**Gemini Multi-Object Spectrograph, North and South**

**GMOS-N & -S**
- Broad- \((u', g', r', i'\text{ and } z'\text{ Sloan})\) and narrow-band optical imaging with a \(5.5' \times 5.5'\) FoV
- Long slit, multi-object and integral field spectroscopy \(0.36-1.03\ \mu\text{m}\)
- Integral field spectroscopy with \(5'' \times 7''\) or \(5'' \times 3.5''\) FoV
- Nod and Shuffle spectroscopic mode (all modes, including IFU for GMOS-S)
- Spectral resolutions \(\sim 150-8700\) in 1st order, up to \(12,000\) with some gratings in second order

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**Gemini High-Resolution Optical Spectrograph**

**GHOST**
- Fiber-fed, echelle optical spectrograph
- Two-target simultaneous spectroscopy over a \(7.5'\) field, at a spectral resolution > 50,000
- Single-target spectroscopy at spectral resolution > 75,000
- Accuracy down to \(\sim 10\ \text{m/s}\) within \(0.43-0.75\ \mu\text{m}\)
- Commissioning in 2022

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**Gemini South Adaptive Optics Imager**

**GSAOI**
- Near-infrared imager used with GeMS
- \(85'' \times 85''\) FoV, sampling 20 milliarcseconds
- 6 broad-band and 16 narrow-band filters covering \(0.9-2.5\ \mu\text{m}\)
- Filters are: \(Z, J, H, Ks, K', K, CH4\) (short and long), \(He\ I, Hel(2p2s), Paschen-\gamma, Paschen-\beta, Brackett-\gamma, [FeII], H2O, H2 1-0 S(1) & 2-1 S(1), CO \Delta \nu=2; J, H, K\) short & long - continuum
- Near diffraction limited imaging in the \(K\) band

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**Gemini Multi-Conjugate Adaptive Optics System**

**GeMS**
- 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 and spatial resolution up to FWHM \(\sim 0.06''\) over \(85'' \times 85''\) FoV
- Currently used with GSAOI; other instruments (Flamingos2 and GMOS-S) under development

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**FLAMINGOS-2 Near-Infrared Imager/Spectrograph**

**FLAMINGOS-2**
- Near-infrared imager with a \(6.1''\)-diameter FoV
- Long slit spectroscopy \(0.9-2.4\ \mu\text{m}\)
- Spectral resolutions \(\sim 300-4500\)
- Multi-object spectrograph mode to be available in 2022 (\(2' \times 6'\) FoV)

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**Immersion GRating INfrared Spectrometer**

**IGRINS**
- High-resolution near-infrared \((H \& K\) simultaneous) spectrometer
- Compact design with no moving parts, fixed spectral format
- Wavelength coverage: \(1.45-2.45\ \mu\text{m}\) continuous
- Spectral resolution \(\sim 45,000\)

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**Gemini Welcomes Visiting Instruments!**

**Note:** GPI is the Gemini Planet Imager for extreme AO with coronographic integral field spectroscopy and polarimetry. It provides diffraction-limited NIR images over a \(2.8'' \times 2.8''\) FoV with contrast of \(\sim 10^{-6}\) at \(0.4''\) radius. It is no longer available at Gemini South and will be upgraded and moved to Gemini North.

Learn more about instrument capabilities at:

**https://www.gemini.edu/caps-instr**

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**Gemini Welcomes Visiting Instruments!**

See back page for details.
**Gemini Near-InfraRed Spectrograph**  
**GNIRS**  
- Near-infrared (0.8–5.4 µm) long-slit and cross-dispersed spectroscopy  
- Spectral resolutions ~ 1200–18,000 in long-slit mode  
- Cross-dispersed spectroscopy delivers complete 0.8–2.5 µm coverage at $R \sim 1700$ and partial coverage at higher resolution  
- Integral field unit provides 5" × 3" FoV with natural seeing and 1" × 1.5" FoV with Altair adaptive optics system (anticipated mid-2022)

**Altair Adaptive Optics System**  
**Altair**  
- Used in conjunction with GNIRS, NIFS, or NIRI  
- Natural guide star mode, FWHM ~ 0.07" with Strehl ratios up to 40%  
- Laser guide star mode, FWHM ~ 0.08" with Strehl ratios up to 20%  
- Nearly full sky coverage “super seeing” mode yields FWHM ~ 0.3"

**Near-Infrared Imager**  
**NIRI**  
- Near-infrared imager with three cameras giving different FoV and pixel scale  
- 22" × 22", 51" × 51", or 120" × 120" FoV  
- Wavelength coverage from 1 to 5 µm with 8 broad-band and 21 narrow-band filters  
- Spatial resolution ~ 0.08" at 2.2 µm with Altair adaptive optics system

**Near-Infrared Integral Field Spectrograph**  
**NIFS**  
- Near-infrared (0.95–2.4 µm) integral field spectrograph and coronagraphic imager with 3" × 3" FoV  
- Spectral resolution ~ 5000–6000  
- Spatially-resolved spectroscopy on 0.15" scales with Altair adaptive optics system

**‘Alopeke & Zorro**  
- Dual-band optical-wavelength instruments for speckle or fast natural-seeing imaging at both sites  
- Speckle mode provides diffraction-limited (~ 0.02" at 650 nm) imaging of targets as faint as $V \sim 18$ over a 2.5" FoV  
- Natural-seeing mode provides a ~ 35" FoV with exposure times as short as ~ 0.01 second

**Visiting high resolution optical spectrographs**  
**MAROON-X & GRACES**  
- **MAROON-X** is optimized for precise radial velocity measurements  
- Wavelength coverage: 0.5–0.92 µm continuous  
- Spectral resolution: 82,000–88,000, radial velocity precision ~ 10 cm/s  
- **GRACES** has 270-m optical fibers feeding a spectrograph at the CFHT Telescope  
- Wavelength coverage: 0.4–1.0 µm continuous  
- Spectral resolutions: 40,000–60,000

*Learn more about instrument capabilities at:*  
https://www.gemini.edu/caps-instr
Science Flexibility

In addition to the common observing modes (classical, queue, Director’s Discretionary Time), Gemini offers multiple and convenient ways for proposing and observing, as described here.

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.

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.

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. PV mode visits are subject to COVID restrictions.

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 programatically 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 Gemini Observatory Archive upon completion of the observations.

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.

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. We offer new and exciting capabilities almost every semester, so remember to check the call for proposals (available at the end of February and August each year) to see what new instruments you can use for your science, and 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 program of NSF’s NOIRLab and is managed by the Association of Universities for Research in Astronomy, Inc. (AURA), under a cooperative agreement with the National Science Foundation (NSF) on behalf of the Gemini Partnership.