# The spectroscopic data reduction activity for LBT-Italia

(the history of a more than twenty-years-"successful" project)

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#### The LBT-Italia spectroscopic reduction center

A INAF reality @IASF-Mi in charge (until the 2021A cycle) to reduce *all* the spectroscopic data acquired in the Italian time @LBT.

The center in a nutshell:

- **TEAM**: A. Gargiulo/B. Garilli, S. Bisogni (LBT-postdoc), M. Fumana, P. Franzetti, M. Scodeggio, L. Cassarà
- **SOFTWARE**: SIPGI, a LBT-customized version of our software VIPGI;
- **WORKLOAD**: ~ 500 complete reductions (1D and 2D spectra  $\lambda$  and flux calibrated) in the 2021;
- **DATA ACCESS**: from Arizona to IA2 from IA2 to our machine.

Since 2021B cycle, the center has delivered SIPGI to the community and now offers an *help desk* to support PI in their spectroscopic reduction (*lbt-italia-spec@inaf.it*).

# How did we get here?



# The VIMOS Interactive Pipeline and Graphical Interface

VIPGI is the spectroscopic pipeline (*Scodeggio et al. 2005*) developed by us to reduce the optical spectra of the VIMOS VLT Deep Survey (*Garilli et al. 2008, Le Fèvre et al. 2013*).

#### VVDS@VIMOS

- MOS observations;
- ~600 spectra per exposure;
- each exposure is splitted in 4 raw frames (4 independent reductions)
- ~ 30000 spectra



The VIPGI goal: *quick but accurate* reduction of thousands of spectra.

# **VIPGI** milestones

Issue	Adopted solution
High level of efficiency	<ul> <li>C language;</li> <li>internal quality control tools;</li> <li>instrument calibrator models.</li> </ul>

# **The Instrument Models**

• The Instrument Model is an analytical description of the instrument distortions.

• It is calibrated on real data and provides first guesses both of the *spectra location* and of the *wavelength solution*.

• It can be checked with a graphical tool.



# **VIPGI** milestones

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Quick and easy data classification	Built-in data organizer
Easy browsing data	Graphical Interface

#### The built-in data organizer & the graphical interface

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# **VIPGI** milestones

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Quick and easy data classification	Built-in data organizer
Easy browsing data	Graphical Interface
Easy visualization of data products	Plotting tools

## **VIPGI** milestones

#### The forward-looking VIPGI approach

Issue	Adopted solution
High level of flexibility	<ul> <li>separation between recipes and functions;</li> <li>minimize instrument dependence;</li> <li>instrument calibrators interchangeability;</li> </ul>

#### The logical scheme of VIPGI functioning



Gargiulo et al. 2022

#### The VIPGI performances

VIPGI-reduced spectra are basically identical to that obtained with a more time-consuming by-hand reduction process (IRAF).

VIPGI was distributed to the astronomers of the VVDS consortium to officially reduce all the ~30000 spectra of this survey.

# How did we get here?



This experience opens the road to the next spectroscopic surveys @VIMOS:

- VIMOS Ultra Deep Survey VUDS (Le Fèvre et al. 2015) and
  - zcosmos (Lilly et al. 2007).

VIPGI was distributed to both consortia to officially reduce all the ~40000 spectra of these surveys.

# The VIPGI heritage 1: EasyLife for VIPERS reduction

The VIMOS Public Extragalactic Redshift Survey - VIPERS (Guzzo et al. 2014) acquired ~100000 spectra.

#### Very simple observing strategy:

- > all the galaxies observed for the same  $t_{exp}$ ;
- > one pass on each pointing.

#### ...but:

- ~100000 spectra;
- > wider area (~24 sq. deg).

EasyLife (Garilli et al. 2012)

- "automatically" reduce VIPERS data (powered VIPGI version);
- automatically provide a first guess of the redshift;
- > monitor the survey advancement.

# The EasyLife power



2002	2013/2014	2018	t
Sw distributed to consortia that divided the reduction workload to consortia members	We and re	developed the sw educe all the data	

# The VIPGI heritage 2: SIPGI for LBT reduction



# The VIPGI heritage 2: SIPGI for LBT reduction

#### LBT:

- is a binocular telescope;
- has two spectrographs: the optical MODS and the Near Infrared LUCI;
- multi-spectroscopic configurations.



#### The Spectroscopic Interactive Pipeline & Graphical Interface

The high flexibility of VIPGI allowed us to "easily" adapt the sw to MODS and LUCI:

- the data organization in quadrants was mirrored to organize data on the two arms and of different configurations;
- the Instrument Model (IM) interchangeability allowed to easily change the VIMOS-IM with the MODS-IM and LUCI-IM;
- The recipes organization in library and functions allowed to easily include the library/functions for near-IR reduction

SIPGI a spectroscopic reduction pipeline for LBT

(Gargiulo et al. 2022)

# SIPGI download & documentation

• Pandora page

http://pandora.lambrate.inaf.it/sipgi/

 SIPGI DOI: 10.20371/inaf/sw/2021 00002

#### SIPGI Tutorials on YouTube



## The VIPGI heritage 3: SpectraPy

- We are now working to extend SIPGI to other optical/near-IR through-slit spectrographs;
- However, the interaction we had with PIs during these 10 years has highlighted that the most "demanding" task is to obtain the 2D spectra lambda calibrated and free of distortions;
  - This has led to the development of SpectraPy.

SpectraPy (by Marco Fumana)

SpectraPy is a <u>spectrograph independent</u> Python library focused on the extraction of 2D wavelength calibrated spectra. It is not a standalone software (differently from VIPGI).

It inherits the VIPGI **instrument model concept**, and allows to apply it to data acquired with all the through-slit spectrographs.

Differently from VIPGI, it does not provide the instrument model, but **allows PIs to derive them.** 

# SpectraPy download



- SpectraPy is an **Astropy affiliated package** <u>https://www.astropy.org/affiliated/</u>
- Open gitlab repository

https://gitlab.com/mcfuman/SpectraPy/

• Pandora page

http://pandora.lambrate.inaf.it/SpectraPv/

- Documentation
   <u>https://mcfuman.gitlab.io/SpectraPy/</u>
- SpectraPy DOI:

10.20371/inaf/sw/2021\_00001

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S SpectraPy	🖿 examples	Added LUCI extraction table example		
Project information	Scripts	Removed useless channel parameter		
Repository	Spectrapy	Bug fixed in catalog type check		
Files	E tests	Improved tests coverage		
Commits Branches	<ul><li>♦ .gitignore</li></ul>	Updated setup.py		
Tags	yitlab-ci.yml	Changed master branch into main		
Contributors	🛱 LICENSE.txt	Added license file		
Graph	MANIFEST.in	Updated MANIFEST template		
Locked Files	M* README.md	Updated readme		
Dr Issues	🅏 setup.py	Added python requirements		
1) Merge requests				
🤗 CI/CD	README.md			
👽 Security & Compliance				
ව Deployments	SpectraPy			
🕎 Monitor	pipeline passed coverage 91.00% Python	3.7 powered by AstroPy		

ᢙ Infrastructure

Packages & Registries

SpectraPy is an Astropy affiliated package, which collects algorithms and methods for data reduction of i through slits spectrograph.

## The VIPGI heritage 4: Euclid & the surveys management



### The VIPGI heritage 5: the surveys management/planning

