



Operations rehearsal

Thibault Guillemin (LAPP)

Focal plane meeting

April 4, 2024





Anticipated commissioning events and workshops leading up to ComCam First Photon

- Operations Rehearsal for Commissioning #3 (2-5 Apr) → **This week**
- Writing Blocks / Scheduler Workshop (mid Apr ?)
- Calibrations w/ ComCam Rehearsal (late Apr ?) → **Week of April 29**
 - Will use simulated ComCam data
- System On-sky Test Plan for ComCam Internal Review (early May ?)
 - Might require multiple iterations
- AOS Commissioning Readiness for ComCam On-sky (mid May ?)
- Operations Rehearsal for Commissioning Follow-up (early Jun)
 - Visit Database and downstream capabilities, reporting and logging, internal communication channels
- Commissioning Science Validation Bootcamp (week of 24 Jun, TBC)
 - Modeled off [2023 bootcamp](#); toolset to provide visibility on science pixel data and system telemetry

In the near future (next ~week), SIT-Com leadership will be working with the points of contact for each of these activities to help set calendar dates and define goals



Scope and Goals of the Rehearsal

Demonstrate full **24-hour operations cycle** to manage **two parallel data streams** from the summit in preparation for **first on-sky ComCam images** in July 2024

- **AuxTel** will be driven “normally” at the summit
- Simonyi telescope will be offline with (or without) ComCam cold
- **ComCam simulated images** run through ComCam DAQ in “playback mode”

Nominally 3 x 24-hour cycles (Tue/Wed/Thur), with one additional night as backup (Fri)

Focus on “data aspects” of operations workflow

- Command and control of physical hardware will tested via other means

All details: https://docs.google.com/presentation/d/1QIRsH5GZCYfyYOMxptTkZ5xk3c5GdGFb96483_r9ARU/edit#slide=id.ga2f7fb1a1f_0_70



Functionality to be Demonstrated

ComCam

- ~~Afternoon calibrations~~ → Separate campaign
- Simulated observations played through ComCam DAQ
- Rapid Analysis
 - RubinTV
- LHN transfer to USDF
- Processing at USDF
 - Prompt Processing at USDF including Alert Production
 - “10am” and Cumulative DRP Processing
- Science analysis
 - Goal to engage Science Units



Observation Simulation

- Simulated observations produced with rubin_scheduler are representative of dense dithered star field observing blocks planned for ComCam
 - “Blocks” of 60 visits = 20 visits in each of gri (3 filters loaded in ComCam at a time)
 - Visit = single 30 second exposure (i.e., no snaps)
 - Translational dithers (± 0.2 deg) between each visit around a pointing center
 - Random rotational dither applied with each filter change
 - Scheduler logic shifts between fields to sample a range of airmass $1 < z < 2$ for each field
 - Avoid Moon
- Simulated 21-day window that includes 3 days of the rehearsal itself
 - Use subset of early images to build templates for difference imaging

TODOs:

- Turn on realistic distribution of delivered image quality



Observation Simulation: Visit Counts by Field

Total number of visits across gri bands for each field

3-day rehearsal time window

COSMOS	360
DEEP_A0	360
DESI_SV3_R1	420
Rubin_SV_125_-15	300
Rubin_SV_225_-40	600
Rubin_SV_250_2	360
Rubin_SV_280_-48	376
Rubin_SV_300_-41	120

21-day simulation time window

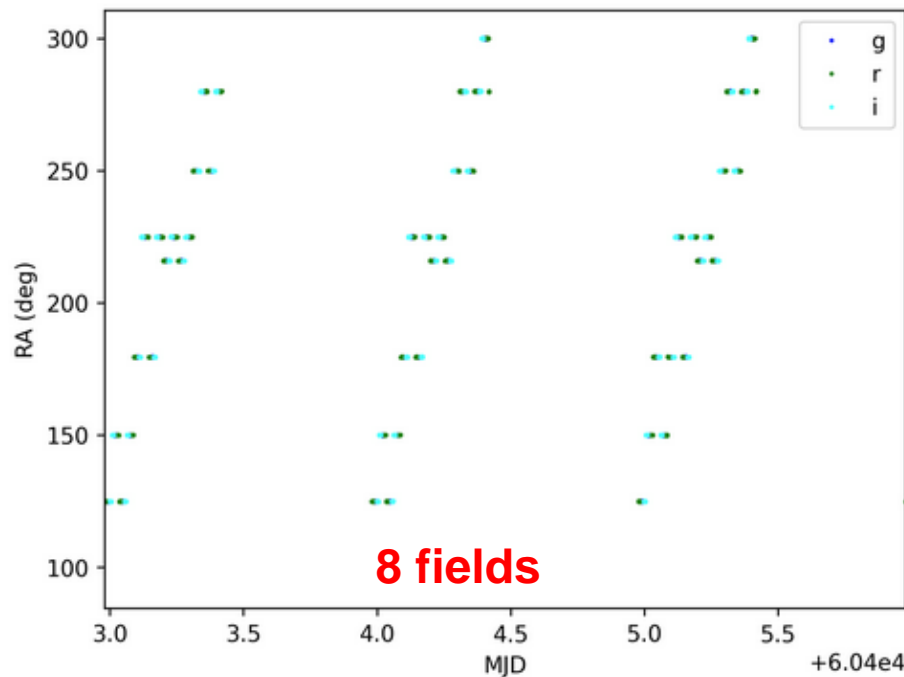
COSMOS	2640
DEEP_A0	2580
DESI_SV3_R1	2400
Rubin_SV_095_-25	420
Rubin_SV_125_-15	2581
Rubin_SV_225_-40	3420
Rubin_SV_250_2	2160
Rubin_SV_280_-48	2729
Rubin_SV_300_-41	1198

2896 30-s visits in 3 nights? 🤔

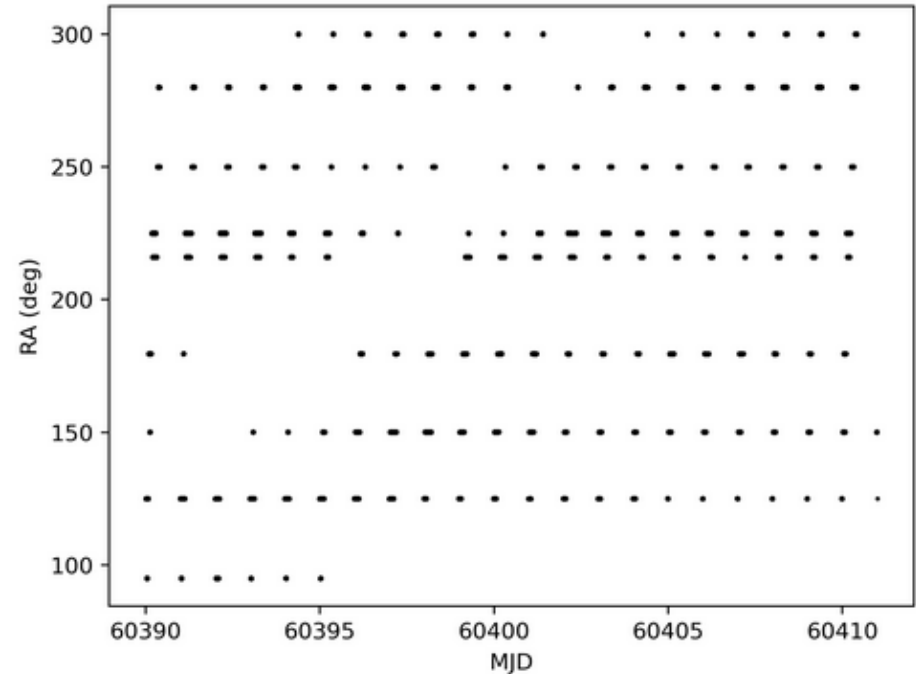


Observation Simulation: Cadence

3-day rehearsal time window



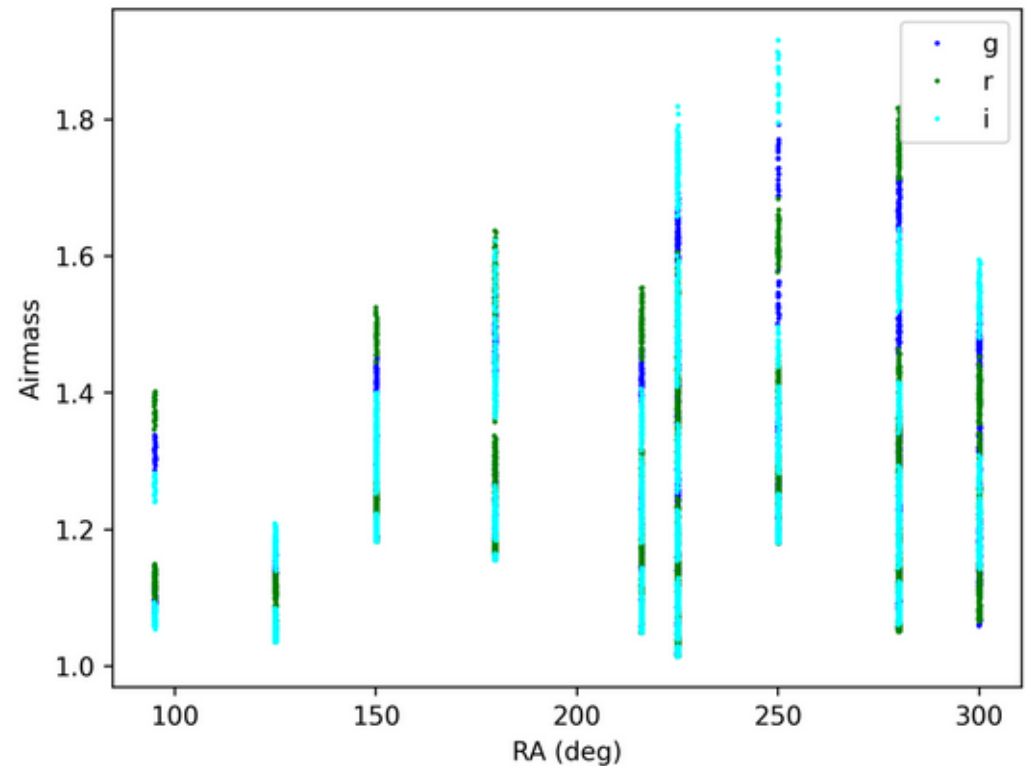
21-day simulation time window





Observation Simulation: Airmass Distribution

Attempting to span airmass $1 < z < 2$
in each field in each filter





ComCam Image Simulations (imSim)

Higher fidelity throughout compared to DC2 using the new major release of **imSim 2.0**:

- Triple silver mirror reflectivity, as-measured filter transmission, etc
- Optical effects realism via ray-tracing with batoid: emergent distortions, vignetting, diffraction spikes, ...
- ComCamSim instrument model with per-detector QE curves
- Airmass dependent throughput
- Reference catalogs with realistic uncertainties and depth (based on Monster refcat)
- Sensor effects: Brighter-Fatter, diffusion, wavelength dependent conversion point, tree rings, ...

Object catalogs:

- Galaxies from cosmoDC2 – rotated to ops-rehearsal fields
- Stars from UW db, based on Galfast model of Juric et al. (2008)
- ~~No transients and variables in rehearsal ⇒ null test for difference imaging~~ Simple sinusoidal variable stars
- Solar System objects from SSO collaboration (TBC)



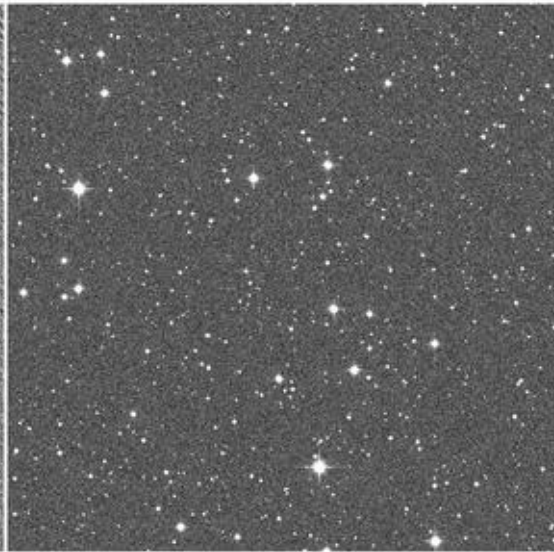
ComCam Image Simulations (imSim)

Example single CCD exposures:

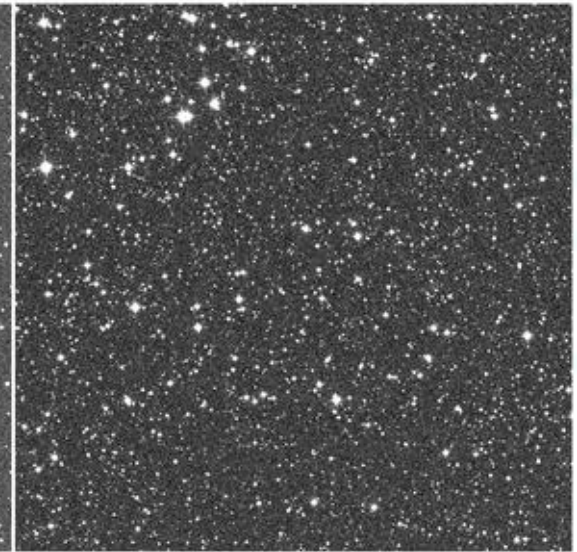
COSMOS



Rubin_SV_250_2



Rubin_SV_280_-48

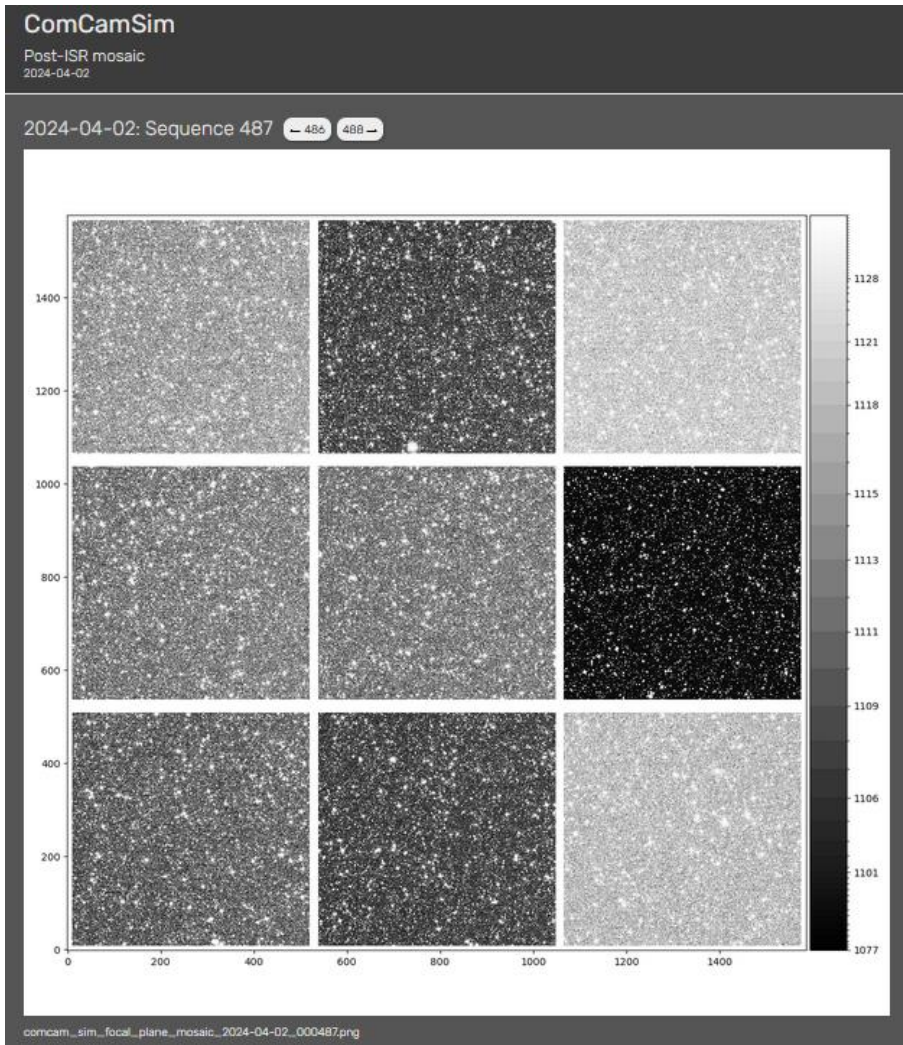


7.55e+03 7.6e+03 7.66e+03 7.71e+03 7.76e+03 7.81e+03 7.86e+03 7.92e+03 7.97e+03

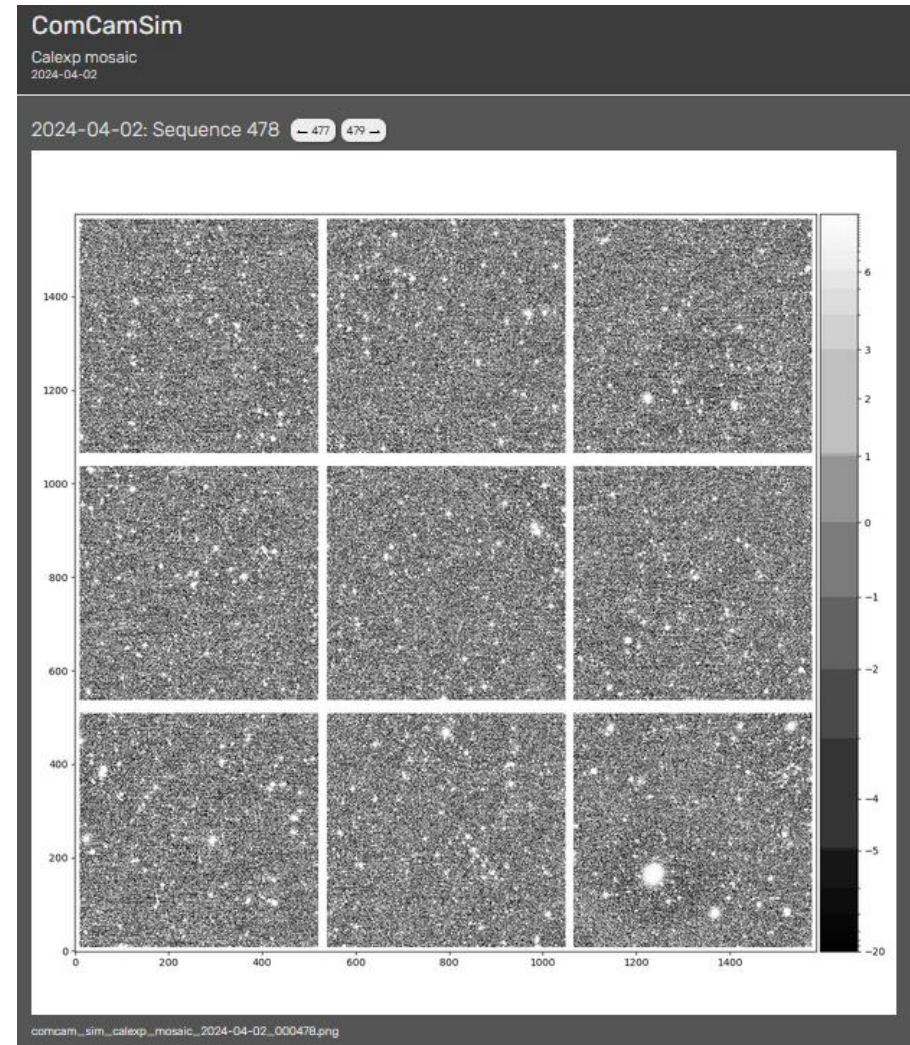
890 920 949 978 1008 1037 1066 1096 1125

1.81e+03 1.85e+03 1.89e+03 1.93e+03 1.97e+03 2.02e+03 2.06e+03 2.1e+03 2.14e+03

First results



PostISRCCD

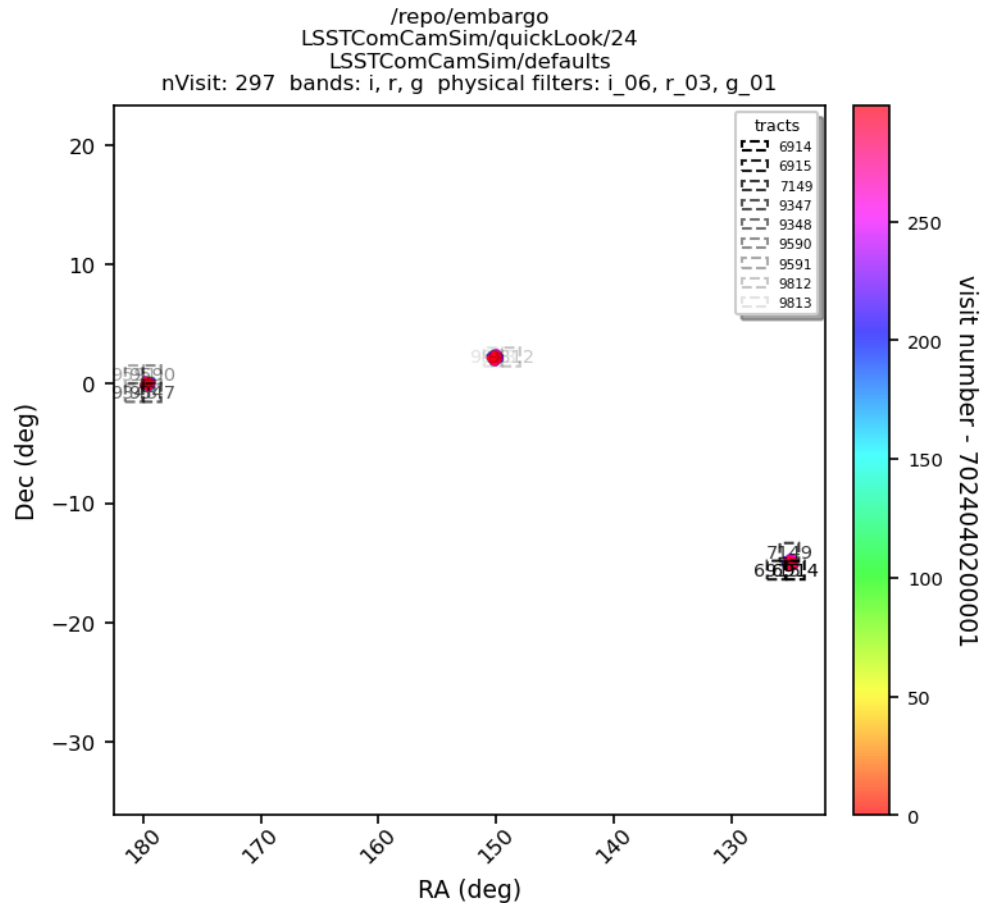


Calexp

First results

From L. MacArthur

With analysis_tools run on data ingested in USDF butler



Calibration aspects

<https://confluence.lsstcorp.org/pages/viewpage.action?pageId=248547428>

Camera

- Brighter-Fatter Effect ✓
- Tree rings - reduced by $\sim 10\times$ from defaults ✓
- y-band fringing ✓ (Not relevant for ops-rehearsal-3 sims)
- Gains, read noise, and saturation levels from comCamSim instrument in obs_lsst ✓
- CTI of $1e-6$ in both parallel and serial transfer directions ✓
- Dark current: 0.02 e-/s/pixel for all amps ✓
- Bias levels from imSim, as measured from comCam calibration data ✓
- No defects ✓
- No crosstalk ✓
- No nonlinearity ✓
- Simulated cosmic-rays extracted from ITL sensor lab data. ✓
- Per-CCD QE curves from lab measurements of ITL raft R42 in LSSTCam ✓

Calibration Products

- The raw frames for the initial testing consist of
 - 20 bias frames
 - 20 100 s dark frames
 - 20 flats per g, r, i band, $50k\text{ e-/pixel}$
 - 100 flat pairs, with logarithmically spaced fluxes covering $30\text{-}100k\text{ e-/pixel}$
- Calibration products, generated from these raw frames using cp_pipe, are in the chained collection u/jchiang/bfk_70240217_w_2024_07. ✓
 - We will use hand-crafted BF kernels from Alex B. in u/abrought/bfk_70240217_w_2024_07_final
- Curated calibration data for transmission_[optics, filter, sensor] curves are available in obs_lsst_data for comCamSim ✓

Calibrations rehearsal

<https://confluence.lsstcorp.org/display/LSSTCOM/Initial+Planning>

We've discussed a "calibration products" ops-rehearsal before July, and @kbechtol and I have pencilled in having it some time during the week of  29 avr. 2024 –  3 mai 2024. The scope would be:

- Take "afternoon" calibrations with LATISS over (say) three afternoons
 - bias, dark, [some] flats -- maybe not enough for a complete PTC per night
- Additionally, process the ComCam calibration data that Jim C. et al. generated for the early-April Ops Rehearsal 3. We'd play that back through the DAQ, so this would give us a chance to work on *taking* ComCam calibs (using BLOCKs and script-queue-3 which was deployed for ops-rehearsal-3)
- Validate that the instruments have not changed significantly
- Warn mountain folk if they have [stretch goal?]
- Process the complete set of calibration data, maybe taken over more than one day, at USDF
 - Generate a complete set of calibration products:
 - bias, dark, flat, readnoise, gain from PTC, defects, [your favourite stretch goal here]
 - Validate that the instrument has not changed significantly, with more attention to subtle changes than on the mountain
- Generate a report for the TAXICAB
- certify new calibrations for ComCam (even if we wouldn't usually certify a new set if nothing has changed)
- install at USDF and on Cerro Pachón