#### Spectroscopic Pipelines from VLT/VIMOS to the LBT instruments and beyond

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#### In the beginning there was IRAF...

The IRAF Data Reduction and Analysis System

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#### ABSTRACT

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The Image Reduction and Analysis Facility (IRAF) is a general purpose software system for the reduction and analysis of scientific data. The IRAF system provides a good selection of programs for general image processing and graphics applications, plus a large selection of programs for the reduction and analysis of optical astronomy data. The system also provides a complete modern scientific programming environment, making it straightforward for institutions using IRAF to add their own software to the system. Every effort has been made to make the system as portable and device independent as possible, so that the system may be used on a wide variety of host computers and operating systems with a wide variety of graphics and image display devices.

#### 1. Introduction

The IRAF project began in earnest in the fall of 1981 at Kitt Peak National Observatory (NOAO did not yet exist at that time). The preliminary design of the system was completed early in 1982, and the first versions of the command language (CL) and the applications programming environment were completed during 1982. The NOAO IRAF programming group was formed in 1983. The first internal release of the system occurred at NOAO in 1984, and a beta release of the system to a few outside sites occurred in 1985.

#### Reducing data with IRAF

- Wavelength calibration: identify, reidentify
- Flux calibration: **standard**, **sensfunc**
- Spectrum extraction: apfind, aprecenter, apresize, apedit, aptrace, apsum (they can be run in a sequence using apall)

VIPERS: 100,000 spectra x 10 tasks x 30 sec = 8500 hours = 1000 working days

multiple IRAF tasks can be executed via a script, and new IRAF tasks can be coded using the IRAF programming language

#### The problem with data proliferation

Data archiving is generally observatory-oriented, and not really astronomer-oriented....

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#### A tool for a project: **VIPGI** the VIMOS Interactive Pipeline and Graphical Interface

- \* Data Organizer
- \* Smart Data Browser
- \* Interface to Pipeline Tasks
- \* Data Visualization
- \* Direct Interface to Redshift Measurement Tool
  - \* Data Reduction Recipes: 150K lines of C code
  - \* GUI and plotting/browsing: 16K lines of Python code

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#### Data reduction with just a few clicks

Smart Browsing; Data organized by Pointing, Mask, and Data Type

Data Reduction: a few tasks available, depending on the selected data type

> VIPERS: 288 masks x 4 quadrants x 6 tasks x 20 min = 2400 hours = 300 working days

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### Integrated data browsing / plotting tools

Browsing and plotting tasks designed to take advantage of the data structures

Single multi-extension FITS file storing all the information needed by the pipeline tasks

Example: slit browser and spectrum extraction info plot



### Integrated data browsing / plotting tools



#### From **VIPGI** to today's tools

- Two separate paths towards today's spectroscopic data reduction
- The Spectroscopic Survey tool Easylife
- The LBT / general purpose **new VIPGI**

#### Easylife for Spectroscopic Surveys

Easylife's concept is relatively simple

- Store all survey info in a Database
- Join together with a script the various pipeline tasks
- Add quality control steps in between the main tasks (See Paolo Franzetti's presentation for details)

### Result: 2 people managed with ease the whole VIPERS data reduction !!

#### The new VIPGI

Like in the original VIPGI:

- \* Data Organizer
- \* Smart Data Browser
- \* Interface to Pipeline Tasks
- \* Data Visualization

More Python and less C code

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#### The new VIPGI

The power of having data organized into smart categories (at the price of needing a special data import facility) Pro

Only homogeneous sets of data are visualized and can be selected to run pipeline taks

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#### The new VIPGI

The data organizer can be fully customized by the user according to his/her preferred scheme.

This involves both the location of files on disk and the visualization through VIPGI

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# Spectra visualization and redshift measurements: **pandora.ez**

Visualization tool, but also redshift and spectral lines measurement tool

Can be used standalone, or integrated within VIPGI



June 10, 2019

# Spectra visualization and redshift measurements: **pandora.ez**

In black: observed spectrum

In yellow; best fitting template



# Spectra visualization and redshift measurements: **pandora.ez**

In black: observed spectrum

In yellow; best fitting template

In green: most common spectral lines



#### **Final Remarks**

- Some twenty years of experience with Spectroscopic Pipelines at IASF-Milano
- Managed all big ESO redshift surveys, like VVDS, zCOSMOS, CLASH-VLT, VIPERS, VANDELS
- Managed almost 10 years of LBT data reduction center
- Tools basically ready to be distributed via the INAF SpecLab: new VIPGI, pipelines, spectra plotting, redshift measurements