Constraining the formation mechanisms of the thick disc in edge-on galaxies using MUSE

Abstract

Our observing programmes 096.B-0054(A) and 097.B-0041(A) aimed at obtaining deep observations (almost three hours) of eight edge-on nearby galaxies with MUSE with the goal of studying the thick disc chemo-dynamics. Here we release the science-ready datacubes. The steps of the reduction are **1)** reduction of the individual exposures using the standard ESO pipeline, **2)** manual alignment of the exposures, and **3)** usage of ZAP to remove sky residuals. Details on the observing programme and the data processing can be found at Comerón et al. (2019, A&A, 623, A89).
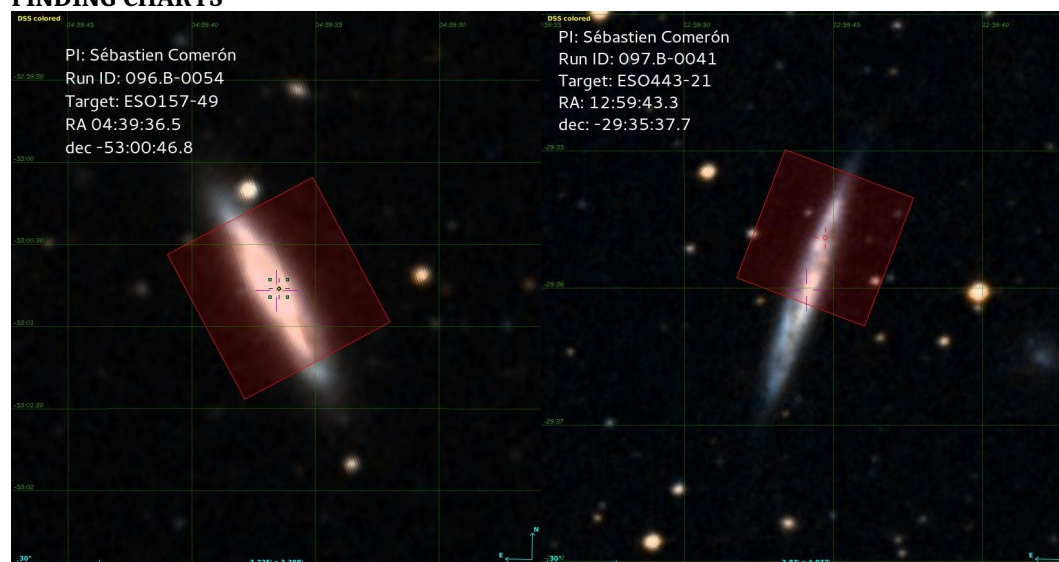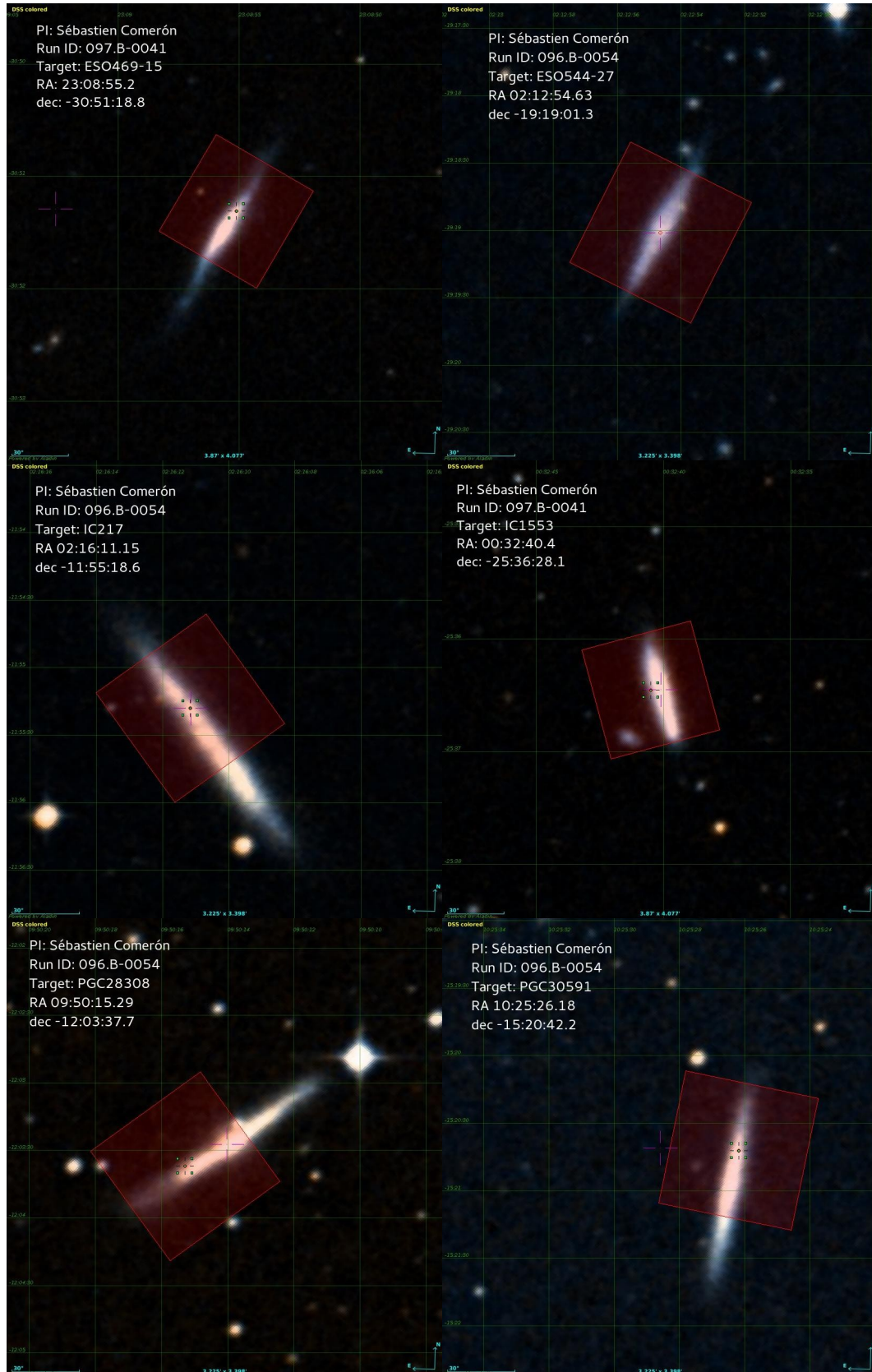
Overview of Observations

The observations were made with MUSE at the Unit Telescope 4 of the VLT. The observations were made in the wide field mode with no adaptive optics and using the standard wavelength range. The programme had no seeing constraints and required for grey nights. It was scheduled as a filler and the observations were carried under seeing values between 0.7 and 1.1 arcsec.

The observational strategy was as follows. Galaxies were exposed for 2624 seconds and then off-target exposures were taken for 240 seconds. Four of such sequences of on- and off-target exposures were scheduled, but one of our targets (IC 217) only had three of them executed. The on-target pointings were rotated with respect to each other (90º degree rotation) and also slightly dithered.

Because the galaxies are edge-on, a large fraction of the field of view of MUSE contains pure sky and it was later found that using it was more efficient at modelling the sky than the off-target exposures.

FINDING CHARTS

PI: Sébastien Comerón
Run ID: 097.B-0041
Target: ESO469-15
RA: 23:08:55.2
dec: -30:51:18.8

PI: Sébastien Comerón
Run ID: 096.B-0054
Target: ESO544-27
RA 02:12:54.63
dec -19:19:01.3

PI: Sébastien Comerón
Run ID: 096.B-0054
Target: IC217
RA 02:16:11.15
dec -11:55:18.6

PI: Sébastien Comerón
Run ID: 097.B-0041
Target: IC1553
RA: 00:32:40.4
dec: -25:36:28.1

PI: Sébastien Comerón
Run ID: 096.B-0054
Target: PGC28308
RA 09:50:15.29
dec -12:03:37.7

PI: Sébastien Comerón
Run ID: 096.B-0054
Target: PGC30591
RA 10:25:26.18
dec -15:20:42.2

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Release Content

We release the datacubes and the white light images of the eight galaxies in our two observation programmes.

The datacubes cover the spectral range between 4750 and 9300 Å and have a spectral resolution of roughly 2.5 to 2.7 Å depending on the wavelength (see Eq. 1 in Comerón et al. 2019 and the wavelength modelling in Bacon et al. 2017). The sampling is of 1.25 Å per pixel. The typical limiting magnitude for a point sources is of 25 mag in AB. The seeing of the data goes 0.7 between and 1.1 arcsec.

The complete dataset comprises eight datacubes and eight images. The datacubes typically weight between 4 and Gb and 6 Gb for a total dataset weight of 38 Gb.

The table below displays some of the information on the targets, namely the name, the coordinates, the date of the observation, the exposure time per pointing, and the number of pointings.

Target	RA	Dec	DATE-OBS	EXPTIME	N
ESO 157-49	04:39:36.5	-53:00:46.8	2015-12-02T04:58:00.858	2624 s	4
ESO 443-21	12:59:43.3	-29:35:37.7	2016-04-13T02:52:49.487	2624 s	4
ESO 469-15	23:08:55.2	-30:51:18.8	2016-05-14T08:58:01.303	2624 s	4
ESO 544-27	02:12:54.6	-19:19:01.3	2015-12-31T03:31:59.287	2624 s	4
IC 217	02:16:11.2	-11:55:18.6	2016-01-15T00:40:03.443	2624 s	3
IC 1553	00:32:40.4	-25:36:28.1	2016-07-28T04:41:48.708	2624 s	4
PGC 28308	09:50:15.3	-12:03:37.7	2016-01-01T04:42:23.741	2624 s	4
PGC 30591	10:25:26.2	-15:20:42.2	2016-01-02T04:12:28.665	2624 s	4

Release Notes

The spectral reference system for the datacubes in barycentric and the wavelength are measured in air.

Data Reduction and Calibration

The individual exposures were reduced using version 2.2 of the MUSE pipeline under version 1.6.2 of the Reflex environment.

The sky was modelled from regions distant from the galaxy disc using the "skymethod=model" option in the pipeline. Because many of the galaxies have significant extra-planar diffuse emission that would be overlooked by a mask generated from a white-light image we ran the pipeline twice per pointing:

- **1)** We made a first reduction of a spectral window of 20 Å centred in the rest-frame Hα line of the galaxy. The pipeline created sky masks based on that spectral window, that is, sky maps based on Hα emission. We set the sky maps to comprise the 10% dimmest spaxels (excluding the 5% dimmest spaxels as possible artefacts).
- **2)** The sky maps of the first run were fed into a second run, this time made over the whole spectral range of the datacubes. Hence, the sky is estimated from extra-planar regions ensured not to have bright Hα emission.

Due to the bad seeing of our observations, the alignment recipe failed. Hence, we aligned the individual pointings manually and we combined them using the muse_exp_combine recipe.

Finally, the datacubes were cleaned from sky residuals using the version 2.1 of ZAP. ZAP uses a sky mask to define sky regions. We used as sky the region with the 7% dimmest spaxels in Hα excluding the 3% dimmest spaxels as possible artefacts. ZAP worked well over most of the field of

view, but generated noisy solutions in some regions with strong emission line. To solve this problem, we detected the spaxels were noise is introduced by ZAP by finding where the standard deviation of the spectra in the range between 5500 Å and 6000 Å is increased after ZAP has been run (we selected that spectral region due to the lack of emission lines and sky lines). The spectra in spaxels where ZAP increased the noise were replaced with their counterparts in un-ZAPped datacubes.

Data Quality
Due to the lack of bright point sources in several of our datacubes, the astrometric calibration is limited to the pointing precision of the VLT and errors of the order of one to two arcseconds are expected.

Typical white-light 5-sigma depths for a point source are estimated to be around 25 mag arcsec^{-2} in AB.

Known issues
None.

Previous Releases
None.

Data Format

Files Types
The datacubes files are named as GALAXY_NAME__DATACUBE_CLEANED.fits (e.g. ESO157-49_DATACUBE_CLEANED.fits). Each datacube has two extensions. The first one (EXTNAME=DATA) contains the data value whereas the second one (EXTNAME=STAT) contains the data variance.

White-light images are name as GALAXY_NAME_collapsed.fits (e.g. ESO157-49_collapsed.fits) and contain a single extension produced by averaging the data datacube extension along the spectral direction. NaN pixels were excluded from the average.

Catalogue Columns
None.

Acknowledgements
Any publication making use of this data, whether obtained from the ESO archive or via third parties, must include the following acknowledgement:
- "Based on data products created from observations collected at the European Organisation for Astronomical Research in the Southern Hemisphere under ESO programme(s) 096.B-0054(A) and 097.B-0041(A)."

If the access to the ESO Science Archive Facility services was helpful for you research, please include the following acknowledgement:
- "This research has made use of the services of the ESO Science Archive Facility."

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Furthermore, a citation to the article describing the data reduction would be appreciated:
- Comerón et al. (2019, A&A, 623, A89).