ESO Phase 3 Data Release Description

Data Collection	UVES
Release Number	3
Data Provider	ESO, Quality Control Group
Document Date	2023-01-08
Document Version	3.1
Document Authors	Isabelle Percheron

We have recently reprocessed all the data from March 2000 (beginning of UVES operations) to March 2020 to produce stacked spectra and a better quality of the early master calibration products.
In this release:

- OB stacked spectra are now available;
- the master calibrations associated with the science data before March 2015 have been reprocessed for better quality and consistency;
- all the products have now QC plots and associated 2D extracted spectral images.

There have been several releases of the UVES phase3 science products:
After the initial release (2013), the following ones (2017 and 2018) concerned only part of the data to correct for issues with the data processing or to add some information.

For this release (2020), the full set of science data has been reprocessed and 1D product spectra are now stacked by OB execution. 2D spectral images are available on demand for QC checks. Some of the science products not available before are now provided due to the reprocessing of all the master calibrations from before 2015.

If you have downloaded UVES spectra from earlier releases and are not interested in stacked products, then there is no need to download these spectra again. There is no known quality issue in earlier spectra that would be fixed in the new release.

Abstract

This is the release of reduced 1D spectra from the UVES[1] spectrograph, ECHELLE mode (as opposed to the FIBRE mode), point sources (as opposed to extended sources), taken without or with the image slicer. Data taken with the absorption cell are also included in the data release.

This release is an open stream release, it includes the so far observed UVES ECHELLE data and will be continued operational lifetime. The data content will grow with time as new data are being acquired and processed (approximately with monthly cadence and with a short delay of 1 or 2 months). The processing scheme is as homogeneous as possible.

The selected data cover the vast majority of the entire UVES data archive, from the begin of operations in March 2000 until present. Whenever applicable stacked spectra have been generated. For the UVES data until 2015-06-30, the master calibrations have been reprocessed using the same pipeline version as used for the science products.

We have used a two-step processing scheme. In the first step, for consistency all single exposures are processed with the UVES pipeline 5.10.13 and higher (recipe *uves_obs_scired).* All data have their instrument signature removed (de-bias, flat-fielded), with the exception of the absorption-cell data which have the signature of the iodine cell not removed. Then the data have been extracted, wavelength-calibrated and order-merged. Whenever possible they have been flux-calibrated. The

[1] http://www.eso.org/sci/facilities/paranal/instruments/uves/

pipeline output products have been converted into the standard binary table format, following the ESO 1D spectroscopic standard[2]. The typical observing pattern of a simultaneous observation in the blue arm and in the red arm is propagated to the data products: there is one blue product and one red product if the original observation used both arms.

For those OBs[3] with more than one exposure per arm and central wavelength, the individual 1D spectra have been stacked in a second step (using the recipe *esotk_spectrum1d_combine* included in ESO tool kit pipeline esotk-0.8.4*)*, this data product being the intended output of the observation.

The processing is performed by the Quality Control Group using a dedicated workflow tool in an automated process. The pipeline processing uses the archived, closest-in-time, quality-controlled, and certified master calibrations. It is important to note that the reduction process itself is automatic, while the quality assessment and certification of the master calibrations was (and still is) human supervised.

The overall data content is not fixed but grows with time as new data are being acquired and processed (approximately with monthly cadence and with a delay of 1 or 2 months).

This data release offers science-grade data products, with the instrumental signature removed, flux-calibrated (if possible), with error estimates and a list of known shortcomings.

These data products are considered to be ready for scientific analysis. They are expected to be useful for any kind of high-resolution spectroscopic research, including line profile studies and radial velocity studies. For studies of energy distributions, the investigator should keep in mind that the UVES instrument is a high-resolution spectrograph, designed for stability and throughput but not for high-precision flux calibration. There are slit losses, and many observations did not care about photometric conditions.

Disclaimer. Data have been pipeline-processed with the best available calibration data. However, please note that the adopted reduction strategy may not be optimal for the original scientific purpose of the observations, nor for the scientific goal of the archive user.

Release Content

The UVES release is a stream release. The overall data content is not fixed but grows with time as new data are being acquired and processed (approximately with monthly cadence and with a delay of 1 or 2 months). The data is tagged with "UVES " in the ESO archive user interface[4].

The first data were published under the tag UVES in September 2013, with UVES data from the begin of operations (March 2000) until May 2013. Since then the data have been added in a processing stream. In 2017 an issue with the RED data taken acquired until 2007-03-31 was discovered. The entire UVES data (BLUE and RED) until that date were reprocessed and made available as version 2.

This new release of the UVES Echelle data supersedes the earlier versions. The main differences to the earlier versions are:

- Spectra are stacked at the OB level;
- The calibration data used to remove the instrumental effects have been reprocessed from start of operations until 2015-03 with the same version of the pipeline used to process the science data.

The earlier releases did not include some of the data taken in VM because the calibrations were not processed at the time.

[2] http://www.eso.org/sci/observing/phase3/p3sdpstd.pdf
[3] OB = Observing block, a single pointing on the sky and the fundamental unit of the VLT observations.
[4] http://archive.eso.org/wdb/wdb/adp/phase3_spectral/form

How to organize

The downloaded data come with their technical archive names. The README file coming with every download contains the information necessary to properly rename the files and establish their association. The fundamental unit of the renaming process is to capture column #2 in the README file (technical name starting with ADP) and column #3 (original name starting with UV_) and use something like 'mv $2 $3'.

Part I: Single exposure spectra

This part is applicable to all single-exposure products.

Data Selection

Data selection is entirely rule-based. It is organized along the following criteria:

- instrument=UVES;
- observing technique (DPR.TECH) = ECHELLE or ECHELLE,ABSORPTION-CELL or ECHELLE,SLIC#<n> (n=1,2,3) or ECHELLE,ABSORPTION-CELL,SLIC#3 where SLIC stands for slicer (**not:** FIBRE);
- category (DPR.CATG) = SCIENCE;
- type (DPR.TYPE) = OBJECT or OBJECT,POINT (**not:** OBJECT,EXTENDED).

Note that the largest fraction of UVES point-source data comes as 'normal' ECHELLE (about 80-90%). Second largest fraction is ECHELLE,SLICER (about 10%). The remaining few percent divide into ABSORPTION-CELL data, with or without the SLICERs. Physical slicers come in three different varieties which however has no impact on the data products.

A priori, no selection is made on the basis of observing mode (visitor or service), nor on settings. UVES ECHELLE settings are defined by the combination of binning, central wavelength and dichroic filter[5].

Note that the fact that a certain UVES raw file does not have a product in this release does not imply a quality issue with the raw data. It is more likely that this raw file falls into the category of VM science taken in the early years of UVES in non-standard settings or in the fast-read mode. Such data would most likely process fine manually.

We have processed all master calibrations between 2000-03 and 2015-07 in order to provide best-possible completeness, and uniform quality. After that date we have used the already existing master calibrations from the archive, since there is no quality difference to the current pipeline version.

Science data with the PROG.ID starting with 60. or 060. have been de-selected, considering them as test data. Data taken at daytime (with obviously wrong 'SCIENCE' tag) have been ignored. Otherwise the metadata tag 'SCIENCE' has been blindly accepted from the raw data (originally defined by the PI), thus including sometimes standard stars. This is often evident from the OBJECT metadata key. Also, there are rare cases when test observations were executed under the SCIENCE label. Most very short exposures with no signal fall into that category but have not been suppressed.

All data (both with and without the SLICERs) have been processed up to the wavelength calibration step. The last step, the flux calibration, was undertaken with master response curves (see below). These do not exist for all settings, not even for all standard settings. The products which could be flux-calibrated have the highest reduction level (FLUXCAL=ABSOLUTE, ORIGFILE names start with UV_SFLX), while the others have FLUXCAL=UNCALIBRATED, names start with UV_SRED (if taken without slicer and without absorption-cell), UV_SREA (without slicer, with absorption-cell), UV_SRES (with slicer, without absorption-cell), or UV_SREB (with slicer and absorption-cell). There are SLICER data which could be flux-calibrated (taken e.g. in the 580 setting), their ORIGFILE name also starts with UV_SFLX.

[5] More under http://www.eso.org/qc/UVES/pipeline/settings.html

There is no raw data selection based on quality. Likewise, we have not considered OB grades: the observations might have any grade between A and D, or X. The availability, or non-availability, of a particular file in this release does not infer any claim about the data quality. E.g. saturated pixels are not flagged by the pipeline. The user is asked to carefully check the data for those cases.

Release Notes

The data reduction for the single exposure data spectra used the standard UVES pipeline recipe `uves_obs_scired`. Find a description of the science recipe in the User Manual[6].

All recipe parameters used were default, except for:

- `reduce.ffmethod=pixel` (with 'pixel', flat-fielding is done in pixel-pixel space, before extraction; the alternative option is 'extract', in pixel-order space, after extraction; the 'pixel' method has been chosen for all data with **central wavelength ≥ 760nm** to suppress residual fringes from the flat field, which would remain with 'extract'; the 'pixel' method has the disadvantage to introduce some artifacts at the order begin and end, therefore it needs a reduction of the inter-order overlap and thereby creates larger spectral gaps in the red wavelength ranges beyond 880 nm; the 'extract' method has been chosen for all data with central wavelength below 760nm);
- `reduce.merge_delt1=14` and `reduce.merge_delt2=4` (related to the previous point: this is the amount in pixels of the order begin and end to be truncated; only applied to data with **central wavelength ≥ 760nm).**

The extraction method (`reduce.extract.method`) is 'optimal' for the normal (non-sliced) ECHELLE data. Because of the multiple stellar signal in case of SLICER data (3-5 depending on the slicer used), these are extracted with the 'linear' method. In 'optimal' mode, the pipeline uses an initial SNR estimate, based on which it selects the appropriate cross-order extraction profile (Gauss, Moffat, Virtual). Find more details in User Manual[6].

The parameter `reduce.extract.method` is set to '2d' for the 2D spectral images distributed as ancillary products.

The processing parameter `reduce.extract.kappa` (threshold for cosmic ray rejection) is set to 10.

Master Calibrations used for data reduction

Table 1: List of master calibrations used for the calibration of the science data

type (pro.catg)	name (first part)	mandatory* / optional**	content
MASTER_BIAS_{ccd}	UV_MBIA	mandatory	master bias: created from 5 raw bias frames; removes bias level and bias structure
ORDER_TABLE_{ccd}	UV_PORD	mandatory	order table: contains a description of the echelle order position, used for extraction
LINE_TABLE_{ccd}	UV_PLI1..3 or UV_PLIN	mandatory	line tables (either three, one for each third of the extraction slit, or one for the whole slit), giving the dispersion solution for the extracted spectra
MASTER_FLAT_{ccd}	UV_MFLT	mandatory	master flat: created from three raw flats; used for: removing gain noise, removing the echelle function, removing slit noise; introducing lamp response

[6] Under the UVES link in http://www.eso.org/sci/software/pipelines/

MASTER_RESPONSE_{ccd}	UV_MRSP	optional	response curve used for flux calibration; derived from selected sets of standard star measurements, collected for most (but not all) standard settings; removes lamp response and remaining instrument signature
EXTCOEFF_TABLE		optional	used to correct for extinction (optional)

ccd = BLUE | REDL | REDU
** if missing, pipeline fails*
*** if missing, final product is not flux-calibrated*

This list is the same for data taken with and without the image slicers.

Pipeline Description

Information about the UVES pipeline (including downloads and manual) can be found under the URL http://www.eso.org/sci/software/pipelines/. The QC pages[7] about UVES data contain valuable information about the UVES Echelle data, their reduction and the pipeline recipes.

Data Reduction and Calibration

The QC pages[8] about science reduction describe the details of the main reduction steps. In essence, the bias level and structure is removed. Then, depending on the flat-fielding method, either the science data are divided by the flat and then extracted using the order table ('pixel' method), or the other way around ('extract'). Upon extraction, the optimal extraction algorithm determines the sky background and removes the cosmics. SLICER data (being extracted with method 'linear' meaning a simple summing up of the total signal in the extraction slit) have no sky background determined: the observing method is suitable for bright sources and short exposure times; hence sky background can be neglected. Then the extracted orders are wavelength-calibrated (using the line tables), rebinned, and merged. This is the final step, if no master response curve is available, otherwise that calibration solution is used to flux-calibrate the extracted spectrum. If so, the spectrum is delivered in physical units. Otherwise it comes in arbitrary units (counts) and contains those instrument or atmospheric signatures which cannot be removed by the flat field (chromatic coating efficiencies, atmospheric extinction) or have been added by the flat field (spectral response of the calibration lamp).

Note that in the case of the absorption-cell data, the signature of the iodine cell has *not been removed.* (There are flat-field data available from the ESO archive with the iodine cell turned on. It was felt that the reduction with these calibration data is too delicate to be executed in an automatic way.)

The reduction of the SLICER data follows exactly the same steps, and uses the same types of calibrations, as the reduction for the non-sliced ECHELLE data. The only exception is the extraction method (linear).

The flux calibration has been applied for the following central wavelengths: 346, 390, 437, 564, 580, 760, and 860 nm.

The UVES Echelle products are wavelength calibrated. No corrections for barycentric or heliocentric motion have been applied. The corresponding values have been calculated by the pipeline from the observation and are stored in the header (HIERARCH.ESO.QC.VRAD.BARYCOR or HELICOR, in km/s).

No correction for telluric absorption lines has been applied.

[7] http://www.eso.org/qc/UVES/pipeline/pipe_gen.html
[8] http://www.eso.org/qc/UVES/pipeline/recipe_science.html

In some cases, the PIs have specified attached arclamp or flat calibration during the night, immediately after the science data. We do not guarantee that these special calibration data have been used for the reduction. More likely is that the standard daytime calibrations have been applied.

The UVES pipeline creates the following product files:

- extracted spectrum (de-bias, flat-fielded, extracted, wavelength-calibrated and rebinned);
- corresponding error file;
- *non-SLICER data only:* background underlying the signal in the slit (sky), by-product from the optimal extraction step;
- fluxed spectrum (*if flux calibration available*);
- corresponding fluxed error (*if flux calibration available*);
- 2D spectral image (pipeline parameter *reduce.extract.method=2d*).

While these pipeline product files are separate (image) fits files, the extracted spectrum and the error file are finally converted into a single binary table fits file which is the delivered data product, with the wavelength scale as first column and all other products as further columns (see 'File Structure' below).

Contrary to the product files of the UVES pipeline (which generates one product for each detector), the converted product from the RED arm (as downloaded from the archive) is a single file. The two non-overlapping red segments have been merged in a single spectrum with non-equal sampling (and no degradation). There is always an unavoidable gap between the two spectral segments due to the geometrical gap between the two red detectors.

The 2D spectral images are provided on demand to the user, they can be used as quality checks (in case of extended sources for example, or in case of centering or extraction issues).

Data Quality

There is some internal quality control on the pipeline process, monitoring:

- quality of the association (checking that the master calibrations are not older than a few days);
- score flag for number of saturated pixels in the raw data;
- QC reports and quick views.

This information has largely been used to improve and fine-tune the processing process. An individual one-by-one inspection of the products has been unaffordable.

SNR: the signal-to-noise ratio of the spectra is measured by the ratio of FLUX/ERR (or FLUX_REDUCED/ERR_REDUCED giving the equivalent result). Its chromatic slope is as complex as the spectrum itself. As representative numbers, the pipeline calculates an average per echelle order (stored in the header per order as 'HIERARCH ESO QC ORDnn OBJ SN' for BLU spectra, and as 'HIERARCH ESO QC CHIPi ORDnn OBJ SN' for RED spectra). From these numbers, a median has been calculated (omitting the respective first and last order) which is the number quoted as SNR on the query interface and in the header. Note that, as a peculiarity in the red wavelength ranges, those files reduced with the `reduce.ffmethod=pixel` method have a higher SNR in the spectral regions with overlapping echelle orders.

Known features and issues

The pipeline applies some assumptions on the source (these assumptions apply to the non-sliced case):

- if there is more than one target in the slit, it always extracts the brightest source;
- if the cross-dispersion profile of the source is not Gaussian, the UVES pipeline may create artefacts (using extraction method 'optimal' for non-sliced data). This may either happen due to an extended source, or for very high counts, close to or at saturation. A typical symptom of non-Gaussian profiles are ripple artifacts;
- If the source is not centered properly but strongly offset, the extraction algorithm might create artefacts.

If in doubt, please check the 2D image showing the calibrated signal before extraction.

Flux calibration. The flux calibration is good enough for obtaining a coarse energy distribution but is not of spectrophotometric quality. The slit losses are unknown, and many observations did not care about photometric conditions. The master response curves have been derived from carefully selected individual standard star observations, but they are applied to science data sometimes taken a long time before or after, in many cases years apart. There has been no attempt to correct for these long-term effects.

The flux-calibrated spectra are provided in units of 10^{-16} erg/cm^2/s/Ångström.

Wavelength range of flux-calibrated spectra: some of the master response curves used for flux calibration have the initial and the final 2.5 nm cut off, hence the flux-calibrated spectra have a slightly smaller wavelength range than the extracted ones.

Spectral gaps. For spectra of the RED arm, increasingly larger gaps occur beyond about 880 nm, related to the 'pixel' flat fielding algorithm. These gaps would be much smaller with the 'extract' algorithm which however has strong artifacts from the fringes in the flat field. It was felt that the spectral gaps are of minor impact in general. An investigator interested in the spectral information in those gaps might want to manually reduce the data with the 'extract' method.

Ozone absorption bands. In the extreme blue part of the 346 nm spectra (shorter than 320 nm) there are the ozone (O_3) absorption bands.

Light leak. Some spectra taken with the old RED upper CCD (upgraded in 2009) and with a long exposure time (3000s and more) are contaminated by a light leak which is visible in the raw frames (see figure below). Under unfavorable conditions this artefact propagates to spectral artefacts. In case of doubts we recommend inspecting the raw files where the light leak is easy to spot.

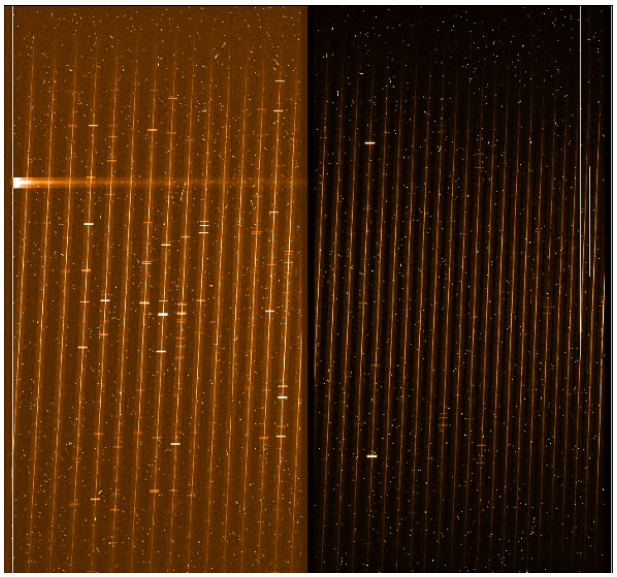

Figure 1: Light leak in the REDU CCD (left) which shows up occasionally in long exposures

Flat-field signature. Quite rarely, the 860 REDU spectra have flat-field related artifacts at the begin of echelle orders, right after the order gaps.

Object centering. If the object is not well-centered in the slit, spectral extraction may fail or produce all kinds of artifacts, including extraction ripples (find examples in the on-line documentation). The position of the object is stored in each product, in the keys HIERARCH. ESO.QC.ORDnn.OBJ.POS (in pix) where *nn* is the echelle order number. Its mean value is stored as

parameter `qc_pos` in the QC1 database table *`uves_science_public`*[9]. You can also check the 2D extracted products for object centering.

Resolving power. The spectral resolving power as displayed on the archive interface is a nominal value based on the slit width. It has been derived from the QC monitoring of health check arclamp exposures.

The current and historical measurements are available under *http://www.eso.org/qc/UVES/reports/HEALTH/trend_report_ECH_RESOLUTION_DHC_HC.html* (use also the links 'FULL' and 'history') and on the interface to the QC1 database which is available *under http://archive.eso.org/bin/qc1_cgi?action=qc1_plot_table&table=uves_wave*. The arclamp-based values are a *lower limit* to the resolving power actually applicable to a given science spectrum. That number, while not being directly measurable (unless telluric lines are available for a FWHM measurement), depends on the slit width and the prevailing seeing. For short exposures under seeing conditions better than the slit width the resolving power could be actually better than the nominal value.

Part II: OB-stacked spectra:

Data Selection

This part applies to the OB-stacked data products. In order to be candidates for a stack, the spectra must:

- belong to the same OBS.ID;
- observe the same target;
- have the same setup;
- have the same TPL.START.

The files with an exposure time which varies by more than 40% from the average value are also not included in the final stacked spectra.

Pipeline Description

The data reduction for the stacking of single exposure product spectra used the instrument independent HDRL recipe *esotk_spectrum1d_combine* describe in the ESOTK User Manual[10].

The recipe first resamples (by interpolation) all input spectra (SPECTRUM_1D) to a common output grid and then combines/stacks them. In 70% of the cases, the stacked spectrum has 2 or 3 input files, 20% between 3 and 9. Few (around 100 products) have more than 100 input single spectra.

For the stacking recipe we use the pipeline parameter *`–rescale-spectra=true`*, the input spectra are multiplicatively rescaled to the median level of the first input spectra. If there is a strong variation of the input flux, the pipeline fails. In this case, we re-process the stacked spectra using the pipeline parameter *`–rescale-spectra=false`*. The value of this parameter is written in the header of the product as well as coded in the bit#6 of the QCFLAG (see Table 2)

Data Quality

SNR. The stacked products have a column "SNR_REDUCED" that is calculated from the signal "FLUX_REDUCED" and the corresponding error "ERR_REDUCED". Its mean value across the spectrum is written into the header as key SNR. There is also the column "CONTRIB_REDUCED" that lists the number of contributing pixels in every wavelength bin. If lower than the number of input spectra, the signal of one or more input files has been rejected, e.g. because of a noise outlier. The average number of contributing spectra, normalized by the number of input spectra, is flagged in the QC_FLAG using the bit `score_contrib` which gets the value 1 if the relative contribution is less than 0.95 (5% loss).

[9] http://archive.eso.org/qc1/qc1_cgi?action=qc1_browse_table&table=uves_science_public
[10] https://www.eso.org/sci/software/pipelines/esotk/esotk-pipe-recipes.html

QC_FLAG: the header keyword QC_FLAG of the single spectra and stacked spectra products contains information on the quality of the product.

The QC_FLAG of the single spectra and of the stacked products are composed of respectively of 5 or 9 binary bits which are listed in the table below. In the case of the single spectrum the quality flag starts with S.

For most of the bits, the value 0 means that there is no concern for the product. For bit#1 a value of 0 means that we are using a standard setup (BLUE: 346, 390 or 437 nm and RED: 520, 564, 580, 600, 760, 860 nm). The table below describes the signification of each of the bits

Table 2: Description of the different bits used to flag the quality of the primary products. The bits 1 to 5 are common to both single and stacked spectra.

Bit	**Description (bit=0)**	
#1: std_setup	standard setup	any setup which is not standard will have bit#1=1. The list of standard setups is given above
#2: fluxcal	flux calibrated	
#3: sat_bit	the number of saturated pixels is less than 1000	this is not an issue if they are due to cosmics
#4: ext_bit	median value of the counts in the reduced file	bit#4 =1 if median value < 0.1. In this case, the extraction went wrong, or indicates a low signal
#5: pos_bit	relative position of maximum is well centered	if the signal is at the center of the slit, the relative position is 0.5. If the relative position is < 0.25 or >0.75, this bit is set to 1
#6: scale_bit	all the input spectra are rescaled to the mean of the first input spectrum (`--rescale-spectra=true`)	in some cases, the processing of the stacked product failed because of strong variations of the input fluxes, the stack is produced using the value `false` for the parameter `rescale-spectra` and bit#6 is set to 1
#7: dev_score	the flux level for the different input single spectra does not show a large variation	the flag is set to 0 when the variation of the flux in the input spectra is less than 30% of the mean
#8: stk_score	the SNR of the stacked product is larger than the mean SNR of the single spectra	
#9: contrib_score	number of single spectra contributing to the stack normalized by the number of input spectra	bit#9=1 if the relative contribution is less than 0.95 (5% loss)

Quick look previews. Previews are available as png plots**.** For stacked products, several plots are available as ancillary files:

- spectral overview of the stacked spectra (Figure 2 and 3);

- spectral overview of each individual spectrum contributing to the stack (Figure 4).

The figures 2 and 3 illustrate these quick look previews:

- On top: acquisition date, setup information, run ID; product ID, DPR.TYPE, OB ID, OB name, number of input files to the stack.
- Bottom: a set of QC parameters applicable to the stacked spectrum and the first input single spectrum, including the score bit (quality flag), TEXPTIME, Wavelength range and binning, SNR, mean of the contribution of the input spectra in the final stack, number of saturated pixels, relative position of the maximum. The quality flag shows the overall quality of the product. For the Figure 2, the bit#6 is 1, the pipeline parameter rescale-spectra was set to FALSE (see Table 2 for the description of the different bits). For Figure 3, the bit #7 is set to 1 which means that there is a high variation of flux levels of the input single spectra against the mean.
- The top plot shows the stacked product with 2 different binnings. The spectrum in black shows the real resolution while the red shows the rebinned spectrum (5 Ångström);
- The 2 middle plots show respectively:
    - the stacked spectrum (black), the N input spectra (red) and the last single spectrum. This is to visualize potential flux variations;
    - the SNR of the stacked product (black) and of the first single spectrum (red);
- The last plot shows the number of contributing spectra per wavelength bin (extracted from the column CONTRIB);
- On the right, we plot 3 different spectral windows in full resolution. The display windows are indicated by a, b, c in the top plot.

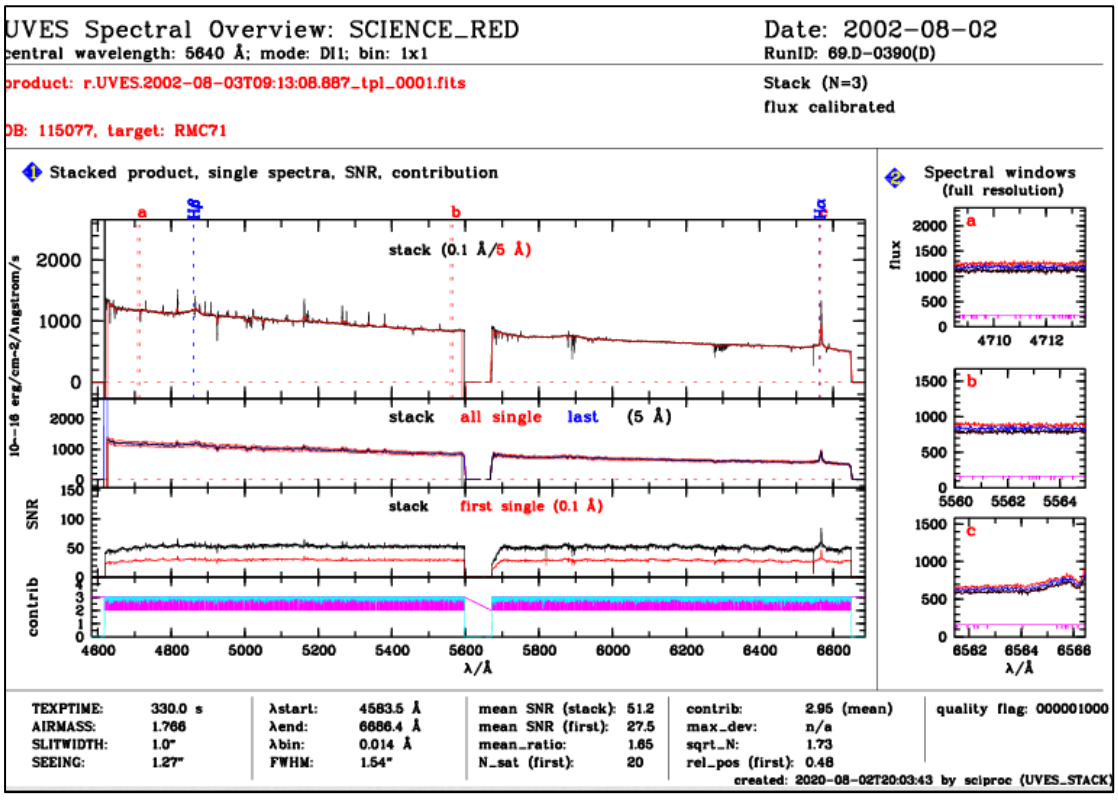

Figure 2: Quick look report of a stacked spectrum. In the case of the RED arm, both CHIPs (U and L) are shown in the same plot.

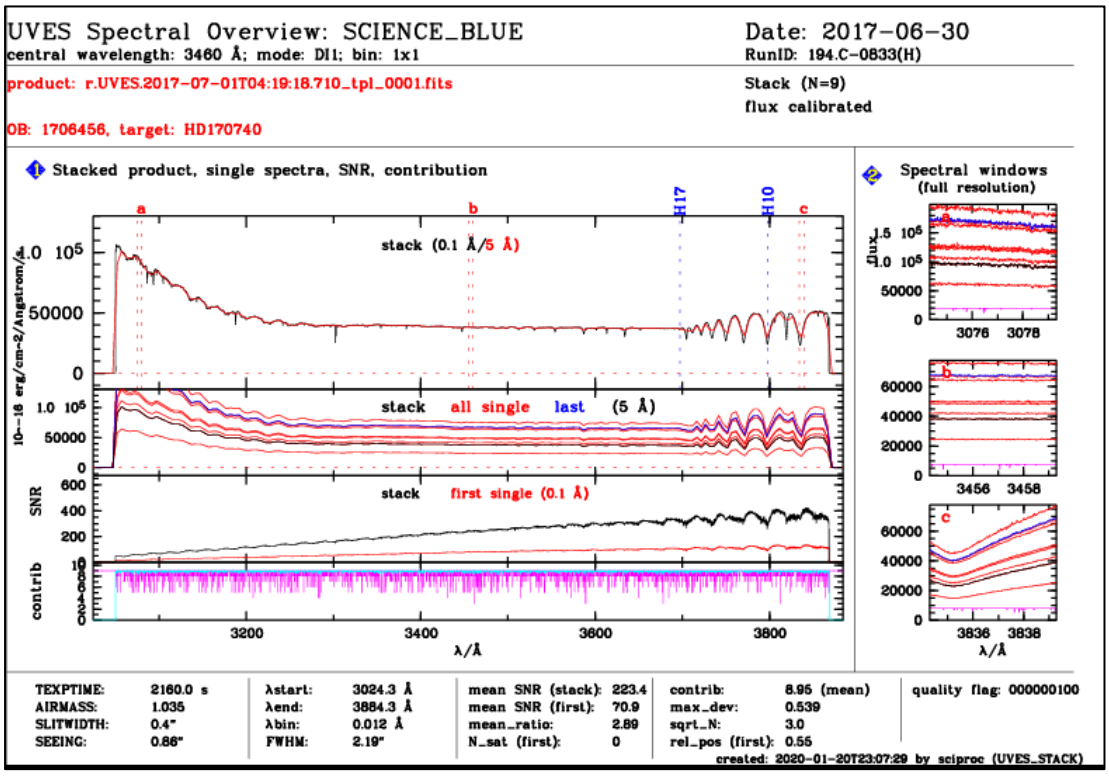

Figure 3 illustrate an example of a stacked spectrum with a high variation of the flux levels of the input spectra against mean. This is seen in the 2nd plot where the spectra of all the single input files are plotted (red).

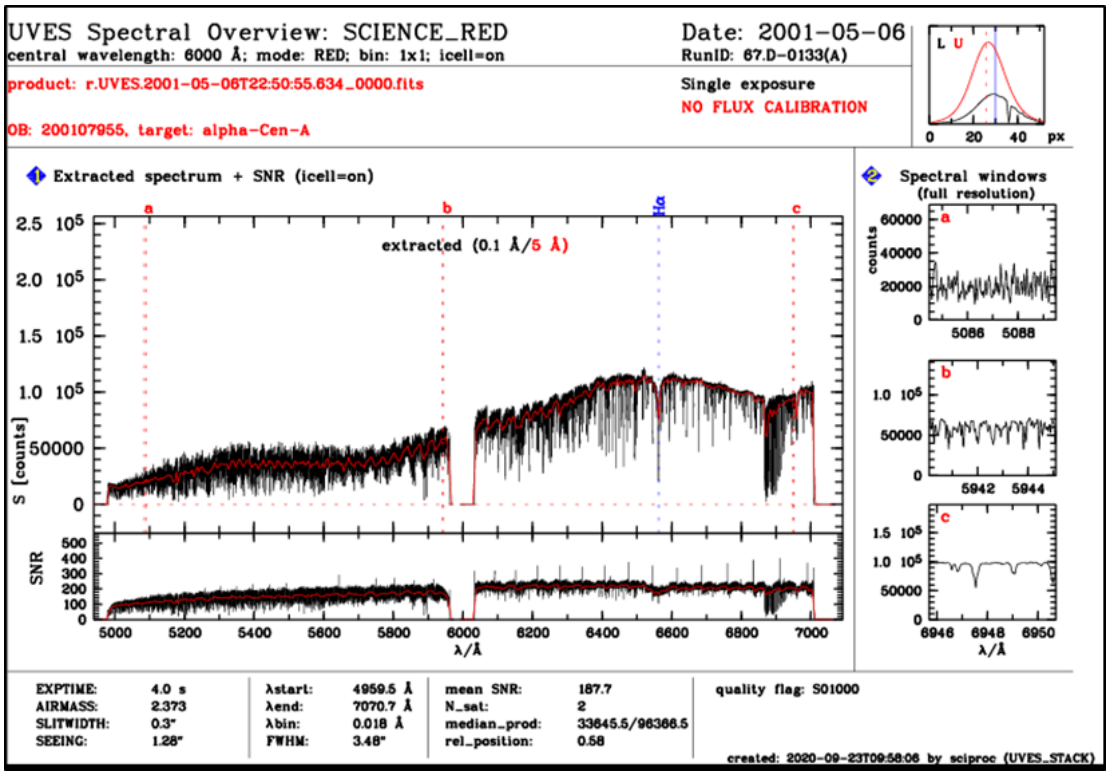

Figure 4: quick look report for a single spectrum product. As with the stacked spectrum the top and bottom of the plot show some information about the observation and the quality of the data reduction. The 2 plots in the middle show the spectrum (full resolution and binned) and the SNR. On the right, three selected spectral windows (a, b, c) are plotted.

Data Format

Files Types

The main products in this release are the primary products: stack spectra (when performed) or single spectra.

Table 3: primary fits products for stacked and single spectra. The ORIGFILE and the product category (PRO.CATG) are written in the fits header of the product delivered to the user.

ORIGFILE names starting with …	Product category PRO.CATG	Description	Comment
1. *Case of single OB products*			
UV_SFLX	FLUXCAL_SCI_POINT_<arm>	flux-calibrated product	if flux-calibration was possible (standard setting)
UV_SRED	RED_SCI_POINT_<arm>	extracted and wavelength-calibrated, but unfluxed	if flux-calibration was not possible (not a standard setting)
UV_SREA	same, for RED_SCI_ABSCELL_RED (absorption-cell data)	always unfluxed	carries signature of absorption-cell
UV_SRES	same, for RED_SCI_SLICER_<arm> (SLICER data)	if unfluxed	
UV_SREB	same, for RED_SCI_SLICABSCELL_RED (SLICER data with absorption-cell)	always unfluxed	carries signature of absorption-cell
2. *Case of OB stacked products*			
UV_SOBF	Primary product: OB-stacked spectrum	FLUXCAL_STACK_POINT_<arm>	flux-calibrated stacked product	if flux calibration was possible (standard setting)
UV_SOBR	Primary product: OB-stacked spectrum	RED_ STACK_POINT_<arm>	extracted and wavelength-calibrated, but unfluxed	if flux-calibration was not possible (not a standard setting)

When requesting science products, the user is offered the primary products and a certain number of ancillary files. Depending of the primary products (stacked or single spectra), different types of ancillary files can be requested, this is shown in the table 5. For the stacked products, the number of ancillary files depends of the number of single spectra stacked.

Table 4: The ancillary products can be downloaded "on-demand" with the primary products through http://archive.eso.org/wdb/wdb/adp/phase3_spectral/form.

ORIG-FILE names starting with …	File type	Number	Product category PRO.CATG	Description	Comment

1. Case of single OB products					
UV_S2DX	fits	1 (BLU) or 2 (RED)	RED_2D_SCI_POINT_<arm> or RED_2D_SCI_SLICER_<arm>	2D spectral image, always unfluxed	useful to check proper centering and spatial signal
	png	1			Quick look report: useful as spectral overview and QC information (figure 3)
2. Case of OB stacked products (N=number of combined exposures)					
UV_SSXP	fits	N	FLUXCAL_SCI_POINT_<arm>	flux-calibrated	if flux calibration was possible; associated to UV_SOBF
UV_SSXP	fits	N	RED_SCI_POINT_<arm>	unfluxed	if flux calibration was not possible; associated to UV_SOBR
UV_S2DX	fits	N (BLU arm), 2xN (RED arm)	RED_2D_SCI_POINT_<arm> or RED_2D_SCI_SLICER_<arm>	2D spectral image, always unfluxed	useful to check proper centering and spatial signal
	png	1			useful as spectral overview and QC information (figure 2)
	png	N			Quick look report: useful as spectral overview and QC information (figure 3)

When a large number of single spectral products belongs to a stack, it is not possible to offer to the archive user all the ancillary files (it could in some cases amount to more than 1000). These limits are described further down under "Remarks".

The following naming convention applies to the ORIGFILE product name:
e.g. `UV_SFLX_58146_2001-09-13T09:12:30.326_RED564d1_2x2_21.fits` has the components:

Table 5: naming convention for the keyword ORIGFILE

ORIGFILE component …	UV	SFLX	58146	2001-09-13T 09:12:30.326	RED564d1_2x2_21.fits
refers to …	UVES	product type	OB ID	timestamp of the first raw file	setup string: RED or BLU for the arm; 564: central wavelength in nm; d1/d2/re/bl: d1/d2 for the use of both arms, with dichroic filters 1 or 2; re/bl for use of the red or blue arm only; 2x2: binning; 21: slit width (=2.1 arcs)

Due to the data format of UVES raw data, the UVES products with d1 or d2 in their name always come as a BLU/RED twin taken (almost) simultaneously (although not necessarily with identical exposure times).

File structure

The primary products are based on the ESO 1D spectroscopic standard[2]. The columns are labeled as follows:

a) non-SLICER data:

column	label	content	UV_SFLX	UV_SRED/UV_SREA*
#1	WAVE	wavelength in Angstrom	**yes**	**yes**
#2	FLUX_REDUCED	extracted, wavelength-calibrated, sky-subtracted SCIENCE signal, **not fluxed**	**yes**	**yes**
#3	ERR_REDUCED	corresponding error (not fluxed)	**yes**	**yes**
#4	BGFLUX_REDUCED	extracted and wavelength-calibrated sky signal, **not fluxed**	**yes**	**yes**
#5	FLUX	like #2 but flux-calibrated, physical units	**yes**	no
#6	ERR	like #3 but flux-calibrated, physical units	**yes**	no

* The UV_SREA products have the absorption-line spectrum of the absorption cell not removed, they are reduced in exactly the same way as the data without absorption cell.

b) SLICER data

column	label	content	UV_SFLX	UV_SRED/UV_SREA
#1	WAVE	wavelength in Angstrom	**yes**	**yes**
#2	FLUX_REDUCED	extracted, wavelength-calibrated, sky-subtracted SCIENCE signal, **not fluxed**	**yes**	**yes**
#3	ERR_REDUCED	corresponding error (not fluxed)	**yes**	**yes**
#4	FLUX	like #2 but flux-calibrated, physical units	**yes**	no
#5	ERR	like #3 but flux-calibrated, physical units	**yes**	no

c) stacked spectrum:

column	label	content	UV_SOBF	UV_SOBR
#1	WAVE	wavelength in Angstrom	**yes**	**yes**
#2	FLUX_REDUCED	extracted, wavelength-calibrated, sky-subtracted SCIENCE signal, **not fluxed**	**yes**	**yes**
#3	ERR_REDUCED	corresponding error (not fluxed)	**yes**	**yes**
#4	FLUX	like #2 but flux-calibrated, physical units	**yes**	no
#5	ERR	like #3 but flux-calibrated, physical units	**yes**	no
#6	QUAL	Indicates bad pixels	**yes**	no
#7	CONTRIB	Number of contributed spectra	**yes**	no
#8	SNR	SNR	**yes**	no
#9	QUAL_REDUCED	Indicates bad pixels (not fluxed)	**yes**	**yes**
#10	CONTRIB_REDUCED	Number of contributed spectra (not fluxed)	**yes**	**yes**
#11	SNR_REDUCED	SNR (not fluxed	**yes**	**yes**

In the case of the RED spectra, the header contains keywords from both pipeline products (remember the pipeline delivers one spectrum per detector, and these are merged into the single 1D binary fits table), distinguished by a field 'CHIP1' or 'CHIP2', resp., in the keyword name.

The 2D products are made available as ancillary files, they come as spectral images. For the BLUE arm, one file is distributed while for the RED arm, two 2D products are produced by the pipeline (one for the CHIPU, one for CHIPL).

File Size

- Single spectra:
  - unbinned BLUE: 2MB;
  - unbinned RED: 3MB.
- Stacked spectra:
  - unbinned BLUE: 6MB
  - unbinned RED: 9MB
- 2D spectral images (ancillary files):
  - unbinned BLUE: 19MB;
  - unbinned RED CHIPU: 15MB;
  - unbinned RED CHIPL: 19MB.

Files are always uncompressed.

Acknowledgment

All users are kindly reminded to notify Mrs. Grothkopf (esodata at eso.org) upon acceptance or publication of a paper based on ESO data, including bibliographic references (title, authors, journal, volume, year, page-numbers) and the program ID(s) of the data used in the paper.

According to the Data Access Policy for ESO Data held in the ESO Science Archive Facility, all users are thus required to acknowledge the source of the data with an appropriate citation in their publications. Since processed data downloaded from the ESO Archive are assigned a Digital Object Identifier (DOI), the following statement must be included in any publications making use of them:
Based on data obtained from the ESO Science Archive Facility with DOI(s) : https://doi.eso.org/10.18727/archive/50.

Remarks

Limited number of ancillary files available

In some cases, it is not possible to provide the users with the full set of ancillary files. This is the case when the number of ancillary files is larger than 999. This happens in the case of stacked spectra which are associated with the single spectra, 2D spectral images and QC plots. In these cases, the keyword ANC_SET = 'incomplete' has been added to the header of these products.
For stacked spectra including more than 249 single spectra, the single spectra and the 2D products will be included as well as the QC plot for the stacked spectrum.
For stacked spectra with more than 332 single spectra, only the single spectra products and the QC plot for the stacked spectrum are provided.
In all other cases, the full set of ancillary files associated to a stack spectrum includes : the single spectra products and the 2D spectral images, the QC plot for the stack spectrum and the QC plots for each single spectrum.

Missing products

Some early run IDs do not have any products or have missing products in this release.
Lack of data products for these runs does not imply a quality issue with the science data.