The AAVSO Photometric All-Sky Survey Completes The Sky

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Abstract

The AAVSO All-Sky Photometric Survey (APASS) will calibrate the entire sky in five passbands: Johnson B and V, and Sloan g',r',i'. The magnitude range is 10<V<17, with photometric accuracy near 0.02mag at the bright end. Pixel size is 2.6 arcsec. The survey has been underway for about two years, and has now achieved the milestone of covering the entire sky a minimum of two times, with approximately 42 million objects in the current catalog. The final survey will have four visits per object, and will be completed in about two years. We may either extend the survey to include brighter objects or more filters, depending on funding. Data Release 6 can be downloaded from http://www.aavso.org/apass .

APASS Hardware

Each APASS site consists of two telescopes on a single mount. The telescopes are ASA N8 astrographs (20cm f/3.6); the cameras are Apogee U16m (KAF 16803, 4kx4kx9micron pixels); the final plate scale is 2.6arcsec/pix with a field of view of 2.9x2.9 square degrees. Each camera has a 7-slot Apogee filter wheel. Both telescopes point to the same area of sky. One telescope/camera takes the two blue filter exposures (B, g'), and the other telescope/camera takes the redder exposures (V,r',i') during the same time window, giving essentially simultaneous color information. The mount is a Paramount ME. Both cameras and the mount are controlled using Virtual Machine instances of Windows XP, running underneath a native linux operating system on a single PC. Software includes TheSky, MaximDL, ACP and ACP Scheduler.

Figure 1: APASS-north installation at Dark Ridge Observatory, Weed, NM. Note the flatfield screens; projection lamps are on the ends of the telescopes.

Figure 2: APASS-south installation at CTIO. This system uses the PROMPT-6 clamshell.

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For more information, please see Arne Henden (left) or email: arne@aavso.org .

Data Acquisition and Reduction

The acquisition is queue-scheduled, with 5667 fields in the primary survey, and an equivalent number of fields in the secondary survey. The secondary survey is offset from the primary by center-to-corner, so that every region of sky gets four visits on separate nights. Tiling is done on 2.8 degree centers so that there is a 5% overlap between fields. Survey exposures are 180 seconds for the blue filters and 90 seconds for the red filters.

On each night, approximately 60 survey fields are imaged, along with a dozen or more equatorial standard-star fields (at high and low airmass). At the end of the night, the images are dark subtracted and flatfielded using iraf on the linux host; then star-lists are extracted and basic aperture photometry performed. The resultant 26GB of nightly raw and processed images are stored on external hard drive, and are shipped to AAVSO HQ once per quarter. The extracted star-lists are transferred via the internet on a daily basis. Once at HQ, basic linear WCS is performed, and the survey queue is updated based on the previous night's images.

The images suffer cubic distortions, so an ancillary step is taken using the initial-guess linear coordinate solution and performing a cubic fit. These WCS corrected, instrumental photometry star-lists are merged into a single file, collecting all measures of each field star. The photometry is corrected for scattered light/flatfielding/distortions by applying a residual map. These fully corrected, merged lists are then individually transformed and then merged into a final catalog.

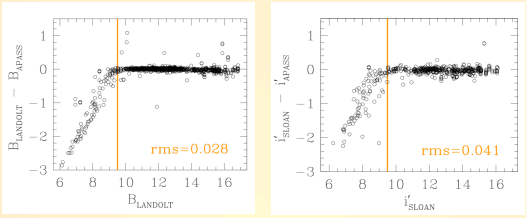

Figure 3: Photometric residuals for two filters, compared to standards. Note that saturation sets in around 9.5mag. Sloan i' has larger error than all other passbands (credit: U. Munari).

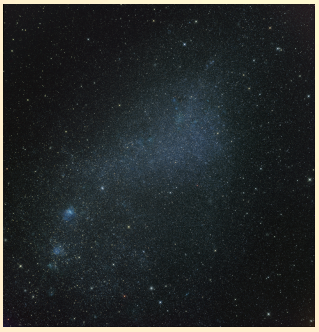

Figure 4: The SMC, as seen in gri from APASS-south (credit: A. Wong)

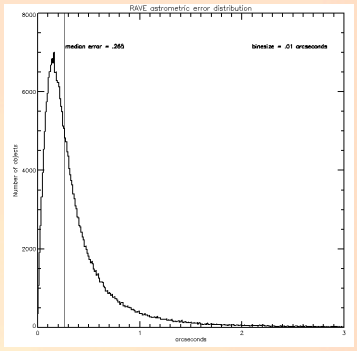

Figure 5: Astrometric APASS residuals compared to matched astrometric standards. The RMS error is currently about 0.26arcsec; with proper plate distortion mapping and improved centroiding, we expect the final astrometry to be better than 0.15arcsec.

Preliminary Catalog

The catalog currently available to the community is preliminary. Only two visits of the desired four visits per field have been completed. While the typical photometry is good, there are caveats that must be remembered for this kind of interim product.

The B filter from Astrodon suffers from a red leak. Stars with (V-I)>3.8 will have a brighter B magnitude than in reality. We will both correct the current photometry using a multi-parameter transformation, and are acquiring new B filters without the red leak for completion of the survey.

The centroiding and photometry suffer in crowded regions. We expect to reprocess the data to improve both of these in a later release. Currently, all photometry uses a 15arcsec diameter aperture to match with those used by Landolt.

The corners of the sensor are outside of the corrected image circle of the telescopes. We will use a weighting scheme in later releases to avoid the corners.

To search the catalog, go to http://www.aavso.org/apass and follow the instructions to the on-line query form. The catalog will also be made VO-compliant and published in the near future. If you need the entire catalog, please contact the authors. This catalog will also be included in the upcoming UCAC4 release.

Future Improvements

As mentioned above, several known deficiencies will be removed in later releases. As we near completion of the main survey, fewer and fewer fields will remain for imaging. We are considering extending the survey to brighter magnitudes, and to using the Las Cumbres Zs and Y filters to keep the telescopes busy. After all imagery is completed, we will be performing a global solution to homogenize the photometry, and will stack images to improve our magnitude limit. Finally, all images and epoch photometry are expected to be released to the general community for data mining.

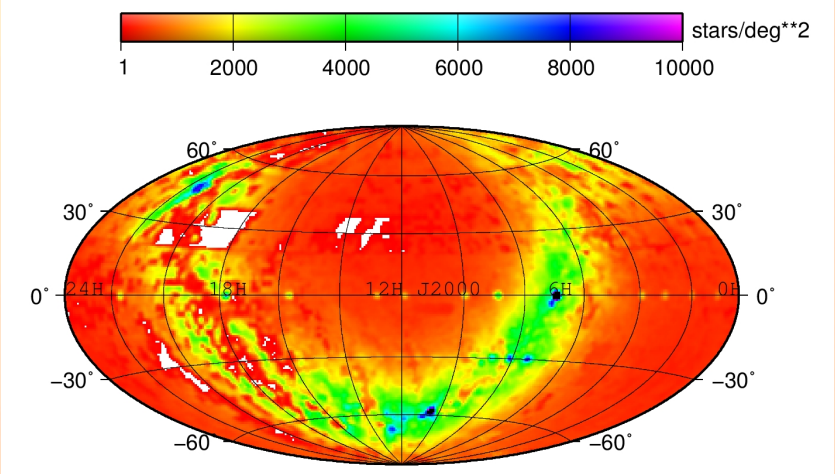

Figure 6: Current coverage map of the primary survey (2 visits per field). About 95% of the sky is covered; the remainder has one visit. (credit: E. Los)