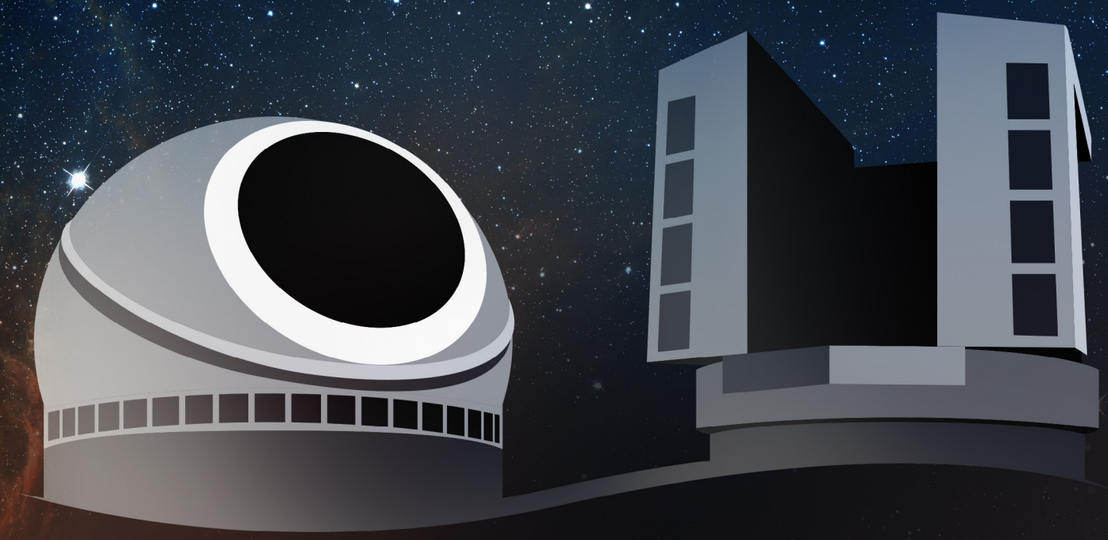
U.S. EXTREMELY LARGE TELESCOPE PROGRAM

The US Extremely Large Telescope Program has been formed by the Association of Universities for Research in Astronomy (AURA) and the organizations building the Thirty Meter Telescope and the Giant Magellan Telescope. The goal of this program is to complete both telescopes and to secure sufficient federal funding to make at least 25 percent of the observing time available for open access by the whole US community. The two-hemisphere system will provide the US science community with greater and more diverse research opportunities than can be achieved with a single telescope. To facilitate access to the telescopes and the data that they deliver, NSF's NOIRLab will provide an extensive suite of user services, documentation, and training to support the entire observing process from submission of proposals to analysis of the data.



U.S. EXTREMELY LARGE TELESCOPE PROGRAM

NOIR Lab

TMT
THIRTY METER TELESCOPE

GIANT MAGELLAN TELESCOPE

NOIR Lab

TMT
THIRTY METER TELESCOPE

GIANT MAGELLAN TELESCOPE

ENGINES OF DISCOVERY

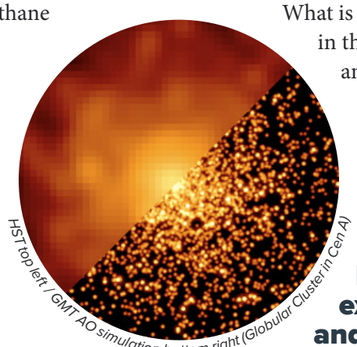
Do rocky planets in the habitable zone have atmospheres like that of Earth?

Spectroscopy will test for a combination of molecular oxygen (O_2), water (H_2O), ozone (O_3), methane (CH_4), and carbon dioxide (CO_2) as habitability indicators.

Is dark matter cold and collisionless?

Two tests:

- 3-D stellar velocities within dark-matter-dominated dwarf galaxies will determine the inner slope of the dark matter density profile.



- Strong gravitational lensing of galaxies will determine the free streaming length and self-interaction cross section of dark matter by measuring the abundance and concentration of halos over the mass range $10^7 < M < 10^{10}$ $M_\odot$, independent of the baryonic content.

How did the flow of gas in and out of young galaxies at cosmic noon shape the development of today's mature galaxies?

Observations of detailed structure within z~2 galaxies at 100 pc resolution, combined with measurements of gas in absorption against background galaxies, will trace inflow from the intergalactic medium (IGM) on Mpc scales, through the circumgalactic medium (CGM) on 100 kpc scales, into giant star formation regions on 100 pc scales, and outflow back to the CGM and IGM.

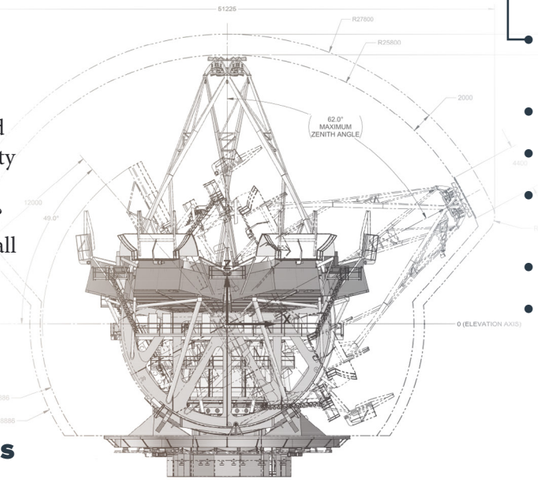
What are the fundamental physics and astrophysics responsible for neutron stars and black holes?

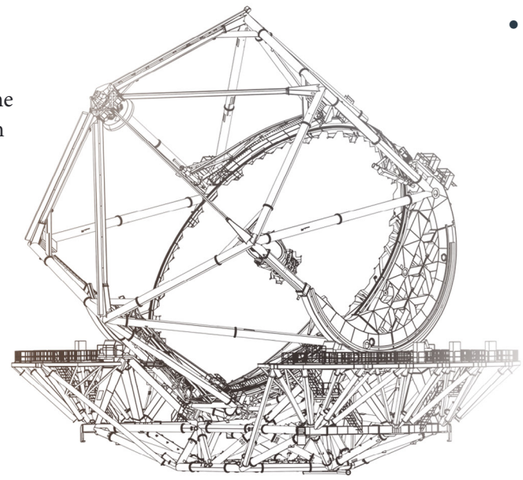
What is the equation of state of dense matter found in the cores of neutron stars? Is general relativity an accurate description of gravity around stellar-mass and supermassive black holes? How do neutron stars and black holes of all masses form, evolve, and influence their environment?

Does the discrepancy between the rates of cosmic expansion derived from early- and late-universe measurements signal new physics?

Angular resolution and sensitivity will enable three independent techniques for measuring the Hubble Constant (H_0):

- **Standard Candles:** Eclipsing binaries throughout the Local Group and infrared tip of the red giant branch stars to 100 Mpc, i.e., well into the Hubble flow.
- **Standard Clocks:** Gravitational lensing time-delay cosmography through the use of multiply imaged quasars and Type Ia supernovae.
- **Standard Sirens:** Gravitational wave signals combined with spectroscopic redshifts and photometric and spectroscopic measurements of kilonovae.





EMPOWERING THE U.S. COMMUNITY

- At least 25% of the observing time on each telescope available through competitive peer review independent of institutional affiliation
- All-sky coverage
- Instruments for optical/infrared imaging and spectroscopy
- Adaptive optics to achieve resolutions on the order of 8 milliarcsec at 1 micron
- Queue observing to match programs to atmospheric conditions
- Support for
  - Key Science Programs that require substantial commitments of observing time
  - Discovery Science Programs that can respond agilely to new ideas
  - Targets of Opportunity with rapid response to observe transients discovered by LSST, gravitational wave events, etc.
- Access to
  - All data obtained with TMT and GMT after an 18-month proprietary period
  - An integrated archive that contains not only TMT and GMT data but also LSST and other survey data to enable putting observations in context
  - Pipeline-processed data and configurable pipelines
  - Science-ready data products
  - Documentation and training materials to enable researchers to prepare competitive observing proposals and/or work with archived data

https://noirlab.edu/public/projects/useltp