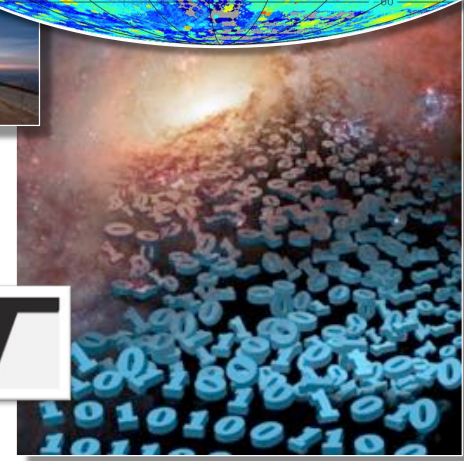
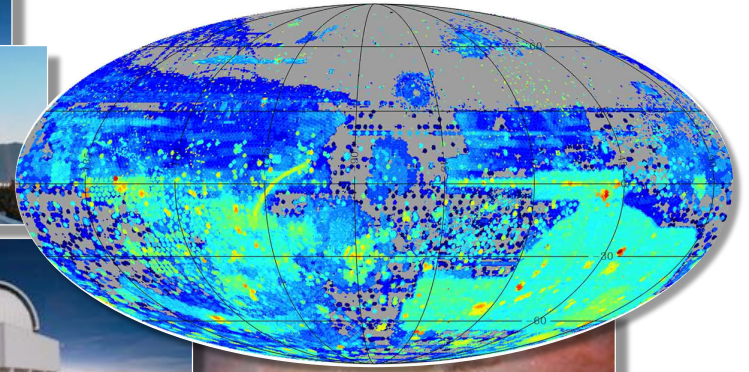




NOAO Town Hall

David Silva, NOAO Director





Vera Rubin (1928 – 2016)



KPNO 2.1-m, 1970
Image credit: Carnegie DTM



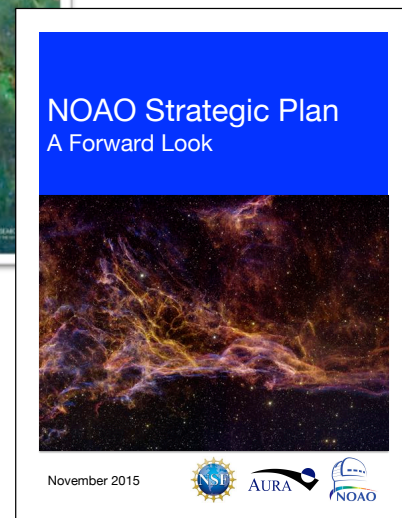
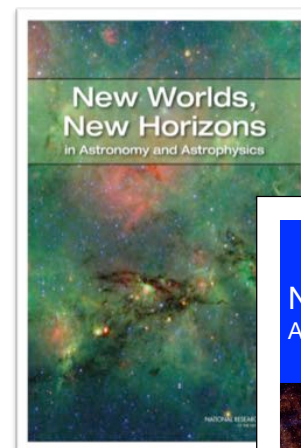
Image credit: AIP Emilio Segre Visual Archives



NOAO: a multi-mission national center

Community research excellence in astronomy Enabled by robust, broad capabilities

- Open access to telescopes
- Open access to data products, data services
- Ultra-wide-field imaging & spectroscopy surveys
- LSST community science support
- Time-domain research infrastructure development
- Education, public outreach



Google for
"NOAO Strategic Plan"



NOAO is an FFRDC operated by AURA under a Cooperative Agreement with NSF



Open access to telescopes
 Broad capabilities = broad opportunities

Telescope	Diameter (m)	Nights Per Year
Subaru	8.2	10
Gemini North	8.1	110
Gemini South	8.1	110
CTIO SOAR	4.1	70
CTIO Blanco	3.9	200
AAT	3.9	10
KPNO Mayall	3.8	100
KPNO WIYN	3.5	125
KPNO 2.1m	2.1	60
CTIO 1.3m	1.3	30
CTIO 0.9m	0.9	30
KPNO 0.9m	0.9	30

Full aperture range
 Full instrument range
 Full user support
 Over-subscription ~ 2.5
 Semi-annual proposal cycle

**KPNO Mayall, open access,
 Last semester, 2017B
 → DESI install starts**

Other available capabilities
 LCO time-domain network
 CHARA optical interferometer
 Large Binocular Telescope



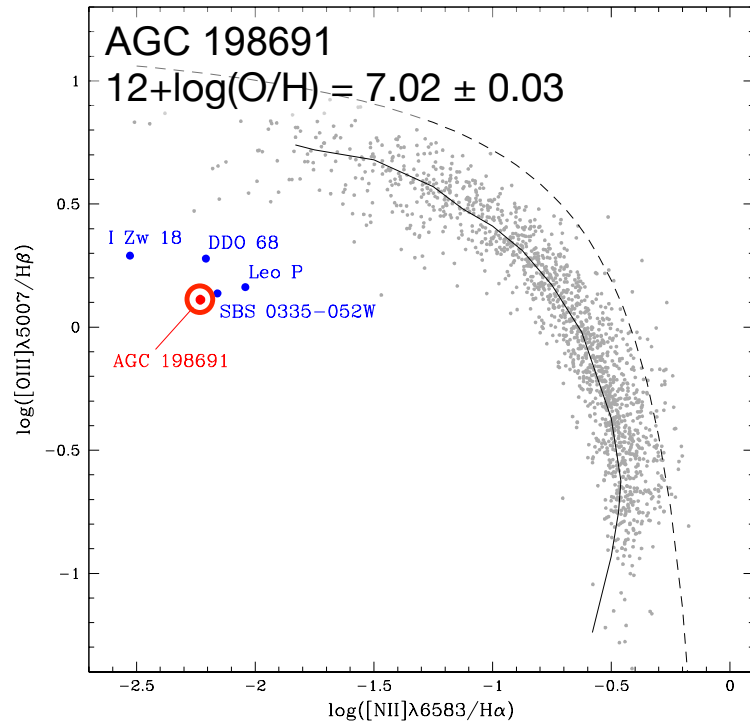
Spectroscopic capabilities Available now or soon

	Optical					Near-IR		
	Medium Resolution				Echelle	Medium		
	Single	Multi Slit	IFU	Fiber	Single	Single	Multi-slit	IFU
Gemini North 8.1	●	●	●		●	●		●
Mayall 3.8	●	●		2019				
WIYN 3.5			●	●	2019			
Gemini South 8.1	●	●	●		2018	●	●	
SOAR 4.1	●	●			2017			
Blanco 3.9	●	●				●		

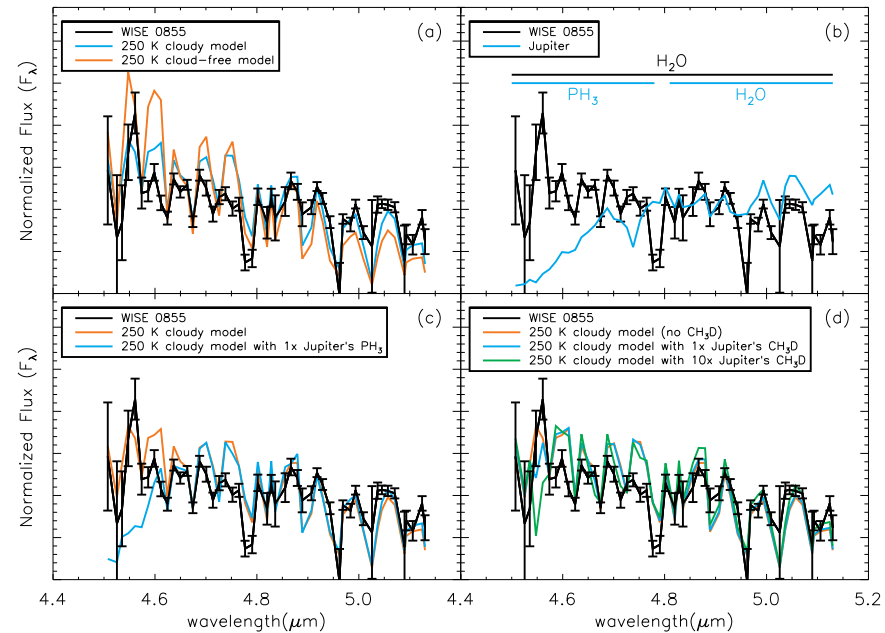
NEW → optical echelle spectroscopy at Gemini N, Gemini S, SOAR, WIYN
 Mid-IR echelle spectroscopy (Gemini North, TEXES)
 Near-IR echelle spectroscopy (Gemini South, Phoenix)

Spectroscopic capabilities

Recent science highlights



Most metal-poor, gas-rich galaxy
 Hirschauer et al. 2016 (KPNO Mayall/
 KOSMOS)

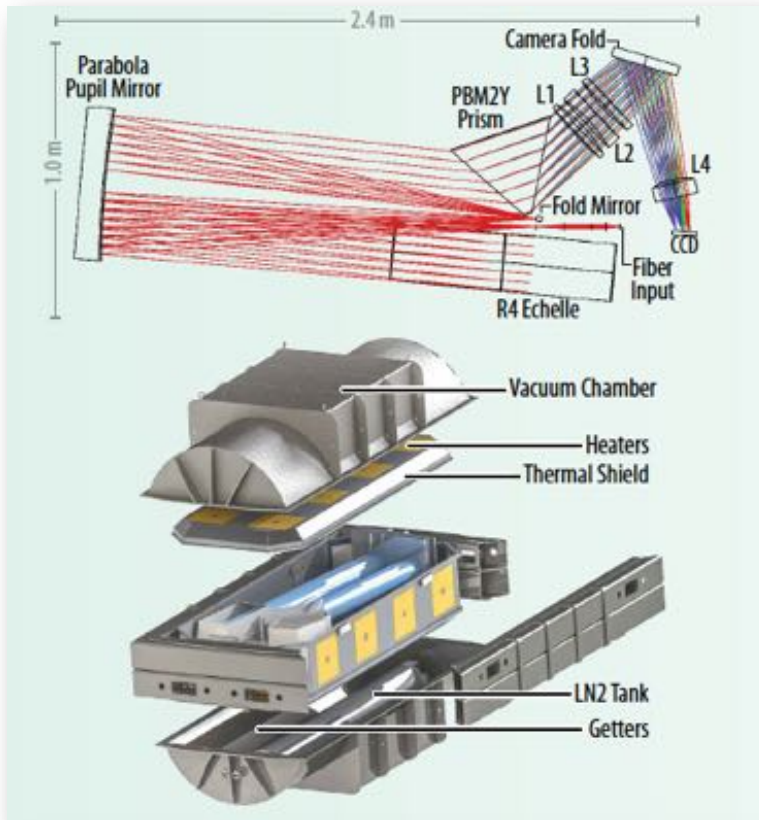


Water vapor clouds on coldest brown dwarf
 Skemer et al. 2016 (Gemini/GNIRS)



Spectroscopic capabilities Coming 2019 → **NEID @ KPNO WIYN 3.5-m**

Derived from Tohono O’odham word “to see”



Extreme Precision Doppler Spectrometer

Motivation: TESS, K2, etc.

Mission: determine masses of Earth-like planets

Requirement: < 50 cm/s

Goal: ~ 10 cm/s

Instrument for the community

Operations start 2019 Q2

PI: S. Mahadevan (PSU)



Spectroscopic capabilities
Coming 2019 → [DESI @ KPNO Mayall 4-m](#)

Dark Energy Spectroscopic Instrument (DESI)

5000-fiber spectrometer

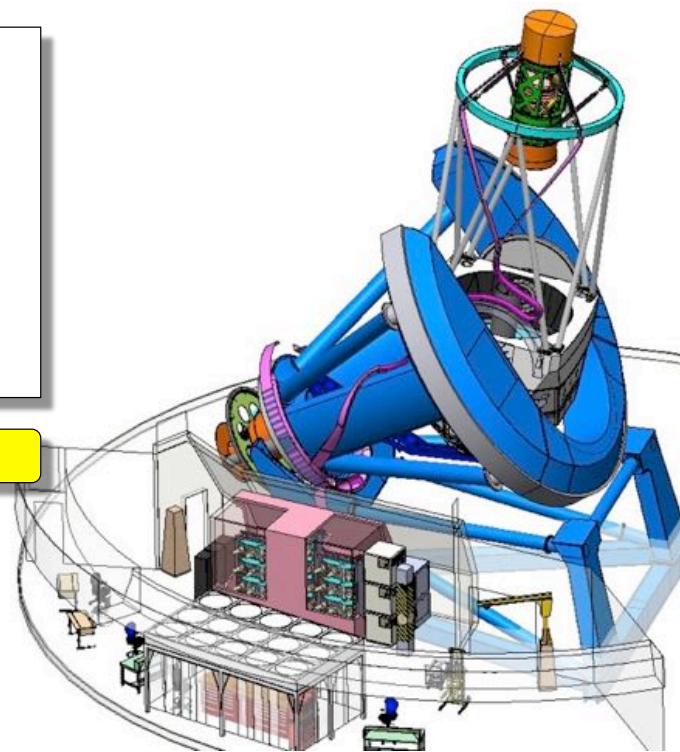
5000 fiber positioner robots @ prime focus

New prime focus corrector (creating an 8 sq deg FOV)

New top ring and cage, barrel and hexapod assembly

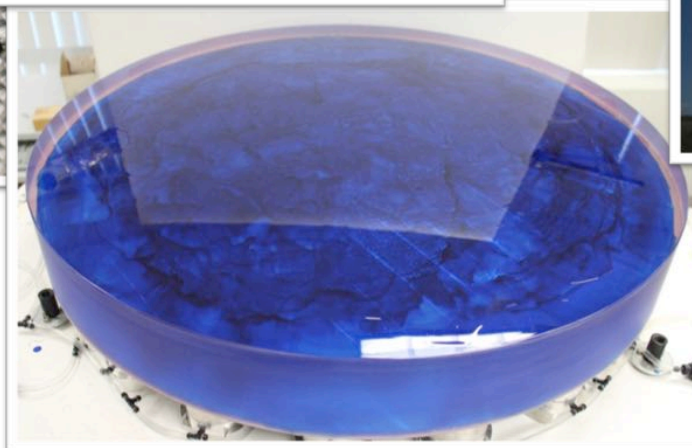
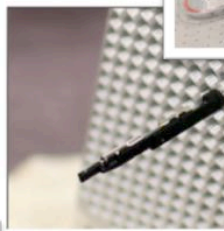
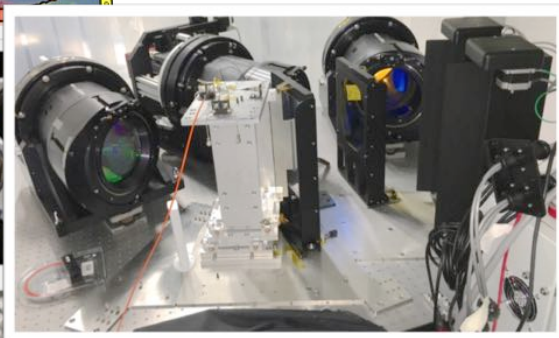
Ten 3-arm spectrographs (cf., BOSS spectrographs)

Images: M. Levi, DESI Project Director





DESI hardware!



NOAO Town Hall, Jan 2017 (D4)

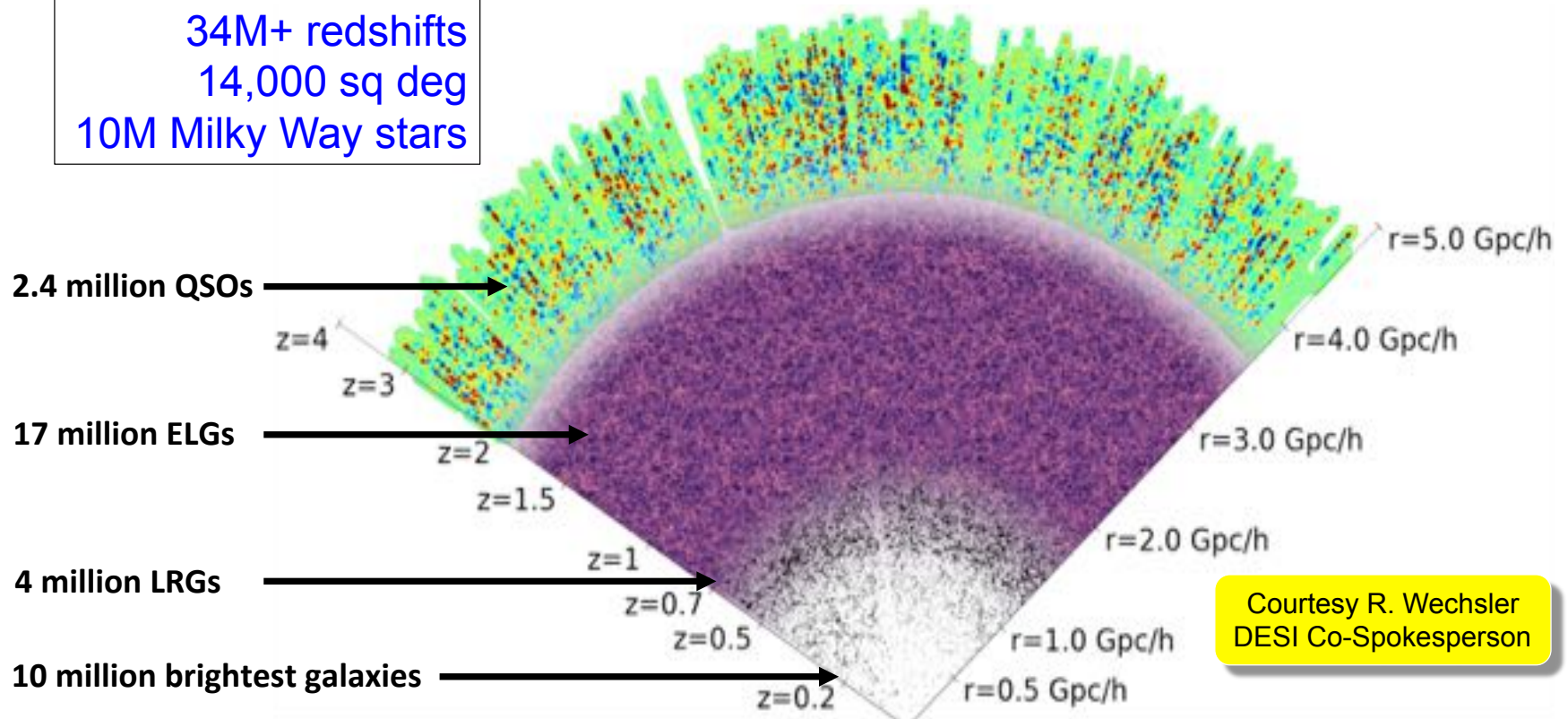
Images: M. Levi, DESI Project Director



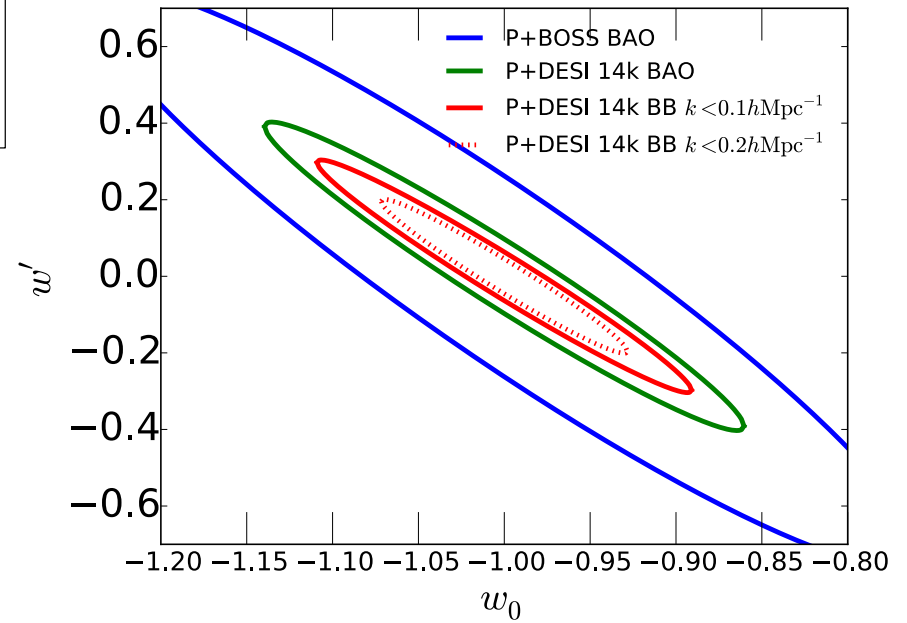
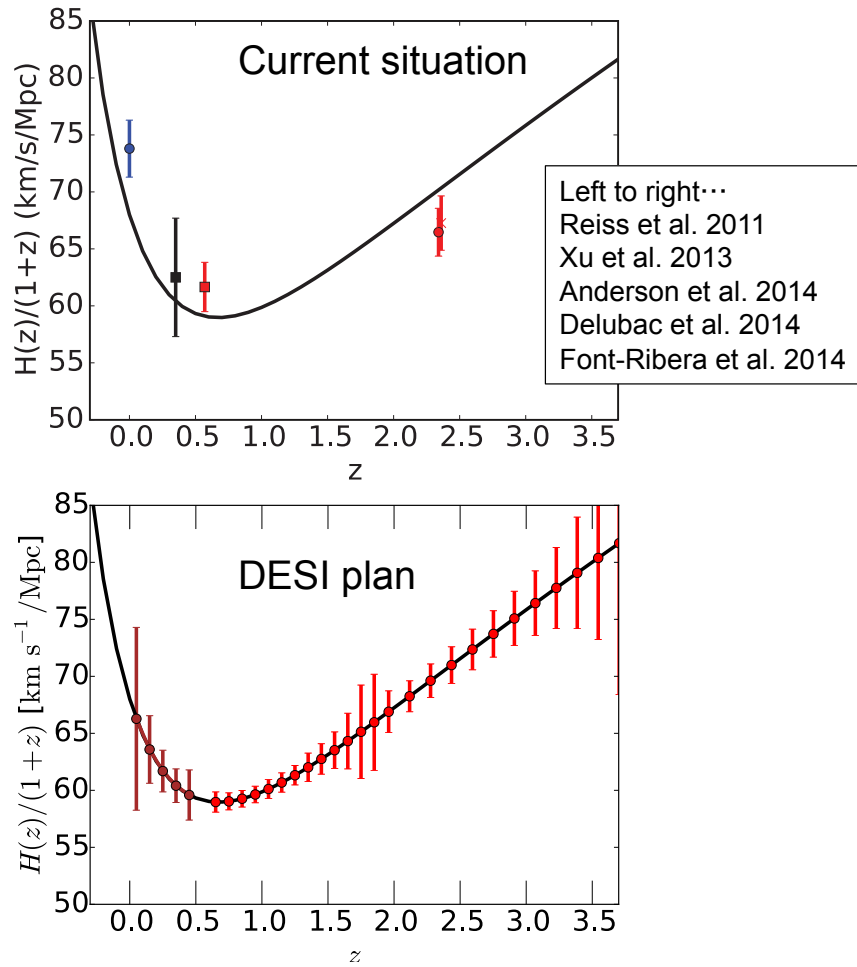
DESI Key Experiment

Ultra-wide, deep spectroscopic survey

34M+ redshifts
14,000 sq deg
10M Milky Way stars



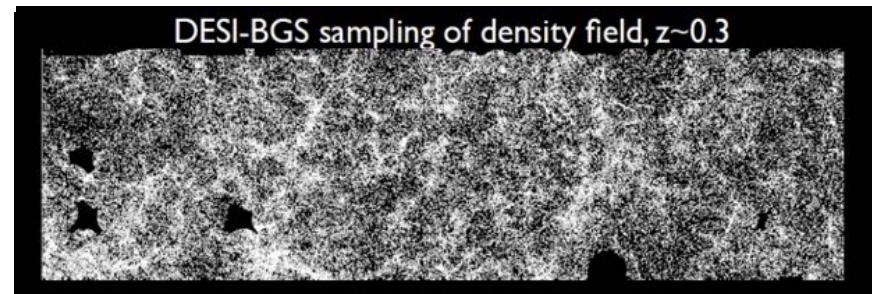
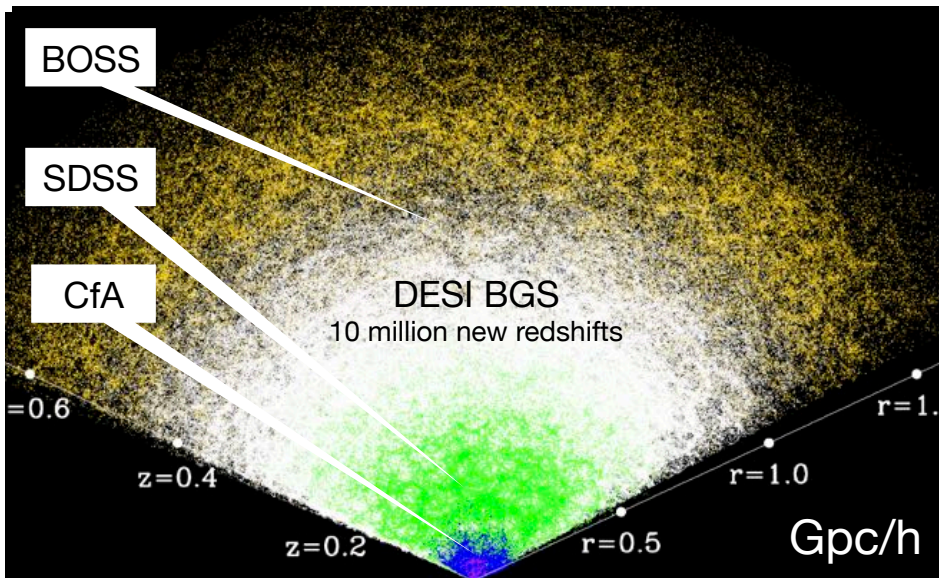
DESI Key Experiment Cosmic Acceleration over Time



Credit: DESI FDR Report, Part 1, DESI Collaboration



DESI Bright Galaxy Survey



Credit: D. Weinberg



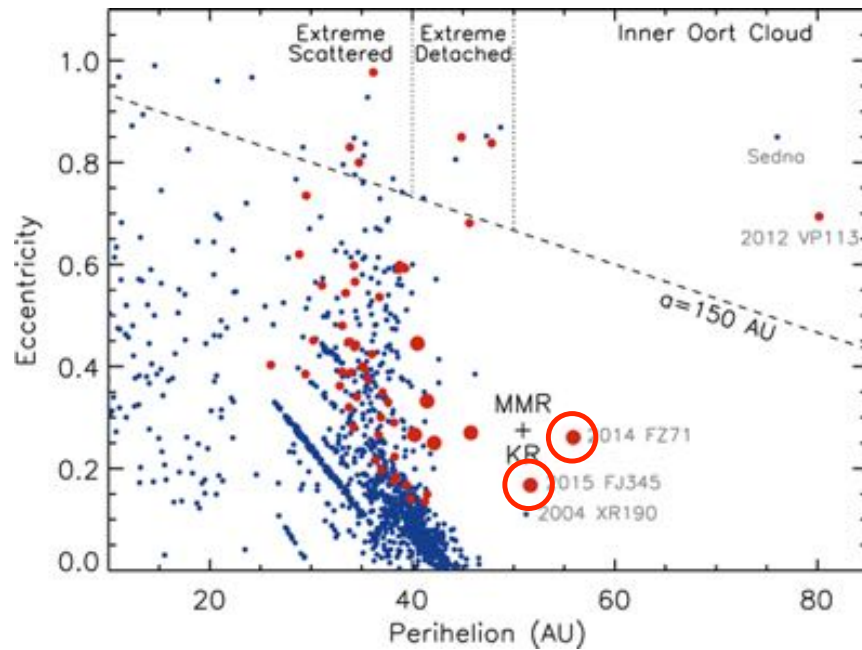
Imaging capabilities Available now

				Optical		
				Natural		AO
				Small Field	Medium Field	Wide Field
Gemini North 8.2	●					
Mayall 3.8		●				
WIYN 3.5		●			Speckle	
KPNO 2.1					Laser SCAO	
Gemini South 8.2	●					
SOAR 4.2	●				GLAO	
Blanco 3.9			●			

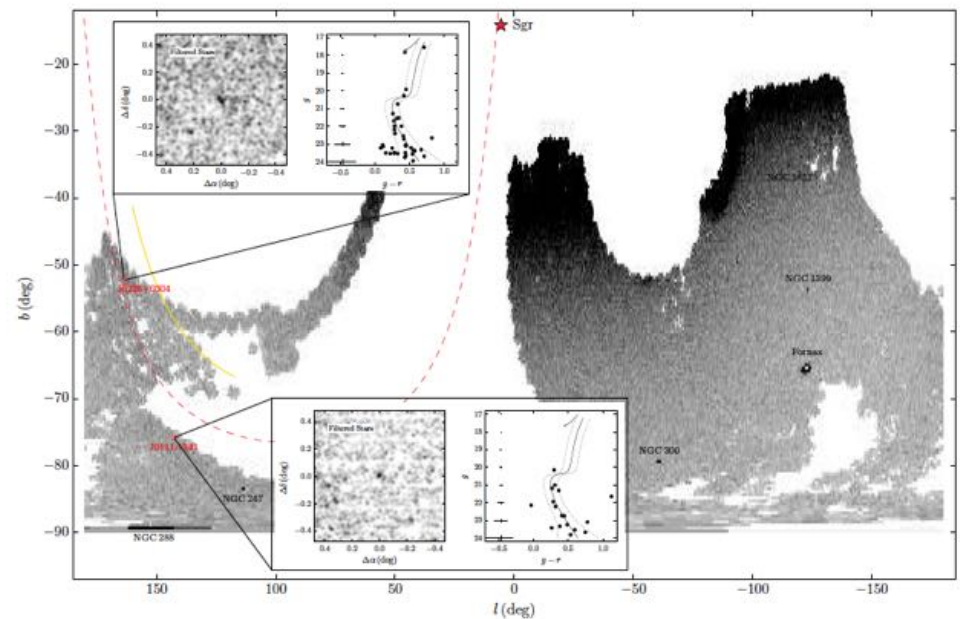
		Near-IR	
		Natural	AO
		Small Field	
	●		Laser SCAO
	●		
			NGS Tip-Tilt
			Laser SCAO
	●		Laser MCAO
	●		

Imaging capabilities

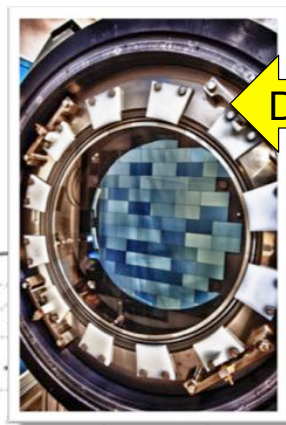
Recent DECam community science highlights



Discovery of two new TNOs
beyond the Kuiper belt edge
Sheppard et al 2016 ApJ 825 L13

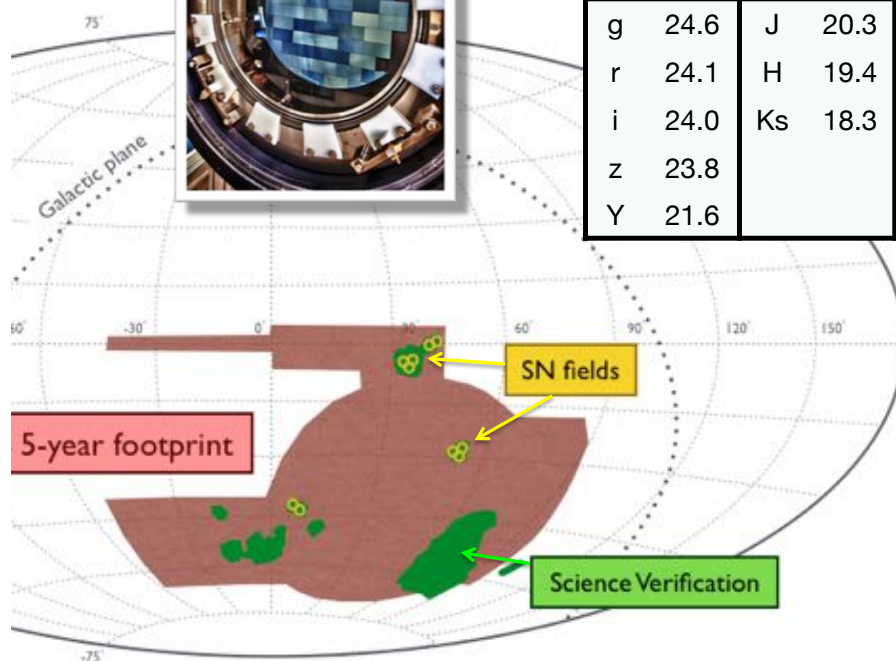


Discovery of two faint stellar systems
associated with the Sgr stream
Luque et al ArXiv 1608.04033



DECam focal plane

DES+VHS (10σ)			
g	24.6	J	20.3
r	24.1	H	19.4
i	24.0	Ks	18.3
z	23.8		
Y	21.6		



Ultra-wide-field imaging surveys Dark Energy Survey

5000 sq deg with Blanco/DECam
 300 million objects, 5-band (g,r,i,z,Y)
 JHK from VISTA surveys
 Year 4 of 5 completed

All data products will be public

Raw data (after 12 mons)
 Processed images (Y1, SV)

Dec 2017 → Public DR1
 Coadded Y1 – 3 (images, catalogs)



Ultra-wide-field imaging surveys Dark Energy Survey

Key Experiment

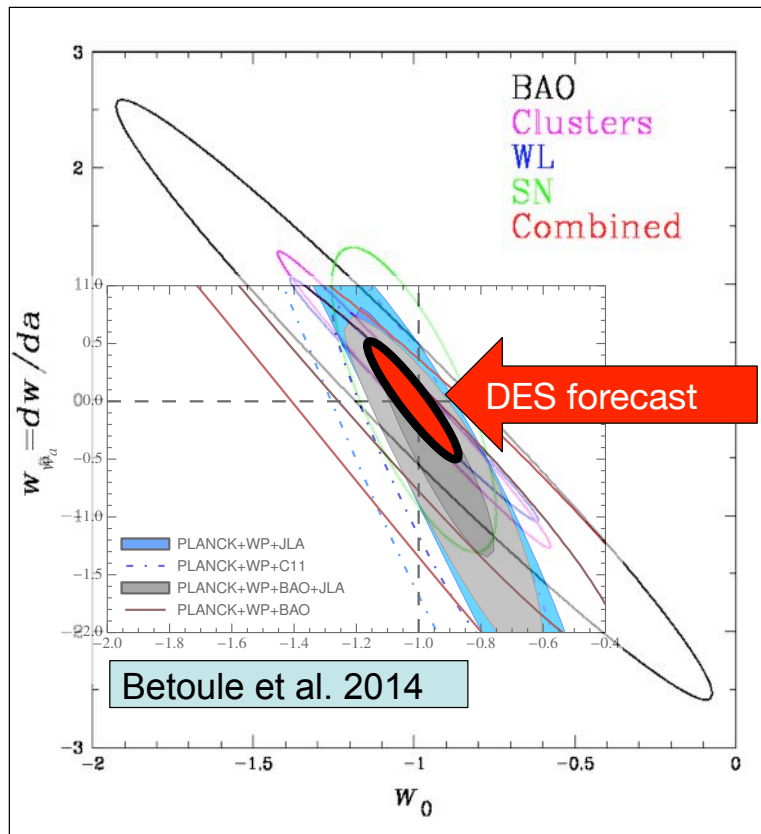
Constrain nature of dark energy

Probes

- Clusters
- Weak Lensing
- Large-scale Structure (BAO)
- Supernovae

DES Collaboration

- Almost 90 papers submitted to date



Ultra-wide-field imaging surveys Legacy Survey

Motivation: DESI targets

Mayall/Mosaic-3 (MzLS)

Blanco/DECam (DECaLS)

Bok/90-Prime Mosaic (BASS)

14,000 sq deg

1200 million unique objects

(g,r,z) = 24.7, 23.9, 23 (5-sigma)

SDSS overlap

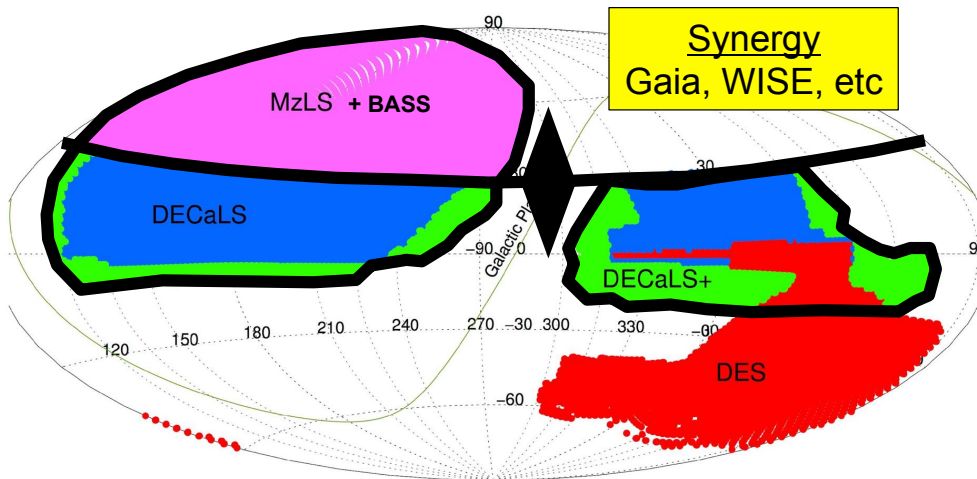
DESI fields

DR3 available now

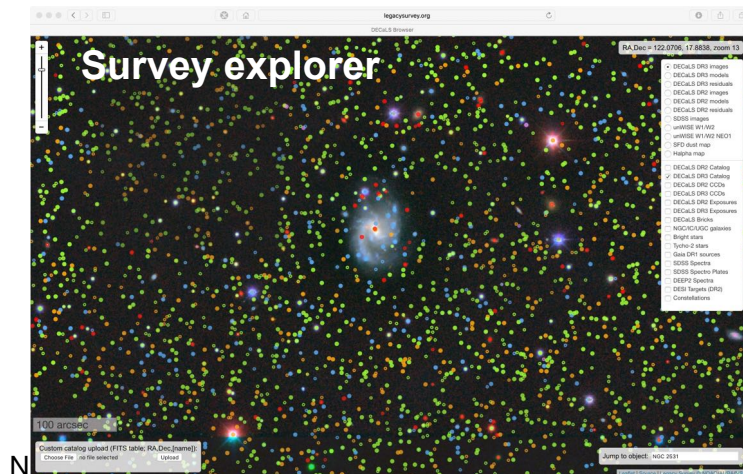
4300 sq deg

→ legacysurvey.org

Also: NOAO Data Lab



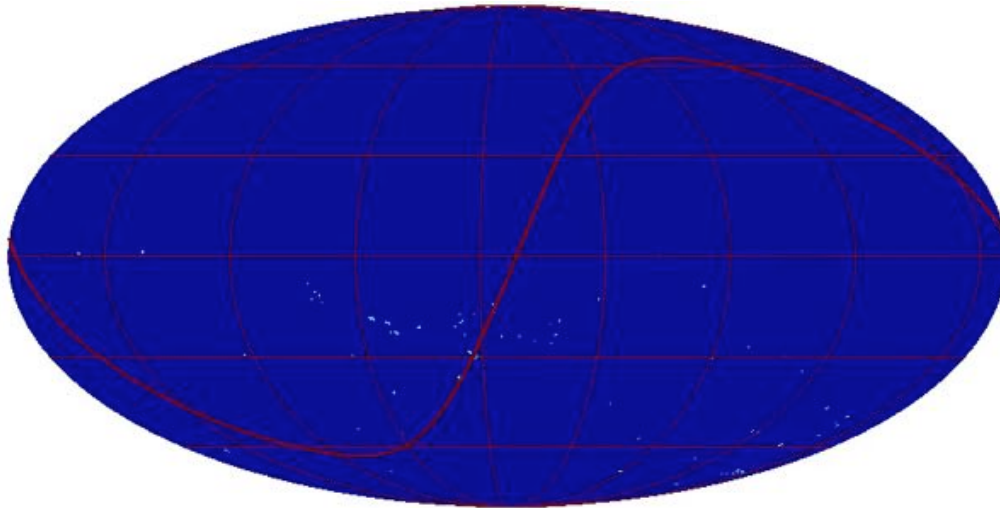
Imaging Survey Status, DESI Collab Meeting, OSU, 2016-12-06





High-value data products @ NOAO

archive.noao.edu



Mosaic, DECam exposure map (May 2016)
Raw, processed images
Catalogs for coherent surveys

- DES Science Verification DR
- DES SN fields
- DES Public DR1 (Jan 2018)
- **SMASH survey fields (Nidever et al.)**
- DECam Legacy Survey DR3+
- Mayall z-band Legacy Survey DR3+
- MW dwarfs (Mighell, internal)
- MW Bulge survey fields (Saha et al.)

Coming Soon (with spectra)

- SDSS DR7 – 13 (Mar 2017)
- SDSS DR14 (Jan 2018)

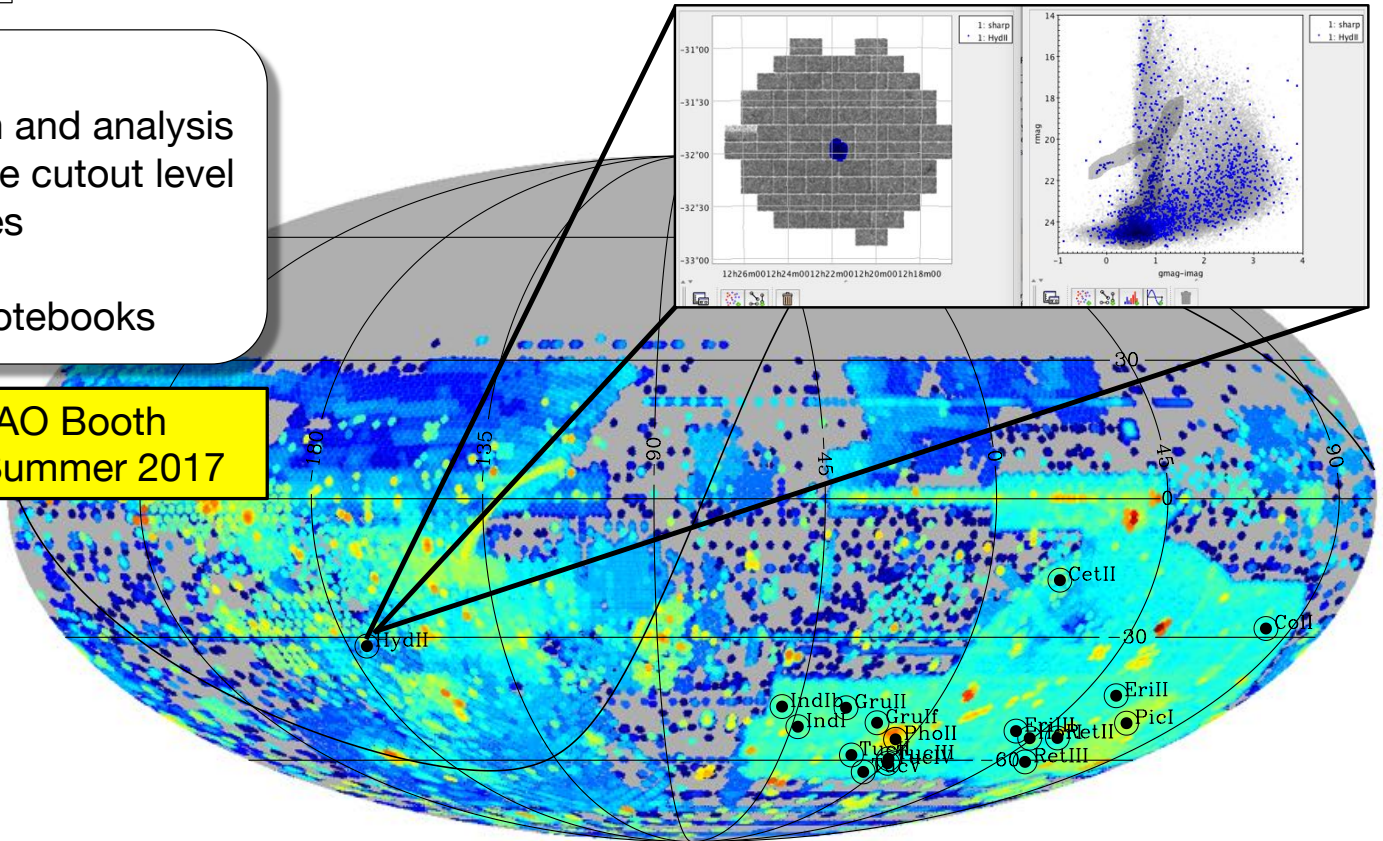


Data services for TB-scale catalogs NOAO Data Lab

“Computing at the data”

- Exploration, visualization and analysis
- Pixel processing at image cutout level
- Collaborative workspaces
- Built-in analysis tools
- Scriptable via Jupyter Notebooks

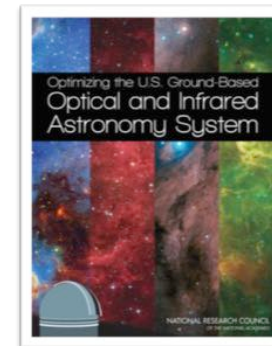
Latest Demo @ NOAO Booth
Public release → AAS Summer 2017

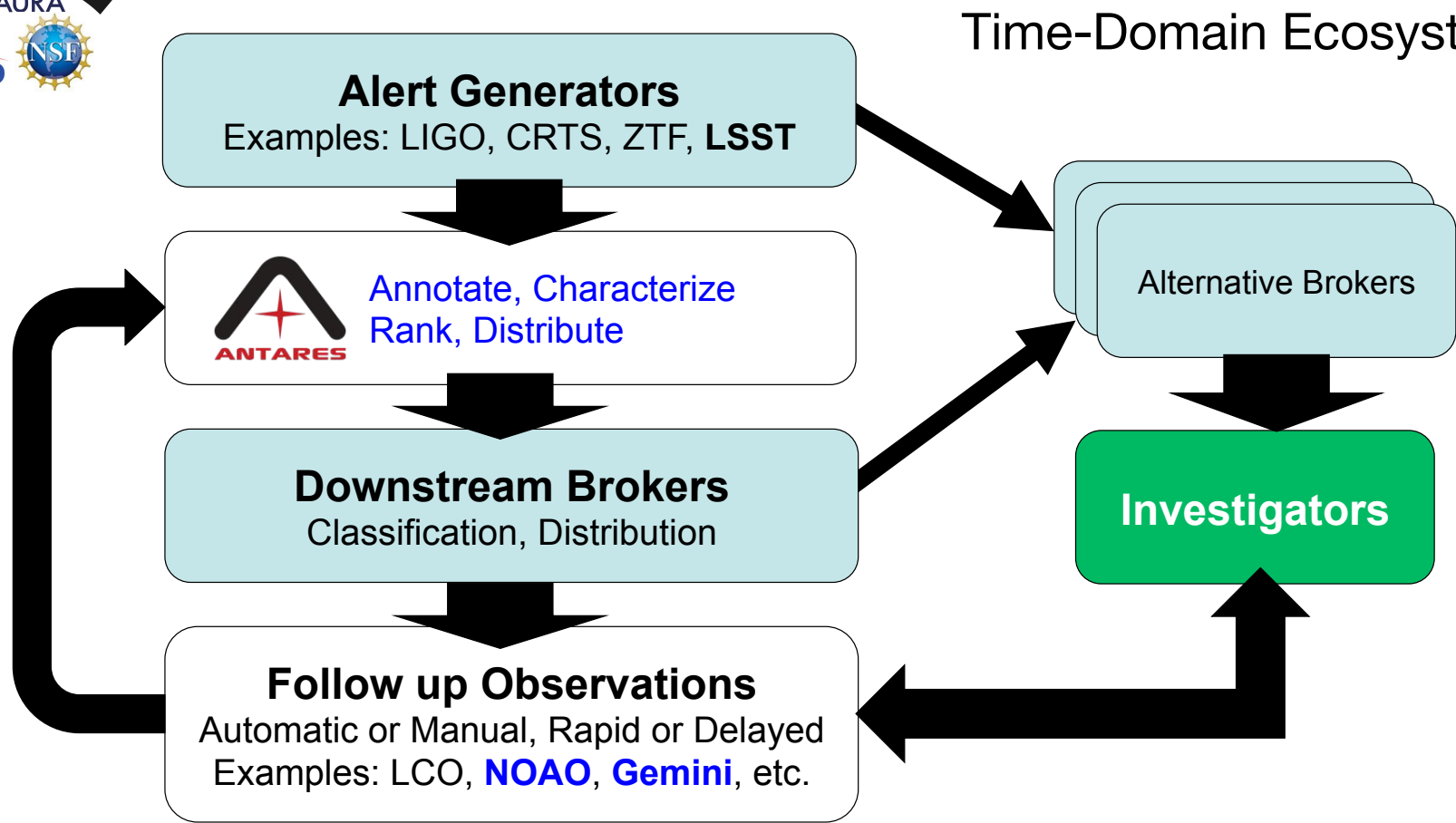




On the road to LSST Focus areas

- Time-domain science analysis and follow-up
- Static-sky science analysis and follow-up
- Custom data-intensive analysis applications
- Community-based planning of new capabilities
- Workshops, conferences, schools, and training







ANTARES

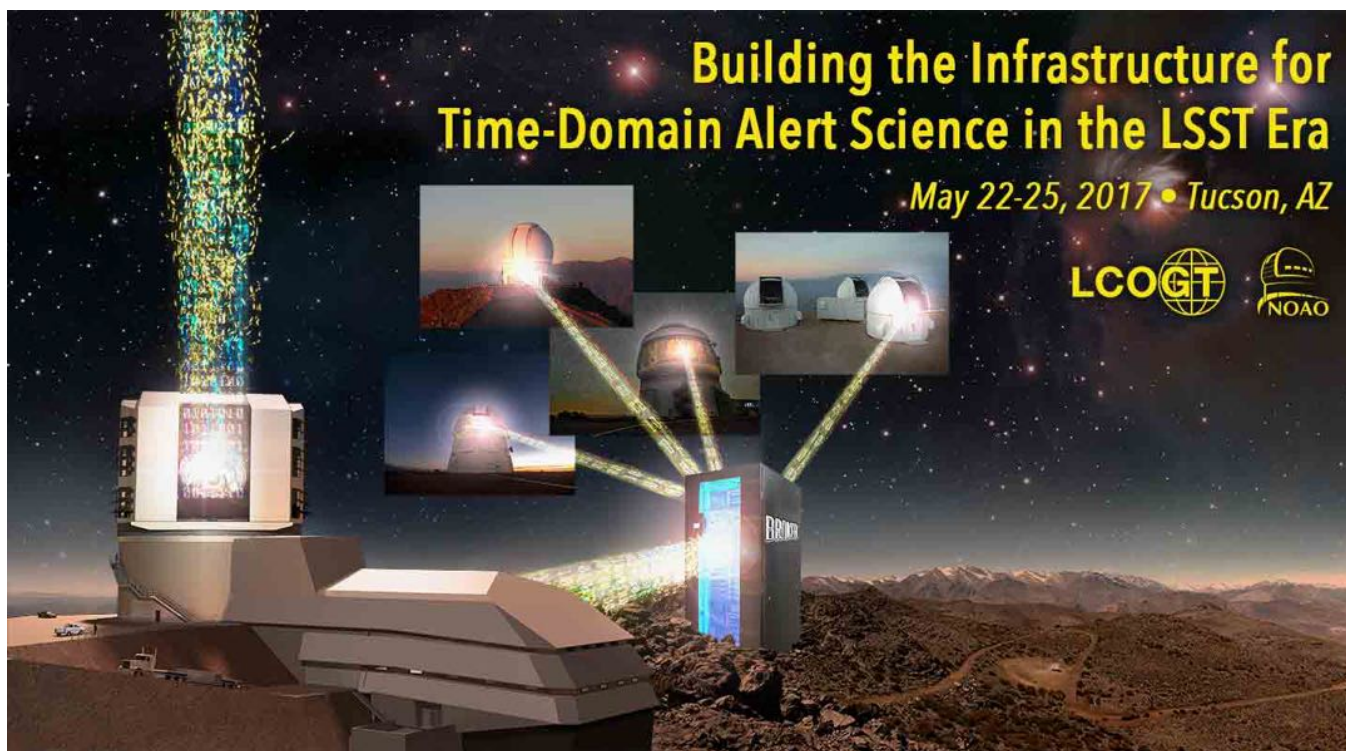
Time-alert brokering for the LSST era

- **Arizona-NOAO Temporal Analysis & Response to Events System**
 - Collaboration: NOAO, U. Arizona Dept. of Computer Science
- **Goal: deploy national broker service at LSST scale**
- Alert processing functionality
 - **Annotate** with external information and past history
 - **Characterize** by features in time-domain
 - **Rank** → identify “rarest of the rare”
 - **Distribute** value-added information
- Flexible, modular architecture
 - Open source, can be run by anyone
- API for user-specific feature filtering





Time-Domain Science Infrastructure Community Workshop, 22 – 25 May 2017





Application deadline: 15 April



NOAO Town Hall, Jan 2017 (D4)

La Serena School for Data Science: Applied Tools for Astronomy

- 21 – 29 August 2017, La Serena, Chile
- Advanced undergrads, early grads
- International, interdisciplinary lecturers
- Team-based, project-based
- Topics include:
 - Astronomical data acquisition
 - Processing pipelines
 - Astronomical databases
 - Virtual Observatory
 - High Performance Computing
 - Statistical tools applied to astronomy



Forward NCOA From NSF Town Hall

National Center for Night-time OIR Astronomy

- Numerous recommendations regarding enhanced coordination among NSF OIR observatories.
- September 2016: After many discussions with AURA management and Observatory leadership, NSF provided guidance to AURA on planning a National Center.
 - Purpose, mission and scope of a single administrative organization to coordinate resources among LSST operations, Gemini Observatory, and continuing NOAO programs.
 - AURA is to deliver to NSF a proposed plan for this National Center, with a targeted delivery date of mid-2017.
 - Separately, the potential National Center is being discussed with Gemini, LSST, and NOAO partners.
- The overall benefit envisioned is the provision of enhanced science return through coordination of capabilities as LSST moves toward operations.

1/04/2017

NSF-AAS Town Hall

1



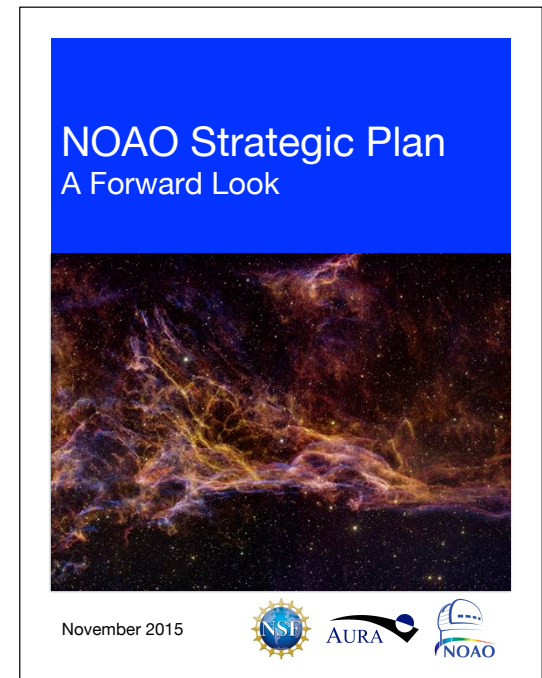
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Google for
“NOAO Strategic Plan”



END OF PRESENTATION

NOAO indicated explicitly
in many cases

Recommendations Elmegreen Report (Apr 2015)

- 1/ Develop telescope time exchange
- 2/ Enable on-going community-wide planning process
- 3/ Develop optical wide-field MOS capability in South

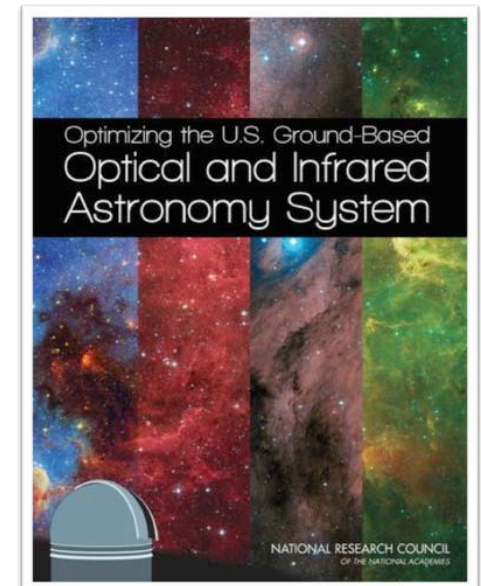
Capability

- 4A/ Develop LSST-scale event brokers
- 4B/ Ensure faint object spectroscopy at Gemini South
- 4C/ Develop time-domain follow up capability
- 4D/ Enhance coordination of Gemini, NOAO, LSST

Time-domain

- 5/ Invest in one or both GSMT projects
- 6/ Invest in instrument technology development (various)
- 7/ Support training programs in instrumentation, software, and data analysis expertise

The Future





NSF Directives to NOAO (March 2016) Topical Areas

1. Telescope Time Exchange & Data Access Across the OIR System
2. Planning New Capabilities
3. Event Broker Development, Archives, and Data Products Serving
4. LSST Follow-up Coordination
5. Community Preparation for the LSST Era

Overarching

- Much of this is “up scope”
- NSF has requested plans for review and (possible) funding