The VIMOS-VLT Deep Survey First Epoch observations: evolution of galaxies, large scale structures and AGNs over 90% of the current age of the universe

The VIMOS VLT Deep Survey (VVDS) is a major redshift survey of the distant universe, aimed at studying the evolution of galaxies, large scale structures and AGNs over more than 90 % of the age of the universe. A total of 41 000 spectra have been observed so far. From the First Epoch observations conducted with VIMOS, we have assembled ~ 11 000 redshifts for galaxies with $0 \leq z \leq 5$ selected with magnitude $I_{AB} \leq 24$ in an area 3.1 times the area of the full moon. We present evidence for a strong evolution of the luminosity of galaxies and show that galaxies are already distributed in dense structures at $z \sim 1.5$. The high redshift population of ~ 1 000 galaxies with $1.4 \leq z \leq 5$ appears to be more numerous than previously believed. As the survey continues, we are assembling multi-wavelength data in collaboration with other teams (Galex, Spitzer-SWIRE, XMM-LSS, VLA), as well as expanding to larger scales (~ 100 Mpc) to probe the universe in an unprecedented way.

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The VVDS aims to map the distribution of galaxies at various epochs in the life of the universe, in order to trace the evolution of galaxies in connection to the large scale structures. From a well defined flux-selected sample of sources identified from deep images, we use VIMOS on the VLT to measure the distance, via the cosmological redshifts, of a large number of galaxies and AGNs back in time up to 12 billion years ago. As we aim to measure the statistical properties of galaxies as free as possible of biases, we are observing several independent fields large enough to be insensitive to large fluctuations in the distribution of galaxies in the universe. The observations of more than 100 000 galaxies are required to characterize the population of galaxies with the basic statistical measurements like the luminosity function, or correlation function.

Two main surveys make the VVDS, the VVDS-Deep and the VVDS-Wide surveys. The VVDS-Deep is a magnitude limited survey reaching down to $I_{AB} = 24$ in 1.3 deg^2 in two fields, while the VVDS-Wide reaches down to $I_{AB} = 22.5$ in 11 deg^2 in 4 fields (Table 1). The "Deep" fields are covered with a 4-passes strategy with VIMOS, leading to a spatial sampling of 1/4th to 1/3rd of the total I-band limited population observed in photometry, while the "Wide" fields are covered in a 2-passes strategy. A total number of 41 000 spectra have been obtained as of October 1st, 2004.

We have now completed the First Epoch catalog on the VVDS-02h field and VVDS-CDFS, corresponding to observations obtained in the fall of 2002. A total of 11 564 spectra have been measured. We are in the process of completing the redshift measurements in the VVDS-Wide fields, for which a

Field	Alpha (2000)	Delta (2000)	Survey area (deg^2)	Survey mode	Observed as of 1 October 2004
VVDS-0026-04	$02^h26^m00.0^s$	-04°30′00″	1.3 (Deep)	Deep	29 deep pointings, ~12 000 slits
VVDS-CDFS	$03^h32^m28.0^s$	-27°48′30″	0.1 (Deep)	Deep	5 deep pointings, 1599 redshifts releases to the community *http://cencosw.oamp.fr*
VVDS-1003+01	$10^h03^m39.0^s$	+01°54′39″	4 (Wide)	Wide now HST-COSMOS field	7 pointings, ~2 600 slits
VVDS-1400+05	$14^h00^m00.0^s$	+05°00′00″	4 (Wide)	Wide	15 pointings, ~6 000 slits
VVDS-2217+00	$22^h17^m50.4^s$	-00°24′27″	4 (Wide)	Wide	48 pointings, ~20 000 slits

Table 1: VVDS fields

total of ~27 000 additional spectra have been observed.

The VVDS-10h field has now become the HST-COSMOS field with 2 deg^2 being observed with an unprecedented 590 orbits of HST-ACS. Our primary choice was the VVDS-02h where more than 10 000 spectra were available at the time of the original HST proposal, which would have made the redshifts and morphology of more than 10 000 galaxies immediately available. Unfortunately, at the pressing request of ESO and HST observatories, the COSMOS field has been set on the VVDS-10h field to avoid a severe time allocation conflict, preventing the COSMOS-VVDS team to assemble redshifts in connection with the HST imaging until the acceptance of the zCOSMOS programme, now secured.

The VVDS was defined to make use of the GTO nights allocated to the VIRMOS consortium in compensation for the substantial institute investment in building VIMOS. After the large cut of the GTO from 80 to 50 nights, with only 33 nights out of these having been clear, we are now seeking Large Program status to complete the VVDS as close to originally planned.

We present here the VVDS First Epoch data, and the main science results obtained. Results discussed below are computed with $H_0 = 70$, $\Omega_m = 0.3$, $\Omega_\Lambda = 0.7$.

Deep photometry

Excellent deep images are required for a deep redshift survey in order to select targets for spectroscopy in an unbiased way, and to constrain the spectral energy distribution of the observed objects. We have completed deep photometry over the VVDS-02, VVDS-10, VVDS-14 and VVDS-22 fields, in *BVR*- and *I*-bands using the CFHT, as well as in *U* (see Le Fèvre et al., 2004b, and references therein) and *K* (Iovino A., and the VVDS team, in prep.) for smaller areas using ESO telescopes. We present an example of our deep images in Figure 1. The photometric catalogs and images are fully public on *http://cencosw.oamp.fr/*. We are complete down to $I_{AB} = 25$, and $K_{AB} = 21.7$, which ensures that no bias is propagated from the photometry to the spectroscopy, for any galaxy type. Recently, deep *u*, *g*, *r*, *i*, and *z* photometry has been obtained on the VVDS-02h field as part of the CFHT Legacy Survey.

VIMOS multi-slit spectroscopy observations and data processing

Multi-object spectra are observed with the LRRED grism with VIMOS on the VLT and 1 arcsec slit width. The average slit number for the VVDS-Deep and VVDS-Wide is 540 and 450 slits, respectively. A pointing pattern has been defined to produce a homogeneous field coverage for the VVDS-Deep, with a grid of VIMOS pointings offset by (2,2) arcmin, with 4 pointings looking in turn at the same area in the sky. The VVDS-Wide pointing strategy allows observing each point in the sky with two VIMOS pointings producing a roughly homogeneous coverage of the large 2 × 2 deg^2 fields. In the "Deep" survey, 10 exposures of 27 minutes each are taken for a total exposure time of 4.5 h. In the "Wide" mode of the VVDS, 5 exposures of 10 minutes are taken for a total exposure time of 50 min. The galaxies observed until 1 October 2004 are shown in Figure 2.

The data processing has been progressing in two steps: extraction of the wavelength and flux calibrated one dimensional spectra with VIPGI (VIMOS Interactive Processing Graphical Interface, Scodeggio et al., 2005), and redshift measurement using KBRED, an automated tool for redshift measurement (Scaramella et al., in prep). VIPGI integrates in a very efficient environment (Scodeggio et al., 2005) the software delivered to ESO by the VIRMOS consortium for the ESO-VIMOS pipeline. It is available along with computing resources at our facilities in Marseille and Milan for anybody who obtains VIMOS data (*http://cosmos.mi.iasf.cnr.it/marcos/vipgi/vipgi.html*). The spectral resolution is R = 230, and the velocity accuracy is 275 km/s as measured from repeated observations of the same objects.

Measuring redshifts in a large range $0 \leq z \leq 5$

The VVDS is the first survey to assemble a complete spectroscopic sample of galaxies based on a simple *I*-band limit down to $I_{AB} = 24$, spanning the redshift range $0 \leq z \leq 5$. Magnitude limited samples have the advantage of a controlled bias in the selection of the target galaxies, which can lead to a reliable census of the galaxy population as seen at a given rest-frame wavelength.

The redshift domain above redshift 1.3 and below the redshift domain of Lyman-break galaxies $z > 2.7$ has been referred to as the "redshift desert". Crossing this "redshift desert" is critical to reduce the incompleteness of deep redshift surveys, and probe the galaxy population at an important time in the evolution. As the VVDS observed wavelength range is 5500–9500 Å, it is relatively easy to observe spectral features such as [OII]3727 Å up to $z \sim 1.4$, and then the strong UV features below 1700 Å for $z > 2.6$, but the redshift range $1.4 < z < 2.7$ is more tricky. Using high quality galaxy templates produced from VVDS galaxies to compute redshifts with KBRED we have been able to identify a large population of objects with $z > 1.4$, successfully crossing the "desert" up to $z \sim 2.2$, as other teams have also recently been doing (e.g. Steidel et al., 2004). The remaining VVDS "desert" $2.2 \leq z \leq 2.6$ is demonstrated to be the result of the selection function imposed by the combination of the faintness of the sources, the wavelength domain of the VIMOS-LRRED, and the strong OH sky emission features. A way to eliminate any possible redshift desert and follow the main population of galaxies including early-type systems would be to combine visible and near-IR multi-object spectros-

Figure 1: Composite *BVI* image from the CFHT12K survey (Le Fèvre et al., 2004a). The limiting magnitude (5σ, in 3 arcsec diameter aperture) is $I_{AB} = 25$. This image shows only 3 × 4 arcmin^2, or 1/5000th of the full 16 deg^2 imaging survey.

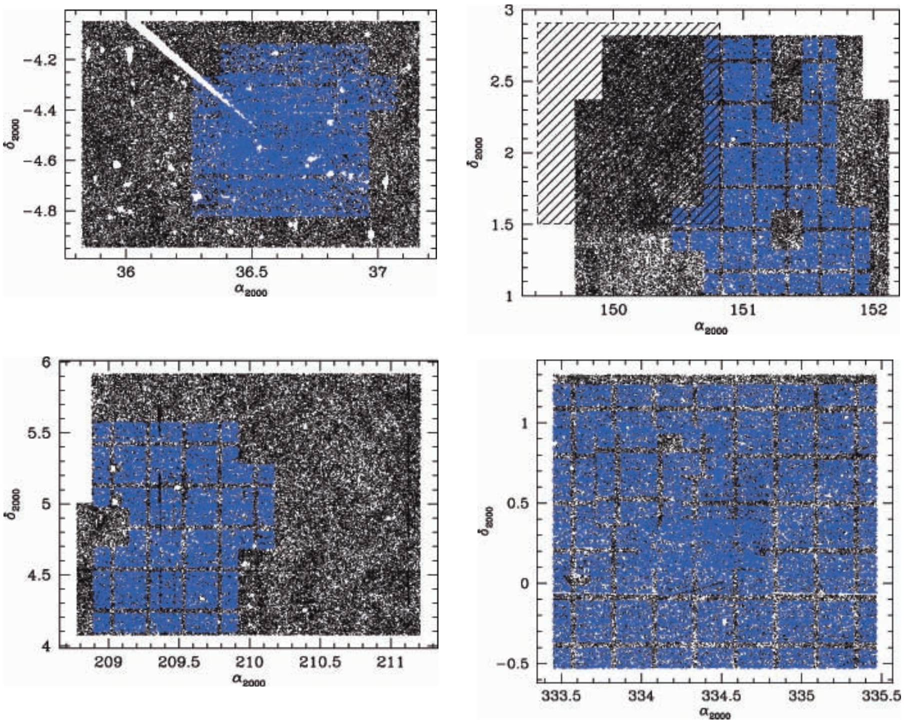


Figure 2: Field coverage of the VVDS fields as of 1st October 2004 (axis are in degrees): VVDS-02h (top-left), VVDS-10h (top-right), VVDS-14h (bottom-left), VVDS-22h (bottom-right). Galaxies with measured spectra are identified as blue dots, superimposed on the background of photometric targets with $I_{AB} \leq 24$ for the VVDS-02h field, and $I_{AB} \leq 22.5$ for the other fields. The shaded area in the VVDS-10h represents the COSMOS survey area. The VVDS-CDFS is not represented here; it contains 1599 measured VVDS redshifts (Le Févre et al., 2004b) A total of 14000 targets have been observed in the VVDS-Deep, and 27000 in the VVDS-Wide. The VVDS-22h has been covered once and awaits a second pass of VIMOS observations.

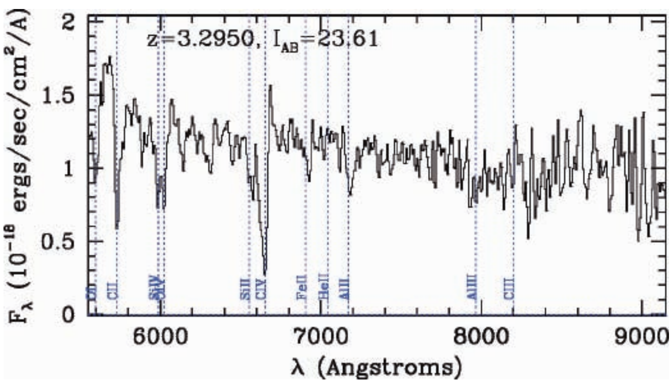


Figure 3: Spectrum of an absorption line galaxy with $I_{AB} = 23.61$, and $z = 3.2950$, demonstrating the ability of low spectral resolution (R ~ 230) to measure redshifts from absorption line galaxies down to the very faint end of the survey and at high redshift.

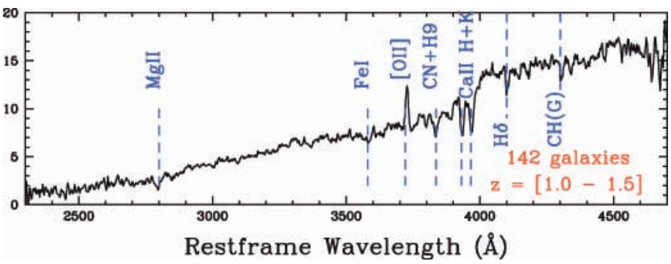


Figure 4: Example of galaxy templates constructed from the VVDS, for early type galaxies with $0.6 \leq z \leq 1.5$.

copy. Unfortunately, the cancellation of NIRMOS has postponed several critical science topics in need of statistically significant samples until KMOS comes into operation after 2010.

Our observations demonstrate that measuring redshifts at $z > 1.4$ from low resolution spectroscopy R ~ 200 can be done efficiently: a sample spectrum is shown in Figure 3, and high quality VVDS templates are shown in Figure 4 and Figure 10. Low resolution with VIMOS allows us to double or triple the number of spectra observed in one single observation compared to medium R ~ 600 resolution and up to 4–5 times more compared to R ~ 2500 observations. It is thus particularly well suited to assemble very large samples in a reasonable amount of observing time. Low resolution surveys have the capability to quantify sub-populations, identify rare populations, and establish well defined unbiased statistical samples which can then be followed up at higher spectral resolution. For programs requiring higher velocity accuracy, better sampling and S/N of narrow spectral features, medium (~ 600) or medium high (~ 2500) spectral resolution can be very useful indeed, but at a significant loss of total observed spectra.

The VVDS First Epoch Sample

The First Epoch sample contains 11564 objects with spectra; 9677 are galaxies with a redshift measurement, 836 objects are stars, 90 are AGNs, and a redshift could not be measured for 961 objects (Le Fèvre et al., 2005a). There are 1065 objects (galaxies and QSOs) with a measured redshift $z \geq 1.4$. When considering only the primary spectroscopic targets, the survey reaches a redshift measurement completeness of 78 % overall (93 % including less reliable flag 1 objects), sampling ~ 25 to 30 % of the population of galaxies with $I_{AB} \leq 24$. The VVDS data on the CDFS is fully public, with 1599 redshifts available at *http://cencosw.oamp.fr/* (Le Fèvre et al., 2004b).

We have assigned to each redshift measurement a quality assessment similar to the scheme used by the CFRS (Le Fèvre et al., 1995). Comparing the redshift measurement of 426 objects observed twice and processed independently, we have been able to estimate that the probability of being correct is 53 ± 5 %, 81 ± 3 %, 94 ± 3 %, and 100 %, for galaxies with flags 1, 2, 3, 4 respectively, and that the velocity accuracy is 275 km/s. Comparison to the dataset of Vanzella et al. (2005) of 39 VVDS galaxies in the CDFS observed with VLT-FORS2, shows only 9 discrepancies, with 8 solved from the better red sensitivity of FORS2 and one with a better S/N from the VVDS spectrum. This excellent agreement is statistically fully compatible with the distribution of probabilities for the VVDS flags given the small comparison sample from FORS2 and the different observing conditions.

Redshift distribution of the $I_{AB} \leq 24$ sample

The redshift distribution of a spectroscopically selected sample of galaxies with

$17.5 \leq I_{AB} \leq 24$ has been measured for the first time from the VVDS, as shown in Figure 5. The distribution of galaxies peaks at $z = 0.8–0.9$ (median $z = 0.76$, mean $z = 0.90$), while there is a significant high redshift tail extending up to $z \sim 5$. There are 558 galaxies in our primary sample with a measured redshift $1.4 \leq z < 2.5$, 258 with $2.5 \leq z < 3.5$ and 161 with $3.5 \leq z < 5$, the largest purely magnitude selected sample at these redshifts so far.

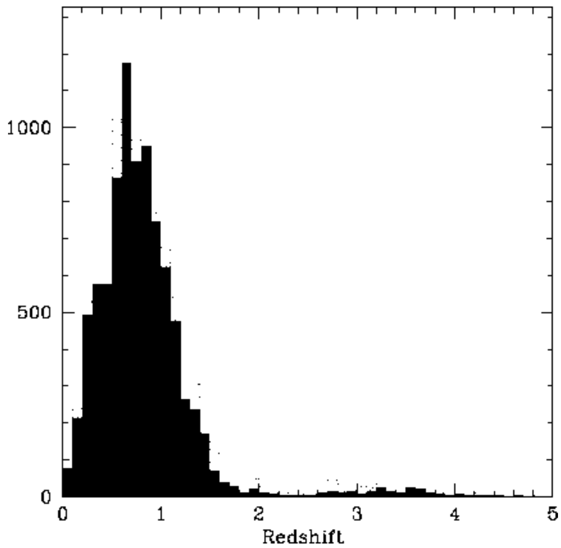


Figure 5: Spectroscopic redshift distribution of a sample of 9141 galaxies with $17.5 \leq I_{AB} \leq 24$. This sample is 78 % complete. The secure redshift sample is shown as the filled histogram, and less secure redshift measurements are represented by the dashed histogram. The median redshift is $z = 0.76$, while the mean is $z = 0.90$. The dearth of objects with $2.2 < z < 2.6$ is a consequence of the observed wavelength range on the ability to measure redshifts, producing the VVDS "redshift desert" (see text).

Evolution of the luminosity function and luminosity density from $z = 2$

The evolution of the Luminosity Function (LF) has been investigated from the First Epoch VVDS sample, for $17.5 \leq I_{AB} \leq 24$ (Ilbert et al., 2005), using the ALF tool. We observe a substantial evolution with redshift of the global luminosity function in all bands from *U* to *I* rest frame, as shown in Figure 6 for the *B*-band. The LFs have been estimated within the absolute magnitude range in which any kind of galaxy is observable (dashed vertical lines in Figure 6, and Figure 7; Ilbert, O., et al., 2004). Compared to the local SDSS values, we measure a brightening ranging from 1.8–2.4 magnitudes in the *U*-band, to 0.8–1.4 magnitudes in the *I*-band, when going from $z = 0.05$ up to $z = 2$ (Ilbert et al., 2005). The stronger brightening toward bluer rest frame wavelengths suggests that most of the evolution of the global LF up to $z = 2$ is related to the star formation history, better probed with the luminosity measured at short rest frame wavelengths.

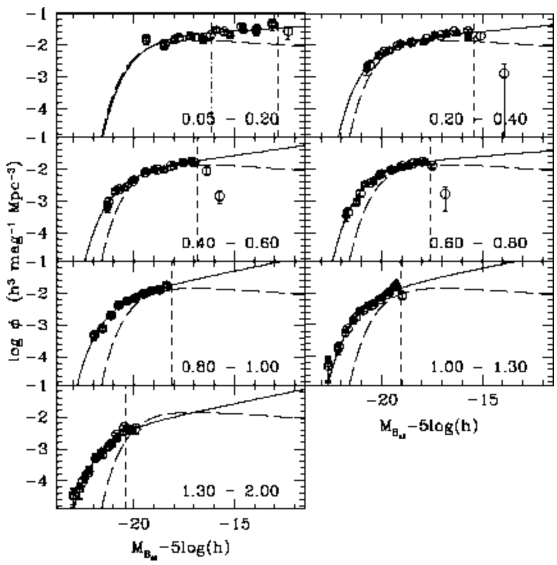


Figure 6: Evolution of the luminosity function in the rest-frame *B*-band (Ilbert et al., 2005). Each panel shows the LF computed in the redshift range identified in the lower right corner. Open circles show the VVDS values computed using the V_{max} and the continuous line is computed using the STY technique. The local LF computed by the SDSS is shown as the long dashed line in each panel as a reference.

The First Epoch sample also allows the derivation of the luminosity function for each of four galaxy types out to $z \sim 1.5$ (Zucca, E., and the VVDS team, in prep.). We present in Figure 7 the LF of two extreme galaxy types (among four) that we have used to classify the galaxies. The difference is striking: galaxies with early spectral types are only mildly evolving with a 0.5 magnitudes brightening, while the late-irregular type galaxies were ~2 magnitudes brighter and twice more numerous at $z \sim 1.2–1.5$. At bright magnitudes $I_{AB} \leq 22.5$, our results are fully consistent with the CFRS results. Down to $I_{AB} \leq 24$, we find some significant differences compared to previous surveys based on photometric redshifts (e.g. Wolf et al., 2003), possibly due to the degeneracy in photometric redshifts computation, demonstrating the need for spectroscopic redshifts to properly assess the statistical properties of the high redshift galaxy population.

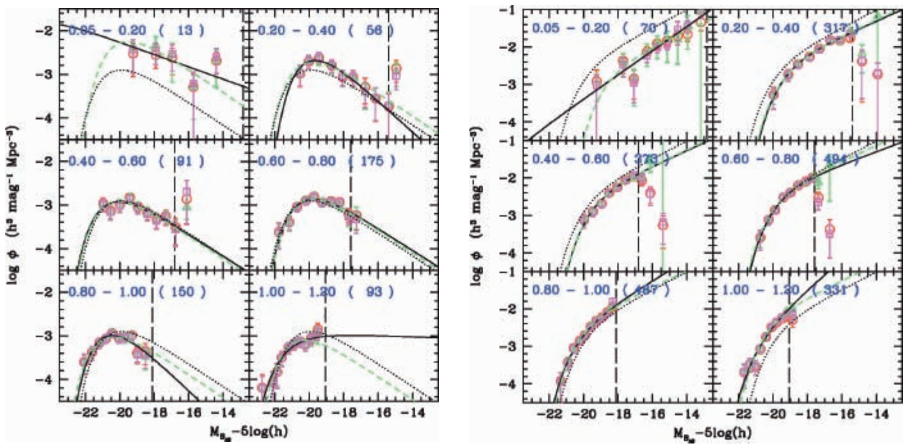


Figure 7: Evolution of the luminosity function in the rest frame *B*-band for galaxies spectrophotometrically classified as early type (left) and late/irregular type (right) (Zucca, E., and the VVDS team, in preparation). Vertical dashed lines indicate the luminosity above which no bias is expected. While the early types show a mild evolution of about 0.5 magnitudes, consistent with passive stellar evolution, the irregular galaxies exhibit a strong 2 magnitudes evolution and an increase in number density of a factor ~2.

Evolution of the distribution of galaxies in large scale structures from $z = 2$

The First Epoch sample allows a direct estimate of the evolution of the spatial distribution of galaxies *from within the same survey* (Le Fèvre et al., 2005b). The main separation between galaxies is best described by the correlation length, which we have computed from the correlation functions $\xi(r_p,\pi)$ and $w_p(r_p)$ for a total of 7155 galaxies in a 0.61 deg^2 area. We find that the correlation length $r_0(z)$ increases only slightly from $z = 0.5$ to $z = 1.1$, with $r_0(z) = 2.5–2.8\ h^{-1}$ Mpc (comoving), for galaxies comparable in luminosity to the local 2dFGRS and SDSS samples. This indicates that the amplitude of the correlation function was ~ 2.5 times lower at $z \sim 1$ than observed at the present time. The correlation length is increasing to

r_0 ~ 3.0 h^{-1} Mpc at higher redshifts z = [1.3,2.1], as we are observing increasingly brighter galaxies, comparable to the clustering length of galaxies with M_B(AB) = –20.5 locally. The slowly varying clustering of VVDS galaxies as redshift increases is markedly different from the predicted evolution of the clustering of dark matter, indicating that bright galaxies were tracing higher density peaks when the large scale structures were emerging from the dark matter distribution 9–10 billion years ago, a supporting evidence for a strong evolution of the galaxy vs. dark matter bias. This is the first time that a consistent picture of galaxy clustering is obtained over such a large time base from within the same survey as shown in Figure 8. The analysis of the clustering of sub-populations (e.g. selected by type or luminosity) is in progress (Meneux et al., Guzzo et al., Pollo et al., in preparation).

The complete spectroscopic survey samples the high redshift universe at z ~ 1 with a mean inter-galaxy separation of ~5 Mpc equivalent to the sampling of the 2dF galaxy redshift survey at a mean redshift z ~ 0.1. The galaxy density field can be computed reliably up to z ~ 1.5. It spectacularly shows strong over-densities (e. g. shown in Figure 9) alternating with low density regions, very dense walls, and filamentary distribution, which can be traced in the entire survey cone, and over transverse scales ~ 30 Mpc. The size of structures observed indicates that probing even larger scales ~ 100 Mpc is necessary, as planned in the original VVDS.

The second moment of the Probability Distribution Function (PDF) of galaxy overdensities stays roughly constant up to z ~ 1.5, with σ_8 = 0.94 ± 0.07 (in redshift space). The third moment of the PDF, the skewness, increases with cosmic time: we find that the probability of having under-dense regions is higher at z ~ 0.7 than it was at z ~ 1.5. By comparing the observed PDF of galaxy fluctuations with the theoretically predicted PDF of mass fluctuations, we find that the galactic bias is increasing by ~ 40% from z ~ 0.7 to z = 1.5. Red objects appear more clustered than blue objects at all epochs investigated. The relative bias between the density fluctuations of red and blue objects is constant as a function of redshift with a relative bias of ~ 1.4 comparable to the local z = 0 value. These results are presented in Marinoni et al. (submitted).

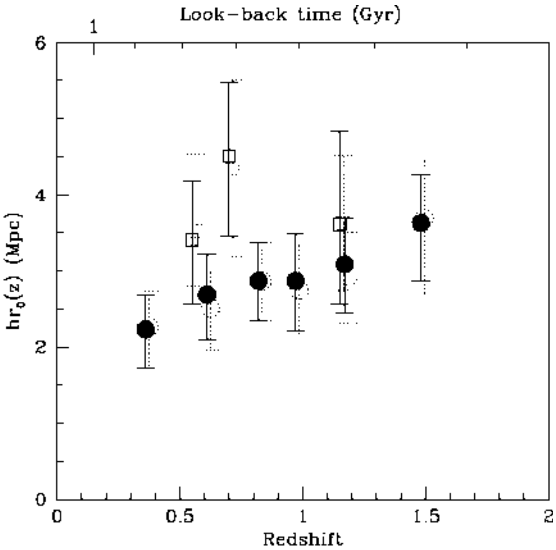


Figure 8: Evolution of the correlation length $r_0(z)$ along cosmic time (Wolf et al., 2003). The filled circles are the VVDS measurements in the VVDS-02h field, while the open squares are measured in the VVDS-CDFS field. The VVDS-CDFS point at z ~ 0.7 shows a higher correlation length because of the presence of a strong over-density at this redshift.

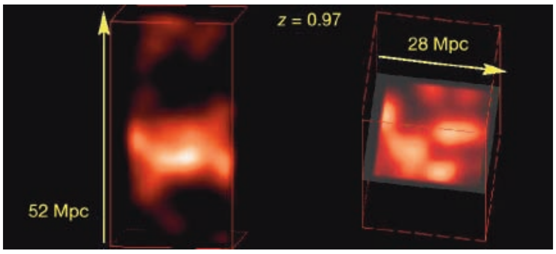


Figure 9: Galaxy density field around a large "wall" of galaxies in the VVDS-02h field. This dense structure is at a redshift z = 0.97, it is relatively thin and extends over the full transverse cone sampled so far or ~ 40 Mpc. Extending the survey up to 2 degrees size would allow us to probe such large scale structures on scales ~ 100 Mpc.

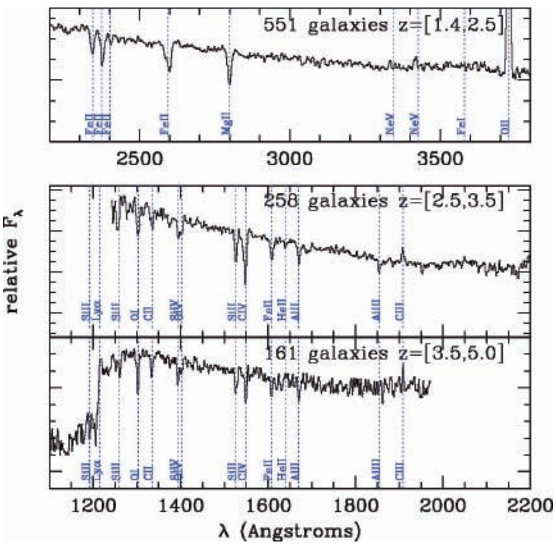


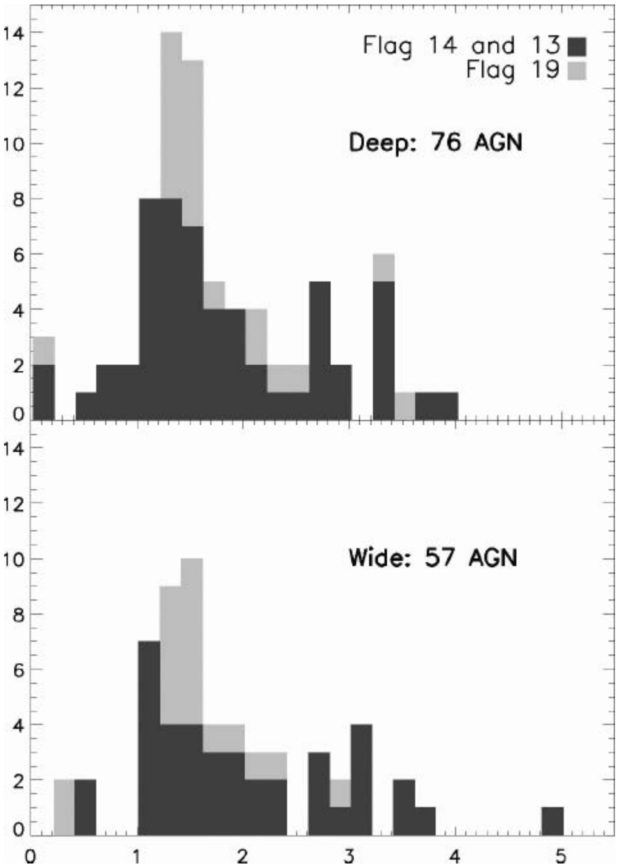
Figure 10: Composite VIMOS spectra of the high redshift VVDS First Epoch galaxy sample in each of the redshift domains z = [1.4,2.5], z = [2.5,3.5], z = [3.5,5]. UV features are clearly identified, and the blue continuum indicates actively star forming galaxies.

The high redshift 1.4 ≤ z ≤ 5 VVDS population

There are more than 970 galaxies with redshifts measured in the range z = [1.4,5] in the primary sample of the First Epoch VVDS. The composite spectra of galaxies with measured redshifts in the range z = [1.4,2.5], z = [2.5,3.5], and z = [3.5,5], are shown in Figure 10. These galaxies are bright, with absolute magnitudes M_B(AB) = –21.5 or brighter. They show a strong UV continuum indicating vigorous star formation (Figure 10). From the rest frame 1500 Å UV flux we can infer that these galaxies produce stars with a star formation rate of several tens of solar masses per year (uncorrected for extinction). The volume density of galaxies at these redshifts seems to be higher than previously reported for other galaxy populations at the same redshifts. This is under investigation and will be reported elsewhere (Le Fèvre, O., and the VVDS team, in prep.), together with the detailed properties of these galaxies (Paltani, S., and the VVDS team, in prep.).

The faint AGN population out to z ~ 5

Since the only selection criterion for the VVDS is magnitude, with no additional criteria based on morphology or colors, the VVDS is also an ideal survey for selecting a complete and unbiased sample of AGN. We have identified 133 broad line QSOs up to now, 76 identified in the VVDS-Deep survey of the VVDS-02h and VVDS-CDFS, and 57 QSOs identified so far in the VVDS-Wide survey of the VVDS-10h and VVDS-22h. The redshift distribution is shown in Figure 11. The VVDS probes ~ 2–3 magnitudes fainter than the 2dF QSO survey, extending the measurement of the LF toward the faint end, and sampling a transition regime between bright AGNs and galaxies, where standard selection for AGN samples is significantly incomplete. This is presented in Gavignaud et al. (in prep.), and Bongiorno et al. (in prep).



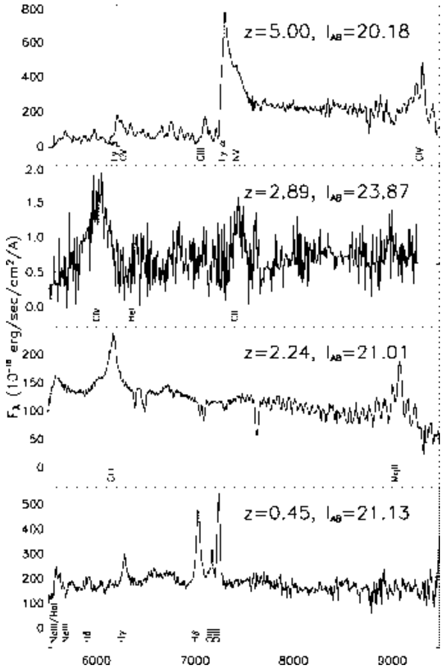


Figure 11: (left) Redshift distribution of broad line AGNs identified in the VVDS-Deep $I_{AB} \leq 24$ sample (top), and in the VVDS-Wide $I_{AB} \leq 22.5$ sample (bottom). QSOs with several features supporting the redshift are represented by the shaded histogram, while the light grey histogram indicates QSOs with only one secure broad line observed. (right) Example of QSO spectra covering our redshift and magnitude range.

Multi-wavelength observations

We have been conducting observations at wavelengths outside the optical and near-infrared window of the VVDS, and we have stimulated observations from other teams. We have observed the VVDS-02h field with the VLA at a depth 17 μJy (1σ) (Bondi et al., 2003, and Ciliegi, P., et al., in prep.). The VVDS-02h field is observed in the UV with GALEX, in the mid-IR with Spitzer by the SWIRE team, in the X-rays with XMM by the XMM-LSS team. The VVDS-22h field is observed by GALEX, and the VVDS-10h, now the COSMOS field, is observed at all wavelength from the radio to the X-ray band (*http://www.astro.caltech.edu/~cosmos/*).
The immediate availability of ~1000 VVDS redshifts of UV sources detected with GALEX in the VVDS-02h has allowed publishing for the first time the luminosity function, luminosity density, and star formation rate directly measured at 1500 Å rest frame (Arnouts et al., 2004).

The SWIRE team has observed the VVDS-02h field with Spitzer, at wavelengths 3.6, 4.5, 5.8, 8 and 24 microns. The joint catalogue of SWIRE and optical data gives redshifts for more than 3200 sources at 3.6 μm, and more than 220 sources at 24 μm. The combination of deep optical, near-IR and mid-IR data will be very powerful to probe the evolution of stellar light, and dust enshrouded star formation.

A detailed dynamical study of VVDS galaxies with $1 < z < 2$ will be conducted with 3D spectroscopy and SINFONI (Lemoine-Buserolle et al.). The VVDS is a uniquely suited sample to perform an unbiased sample selection for follow-up spectroscopy, in particular to measure star formation indicators like the Hα line in emission, from near-IR spectroscopy. A UK team led by A. Bunker is proposing to use CIRPASS as a visiting instrument on the VLT to perform near-IR multi-fiber spectroscopy.

Prospects

The VVDS is now bringing into full view the distant universe of normal galaxies like our Milky Way and its progenitors over a large time of evolution. The hard but rewarding approach of a magnitude limited sample allows a statistically robust measurement of the evolution of the galaxy population using the luminosity function, correlation function, or the probability distribution function of density fluctuations. A wealth of new results will appear in the months to come from the First Epoch catalogue of ~10 000 redshifts and the ~30 000 spectra being processed. It is essential to our understanding of galaxy evolution that the VVDS be completed as originally planned with (i) an increase of the area covered in the VVDS-02h "deep" field by at least a factor 2, and (ii) a complete redshift measurement in ~10 deg^2 in the full VVDS-14h and VVDS-22h. This will extend the survey to ~100 Mpc at z ~ 1–5, unprecedented up to now, probing scales larger than the mean size of large voids and dense structures. This will undoubtedly bring new insight into the complex interplay between galaxy evolution and the underlying large scale structure distribution. The VVDS, combined with the zCOSMOS survey connecting the evolution of galaxy morphology to the large scale structures, is establishing European astronomy as a leading authority in high statistical accuracy deep redshift surveys, a central key to our understanding of galaxy evolution.

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