

## The US Extremely Large Telescope Program

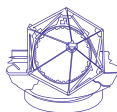
# Two Telescopes, One System

The **US Extremely Large Telescope Program** (US-ELTP) is a joint endeavor of **NSF's NOIRLab**, the US national center for optical astronomy, and the organizations building the **Giant Magellan Telescope** and the **Thirty Meter Telescope**. This powerful system will provide unique access to the entire sky with a level of precision and sensitivity never seen before, offering great synergy with other facilities in space and on the ground.



**4x** Sharper than any telescope on Earth and in space

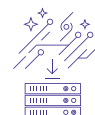
**200x** As sensitive as today's largest telescopes



**Thirty Meter Telescope**  
**30 meters**  
Main mirror made of 492 hexagonal segments



**Giant Magellan Telescope**  
**25.4 meters**  
Main mirror made of 7 round segments



**5** petabytes/yr  
Total data collected in US-ELTP Science Archive

### THE POWER OF TWO

With a combined light-gathering power greater than any other current or planned telescope, the US-ELTP will realize extraordinary scientific and societal benefits, delivering more than twice the science, twice the sky, twice the night, twice the technology, and twice the outreach of a single telescope. The combined system will provide unique access to the entire sky with a level of precision and sensitivity never seen before. The US-ELTP will maintain US astronomy leadership well into the next generation and beyond.

- **Twice the Science** – The US-ELTP will deliver significantly more scientific output than a single telescope would achieve. With twice the amount of data collected, the US-ELTP will make ground-breaking discoveries and shape our understanding of the Universe.
- **Twice the Sky Coverage** – With one telescope in the northern hemisphere and one in the southern hemisphere, the US-ELTP system will be able to observe the entire night sky with a level of clarity unrivaled by any existing telescopes on the planet. This means that researchers will be able to observe rare and interesting objects *wherever* in the sky they occur, something not possible with a single telescope.
- **Twice the Night** – The two US-ELTP telescopes are separated not only in latitude but also in longitude. When the Chilean night is ending for the Giant Magellan

Telescope, the Hawaiian night is entering its prime for the Thirty Meter Telescope. Astronomers will be able to take advantage of the extended night and be twice as likely to have a telescope in the dark when needed to rapidly follow up on a new discovery.

- **Twice the Technology** – The US-ELTP combines two sophisticated methods of making extremely large segmented mirror telescopes. Combined with state-of-the-art adaptive optics systems and a diverse suite of scientific instruments, the US-ELTP will provide a solid foundation for future technologies and technical spin-offs to come.
- **Twice the Outreach** – With engaged communities surrounding each US-ELTP telescope, there will be twice the opportunities for outreach, STEM education, and community engagement. The individual and combined efforts of the three US-ELTP partners will enable the combined team to employ a community-based model of astronomy to build deeper connections with traditionally underserved communities.

### MORE THAN TWICE THE BENEFIT

The US-ELTP enhances all these benefits by optimizing tasks, leveraging existing investments, joining forces where most needed, and achieving greater efficiency and depth than any partner could accomplish on its own.

# Transformative Science Enabled by the US-ELTP

## Worlds and Suns in Context

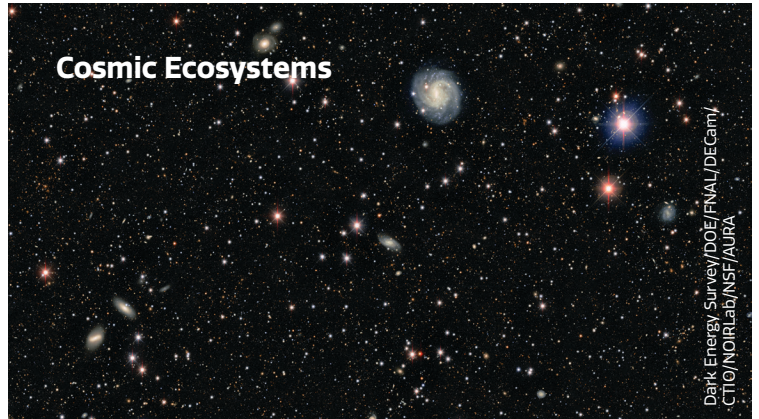


IAU/L. Calçada

### Is there life outside our Solar System?

The US-ELTP will study planets in the habitable zones around nearby stars in any part of the sky and measure atmospheric biomarkers that can indicate whether a planet harbors life.

## Cosmic Ecosystems



Dark Energy Survey/DOE/FNAL/DECam/CTIO/NOIRLab/NSF/AURA

### How did galaxies form and grow in the early Universe?

The US-ELTP will study the detailed structures and motions of galaxies 13 billion years ago, improving our understanding of the early Universe and galaxy formation during this time.

### What is the relationship between black holes and galaxies, and how do they evolve with time?

The US-ELTP will perform "galactic archeology" by identifying the oldest stars and studying their composition. Astronomers will also use the US-ELTP to search inside the oldest star clusters for intermediate-mass black holes, the missing link in our understanding of black hole growth.

## New Messengers and New Physics



NOIRLab/NSF/AURA/J. da Silva/Spaceengine

### What are gravitational waves telling us about the nature and structure of the Universe?

Mergers of black holes and neutron stars will produce gravitational waves, and US-ELTP optical and infrared observations of the aftermath of such mergers will help answer fundamental questions about gravity and the nature of matter in extreme environments.

### What is the nature of the Universe?

More than 95% of the Universe is composed of dark matter and dark energy that remain poorly understood. Unique measurements of cosmic expansion by the US-ELTP system will lead to a better understanding of their properties and true nature.

## Unexpected Discoveries Anywhere in the Sky



International Gemini Observatory/NOIRLab/NSF/AURA/M. Zamani, J. da Silva

### What else is out there?

The US-ELTP will allow US astronomers to make unexpected and surprising discoveries in both the northern and southern skies, opening new avenues of inquiry. The Universe never fails to astonish!