US-ELTP User Services: Enabling Transformational Community Research

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TMT THIRTY METER TELESCOPE

NOIR Lab

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Guiding principles for the US ELT Program

- Enable **transformational science** through US access to a bi-hemispheric ELT system
- Enable and support large-scale, systematic, collaborative research (**Key Science Programs**)
- Provide **outstanding user support** commensurate with the proposed US-ELTP investment
- **Broaden participation in TMT/GMT science** and foster research inclusivity
- **Engage and represent the whole US community** in GMT and TMT governance, scientific planning, and instrumentation development

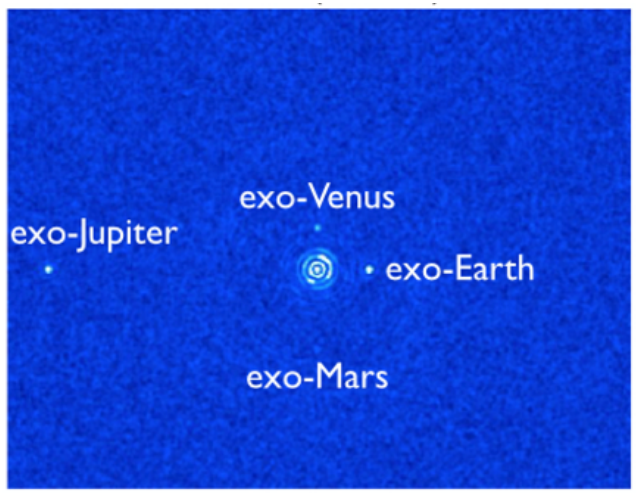
All US astronomers should benefit from national participation in a US ELT Program

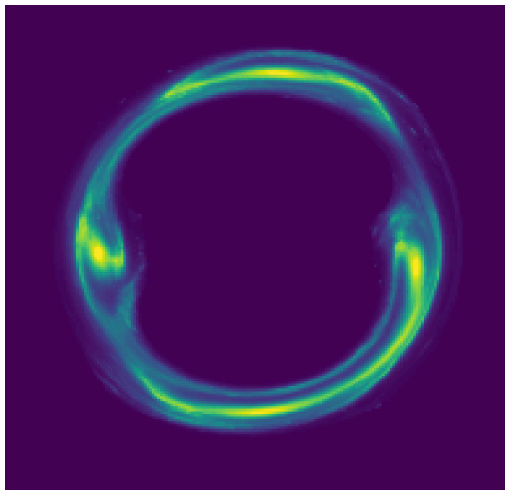
Key Science Programs (KSPs)

- **Scientific legacy** through systematic investment in **large-scale, transformative research** using TMT and GMT
- Projects on scales difficult to realize within current GMT/TMT partner shares
  - The US national community will have the largest partner share in these observatories
- At least half of US-ELTP observing time will be devoted to **Key Science Programs**
  - ≥ 80 nights/year for GMT+TMT combined
- Broad, inclusive scientist participation in KSPs via open collaboration models
  - Harness resources of a diverse research community
  - Spread scientific benefits widely through the community
- Data products with high archival reuse value
- Also, observing time for smaller, PI-class **Discovery Science Programs**
  - Nimble, responsive to new discoveries, new opportunities, new ideas

Highlights of community-developed KSP concepts

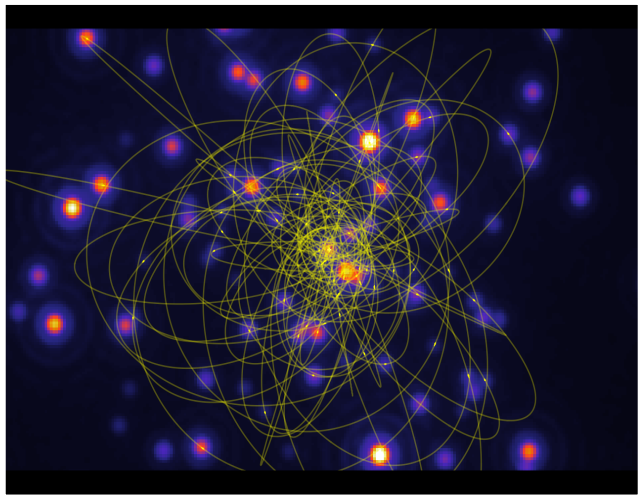
Extrasolar Planets and the Search for Extraterrestrial Life

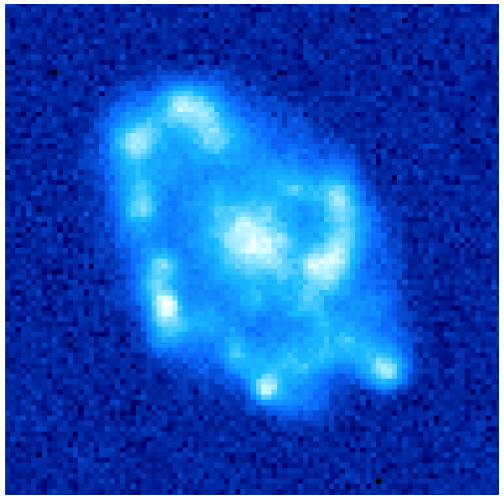




The Dark Universe and Physics Beyond the Standard Model

Extreme Gravity: from Gravitational Waves to Supermassive Black Holes





Resolving the Physics of Galaxy Evolution

+ Solar System, Stars & Stellar Evolution, Explosive Transients, and more

Actual, future KSPs would be selected by peer-review

NOIRLab will provide end-to-end user support

NOIRLab US-ELTP services	NOIRLab precursors
Observing Time Allocation	NOIRLab Time Allocation
Observation Management	Gemini Program Platform (GPP)
Queue scheduling system	Gemini automated scheduler
Data Management and Archiving	NOIRLab and Gemini Data Archives
Data Reduction and Calibration	CTIO/KPNO wide field imager pipelines; Rubin DM
Data Analysis Tools	Astro Data Lab; Rubin Science Platform
Documentation, Training, and Help Desks	Documentation & help desks

- User support tools will be available to the US national community and to TMT and GMT partners

Observing Time Allocation

TMT and GMT will be open to any US astronomer with a great idea

- Apply for either or both TMT and GMT, and for other telescopes offered through NOIRLab, through a single proposal process
- Peer-review process designed to mitigate conflicts of interest and implicit bias
- PI-class **Discovery Science Programs** and large-scale **Key Science Programs**
- Track projects from proposal submission to publication to archival data products
- Community engagement to support development of Key Science Programs and organization of broad, inclusive research teams

Observation Management

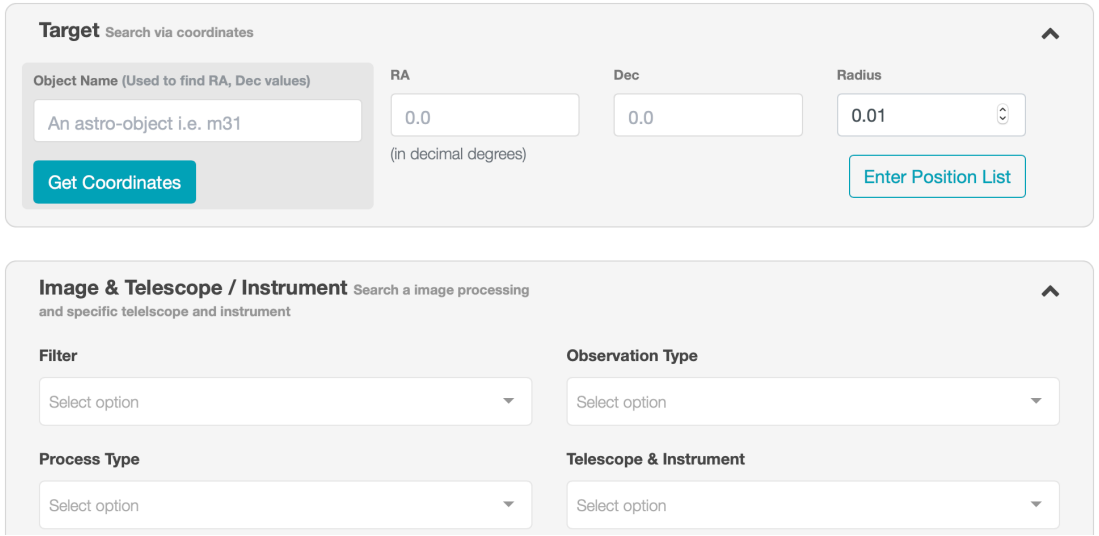
Uniform community interfaces for GMT and TMT

- Phase I (proposal) and Phase II (observation preparation) systems
  - Integrate tools to evaluate exposure time, identify guide stars, etc.
  - Designed to support and assist new users, not just insiders/experts
- Dynamic/adaptive scheduling system for TMT and GMT
  - Accommodate queue/service and classical/visitor modes (+ other modes as required)
  - Assemble observations into prioritized queue based on target visibility, atmospheric conditions, timing constraints, instrument availability, etc.
  - Flexible and responsive to changing conditions and constraints
  - Accommodate interrupts (ToOs, etc.)
  - Enable coordinated observations (TMT+GMT, or with other NOIRLab telescopes)

Data Management and Archiving

All TMT/GMT data will be archived and available for US community research

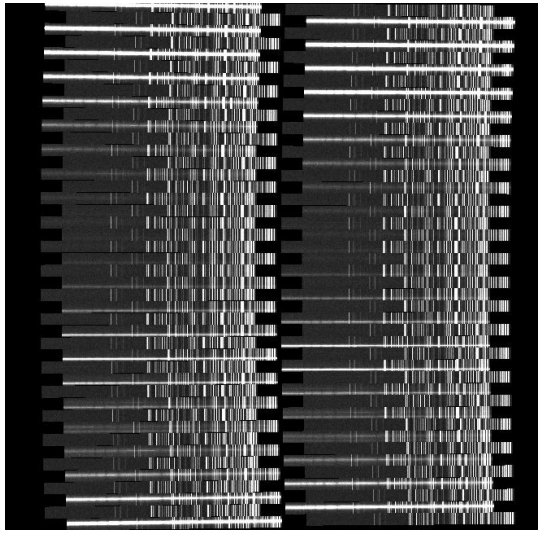
- Data transfer, archiving, and distribution for all GMT and TMT observing time
  - Raw, calibrated, and reduced data
  - High-level science products from Key Science Programs
  - Full implementation of proprietary controls
  - Public discoverability and accessibility after proprietary period
  - Long-term archiving and stewardship
- Integration with other systems
  - TMT & GMT data management systems
  - Automated calibration and pipeline execution
  - US-ELTP Data Science Suite
  - DOI generation and publication tracking

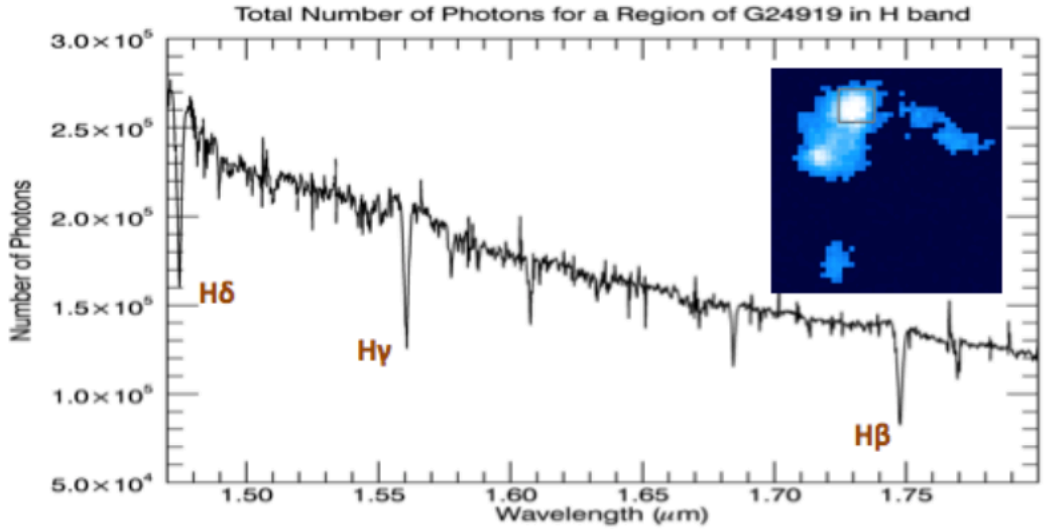


Data Reduction and Calibration

Removing barriers for carrying out research with TMT/GMT data

- Pipelines will be provided by instrument teams and deployed in NOIRLab environment
- NOIRLab will operate pipelines to produce and archive reduced/calibrated data products
- External users can also access and operate pipelines on the NOIRLab platform
- NOIRLab will collaborate with GMT/TMT teams and community on further evolution of pipelines

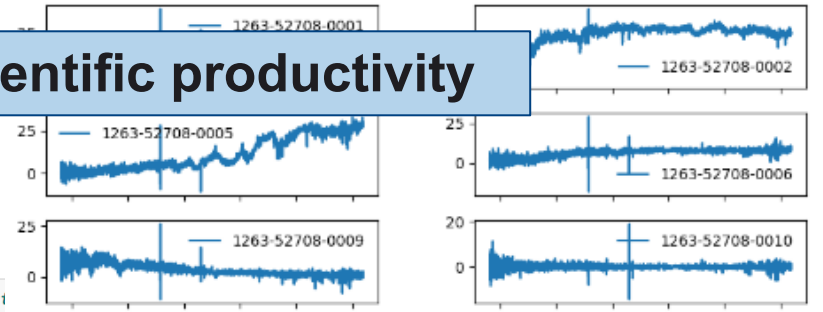




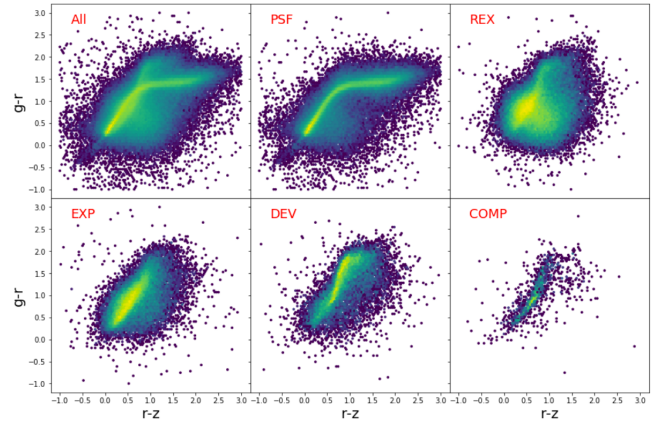
Data Analysis Tools

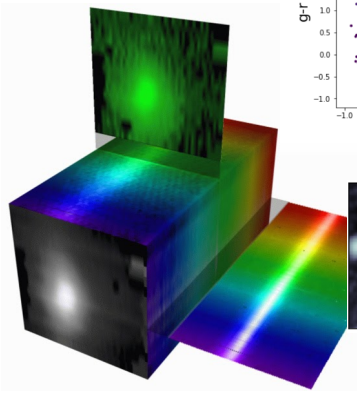
Outstanding support for data analysis enhances scientific productivity

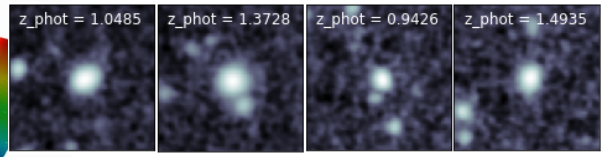
- High-level data visualization and analysis tools
- Interactive notebook and/or login environments
- Common astronomy software stack available to users
- Catalog query capabilities
- Support for multi-user collaboration
- User-driven data publication capabilities
- Integration with other NOIRLab data holdings and services




```
In [6]: # Select range of int
thres = 5.   #threshold value for S/N (here, making it more stringent than query)
keep = (result['snr_g']>thres)&(result['snr_r']>thres)&(result['snr_z']>thres)

# Colors
g_r   = result['gmag'][keep] - result['rmag'][keep]
r_z   = result['rmag'][keep] - res
z_w1  = result['zmag'][keep] - res

len(g_r)

# Classification per object type
objtype = result['type'][keep]
```







Supporting US astronomers in the global ELT era

- US community access to forefront, bi-hemispheric OIR observatories has been central to the National Observatory's mission for more than 50 years
- US-ELTP user support services will build from decades of experience at NOIRLab
- Outstanding user support from proposal to publication enhances scientific productivity
- The US ELT Program will carry these principles into the global ELT era:
  - Access for all US astronomers
  - Minimize barriers for community use of telescopes and their data
  - Broaden participation in frontier US-ELTP research

Stay tuned!

This year, we will be asking for **your input** on use cases and science requirements for US-ELTP user support services.


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