

Building the Infrastructure for Time-Domain Alert Science in the LSST Era

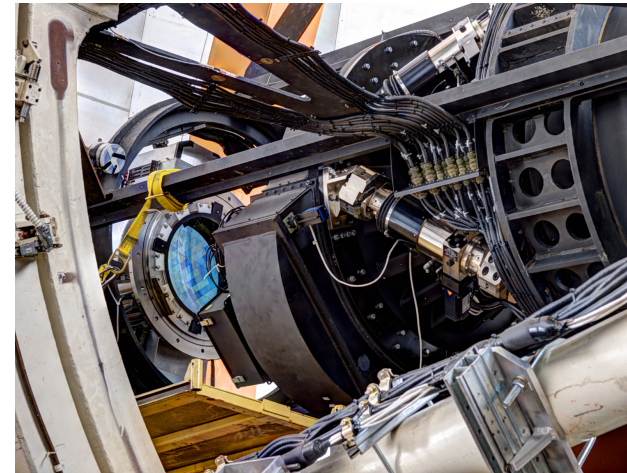
CTIO/Blanco

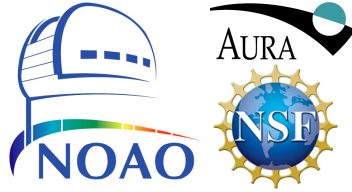
Steve Heathcote



Instrumentation, Current & Future DECam @ Blanco

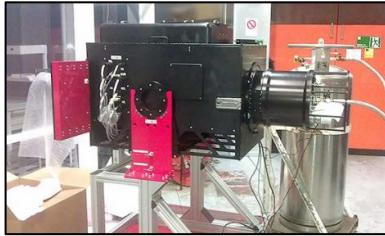
- 520 Mpixel camera
 - 64 2kx4k red-sensitive LBNL CCDs
- 2.2 degree FOV @ 0.263"/pix
- Space for 8 filters
 - Available: Broad – ugrizY + VR
 - Narrow – (~10nm): N964, H α
 - Changing out filters is a major day time task
 - Filters cost ~US\$100k each
 - Filters narrower than ~10nm are not feasible
- Although 40+ years old Blanco and Mayall have proven to be a versatile platforms adaptable to host new cutting edge instruments





Instrumentation Current & Future

Blanco f/8 Instruments

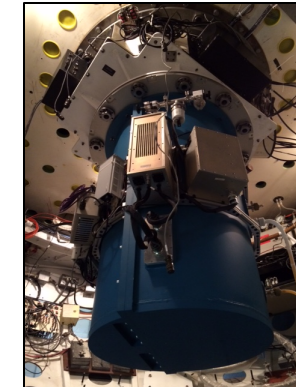


COSMOS

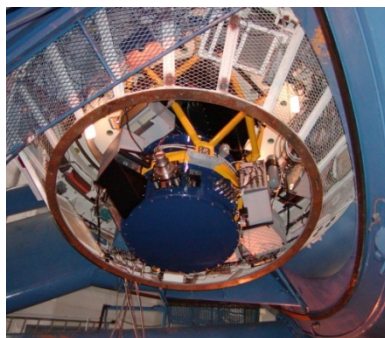
- Optical long-slit & multi-slit $R \leq 3000$ spectroscopy, plus imaging

ARCoIRIS

- Moderate resolution near IR spectrograph
- $0.9 < \lambda < 2.4 \mu\text{m}$ simultaneously in 5.5 cross-dispersed orders @ $R \sim 3000$



To SOAR



NEWFIRM

- $1.0 - 2.4 \mu\text{m}$ imager
- 28×28 arcmin FOV @ $0.4''/\text{pixel}$
- Requires \$\$ so need a strong enough science driver
 - Not a 2 degree FOV IR image on an 8m telescope!
 - But the only moderate FOV IR imager in the south

From Mayall ?



TAC Policies & Scheduling

- Chile gets 10% of Science time.
- NOAO policy sets a maximum proprietary period of 18 months but encourages less
- Proposal types
 - **Standard:** half (minimum) to a few night classical PI programs
 - **Long term:** as above but guaranteed time over several semesters
 - **ToO:** limited in number and duration of interrupts
 - **Surveys:** currently limited to 20% of available time
- Time-domain support requires significant policy changes
- Changing from DECam to f/8 and between f/8 instruments is a day-time task so instruments are block scheduled for periods of several nights



Observing Modes

- Classical, in-person (on mountain)
 - Most observing done this way
- Classical, remote (somewhere on Earth with internet)
 - Currently In use by “power users” from Tucson and Fermi-lab
 - Extension to general users and more sites is planned
- Target of Opportunity
 - Infrequent, short (< 20 min) interruptions e.g. for NEO recovery
 - GW follow-up program with multiple half-night interrupts. ToO scheduled, but so far has only interrupted during DES time
- Service/Queue
 - Current CTIO staffing levels can't support this
- Robotic
 - Difficult/expensive to implement with our 40+ year old telescope and facility and its unclear that it adds real value

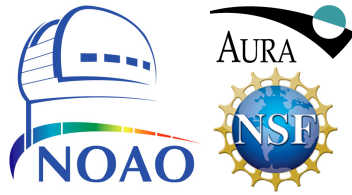




Software Tools

Scripting & Automation

- DECam
 - Observations are fully scripted including control of telescope and instrument, focusing, and guide star acquisition
 - Tactical planning tools have been developed for the DES & DECaLS surveys that can orchestrate an entire nights observations
- COSMOS & NEWFIRM
 - These instruments have a similar more rudimentary scripting capability which includes control of telescope and instrument
- With work these could be extended to
 - Support efficient queue observing with a person in the loop either on site or remote
 - Provide hooks to interface to an external tactician (TOM)
 - Fully robotic operation is not a goal



Software Tools

Data Handling & Reduction

- TADA: Efficient transport of data from telescope to archive typically within a few minutes of readout
- NOAO Science Archive efficiently hosts raw (& reduced) data, serves it to PI & collaborators, and to public at end of proprietary period
- Data reduction pipelines exist or under development
 - DECam: Community Pipeline is efficient and capable
 - Calibrates raw single images and stacked frames providing astrometric and rough photometric solutions
 - Based on DES-DM pipeline and incorporates many recent improvements
 - NEWFIRM: pipeline exists but would require maintenance
 - ARCoIRIS: customized version of IDL package Spextool
 - COSMOS: could build on Goodman pipeline in development



Other Telescopes on Tololo

Sources & Sinks For Time Domain Data

