CCD Imagers at CTIO: From 0.16 to 520 Megapixels

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National Optical Astronomy Observatory

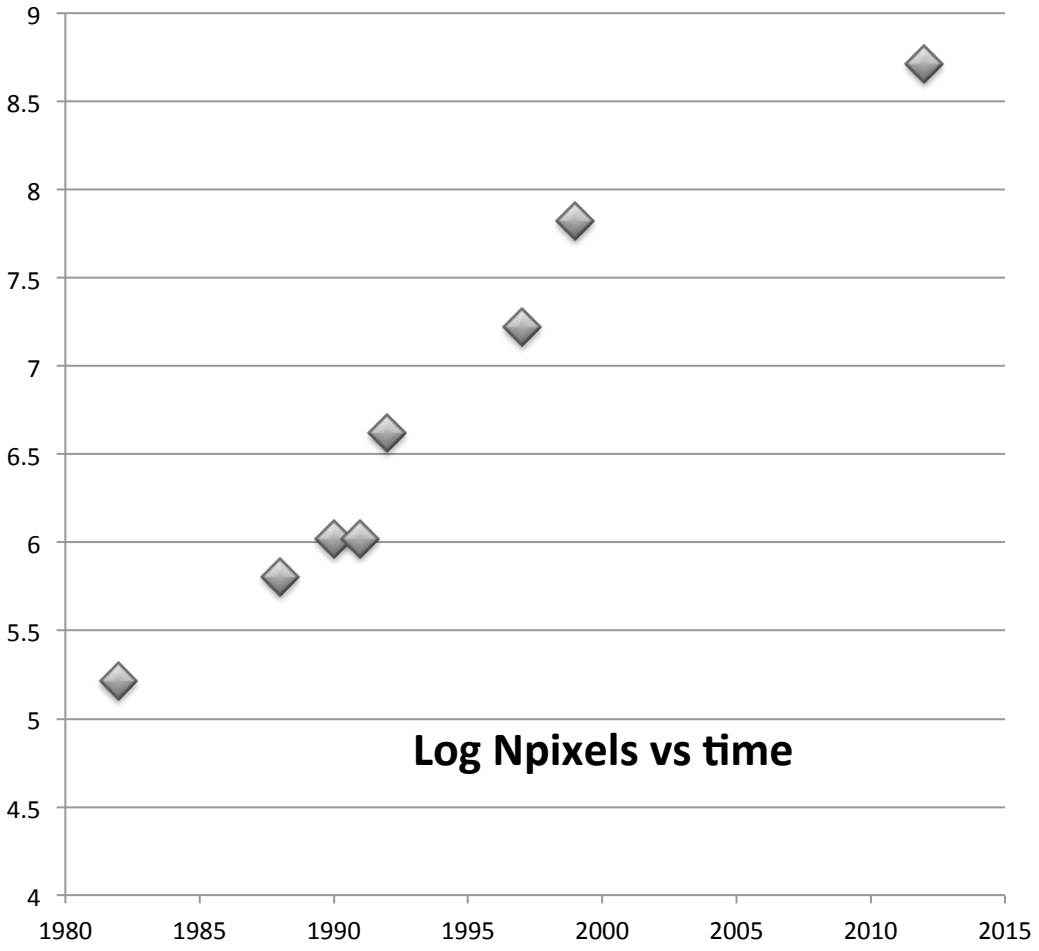
For the Blanco 4m prime focus, this took –

- 30 years
- Six Cameras
- Pre-DECam, 25 different CCDs of 6 different types
- DECam 62 Science 2Kx4K CCDs, plus 8 Focus & Alignment CCDs, Four Guide CCDs, all 2Kx2K.

Blanco CCD Cameras

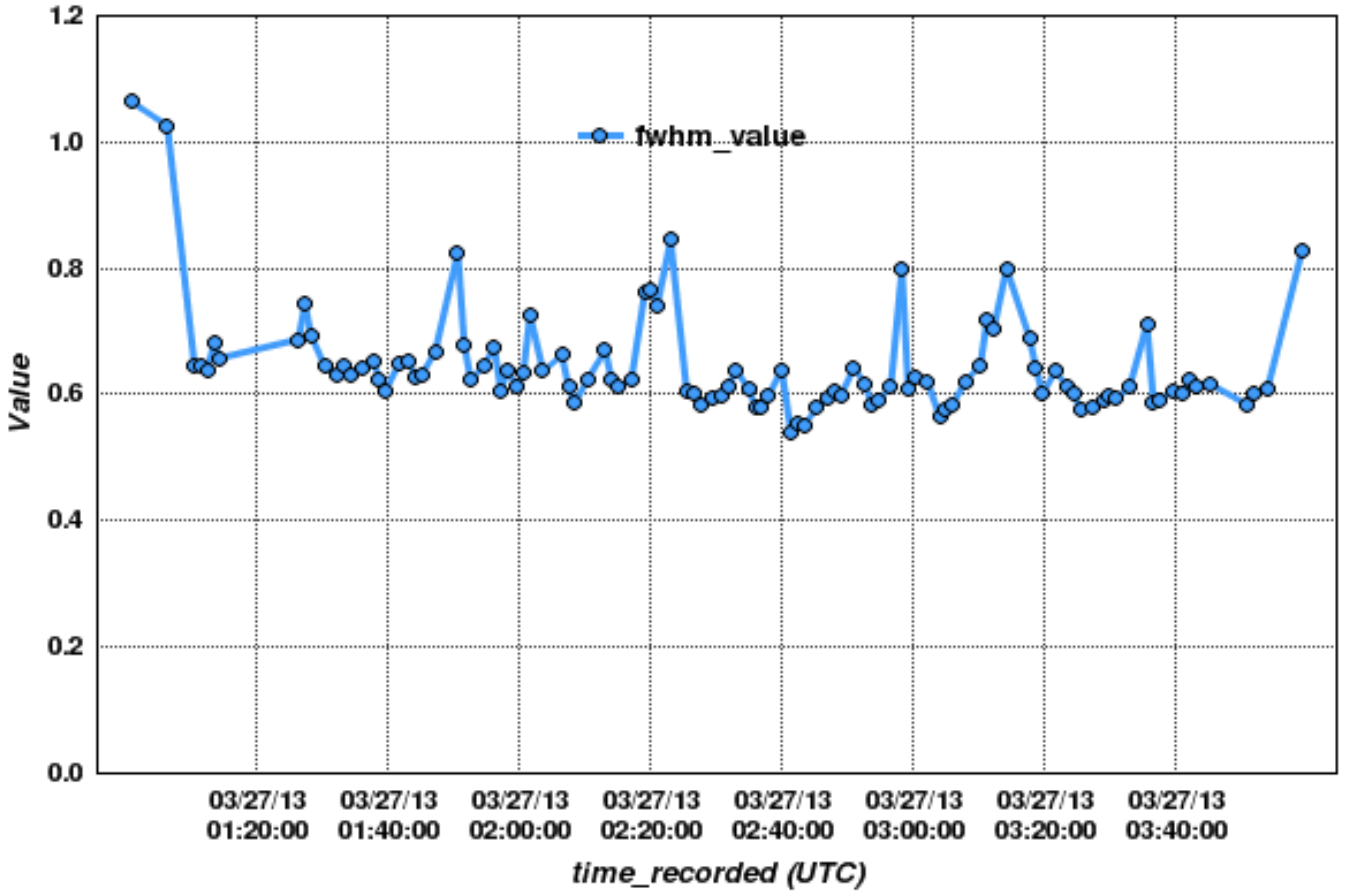
When	System	CCDs	Controller, Channels
1982-88	Kitt Peak PFCCD	RCA 512x320	KPNO, 1
88-92	CTIO “interim”	TI 800, Thomson 1024, Tek 1024	CTIO VEB, 1
92-97	CTIO “LF” PFCCD	Tek (Site) 2048	Arcon, 4
98-99	Big Throughpout Camera (BTC)	Four Tek 2048	Bell Labs, 4
99-2011	Mosaic II	Eight Site 2Kx4K	Arcon, 16
2012-	DECam	62 LBNL 2Kx4K	Monsoon, 124

Pixels 1982-2012



CTIO-50

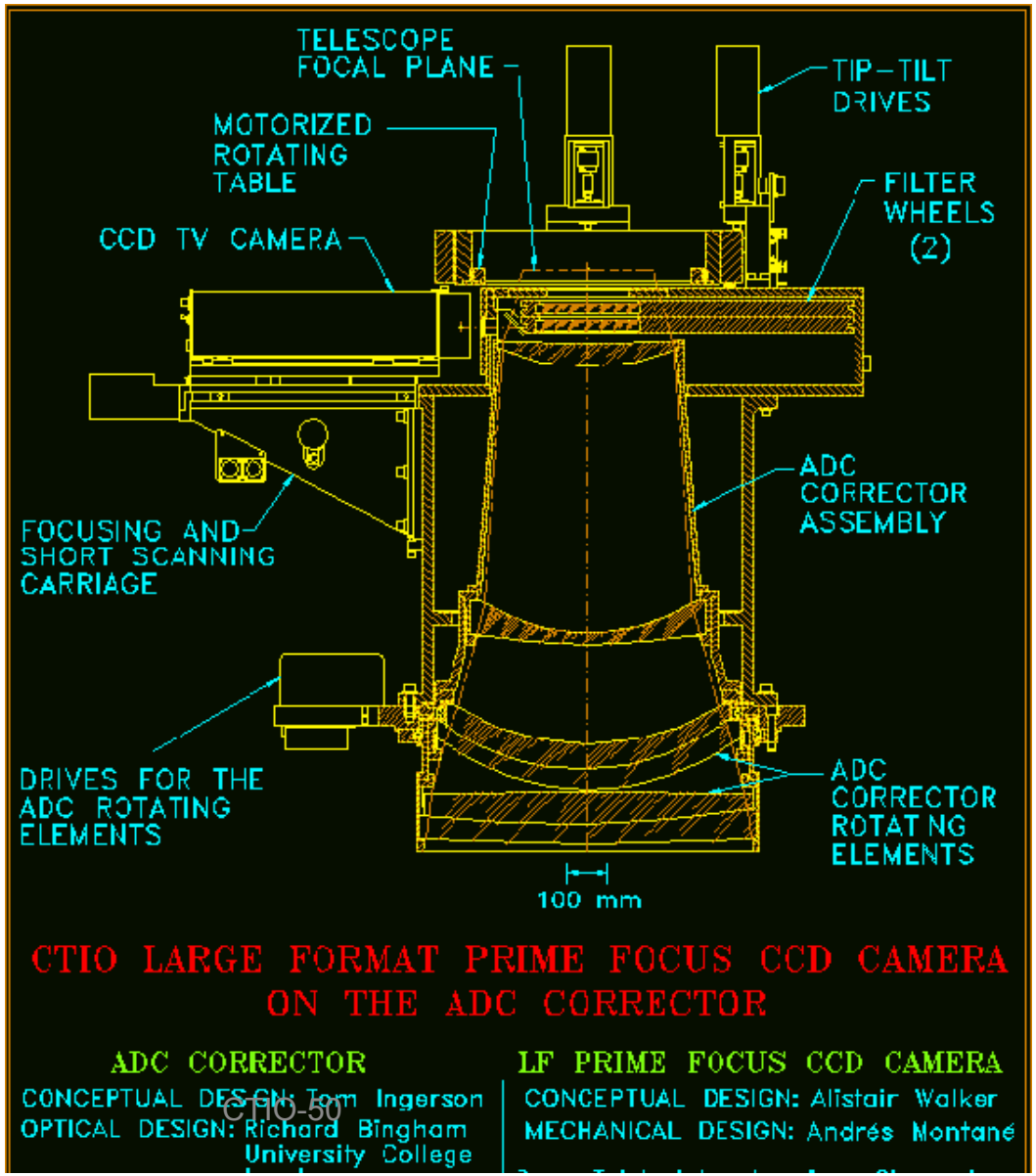
Image Quality



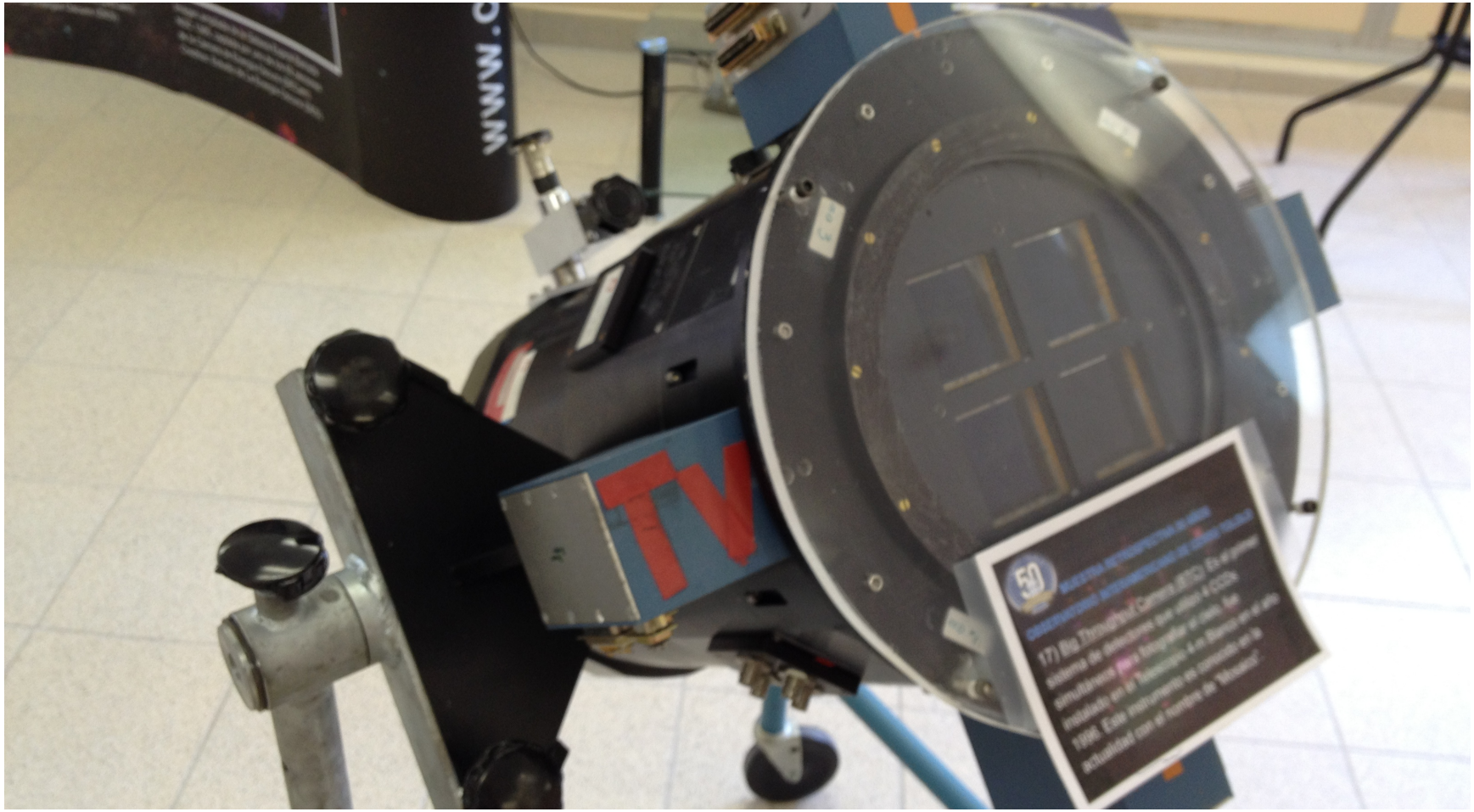
← Best (so far) DECam images →

- The first Blanco PF CCD camera had 0.6 arcsec pixels!

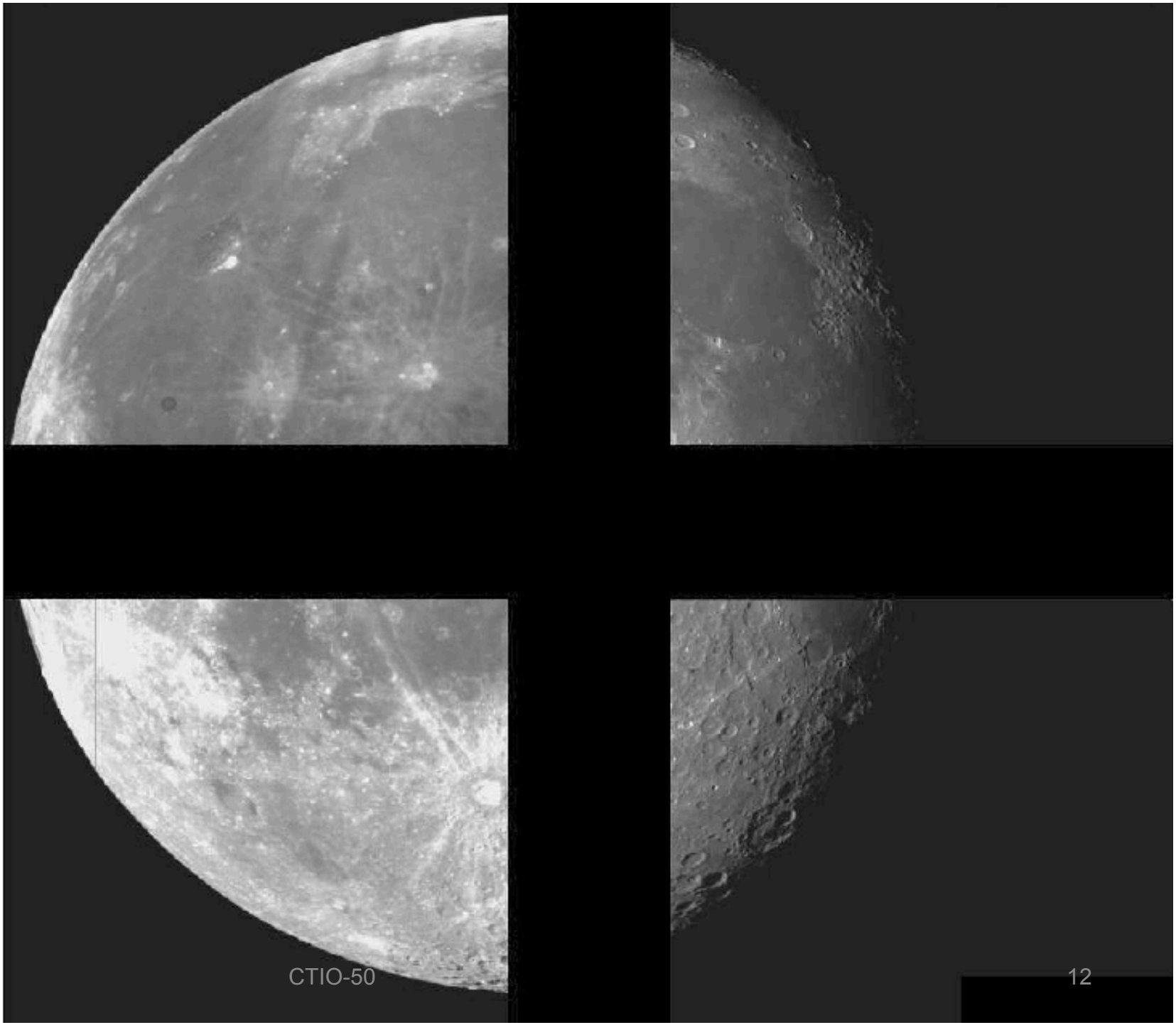
LF-PFCCD Camera

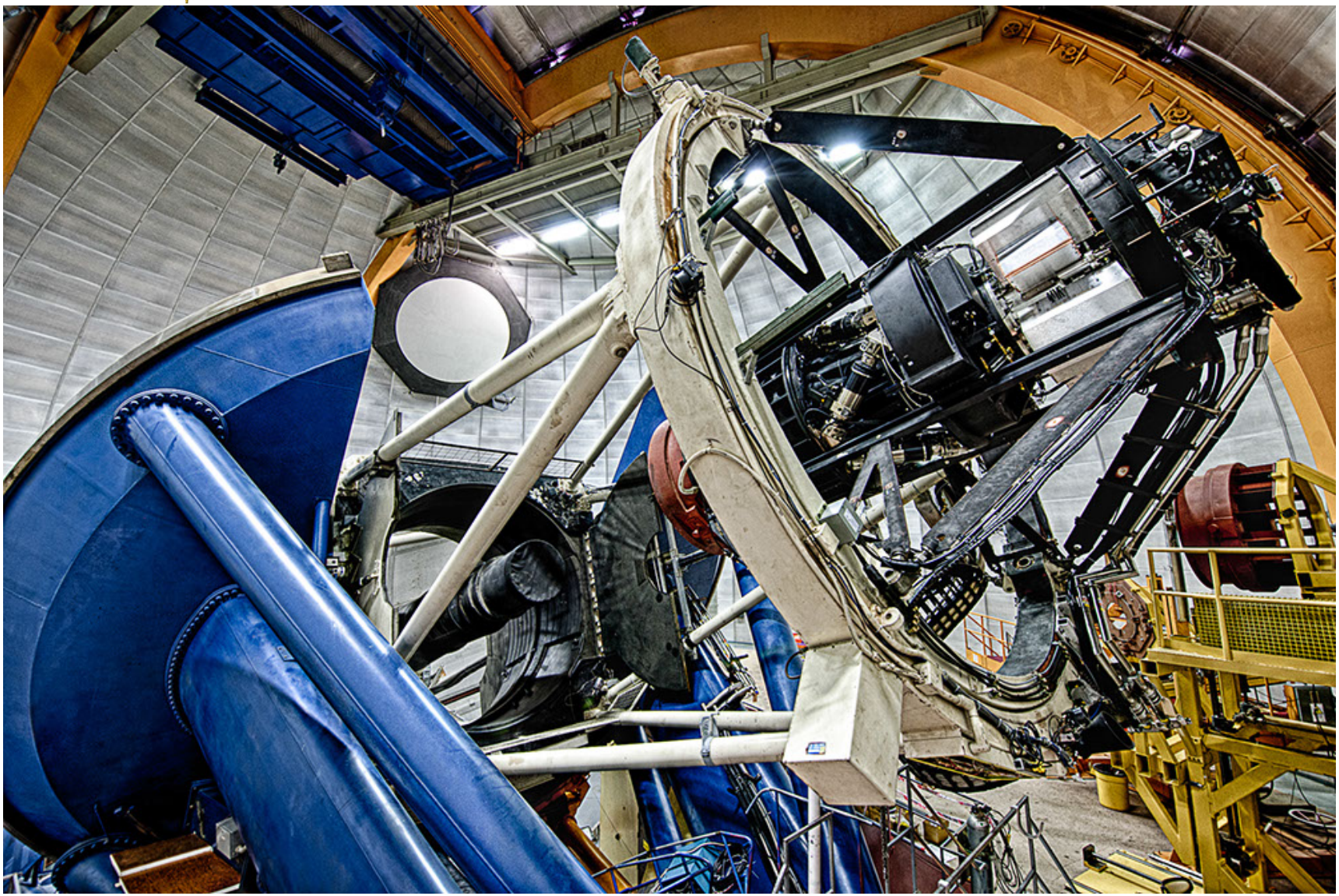


BTC



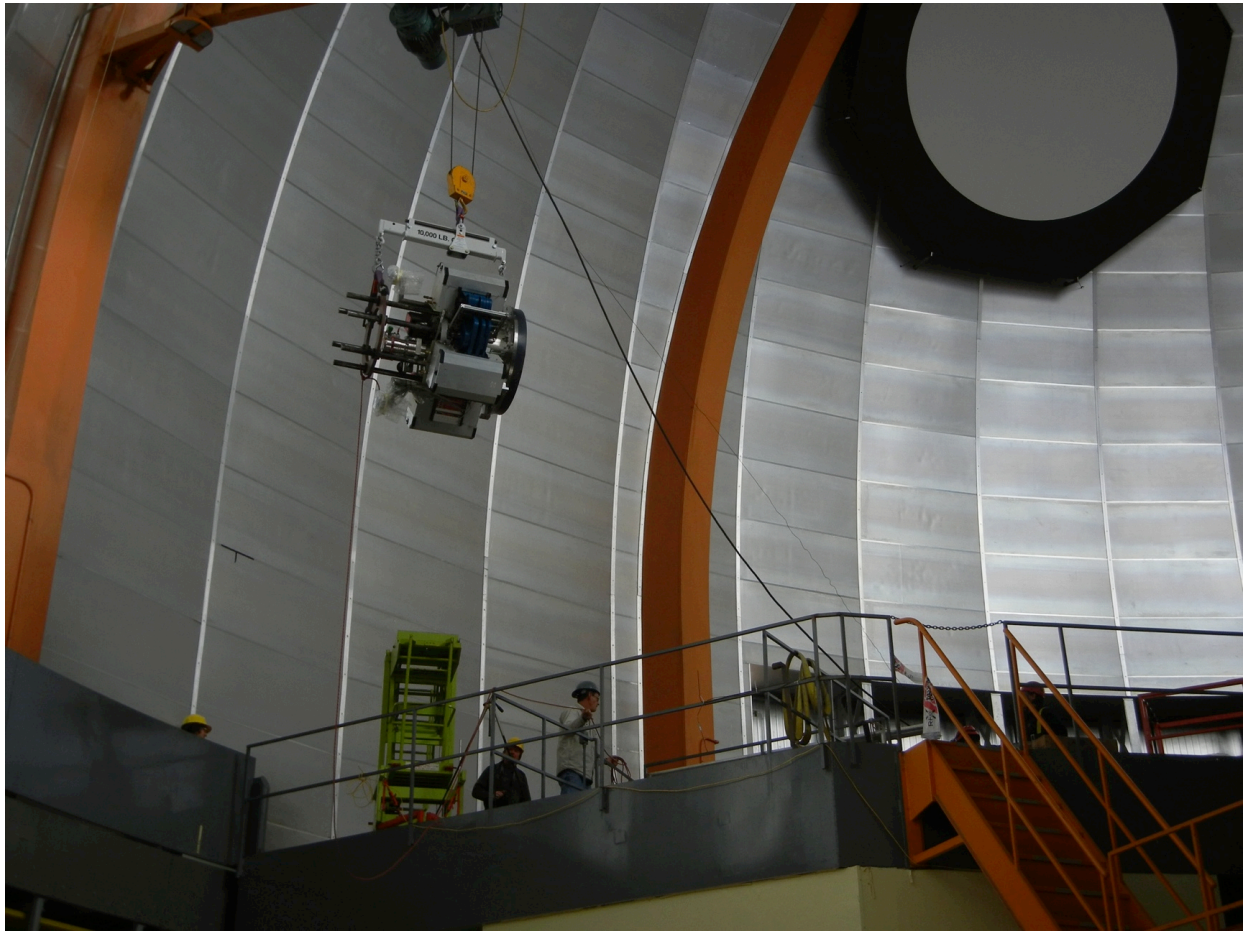
BTC – First multi-CCD camera



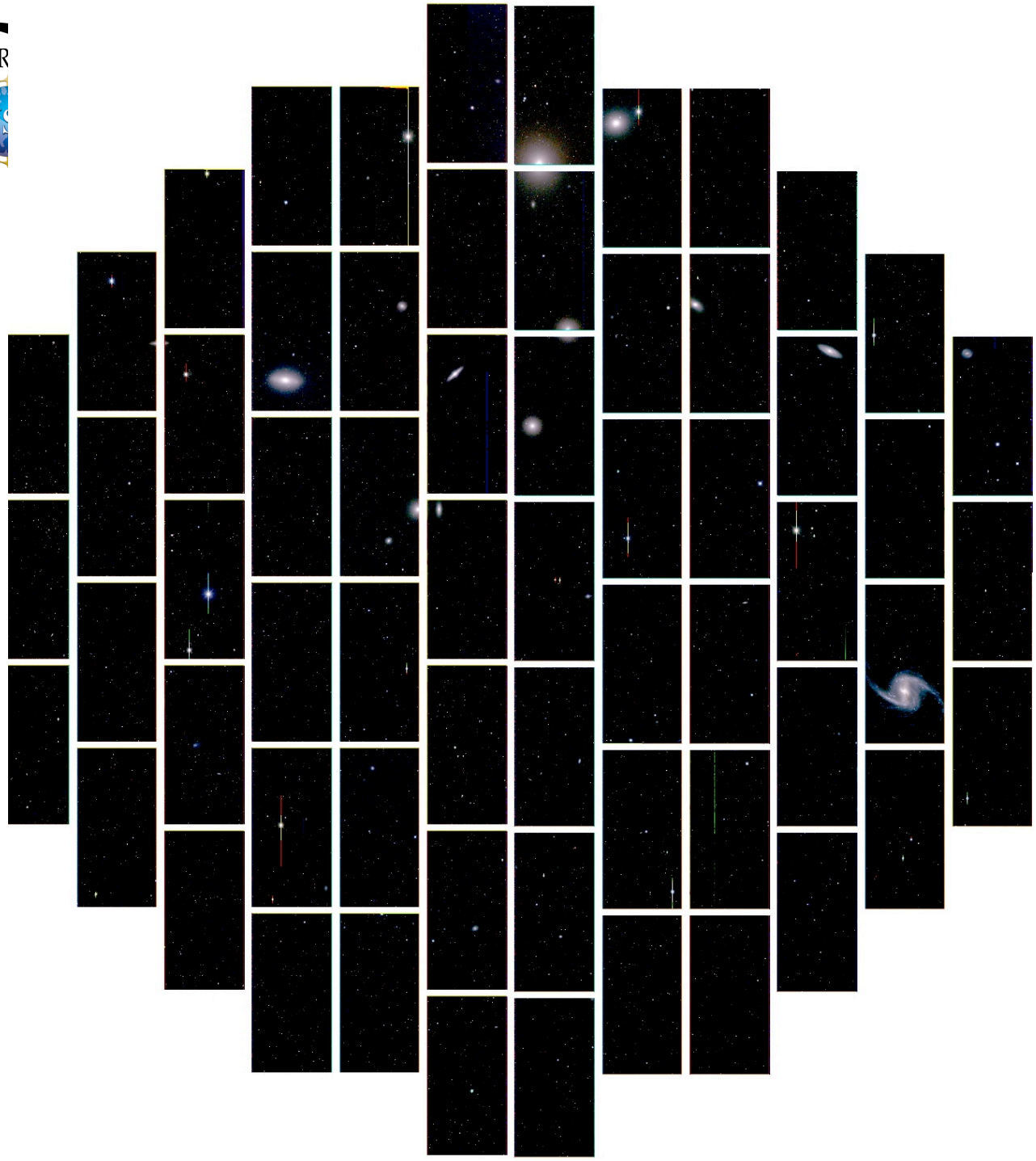


Decam Shutter

We are ~7 months from this



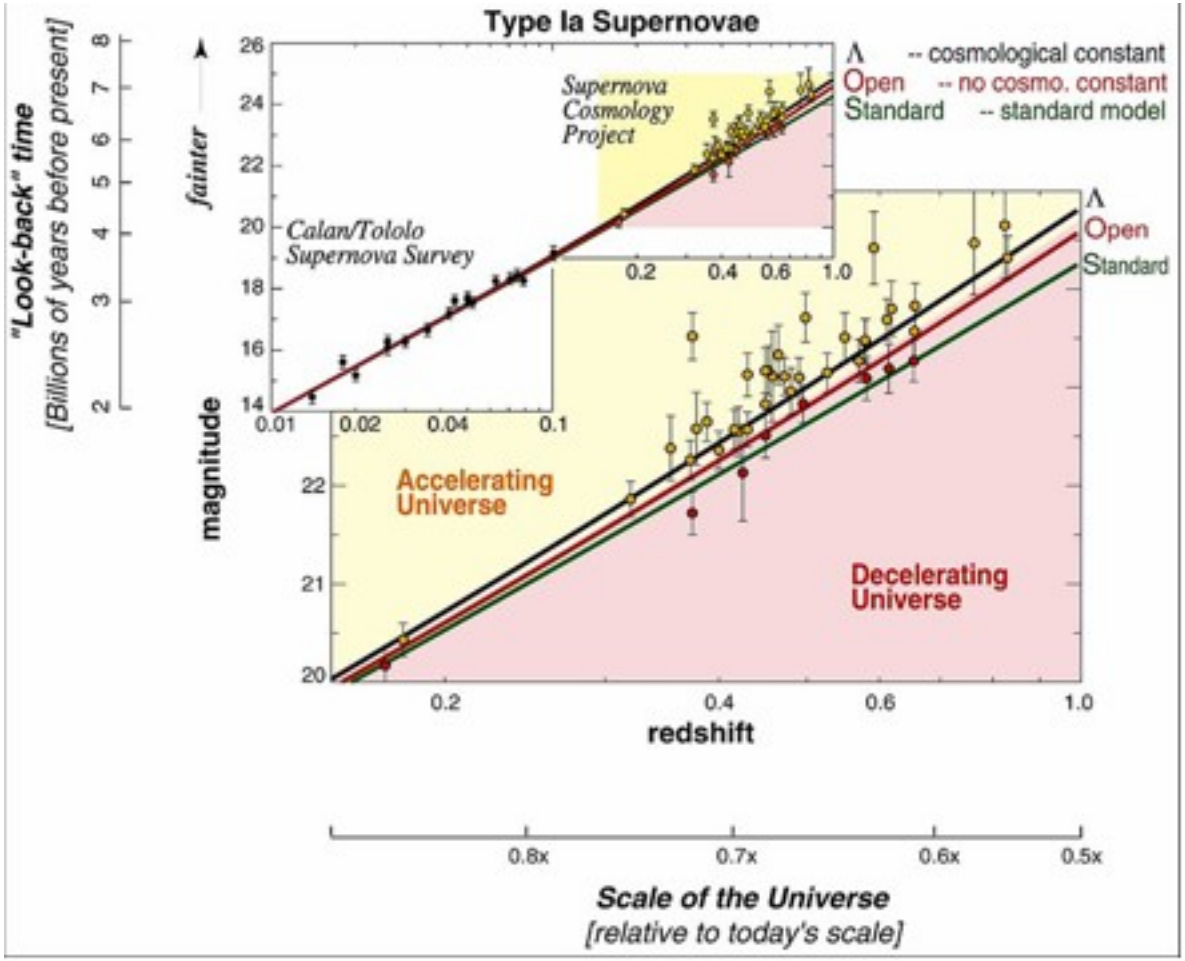
- New Camera
- New Corrector
- New PF cage
- Modified Telescope
- New Telescope Control



NGC 1365

Surveys…

- Surveys on the Blanco started in the 90's with the Perlmutter et al and the Suntzeff, Schmidt et al. high-z SN searches.
- These used the PFCCD Camera and the BTC.
- The NOAO Survey Programs opportunities began with the Mosaic Imagers on the Mayall and Blanco.

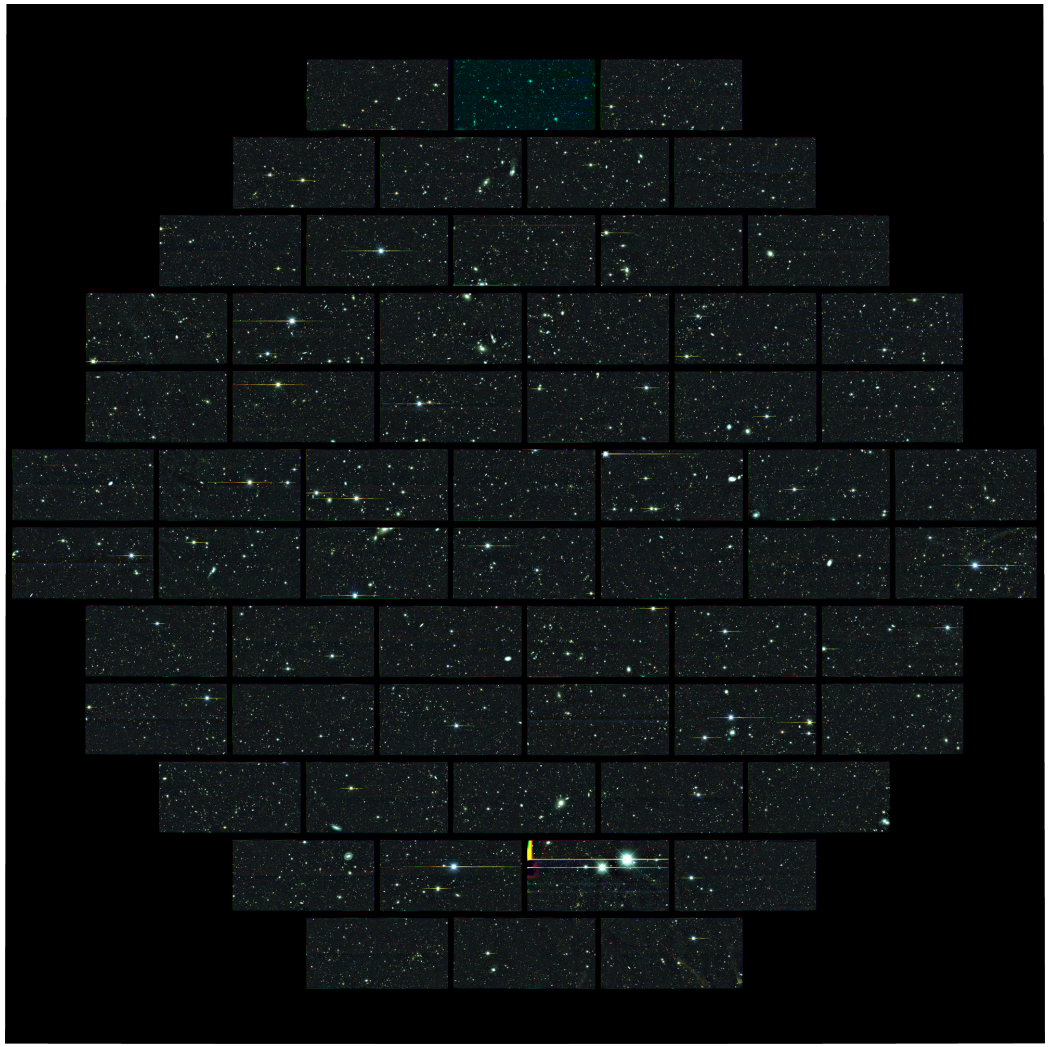


www.darkenergysurvey.org

The Dark Energy Survey

- Built new 3 deg^2 FOV camera and Data management system
  - Survey 2013-2018 (525 nights)
  - Premier facility instrument for astronomy community
- Stage III DE project using 4 complementary techniques:
  - I. Clusters
  - II. Weak Lensing
  - III. Large-scale Structure
  - IV. Supernovae
- Two multiband surveys:
  - 5000 deg^2 *grizY* to 24th mag
  - 30 deg^2 time-domain griz (SNe)

Composite image of deep SN field

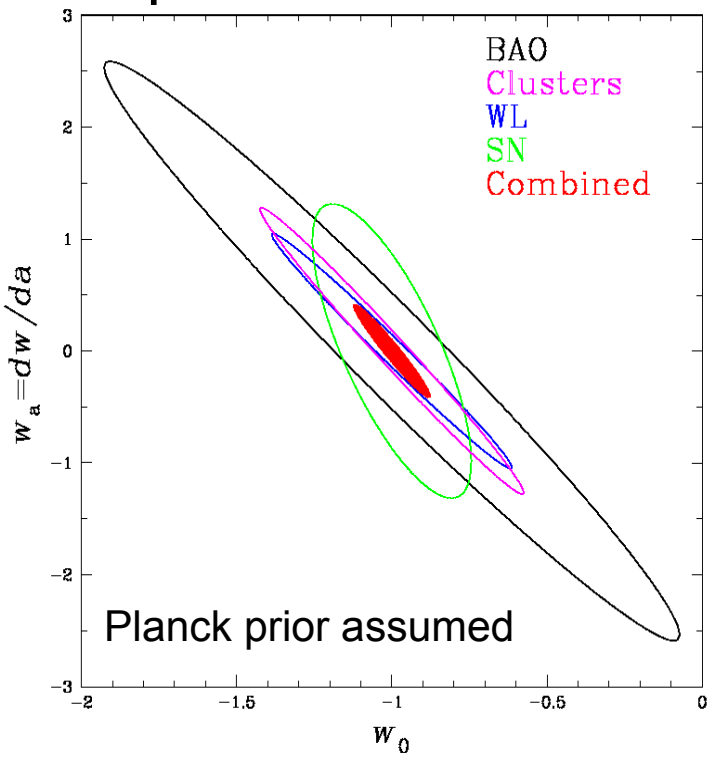


DES Science Summary

Four Probes of Dark Energy

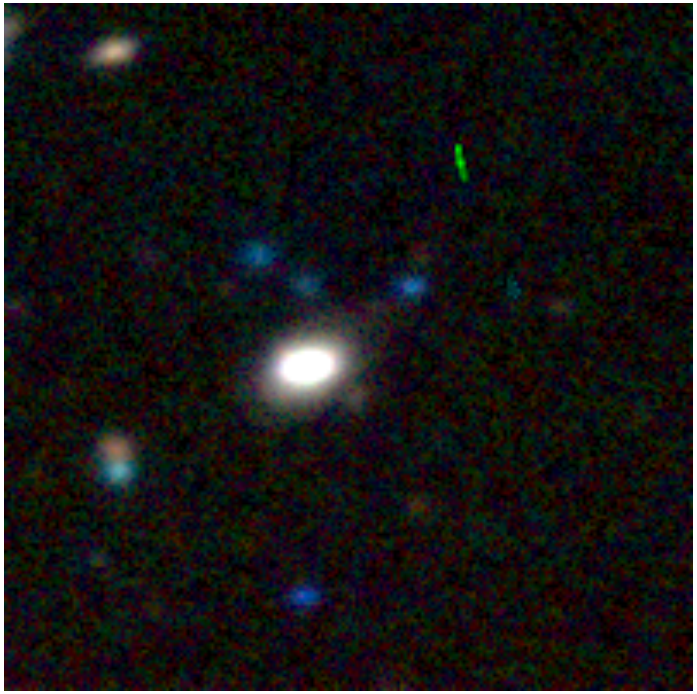
- Galaxy Clusters
  - ~100,000 clusters to z>1
  - Synergy/overlap with SPT
  - Growth of structure and expansion history
- Weak Lensing
  - Shape measurements of 200 million galaxies
  - Growth of structure and expansion history
- Large-scale Structure (BAO)
  - 300 million galaxies to z = 1 and beyond
  - Expansion history
- Supernovae
  - 30 sq deg time-domain survey
  - ~4000 well-sampled SNe Ia to z ~1
  - Expansion history

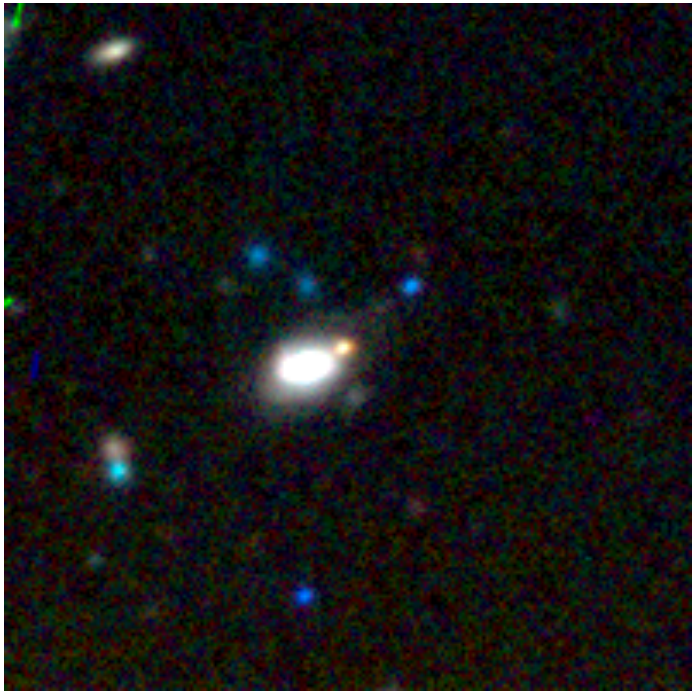
Forecast Constraints on DE Equation of State



Factor 3-5 improvement over Stage II DETF Figure of Merit

First Confirmed DES Supernova





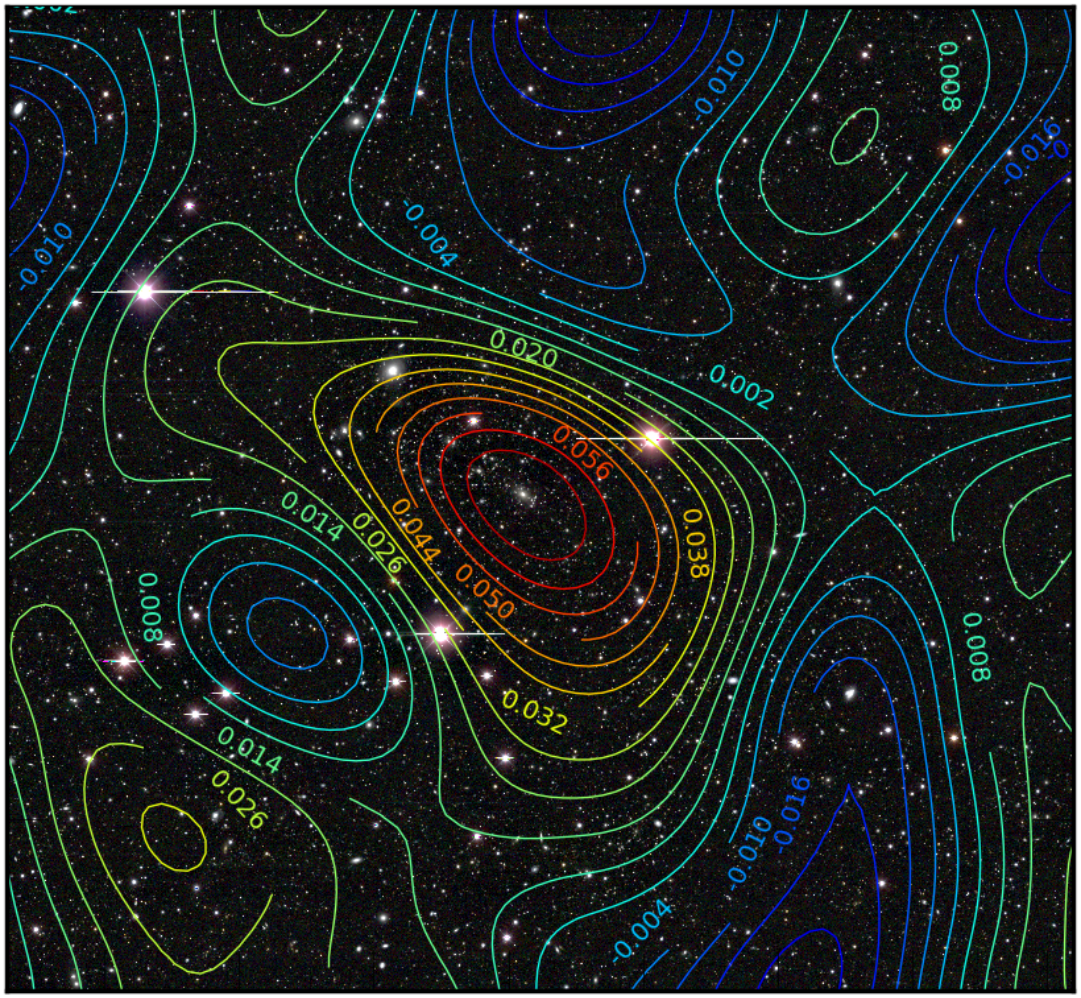
Nov. 7 Dec. 15

SN Ia at z=0.2 confirmed at AAO

Cluster Weak Lensing

Cluster RXJ2238 at z=0.35

Preliminary cluster mass map from DES SV data



From then…

THE CARINA DWARF SPHEROIDAL—AN INTERMEDIATE AGE GALAXY

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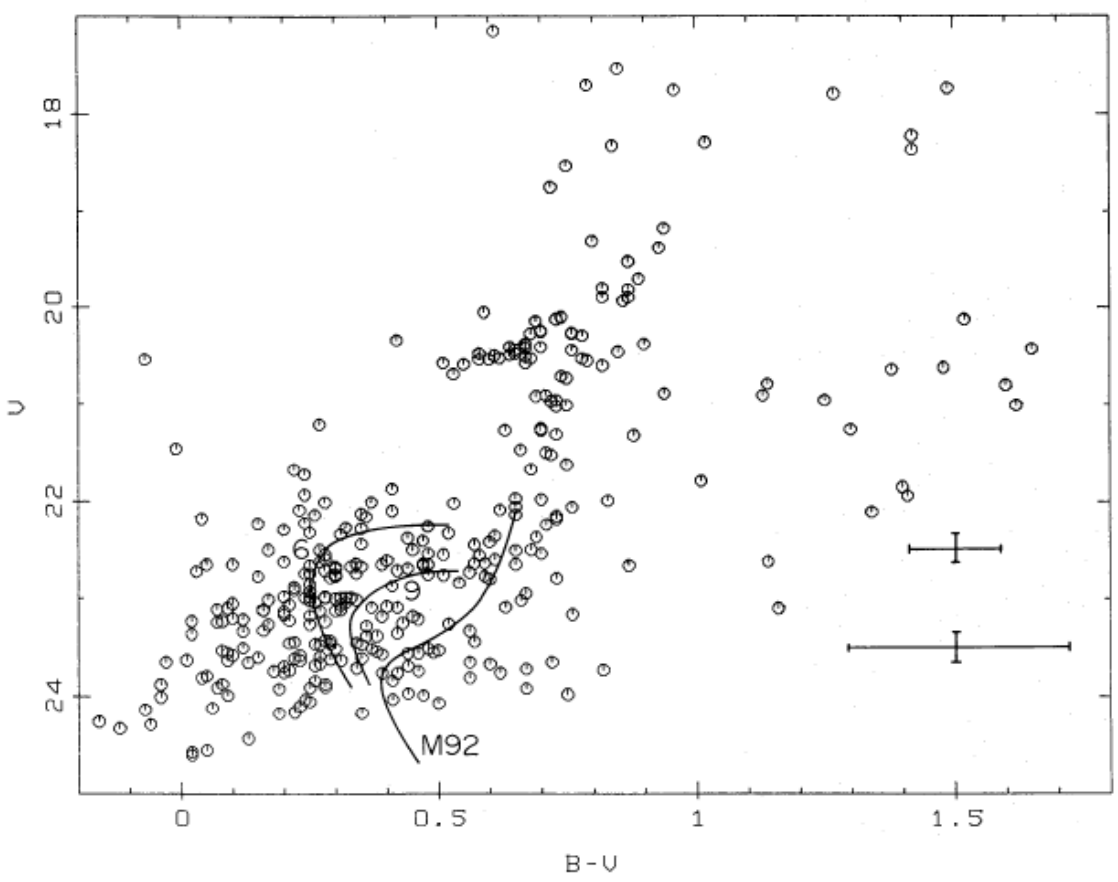
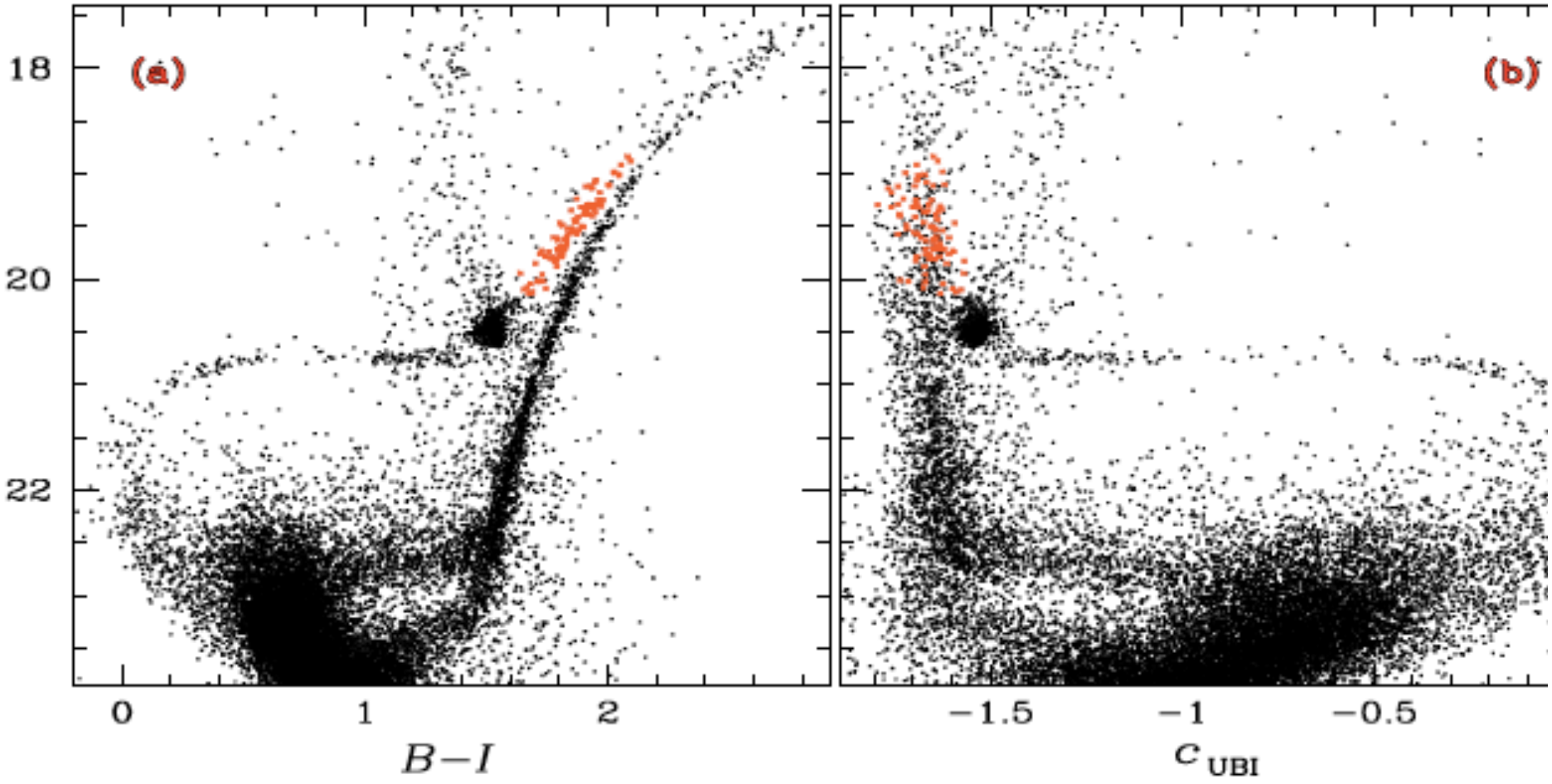


FIG. 2.—The Carina dwarf spheroidal color magnitude diagram. Theoretical isochrones for 6 and 9 Gyrs ($Y = 0.2$, interpolated metallicity) are shown from Ciardullo and Demarque together with Sandage's mean locus of the main sequence for the galactic globular cluster M92. The error bars indicate 1 σ uncertainties for a single star at the corresponding magnitude.

Mosaic Imager data

Monelli et al.




THE END