pandora.vipgi

the LBT (and not only) spectroscopic data reduction Pipeline

Marco Fumana

LBT and the pipeline description

LBT spectroscopic reduction center

Future developments

LBT-ITALY Team

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Susanna Bisogni	IASF-MI	Spect. data reduction & Observer (coming soon)
Marco Fumana	IASF-MI	Cloud maintenance & spec. pipeline (2010- 2014)

Former Observers
Konstantina Boutsia ➔ Instrumentation Scientist @ Magellan
Eleonora Sani (2012-2015) ➔ Support Astronomer @ ESO VLT
Alida Marchetti - IASF MI

Credits: Roberto Speziali

IASF-MI & LBT

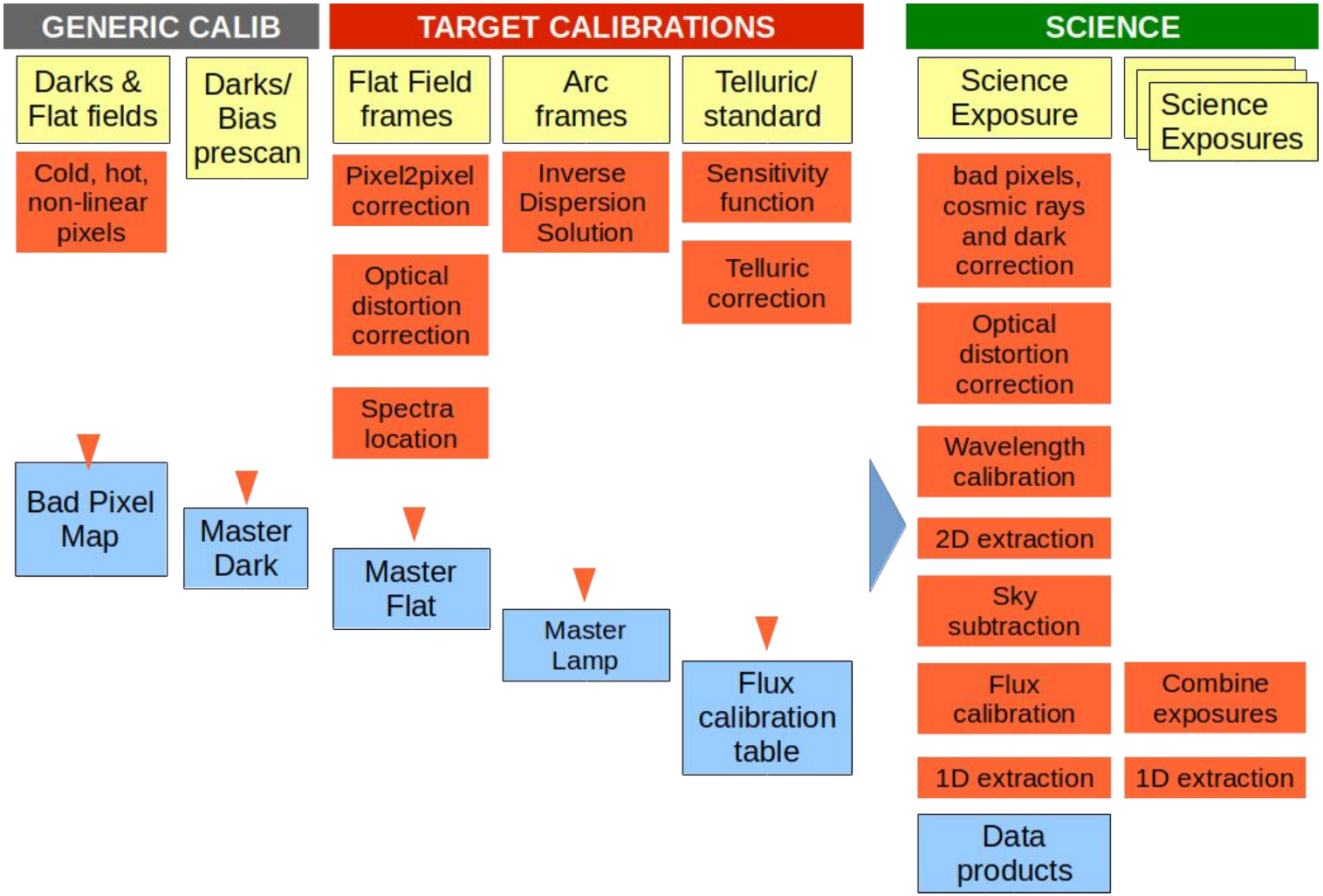
- **pandora.vipgi** development and test:
  *The Italian spectroscopic data reduction pipeline for **LUCI** and **MODS***
- LBT-Italy spectroscopic **reduction center**
- **Observation** support

Letizia Cassarà, Paolo Franzetti, Marco Fumana, Adriana Gargiulo, Bianca Garilli, Marco Scodeggio

LBT pipeline description

VIPGI (Scodeggio et al, 2005)

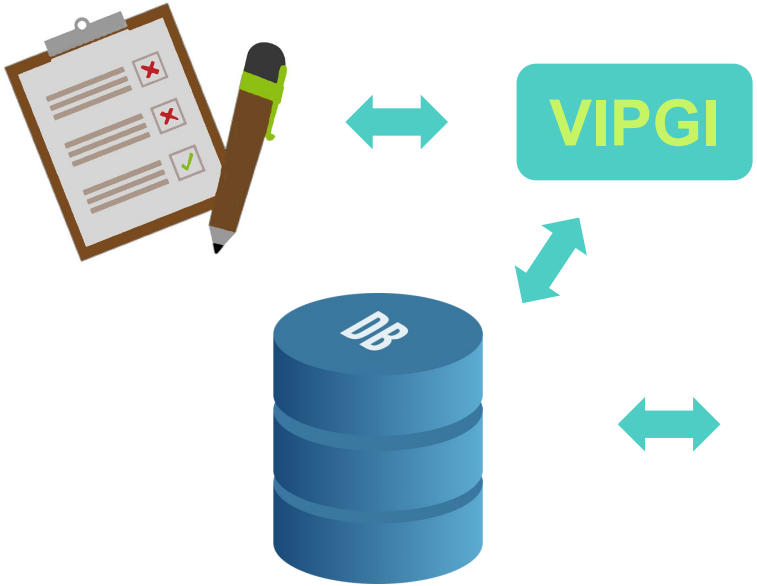
- VIMOS Interactive Pipeline and Graphical Interface (has been created with the VVDS survey)
- Mainly developed at IASF Milano
- Collection of C programs, glued together by Python2 classes
- Tcl/Tk interface and BLT extension
- Used to achieve data reduction of VVDS, zCosmos and VUDS surveys

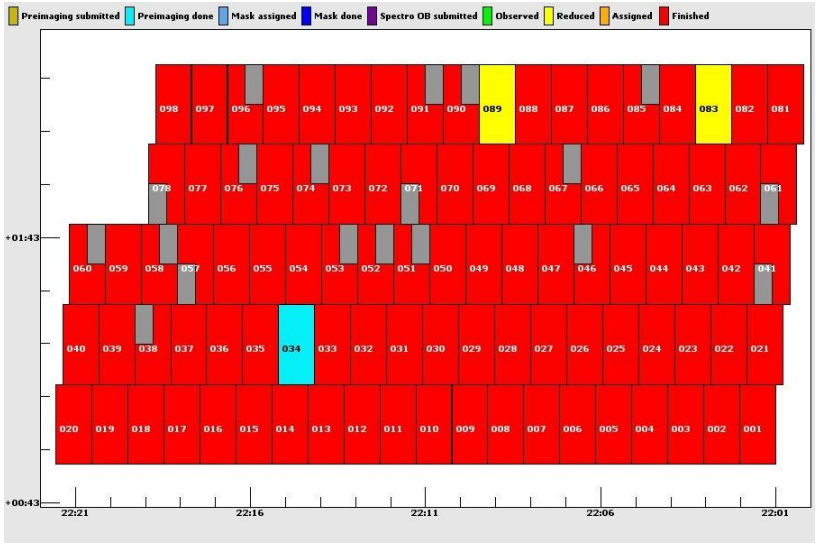

GENERIC CALIB
TARGET CALIBRATIONS
SCIENCE
Darks & Flat fields
Darks/ Bias prescan
Flat Field frames
Arc frames
Telluric/ standard
Science Exposure
Science Exposures
Cold, hot, non-linear pixels
Pixel2pixel correction
Inverse Dispersion Solution
Sensitivity function
bad pixels, cosmic rays and dark correction
Optical distortion correction
Telluric correction
Optical distortion correction
Spectra location
Wavelength calibration
Bad Pixel Map
Master Dark
Master Flat
Master Lamp
Flux calibration table
2D extraction
Sky subtraction
Flux calibration
Combine exposures
1D extraction
1D extraction
Data products

Easylife

VIPERS survey lead us to introduce automatization

Easylife = VIPGI + automation + DB + WEB interface





Amount of spectra

- VVDS: ~35000 spectra (Le Fevre et al. 2013)
- zCosmos: ~30000 spectra (Lilly et al. 2007)
- VIPERS: ~90000 spectra (Scodegio et al. 2018)
- VUDS: ~10000 spectra (Le Fevre et al. 2015)
- VANDELS*: ~2500 spectra (Pentericci at al. 2018)

*Easylife had to reduce a large number of data also in this case, because the observing strategy of VANDELS consists in many repeated observations

The LBT pipeline development began between VIPERS and VANDELS

LBT pipelines

LBT pipelines development benefits from the expertise acquired with all these surveys.

Main problems to achieve:

- for the first time VIPGI is facing on with **no VIMOS data**
- VIPGI must be able to handle **not homogenous data**
- Instruments **less stable** than VIMOS

The LBT telescope

- Binocular telescope
- 2 primary mirrors ~8.5m ø each
- 2 spectrographs on each arm:
  - LUCI
  - MODS

The new spectrographs

LUCI

Grating	Band	Order	λ_{cen} [μm]	50 % Cut on/off [μm]	Resolution [$\lambda_{cen}/\delta\lambda$]	Free Spectral Range [μm]
G210	K	2	2.20	2.02 – 3.18	5000	0.328
G210	H	3	1.65	1.41 – 1.90	5900	0.202
G210	J	4	1.25	1.09 – 1.41	5800	0.150
G210	z	5	0.97	0.89 – 1.11	5400	0.124
G200	HK	1	1.93	1.32 – 2.40	1900/2600	0.880
G200	zJ	2	1.17	0.90 – 1.25	2100/2400	0.440
G150	Ks	2	2.15	1.81 – 2.40	4150	0.533

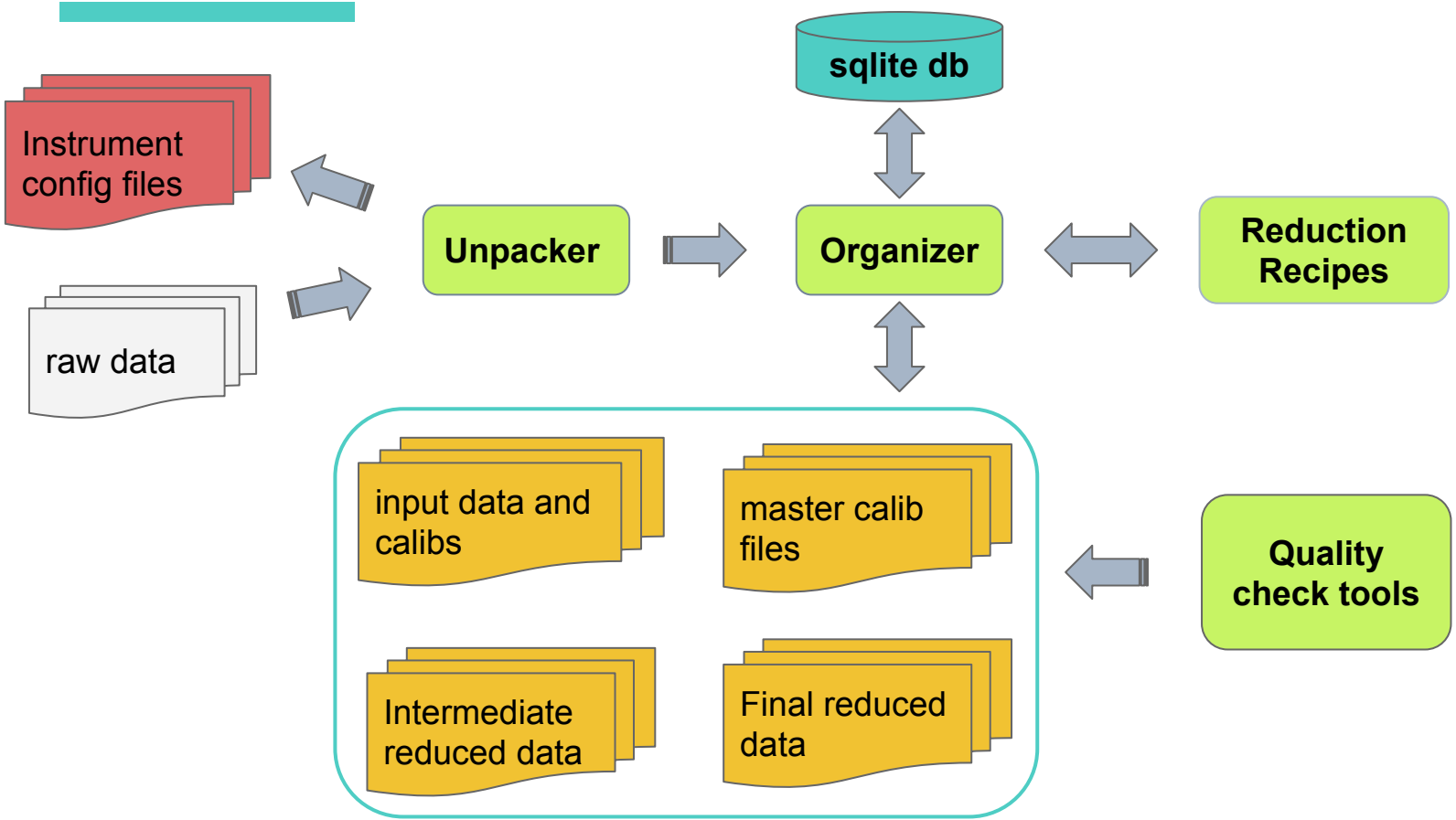
MODS

Type	ID[1]	Lines mm^{-1}	Blaze Angle	Order	Nominal Range (Å)[2]	Linear Dispersion[3]	Spectral Pixels
Grating	G670L	250	4.3°	1	5800-10000	0.8Å/pix	5700
	G400L	400	4.4°	1	3200-5800	0.5Å/pix	5200
Prism	P700L	n/a	n/a	n/a	5800-10000	5 Å/pix	650
	P450L	n/a	n/a	n/a	3200-5800	5 Å/pix	650

Main changes required

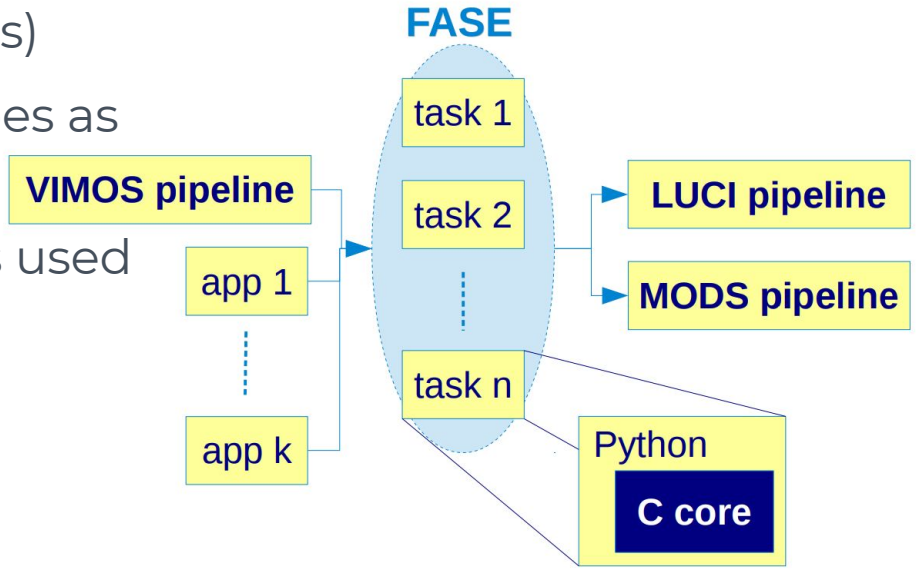
- more flexibility: **MOS** and **LONGSLIT** mode
- set of **configuration files** in order to handle lots of configurations allowed by LUCI
- Handle **new issues** (i.e. related with NIR data)
- New unpackers to properly **categorize file types** of different instruments: acquisition, spectra, flats, arcs, science, ...
- New **organizer** to gather data according with PI, proposal, mask, ...

pandora.vipgi schema



pandora.vipgi architecture

- Reduction recipes are still written in C, but a **dynamic library** is created (no more executables)
- **SWIG** is used to wrap C recipes as Python modules
- **FASE** (P. Grosbøl et al 2012) is used for recipe management, execution and logging
- ESO **CPL library** has been introduced for file I/O
- Files organization is coupled with a **sqlite db**



Spectroscopic reduction center

Reduction center

- The Spectroscopic reduction center exists **since 2010**.
- It is located here at **IASF Milano**
- It is in charge to reduce **all spectroscopic data** acquired at LBT during the Italian nights.
- Products we release, in the most cases, are ready for science analysis
- We have interactions with the PIs, if some custom reduction is required

Data volume

- The reduction center activities started when only LUCI1 was mounted.
- 2011 MODS has been added
  (MODS has 2 channels which act like 2 separate instruments)
- 2015 LUCI2 becomes operative
- 2016 also MODS2 was available
- The open shutter time is increased
- statistically: LBT-Italy observes more short programs, than longer one

Present scenario

- The amount of spectra **is becoming larger and larger**
- The person who is in charge to reduce data, has **no time for its science**: it's a full time job, not properly rewarded by INAF
- The type of observation becomes very diversified, and a standard reduction can be no more satisfactory

pandora.vipgi distribution

- PI can tune the recipes parameters according with his needs
- PI can also skip some steps and use its own software to achieve special needs

Future developments

TODO list

- Python3 migration
- improve the instrument configuration management
- code pruning: removing useless part of code
- fix known bugs/issues/features
- write user documentation

Timeline

Idea is to release the first public version of pandora.vipgi on **september 2020**
(in time for the 2020/21 LBT season)

open **help desk** here in Milan

solve future bugs raised by users