Unveiling the combined evolution of galaxies and large scale structure at $0.5 < z < 1.2$

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on behalf of the VIPERS Team

Multi-Object Spectroscopy in the Next Decade
Big Questions, Large Surveys and Wide Fields

La Palma
March 2015
VIPERS: VIMOS Public Extragalactic Redshift Survey

Total volume covered
$5 \times 10^7 \text{ Mpc}^3$

~100,000 redshifts,

~40% sampling

Density and volume comparable to 2dFGRS, but at $z \sim 0.8$

~ half volume of SDSS main at $z \sim 0$
VIPERS in a nutshell

- 440.5 VLT hours @ VIMOS + LR Red grism

Exploiting VIMOS Multi-Object Spectroscopy at VLT
VIPERS in a nutshell

- 440.5 VLT hours @ VIMOS + LR Red grism
- ~24 deg$^2$ over W1 and W4 CFHTLS wide fields (~16 + 8)
VIPERS in a nutshell

- 440.5 VLT hours @ VIMOS + LR Red grism
- $\sim 24 \text{ deg}^2$ over W1 and W4 CFHTLS wide fields ($\sim 16 + 8$)
- $I_{AB} < 22.5 + z > 0.5$ color-color pre-selection
- PSF + SED–based star-galaxy separation (AGN color recovery)
VIPERS COLOR-COLOR SELECTION: ISOLATING $z>0.5$ GALAXIES (calibrated using VVDS)
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- Colour Sampling Rate = 1 for $z>0.6$
- Transition range $0.4<z<0.6$ (due to mag errors and intrinsic scatter in color-redshift relation)
- Selection function in the transition reconstructed using complete VVDS data
- Data in this range can be used for some analyses but not for others

Guzzo & VIPERS team 2014
Advantages of VIPERS selection strategy

- Sampling ~40% of all $I_{AB} < 22.5$ galaxies between $z=0.5$ and 1.2 in only one VIMOS pass:
  - Get high density of tracers at desired $z$ range
  - Avoid multiple passes, thus maximize area for given telescope allocation
  - Targets are not dense: preserve most of angular clustering signal (minimize “proximity bias”)
Fully automated web-based archive

All data are already in our hands
Redshift measurements are finishing these days

<table>
<thead>
<tr>
<th>EFFECTIVE TARGETS</th>
<th>MEASURED REDSHIFTS</th>
<th>STELLAR CONTAMINATION</th>
<th>COVERED AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>89052</td>
<td>84674</td>
<td>2207 (2.6 %)</td>
<td>93.7 %</td>
</tr>
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</table>

EFFECTIVE TARGETS (ET) are all the primary targeted objects with the exclusion of the ones flagged as -10 (undetected). MEASURED REDSHIFTS (MR) are the fraction of ET for which a redshift has been measured. STELLAR CONTAMINATION are the MR objects which have been identified as stars.
Fully automated web-based archive
VIPERS Target Sampling Rate

Guzzo & VIPERS team 2014

\(~40\%\) on the whole VIPERS area
VIPERS Spectroscopic Success Rate

Guzzo & VIPERS team 2014

\(~80\%\) on the whole VIPERS area
Public Data Release 1 (PDR1)  
(Oct. 2013, see Garilli & VIPERS Team A&A 2014)

• Completion 64%

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<thead>
<tr>
<th></th>
<th>W1</th>
<th>W4</th>
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<tbody>
<tr>
<td>Final surveyed area</td>
<td>15.7</td>
<td>7.8</td>
</tr>
<tr>
<td>PDR-1 surveyed area</td>
<td>7.9</td>
<td>7.8</td>
</tr>
<tr>
<td>PDR-1 effective area</td>
<td>5.5</td>
<td>5.1</td>
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</tbody>
</table>
VIPERS Team Members

57 people, 10 institutions, 5 nations
PDR1 cone diagrams
VIPERS broad scientific goals

- Cosmological constraints from galaxy clustering measured up to 100 Mpc scales at $z \sim 1$
- Measure structure growth through Redshift Space Distortions out to $z \sim 1$, possibly using different tracers

First estimate of the mean growth rate of structure at $z \sim 0.8$
VIPERS broad scientific goals

- Cosmological constraints from galaxy clustering measured up to 100 Mpc scales at $z \sim 1$
- Measure structure growth through Redshift Space Distortions out to $z \sim 1$, possibly using different tracers

See also:
- Marulli et al. A&A 2013: Luminosity and stellar mass dependence of galaxy clustering at $0.5 < z < 1.1$
- Bel et al. A&A 2014: $\Omega_m$ from the clustering ratio measured at $z \sim 1$
- Di Porto et al. A&A 2015: Measuring non-linear galaxy bias at $z \sim 0.8$
For each galaxy there is a suite of photometric data:
- $u, g, r, i, z$ from CFHTLS,
- near-UV (FUV and NUV) from GALEX,
- K-band from WIRCAM follow-up,
- UKIDSS public data ($Y, J, H, K$) where available

SED fitting program Hyperzmass

Galaxy rest-frame magnitudes, stellar masses together with measured spectral features
VIPERS broad scientific goals

- Precise measurements of statistical properties of galaxy population (color, luminosity, stellar mass ...)

Most precise measurement of the number density of massive galaxies at z~1
VIPERS broad scientific goals

- Precise measurements of statistical properties of galaxy population (color, luminosity, stellar mass ...)

See also:
- Fritz et al. A&A 2013: A quiescent formation of massive red sequence galaxies over the past 9 Gyr
- Marchetti et al. A&A 2013: Spectral classification through Principal Component Analysis
VIPERS broad scientific goals

- Identify structures as groups, filaments, voids

First catalog of voids at these redshifts

Anisotropy of voids-galaxy cross-correlation function indicates that galaxies are outflowing from voids

Micheletti, AI, Hawken & VIPERS Team 2014
VIPERS broad scientific goals

- Identify structures as groups, filaments, voids

Groups catalog using FoF and VDM algorithms AI in prep.
VIPERS broad scientific goals

- Identify structures as groups, filaments, voids

VIPERS skeleton obtained with Disperse (Sousbie 2013)

Filaments using Disperse - Davidzon in prep.
VIPERS broad scientific goals

- Identify structures as groups, filaments, voids

Local density reconstruction:
ZADE photo-z attractor

Statistical reconstruction using Wiener filtering

Cucciati & VIPERS Team 2014
Summary

- VIPERS exploits VIMOS@VLT, filling a specific niche at $z \sim 1$: large volume $\sim 6 \times 10^7 \, h^{-3} \, Mpc^3$, high $\sim 40\%$ sampling. It is complementary to larger-volume, sparser BAO surveys.

- VIPERS is designed to measure clustering, RSD, structures and environmental properties of galaxies at $0.5 < z < 1.0$.

- VIPERS is a powerful probe for galaxy evolution studies over 8 billion years (see large and growing set of ancillary data: GALEX, WIRCAM, VISTA, XMM ...).

- Strong legacy value: DR1 is already available.

- See www.VIPERS.inaf.it for more info.