NOAO Community Survey for Astro2020

1. Make Your Views (and Needs) Known!

Survey Goals

As part of our preparation for the Astro2020 Decadal Survey, NOAO invites all interested members of the US community to participate in our online NOAO Community Survey. The survey results will be used in NOAO's planning process and input to Astro2020. The survey closing date is Friday 17 May 2019.

Survey Details

The survey should take 15-20 minutes and covers 10 general topics:

- **Demographics: tell us about yourself**
- **Your science in the 2020s**
- **How you will obtain data in the 2020s**
- **Time domain services**
- **Observing facilities that are important to your research**
- **Survey and data discovery services**
- **Software-related services**
- **New instrumentation and/or facilities**
- **Student and mentor training**
- **Your overall priorities for the 2020s**

You can

- **Skip sections you don't want to answer**
- **Page back and forth to change your answers until you click "Done"**

Why take this survey? NOAO's last US community survey was carried out in 2011, and much has changed since then. This survey aims to learn how the NOAO community has changed in the last decade, and what are our community's needs and priorities for the coming decade? This *Currents* article provides further details about the survey goals.

Your email address. At the end of the survey, we ask for your email address to ensure that each survey response corresponds to a unique individual. If you indicated that you are interested in additional information on any topic in the survey, we may use this email address to contact you. The survey itself is anonymous: the results will be evaluated and reported in an anonymized way.

Preview It? If you would like to view the entire survey before you begin, a pdf is available here.

Questions or Concerns? Please contact Joan Najita, NOAO Chief Scientist (najita@noao.edu).

2. **Demographics.** Tell us about yourself!

I am a...
(select best match)

- ◯ Graduate student
- ◯ Postdoctoral fellow/researcher
- ◯ Faculty member or researcher with primarily research responsibilities
- ◯ Other (please specify)
- ◯ Faculty/staff member or researcher with significant teaching responsibilities
- ◯ Faculty/staff member or researcher with significant service responsibilities

My home institution is

- ◯ In the U.S. (or operated/funded by a U.S. based Institution)
- ◯ Not in the U.S. (and not funded by a U.S. based institution)

My home institution is a
(select best match)

- ◯ Research university or observatory affiliated with a university
- ◯ Primarily undergraduate college/university
- ◯ Independent observatory
- ◯ Federally funded research organization (including FFRDC)
- ◯ Non-profit institution
- ◯ Other (please specify)

I consider myself a/an

(select all that apply)

- [ ] Observer
- [ ] Theorist
- [ ] Astro-informatics/data scientist
- [ ] Computer scientist
- [ ] Software developer
- [ ] Instrumentalist
- [ ] OIR astronomer
- [ ] Radio astronomer
- [ ] X-ray astronomer
- [ ] Other (please specify)

What kinds of observing resources from the US ground-based OIR system have you used in the past 3 years (e.g., published a paper with data from, proposed for time on, used data from)? and How did you get access to the resource?(Through your institution; via a collaborator with institutional access to the resource; via open time allocation; via publicly available data or data products?)

(select all that apply)

	Via my institution	Via a collaborator	Open time allocation	Public data / datasets	None of these
6-10m telescope	☐	☐	☐	☐	☐
3-5m telescope	☐	☐	☐	☐	☐
< 3m telescope	☐	☐	☐	☐	☐

3. My Science in the 2020s

The Astro2020 Decadal Survey divides up astronomy into the following broad thematic science areas.

- **Planetary Systems including solar system bodies (other than the Sun), debris disks, and extrasolar planets; exobiology and the search for life beyond the solar system.**
- **Star and Planet formation, including formation of stars and clusters, protostellar and protoplanetary disks, planet-disk interactions, molecular clouds and the cold interstellar medium, dust, and astrochemistry.**
- **Stars and Stellar Evolution, including the Sun, stellar astrophysics, the structure and evolution of single and multiple stars, and brown dwarfs.**
- **Formation and evolution of compact objects, including stellar-mass black holes, neutron stars, white dwarfs, supernovae, mergers of compact objects, gamma-ray bursts, accretion, production of heavy elements and other extreme physics on stellar scales.**
- **Resolved stellar populations and their environments, including the structure and properties of the Milky Way and nearby galaxies, their stellar populations and evolution, as well as interstellar media and star clusters.**
- **Galaxy Evolution, including the formation, evolution, dynamics, and properties of supermassive black holes, galaxies, and galaxy clusters, active galactic nuclei and QSOs, mergers, star formation rates, gas accretion, and the circumgalactic and intergalactic media.**
- **Cosmology and Fundamental Physics, including the early universe, the cosmic microwave background, reionization and galaxy formation up to the virialization of protogalaxies, large scale structure, the intergalactic medium, determination of cosmological parameters, dark matter and dark energy, astroparticle physics, tests of gravity, and astronomically determined physical constants.**
- **Multi-Messenger Astronomy and Astrophysics, including the sources of gravitational waves, astrophysical and cosmogenic neutrinos, cosmic rays and gamma rays, and the coordinated multi-messenger and multi- wavelength follow-ups.**

Indicate the Astro2020 topics you expect to work on, or might work on, in the coming decade:

	Expect to work on	Might work on
Planetary systems (includes solar system, debris disks, exoplanets, astrobiology)	○	○
Star and planet formation (includes cold ISM, dust, and astrochemistry)	○	○
Stars and stellar evolution	○	○
Formation and evolution of compact objects	○	○
Resolved stellar populations and their environments	○	○
Galaxy Evolution	○	○
Cosmology and Fundamental Physics	○	○
Multi-Messenger Astronomy and Astrophysics	○	○

Other topics (please specify)

What is the most important science question you wish to address in your research in the 2020s?

What is the biggest challenge you face in answering this question?(e.g., lack of observational data, instrumentation, observing nights, appropriate observing modes, analysis techniques, supporting infrastructure, etc.)

How important will **ground-based OIR resources** be to your research in the 2020s?

Critical	Important	Helpful	N/A
○	○	○	○

If you will use **other resources** in your research (i.e., non-OIR and/or space-based facilities) in the coming decade, indicate their relative importance in your research program.

	Critical	Important	Helpful	N/A
X-ray	○	○	○	○
Gamma ray	○	○	○	○
Gravitational wave	○	○	○	○
UV	○	○	○	○
OIR from space	○	○	○	○
FIR/submm	○	○	○	○
Millimeter/submm	○	○	○	○
Radio	○	○	○	○
Other	○	○	○	○

Other (please specify)

4. **How I will obtain data in the 2020s**

Data can be obtained in person by going to a telescope, by observing remotely, through a queue or service observing (an observatory professional observes for you), as a target of opportunity (ToO) that may require rapid scheduling and may interrupt other scheduled observations, or as a time critical or coordinated observation that does not require rapid scheduling. Programs can be carried out as individuals, small groups, or large collaborations.

Research can also be carried out with archival data, either raw or reduced (e.g., images and spectra), and with higher-level data products (e.g., catalogs, including public coherent data sets such as 2MASS, SDSS, DECaLS).

Will you take data at a telescope? How?

	Intend to use	Might use	Will not use	Not sure; need more info
In person / on-site	○	○	○	○
Queue or service observing	○	○	○	○
ToO with rapid scheduling, interrupt access	○	○	○	○
Time critical or coordinated observations	○	○	○	○
As part of a large collaboration	○	○	○	○

If you will require another observing method, please describe it here.

Will you use archival data and/or data products?

	Intend to use	Might use	Will not use	Not sure; need more info
Raw data	○	○	○	○
Reduced data	○	○	○	○
Data products	○	○	○	○

If you require a different archival data resource, please describe it here.

5. Time domain services needed for my research in the 2020s

The Zwicky Transient Facility (ZTF) is currently delivering hundreds of thousands of alerts per night, and the Large Synoptic Survey Telescope (LSST) is expected to generate millions of alerts per night. Previous studies have argued that alert brokers and follow up observing systems are needed to maximize the science they produce.

Alert brokers like NOAO's ANTARES take alerts generated by facilities like ZTF and LSST and associate them with ancillary data (catalog information across the electromagnetic spectrum as well as the past history of a source) in order to characterize and filter the alerts into bins of interest (e.g., extragalactic nuclear transient, variable star, Solar System object, etc.). Rare sources are ranked by their rarity, and filtered streams of alerts are distributed to interested users. (Read more at: https://antares.noao.edu; or this *Currents* article.)

Follow up Observing Systems like AEON. While astronomical surveys can deliver alerts within minutes of the discovery of a transient or variability event, follow up observations are often needed to understand the event and deliver the scientific return. Follow up observing systems are designed to respond on an appropriate timescale and deliver the needed observations. Optional automation can facilitate the scheduling, acquisition, and data reduction process. NOAO is working with LCO, SOAR and Gemini to develop a system called AEON for "Astronomical Event Observation Network". (Read more at https://lco.global/aeon/)

How likely are you to use these resources in your research?

	Intend to use	Might use	Will not use	Don't know or need more info
Alert broker	○	○	○	○
Follow up observing system	○	○	○	○

If you require a different time domain service than those above, please describe it here.

6. **Facilities that are important to my future research**

NOAO community resources include telescopes that offer open access observing and/or publicly available data. Some telescopes are operated by NOAO, and other observatories receive major NSF funding (Gemini, LSST). The proposed US Extremely Large Telescope Program would provide US national open access to observing time on the Giant Magellan Telescope (GMT) and Thirty Meter Telescope (TMT).

In the past decade, some NOAO facilities have transitioned to supporting large surveys or focused research programs that are enabled by external funding.

Some non-federal facilities receive limited NSF funding and, as a result, offer a benefit to the US community in the form of publicly available data or open access observing time.

Open access facilities.

NOAO, Gemini, and LSST are a collective gateway to the following resources. Which of these facilities and associated data will be important for your research in the coming decade?

Using the dropdown menus below, indicate which open access facilities and/or their publicly available data are 1=Very important, 2=Important, 3=Possibly Important/Need more info. Indicate all that apply.

	Open access observing	Publicly available data
TMT and GMT		
8-m Gemini N/S		
4m Blanco		
4m SOAR telescope		
3.5m WIYN telescope		
SMARTS telescopes		
0.9m WIYN telescope		

Please do the same for LSST, which offers publicly available data but not open access observing.

	Publicly available data
LSST	

Externally-funded facilities, programs, and projects.

Over the past decade, some NOAO facilities have transitioned to supporting large surveys or focused research programs that are enabled by external funding. Examples include the Dark Energy Survey (DES) on the 4-m Blanco telescope, the Dark Energy Spectroscopic Instrument (DESI) on the 4-m Mayall telescope, the NASA-NSF Exoplanet Observational Research (NN-EXPLORE) partnership for exoplanet discovery and characterization on the 3.5m WIYN telescope, and Robo-AO on the Kitt Peak 2.1m telescope. Data from or related to these programs are often publicly available (e.g., DES, Legacy Surveys, NN-EXPLORE).

How important to your research are these programs or any future programs on these facilities? How likely are you to make use of publicly available data from these programs?

Using the dropdown menus below, indicate which are 1=Very important, 2=Important, 3=Possibly important/Need more info). Indicate all that apply.

	Participate in project	Use of publicly available data
4m Mayall		
4m Blanco		
3.5m WIYN		
Kitt Peak 2.1m		

NSF-funded community resources.

In previous years, the NOAO community has had access to non-federal facilities (Keck, MMT, Magellan, LBT, etc.) through NSF's Telescope Systems Instrumentation Program (TSIP). More recently NSF's Mid-Scale Innovations program (MSIP) has made awards in ground-based OIR astronomy, the majority of which offer a benefit to the US community in the form of publicly available data or open access observing time.

- Zwicky Transient Facility (ZTF): open data from community surveys
- Dark Energy Survey: images and public data products
- PFS/Subaru: publicly available SuMIRe survey images and spectra
- CHARA array: open access through the NOAO TAC (currently available 2010-2023)
- Las Cumbres Observatory: open access through NOAO TAC (currently available 2017-2020)
- Keck All Sky Precision AO: all data publicly available

Have you used (or how likely are you to use) the benefits from these MSIP awards?

	Have used or intend to use	Might use	Will not use	Don't know; need more info
Zwicky Transient Facility	◯	◯	◯	◯
Dark Energy Survey	◯	◯	◯	◯
Subaru/PFS SuMIRe	◯	◯	◯	◯
CHARA array	◯	◯	◯	◯
Las Cumbres Observatory	◯	◯	◯	◯
Keck All Sky Precision AO	◯	◯	◯	◯

How important to your research are future NSF awards that enable open access time on or publicly available data from these or other facilities?

◯ Very important

◯ Important

◯ Unimportant

◯ Undecided

More generally, what non-federal ground-based OIR telescope facilities will be critical to your research in the 2020s?

How do you plan to access these facilities? Through your institution, a collaborator, via publicly available data, or another path (please specify)?

7. **Survey and data discovery services**

The past decade has seen the increasing importance oflarge surveys as pathways to discovery. The coherent data sets they produce are also frequently used to make new discoveries on their own or to support other science investigations. Science platforms for data discovery, analysis, and visualization are designed to facilitate these uses.

NOAO's Science platform, the NOAO Data Lab, provides users with access to large datasets and databases, analysis tools, and user data storage. Its current holdings comprise over 50 TB of catalog tables across the full sky, including wide-area surveys from NOAO facilities (e.g., DES, DESI, NSC), and other wide or all-sky surveys (e.g., Gaia, WISE, SDSS). Read more at https://datalab.noao.edu. Similar capabilities for LSST data will be supported in the future via the LSST Science Platform.

How likely are you to use the following resources in your future research?

	Intend to use	Might use	Will not use	Don't know; need more info
Opportunity to carry out a large survey	○	○	○	○
Access to coherent survey data sets	○	○	○	○
Science platforms	○	○	○	○

If you anticipate needing to carry out your own**large survey** program (i.e. on order hundreds of observing nights or large fractions of a particular observing capability) to support your research, briefly describe the resources you will need (nights of telescope + instrument time, data pipelines and data services).

If you intend to use **coherent data sets** produced by others, please list those most critical to your research.

8. Other Software-related Services

Software for data reduction and analysis is an essential component of observational astronomy. In the past, NOAO developed and supported IRAF to address this need. The landscape of software, computing, and data in astronomy has changed significantly over the past several decades.

How important is it for a national center like NOAO to support these software-related resources?

	Very important	Important	Unimportant	Need more info
General purpose astronomy software (IRAF, Astropy, and others)	○	○	○	○
Instrument- or project-specific pipelines, tools, and cookbooks	○	○	○	○
Hosting and curation of user-contributed scripts and modules	○	○	○	○
Science-quality reduced data products	○	○	○	○
Facilitating application of non-astronomy software to astronomy research	○	○	○	○
Training for programming and software use in astronomy	○	○	○	○

Other (please specify)

9. **New Instrumentation or facilities**

New telescopes and instrumentation can open new discovery spaces and research horizons. Would a particular kind of instrumentation or telescope enable qualitatively new science for you in the coming decade?

Previous studies have called for capabilities like those in the list below. If your needed capability is in the list, indicate its importance. If it is not in the list, please describe it in the comment box below.

	Very Important	Important	Unimportant/Uncertain
Highly multiplexed wide-field spectroscopy on ~4m telescopes	○	○	○
Highly multiplexed wide-field spectroscopy on ~8m telescopes	○	○	○
Wide-field infrared imaging capability	○	○	○
Extremely large telescopes (20-30m)	○	○	○
Other	○	○	○

Other (please specify)

10. **Student and Mentor Training**

As we enter an era when archival datasets are increasingly used in research and data analysis methods are increasingly sophisticated, how important are the traditional elements of student training in ground-based OIR astronomy? How important are new techniques to a student's career? Does a student's mentor (e.g., a professor) require any training to remain an effective mentor?

How important is it for **students** to acquire the following types of training or resources?

	Very Important	Important	Unimportant/Uncertain
Hands-on observing experience	○	○	○
Instrumentation or facility development and/or facility operations experience	○	○	○
Access to raw data	○	○	○
Simple access to very large, homogeneous data catalogs	○	○	○
Training in basic data reduction and analysis techniques	○	○	○
Training in specialized data analysis techniques (e.g., analysis of AO imaging data)	○	○	○
Training in software development practices	○	○	○
Training in statistics and data science methods (e.g., machine learning)	○	○	○

Other (please specify)

How important is it for **established researchers and student mentors** to receive the following types of training or resources?

	Very Important	Important	Unimportant/Uncertain
Simple access to very large, homogeneous data catalogs	○	○	○
Training in specialized data analysis techniques (e.g., analysis of AO imaging)	○	○	○
Training in data science methods (e.g., machine learning)	○	○	○

Other (please specify)

11. **Your Priorities Overall for the 2020s**

Now considering your responses to the previous questions in a relative sense, please indicate how important these resources are to you in a **funding-limited environment**.

	Critical	Important	Unimportant	Need more info
Observing time on telescopes	○	○	○	○
New instrumentation	○	○	○	○
New telescopes	○	○	○	○
Software and data pipelines	○	○	○	○
Archival data products (reduced data, catalogs)	○	○	○	○
Alert broker (e.g., ANTARES)	○	○	○	○
Follow up observing system (e.g., AEON)	○	○	○	○
Science platforms for data discovery, analysis, visualization (e.g., Data Lab)	○	○	○	○
Student or mentor training	○	○	○	○

Your priorities for increased federal funding. If there is an opportunity for increased federal funding, what is the most important resource that NOAO should develop?

12. **Last Words**

Do you have any additional comments?

* Please provide your email address:

Providing your email address will help us ensure that each survey response corresponds to a unique person. If you indicated that you are interested in additional information on any topic in the survey, we will use this email address to contact you. The survey itself is anonymous: the results will be evaluated and reported in an anonymized way.

Thank you for your input!