The ESO UVES advanced data products quasar sample

I. Dataset and new N_{HI} measurements of damped absorbers

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ABSTRACT

We present here a dataset of quasars observed with the Ultraviolet Visual Echelle Spectrograph (UVES) on the Very Large Telescope and available in the European Southern Observatory UVES Advanced Data Products archive. The sample is made up of a total of 250 high resolution quasar spectra with emission redshifts ranging from $0.191 \leq z_{\text{em}} \leq 6.311$. The total UVES exposure time of this dataset is 1560 h. Thanks to the high resolution of UVES spectra, it is possible to unambiguously measure the column density of absorbers with damping wings, down to $N_{\text{HI}} \gtrsim 10^{19} \text{ cm}^{-2}$, which constitutes the sub-damped Ly α absorber (sub-DLA) threshold. Within the wavelength coverage of our UVES data, we find 150 damped Ly α systems (DLAs)/sub-DLAs in the range $1.5 < z_{\text{abs}} < 4.7$. Of these 150, 93 are DLAs and 57 are sub-DLAs. An extensive search in the literature indicates that 6 of these DLAs and 13 of these sub-DLAs have their N_{HI} measured for the first time. Among them, 10 are new identifications as DLAs/sub-DLAs. For each of these systems, we obtain an accurate measurement of the HI column density and the absorber's redshift in the range $1.7 < z_{\text{abs}} < 4.2$ by implementing a Voigt profile-fitting algorithm. These absorbers are further confirmed thanks to the detection of associated metal lines and/or lines from members of the Lyman series. In our data, a few quasars' lines-of-sight are rich. An interesting example is towards QSO J0133+0400 ($z_{\text{em}} = 4.154$) with six DLAs and sub-DLAs reported.

Key words. galaxies: abundances – galaxies: high-redshift – quasars: absorption lines – quasars: general

1. Introduction

Among the absorption systems observed in the spectra of quasars, those with the highest neutral hydrogen column density are thought to be connected with the gas reservoir responsible for forming galaxies at high redshift and have deserved wide attention (see review by Wolfe et al. 2005). These systems are usually classified according to their neutral hydrogen column density as damped Ly α systems (DLAs) with $N_{\text{HI}} \geq 2 \times 10^{20} \text{ atoms cm}^{-2}$ (e.g., Storrie-Lombardi & Wolfe 2000; Wolfe et al. 2005) and sub-damped Ly α systems (sub-DLAs) with $10^{19} \leq N_{\text{HI}} \leq 2 \times 10^{20} \text{ atoms cm}^{-2}$ (e.g., Péroux et al. 2003a).

The study of these systems has made significant progress in recent years, thanks to the availability of large sets of quasar spectra with the two-degree field survey (2dF, Croom et al. 2001) and the Sloan Digital Sky Survey (SDSS; Prochaska et al. 2005; Noterdaeme et al. 2009; Noterdaeme et al. 2012b). They have been shown to contain most of the neutral gas mass in the Universe (Lanzetta et al. 1991, 1995; Wolfe et al. 1995) and are currently used to measure the redshift evolution of the total amount of neutral gas mass density (Lanzetta et al. 1991; Wolfe et al. 1995; Storrie-Lombardi & Wolfe 2000; Péroux et al. 2003b; Prochaska et al. 2005; Noterdaeme et al. 2009, 2012b). In addition, the sub-DLAs may contribute significantly to the cosmic metal budget, which is still highly incomplete. Indeed, only ~20% of the metals are observed when one adds the contribution of the Ly α forest, DLAs, and galaxies, such as Lyman break galaxies (e.g., Pettini et al. 1999; Pagel 2002; Wolfe et al. 2003; Pettini 2004, 2006; Bouché et al. 2005, 2006, 2007).

Therefore, to obtain a complete picture of the redshift evolution of both the cosmological neutral gas mass density and the metal content of the Universe, the less-studied sub-DLAs should be taken into account (Péroux et al. 2003a). However, these systems cannot be readily studied at low resolution, and only limited samples of high-resolution quasar spectra have been available until now (e.g., Péroux et al. 2003a; Dessauges-Zavadsky et al. 2003; Ledoux et al. 2003; Kulkarni et al. 2007; Meiring et al. 2008, 2009). The excellent resolution and large wavelength coverage of UVES allows this less studied class of absorber to be explored.

We have therefore examined the high-resolution quasar spectra taken between February 2000 and March 2007 and available in the UVES (Dekker et al. 2000) Advanced Data Products archive, ending up with a sample of 250 quasar spectra. In this paper we present both the dataset of quasars observed with UVES and the damped absorbers (DLAs and sub-DLAs) covered by these spectra. In addition, we measured column densities of DLAs/sub-DLAs seen in the spectra of these quasars and not reported in the literature. In a companion paper (Zafar et al. 2013), we built a carefully selected subset of this dataset to study the statistical properties of DLAs and sub-DLAs, their column density distribution, and the contribution of sub-DLAs to the gas mass density. Further studies, based on specifically designed subsets of the dataset built in this paper, will follow (e.g., studies of metal abundances, molecules).

This work is organized as follows. In Sect. 2, information about the UVES quasar data sample is provided. In Sect. 3, the properties of the damped absorbers are described. This section

also summarizes the details of the new column density measurements. In Sect. 4, some global properties of the full sample are presented and lines-of-sight of interest are reported in Sect. 5. All log values and expressions correspond to log base 10.

2. The quasar sample

2.1. ESO advanced data products

In 2007, the European Southern Observatory (ESO) managing the 8.2 m Very Large Telescope (VLT) observatory has made available to the international community a set of Advanced Data Products for some of its instruments, including the high-resolution UVES¹ instrument. The reduced archival UVES echelle dataset is processed by the ESO UVES pipeline (version 3.2) within the MIDAS environment with the best available calibration data. This process has been executed by the quality control (QC) group, part of the Data Flow Department. The resulting sample is based on a uniform reprocessing of UVES echelle point source data from the beginning of operations (dated 18th of February 2000) up to the 31st of March 2007. The standard quality assessment, quality control and certification have been integral parts of the process. The following types of UVES data are not included in the product data set: i) data using the image slicers and/or the absorption cell; ii) Echelle data from extended objects and iii) data from the Fibre Large Array Multi Element Spectrograph (FLAMES)/UVES instrument mode.

In general, no distinction has been made between visitor mode (VM) and service mode (SM) data, nor between standard settings and non-standard settings. However, the data reduction was performed only when robust calibration solutions i.e., (“master calibrations”) were available. In the UVES Advanced Data Products archive, these calibrations are available only for the standard settings centered on λ 346, 390, 437, 520, 564, 580, 600 or 860 nm. For certain “non-standard” settings, master calibrations were not produced in the first years of UVES operations (until about 2003). These are e.g. 1×2 or 2×3 binnings, or the central wavelengths mentioned above. As a result, the Advanced Data Products database used for the study presented here is not as complete as the ESO UVES raw data archive.

2.2. Quasars selection

The UVES archives do not provide information on the nature of the targets. Indeed, the target names are chosen by the users and only recently does the Phase 2 step propose for the user to classify the targets, but only on a voluntary-basis. Therefore, the first step to construct a sample of quasar spectra out of the Advanced Data Products archive is to identify the nature of the objects. For this purpose we retrieved quasar lists issued from quasar surveys: the Sloan digital sky survey data release 7 (DR7) database², HyperLeda³, 2dF quasar redshift survey⁴, Simbad⁵ and the Hamburg ESO catalogue. The resulting right ascension (RA) and declination (Dec) of the quasars were cross-matched with UVES Advanced Data Products archive within a radius of $15.0''$. The large radius was chosen to overcome possible

relative astrometric shifts between the various surveys and the UVES database. Because of this large radius, the raw matched list do not only contain quasars but also other objects such as stars, galaxies, Seyferts. The non-quasar objects have been filtered out by visual inspection of the spectra. The data in an ESO OPC category C (Interstellar Medium, Star Formation and Planetary Systems) and D (Stellar Evolution) are usually targeting galactic objects, but for some cases observers targeted quasars under the same program. The spectra have been visually inspected for those particular cases.

2.3. Further data processing

In the UVES spectrograph, the light beam from the telescope is split into two arms (UV to Blue and Visual to Red) within the instrument. The spectral resolution of UVES is about $R = \lambda/\Delta\lambda \sim 41\,400$ when a $1.0''$ slit is used. By varying slit width, the maximum spectral resolution can reach up to $R = 80\,000$ and $110\,000$ for the BLUE and the RED arm, respectively. For each target, individual spectra (most often with overlapping settings) were merged using a dedicated Python code which weights each spectrum by its signal-to-noise ratio. All contributing spectra were regridded to a common frame, with the resolution being that of the spectrum with the highest sampling. When present, the bad pixels were masked to assure that they would not contribute to the merged spectrum. In the regions of overlap the spectra were calibrated to the same level before being error-weighted and merged. Particular attention was given to “step” features in the quasar continua and a visual search has identified and corrected these features when they corresponded to the position in between two orders of the Echelle spectrum. In the merging process for each individual spectrum, a radial velocity correction for barycentric and heliocentric motion (using heliocentric correction values from the files header) was applied. A vacuum correction on the wavelength was also applied.

The resulting list comprises 250 quasar spectra. The number of individual spectra used to produce the co-added spectrum, Simbad V-band magnitudes, together with total exposure time in seconds for each target, are provided in Table 1. Throughout the paper, this sample obtained from the ESO UVES Advanced Data Products facility is called EUADP sample. The total VLT exposure time of this dataset is $T_{\text{tot}} = 1560$ h.

In the case of close pairs of quasars or gravitationally-lensed quasars, we have separated the objects if different slit-positions were used but only analyzed the brightest object if these objects were aligned along the slit. Our sample contains two lensed quasars: QSO B0908+0603 (double system) and QSO B1104-181 (quadruple system). In the former case two objects, and, in the latter case, three objects were aligned on the slit (Lopez et al. 2007). In these cases we only analyzed the brightest objects. Our sample contains four quasar pairs: QSO J0008-2900 & QSO J0008-2901 (separated by $1.3''$), J030640.8-301032 & J030643.7-301107 (separated by $\sim 0.85''$), QSO B0307-195A & B (separated by $\sim 1''$), and QSO J1039-2719 & QSO B1038-2712 (separated by $17.9''$). For these eight objects, eight different slit-positions were used.

3. The DLA/sub-DLA sample

The quasar spectra were normalized to unity within the MIDAS environment. For each quasar the local continuum was determined in the merged spectrum by using a spline function to smoothly connect the regions free of absorption features (see Fig. 1). The final normalized spectra used for column density

¹ http://archive.eso.org/eso/eso_archive_adp.html

² <http://www.sdss.org/dr7/>

³ <http://leda.univ-lyon1.fr/>

⁴ http://www.2dfquasar.org/Spec_Cat/2qzsearch2.html

⁵ <http://simbad.u-strasbg.fr/>

Fig. 1. Example of a UVES quasar spectrum of J223941.8-294955 at $z_{\text{em}} = 2.102$. The quasar continuum (red overlay) is fitted using a spline function.

analysis were obtained by dividing merged spectra by these continua. During normalization, the artifact from residual fringes (especially in standard setting centered on λ 860nm) and spectral gaps are also included in the spline fitting. In order to secure all DLAs and sub-DLAs in a given spectrum, we proceeded as in Lanzetta et al. (1991) and used an automated Python detection algorithm. This code builds an equivalent width spectrum over 400 pixel wide boxes ($\sim 12 \text{ \AA}$ for $0.03 \text{ \AA pixel}^{-1}$) blueward of the quasar's $\text{Ly}\alpha$ emission and flags regions of the spectra where the observed equivalent width exceeds the sub-DLA definition (i.e. $N_{\text{HI}} \gtrsim 10^{19} \text{ cm}^{-2}$). This candidate list of DLAs and sub-DLAs is further supplemented by visual inspection done by TZ and CP. The DLAs and sub-DLAs have been confirmed by looking for associated metal lines and/or higher members of the Lyman series. This resulted in 150 DLAs/sub-DLAs with $1.6 < z_{\text{abs}} < 4.7$ for which $\text{Ly}\alpha$ is covered in the spectra of these quasars. This method is complete down to the sub-DLA definition of $N_{\text{HI}} = 10^{19}$ equivalent to $EW_{\text{rest}} = 2.5 \text{ \AA}$ based on a curve of growth analysis (Dessauges-Zavadsky et al. 2003).

3.1. N_{HI} measurements of DLAs and sub-DLAs

An extensive search in the literature was undertaken to identify which of these damped absorbers were already known. Of the 150 DLAs/sub-DLAs that we have identified above, 131 (87 DLAs and 44 sub-DLAs) have their N_{HI} already reported in the literature. Of the remaining 19 (6 DLAs and 13 sub-DLAs), 10 (3 DLAs and 7 sub-DLAs) are new identifications (see Table 2 and Sect. 3.2 for details on each system).

For damped absorbers, the Lorentzian component of the Voigt profile results in pronounced damping wings, allowing precise determination of N_{HI} down to the sub-DLA definition at high-resolution. The neutral hydrogen column density measurements of these absorbers are determined by fitting a Voigt profile to the $\text{Ly}\alpha$ absorption line. The fits were performed using the χ^2 minimization routine FITLYMAN package in MIDAS (Fontana & Ballester 1995). Laboratory wavelengths and oscillator strengths from Morton (2003) were used. The global fit returns the best fit parameters for central wavelength, column density, and Doppler turbulent broadening, as well as errors on each quantity. The central redshift was left as a free parameter except when no

satisfactory fit could be found in which case the strongest component of the metal line was chosen as central redshift. The Doppler turbulent parameter b -value was usually left as a free parameter and sometimes fixed because of low signal-to-noise or multiple DLAs at 30 km s^{-1} (for DLAs) or 20 km s^{-1} (for sub-DLAs). The N_{HI} fit is performed using the higher members of the Lyman series, in addition to $\text{Ly}\alpha$, where these are available. For fitting N_{HI} , we usually used the components from O I. The other low ionization line components are used to fit N_{HI} for the cases where there is no O I covered by our data. Table 2 summarizes the properties of the DLAs/sub-DLAs for which we obtained HI column density for the first time and provides quasar emission redshifts, absorption redshifts, HI column densities and metal line lists.

Moreover, the majority of the N_{HI} measurements of the DLAs/sub-DLAs towards the 250 EUADP quasars comes from high-resolution data mostly from UVES or Keck/HIRES. In 7 cases, we cover the DLA/sub-DLA in our data but the N_{HI} in the literature is obtained from low/moderate resolution spectra. For these 7 cases, we refitted the DLA/sub-DLA using the EUADP data and new N_{HI} are reported in Table 3. For most of the cases, we find consistent results with the low resolution studies. In the case of QSO B1114-0822, Storrie-Lombardi & Wolfe (2000) reported a DLA with $\log N_{\text{HI}} = 20.3$ at $z_{\text{abs}} = 4.258$ while we find a sub-DLA with $\log N_{\text{HI}} = 20.02 \pm 0.12$.

3.2. Notes on individual objects

In this section, we provide details on the DLAs and sub-DLAs in the EUADP sample for which HI column density is determined in this work. Best fit parameters of the Voigt profile fits to the HI absorption lines are detailed below.

1. QSO J0008-2900 ($z_{\text{em}} = 2.645$). The quasar was discovered during the course of the 2dF quasar redshift survey (Croom et al. 2001). An HI absorber at $z = 2.253$ is reported by Tytler et al. (2009). We find that the absorber is a sub-DLA with $\log N_{\text{HI}} = 20.22 \pm 0.10$ and $b = 28.5 \pm 2.2 \text{ km s}^{-1}$ at $z_{\text{abs}} = 2.254$. The Lyman series lines down to $\text{Ly}\beta$ are fitted together. In the red part of the spectrum metal lines from O I λ 1302, Fe II $\lambda\lambda\lambda\lambda$ 2344, 2374, 2382, 2586, Si II $\lambda\lambda\lambda\lambda$ 1260, 1304, 1526, 1808, C II λ 1334, Mg II $\lambda\lambda$ 2796, 2803, Al III $\lambda\lambda$ 1854, 1862, and Si IV $\lambda\lambda$ 1393, 1402 are detected at the redshift of the sub-DLA. Figure 2 shows our best fit result of the HI lines.
2. QSO J0008-2901 ($z_{\text{em}} = 2.607$). The quasar was also discovered during the course of the 2dF quasar redshift survey (Croom et al. 2001). An HI absorber at $z = 2.491$ is reported by Tytler et al. (2009). We find that the absorber at $z_{\text{abs}} = 2.491$ is a sub-DLA with $\log N_{\text{HI}} = 19.94 \pm 0.11$ and $b = 39 \pm 3.5 \text{ km s}^{-1}$ detected down to $\text{Ly}\gamma$. Metal lines from O I λ 1302, Fe II $\lambda\lambda\lambda\lambda$ 2344, 2374, 2382, 2586, Si II $\lambda\lambda\lambda$ 1260, 1304, 1808, C II λ 1334, Al II λ 1670, and Si IV $\lambda\lambda$ 1393, 1402 are detected in the red part of the spectrum. Figure 3 shows our best fit result of the HI lines.
3. QSO J0041-4936 ($z_{\text{em}} = 3.240$). A damped absorber is known in this quasar from the Calán Tololo survey (Maza et al. 1995). From a low-resolution spectrum, Lopez et al. (2001) measured the equivalent width of the HI absorption line to be $EW_{\text{obs}} = 34.60 \text{ \AA}$ but state that they cannot measure the HI column density due to the limited spectral resolution. Using the high-resolution UVES spectrum, we are able to measure the column density of the DLA to be $\log N_{\text{HI}} = 20.46 \pm 0.13$ and $b = 29 \pm 3.9 \text{ km s}^{-1}$

Table 2. List of 6 damped and 13 sub-damped absorbers with new N_{HI} measurements.

Quasar	z_{em}	z_{abs}	$\log N_{\text{HI}}$ cm^{-2}	Ly series	Metals	New?
QSO J0008-2900	2.645	2.254	20.22 ± 0.10	Ly β	O I, Fe II, Si II, C II, Mg II, Al III, Si IV	no
QSO J0008-2901	2.607	2.491	19.94 ± 0.11	Ly γ	O I, Fe II, Si II, C II, Al II, Si IV	no
QSO J0041-4936	3.240	2.248	20.46 ± 0.13	Ly β	O I, Fe II, Si II, C II, Al II, Zn II, Al III, C IV	no
QSO B0128-2150	1.900	1.857	20.21 ± 0.09	Ly α	O I, Fe II, Si II, C II, Al III	no
J021741.8-370100	2.910	2.429	20.62 ± 0.08	Ly β	O I, Si II	no
...	...	2.514	20.46 ± 0.09	Ly β	Fe II, Si II	no
J060008.1-504036	3.130	2.149	20.40 ± 0.12	Ly α	O I, Fe II, Si II, C II, Al II, Al III	yes
QSO B0952-0115	4.426	3.476	20.04 ± 0.07	Ly α	Fe II, Si II, Al II, Al III, C IV	yes
Q1036-272	3.090	2.792	20.65 ± 0.13	Ly β	O I, Fe II, Si II, Al III	yes
QSO B1036-2257	3.130	2.533	19.30 ± 0.10	Ly α	Fe II, Si II, C II, Al III, Si IV, C IV	no
QSO B1036-268	2.460	2.235	19.96 ± 0.09	Ly β	O I, Fe II, Si II, C II, Al II, Mg II, Al III, Si IV, C IV	yes
LBQS 1232+0815	2.570	1.720	19.48 ± 0.13	Ly α	O I, Fe II, Si II, Al III, Si IV, C IV	yes
QSO J1330-2522	3.910	2.654	19.56 ± 0.13	Ly α	Si II, Al II, Al III, Si IV, C IV	yes
QSO J1356-1101	3.006	2.397	19.88 ± 0.09	Ly α	O I, Fe II, Si II	yes
QSO J1723+2243	4.520	4.155	19.23 ± 0.12	Ly γ	metal lines blended or not covered	yes
LBQS 2114-4347	2.040	1.912	19.50 ± 0.10	Ly α	O I, Fe II, Si II, C II, Al II, Mg II, Si IV, C IV	yes
J223941.8-294955	2.102	1.825	19.84 ± 0.14	Ly α	O I, Fe II, Si II, C II, Al II, Mg II, Al III, Si IV, C IV	no
QSO B2318-1107	2.960	1.629	20.52 ± 0.14	Ly α	Fe II, Si II, C II, Al II, Al III, Si IV	yes
QSO B2342+3417	3.010	2.940	20.18 ± 0.10	Ly γ	limited red wavelength coverage	no

Notes. The details of these absorbers are provided in the columns as (1) Simbad quasar name; (2) emission redshift; (3) absorption redshift; (4) H I column density with corresponding errors; (5) members of Lyman series covered; (6) metal lines associated with the system; and (7) is the absorber a new identification as DLA/sub-DLA?

at $z_{\text{abs}} = 2.248$ detected down to Ly β . Metal lines from O I λ 1302, Fe II $\lambda\lambda$ 1608, 1611, Si II $\lambda\lambda\lambda\lambda$ 1260, 1304, 1526, 1808, C II λ 1334, Al II λ 1670, Zn II λ 2026, Al III $\lambda\lambda$ 1854, 1862, and C IV $\lambda\lambda$ 1548, 1550 associated with the DLA are detected in the red part of the spectrum. Figure 4 shows the best fit result of the H I lines.

4. QSO B0128-2150 ($z_{\text{em}} = 1.900$). This quasar was discovered during the course of the Montréal-Cambridge-Tololo survey (Lamontagne et al. 2000). Two absorbing systems at $z_{\text{abs}} = 1.64$ and 1.85 are reported in the UVES observing proposal. We find that the system at $z_{\text{abs}} = 1.857$ is a sub-DLA with $\log N_{\text{HI}} = 20.21 \pm 0.09$ and $b = 25 \pm 2.6 \text{ km s}^{-1}$. Metal lines from O I λ 1302, Fe II $\lambda\lambda$ 2344, 2374, 2382, Si II $\lambda\lambda\lambda$ 1260, 1304, 1808, C II λ 1334, and Al III $\lambda\lambda$ 1854, 1862 at the redshift of the absorber are observed in the red part of the spectrum. Figure 5 shows our best fit result of the H I column density. The absorbing system at $z_{\text{abs}} = 1.64$ is below sub-DLA limit.
5. J021741.8-370100 ($z_{\text{em}} = 2.910$). Damped absorbers have been known in this quasar from the Calán Tololo survey (Maza et al. 1996). The column densities for these DLAs have not been reported before. We measure $\log N_{\text{HI}} = 20.62 \pm 0.08$ at $z_{\text{abs}} = 2.429$ and $\log N_{\text{HI}} = 20.46 \pm 0.09$ at $z_{\text{abs}} = 2.514$. Both absorbers are seen down to Ly β . The b parameter is fixed to $b = 30 \text{ km s}^{-1}$ for both absorbers. Due to limited wavelength coverage only a few metal lines associated with the absorbers are seen in the spectrum. Metal lines from O I λ 1302 and Si II $\lambda\lambda\lambda\lambda$ 1190, 1193, 1260, 1304 are covered for the absorber at $z_{\text{abs}} = 2.429$. The lines from Fe II λ 1144 and Si II $\lambda\lambda\lambda$ 1190, 1193, 1260 associated with the absorber at $z_{\text{abs}} = 2.514$ are covered in the spectrum. Figures 6 and 7 show our best fit of H I lines for absorbers at $z_{\text{abs}} = 2.429$ and $z_{\text{abs}} = 2.514$ respectively.
6. J060008.1-504036 ($z_{\text{em}} = 3.130$). This quasar was discovered during the course of the Calán Tololo survey (Maza et al. 1996). No detailed analysis of this quasar has been published. A Lyman limit system at $z_{\text{LLS}} = 3.080$ is seen in the spectrum. We identified a DLA at $z_{\text{abs}} = 2.149$. The

Table 3. New high-resolution N_{HI} measurements of DLAs/sub-DLAs previously observed at low/medium resolution.

Quasar	High resolution		Low/medium resolution	
	z_{abs}	$\log N_{\text{HI}}$ cm^{-2}	Survey/ Instrument	$\log N_{\text{HI}}$ cm^{-2}
J004054.7-091526	4.538	20.20 ± 0.09	SDSS	20.22 ± 0.26^1
...	4.740	20.39 ± 0.11	SDSS	20.55 ± 0.15^2
QSO B1114-0822	4.258	20.02 ± 0.12	WHT	20.3^3
J115538.6+053050	2.608	20.37 ± 0.11	SDSS	20.47 ± 0.23^1
...	3.327	21.00 ± 0.10	SDSS	20.91 ± 0.27^1
LBQS 2132-4321	1.916	20.74 ± 0.09	LBQS	20.70^3
J235702.5-004824	2.479	20.41 ± 0.08	SDSS	20.45^2

References. (1) Noterdaeme et al. (2009); (2) Prochaska et al. (2008); (3) Storrie-Lombardi & Wolfe (2000).

column density of the DLA is fitted using three strong components (at 24, 0, and -44 km s^{-1}) seen in O I, resulting in a total column density of $\log N_{\text{HI}} = 20.40 \pm 0.12$ with $b = 20 \text{ km s}^{-1}$ fixed for each component. Metal absorption lines from O I λ 1302, Fe II $\lambda\lambda$ 1608, 1611, Si II $\lambda\lambda\lambda\lambda$ 1260, 1304, 1526, 1808, C II λ 1334, Al II λ 1670, and Al III $\lambda\lambda$ 1854, 1862 at the redshift of the DLA are covered in the red part of the spectrum. Figure 8 shows our best fit of the neutral hydrogen column density of the DLA at $z_{\text{abs}} = 2.149$.

7. QSO B0952-0115 ($z_{\text{em}} = 4.426$). One damped absorber was previously reported in this quasar at $z_{\text{abs}} = 4.024$ (Storrie-Lombardi & Wolfe 2000; Prochaska et al. 2007). A Lyman limit system at $z_{\text{LLS}} = 4.242$ is detected in the spectrum. We find a sub-DLA at $z_{\text{abs}} = 3.476$ with $\log N_{\text{HI}} = 20.04 \pm 0.07$ and $b = 32 \pm 3.9 \text{ km s}^{-1}$. Metal lines from Fe II $\lambda\lambda$ 1608, 1611, Si II $\lambda\lambda\lambda$ 1260, 1304, 1526, Al II λ 1670, Al III $\lambda\lambda$ 1854, 1862, and C IV $\lambda\lambda$ 1548, 1550 associated with

Fig. 2. Sub-DLA detected towards QSO J0008-2900 at $z_{\text{abs}} = 2.254$. The solid red line shows the Voigt profile fit to the sub-DLA with an inferred column density of $\log N_{\text{HI}} = 20.22 \pm 0.10$. The system is detected down to Ly β . Here and in the following figures, the dotted blue line represents 1σ error on the spectrum. The vertical dotted line is the adopted zero velocity corresponding to the redshift of the sub-DLA. The horizontal line is at a level of one.

Fig. 3. Sub-DLA detected towards QSO J0008-2901 at $z_{\text{abs}} = 2.491$. The solid red line corresponds to the Voigt profile fit to the sub-DLA with an inferred column density of $\log N_{\text{HI}} = 19.94 \pm 0.11$. The system is detected down to Ly γ .

the sub-DLA are covered in the red part of the spectrum. Figure 9 shows the best fit result of the H I column density.

8. Q1036-272 ($z_{\text{em}} = 3.090$). A low-resolution spectrum of this quasar has been previously published (Jakobsen & Perryman 1992). We report a DLA with H I column density of $\log N_{\text{HI}} = 20.65 \pm 0.13$ and $b = 35 \pm 5 \text{ km s}^{-1}$ down to Ly β at $z_{\text{abs}} = 2.792$. Several metal absorption

Fig. 4. DLA detected towards QSO J0041-4936 at $z_{\text{abs}} = 2.248$. For plotting purposes the Ly β region of the spectrum is smoothed with a boxcar average of 2.0 pixels. The solid red line represents the Voigt profile fit to the DLA with an inferred column density of $\log N_{\text{HI}} = 20.46 \pm 0.13$. The system is detected down to Ly β .

Fig. 5. Sub-DLA detected towards QSO B0128-2150 at $z_{\text{abs}} = 1.857$. The solid red line shows the Voigt profile fit to the sub-DLA with an inferred column density of $\log N_{\text{HI}} = 20.21 \pm 0.09$.

lines from O I λ 1302, Fe II $\lambda\lambda\lambda\lambda$ 1144, 2344, 2374, 2382, Si II $\lambda\lambda\lambda$ 1190, 1193, 1260, 1304, and Al III $\lambda\lambda$ 1854, 1862 are covered in the red part of the spectrum. Figure 10 shows best fit result of the H I lines at $z_{\text{abs}} = 2.792$.

9. QSO B1036-2257 ($z_{\text{em}} = 3.130$). A damped and sub-damped absorber were previously reported in this quasar at $z_{\text{abs}} = 2.777$ (Fox et al. 2009) and $z_{\text{abs}} = 2.531$ (Lopez et al. 2001) respectively. A Lyman limit system at $z_{\text{LLS}} = 2.792$ is also detected. From a low-resolution spectrum, Lopez et al. (2001) measured the equivalent width of the H I absorption line to be $EW_{\text{obs}} = 13.52 \text{ \AA}$ but state that they cannot measure the H I column density due to the limited spectral resolution. Using the high-resolution UVES spectrum, we are able to identify two main components in the system from the metal lines at 0 and -144 km s^{-1} . Fitting these components we measure the total column density of the sub-DLA to be

Fig. 6. DLA detected towards J021741.8-370100 at $z_{\text{abs}} = 2.429$. The solid red line represents the Voigt profile fit to the DLA with an inferred column density of $\log N_{\text{HI}} = 20.62 \pm 0.08$. The system is detected down to Ly β .

Fig. 7. DLA detected towards J021741.8-370100 at $z_{\text{abs}} = 2.514$. The solid red line corresponds to the Voigt profile fit to the DLA with an inferred column density of $\log N_{\text{HI}} = 20.46 \pm 0.13$. The system is detected down to Ly β .

$\log N_{\text{HI}} = 19.30 \pm 0.10$ with b parameter of $b = 26 \pm 3.4$ and fixed 20 km s^{-1} (at 0 and -144 km s^{-1}). The component at 0 km s^{-1} is stronger and heavily dominates over the component at 144 km s^{-1} . Metal lines from Fe II $\lambda\lambda\lambda\lambda$ 1144, 2344, 2382, 2586, Si II $\lambda\lambda$ 1193, 1260, 1526, C II λ 1334, Al III $\lambda\lambda$ 1854, 1862, Si IV $\lambda\lambda$ 1393, 1402, and C IV $\lambda\lambda$ 1548, 1550 associated with the sub-DLA are detected in the red part of the spectrum. Figure 11 shows the best fit result of the H I column density.

10. QSO B1036-268 ($z_{\text{em}} = 2.460$). A low-resolution slit spectrum of the quasar has been previously published (Jakobsen & Perryman 1992). We find four strong velocity components in the system at $z_{\text{abs}} = 2.235$ from the metal lines. The column density of the sub-DLA fitted down to Ly β with

Fig. 8. DLA detected towards J060008.1-504036 at $z_{\text{abs}} = 2.149$. The solid red line shows the Voigt profile fit to the DLA with a total column density of $\log N_{\text{HI}} = 20.40 \pm 0.12$ using velocity components at 24, 0, -44 km s^{-1} .

Fig. 9. Sub-DLA detected towards J0952-0115 at $z_{\text{abs}} = 3.476$. The solid red line corresponds to the Voigt profile fit to the sub-DLA with an inferred column density of $\log N_{\text{HI}} = 20.04 \pm 0.07$.

four components at 0, -55 , -95 , and -144 km s^{-1} , resulting a total of $\log N_{\text{HI}} = 19.96 \pm 0.09$ and $b = 20, 20, 20$ (fixed), and $35 \pm 3.0 \text{ km s}^{-1}$ respectively. The component at 0 km s^{-1} is strongest and heavily dominates over other components. Strong metal absorption lines from O I λ 1302, Fe II $\lambda\lambda\lambda\lambda\lambda$ 1144, 1608, 1611, 2344, 2374, 2382, 2586, Si II $\lambda\lambda\lambda\lambda$ 1190, 1193, 1260, 1304, 1526, C II λ 1334, Al II λ 1670, Mg II $\lambda\lambda$ 2796, 2803, Al III $\lambda\lambda$ 1854, 1862, Si IV $\lambda\lambda$ 1393, 1402, and C IV $\lambda\lambda$ 1548, 1550 at the redshift of the sub-DLA are covered in the red part of the spectrum. Figure 12 shows our best fit result of H I lines of the sub-DLA.

11. LBQS 1232+0815 ($z_{\text{em}} = 2.570$). A DLA was known at $z_{\text{abs}} = 2.338$ along the line-of-sight of this quasar (Prochaska et al. 2007; Ivanchik et al. 2010). We report for the first time a sub-DLA at $z_{\text{abs}} = 1.720$ with total $\log N_{\text{HI}} = 19.48 \pm 0.13$. From O I, we identified two main velocity components from the system at 0 and -78 km s^{-1} (see Fig. 14) where b is fixed at $b = 20 \text{ km s}^{-1}$ for both components. Metal absorption lines from O I λ 1302, Fe II $\lambda\lambda\lambda\lambda\lambda$ 1608, 1611, 2344, 2374, 2382, Si II $\lambda\lambda$ 1526, 1808, Al III $\lambda\lambda$ 1854, 1862, Si IV $\lambda\lambda$ 1393, 1402, and C IV $\lambda\lambda$ 1548, 1550 associated with

Fig. 10. DLA detected towards QSO 1036-272 at $z_{\text{abs}} = 2.792$. The solid red line represents the Voigt profile fit to the DLA with an inferred column density of $\log N_{\text{HI}} = 20.65 \pm 0.13$. The system is detected down to $\text{Ly}\beta$.

Fig. 11. Sub-DLA detected towards QSO 1036-2257 at $z_{\text{abs}} = 2.533$. The solid red line represents the Voigt profile fit to the sub-DLA with a total column density of $\log N_{\text{HI}} = 19.30 \pm 0.10$ fitted with two velocity components at 0 and -144 km s^{-1} .

the sub-DLA are covered in the red part of the spectrum. Figure 13 shows the best fit result of H I column density of the sub-DLA. While the $\text{Ly}\alpha$ line is noisy, the presence of the sub-DLA is confirmed through the metal lines detected in the spectrum (see Fig. 14).

12. QSO J1330-2522 ($z_{\text{em}} = 3.910$). Two sub-DLAs were previously reported at $z_{\text{abs}} = 2.910$ and 3.080 (Péroux et al. 2001) along the line-of-sight of this quasar. A Lyman limit system at $z_{\text{LLS}} = 3.728$ is also seen. We report a new sub-DLA at $z_{\text{abs}} = 2.654$ with neutral hydrogen column density of $\log N_{\text{HI}} = 19.56 \pm 0.13$ and $b = 25.5 \pm 2.4 \text{ km s}^{-1}$. Figure 15 shows our best fit result. Metal lines from Si II $\lambda\lambda$ 1260, 1526, 1808, Al II λ 1670, Al III $\lambda\lambda$ 1854, 1862, Si IV $\lambda\lambda$ 1393, 1402, and C IV $\lambda\lambda$ 1548, 1550 are covered in the red part of the spectrum at the redshift of the sub-DLA. As an example of metal lines, low ionization lines from the sub-DLA confirming its presence are plotted in Fig. 16. High

Fig. 12. Sub-DLA detected towards QSO B1036-268 at $z_{\text{abs}} = 2.235$. $\text{Ly}\beta$ region of the spectrum is smoothed with a boxcar average of 2.0 pixels for plotting purposes. The solid red line corresponds to the Voigt profile fit to the sub-DLA with a total column density of $\log N_{\text{HI}} = 19.96 \pm 0.09$ from 0, -55 , -95 , and -297 km s^{-1} velocity components. The system is detected down to $\text{Ly}\beta$.

Fig. 13. Sub-DLA detected towards LBQS 1232+0815 at $z_{\text{abs}} = 1.720$. The spectrum is smoothed with a boxcar average of 0.5 pixel for plotting purposes. The solid red line represents the Voigt profile fit to the sub-DLA with a total column density of $\log N_{\text{HI}} = 19.48 \pm 0.13$ using 0 and -78 km s^{-1} velocity components (see Fig. 14).

ionization lines are blended with the lines from the other two sub-DLAs.

13. QSO J1356-1101 ($z_{\text{em}} = 3.006$). Two damped absorbers have been previously reported in this quasar at $z_{\text{abs}} = 2.501$ and 2.967 (Prochaska et al. 2007; Noterdaeme et al. 2008; Fox et al. 2009). We report for the first time a sub-DLA at $z_{\text{abs}} = 2.397$ in the quasar. From the O I, we find four strong components in the system at 29, 0, -48 , and -300 km s^{-1} . The total H I column density of the system is $\log N_{\text{HI}} = 19.88 \pm 0.09$ with $b = 20, 20, 20$, (fixed) $28 \pm 2.8 \text{ km s}^{-1}$ for 29, 0, -48 , and -300 km s^{-1} components respectively. The component at 0 km s^{-1} is strongest and heavily dominates over other components. Metal absorption lines from O I λ 1302, Fe II $\lambda\lambda\lambda\lambda$ 1144, 2344, 2374, 2382, 2586, and Si II $\lambda\lambda$ 1190, 1193, 1260, 1304 associated with the sub-DLA are detected in the red part of the spectrum. Figure 17

Fig. 14. Low and high ionization metal lines associated with the sub-DLA at $z_{\text{abs}} = 1.720$ (zero velocity) along the line-of-sight of LBQS 1232+0815 are shown. The line IDs are given in each panel.

Fig. 15. Sub-DLA detected towards QSO J1330-2522 at $z_{\text{abs}} = 2.654$. The solid red line shows the Voigt profile fit to the sub-DLA with an inferred column density of $\log N_{\text{HI}} = 19.56 \pm 0.13$.

shows the best fit result of the neutral hydrogen column density of the sub-DLA.

14. QSO J1723+2243 ($z_{\text{em}} = 4.520$). A damped absorber has been previously reported in this quasar at $z_{\text{abs}} = 3.697$ (Prochaska et al. 2007; Guimarães et al. 2009). We observed a sub-DLA down to Ly γ at $z_{\text{abs}} = 4.155$ with H I column of $\log N_{\text{HI}} = 19.23 \pm 0.12$ with a fixed $b = 20 \text{ km s}^{-1}$. The metal lines associated with this system are either blended with other features or not covered by our data so that this detection is based on the Lyman line only and is a little less secure than the others. The detection of absorption lines from the Lyman series confirm the presence of the sub-DLA. Figure 18 shows our best fit result of H I lines.
15. LBQS 2114-4347 ($z_{\text{em}} = 2.040$). The quasar has been discovered as part of the Large Bright Quasar Survey (LBQS; Morris et al. 1991). No absorber has been previously reported in this quasar (Péroux et al. 2003b). We observed, for the first time, a sub-DLA at $z_{\text{abs}} = 1.912$ with best fit column

Fig. 16. Low ionization metal lines associated with the sub-DLA at $z_{\text{abs}} = 2.654$ along the line-of-sight of LBQS 1330-2522. The vertical dashed line is adopted zero velocity corresponding to $z_{\text{abs}} = 2.654$. The line IDs are given in each panel. The shaded area corresponds to the regions affected by cosmic rays.

Fig. 17. Sub-DLA detected towards QSO J1356-1101 at $z_{\text{abs}} = 2.397$. The solid red line represents the Voigt profile fit to the sub-DLA with a total column density of $\log N_{\text{HI}} = 19.88 \pm 0.09$ using 29, 0, -48 and -300 km s^{-1} velocity components.

- density of $\log N_{\text{HI}} = 19.50 \pm 0.10$ and $b = 31.7 \pm 3.4 \text{ km s}^{-1}$. Several metal absorption lines from O I λ 1302, Fe II $\lambda\lambda\lambda\lambda$ 1144, 1608, 2344, 2374, 2382, 2586, Si II $\lambda\lambda\lambda\lambda$ 1193, 1260, 1304, 1526, 1808, C II λ 1334, Al II λ 1670, Mg II $\lambda\lambda$ 2796, 2803, Si IV $\lambda\lambda$ 1393, 1402, and C IV $\lambda\lambda$ 1548, 1550 at the redshift of the sub-DLA are covered in the red part of the spectrum. Figure 19 shows our best fit of H I column density.
16. J223941.8-294955 ($z_{\text{em}} = 2.102$). This quasar was discovered during the course of the 2dF quasar redshift survey. The absorber at $z_{\text{abs}} = 1.825$ in this quasar has been reported before by Cappetta et al. (2010) with a column density of $\log N_{\text{HI}} = 20.60$ (where H I fit was not shown). We fit the H I of the absorber again and find that the absorber at $z_{\text{abs}} = 1.825$ fits well with H I column density of $\log N_{\text{HI}} = 19.84 \pm 0.14$ and $b = 53.0 \pm 4.7 \text{ km s}^{-1}$. Emission is clearly seen in the trough of this absorber which is likely to correspond to the Lyman- α emission from the sub-DLA host. Several metal absorption lines from O I λ 1302, Fe II $\lambda\lambda\lambda\lambda$ 1144, 1608, 2344, 2374, 2382, 2586, Si II $\lambda\lambda\lambda\lambda$ 1193, 1260, 1304, 1526, 1808, C II λ 1334, Al II λ 1670, Mg II $\lambda\lambda$ 2796, 2803, Al III $\lambda\lambda$ 1854, 1862, Si IV $\lambda\lambda$ 1393, 1402, and C IV $\lambda\lambda$ 1548,

Fig. 18. Sub-DLA detected towards J1723+2243 at $z_{\text{abs}} = 4.155$. The solid red line corresponds to the Voigt profile fit to the sub-DLA with an inferred column density of $\log N_{\text{HI}} = 19.23 \pm 0.12$. The system is detected down to the Ly γ range.

Fig. 19. Sub-DLA detected towards LBQS 2114-4347 at $z_{\text{abs}} = 1.912$. For plotting purposes the spectrum is smoothed with a boxcar average of 1.0 pixel. The solid red line shows the Voigt profile fit to the sub-DLA with an inferred column density of $\log N_{\text{HI}} = 19.50 \pm 0.10$.

1550 associated with sub-DLA are covered in the red part of the spectrum. Figure 20 shows our best fit result of neutral hydrogen column density fit.

17. QSO B2318-1107 ($z_{\text{em}} = 2.960$). A DLA was previously known at $z_{\text{abs}} = 1.989$ along the line-of-sight of the quasar (Noterdaeme et al. 2007; Fox et al. 2009). We find a new DLA in the quasar at $z_{\text{abs}} = 1.629$ with neutral hydrogen column of $\log N_{\text{HI}} = 20.52 \pm 0.14$ with fixed $b = 30.0 \text{ km s}^{-1}$. Several metal absorption lines from Fe II $\lambda\lambda\lambda\lambda$ 1608, 1611, 2344, 2374, 2382, Si II $\lambda\lambda\lambda\lambda$ 1193, 1260, 1304, 1526 C II λ 1334, Al II λ 1670, Al III $\lambda\lambda$ 1854, 1862, and Si IV $\lambda\lambda$ 1393, 1402 associated with the DLA are covered in the red part of the spectrum. Figure 21 shows our best fit of the H I column to the DLA.

Fig. 20. Sub-DLA detected towards J223941.8-294955 at $z_{\text{abs}} = 1.825$. The spectrum is smoothed with a boxcar average of 1.0 pixel for plotting reasons. The solid red line corresponds to the Voigt profile fit to the sub-DLA with an inferred column density of $\log N_{\text{HI}} = 19.84 \pm 0.14$. Emission is clearly seen in the trough of this absorber which is likely to correspond to the Lyman- α emission from the sub-DLA host.

Fig. 21. DLA detected towards QSO B2318-1107 at $z_{\text{abs}} = 1.629$. For plotting purposes the spectrum is smoothed with a boxcar average of 0.5 pixel. The solid red line corresponds to the Voigt profile fit to the DLA with an inferred column density of $\log N_{\text{HI}} = 20.52 \pm 0.14$.

18. QSO B2342+3417 ($z_{\text{em}} = 3.010$). A damped absorber with $\log N_{\text{HI}} = 21.10 \pm 0.10$ was previously reported at $z_{\text{abs}} = 2.909$ in the quasar (Prochaska et al. 2003; Fox et al. 2009). A joint fit was implemented by Prochaska et al. (2003) to fit the DLA together with the neighboring sub-DLA, but the column density of the sub-DLA was not reported. We measure $\log N_{\text{HI}} = 20.18 \pm 0.10$ down to Ly γ at $z_{\text{abs}} = 2.940$ with a fixed $b = 20.0 \text{ km s}^{-1}$. The metal lines associated with this system are not seen because of limited wavelength coverage in the red part of the spectrum. Figure 22 shows the best fit result of the H I lines.

3.3. DLAs/sub-DLAs towards EUADP quasars

Besides the 150 DLAs/sub-DLAs, we found another 47 damped absorbers (21 DLAs and 26 sub-DLAs) in the literature along the lines-of-sight of our 250 EUADP quasars, for which Ly α absorption lines are not covered by our data either due to the limited wavelength coverage or non-overlapping settings. These systems are however of interest to us because their metal lines might still be included in our data and are helpful in further studies of the

Fig. 22. Sub-DLA detected towards QSO B2342+3417 at $z_{\text{abs}} = 2.940$. The solid red line corresponds to the Voigt profile fit to the sub-DLA with an inferred column density of $\log N_{\text{HI}} = 20.18 \pm 0.10$. The system is detected down to the Ly γ . The system is fitted simultaneously with a high column density absorber at $z_{\text{abs}} = 2.909$ ($\log N_{\text{HI}} = 21.10 \pm 0.10$) to determine the column density precisely.

EUADP sample. These 150 and 47 damped absorbers (with and without Ly α covered by the EUADP dataset) make up a total of 197 DLAs/sub-DLAs along lines-of-sight of the 250 EUADP quasars where 114 are DLAs and 83 are sub-DLAs. The EUADP sample by design is biased towards DLAs and therefore we see less sub-DLAs than DLAs in the sample. Indeed, in the redshift range $0.2 < z < 4.9$, we expect twice as many sub-DLAs as DLAs based on the number density of absorbers at a mean redshift of $z = 2.4$ (see Péroux et al. 2005).

4. Global properties of the EUADP sample

The emission redshifts of the 250 EUADP sample quasars are initially obtained from the Simbad catalogue and later double checked for the cases where Ly α emission from the quasar is covered by our data. The Ly α emission for 5 quasars (i.e., QSO J0332-4455, QSO B0528-2505, QSO B0841+129, QSO B1114-0822 and QSO J2346+1247) is not seen because of the presence of DLAs belonging to the “proximate DLA” class with $z_{\text{abs}} \approx z_{\text{em}}$ (e.g., Møller et al. 1998; Ellison et al. 2011; Zafar et al. 2011). For the emission redshifts of these 5 cases, we rely on the literature. The emission redshifts of all the other objects in the EUADP sample have been compared with measurements from the literature. For a few cases, emission redshifts provided in the Simbad catalogue are not correct and the correct redshifts are obtained from the literature. In our sample, there are 38 quasars with emission redshifts below $z_{\text{em}} < 1.5$. For these cases we cannot see Ly α emission from the quasar because of the limited spectral coverage, therefore, we relied mostly on the Simbad catalogue. However, other emission lines are covered in the spectra, helping us to confirm the emission redshifts. The emission redshifts of 250 quasars of EUADP sample ranges

Fig. 23. Distribution of quasar emission redshift of the EUADP sample (black histogram). The red histogram shows the redshift distribution of DLAs/sub-DLAs along the lines-of-sight of EUADP quasars. The red shaded area corresponds to the distribution of the 150 damped absorbers with Ly α covered by our EUADP sample.

Fig. 24. Histogram showing the number of DLAs and sub-DLAs along lines-of-sight to the quasars in the EUADP sample. The shaded area represents the column density distribution of damped absorbers for which the Ly α line is covered by the EUADP data. The vertical dashed line is the dividing line between the sub-DLAs and DLAs classes.

from $0.191 \leq z_{\text{em}} \leq 6.311$. Their distribution is shown in Fig. 23 and is found to peak at $z_{\text{em}} \approx 2.1$.

In Fig. 24, the column density distribution of DLAs and sub-DLAs is presented (see Zafar et al. 2013 for complete list of DLAs and sub-DLAs H I column densities). It is worth noting that in the EUADP sample, damped absorbers with column densities up to $\log N_{\text{HI}} = 21.85$ are seen, while higher column densities have been recently reported (Guimarães et al. 2012; Kulkarni et al. 2012; Noterdaeme et al. 2012a). As mentioned above in the EUADP sample, the number of sub-DLAs is lower than the number of DLAs. Indeed, a large fraction (~45%) of the quasars in the EUADP sample were observed because of a known strong damped absorber along their line-of-sight. A carefully selected subset of the EUADP will have to be built for the purpose of statistical analysis of DLAs and sub-DLAs (Zafar et al. 2013).

5. Lines-of-sight of interest

In the EUADP sample, a few lines-of-sight of quasars are rich and contain more than one absorber. One interesting example is the line-of-sight of QSO J0133+0400, containing six DLAs and sub-DLAs. In this line-of-sight two sub-DLAs $z_{\text{abs}} = 3.995/3.999$ are separated by only $\Delta v = 240 \text{ km s}^{-1}$. Three more examples of rich lines-of-sight are: i) QSO J0006-6208 with 3 DLAs and one sub-DLA; ii) QSO J0407-4410 with 4 DLAs, where three DLAs have $\log N_{\text{HI}} \gtrsim 21.0$, and iii) QSO B0841+129 containing 3 DLAs (with $\log N_{\text{HI}} \gtrsim 21.0$) and one sub-DLA. Such complex group or systems can be classified as multiple DLAs (MDLAs; Lopez & Ellison 2003).

In addition, there are four quasar pairs in the EUADP sample: i) QSO J0008-2900 & QSO J0008-2901 separated by $1.3'$. Two sub-DLAs at $z = 2.254$ and $z = 2.491$ are seen along the lines of sight of QSO J0008-2900 and QSO J0008-2901 respectively. ii) J030640.8-301032 and J030643.7-301107 separated by ~ 0.85 arcmin and no absorber is seen along the line-of-sight to the pair. iii) QSO B0307-195A and B separated by ~ 1 arcmin. A sub-DLA (at $z = 1.788$ with $\log N_{\text{HI}} = 19.00 \pm 0.10$) along the line-of-sight of QSO B0307-195B is detected (D'Odorico et al. 2002), but is not seen in its companion. iv) QSO J1039-2719 and QSO B1038-2712 separated by $17.9'$. A sub-DLA (at $z = 2.139$ with $\log N_{\text{HI}} = 19.90 \pm 0.05$) along the line-of-sight of QSO J1039-2719 is detected (D'Odorico et al. 2002), but no damped absorber is seen in its companion.

6. Conclusion

In this study, high-resolution spectra taken from the UVES Advanced Data Products archive have been processed and combined to make a sample of 250 individual quasars spectra. The high-resolution spectra of these quasars allow us to detect absorbers down to $\log N_{\text{HI}} = 19.00 \text{ cm}^{-2}$. Automated and visual searches for quasar absorbers have been undertaken leading to a sample of 93 DLAs and 57 sub-DLAs. An extensive search in the literature shows that 6 of these DLAs and 13 of these sub-DLAs have their HI column densities measured for the first time, where 10 are new identifications. These new damped absorbers are confirmed by detecting metal lines associated with the absorber and/or lines from the higher members of the Lyman series. The HI column densities of all these new absorbers are determined by fitting a Voigt profile to the Ly α line together with the lines from higher order of the Lyman series whenever covered. Our data contain five proximate DLA cases and three quasar pairs. We found that a few lines-of-sight of quasars are very rich, particularly the line-of-sight of QSO J0133+0400 which contains six DLAs and sub-DLAs.

In an accompanying paper (Zafar et al. 2013), we use a carefully selected subset of this dataset to study the statistical properties of DLAs and sub-DLAs, measure their column density distribution, and quantify the contribution of sub-DLAs to the HI gas mass density. Further studies using specifically designed subsets of the EUADP dataset will follow.

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Table 1. Properties of the EUADP quasar sample.

Quasar	RA 2000	Dec 2000	Mag.	z_{em}	Wavelength coverage Å	Prog. ID	No. spec	T_{exp} s
LBQS 2359-0216B	00 01 50.00	-01 59 40.00	18.00	2.810	3290-5760,5835-8520,8660-10420	66.A-0624(A), 073.B-0787(A)	16	21 300
QSO J0003-2323	00 03 44.92	-23 23 54.80	16.70	2.280	3050-5760,5835-8520,8660-10420	166.A-0106(A)	36	43 200
QSO B0002-422	00 04 48.28	-41 57 28.10	17.40	2.760	3050-5760,5835-8520,8660-10420	166.A-0106(A)	84	97 421
QSO J0006-6208	00 06 51.61	-62 08 03.70	18.29	4.455	4780-5750,5830-6800	69.A-0613(A)	4	7200
QSO J0008-0958	00 08 15.33	-09 58 54.45	18.85	1.950	3300-4510,5720-7518,7690-9450	076.A-0376(A)	18	21 600
QSO J0008-2900	00 08 52.72	-29 00 43.75	19.12 [†]	2.645	3300-4970,5730-10420	70.A-0031(A), 075.A-0617(A)	17	24 000
QSO J0008-2901	00 08 57.74	-29 01 26.61	19.85 [†]	2.607	3300-4970,5730-10420	70.A-0031(A), 075.A-0617(A)	18	17 700
QSO B0008+006	00 11 30.56	+00 55 50.71	18.50	2.309	3760-4980,6700-8510,8660-10420	267.B-5698(A)	6	7200
LBQS 0009-0138	00 12 10.89	-01 22 07.76	18.10	1.998	3300-4510,4770-5755,5835-6805	078.A-0003(A)	6	6000
LBQS 0010-0012	00 13 06.15	+00 04 31.90	19.43	2.145	3050-3870,4610-5560,5670-6650	68.A-0600(A)	3	5400
LBQS 0013-0029	00 16 02.41	-00 12 25.08	17.00	2.087	3054-6800	66.A-0624(A), 267.A-5714(A)	66	88 200
LBQS 0018+0026	00 21 33.28	+00 43 00.99	18.20	1.244	3320-4510,4620-5600,5675-6650	078.A-0003(A)	3	3000
QSO B0027-1836	00 30 23.63	-18 19 56.00	17.90	2.550	3050-3870,4780-5755,5835-6800	073.A-0071(A)	15	23 772
J004054.7-091526	00 40 54.66	-09 15 26.92	24.55	4.976	6700-8515,8655-10420	072.B-0123(D)	6	7285
QSO J0041-4936	00 41 31.44	-49 36 11.80	17.90	3.240	3290-4520,4620-5600,5675-6650	68.A-0362(A)	3	3600
QSO B0039-407	00 42 01.20	-40 30 39.00	18.50	2.478	3290-4520,4620-5600,5675-6650	075.A-0158(A)	15	16 500
QSO B0039-3354	00 42 16.45	-33 37 54.50	17.74	2.480	3295-4520	072.A-0442(A)	1	1800
LBQS 0041-2638	00 43 42.80	-26 22 11.00	17.79	3.053	3757-4980,6700-8520,8660-10420	70.A-0031(A)	6	5400
LBQS 0041-2707	00 43 51.81	-26 51 28.00	17.83	2.786	3757-4980,6700-8520,8660-10420	70.A-0031(A)	6	5400
QSO B0042-2450	00 44 28.10	-24 34 19.00	17.30	0.807	3300-4520,4620-5600,5675-6650	67.B-0373(A)	6	1800
QSO B0042-2656	00 44 52.26	-26 40 09.12	19.00	3.358	3750-4980,6700-8520,8660-10420	70.A-0031(A)	6	3600
LBQS 0042-2930	00 45 08.54	-29 14 32.59	17.92 [†]	2.388	3290-4510,4780-5750,5830-6800	072.A-0442(A)	3	1800
LBQS 0042-2657	00 45 19.60	-26 40 51.00	18.72	2.898	3757-4980,6700-8520,8660-10420	70.A-0031(A)	9	5400
J004612.2-293110	00 46 12.25	-29 31 10.17	19.89	1.675	3050-3870,4620-5600,5675-6650	077.B-0758(A)	26	45 470
LBQS 0045-2606	00 48 12.59	-25 50 04.80	18.08 [†]	1.242	3300-4520,4615-5595,5670-6650	67.B-0373(A)	6	3000
QSO B0045-260	00 48 16.84	-25 47 44.20	18.60	0.486	3300-4520,4615-5595,5670-6650	67.B-0373(A)	6	7200
QSO B0046-2616	00 48 48.41	-26 00 20.30	18.70	1.410	3300-4520,4615-5595,5670-6650	67.B-0373(A)	6	7200
LBQS 0047-2538	00 50 24.89	-25 22 35.09	18.40	1.969	3290-4520,4615-5595,5670-6650	67.B-0373(A)	9	5400
LBQS 0048-2545	00 51 02.30	-25 28 48.00	18.20	2.082	3295-4520,4615-5595,5670-6650	67.B-0373(A)	12	7200
QSO B0018-2608	00 51 09.10	-25 52 15.00	18.20	2.249	3300-4520,4615-5595,5670-6650	67.B-0373(A)	6	3600
LBQS 0049-2535	00 52 11.10	-25 18 59.00	19.20	1.528	3300-4520,4615-5595,5670-6650	67.B-0373(A)	12	7200
LBQS 0051-2605	00 54 19.78	-25 49 01.20	18.04 [†]	0.624	3300-4520,4615-5595,5670-6650	67.B-0373(A)	15	9000
QSO B0055-26	00 57 58.00	-26 43 14.90	17.47	3.662	3050-5755,5835-6810	65.O-0296(A)	17	37 800
QSO B0058-292	01 01 04.60	-28 58 00.90	18.70	3.093	3300-5750, 5830-8515,8650-10420	67.A-0146(A), 66.A-0624(A)	29	41 222
LBQS 0059-2735	01 02 17.05	-27 19 49.91	18.00 [†]	1.595	3100-5755,5830-8520,8660-10420	078.B-0433(A)	24	22 800
QSO B0100+1300	01 03 11.27	+13 16 17.74	16.57	2.686	3290-4525,6695-8520,8660-10420	074.A-0201(A), 67.A-0022(A)	7	12 600
QSO J0105-1846	01 05 16.82	-18 46 41.90	18.30	3.037	3300-5595,5670-6650,6690-8515, 8650-10420	67.A-0146(A)	9	14 400
...								
QSO B0102-2931	01 05 17.95	-29 15 11.41	19.90	2.220	3300-4515,5720-7520,7665-9460	075.A-0617(A)	3	3900
QSO B0103-260	01 06 04.30	-25 46 52.30	18.31	3.365	4165-5160,5220-6210	66.A-0133(A)	16	24 800
QSO B0109-353	01 11 43.62	-35 03 00.40	16.90	2.406	3055-5755,5835-8515,8650-10420	166.A-0106(A)	39	46 800
QSO B0112-30	01 15 04.70	-30 25 14.00	...	2.985	4778-5760,5835-6810	68.A-0600(A)	6	13 500
QSO B0117+031	01 15 17.10	-01 27 04.51	18.90	1.609	4165-5160,5230-6200	69.A-0613(A)	2	3600
QSO J0123-0058	01 23 03.23	-00 58 18.90	18.76	1.550	4165-5160,5230-6200	078.A-0646(A)	4	5400
QSO J0124+0044	01 24 03.78	+00 44 32.67	17.90	3.834	4165-6810	69.A-0613(A)	10	15 600
QSO B0122-379	01 24 17.38	-37 44 22.91	17.10	2.190	3050-5760,5835-8520,8660-10420	166.A-0106(A)	39	46 800
QSO B0122-005	01 25 17.15	-00 18 28.88	18.60	2.278	3300-4520,4620,5600,5675-6650	075.A-0158(A)	12	13 200
QSO B0128-2150	01 31 05.50	-21 34 46.80	15.57	1.900	3045-3868,4785-5755,5830-6810	072.A-0446(B)	6	6130
QSO B0130-403	01 33 01.93	-40 06 28.00	17.40	3.023	3300-4520,4775-5755,5828-6801	70.B-0522(A)	3	3065
QSO J0133+0400	01 33 40.40	+04 00 59.00	18.30	4.154	4180-5165,5230-6410, 6700-8520,8660-10250	69.A-0613(A), 073.A-0071(A), 074.A-0306(A)	5	9100
...								
QSO J0134+0051	01 34 05.77	00 51 09.35	18.37	1.522	3050-3870,4620-5600,5675-6650	074.A-0597(A)	8	14 400
QSO B0135-42	01 37 24.41	-42 24 16.80	18.46	3.970	4170-5165,5235-6210	69.A-0613(A)	2	3600
QSO J0138-0005	01 38 25.54	-00 05 34.52	18.97	1.340	3050-3870,4620-5598,5675-6650	078.A-0646(A)	9	15 600
QSO J0139-0824	01 39 01.40	-08 24 44.08	18.65	3.016	3300-4520	074.A-0201(A)	1	4800
QSO J0143-3917	01 43 33.64	-39 17 00.00	16.28	1.807	3050-5755,5830-8515,8655-10420	67.A-0280(A)	33	39 600
QSO J0153+0009	01 53 18.19	00 09 11.39	17.80	0.837	3100-3870,4625-5600,5675-6650	078.A-0646(A)	6	10 800
QSO J0153-4311	01 53 27.19	-43 11 38.20	16.80	2.789	3100-5757,5835-8520,8650-10420	166.A-0106(A)	53	63 900
QSO J0157-0048	01 57 33.88	-00 48 24.49	17.88	1.545	3300-4515,4785-5757,5835-6810	078.A-0003(A)	6	6000
QSO B0201+113	02 03 46.66	+11 34 45.41	19.50	3.610	3760-4980,6700-8515,8660-10420	68.A-0461(A)	3	3000

Notes. The details of the sample are provided in the columns as the (1) Simbad quasar names; (2) right ascension (RA); (3) declination (Dec); (4) Simbad V-band magnitude of each quasar except when noted otherwise; (5) emission redshift of the quasars; (6) wavelength coverage of the spectra; (7) ESO program ID; (8) number of spectra used for co-adding, where spectra from BLUE, RED upper and lower arms are counted separately; and (9) total exposure time of each quasar. ^(†) B-band magnitude. ^(*) J-band magnitude.

Table 1. continued.

Quasar	RA 2000	Dec 2000	Mag.	z_{em}	Wavelength coverage Å	Prog. ID	No. spec	T_{exp} s
QSO J0209+0517	02 09 44.62	+05 17 14.10	17.80	4.174	3300-4520,4775-5754,5830-6810	69.A-0613(A)	3	3600
J021741.8-370100	02 17 41.78	-37 00 59.60	18.40	2.910	3300-4520	072.A-0442(A)	2	7200
QSO J0217+0144	02 17 48.95	+01 44 49.70	18.33	1.715	4165-5160,5230-6210	078.A-0646(A)E	4	5400
QSO B0216+0803	02 18 57.36	+08 17 27.43	18.10	2.996	3065-4520,4775-5755,5835-8525, 8665-10250	073.B-0787(A), 072.A-0346(A)	30	37 200
...								
QSO B0227-369	02 29 28.47	-36 43 56.78	19.00	2.115	3300-4520,4620-5600,5675-6650	076.A-0389(A)	12	12 800
QSO B0237-2322	02 40 08.18	-23 09 15.78	16.78 [†]	2.225	3050-5757,5835-8525,8660-10420	166.A-0106(A)	78	91 149
QSO J0242+0049	02 42 21.88	+00 49 12.67	18.44	2.071	3300-4985,5715-7520,7665-9460	075.B-0190(A)	12	20 700
QSO J0243-0550	02 43 12.47	-05 50 55.30	19.00	1.805	3300-4518,4620-5600,5675-6650	076.A-0389(A)	9	6180
QSO B0241-01	02 44 01.84	-01 34 03.70	17.06*	4.053	4165-6810	69.A-0613(A), 074.A-0306(A)	4	5400
QSO B0244-1249	02 46 58.47	-12 36 30.80	18.40	2.201	3290-4520,4625-5600,5675-6650	076.A-0389(A)	6	6000
QSO B0253+0058	02 56 07.26	+01 10 38.62	18.88	1.346	3300-4515,4620-5600,5675-6650	074.A-0597(A)	9	16 200
QSO B0254-404	02 56 34.03	-40 13 00.30	17.40	2.280	3292-4520	072.A-0442(A)	1	1800
QSO J0300+0048	03 00 00.57	+00 48 28.00	19.48	0.314	3100-5755	267.B-5698(A)	9	16 492
J030640.8-301032	03 06 40.93	-30 10 31.91	19.32 [†]	2.096	3050-5600,5670-6650,6700-8525, 8665-10420	70.A-0031(A)	12	8558
...								
J030643.7-301107	03 06 43.77	-30 11 07.58	19.85 [†]	2.130	3060-5595,5675-6650,6700-8520, 8665-10420	70.A-0031(A)	15	12 600
...								
QSO B0307-195A	03 10 06.00	-19 21 25.00	18.60	2.144	3050-5758,5835-8525,8660-10420	69.A-0204(A), 68.A-0216(A), 65.O-0299(A)	18	28 450
...								
QSO B0307-195B	03 10 09.00	-19 22 08.00	19.10	2.122	3065-5758,5835-8520,8660-10420 65.O-0299(A)	69.A-0204(A), 68.A-0216(A), 65.O-0299(A)	27	37 700
...								
J031856.6-060038	03 18 56.63	-06 00 37.75	19.31	1.927	3100-5760,5835-8525,8665-10250	078.B-0433(A)	24	22 800
QSO B0329-385	03 31 06.41	-38 24 04.60	17.20	2.423	3060-5758,5835-8520,8655-10420	166.A-0106(A)	36	31 200
QSO B0329-2534	03 31 08.92	-25 24 43.27	17.10	2.736	3100-5763,5830-8525,8665-10420	166.A-0106(A)	66	77 363
QSO J0332-4455	03 32 44.10	-44 55 57.40	17.90	2.679	3300-4515,4780-5760,5840-6810	078.A-0164(A)	12	12 000
QSO B0335-122	03 37 55.43	-12 04 04.67	20.11	3.442	3755-4980,6700-8520,8660-10420	71.A-0067(A)	11	16 200
QSO J0338+0021	03 38 29.31	+00 21 56.30	18.79*	5.020	6700-8525,8660-10420	072.B-0123(D)	6	10 450
QSO J0338-0005	03 38 54.78	-00 05 20.99	18.90	3.049	3100-3870	074.A-0201(A)	1	4600
QSO B0336-017	03 39 00.90	-01 33 18.00	19.10	3.197	3757-4983,6700-8520,8660-10420	68.A-0461(A)	9	15 600
QSO B0347-383	03 49 43.68	-38 10 31.10	17.30	3.222	3300-5757,5835-8520,8660-10420	68.B-0115(A)	18	28 800
QSO B0347-2111	03 49 57.83	-21 02 47.74	21.10	2.944	3300-4520,4775-5755,5832-6810	71.A-0067(A)	9	8873
J035320.2-231418	03 53 20.10	-23 14 17.80	17.00	1.911	3300-4515,4620-5600,5675-6650	078.A-0068(A)	3	1120
QSO J0354-2724	03 54 05.56	-27 24 21.00	17.90	2.823	3300-4515,4780-5760,5835-6810	078.A-0003(A)	12	10 240
J040114.0-395132	04 01 14.06	-39 51 32.70	17.00	1.507	3300-4515,4620-5600,5675-6650	078.A-0068(A)	3	2160
QSO J0403-1703	04 03 56.60	-17 03 23.00	18.70	4.227	4780-5757,5832-8525,8660-10420	074.A-0306(A)	10	12 625
QSO J0407-4410	04 07 18.08	-44 10 14.10	17.60	3.020	3300-8520,8665-10420	68.A-0600(A), 70.A-0017(A), 68.A-0361(A)	54	94 000
...								
QSO J0422-3844	04 22 14.79	-38 44 52.90	16.90	3.123	3300-5600,5675-6650,6700-8515, 8660-10420	166.A-0106(A)	49	57 750
...								
QSO J0427-1302	04 27 07.30	-13 02 53.64	17.50	2.166	3285-4515,4780-5760,5835-6810	078.A-0003(A)	6	6000
QSO J0430-4855	04 30 37.31	-48 55 23.70	16.20 [†]	1.940	3060-5765,5845-8530,8665-10420	66.A-0221(A)	27	29 559
QSO B0432-440	04 34 03.23	-43 55 47.80	19.60	2.649	3300-4520,4780-5755,5830-6810	71.A-0067(A)	12	14 300
QSO B0438-43	04 40 17.17	-43 33 08.62	19.50	2.852	3100-5757,5835-8515,8660,10420	072.A-0346(A), 69.A-0051(A)	17	22 425
QSO J0441-4313	04 41 17.32	-43 13 45.40	16.40	0.593	3757-5758,5835-8515,8665-10420	70.C-0007(A)	18	20 742
QSO B0449-1645	04 52 13.60	-16 40 12.00	17.00	2.679	3285-4515,4620-5600,5675-6650	078.A-0646(A)	9	15 600
QSO B0450-1310B	04 53 12.80	-13 05 46.00	16.50	2.250	3060-3874,4780-5760,5835-8525, 8670-10420	70.B-0258(A)	15	15 000
...								
QSO J0455-4216	04 55 23.05	-42 16 17.40	17.30	2.661	3055-5758,5835-8520,8660-10420	166.A-0106(A)	51	61 994
PKS 0454-220	04 56 08.93	-21 59 09.54	16.10	0.534	3050-3870,4170-5162,5230-6210	076.A-0463(A)	9	8500
4C-02.19	05 01 12.81	-01 59 14.26	18.40	2.286	3100-8520,8660-10250	074.B-0358(A), 66.A-0624(A), 076.A-0463(A)	26	42 422
...								
QSO B0512-3329	05 14 10.91	-33 26 22.40	17.00	1.569	3300-4520,4620-5605,5675-6655	70.A-0446(A), 66.A-0087(A)	30	30 000
QSO B0515-4414	05 17 07.63	-44 10 55.50	14.90	1.713	3060-3875,4785-5760,5840-8525, 8665-10420	66.A-0212(A)	9	13 500
...								
J051939.8-364613	05 19 39.82	-36 46 11.60	17.30	1.394	3290-4515,4620-5600,5675-6650	078.A-0068(A)	3	1520
QSO B0528-2505	05 30 07.96	-25 03 29.84	17.30	2.765	3050-6810	68.A-0106(A), 66.A-0594(A), 68.A-0600(A)	43	78 988
...								
QSO J0530+13	05 30 56.42	+13 31 55.15	20.00	2.070	3300-5160,5230-6210,6705-8529, 8665-10420	70.C-0239(A)	18	12 600
...								
QSO B0551-36	05 52 46.19	-36 37 27.60	17.00	2.318	3060-5757,5835-6810	66.A-0624(A)	17	26 100
J060008.1-504036	06 00 08.10	-50 40 36.80	18.20 [†]	3.130	3300-4520,4620-5600,5675-6650	68.A-0639(A)	20	24 000
QSO B0606-2219	06 08 59.69	-22 20 20.96	20.00	1.926	3300-4515,4625-5600,5675-6650	076.A-0389(A)	13	16 000
QSO B0642-5038	06 43 27.00	-50 41 12.80	18.50	3.090	3300-4520,4785-5757,5835-6810	073.A-0071(A)	9	17 500

Table 1. continued.

Quasar	RA 2000	Dec 2000	Mag.	z_{em}	Wavelength coverage Å	Prog. ID	No. spec	T_{exp} s
QSO B0736+01	07 39 18.03	+01 37 04.62	16.47	0.191	3300-5160,5230-6208,6715-8525, 8665-10420	70.C-0239(A)	26	17 600
...								
QSO B0810+2554	08 13 31.29	+25 45 03.06	15.40 [†]	1.510	3050-3868,4625-5598,5675-6650	68.A-0107(A)	12	14 100
QSO B0827+2421	08 30 52.08	+24 10 59.82	17.30	0.939	3060-3872,4620-5600,5675-6650	68.A-0170(A), 69.A-0371(A)	23	34 071
QSO B0841+129	08 44 24.20	+12 45 48.90	18.50	2.505	3290-4520,6710-8525,8665-10420	70.B-0258(A)	9	10 800
QSO B0908+0603	09 11 27.61	+05 50 54.28	18.30 [†]	2.793	3300-4522,4620-5600,5675-6650	70.A-0439(A)	39	46 800
QSO B0913+0715	09 16 13.94	+07 02 24.30	17.10	2.785	3280-10420	078.A-0185(A)Ê, 68.B-0115(A)	62	77 523
QSO B0919-260	09 21 29.36	-26 18 43.28	18.40	2.299	3300-4518,4618-5600,5675-6650	075.A-0158(A)	12	13 200
QSO B0926-0201	09 29 13.57	-02 14 46.40	16.44	1.661	3050-5757,5835-8525,8660-10420	072.A-0446(A)	15	15 325
QSO B0933-333	09 35 09.23	-33 32 37.69	20.00	2.910	3760-4984,6705-8525,8660-10420	71.A-0067(A), 69.A-0051(A)	12	14 300
QSO B0951-0450	09 53 55.70	-05 04 18.00	19.00	4.369	4785-5750,5832-6807	072.A-0558(A)	8	30 960
QSO B0952+179	09 54 56.82	+17 43 31.22	17.23	1.472	3060-3870,4618-5600,5675-6650	69.A-0371(A)	9	17 100
QSO B0952-0115	09 55 00.10	-01 30 07.00	18.70	4.426	3760-5754,5832-8525,8662-10420	70.A-0160(A), 072.A-0558(A)	55	97 676
QSO B1005-333	10 07 31.39	-33 33 06.72	18.00	1.837	3300-4518,4620-5600,5675-6650	075.A-0158(B)	6	6000
QSO J1009-0026	10 09 30.47	-00 26 19.13	17.53	1.241	3300-4515,4620-5600,5675-6650	078.A-0003(A)	6	6000
LBQS 1026-0045B	10 28 37.02	-01 00 27.56	18.40	1.530	3300-4515,4620-5600,5675-6650	078.A-0003(A)	12	10 240
QSO B1027+0540	10 30 27.10	+05 24 55.00	18.87 [*]	6.311	8000-10040	69.A-0529(A)	6	33 400
Q1036-272	10 38 49.00	-27 29 19.10	21.50	3.090	3757-4980,6700-8520,8660-10420	70.A-0017(A)	9	12 133
QSO B1036-2257	10 39 09.52	-23 13 26.20	18.00	3.130	3300-5758,5838-8525,8660-10420	68.B-0115(A)	12	21 600
QSO J1039-2719	10 39 21.86	-27 19 16.45	17.40	2.193	3290-5600,5675-6650,6705-8525, 8665-10420	69.B-0108(A), 70.A-0017(A)	30	36 500
...								
QSO B1038-2712	10 40 32.23	-27 27 49.00	17.70	2.331	3045-3865,4780-5757,5835-6810	67.B-0398(A), 65.O-0063(B)	9	16 200
QSO B1036-268	10 40 40.32	-27 24 36.40	20.00	2.460	3285-5600,5675-6650,6700-8520, 8660-10420	67.B-0398(A)	15	27 000
...								
QSO J1044-0125	10 44 33.04	-01 25 02.20	18.31 [*]	5.740	8660-10420	268.A-5767(A), 69.A-0529(A)	7	30 270
J104540.7-101813	10 45 40.56	-10 18 12.80	17.40	1.261	3300-4515,4620-5600,5675-6650	078.A-0068(A)	3	1650
J104642.9+053107	10 46 42.84	+05 31 07.02	18.00	2.682	3060-3870,4780-5755,5835-6810	074.A-0780(A)	9	12 528
QSO B1044+059	10 46 56.71	+05 41 50.32	18.30	1.226	3060-3870,4780-5757,5835-6810	074.A-0780(A)	12	13 488
QSO B1044+056	10 47 33.16	+05 24 54.88	17.99	1.306	3060-3870,4780-5757,5835-6810	074.A-0780(A)	10	13 952
QSO B1045+056	10 48 00.40	+05 22 09.76	20.30	1.230	3060-3870,4780-5757,5830-6810	074.A-0780(A)	12	20 932
QSO B1052-0004	10 54 40.98	-00 20 48.47	18.51	1.021	3300-4515,4620-5600,5675-6650	078.A-0003(A)	12	10 240
QSO B1055-301	10 58 00.43	-30 24 55.03	19.50	2.523	3300-4520,4780-5757,5840-6810	71.A-0067(A)	9	10 725
QSO B1101-26	11 03 25.31	-26 45 15.88	16.00	2.145	3780-4985,6710-8525,8665-10250	076.A-0463(A)	27	60 672
QSO B1104-181	11 06 33.39	-18 21 23.80	15.90	2.319	3060-8520,8655-10420	67.A-0278(A)	51	60 948
QSO J1107+0048	11 07 29.03	+00 48 11.27	17.66	1.392	3300-4515,4620-5600,5675-6650	074.A-0597(A)	6	7200
QSO B1108-07	11 11 13.60	-08 04 02.00	18.10	3.922	3760-8520,8660-10420	67.A-0022(A), 68.B-0115(A), 68.A-0492(A)	14	28 498
...								
QSO J1113-1533	11 13 50.61	-15 33 33.90	18.70	3.370	3760-5600,5675-6650	68.A-0492(A)	10	25 200
QSO B1114-220	11 16 54.50	-22 16 52.00	20.20	2.282	3300-4520,4620-5600,5675-6650	71.B-0081(A)	30	14 115
QSO B1114-0822	11 17 27.10	-08 38 58.00	19.40	4.495	4780-5757,5835-8520,8665-10250	074.A-0801(B)	9	28 525
QSO B1122-168	11 24 42.87	-17 05 17.50	16.50	2.400	3290-4520,4620-5600,5675-6650	68.A-0570(A), 073.B-0420(A)	82	104 493
J112910.9-231628	11 29 10.86	-23 16 28.17	17.30	1.019	3300-4520,4620-5600,5675-6650	078.A-0068(A)	3	1470
QSO J1142+2654	11 42 54.26	+26 54 57.50	17.00	2.630	3757-4980,6705-8520,8660-10420	69.A-0246(A)	42	48 696
QSO B1145-676	11 47 32.40	-67 53 42.70	18.50 [†]	0.210	3300-5160,5230-6210,6700-8525, 8660-10420	70.C-0239(A)	16	10 800
...								
QSO B1151+068	11 54 11.12	+06 34 37.80	18.60	2.762	3060-5757,5835-8520,8660-10420	65.O-0158(A)	18	21 600
J115538.6+053050	11 55 38.60	+05 30 50.67	19.08	3.475	3300-5600,5675-7500,7665-9460	076.A-0376(A)Ê	11	14 400
QSO J1159+1337	11 59 06.52	+13 37 37.70	18.50	3.984	4780-5757,5835-6810	074.A-0306(B)	2	3000
QSO B1158-1842	12 00 44.94	-18 59 44.50	16.90	2.453	3050-5757,5835-8520,8660-10420	166.A-0106(A)	36	43 200
QSO B1202-074	12 05 23.12	-07 42 32.40	17.50	4.695	3300-4520,4785-5765,5835-8525, 8665-10420	71.B-0106(A), 66.A-0594(A), 166.A-0106(A)	43	82 086
...								
J120550.2+020131	12 05 50.19	+02 01 31.55	17.46	2.134	3290-4520,4780-5757,5840-6810	273.A-5020(A)	3	3000
QSO B1209+0919	12 11 34.95	+09 02 20.94	18.50	3.292	3300-8515,8650,10420	073.B-0787(A), 67.A-0146(A)	15	23 765
LBQS 1209+1046	12 11 40.59	+10 30 02.03	17.80	2.193	3290-4520,4620-5600,5675-6650	68.A-0170(A)	12	14 400
LBQS 1210+1731	12 13 03.03	+17 14 23.20	17.40	2.543	3060-3875,6705-8525,8665-10420	70.B-0258(A)	21	30 500
QSO J1215+3309	12 15 09.22	+33 09 55.23	16.50	0.616	3300-4520,4620-5600,5675-6650	69.A-0371(A)	12	18 468
QSO B1220-1800	12 23 10.62	-18 16 42.40	18.10	2.160	3280-4520,4620-5600,5675-6650	273.A-5020(A)	3	3000
LBQS 1223+1753	12 26 07.20	+17 36 49.90	18.10	2.940	3300-5600,5675-6650,6700-8520, 8660-10420	69.B-0108(A), 65.O-0158(A)	14	18 000
...								
QSO B1228-113	12 30 55.54	-11 39 09.62	22.01 [†]	3.528	3300-4520,4780-5760,5835-6810	71.A-0067(A)	14	17 875
QSO B1230-101	12 33 13.16	-10 25 18.44	19.80	2.394	3300-4515,4620-5600,5675-6650	075.A-0158(A)	12	12 000
LBQS 1232+0815	12 34 37.55	+07 58 40.50	18.40	2.570	3285-4520,4620-5600,5675-6650	68.A-0106(A), 69.A-0061(A),	36	59 400
LBQS 1242+0006	12 45 24.60	-00 09 38.01	17.70	2.084	3290-4520,4620-5600,5675-6650	273.A-5020(A)	3	3000
QSO J1246-0730	12 46 04.24	-07 30 46.61	18.00	1.286	3050-3870,4780-5758,5835-6810	69.A-0410(A)	12	12 000
LBQS 1246-0217	12 49 24.87	-02 33 39.76	18.10	2.117	3285-4520,4620-7500,7665-9460	076.A-0376(A), 67.A-0146(A)	21	27 000

Table 1. continued.

Quasar	RA 2000	Dec 2000	Mag.	z_{em}	Wavelength coverage Å	Prog. ID	No. spec	T_{exp} s
J124957.2-015929	12 49 57.24	-01 59 28.76	18.58	3.635	3300-4515,4775-5757,5835-6810	075.A-0464(A)	33	33 650
QSO B1249-02	12 51 51.39	-02 23 33.60	17.10	1.192	3300-4520,4620-5600,5675-6650	078.A-0068(A)	3	1218
QSO B1256-177	12 58 38.29	-18 00 03.18	20.20	1.956	3290-4520,4620-5600,5675-6650	075.A-0158(A)	12	12 000
QSO J1306+0356	13 06 08.26	+03 56 26.30	18.77*	5.999	6700-10420	69.A-0529(A), 077.A-0713(A)	8	38 131
QSO B1317-0507	13 20 29.98	-05 23 35.50	16.54	3.710	3300-4520,4775-5757,5835-6810	075.A-0464(A)	23	24 040
QSO B1318-263	13 21 14.06	-26 36 11.19	20.40†	2.027	3300-4520,4620-5600,5675-6650	075.A-0158(A)	20	23 100
LBQS 1320-0006	13 23 23.79	-00 21 55.24	18.20	1.388	3300-4520,4620-5600,5675-6650	274.A-5030(A)	15	13 841
QSO B1324-047	13 26 54.61	-05 00 58.98	19.00	1.882	3290-4520,4620-5600,5675-6650	075.A-0158(A)	17	19 800
QSO J1330-2522	13 30 51.98	-25 22 18.80	18.46	3.910	3300-4515,4780-5757,5835-6810	077.A-0166(A)	3	5400
QSO B1331+170	13 33 35.78	+16 49 03.94	16.71	2.084	3060-4520,4620-5600,5675-5660, 6692-8515,8650-10420	67.A-0022(A), 68.A-0170(A)	15	20 700
...								
QSO J1342-1355	13 42 58.86	-13 55 59.78	19.20	3.212	3300-5600,5675-6650	68.A-0492(A)	10	25 100
QSO J1344-1035	13 44 27.07	-10 35 41.90	17.10	2.134	3050-5760,5835-8520,8660-10420	166.A-0106(A)	51	58 933
QSO B1347-2457	13 50 38.88	-25 12 16.80	16.30	2.578	3050-5765,5835-8525,8660-10420	166.A-0106(A)	30	35 444
QSO J1356-1101	13 56 46.83	-11 01 29.22	19.20	3.006	3757-4985,6700-8520,8660-10420	71.A-0067(A), 71.A-0539(A), 69.A-0051(A)	18	13 725
...								
QSO B1402-012	14 04 45.89	-01 30 21.84	18.38	2.522	3757-4985,5710-7518,7665-9460	075.A-0158(B) 71.B-0136(A)	6	5300
...								
QSO B1409+0930	14 12 17.30	+09 16 25.00	18.60	2.838	3050-5757,5830-8520,8665-10420	65.O-0158(A), 69.A-0051(A)	44	51 950
QSO B1412-096	14 15 20.83	-09 55 58.33	17.50	2.001	3300-4515,4620-5600,5675-6650	075.A-0158(B)	3	3300
QSO J1421-0643	14 21 07.76	-06 43 56.30	18.50	3.689	3757-4980,6705-8520,8665-10420	71.A-0067(A), 71.A-0539(A)	20	18 120
QSO B1424-41	14 27 56.30	-42 06 19.55	17.70	1.522	3300-5160,5235-6210,6700-8520, 8660-10420	67.C-0157(A)	10	8000
...								
QSO B1429-008B	14 32 28.95	-01 06 13.55	20.00*	2.082	3300-5600,5675-6650-6700-8525, 8660-10420	69.A-0555(A)	49	58 048
...								
QSO J1439+1117	14 39 12.04	+11 17 40.49	16.56*	2.583	3300-4515,4780-7105	278.A-5062(A)	23	34 273
QSO J1443+2724	14 43 31.17	+27 24 36.77	19.30	4.443	4780-5757,5835-7915,9900	077.A-0148(A), 072.A-0346(B)	28	71 402
LBQS 1444+0126	14 46 53.04	+01 13 56.00	18.50	2.210	3290-4530,4620-5600-5675-6650	67.A-0078(A), 69.B-0108(A), 65.O-0158(A), 71.B-0136(A)	36	54 000
...								
QSO B1448-232	14 51 02.51	-23 29 31.08	16.96	2.215	3050-8515,8660-10420	077.A-0646(A), 166.A-0106(A)	60	66 532
J145147.1-151220	14 51 47.05	-15 12 20.10	19.14	4.763	3755-5757,5835-8515,8655,10420	166.A-0106(A)	31	48 400
QSO J1453+0029	14 53 33.01	+00 29 43.56	21.46	1.297	4780-5755,5830-8550,8650-10420	267.B-5698(A)	8	18 000
J151352.52+085555	15 13 52.53	+08 55 55.74	15.57*	2.904	3300-4520,4620-5600,5675-6650	69.B-0108(A), 71.B-0136(A)	15	15 514
QSO J1621-0042	16 21 16.92	-00 42 50.90	17.23	3.700	3300-4515,4780-5757,5835-6810	075.A-0464(A)	23	19 096
4C 12.59	16 31 45.16	+11 56 03.01	18.50	1.792	3060-3870,4780-5757,5835-6810	69.A-0410(A)	12	12 000
QSO J1723+2243	17 23 23.10	+22 43 56.90	18.17	4.520	4780-5757,5835-6810	073.A-0071(A)	2	4500
QSO B1730-130	17 33 02.72	-13 04 49.49	18.50	0.902	3300-5160,5230-6210,6695-8515, 8655-10420	67.C-0157(A)	10	9600
...								
QSO B1741-038	17 43 58.86	-03 50 04.62	18.50	1.054	3300-5160,5230-6210,6690-8515, 8650-10420	67.C-0157(A)	13	12 000
...								
QSO B1937-1009	19 39 57.25	-10 02 41.54	19.00	3.787	4780-5760,5835-6810	077.A-0166(A)	10	27 000
QSO B1935-692	19 40 25.51	-69 07 56.93	18.80	3.152	4780-5757,5835-6810	65.O-0693(A)	10	23 512
QSO B2000-330	20 03 24.12	-32 51 45.03	18.40	3.783	3760-8535,8650-10420	166.A-0106(A), 65.O-0299(A)	43	75 600
QSO J2107-0620	21 07 57.67	-06 20 10.66	17.49	0.642	3757-4985	075.B-0190(A)	3	5400
LBQS 2113-4345	21 16 54.25	-43 32 34.00	18.50	2.053	3050-7500,7660-9460	69.A-0586(A), 077.A-0714(A)	17	10 536
LBQS 2114-4347	21 17 19.34	-43 34 24.40	18.30	2.040	3050-10420	69.A-0586(A), 077.A-0714(A)	19	22 325
J211739.5-433538	21 17 39.46	-43 35 38.50	18.30†	2.050	3050-5757,5835-8520,8660-10420	69.A-0586(A)	24	10 300
QSO J2119-3536	21 19 27.60	-35 37 40.60	17.00	2.341	3290-4530,4620-5600,5675-6650	65.O-0158(A)	6	7200
QSO B2126-15	21 29 12.17	-15 38 41.17	17.30	3.268	3300-5600,5675-6650,6695-8520, 8650-10420	166.A-0106(A)	87	102 302
...								
QSO B2129-4653	21 33 02.10	-46 40 28.80	18.90	2.230	3290-4515,4620-5600,5675-6650	074.A-0201(A)	6	7200
J213314.2-464031	21 33 14.17	-46 40 31.80	19.96†	2.208	3290-4520,4620-5600,5675-6650	073.A-0071(A)	9	18 000
LBQS 2132-4321	21 36 06.04	-43 08 18.10	17.68	2.420	3290-4530,4620-5600,5675-6650	65.O-0158(A)	3	3600
LBQS 2138-4427	21 41 59.79	-44 13 25.90	18.20	3.170	3757-4983,6692-8515,8650-10420	67.A-0146(A)	9	15 120
QSO B2139-4433	21 42 22.23	-44 19 29.70	20.18	3.220	4778-5757,5835-6810	69.A-0204(A)	8	21 600
QSO B2149-306	21 51 55.52	-30 27 53.63	18.00	2.345	3300-4518,4620-5600,5675-6650	075.A-0158(B)	6	5200
QSO B2204-408	22 07 34.41	-40 36 56.00	17.50	3.155	4778-5755,5835-6810	71.B-0106(B)	6	9900
LBQS 2206-1958A	22 08 52.07	-19 44 00.00	17.33	2.560	3060-8520,8665-10420	65.O-0158(A), 072.A-0346(A)	27	33 900
QSO J2215-0045	22 15 11.94	-00 45 50.01	17.40	1.476	3060-5757,5830-8515,8650-10420	267.B-5698(A)	18	21 600
QSO J2220-2803	22 20 06.76	-28 03 23.34	16.00	2.406	3060-8520,8655-10420	166.A-0106(A), 65.P-0183(A)	60	72 000
QSO B2222-396	22 25 40.44	-39 24 36.66	17.90	2.198	3290-4520	072.A-0442(A)	1	1800
QSO J2227-2243	22 27 56.94	-22 43 02.60	17.60	1.891	3060-5757,5835-8515,8660-10420	67.A-0280(A)	36	41 813
QSO B2225-4025	22 28 26.95	-40 09 58.90	18.10	2.030	3300-4520	072.A-0442(A)	1	1800
LBQS 2230+0232	22 32 35.23	+02 47 55.80	18.04	2.147	3060-3872,6705-8525,8665-10420	70.B-0258(A)	9	13 500

Table 1. continued.

Quasar	RA 2000	Dec 2000	Mag.	z_{em}	Wavelength coverage Å	Prog. ID	No. spec	T_{exp} s
J223851.0-295301	22 38 50.97	-29 53 00.59	19.53 [†]	2.387	3080-5750,5830-8520,8660-10420	69.A-0586(A)	14	12 180
J223922.9-294947	22 39 22.86	-29 49 47.73	19.59 [†]	1.849	3060-5757,5835-6810	69.A-0586(A)	11	10 708
J223938.9-295451	22 39 38.91	-29 54 50.62	19.66 [†]	1.907	3080-7505,7670-9460	69.A-0586(A), 077.A-0714(A)	28	29 190
J223941.8-294955	22 39 41.76	-29 49 54.54	19.31 [†]	2.102	3060-7500,7670-9460	69.A-0586(A), 077.A-0714(A)	22	21 626
J223948.7-294748	22 39 48.67	-29 47 48.18	20.19 [†]	2.068	3060-10420	69.A-0586(A), 077.A-0714(A)	33	31 590
J223951.9-294837	22 39 51.84	-29 48 36.52	18.85 [†]	2.121	3070-5757,5835-6810	077.A-0714(A)	11	8450
QSO B2237-0607	22 39 53.66	-05 52 19.90	18.30	4.558	4775-5753,5830-6810	69.A-0613(A)	2	3600
QSO J2247-1237	22 47 52.64	-12 37 19.72	18.50	1.892	3300-4518,4620-5600,5675-6650	075.A-0158(B)	9	7200
QSO B2311-373	23 13 59.71	-37 04 45.20	18.50	2.476	3290-4520,4780-5757,5835-6810	69.A-0051(A)	9	10 725
J232046.7-294406	23 20 46.72	-29 44 06.06	19.83 [†]	2.401	3050-5757,5835-8520,8660-10420	69.A-0586(A)	12	6050
J232059.4-295520	23 20 59.41	-29 55 21.49	18.99 [†]	2.317	3060-5757,5835-8520,8660-10420	69.A-0586(A)	12	6050
J232114.3-294725	23 21 14.25	-29 47 24.29	19.99 [†]	2.677	3758-4982,6700-8525,8665-10420	70.A-0031(A)	6	4800
J232121.2-294350	23 21 21.31	-29 43 51.16	19.70 [†]	2.184	3060-5757,5835-8520,8660-10420	69.A-0586(A)	12	9155
QSO B2318-1107	23 21 28.80	-10 51 21.20	...	2.960	3050-4515,4780-5760,5840-6810	072.A-0442(A), 073.A-0071(A)	13	23 400
QSO J2328+0022	23 28 20.38	+00 22 38.26	17.95	1.302	3300-4520,4620-5600,5675-6650	074.A-0597(A)	9	15 900
QSO B2332-094	23 34 46.40	-09 08 12.33	18.66	3.330	3757-5757,5835-8520,8660-10250	68.A-0600(A), 073.B-0787(A)	25	31 920
J233544.2+150118	23 35 44.19	+15 01 18.33	18.20	0.791	3060-3870,4620-5600,5675-6650	078.A-0646(A)	12	17 920
QSO B2342+3417	23 44 51.26	+34 33 48.74	19.10	3.010	3757-4985,6705-8525,8665-10420	71.A-0539(A)	24	12 000
QSO J2346+1247	23 46 25.40	+12 47 44.00	...	2.578	3300-4518,4620-5600,5675-6650	075.A-0018(A)	42	70 240
QSO B2343+125	23 46 28.22	+12 48 59.93	17.50	2.763	3060-3872,4780-5757,5835-8515, 8650-10420	67.A-0022(A)	19	25 200
...								
QSO B2345+000	23 48 25.37	+00 20 40.11	19.3	2.654	3300-4518,4620-5600,5675-6650	076.A-0320(A)	24	25 600
QSO B2347-4342	23 50 34.27	-43 25 59.70	16.30	2.885	3070-5757,5835-8520,8655-10420	71.A-0066(A), 166.A-0106(A), 68.A-0230(A)	71	125 443
...								
QSO B2348-0180	23 50 57.89	-00 52 10.01	19.50	3.023	3300-4520,4780-5755,5835-6810	072.A-0346(A)	9	16 200
QSO B2348-147	23 51 29.81	-14 27 56.90	16.90	2.933	3290-4520,6100-7928,8070-9760	70.B-0258(A)	9	10 350
J235534.6-395355	23 55 34.61	-39 53 55.30	16.30	1.579	3300-4515,4620-5600,5675-6650	078.A-0068(A)	3	612
J235702.5-004824	23 57 02.55	-00 48 24.00	19.53	3.013	3300-4986	075.B-0190(A)	7	25 200
QSO J2359-1241	23 59 53.64	-12 41 48.20	16.7	0.868	3050-5757,5835-8525,8665-10250	078.B-0433(A)	24	22 800
Total	...	...	...	...	...	...	4309	5 616 229