Sloan Digital Sky Survey

Schedule for the Five-Year Baseline Plan for SDSS Operations

Revised October 10, 2001

Introduction

The Sloan Digital Sky Survey is creating two surveys of the sky; The Northern Survey and the Southern Survey. Each survey consists of a photometric survey and a spectroscopic survey of the brighter objects found in the photometric survey. The two primary goals of the Northern Survey are a photometric survey of approximately pi steradians of the North Galactic Cap in five filters and a redshift survey of objects selected from the photometric survey consisting of approximately 100 galaxies per square degree and approximately 15 quasar candidates per square degree, identified by photometric indices. Two of the goals of the Southern Survey are to carry out a photometric survey of three stripes in five filters in the South Galactic Cap region centered on the equator and to obtain spectra of the brighter objects in these regions. Each stripe is 2.5 degrees wide and approximately 90 degrees long. All of the observing and data processing systems have been designed and built to meet these goals. A third goal of the Southern Survey is to obtain repeated images of the South Equatorial Stripe, which will enable a deeper photometric survey in five filters by co-addition of the repeated images. The repeated observations of the Southern Equatorial Stripe will allow the investigation of motion and variability. An additional pipeline will need to be developed to carry out the co-addition of the repeated images. The data acquisition system will probably need to be upgraded to properly handle the challenge of rapidly identifying variable objects. In addition, a new pipeline, or improvements to the existing imaging pipeline, will be needed to identify variable objects in the imaging data. ARC intends to seek additional funds to carry out the full investigation of variability and coaddition that the repeated observations will enable, since this is more than can be achieved with the ARC-approved Five-year Baseline Survey. These repeated photometric observations will constitute part of the Southern Equatorial Survey. The scope of this phase of the survey may be expanded to include imaging of additional areas of the sky that have special interest to NASA missions and the programs of the large 8-meter class telescopes.

A model has been developed to forecast the amount of photometric and spectroscopic data that can be acquired per quarter during the ARC-approved Five-Year Baseline Survey. It identifies and uses the key factors that limit the rate at which the sky can be covered during the five-year observing period. The result of this forecast is the Five-Year Baseline Plan, or “baseline plan” for short. The baseline plan contains the performance goals and a description of the key limiting factors used to develop the plan and is available on-line through the SDSS website or directly at

http://tdserver1.fnal.gov/sdss/SurveyDocs/5yearbaseline.pdf. This document, the 5-Year Baseline Schedule or "baseline schedule" for short, summarizes the performance goals and timeline for acquiring and processing photometric and spectroscopic data that meets the goals of the baseline plan.

Overview of the Baseline Plan

The progress of the SDSS is evaluated with respect to the baseline plan by accounting for the available observing time and the efficient use of the time. The baseline plan takes into account the number of dark hours in each quarter during the survey period, the relative allocation of those hours to imaging and spectroscopy, and various factors that limit the efficiency of operations. It specifies the number of hours that have been allocated to collecting data for imaging and spectroscopy separately. These two numbers can then be converted into square degrees and plates, thereby allowing a straightforward comparison with the quantity of data actually collected.

To capture the manner in which the data are collected and processed, a hierarchy of data categories has been devised. The full set of categories is described in the baseline plan. One of the categories, "Unique", provides the statistic used for tracking imaging progress against the baseline forecast. Data classified as "Unique" have been successfully processed through the imaging pipelines, have passed QA tests for seeing, tracking, and photometricity, and have been corrected for overlaps of the separate runs of the same stripe. Unique data must also lie within the official survey area in order to be counted. The quantity of "Unique" data has not been corrected for natural stripe to stripe overlaps.

The baseline plan established April 1, 2000 as the formal start of survey operations. This date marked the transition from the completion of major construction and commissioning to the start of scheduled operations. In view of the need to acquire sufficient photometric data for the selection of spectroscopic targets prior to the start of spectroscopy, the baseline plan forecast the start of the spectroscopic survey of the North Galactic Cap in the first quarter of 2001. Since some of the photometric data acquired during commissioning met survey requirements for target selection, it was possible to begin the acquisition of survey quality spectroscopic data prior to the first quarter of 2001. While the commissioning data enabled this head start, the baseline plan and the baseline schedule were not changed.

Northern Survey Baseline

The baseline schedule for the survey of the North Galactic Cap is presented in Table 1.

Table 1. SDSS 5-Year Baseline Projection – North Galactic Cap

Period	"Unique" Imaging Area (Sq. deg.)	Number of Spectroscopic Plates
2000-Q1	0.0	0
Q2	140.7	0
Q3	38.7	0
Q4	384.0	0
2001-Q1	1090.9	114
Q2	651.2	82
Q3	78.4	10
Q4	460.8	58
2002-Q1	1090.9	137
Q2	651.2	82
Q3	78.4	10
Q4	307.2	66
2003-Q1	727.3	156
Q2	434.2	93
Q3	52.2	11
Q4	307.2	66
2004-Q1	727.3	156
Q2	434.2	93
Q3	52.2	11
Q4	0.0	83
2005-Q1	0.0	195
Q2	0.0	117
Total	7706.9	1540

In order to provide sufficient imaging data for the selection of spectroscopic targets for subsequent spectroscopic observations, the plan allocates more time for imaging through the second quarter of 2002 than is allocated in subsequent quarters. In addition, the baseline plan assumes that the acquisition of imaging data will end in the fourth quarter of 2004 and thus allocates 100% of the available time after that date to spectroscopic operations. In practice, the actual proportions of time allocated to imaging and spectroscopy will be adjusted as the survey progresses to yield the best strategy for maximizing the quantity of data that can be obtained in five years for both the photometric and spectroscopic surveys.

Figure 1 compares the cumulative photometric data collected in the Northern Survey Region through July 2001 against the baseline plan. Figure 2 compares the total number of spectroscopic plates observed in the North through July 2001 against the baseline plan.

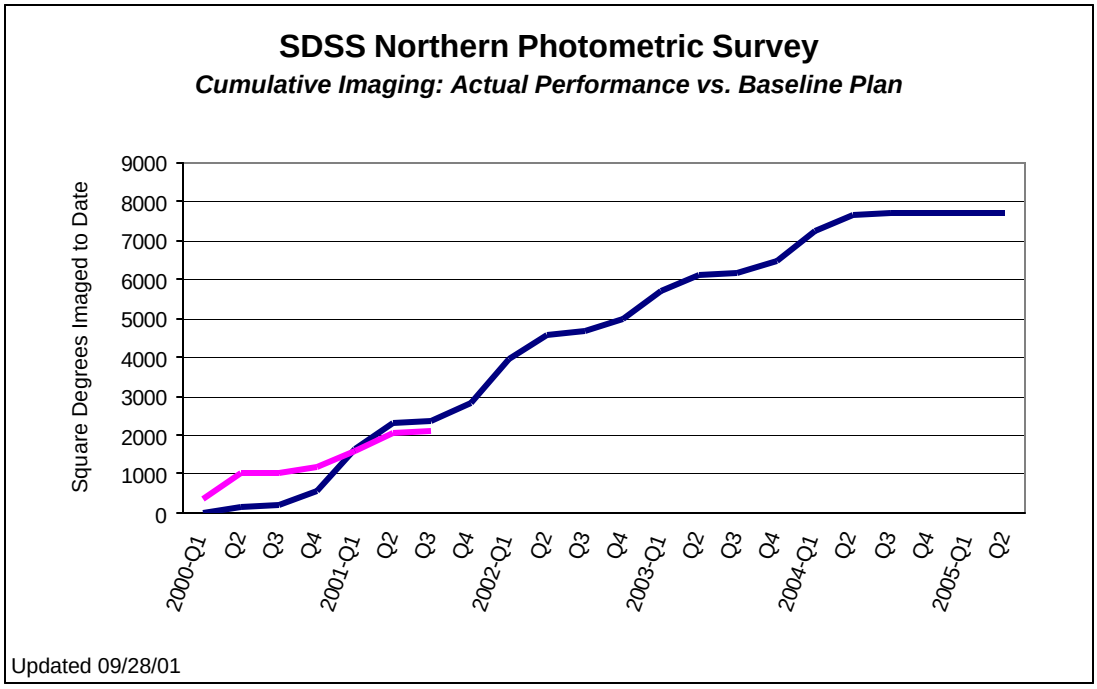

Figure 1. Baseline Schedule and Performance for the Photometric Survey of the North Galactic Cap

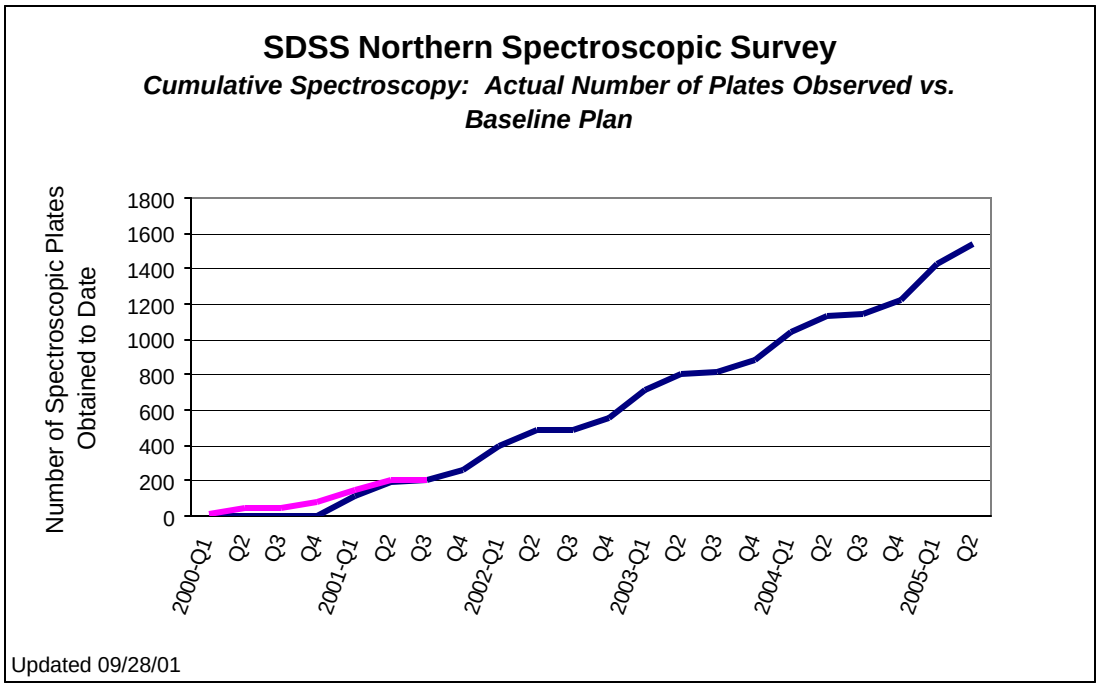

Figure 2. Baseline Schedule and Performance for the Spectroscopic Survey of the North Galactic Cap

Southern Survey Baseline

Only a small part of the North Galactic Cap is visible from Apache Point Observatory during the months of September, October, and most of November. For that reason observations are largely limited to the South Galactic Cap during the third and fourth quarter. The ARC-approved Southern Survey consists of the initial pass of the photometric and spectroscopic observations of each of the three southern stripes. These stripes consist of the equatorial stripe and the two "outrigger" stripes that flank the equatorial stripe. Table 2 presents the baseline projection for the quantities of data acquired during the Southern Survey.

Table 2. SDSS 5-Year Baseline Projection – Southern Survey

Period	"Unique" Imaging Area (Sq. deg.)	Number of Spectroscopic Plates
2000-Q1	0	0
Q2	0	0
Q3	141.5	15
Q4	361.8	52
2001-Q1	0	0
Q2	0	0
Q3	132.0	28
Q4	109.7	53
2002-Q1	0	0
Q2	0	0
Q3	0	0
Q4	0	0
2003-Q1	0	0
Q2	0	0
Q3	0	0
Q4	0	0
2004-Q1	0	0
Q2	0	0
Q3	0	0
Q4	0	0
2005-Q1	0	0
Q2	0	0
Total	745.0	148

Figure 3 compares the cumulative photometric data collected in the Southern Survey through July 2001 against the baseline plan. Figure 4 compares the total number of spectroscopic plates observed in the South through July 2001 against the baseline plan.

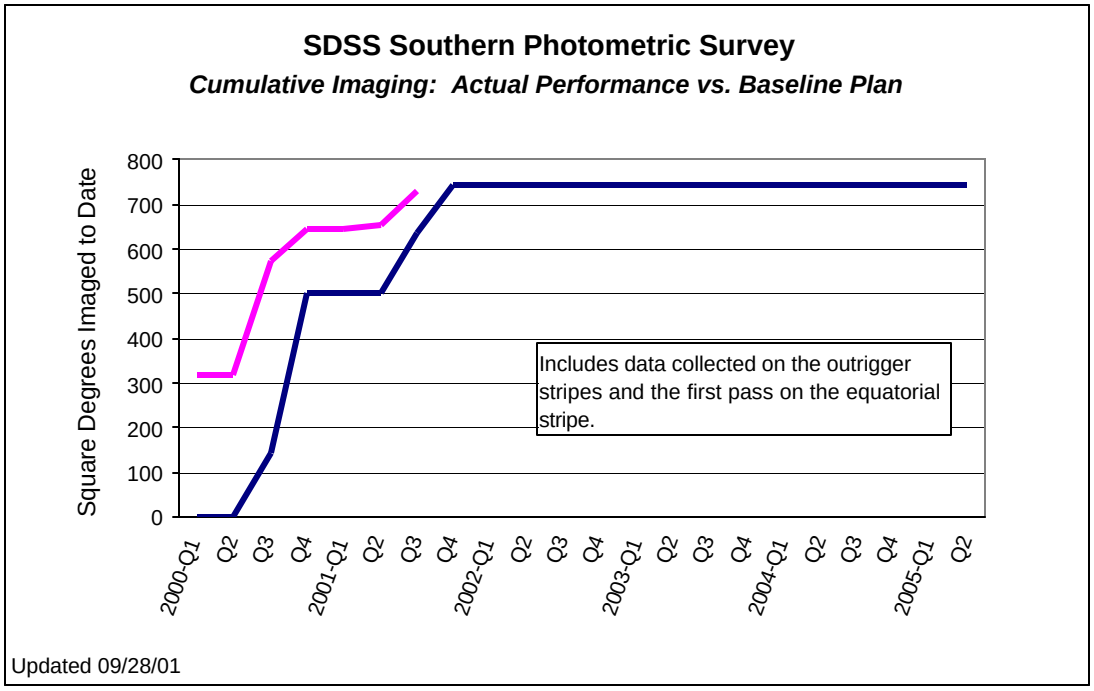

Figure 3. Baseline Schedule and Performance for the Photometric Survey of the Southern Stripes

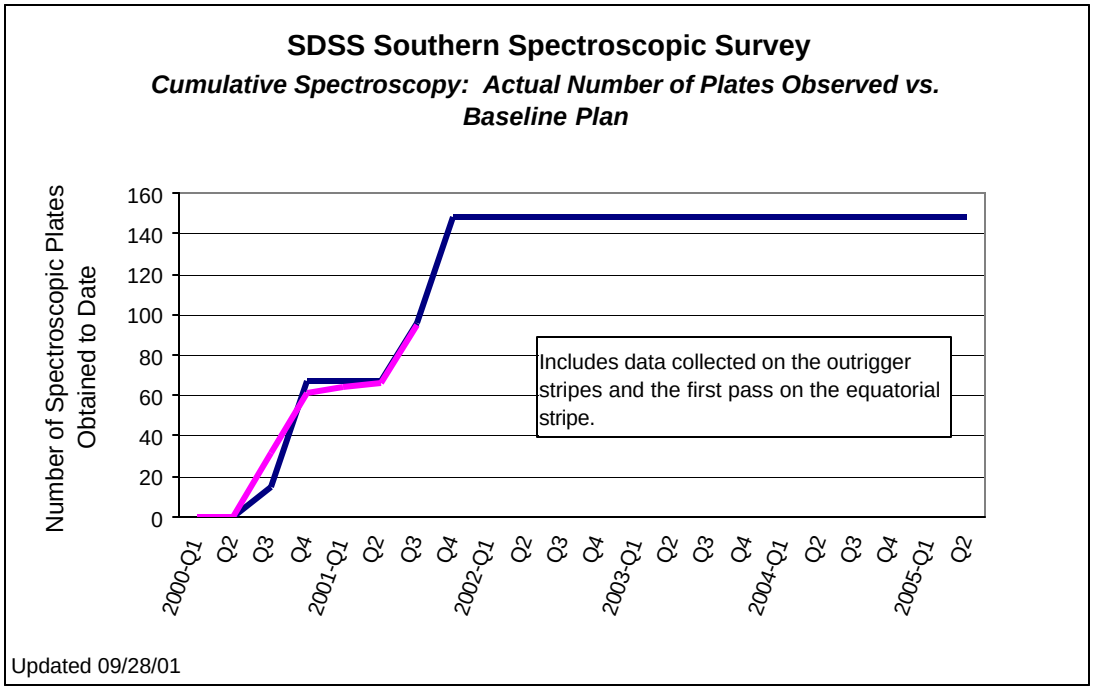

Figure 4. Baseline Plan and Performance for the Spectroscopic Survey of the Southern Survey Stripes

Southern Equatorial Survey

Once the initial survey quality photometric and spectroscopic observations of the three southern stripes have been made, the South Equatorial Stripe will be imaged many times during the remainder of the five-year survey. This stripe is 108 degrees long and has a footprint of 270 square degrees. Since the repeated images constitute the defining characteristic of this part of the survey, we distinguish it from the rest of the Southern Survey by calling it the Southern Equatorial Survey. It includes the standard processing of the photometric data. Finally, it allocates additional time for spectroscopic observation of targets in this stripe and thus will afford opportunities for pursuing different strategies for the spectroscopic observations than will be pursued in the other regions. For these reasons, the Southern Equatorial Survey will provide complementary information to the other surveys. Table 3 presents the baseline projection for a potential Southern Equatorial Survey. Instead of forecasting the number of spectroscopic plates to be obtained, in Table 3 we forecast the number of hours allocated to spectroscopic operations.

Table 3. SDSS 5-Year Baseline Projection – Southern Equatorial Survey

Period	"Good minus Unique" Imaging Area (Sq. deg.)	Number of Spectroscopic Hours
2000-Q1	0	0
Q2	0	0
Q3	0	0
Q4	0	0
2001-Q1	0	0
Q2	0	0
Q3	245.6	15
Q4	429.5	26.25
2002-Q1	0	0
Q2	0	0
Q3	509.4	30.75
Q4	868.3	52.5
2003-Q1	0	0
Q2	0	0
Q3	509.4	30.75
Q4	868.3	52.5
2004-Q1	0	0
Q2	0	0
Q3	509.4	30.75
Q4	868.3	52.5
2005-Q1	0	0
Q2	0	0
Total	4808.1	291

The co-addition of these images will achieve a deeper image of the sky than will be obtained in the other regions. Moreover, the separation in time of these images can enable the detection of objects that vary in brightness or that change position with time.

The approved budget does not provide for improvements to the data acquisition system, the data processing pipelines and the distribution databases that would allow the full exploitation of the repeated scans. ARC intends to seek additional funding to carry out a full exploitation of the data from the Southern Equatorial Survey, once funding for the Five-Year Baseline Survey has been secured.

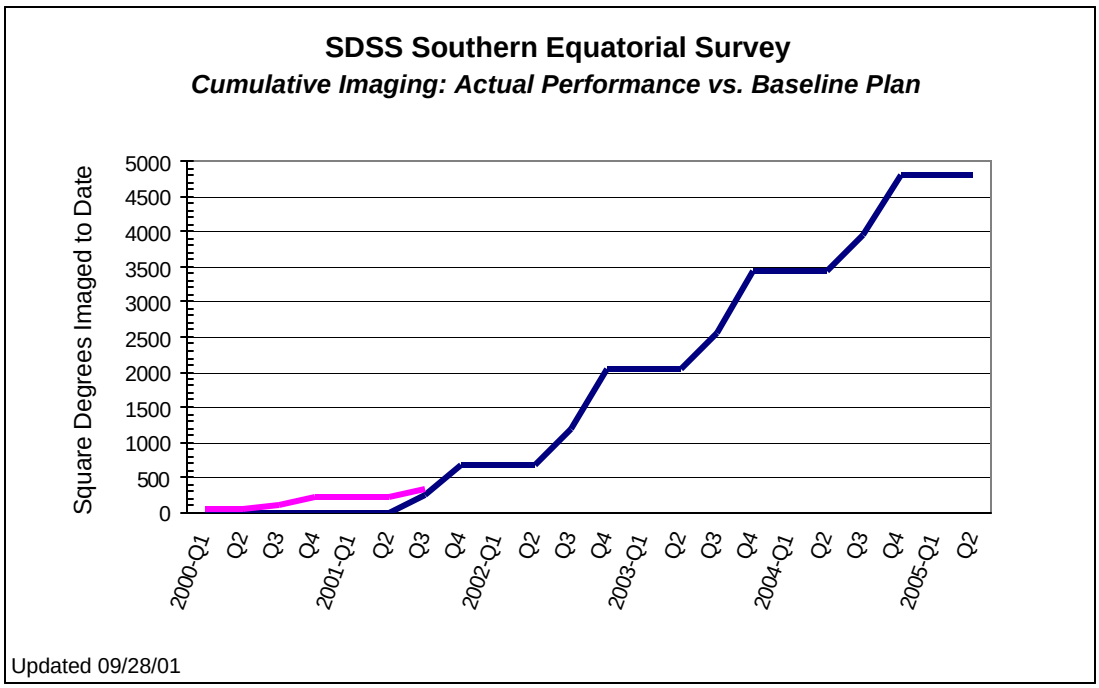

Figure 5. Baseline Plan for Photometric Survey Progress in the Southern Equatorial Survey

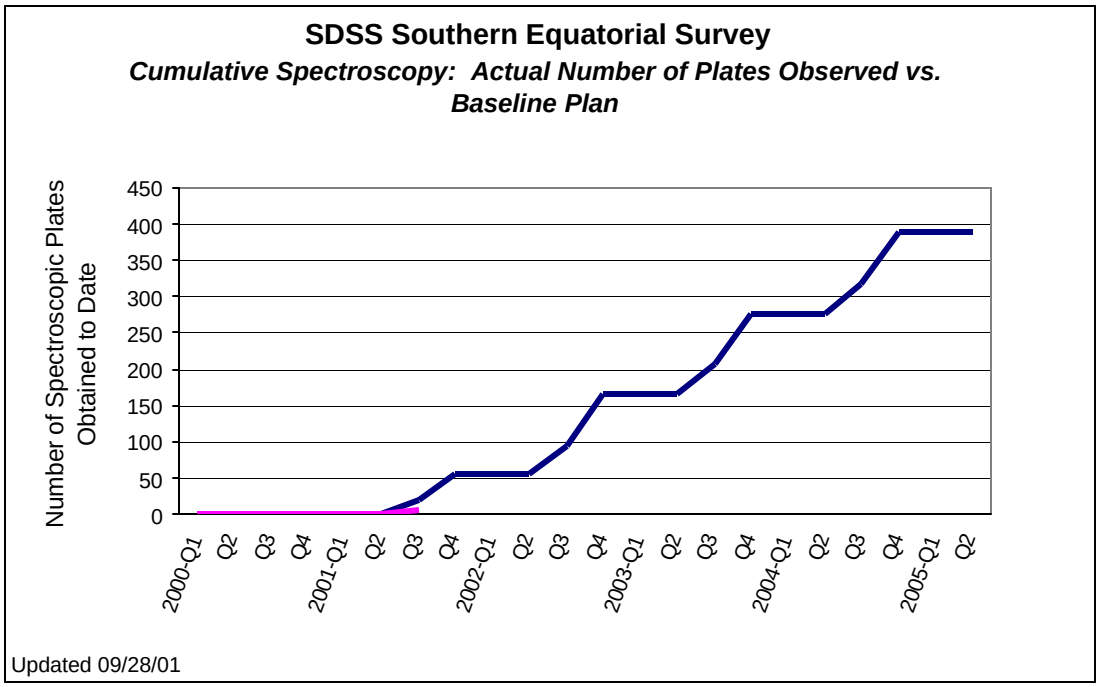

Figure 6. Baseline Plan for Spectroscopic Survey Progress in the Southern Equatorial Survey