Sloan Digital Sky Survey II

2008 FIRST QUARTER REPORT
January 1, 2008 – March 31, 2008

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Q1 PERFORMANCE HIGHLIGHTS

- We completed SEGUE imaging on January 1st. We completed a total of 43 SEGUE plates (21 bright and 22 faint, corresponding to 65 plate-equivalents).
- We completed 84 Legacy spectroscopic plates against a baseline goal of 86 plates (98%). Consistent with our baseline plan, no new Legacy imaging data were obtained.
- We released DR7.1 to the collaboration on February 14th.
- We finalized the idlsped2d code for the spectroscopic pipeline.
- We recorded 28.9 million hits on our SkyServer interfaces and processed 4.4 million SQL queries. We also transferred 18.9 terabytes of data through the Data Archive Server interfaces.
- Q1 cash operating expenses were $1,041K against a baseline budget of $1,3304K before management reserve. In-kind contributions were $127K against anticipated contributions of $154K. No management reserve funds were expended.
1. SOME RECENT SCIENCE RESULTS

The following descriptions highlight 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 Exhibit 3 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.

A Slimmer Milky Way

The mass of the Milky Way is one of its most fundamental properties, but it is also one of the most difficult to measure because it is dominated by invisible dark matter. Graduate student Xiangxiang Xue (at the Max Plank Institute for Astronomy in Heidelberg) and collaborators have used a sample of 2,400 blue horizontal branch stars observed by SEGUE to obtain the most precise measurement to date of the Milky Way halo mass. The line-of-sight velocities of these stars measured by SEGUE are used to infer the gravitational potential in which they are orbiting.

The above illustration shows the stellar disk of the Milky Way embedded in the more massive and more extended dark matter halo, indicated in dim red. The SEGUE blue horizontal branch sample reaches to distances of 60 kpc (about 200,000 light years), roughly the edge of the region shown above. The team’s analysis yields a tight constraint on the total mass within 60 kpc, and extrapolating to larger distances based on computer simulations of the Milky Way allows them to estimate the total mass out to the edge of the dark halo.

Their value of one trillion solar masses is significantly lower than some previous estimates, which were based on mixed samples of 50 to 500 objects and yielded up to two trillion solar masses. This lower total mass implies that the Milky Way was more efficient than previously thought at converting its available baryons into stars, and it has implications for the formation history of the Milky Way, the dynamics of its satellite galaxies, and the comparison between the Milky Way and distant galaxies.
References:

2. SURVEY PROGRESS

The period of accounting for this report includes observing runs spanning the period from December 25, 2007 through March 21, 2008

2.1. Legacy Survey

Table 2.1 compares the imaging and spectroscopic data obtained against the Legacy baseline plan. No new Legacy imaging data were obtained in 2008-Q1.

<table>
<thead>
<tr>
<th></th>
<th>2008-Q1</th>
<th>Cumulative through Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Actual</td>
</tr>
<tr>
<td>Legacy Imaging (sq. deg)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Legacy Spectroscopy (tiles)</td>
<td>86</td>
<td>84</td>
</tr>
</tbody>
</table>

We have 40 legacy plates remaining to be observed and 4 dark runs to go, so we need to observe 10 or 11 plates per dark run. Through the end of Q1, we have completed 1,597 plates compared to the goal of 1,627 plates. (The 40 remaining plates differs from 1627 – 1597 = 30 because when the baseline projection was constructed, we had not yet done the final tiling solution.)

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
2.2. SEGUE Survey

Table 2.2 compares SEGUE progress against the baseline plan.

Table 2.2 SEGUE Survey Progress in 2008-Q1

<table>
<thead>
<tr>
<th>SEGUE Imaging (sq. deg)</th>
<th>2008-Q1</th>
<th>Cumulative through Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Actual</td>
</tr>
<tr>
<td>SEGUE Imaging (sq. deg)</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>SEGUE Spectroscopy (bright plates)</td>
<td>30</td>
<td>21</td>
</tr>
<tr>
<td>SEGUE Spectroscopy (faint plates)</td>
<td>30</td>
<td>22</td>
</tr>
</tbody>
</table>

The SEGUE imaging was completed this quarter on Jan 1, 2008.

Significant SEGUE spectroscopic observing was obtained in Q1 2008. A total of 43 SEGUE plates (21 bright and 22 faint, corresponding to 65 plate-equivalents) were completed. This was SEGUE's most productive spectroscopic quarter to date. This is roughly equivalent to completing 22 SEGUE tiles, against a baseline goal of 30 tiles. Recall that a SEGUE tile is considered complete when the faint and bright plate combination for a field is observed.

To date, SEGUE has obtained approximately 3300 square degrees of imaging (complete) and approximately 375/400 plate equivalents towards its baseline goal. There are approximately 60 accessible (i.e. in the right RA range through June) SEGUE plates remaining on the mountain to be observed. This total plate count includes some 30 star cluster plates and 5 low-latitude plates which fall outside the total of 200 pointings evenly distributed on the sky. The cluster and low-latitude plates are nevertheless critical for a successful calibration.

Figure 2.3 shows the current SEGUE layout and progress map, as of January 2008. The plot can be found online at: [http://segue.uchicago.edu/skycoverage.html](http://segue.uchicago.edu/skycoverage.html)
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.
The bright moon observing has been very successful, but in Q2 it will no longer be necessary to attempt SEGUE plates within +/- 2 days of full moon.

2.3. Supernova Survey

During the first quarter of 2008, progress on analyzing the supernova data both for use in science analysis and for public release continued. The fall 2007 data runs were reprocessed through PHOTO at Fermilab and made available to the public through DRSN. Final photometric processing on the 2006 Supernova data was completed and plans were laid for (a) final photometric processing of confirmed supernovae from the 2007 run, and (b) final photometric processing of all potential supernova candidates for all three seasons. To carry out this task, portable disks will be shipped between Fermilab and APO, to use the cycles on the APO compute cluster originally used for Supernova data processing. In addition, we made progress on gathering spectroscopic follow-up data into a central database at Fermilab.

As of this writing, seven papers using and/or describing SDSS Supernova data have been submitted for publication; five of these have been published or accepted for publication. Three papers presenting the first-season cosmology results and their implications are nearing completion. A number of proposals to NOAO, Gemini, HST, and ESO have been recently submitted for further follow-up observations of the host galaxies.

2.4. Photometric Telescope

The Photometric Telescope (PT) observed 34 secondary patch sequences during Q1. Of these, 23 were deemed survey quality after processing and 11 were declared bad.

The PT also observed 2,275 manual target sequences over this time period for projects outside of the SDSS-II. These manual target sequences included a planetary nebula program (which uses a non-SDSS filter and thus requires special processing); an extra-solar planet transit program; a ROTSE supernova follow-up program; and a cataclysmic variable program.
3. 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 as expected in the baseline projections.

<table>
<thead>
<tr>
<th>Observing Condition</th>
<th>Total hours potentially available for observing</th>
<th>Total hours lost to weather</th>
<th>Fraction of time suitable for observing</th>
<th>Baseline Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark Time</td>
<td>465</td>
<td>185</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Dark &amp; Gray Time</td>
<td>858</td>
<td>348</td>
<td>59%</td>
<td>60%</td>
</tr>
</tbody>
</table>

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. 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>
<thead>
<tr>
<th>Observing Condition</th>
<th>Total hours potentially available for observing</th>
<th>Total hours lost to problems</th>
<th>System Uptime</th>
<th>Baseline Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark Time</td>
<td>465</td>
<td>3</td>
<td>99%</td>
<td>90%</td>
</tr>
<tr>
<td>Dark &amp; Gray Time</td>
<td>858</td>
<td>7</td>
<td>99%</td>
<td>90%</td>
</tr>
</tbody>
</table>
3.3. 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 was above baseline goals; average efficiency in Q1 was 67% against the baseline goal of 64%.

<table>
<thead>
<tr>
<th>Category</th>
<th>Baseline</th>
<th>Run starting Dec 27</th>
<th>Run starting Jan 26</th>
<th>Run starting Feb 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument change</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Setup</td>
<td>10</td>
<td>8</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Calibration</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>CCD readout</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total overhead</td>
<td>25</td>
<td>22</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>Science exposure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(assumed)</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Total time per plate</td>
<td></td>
<td>70</td>
<td>67</td>
<td>75</td>
</tr>
<tr>
<td>Efficiency</td>
<td>0.64</td>
<td>0.67</td>
<td>0.68</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Figure 3.3 plots spectroscopic efficiency over time.
4. OBSERVING SYSTEMS

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

4.1. The Instruments

During this quarter, we managed to get the Imager Calibrator back on-line. Modifications and upgrades to the Imager Calibrator were finished and implemented. The calibrator has demonstrated sufficient stability to allow the observers to collect data on weather-lost nights.

A better understanding of the Astigmatism Actuator Controller problems was achieved this quarter. Tests were conducted to determine the amount of air blow-by that the actuators produce. Airflow and leaks were thereby identified and repaired.

4.2. The 2.5m Telescope

We experienced a power failure to the enclosure resulting from ice build-up on the enclosure power rails. During the repairs and replacement of the power rail shoes and arms, we discovered that the other shoes had considerable wear. We decided that these components needed to be replaced on a periodic schedule, namely once every 2 years.

Analysis of the power supply for the Neon/Argon lamps demonstrated that instability of this supply is the cause of intermittent functionality. We began a design upgrade of the power supply system which will be completed in the next quarter.

Problems with the Altitude fiducials cropped up again during this quarter. We spent two days readjusting the fiducial blocks, and we got them all within +/- .001” position tolerance. After so doing, all the fiducials began to work properly and seem to continue to perform well.

After completion of the new LN2 dewar storage shed, we discovered that during LN2 transfer operations the shed became an ODH area. Sensors were installed.
Rotator drive motor vibrations visited us again. The PID parameters had to be changed to new values to bring the vibrations back under control.

Vibration measurements were taken for the DIMM telescope enclosure. We discovered that the telescope camera does not see a difference in vibrations with the dome enclosure opened or closed. The vibrations seem to be wind generated and to affect the whole structure.

Next quarter we will begin work on our closeout activities for SDSS II which includes reviewing and updating the documentation on the telescope's operating and maintenance procedures and disposing of plug plates.

4.3. The Photometric Telescope

The Photometric Telescope (PT) drop out slit drive motor failed this quarter and, after polling the Observers to determine the usefulness of this motor, we decided to replace it. Early next quarter we will also upgrade the clutch on the manual hand crank.

4.4. Operations Software and the Data Acquisition System

The observing software and DA system were stable over the quarter. No changes were made to either system.

4.5. Observatory Operations

Throughout the first quarter of 2008, we emphasized SEGUE and Legacy spectroscopy. The only imaging consisted of two SEGUE scans completed on January 1.

We started to encounter end-game observing schedule problems. We ran out of plates available during the early hours of March nights, so re-observed some Legacy and SEGUE plates and observed some lower priority test plates for BOSS and MARVELS.

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 also provided 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.

Observers continued to use the Photometric Telescope (PT) to obtain observations of exoplanet transit timings, white dwarf standard stars, planetary nebula candidates, and made follow-up observations of ROTSE-detected supernovae. These were in addition to observing the few remaining secondary patches with the PT for SEGUE, and obtaining nightly photometric solutions on the few nights we imaged with the 2.5-m telescope.

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

- Galaxy morphology research to constrain dark matter models in galaxies.
- Participation in studies of dynamical and spectral properties of S0 galaxies (in collaboration).
- Solar physics research (Bayesian image recognition in magnetograms).
• Collaborating with Ukrainian astronomers on cataclysmic variables and oxygen abundances in SDSS galaxies.
• Stellar abundance modeling.
• Continuing the search for Galactic halo planetary nebulae using the SDSS CAS, DAS and the PT.
• Monitoring observer contributions to announced SDSS and SDSS-II "discovery papers."
• Using the SDSS equatorial stripe co-added data to find L and T dwarfs.

One Observer was awarded an American Astronomical Society small research grant allowing him to purchase a workstation to be used for astrophysical modeling essential to his dark matter in galactic halos research.

Work on the support building extension was completed this quarter. Ongoing measurements are being taken to evaluate the environmental conditions inside the new instrument rooms.

We also prepared the site for extreme fire danger due to extremely dry weather conditions in southeastern New Mexico. Fire protection equipment is in place and we have updated our fire evacuation procedures.

5. DATA PROCESSING AND DISTRIBUTION

5.1. Data Processing

5.1.1. Software Development and Testing

The principal effort in Q1 has been on the spectroscopic pipeline, and the processing of SEGUE imaging runs through both PHOTO and the Pan-STARRS image-processing code (psPhot).

On the spectroscopic side we focused our effort to finalize the idlspec2d code. The following updates were put in place and the code was formally delivered:

• Improved templates for specBS;
• Improved wavelength calibration, using global solutions;
• Improved handling of sharp emission lines;
• Improved flat fielding to properly handle changing features around the dichroic; and
• Improved robustness of the code to unusual observing conditions (especially the notorious cluster plates).

All extant plates have been reduced at Fermilab and will be released as part of DR7.

On the imaging side, we continued to assess the differences between the current version of PHOTO, and the improved version that does a better job of sky subtraction near bright galaxies. This will be captured in documentation of the known problems with PHOTO in the DR7 paper and website.

We also have been working on reducing the remaining SEGUE scans through both PHOTO and psPhot, to be incorporated into DR7. There are some subtle issues having to do with incorporating aperture corrections into the psPhot outputs.
We performed various diagnostic tests of the quality of the psPhot photometry and found that in a small fraction (<1%) of fields, there are systematic offsets of the photometry at the level of 0.1 mag or so. We are trying to find a diagnostic of what might be triggering this.

In the upcoming quarter, we will focus on delivering the final global ubercal results for everything, further testing of the image processing code, and documentation of all of the above.

Work continued by the JINA-MSU team on the development of the SEGUE Stellar Parameter Pipeline (SSPP). A mini-meeting was held at Fermilab in March, to finalize calibration and pipeline projects related to SEGUE.

Our plans for next quarter includes delivery of the final version of SSPP by the end of May 2008, and loading the latest SSPP results into DR7.2 CAS. We also plan to document SEGUE pipelines and science in journal papers.

5.1.2. Data Processing Operations at APO

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

5.1.3. Data Processing Operations at Fermilab

We reprocessed all spectroscopic data through a new version of the spectroscopic pipeline v5_3_12 spectro2d and 1d. This required some changes in the GRID processing software.

We continued processing new data as they arrived. We processed a total of 161 new spectroscopic plates. We completed processing of the final two SEGUE runs.

We reprocessed all existing imaging data with the new version of the astrometric pipeline and checked the quality of its output in collaboration with the developers at USNO.

We processed a limited subsample of the imaging data with the improved photometric pipeline (the one with better sky-subtraction around bright galaxies) in order to provide users with a comparison data set.

We transferred the reduced imaging data outputs for low-latitude scans from Princeton to Fermilab, so that they can be loaded into the CAS and included in the DAS.

We began an inventory and reorganization of the data on the processing cluster to make in easier to locate data on the cluster, simplify maintenance and reliability on older systems, and recover space used for duplicate or unnecessary data.

5.2. Data Distribution

Data distribution activities were focused on releasing DR7.1 to the Collaboration and supporting existing public releases. For the DR7.1 release to the Collaboration, we updated the sqlFits2Csv with psObj changes and applied the psObj schema changes to BestDR7.1.
5.2.1. Data Usage Statistics

Through March, the general public and astronomy community have had 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 and DR7.1 released on February 14, 2008.

Figure 5.1 plots the number of web hits we received per month through the various SkyServer interfaces. In Q1 we recorded an average 9.6 million hits per month, compared to an average 12 million hits per month in Q4.

![Figure 5.1 SkyServer usage per month, for all public releases combined.](image1)

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 an average 1.5 million queries per month in Q1, compared to an average 2.3 million queries per month in Q4.

![Figure 5.2 SkyServer usage, measured by the number of SQL queries submitted per month.](image2)

Figure 5.2 SkyServer usage, measured by the number of SQL queries submitted per month.
Through March 31, 2008, the SkyServer interfaces have received over of 393 million web hits and processed over 48 million SQL queries. Over the past quarter, the SkyServer sites received a total of 28.9 million hits and processed 4.4 million SQL queries.

Figure 5.3 shows the volume of data transferred monthly from the DAS through the rsync server. A total of 5.8 TB of data were transferred via rsync in Q1 compared to 8.2 TB in Q4. As we have seen in the past, the volume of data transferred varies significantly from month to month. By month the amount of data transferred was 0.5 TB in January, 0.6 TB in February, and 4.6 TB in March.

Figure 5.3 Monthly volumes 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 13.1 TB of data were transferred via the web interface in Q1, compared to 20.2 TB in Q4. By month the amount of data transferred were 7.6 TB in January, 2.3 TB in February, and 3.1 TB in March.

Figure 5.4 Monthly volume of data transferred via the DAS web interface.
5.2.2. Data Archive Server

We continued the process of preparing the DAS for long-term stewardship. We began a reimplemention of the DAS web interface to reduce the dependencies on the SDSS data processing infrastructure.

In Q2 we plan to make additional changes to the DAS before the final data release. New data will be added, including new types of files accommodating new processings of the data. The data set will be migrated from a cluster system to a network attached storage system.

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 eight problem reports filed through the SDSS Problem-Reporting Database were fixed and closed, including two filed as critical/high against CAS and SkyServer.

We tested and deployed an enhanced version CasJobs, v3_4_1, on our production sites.

5.2.4. Data Release 7

The DR7.1 release to the collaboration on Feb 14, 2008 included a second year of SEGUE imaging and spectra.

5.2.5. Runs Database

We modified the neighbors table processing from the RunsDB to eliminate multiple observations from a second round of neighbors’ computation.

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, 83 plates were designed and drilled in two drilling runs. Of these, 17 plates were for the Legacy program (North survey area), 30 were bright SEGUE plates, 30 were faint SEGUE plates, and 6 plates were test plates for the BOSS program in SDSS-III.

6.3. Survey Planning

Many of the SEGUE plates replaced existing plates that had not yet been observed; the new plates use improved algorithms for selecting targets. The BOSS test plates are for observing during certain times of the night when all Legacy and SEGUE plates have been exhausted.
7. EDUCATION AND PUBLIC OUTREACH

We continued to work with high school teachers who are offering the University of Washington Astronomy 101 course for college credits in their schools. During this school year three teachers will incorporate elements from SkyServer into their courses. SkyServer is also used by some of the UW faculty in their courses and laboratories, both in Astronomy 101 and in more advanced courses.

We explored how Google Sky, which incorporates the SDSS imaging data, can link to SkyServer education materials. In two workshops with formal and informal educators and Google Sky representatives, discussions were held about how to enrich the usefulness of Google Sky and what links might be useful to educators.

We promoted SkyServer in several presentations to educators and other audiences. These included the Washington NASA Space Grant Consortium members meeting and the NASA Out-of-School Time Working Group. We also worked with a high school student interested in astronomy who did a SkyServer project (spectra) as part of his senior project.

We participated in the group that is exploring the education and public outreach potential for LSST and how that relates to the experiences with SkyServer. We also participated in a group that is exploring the educational applications of Google Sky.

8. COST REPORT

The operating budget that the Advisory Council approved and the Board of Governors approved for the period January 1 through December 31, 2008 consists of $403K 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 $4,018K for ARC-funded cash expenses.

Table 8.1 shows forecast cost performance for ARC-funded cash expenses in Q1. More complete tables comparing forecast to baseline performance are included in the appendices of this report. Exhibit 1 compares cash expenses to the budget by quarter and annually. Exhibit 2 compares forecast in-kind contributions to the budget by quarter and annually.
Table 8.1  Q1 Cash Expenses and Forecast for 2008 ($K)

<table>
<thead>
<tr>
<th>Category</th>
<th>2008 – 1st Quarter</th>
<th>2008 Operations Budget Total (for the period Jan-Dec 2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline Budget</td>
<td>Baseline Budget</td>
</tr>
<tr>
<td>1. Survey Management</td>
<td>152</td>
<td>488</td>
</tr>
<tr>
<td>2. Survey Operations</td>
<td>196</td>
<td>412</td>
</tr>
<tr>
<td>2.1 Observing Systems</td>
<td>453</td>
<td>1,255</td>
</tr>
<tr>
<td>2.2 Observatory Operations</td>
<td>337</td>
<td>782</td>
</tr>
<tr>
<td>2.3 Data Processing</td>
<td>165</td>
<td>411</td>
</tr>
<tr>
<td>2.4 Data Distribution</td>
<td>18</td>
<td>26</td>
</tr>
<tr>
<td>2.5 ARC Support for Survey Ops</td>
<td>9</td>
<td>31</td>
</tr>
</tbody>
</table>

Sub-total 1,330 1,041 3,405 3,268

3. New Development
   3.1 SEGUE Development 0 0 0 0
   3.2 Supernova Development 0 0 0 0
   3.3 DA Upgrade 0 0 0 0
   3.4 Photometric Calibration 0 0 0 0

4. ARC Corporate Support 9 9 31 31

Sub-total 1,330 1,041 3,405 3,268

5. Management Reserve 175 0 613 613

Total 1,505 1,041 4,018 3,881

8.1. Q1 Performance - In-kind Contributions

The sum of in-kind contributions in Q1 was $127K against the baseline budget of $154K. In-kind contributions were 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, planning, and development work for the SEGUE and Supernova projects. The level of in-kind effort required from Fermilab was less than budgeted.
- JHU provided support for the development, loading and hosting of databases associated with the CAS, CasJobs, and SkyServer.
- UW contributed the overhead associated with the plate drilling operation as anticipated.

8.2. Q1 Performance – ARC Funded Cash Expenses

ARC-funded expenses in Q1 were $1,041K, or $288K (22%) below the budget of $1,330K, before management reserve.

Survey Management costs were $132K against a budget of $152K. Expenses to support the ARC EPO Coordinator and project management were less than budgeted, driven by reduced travel by the EPO coordinator and work constraints at Fermilab which limited the amount of time employees were available to work. All other survey management costs were as anticipated. For the year, the
revised forecast for Survey Management expenses is $479K, or $9K (2%) below the baseline budget of $488K.

Observing Systems costs were $130K against a budget of $196K. Fermilab personnel costs were lower than budgeted due work constraints at Fermilab. Princeton, and ARC observing systems support costs were as anticipated. For the year, the revised forecast for Observing Systems expenses is $355K, or $57K (14%) below the baseline budget of $412K.

Observatory Support costs were $402K against a budget of $453K. NMSU personnel and utility expenses were less than anticipated. For the year, the revised forecast for Observatory Support expenses is $1,201K, or $54K (4%) below the baseline budget of $1,255K.

Data Processing costs were $230K against a budget of $337K. Fermilab expenses were less than budgeted because delivery of new hardware has been delayed until the second quarter. For the year, the revised forecast for Data Processing costs is $766K, or $16K (2%) below the baseline budget of $782K.

Data Distribution costs were $119K against a budget of $165K. FNAL personnel expenses were less than budgeted due to work constraints which reduced employees working hours. JHU expenses were less than budgeted due to accounting timing and will be resolved in the second quarter. For the year, the revised forecast for Data Distribution costs is $411K as budgeted.

ARC Support for Survey Operations costs and Miscellaneous ARC corporate expenses (i.e., audit fees, bank fees, petty cash, and APO trailer rentals) were as anticipated.

8.3. Q1 Performance - Management Reserve

No management reserve funds were expended in Q1.

9. PUBLICATIONS

In Q1, there were 129 papers published using publicly available data. Exhibit 3 lists the papers published. The Q2 Report will include papers by the Collaboration using non-public data.
## SDSS-II CY2008 Cost Performance as of March 31, 2008

### OPERATIONS BUDGET - CASH EXPENSES

#### 1.0 Survey Management

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<th>Project Title</th>
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<th>PI Center</th>
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<th>Apr-Dec</th>
<th>CY2008</th>
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**Survey Management Sub-total:** 152 | 132 | -13% | 331 | 336 | 2% | 488 | 479 | -2%

#### 2.0 Survey Operations

##### 2.1 Observing Systems

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<th>Project ID</th>
<th>Project Title</th>
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<th>Apr-Dec</th>
<th>CY2008</th>
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<td>SSP-231</td>
<td>UW Observing Systems Support</td>
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**Observing Systems Sub-total:** 196 | 130 | -34% | 216 | 224 | 4% | 412 | 355 | -14%

##### 2.2 Observatory Support

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<td>NMSU Site Support</td>
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**Observatory Support Sub-total:** 453 | 402 | -11% | 803 | 799 | 0% | 1,255 | 1,201 | -4%

##### 2.3 Data Processing

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<th>Project Title</th>
<th>PI Institute</th>
<th>PI Center</th>
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**Data Processing Sub-total:** 337 | 230 | -32% | 445 | 535 | 20% | 782 | 768 | -2%

##### 2.4 Data Distribution

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<th>Project Title</th>
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<th>PI Center</th>
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<th>Apr-Dec</th>
<th>CY2008</th>
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<td>SSP-268</td>
<td>FNAL Data Distribution Support</td>
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**Data Distribution Sub-total:** 165 | 119 | -28% | 246 | 291 | 18% | 411 | 411 | 0%

##### 2.5 ARC Support for Survey Operations

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<th>Project Title</th>
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<th>PI Center</th>
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<th>Apr-Dec</th>
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<td>SSP91f</td>
<td>ARC Additional Scientific Support</td>
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<td>SSP91h</td>
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**Data Distribution Sub-total:** 18 | 18 | 0% | 9 | 9 | 0% | 27 | 27 | 0%

**Survey Operations Sub-total:** 1,168 | 900 | -23% | 1,718 | 1,859 | 8% | 2,886 | 2,759 | -4%
### SDSS-II CY2008 Cost Performance as of March 31, 2008

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<th>Baseline</th>
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### Exhibit 2 CY2008 In-Kind Contributions ($000s)

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<td>SSP-269 MSU SEGUE Software Development and Support</td>
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<td>SEGUE Development Sub-total</td>
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**Total In-Kind Contributions**: 154,094

**Total Operating Budget (Cash and In-kind)**: 1,659,273
Exhibit 3 Publications Based on Public Data


3. Two More Candidate AM Canum Venaticorum (AM CVn) Binaries from the Sloan Digital Sky Survey. AJ 2008 Accepted – Scott Anderson


14. Large Misalignment between Stellar Bar and Dust Pattern in NGC 3488 Revealed by Spitzer and SDSS. New Astronomy 2008, 13, 16-23 – C. Cao


34. The Outer Disks of Early-Type Galaxies. I. Surface-Brightness Profiles of Barred Galaxies. AJ 2008, 135, 20-54 – Peter Erwin


49. Current Star Formation in Early-Type Galaxies and the K+A Phenomenon. MNRAS 2008 Accepted – J. F. Helmboldt


52. QSOs in the Combined SDSS/GALEX Database. PASP 2008, 120, 275-280 – J. B. Hutchings


68. Connecting the Physical Properties of Galaxies with the Overdensity and Tidal Shear of the Large-Scale Environment. MNRAS 2008, Submitted – Jounghun Lee


70. What Do WMAP and SDSS Really Tell Us about Inflation? J Cosmology Astroparticle Physics 2008, 1, 10 – Julien Lesgourgues


75. Galaxy Clusters in the Line of Sight to Background Quasars. I. Survey Design and Incidence of MgII Absorbers at Cluster Redshifts. ApJ 2008 Accepted – S. Lopez


79. On the HI Content, Dust-to-Gas Ratio and Nature of MgII Absorbers. MNRAS 2008 Submitted – Brice Ménard


89. The Real-Space Clustering of Luminous Red Galaxies around z<0.06 Quasars in the Sloan Digital Sky Survey. MNRAS 2008, Submitted – N. Padmanabhan

90. Is There a Quad Problem among Optical Gravitational Lenses? New Journal Physics 2007, 9, 442 – Masamune Oguri

91. A Large Sample of BL Lacs from SDSS and FIRST. AJ 2008 Accepted – Richard M. Plotkin


94. Improved optical mass tracer for galaxy clusters calibrated using weak lensing measurements. MNRAS 2008 Submitted – Reinabelle Reyes

95. Space Density of Optically-Selected Type 2 Quasars. AJ 2008 Submitted – Reinabelle Reyes


97. The L_X–M Relation of Clusters of Galaxies. MNRAS 2008 Accepted – E. S. Rykoff


106. Triplets of Quasars as Lighthouses of Rich Galaxy Clusters. MNRAS 2008 Accepted – Ilona K. Söchting


110. AGN Environments in the Sloan Digital Sky Survey. I. Dependence on Luminosity, Type, and M_{BH}. eprint arXiv:0712.2474 – Natalie E. Strand

111. The Shape Distribution of Asteroid Families – Evidence for Evolution Driven by Small Impacts. Icarus 2008 Accepted – Gyula M. Szabo


118. Inclination-Dependent Extinction Effects in Disk Galaxies in the Sloan Digital Sky

120. The 2dF-SDSS LRG and QSO Survey: Evolution of the Clustering of Luminous Red Galaxies since z = 0.6. MNRAS 2008 Submitted – David A. Wake


