The Willard L. Eccles Telescope at the Frisco Peak Observatory:

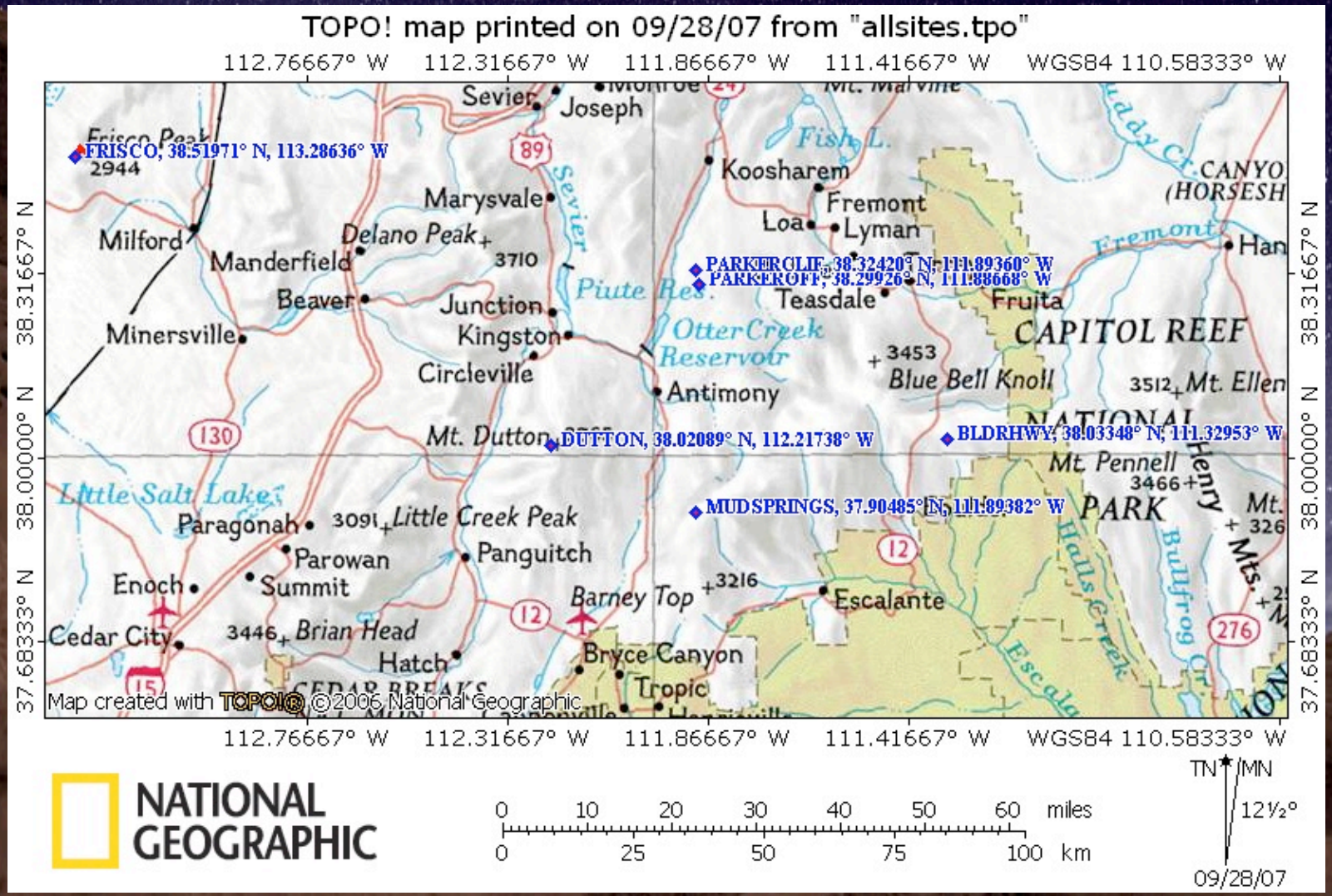
Commissioning and development of remote operation capabilities

Wayne Springer, Kyle Dawson, Paul Ricketts,Nicolas Ramsrud, Upul Samarasingah
University of Utah

- Where is Frisco Peak, Utah? Why at Frisco Peak ? …
- Construction/Commissioning and “First Light”
- Remote/autonomous operations
- What will we do with it?
- Advice sought…

Department of Physics and Astronomy
ASTRONOMY AND ASTROPHYSICS GROUP
THE UNIVERSITY OF UTAH

Observatory Site Surveys
Why Southern Utah?

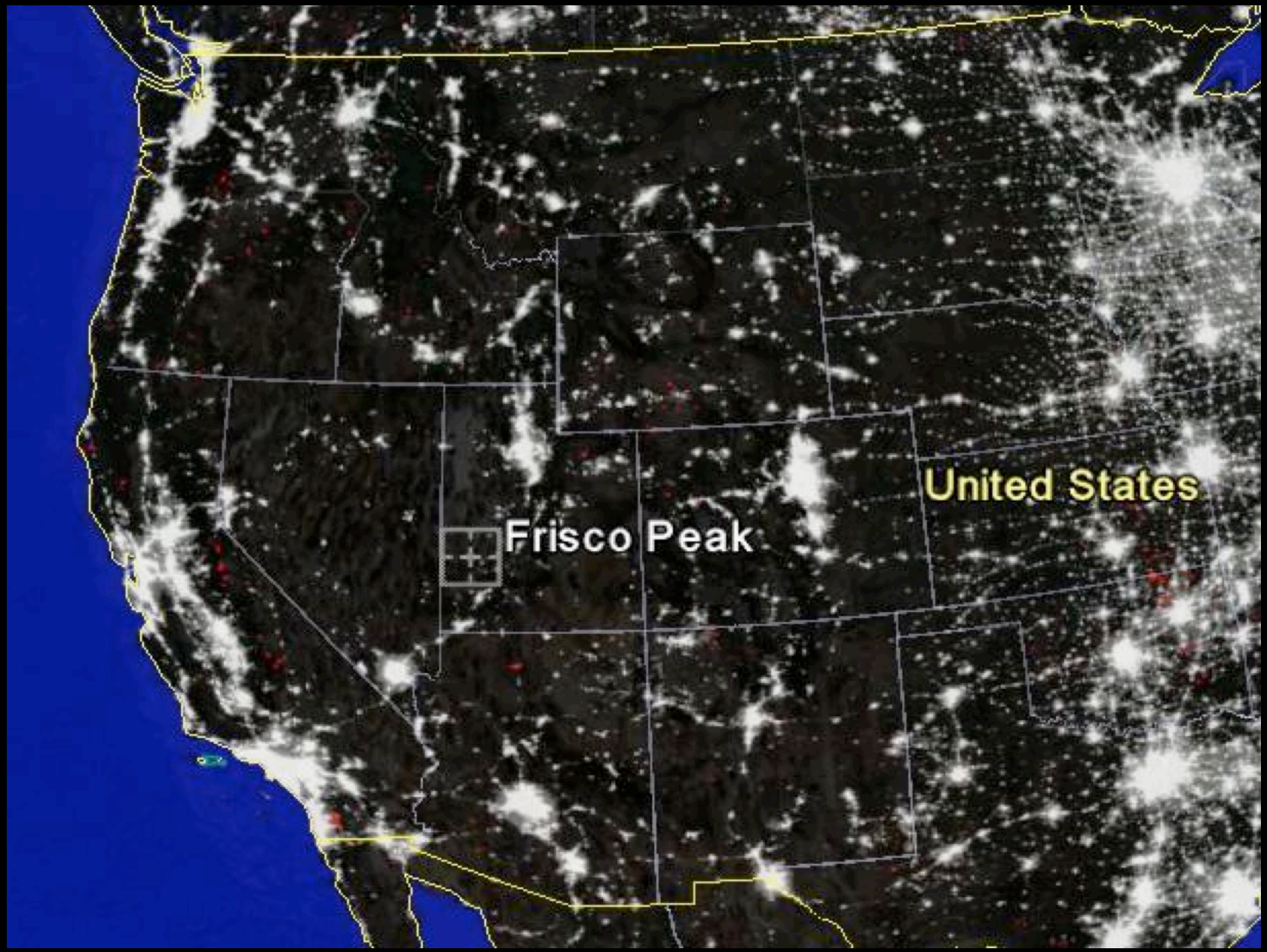


Dan Duriscoe

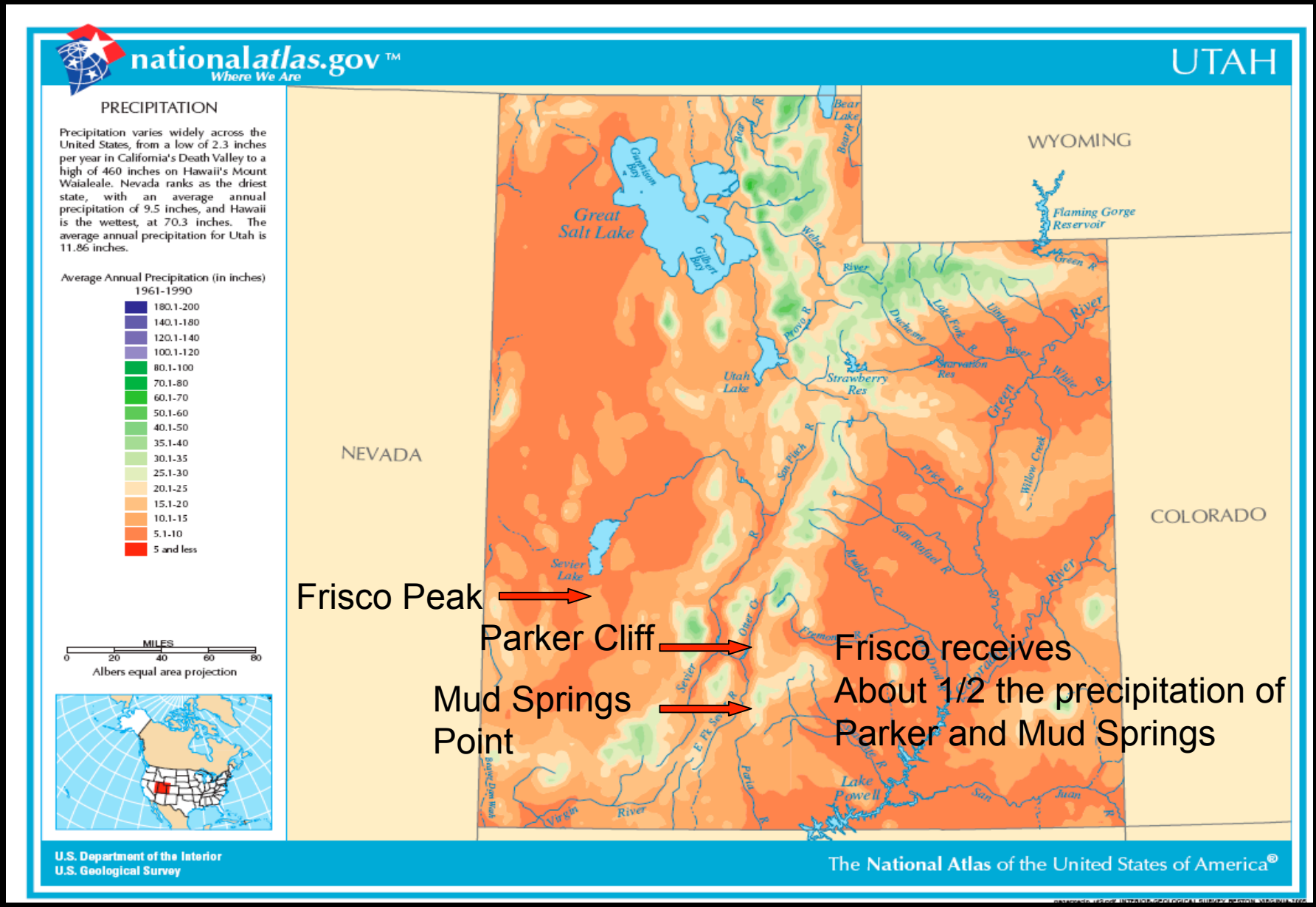
Observatory Site Surveys
Why Southern Utah?

Photo by Dan and Cindy Duriscoe
http://www.nps.gov/arch/naturescience/lightscape.htm

Dark Location



Dry Location



Existing Infrastructure
Road and Communications
Ground Breaking…July 16,2009

Observatory Site
View from Telescope Pier...~4 weeks in

2.5 months later….Control Room and Dome

3 months later …Telescope Installation completed

Aerial Views…


“First Light” Photo
NGC891
Paul Ricketts. Willard Eccles Observatory
October 17,2009
23.9 Million light years away
…yet visible in the eyepiece at Frisco Peak!!!

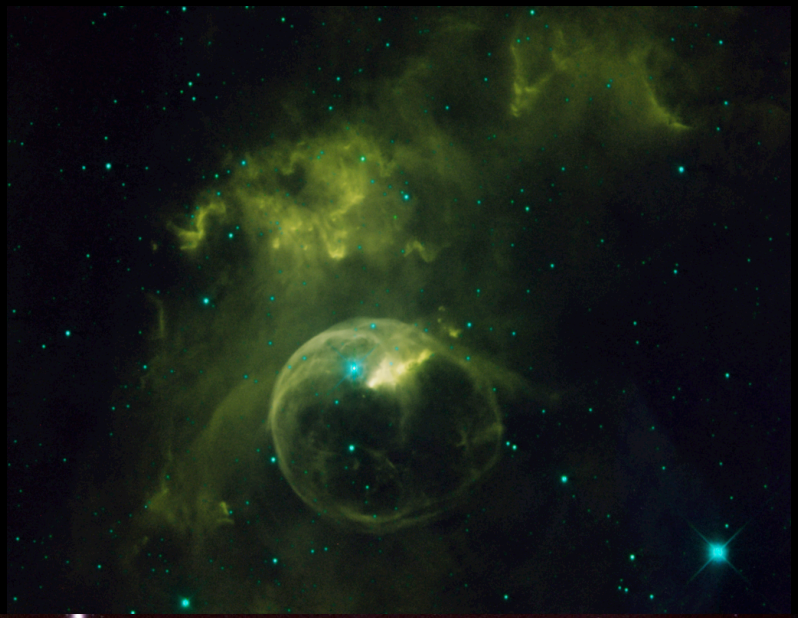

Second Night Photos
Horsehead Nebula
Paul Ricketts. Willard Eccles Observatory


Second Night Photos
Galaxy Cluster
Paul Ricketts. Willard Eccles Observatory


Second Night Photos
Galaxy Cluster NGC 1274 in Perseus
Paul Ricketts. Willard Eccles Observatory


Second Night Photos
Crab Nebula
Paul Ricketts. Willard Eccles Observatory

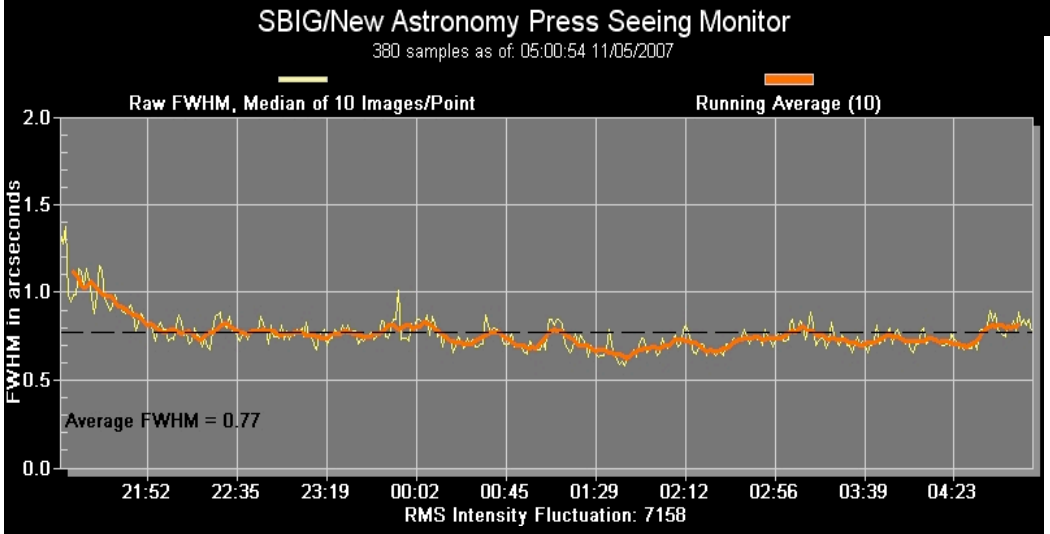
Recent Images

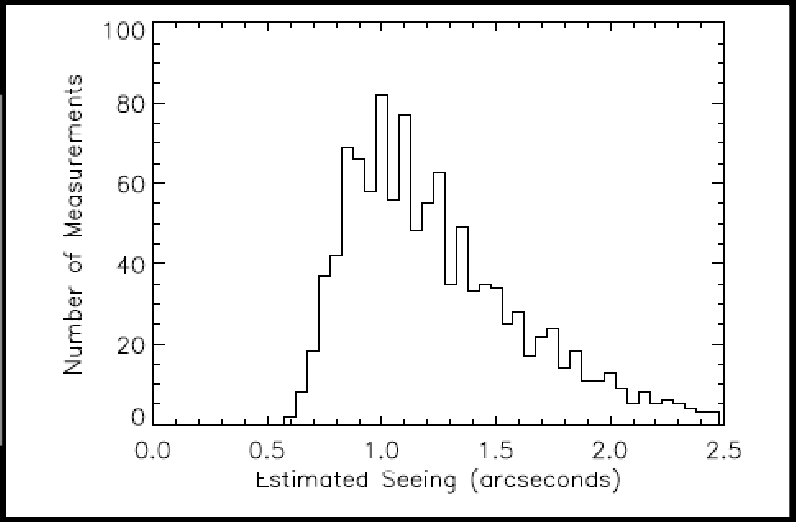


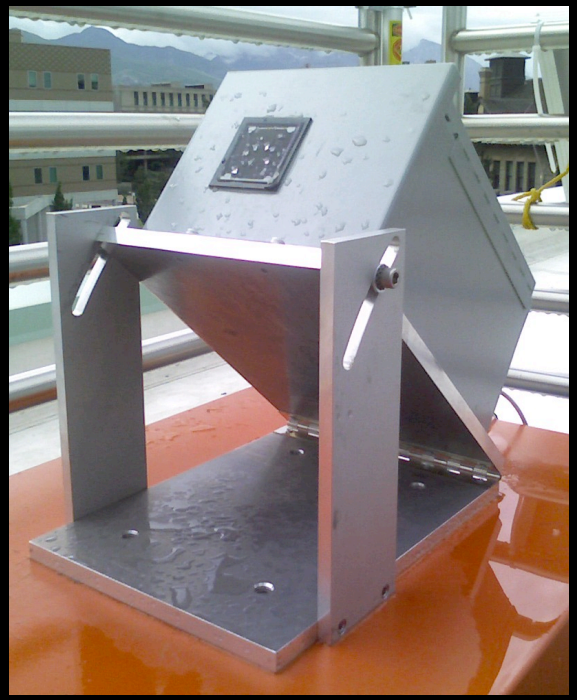
Current Operations

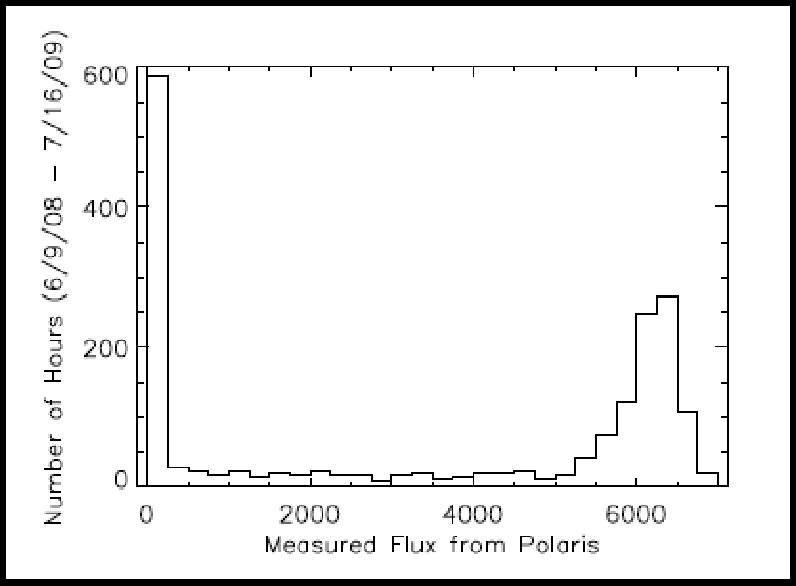
- On-site operation with Observatory Personnel
- Characterization Studies
  - Seeing measurements
  - Calibration Stars,…
- On-site Class Visits / “Star Parties”
- Remote Observing from Campus Observatory Star Parties
- Observational Astronomy Course Projects
  - Imaging
  - Supernovae Light Curves
  - Transits of Known Extra-Solar Planets
  - Color Magnitude Diagrams
  - Strong Lensing
- Remotely controllable…but still Working on fail-safe protection…

Site Characterization

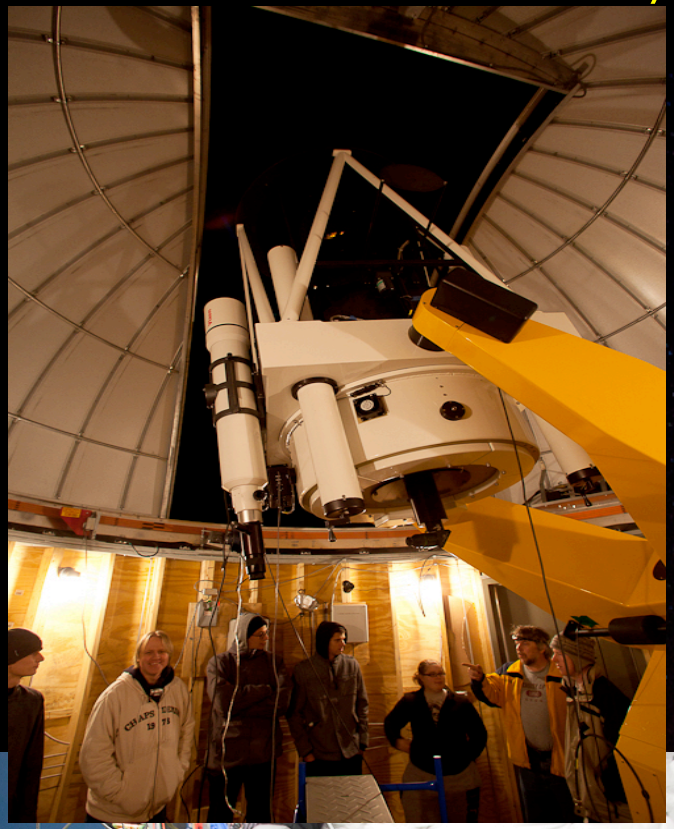








On-site Visits
Astronomy Classes



Observational Astronomy Course
Student Projects

Submitted to *ASTR5015*

Gravitational lens HE0047 and HE0235 on the Willard Eccles Observatory

X.Sui[1], R.Arneson[1], K.Dawson[1], D.Della Corte[1], D.Harris[1], N.Ramsrud[1]

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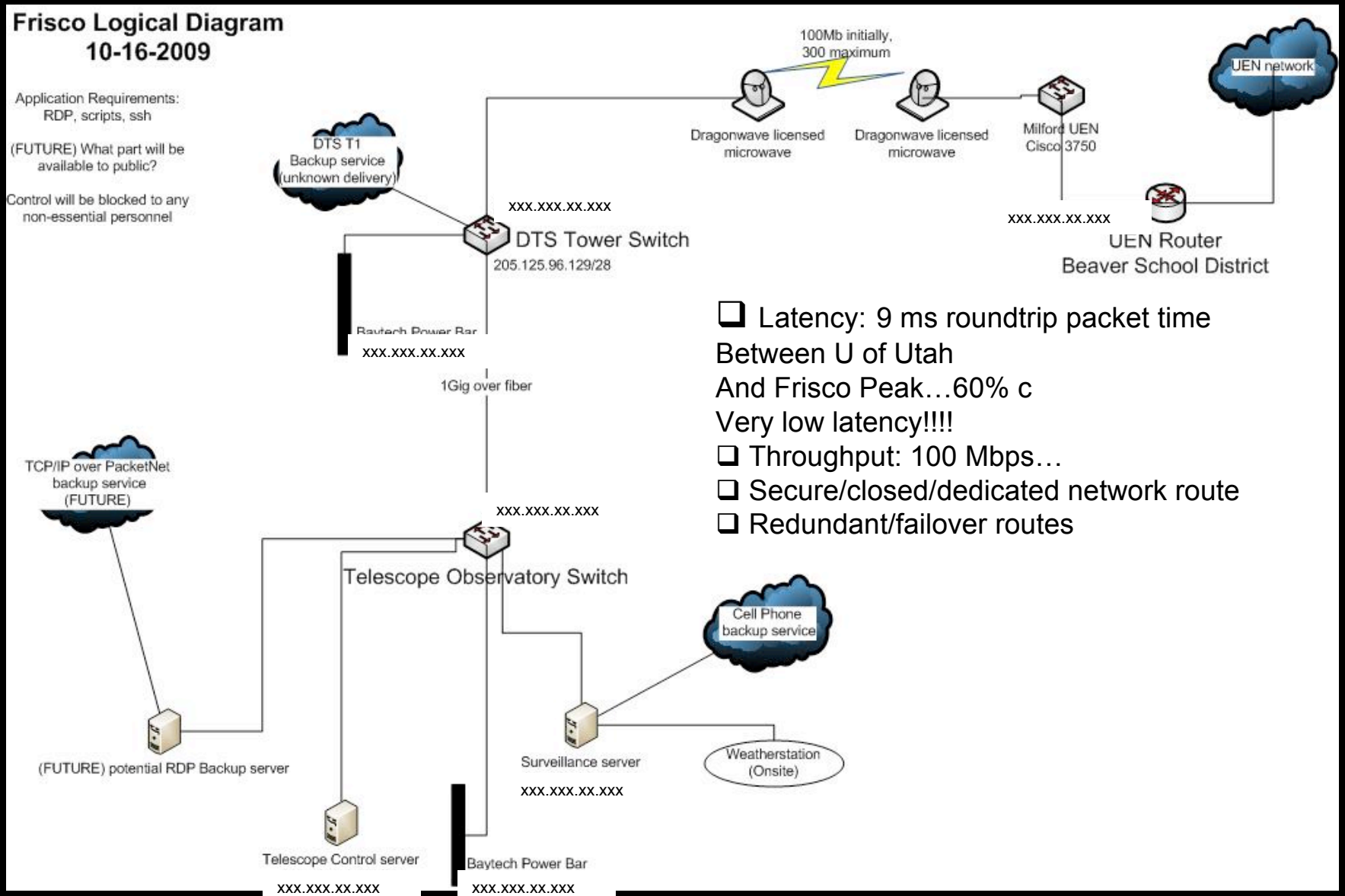
ABSTRACT

Here we focus on two gravitational lenses, HE0435-1223 and HE0047-1756. We measure the flux ratio of the different lens images on the same day for each day, and we also measure the variation of the flux of images on different day. In this paper, we introduce the way to process the data from the CCD telescope step by step by using the true data. The way to build calibration images, including bias, dark current, bad pixels mask and smoothed flat field image will be shown in detail. We use these calibrations to process the objects images and get a relatively true flux images with its invar image for each one. Then we do some analysis on the processed images. We compare our data with the data from Castles Gravitational Lens Data Base and analyze the problem we meet with. The IDL program we use will be introduced in the paper like DJS_ISTERSTAT, WHERE, DJS_PHOT, SMOOTH, GAUSSFIT.

Remote Operations Characteristics

- Network
  - Latency
  - Throughput
  - Isolation/Redunancy
- Power
  - Uninterruptible Power Supplies
  - Remote Controlled Power Strip
- Video Surveillance
- Robotic Telescope
- Robotic Dome
- Control Software
  - Telescope and Dome
  - Instruments

Network
An essential link for remote operation of WEO

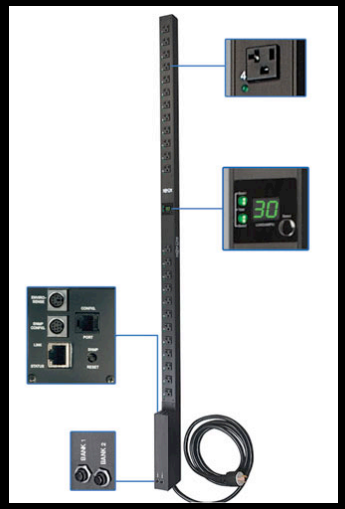


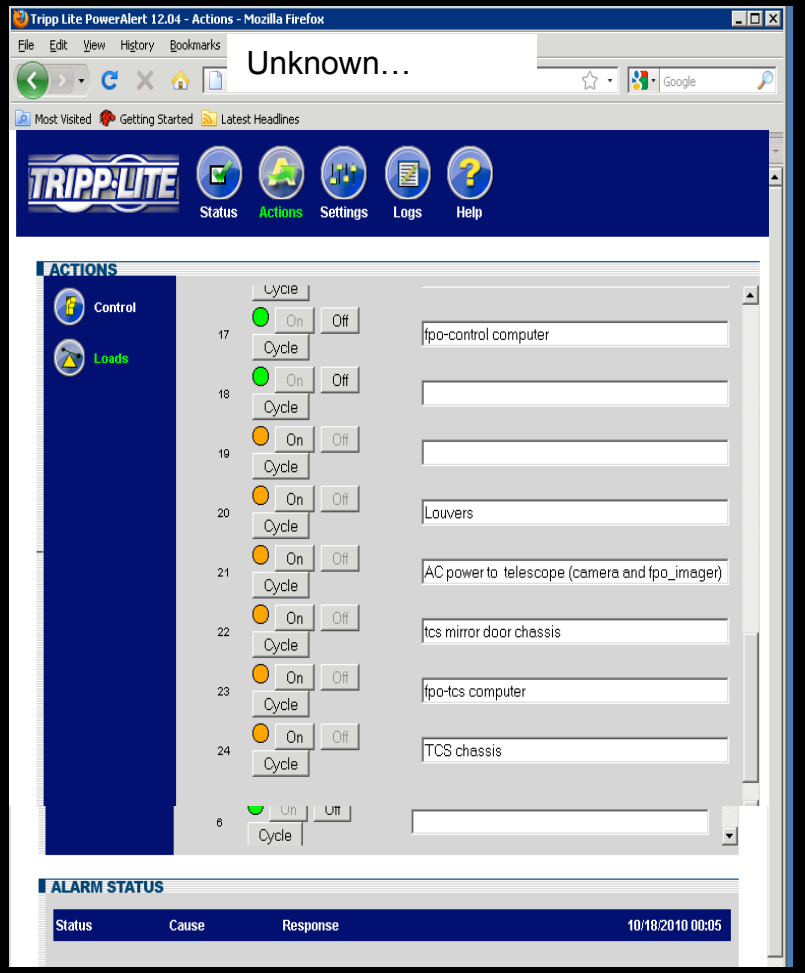
- Latency: 9 ms roundtrip packet time

Between U of Utah
And Frisco Peak…60% c
Very low latency!!!!

- Throughput: 100 Mbps…
- Secure/closed/dedicated network route
- Redundant/failover routes

Power
UPS and Switched PDU-Another essential link for remote operation of WEO

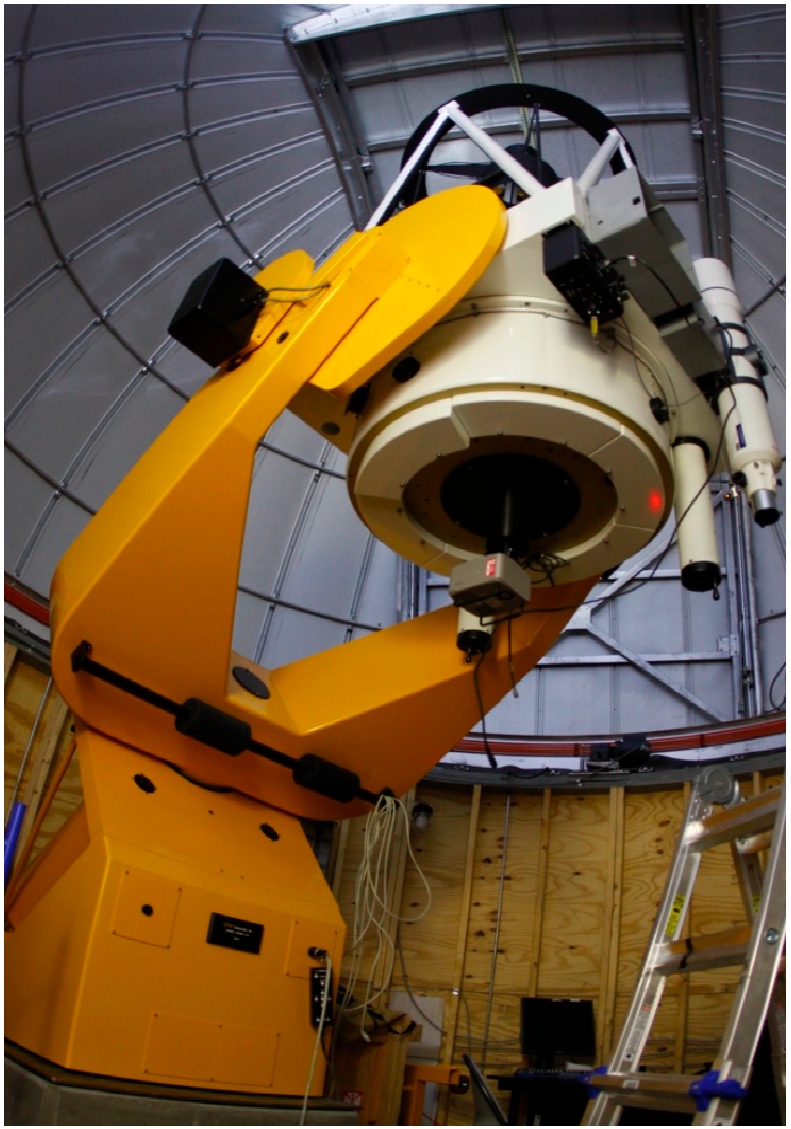




- ❑ Observatory is run from two UPS (110V, 220V)
- ❑ Remotely controllable (HTTP,SNMP) Power Strip
- ❑ Each piece of equipment can be independently powered on/off/cycled

Video Surveillance
Remote operation…first step is to have “eyes” on the site

Robotic Telescope



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Salt Lake City Utah 84112
(801) 581-6901
http://www.physics.utah.edu/weo

Technical Specifications

Location:

Latitude	Longitude	Elevation
38.52N	113.28W	9551 ft

Telescope Specifications:

- Manufacturer: DFM Engineering Longmont, Colorado
- Optical Design: 32" diameter f/8 (effective focal ratio) Ritchey-Chretien
- Field-of-View: Fully shielded unvignetted FOV is 43'
- Load Capability: >200 lbs of instrument bearing capability, 100lbs of auxiliary telescopes
- Instrument Clearance: 0.81m between primary cell and fork
- Drive System: Friction drive with zero backlash, fiducial position repeatability better than 5"
- Slew Time: Maximum slew time < 60 seconds
- Time Keeping: Garmin GPS receiver better than 0.05 second resolution

Dome:

- Manufacturer: ASH manufacturing
- Model: MEBH-18'6"with radio control
- Diameter: 18.5 feet
- Shutter Width: 7 feet
- Height Above Ground: 10 feet

Camera/Filter(s):

- Model: SBIG STL-6303E
- Filters: ASTRODON SLOAN g and r

Site Characteristics:

- Seeing Conditions: Median approximately 1.0"

For other questions, please contact Prof. Wayne Springer at springer@physics.utah.edu

Robotic Dome

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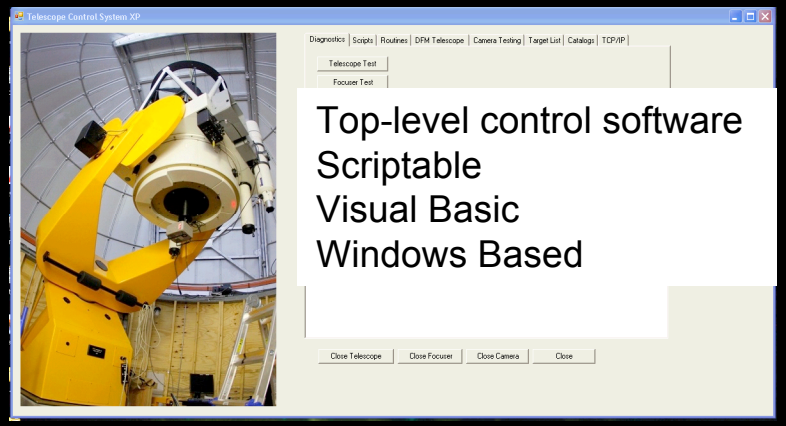
Remote Operations
Top Level Control Software
Current Scheme-Microsoft Windows Based



Top-level control software
Scriptable
Visual Basic
Windows Based

Power Systems

Maxim DL

SBIG STL-6303

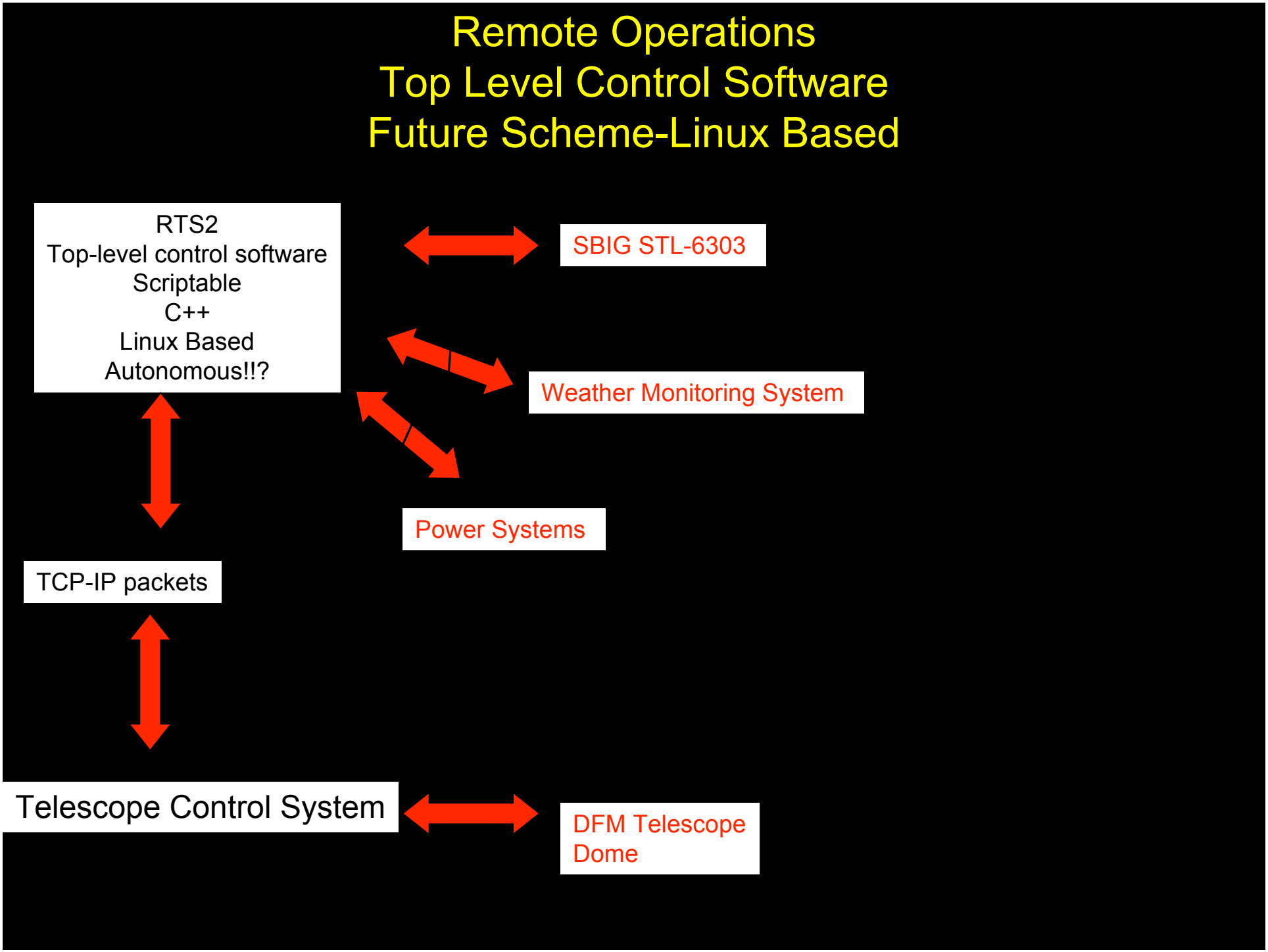
TCP-IP packets

"The Sky" Planetarium Software

Telescope Control System

DFM Telescope
Dome

Remote Operations
Top Level Control Software
Future Scheme-Linux Based



Remote Operations
“Failsafe”: Dome -Radio Control

- Radio Control through DFM TCS
- Building stand-alone fail-safe system to issue command to close shutters via Radio
- Require “everything” to be good:
  - Weather
  - Power
  - Network
  - …

Site Monitoring Systems

- Surveillance Cameras
- All-Sky Monitor
- Cloud Monitor
- Seeing Monitor
- Weather Station
  - Wind Speed
  - Wind Direction
  - Relative Humidity

Site Monitoring Systems
Local Web Page

Current WEO Weather Information - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://205.125.96.80/conditions_current.html

Most Visited Getting Started Latest Headlines

Current WEO Weather Information

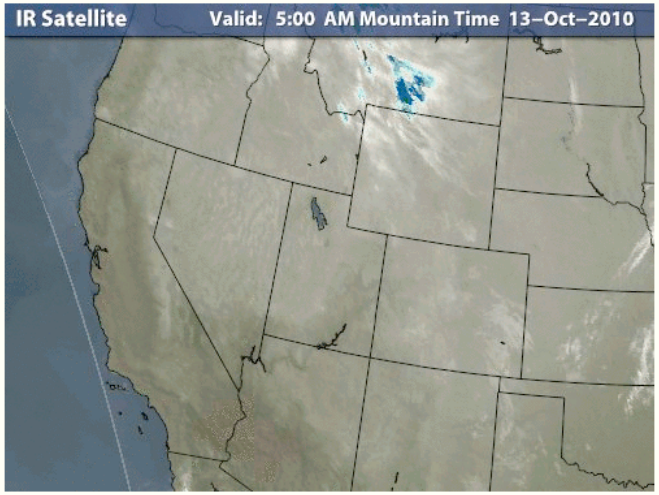
Willard Eccles Observatory

Research telescope for University of Utah
NOAA Weather for Frisco Peak
Security Cams (fpoadmin)

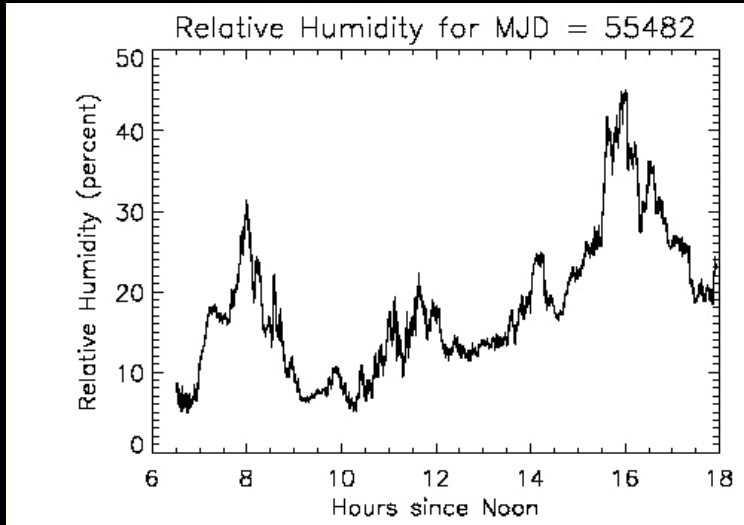
Weather information for Frisco Peak, UT (near Milford, UT)
38° 31 06.54" N 113° 17 08.46" W
elevation 2917 m / 9570 ft

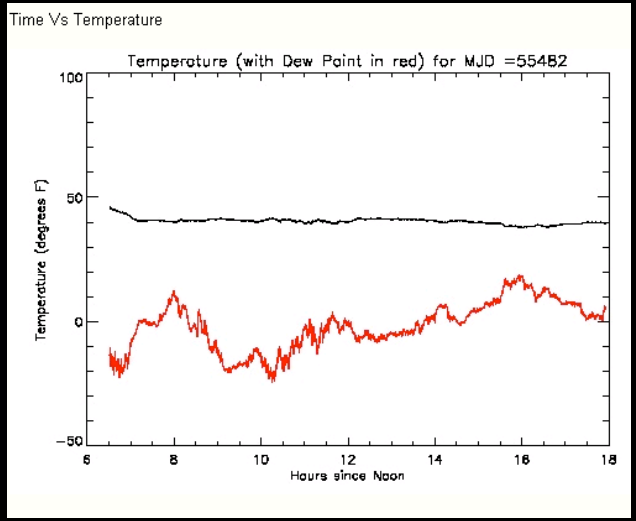
For MJD: 55482, 2010-10-13

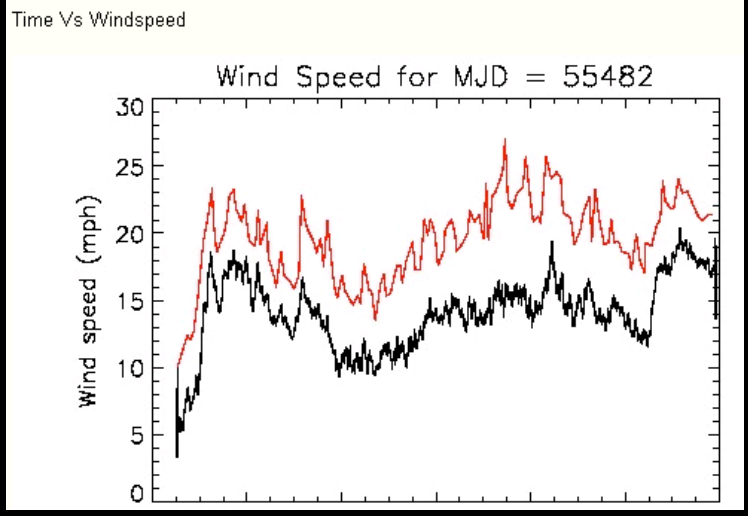
Almanac		
	Current MJD: 55482.0	Moon Illumination: 0.33925058
	Hours Since Noon (MT)	LST
Sunrise:	19.733334	7.6483641
Sunset:	6.9166667	18.796606
Moonrise:	1.1833333	13.047576
Moonset:	10.733334	22.623723
Evening 12 Degree Twilight:	7.9500003	19.832769
Evening 18 Degree Twilight:	8.4666667	20.350850
Morning 12 Degree Twilight:	18.699999	6.6122006
Morning 18 Degree Twilight:	18.200000	6.1108321
Moon Position:	RA: 17.615792	DEC: -24.319663

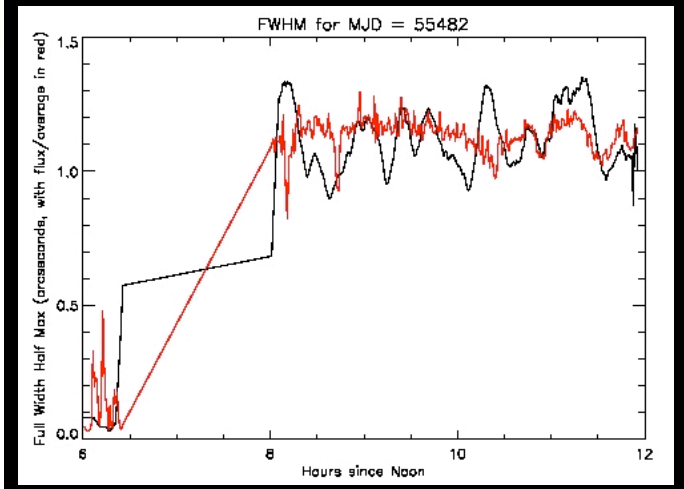


Site Monitoring Systems
Local Web Page

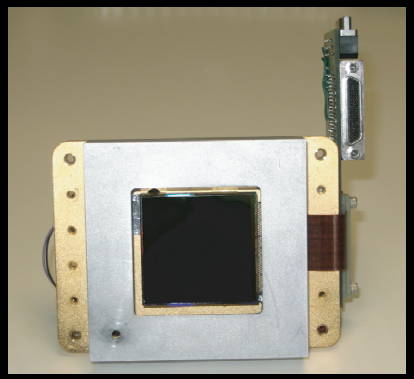


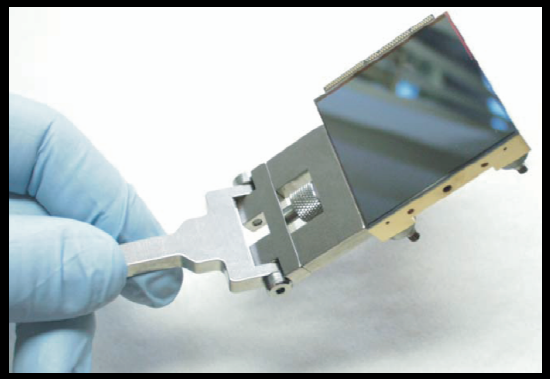






What's next for WEO?
Dual Band Imager





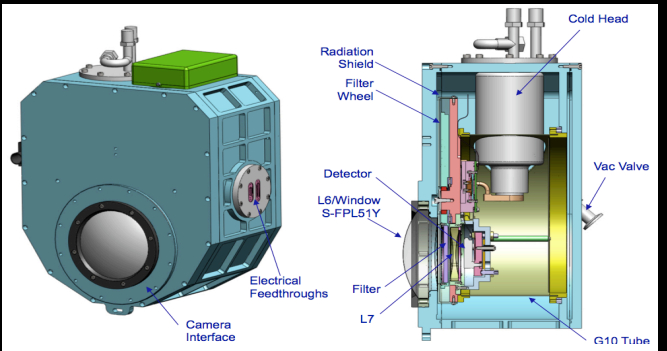


Figure 9 SALT RSS dewar design (courtesy of S. Smee JHU)

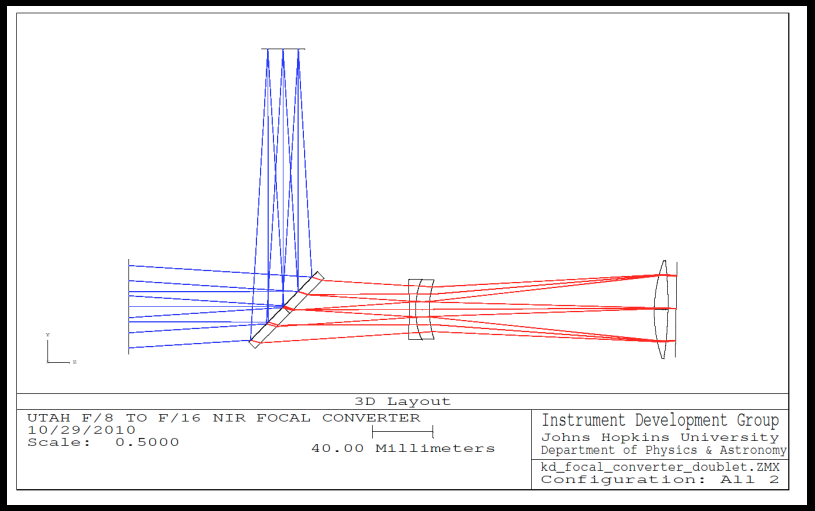


Figure 6 Optical Layout of focal converter..

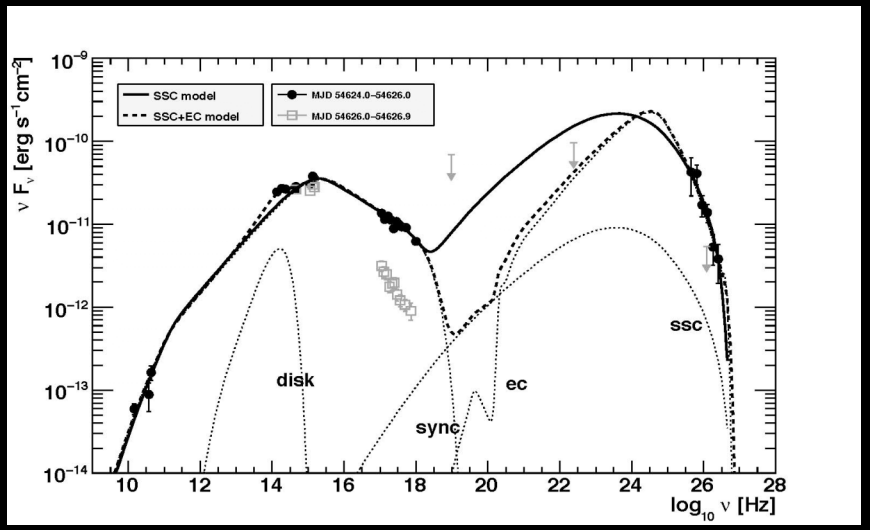


Figure 5 Multiwavelength observations Multiwavenelgth SED model for W Comae (from Acciari 2009c)

Spectral energy distribution – observations vs. models

What's next for WEO?

- Education and Public Outreach
  - Advanced Course Topics
    - Strong lensing
    - Supernovae light curves
    - Transits of known extra-solar planets
    - Color-magnitude diagrams of galaxy clusters,….
  - Use from Campus Observatory for Public Outreach
- Research
  - Obtain Grants
    - Submitting ATI proposal to NSF for IR- Imaging/Photometry
  - Develop Research Program
  - Build (State-wide) Consortium of Universities
- Remote Operations
  - Continuing development of automated control hardware/software
  - Conquer Fear!!! Autonomous Operations…