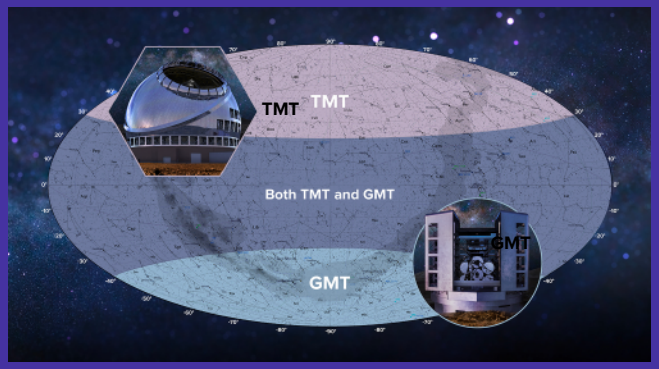
Finding the Ideal Ground-Based Telescope Location

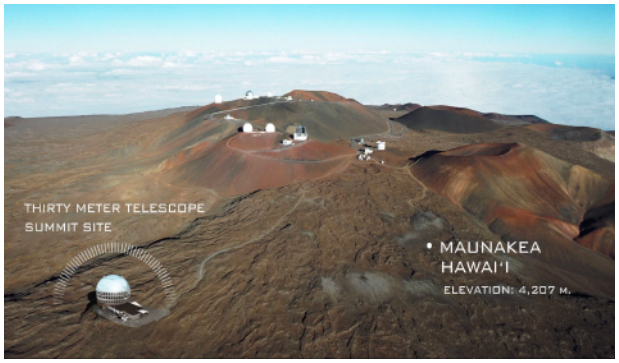
US EXTREMELY LARGE TELESCOPE PROGRAM

TMT
THIRTY METER TELESCOPE

NOIR Lab

GIANT MAGELLAN TELESCOPE





Finding the Ideal Ground-Based Telescope Location

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 two of the next generation of extremely large telescopes, the Giant Magellan Telescope and the Thirty Meter Telescope. This collaboration will lead to revolutionary astronomical discoveries and provide full-sky access to all US astronomers. With mirror diameters between 25.4 and 30 meters (roughly the size of the grass and dirt baseball infield), these telescopes each gather more light than the world's current 10 largest optical telescopes combined.

Dual-Hemisphere System

With the Giant Magellan Telescope's location in Las Campanas, Chile, able to observe the southern sky, and the Thirty Meter Telescope's preferred location on Maunakea, Hawai'i, observing the northern sky, the two telescopes will work as a dual-hemisphere system that will permit astronomers to study objects anywhere in the sky. There is more than 50% sky overlap between the two sites, meaning many objects will be observable for an extended period of time starting at nightfall in Chile and ending at dawn in Hawai'i. With astronomy entering a new domain of quick observation and identification of moving or changing objects, the full-sky coverage provided by the telescopes will enable observations of the rarest, most unusual, and scientifically valuable targets.

Selecting the Ideal Location

Many factors come into play when determining a location for future ground-based telescopes. Ideal locations have dry, stable climates and are in coastal mountain ranges away from city lights. Dry areas with few clouds are optimal for observations as clouds can scatter and dim starlight. In addition to the unobstructed views offered by a mountaintop location, high altitudes produce better image quality thanks to the thin, dry, and steady air.

Giant Magellan Telescope's Location

Las Campanas, Chile, was selected for the location of the Giant Magellan Telescope, based on the exquisite conditions in the Atacama Desert (the world's driest non-polar desert). The site offers over 300 nights per year of clear skies, an altitude of 2514 meters (over 8200 feet), and a distance of 160 kilometers (100 miles) from the lights of La Serena, the nearest city center. Beyond the superb atmospheric conditions, Las Campanas provides the Giant Magellan Telescope and the US-ELTP with an environment to foster valuable relationships between existing telescopes, international partnerships, and local communities.

Thirty Meter Telescope's Location

Maunakea was selected as the preferred location for the Thirty Meter Telescope based on its stable and dry climate, high-altitude site location of 4050 meters (over 13,200 feet), and clear skies, providing optimal conditions for operating **adaptive optics** systems on an extremely large telescope. Maunakea is an important cultural and genealogical site and is considered sacred by many Native Hawaiians. The Thirty Meter Telescope project reflects this importance by working directly with Native Hawaiian and other community members to support their discussions on the future of Maunakea and contribute to a better future for everyone in Hawai'i. The observatory supports a community collaboration model of astronomy that upholds the values of respect, inclusion, and community stewardship. The Thirty Meter Telescope and the US-ELTP recognize that the future of the telescope on Maunakea rests with the Hawai'i and Native Hawaiian communities.

The Power of the Combined System

Observations with the US-ELTP's advanced facilities will help unravel some of the Universe's biggest mysteries. The stable atmospheric conditions at the two US-ELTP sites will result in observations of the highest sensitivity and precision, enabling scientists to peer deep into the Universe to observe some of the first galaxies that formed and help us develop a better understanding of the past and future of our Milky Way and the Universe. With full-sky coverage, excellent sites, and adaptive optics, the US-ELTP telescopes will set a standard for ground and space-based observatories, complementing and supporting the capabilities of the *Hubble Space Telescope*, the *James Webb Space Telescope,* and *Vera C. Rubin Observatory.*

Vocabulary

Adaptive Optics — Adaptive optics uses nearby bright stars or artificial stars to correct for atmospheric blurring. Adaptive optics systems use special sensors to measure the distortion caused by the atmosphere and deformable mirrors to correct it.

About the Images

Front: Artists' renderings of the Thirty Meter Telescope (left) and the Giant Magellan Telescope (right). *Credit: US-ELTP/NOIRLab/GMT/TMT*

Back: (Left) A map representing the all-sky coverage provided by the Giant Magellan Telescope in the south and the Thirty Meter telescope in the north. This includes the region of the sky (dark purple) visible to both telescopes. (Center) Site location for the Giant Magellan Telescope at Las Campanas, Chile. (Right) The Thirty Meter Telescope preferred site location on Maunakea, Hawai'i. *Credits (left to right): NOIRLab; GMTO Corporation; TMT International Observatory*

For more information, visit us at useltp.org