Capabilities of existing large ground-based optical/IR facilities

	Gemini	Gemini	Keck	Keck	VLT	VLT
	Optical	**Infrared**	**Optical**	**Infrared**	**Optical**	**Infrared**
Imaging	*GMOS*	*NIRI, MICHELLE*	*LRIS, DEIMOS*	*NIRC2*	*FORS*[1], *VIMOS*[2]	*ISAAC*
Waveband	0.3 – 1.0 μm	0.9 – 5 μm 10, 20 μm	0.3 – 1.0 μm	0.9 – 5 μm	0.3 – 1.0 μm	1 - 5 μm
Angular res'n (widefield,)	0.8" V-band	0.5" K-band	0.8" V-band	0.5" K-band	0.8" R-band	0.5" K-band
Sensitivity	V=26.5, r'= 26.1, i'=25.5 S/N=5, 1hour	J=23.5, K=22.6, L'=17.0, N~11 S/N=5, 1hour	V=27, i'=26.0 S/N=5, 1hour	J=23.0, K=21.0, L'=15.5 S/N=5, 1hour	V=27.0, R= 26.6, I=25.5 S/N=5, 1hour	J=24, K=22, L'=16 S/N=5, 1hour
Field of view	5.5' x 5.5 '	22"x22" to 120"x120" 32"x24" (*Michelle*)	6' x 7.8' 16.7' x 5.0'	10"x10" to 40"x40"	3.4'x3.4' or 6.8'x6.8'[1] 4 x 7' x 8'[2]	73"x73" or 152"x152"
Spectroscopy	*GMOS*	*NIRI, GNIRS, NIFS, MICHELLE, PHOENIX, FLAMINGOS, T-ReCs*	*LRIS, DEIMOS, HIRES, ESI*	*NIRSPEC, OSIRIS*	*FORS*[1], *FLAMES*[2], *UVES*[3], *VIMOS*	*ISAAC*[1], *VISIR*[2], *SINFONI*
Waveband	0.3-1.0 μm	0.9 – 5 μm 5 – 25 μm	0.3-1.0 μm	0.96 – 5.5 μm	0.3-1.0 μm	1 - 5 μm 8 – 25 μm
Spectral res'n	~200-800 ~8,800 with AO	1,700 *GNIRS* 30,000-100,000	300-6,000 30,000-80,000	2,000 25,000	250-2,000[1] 10,000-47,000[2] 80,000-110,000[3]	500-3,000[1] 350-25,000[2]
Sensitivity	r'= 22.7 S/N=5, 1hour	J=19.7, K=18.5, L'=14.4, N~9 S/N=5, 1hour low resolution	V=24.0 S/N=5, 1hour *DEIMOS*		R=22.8-24.0 S/N=5, 1hour *FORS*	J-K ~18 to 20[1] L ~ 11-14[1] N ~ 8.5-9.0[2] S/N=5, 1hour
Multiplex	*GMOS*	*FLAMINGOS*	*LRIS, DEIMOS*	*OSIRIS*	*FORS, FLAMES*	*SINFONI*
Other						
Adaptive Optics		*ALTAIR*		*Natural GS & Laser GS*		*NACO*
Polarimetry		*MICHELLE*	*LRISp*		*FORS, VIMOS*	*ISAAC*
Coronagraphy		*NICI*		*NIRC2*		

We have taken the Gemini, Keck and ESO Very Large Telescope facilities as representative of the performance of the current generation of large ground-based optical/IR telescopes; other examples are Magellan, the Hobby-Eberle Telescope, the MMT, the Large Binocular Telescope (LBT) and the South African Large Telescope (SALT). The characteristics and sensitivities of the individual instruments are either taken directly from the appropriate web pages, or computed based on information in those pages. The average seeing conditions for Manua Kea are taken from the Gemini web pages; those for Paranal are from the VLT web pages.

Future large ground-based optical/IR projects

Future ground-based projects centre on two complementary observing modes: extremely large telescopes (25 to 50+ metre diameters), that aim to use multi-conjugate adaptive optics (MCAO) to push to extreme depth, and synoptic, wide-area surveys. We summarise the main properties of two examples from each area:

GSMT: The Giant Segmented Mirror Telescope is envisaged as having a diameter of ~30 metres. As implied by the name, the telescope will build on the segmented technology pioneered by the Keck telescope. The aim is use MCAO to achieve diffraction-limited imaging at near- and mid-infrared wavelengths, allowing multi-object intermediate resolution (R~5000) spectroscopy of I_{AB}~27 magnitude objects over a field of view of ~20 arcminutes. Observations will also be possible in the optical (3000 to 10,000 Å), although full AO correction will not be possible at those wavelengths. The telescope will likely be instrumented with a suite of optical, near-infrared and mid-infrared images and spectrographs.

GMT: The Giant Magellan Telescope is also as a segmented-mirror telescope, incorporating six off-axis 8.4-metre segments to give an effective collecting area of 21.4 metres (filled aperture). As with GSMT, observations can be made in the optical (3000 to 10,000 Å), although full AO correction will not be possible at those wavelengths. The telescope will be instrumented with a suite of optical, near-infrared and mid-infrared images and spectrographs. GMT will probably be constructed at a site in central or northern Chile, with completion is envisaged in ~2016.

LSST: The Large Synoptic Survey Telescope is proposed as an 8.4-metre single-mirror telescope with a field of view of ~10 square degrees. LSST will use an array of ~200 4kx4k CCDs to survey one-third of the sky (~8,000 square degrees) each night with a resolution of 0.2 arcseconds. The primary observations, each 10 to 15 seconds exposure time, will use grizy filters to span the wavelength range 0.4-1.0 μm, with an optional u filter for additional ultraviolet observations. The goal is to obtain first light observations in 2012.

Pan-STARRS: The science goals of the Panoramic Survey Telescope and Rapid Response System are similar to those of LSST, but, rather than a single, large monolithic mirror, the system will comprise an array of four optical systems. Each will have a 1.8-metre diameter primary mirror, each will cover 3 square degrees, and each will use an array of CCDs as a detector. As with LSST, each camera will use a series of 5 to 6 filters to cover the optical spectrum from 3,000 to 10,000µm. A key science goal of this survey is reliable detection of asteroids and comets on Earth-crossing orbits. Pan-STARRS will cover approximately 6,000 square degrees each night, with exposure times between 30 and 60 seconds giving a limiting magnitude of ~24. The prototype version of Pan-STARRS is currently undergoing on-sky tests at Haleakala Observatory, Maui; the full-scale version of Pan-STARRS may replace the UH 2.2-metre on Mauna-Kea.

Links to web pages

Current large optical/IR telescopes:

Gemini: http://www.us-gemini.noao.edu/sciops/instruments/instrumentIndex.html
Keck: http://www2.keck.hawaii.edu/inst/index.html
VLT: http://www.eso.org/instruments/
Magellan: http://www.lco.cl/lco/magellan/instruments/index.html
Hobby-Eberle: http://www.as.utexas.edu/mcdonald/het/het_gen_01.html
LBT: http://medusa.as.arizona.edu/lbto/
MMT: http://www.mmto.org
SALT: http://www.salt.ac.za/

Future large optical/IR telescope projects:

GSMT: http://www.noao.edu/future/gsmt.html
GMT: http://www.gmto.org
LSST: http://www.lsst.org/lsst_home.shtml
PAN-STARRS: http://pan-starrs.ifa.hawaii.edu/public/

Current and future large millimetre and radio telescopes:

For completeness, we also list the major future projects at these longer wavelengths.

CARMA: http://www.mmarray.org
ALMA: http://www.alma.nrao.edu/
VLA: http://www.vla.nrao.edu/
SMA: http://sma-www.harvard.edu/