Observing with DECam

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~ 20 seconds readout time
S-Link (optical fiber)
100 Mbits/s input per PAN
17 Mbits/s output per PAN (for a 100 s exposure)

Gigabit Ethernet

PC Farm with N nodes
Processing time per node
\[ t = N \times 17 \text{ seconds} \]

1 GB Images (600 MB compressed)

Directory service to locate DES images on distributed filesystem

DTS (NOAO) Workstation
DECam Observer Console

What to expect:
• Linux workstation
• DECam GUIs are web-based
• Some VNC
• 8 screens
• How-To’s, Manuals, Procedures on Wiki
• Webcam with Skype: DECamObserver
• Chat
• Gmail account: decamobserver@gmail.com
• Observer workstation (4 screens)
Observation Control (OCS) and Exposure Queue

- OCS orchestrates entire exposure sequence
- 2 exposure deep pipeline
- Exposure requests are submitted to Exposure Queue
  - Manual
  - Obstac (DES)
  - Script (Script Editor)
DECam Image Format

• **Standard FITS Format**
  – Multi-extensions
    • 62 4kx4k science CCDs
    • 8 2kx2k focus & alignment CCDs
  – 1 ccd = 2 amp per extension
  – 16 bits per pixel

• **Tile compression**
### Environment

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Data Type</th>
<th>Example</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>WINDSO</td>
<td>Float</td>
<td>5.4 [m/s]</td>
<td>Wind speed</td>
</tr>
<tr>
<td>WINDDIR</td>
<td>Float</td>
<td>24 [deg]</td>
<td>Wind direction (from North)</td>
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<tr>
<td>AMBIENT_TEMP</td>
<td>Float</td>
<td>11.95 [deg C]</td>
<td>Ambient temperature (micros degree)</td>
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<tr>
<td>HUMIDITY</td>
<td>Float</td>
<td>18%</td>
<td>Relative humidity</td>
</tr>
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<td>PRESSURE</td>
<td>Float</td>
<td>782 [torr]</td>
<td>Barometric pressure</td>
</tr>
<tr>
<td>UP_TEMP</td>
<td>Float</td>
<td>11.45 [deg C]</td>
<td>Upper trunk temperature</td>
</tr>
<tr>
<td>DOWNTEMP</td>
<td>Float</td>
<td>17 [deg C]</td>
<td>Outside temperature</td>
</tr>
<tr>
<td>RH</td>
<td>Float</td>
<td>0.7</td>
<td>Humidity</td>
</tr>
<tr>
<td>CLOUDSTAT</td>
<td>String</td>
<td>T</td>
<td>Cloud state</td>
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<tr>
<td>SKYCOND</td>
<td>Logical</td>
<td>0</td>
<td>Cloud cover</td>
</tr>
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<td>0.21</td>
<td>RASISG local sky clear flag</td>
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<td>0.51</td>
<td>RASISG local sky fraction above threshold</td>
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<tr>
<td>SKY10YR(2)</td>
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<td>0.32</td>
<td>RASISG local sky normalized power</td>
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<td>SKY10YR(3)</td>
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<tr>
<td>SKY10YR(4)</td>
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<tr>
<td>SKY10YR(5)</td>
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<td>SKY10YR(6)</td>
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</table>

### Cloud Camera

- **WCS (World Coordinate System)**
- **DECam Exposure Primary Header**
- **DECam Exposure Extension Header**

#### WCS

- **16 bit data**

#### Environment

- **70 extensions**

#### Cloud Camera

- **2 Amps per extension**
Quality Assurance: **Image Health**

- **ImageHealth** analyzes *every* image
- **Algorithms include:**
  - Seeing per CCD
  - Sky noise per CCD
  - Mean, variance per amps for overscan and data regions
- **Graphical user interface to represent results with different views:**
  - Data
  - PSF
  - Sky
  - CCD Image
Quality Assurance: Comfort Display
Quality Assurance: **Quick Reduce**

- Quick Reduce analyzes a sample of all image.
- DESDM Astronomy codes, but:
  - No crosstalk correction
  - No bad pixel map
  - No illumination correction
  - (still in flux)
- Astrometry & Photometry
- Plots and Histograms:
  - Seeing
  - Distortions
  - Sky brightness
  - Magnitude limit
  - # of objects
  - ....
- DES CTIO Portal web interface
- Nightly Summaries
- different views:
  - Data
  - PSF
  - Sky
  - CCD Image
Quality Assurance: Observer Workstation

- Every image will be copied to local disk
- Uncompressed
- Standard astronomy software packages:
  - IRAF
  - DS9
  - IDL (is this needed?)
  - fv (is this needed?)
  - fitsutil (is this needed?)
  - SExtractor
- Run your own analysis and algorithms
- USB external disk
DECam Guider

- 4 2kx2k guide CCDs
- Behind the shutter
- 7 s full readout
  <0.5 s in ROI mode
- 1 Hz update rate
- Modes supported:
  - AUTO (Catalog look up)
  - SELF
  - USER
- Tested with PreCAM

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DECam Hexapod, Focus

- Focus controlled by camera, not TCS
- DECam Hexapod
- Closed feedback loop (eventually) using 8 2kx2k CCDs
- Manual focus sequence

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and much more...

• **Monitoring and Alarms**
  – Hardware is protected
  – Only experts have access to critical components (e.g. CCD substrate voltage)
  – Call list, paging system
  – Telemetry information archived in DECam DB

• **Remote Access (View information, No control)**
  – Exposure Browser
  – Telemetry, trend charts, correlations

• **Electronic Logbook**
Summary

• DECam readout time ~20 seconds
• DECam image size 1 GB (~600 MB compressed)
• Provided QA:
  – Image Health
  – Quick Reduce
  – Comfort Display
• Observer QA:
  – Observer Workstation

• Feedback, questions: kh@physics.osu.edu