Apache Point Observatory

Capabilities Relevant to Time-Domain Astronomy

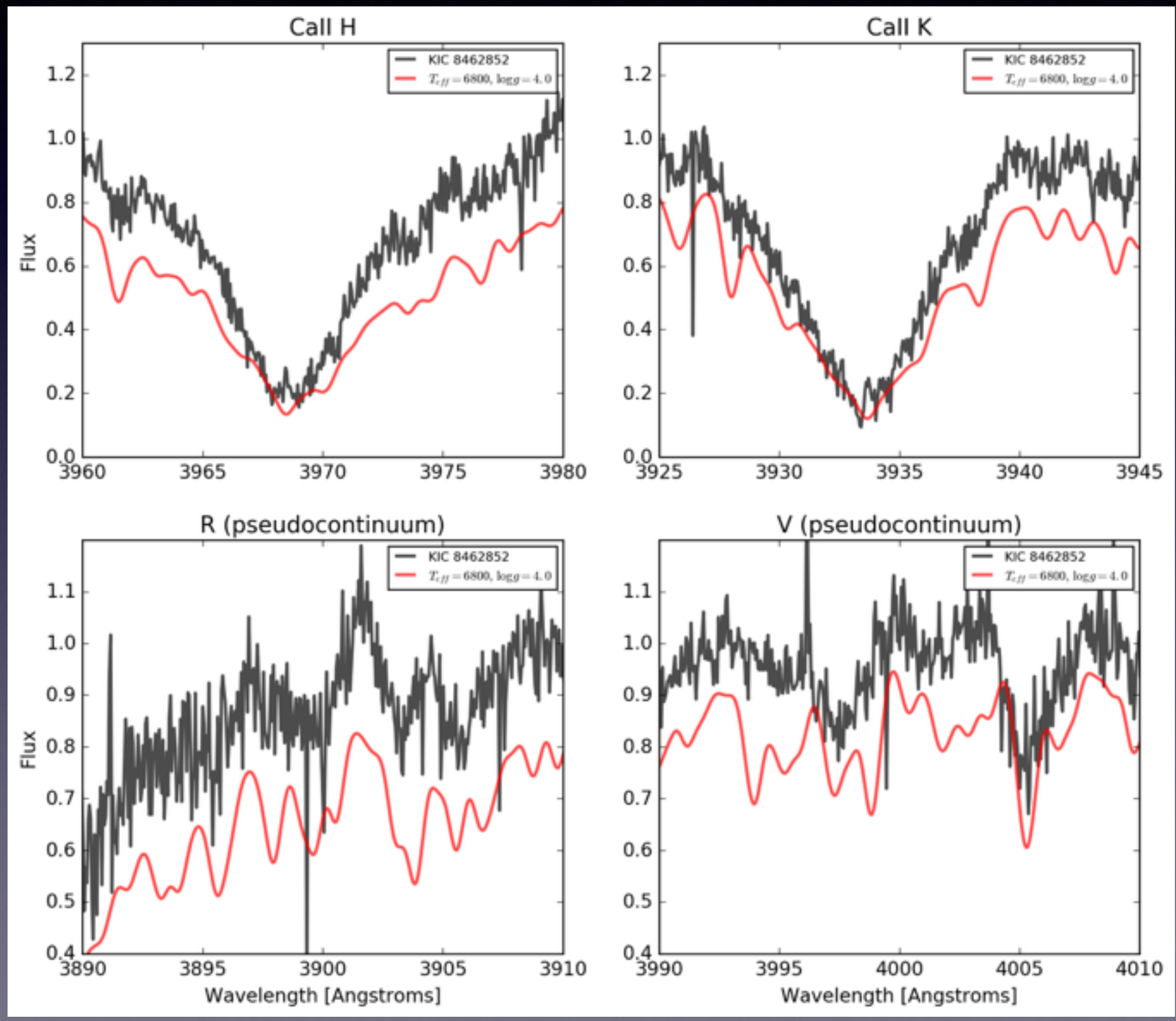
Nancy Chanover (NMSU), Director
Ben Williams (UW), Deputy Director

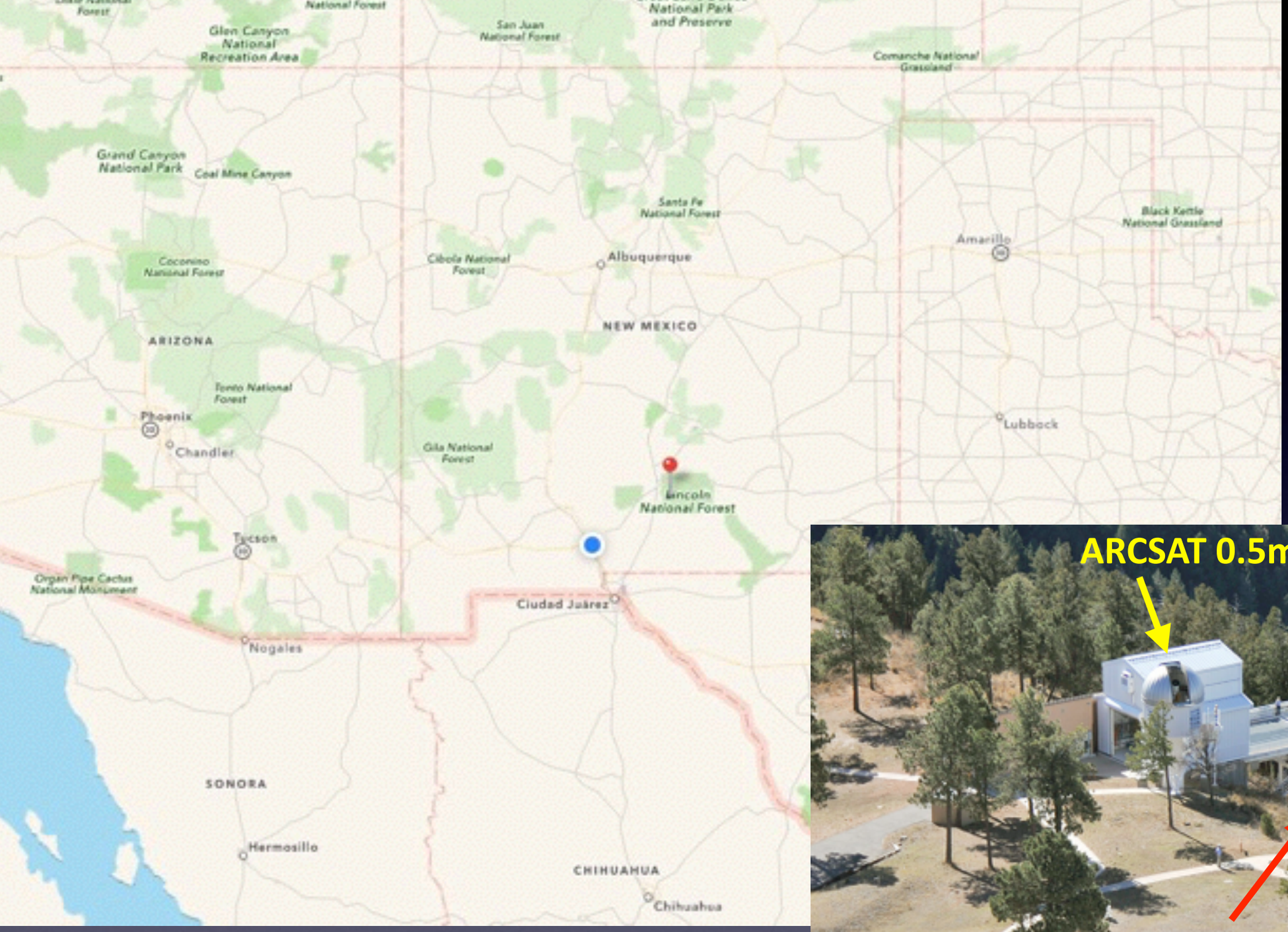
From Friday Night!

Boyajian's Star

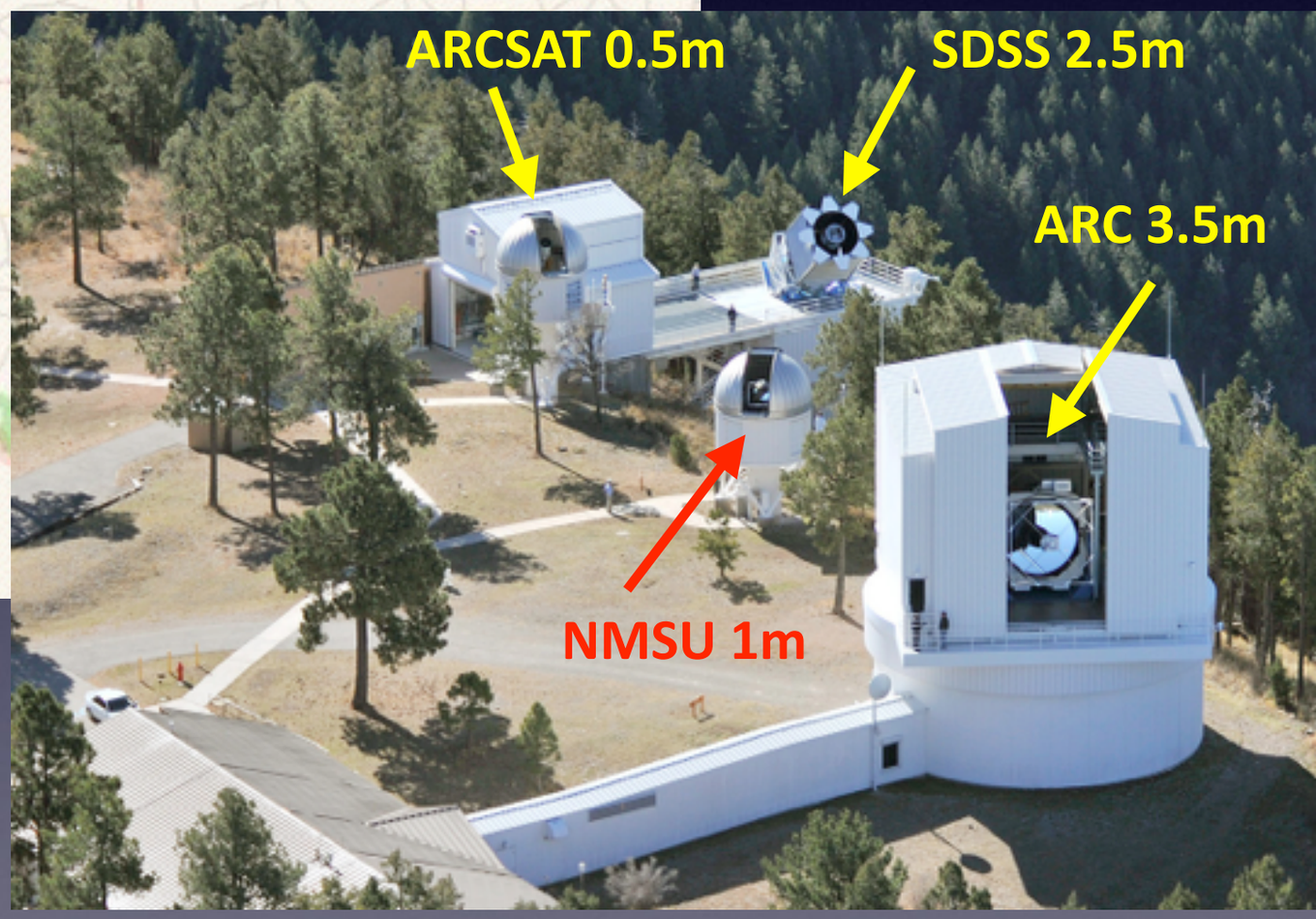
5/20/17 10:34 UTC

Brett Morris (UW grad student) triggered these ToO observations, derived Ca II H & K S-ind = 0.23±0.02



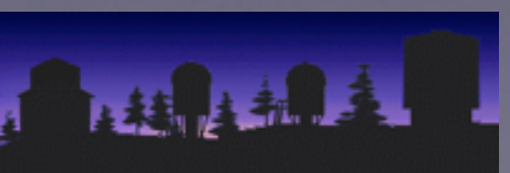


2788 m elevation



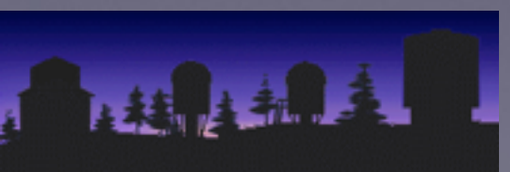
Astrophysical Research Consortium

- consortium of 8 universities that owns/operates all telescopic facilities at Apache Point
- members: University of Washington, New Mexico State University, University of Colorado, Johns Hopkins University, University of Virginia, Georgia State University, University of Oklahoma, University of Wyoming
- currently 86% of the 3.5m time is allocated to partners - some more is leased through 2-4 yr agreements, but ***we are actively seeking new partners to join ARC***



Instrument Suite: Imagers

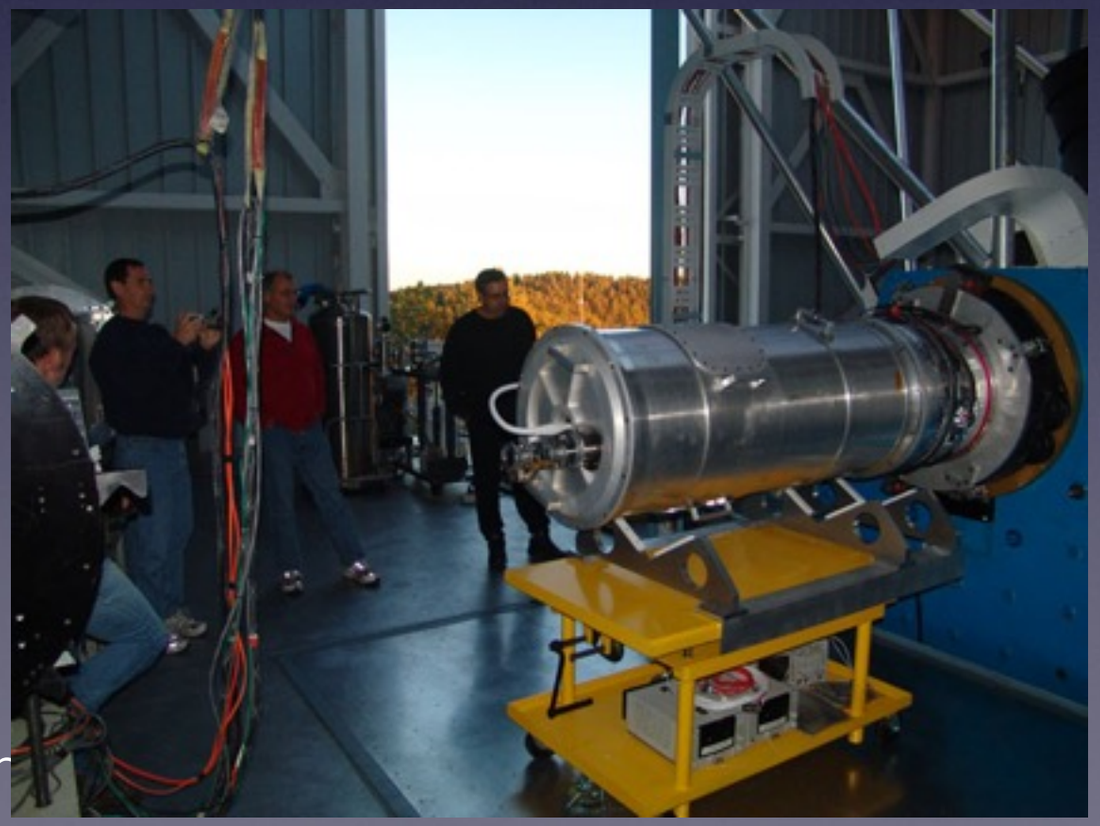
	Wavelength Coverage	Detector Format	FOV	Sensitivity	Additional Info
ARCTIC	optical	4096 x 4096	7.5’	r~18 in 1 min (S/N~100)	add-on diffuser for high precision photom.
Agile	optical	1024 x 1024	2.2’	r~19 in 15 sec (S/N=10)	frame transfer CCD, 0.3 s time resolution
NICFPS	ZJHK + many narrow band filters	1024 x 1024	4.5’	J~20 in 5 min (S/N=10)	also contains Fabry-Perot etalon



Agile

ARCTIC

NICFPS



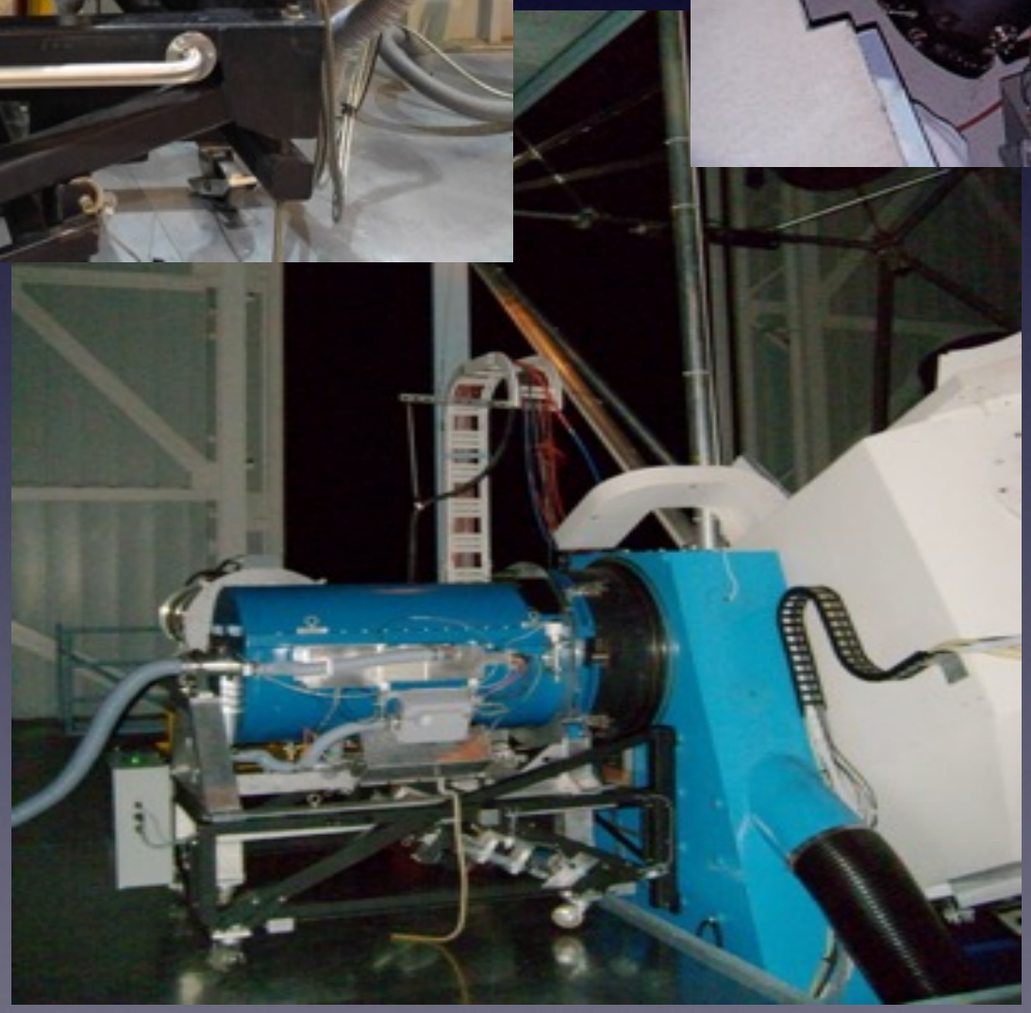
Apache Poir

Instrument Suite: Spectrographs

	Wavelength Coverage	Detector Format	R	Sensitivity	Additional Info
DIS	370-1000 nm (2 channels)	4096 x 4096	1000 - 5000	V~20 in 1 hr (S/N=10)	long slit (6'), multislit capability
ARCES	320-1000 nm	1024 x 1024	31,500	V~15 in 1 hr (S/N=10)	single aperture
TripleSpec	JHK	2048 x 1024	3,500	J~15 in 30 min (S/N=10)	x-dispersed; integral K-band slit viewer

DIS

ARCES

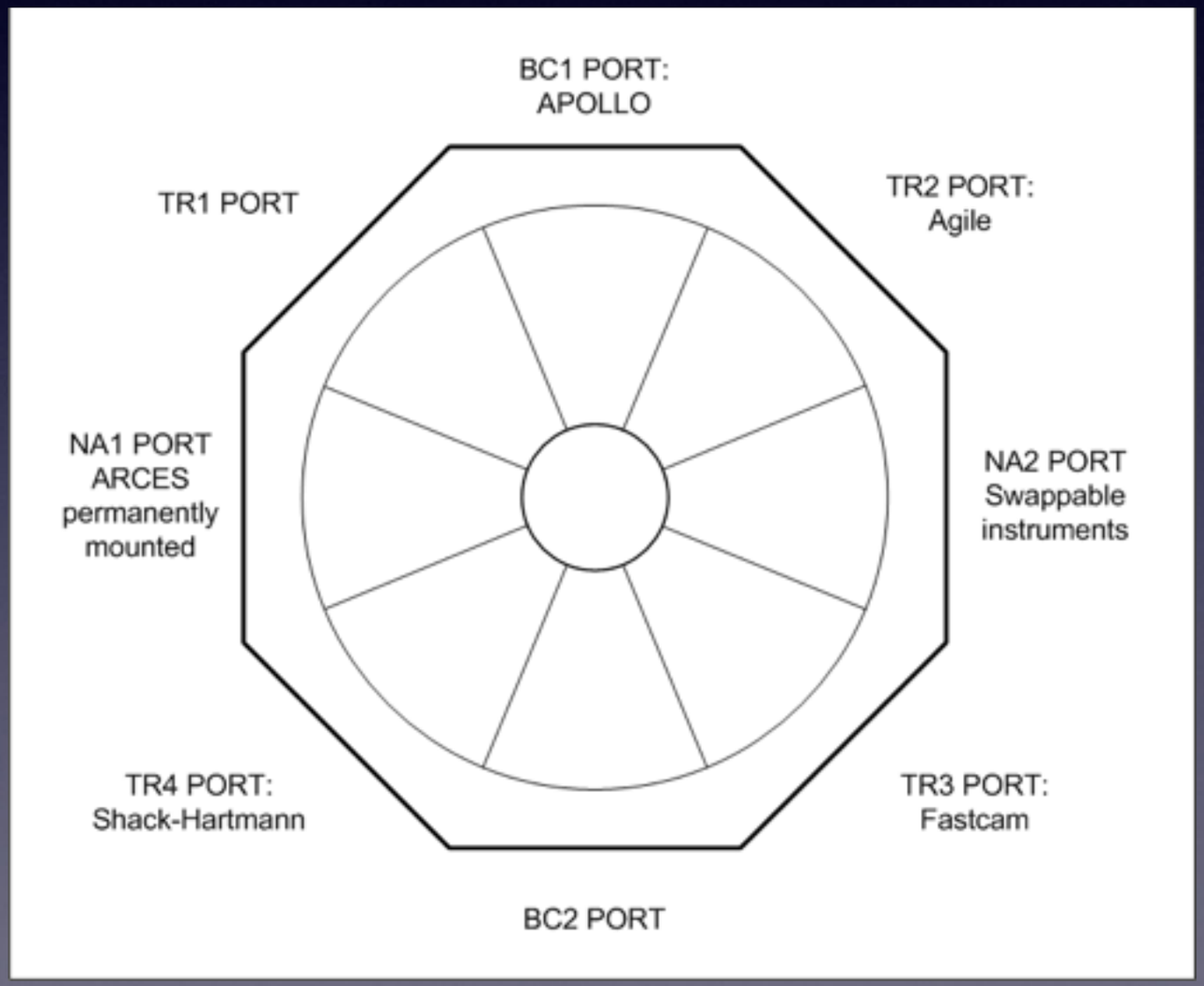


TripleSpec

Apache Point Observatory

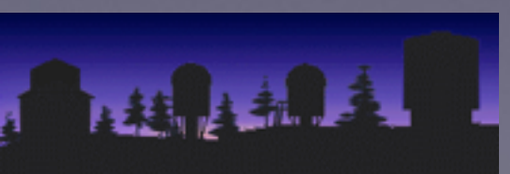
Instrument Configuration

- use of multiple Nasmyth ports allows for flexible instrument requests and rapid instrument changes



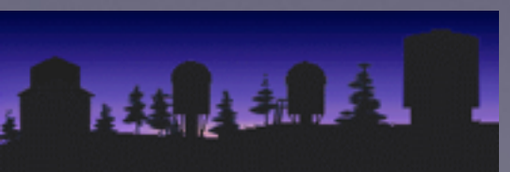
Planned Instrumentation

- new fiber-fed optical spectrograph:
  - exploring IFU (~1’ FOV, hundreds of fibers/lenslets in fixed positions) vs. MOS (large FOV, hundreds of positionable fibers/lenslets)
- fiber feed from 3.5m to SDSS/APOGEE spectrograph:
  - 217 fibers forming IFU 32” on sky (also examining MOS capability)
  - APOGEE specs: R=22,500 from 1.51-1.70 um; radial velocities to 100 m/sec
- both projects are on ~2-3 yr horizon



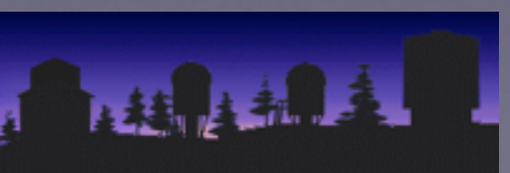
Time Allocation

- time is allocated quarterly, generally in half-night blocks
- each quarter every institution is allocated their number of dark/grey/bright half-nights
- each institution conducts its own internal proposal/TAC review, the requests are prioritized and sent to the master scheduler, the quarterly schedule is built
- DD time is used for special requests, “test drives” for potential partners, etc.



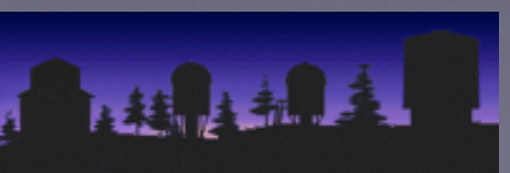
Targets of Opportunity

- user proposes ToO, is scheduled for dark time late in quarter… that time is used to pay back the usurped user when a ToO is triggered
- current scheduling system can handle ~ 4-6 of these types of programs per quarter
- have to know in advance what object looking at, proposal has to be strong enough to get dark time
- we are current evaluating this approach in order to be more responsive to new discoveries



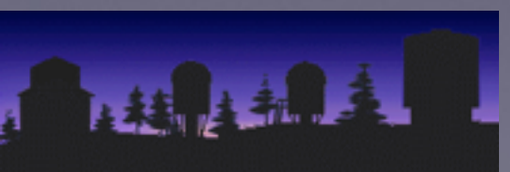
Observing Modes

- generally using classical observing mode
- nearly all observing is conducted remotely
- time can be scheduled in shorter (~ 1hr) blocks for monitoring or ToO requests
- can use twilight time for echelle, NIR, lunar laser ranging programs
- experimenting with time trades with WIYN



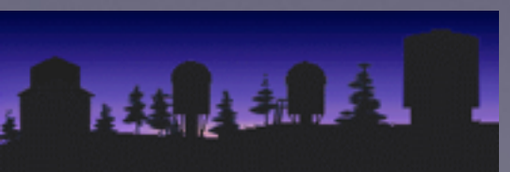
Data Rights/Access

- PI owns the data, no sharing or archiving requirement beyond those required by funding agencies and/or publications
- on-site backup retained for 12 months



Software Systems

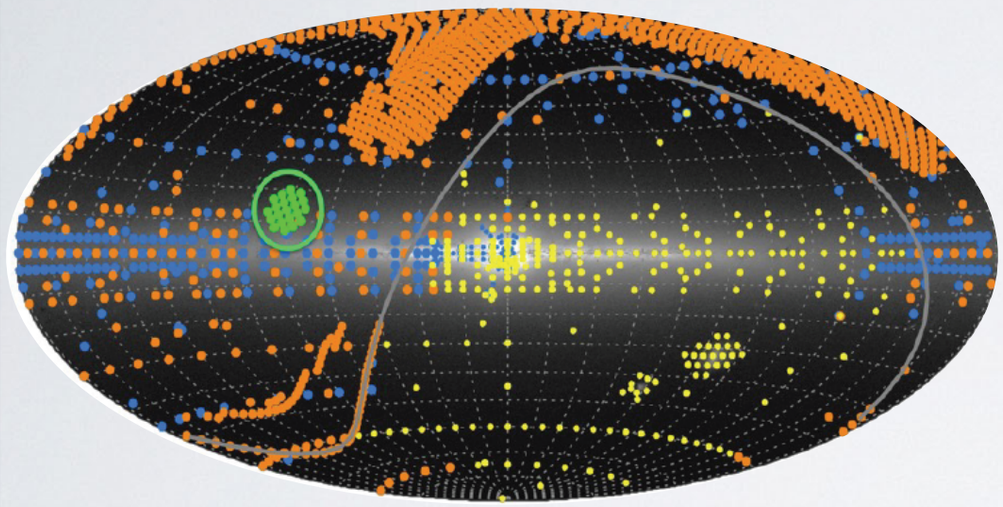
- observing control system: all telescope and facility instrument controls are handled through a single integrated user interface (“TUI”)
- observers download software to their own machines and log in to connect to TCC
- data pipelines: reduction routines are written, maintained, and shared by ARC 3.5m users and accessible through a wiki



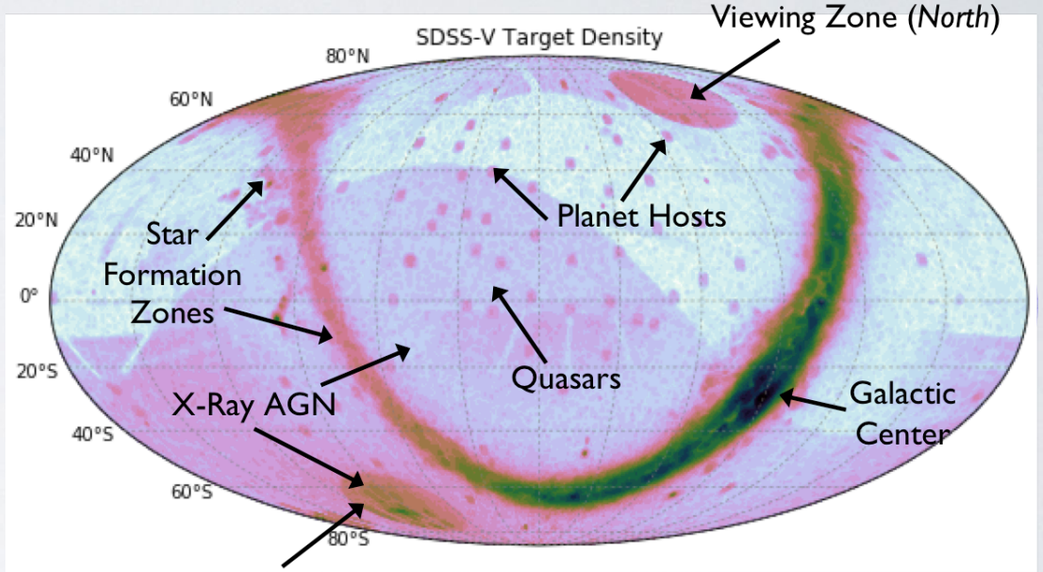
Role of SDSS in Time Domain Studies

PLATES —> ROBOTS

SDSS-IV Revolution

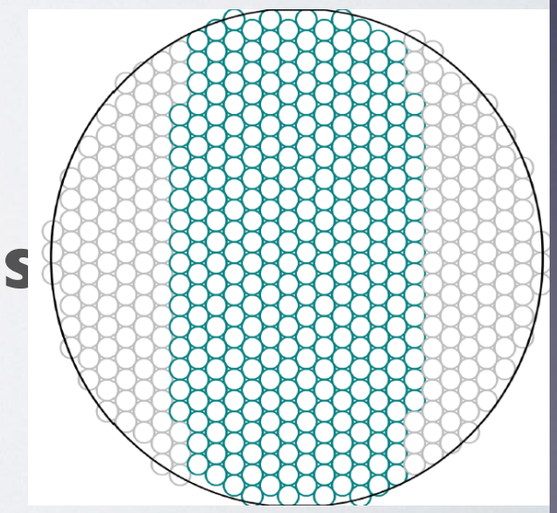


SDSS-V



Plug Plates

ALL Sky
Dust-Penetrating
Multi-epoch (1-60)/y epochs
High-quality
High-flexibility
spectroscopy



Zonal Robots

Conclusions

- the 3.5m telescope at APO is capable of remote observing on short notice
- it has many of the desired instrument capabilities outlined in *Maximizing Science in the Era of LSST: A Community-Based Study of Needed US OIR Capabilities*
- it is well-suited for rapid followup of interesting transient events
- there is room in ARC for more partners!