The Large Binocular Telescope Observatory (LBTO) in short

The LBTO is located in southeastern Arizona near Safford in the Pinaleño Mountains on Emerald Peak at an altitude of 3200 m. This area is part of the Coronado National Forest. LBTO is headquartered on the Tucson campus of the University of Arizona.

The binocular design of LBT has two identical 8.4 m telescopes mounted side-by-side on a common altitude-azimuth mounting. This design allows LBT to be used in three modes: 1) twinned binocular with an effective collecting area of 11.9m; 2) in interferometric (LBTI) mode with an effective collecting area baseline of 22.7m; or 3) as twin 8.4 m telescopes.

The binocular design, combined with integrated adaptive optics utilizing adaptive Gregorian secondary mirrors to compensate for atmospheric phase errors, provides a large effective aperture, high angular resolution, low thermal background, and exceptional sensitivity for the detection of faint objects.

The Facility Instrument Suite

LBC Red - LBC Blue
The Large Binocular Cameras (LBC) are two wide-field cameras mounted at the prime focus of LBT. LBC Blue is blue-optimized for observations from 0.35 to 0.65 μm, and LBC Red is red-optimized for observations from 0.55 to 1 μm. The LBCs are primarily used in binoculare mode but can be used in mixed mode with other instruments. The LBC focal plane consists of four EEV42-90 CCDs (2048 x 4608 pixels, with 0.2255 arcsec/pixel) arranged with three in a row and a fourth rotated 90 degrees and above them. Each CCD covers approximately 7.8 x 17.6 arcmin. The entire science field of view is 23 x 25 arcmin.

LUCI1 and LUCI2
LUCI 1 and LUCI2 are a pair of cryogenically cooled near-IR instruments capable of imaging and spectroscopy (including long-slit and user created multi-object spectroscopic masks). The LUCIs are mounted at an f/15 Bent Gregorian focal station. The LUCIs can operate at wavelengths from 0.89 μm (LUCI-1) or 0.95 μm (LUCI-2) through 2.4 μm in one of four modes: seeing limited (SL), Enhanced Seeing Mode (ESM), ARGOS (A Ground Layer Adaptive Optics System), or diffraction limited Adaptive Optics (AO).

The LUCIs have three cameras: an f/1.8 camera with a 0.25 per pixel scale (N1.8) used for SL spectroscopy only; an f/3.75 camera with a 0.12 per pixel scale (N3.75) corresponding to a 4’x 4’ FOV for SL, ESM, and ARGOS imaging and spectroscopy; and an f/30 camera with a 0.015 per pixel scale (N30) designed exclusively for use with diffraction limited imaging or spectroscopy. The LUCIs have a full-complement of near-IR broad, medium, and narrow wavelength filters. The spectroscopic capabilities of LUCI offer a wide range of possible configurations, including (but not limited to): low-resolution (G200) grating with R~2000 and full band coverage over zJ or HK with the N/1.8 camera; the high-resolution (G210) grating with R~5000-6000 and full band coverage at z, J, H, or K; and(future) AO R~30,000 with either the G210 or G040 gratings.

LBTO and TSIP
The three pairs of LBT facility instruments (LBC, LUCI in seeing limited mode, MODS) are offered to the US community for 2018 and 2019 through the NOAO-administered TSIP program for eight nights a semester.
MODS1 and MODS2

MODS1 and MODS2 (Multi-Object Double Spectrographs) are a pair of matched low- to medium-resolution spectrographs/imagers. The MODS are located at the direct f/15 Gregorian foci of the LBT. Each MODS offers a high-throughput over [0.32 - 1.05 μm] for both imaging and spectroscopy over a 6' x 6' FOV. Gratings provide a spectral resolution of R~2000 and double-pass prisms provide a low-resolution (R=500-150) faint-object mode. Each MODS has a dichroic allowing for simultaneous [0.32-1.05 μm] coverage. MODS can use single longslits (0.3-2.4 arcsec wide x 300 arcsec long) or user-designed Multi-Object Spectroscopy (MOS) masks. Each MOS mask can spatially cover an area of 6 x 6 arcmin with full wavelength coverage.

LMIRcam on LBTI

LMIRCam is a camera and coronagraph built to exploit the unique sensitivity and resolution of the LBT Interferometer. LMIRcam is available in three modes: (1) Single and dual aperture non-coherent (direct) imaging - (2) Single and Dual aperture nonredundant mask imaging. - (3) Single aperture apodizing phase plate coronagraphy. The LMIRcam detector is a Teledyne H2RG device with sensitivity from 1 to 5 μm. The field of view is ~20 x 20 arcsec with a pixel scale of 0.0107 arcsec/pixel. While optimized for 3-5 μm, LMIRcam can also be used at shorter wavelengths.

PEPSI (PI Instrument - Klaus Strassmeier, PI)

PEPSI is a spectrograph located in the telescope pier. It receives light from polarimeters and permanent focal stations via 45m long fibers, coupled with image slicers. Each focal station contains three fiber sizes which determine the spectral resolution: 0.75 diameter for R = 270,000; 1.5 for R = 120,000; and 2.3 for R = 43,000. The two spectrograph cameras each are equipped with a monolithic 10.3k x 10.3k CCD. For each spectral order, four spectra are recorded, i.e. two polarization states or object/sky for each telescope. The entire spectral range from 383 to 907 nm can be covered in three exposures. The two polarimeters (one for each of the 8.4m primary mirrors of LBTO) saw first light in the fall of 2017, providing circular and linear polarization simultaneously with a resolution of 120,000.

Interferometry at LBTO

The LBT Interferometer (LBTI, a UA strategic instrument - PI P. Hinz) routinely uses the interferometric edge-to-edge baseline of 22.7 m offered by the LBT design. Nulling interferometry uses NOMIC, an 8-12 μm camera, while Fizeau interferometry is mostly performed with LMIRcam. Shown here (right) are volcanoes on Io with a single 8.4m aperture (left) and with Fizeau interferometry imaging (right).

LINC-NIRVANA (LN, an LBTB/INAF strategic instrument - PI Tom Herbst) was also designed and built as an interferometer. However, it is now on the telescope only to test its MCAO mode, to be commissioned and used for specific observing programs over the next two years. LN came to the telescope with its interferometric capabilities (10"x10" fov), which will hopefully be tested once the LN MCAO capabilities have been demonstrated.

If you want to know more about LBTO instruments

Visit www.lbto.org or go directly to https://sites.google.com/a/lbto.org/science-operations/home. An SPIE paper is also available from the “instruments” page of the LBTO web site or can be accessed from SPIE: Current status of the facility instrumentation suite at the Large Binocular Telescope Observatory. Barry Rothberg et al. Proc. SPIE 9906, Ground-based and Airborne Telescopes VI, 990622 (July 27, 2016); doi:10.1117/12.2233245

The LBT is an international collaboration among institutions in the United States, Italy and Germany. LBT Corporation partners are: The University of Arizona on behalf of the Arizona Board of Regents; Istituto Nazionale di Astrofisica, Italy; LBT Beteiligungsgesellschaft, Germany, representing the Max-Planck Society, The Leibniz Institute for Astrophysics Potsdam, and Heidelberg University; The Ohio State University, and The Research Corporation, on behalf of The University of Notre Dame, University of Minnesota and University of Virginia.