

# Photometric Calibration of SkyMapper

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# The Australian National University's SkyMapper

## What is it?

- A southern Sloan photometric survey?  
No not entirely...
- 1.3m modified Cassegrain with a 5.7 square degree field of view
- Sited at the Australian National University's Siding Spring Observatory
- Fully automated, remote facility
- Data transferred via Gigabit link to ANU
- Aiming for science operation late 2008
- To conduct the Southern Sky Survey:
  - Five year
  - Multi-colour (6 filters)
  - Multi-epoch (6 exposures, each filter)
  - entire southern sky to  $g \sim 23$ rd
- nightly data rate up to 0.8TB, data set of 324TB science + 150TB calibration
- Enable global access to 30TB via web
- Summary of program: Keller et al. 2007



# The SkyMapper CCDs

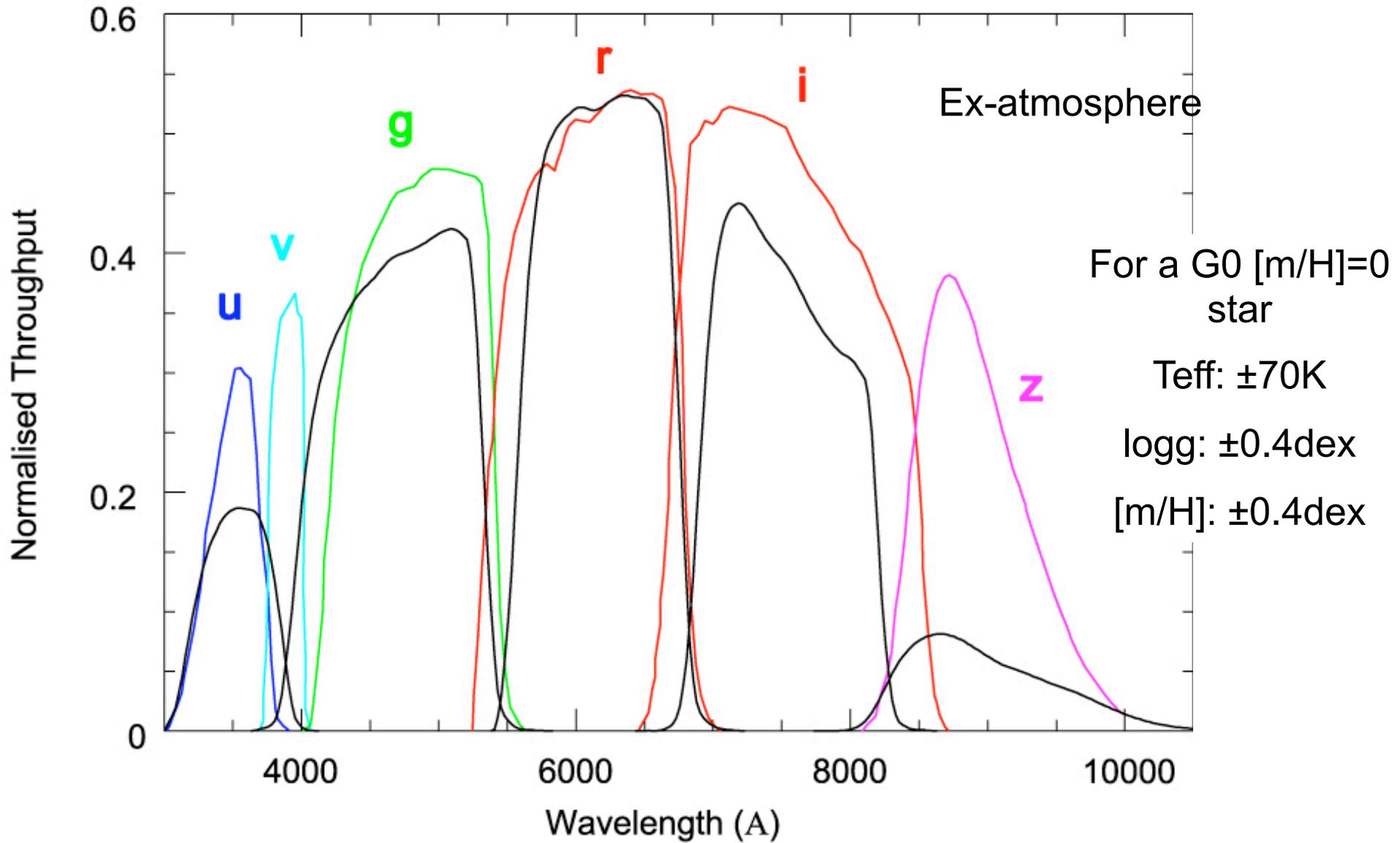
- A mosaic of 32 2kx4k CCDs.
- 0.5" per pixel = 5.7 square degrees fov.
- Using new STARGRASP controllers
- Readout in ~15 seconds
- Readnoise  $\sim 5e^-$  @ 15 seconds
- ➔ 1000 square deg. per night



# The Southern Sky Survey

- $2\pi$  coverage: 4096 fields observed in six filters, six times per filter
- Cadence: hours, days, weeks, months, years
- star/galaxy photometry to 3% globally ( $g < 18$ )
- astrometry to 50 milliarcsec (absolute)
  - 36 images of each object over 5 years
    - ⇒ proper motions to  $\pm 2$  mas/yr. (i.e.  $\sigma_{\text{tan}} = 25 \text{ km/s}$  at 2.5 kpc)
    - ⇒ parallax  $\pm 5$  mas (i.e. 20 pc  $\sigma_d = 10\%$ )
- survey complete in 5 years

# SkyMapper Filter Set

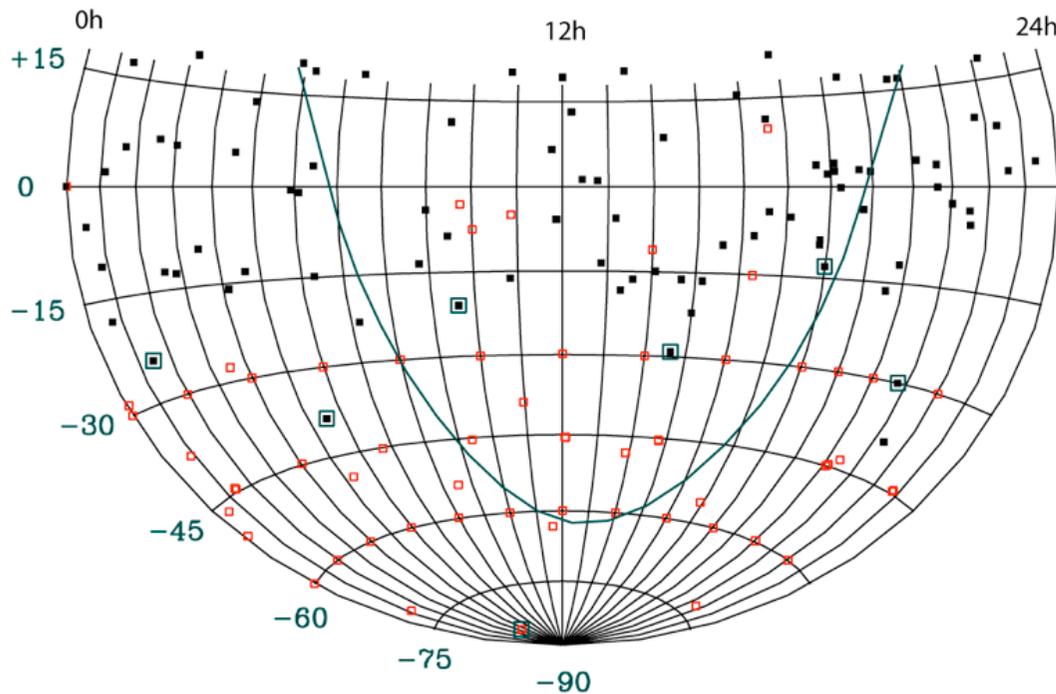


# Expected Survey Limits

	<i>u</i>	<i>v</i>	<i>g</i>	<i>r</i>	<i>i</i>	<i>z</i>
1 epoch	21.5	21.3	21.9	21.6	21.0	20.6
6 epochs	22.9	22.7	22.9	22.6	22.0	21.5
Sloan Digital Sky Survey comparison	22.0	n/a	22.2	22.2	21.3	20.5

AB mag. for signal-to-noise = 5 from 110s exposures

# SkyMapper's Calibration Plans



- Understanding the illumination correction is critical to our calibration efforts.

## Establishment of Photometric + Astrometric Reference Fields

- We will establish 7 fields - 96 dithers covering 23 sq. deg. each
- Fields are chosen to have sufficient stellar densities and contain STIS spectrophotometric standards (Gregg et al.) and photometry from Hipparcos (Polar field contains Walraven standard).

- STIS Spectrophotometric Standard (Gregg et al.)
- ▣ SDSS Southern Extension Field (Smith et al.)
- ▣ SkyMapper Reference Fields

# SkyMapper's Calibration Plans

## Absolute Primary Standards and Transformations to Other Systems

- We will have 6 primary standards to derive absolute photometry
- Photometry is in the natural system of SkyMapper (i.e. the mean for the mosaic of CCDs).
- Primary standards to define AB magnitudes that may then be transformed into your choice of photometric system.
- In our sweep of the sky we will have a large number of standards with which to define these transformations.
- Note: our ability to provide an estimate of  $\log g$  enables us to avoid a major limitation of such transformations, that is, their dependency on surface gravity.

# SkyMapper's Calibration Plans

## The Five-Second Survey

- We will conduct the Five-Second Survey
  - cover  $2\pi$  in photometric conditions in 3 epochs of 5s.
  - cover magnitudes 7th - 16th.
  - During five-second survey nights observe the two highest reference fields and the polar field every 90 minutes.
- Anchor the deeper Main Survey to the Five-Second photometry and astrometry
  - This enables the Main Survey to proceed under non-photometric conditions.

# SkyMapper's Calibration Plans

## Astrometry

- We tie to the UCAC2 standards
- In establishing our reference fields one of our goals is to understand the astrometric distortions of our imager.
  - fit ZPN model for WCS
  - investigate distortions by looking at residuals derived after rotating the imager

# SkyMapper's Calibration Plans

## Monitoring Photometric Nature of the Night

- Establishing the photometric nature of a Five-Second night is critical.
- A monitoring strategy:
  - monitor the zeropoint of the system in each science frame utilising photometry for the stars contained within it.
  - At first we utilise a set of uvgriz magnitudes created from the merged NOMAD + 2MASS catalogues
  - This will be superseded later by the Five-Second survey itself.

# Summary

- SkyMapper's Southern Sky Survey will provide a valuable resource for the southern sky
  - uniform optical survey deeper than SDSS limits over the entire southern sky (galactic plane included)
- On sky end of this year
- First data products late 2009
- Providing a freely available resource for the southern skies

