GEMINI OBSERVATORY: STATUS AND PLANS

LAURA FERRARESE, INTERIM DIRECTOR, GEMINI OBSERVATORY

SUBARU USER MEETING

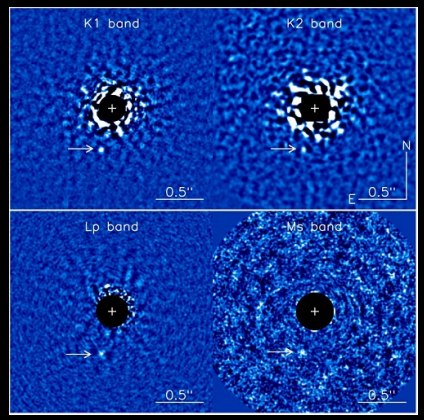
JANUARY 17, 2018

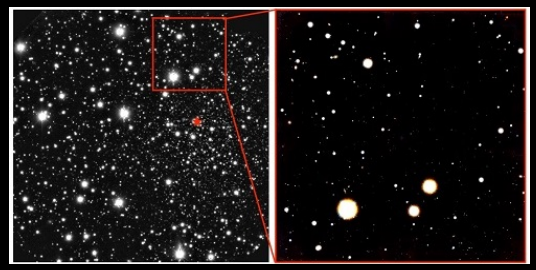
OUTLINE

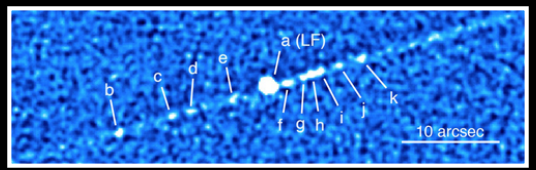
- Science Highlights
- The Subaru/Gemini Time Exchange Program
- Gemini Operations
- Current and Future Instrument Complement
- Partnership Status
- Observatory's Future and Strategic Initiatives

SCIENCE HIGHLIGHTS

Jan 12	**Game Over for Supernovae Hide & Seek** (GeMS/GSIO)
Dec 18	**The Birth of Massive Stars Around an Unlikely Galaxy** (GMOS)
Dec 6	**Supermassive Black Hole is Ahead of its Time** (GNIRS)
Nov 29	**Gemini Observations Show Distant Black Hole Pair is "Photobombing" Culprit** ((GMOS)
Nov 20	**First Known Interstellar Visitor is an "Oddball"** (GMOS)
Nov 3	**Gemini Observatory Confirms Spiral Nature of Extremely Distant Lensed Galaxy** (NIFS)
Oct 16	**Astronomers Feast on First Light From Gravitational Wave Event** (F2/GMOS)
Sept 22	**The Galactic Center's Mysterious Quintuplet Stars Unmasked** (GNIRS/NIFS)
Sept 6	**Rocky Planet Engulfment Explains Stellar Odd Couple** (GRACES)
Aug 15	**The Little Star that Survived a Supernova** (GRACES)
Aug 2	**Gemini Confirms a New Class of Variable Stars** (GMOS)
Jul 20	**Gemini Confirms Super-distance, Superluminous Supernova** (GMOS)
Jun 30	**Gemini Images Point Juno Spacecraft Towards Discovery** (NIRI)
Jun 27	**Korean Astronomers Dissect a Fragmented Asteroid** (GMOS)
Jun 6	**A Partly Cloudy Exoplanet** (GPI)
May 11	**Gemini Tracks Distant Star Clusters with Adaptive Optics** (GeMS/GSAOI)

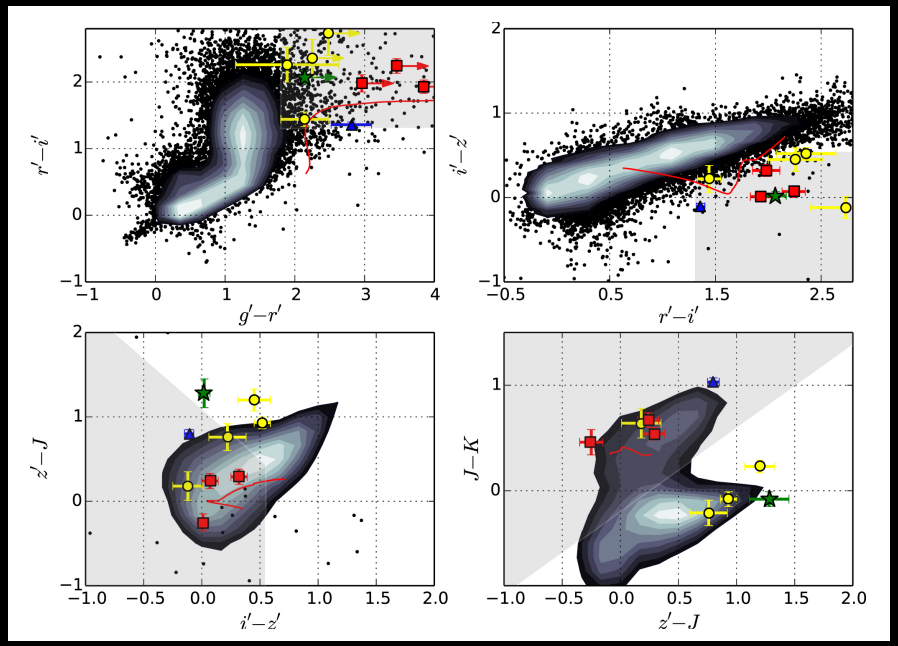




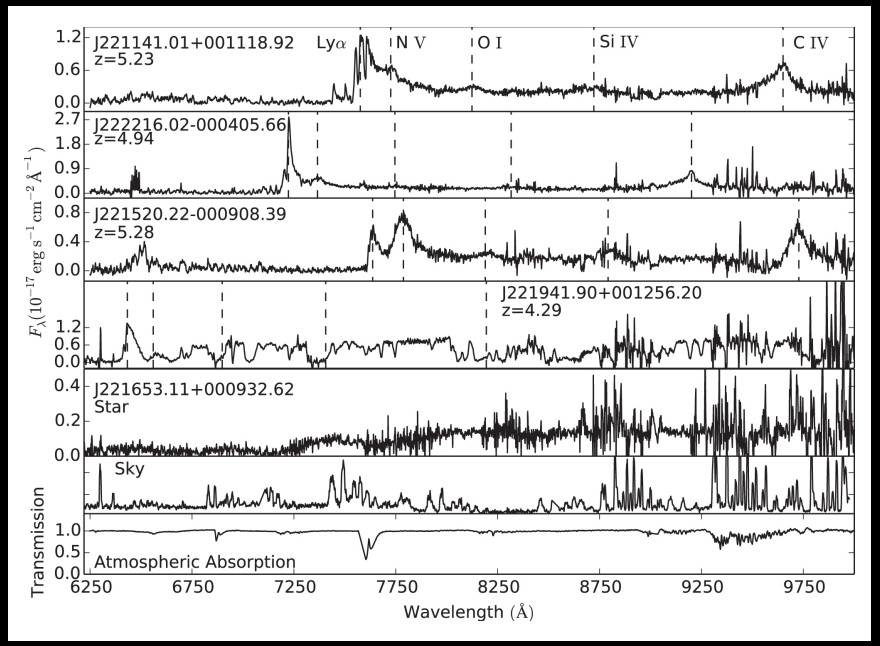


An Optically Faint Quasar Survey at z~5 in the CFHTLS Wide Field: Estimates of Black Hole Masses and Eddington Ratios

CFHT+UKIRT IMAGING



GEMINI SPECTROSCOPY
(THROUGH GEMINI/SUBARU TIME EXCHANGE)



Ikeda et al. 2017, ApJ, 846, 57

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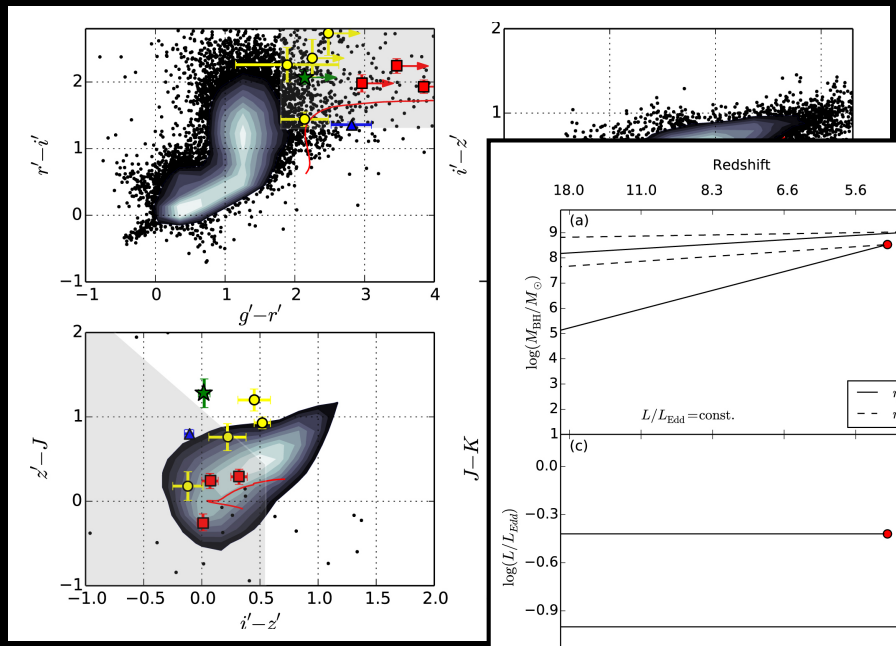

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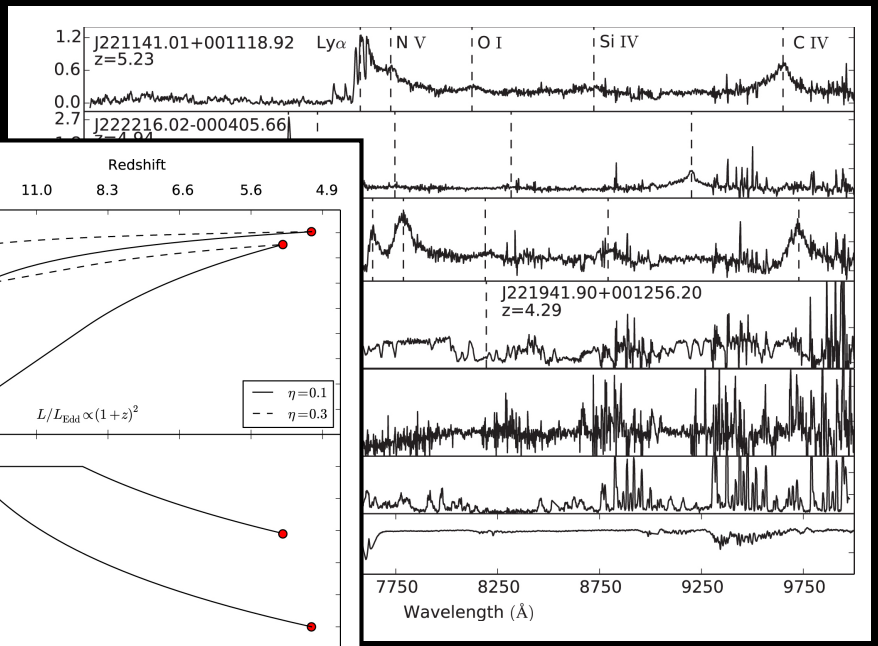
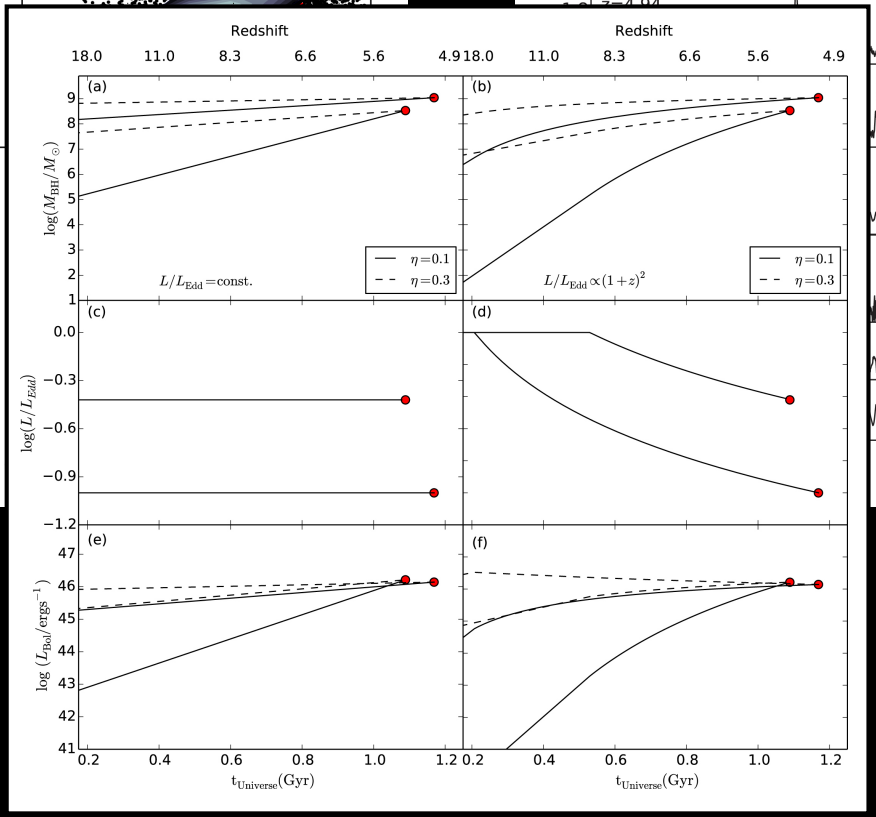
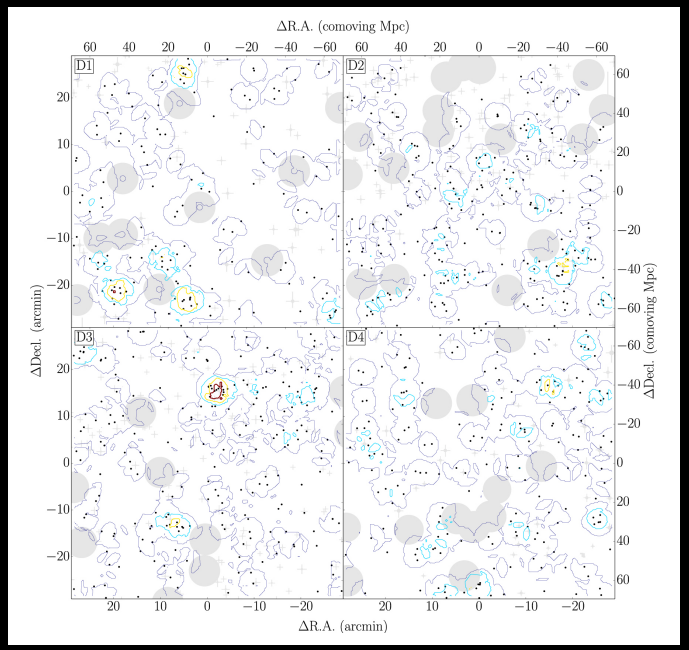


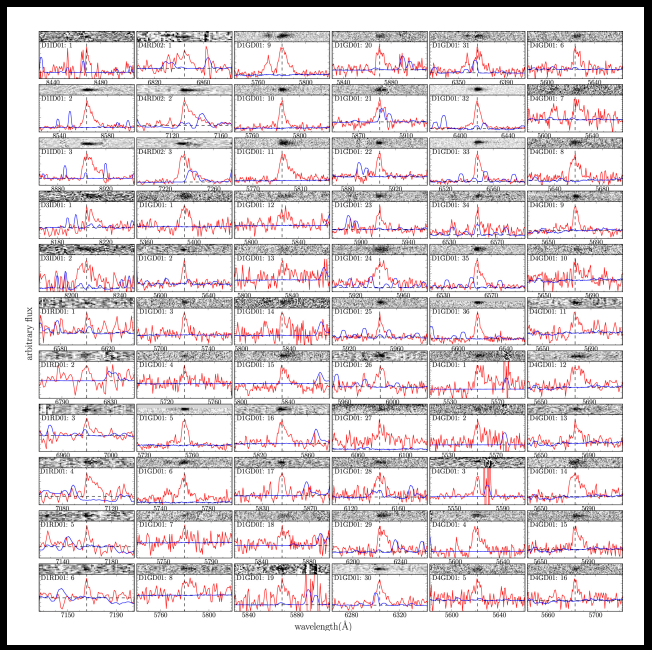


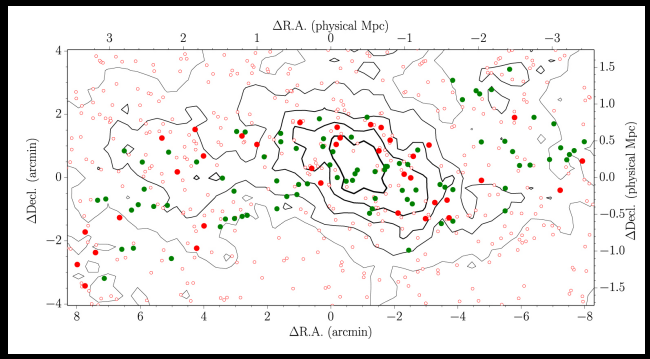
DETECTION OF FOUR Z=4-5 QUASARS AND CONSTRAINTS ON SBH EVOLUTION

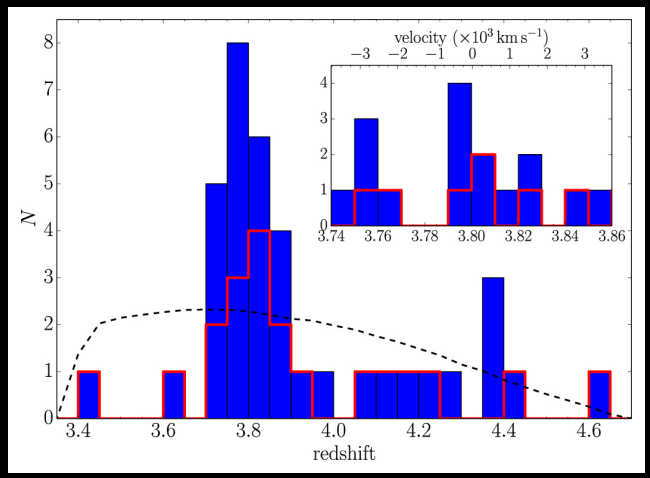
Ikeda et al. 2017, ApJ, 846, 57

A Systematic Survey of Protoclusters at z~3-6 in the CFHTLS Deep Fields
(See Toshikawa-san Talk on Friday!)









CFHT IMAGING → SUBARU, GEMINI & KECK SPECTROSCOPY → PROTOCLUSTERS!

Toshikawa, J. et al.. 2017, ApJ, 826, 114

SUBARU/GEMINI TIME EXCHANGE

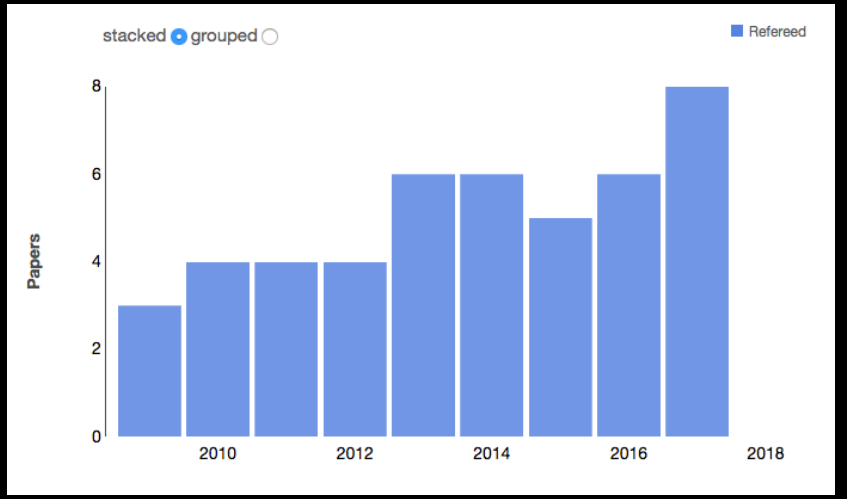
- Started in 2006B;
- Open to researchers with Japanese Citizenship, and those working in institutes in Taiwan and Japan;
- Minimum of five nights each semester (depending on request);
- Subaru users have access to
  - All Gemini proposal submission modes (including Fast Turnaround);
  - All Gemini observing modes (including queue and Target of Opportunity);
  - All instruments (including Visiting Instruments) at both sites.

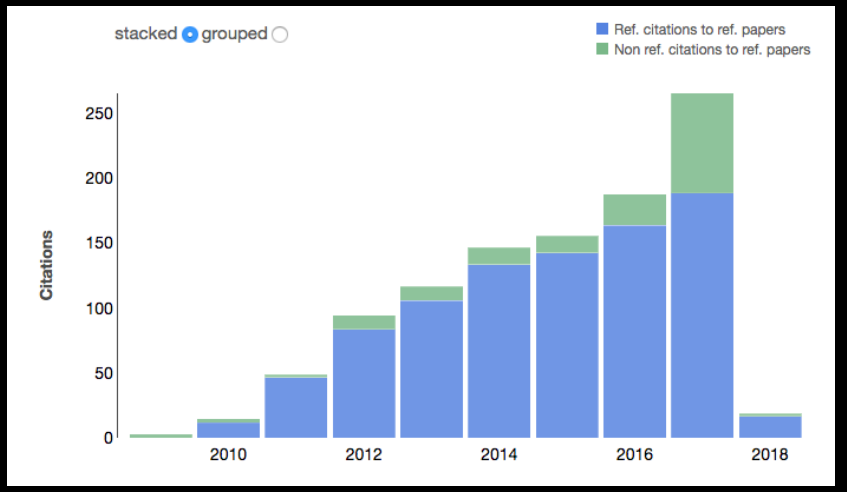
What can Gemini offer to the Subaru user community?

- Two sites! All sky access; longer monitoring for fast transients; twice the insurance against bad weather for exceptional events that can be reached from both sites;
- GeMS
- Complementarity between CHARIS/SCExAO and GPI
- Flexible operations: efficient (minutes) switching between instruments and a queue that can be adjusted in real-time, allowing for last minute changes if necessary (PIs can eavesdrop while their queue data are being taken)
- Ease of proposing outside of the regular semester cycle

USE OF GEMINI BY THE JAPANESE COMMUNITY

1	2017PASJ...69...82M	2017/10	cited: 1	
	OISTER optical and near-infrared monitoring observations of peculiar radio-loud active galactic nucleus SDSS J110006.07+442144.3			
	Morokuma, Tomoki; Tanaka, Masaomi; Tanaka, Yasuyuki T. *and 80 more*			
2	2017Natur.550...80J	2017/10	cited: 2	
	A hybrid type Ia supernova with an early flash triggered by helium-shell detonation			
	Jiang, Ji-An; Doi, Mamoru; Maeda, Keiichi *and 22 more*			
3	2017ApJ...848...42K	2017/10		
	N uSTAR Hard X-Ray Data and Gemini 3D Spectra Reveal Powerful AGN and Outflow Histories in Two Low-redshift Lyα Blobs			
	Kawamuro, Taiki; Schirmer, Mischa; Turner, James E. H. *and 2 more*			
4	2017ApJ...846...57I	2017/09	cited: 1	
	An Optically Faint Quasar Survey at z ˜ 5 in the CFHTLS Wide Field: Estimates of the Black Hole Masses and Eddington Ratios			
	Ikeda, H.; Nagao, T.; Matsuoka, K. *and 5 more*			
5	2017PASJ...69...27N	2017/04	cited: 2	
	The redshift-selected sample of long gamma-ray burst host galaxies: The overall metallicity distribution at z < 0.4†‡			
	Niino, Yuu; Aoki, Kentaro; Hashimoto, Tetsuya *and 7 more*			
6	2017MNRAS.465.4895W	2017/03	cited: 29	
	H0LiCOW - IV. Lens mass model of HE 0435-1223 and blind measurement of its time-delay distance for cosmology			
	Wong, Kenneth C.; Suyu, Sherry H.; Auger, Matthew W. *and 13 more*			
7	2017RAA....17...15L	2017/02		
	Double-lined M dwarf eclipsing binaries from Catalina Sky Survey and LAMOST			
	Lee, Chien-Hsiu; Lin, Chien-Cheng			
8	2017MNRAS.465.2411M	2017/02	cited: 5	
	A new quadruple gravitational lens from the Hyper Suprime-Cam Survey: the puzzle of HSC J115252+004733			
	More, Anupreeta; Lee, Chien-Hsiu; Oguri, Masamune *and 16 more*			
9	2016A&A...595A..79M	2016/11	cited: 2	
	High-contrast imaging of ϵ Eridani with ground-based instruments			
	Mizuki, T.; Yamada, T.; Carson, J. C. *and 48 more*			
10	2016MNRAS.461L..37L	2016/09		
	AGB stars in Leo P and their use as metallicity probes			
	Lee ( ), Chien-Hsiu			





- 46 papers published since 2009 by the Japanese community using Gemini, collecting 1055 citations.
- Half of these papers make use of both Subaru and Gemini data

USE OF GEMINI BY THE JAPANESE COMMUNITY

Survey
Oguri, Masamune; Bayliss, Matthew B.; Dahle, Hâkon *and 5 more*

35 2012ApJ...745...74[illegible] 2012/01 cited: 18
Unburned Material in the Ejecta of Type Ia Supernovae
Folatelli, Gastón; Phillips, M. M.; Morrell, Nidia *and 17 more*

36 2011AJ....142..63M 2011/08 cited: 2
1 μm Excess Sources in the UKIDSS. I. Three T Dwarfs in the Sloan Digital Sky Survey Southern Equatorial Stripe
Matsuoka, Y.; Peterson, B. A.; Murata, K. L. *and 8 more*

37 2011MNRAS.413.3075M 2011/06 cited: 55
Effects of the explosion asymmetry and viewing angle on the Type Ia supernova colour and luminosity calibration
Maeda, Keiichi; Leloudas, Giorgos; Taubenberger, Stefan *and 7 more*

38 2011AJ....141..156I 2011/05 cited: 20
Subaru and Gemini High Spatial Resolution Infrared 18 μm Imaging Observations of Nearby Luminous Infrared Galaxies
Imanishi, Masatoshi; Imase, Keisuke; Oi, Nagisa *and 1 more*

39 2011AJ....141..119K 2011/04 cited: 27
The Widest-separation Substellar Companion Candidate to a Binary T Tauri Star
Kuzuhara, M.; Tamura, M.; Ishii, M. *and 3 more*

40 2010Natur.466...82M 2010/07 cited: 145
An asymmetric explosion as the origin of spectral evolution diversity in type Ia supernovae
Maeda, K.; Benetti, S.; Stritzinger, M. *and 10 more*

41 2010Icar..207...45M 2010/05 cited: 15
Mid-infrared spectra of the shocked Murchison CM chondrite: Comparison with astronomical observations of dust in debris disks
Morlok, A.; Koike, C.; Tomioka, N. *and 2 more*

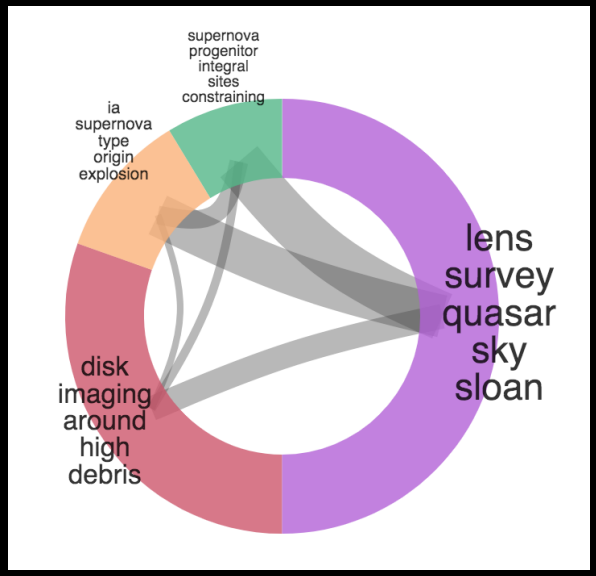
42 2010MNRAS.402..335K 2010/02 cited: 6
Stellar population and dust extinction in an ultraluminous infrared galaxy at z = 1.135
Kawara, K.; Oyabu, S.; Matsuoka, Y. *and 6 more*

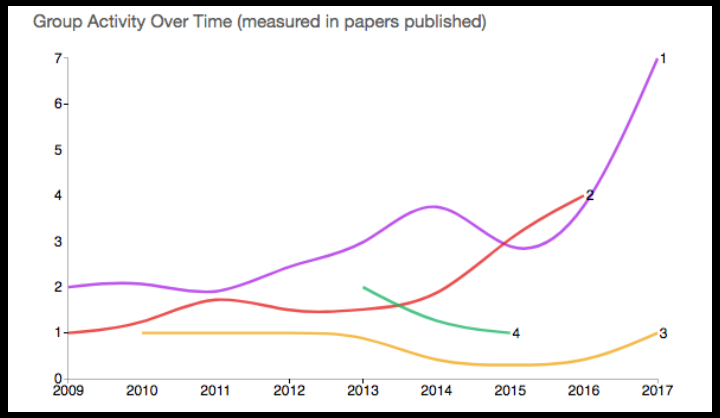
43 2010ApJ...709.1374K 2010/02 cited: 25
Subaru And Gemini Observations Of SS 433: New Constraint On The Mass Of The Compact Object
Kubota, K.; Ueda, Y.; Fabrika, S. *and 4 more*

44 2009ApJ...704..117K 2009/10 cited: 3
Lyman Break Galaxies at z ~ 5: Rest-Frame UV Spectra. III.
Kajino, Hiroki; Ohta, Kouji; Iwata, Ikuru *and 6 more*

45 2009MNRAS.395.1087S 2009/05 cited: 13
Ultraviolet FeII emission in z ~ 2 quasars
Sameshima, H.; Maza, J.; Matsuoka, Y. *and 6 more*

46 2009ApJ...695L..88F 2009/04 cited: 12
Hot Debris Dust Around HD 106797
Fujiwara, Hideaki; Yamashita, Takuya; Ishihara, Daisuke *and 10 more*

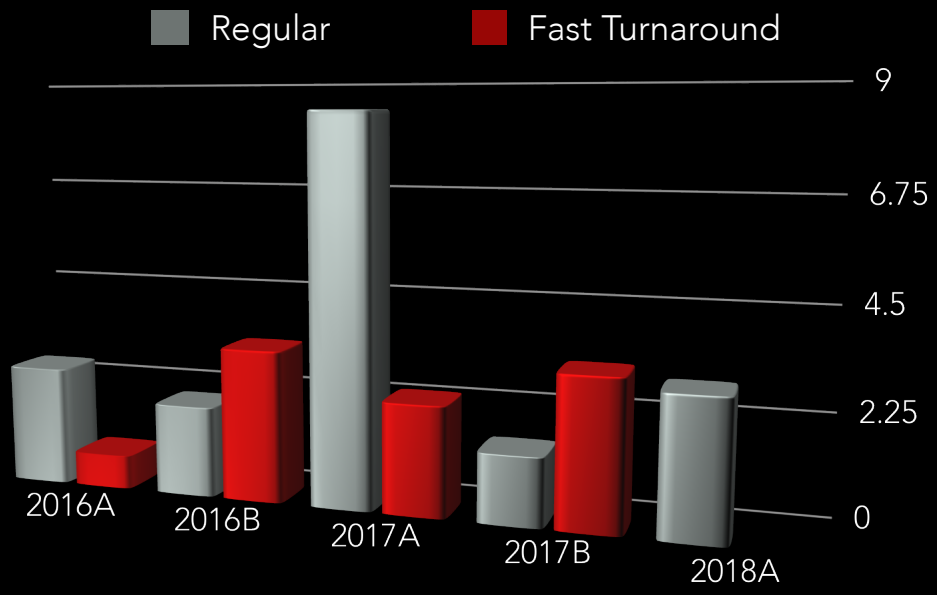


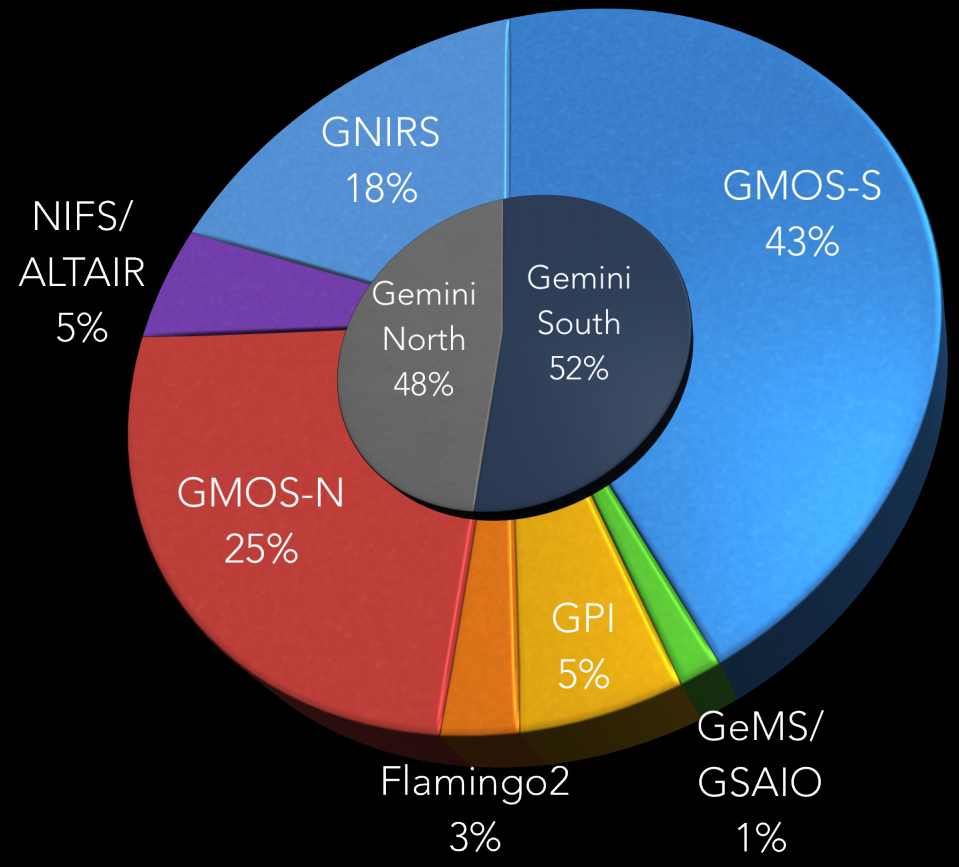


- 46 papers published since 2009 by the Japanese community using Gemini, collecting 1055 citations.
- Half of these papers make use of both Subaru and Gemini data
- Papers target both nearby and high redshift Universe

SUBARU/GEMINI TIME EXCHANGE PROGRAM @ GEMINI

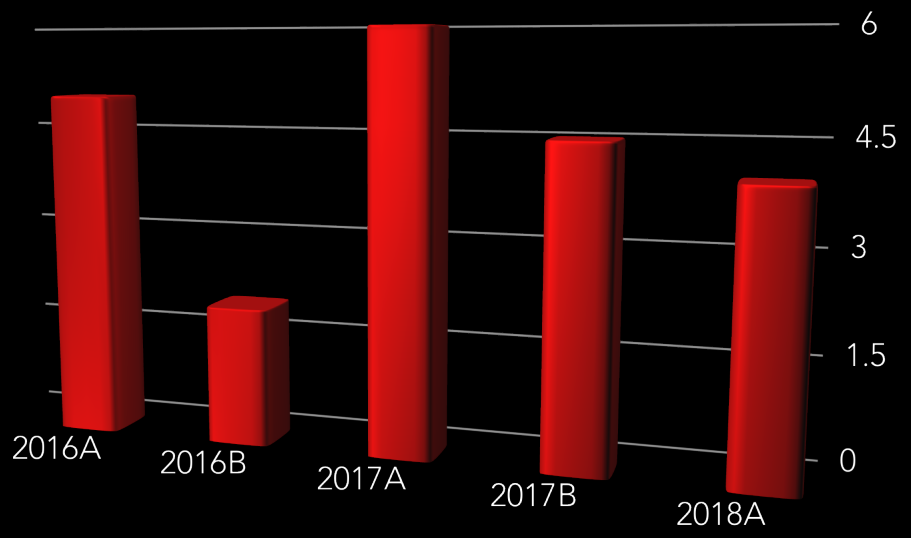
- 27.3 nights allocated to the Subaru community on Gemini since 2016A
- Time request almost equally divided between Gemini North and South
- GMOS by far the most requested instrument, followed by GNIRS

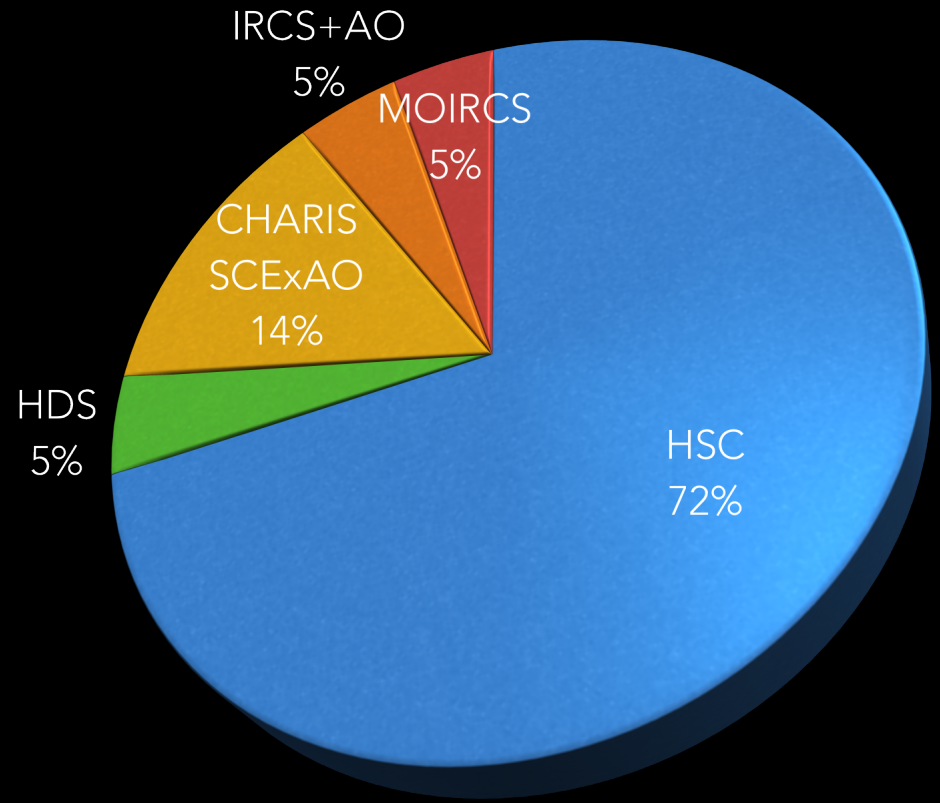




SUBARU/GEMINI TIME EXCHANGE PROGRAM @ SUBARU

- 21.5 nights allocated to the Gemini community on Subaru since 2016A
- HSC by far the most requested instrument, followed by CHARIS/SCExAO





OPERATIONS

PROPOSAL MODES:

- **REGULAR PROGRAMS** 70% of all observing; call twice a year, deadlines ~Sept 30 and ~Mar 30.
- **LARGE AND LONG PROGRAMS** Proposals accepted annually for observations starting in the B semester. Extend for 2 to 6 semesters; no lower limit on amount of time; up to 20% of available observing time at each telescope. 20 programs accepted to date (7 on-going). GUARANTEED 80% COMPLETION RATE
- **FAST TURNAROUND** 10% of time at each telescope. Proposals accepted monthly. If you apply, you will be asked to peer review the other proposals.
- **POOR WEATHER PROPOSALS** Can be submitted at any time. Executed only if nothing else in the queue is observable.

OBSERVING (done from the Base Facility in Hilo and La Serena):

- **QUEUE** Carried out for the PI by the Observatory staff. Observing conditions are best matched to the program. PIs can "eavesdrop" during the observations.
- **CLASSICAL** Carried out by the PIs at the PI request (rare, 1 night minimum).
- **PRIORITY VISITOR OBSERVING MODE** PIs are at the base facility for any length of time, and can interrupt the queue to run their own program (Band 1 Programs only)

OPERA

Letters of intent due February 2, Proposals due March 30 for start in 2018B (August 1, 2018)

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- **REGULAR PROGRAMS** 70% of all observing; call twice a year, deadlines ~Sept 30 and ~Mar 30.
- **LARGE AND LONG PROGRAMS** Proposals accepted annually for observations starting in the B semester. Extend for 2 to 6 semesters; no lower limit on amount of time; up to 20% of available observing time at each telescope. 20 programs accepted to date (7 on-going). GUARANTEED 80% COMPLETION RATE
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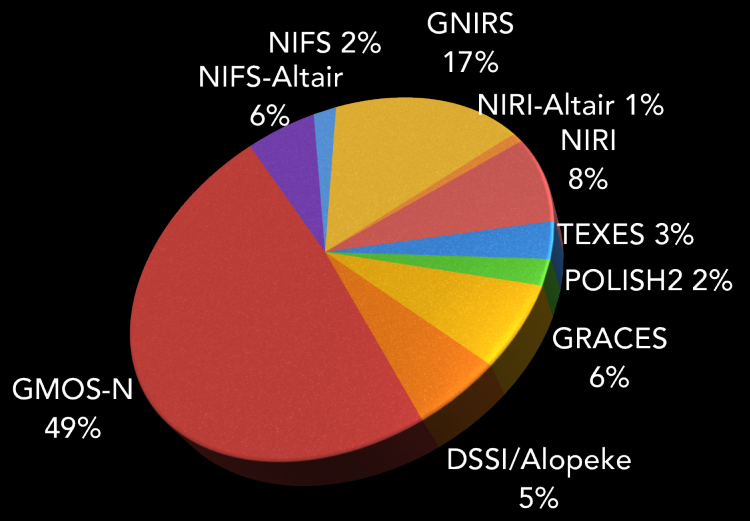
FACILITY INSTRUMENS

Gemini North

- **GMOS** (0.36-0.95 μm multi-object, long-slit and IFU spectrograph and imager)
- **NIRI** (1-5 μm imager)
- **NIFS** (1.0-2.5 μm integral field spectrograph)
- **GNIRS** (1-5 μm long-slit and 0.9-2.5μm cross-dispersed spectrograph)
- AO system: **ALTAIR**



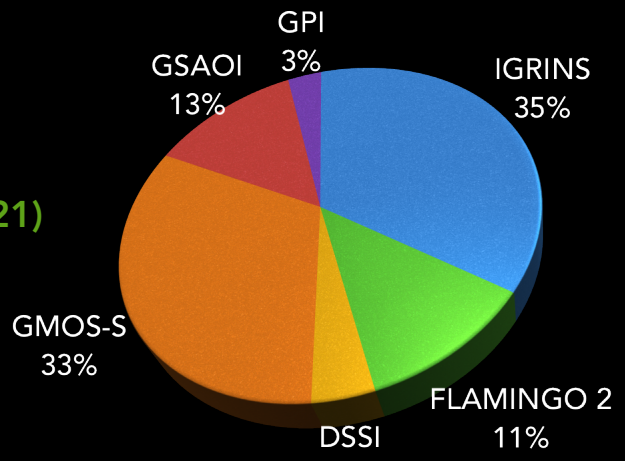
2018A time request

Gemini South

- **GMOS** (0.36-0.95 μm multi-object, long-slit and IFU spectrograph and imager)
- **GSAOI** (0.9-2.4 μm high-resolution imager for use with Multi-Conjugate Adaptive Optics system "GeMS")
- **GPI** (0.9-2.4 μm adaptive-optics imaging polarimeter/integral-field spectrometer)
- **FLAMINGOS-2** (1.0-2.4 μmlong-slit spectrograph and imager)
- AO system: **GeMS** (Multi-conjugate adaptive optics system, GSAOI and Flamingo 2)

UPCOMING:

- **GHOST (2019)**
- **OCTOCAM (2021)**



2018A time request

FACILITY INSTRUMENTS

2020: new IFUs installed

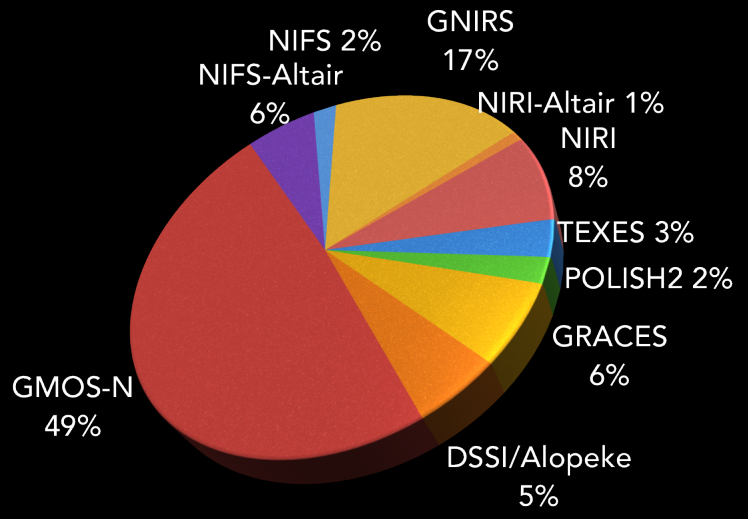
2019-2021: potential upgrades and move to Gemini-North

2019: NGS2 commissioned, increasing sky coverage to 30%.
2020: new RTC planned
2022: potential upgrades and move to Gemini-North (under study)

Gemini North

Decommissioned when (if) GPI arrives at Gemini-North

- GMOS (0.36-0.9 IFU spectrograph and imager)
- NIRI (1-5 µm imager)
- NIFS (1.0-2.5 µm integral field spectrograph)
- GNIRS (1-5 µm long-slit and 0.9-2.5µm cross-dispersed spectrograph)
- AO system: ALTAIR



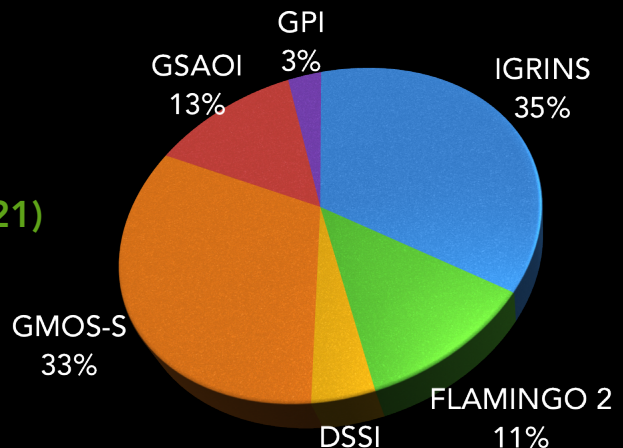
2018A time request

Gemini South

- GMOS (0.36 IFU spectrograph and imager)
- GSAOI (0.9-2.4 µm high-resolution imager for use with Multi-Conjugate Adaptive Optics system "GeMS")
- GPI (0.9-2.4 µm adaptive-optics imaging polarimeter/integral-field spectrometer)
- FLAMINGOS-2 (1.0-2.4 µmlong-slit spectrograph and imager)
- AO system: GeMS (Multi-conjugate adaptive optics system, GSAOI and Flamingo 2)

UPCOMING:

- GHOST (2019)
- OCTOCAM (2021)

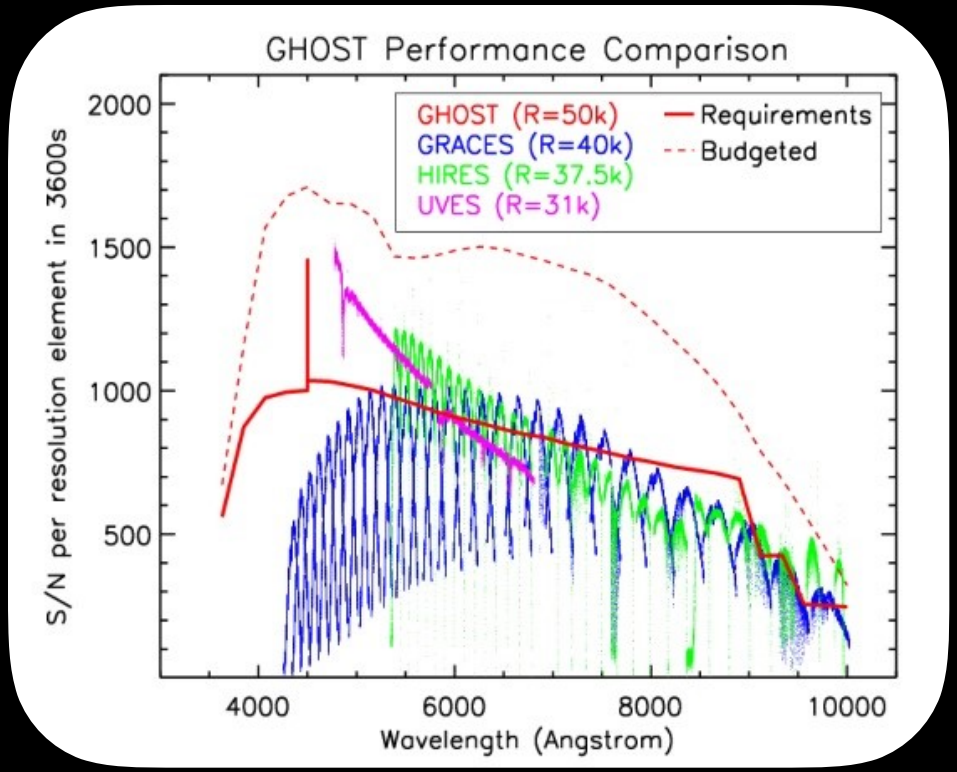


2018A time request

GEMINI HIGH-RESOLUTION SPECTROGRAPH (GHOST)

Fiber-fed, white pupil échelle, high efficiency spectrograph capable of two object spectroscopy

Simultaneous Wavelength Coverage:	363 - 950 µm
Resolution:	Standard R=50,000
	High R=75,000
Limiting Magnitude:	17.5 at 450 nm
	(30 sigma per res element)
Spatial Sampling:	over 1.2 arcsec
RV Precision:	Standard res.: 600 m/s;
	High res.: 10 m/s
Multiplex:	2 object + sky in
	7.5 arcmin FOV at R=50K



Science: Galactic structure, Stellar Abundances, Globular Clusters, GAIA follow-up, exoplanets, GRB

Integration and Testing: June-October 2018

Shipping to Gemini: November 2018

Commissioning: February-April 2019

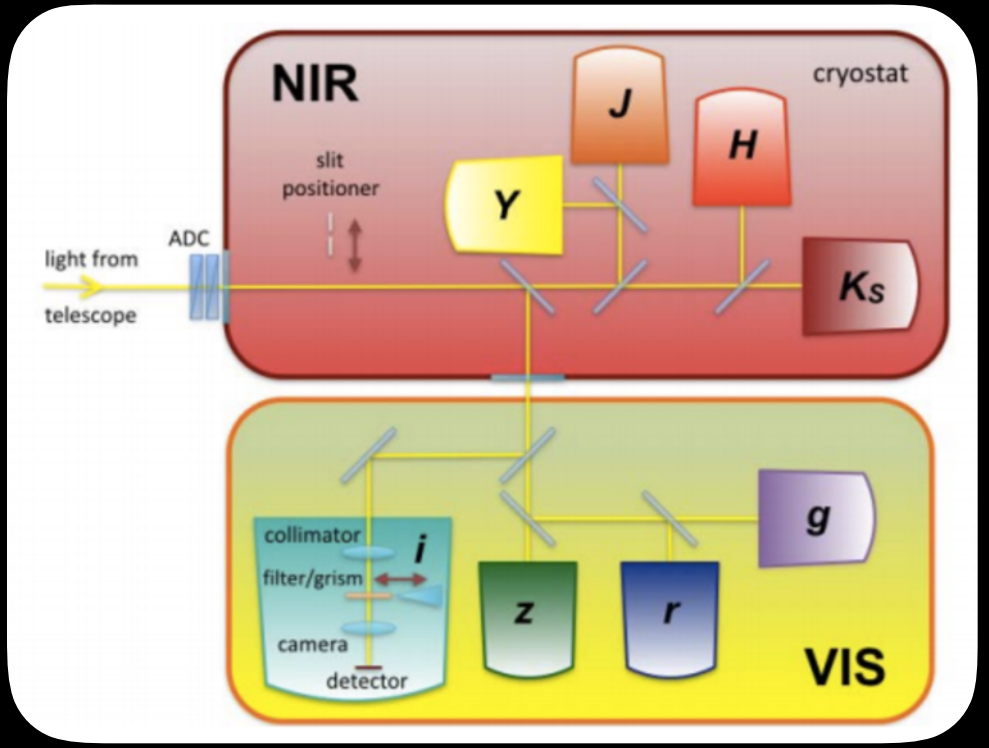
AAO · Canada NRC·CNRC · Australian National University

OCTOCAM

8-channel imager and spectrograph capable of multi-band imaging, long slit broad-band spectroscopy and high-time-resolution (Gemini-South)

Simultaneous Spectral Coverage:	0.40-2.35 µm (imaging)
	0.37 - 2.35 µm (spectroscopy)
Spectral Resolution:	R=4,000
Time Resolution:	50ms
FOV:	3′ X 3′ (square)
	D= 4.24′ (circular)
Plate Scale:	0.18″/pixel

Science: Transient/variable events (fast radio bursts, gravitational wave sources, gamma-ray bursts, Supernaovae, tidal disruption events), X-ray binaries, Neutron Stars, White Dwarfs, Transiting Extrasolar Planet, Trans-Neptunian Objects, Asteroseismology, eclipsing binary systems, AGNs, Galaxy clusters



Contract Signed on March 3, 2017

CoDR passed on August 3, 2017

Expected Commissioning on March 2022

SwRI Southwest Research Institute

Fractal SLNE

The George Washington University Washington, DC

VISITING INSTRUMENTS

Current @ Gemini North

- **GRACES** High-resolution, R ~ 67,500, optical (0.4-1 micron) spectrometer. 270 m fiber optics feed from the Gemini North telescope to CFHT/ESPaDOnS.
- **TEXES** High resolution (R ~ 4,000-100,000) mid-infrared (4.5-25 micron) spectrometer (Univ. of Texas, formerly at McDonald Obserbatory and IRTF)
- **ALOPEKE** Dual-channel visual-wavelength camera providing both diffraction limited and wide-field imaging capabilities with SDSS filters. (NASA Ames Research Center, commissioned at GN October 2017)
- **POLISH2** High-precision polarimeter (CalTech, formerly at Hale 5m Telescope)

Current @ Gemini South

- **DSSI** Diffraction-limited (FWHM~0.02" at 650nm) speckle optical imaging of targets as faint as V~16-17 over a ~2.8 - 5.6 arcsecond field-of-view (Southern Connecticut State University, formerly at WIYN)
- **IGRINS** Cross-dispersed immersion grating near-IR (1.45 - 2.45 μm)spectrograph with R=45,000 (University of Texas and KASI, formerly at McDonald Observatory and Lowell Observatory)

VISITING INSTRUMENTS

Future:

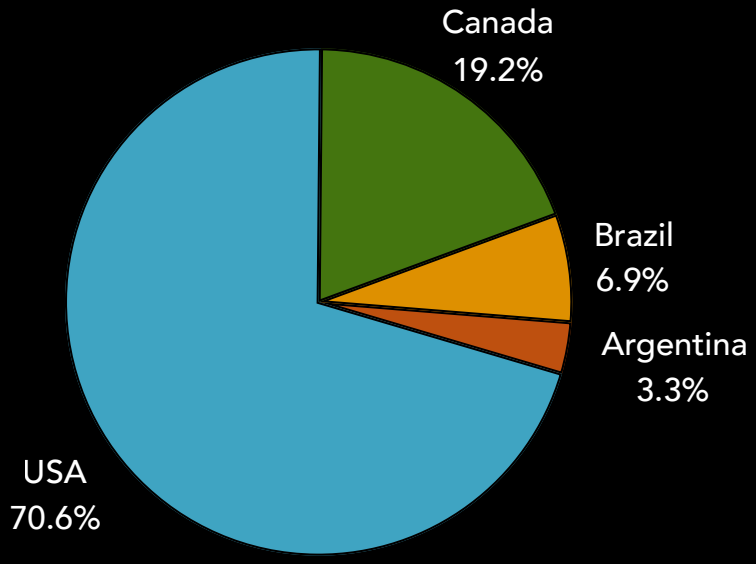
- **GIRMOS** (GS): MCAO multi-object, integral-field spectrograph, with 6 arcsec FOV, and spectral resolutions R=3000 and R=6000. University of Toronto, built specifically for Gemini. 13M CAN$ through CFI with matching funds from the Provinces. First light 2023
- **MAROON-X** (GN): R=80,000 fiber fed high-precision radial-velocity spectrograph covering the range from 500 to 900 nm. University of Chicago, built for Magellan. $315K awarded by NSF to build the top end. First light 2019

Planned:

- **BATMAN** (GS): Digital Micromirror Device (DMD) spectrometer (MOS/IFU/Imaging) with large FOV (88x88 arcsec), from LAM, Marseille. In construction for TNG, expected first light at TNG in 2017, expected move to Gemini South in ~2020. Requires GeMS.
- **GMOX-2** (GS): Wide-band R~5000 spectrograph covering 0.32 – 2.4μm using existing MEMS technology, Led by JHU, not yet funded. Requires GeMS.
- **TIKI** (GS) Exoplanet Mid-IR AO chronographic imager, led by UVic/HIA. Uses GeMS. Not yet funded, expected ~2023

PARTNERSHIP STATUS

2018 Partners' Shares



O&M Budget: $ 27.1M

IDF Contributions: $ 2.7M

Limited Term Collaborators:

- Korea
- Weizmann Institute
- Ben Gurion University

Current International Agreement expires in 2021; "assessment point" in late 2018

The Gemini Board has encouraged new collaborations and is open to considering potential new partners:

- Collaborations should always be in the best strategic interests of the Observatory and strengthen the current partnership;
- Shares in the 5% to 20% range are considered.

THE FUTURE (BEYOND 2021)

The Gemini Board has developed a "Beyond 2021 Strategic Vision", the main points of which are:

- ***Preservation of PI science.*** *As the only 8m class public-access optical/NIR facility available to the US, Canadian, Argentinian and Brazilian communities, Gemini will continue to support PI-mode observing and general purpose instrumentation.*

1. Continue to offer Fast Turnaround, Long and Large Programs, and DD time in addition to the regular proposal calls;
2. Continue to encourage Visiting Instruments as a way to broaden the Observatory capabilities and provide the community with additional opportunities;
3. Develop robust data reduction pipelines

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- ***Synergy with other facilities****. The scientific impact of the post-2021 Gemini will be enhanced by operating in a mode that is closely synergistic with other observatories. This implies that:*
  - *Some degree of specialization is desirable for either or both telescopes;*
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Gemini-South: the premier facility for follow-up investigations of targets identified by LSST

Direct operations and instrumentation development towards specializing in fast follow-up of transients , including:

1. Providing multi-band, high-cadence photometry (OCTOCAM, 2022) and medium and high resolution spectroscopy (GHOST, 2019)
2. Incorporating Gemini in an Observatory network to optimize rapid follow-up of LSST targets through a common and efficient proposal process and triggering mechanism.

Gemini-South is naturally positioned to join a consortium of Southern Telescopes. The same opportunity is open to Gemini-North within a network of Maunakea Observatories

Gemini-North: an AO Renaissance

~2019: upgrade Altair and install new IFUs on GNIRS
~2020: upgrade and commission GPI
~2022: deploy the next Generation AO system (GeMS-North?)
~2023: commission GIRMOS

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The NSF has mandated AURA to integrate its national research assets in a single, matrixes organization (the National Center for Optical and Infrared Astronomy, NCOA).

- NCOA will include Gemini, NOAO, and LSST Operations;
- The National Science Board review is expected in February 2018;
- Beginning of NCOA Operations expected in October 2018;
- Gemini users will not be immediately impacted by the reorganization, but will indirectly benefit from it in the long run.

THANK YOU
ありがとうございます