International Gemini Observatory Capabilities

Gemini Near–InfraRed Spectrograph (GNIRS)
- **Facility:** Gemini North
- **Type:** Near-infrared (0.8–5.4 µm) long-slit and cross-dispersed spectroscopy
- **What:**
  - Spectral Resolution (long-slit mode): \( R \sim 1200–18,000 \) in long-slit mode.
  - Cross-dispersed spectroscopy
    - Wavelength Coverage: 0.8–2.5 µm.
    - Spectral Resolution: \( R \sim 1700 \).
    - Partial coverage at higher resolution.
  - Integral field unit (replacing NIFS capabilities in late 2023)
    - FoV (natural seeing): 5 arcsec \( \times \) 3 arcsec (\( R \sim 1700/6000 \)).
    - FoV (with ALTAIR): 1 arcsec \( \times \) 1.5 arcsec (\( R \sim 5000/18000 \), anticipated early 2023, to replace NIFS IFU).

Near–Infrared Imager (NIRI)
- **Facility:** Gemini North
- **Type:** Near-infrared imager
- **What:**
  - Three cameras giving different FoV and pixel scales.
  - FoV: 22 arcsec \( \times \) 22 arcsec, 51 arcsec \( \times \) 51 arcsec, or 120 arcsec \( \times \) 120 arcsec.
  - Wavelength Coverage: 1–5 µm.
  - Spectral Resolution (with ALTAIR): \( R \sim 0.08 \) arcsec at 2.2 µm.
  - 8 broad-band and 21 narrow-band filters.

Near–Infrared Integral Field Spectrograph (NIFS)
- **Facility:** Gemini North
- **Type:** Near-infrared integral field spectrograph and coronagraphic imager
- **What:**
  - Spatially-resolved spectroscopy on 0.15-arcsec scales with Altair adaptive optics system.
  - Wavelength Coverage: 0.95–2.4 µm.
  - Spectral Resolution: \( R \sim 5000–6000 \).
  - FoV: 3 arcsec \( \times \) 3 arcsec.
  - Final planned full semester at Gemini-N: 2023A.

ALTitude conjugate Adaptive optics for the InfraRed (ALTAIR)
- **Facility:** Gemini North
- **Type:** Adaptive optics system
- **What:**
  - Used in conjunction with GNIRS, NIFS, or NIRI.
  - 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.

Learn more about Gemini’s observing modes at: [https://www.gemini.edu/observing/start-here](https://www.gemini.edu/observing/start-here)
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 × 5.5 arcmin.
  - Long-slit, multi-object and integral field spectroscopy 0.36–103 μm.
  - Integral field spectroscopy.
  - FoV: 5 arcsec × 7 arcsec or 5 arcsec × 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 available in 2023 with balanced sensitivity across the 0.4 –0.9 μm interval.

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~50,000.
  - Single-target spectroscopy
  - Spectral Resolution: R~75,000.
  - Simultaneous Wavelength Coverage: 0.36–0.95 μm.
  - PRV accuracy down to ~10 m s⁻¹ within 0.43–0.75 μm.
  - To be offered for community science in 2023.

Gemini Capabilities 2023
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:** $R$~45,000.

**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:** $R$~82,000–88,000.
  - **Radial Velocity Precision:** ~10 cm s$^{-1}$.

**‘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 $V$~18.
    - **FoV:** 2.5 arcsec.
  - Natural-seeing mode:
    - **Exposure Time:** as short as ~0.01 second.
    - **FoV:** ~35 arcsec.

**Gemini Remote Access to CFHT ESPaDOnS Spectrograph (GRACES)**
- **Facility:** Gemini South
- **Type:** Visiting instrument: high-resolution optical spectrograph
- **What:**
  - 270-m optical fibers feeding a spectrograph at the CFHT Telescope.
  - **Wavelength Coverage:** 0.4–1.0 µm (continuous).
  - **Spectral Resolution:** $R$~40,000–60,000.
  - Final planned full semester at Gemini-N: 2023A.

**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 × 2.8 arcsec FoV with contrast of ~ $10^{-5}$ at 0.4 arcsec radius. It is in the process of being upgraded and is scheduled to commission at Gemini North in 2024.
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](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](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](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](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](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](mailto: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.