SLOAN DIGITAL SKY SURVEY

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Abstract. The Sloan Digital Sky Survey is a project which will produce a detailed digital phometric map of half the northern sky to about 23 magnitude using a special purpose wide field telescope of 2.5 meter aperture. This map will be used to select about a million galaxies and 100,000 quasars, for which high resolution spectra will be obtained using the same telescope. A catalog will be produced of all the detected objects, about 100 million galaxies and a similar number of stars, and a million quasar candidates.

Key words: Surveys – SDSS

1. To Start

The partners in the SDSS are the University of Chicago, Princeton University, the Institute for Advanced Study, Fermilab, Johns Hopkins University, and the Japanese Promotion Group.

The specific goals of the survey are as follows:

1. In π steradians of the North Galactic Pole,
   a) Obtain a photometric survey in 4 or 5 filters to $R = 23$ (5σ).
   b) Obtain redshifts for all galaxies to $B = 19$.
   c) Obtain redshifts for all quasars to $B = 20$.
2. In a strip $2^\circ \times 50^\circ$ of the South Galactic Pole
   a) Obtain a deep photometric survey to $R = 25$.
   b) Obtain redshifts for all galaxies to $B = 20$.
   c) Obtain redshifts for all quasars to $B = 21$.
3. If feasible, obtain a best effort imaging survey of the Galactic Plane.

The survey will be carried using a new $f/5$ 2.5 meter telescope of altitude-azimuth design that is under construction at Apache Point Observatory in New Mexico. The telescope is a modified Ritchey-Chrétien design that uses two corrector lenses near the focal plane to achieve a field of view of 3 degrees with no distortion.

Two major instruments will be provided.

Imaging will be done using a camera that consists of a mosaic of 52 CCDs. Thirty of these CCDs are Tektronix 2048^2 arrays that are used for the primary imaging observations. They are arranged in an array of 6 columns with 5 CCDs per column (Fig. 1). Each CCD in a column has a different filter as given in Table I.

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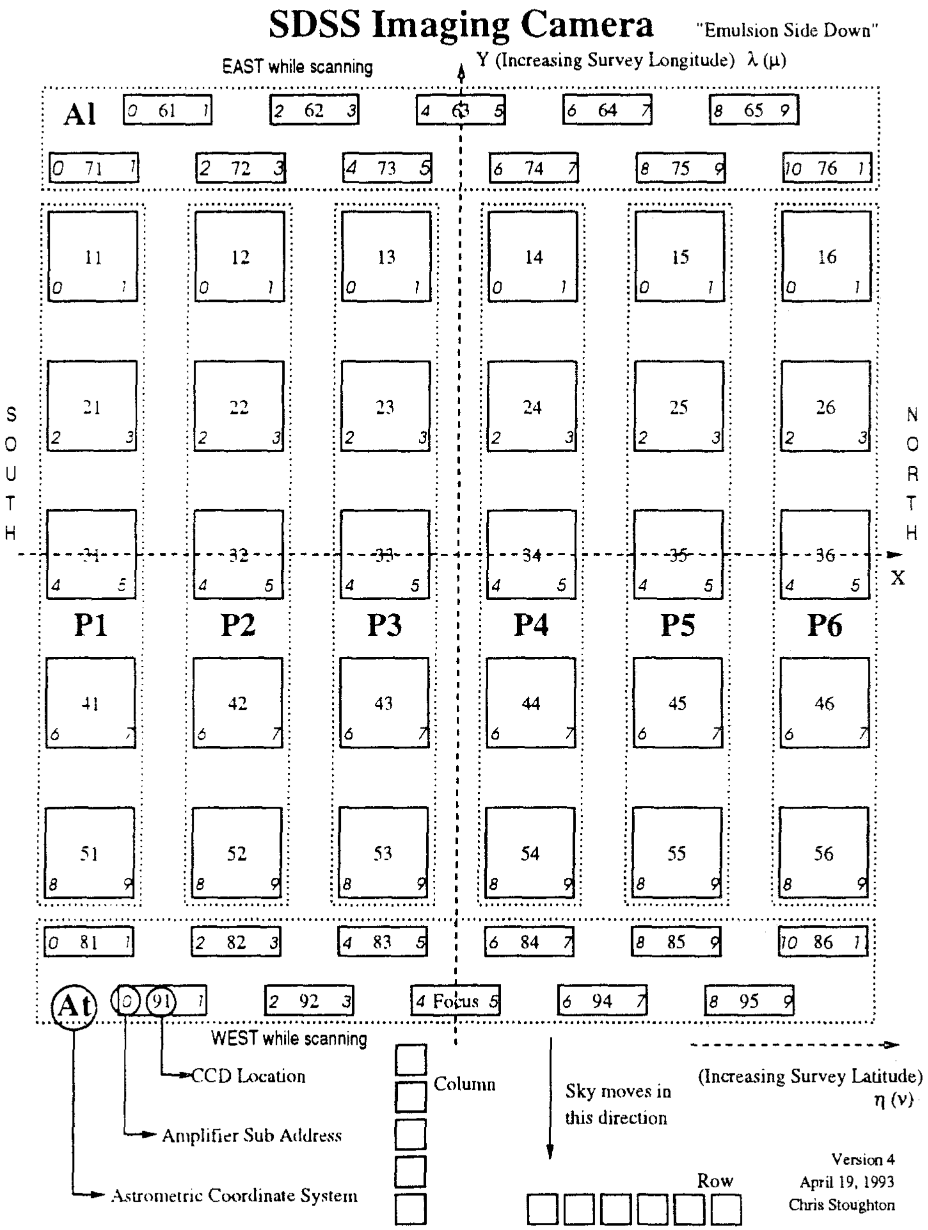

Fig. 1. Layout of the imaging camera focal plane.

TABLE I
Filters.

Filter	Wavelength (Å)	Width (Å)
u	3506	616
g	4734	1456
r	6270	1456
i	7691	1544
z	9247	1632

The z will be included contingent on funding.

The imaging survey will be conducted in drift scan mode. The telescope will be actively tracked so that a given piece of the sky trails along the 5 CCDs of a column in succession. The transit time of a single CCD will be 55 seconds and the time to cross the array will be about 7 minutes. The columns of CCDS are spaced by slightly less that one CCD width; thus, 2 successive interlaced scans of the telescope will produce a completely filled image of a strip of the sky 2.5 degrees wide. Minimal processing of the data will be done online. This processing will calculate flatfields and extract parameters from bright stars to be used in monitoring observing conditions. The data will be stored on exabyte tapes and the bulk of the data processing will be done offline at Fermilab.

A total of 22 small CCDs, leading and trailing the main imaging CCDs, will be used to provide the astrometric calibration. These CCDs will be used to tie bright ($V < 9$) stars with good astrometric positions to fainter ($V = 14$) secondary stars that will be used to calibrate the final object positions. The desired accuracy is $0.2''$ rms in each coordinate.

A separate 0.61 meter monitor telescope will be used for the photometric calibration. This telescope will be equipped with a single CCD and filter wheel box. The functions of this telescope are fourfold. First, it will set up a set of standard stars for the photometric calibration (the SDSS filters are not on any standard system). Second, during imaging observations, it will repeatedly observe the standard stars to monitor the atmospheric transparency. Third, it will observe a large number of patches in common with the 2.5 meter telescope which will be used to calibrate the main imaging survey. Fourth, it will be used to calibrate spectrophotometric standards that will be observed during the spectroscopy.

Galaxy and quasar candidates will be identified from the imaging data for followup spectroscopy. The spectroscopy will be done with two multifiber spectrographs, each with a blue and red channel. The two spectrographs can measure 600+ objects simulataneously. The fibers will be positioned using drilled plates. The field size of each plate will be about 3 degrees. The spectroscopic resolution will be approximately 3 Å, allowing velocity dispersions to be measured for the brighter galaxies. The exposure times will be on the order of 1 hour.

The galaxy survey is intended to be as complete as possible. Galaxies will be skipped only if they are so close so as to cause interference between fibers. Since the distribution of galaxies on the sky is highly variable, the plate centers will not be placed on a uniform grid but rather will be adjusted by a procedure known as adaptive tiling whereby plates overlap considerably in regions of high galaxy density. Fibers will be made available for observations of stars and serendipitous objects of interest found in the course of the survey.

The results from the survey will be distributed in a form that is as yet to be determined. The products that might be produced include:

1. Tables of all objects found in the survey (approx 200 million) with parameters.
2. Postage stamps of all objects.
3. Tables of redshifts for all objects with spectroscopy
4. Reduced 1 dimensional spectra.
5. The 2 dimensional images from which spectra were extracted.

The imaging survey will produce of order 10 terabytes of data. It is still to be determined in what form the full imaging data will be made available.