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ESO programme A MUSE survey of the dense halo gas in z~3 galaxies near optically-thick absorbers, Data Release DR1
provided by Michele Fumagalli, submitted on 2019-12-21, published on 2020-03-18

A MUSE survey of the dense halo gas in z~3 galaxies near optically-thick absorbers

Abstract

This is the first data release of 23 MUSE cubes obtained in quasar fields at z∼3-4.5 as part of the Large Programme ID 197.A-0384, aimed at studying the distribution of gas around galaxies. For each field, we release the final coadded data cubes totaling ∼4 hours of on source observations using the extended wavelength mode. Data have been reduced with the ESO/MUSE pipeline via the Esorex Recipe Execution Tool and are released jointly with the associated white-light images.

Overview of Observations

Observations for this large programme have been obtained between period 96 and period 103 using the MUSE instrument in wide-field mode with extended wavelength coverage, encompassing a region of approximately 1x1 arcmin^2 with the targeted quasar close to the centre of the field of view. Observations collected exclusively as part of the Large Programme ID 197.A-0384 have been acquired in a series of 5 observing blocks, where each observing block was composed of ∼3x960s exposures, totaling ∼4 hours of observation on source. Four objects (J012403+004432, J111113-080401, J120917+113830, J193957-100241) include also archival data, collected as part of the programmes ID 094.A-0585, 094.A-0131, 095.A-0200, 096.A-0222. For three of these objects (all but J012403+004432), the archival data have been collected in nominal wavelength mode and combined with data in extended mode collected as part of this large programme.

Release Content

Data for the sources listed in the following table are released.

The table lists: the reference name of the quasar; the common name in the NASA/IPAC Extragalactic Database (NED); the right ascension and declination of the quasar at the centre of the field (J2000); the quasar r-band magnitude with its associated uncertainty; the quasar redshift derived from rest-frame UV lines with its associated uncertainty; the number of known strong absorption line systems; the total on-source exposure time of MUSE observations; the programme number under which observations have been collected; the resulting image quality in the reconstructed r-band from MUSE data; the limiting flux (1σ pixel rms) measured at 5500A and the corresponding AB magnitude (2σ) for a 0.7 arcsec aperture. For further details on the listed quantities see Lofthouse et al. 2019, doi:10.1093/mnras/stz3066.

Name	Common Name	R.A. (hh:mm:ss)	Dec. (dd:mm:ss)	m_r (mag)	$z_{qso,uv}$	N_{lls}	t_{exp}^{MUSE} (hours)	PID	I.Q. (arcsec)	F_{rms}/m_{ap} (10^{-20}erg s^{-1} cm^{-2} Å^{-1}/mag)
J010619.24+004823.3[a]	SDSS J010619.24+004823.3	01:06:19.24	+00:48:23.31	19.10(0.01)	4.4402(0.0002)	2	4.02	197.A−0384	0.67	1.84/26.25
J012403.77+004432.7[a]	SDSS J0124+0044	01:24:03.77	+00:44:32.76	17.95(0.01)	3.8359(0.0003)	2	4.38	197.A−0384,096.A−0222	0.73	1.99/26.16
J013340.31+040059.7[a]	SDSS J013340.31+040059.7	01:33:40.31	+04:00:59.77	18.45(0.01)	4.1709(0.0002)	3	4.02	197.A−0384	0.63	1.86/26.24
J013724.36−422417.3[c]	BRI J0137−4224	01:37:24.36	−42:24:17.30	18.46(0.05)	3.975(0.012)[d]	2	4.82	197.A−0384	0.68	1.41/26.54
J015741.56−010629.6[a]	SDSS J015741.56−010629.5	01:57:41.56	−01:06:29.66	18.30(0.01)	3.5645(0.0001)	2	4.02	197.A−0384	0.77	1.78/26.29
J020944.61+051713.6[a]	SDSS J020944.61+051713.6	02:09:44.61	+05:17:13.66	18.44(0.01)	4.1846(0.0006)	3	4.55	197.A−0384	0.57	1.58/26.41
J024401.84−013403.7[a]	BRI 0241−0146	02:44:01.84	−01:34:03.78	18.18(0.01)	4.044(0.012)[d]	2	4.02	197.A−0384	0.67	1.62/26.39
J033413.42−161205.4[b]	BR 0331−1622	03:34:13.42	−16:12:05.36	18.63(0.01)	4.380(0.013)[d]	2	4.02	197.A−0384	0.67	1.66/26.36
J033900.98−013317.7[c]	PKS 0336−017	03:39:00.98	−01:33:17.70	19.17(0.05)	3.204(0.009)[d]	2	4.02	197.A−0384	0.62	1.61/26.40
J094932.26+033531.7[a]	SDSS J094932.26+033531.7	09:49:32.26	+03:35:31.78	18.03(0.01)	4.1072(0.0004)	2	4.02	197.A−0384	0.69	1.82/26.26
J111008.61+024458.0[a]	SDSS J111008.61+024458.0	11:10:08.61	+02:44:58.07	18.28(0.01)	4.1582(0.0003)	2	4.02	197.A−0384	0.72	1.97/26.17
J111113.79−080402.0[b]	BRI 1108−0747	11:11:13.79	−08:04:02.00	18.49(0.01)	3.930(0.012)[d]	3	4.41	197.A−0384,095.A−0200	0.70	2.26/26.02
J120917.93+113830.3[a]	[HB89] 1206+119	12:09:17.93	+11:38:30.34	17.45(0.01)	3.0836(0.0001)	2	3.96	197.A−0384,094.A−0585	0.66	1.88/26.22
J123055.57−113909.3[c]	BZQ J1230−1139	12:30:55.57	−11:39:09.30	19.84(0.05)	3.557(0.012)[d]	1	4.02	197.A−0384	0.66	1.75/26.30
J124957.23−015928.8[a]	SDSS J124957.23−015928.8	12:49:57.23	−01:59:28.80	17.78(0.01)	3.6337(0.0003)	1	4.02	197.A−0384	0.65	2.10/26.11
J133254.51+005250.6[a]	SDSS J133254.51+005250.6	13:32:54.51	+00:52:50.63	18.35(0.01)	3.5071(0.0001)	1	4.02	197.A−0384	0.65	1.62/26.38
J193957.25−100241.5[c]	PKS1937−101	19:39:57.25	−10:02:41.50	16.61(0.05)	3.787(-)[e]	1	4.61	197.A−0384,094.A−0131	0.80	2.00/26.16
J205344.72−354655.2[c]	[WHO91] 2050−359	20:53:44.72	−35:46:55.20	18.41(0.05)	3.490(-)[e]	2	4.02	197.A−0384	0.66	2.16/26.07
J221527.29−161133.0[b]	BR 2212−1626	22:15:27.29	−16:11:33.00	18.13(0.01)	4.000(0.013)[d]	2	4.02	197.A−0384	0.68	2.26/26.02
J230301.45−093930.7[a]	SDSS J230301.45−093930.6	23:03:01.45	−09:39:30.72	17.68(0.01)	3.4774(0.0003)	1	4.02	197.A−0384	0.69	1.75/26.30
J231543.56+145606.4[a]	SDSS J231543.56+145606.3	23:15:43.56	+14:56:06.41	18.54(0.01)	3.3971(0.0004)	2	4.28	197.A−0384	0.73	1.77/26.29
J233446.40−090812.2[a]	FBQS J2334−0908	23:34:46.40	−09:08:12.24	18.03(0.01)	3.3261(0.0005)	2	4.02	197.A−0384	0.74	1.66/26.36
J234913.75−371259.2[b]	BR J2349−3712	23:49:13.75	−37:12:59.25	19.15(0.02)	4.240(0.012)[d]	2	4.28	197.A−0384	0.71	1.56/26.43

Release Notes

Data Reduction and Calibration

The reduction pipeline used is based on the recipes distributed as part of the ESO MUSE pipeline (Weilbacher et al. 2014, version 2 or greater), which processes the raw data and applies standard calibrations to the science exposures. Briefly, the pipeline generates a master bias, a master flat, processes the arcs, and reduces the sky flats. Next, calibrations are applied to the standard star and a sensitivity function is then generated. Finally, these calibrations are applied to the raw science exposures and data cubes with associated pixel tables are reconstructed.

After this stage, using the ESO MUSE pipeline, we reconstruct cubes that are sky subtracted by the ESO pipeline with models of the sky continuum and sky lines that are computed using the darkest pixels in the field of view. After aligning the individual exposures by using point sources in the field, we generate a stack of all science frames into a single final cube. Finally, we register this final stack on a reference coordinate system by imposing an absolute zero-point for the world coordinate system using the position of the quasar at the centre of the field. For our reference system, we use Gaia astrometry (Gaia Collaboration 2018). Wavelengths are in air with barycentric corrections applied. Readers can refer to Lofthouse et al. 2019 (doi:10.1093/mnras/stz3066) for further details on the reduction.

Data Quality

To validate the photometric calibration of our fields, we compared the r-band aperture magnitudes obtained from the data cubes against the Petrosian magnitude from SDSS. We found that for 443 bright sources ($m_r < 22$ mag), the median difference between the MUSE magnitudes and the SDSS ones is less than 3 per cent. Similarly, we compared the quasar spectra extracted from the MUSE cubes with the archival spectroscopy described above, finding excellent agreement with respect to the wavelength calibration. Finally, we measured the resulting image quality on the reconstructed r−band images by fitting a 2D Moffat function to point sources in the fields. The resulting full widths at half-maximum are listed in the table above, showing that we achieve an image quality $\lesssim 0.8$ arcsec for all the fields. In this table, we also list the 1σ root-mean-square (rms) of background pixels computed in a 50 Å window centred at 5500 Å in each cube, as a metric of the achieved depth in our observations. These values are also converted to 2σ AB limiting magnitudes assuming a 0.7 arcsec aperture.

Known issues

Data provided in this data release are known to have imperfections in the sky subtraction and in the illumination uniformity of the field. Also, the standard deviation computed during the standard data reduction is known to be underestimated by a factor of ∼1.2 compared to the true noise. For more details on these issues, and ways to correct them, see Lofthouse et al. 2019, doi:10.1093/mnras/stz3066. Future data releases will deliver data products that correct these issues.

Data Format

Files Types

The cubes and white-light images released follow the standard format described in the MUSE pipeline manual. Cubes and images are named according to the following convention:
JXXXXXXxXXXXXX_cube_eso.fits
JXXXXXXxXXXXXX_image_eso.fits

where JXXXXXXxXXXXXX is the short form of the quasar R.A. and Dec. (J2000).

Acknowledgements

Publications making use of these data should acknowledge the paper accompanying the data release of this programme: Lofthouse et al. 2019, doi: 10.1093/mnras/stz3066.

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To access the codes and scripts used, please visit http://www.michelefumagalli.com/codes.html.

Any publication making use of these data, whether obtained from the ESO archive or via third parties, must include the following acknowledgment:

- "Based on data products created from observations collected at the European Organisation for Astronomical Research in the Southern Hemisphere under ESO programme 197.A-0384 "

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