

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

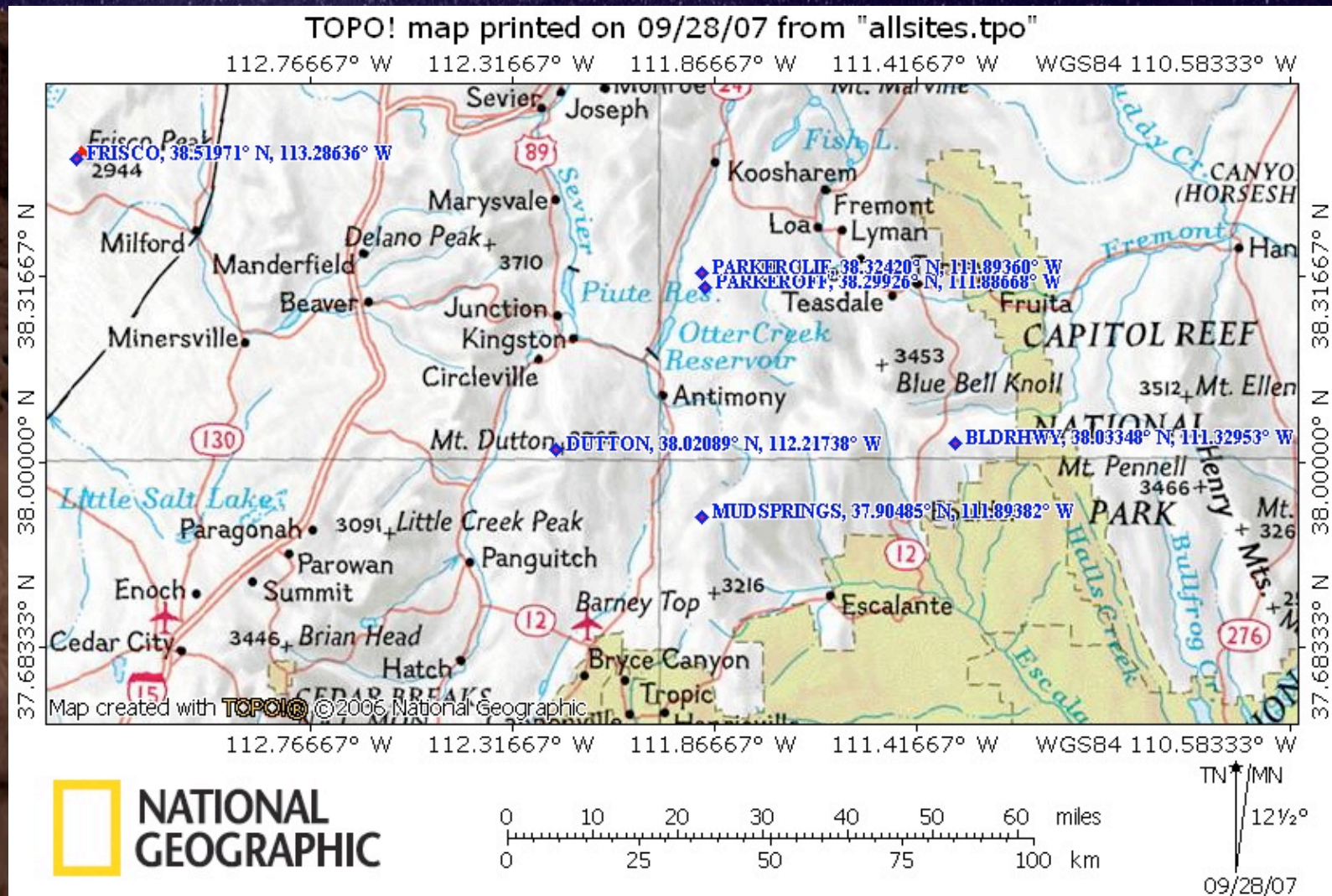
Commissioning and development of remote operation capabilities

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...

Observatory Site Surveys

Why Southern Utah?



Observatory Site Surveys Why Southern Utah?

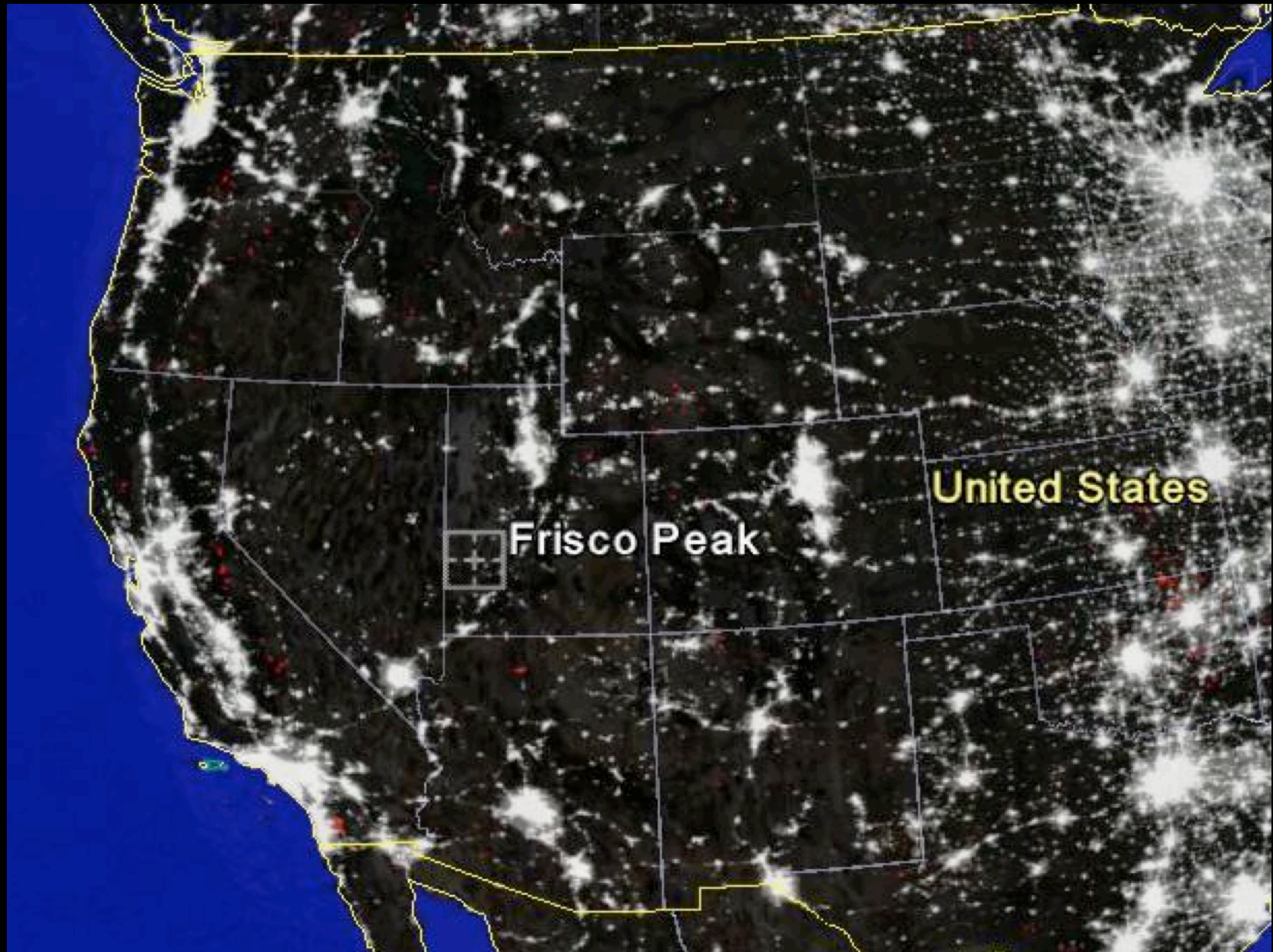


Photo by Dan and Cindy Duriscoe

<http://www.nps.gov/arch/naturescience/lightscape.htm>

Dan Duriscoe

Dark Location



Dry Location



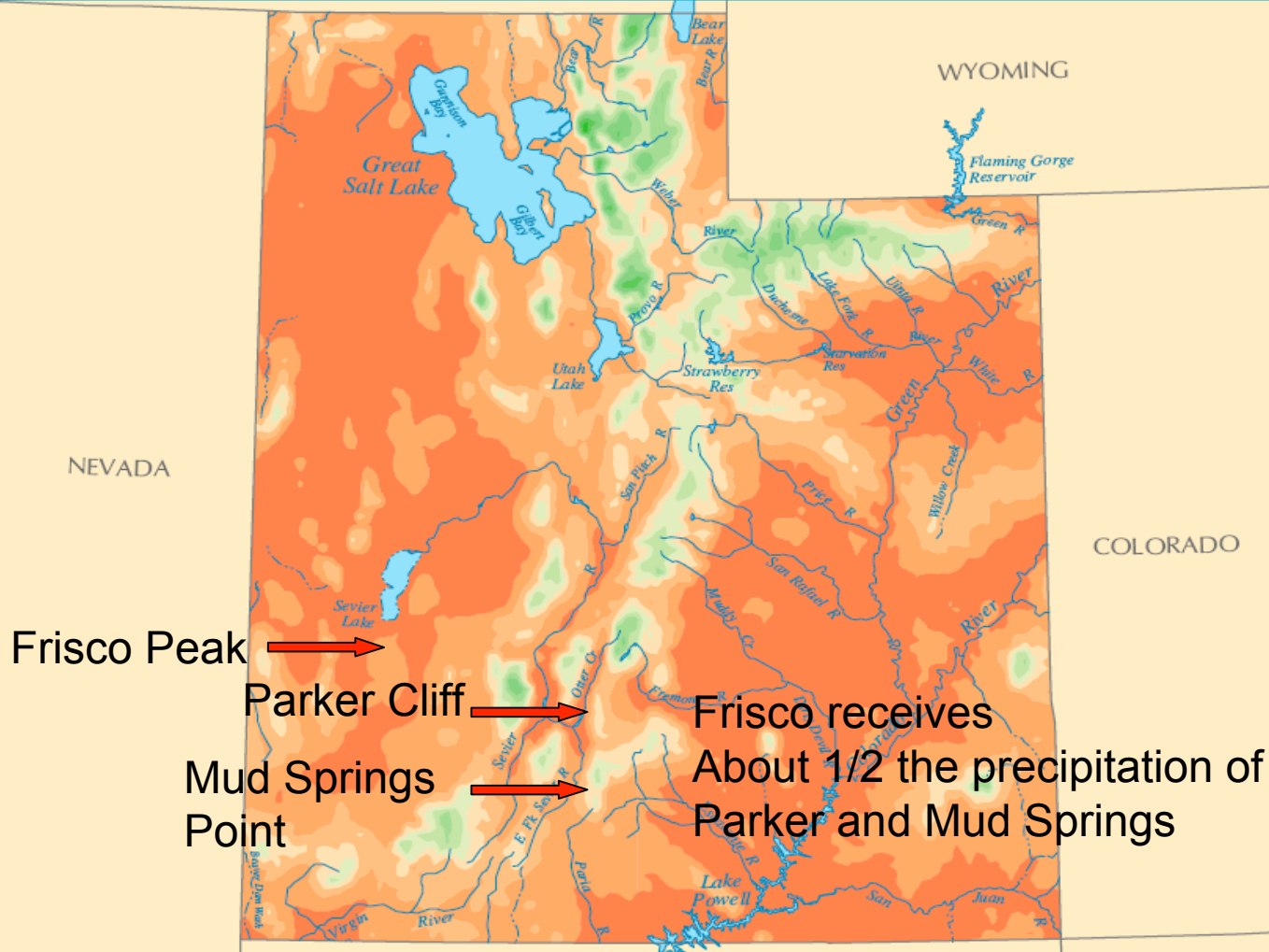
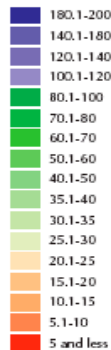
nationalatlas.govTM
Where We Are

UTAH

PRECIPITATION

Precipitation varies widely across the United States, from a low of 2.3 inches per year in California's Death Valley to a high of 460 inches on Hawaii's Mount Waialeale. Nevada ranks as the driest state, with an average annual precipitation of 9.5 inches, and Hawaii is the wettest, at 70.3 inches. The average annual precipitation for Utah is 11.86 inches.

Average Annual Precipitation (in inches)
1961-1990



Frisco Peak →

Parker Cliff →

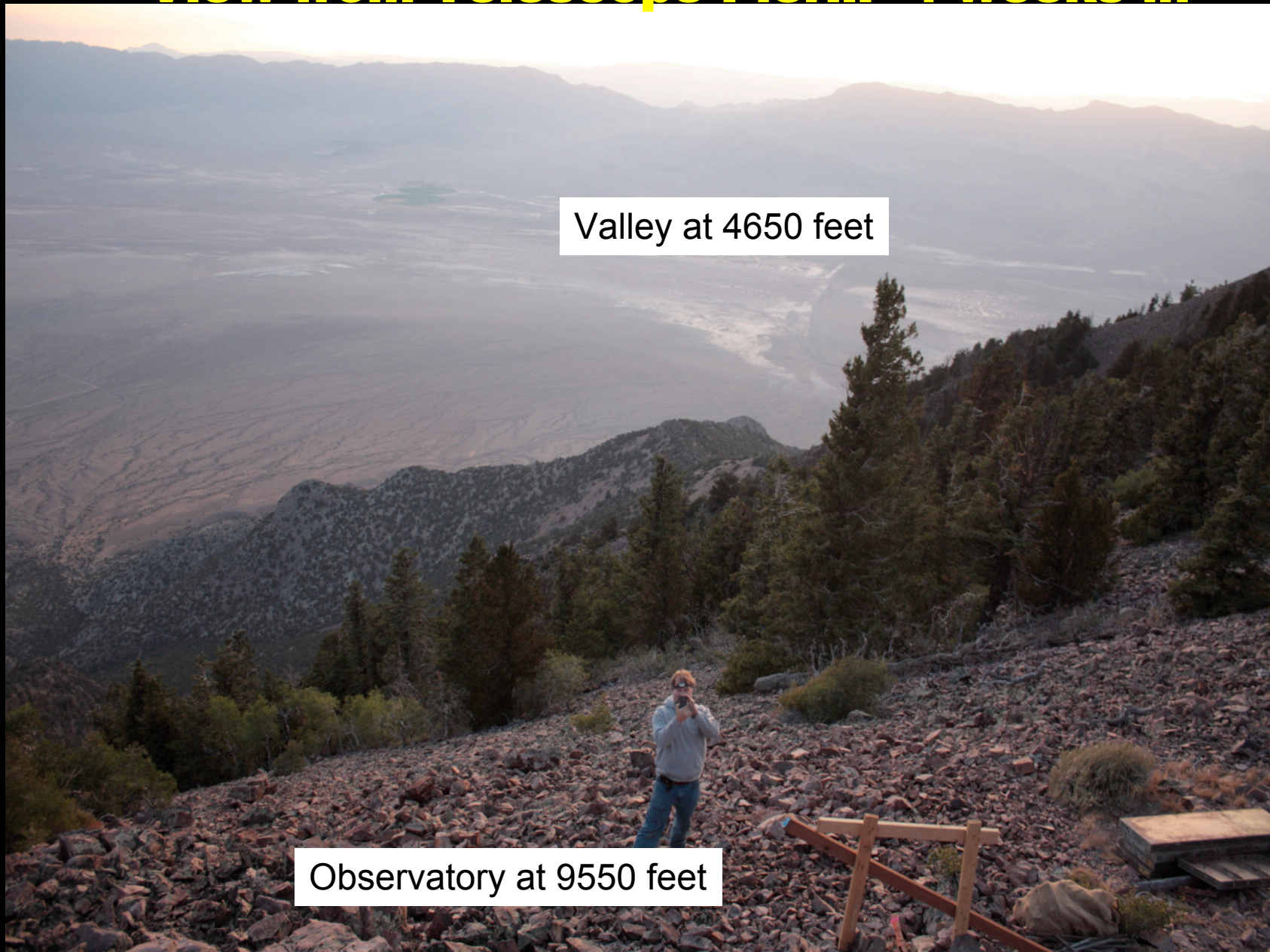
Mud Springs Point →

Frisco receives
About 1/2 the precipitation of
Parker and Mud Springs

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



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



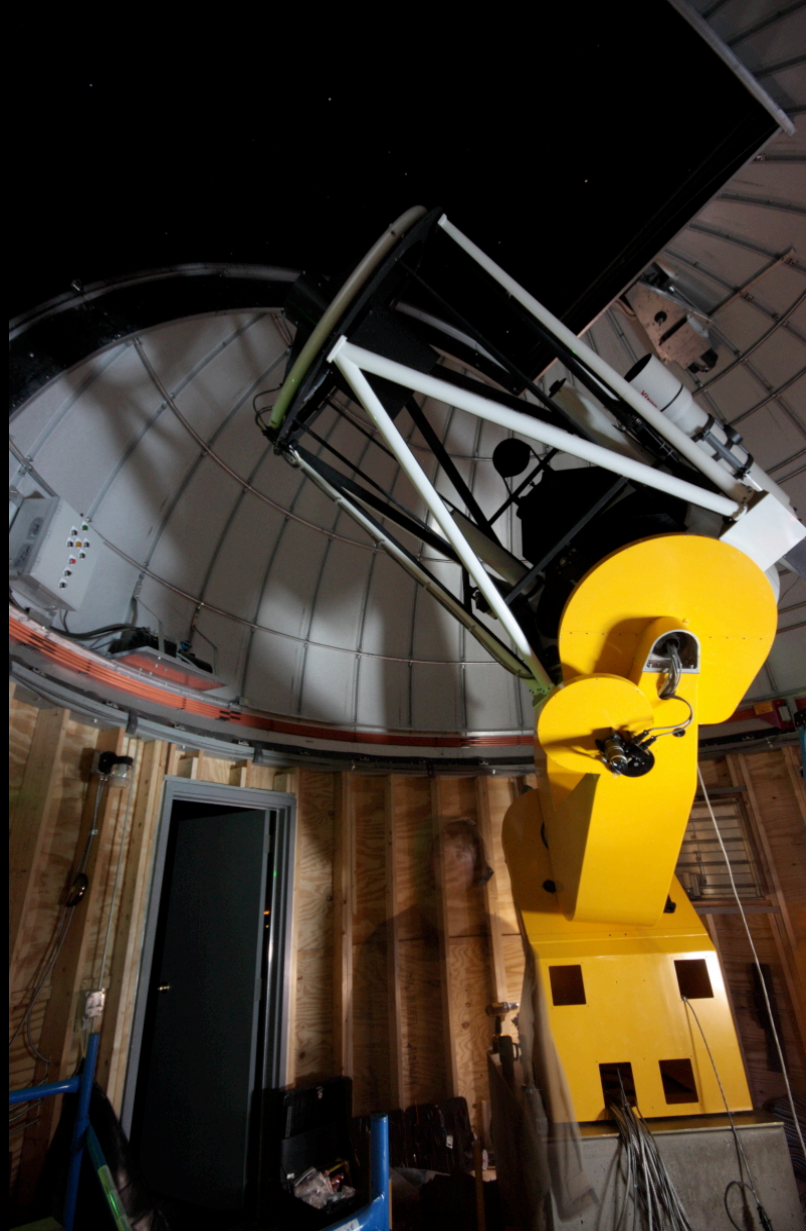
Valley at 4650 feet

Observatory at 9550 feet

2.5 months later...Control Room and Dome



3 months later ...Telescope Installation completed



Aerial Views...





**“First Light” Photo
NGC 891**

Paul Ricketts. Willard Eccles Observatory

October 17, 2009

**23.9 Million light years away
...yet visible in the eyepiece at Frisco Peak!!!**

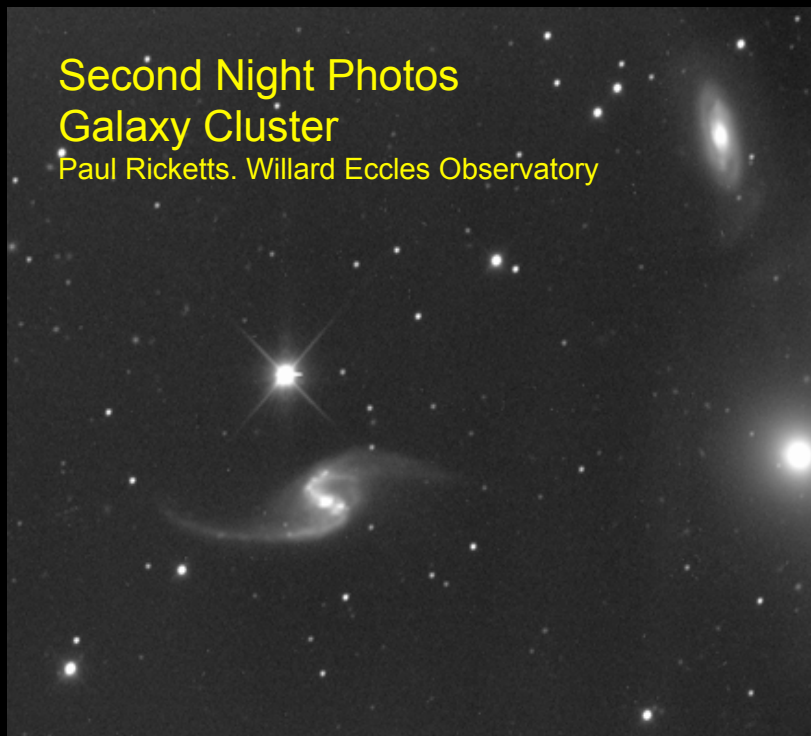
Second Night Photos
Horsehead Nebula

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

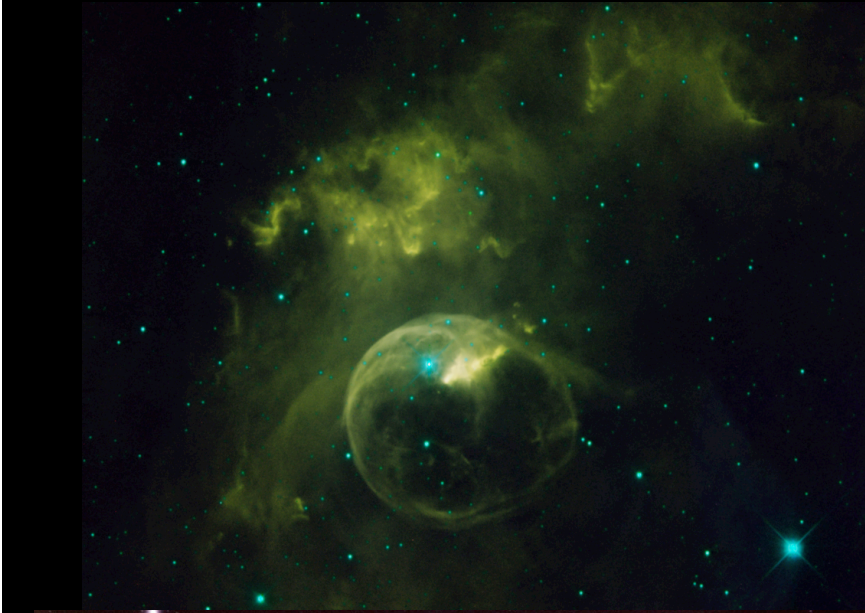


Second Night Photos
Crab Nebula

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

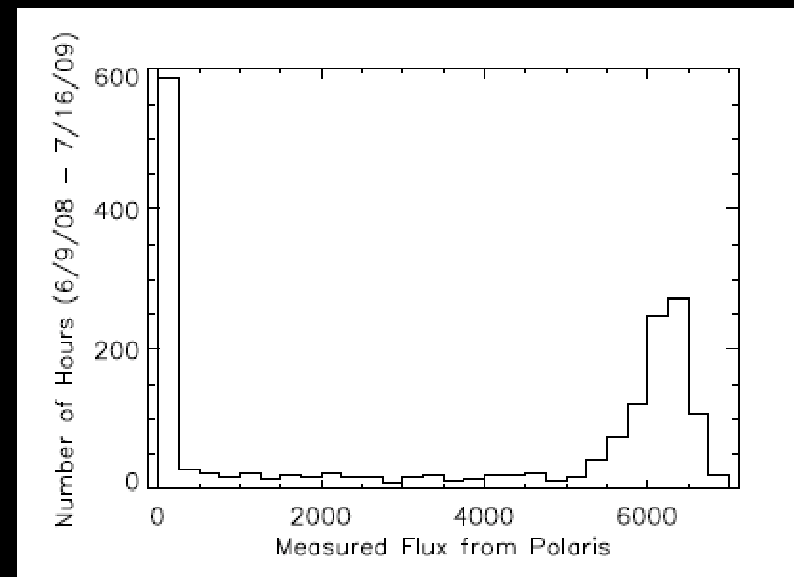
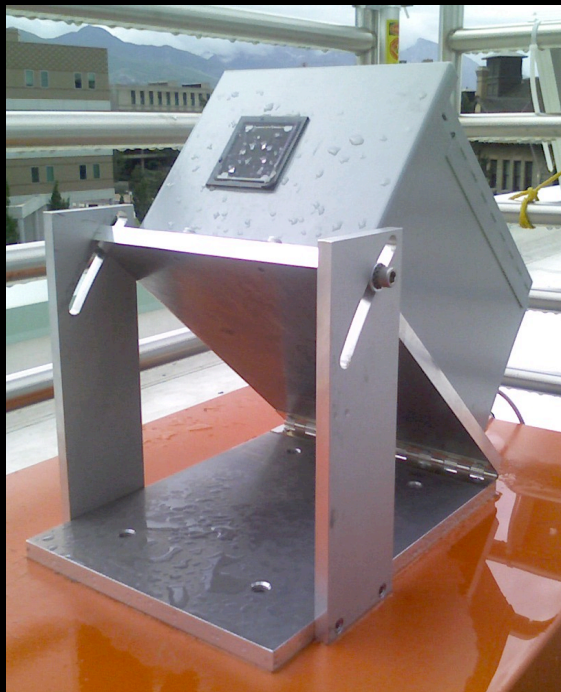
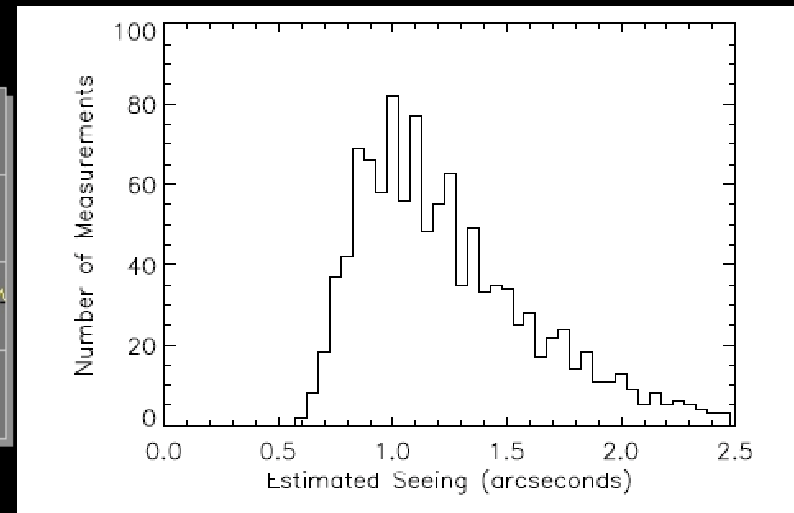
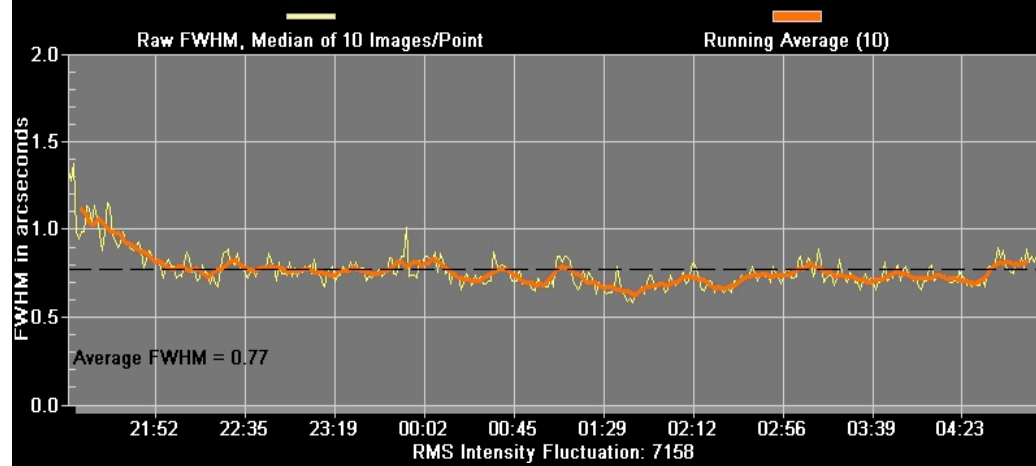
- ❑ Observational Astronomy Course Projects
 - ❑ Imaging
 - ❑ Supernovae Light Curves
 - ❑ Transits of Known Extra-Solar Planets
 - ❑ Color Magnitude Diagrams
 - ❑ Strong Lensing

- ❑ Remotely controllable...but still Working on fail-safe protection...

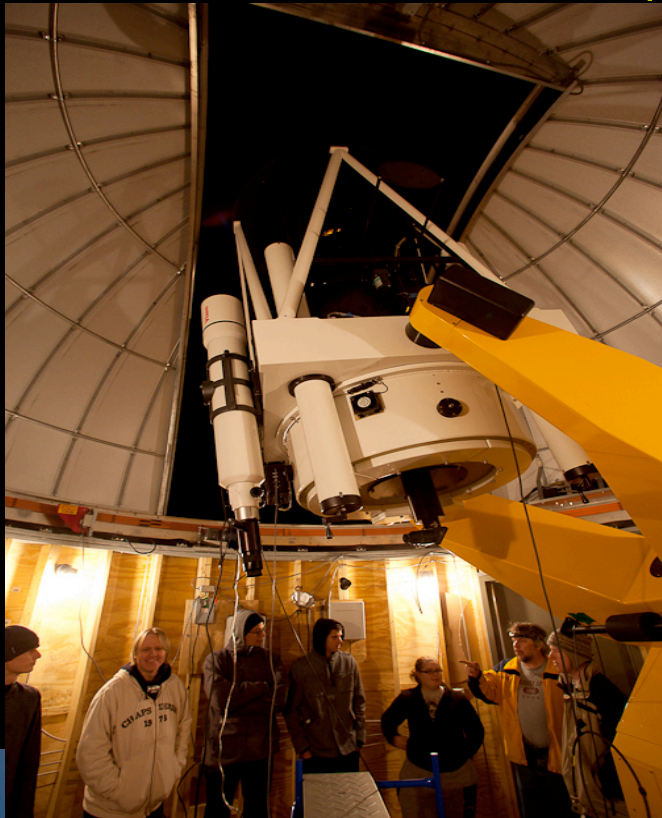
Site Characterization

SBIG/New Astronomy Press Seeing Monitor

380 samples as of: 05:00:54 11/05/2007



On-site Visits Astronomy Classes



Observational Astronomy Course

Student Projects

Submitted to *ASTR5015*

Gravitational lens HE0047 and HE0235 on the Willard Eccles Observatory

X.Sui¹, R.Arneson¹, K.Dawson¹, D.Della Corte¹, D.Harris¹, N.Ramsrud¹

xuefang.sui@utah.edu

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

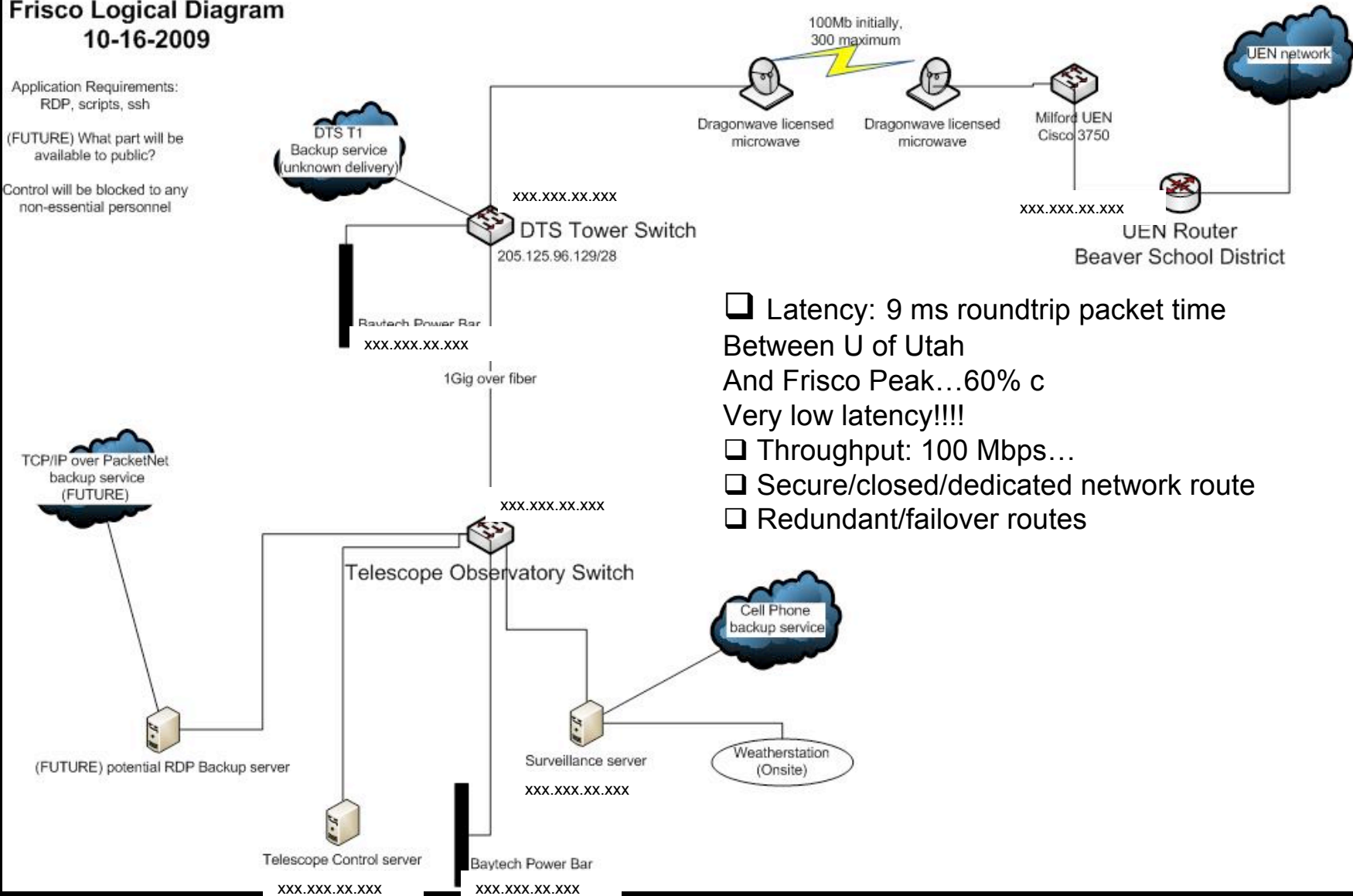
An essential link for remote operation of WEO

Frisco Logical Diagram 10-16-2009

Application Requirements:
RDP, scripts, ssh

(FUTURE) What part will be
available to public?

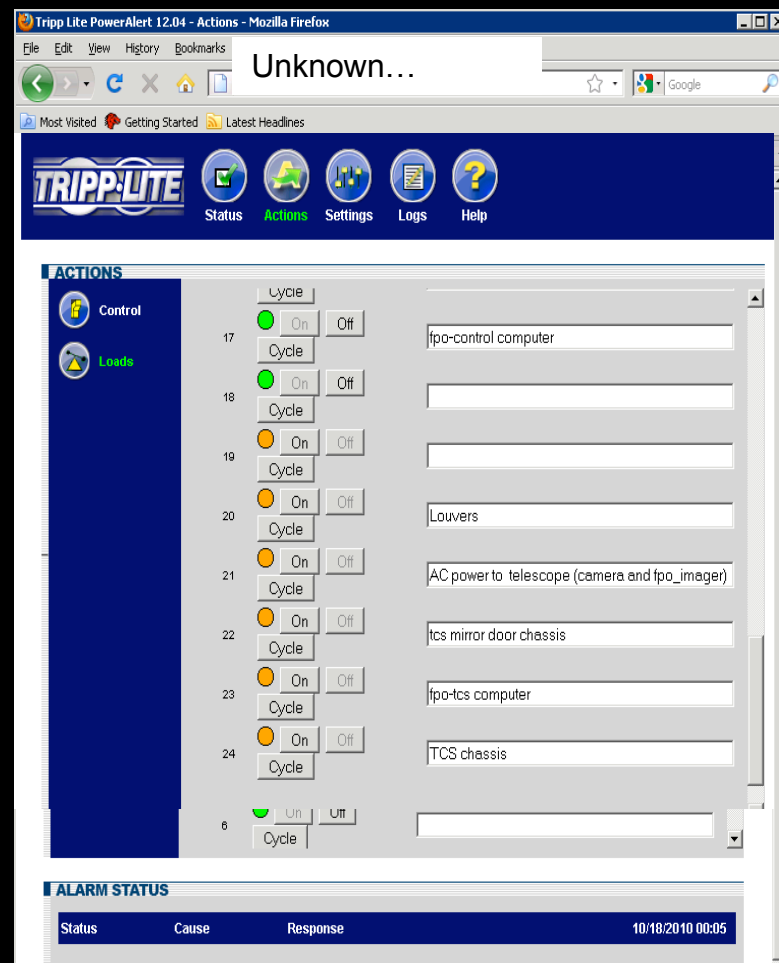
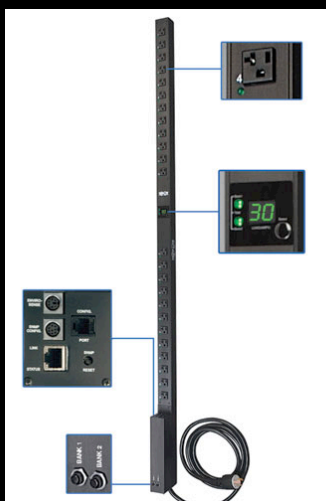
Control will be blocked to any
non-essential personnel



- ❑ 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



Status	Cause	Response	
			10/18/2010 00:05

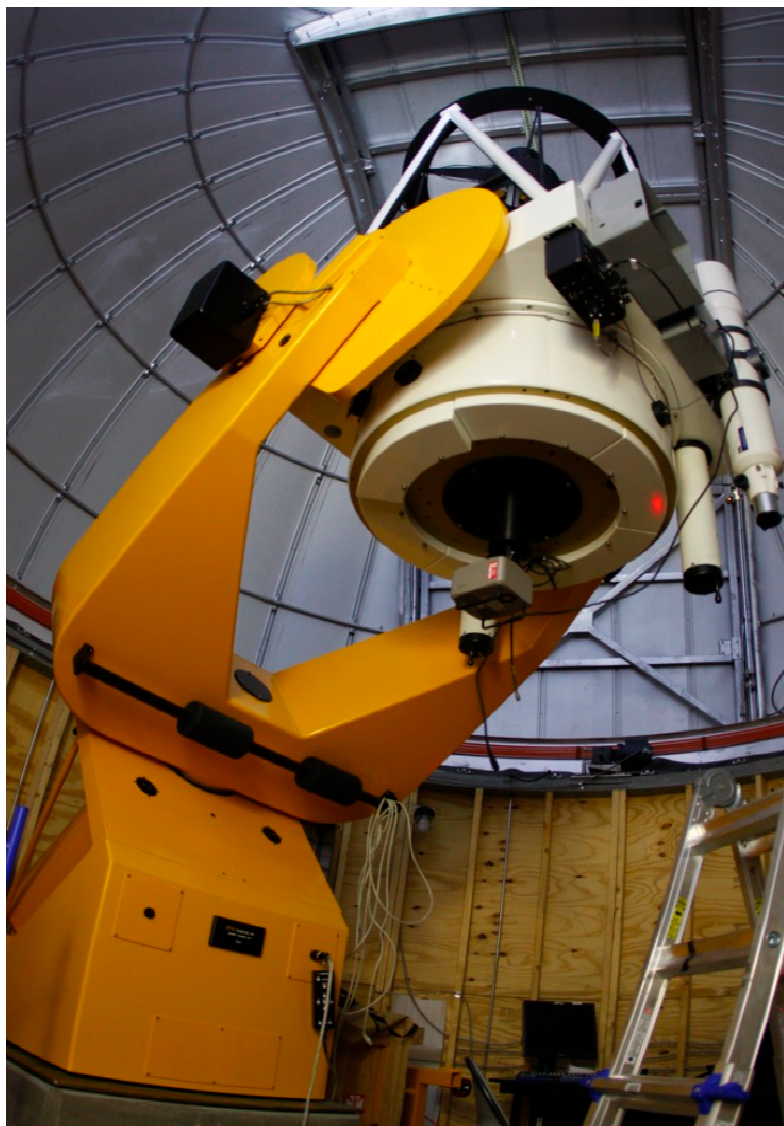
- ❑ Observatory is run from two UPS (110V, 220V)
- ❑ Remotely controllable (HTTP,SNMP) Power Strip
- ❑ Each piece of equipment can be independently powered on/off/cycled

Video Surveillance

Remote operation...first step is to have "eyes" on the site

The screenshot displays the EZWATCH PRO Digital Surveillance System interface. The main area is a 3x3 grid of camera feeds. Camera 1 (top-left) shows an indoor scene with a table and chairs. Camera 2 (top-middle) shows a dark, possibly outdoor or industrial scene. Camera 3 (top-right) shows a close-up of a camera lens. Camera 5 (middle-left) shows a dark, possibly outdoor scene. Camera 6 (middle-middle) shows a dark scene with a temperature reading of 16.0° / 18° and a zoom level of X1. Camera 7 (middle-right) shows an indoor scene with a person. Camera 4 and Camera 8 are not visible in the grid. The right side of the interface features a control panel with the EZWATCH PRO logo, a 'Server' tab, 'View' and 'Group' buttons, 'Log In' and 'Log Out' buttons, a list of IP addresses (192.168.1.6, 192.168.1.8, 166.166.192.143) and camera names (Camera 1 through Camera 8), 'SET', 'Preset', and 'GO' buttons, a 'Zoom' control, a directional pad with a home button, and 'Patrol' and 'Focus' buttons. The bottom of the interface has a power button, a volume control, and a playback control bar with buttons for play, stop, and close. A status bar at the bottom right shows 'Unknown..... Camera 7', 'Playing', and '4.0 kbps'.

Robotic Telescope



WILLARD L. ECCLES OBSERVATORY

Dept. of Physics & Astronomy
115 South 1400 East
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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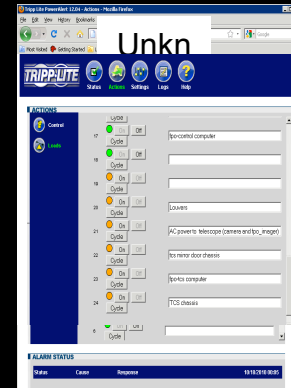
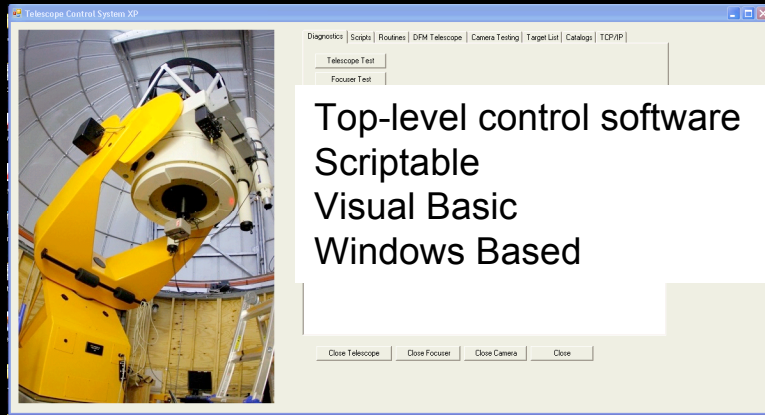
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Remote Operations Top Level Control Software Current Scheme-Microsoft Windows Based



Power Systems

Maxim DL

TCP-IP packets

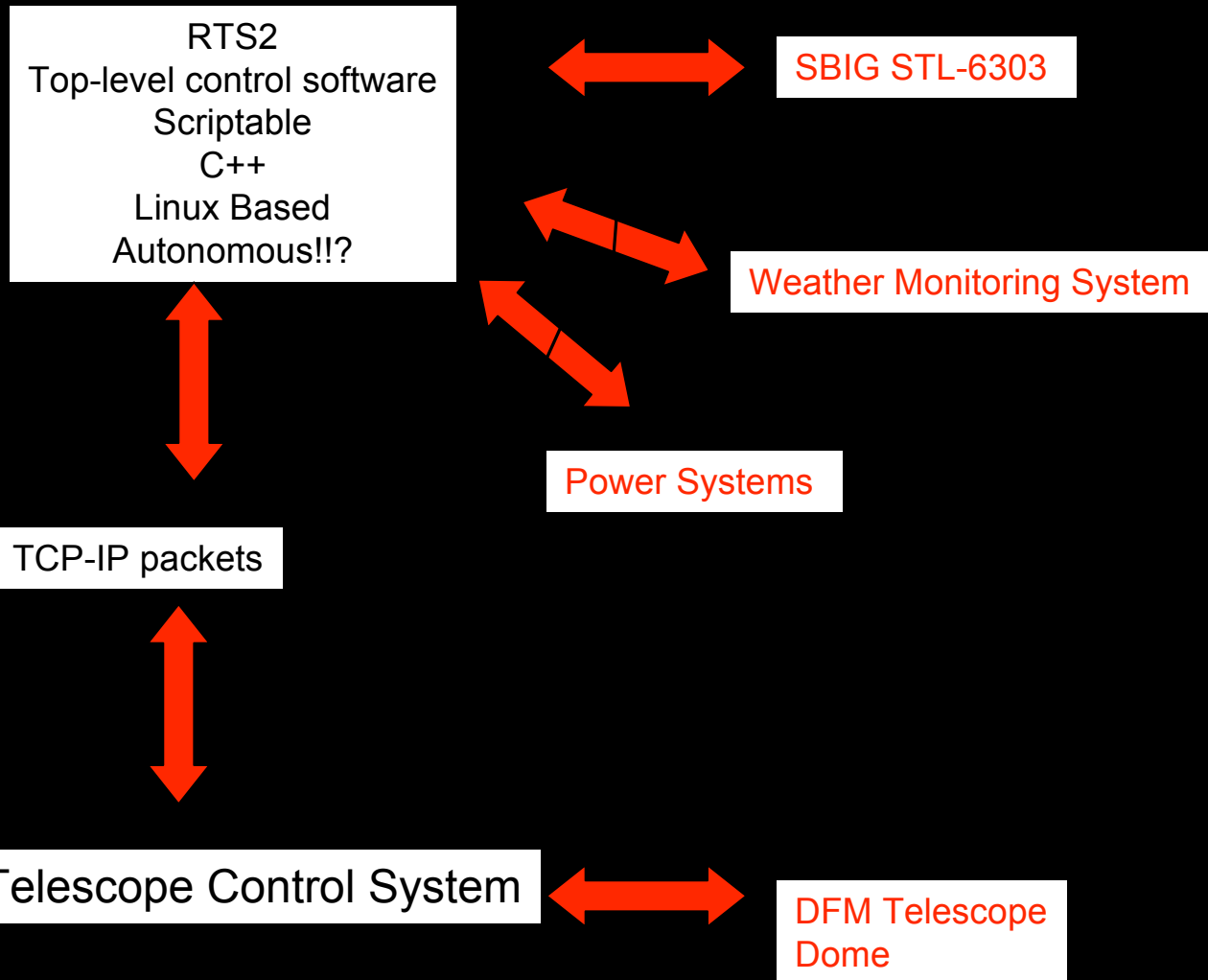
“The Sky” Planetarium Software

SBIG STL-6303

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
http://205.125.96.80/conditions_current.html

Willard Eccles Observatory
Research telescope for [University of Utah](#)
[NOAA Weather for Frisco Peak](#)
[Security Cams \(fpoadmin\)](#)

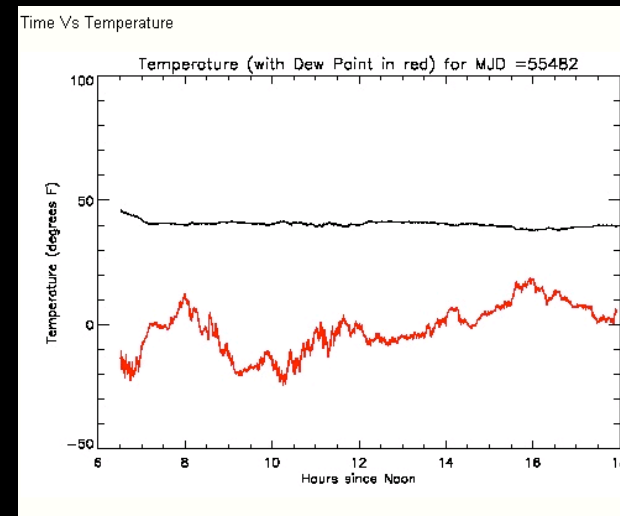
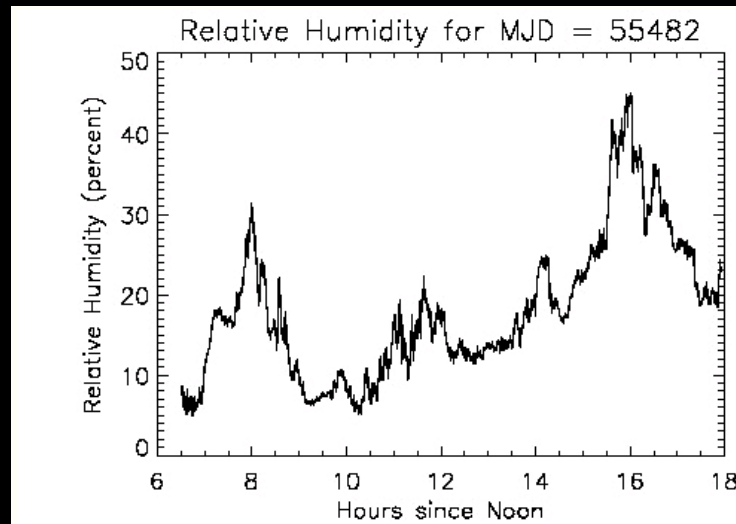
Weather information for Frisco Peak, UT (near Milford, UT)
38° 31 06.54" N 113° 17 08.46" W
elevation 2917 m / 9570 ft

For MJD: 55482, 2010-10-13

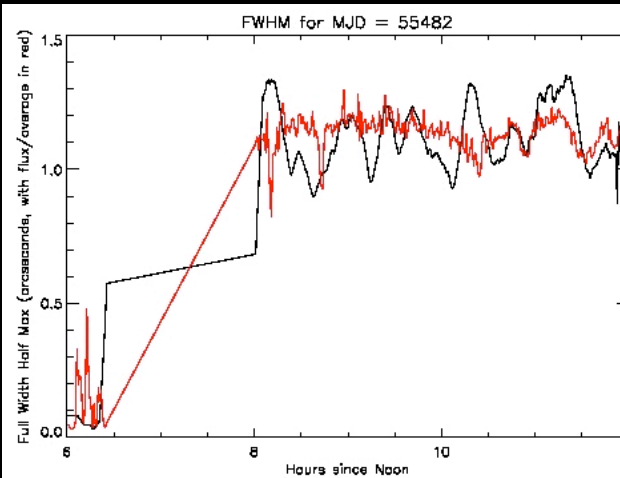
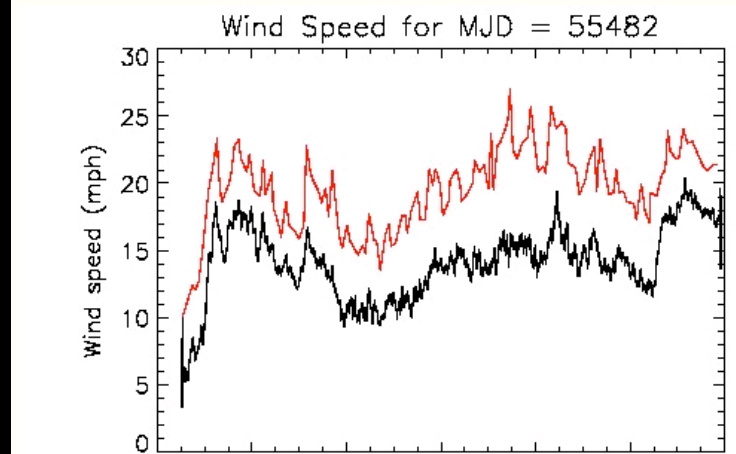
Almanac		
	Current MJD: 55482.0	Moon Illumination: 0.33925058
	Hours Since Noon (MT)	LST
Sunrise:	19.733334	7.6483641
Sunset:	6.9166667	18.796606
Moonrise:	1.1833333	13.047576
Moonset:	10.733334	22.623723
Evening 12 Degree Twilight:	7.9500003	19.832769
Evening 18 Degree Twilight:	8.4666667	20.350850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

IR Satellite Valid: 5:00 AM Mountain Time 13-Oct-2010

Site Monitoring Systems Local Web Page



Time Vs Windspeed



What's next for WEO? Dual Band Imager

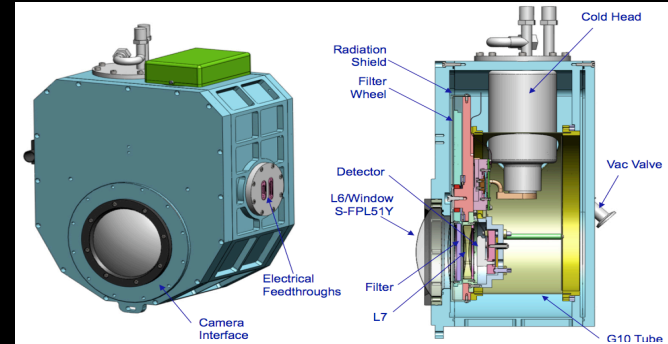
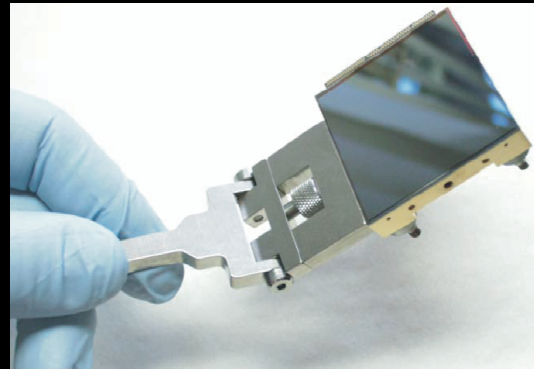
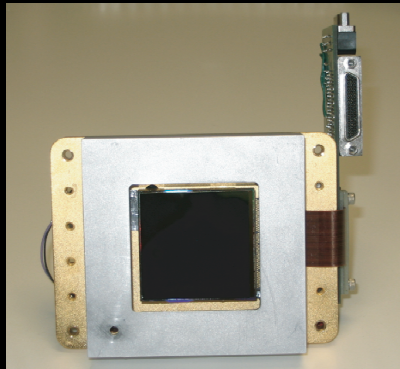


Figure 9 SALT RSS dewar design (courtesy of S. Smee JHU)

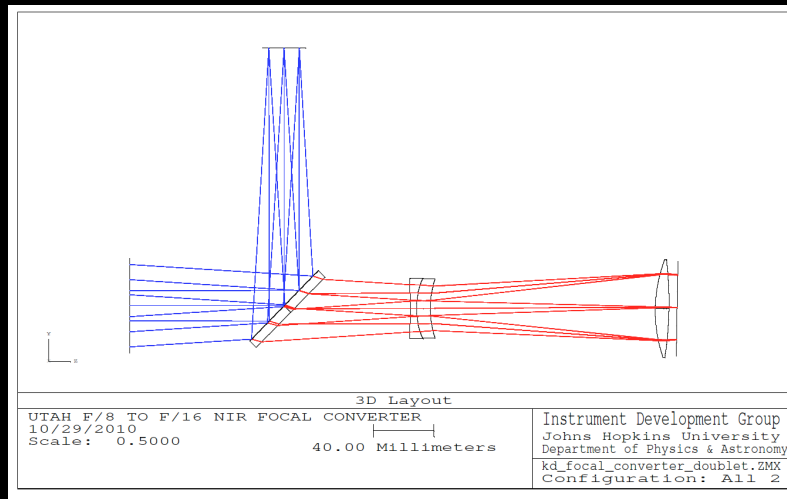


Figure 6 Optical Layout of focal converter..

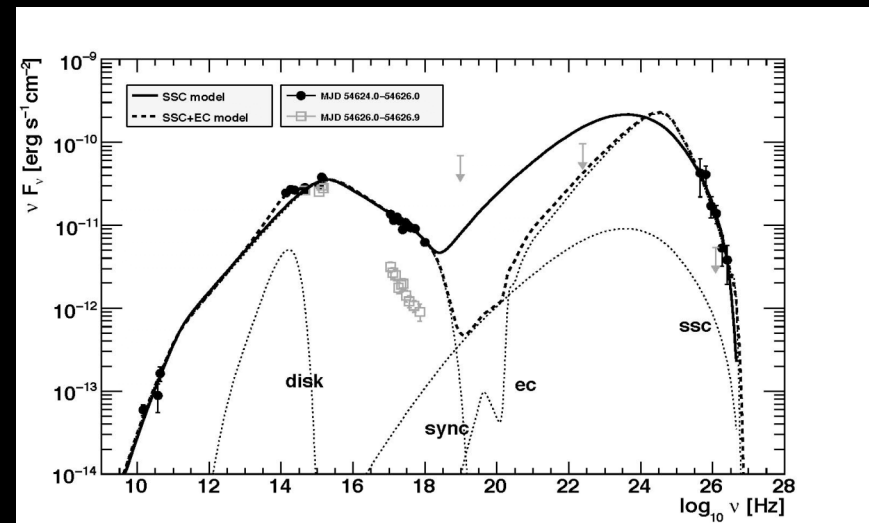


Figure 5 Multiwavelength observations Multiwavelength SED model for W Comae (from Acciari 2009c)

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...