Prime Focus Spectrograph
SuMIRe

LAM
LABORATOIRE D'ASTROPHYSIQUE DE MARSEILLE

The PFS 1D-Pipeline team

A mixed team of scientist, permanent LAM staff and short-term software engineers, working together on the PFS and Euclid pipelines, as well as a generic tool.

The (AMAZED) team
Resp. V. Le Brun

The permanent staff :

- Pierre-Yves CHABAUD (80%)
- Morgan GRAY (50%)
- Christian SURACE (20%)
- Didier VIBERT (50%)

Update on the AMAZED team

The working people (2 from Euclid, 1 from PFS):

- Florian Fauchier left in March 2019
- Guillaume Pernot left in July 2019
- Alain Schmitt left in August 2019

Replaced by:

- Edouard MARGUERITE (July 2019)
- Mira SARKIS (September 2019)
- Ali ALLAOUI (October 2019)

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The methods

Redshift estimation method

- A least-square fit of model parameters weighed by signal variance

$$-2\log\mathcal{L}(z) = \min_{\theta} \sum_{\lambda} \frac{(S_\lambda - M_\theta(\frac{\lambda}{1+z}))^2}{\sigma_\lambda^2}$$

- A redshift Probability Distribution Function calculation for each model
- Combination of all zPDFs into one
- The best redshift is defined as the location of the maximum of the PDF

The model

- Continuum (including stellar absorption lines)

  21 templates built from BC03 models (Tremonti+ 2003)

  The amplitude is fitted

- Emission lines

  A predefined list of lines (excluding Lyα)

  Relative ratios predefined from 13 VVDS stacked spectra

  The position and width are fitted

The model

- Interstellar absorption lines

Velocity shift is fixed (-150 km/s)

Relative ratios predefined from 13 VVDS/Steidel stacked spectra

- Intergalactic Medium absorption

Tabulated from Meiksin (2002)

7 curves at 11 redshifts between 2 and 7

- Interstellar extinction

Tabulated from Calzetti (2000)

9 curves

PDF computation

- PDF from each model are combined
  - Marginalization
  - Best model parameter
- The best redshift is taken at the maximum after a gaussian fit
- Secondary redshift values at following peaks
- Code is ready to integrate priors (N(z), L(Hα), …)

Two Steps process

- Step 1 : produce a coarse PDF on a $\Delta z=1e^{-3}$ grid
  - Rebinned spectrum
  - Reduced number of parameters
  - Produces from 2 to 10 preliminary redshift solutions

- Step 2 : Full model on a fine grid around the preliminary solutions

Faster computation

No solution is lost during the first step

Galaxy/Stars/QSO classification

- Direct comparison of maximum values of the 3 PDF
  - Galaxy method :
    - **Fullmodel** as described earlier
  - Stellar method:
    - **Template**-fitting with a 37-star templates catalog
    - extinction fitted (same as galaxies)
    - Redshift in the range [-1e-3; 1e-3]
  - QSO method:
    - **Template**-fitting with 1 Mean QSO template (Paris et al.),
    - IGM fitted (Meiksin)
    - Redshift in the range [0.0; 6.0]

Global results and future tests

- Tests presented last year :
  - 7k galaxies from the galaxy evolution working group
  - 7k galaxies from the cosmology WG

  More than 95% success in redshift measurement
- New samples
  - 50k galaxies from GE-WG, processed but not analyzed
  - 500k galaxies from Cosmology-WG
- Future/missing samples
  - Stars, QSO, high-z galaxies, outputs of the 2D simulator

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Pipeline status and evolution

Open Issues and future evolutions

- Apply IGM to em/abs lines (eg Lyman series)
  - Produces a better profil for Lyα
  - Reduces the number of free parameters
- Produce a new set of templates
  - Equiprobable in the Mass/SFR plane
- Compression of the PDF
  - Currently 6.10^4 points
  - Keep only peaks or compress outside peaks ?

Open Issues and future evolutions

- Allow variations in the amplitudes of emission lines
  - Less rigidity but not fully open
  - Reduces the number of free parameters
  - Max variation to be decided (10%, 20%, ?)
- Convolution of IGM curves by LSF to avoid discontinuities
- Develop the visualization tool …