ESO Phase 3 Data Release Description

Data Collection	VIPERS
Release Number	1
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VIMOS Public Extragalactic Redshift Survey (VIPERS) Public-Data Release 2 (PDR-2)

Abstract

VIPERS is the result of a Large Programme (182.A-0886) and is the largest galaxy redshift survey conducted at ESO to date. This data release includes the final redshift catalogue, corresponding to 91,507 spectroscopic measurements, of which 86,775 are galaxies, distributed over two equatorial areas of sky centered around RA=22 hrs and RA=2 hrs. The data provide an unprecedented sampling (in terms of volume and statistics) of galaxies and large-scale structure at $0.5 < z < 1.2$. The PDR-2 is the first data release hosted by ESO; a partial set of VIPERS data (PDR-1) has been distributed in 2013 only trough the VIPERS website (http://vipers.inaf.it)

Overview of Observations

VIPERS is a general-purpose spectroscopic survey of galaxies carried out using VIMOS (ESO VIsible Multi-Object Spectrograph), on 'Melipal', Unit 3 of the ESO Very Large Telescope (VLT). Observations were conducted in the framework of Large Programme 182.A-0886; they started in P82 (2008), with the very last data collected in P94 (2015). The data cover an overall area of ~ 23.5 deg^2 with a mosaic of 288 VIMOS pointings, split between W1 and W4 CFHTLS fields (192 and 96 pointings, respectively). This area includes gaps from the VIMOS lay-out and the parent photometric mask (corresponding to areas with insufficient photometric quality or affected by foreground objects like bright stars or nearby galaxies), such that the effectively usable sky area sampled by the data is of 16.3 deg^2.

In summer 2010, VIMOS was upgraded with new red-sensitive CCDs, as well as with a new active flexure compensation system and improved mask exchange system (Hammersley et al. 2010). The original thinned E2V detectors were replaced by twice-thicker E2V devices, considerably lowering the fringing and increasing the global instrument efficiency by up to one magnitude in the redder part of the wavelength range. This upgrade improved the average quality of VIPERS spectra, resulting in a significantly higher redshift measurement success rate.

These and more details on the survey construction and the properties of the sample can be found in the accompanying paper Scodeggio et al., 2016, arXiv:1611.07048, and in the previous survey description and data release papers (Guzzo et al., 2014, A&A, 566, A108; Garilli et al., 2014, A&A, 562, A23).

Release Content

We release here 91,507 spectroscopic measurements and spectra, which include 86,775 galaxies and 2247 (contaminant) stars.

The parent photometric catalog for target selection was based on the release T0005 of the CFHTLS survey. The target sample included all galaxies with $i_{AB} < 22.5$, further limited to having z>0.5 through a robust *ugri* colour pre-selection. This yields an average target sampling rate over the survey area of 47%.

All spectroscopic observations were carried out with VIMOS using the 'low-resolution red' (LR-Red) grism with a slit width of 1 arcsec were used, resulting in a spectral resolution $R \simeq 220$ at the centre of the wavelength range ($\sim 5500 - 9600$ Å) and a sampling of 7.14 Angstrom per pixel. The total exposure time was 45 min, for a total of 372 hours of MOS observations (plus 68.5 hours of pre-imaging), yielding a typical redshift rms error s_z=0.00054 (1+z).

Release Notes

Data Reduction and Calibration

The VIMOS observations were reduced using the EASYLIFE software package (Garilli et al. 2012, PASP, 124, 1232) and redshift were measured using the EZ tool (Garilli et al. 2010, PASP, 122, 827) . This automated measurement was followed by a human verification step, which involved two separate astronomers verifying the redshift value for each galaxy.

Redshift measurements are provided in the observatory rest-frame; no conversion to an heliocentric or galacto-centric rest-frame has been applied.

While the overall spectral shape has been corrected via observations of a few spectro-photometric standards, individual spectra have been absolutely flux calibrated by rescaling the spectral fluxes to the observed CFHTLS i-band magnitude.

Data Quality

The quality flag system adopted by the VIPERS survey has been inspired by and is in fact very close to those of other precursor surveys.

- Flags 4.X and 3.X: highly secure redshift, with confidence > 99%
- Flag 2.X: still fairly secure, > 95% confidence level
- Flag 1.X: tentative redshift measurement, with ~ 50% chance to be wrong
- Flag 9.X: redshift based a single emission feature, usually [OII]3727 Å.

After the human validation procedure has produced the integer part of the redshift quality flag, a decimal fraction is added to it, with possible values 0.2, 0.4, 0.5, to indicate respectively no, marginal or good agreement of the spectroscopic measurement with the object photometric redshif. If no photometric redshift exists for that object, the decimal part is set to 0.1.

A "1" in front of the above flags indicates a broad lines AGN spectrum, while a "2" indicates a second object serendipitously observed within the slit of a VIPERS target.

In all VIPERS papers, objects with a redshift flag between 2.X and 9.X are referred to as reliable (or secure) redshifts and are the only ones normally used in the science analyses.

The quality flag is recorded in the *zflg* column of the survey spectroscopic catalog.

Given the method used to obtain an absolute flux calibration for the released spectra we estimate an uncertainty on this calibration of no less than 10%, but this estimate is not supported by any

rigorous statistical analysis; so we prefer to keep the value of the FLUXERR k/w in the spectra headers undefined (i.e. set to -2).

Data Format

Files Types

For each target the following data files are being released:

- the 1-dimensional spectrum in FITS format, containing the following arrays
  - WAVE: wavelength in Angstrom
  - FLUX: 1D cleaned spectrum flux in erg cm**(-2) s**(-1) angstrom**(-1)
  - ERR: noise estimate in erg cm**(-2) s**(-1) angstrom**(-1)
  - SKY: the subtracted sky in counts
  - FLUX_UNEDIT: 1D unedited spectrum flux
  - MASK: the mask describing the editing that has been done at each wavelength
    - 0: not edited
    - 1: wavelength edited by a human intervention; the original manual editing ha been replaced by the PCA automatic editing
    - 2: wavelength edited by the PCA algorithm
    - 3: wavelength marked to be edited by the PCA algorithm, but not really edited being in a region where a prominent spectral feature could be present

- the 2-dimensional resampled and sky subtracted (but not flux calibrated and atmospheric extinction corrected) spectrum in FITS format

Catalogue Columns

NAME	DESCRIPTION	DATA TYPE	UNIT
id_IAU	IAU Object ID	CHAR	
num	Object ID	VARCHAR	
alpha	Right ascension	DOUBLE	deg
delta	Declination	DOUBLE	deg
selmag	Selection mag (CFHTLS T0005 i galac. ext. corr.)	FLOAT	mag
errselmag	Selection mag error	FLOAT	mag
pointing	Pointing	VARCHAR	
quadrant	Quadrant number	INT	
zflg	Redshift flag	FLOAT	
zspec	Redshift	FLOAT	
norm	Normalization factor	FLOAT	
classFlag	Selection flag	INT	
epoch	Epoch (1=old CCD, 2=new CCD)	INT	
photoMask	Photometric mask flag; 1 if the object is inside	TINYINT	
tsr	Target Sampling Rate	DOUBLE	

ssr	Spectroscopic Success Rate	DOUBLE	

id_IAU and num	VIPERS object name, according to IAU standards. The name is composed of the prefix VIPERS plus the internal identification number. The internal id number (num) is in the form attxxxxxx where a identifies the sky area (1 for W1 and 4 for W4), tt identifies the CFHTLS tile number where the object is located, xxxxxx is the original CFHTLS ID within the tile. The correspondence between our tile identifier and the official CFHTLS tile name is provided in Guzzo et al 2014
alpha and delta	J2000 equatorial coordinates in degrees
selmag and errselmag	i_AB selection magnitude and error. The selection magnitude comes from CFHTLS T0005 catalogues
zspec	Spectroscopic redshift.
zflg	Redshift measurement quality flag The integer part of the flag has the following meaning: • **4** a high-confidence, highly secure redshift, based on a high SNR spectrum and supported by obvious and consistent spectral features. The confidence level of Flag 4 measurements is estimated to be 99% secure. • **3** also a very secure redshift, comparable in confidence with Flag 4, supported by clear spectral features in the spectrum, but not necessarily with high SNR. • **2** a fairly secure, ~90% confidence redshift measurement, supported by cross-correlation results, continuum shape and some spectral features. • **9** a redshift based on only one single clear spectral emission feature. • **1** a reasonable redshift measurement, based on weak spectral features and/or continuum shape, for which there is roughly a 50% chance that the redshift is actually wrong. In case of broad emission lines typical of broad line AGN, a prefix of 1 is added to zflag, i.e. • **14** secure AGN with a >95% secure redshift, at least 2 broad lines; • **13** secure AGN with good confidence redshift, based on one broad line and some faint additional feature; • **12** a >95% secure redshift measurement, but lines are not significantly broad, might not be an AGN; • **19** secure AGN with one single secure emission line feature, redshift based on this line only; • **11** a tentative redshift measurement, with spectral features not significantly broad. Second objects in slit get a 2 as prefix to the flag, i.e. • **24** a second object with flag 4

	• **23** a second object with flag 3 • **22** a second object with flag 2 • **29** a second object with flag 9 • **21** a second object with flag 1 And similarly for BLAGN (**214**, **213**, **212**, ...). Suffix in form of decimal digit has the following meaning: • **.5** the spectroscopic redshift is compatible within 1σ with photometric redshift, i.e $zphot_{min} < zspec < zphot_{max}$ • **.4** the spectroscopic redshift is compatible with photometric redshift at the 2σ level, i.e. minvalue < zspec < maxvalue where minvalue=*min*[zphot-(1+zphot)*0.05, $zphot_{min}$] maxvalue=*max*[zphot+(1+zphot)*0.05, $zphot_{max}$] and 0.05 is twice the median scatter of the comparison between spectroscopic and photometric redshifts. • **.2** spectroscopic redshift is NOT compatible with photometric redshift • **.1** no photometric redshift available
norm	Normalization factor. The spectrum has been multiplied by this value to be normalized to the selmag value.
epoch	Observing epoch. epoch=1 objects have been observed before VIMOS refurbishing in summer 2010, epoch=2 objects have been observed after summer 2010
classFlag	The VIPERS galaxy target selection flag, based on the CFHTLS T005 catalogue, where **1: VIPERS main galaxy target**, i.e. galaxy with colors compatible with z > 0.5, according to the color criteria described in Guzzo et al. 2014 **0:** galaxy with colors compatible with z < 0.5, according to the color criteria described in Guzzo et al. 2014 **-1:** stellar like object according to the VIPERS star/galaxy separation criteria **-2:** magnitude i > 22.5 **-3:** magnitude i < 17.5 **-88:** problematic object, possibly saturated image **-99:** problematic object, missing photometric data
photoMask	Flag indicating whether the object falls within the photometric mask. 1 if the object is inside the mask, 0 if it is outside. Objects outside the photometric mask have a less reliable photometry
tsr	The Target Sampling Rate (TSR) is defined as the ratio of the observed objects over the number of possible targets: TSR=Nspec/Nparent, where Nspec is the number of detected targets and Nparent is the number of all the possi-

	ble random targets. TSR has been computed in small rectangular apertures to take into account the shadowing effect of MOS slits in the sampling of the galaxy distribution. TSR and is needed to take into account the fact that not all the possible targets can be observed in the single pass strategy adopted in VIPERS. See Scodeggio et al. 2016 for details
ssr	The Spectroscopic Success Rate (SSR) is defined as the ratio of the galaxies with a successfully measured redshift (flag = 2.*,3.*,4.*,9.*) over the total sample of detected galaxies. SSR is a function of the apparent magnitude (since to bright objects correspond spectra with high signal-to-noise, from which the redshift can be more easily measured), of the galaxy luminosity and rest-frame color and of the overall quadrant quality, quantified via the mean SSR for all galaxies in that quadrant. See Scodeggio et al. 2016 for detail

Acknowledgements

Please add the following statement in your articles when using these data:

This paper uses data from the VIPERS survey (Guzzo et al. 2014; Garilli et al. 2014; Scodeggio et al. 2016). Based on data products from observations made with ESO Telescopes at the La Silla Paranal Observatory under programme ID 182.A-0886.