: from data to users
The archive of the scientific products @ OAR

Authors: Diego Paris, Vincenzo Testa, Stefano Gallozzi, Adriano Fontana
LBT Science Center

- Service to support the Italian community in the exploitation of LBT observations (since 2007):
  - Preparation and collection of proposals (in collaboration with LBTO) and storage in the LSC archive
  - Support to the observers before and during observations (OB storage, finding charts, visibility plots, etc.)
  - Notification to the PIs of raw and reduced data availability
  - Service data reduction with ad-hoc pipelines
  - Distribution of reduced data to PIs
  - Support to the “customer” from the proposal to the publication
LSC ARCHIVE

- 3 MySQL DBs:
  - LBTOBS: stores the information concerning the scheduled observing programs (observing runs, observability of the targets, observing blocks)
  - LBTDB: Raw data and metadata
  - LBTRED: Reduced science-ready data and metadata
Data Flow

- **American raw data** flows to **TUCSON Archive**
- **Italian raw data** flows to **TUCSON Archive**
- **German raw data** flows to **TUCSON Archive**

**TUCSON Archive** is designed and powered by IA2

**LBT partner**

**Imaging Data reduction** (LSC-OA Roma)

- "Reduced" images: ~1 day
- ~2-4 weeks

**Spectroscopic Data reduction** (IASF-Milano)

- "Reduced" Spectra: ~2-4 weeks

**PI**
PROPOSAL HANDLING SYSTEM

- Every year the LBT Italian Coordination Facility (R. Speziali) announces a new Call for Italian proposals at LBT.
- In collaboration with LBTO and making use of the PIT, proposals are submitted.
- Since the current year (2019) proposals are submitted anonymously to avoid gender bias.
- The TAC evaluates and ranks the proposals.
- The LSC proposal handling system stores all the information (obs. run) into the LBTOBS DB.
PROPOSAL HANDLING SYSTEM

- LBTO defines the schedule optimizing as much as possible the execution of the programs.
- The Pis of programs scheduled for execution are contacted by the Italian Team to produce and submit the needed information (OB, finding charts, masks)
- Making use of the LSC portal the Pis can check the status of their observing runs
  
  http://lsc.oa-roma.inaf.it
SERVICE DATA REDUCTION

LBT Imaging Reduction Facility @ OAR
- V. Testa, D. Paris, S. Gallozzi

LBT Spectroscopic Reduction Facility @ IASF-Milano
- B. Garilli, A. Gargiulo, L. Cassarà, M. Fumana

LBC Optical Pipeline
LUCI, LMIRCam IR Pipeline
MODS Spectra
LUCI Spectra
Imaging Pipeline: three-layers architecture

External Layer

JAVA USER INTERFACE

Instrument XML Model

Reduction XML Sheet

Prepping

Parser

Engine Layer

Python engine

Calling

Instrument XML Model

Reduction XML Sheet

calling

Organizing

Organizing

Processed images

Reduction data

Computational Layer

Core function

Core function

Ingestion

Reduction products

Mosaics

Reduction XML metadata

LSC
IMAGING PIPELINE WORKFLOW

RAW data

Pre-reduced data

Sky-subtracted data

Astrometry calibrated data

X-talked data

Bias (or dark) stack

Masterbias (Masterdark)

bias-subtracted flat stack

Masterflat

Bad pixel mask

Object mask

Binary weights

Object mask complements

Background maps

xtalk

prerreduce

flag2weight

Astrom

SExtractor

resampled data

Stack of calibrated data

SWarp

SWarp

crmask

flag2weight

xtalk

Table: IMAGING PIPELINE WORKFLOW

RAW data

Pre-reduced data

Sky-subtracted data

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Bias (or dark) stack

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flag2weight

Astrom
M16: g-sloan (B), r-sloan (B+R), i-sloan (R)
PI: D. Thompson, 10 m each filter
UGC1249 (P.I. Annibali)
1 hr g-SLOAN + 1 hr r-SLOAN (LBC)
IMAGING PIPELINE PERFORMANCE

- LBC dataset, 15 raw images ~ 1.23 GB*
  - Time consuming: 1.75 hr. Rate ~ 0.7 GB/hr

- LUCI dataset, 36 images ~ 0.61 GB*
  - Time consuming: 0.47 hr. Rate ~ 1.3 GB/hr

* without considering calibrations

GNU-parallel “embarassing parallelization” – serial parallelization, factor ~8 gain
SPECTROSCOPIC PIPELINE

The Italian LBT spectroscopic data reduction pipeline – *FLOW CHART LUCI*

**GENERIC CALIB**
- Darks & Flat fields
- Dead/hot pixels
- Bad Pixel Map
- Master dark
- Master Flat
- Master Lamp

**TARGET CALIBRATIONS**
- Flat Field
- Arc frames
- Inverse Dispersion Solution
- Spectra location
- Optical distortion correction
- Pixel2pixel correction
- Telluric
- Sensitivity function
- Telluric correction

**SCIENCE**
- Science Exposure
- bad pixels, cosmic rays and dark correction
- Optical distortion correction
- Flux calibration
- 1D extraction
- Combine exposures
- Data products
- Sky subtraction
- Wavelength calibration
- 2D extraction
The LSC Portal
The Exposure Time Calculator

Simulation PARAMETERS

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**Input Generic Parameters:**
- Filter = LBCBlue_Bcdf (Total Efficiency)
- Moon Phase = 0 (days)
- Airmass = 1.3
- Sky AB mag = 22.5 AB mag/arcsec^2
- Magnitude Correction = 0.12 (mag)
- Flat Field Accuracy = 0.005

**Input Photometric Parameters:**
- Simulation Type = star
- Seeing = 0.8 (arcsec)
- Photometric Aperture = 2.4 arcsec

**Output Object Parameters:**
- Number of Exposures = 15
- Single Exposure Time = 100 (s)
- Total Exposure Time = 1500 (s)
- Total Observing Time = 1950 (s)
- Total AB Magnitude = 26.48 (AB mag)
- [26.05 Vega mag]
- Signal to Noise Ratio = 5.0
- Flux of the Source = 3649.31 (ADU)

**Output Image Parameters:**
- Magnitude of Saturation = 17.31 (AB mag)
- Mag/arcsec^2 = 27.44 (AB mag)
- Zeropoint = 35.56 (AB mag)
- Zeropoint(1 s exposure) = 27.62 (AB mag)
- Single Exposure Background = 786.49 (ADU/px)
- Simulation Max = 11965.80 (ADU)
- Sextractor Background = 11640.80 (ADU/px)
- Sextractor RMS = 86.52 (ADU)
- Cut Levels = [11467.76; 12225.36]

**Total Efficiency:**

- Date = 2011-03-23
- Filter = LBCBlue_Bcdf
- Airmass = 1.3

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LBT Observing Scheduler

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<tr>
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The Target Observability Calculator

The target's hourly airmass plot is shown by the red line (in bold style). The target is located at 19° deg of mean distance from the moon (airmass fraction=0.33).

Object Constraints are:
- Max Airmass for the Observation: 2.0
- Min Moon Distance from the Object during the Observation: 100.0
- Max Illumination Fraction for the Moon during the Observation: 0.25

According to these constraints the target is observable for about 0.0 hours.

Target Observability: RA=10:10; DEC=04:33 in date=2011/03/18

back to calculator

Tue, 22 Mar 2011 18:14:26 +0100
INAF Science Archives & the Big Data Challenge
### L.S.C. credits (Data Reduction & Analysis):

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<th>Dataset Name</th>
<th>Description</th>
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<tr>
<td>LBT Spectroscopic Reduction Center <em>AT</em></td>
<td>IASF-Milano staff</td>
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### LSC Data Centre Image Repository

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### LSC database / LBT Scheduler

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</table>
LSC System Architecture

- WEB-based service built on a LAMP architecture
- Three DBs: LBTDB, LBTRED, LBTOBS
- Total LBTDB size: about 4 TB of raw data
- Total n. of PIs who have used the service: about 30
- Total LBTRED size: about 700 Gb of reduced data
- N. proposal ingested: about 450 (last decade)
LSC System Architecture

LBT Survey Centre services

Pipeline services
LESSONS LEARNED AND FINAL CONSIDERATIONS

• Last Call for Proposals expired last May, 17th and the TAC is going to evaluate them
• Got good suggestions from users and some of them already implemented
• Don’t hesitate to ask for help, we do our best to satisfy our “customers” (despite manpower)