LGS Operations at the Large Binocular Telescope Observatory

Gustavo Rahmer
Laser Systems Engineer / LSO
Large Binocular Telescope Observatory
University of Arizona

grahmer@lbto.org
Where is the LBT?
Where is the LBT?
ARGOS: Ground-layer LGS @LBT

• Ground-layer AO for wide-field corrections (4x4 arcmin) ⇒ Correction factor of 2-3
• 3 “Rayleigh beacons” at 12 Km (above each mirror)
• Each laser: Nd:YAG, 18 W, pulsed @10KHz, 532 nm
• Designed to work with the two LUCI instruments (near-IR multimode)
ARGOS Performance

Temporal evolution of an imaging observation

ARGOS commissioning performance plot
Science with ARGOS

NGC 6384
Gravitational lensed arc $z=2.48$ SDSSJ1110. Identical MOS Masks with curved slits observed with LUCI1 & LUCI2 simultaneously. 2h integration time on each side add up to 4h total on the Hα line.
Science with ARGOS

NGC 2903
Laser Operations Challenges

• Airplanes

• Satellites
Aircraft Safety
Aircraft Safety

• Regulated by the FAA
• FAA Advisory Circular 70-1
• Registration process: Form 7140-1 Notice of Proposed Outdoor Laser Operations

• Letter of Determination:
  • Location
  • Minimum elevation angle
  • Aircraft spotters
  • Coordination requirements (ATC, Military)
Aircraft Safety

- Automatic aircraft detection:
  - Local radar.
  - Cameras (Vis/IR).
  - TBAD (Transponder-Based Aircraft Detection).


- LOD (Letter of Determination) for TBAD-only operation received on October 2018, following LBTO’s statement of compliance with SAE AS6029A.
TBAD @LBTO
TBAD Detections Temporal Distribution

TBAD Closures (9/17/2015 - 5/26/2016)

Time (UTC)

Frequency

Local midnight
Trajectories computed from ADS-B data

Red: “in-beam,” shuttered
Yellow: shuttered
Blue: not shuttered

Self-assessment based on transmitted lat/lon and TBAD disposition to that transmission

(*) Automatic Dependent Surveillance – Broadcast
Trajectories computed from ADS-B data
LGS Operation Issues @LBTO

• Air traffic:
  • Nearby airports: PHX and TUS.
  • Higher frequency during the first third of the night.
  • Traffic mostly West – East (California to Texas/Florida).
  • Human spotters interaction (not anymore!).
  • TBAD keeps shutter signal active for 10 sec after end of detection.
  • Science camera execution script is manually paused when there is a chance of closure.
Satellite Avoidance

• DOD Instruction 3100.11, “Illumination of Objects in Space by Lasers”

• Groups involved:
  • Joint Space Operations Center (JSpOC).
  • Laser Clearinghouse (LCH).
LGS Operation Issues @LBTO

• Satellites:
  • Mostly very short closures (3-10 seconds).
  • Extra guard of 2 seconds before and after.
  • Keep-Out-Cone: no apparent impact of reducing half-angle from 1.8° to 1.0°
  • Blanket closures not a regular occurrence.
  • A few cases of targets almost completely blocked.