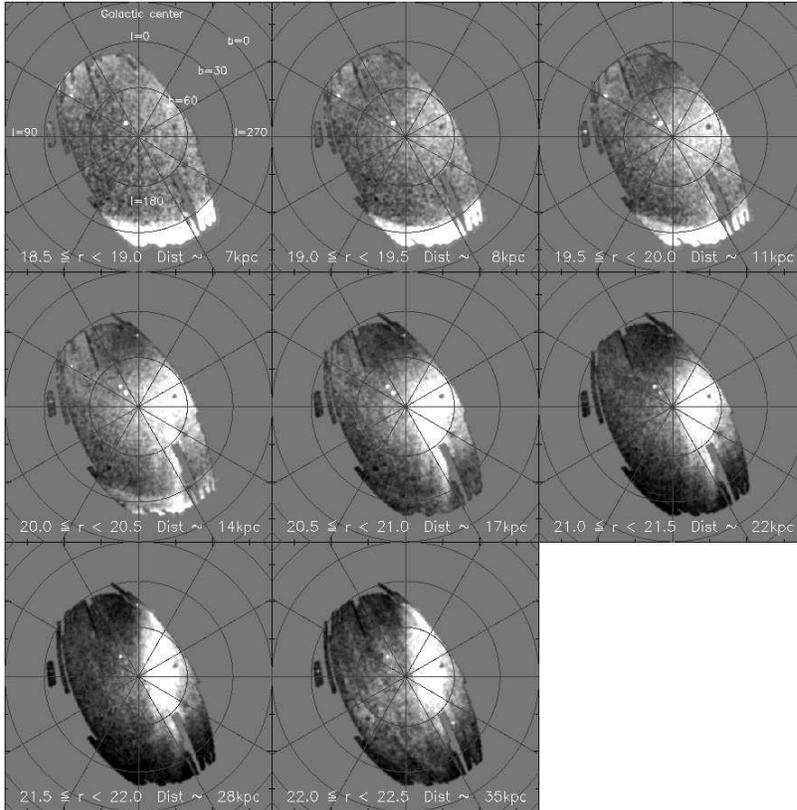
During the fall seasons of 2005 and 2006, the SDSS-II Supernova Survey discovered and confirmed the identity of 327 Type Ia supernovae. The diagram above superposes these 327 supernovae (large blue dots) on the map of some 30,000 galaxies (black and magenta dots representing two different galaxy classes) in the same region of sky from the SDSS galaxy redshift survey. The earth is at the vertex of the wedge, and the outer boundary is 4 billion light years away. The following page presents a “rogue's gallery” of supernovae from these two observing campaigns, with the supernovae visible as bright points within or just outside their extended host galaxies. The third and final season of the supernova survey is nearing completion.

The supernova team is now analyzing these data to measure the expansion of the universe over the last 4 billion years. These high-precision measurements will provide vital clues to the nature of dark energy, the mysterious, pervasive substance whose repulsive gravity is causing the cosmic expansion to accelerate. The SDSS-II supernova data set will also be a crucial anchor point for interpreting measurements of still more distant supernovae, from the ground and from space.



References:

1. "The Sloan Digital Sky Survey-II Supernova Survey: Technical Summary," by J.A. Frieman et al., submitted to the *Astronomical Journal*, preprint ArXiv:0708.2749.



The Lumpiness of the Outer Galaxy

The principal stellar components of the Galaxy are the central bulge, the thin disk (in which the sun resides), and an extended, roughly spherical halo of old, chemically primitive stars. SDSS maps show that the stellar halo is far from the smooth, simple distribution it was once thought to be. The panels above show the variations about a smooth model of the stellar halo, measured in nine shells of increasing distance from the sun, from 20,000 light years (top left) out to 100,000 light years (bottom center). Bright areas indicate an excess of stars relative to the smooth model, and dark areas indicate a deficit. One can see the boundaries of the SDSS map, which covers about 1/5 of the full sky.

Some of the structures seen in these maps were first discovered by the SDSS, while others were previously known. The remarkable feature of the maps, however, is that structures are so ubiquitous, across the sky and in distance from the sun. Quantitative analysis shows that these structures account for at least 30% of the stars in the halo, and it may be that there is no smooth underlying halo at all.

This result actually agrees quite well, qualitatively and quantitatively, with modern theoretical calculations of galaxy formation, which show that the Milky Way's stellar halo could be built entirely from dwarf satellite galaxies that were gravitationally disrupted when they strayed too close to the Milky Way itself.

References:

1. The accretion origin of the Milky Way's stellar halo," by E. F. Bell, D. B. Zucker, V. Belokurov, S. Sharma, K. V. Johnston, J. S. Bullock, et al., submitted to the *Astrophysical Journal*, preprint ArXiv:0706.0004.

2. SURVEY PROGRESS

The period of accounting for this report includes observing runs spanning the period from August 14, 2007 through September 28, 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-Q3.

Table 2.1. Legacy Survey Progress in 2007-Q3

	2007-Q3		Cumulative through Q3	
	Baseline	Actual	Baseline	Actual
Legacy Imaging (sq. deg)	0	0	7808	7577
Legacy Spectroscopy (tiles)	5	1	1526	1506

Due to marginal weather conditions, we fell short of the Q3 baseline goal for obtaining new spectroscopic data. We completed 1 plate against a baseline goal of 5. Through the end of Q3, we have completed 1506 plates compared to the goal of 1526 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.

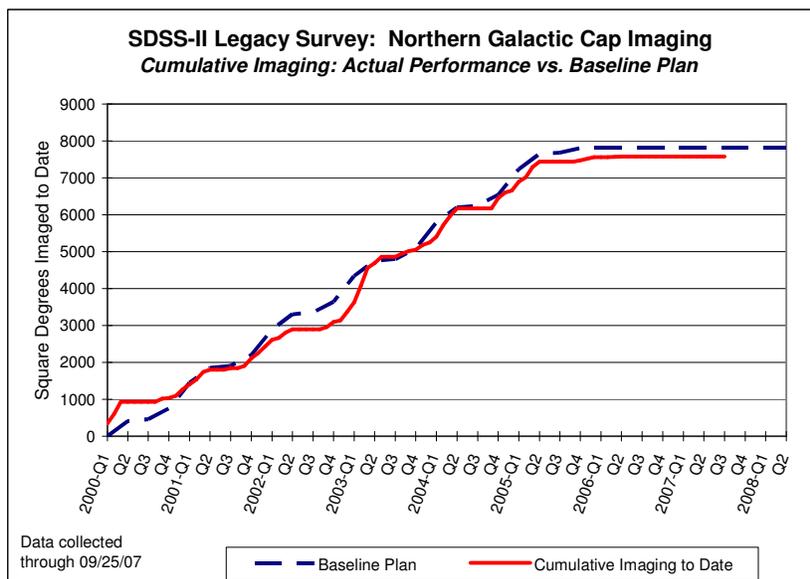


Figure 2.1. Imaging Progress against the Baseline Plan – Legacy Survey

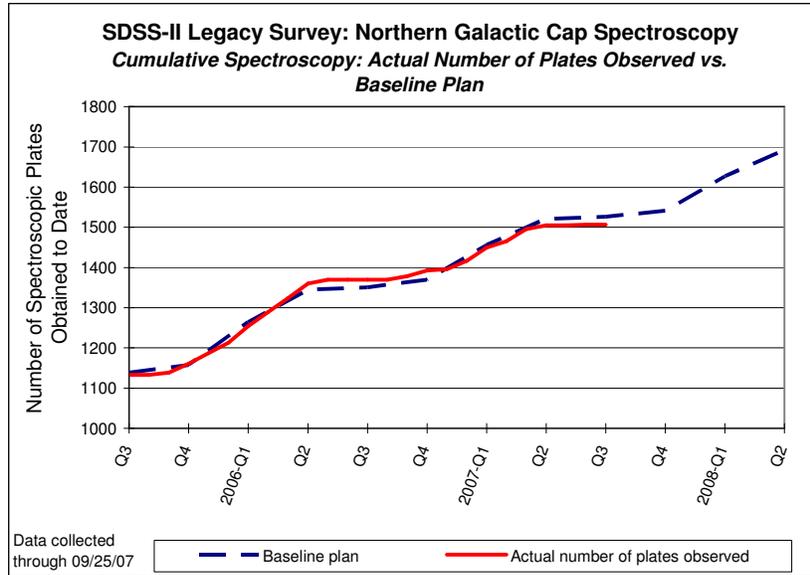


Figure 2.2. Spectroscopic Progress against the Baseline Plan – Legacy Survey

2.2. SEGUE Survey

Table 2.2 compares SEGUE progress against the baseline plan.

Table 2.2. SEGUE Survey Progress in 2007-Q3

	2007-Q3		Cumulative through Q3	
	Baseline	Actual	Baseline	Actual
SEGUE Imaging (sq. deg)	215	14	2885	3219
SEGUE Spectroscopy (bright plates)	12	9	135	125
SEGUE Spectroscopy (faint plates)	12	7	135	111

A short calibration SEGUE imaging scan crossing the important high-metallicity cluster M71 was obtained in August. This was the only SEGUE imaging obtained. The SEGUE imaging is effectively complete; however there remain a couple of short segments which will be observed if there is photometric time in Dec 2007.

A total of 16 SEGUE plates (9 bright and 7 faint, corresponding to 23 plate-equivalents) were completed. This is roughly equivalent to completing 8 SEGUE tiles, against a baseline goal of 12 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, it is not always efficient to complete plates in “pair combinations” given the many factors that affect observing operations (atmospheric conditions, available time, etc.) 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).

The SEGUE Survey is ahead of the baseline in imaging due to the acquisition of SEGUE data prior to July 2005, when commissioning and proof-of-concept observations were made. To date, SEGUE has obtained approximately 3300/3500 square degrees of imaging (effectively complete

for science purposes) and approximately 274/400 plates towards its baseline goal. The SEGUE Survey is behind the spectroscopic baseline goals for bright and faint plates due to marginal weather conditions.

Figure 2.3 shows the current SEGUE layout and progress map, as of July, 2007. The plot can be found online at: <http://segue.uchicago.edu/skycoverage.html>

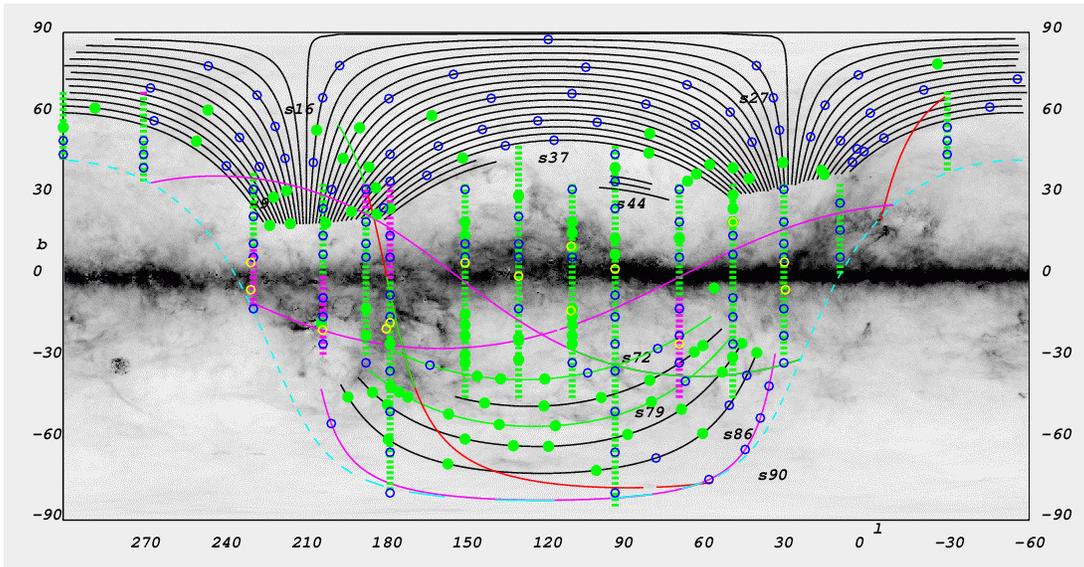


Figure 2.3. SEGUE Imaging Sky Coverage and Plate Layout (as of July 2007).

Figures 2.4 and 2.5 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 are completing bright and faint plates separately.

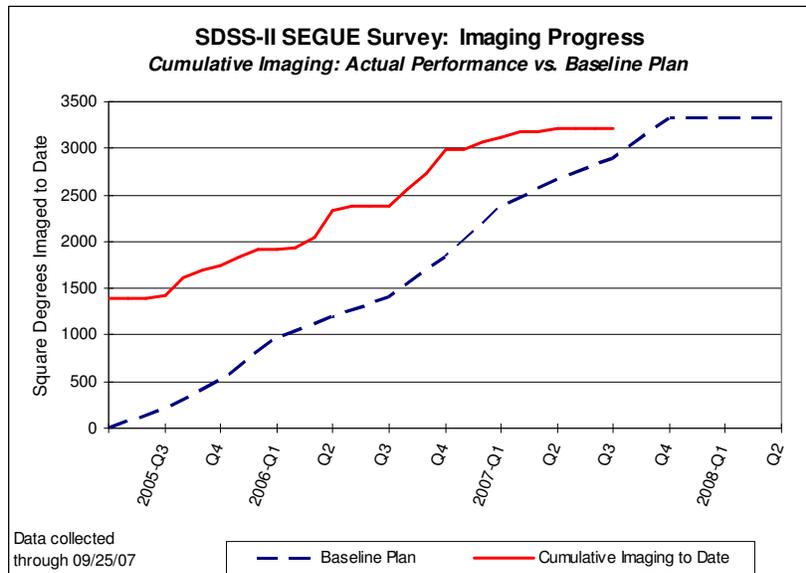


Figure 2.4. Imaging Progress against the Baseline Plan – SEGUE Survey

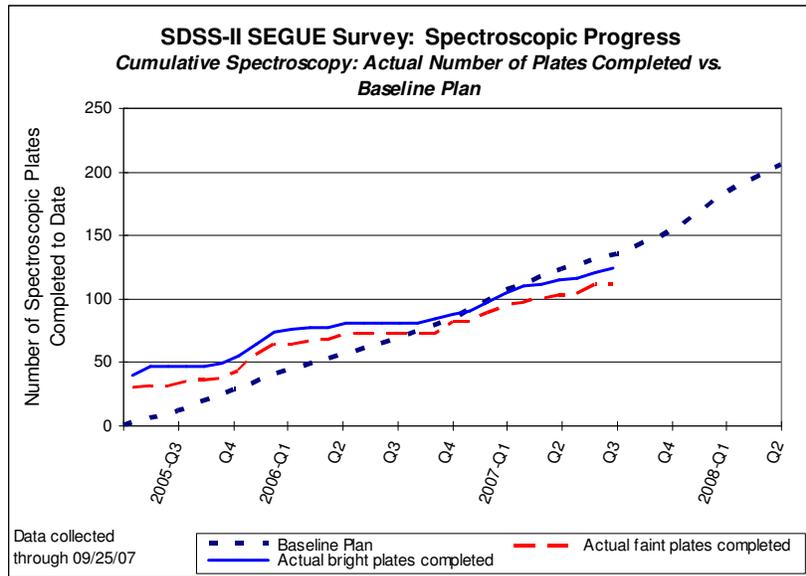


Figure 2.5. Spectroscopic Progress against the Baseline Plan – SEGUE Survey

Approximately 115 SEGUE plates remain to be observed by July 2008. We continue to prioritize the remaining SEGUE plates and make use of all available time (including bright moon time), in order to meet our science goals and come as close as possible to finishing the original SEGUE baseline survey by July 14, 2008.

SEGUE spectroscopy was obtained in bright moon (2 days from full) at the end of September 2007. This experiment, an effort to effectively use all available time in order to catch up on SEGUE spectroscopy, was a success, with 4 good quality SEGUE plates completed during the moony time. The S/N² builds up at about 1/2 to 1/3 the normal rate during moony time. SEGUE intends to make use of similar time around the full moon during the remaining months of SDSS-II in order to complete as many SEGUE plates as possible.

The USNO-1m observing program in support of SEGUE had five nights scheduled this quarter, which was part of a six-night run that began on the last night of the second quarter. Data were obtained on all six nights; processing of the data from these six nights is pending.

The K-giant algorithm was adjusted slightly to be more efficient at obtaining very red (and therefore very luminous and distant) giant stars. This is the last anticipated change to the SEGUE target selection algorithm.

In the next quarter, SEGUE participants will meet face-to-face at the SDSS collaboration meeting at Fermilab Nov 1-4, 2007. Topics of discussion are: calibration of [Fe/H] and log g scales, processing of 'segcluster' special plates, and current SEGUE science.

2.3. Supernova Survey

The Supernova Survey began its third observing season in Q3 2007, carrying out repeat imaging on stripe 82 to rapidly identify SN candidates and target them spectroscopically. During September, the team collectively scanned several thousand frame subtraction objects, identifying about 1250 possible supernova candidates worthy of further study. During this quarter approximately 79

supernovae were spectroscopically confirmed, including 49 type Ia supernovae, on other telescopes.

All confirmed SN discoveries were promptly released in astronomical telegrams and instantly appear on our publicly accessible website, as do all SN candidates we identify.

We also submitted several publications during this quarter. As of this writing, 7 papers using and/or describing SDSS SN data have been submitted for publication in refereed journals.

2.4. Photometric Telescope

The Photometric Telescope (PT) observed 76 secondary patch sequences during Q3. Of these, 38 were deemed survey quality after processing and 38 were declared bad. The PT also observed 344 manual target sequences over this time period; of these, 9 were classified as survey quality and 335 were classified as non-survey quality, although this latter designation is somewhat misleading. Nearly all these 335 bad manual target sequences were either part of a planetary nebulae program which uses a non-SDSS filter and thus required special processing not part of standard operations or part of a extra-solar planet transit program which does not require photometric conditions.

3.0 OBSERVING EFFICIENCY

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

3.1. Weather

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 slightly worse than predicted in the baseline plan. The baseline predicted that weather would be suitable for observing 50% of the time. By month, weather conditions in August were only suitable for observing 36% of the time as the monsoon moisture hung around well into the month. Conditions in September exceeded our baseline goal, with 62% of the available time suitable for observing.

Table 3.1. Potential Observing Hours Lost to Weather in Q3

Observing Condition	Total hours potentially available for observing	Total hours lost to weather	Fraction of time suitable for observing	Baseline Forecast
Dark Time	243	128	47%	50%
Dark & Gray Time	347	188	46%	50%

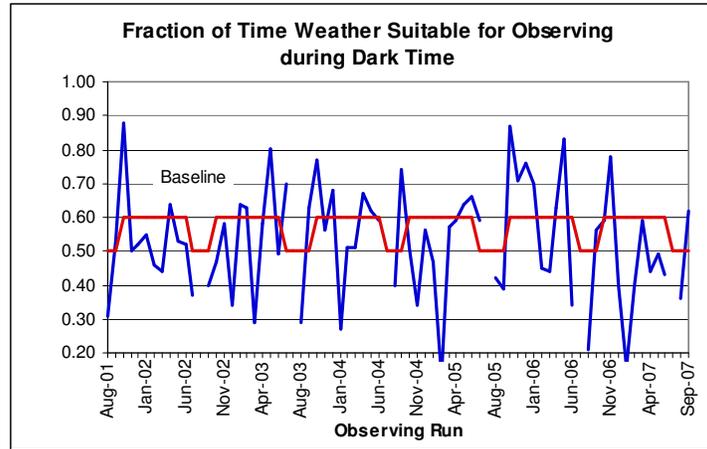


Figure 3.1. Percentage of Time Weather Suitable for Observing

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%. Some on sky time was needed to track down the problem with the DA not updating time and position properly during imaging. 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 Q3

Observing Condition	Total hours potentially available for observing	Total hours lost to problems	System Uptime	Baseline Forecast
Dark Time	243	2	99%	90%
Dark & Gray Time	347	3	99%	90%

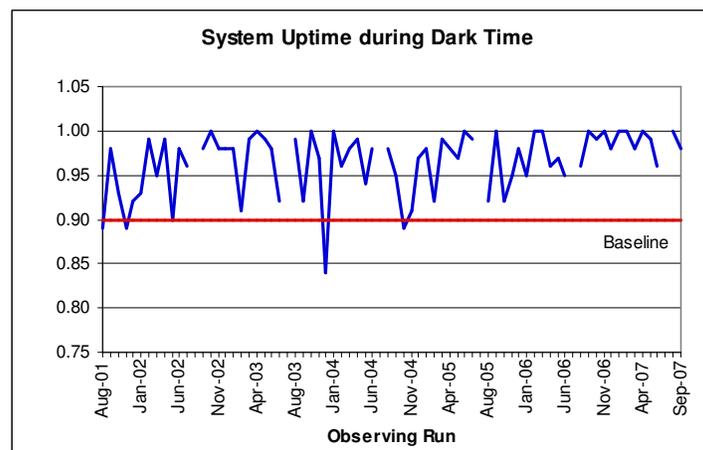


Figure 3.2. System Uptime

3.3. Imaging Efficiency

Imaging efficiency averaged 77% against a baseline goal of 86. With only one short SEGUE imaging run in August, SEGUE imaging efficiency was sub-par. Shorter runs tend to drive down efficiency because setup and calibration time reflect a larger fraction of the total time spent per scan.

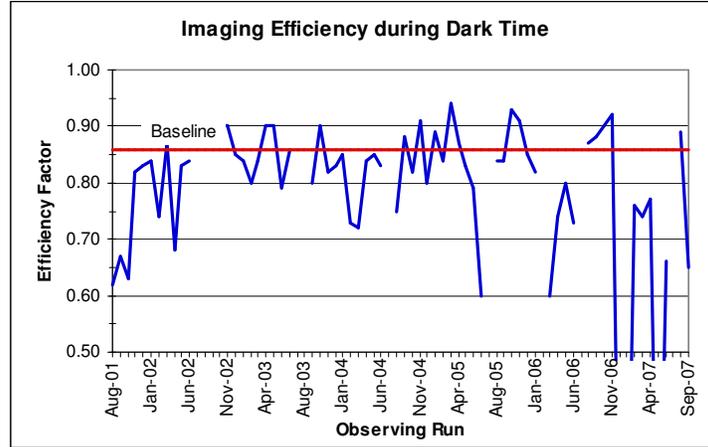


Figure 3.3. Imaging Efficiency

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. In September the Supernova project had the lion's share of time this dark run. 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 was slightly below baseline goals; average efficiency in Q3 was 62% against the baseline goal of 64%.

Table 3.3. Median Time for Spectroscopic Observing Activities

<i>Category</i>	<i>Baseline</i>	<i>Run starting Aug 12</i>	<i>Run starting Sep 3</i>
Instrument change	10	5	5
Setup	10	6	7
Calibration	5	16	11
CCD readout	0	3	3
Total overhead	25	30	26
Science exposure (assumed)	45	45	45
Total time per plate	70	75	71
Efficiency	0.64	0.60	0.63

Figure 3.4 plots spectroscopic efficiency over time and shows that efficiency continues to remain close to the baseline goal.

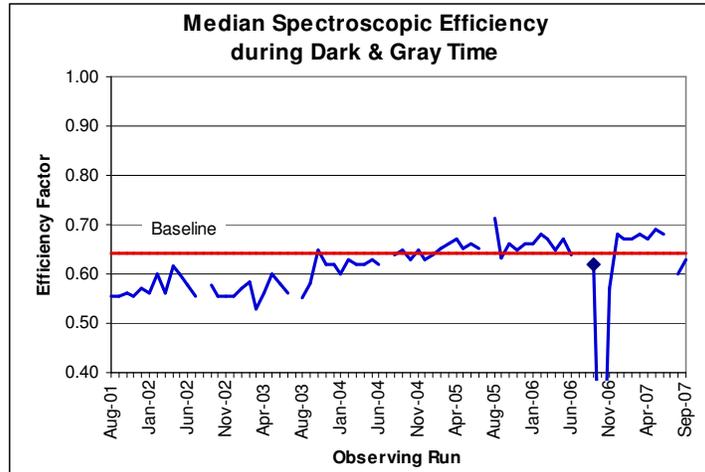


Figure 3.4. Spectroscopic Efficiency

4. OBSERVING SYSTEMS

Observing systems includes the instruments, telescopes, computers and various sub-systems that support observing operations at APO. In addition to observing operations, Q3 includes the annual summer shutdown for scheduled maintenance, details of which are discussed in the following sections.

4.1. The Instruments

There were no significant problems with the imaging camera, spectrograph, or PT camera during Q3. Construction began on the Plug Lab Support building extension to house new instruments for SDSS-III. Work during the shutdown included the following:

- a. Imager yearly maintenance
- b. Tested new spectrograph camera cradles
- c. Installed humidity sensors inside the spectrographs bodies

We also rewired the imager backup UPS system to ensure the image is always protected by the isolation filter. This system was tested and found to work well. We also installed new batteries in all UPS units on the telescope.

Further trouble with spectrograph autofill system developed during this quarter. We believe we have identified and resolved all the problems. The major problem is the grounding through the quick release fittings on the fill lines. We plan to resolve this by using a pressure switch signal thereby avoiding the grounding issue altogether.

After we completed the summer shut down we tackled the Imager Calibrator. Initial investigations discovered a whole series of issues plaguing this equipment. We have been slowly resolving all the problems and should have the system working robustly sometime during the next quarter.

4.2. The 2.5m Telescope

The Engineering Summer Shutdown occurred during this quarter. It began the first week of July and ended mid August. The most significant problem encountered during the shut down was the effect of rain on the shut down schedule and more specifically on the reassembly schedule. This caused unanticipated delays. Although experience has taught us to allow for delays due to foul weather the second half of this shut down delivered an unprecedented amount of foul weather. Coupling this with the lack of storage facilities, requiring that telescope components and subassemblies be stowed under tarps, we were unable to reassemble the telescope on schedule and encountered rust damage on critical metal surfaces.

The summer shutdown activities included:

- a. Successfully aluminized the Primary mirror.
- b. Removed rotator bearing, replaced bearing balls and reassembled
- c. Rewired PMSS and Truss to route M2 utility cabling to west side of telescope
- d. Preliminary machining on rotator bearing in order to accept new Heidenhain read head mounting brackets
- e. Replaced instrument TEC pump motors
- f. Installed stiffening brackets on Wind Baffle panels
- g. Conducted yearly maintenance for Thermal King chiller unit
- h. Rebuilt astigmatism actuator system
- i. Keyed shaft-gear assemblies on Flat Field screen drives
- j. Rebuilt instrument latches

We became aware of an air leak problem with the slithead door actuators. At first we thought the problem was associated with the control valve but later found the cause to be with the actuator itself – blow by in the air cylinder. We have replaced these air cylinder actuators. Due to the intermittent nature of the problem we will monitor to ensure that we have indeed resolved this air leak problem.

At the beginning of September we experienced an interlock PLC failure. This was found to be a failed CPU module in the PLC crate. We installed a spare CPU unit then found a bad IO module. We replaced this with a spare and the system was returned to a normal operational state. Replacement spares have been ordered.

We installed a duplex instrument latch booster pump system. After a nighttime failure in the spring of this year we decide to upgrade this system to prevent loss of observing time.

Azimuth motor aborts were discovered to be plaguing us again this quarter. We investigated and found what we call “Ghost” currents appearing at indiscriminate times causing the Glentek motor amplifiers to register an over-current condition thereby aborting the axis drive motors. Although we have yet to discover the definitive cause of this condition we have gained a much better understanding of its workings and continue to seek the source of the “Ghost” currents.

4.3. The Photometric Telescope

The Photometric Telescope (PT) worked well throughout the quarter, with no significant problems to report. Work during the summer shutdown included annual preventive maintenance and aluminizing the PT primary mirror.

The PT control computer failed and a spare computer installed. This computer is obsolete but we have been fortunate in finding new replacement computers, also obsolete, and storing them for spares.

4.4. Operations Software and the Data Acquisition System

The observing software was stable over this quarter; the only change was to allow SOP to work with new spectrograph mechanical code that includes additional environmental sensor readings.

We ran preliminary tests on the five VCI+ cards that were returned to Fermilab for testing. On the surface, the boards appeared to be fine, but a closer inspection showed occasional bit errors. These still need to be investigated further.

4.5. Observatory Operations

Third quarter included summer shutdown, and no observing was done for most of the month of July. One observer provided support to the engineering staff during the 2.5-m primary mirror aluminization. In addition to SDSS-II observing and periodic instrument and telescope calibrations and maintenance, the observers continued to provide near-real-time data quality assurance and made nightly decisions to acquire survey-quality data in the most efficient way possible. Observers provided support to the Supernova and SEGUE projects during bright time, in addition to shakedown/shakeup and cloudy-night support of SDSS-II tests. On-site observing documentation and procedures were maintained and updated on a regular basis during the quarter. New projects included obtaining transit timing observations with the PT, and observing white dwarf standard stars and planetary nebula candidates, also with the PT.

The observers continued to be involved in individual research and professional development projects, as time permitted. During the third quarter, these projects included:

- Visiting the LAMOST team in China; gave a presentation on SDSS-II operations methods.
- Stellar abundance modeling.
- Assisting in testing and assembly of ARC's TripleSpec.
- Developing a web page archive of IR camera calibrations and the calibration procedure.
- Searching for Galactic halo planetary nebulae using the SDSS CAS, DAS and the PT.

Operations continued to run smoothly and there were no recordable personnel injuries. We completed an inspection by the NMSU safety office with no corrections indicated. All site infrastructure support, such as the provision of liquid nitrogen, visitor housing, etc., was furnished as needed.

Work began on the support building extension this quarter. The new addition will house our optical benches. The architectural designs were completed, construction bid awarded and construction started on Sept 10th. To date the west extension footings and slab are complete. We expect completion of the building at the end of November.

5. DATA PROCESSING AND DISTRIBUTION

5.1. Data Processing

5.1.1. Software Development and Testing

The principal effort in the third quarter has been on the imaging and spectroscopic pipelines for SDSS II.

We have rewritten the sky subtraction algorithm within Photo, to give more robust unbiased values near large galaxies. This is one of the most pernicious systematic effects we know of in the pipeline. With proper sky subtraction, galaxies now are measured to have quite a bit larger extent than they did before, meaning that they tend to be blended with more objects. This in turn caused serious problems in memory allocation in the deblender. We rewrote the inner workings of the deblender to reduce the memory allocation; by the end of the quarter, we had a working version. We will test the result in the 4th quarter.

We worked on incorporating the Pan-STARRS stellar photometry pipeline into Photo, using ubercalibration to calibrate it, testing the results by comparing with standard photo outputs, and putting all this into a form easily digestible by the SEGUE team.

We worked on refinements to the spectroscopic pipeline, idlspec2d, including improved wavelength calibration (especially in the blue) needed for stellar velocity work, as well as a reworking of the code which combines individual exposures to handle sharp emission lines better. We started working on the next set of refinements for the pipeline, namely improved flat fields in the presence of changing features around the central wave length of the dichroic.

In the upcoming quarter, we will focus on delivering a tested code for both Photo and Spectro to be used in DR7.

Work continued by the JINA-MSU team on the development of the SEGUE Stellar Parameter Pipeline. The SEGUE Stellar Parameter Pipeline (SSPP) continues to evolve slightly, with new versions being mirrored for testing and verification of code at FNAL. A few changes have been made, and a few new techniques are being tested for inclusion in the collaboration release version for DR-7, which we expect to have ready in the fourth quarter.

The highlights of third quarter's progress are:

- Acquisition of additional 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.
- A paper describing high-resolution observations of carbon-enhanced metal-poor stars from SDSS/SEGUE has been submitted to the journals (Aoki et al. 2007).
- Tests of the effect of S/N on the parameter estimates from SSPP have been carried out based on our new noise-injection routines. These will be used to make improved choices for parameter estimate techniques to be included for stars in the DR-7 version of SSPP.
- Three papers have been submitted to the AJ, describing the operation, testing, and validation of the SSPP. These will also be posted to astro-ph.

Further refinements of the SSPP will be carried out in Q4, making use of several additional techniques, and taking advantage of new observations of ~ 100 metal-poor stars at high resolution,

obtained on the Hobby-Eberly Telescope. The goal is to arrive at the version of the SSPP that will be used for the final public release of SEGUE data.

5.1.2. Data Processing Operations at APO

We began the third observing season of the Supernova Survey this quarter. The data collected were promptly reduced using the SN compute cluster at APO using the software that we put in place before the 2005 run, augmented with upgrades in the SN filtering software that were put in place before the 2006 run. After an initial glitch due to a change in the data acquisition system that had been put in place after the 2006 run, the on-mountain processing has gone very smoothly and has been able to keep up with the data flow. The main impediment was poorer weather this September than in the previous year.

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. Imaging processing this quarter has been all Supernova all the time. We finished processing 1207 square degrees in 25 runs.

Spectro processing consisted of 21 plates; 20 SEGUE and 1 Legacy.

All useful data from DLT tapes obtained during the first five years of observing have been copied to new tapes in the Fermilab tape robot system, and the original tapes are being removed from the system.

5.2. Data Distribution

Data distribution activities were focused on supporting existing releases. We worked on various aspects of the DR6 web pages, and led the writing of the DR6 paper (now in press).

5.2.1. Data Usage Statistics

Through September, the general public and astronomy community have access to the EDR, DR1, DR2, DR3, DR4, DR5 and DR6 through the DAS and SkyServer interfaces. In addition, the collaboration has access to the Runs DB.

Figure 5.1 plots the number of web hits we receive per month through the various SkyServer interfaces. In Q3 we recorded 22.2 million hits, compared to 26.3 million hits in Q2.

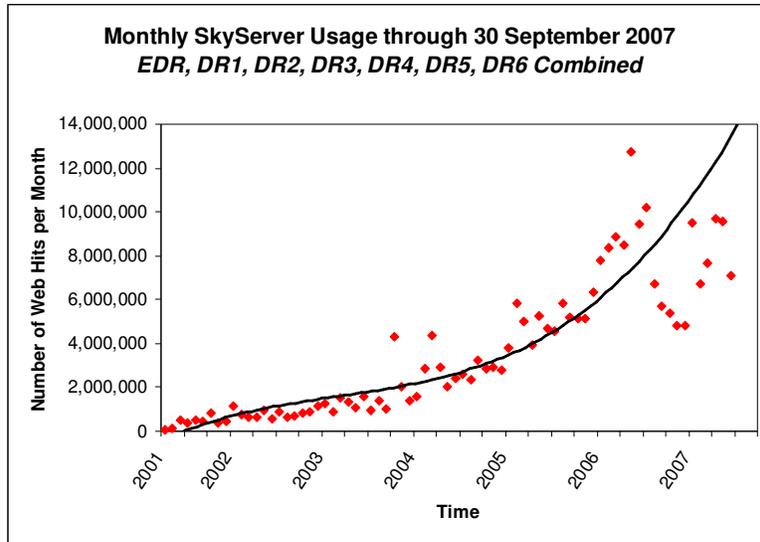


Figure 5.1. SkyServer usage per month, for all public releases combined.

Figure 5.2 shows the total number of SQL queries executed per month. We executed 3.6 million queries in Q3, compared to 1.7 million queries in Q2.

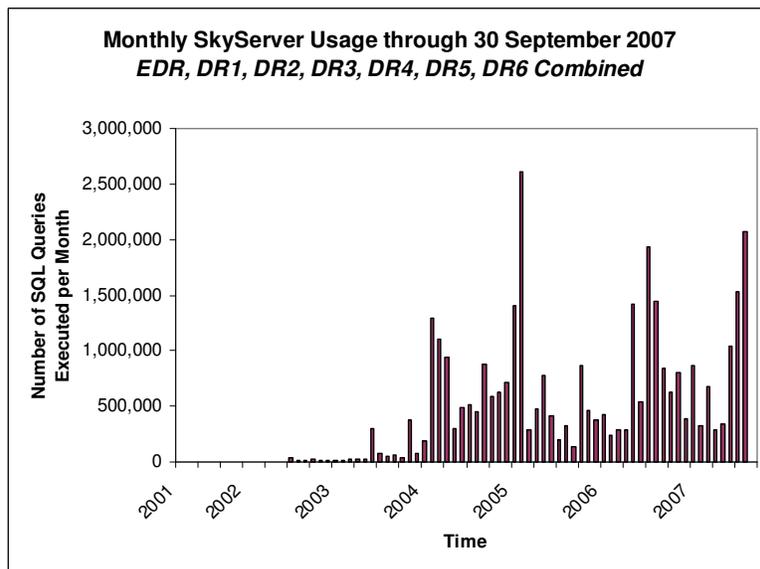


Figure 5.2. SkyServer usage, measured by the number of SQL queries submitted per month.

Through September 30, 2007, the SkyServer interfaces have received over of 328 million web hits and processed over 32 million SQL queries. Over the past quarter, the SkyServer sites received an average of 22 million hits each month and processed an average 1.2 million SQL queries per month.

Figure 5.3 shows the volume of data transferred monthly from the DAS through the rsync server. A total of 14.4 TB of data were transferred via rsync in Q3 compared to 5.6 TB in Q2. As we have

seen in the past, the volume of data transferred varies significantly from month to month. The amounts of data transferred by month are July 1.4TB, August 7.8TB and 5.2TB in September.

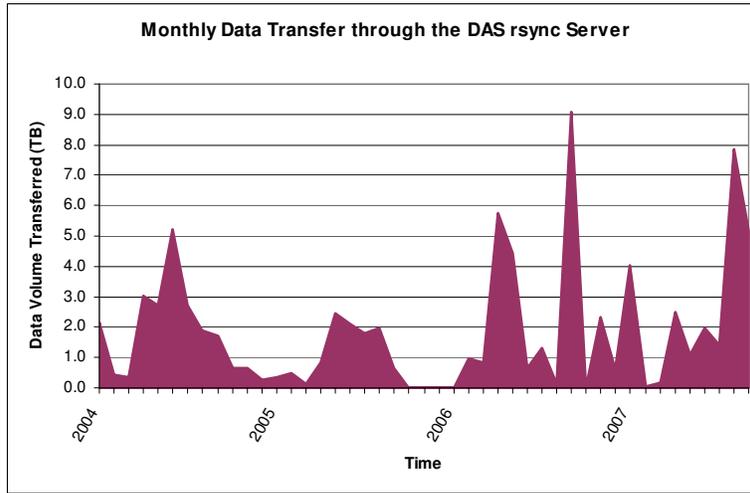


Figure 5.3. Monthly volume of data transferred via the DAS rsync Server.

Figure 5.4 shows the volume of data transferred monthly through the DAS web interface. A total of 22.1 TB of data were transferred via the web interface in Q3, compared to 0.3 TB in Q2. By month it is 4.0TB in July, 8.0TB in August, and 9.1TB in September.

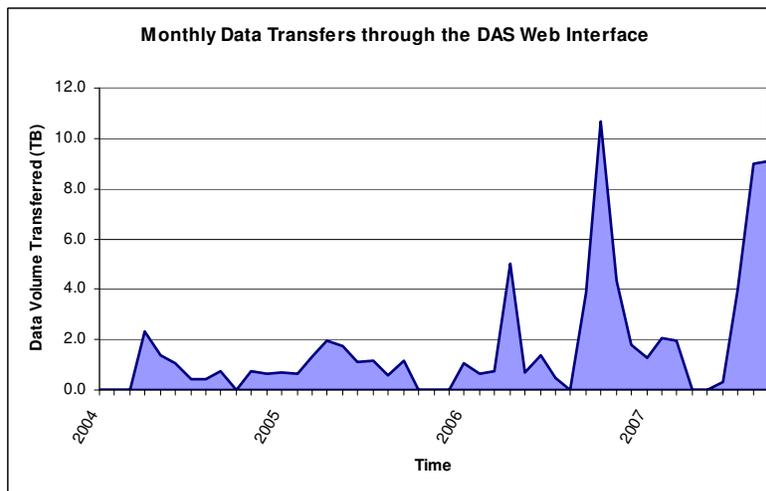


Figure 5.4. Monthly volume of data transferred via the DAS web interface.

Figure 5.5 shows the total volume of data transferred from the DAS through the two access portals. 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, but this trend has been fluctuating over the past year. In Q3, 40% of the data transferred was via the rsync interface versus 60% via web interface.

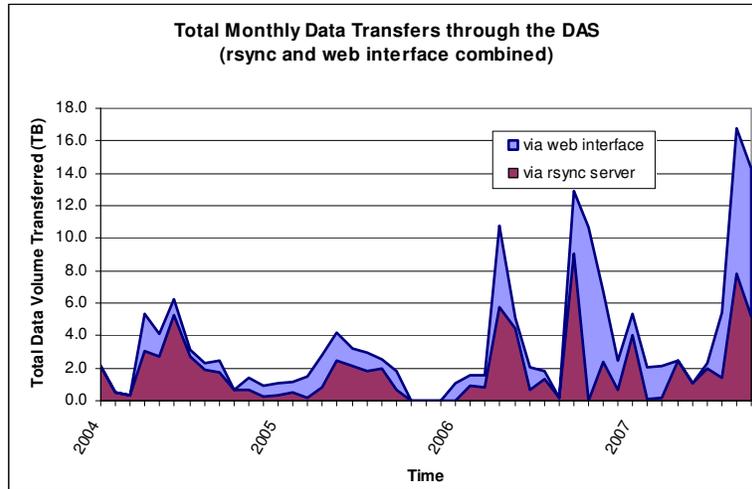


Figure 5.5. Total monthly volume of data transferred via the DAS

5.2.2. Data Archive Server

There were no significant activities related to the Data Archive Server (DAS) in Q2, nor were there any significant hardware problems affecting data accessibility. Work on the DAS included addressing problem reports, and providing general support for data distribution operations. A total of 2 problem reports filed through the SDSS Problem-Reporting Database were fixed and closed, including one filed as critical/high.

We met with the University of Chicago Crerar Library to complete the design phase of transferring the help desk responsibilities from Fermilab to the library. All help desk queries will go to the library and a librarian will route the query to a subject matter expert. The librarian will also be responsible for forwarding the response from the subject matter expert back to the user. The library is close to finishing their implantation plans and will begin routing help desk queries for both the DAS and CAS in the fourth quarter.

5.2.3. Catalog Archive Server

Work on the Catalog Archive Server (CAS) included addressing problem reports, and providing general support for data distribution operations. A total of 36 problem reports filed through the SDSS Problem-Reporting Database were fixed and closed, including nine filed as critical/high (five against CasJobs).

As part of our long-term stewardship and archiving planning, we met with the library staff from the University of Chicago and John Hopkins University to finalize plans for setting up test mirror sites of the DR5-CAS and SkyServer. Representatives from the libraries attended a four day hands on training session at Fermilab. We ordered the hardware required to support the mirror sites and we will configure the hardware in Q4. We will begin operating the test mirror sites in Q4.

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 Q3. The program that provides feedback to the observers on the status of spectra as they are being collected (SOS) sometimes has trouble with the variety of plates for the SEGUE program. Rather than change the program, the guidelines for interpreting the results from the program have been modified to enable the observers to still make valid judgments.

6.2. Target Selection

For this quarter, 42 plates were designed and drilled in one drilling run. All were for the SEGUE program, half for SEGUE bright targets and half for faint targets.

6.3. Survey Planning

The split of time between the Supernova program and the SEGUE program was adjusted compared with prior years since the SEGUE program has fallen behind the nominal baseline projection. We reviewed the original assumptions behind the SEGUE program and carried out survey strategy simulations based on the known positions of remaining SEGUE fields. We determined that the SEGUE program had been absorbing an excessive amount of risk in prior years from factors such as bad weather and late startups after the end of summer shutdown. The revised plan calls for SEGUE to be allocated 4 full nights of observing time between September and November interspersed with the Supernova program. We will also allocate about 1 hour of time at the beginning of the night in October for SEGUE (while preserving the remaining 8 hours for the supernova program), whereas previously we had allocated the hour at the end of the night.

7. EDUCATION AND PUBLIC OUTREACH

Observing on the SDSS follow-up research projects at the University of Washington's Manastash Ridge Observatory started in July 2007 and continued through mid-August. A high school teacher is doing observations of RR Lyr variable star candidates that were mined from the SDSS database. Another high school teacher observed some known symbiotic stars and some candidates derived from the SDSS database. An UW undergraduate astronomy student collaborated on the symbiotic star project with funding provided by the Washington NASA Space Grant Consortium and the Kenilworth Fund. About 12 nights of data were obtained with the 30-inch telescope. The data are being reduced. Research summary posters were given by the teachers at the Murdock Charitable Trust meeting in Vancouver, WA and we presented a poster at the Space Grant student reception in late September.

We worked on modifying some of the exercises in SkyServer during Q3. We looked through the existing exercises and made modifications that would help teachers and students to understand some of the background material and instructions more readily. We also developed a new exercise on stellar spectra that will be tested over the next school year.

We developed a bookmark to advertise the GalaxyZoo project. The impetus was to have a reminder to distribute at the Astronomical Society of the Pacific meeting in September.

A major undertaking this quarter was the SDSS exhibit at the ASP meeting in Chicago. Most of the 240 people attending the conference visited the SDSS booth. Many attendees from community colleges and 4-year undergraduate schools seem to be using SkyServer in various ways in their astronomy classes. We estimate that about half of the attendees had heard of GalaxyZoo before

they came to the ASP meeting and many of them thought it would be useful for classes. Attendees who learned about it for the first time via the exhibit booth were very enthusiastic.

We are carrying out a SkyServer database project on finding planetary nebulae in the halo of the Milky Way Galaxy. Follow-up observations on candidates found in the database have started at Manastash Ridge Observatory.

In the 4th quarter we plan to produce a revised version of the Stars and Spectra exercise for the SkyServer. We are recruiting high school astronomy teachers to go through the exercise and make comments and suggestions. We will produce a final version of the exercise, which will go online in January 2008. The teachers who are working with us will use the exercise during the “stars and spectra” part of their teaching in early 2008.

In the 4th quarter we will begin planning the SDSS sessions for the National Science Teachers Association meeting in Boston. Also, we will be thinking ahead to the joint AAS-ASP meeting in St. Louis in June 2008. Proposals for special sessions will be due in January 2008.

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 \$4,856K for ARC-funded cash expenses.

Table 8.1 shows actual cost performance for ARC-funded cash expenses in Q3. More complete tables comparing actual to baseline performance are included in the appendices of this report. Exhibit 1 compares cash expenses to the budget and presents the revised cash forecast for 2007. Exhibit 2 compares actual in-kind contributions to the budget and presents the revised in-kind forecast for 2007.

Table 8.1. Q3 Cash Expenses and Forecast for 2007 (\$K)

Category	2007 – 3rd Quarter		2007 Operations Budget Total (for the period Jan-Dec 2007)	
	Baseline Budget	Actual Expenses	Baseline Budget	Current Forecast
1. Survey Management	193	180	477	464
2. Survey Operations				
2.1. Observing Systems	174	159	702	687
2.2. Observatory Operations	433	424	1,732	1,677
2.3. Data Processing	189	206	722	759
2.4. Data Distribution	156	149	491	534
2.5. ARC Support for Survey Ops	4	4	32	13
3. New Development				
3.1. SEGUE Development	42	47	151	126
3.2. Supernova Development	0	0	0	0
3.3. DA Upgrade	0	0	0	0
3.4. Photometric Calibration	23	17	94	68
4. ARC Corporate Support	13	19	44	81
Sub-total	1,228	1,205	4,446	4,409
5. Management Reserve	103	0	410	410
Total	1,331	1,205	4,856	4,819

8.1. Q3 Performance - In-kind Contributions

The sum of in-kind contributions in Q3 was \$159K against the baseline budget of \$167K and was provided by Fermilab, JHU, and UW, 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 level of support provided was less than anticipated however we project support in Q4 will be greater than planned.
- UW contributed the overhead associated with the plate drilling operation as anticipated.

8.2. Q3 Performance – ARC Funded Cash Expenses

ARC-funded expenses were \$1,205K, or \$23K (2%) below the budget of \$1,228K, before management reserve.

Survey Management costs were \$180K against a budget of \$193K. Expenses to support the ARC EPO webmaster were as anticipated. Expenses for the ARC Business Manager, the EPO Coordinator, and project management support staff were higher than anticipated. All other survey management costs were less that anticipated. For the year, the revised forecast for Survey Management expenses is \$464K, or \$13K (3%) below the baseline budget of \$477K.

Observing Systems costs were \$159K against a budget of \$174K. Fermilab and Princeton costs were less than budgeted, driven by a reduced need for data acquisition system support. UW and ARC observing systems support costs were higher than anticipated. For the year, the revised forecast for Observing Systems expenses is \$687K, or \$14K (2%) below the baseline budget of \$702K.

Observatory Support costs were \$424K against a budget of \$433K. The equipment spending for this quarter was less than planned. The under spending on equipment for the year is being used to offset the capital equipment purchased with funds from ARC corporate support. For the year, the forecast for Observatory Support expenses is \$1,677K, or \$55K (3%) below the baseline budget of \$1,732K.

Data Processing costs were \$206K against a budget of \$189K. Actual expenses at Fermilab were greater than budgeted because equipment expenses that were planned in the second quarter occurred in the third quarter. Actual expenses at Princeton and University of Chicago were greater than anticipated due to part of the scientists' time being charged to data processing instead of SEGUE development work. The overage in data processing costs is offset by under spending in SEGUE development. For the year, the revised cost forecast for Data Processing is \$722K, or \$37K (5%) above the baseline budget of \$759K.

Data Distribution costs were \$149K against a budget of \$157K. Fermilab expenses were lower than budgeted because of a favorable year end reconciliation of employee benefit expenses. For the year, the cost forecast for Data Distribution is \$534K or \$43K (9%) above the baseline budget of \$491K.

ARC Support for Survey Operations costs were \$4K against a budget of \$3.5K. We predict that 2007 actual expenses will be substantially less than budgeted. Overall, the revised forecast for Survey Operations support is \$13K, or \$20K (61%) below the baseline budget of \$32K.

Expenses associated with development work for the SEGUE Survey were \$47K against a budget of \$42K. Expenses for development work at Princeton were less than budget due to part of the scientists' time being charged to data processing instead of development work. Expenses for software development work at University of California Santa Cruz were budgeted in the first half of the year but did not begin until the Q3. For the year, the revised forecast is \$126, or \$25K (17%) below the baseline budget of \$151K.

Expenses associated with photometric calibration efforts at Princeton were \$17K against a budget of \$23K. For the year, the revised forecast is \$68, or \$25K (27%) below the baseline budget of \$94K.

Miscellaneous ARC corporate expenses (i.e., audit fees, bank fees, petty cash, and APO trailer rentals) were \$19K against a budget of \$13K. The increase is driven by an audit expense that was budgeted for the second quarter. For the year, the revised forecast is \$81K against the baseline budget of \$44K.

8.3. Q3 Performance - Management Reserve

No management reserve funds were expended in Q3. Unspent management reserve funds have been carried forward into Q4.

9. PUBLICATIONS

In Q3, there were 11 papers based on SDSS data that were published by members of the SDSS collaboration. There were also 14 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 (\$000s)

SDSS-II CY2007 Cost Performance as of September 30, 2007

Inst	Qtr 1 Jan-Mar		Qtr 2 Apr-Jun		Qtr 3 Jul-Sep		Qtr 4 Oct-Dec		CY2007 Total		
	Actual Expenses	Actual Expenses	Actual Expenses	Actual Expenses	Actual Expenses	Actual Expenses	Approved Baseline Budget	Approved Baseline Budget	Oct-2007 Forecast	Oct-2007 Forecast	
	Variance (%)		Variance (%)		Variance (%)		Variance (%)		Variance (%)		
OPERATIONS BUDGET - CASH EXPENSES											
1.0 Survey Management											
SSP-221	ARC	2	2	3	2	2	11%	4	5	12	-7%
SSP-224	ARC	16	17	17	19	19	-15%	18	21	69	-6%
SSP-246	PU	.2	.1	63	61	61	3%	3	4	73	10%
SSP-248	FNAL	13	19	14	22	22	-55%	14	24	58	-36%
SSP-267	UC	16	18	37	33	33	9%	14	14	79	-4%
SSP-270	UW	10	12	14	16	16	-15%	11	11	48	-2%
SSP-274	PU	0	0	0	0	0	---	0	0	0	---
SSP-291A	ARC	18	7	0	0	0	---	0	0	16	-62%
SSP-291B	ARC	1	0	3	0	0	100%	3	3	10	4%
SSP-291C	ARC	3	12	16	4	4	74%	16	15	64	47%
SSP-291I	ARC	4	2	8	2	2	75%	8	5	31	59%
SSP-291K	ARC	2	0	0	0	0	---	0	7	0	---
SSP-291L	ARC	0	0	20	20	20	0%	0	0	20	0%
Survey Management Sub-total		86	89	193	180	180	10%	91	109	477	7%
2.0 Survey Operations											
2.1 Observing Systems											
SSP-231	UW	30	45	40	54	54	-34%	43	34	168	3%
SSP-232	PU	12	11	15	12	12	20%	12	12	49	6%
SSP-242	FNAL	115	76	93	72	72	22%	92	105	368	0%
SSP-261	FNAL	6	1	7	1	1	85%	6	6	27	14%
SSP-291D	ARC	36	23	19	20	20	-5%	10	18	89	-8%
Observing Systems Sub-total		198	156	174	159	159	9%	163	174	702	-2%
2.2 Observatory Support											
SSP-235	NMSU	383	434	418	409	409	2%	418	418	1,698	3%
SSP-272	JHU	0	5	15	15	15	2%	15	15	34	---
Observatory Support Sub-total		383	438	433	424	424	2%	433	433	1,732	3%
2.3 Data Processing											
SSP-240	FNAL	98	116	127	132	132	-4%	117	171	516	0%
SSP-238	PU	42	43	45	49	49	-9%	40	41	159	-9%
SSP-239	UC	8	9	18	26	26	-44%	18	26	47	-46%
Data Processing Sub-total		147	168	189	206	206	-9%	175	238	722	-5%
2.4 Data Distribution											
SSP-268	FNAL	110	54	124	102	102	18%	67	119	395	3%
SSP-237	JHU	6	3	32	47	47	-45%	24	93	95	-57%
SSP-291M	ARC	0	0	0	0	0	---	0	0	1	100%
Data Distribution Sub-total		116	58	157	149	149	5%	90	212	491	-9%
2.5 ARC Support for Survey Operations											
SSP911	ARC	1	0	0	0	0	---	0	3	18	81%
SSP91h	ARC	0	2	4	4	4	-14%	4	3	14	36%
Data Distribution Sub-total		1	2	4	4	4	-14%	4	6	32	61%
Survey Operations Sub-total		845	821	956	941	941	2%	865	1,063	3,680	0%

Exhibit 1. CY2007 Cash Budget Forecast (continued)

SDSS-II CY2007 Cost Performance as of September 30, 2007

	Inst	Qtr 1			Qtr 2			Qtr 3			Qtr 4			CY2007	
		Jan-Mar		Apr-Jun	Jul-Sep		Oct-Dec	Approved Baseline Budget		Approved Baseline Budget		Oct-2007 Forecast	Oct-2007 Forecast	Variance (%)	Variance (%)
		Actual Expenses	Variance (%)	Variance (%)	Variance (%)	Variance (%)	Variance (%)	Variance (%)	Variance (%)						
3.0 New Development															
3.1 SEGUE Survey Development															
SSP-138	PU	14	13	24	17	26%	24	24	24	0%	94	68	27%		
SSP271	ARC	9	10	9	10	-18%	0	0	0	---	29	29	0%		
SSP273	ARC	0	0	10	19	-91%	0	9	9	---	28	28	0%		
SSP-268	FNAL	0	0	0	0	---	0	0	0	---	0	0	---		
	SEGUE Development Sub-total	23	23	42	47	-10%	24	33	33	-40%	151	126	17%		
3.2 Supernova Survey Development															
	No allocation	0	0	0	0	---	0	0	0	---	0	0	---		
	Supernova Development Sub-total	0	0	0	0	---	0	0	0	---	0	0	---		
3.3 Data Acquisition System Upgrade															
	No allocation	0	0	0	0	---	0	0	0	---	0	0	---		
	DA Upgrade Sub-total	0	0	0	0	---	0	0	0	---	0	0	---		
3.4. Photometric Calibration Development															
SSP-138	PU	14	13	24	17	26%	24	24	24	0%	94	68	27%		
	Photometric Calibration Development Sub-total	14	13	24	17	26%	24	24	24	0%	94	68	27%		
	New Development Sub-total	36	37	66	64	3%	48	57	57	-20%	245	194	21%		
4.0 ARC Corporate Support															
SSP291e	ARC	20	8	13	19	-49%	8	10	10	-32%	44	58	-32%		
SSP291g	ARC	0	23	0	0	---	0	0	0	---	0	23	---		
	ARC Corporate Support Sub-total	20	32	13	19	-49%	8	10	10	-32%	44	81	-85%		
	Cash Budget Sub-total	987	978	1,228	1,205	2%	1,011	1,239	1,239	-22%	4,446	4,409	1%		
5.0 Management Reserve															
	ARC	0	0	103	0	100%	103	410	410	-300%	410	410	0%		
	TOTAL CASH BUDGET	987	978	1,331	1,205	9%	1,114	1,649	1,649	-48%	4,856	4,819	1%		

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

SDSS-II CY2007 Cost Performance as of September 30, 2007

Inst	Qtr 1			Qtr 2			Qtr 3			Qtr 4			CY2007	
	Jan-Mar		Actual	Apr-Jun		Actual	Jul-Sep		Actual	Oct-Dec		Approved	Total	
	Expenses	Expenses	Expenses	Expenses	Expenses	Expenses	Expenses	Expenses	Expenses	Expenses	Baseline Budget	Oct-2007 Forecast	Variance (%)	Forecast
OPERATIONS BUDGET: IN-KIND														
1.0 Survey Management														
SSP-248	FNAL	27	23	23	35	18	49%	36	28	23%	140	96	31%	31%
Survey Management Sub-total		27	23	23	35	18	49%	36	28	23%	140	96	31%	31%
2.0 Survey Operations														
2.1 Observing Systems														
SSP-231	UW	15	15	15	15	15	0%	15	15	0%	60	60	0%	0%
Observing Systems Sub-total		15	15	15	15	15	0%	15	15	0%	60	60	0%	0%
2.2 Data Processing														
SSP-239	UC	0	10	5	10	-103%	5	5	0	105%	19	19	0%	0%
SSP-240	FNAL	89	91	85	97	-14%	88	88	88	0%	342	364	-7%	-7%
SSP-269	MSU	0	0	0	0	---	0	0	0	---	0	0	---	---
Data Processing Sub-total		89	101	89	106	-19%	93	88	88	5%	361	384	-6%	-6%
2.3 Data Distribution														
SSP-237	JHU	0	27	14	3	75%	14	14	31	-119%	50	62	-24%	-24%
SSP-268	FNAL	19	18	14	16	-18%	15	14	14	0%	56	68	-22%	-22%
Data Distribution Sub-total		19	46	28	20	29%	29	45	45	-58%	106	130	-23%	-23%
Survey Operations Sub-total		123	162	132	141	-7%	136	148	148	-8%	527	574	-9%	-9%
3.0 New Development														
3.1 SEGUE Survey Development														
SSP-237	JHU	0	22	0	0	---	0	0	0	---	22	22	0%	0%
SSP-269	MSU	16	16	0	0	---	0	0	0	---	31	31	0%	0%
SEGUE Development Sub-total		16	37	0	0	---	0	0	0	---	53	53	0%	0%
New Development Sub-total		16	37	0	0	---	0	0	0	---	53	53	0%	0%
TOTAL IN-KIND CONTRIBUTIONS		166	222	167	159	5%	172	176	176	-2%	720	723	0%	0%
TOTAL OPERATING BUDGET (Cash and In-kind)		1,153	1,200	1,498	1,364	9%	1,286	1,824	1,824	-42%	5,575	5,542	1%	1%

Exhibit 3. Papers from within the SDSS Collaboration

1. The Sloan Digital Sky Survey Quasar Lens Search. III. Constraints on Dark Energy from the Third Data Release Quasar Lens Catalog. AJ Submitted – Masamune Oguri, et al
2. The SEGUE Stellar Parameter Pipeline. III. Comparison with High Resolution Spectroscopy of SDSS/SEGUE Field Stars. AJ Submitted – Carlos Allende Prieto, et al
3. The Sloan Digital Sky Survey-II Supernova Survey: Search Algorithm and Follow-up Observations. AJ Submitted – Masao Sako, et al
4. Satellite Luminosities in Galaxy Groups. MNRAS Submitted – Ramin A. Skibba, et al
5. Average Properties of a Large Sample of $z(\text{abs})\sim z(\text{em})$ Associated Mg II Absorption Line Systems. ApJ Submitted – Dan Vanden Berk
6. Distances to Galactic High-Velocity Clouds. I. Cohen Stream, complex GCP, cloud g1 1.00. ApJ Accepted – Bart Wakker, et al
7. Distances to Galactic High-Velocity Clouds. II. Complex C. ApJL Accepted – B. P. Wakker
8. Constraining the Age-Activity Relation for Cool Stars: The SDSS DR5 Low-Mass Spectroscopic Sample. AJ Submitted – Andrew A. West, et al
9. Identification of RR Lyrae Variables in SDSS from Single-Epoch Photometric and Spectroscopic Observations. AJ Submitted – Ron Wilhelm, et al
10. First Year Spectroscopy of SDSS-II Supernova Survey. AJ Submitted – Chen Zheng, et al

Data Release

11. The Sixth Data Release of the Sloan Digital Sky Survey. ApJS In Press – Michael Strauss et al

Exhibit 4. Publications Based on Public Data

1. Testing Cold Dark Matter with the Low Mass Tully-Fisher Relation. ApJ Submitted – Michael R. Blanton, et al
2. The Dichotomy of the Halo of the Milky Way. Nature Accepted – D. Carollo, et al
3. Gemini Near-infrared Spectroscopy of Luminous $z \sim 6$ Quasars: Chemical Abundances, Black Hole Masses, and MgII Absorption. AJ 134: 1150 (2007) Linhua Jiang, et al
4. The Luminosity Function of the Milky Way Satellites. ApJ Submitted – S. Koposov, et al
5. The Growth of Luminous Red Galaxies by Merging. ApJ Submitted – Morad Masjedi, et al
6. Quasar Clustering at 25kpc/h from a Complete Sample of Binaries. ApJ Submitted – Adam Myers, et al
7. Source Matching in the SDSS and RASS: Which Galaxies are Really X-ray Sources? AJ Submitted – John K. Parejko, et al
8. Transformation of Morphology and Luminosity Classes of the SDSS Galaxies. ApJ Accepted – Changbom Park, et al
9. Biases in Virial Black Hole Masses: An SDSS Perspective. ApJ Submitted – Yue Shen, et al
10. The SDSS Discovery of a Strongly Lensed Post-Starburst Galaxy at $z=0.766$. AJ Submitted – Min-Su Shin
11. The Properties of Jovian Trojan Asteroids Listed in SDSS Moving Object Catalog 3. MNRAS 377: 1393 (2007) G. Szabo et al.
12. Void Statistics in Large Galaxy Redshift Surveys: Does Halo Occupation of Field Galaxies Depend on Environment? ApJ Submitted – Jeremy Tinker, et al
13. The Discovery of 1000 km/s Outflows in Massive Post-starburst Galaxies at $z = 0.6$. ApJL 663: L77 (2007) Christy Tremonti
14. A New Technique for Galaxy Photometric Redshifts in the Sloan Digital Sky Survey. APJ Submitted – James Wray et al