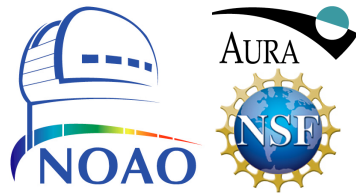


Astrophysics and Dark Energy with Large-Aperture, Wide-Field Spectroscopy

Adam S. Bolton, NOAO

2017 November 14



Survey Spectroscopy Maximizes LSST

Common cause between astronomy and cosmology

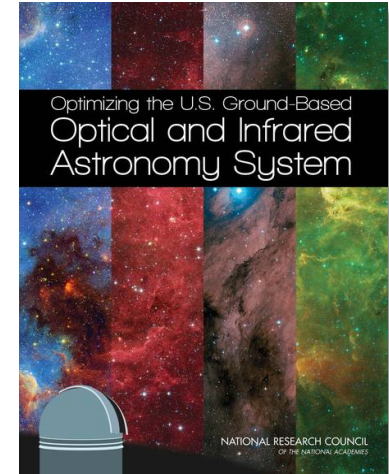
- A large-aperture (8-10m), wide-field (\gtrsim degree²), multiplexed (many 1000's) spectroscopic telescope in the southern hemisphere is the highest “unsolved” priority for maximizing the astronomy and astrophysics science return on the investment in LSST.
 - Co-evolution of dark matter, galaxies, and black holes
 - Structure of the Milky Way and its dwarf satellites
 - Physics of stellar variability
- This same class of facility would maximize the cosmological science reach of LSST
- This presents a clear opportunity for inter-agency and international collaboration

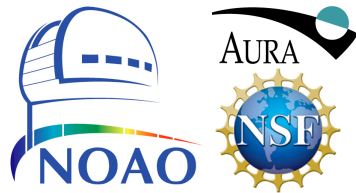


Wide-Field MOS = High Priority

Confirmed and detailed by recent reports

- OIR System Report (Elmegreen et al.)
 - http://sites.nationalacademies.org/bpa/bpa_087934
 - **Recommendation:**
The National Science Foundation should support the development of a wide-field, highly multiplexed spectroscopic capability on a medium- or large-aperture telescope in the Southern Hemisphere to enable a wide variety of science...
- Maximizing Science (Najita & Willman et al.)
 - <https://arxiv.org/abs/1610.01661>
 - **Recommendation:**
Develop or obtain access to a highly multiplexed, wide-field optical multi-object spectroscopic capability on an 8m-class telescope, preferably in the Southern Hemisphere.



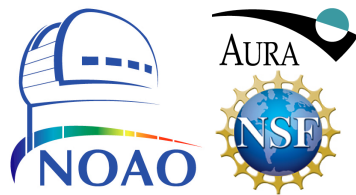


Major astrophysics science drivers

Numbers approximate, from *Maximizing Science* Report

- Environment-dependent galaxy evolution from a survey of $\sim 100,000$ galaxies to $z = 2$ in LSST deep-drilling fields
 - Requires $\sim 2,000$ hours on a Subaru/PFS-like facility
- Stellar populations, kinematics, and dark matter in the Milky Way and local dwarf galaxies
 - Requires $\sim 10,000$ hours on a Subaru/PFS-like facility
- Characterization of stellar parameters for studies of variability, rotation, and magnetism in field and clusters
 - Requires $\sim 4,000$ hours on a Subaru/PFS-like facility
- Also: targeting LSST transients on spare fibers during other surveys; supplementing supernova cosmology by obtaining redshifts for past photometric SN hosts

(slide adapted from J. Newman)



Basic Parameters

From science cases in *Maximizing Science Report*

- **8m-class aperture**
 - (3-5m *maybe* ok with large allocations for some science)
- **R ~ 5,000 in red; R ~ 2,500 in blue**
 - (R ~ 20,000 – 100,000 desired for stellar chemistry)
- **0.37 to 1 micron wavelength coverage required**
 - (0.35 to 1.3-1.5 desired for extragalactic science)
- **> 1 degree diameter FOV**
 - (20 arcmin FOV minimum)
- **Multiplexing of ~ 2,500 – 5,000**
- **Southern hemisphere location**
 - (Northern *maybe* ok for some science)
- **Community access**

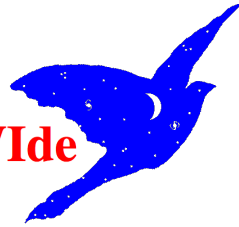


Sustained Interest in the NSF Sphere

Significant conceptual and detailed design heritage

ca. 1999

SWIFT: Spectroscopic Wide Field Telescope

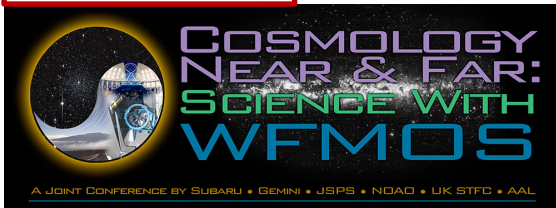


ca. 2003

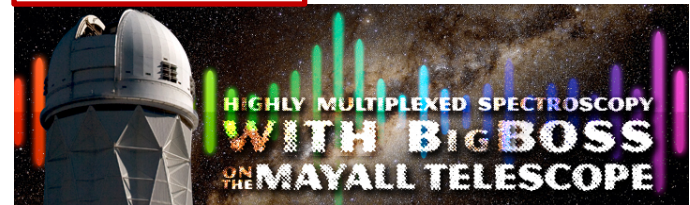
K.A.O.S.



ca. 2008

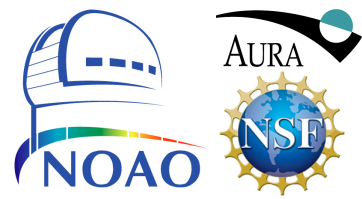


ca. 2011



ca. now!

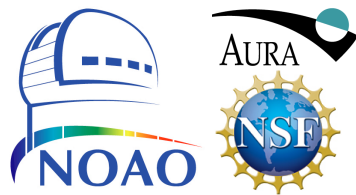




Implementation paths

As currently identified

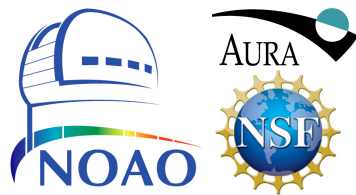
- DESI-2 in North
- DESI or DESI-like instrument in south
- Obtaining US community access to Subaru-PSF
- Maunakea Spectroscopic Explorer
- Partnership with ESO in South
- **Southern Spectroscopic Survey Instrument (SSSI)**
 - **Potential NSF+DOE interagency collaboration, following history of BOSS, DES, DESI, LSST**
- *Some combination or superposition of more than one of the above*



Astro 2020 Decadal Survey

(Timeline may have changed since this slide was made)

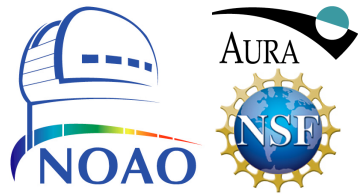
- **2018 March:** Astro 2020 proposal submitted to Agencies
- **2018 December:** Chair nominated
- **2019 January:** AAS Town Hall
- **2019 Feb/March:** Committee begins meeting
- **2019 May/June:** Panels begin meeting
- **2020 May:** Panels complete reports and deliver to Committee
- **2020 August:** Review of survey and panel reports begins
- **2020 December:** Astro 2020 completed and report released to Agencies and public



Decadal Survey Planning

NOAO activities to coordinate community input

- 2020 Decadal Survey planning website
 - www.noao.edu/2020Decadal
- Community planning meeting
 - 20-21 February 2018, (ex-)Marriott, Tucson, AZ
 - Analogous to CVDE for OIR astronomy community
- SnowPAC 2018 (*Big Questions, Big Surveys, Big Data*)
 - <http://www.physics.utah.edu/snowpac>
 - 11-16 March 2018, Snowbird Resort, UT
 - Joint sponsorship by NOAO and U. of Utah
 - *Build on previous work to develop coordinated cosmology and astrophysics cases and concepts for input to Astro 2020 and P5 processes*



Questions / Discussion