

SKYMAPPER



Australian
National
University

It's a long way to the top of S S O

1 Jan 2003 - Our ARC DP grant starts.

E1 Title: The Southern Sky Survey

E2 Project Description, Aims and Background

Project Description and Aims: We propose to use the robotic Great Melbourne Telescope (GMT) to carry out an optical survey of the entire southern sky. The survey will be:

- Multi-Colour. We will observe at six wavelengths, from the near-UV to the near-IR
 1. **Photometric.** We will measure the brightness of each object detected, at each wavelength, with systematic errors of less than 0.02 mag
 2. **Astrometric.** We will determine the absolute positions of the objects we detect with an accuracy of better than 0.05 arcsec.
 3. **Sensitive to variability.** Each part of the sky will be observed multiple times, to look for time variability and movement.

The RSAA director has guaranteed that at least 80% of the Great Melbourne Telescope observing time will be devoted to this project, over 5 years. We will generate 25 terabytes of data and will detect more than 10^9 objects. All calibrated data will be made publicly available on-line via the ANU supercomputer facility.

We anticipate that the survey will be used for an enormous variety of scientific projects by astrophysicists worldwide for decades to come. The team members, however, are particularly interested in the following science goals:

- Mapping the distribution of dark matter in the outer regions of our own galaxy.
- Searching for high redshift QSOs to probe the reionisation of the universe.

20th January 2003



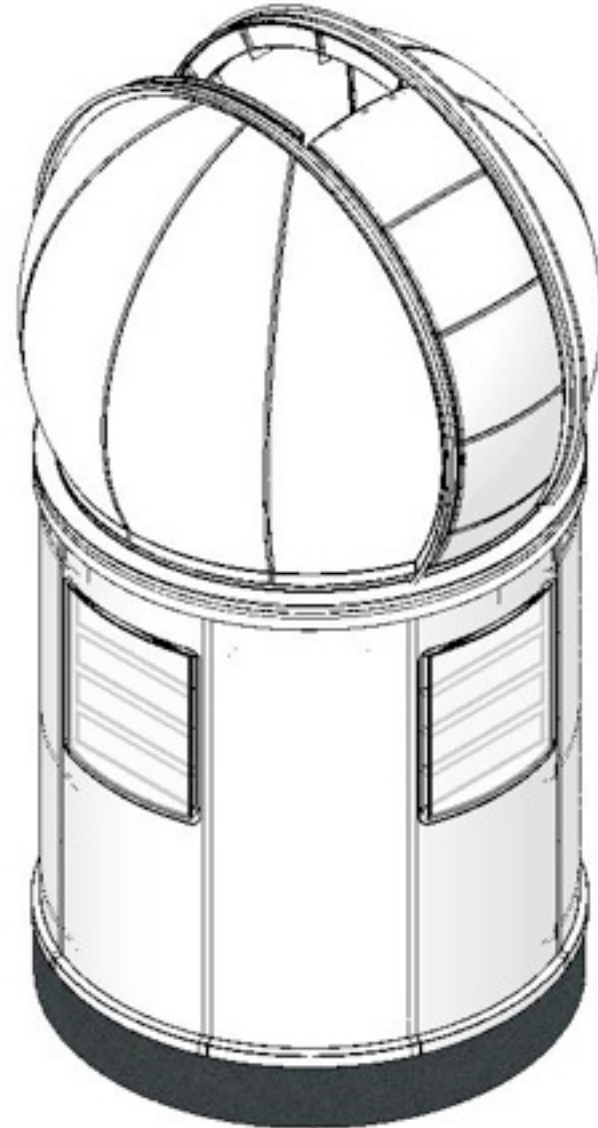
8 April 2003... Bushfire report to ARC

- 5. Supervise construction of a wide field (approx 7sq degree field of view) 1.8 meter telescope at Siding Spring Observatory. (New Goal)
- 6. Supervise construction of a >100 million pixel CCD array for the Siding Spring Survey Telescope. (New Goal)
- 7. Start taking data for the Southern Sky survey using the new Survey Telescope.

- ***Aug 2004***
- ***Contract let for 1.35m SkyMapper Telescope to EOS.***

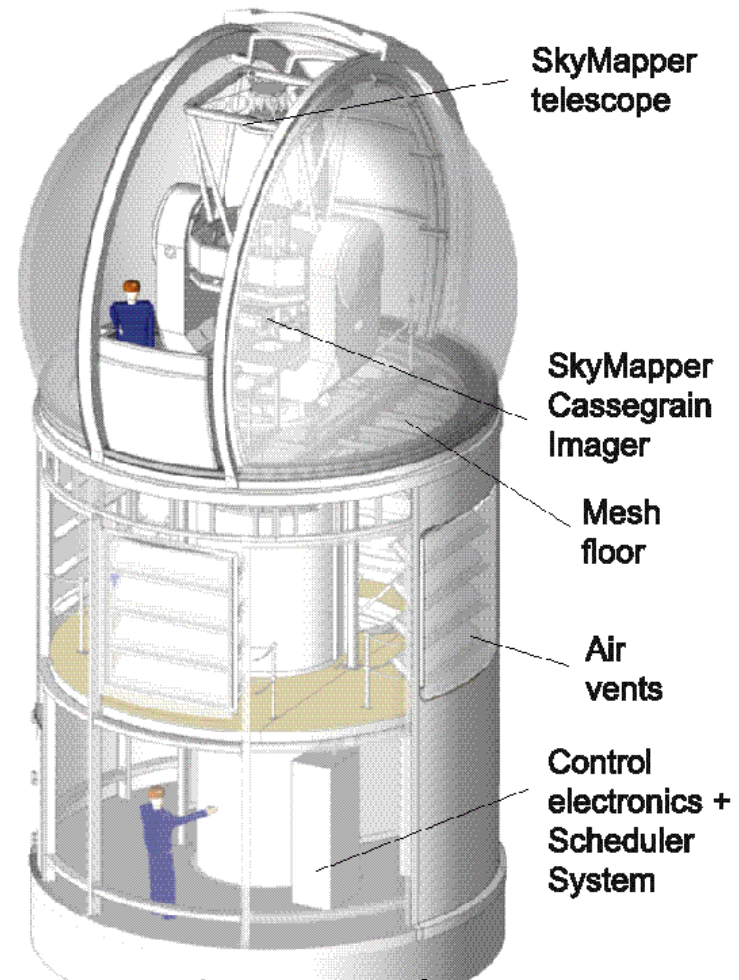


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What is SkyMapper?

- 1.35m telescope with a 5.7 sq. degree field of view
- Fully Autonomous observing
- To conduct the Southern Sky Survey:
 - Five year
 - Multi-colour (6 filters)
 - Multi-epoch (6 exposures, each filter)
 - 2π steradians
 - Limiting mag. $g \sim 23$
- Aiming for regular operations this year
- Summary of program: Keller et al. 2007 PASA 24,1



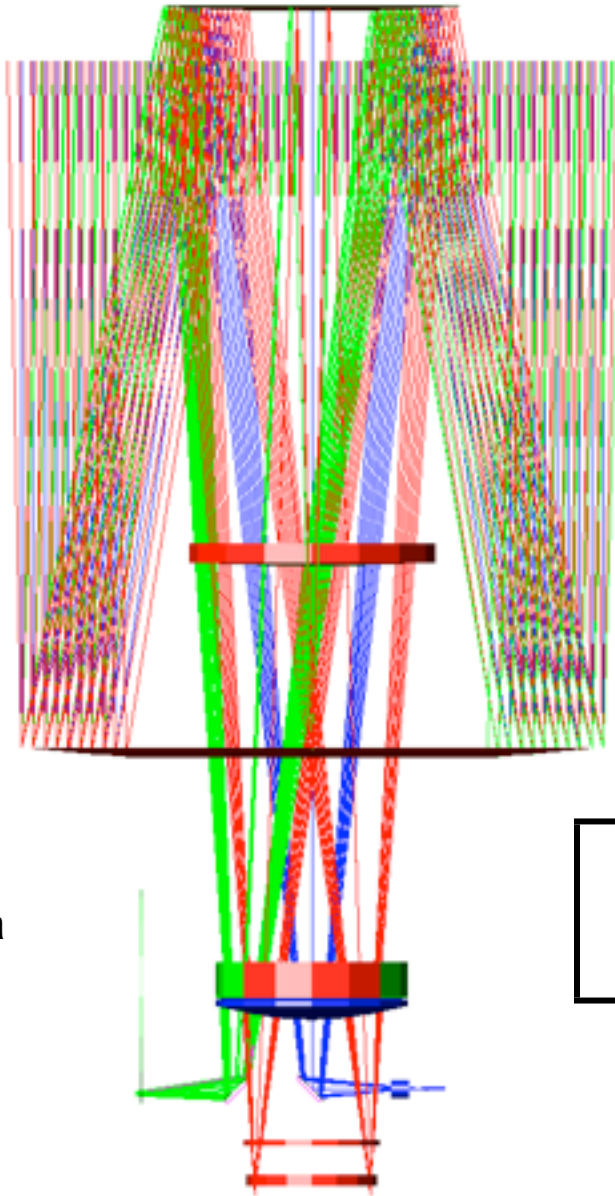
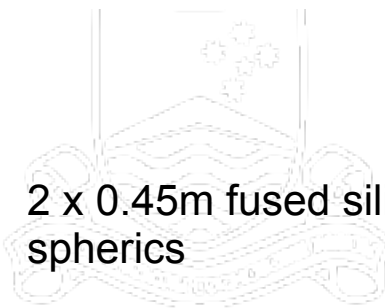
Telescope Optics

0.75m secondary

0.6m fused silica
asphere

1.3m primary

2 x 0.45m fused silica
spherics



Modified Cassegrain
design

Telescope – Focal length & f/ ratio.	16224.75mm f/4.78
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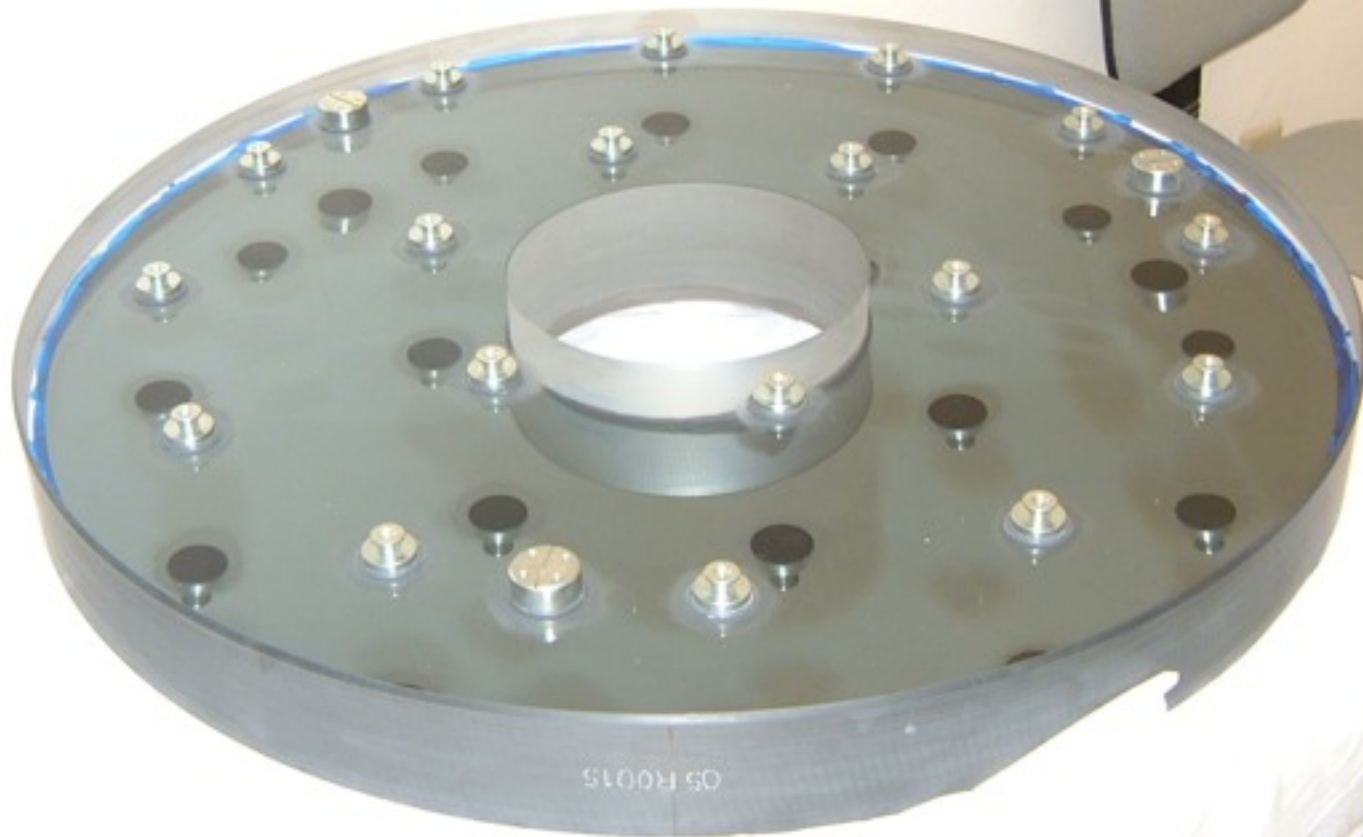
- **The Mirror Crack'd - 2005**
 - **The sequel**
 - **The Mirror Crack'd Part III**
 - **The Mirror Crack'd - The Final Chapter**
 - **New Mirror supplier**

2006 - Russian Deliver more or less on time

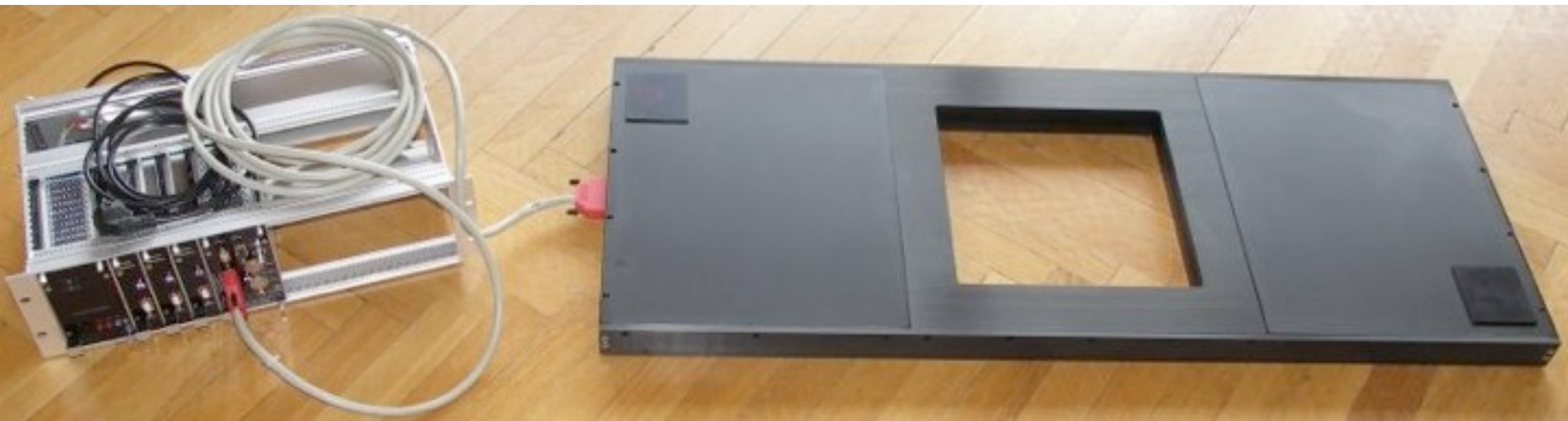


Secondary from SAGEM - 2006 - on time

CAUTION
SHARP EDGES
WEAR GLOVES
AND SAFETY GLASSES

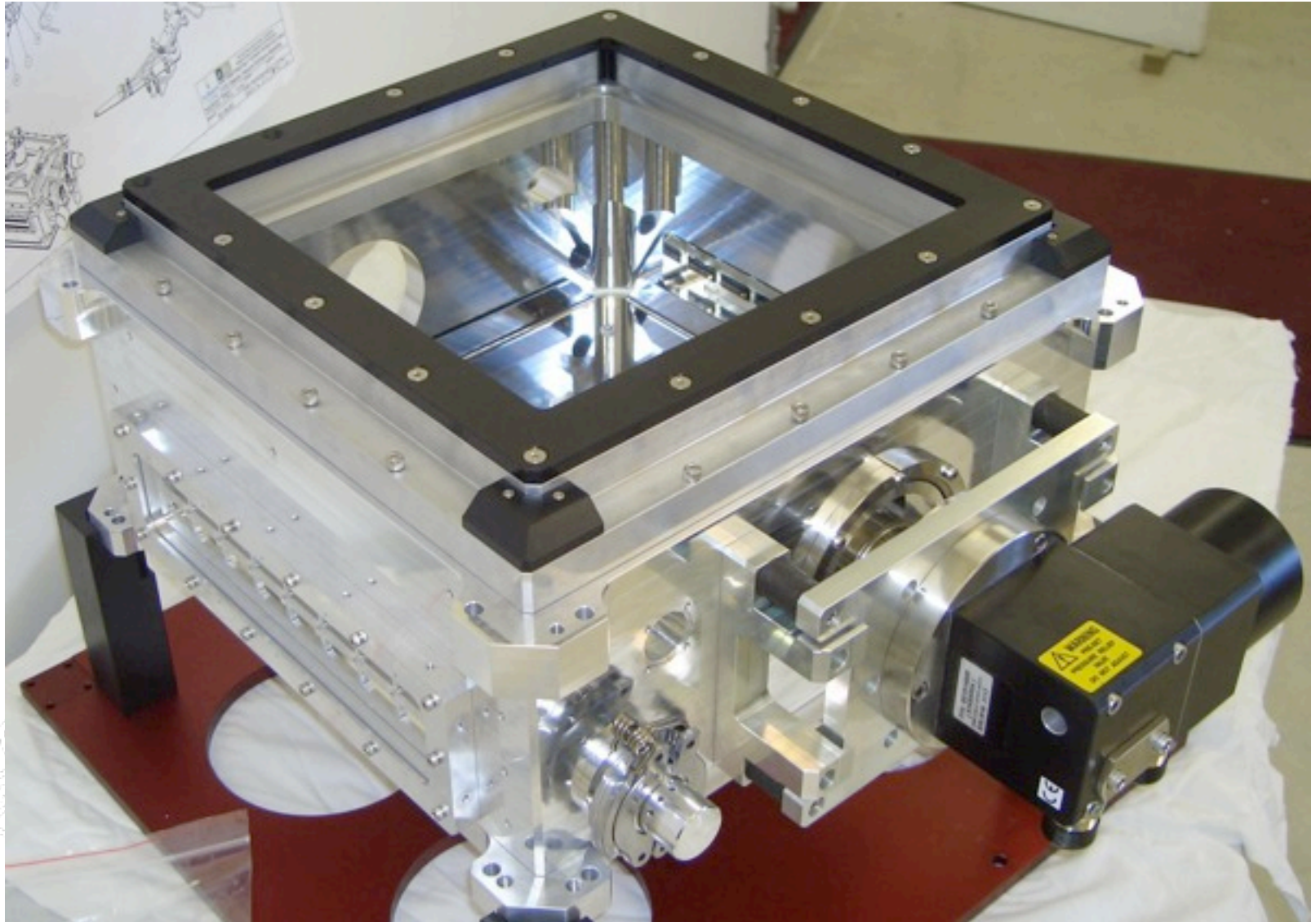


- **Bonn-Shutter - 2006 - arrives on time**





2006 - Focal Plane Dewar assembled



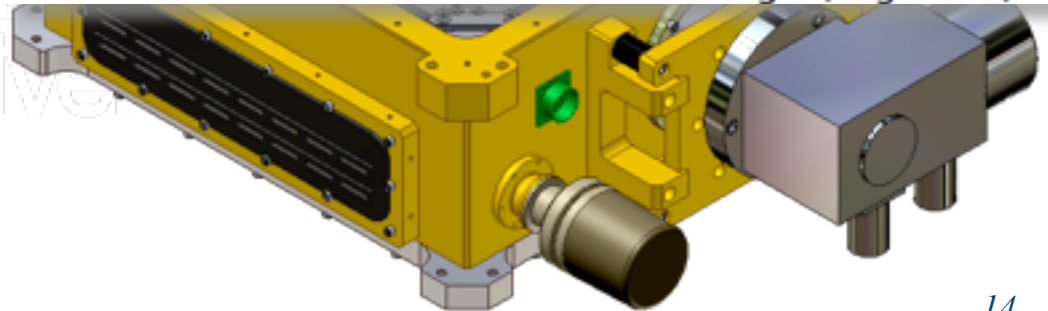
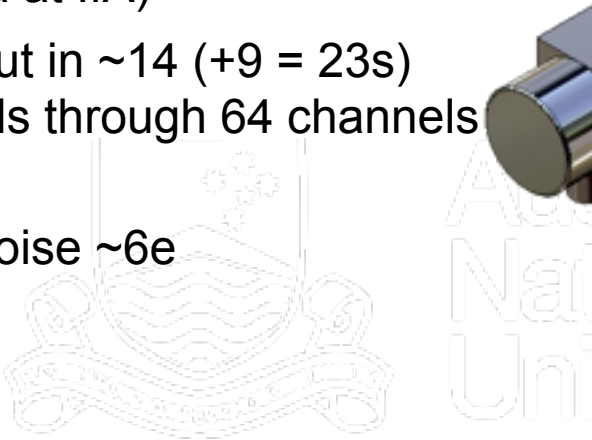
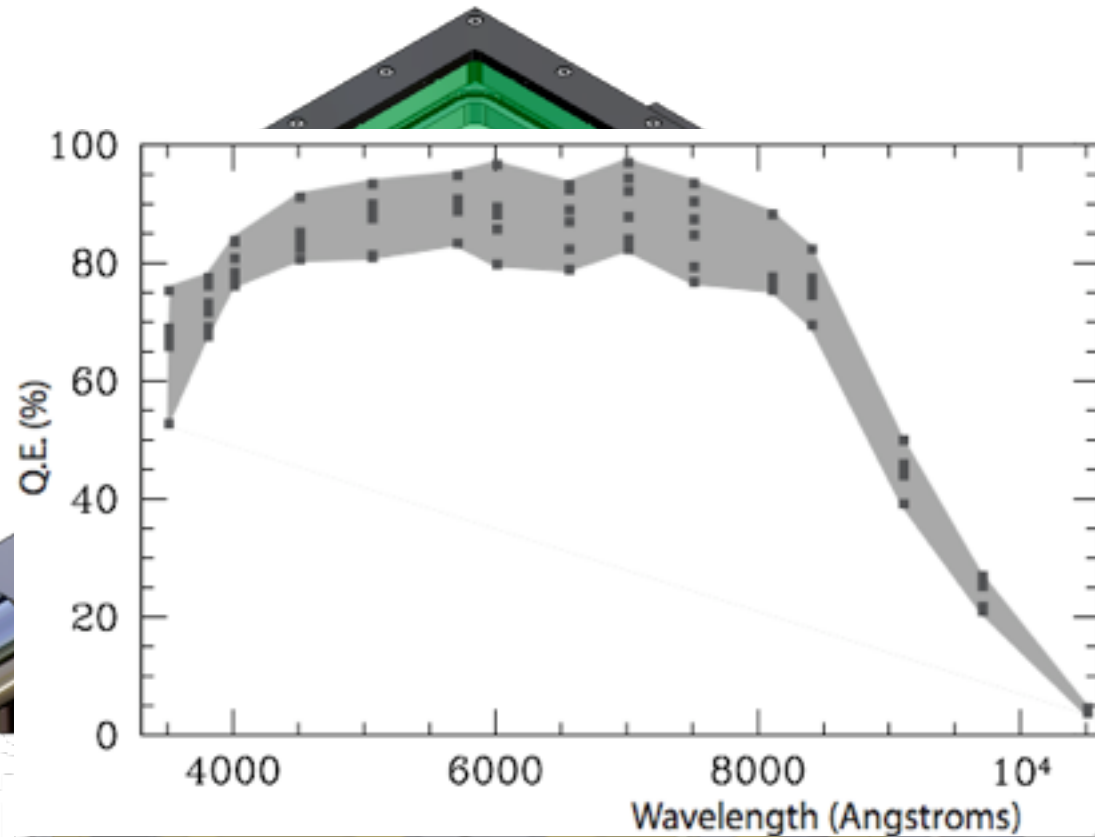
\$2.5M of CCDs from E2V - arrive in 2006, on time



Wednesday, 16 April 14

The SkyMapper CCDs

- 32 E2V CCD44-82 devices:
 - 2048x4096 15 micron pixel CCDs
 - Broadband coated
 - 40 micron (thick) devices
 - Reduced fringing, inc. red response, without bad blue
- 16384x16384 0.5" pixels
- Using new Pan Starrs controllers (Onaka at IfA)
- Readout in ~ 14 (+9 = 23s) seconds through 64 channels kpix/s)
- Readnoise $\sim 6e$



**\$40,000
of filter
glass from
Russia...**

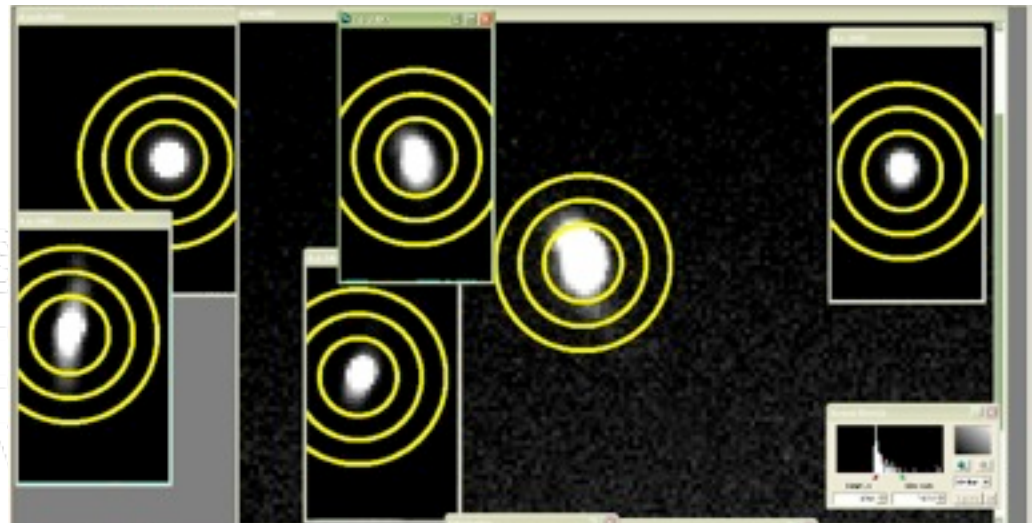
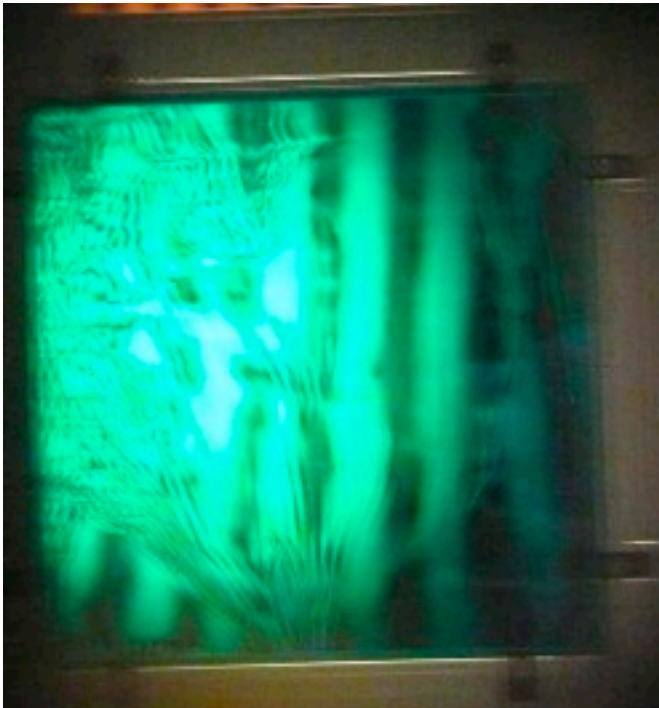
**Complete
with with
Cheese &
Pepperoni**



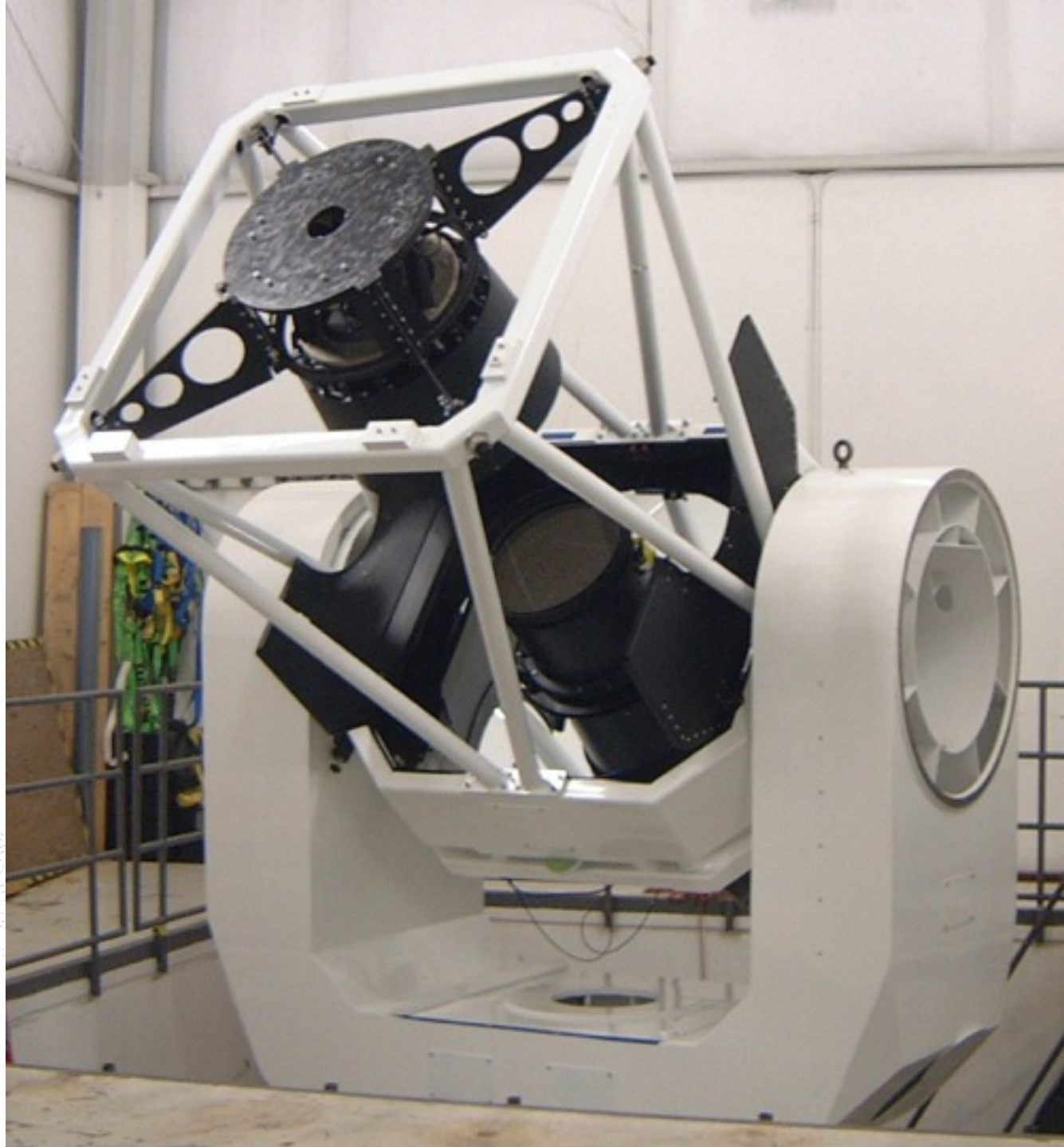
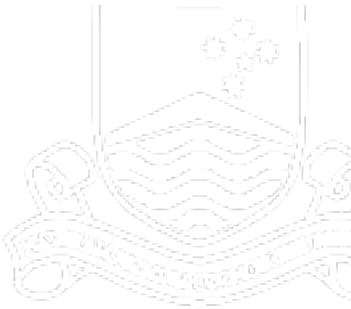
Filters:

u,r,z still complete

we await i filter to be finished in New Mexico
Gabe is investigating issues in our v,g glass.



- The whole thing put together mid 2007, in Tucson



- **First light, Tucson,**
- **July 2007**



Dome - 2007



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July 2008



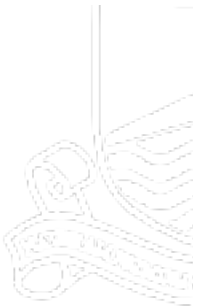
Telescope to SSO Sep 2008



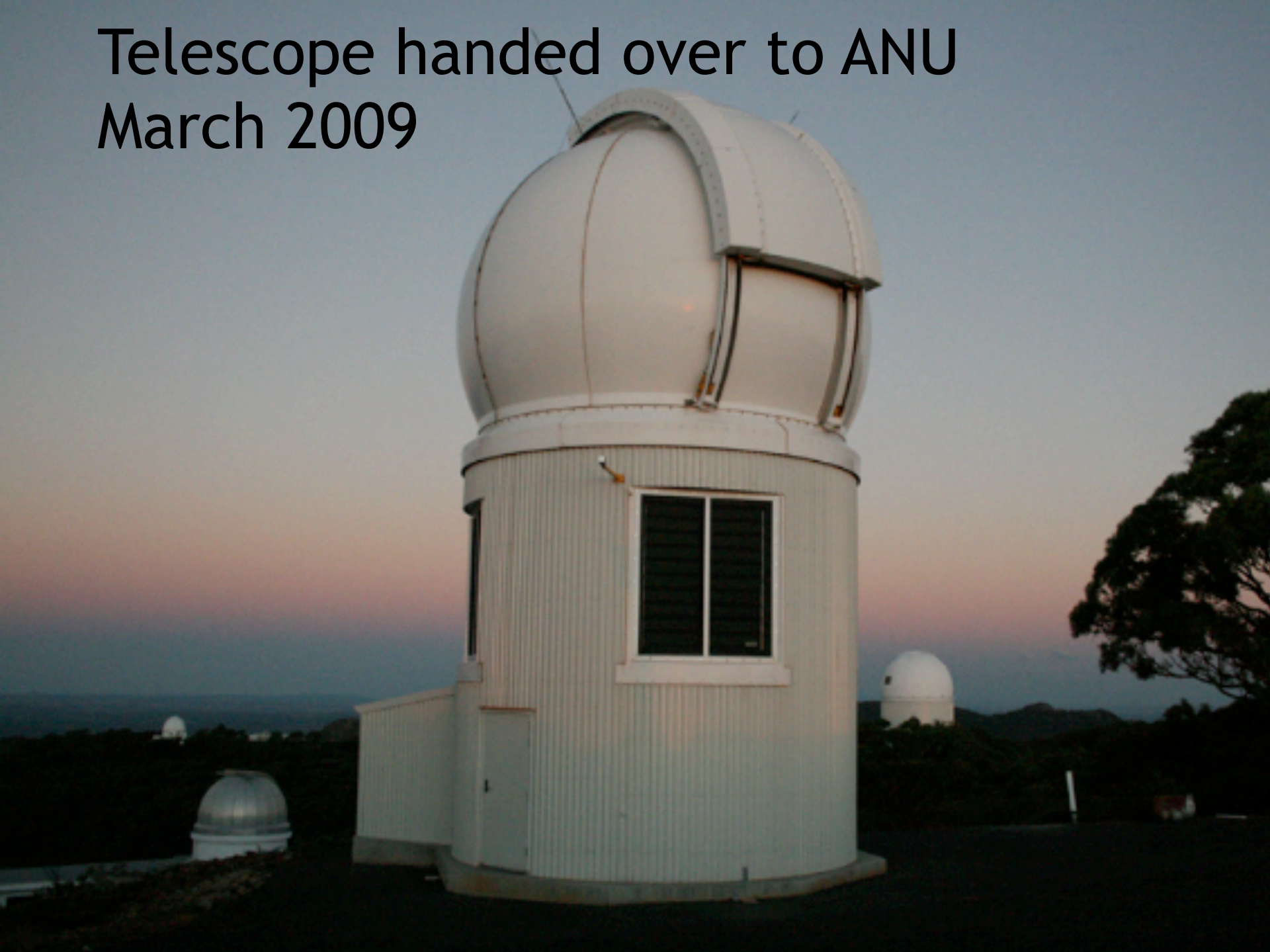
Telescope to SSO Sep 2008



Telescope to SSO Sep 2008



Telescope handed over to ANU March 2009





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CCD Array -2011

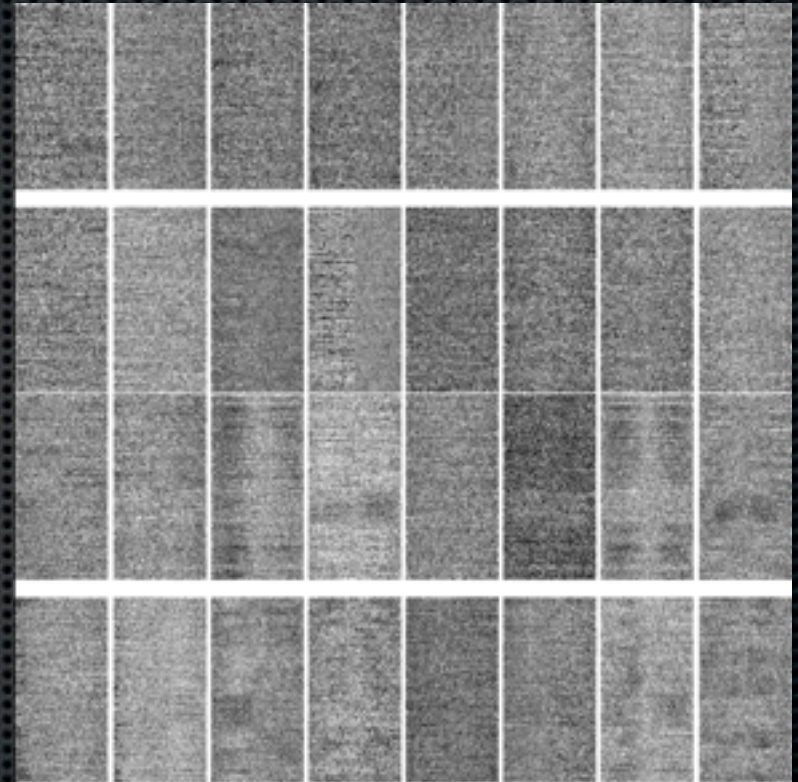
CCD Array has developed problems

Saturation problems largely resolved - caused by short on pin

Two chips failed - caused by short inside dewar between two adjacent pins.

Entire side has now failed due to power supply prob.

RN in some channels has increased over time



Text

CCD Array

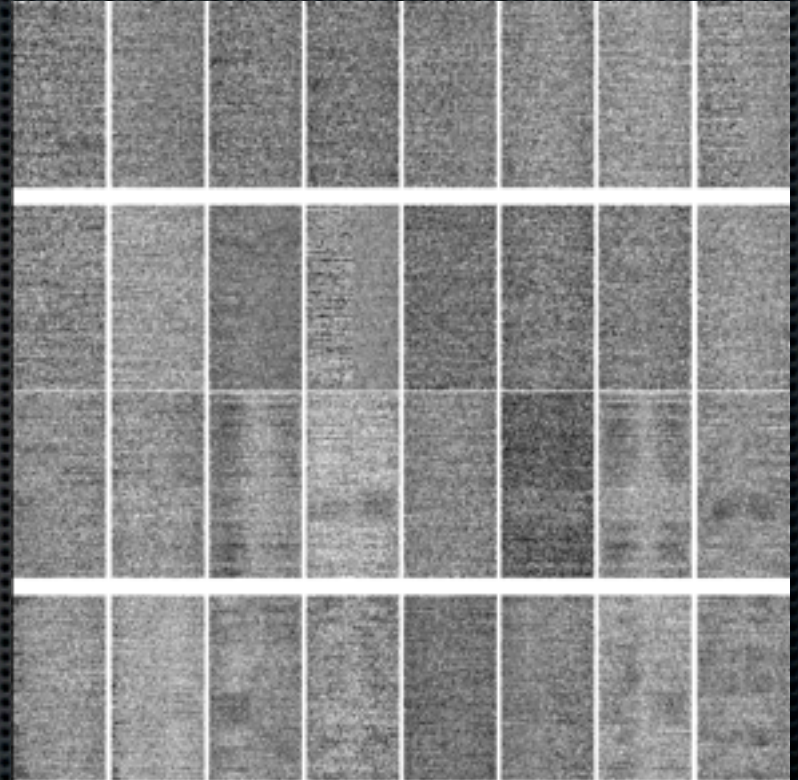
CCD Array delivered to
telescope in 2010

Taken until 2013 to get all
most of the issues sorted
with it including

lower noise

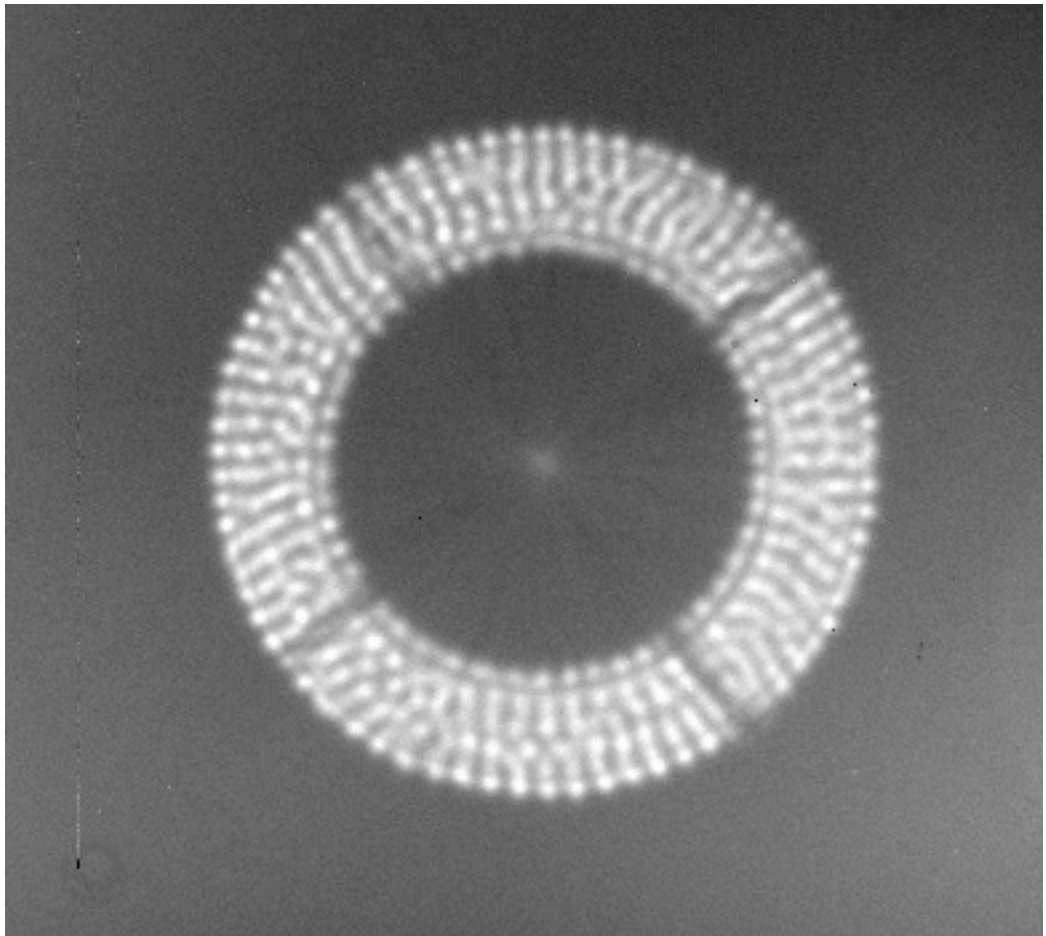
and fast cycle times

a fault inside the dewar





Looks scary, but seems to be a very small ripple on the primary from milling which does not affect overall imaging of telescope.
(pattern goes away at different focus values)

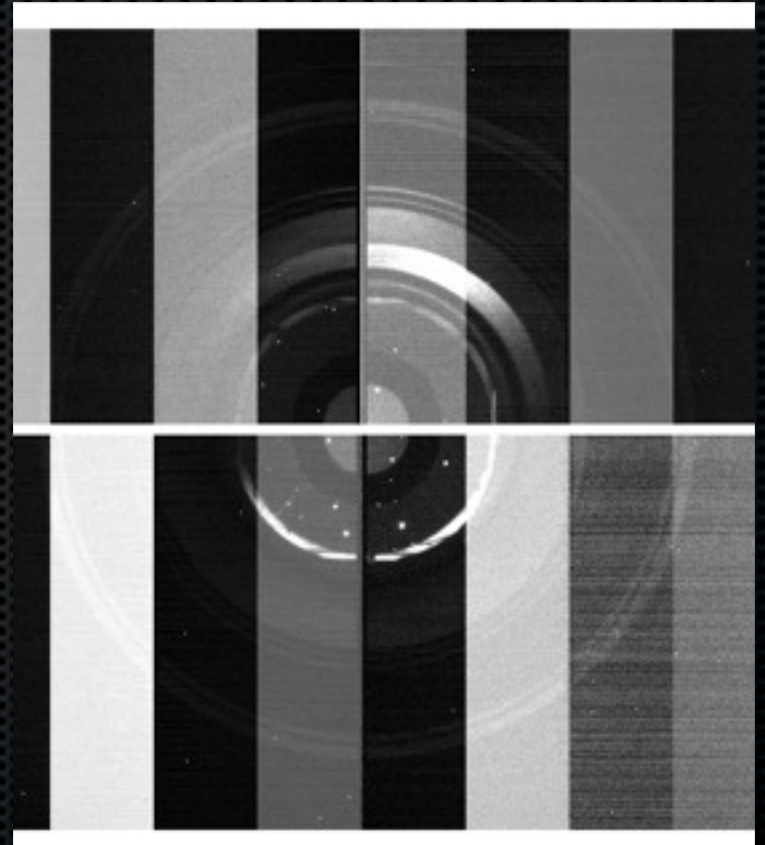


AN OUT OF FOCUS IMAGE

Optics

Images cleaned up considerably by masking edge of primary

Scattered light lowered through careful covering up of exposed white areas

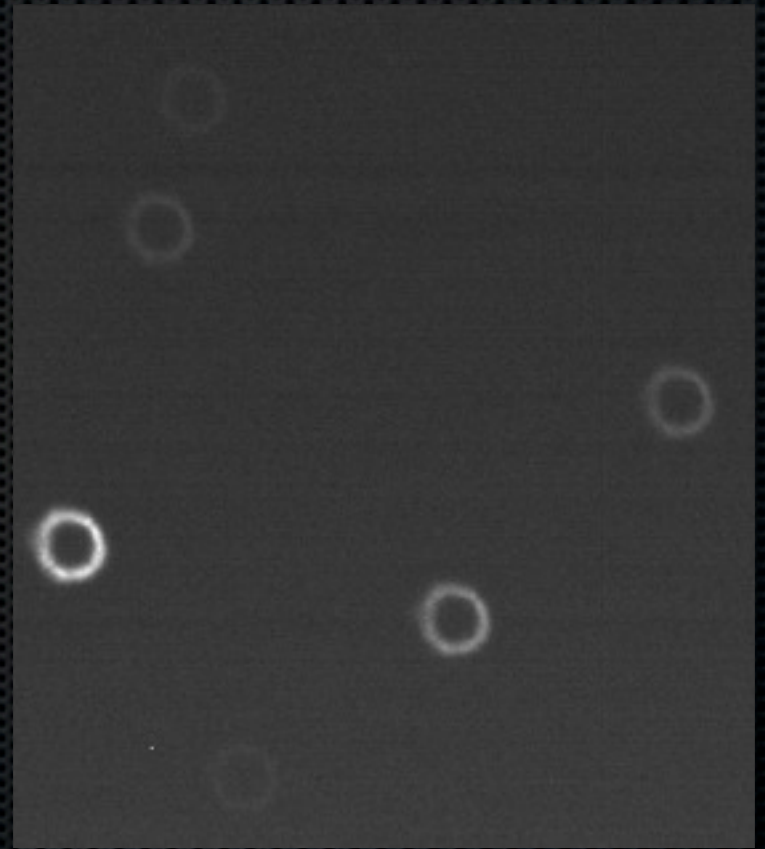


Optical Alignment

high-order pattern seems to be a nuisance, rather than a problem

Need more time to get optics aligned, but looks promising.

Central images limited by dome Temp



Dome Temp

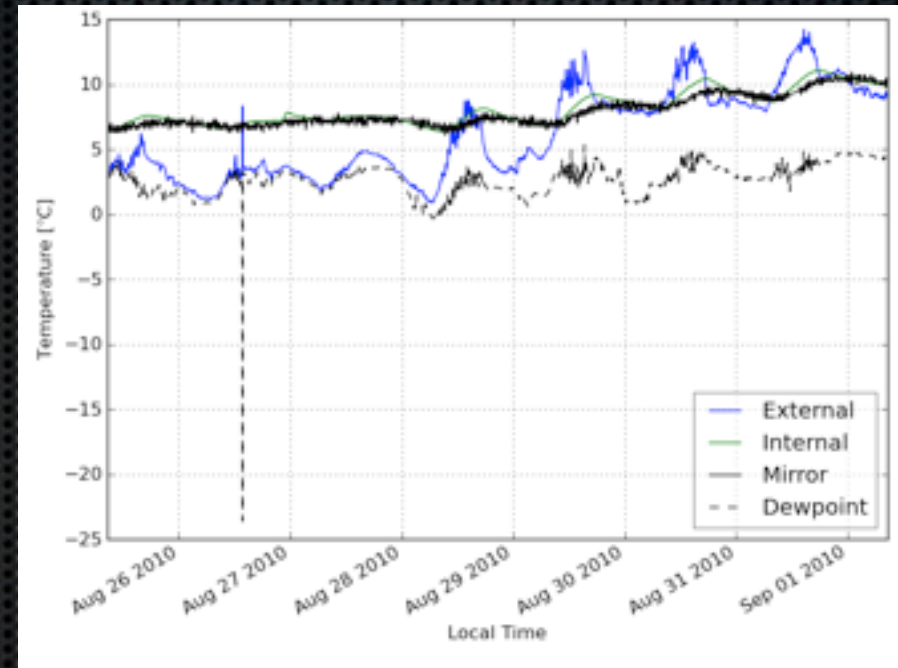
<http://www.mso.anu.edu.au/metdata/>

Plumbing issues preventing aircon from working perfectly. Longer term fix

We are currently generating 2kW in the dome because chilling system supplies too cold water to electronics and frosting/dew will occur. Short-term fix with second unit, will be addressed by longer term fix.

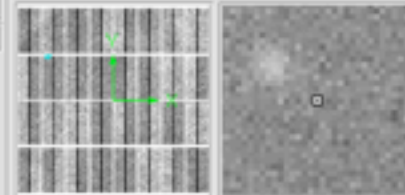
Dome leaks hot air around vents. Investigated next week with thermal camera.

Probably need addition Aircon unit.



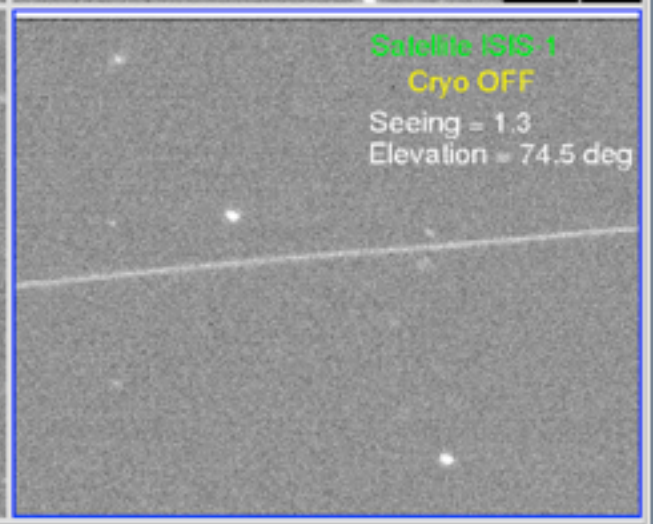
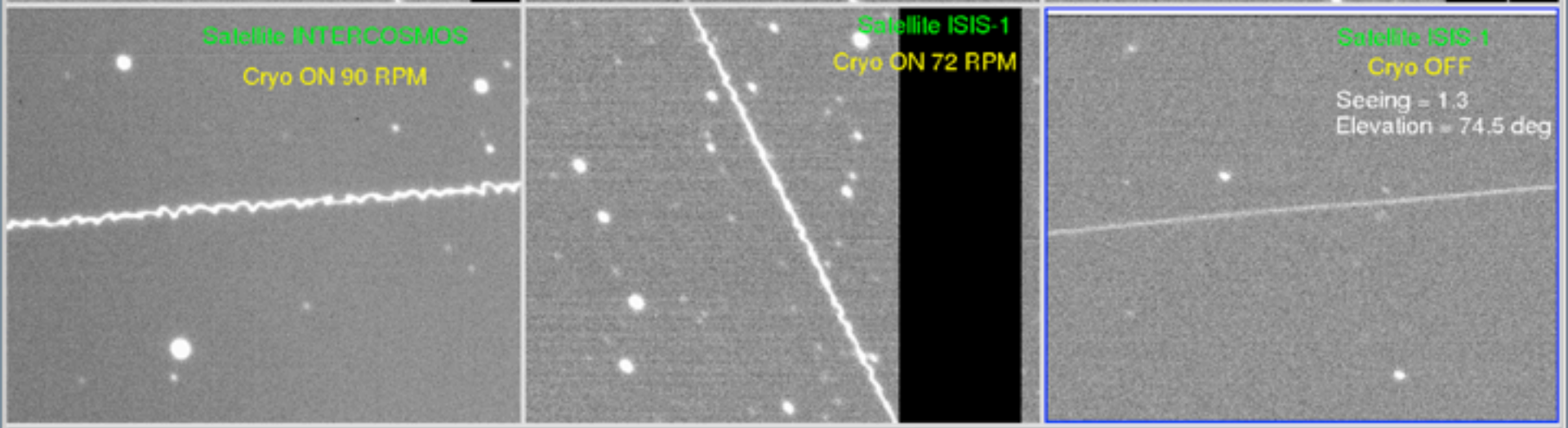
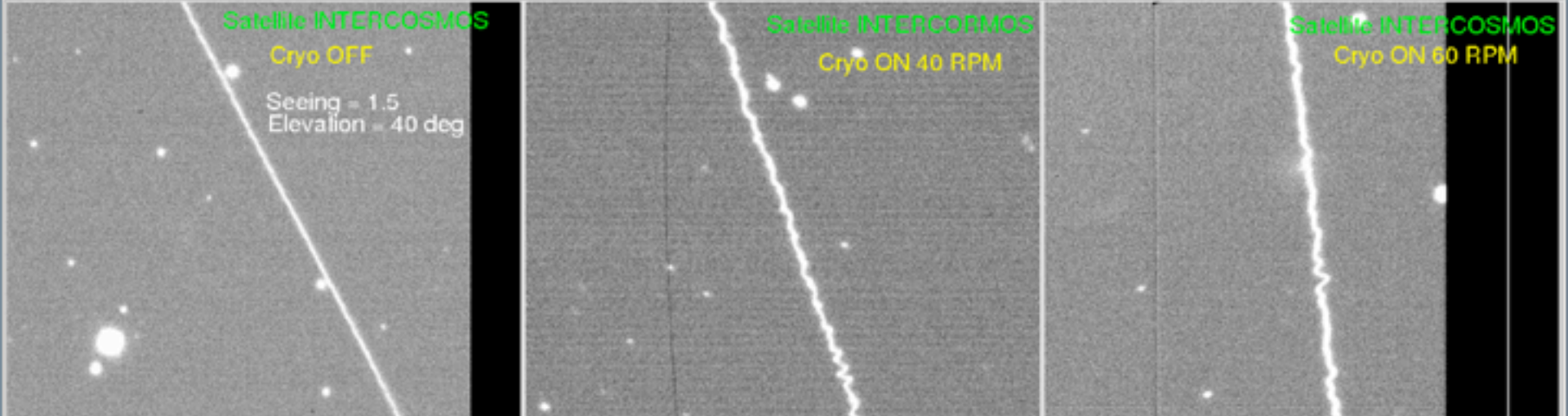
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help

File: ccd00039.fits[im6]
 Object: Satellite INTERCOSMOS
 Value: 2885
 WCS: [] []
 Physical X: 346.000 Y: 305.000
 Image X: 346.000 Y: 305.000
 Frame4 Zoom: 1.000 Angle: 0.000



file edit view frame bin zoom scale color region wcs help

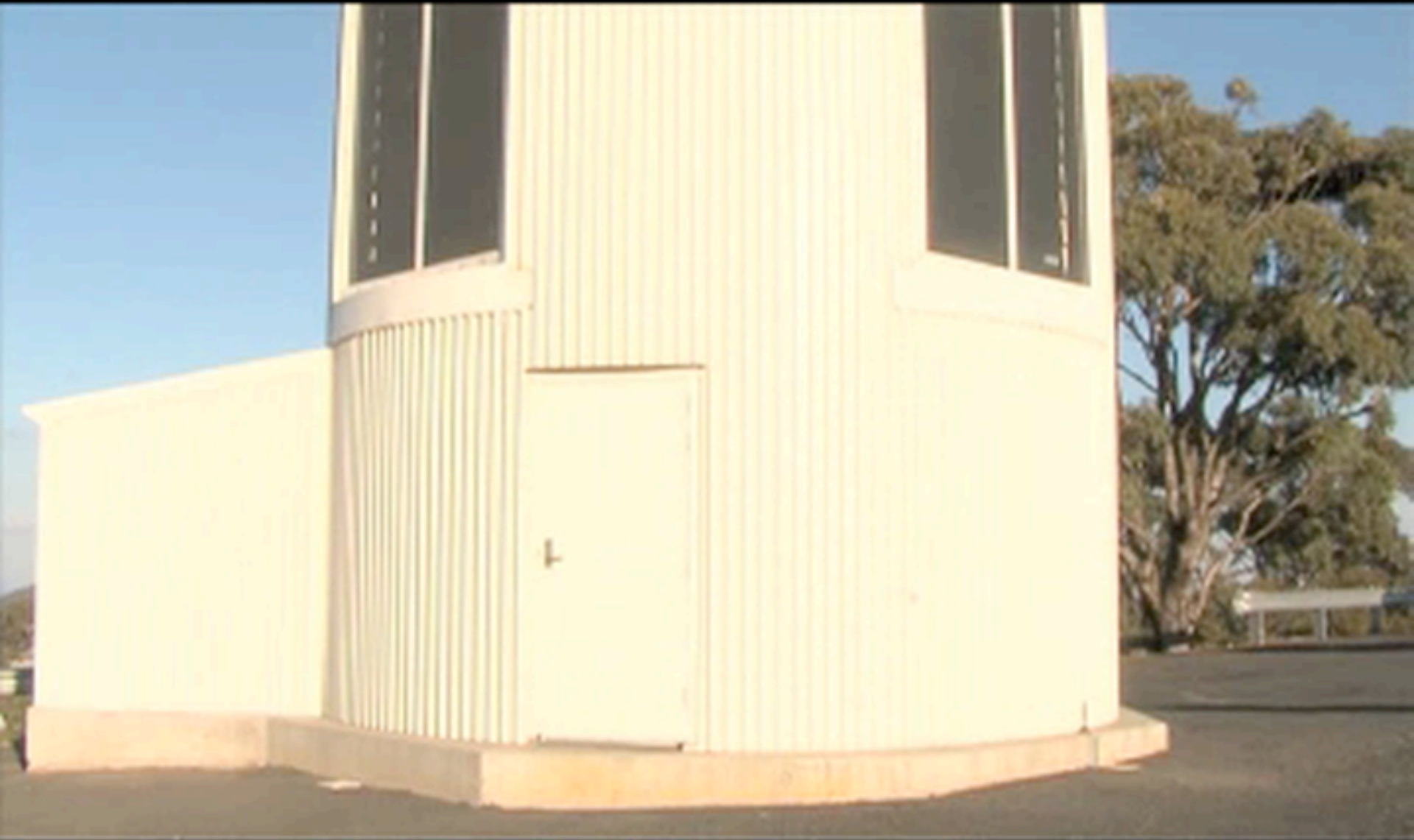
- * zoom 1/8 zoom 1/4 zoom 1/2 zoom 1 zoom 2 zoom 4 zoom 8





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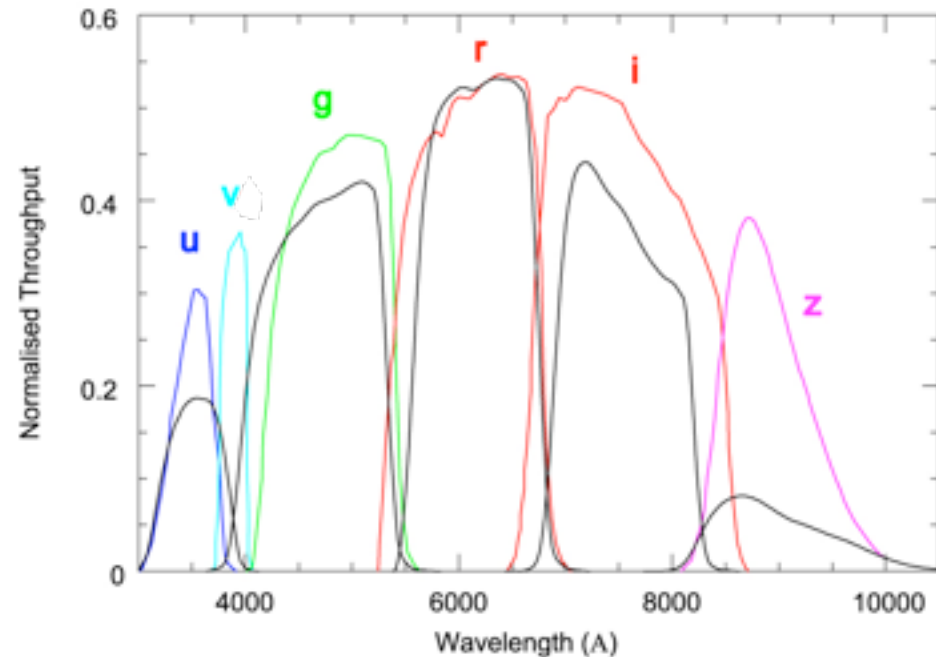


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SkyMapper

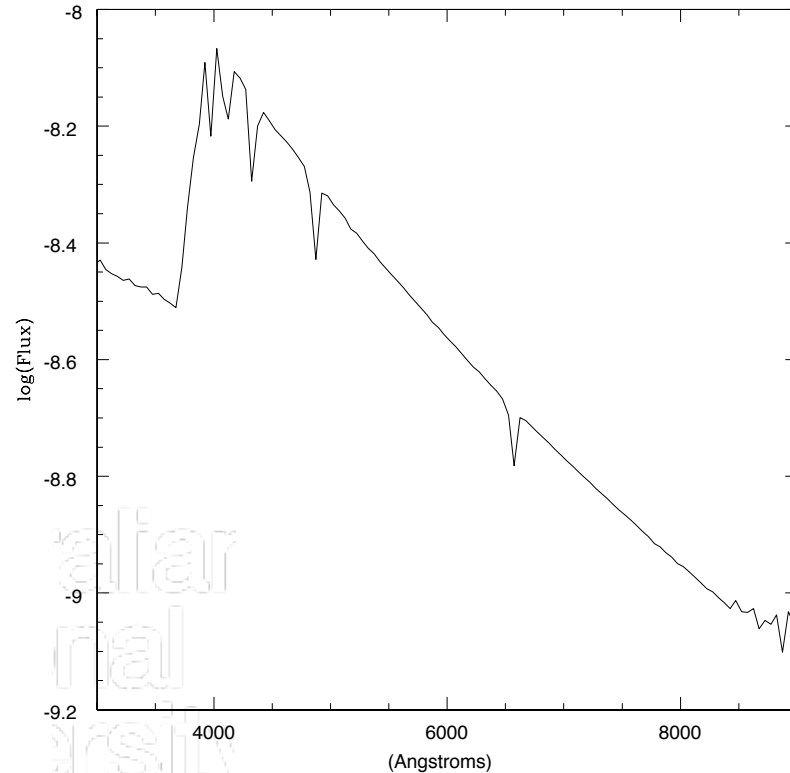
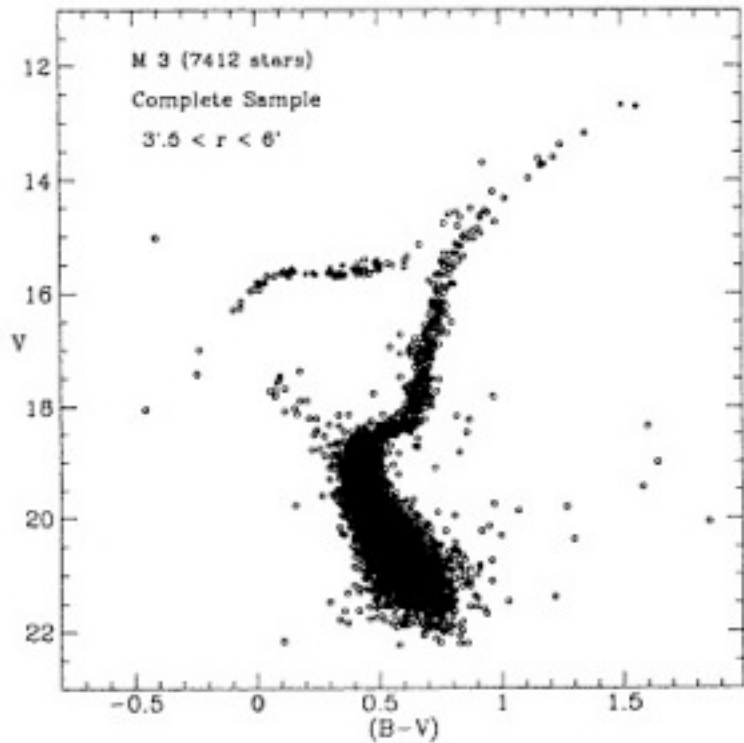
Optimised for Stellar Astrophysics

- Encoded in the spectrum of each star
- Using filters we can isolate portions of the spectrum
- In designing our survey we sought to optimise our ability to determine the three important stellar parameters (T , $\log(g)$, Z)
- so SkyMapper not only compliments survey efforts in the northern hemisphere but enables us to tackle important astrophysics in an exciting new way.



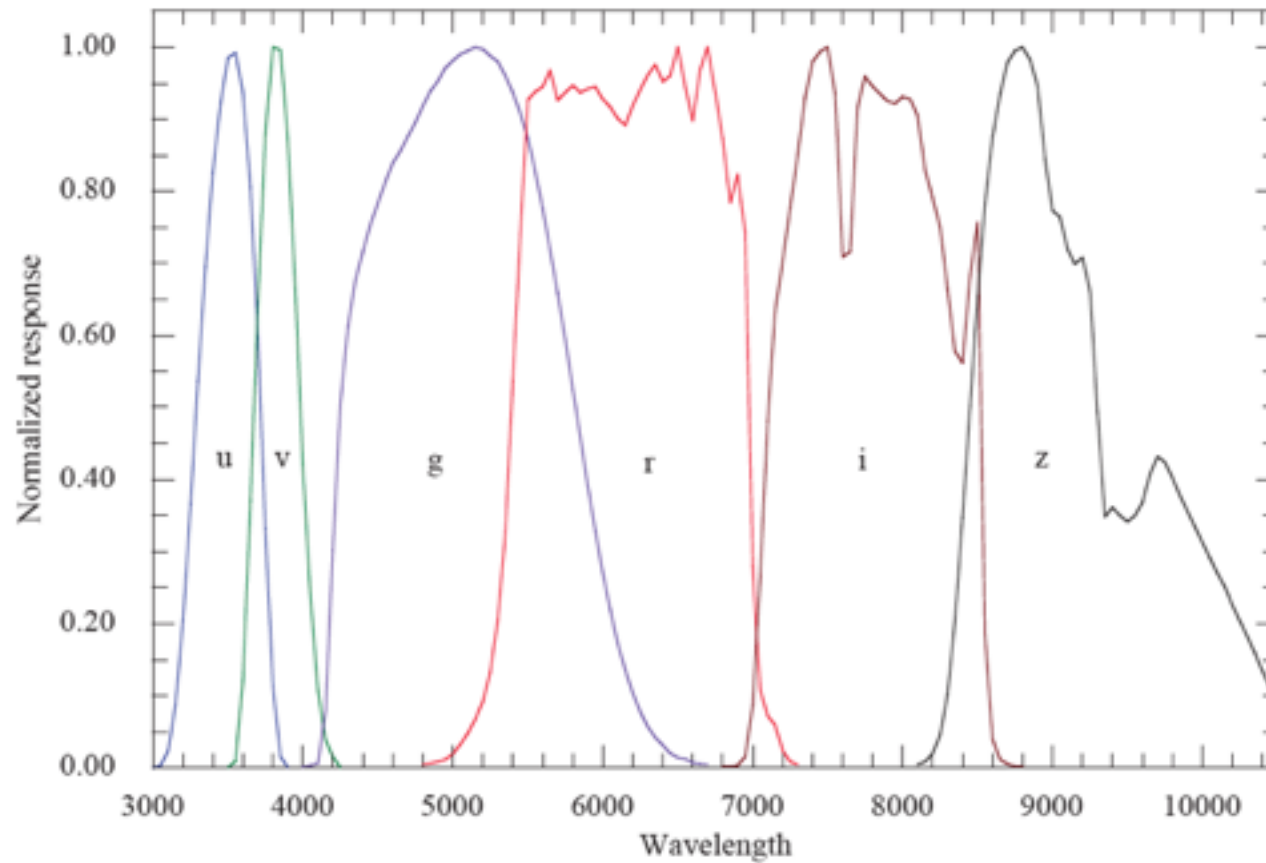
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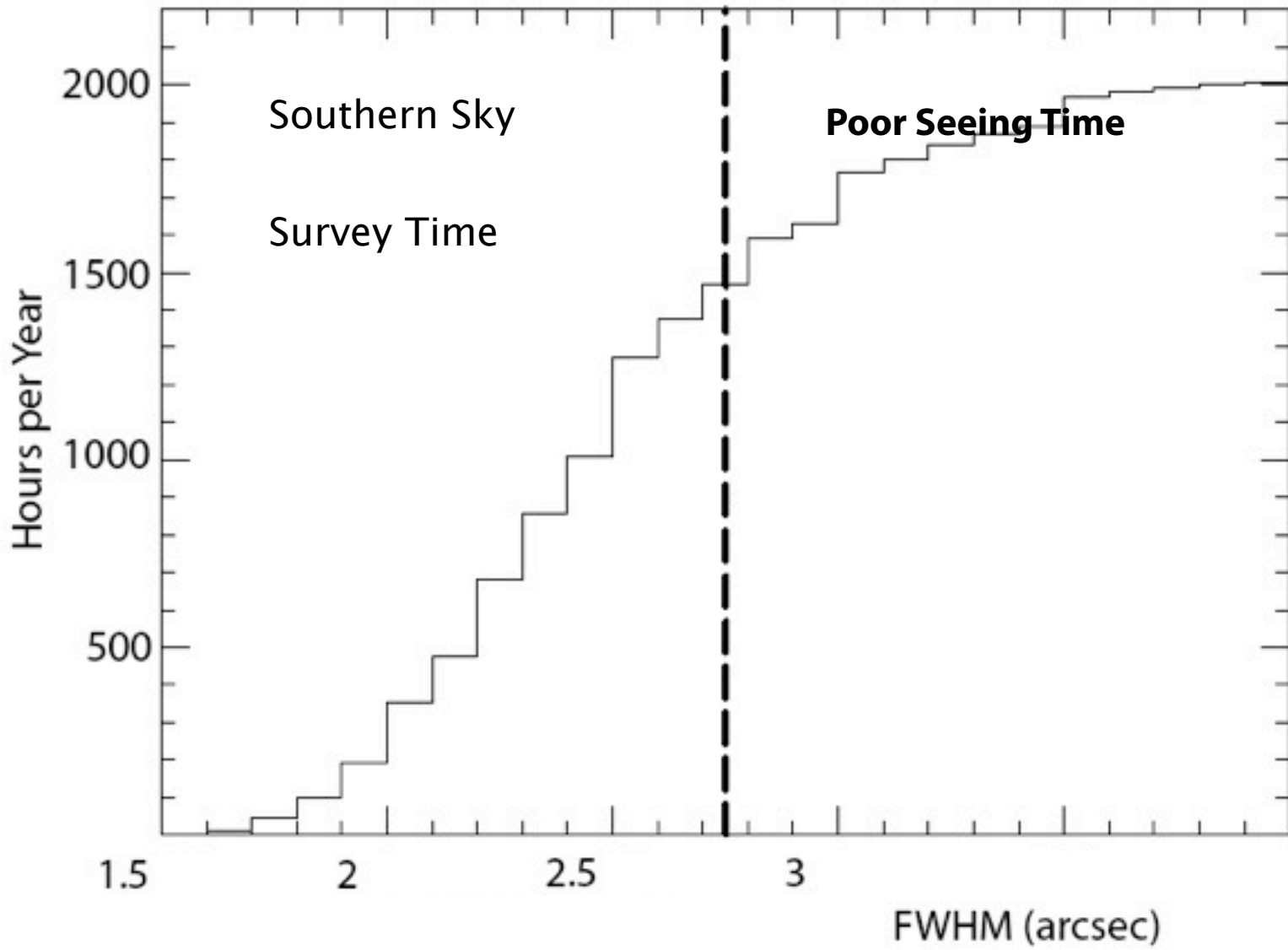
SkyMapper Filter Set is sensitive to Stellar Parameters



SkyMapper Filter Set

Filter+CCD
+Atmosphere





The Southern Sky Survey

($\geq 75\%$ of all available time)

- 2π coverage: 5-sec survey. Photometric and astrometric Calibration of the Southern Sky in 6-filters (3-epochs per colour)
- 2π coverage: ~ 4000 fields observed in six filters, six times per filter to a (13-22 mag)
- Cadence: hours, days, weeks, months, years
- Photometry to 0.03(0.01 aspiration) mag globally ($g > 18.5$)
- astrometry to 50 (15) mas
 - 36 images of each object over 5 years
 - \Rightarrow proper motions to $\pm 5(2)$ mas/yr. (i.e. $\sigma v \tan = 25 \text{ km/s}$ at 2.5(6) kpc)
 - \Rightarrow parallax $\pm 5(2)$ mas (i.e. 20pc (50) $\sigma d = 10\%$)
- survey complete in 5 years using 75% of telescope time

Data Release

Deliverables to the Outside User:

- Data (epoch, RA, DEC, mags, galaxy shape info,...) to be available through a web-served interface which provides catalogs over a user defined area
- Images to be available through a web-served interface which provides images over a user defined area (1 degree max, cut out of a 2-degree TAN projection across the sky), or individual frames.

Data release will occur after extensive data validation:

- Five-Second data after closure in RA and trial application to concurrently obtained main-survey data
- FDR Main Survey 3 epochs all filters
- SDR Main Survey 6 epochs all filters

The Rapid Imaging Survey Era- May 2010

Name	Aperture (m)	FOV (sq deg)	Filter Set	Areal Coverage	Hemi sphere	First Light
SDSS	2.5	Drift scan	ugriz	π of $3/2\pi$	N	Operating
CFHT MegaCam	3.6	1	ugriz	<1000	N	Operating
SkyMapper	1.35	5.7	uvgriz	2π	S	2007
PanStarrs	1.8 (+3x)	7	grizY	3π	N	2008
VISTA	4	1.65	zYJHK	2π	S	2008
VST	2.6	1	ugriz	~5000	S	2008
Discovery Chn	4	2	?	?	N	2009?
Dark Energy	4	2	?	5000	S	2009?
LSST	8.4	10	ugrizY	3π	S	2013

Quicklook 2014-04-05 16:00:00 to 2014-04-06 08:00:00 (AEST)

