SkyMapper

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Who is SkyMapper?

Skymapper Team of
14 engineers
6 academics
and 5 students
SkyMapper

- 1.3m modified Cassegrain with a 5.7 square degree field of view
- Sited at the ANU’s Siding Spring Observatory
- Fully automated, remote facility
- Data transferred via Gigabit link to ANU
- Aiming for science operation late 2008
- Main Purpose is to conduct the Southern Sky Survey (SSS):
  - Multi-colour (6 filters)
  - Multi-epoch (6 exposures, each filter)
  - entire southern sky to g~23rd
  - 5 years for completion
- 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 Rapid Imaging Survey Era

<table>
<thead>
<tr>
<th>Name</th>
<th>Aperture (m)</th>
<th>FOV (sq deg)</th>
<th>Filter Set</th>
<th>Areal Coverage</th>
<th>Hemisphere</th>
<th>First Light</th>
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<tbody>
<tr>
<td>SDSS</td>
<td>2.5</td>
<td>Drift scan</td>
<td>ugriz</td>
<td>1/3 of 3/2π</td>
<td>N</td>
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<td>CFHT MegaCam</td>
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<td>&lt;1000 deg^2</td>
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<td>PanStarrs</td>
<td>1.8 (+3x)</td>
<td>7</td>
<td>grizY</td>
<td>3π</td>
<td>N</td>
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<td>5.7</td>
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<td>2π</td>
<td>S</td>
<td>2008</td>
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<td>VISTA</td>
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<td>1.65</td>
<td>zYJHK</td>
<td>2π</td>
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<td>~5000 deg^2</td>
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<td>10</td>
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<td>3π</td>
<td>S</td>
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</table>
The SkyMapper CCDs

- A mosaic of 32 2kx4k CCDs.
- $ 2.5 M
- 0.5” per pixel = 5.7 square degrees fov.
- Using new STARGRASP controllers
- Readout in ~15 seconds
- Readnoise ~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 ±2 mas/yr.
      (i.e. $\sigma=25$ km/s at 2.5 kpc)
    - Parallax ±5 mas (i.e. 20 pc $\sigma=10\%$)

- Interest / Difficulty:
  - High and Low Galactic latitude fields
    ~15000 deg$^2$: uncrowded fields
    ~6000 deg$^2$: crowded fields
# Expected Survey Limits

<table>
<thead>
<tr>
<th></th>
<th>$u$</th>
<th>$v$</th>
<th>$g$</th>
<th>$r$</th>
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<td>21.9</td>
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<td>22.0</td>
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<tr>
<td>Sloan Digital Sky Survey comparison</td>
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<td>22.2</td>
<td>21.3</td>
<td>20.5</td>
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AB mag. for signal-to-noise = 5 from 110s exposures
Survey Science

• What is the distribution of large Solar-System objects beyond Neptune?
• What is the history of the youngest stars in the Solar neighbourhood?
• How far does the dark matter halo of our galaxy extend and what is its shape?
• Gravity and metallicity for on order of 100 million stars ⇒ the assembly and chemical enrichment history of the bulge, thin/thick disk and halo?
• Extremely metal poor stars.
• Undiscovered members of the local group of galaxies
• bright z>6 Quasi-Stellar Objects ⇒ probes of the ionization history of the Universe.

• Photometric redshift of Spiral Galaxies to z~0.3 - 0.4, E0 to z~0.7 (±0.5)

+ Non Survey Science (25% of the time):
  - Planet Transits
  - GRB + Low-z Supernovae
  - Microlensing
  - ...

Status: Mirrors / telescope

Secondary from SAGEM (France) - 2006

Tucson / EOS 2007 - assembled

Primary made in Russia

First light July 2007
Status : Dome

Telescope on site - September 2008

Test on Alignment / Pointing / tracking
Site Acceptance Test - Delivery : February
Status: Camera

2006 - Focal Plane Dewar assembled

Bonn-Shutter - 2006

Filters u, r, z completed...

v, g about to be assembled

i awaits final coatings

CCDs from E2V - 2007

Camera fully mounted

Actual tests: read-noise, fast with multiple CCD

on site: March / April
High-z QSOs ($5.8 < z < 6.7$)

- SDSS has found 17 bright High-z QSOs (Mag Z < 20).
- 3 ($z > 6.2$) show complete Gunn-Peterson effect but WMAP polarisation measurements $\Rightarrow$ reionisation at $z \sim 15$: two separate eras of reionisation, patchy reionisation?
- A larger sample of very high redshift QSOs is needed. BUT only bright ones are really interested for 8m-class telescope follow-up!

- SkyMapper should be able to find $\sim 30$ bright high-z QSOs (1 per 400 deg$^2$). from Fan et al. Luminosity function, about 170 faint ones (Mag 20$<$Z$<$20.5)

- Avantage / SDSS :
  - Z band sensitivity (1 mag)
  - Multiple epoch : proper motion
High-z QSOs detection

- I-band dropouts.
But contaminants...

- L+T dwarfs (ratio 20/1), Rejected using proper motion and/or Infra-red photometry
- distance < 100pc  pm > 100 mas/yr
- Easier to eliminate the bright dwarfs (faster)

Infra-red broad-band photometry needed:

Fan et al. (2004)