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## Currents

### In this Issue...

**NOAO Directorate — Silva Departs, Allen and Bolton to Lead:** After 10 years of committed leadership as NOAO Director, David Silva is joining the University of Texas at San Antonio as Distinguished Professor and Dean of the College of Sciences. Lori Allen has been appointed Acting NOAO Director and Adam Bolton Acting NOAO Deputy Director. [Read more...](#)

**NASA Time available on CHIRON/1.5m:** Approximately 40 nights of observing time with the CHIRON high-resolution spectrograph on the CTIO/SMARTS 1.5m telescope is again available for exoplanet research in the 2019B semester, with TESS follow-up currently a high priority. An estimated 18 additional nights of NOAO time is also available for general scientific programs not limited to exoplanet science. [Read more...](#)

**ANTARES Now Filtering and Streaming ZTF Alerts:** The keenly anticipated era of large-scale time-domain surveys has arrived, with the Zwicky Transient Facility (ZTF) now generating hundreds of thousands of public alerts each night! The [ANTARES alert broker](#) is up and running, automatically filtering the alerts into eight streams of transients, variable stars, and known Solar System objects and distributing them to interested users. [Read more...](#)

**Astro2020 White Paper Coordination Hub Available:** To help you develop and share your Science White Papers for the 2020 Decadal Survey (due **11 March 2019**), NOAO has created a [community coordination hub](#) where you can submit potential white paper topics, review topics suggested by others, find people with similar interests who may want to collaborate on white papers, and provide links to completed white papers. [Read more...](#)

**Astro2020 White Paper on "Investing for Discovery and Sustainability in Astronomy":** Based in part on messages from the 2018 NOAO Community Planning workshop, a [recent white paper](#) argues that a balanced set of investments in small-to large-scale initiatives is essential to continued discovery and a sustainable future for astronomy. It also describes how investments in data-intensive missions have benefits to society beyond the science they deliver. Training data-capable scientists both contributes to our society's future workforce needs and can lead to a more sustainable workforce flow within astronomy. [Read more...](#)

**US NGO Mini-workshop Highlights:** Gemini high-resolution spectroscopy was the featured topic of the [US National Gemini Office \(US NGO\) workshop](#) held at the January 2019 AAS meeting. Although Gemini has historically offered few opportunities for high resolution spectroscopy, opportunities now abound. This

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article describes the instruments that were covered in the workshop and links to the archived presentations. [Read more...](#)

### **Workshop Report: Helping AAS Members Help the World by Teaching**

**Climate Change:** A workshop held at the January AAS meeting introduced participants to (1) resources to improve our science content knowledge about climate change, (2) effective interactive and inclusive methods for teaching climate change in introductory astronomy classes, and (3) established strategies for engaging the public. This article describes the workshop and links to annotated slides from the workshop. [Read more...](#)

**US ELT Program News:** The January 2019 AAS meeting featured two sessions devoted to the US Extremely Large Telescope Program. This article describes highlights from the sessions and provides [links to the session presentations](#), which are now available at the NOAO US-ELTP web site. [Read more...](#)

### **Meeting Announcement — “Extremely Big Eyes on the Early Universe”:**

Registration is now open for the last of a three-part international conference series that will review the current state of the art in studying the high redshift universe and discuss how to best use giant telescopes to go beyond. The **9-13 September 2019** event, to be held in Rome, Italy, at the Accademia dei Lincei has an abstract submission deadline of **15 April 2019**. [Read more...](#)

### **NOAO in the News**

#### **Milky Way’s Neighbors Pick Up the Pace:**

After slowly forming stars for the first few billion years of their lives, the Magellanic Clouds have upped their game and are now forming new stars at a fast clip. This new insight into the “activity history” of the Clouds comes from the first detailed chemical maps made of galaxies beyond the Milky Way. The project, carried out by the Sloan Digital Sky Survey (SDSS), was led by NOAO Astronomer David Nidever. [Read more in NOAO press release 19-03.](#)



#### **Holy Cow! Birth of a Black Hole or Neutron Star?**

An unusual supernova studied by multiple telescopes, including the SOAR telescope and other telescopes at CTIO and KPNO, is thought to herald the birth of a new black hole or neutron star, caught at the exact moment of its creation. The event gives astronomers a rare glimpse into the physics at play during the creation of a black hole or neutron star. [Read more in NOAO press release 19-02.](#)

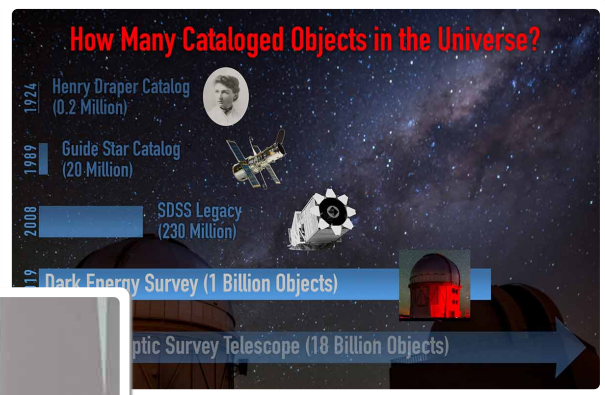


#### **A Survey Machine and a Data Trove: Dark Energy Survey’s Rich Legacy:**

Over the past six years the Dark Energy Survey collected a rich trove of data, mapping nearly a billion objects over one-fourth of the southern sky! Carried out at CTIO, the survey explores the nature of dark energy, the mysterious form of energy that is accelerating the expansion of the Universe. Although the survey has ended, with the final images taken in January, both the camera built for the

survey and the survey data itself will continue to yield new discoveries. [Read more in NOAO press release 19-01.](#)

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NCOA Deputy Director Beth Willman and outgoing NOAO Director David Silva addressing the audience at the NOAO Town Hall held at the January 2019 AAS meeting.

## NOAO Director David Silva to Join University of Texas at San Antonio

After 10 years of committed leadership as NOAO Director, David Silva is joining the University of Texas at San Antonio as Distinguished Professor and Dean of the College of Sciences beginning 1 March 2019.

Commenting on his long association with AURA, Silva said, "From my position as Kitt Peak National Observatory post-doc to WIYN Project Manager and then Assistant Astronomer in the US Gemini Project Office to Thirty-Meter Telescope Observatory Scientist and finally NOAO Director I grew, learned and worked with great people." He continued, "It was an honor to serve the community at large in all these roles. A new chapter begins, but I'll always be a vocal supporter of public facilities and public access, AURA's core mission."

With Silva's departure, Lori Allen will serve as Acting NOAO Director through 2019, while also continuing as Associate Director for Kitt Peak National Observatory. Adam Bolton will be the Acting NOAO Deputy Director, while also continuing as Associate Director for NOAO's Community Science and Data Center. Steve Heathcote will continue as Associate Director for NOAO South.



NOAO Acting Director Lori Allen.



## NASA Time Available on CHIRON/1.5m

Todd Henry & Steve Heathcote

Observing time for exoplanet (and other) research is again available with the CHIRON high-resolution spectrograph on the CTIO/SMARTS 1.5m telescope in the 2019B semester.

The exoplanet observing time is made available through the NASA-NSF Exoplanet Observational Research (NN-EXPLORE) Program, with TESS follow-up currently a high priority. In the 2019A semester, seven NASA programs were awarded a total of 40 nights with CHIRON, and a similar number of nights are to be awarded in the 2019B semester. An estimated 18 nights of NOAO time will also be available in 2019B for general scientific programs not limited to exoplanet science.

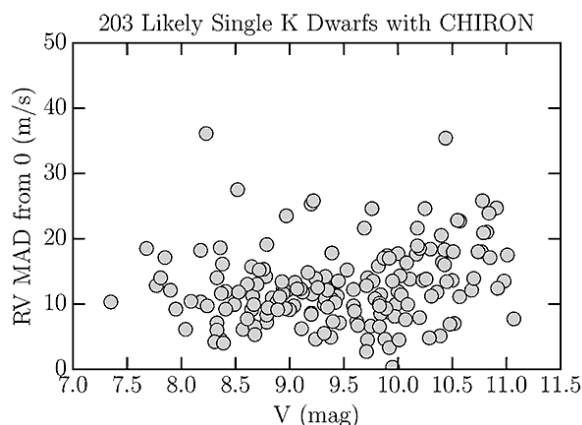
CHIRON is primarily known as a radial velocity instrument that is used to detect exoplanets, brown dwarfs, and stellar companions orbiting stars in the solar neighborhood, with a typical velocity precision of 10-30 m/s for bright stars ( $V = 7-12$ ; Figure 1). An example of the use of CHIRON for TESS follow up is the confirmation of a hot Jupiter in a 3.3-day orbit around the mildly evolved F/G star HD 202772 (Wang et al. 2019, AJ, 157, 51). Other programs that have used CHIRON to great effect include mapping the orbits of spectroscopic binaries, nightly monitoring of novae, and stellar youth and metallicity studies.

CHIRON observations are taken by SMARTS observers at the CTIO 1.5m in a queue operated by the RECONS team in Atlanta. The queue offers significant scheduling flexibility that allows a wide range of research avenues to be explored. For details about observing with CHIRON at the CTIO/SMARTS 1.5m please contact Todd Henry at [thenry@astro.gsu.edu](mailto:thenry@astro.gsu.edu).

All proposals for 1.5m time should be submitted using the standard [NOAO Observing Proposal Form](#). For time under the NN-EXPLORE program select "NASA Exoplanet TAC (WIYN 3.5m) or (CTIO 1.5m)" as the proposal type on the login page. These proposals are evaluated by a special TAC panel that also evaluates NN-EXPLORE proposals for WIYN. For regular NOAO proposals select "Standard (NOAO TAC)". These proposals are reviewed by the regular TAC panel for the corresponding area of investigation. Further information will be available in the 2019B Call for Proposals, which will be posted on the NOAO website on **1 Mar 2019**.



CTIO 1.5m in operation with CHIRON in December 2018. The Pleiades is visible above the dome, and the smudge above it is comet 46P/Wirtanen. Credit: Rodrigo Hinojosa-Goni/SMARTS.



K dwarfs within 50 pc observed by the RECONS team at the CTIO/SMARTS 1.5m with the CHIRON spectrograph. The stars have been observed on at least weekly and monthly timescales, and a few dozen on yearly timescales as well. Points indicate residual radial velocities (Mean Absolute Deviations; MADs) from a constant relative velocity. Typical residuals are 5–15 m/s for K dwarfs with  $V = 7-10$  and 10–30 m/s for those with  $V = 10-12$ . Credit: Leonardo Paredes/RECONS



## ANTARES Now Filtering and Streaming ZTF Alerts

Tom Matheson, NOAO

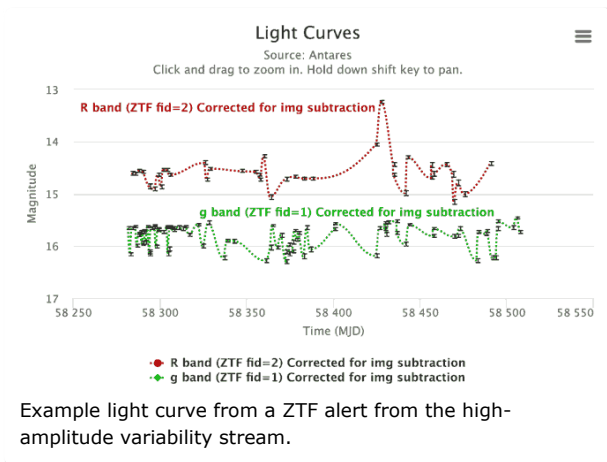
The keenly anticipated era of large-scale time-domain surveys has arrived! The Zwicky Transient Facility (ZTF) is now generating hundreds of thousands of public alerts each night. The Large Synoptic Survey Telescope (LSST), which will produce several million alerts each night over its ten-year lifetime, is rapidly approaching the beginning of commissioning and full-scale operations are just three years away. This volume of time-domain events is well beyond the capacity of individual astronomers to sort through, identify, and prioritize. As described in previous NOAO newsletters ([March 2014](#), [April 2018](#)), astronomers at NOAO and computer scientists from the University of Arizona are engaged in a collaboration to build a software infrastructure tool that will automatically process, filter, and distribute alerts from these surveys. This is the ANTARES (Arizona-NOAO Temporal Analysis and Response to Events System) project.

The ANTARES system is currently active and filtering alerts from ZTF. Once registered at the [ANTARES web site](#), users can access different streams of alerts. As of this writing, eight streams are available:

- Extragalactic
- M31
- nuclear transients (transients close to the center of a galaxy)
- high signal-to-noise ratio
- high brightness
- high amplitude
- high amplitude variable stars, and
- known Solar System objects.

The streams are available on the ANTARES web page, via a Slack channel, and through Apache Kafka streaming technology. We provide a toolkit to access these Kafka streams. In addition, users can create watch lists of objects that will provide direct notifications if the objects change enough to generate an alert.

We will continue to add capabilities. We have just deployed a development kit for filters that will enable user-supplied filters. In the immediate future, new features will include a searchable database of alerts and ingestion of alerts from time-domain surveys other than ZTF. Our main goal is to enable time-domain science for our community. If you are interested in using the system, developing filters, or engaging with us in any other way, please contact the ANTARES team at [antares\\_help@noao.edu](mailto:antares_help@noao.edu).



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## Astro2020 White Paper Coordination Hub Available

*Mark Dickinson and Joan Najita, NOAO*

To help you develop and share your Science White Papers for the 2020 Decadal Survey, NOAO has created a community coordination hub:

<https://www.noao.edu/astro2020hub/>

where you can submit topics for potential white papers, review topics suggested by others, post comments, find other people with similar interests who may want to collaborate on white papers, and provide links to completed white papers.

NOAO has a particular interest in topics for which ground-based optical-infrared (OIR) capabilities may be relevant, but this hub is open to submissions in any area of astronomy and astrophysics. We hope that you will find it useful, and we encourage you to post your white paper ideas soon, well in advance of the **11 March** submission deadline, in order to facilitate potential opportunities for collaboration and coordination.

The NOAO hub also has links to other community-based Decadal Survey resources, including [AstroSlack2020](#) (a Slack channel for Astro2020 discussion) and white paper coordination sites maintained by [NRAO](#) and the [NASA Exoplanet Exploration Program Analysis Group](#) (ExoPAG). We encourage you to use all of these resources to reach out to as broad and diverse an audience of potential white paper collaborators as possible.

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## Decadal Survey white paper – “Investing for Discovery and Sustainability in Astronomy in the 2020s”

*Joan Najita, NOAO Chief Scientist*

As the next decade approaches, it is once again time for the US astronomical community to assess its investment priorities on the ground and in space in the coming decade. In a recent white paper, created to aid NOAO in its planning for the 2020 Decadal Survey on Astronomy and Astrophysics, I offer thoughts for the coming review, based in part on the themes and messages that emerged from the 2018 NOAO Community Planning workshop “[NOAO Community Needs for Science in the 2020s](#).” The white paper, [available at NOAO](#) and [at arXiv](#), is summarized briefly below.

### Science Forecast: A Decade of Thrilling Discoveries

As described in [previous issues of Currents](#), the 2018 NOAO Community Planning workshop forecast a decade of thrilling discoveries and significant advances in our understanding of stars, exoplanets, Galactic structure and evolution, cosmology, the

solar system, the time domain Universe, and more! A more general takeaway from the workshop is that astronomy in the 2020s will be driven by diverse questions with diverse pathways to success. While future big-ticket items will continue to be important for discovery, making advances and discoveries in astronomy will not be contingent on these: a multitude of existing facilities, capably instrumented, will open new horizons, solve problems, and raise new questions.

### **Balance Investments in Large and Small Initiatives for a Sustainable Future**

The message from the workshop of “diverse pathways to success” is strongly supported by the discovery track record in astronomy over the past few decades. Discoveries have been made in diverse ways, using observing resources that range from relatively modest to state-of-the-art, with (perhaps surprisingly) relatively small aperture facilities playing the leading role in many major discoveries.

As a result, a balanced set of investments in small- to large-scale initiatives is essential to a sustainable future. While large facilities are the “value” investments that are guaranteed to produce compelling science and discoveries, smaller facilities are the “growth stocks” that are likely to deliver the biggest science bang per buck, sometimes with outsize returns. Investments in the latter category are critical because that is where growth arises reliably and at modest cost.

### **Invest in Training the Data-Capable Workforce of the Future**

Investments in data-intensive missions also have benefits to society beyond the science they deliver. By training scientists who are well equipped to use their data science skills to solve problems in the public or private sector, astronomy can provide a valuable service to society by contributing to the data-capable workforce of the future. These ideas find strong synergy in two of NSF’s “10 Big Ideas,” namely *Harnessing the Data Revolution for 21st Century Science and Engineering* and *NSF INCLUDES*.

Training data-capable scientists who are well suited to society’s future workforce needs (i.e., to employment outside of astronomy) can also lead to a more sustainable workforce flow within astronomy. In recent decades, astronomy has produced more highly trained students and postdocs than the number of available permanent positions in astronomy, a mismatch that has been a source of distress for our community. Investing in training data-capable scientists may partly resolve this mismatch.

These benefits to society and astronomy as a profession are arguably important “broader impact” considerations in prioritizing future astronomy-related investments.

For further details and a more complete discussion, please see the version (with working hyperlinks!) posted at [NOAO’s Decadal Survey page](#) or the [arXiv version of the white paper](#).



## US NGO Mini-workshop Highlights: The Resurgence of High Resolution Spectroscopy at Gemini

*Ken Hinkle, NOAO*

The US National Gemini Office (US NGO) held a workshop at the January 2019 AAS on high-resolution spectroscopy at Gemini. Historically Gemini has offered few opportunities for spectroscopy at spectral resolutions  $R > 20,000$ . This situation has reversed recently, with Gemini becoming a leader in high-resolution spectroscopy. Speakers at the workshop reviewed four of the instruments that are either now offered or are expected to join the Gemini instrument suite in the next year or two:

**GRACES:** Currently available at Gemini North, GRACES offers  $R=40,000$  or  $R=67,500$  with 420–1010 nm coverage. Due to the silver coatings on the Gemini mirrors, GRACES is faster than Keck/HIRES in the red.

**IGRINS** offers complete coverage of the K and H bands at  $R=45,000$ . IGRINS was a visitor instrument at Gemini South in 2018A and is expected to return.

**MAROON-X:** a fiber-fed optical high precision radial velocity spectrograph currently under construction, MAROON-X is expected to be offered at Gemini North in 2020A.

**GHOST:** a  $R=50,000$  or  $75,000$  facility spectrograph that will cover the 363–950 nm region, GHOST is currently under construction.

To view the workshop presentations, which provide details on these spectrographs as well as the near-IR Phoenix spectrograph and the mid-IR TEXES spectrograph, please visit <http://ast.noao.edu/csdc/usngo/mini-workshops>.

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## Helping AAS Members Help the World: a Workshop on Teaching Climate Change

*Travis Rector (University of Alaska Anchorage)*

Over seventy astronomers attended a workshop on climate change at the 233rd AAS meeting in Seattle. The purpose was to help improve the ability of astronomers to engage the topic of climate change, whether it be in introductory astronomy (i.e., “Astro 101”) courses or discussing it with the public. Simply put, climate change is now the most important science topic for astronomers to teach because it affects everyone. Its effects are already being felt, and its consequences will define the 21st century.





Fortunately astronomers are in a position to make a positive impact on people's understanding of and attitudes towards climate change. Approximately a quarter million US undergraduates enroll in introductory astronomy courses annually. For many this is their last formal science class, and therefore the last chance to teach them about this critical topic. AAS members also often engage in public outreach, e.g., through presentations in schools and planetariums. We can, and should, take this opportunity to make a difference.

The purpose of the workshop was therefore to introduce AAS members to: (1) resources that will improve their science content knowledge about climate change, (2) effective interactive and inclusive methods for teaching the topic in Astro 101 classes, and (3) established strategies for engaging the public. Climate change is a difficult topic to teach because it spans a wide range of subject areas, from physics to psychology. It is also a controversial topic, meaning that simply knowing the science content is not enough to effectively teach it. The workshop therefore focused on "climate change communication," which are strategies that help scientists better convey the science and the urgency.

The 90-minute workshop included several opportunities for participants to interact, practice communication, and develop their own climate communication strategies. The slides from the workshop can be found here:

[http://morpheus.phys.lsu.edu/~gclayton/CC\\_workshop.pptx](http://morpheus.phys.lsu.edu/~gclayton/CC_workshop.pptx)

Each slide is annotated with a description of what was discussed or done at that time. Note that these slides are not intended for actually teaching climate change, although several of the slides will be useful for that. People should feel free to use the slides as they see fit; e.g., to encourage fellow faculty to teach climate change. Questions about the workshop or the slides can be addressed to Travis Rector at: [tarector@alaska.edu](mailto:tarector@alaska.edu).

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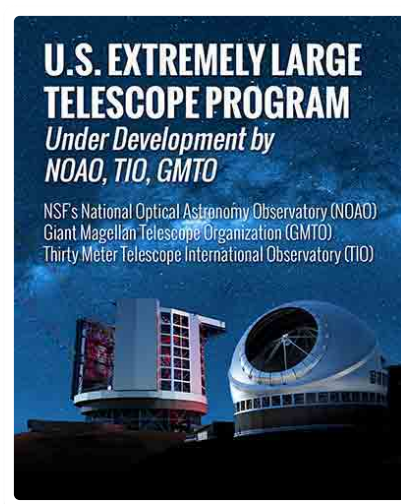
## The US Extremely Large Telescope Program at the January AAS meeting

*Mark Dickinson, NOAO*

The January 2019 AAS meeting #233 in Seattle featured two sessions devoted to the US Extremely Large Telescope Program. Presentations from these sessions are [now available at the NOAO US-ELTP web site](#).

The US ELT Program (US-ELTP) proposes national open access to at least a 25% share of observing time at both the Giant Magellan Telescope (GMT) and the Thirty Meter Telescope (TMT). This 2-telescope, 2-hemisphere system will provide unique opportunities for US research leadership in the global ELT era. The US-ELTP is being developed jointly by NOAO, TMT, and GMT for presentation to the 2020 Decadal Survey and to the National Science Foundation.

A core element of the US-ELTP is the concept of Key Science Programs (KSPs), in which tens to hundreds of nights on GMT and TMT would be dedicated to tackling astrophysical problems of fundamental importance. It is envisioned that KSP teams would involve a broad and diverse range of observers, theorists and data scientists, organized by open collaboration models, to develop and execute these research programs. More than 250



community members responded to NOAO's call to participate in KSP development, leading to at least 25 detailed KSP proposals that span a wide range of science from our solar system to the outer limits of the observable universe. The current KSP concepts are exemplars of the scientific potential of coordinated open access to both TMT and GMT. Actual, future KSPs would be proposed later when the observatories are entering their operations phases, and would be selected by peer review. Some open access observing time would also be reserved for smaller, PI-class "Discovery Science Programs" that would be responsive to new discoveries and research opportunities.

At the Seattle AAS meeting, a daytime session featured an overview of the US ELT Program presented by NOAO director David Silva, followed by six presentations with highlights from the community-developed Key Science Programs:

- Extrasolar Planets: Formation, Discovery & Characterization – Quinn Konopacky (UC San Diego) & Nikole Lewis (Cornell)
- The First Stars and the Origin of the Elements – Ian Roederer (University of Michigan)
- Origins and Fundamental Physics of Supermassive Black Holes – Jenny Greene (Princeton University)
- Dissecting Galaxy Assembly at Cosmic Noon from 1 Mpc to 100 pc Scales – Rachael Bezanson (University of Pittsburgh)
- The Nature of Dark Matter – Josh Simon (Carnegie Observatories)
- Discovery Frontiers in Time-Domain Astrophysics: Multi-Messenger Astronomy – Raffaella Margutti (Northwestern University).

These presentations demonstrated the broad range of transformational science that could be accomplished through systematic investment in large-scale, coherent GMT/TMT investigations. KSPs will also be used as guidance for investment in instrumentation development for TMT and GMT beyond the currently-planned first-light capabilities.

An evening joint Open House for GMT, TMT, and the US-ELTP was hosted by Robert Kirshner (Gordon & Betty Moore Foundation), and featured presentations by Shelley Wright (UC San Diego), project scientist for TMT's first-light Infrared Imager and Spectrometer (IRIS); by Rebecca Bernstein (GMTO/Carnegie Observatories), GMT's project scientist; and by AURA Board chairperson Debra Elmegreen (Vassar College) on behalf of the US ELT Program. These were followed by ample time for audience discussion over refreshments that were kindly sponsored by the Moore Foundation.

All presentations from both AAS sessions are [posted on NOAO's US-ELTP web pages](#).



AURA Board chairperson Debra Elmegreen (Vassar College) discusses the US ELT Program at a joint open house for GMT, TMT, and the US-ELTP at the Seattle AAS meeting. Photo credit: Michael Bolte.

# EXTREMELY BIG EYES ON THE EARLY UNIVERSE

A new series of conferences in 2019

## **Extremely Big Eyes on the Early Universe III: Rome**

*9-13 September 2019*

"[Extremely Big Eyes on the Early Universe](#)" is a three-part international conference series focusing on the capabilities of a new generation of Extremely Large Telescopes for studying galaxy formation and evolution. The first episode of Big Eyes was a smashing success, playing at UCLA from 28 January to 1 February 2019. The second episode will run at the Kavli Institute for the Physics and Mathematics of the Universe, in Tokyo, 25-29 March 2019.

[Registration and abstract submission](#) is now open for Big Eyes III, to be held in Rome, Italy, at the Accademia dei Lincei on **9-13 September 2019**.

- Abstract submission deadline: **15 April**
- Registration deadline: **15 June**

In the next decade, the commissioning of Extremely Large Telescopes (20-40m class) will allow us to see the high redshift universe using new eyes of unprecedented power. By themselves or in combination with other facilities, these new eyes will have the potential to transform our understanding of the formation and early evolution of galaxies and black holes, first light and cosmic reionization, as well as the evolution of the intergalactic and circumgalactic media.

The Big Eyes conferences will bring together an international group of experts to review the current state of the art in the study of the high redshift universe and to discuss how best to use giant telescopes to learn about it. These meetings will address the following questions:

- What potentially transformative observations will be enabled by giant telescopes? What capabilities are required?
- What are the key synergies between giant telescopes and other facilities? What are the areas and topics where a concerted effort will yield far superior results than the sum of all parts?
- What theoretical or observational work is needed in preparation for first light? What are the limitations in our understanding that need to be overcome?
- What calculations are required in order to make testable predictions and interpret the results of future astronomical observations?

It is important to consider these questions now, while the plans for giant telescopes can still be influenced, and there is still sufficient time to carry out preparatory theoretical and observational work that will be needed to make the most of the large investments in these facilities.

**For more information, please visit:**

- [Conference series](#)

- [Big Eyes III in Rome](#)

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## Contact Us

We welcome your input on this issue of *Currents*. Please contact us at [currents@noao.edu](mailto:currents@noao.edu). We look forward to hearing from you!

*Currents* is a spark plug for communication between NOAO and our community. It provides updates—and solicits community input—on NOAO observing opportunities and NOAO programs and policies on a more rapid timescale than is possible with the *NOAO Newsletter*.

NOAO is the national center for ground-based nighttime astronomy in the United States and is operated by the Association of Universities for Research in Astronomy (AURA), Inc. under cooperative agreement with the National Science Foundation.

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