

Gemini Capabilities 2024



noirlab.edu/gemini-caps-pdf

Credit: (Top) International Gemini Observatory/NOIRLab/NSF/AURA/B. Cooper
(Bottom) International Gemini Observatory/NOIRLab/NSF/AURA/M. Paredes

International Gemini Observatory Capabilities

NORTH

Gemini Near-InfraRed Spectrograph ([GNIRS](#))

- **Facility:** Gemini North
- **Type:** Near-infrared (0.8–5.4 μm) long-slit, cross-dispersed and integral field spectroscopy
- **What:**
 - Spectral Resolution (long-slit mode): R –1200–18,000.
 - **Cross-dispersed spectroscopy**
 - Wavelength Coverage: 0.8–2.5 μm .
 - Spectral Resolution: R –1700.
 - Partial coverage at R –5900.
 - **Integral field unit**
 - Low-resolution IFU (ALTAIR-compatible): 4.80 arcsec \times 3.15 arcsec FoV, R –1700/7200.
 - High-resolution IFU (ALTAIR-optimized): 1.25 arcsec \times 1.80 arcsec FoV, R –5000/18000 (expected to complete commissioning in 2024).
 - 'Keyhole' imaging mode with a 0.1–0.35 arcmin² field of view (varies with filter/camera choice).

ALtitude conjugate Adaptive optics for the InfraRed ([ALTAIR](#))

- **Facility:** Gemini North
- **Type:** Adaptive optics system
- **What:**
 - Used in conjunction with GNIRS.
 - Natural Guide Star mode: FWHM \sim 0.07 arcsec with Strehl ratios up to 40%.
 - Laser Guide Star mode: FWHM \sim 0.08 arcsec with Strehl ratios up to 20%.
 - 'Super Seeing' mode: Nearly full sky coverage yields FWHM \sim 0.3 arcsec.

Immersion GRating INfrared Spectrograph 2 ([IGRINS-2](#))

- **Facility:** Gemini North
- **Type:** Near-infrared (1.49–2.46 μm) long-slit and cross-dispersed spectroscopy
- **What:**
 - H & K simultaneous observations.
 - Compact design with no moving parts, fixed spectral format.
 - Wavelength Coverage: 1.49–1.80 μm (H -band), 1.96–2.46 μm (K -band).
 - Spectral Resolution: R –40,000.
 - Based on IGRINS visiting instrument at Gemini South.
- To be offered to the community in late 2024 after finishing on-sky testing and system verification.

Gemini Multi-Object Spectrograph, North and South ([GMOS-N & GMOS-S](#))

- **Facility:** Gemini North and Gemini South
- **Type:** Spectrograph
- **What:**
 - Broad- (u' , g' , r' , i' and z' Sloan) and narrow-band optical imaging.
 - FoV: 5.5 arcmin \times 5.5 arcmin.
 - Long-slit, multi-object and integral field spectroscopy 0.36–1.03 μm .
 - Integral field spectroscopy.
 - FoV: 5 arcsec \times 7 arcsec or 5 arcsec \times 3.5 arcsec.
 - Nod and Shuffle spectroscopic mode (all modes, including IFU for GMOS-S).
 - Spectral Resolution: R –150–8700 in 1st order, up to R –12,000 with some gratings in the second order. New B480 grating with balanced sensitivity across the 0.4–0.9 μm interval.

Gemini Multi-Conjugate Adaptive Optics System (GeMS)

- **Facility:** Gemini North
- **Type:** Multi-Conjugate Adaptive Optics System
- **What:**
 - Multi-conjugate adaptive optics system uses two deformable mirrors, five laser guide stars, and three natural guide stars.
 - Strehl ratios up to 30% in *K* band.
 - Spectral Resolution: up to FWHM ~ 0.06 arcsec.
 - FoV: 85 arcsec \times 85 arcsec.
- Currently used with GSAOI; other instruments (FLAMINGOS-2 and GMOS-S) under development.

Gemini High-Resolution Optical Spectrograph (GHOST)

- **Facility:** Gemini South
- **Type:** Fiber-fed, echelle optical spectrograph
- **What:**
 - Two-target simultaneous spectroscopy.
 - FoV: 7.5 arcmin field.
 - Spectral Resolution: $R \sim 50,000$.
 - Single-target spectroscopy
 - Spectral Resolution: $R \sim 75,000$.
 - Simultaneous Wavelength Coverage: 0.36–0.95 μm .
 - PRV accuracy down to $\sim 10 \text{ m s}^{-1}$ within 0.43–0.75 μm .
- First full semester 2024A.

FLAMINGOS-2

- **Facility:** Gemini South
- **Type:** Near-infrared imager and multi-object spectrograph
- **What:**
 - Near-infrared imager.
 - Filters: *J_low*, *J*, *H*, *Ks*, *K_blue*, *K_red*.
 - Wavelength Coverage (spectroscopy): 0.9–2.4 μm .
 - Spectral Resolution: $R \sim 300\text{--}4500$.
 - FoV: 6.1 arcmin diameter.
 - Multi-object spectroscopy.
 - FoV: 2 arcmin \times 6 arcmin.
 - Maximum of 72 or 153 slits depending on sky-subtraction strategy.

Gemini South Adaptive Optics Imager (GSAOI)

- **Facility:** Gemini South
- **Type:** Near-infrared imager
- **What:**
 - Used with GeMS
 - 6 broadband and 16 narrowband filters.
 - Wavelength Coverage: 0.9–2.5 μm .
 - Filters: *Z*, *J*, *H*, *Ks*, *K'*, *K*, *CH₄* (*short and long*), *He I*, *He I (2p2s)*, *Paschen- γ* , *Paschen- β* , *Brackett- γ* , *[FeII]*, *H₂O*, *H₂ 1-0 S(1) & 2-1 S(1)*, *CO $\Delta v=2$* , *J*, *H*, *K* short & long continuum.
 - Near diffraction-limited imaging in the *K* band.
 - FoV: 85 arcsec \times 85 arcsec, sampling 20 milliarcsec.

Learn more about Gemini's observing modes at:
<https://www.gemini.edu/observing/start-here>

Gemini Visiting Instruments

Immersion GRating INfrared Spectrometer (IGRINS)

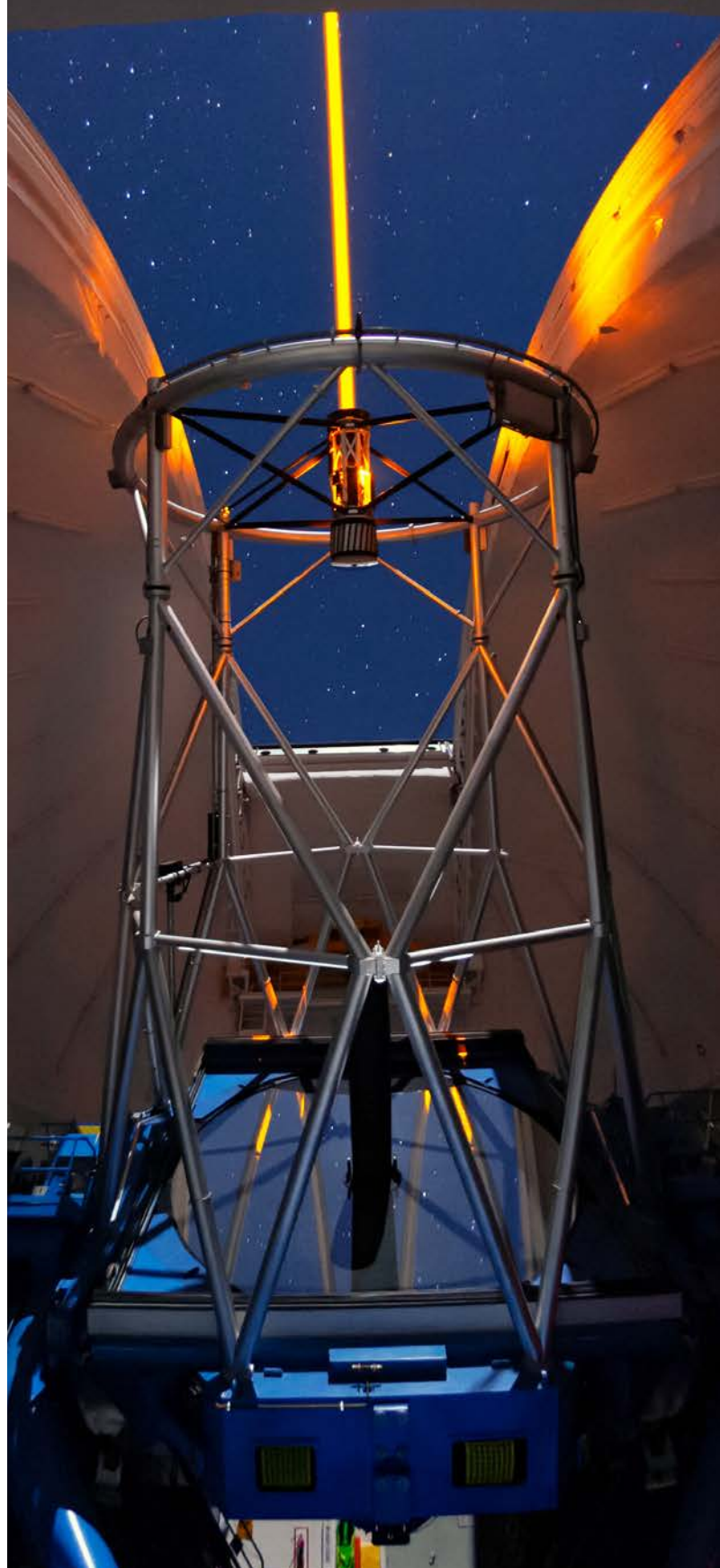
- **Facility:** Gemini South
- **Type:** Visiting instrument: Near-infrared spectrograph
- **What:**
 - *H* & *K* simultaneous observations.
 - Compact design with no moving parts, fixed spectral format.
 - Wavelength Coverage: 1.45–2.45 μm (continuous).
 - Spectral Resolution: $R \sim 45,000$.
- Offered only until April or early May 2024

'Alopeke & Zorro

- **Facility:** Gemini North and South
- **Type:** Visiting instrument: Speckle Imager
- **What:**
 - Dual-band optical-wavelength instruments for speckle or fast natural-seeing imaging at both sites.
 - Speckle mode:
 - Provides diffraction-limited (~ 0.02 arcsec at 650 nm) imaging of targets as faint as $V \sim 18$.
 - FoV: 2.5 arcsec.
 - Natural-seeing mode:
 - Exposure Time: as short as ~ 0.01 second.
 - FoV: ~ 35 arcsec.

MAROON-X

- **Facility:** Gemini South
- **Type:** Visiting instrument: high-resolution optical spectrograph
- **What:**
 - Optimized for precise radial velocity measurements.
 - Wavelength Coverage: 0.5–0.92 μm (continuous).
 - Spectral Resolution: $R \sim 82,000$ –88,000.
 - Radial Velocity Precision: ~ 10 cm s^{-1} .



Gemini Planet Imager-2 (GPI-2)

Note: GPI is the Gemini Planet Imager for extreme AO with coronagraphic integral-field spectroscopy and polarimetry. It provides diffraction-limited NIR images over a 2.8 arcsec \times 2.8 arcsec FoV with contrast of $\sim 10^{-5}$ at 0.4 arcsec radius. It is in the process of being upgraded and is scheduled to commission at Gemini North in 2025.

Gemini Science Flexibility

In addition to standard observing modes (classical, queue, Director's Discretionary Time), Gemini offers proposal modes that enable science programs requiring both more rapid and longer execution timescales.

Gemini Fast Turnaround Programs

Around ten percent of the time on each telescope is allocated via the innovative Fast Turnaround program, which accepts new proposals every month from participating partners. Proposals are reviewed by other proposers during that round. PIs are notified within three weeks of the outcome, and accepted programs are observed within one to four months. Graduate students may review proposals with a PhD PI or Co-I designated as a 'mentor', giving them valuable early insight into science peer review.

<https://www.gemini.edu/observing/phase-i/ft>

Gemini Large and Long Programs

Large and Long Programs (LLPs) occupy up to 20% of Gemini observing time of the participating partners (United States and Canada). LLPs require significantly more time than is typically approved for a single program, or extend over multiple semesters, or both. The annual announcement of opportunity is issued late each year, with Letters of Intent due in early February and a proposal deadline in early April. Observations begin in the subsequent B semester.

<https://www.gemini.edu/observing/phase-i/llp>

Gemini Priority Visitor Observing Mode

Priority Visitor (PV) observing mode allows PIs (or team members) to visit Gemini for a period during which they observe their program if the conditions are as good as (or better than) required, and other approved queue programs if not. Any unobserved portions of the PI's program can then be executed within the regular queue. PV mode is the default for Band 1 LLPs and may also be requested by other PIs.

<https://www.gemini.edu/observing/phase-i/pv>

Gemini Targets of Opportunity (ToOs)

Gemini provides ToO modes for the time domain, and for follow-up of ongoing surveys. For the most urgent time-domain targets, Gemini interrupts the ongoing queue to execute observations triggered either manually by the PI or programmatically via an application programming interface (API). The shortest reaction times to a ToO yield a timescale of three to five minutes for starting the requested imaging or spectroscopy. The DRAGONS real-time, quick-look pipeline will reduce imaging and GMOS long-slit spectroscopy data and upload them to the International Gemini Observatory Archive upon completion of the observations.

<https://www.gemini.edu/observing/phase-i/too>

Gemini Remote Eavesdropping

Remote eavesdropping allows a PI to remotely monitor data-taking on their program, while observations are carried out by the Gemini night staff. PIs sign up for particular dates in advance, and, depending on the circumstances, we may call the PI if and when we're about to start observations.

<https://www.gemini.edu/observing/phase-i/eavesdropping>

Gemini Welcomes Visiting Instruments


Visiting Instruments expand the capabilities we offer to all users. Outstanding results have been produced by instruments such as GRACES, 'Alopeke, Zorro, MAROON-X and IGRINS. If you have an instrument you would like to bring to Gemini, contact us at

gemini-vip@gemini.edu

The International Gemini Observatory is a facility of NSF, NRC–Canada, ANID–Chile, MCTIC–Brazil, MINCyT–Argentina, and KASI–Republic of Korea. It is operated by NSF’s NOIRLab.


 <https://www.gemini.edu/observing/start-here>

 gemini@noirlab.edu

 +1 520 318 8000



@NOIRLabAstro
@NOIRLabAstroES

 NOIRLab HQ
950 N Cherry Ave,
Tucson, AZ 85719
USA