



USNO Robotic Astrometric Telescope (URAT)

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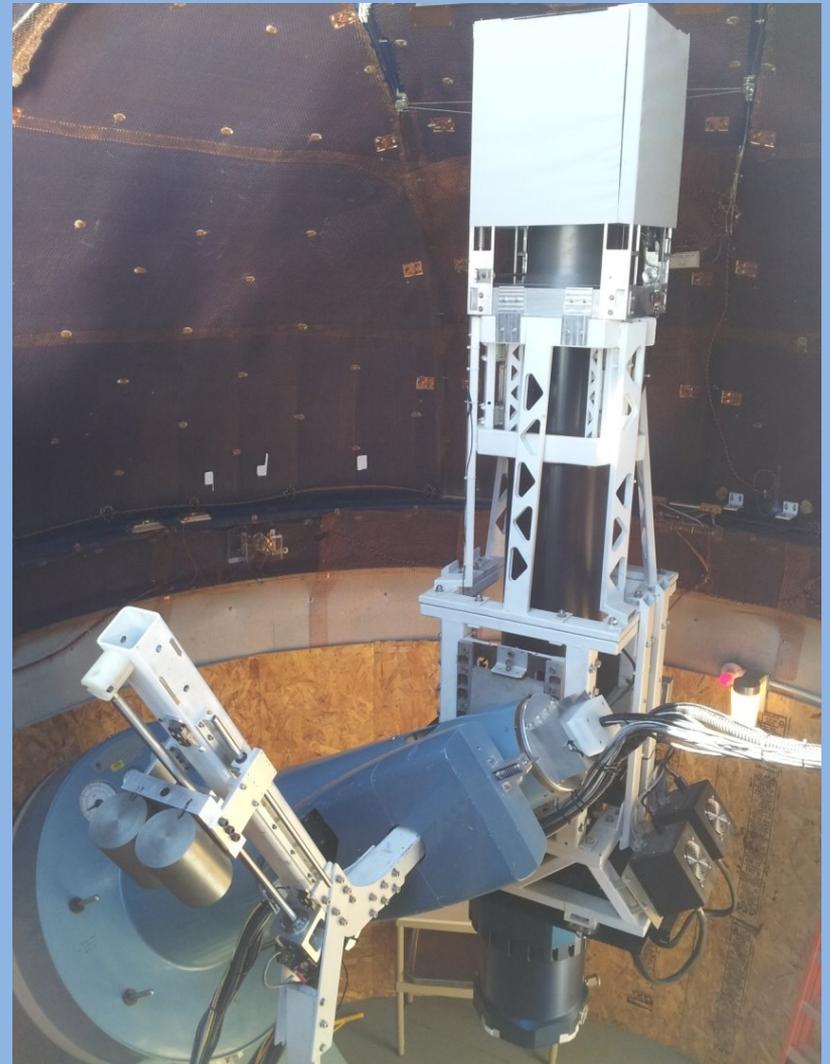
Outline of today's talk

- what is a robotic telescope?
- URAT introduction
- computer interface
- software interface
- fail safe
- Issues
- questions



What is a robotic telescope?

- computer controlled
- software manipulated
- remote monitoring





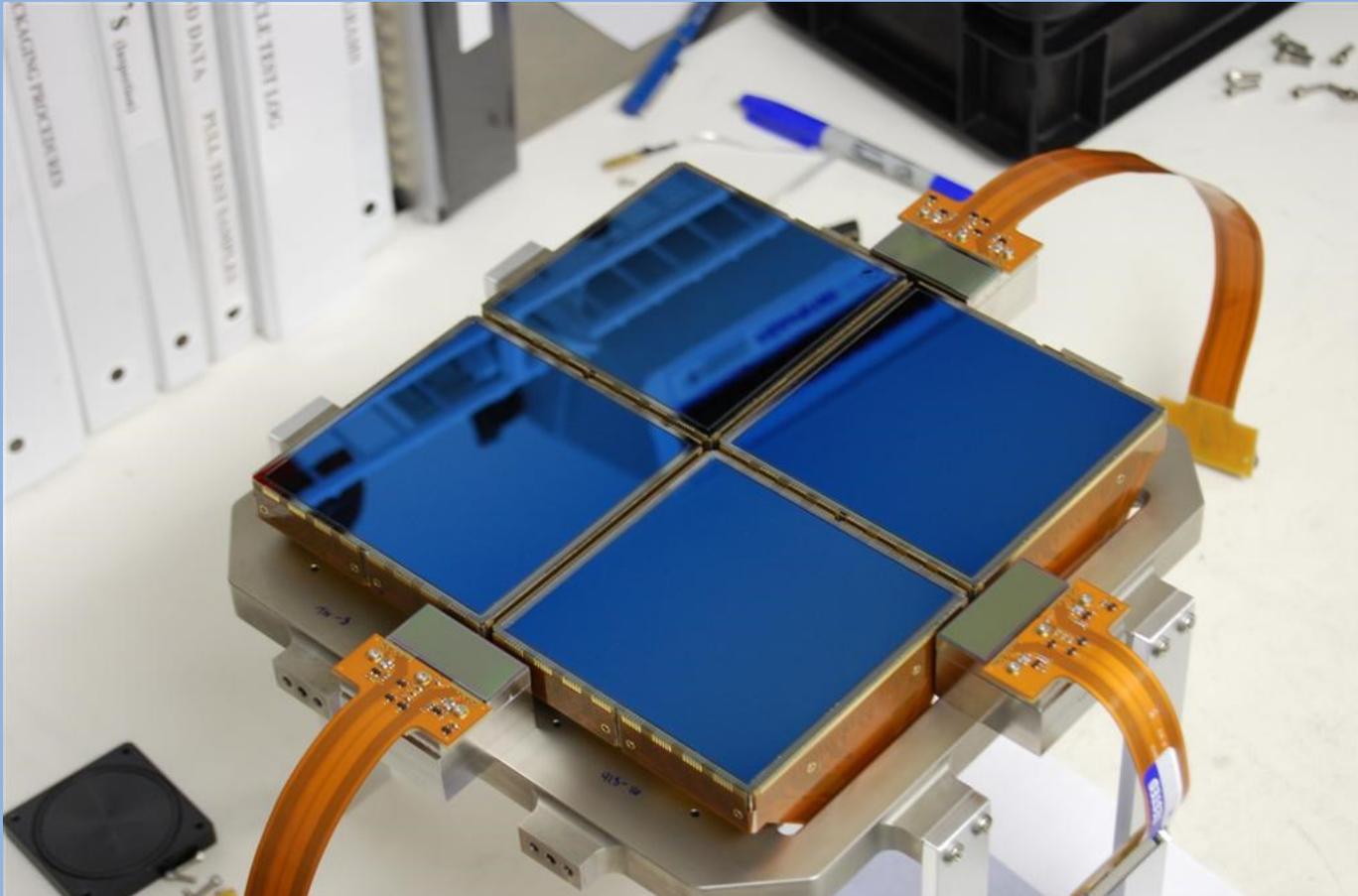
About URAT

all sky astrometric telescope

telescope	USNO astrograph		
	aperture	203	mm
	focal length	2060	mm
	bandpass	680-750	nm
camera	4 CCDs, each	10.5k x 10.5k	pixels
	scale	0.905	arcsec/pixel
	field of view	28	square degrees
guiding camera	3 CCDs, each	2k x 2k	pixels
	scale	0.8	arcsec/pixel
regular survey	2 exposures/field	60 & 240	sec
grating survey	2 exposures/field	10 & 30	sec

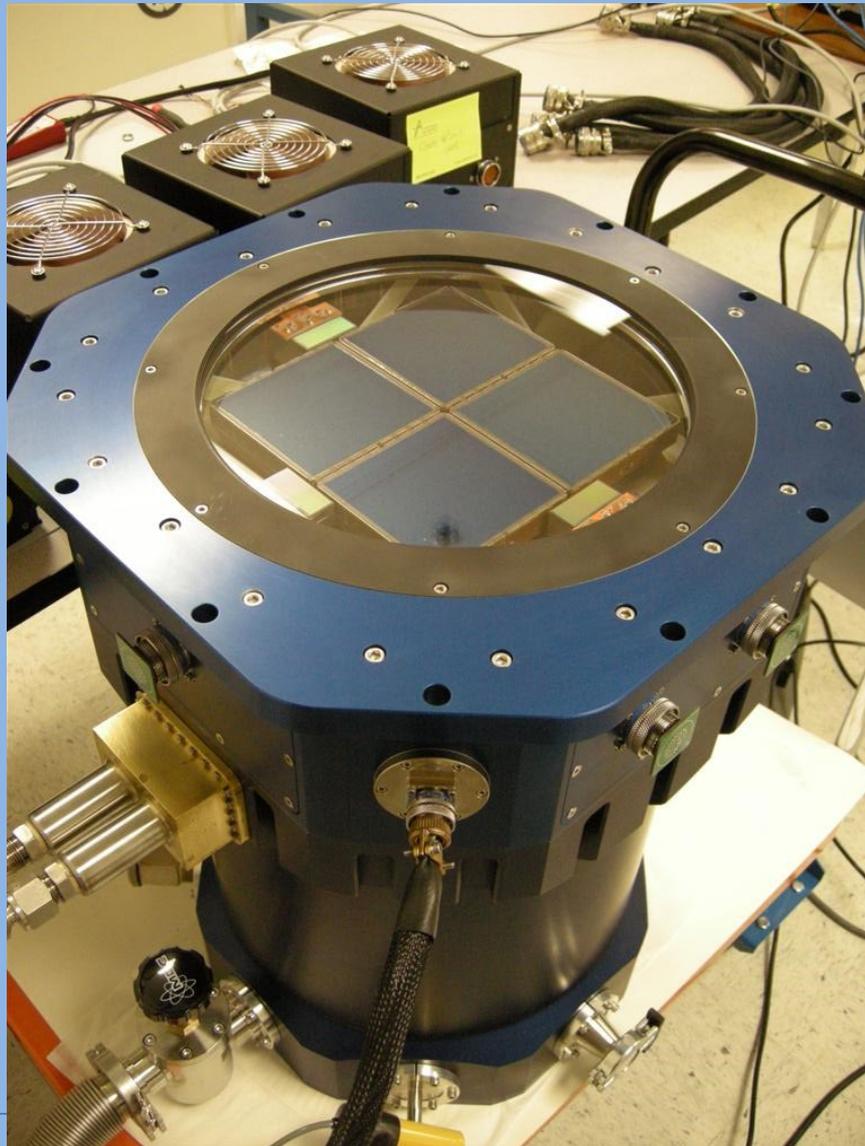


About URAT





About URAT





About URAT

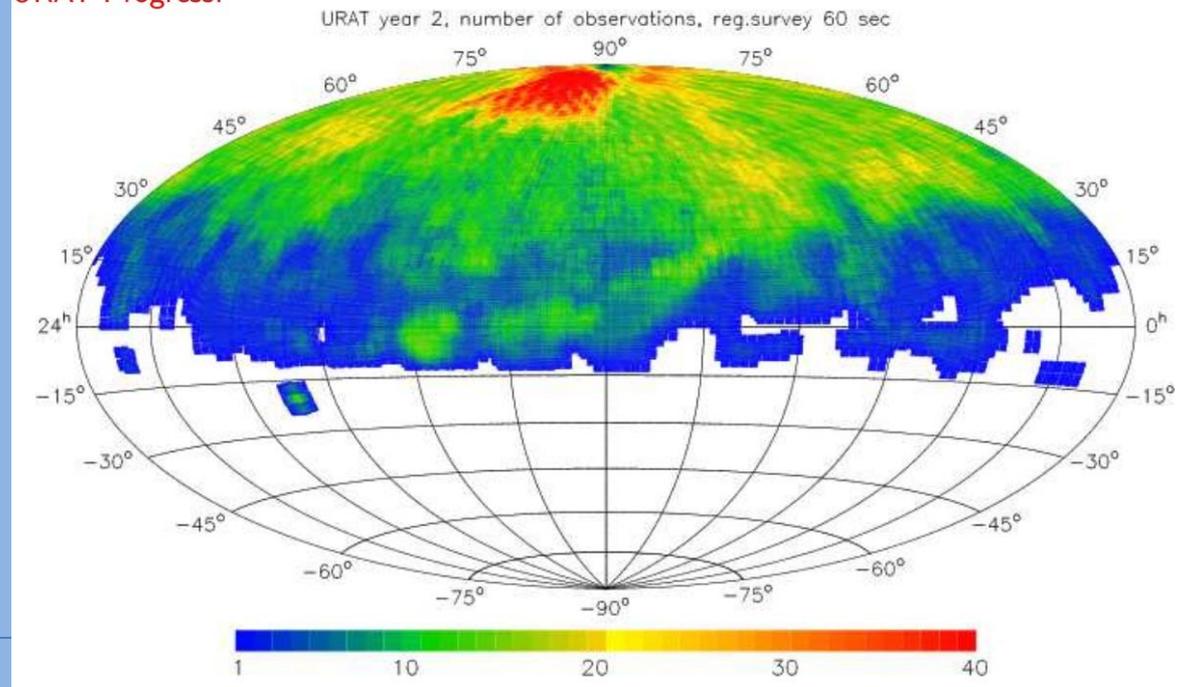
- 2006-2007:
 - research and development of 10k detector
- 2008:
 - funding for 4-shooter camera becomes available
- 2009:
 - production of 10k chips, construction of new telescope tube, delivery of Bonn shutter
- 2010:
 - camera electronics complete, computer control of mount tested in DC
- 2011:
 - 4-shooter camera and 3 guide chips tested, Dewar complete and tested, first light Washington DC (August), first light NOFS (September)
 - Dewar upgrades and improvements
- 2012:
 - Dewar back on telescope
 - survey begins April 2012!



About URAT

- located at USNO Flagstaff station (NOFS)
- year 3; over 62,000 frames taken so far
- quality control, daily x,y pixel reduction, reduction pipeline in place

URAT Progress:





Computer Interface

- Galil: dedicated control computer
 - talks to telescope (motion of motors, reads limit switches)
- lakeshore: camera temperature controller
 - talks to computers
- digital dome works (DDW): controls dome
 - talks to computers
- weather station: boltwood cloud sensor II
 - talks to computers
- network/sky cameras: for monitoring telescope and clouds
 - talks to computers
- Linux box 1: interfaces with Galil/DDW, weather station, UPS units
 - dedicated control software for telescope, camera
 - interface control software
 - backup scripts
- Linux box 2: reductions
 - data copied to linux box 2 after observing
 - reductions start automatically
 - quality control software ; humans kick off + look at plots



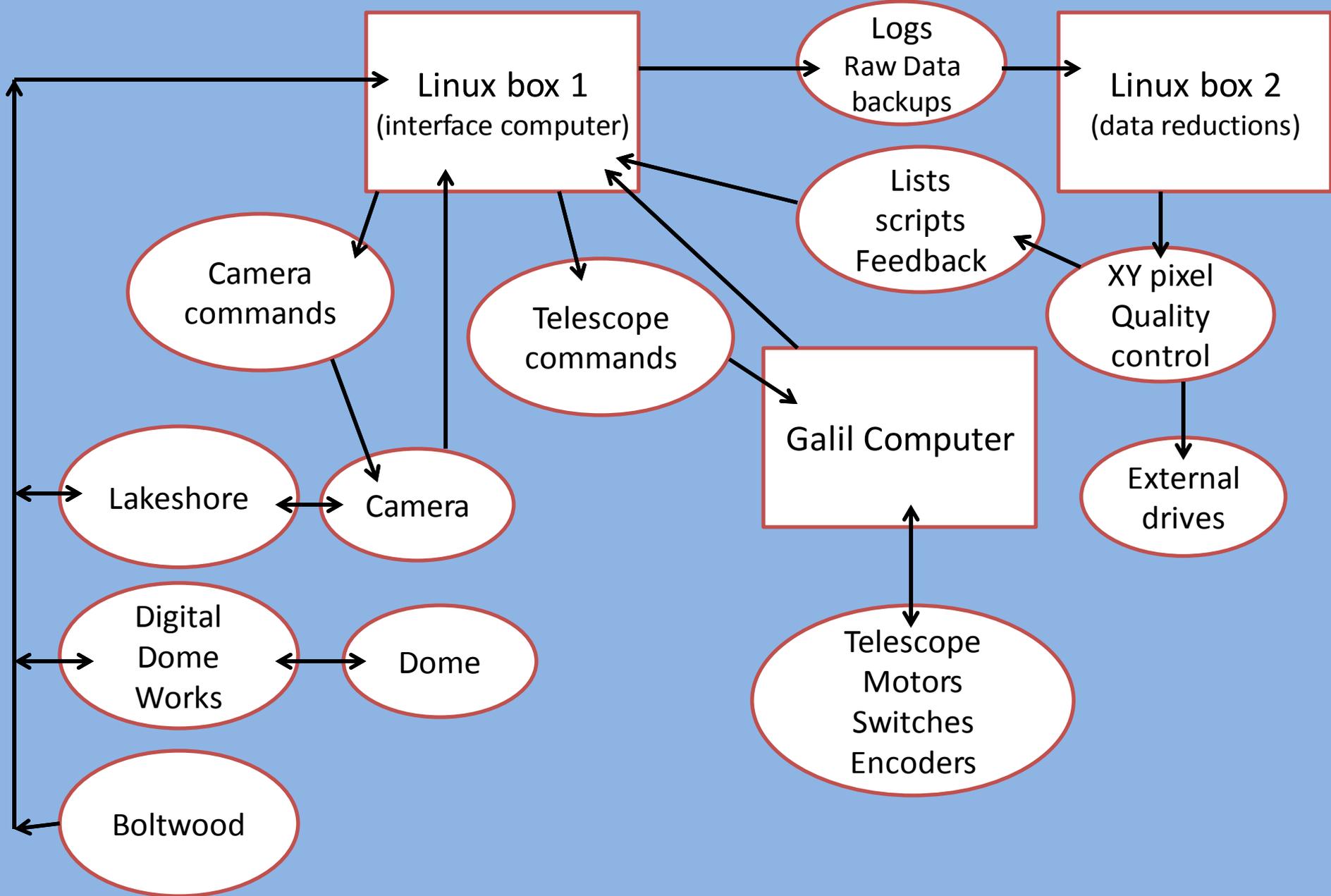
Computer Interface





Computer Interface







Software

- CCD control software (written in C)
 - interfaces with the 4-shooter camera
 - reads health of camera (temp, status)
- telescope control software (written in C)
 - interface with telescope
 - reads health of telescope (status, encoder readings)
- user interface software (written in Fortran)
 - front end to control software
 - can be easily manipulated
 - accepts scripts, checks parameters, report issues, keep logs
 - interactive if needed
- remote software (written in Fortran)
 - check status of system



Sequence of events

1. human checks system and start control code
2. control code reads in files
 1. 1 minute loop
 2. Opens dome starts camera
 3. take focus sequence
 4. starts observing
 5. end of night send out email
 6. rsync raw data to Linux box 2
 7. kick off reductions
 8. rsync backup of raw and processed data to 2 external drives
3. human kicks off quality control and flagbad code, looks at plots



Fail Safe

- power outage
 - checked every minute during loop
 - computer, electronics, DDW, encoders, lakeshore
 - determine how much power is needed
- weather station (boltwood cloud sensor II)
 - checked every minute during loop
 - calibrate
- limit switches
 - software (first line of defense)
 - optical
 - mechanical (last line of defense)
- computer crashes
 - back up fail safe to close dome
- software crash
 - watchdog script to close dome; email human



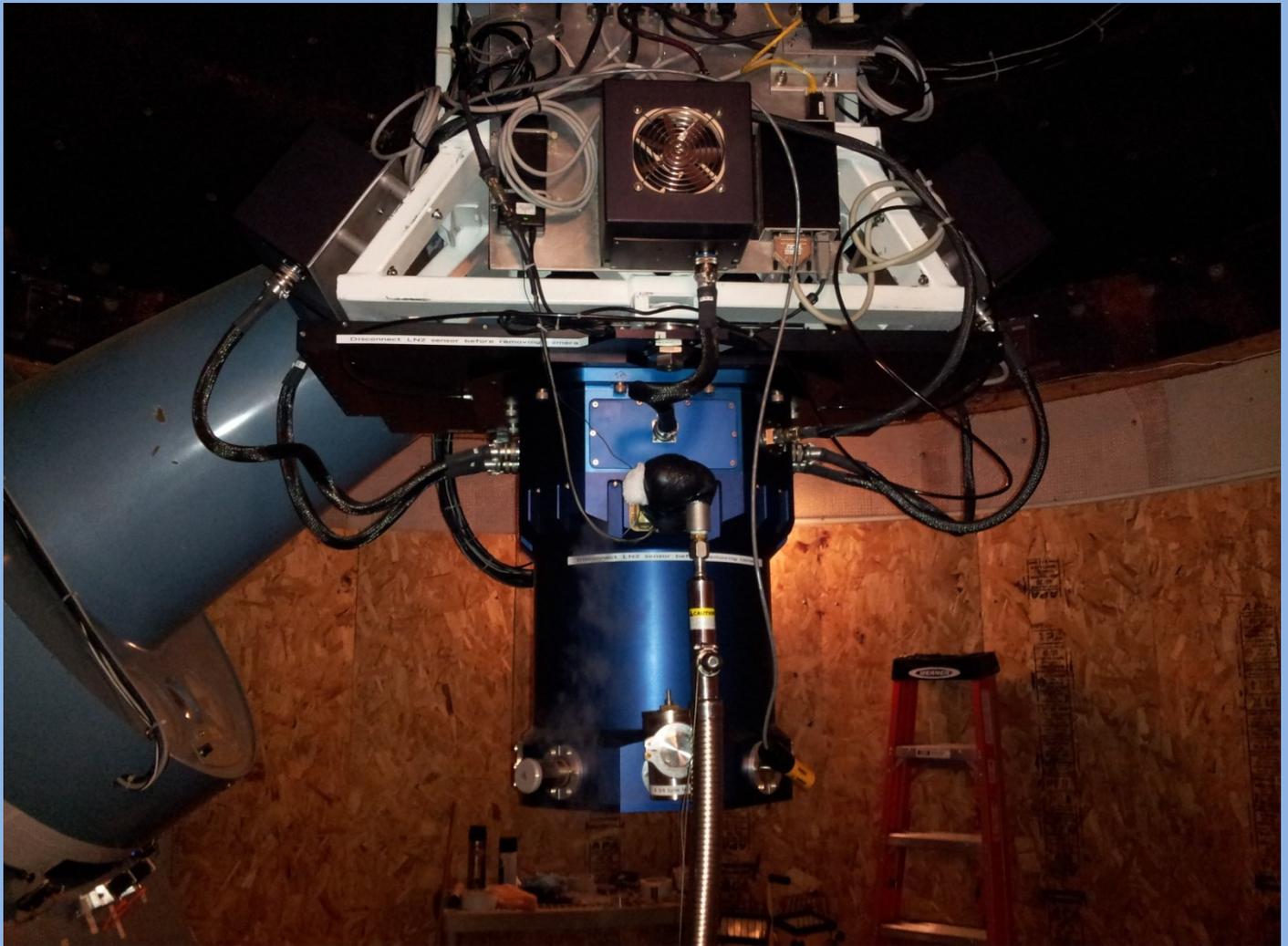
Issues

Filling the Dewar

- need human if using LN2
- auto-fill
 - fills every 24 hours
 - automatic shutoff when full
 - cut-off valve
 - needs monitoring
 - hook up/disconnect
 - changing of bottle



Issues





Issues

ICE!

- heater to prevent ice build up





Issues

Deal with data

- data too large to process on control computer
 - control computer needs full CPU when reading out CCD
- 4tb hard drives
 - need human
 - change drives every 2 weeks
- 2 copies (check data)
 - leave one at NOFS
 - send one to Washington DC



Issues

Software and drivers!

- drivers
 - boltwood
 - camera cards
 - UPS monitoring
 - USB drivers
- IT restriction rules
- user interface
 - interactive
 - simple



Issues

Hardware maintenance

- needs human
- cleaning lens (not often)
- dome
 - mechanical parts
- computers
 - dust
 - updates
- telescope
 - drives
 - mechanical parts
 - change desiccant
 - install/remove grating



Issues

Hardware specs/time constraints

- upgrades
 - lightening protection
 - dome
 - UPS units
- fixing on the fly
- full automation
 - time/money
 - safety



Questions?