



FITS File Description for WEAVE Observations

Project name WEAVE

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Document History

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Revision History

Revision date	Ver.	Summary of Changes	Changes marked
(Revision history up to v6.0 moved to Appendix, to ease browsing)			
13/02/20	6.0	<p>Version resulting from the WEAVESPA-341 epic, agreed upon during SPA 10.</p> <ul style="list-style-type: none"> • OBID=-1 will indicate the exposure does not belong to any OB (WEAVESPA-122). • BIASSEC_n and TRIMSEC_n added to the image extensions, as this ability has now been added to UltraDAS (WEAVESPA-310). • Changed unit of DISPERSI to nm/mm (WEAVESPA-313). • Updated description of EQUINOX keyword in TCS packet (WEAVESPA-315). • Unit of TARGPARAL changed to mas (WEAVESPA-325). • Added discussion on the order of FITS extensions at the beginning of the Overview section (WEAVESPA-329). • Updated description of NSALSA and SALSA_I to specify null value (0) for non-salsa configurations (WEAVESPA-332). • Updated length of certain string fields in the FIBTABLE (WEAVESPA-333). This reduced the row length from 469 to 281 bytes. • Updated description of OBJECT keyword (WEAVESPA-336). • Added FLDISTN_n in POS packet (WEAVESPA-339). • Added PLATEX0, PLATEY0, PLATER0 in POS packet (WEAVESPA-340). • Added type of magnitude (AB or VEGA) to FIBTABLE (WEAVESPA-345). • Added CASUID keyword to OB packet (WEAVESPA-346). 	Gafton/ Peralta/ Pico/ Murphy

		<ul style="list-style-type: none"> • Updated the definition of TARGPMRA (WEAVESPA-356). • Updated the definition of PM-RA (WEAVESPA-357). • Updated the definition of TARGUSE (WEAVESPA-358). • Updated the definition of TARGCLASS (WEAVESPA-362). • Added XML sources to the POS packet (WEAVESPA-375). • Revision up to v5.0 moved to Appendix. 	
18/05/2020	6.1	<p>From WEAVEOCS-560</p> <ul style="list-style-type: none"> • CAT-EQUI Units description updated. • STSTART Units description updated. • ST Units description updated. • M1PETALS Added tolerance to description. • LINEMM Value=0 added to possible values. • TILT Added -9999 to possible values. • FOCUS Added -9999.0 to possible values. • SKYCMX and SKYCMY Change in possible values. • NSALSA and SALSA_I moved to OB Packet. • Recovered SKYBRZEN and SKYBRTEL in Section 2.1.7. • Fibre table Extension. Added exact TFORM format as generated. • CHECKSUM and DATASUM Added to all HDUs (primary, binary, image). • TRIMSEC Clarified in the comment that it does not appear in the dummy bias image extensions. <p>From WEAVESPA-510</p> <ul style="list-style-type: none"> • CFGVER Changed to character. • CCDCHIP Updated comment to reflect that it is always the same as CHIPNAME. • Fibre table Extension. TTYPE column made wider. • DATAMVER updated description. • RATRACK fixed units. • 2.1.1 'Meaning' aligned to the left. • OBSTYPE and IMAGETYP alphabetically sorted; the correspondence between them made clear after the keywords table in Section 2.1.2. 	Pico/ Peralta/ Gafton

		<ul style="list-style-type: none"> • History before v6.0 moved to appendix. • Added hyperlinks to all JIRA tickets and BSCW documents. • Removed bibliography (INS-DAS-26 already appears in Sec. 1.3.1). • Updated documents section (1.3). • Added list of possible values for TELSTAT. • Removed all references to ICS-029 (which does not exist). <p>From WEAVEOCS-562</p> <ul style="list-style-type: none"> • Added values for CHIPNAME • SKBRZENB and SKBRZENE swapped • Updated DATASUM in Image extension • Fixed some problems from previous candidate version: <ul style="list-style-type: none"> ○ Reordered OBSTYPE and IMAGETYP values ○ Fixed typo in SKYBRTEL/ZEN names ○ Deleted empty row below SKYBRTEL ○ Fixed TARGX/Y TFORM ○ Rearranged table on 2.4 • Added TDIMn column in Fib table • Clarified description of TRIMSEC, BIASSEC, TRIMSEC_n, BIASSEC_n • OBJECT no longer needs to be in uppercase 	
02/07/20	6.2	<p>From WEAVESPA-512</p> <ul style="list-style-type: none"> • Fixed REGEX of UTSTART at page 29 <p>From WEAVEOCS-559</p> <ul style="list-style-type: none"> • Units fixed for FTSTILT and FTSDM (now degrees) • Added -9999 for non-valid values in PFC packet 	Pico/ Gafton
11/09/20	8.0	<p>From WEAVESPA-536</p> <ul style="list-style-type: none"> • Added CTYPE1, CTYPE2, BUNIT keywords in the image extensions <p>From WEAVEOCS-640</p> <ul style="list-style-type: none"> • Removed duplicated keywords <p>From WEAVESOP-10</p> <ul style="list-style-type: none"> • Clarified meaning of CCDXBIN and CCDYBIN <p>From WEAVESOP-4</p> <ul style="list-style-type: none"> • Added XML source for CAT-RA and CAT-DEC <p>From RFC-027:</p>	Gafton/ Pico

		<ul style="list-style-type: none"> • Section 6.1 • Section 6.2 • Section 6.3.1 • Section 6.3.2 • Section 6.3.3 • Section 6.3.4 • Section 6.3.5 • Section 6.3.6 • Section 6.3.7 • Section 6.3.8 • Section 6.3.9 • Section 6.5 <p>Misc:</p> <ul style="list-style-type: none"> • Clarified that PM-RA, PM-DEC, CAT-EQUI, CAT-EPOC, RADECSYS, PARALLAX and RADVEL have fixed values in the case of WEAVE. • Removed dummy bias extensions, since UltraDAS can no longer write them (see WEAVEOCS-638). • Clarified that RICE compression is applied outside of UltraDAS (e.g., by the OCS before synchronizing the FITS files with CASU). 	
05/08/22	8.0 (cont'd)	<p>- Section 2: Clarified that UDAS now produces RICE-compressed FITS files. Explained how the Packet Collectors handle missing keywords (i.e., by inserting an error value, e.g. -9999.0 for floats);</p> <p>- INSTRUME and CAMERA moved to the “spectrograph” PHDU packet, since they are technically written by that packet collector;</p> <p>- Added CAMTEMP keyword (Lakeshore temperature);</p> <p>- Added BIASOFFn[1-4] keywords in the image extensions; related to WEAVESPE-74;</p> <p>- AGSNRTHn[1-8] is now AGSNRTH (a single keyword), since the SNR threshold cannot be set per fibre, but is a global parameter;</p> <p>- Added DITHVER to the “ob” packet (related to WEAVESPA-603).</p>	Gafton/ Pico

Approvals This document requires the following approvals.

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1 INTRODUCTION

WEAVE is a new wide-field spectroscopy facility proposed for the prime focus of the 4.2m William Herschel Telescope. The facility comprises a new 2 degree field of view prime focus corrector with a 1000-multiplex fibre positioner, a small number of individually deployable integral field units, and a large single integral field unit. The IFUs and the MOS fibres can be used to feed a dual-beam spectrograph that will provide full coverage of the majority of the visible spectrum in a single exposure at a spectral resolution of ~ 5000 or modest wavelength coverage in both arms at a resolution ~ 20000 . The instrument is expected to be on-sky by 2020 to provide spectroscopic sampling of the fainter end of the Gaia astrometric catalogue, chemical labelling of stars to $V \sim 17$, and dedicated follow up of substantial numbers of sources from the medium deep LOFAR surveys.

1.1 Abbreviations

The abbreviations and acronyms used in this document can be found in [WEAVE-MAN-001](#).

1.2 Purpose

The purpose of this document is to provide a description of the format of the FITS image files that will be produced as a result of the WEAVE operations. It describes both the headers and the expected format of the files which will include the various extensions utilised in the storage of the image data and its associated meta-data.

This document is based on the content of [INS-DAS-26](#) (Rixon, Bevil, Rees, Bassom, & Fisher).

For a high-level description of the whole OCS system, see [WEAVE-OCS-007](#).

1.3 Documents

1.3.1 Applicable Documents

Document Identifier	Document Title
INS-DAS-26	Observation files produced by UltraDAS
WEAVE-ICD-001	WEAVE control system interface document
WEAVE-ICS-017	Final Design for the SPE Control Software
WEAVE-MAN-015	Work Package Assignments
WEAVE-OCS-007	System Architecture description
WEAVE-POS-007	Fibre Positioner System Software FDR
WEAVE-SCI-006	Requirements from ConOps
WEAVE-SPE-017	Detector Subsystem Final Design
WEAVE-SYS-001	Instrument Development Specification Document

1.3.2 Referenced Documents

Document Identifier	Document Title
WEAVE-MAN-001	Abbreviations and Definitions
WEAVE-MAN-002	Change Management Procedures
WEAVE-MAN-003	Configuration Management Procedure
WEAVE-MAN-004	Product Breakdown Structure
WEAVE-MAN-007.2	Risk Log
WEAVE-MAN-007.3	Issue Log
WEAVE-MAN-009	Project Management Team Responsibilities
WEAVE-TEM-007	Work Package Description Notes

2 OVERVIEW

There will be two discrete science Data Acquisition Systems associated with the WEAVE instrument. The raw data from each camera system in conjunction with the image meta-data and instrument status information will be assembled into a FITS compliant image file which will contain all the necessary information required for the scientific data reduction.

The content of this document is based on the [INS-DAS-26](#) (Rixon, Bevil, Rees, Bassom, & Fisher).

The following sections describe the expected format of these files. Note that UltraDAS **cannot** write the HDUs of the FITS files in the desired order expressed in the table below (raw files as produced by UltraDAS will have groups **1** and **2** interchanged, with the image extensions at the end). However, UltraDAS will internally call a postprocessing script that uses **astropy.fits.io** to switch the positions of the image and binary table extensions, in order to produce the order shown below, as required by ICD-027.

Important! Note that if for any reason (e.g., I/O error, corrupted FITS file, etc.) the postprocessing fails, the raw file produced by UltraDAS (with the binary tables before the image extensions) will be saved to disc and will therefore be further propagated to the pipelines and the WEAVE archive.

We cannot stress enough that external software should never rely on any hard-coded relative position of the extensions, but should instead address them by name (this is trivial, for instance, in Astropy, where **hdul[0]** and **hdul['PRIMARY']** refer to the same object in the table below, as do **hdul[-3]** and **hdul['FIBTABLE']**). This fully protects the downstream software from a failure in the postprocessing of the FITS file by UltraDAS (which, as explained above, would result in an order of the FITS extensions that does not match the table below).

Group	Position	HDU name	HDU description	XTENSION
0	0	PRIMARY	Primary HDU	

1	1	RED1_DATA / BLUE1_DATA	CCD1 data	IMAGE
	2	RED2_DATA / BLUE2_DATA	CCD2 data	
2	3	FIBTABLE	Fibres binary table	BINTABLE
	4	GUIDINFO	Guiding binary table	
	5	METINFO	Meteo binary table	

Dummy image extensions (<DETECTOR>_BIAS) can no longer be written by UltraDAS (see [WEAVEOCS-638](#)), therefore they do not appear in the above table.

In a similar way to how it reorders the image extensions, UltraDAS also RICE-compresses the FITS files in postprocessing, using the CFITSIO application *fpack* (as required in WEAVE_ICD_027, section 2). All FITS files produced by UltraDAS are expected to be compressed, except in the unlikely scenario that postprocessing fails (see above). In that case, the “original” file produced by DAS (uncompressed) will be saved to disc instead.

Finally, all FITS header keywords present in this document are collected, regardless of whether the system responsible for providing them is functioning or not, of whether the mechanisms they describe are in error, etc.

If – for any reason – the FITS keyword is not present in the Parameter Notice Board, or is invalid, etc., the Header Collection Task will insert an error value in the FITS header; depending on the keyword type, this will be:

Keyword Type	Error value
real	-9999.0
integer	-9999
character	‘MISSING’

2.1 Primary HDU

The primary header description unit (HDU) will be used to hold the general instrument headers related to the various subsystems that make up the WEAVE system. The following sections outline the headers that will be included in the primary HDU.

The header keywords below have been checked against the FITS standard at https://archive.stsci.edu/fits/fits_standard/fits_standard.html.

Image data will be stored in extensions detailed later in the document.

The primary HDU will contain the header integrity keywords **CHECKSUM** (ASCII character string whose value forces the 32-bit 1's complement checksum accumulated over all the 2880-byte FITS logical records in the HDU to equal negative zero) and **DATASUM** (character string containing the unsigned integer value of the 32-bit 1's complement checksum of the data records in the HDU).

2.1.1 The Camera Packet

The camera packet describes aspects of the camera that apply equally to all channels and will be produced by the Data Acquisition System. This is not really a "packet" since it is not provided by the PacketCollector task, but is instead written directly by the camera server, at the moment it starts writing the FITS file to disk.

Keyword	Data Type	Meaning
SIMPLE	boolean	T, since the file conforms to the FITS standard.
BITPIX	integer	Specifies the number of bits that represent a data value. Value=8.
NAXIS	integer	Represents the number of axes in the associated data array. Value=0.
EXTEND	boolean	T, since the FITS files contain extensions.
RUN	integer	Run number.
IRAFNAME	character	File name to be used by RFITS.
DETECTOR	character	Formal name of the camera. For WEAVE the possible values will be 'WVRED' or 'WVBLUE'.
CCDSPEED	character	Readout speed. Possible values: 'FAST' or 'SLOW'.
CCDXBIN	integer	Binning factor in the <i>x</i> / serial / spectral direction of the amplifier frame.
CCDYBIN	integer	Binning factor in the <i>y</i> / parallel / spatial direction of the amplifier frame.
CCDSUM	character	Both binning factors, <i>x</i> given first, with no punctuation, e.g. "2 4".
CCDTEMP	real	[K] Cryostat temperature.

CCDTEMP1	real	[K] Monitor pt 1 temperature.
CCDTEMP2	real	[K] Monitor pt 2 temperature.
NWINDOWS	integer	Number of readout windows.
WINSECn[1-4]	character	Readout window n (d-space).
READMODE	character	Readout mode.
STORMODE	character	Store mode.
NUMREADS	integer	Number of reads.
COAVERAG	integer	Number of cycles covered.
DATE-OBS	character	Date of observation in the FITS-approved format.
UT	character	[hh:mm:ss.sss] UTC of start of observation.
UTSTART	character	[hh:mm:ss.sss] UTC of start of observation (same as UT).
UT-MID	character	[hh:mm:ss.sss] UTC at the middle of the exposure.
EXPOSED	real	[s] Length of exposure, excluding pauses, from the first opening of the shutter to its final closing.
EXPTIME	real	[s] Same as EXPOSED.
ELAPSED	real	[s] Length of exposure, including pauses, from end of clearing to start of readout.
DARKTIME	real	[s] Same as ELAPSED.
REQTIME	real	[s] Requested length of observation. It matches exposure.exp_time in the XML.

The numbers in RUN are unique among observations at the WHT. The numbers reflect the order in which observations are started.

IRAFNAME takes the value $r<n>$ where n is the run number as in RUN.

DATE-OBS is the UT date and changes at 0000hrs UTC. It has the format yyyy-mm-dd. DATE-OBS and UTSTART must be derived from the same timestamp. It is an error for UTSTART and DATE-OBS to refer to instants on opposite side of the date-change at midnight.

2.1.2 The Observation Packet

The packet is formally called “observation” and is provided by the UDAS client (e.g., the **udas_run** program).

Keyword	Values	Data type	Notes
RUNSET		character	[i:n:r] Format i:n:r - see below.
SYSVER		character	Version number of the

		r	observing system.
ORIGIN	ING La Palma	character	As used at the WHT.
OBSERVAT	LAPALMA	character	Used by IRAF.
OBSERVER		character	Typically, this contains the observer's initials.
PROPOSAL		character	This is the code for the PATT/CAT proposal.
OBJECT	<Observation name> for science observation, otherwise it can be: ARC, BIAS, DARK, FIBRE_LAMPFLAT, FIBRE_LAMPFLAT, FIBRE_TWIFLAT, FIBRE_SKYFLAT, DETECTOR_FLAT, SALSA_LAMPFLAT, SALSA_TWIFLAT, SALSA_SKYFLAT, SALSA_ARC, STDFIBRE_LAMPFLAT, STDFIBRE_TWIFLAT, STDFIBRE_SKYFLAT	character	This field is taken directly from the XML. For exposure.type='science' observations, it is the observation.name attribute, whilst otherwise it is the exposure.type .
OBSTYPE	ARC, BIAS, DARK, DETECTOR_FLAT, FIBRE_FLAT, FLAT, FLUX_STD, FOCUS, GLANCE, RV_STD, SALSA_ARC, SALSA_FLAT, SCRATCH, SKY, TARGET	character	The type of observation, in the format understood by the archive and associated software at IOA, Cambridge. Upper case is mandatory.
IMAGETYP	arc, dark, detector_flat, fibre_flat, flat, flux_std, focus, glance, object, rv_std, salsa_arc, salsa_flat, scratch, sky, zero	character	The type of observation in the form preferable by IRAF. The value must match the value of OBSTYPE (see the note below). Lower case is mandatory.
OBSCOMM <i>n</i> [1-9]		character	Comments from the observer, after CCD Readout, relating QC issues, calibration issues or observing conditions.

The correspondence between OBSTYPE and IMAGETYP is as follows (see also the discussion in [WEAVESPA-308](#)):

OBSTYPE	IMAGETYP
ARC	arc
BIAS	zero
DARK	dark
DETECTOR_FLAT	detector_flat
FIBRE_FLAT	fibre_flat
FLAT	flat
FLUX_STD	flux_std
FOCUS	focus
GLANCE	object
RV_STD	rv_std
SALSA_FLAT	salsa_flat
SALSA_ARC	salsa_arc
SCRATCH	object
SKY	sky
TARGET	object

RUNSET describes the observation's relationship to a set of runs such as a dither sequence. The run is stated to be run i of a set of n runs, starting at run number r , these numbers being formatted in a string and separated by colons: e.g. '2:10:1234567' means second run of a sequence of 10, starting at run 1234567. Both i and n are counted from 1.

2.1.3 The TCS Packet

The packet is formally called “tcs” and is provided by the TCS bridge computer via the TCSPKT task.

Keyword	value	Data type	Meaning
TELESCOP	WHT	character	Common name of telescope.
LATITUDE		real	[deg] Latitude of telescope corrected for polar motion.
LONGITUD		real	[deg] Longitude of telescope corrected for polar motion.
HEIGHT	2344	real	[m] Height of observing floor above sea-level.
SLATEL	LPO4.2	character	The name for the telescope as understood by the library subroutine <i>slaObs()</i> .
TELSTAT	ENGMODE, GUIDING, LIMIT, MOVING, STOPPED, TRACKING	character	Telescope status at end of observation.

MJD-OBS		real	[days] Modified Julian date at the start of the observation.
JD		real	[days] Julian date at the start of the observation.
CAT-NAME		character	The name of the target as stored in the target list. May be different from the name stored under OBJECT.
CAT-RA		character	[hh:mm:ss.sss] Target Right Ascension. Matches the observation.RA_d attribute in the XML file.
CAT-DEC		character	[sdd:mm:ss.ss] Target Declination. Matches the observation.Dec_d attribute in the XML file.
CAT-EPOC	2000	real	[year] Target epoch of proper motions. Always 2000 for WEAVE.
CAT-EQUI	J2000.00	character	[J Bnnnn.nn or A] Equinox of target coordinates. Always J2000.00 for WEAVE.
PM-RA	0	real	[seconds/yr] Proper motion in R.A. (this is the rate of change in RA, not the true angular motion on the sky). Always 0 for WEAVE.
PM-DEC	0	real	[arcsec/yr] Proper motion in Dec. Always 0 for WEAVE.
PARALLAX	0	real	[arcsec] Annual parallax. Always 0 for WEAVE.
RADVEL	0	real	[km/s] Heliocentric radial velocity of the target. Always 0 for WEAVE.
RATRACK		real	[arcsec/s] Differential-tracking rate in R.A.
DECTRACK		real	[arcsec/s] Differential-tracking rate in Dec.
RA		character	[hh:mm:ss.sss] R.A. that the telescope is tracking at the start of the observation.
DEC		character	[sdd:mm:ss.ss] Dec. that the telescope is tracking at the start of the observation.
RADECSYS	ICRS	character	Reference system for celestial coordinates (FK4, FK5, GAPPT, ICRS). Always ICRS

			for WEAVE.
EQUINOX		real	[nnnn.nn...] For RADECSYS of FK4 or FK5: equinox of the coordinates in RA, DEC: a decimal number of years AD. Ideally, these coordinates should be given to the same equinox as CAT-RA and CAT-DEC. For RADECSYS of GAPPT or ICRS: current date as fraction of year.
UTOBS		character	[hh:mm:ss.s] Universal time at the start of the observation.
STSTART		character	[hh:mm:ss.sss] Local sidereal time at the start of the observation.
ST		character	[hh:mm:ss.sss] Same as STSTART.
AZSTART		real	[deg] Azimuth of telescope at the start of the observation.
AZEND		real	[deg] Azimuth of telescope at the end of the observation.
ZDSTART		real	[deg] Zenith distance at the start of the observation.
ZDEND		real	[deg] Zenith distance at the end of the observation.
AMSTART		real	Airmass at the start of the observation.
AMEND		real	Airmass at the end of the observation.
AIRMASS		real	Effective mean airmass during observation.
XAPOFF		real	[deg] Total aperture offset in 'x'.
YAPOFF		real	[deg] Total aperture offset in 'y'.
XAPNOM		real	[deg] Offset of nominal pointing position from the rotator centre.
YAPNOM		real	[deg] Offset of nominal pointing position from the rotator centre.
RAOFF		real	[arcsec] Positional offset parallel to RA (tangent plane).
DECOFF		real	[arcsec] Positional offset in Dec (tangent plane).
ROTTRACK		boolean	True if the instrument platform

			maintained constant sky PA through the observation.
ROTSKYPA		real	[deg] Sky position angle at the start of the observation.
MNTPASTA		real	[deg] Mount position angle at the start of the observation.
MNTPAEND		real	[deg] Mount position angle at the end of the observation.
PARANSTA		real	[deg] Parallax angle at the start of the observation.
PARANEND		real	[deg] Parallax angle at the end of the observation.
VIGNETTE		boolean	True if the mirror petals or the dome vignette the telescope's beam.
DAZSTART		real	[deg] Azimuth of dome at the start of the observation.
DAZEND		real	[deg] Azimuth of dome at the end of the observation.
AUTOMODE	UNLOCKED, AUTOGUIDE, AUTOGUIDESUSP	character	State of guide loop at start of observation.
AUTOX		real	[pixel] x coord of autoguiding reference position.
AUTOY		real	[pixel] y coord of autoguiding reference position.
TEMP TUBE		real	[deg C] Temperature of telescope tube, ten minute running mean at the end of the observation.
FSTATION	CASSEGRAIN, PRIME, GHRIL_ROT, GHRIL_UVDEROT, GHRIL_OPTDEROT, GHRIL_NOROT, GRACE_ROT, GRACE_IRDEROT, GRACE_NOROT, GHRIL_CANARY, WEAVE	character	Focal station of observation.
TELFOCUS		real	[m] Telescope focus
PLATESCA		real	[deg/m] Plate scale at the telescope focus.
ACTELFOC		real	[m] Actual value of telescope focus encoder.
FOCUSTMP		real	[mm] Focus temperature

			correction.
FOCUSALT		real	[mm] Focus elevation correction. Currently only applied for WHT at Prime.
FOCUSFLT		real	[mm] Focus correction for filter.
M1PETALS		real	M1 mirror petals position (%). 0 for closed. 100 open. +/- 4 of tolerance
ARCHIVEB		character	UT when TCS received Archive_B.
ARCHIVEE		character	UT when TCS received Archive_E.

In the case of AIRMASS, the values are integrated every second to produce the effective mean airmass under the normal definition of that term.

EQUINOX should be read with RADECSYS to determine whether the coordinates are Besselian or Julian: FK4 coordinates are Besselian. The old ING convention of prefixing the EQUINOX value with J or B is dropped because it conflicts with the FITS standard.

The latitudes and longitudes of the telescopes can be found in the 1994 ING Observer's Guide.

2.1.4 The Spectrograph Packet

The spectrograph packet contains all of the header information related to the status and configuration of the spectrograph subsystem. It is provided by the OCS spectrograph high-level server (see [WEAVE-ICS-017](#)).

The details of the headers that will be provided as part of this package are shown in the table below:

Keyword	Data Type	Meaning
INSTRUME	character	Name of instrument, reflecting the \$INSTRUMENT environmental variable. Note that for the WHT observing system each arm is considered a different instrument. Possible values: 'WEAVERED', 'WEAVEBLUE'.
CAMERA	character	Duplicate of INSTRUME . This is NOT the name of the camera, as understood at the WHT (that would be DETECTOR), but of the instrument (!) This is because the CPS team wants to have WEAVERED/WEAVEBLUE in the CAMERA header.
CAMTEMP	real	[K] Temperature of the camera, as provided by the

		Lakeshore device.
VPH	character	Name of the VPH grating for the current arm. Possible values 'N/A', 'LowRes', 'HighRes1', 'HighRes2'.
LINEMM	integer	[lines/mm] Number of lines per mm associated with VPH grating. Possible values:0 if no grating is deployed. Blue arm: low-res :1385, high-res 1 3580, high-res 2 3056 . Red arm: low-res: 876 , high-res 1 2431.
CENWAVE	integer	[nm] TBD in commissioning Central wavelength of the VPH grating. Values: Low-res mode: R = 5000, blue arm 366 - 606 nm, red arm 579 - 959 nm, High-res mode: R = 20000, blue arm 404 - 465 nm or 473 - 545 nm, red arm 595 - 685 nm.
DISPERSI	real	[nm/mm] Nominal dispersion.
HART	character	The position of the Hartmann shutter. Possible values: 'BOTH_OPEN', 'BOTH_CLOSE', 'LEFT_OPEN', 'RIGHT_OPEN'.
MODE	character	The current mode of the arm. Possible values 'LOWRES', 'HIGHRES'.
FLILU1	integer	The power reading of the flat field illumination LED 1 in the current arm. Possible values: 0-100.
FLILU2	integer	The power reading of the flat field illumination LED 2 in the current arm. Possible values: 0-100.
FLILU3	integer	The power reading of the flat field illumination LED 3 in the current arm. Possible values: 0-100.
TIP	integer	[microns] The position of the tip mechanism associated with the cryostat in the current arm.
TILT	integer	[microns] (-4000,4000). -9999 if in Error. The position of the tilt mechanism associated with the cryostat in current arm.
FOCUS	real	[mm] The position of the focus mechanism in the current cryostat. -9999.0 if in Error
FOCUSMTA	int	[mm] The position of the Focus motor A.
FOCUSMTB	int	[mm] The position of the Focus motor B.
DUSTCOVR	boolean	Whether the dust cover was open or closed. 'T' for open, otherwise, 'F'.
SLITEX	character	The position of the slit exchanger. 'MOS-A', 'MOS-B', 'LIFU', 'mIFU'
SLITILL	character	The current state of the slit illumination. Possible values are: 'MOS-A', 'MOS-B', 'LIFU', 'mIFU-MOS-B', 'mIFU'.
ARCSRC	character	The arc calibration lamp source in use. Possible values are: 'NONE', 'Hg', 'Ne', 'He', 'Zn', 'Cd', 'ThAr', 'ThArCr'.
FLATSRC	character	Source of flat field. Possible values are 'NONE', 'TWILIGHT', 'W', 'QTH', 'DARK_SKY',

		<p>‘WL1,WL2,WL3’ , where WLn describe the LED wavelengths (in nm) corresponding to each LED . Currently the values for each LED are: LED1 375 , LED2 490, LED3 590, for the Blue Arm. LED1 590 , LED2 780, LED3 940, for the Red Arm. When any of the LED is not powered, its wavelength value will be substituted for ‘-’. For example: ‘375,-, 590’ or ‘-,-, 940’</p>
CALFLTA	character	<p>Calibration lamp filter used in position A. Possible values: ‘WCALU_clear1’, ‘WCALU_ND2.0’, ‘WCALU_ND3.0’, ‘WCALU_ND1.0’, ‘WYC_ND0.5’, ‘WCALU_DARK1’, ‘EMPTY’ The requested filter can be found in the exposure.cal_lamp_filter_A attribute of the XML file.</p>
CALFLTB	character	<p>Calibration lamp filter used in position B. Possible values: ‘WCALU_clear2’, ‘WCALU_GG395’, ‘WCALU_BG38’, ‘WCALU_DARK2’, ‘WCALU_clear3’, ‘WCALU_DARK3’, ‘EMPTY’. The requested filter can be found in the exposure.cal_lamp_filter_B attribute of the XML file.</p>
MAITSLIT	boolean	True if MAIT Slit is deployed.

2.1.5 The Prime Focus Corrector Packet

This packet contains all of the header information associated with the prime focus corrector and the ADC control. The packet is produced by the TCS.

Keyword	Data type	Meaning
ADC1	real	[deg] Angle of first ADC element. -9999 if in Error
ADC2	real	[deg] Angle of second ADC element. -9999 if in Error
ADCINPOS	boolean	ADC in position.
ADCCORR	boolean	ADC correction enabled.
FTSINPOS	boolean	FTS in position.
FTSTILT	real	[deg] Actual FTS Tilt. -9999 if in Error
FTSTDEM	real	[deg] FTS tilt demand. -9999 if in Error
FOCUBOTR	real	[microns] Focus drive bottom right. -9999 if in

		Error
FOCUBOTL	real	[microns] Focus drive bottom left. -9999 if in Error
FOCUTOPR	real	[microns] Focus drive top right. -9999 if in Error
FOCUTOPL	real	[microns] Focus drive top left. -9999 if in Error
TILTCORR	boolean	FTS Tilt enabled.

2.1.6 The Autoguider Packet

This packet will be produced by the autoguider system and contains the header information related to the autoguider status and performance throughout the execution of the integration.

Some keywords are suffixed by n to indicate which of the 8 guide fibres it refers to. When in the MOS mode, there will always be information for 8 guide fibres.

In the case of LIFU-based observations which uses a camera, parameters relating to the configuration and performance of the autoguiding will be stored in the keywords where n equals 1.

Keyword	Data type	Meaning
AGACQT	real	[s] Integration time for acquisition.
AGGUIT	real	[s] Integration time for guiding.
AGMODE	char	Name of autoguider mode i.e. LIFU or MOS.
AGXSEEn[1-8]	real	[arcsec] Mean FWHM of guide star, x -axis.
AGYSEEn[1-8]	real	[arcsec] Mean FWHM of guide star, y -axis.
AGXSRMSn[1-8]	real	[arcsec] RMS on FWHM of guide star, x -axis.
AGYSRMSn[1-8]	real	[arcsec] RMS on FWHM of guide star, y -axis.
AGEXPMGn[1-8]	Real	[mag] Expected magnitude of guide star.
AGMAGIn[1-8]	real	[mag] Mean magnitude of guide star.
AGMRMSn[1-8]	real	[mag] RMS variation of magnitude of guide star.
AGMAGOFF	real	[mag] Magnitude zero-point.
AGSTAT	integer	Number of readings used for statistical calculations.
AGXn[1-8]	real	[pixels] Guiding position of fibre n on autoguider, x -axis.
AGYn[1-8]	real	[pixels] Guiding position of fibre n on autoguider, y -axis.
AGSIGBn[1-8]	boolean	Whether this guide signal was used at the beginning of the integration.
AGSIGEn[1-8]	boolean	Whether this guide signal was used at the end of the integration.
AGSNRTH	real	Signal to noise threshold for exclusion of

		guide signal.
AGDRXB_n[1-8]	real	[arcsec] Calculated compensation in X for differential refraction at the beginning of the exposure.
AGDRYB_n[1-8]	real	[arcsec] Calculated compensation in Y for differential refraction at the end of the exposure.
AGDRXE_n[1-8]	real	[arcsec] Calculated compensation in X for differential refraction at the beginning of the exposure.
AGDRYE_n[1-8]	real	[arcsec] Calculated compensation in Y for differential refraction at the end of the exposure.
AGTRAN_n[1-8]	real	Mean measured sky transparency.
AGTRMS_n[1-8]	real	RMS measured sky transparency.
AGBUNDLE	character	AG fibre bundle selected: "MOSA", "MOSB" or "LIFU".

2.1.7 The Environmental Packet

This packet contains the environmental information acquired by the various sensors located outside of the WHT.

Keyword	Data type	Meaning
WINDSPB	real	[km/h] The wind speed at the beginning of an integration.
WINDSPE	real	[km/h] Wind speed at the end of an integration.
WINDDIRB	integer	[deg] The wind direction at the beginning of the integration. (North being 0).
WINDDIRE	integer	[deg] The wind direction at the end of the integration. (North being 0).
LOCPRESB	real	[mbar] On-site air pressure at the beginning of the integration.
LOCPRESE	real	[mbar] On-site air pressure at the end of the integration.
LOCTEMPB	real	[degC] on-site temperature at the beginning of the integration.
LOCTEMPE	real	[degC] on-site temperature at the end of the integration.
TELTEMPB	real	[degC] Telescope temperature at the beginning of the integration.
TELTEMPE	real	[degC] Telescope temperature at the end of the integration.
MIRTEMPB	real	[degC] Mirror temperature at the

		beginning of the integration.
MIRTEMPE	real	[degC] Mirror temperature at the end of an integration.
LOCHUMB	real	[%] The on-site air relative humidity at the beginning of the integration.
LOCHUME	real	[%] The on-site air relative humidity at the end of the integration.
TELHUMB	real	[%] Telescope relative humidity at the beginning of the integration.
TELHUME	real	[%] Telescope relative humidity at the end of the integration.
SKBRTELB	real	[mag/arcsec ²] Sky brightness measured at the telescope pointing at the beginning of the integration.
SKBRTELE	real	[mag/arcsec ²] Sky brightness measured at the telescope pointing at the end of the integration.
SKBRZENB	real	[mag/arcsec ²] Sky brightness measured at zenith at the beginning of the integration.
SKBRZENE	real	[mag/arcsec ²] Sky brightness measured at zenith at the end of the integration.
SKYBRTEL	real	[mag/arcsec ²] Sky brightness measured at the telescope pointing at the end of the integration. Matches SKBRTELE
SKYBRZEN	real	[mag/arcsec ²] Sky brightness measured at zenith at the end of the integration. Matches SKBRZENE
SEEINGB	real	[arcsec] Measured seeing at the beginning of the integration.
SEEINGE	real	[arcsec] Measured seeing at the end of the integration.
AGXSEE	real	Average value of the AGXSEEn[1-8] headers from the Autoguider packet.
AGYSEE	real	Average value of the AGYSEEn[1-8] headers from the Autoguider packet.
AGTRAN	real	Average value of the AGTRANn headers from the Autoguider packet.
GHRILTMB	real	[degC] Temperature at GHRIL room at the beginning of the integration.
GHRILTME	real	[degC] Temperature at GHRIL room at the end of the integration.

2.1.8 The OB Packet

This header packet contains various headers related to the information that was entered by Survey Working Group as part of the field definition. Many of these keywords are inherited from the Configure XML [ref: ICD-025]

Keyword	Data Type	Meaning
OBTITLE	character	The title associated with this Observation Block.
OBID	integer	The Observation Block identifier associated with this integration. OBID=-1 will indicate the exposure does not belong to any OB.
OBCLASS	character	The type of observation. Possible values: 'science', 'calibration', 'onskytest', 'offskytest'. Matches the observation.ob_class attribute in the XML file.
CASUID	integer	CASU Operational Repository Identifier. CASUID=-1 will indicate an exposure that does not belong to any OB, or an OB generated internally at the ING. Otherwise it matches observation.casuid on the XML
OBSTART	real	[days] MJD of the start time of the current OB.
OBPRIORI	real	Priority of the OB. It matches observation.ob_priority on the XML
TRIMESTE	character	The [trimester] this OB was submitted in: YYYY[a/b][1/2]. It matches observation.trimester on the XML.
PROGTEMP	character	The Program Template code. It matches observation.progtemp on the XML
OBSGROUP	character	Identifier of the OBSGROUP where the OB belongs (if any). It matches observation.obsgroup on the XML.
CHAINED	boolean	Defines if this observation is probabilistically linked to another. It matches observation.chained on the XML
OBSTEMP	character	The Observing Template code. It matches observation.obstemp on the XML.
CHAINID	integer	OBID of the first element of the chain.
LNKGROUP	character	Identifier of the LINKED_GROUP where the OB belongs (if any). it

		matches observation.linkedgroup on the XML.
DATAMVER	character	WEAVE Data Model Version e.g. '10.00'.
DITHVER	character	The version of the dither programme used to generate the dithering pattern. Blank for undithered observations. It matches dithering.dither_version on the XML.
CFGVER	character	The version of Configure used to allocate the fibres. it matches configure.configure_version on the XML
NSALSA	integer	Number of salsa observations. 0 for non-salsa configurations.
SALSA_I	integer	Index of the salsa observation. 0 for non-salsa configurations.

2.1.9 The Fibre Positioner System Packet

The data included in this packet will be provided by the Fibre Positioner System and are used to determine the configuration and setup of the FPS for the current observation.

Keyword	Data Type	Meaning
INFILE	character	Name of the input configuration file (xml).
OUTFILE	character	Name of the output configuration file (xml).
PLATE	character	The current position of the tumbler i.e. PLATE_A, PLATE_B or LIFU. Matches the positioner_setup.plate attribute in the XML file.
OBSMODE	character	Observation Mode i.e. MOS, mIFU, LIFU. Matches the observation.obs_mode attribute in the XML file.
FPMODE	character	Focal Plane mode: MOS-A, MOS-B, mIFU, LIFU.
FLORIENT	real	[deg] Field orientation. Matches the positioner_setup.pa attribute in XML file.
FLDRA	real	[deg] Field centre RA. Matches the field.RA_d attribute in the XML file.
FLDDEC	real	[deg] Field centre Dec. Matches the

		field.Dec_d attribute on the XML file.
FLDISTNn[1,3,5,7]	real	n -th order coefficient of the field distortion model. It matches distortion_coefficient.cn on the XML
PLATEX0	real	[mm] intersection of the optical/rotator axis and the plate, in x-direction. It matches optical_axis.x0 on the XML
PLATEY0	real	[mm] intersection of the optical/rotator axis and the plate, in y-direction. It matches optical_axis.y0 on the XML
PLATER0	real	[deg] angle between the y-axis of the focal plane and the y-axis of the plate. It matches optical_axis.r0 on the XML
SKYCMX	real	[mm] (-330,213) X position of the sky camera.
SKYCMY	real	[mm] (-216,514) Y position of the sky camera.
LFUGSRA	character	[hh:mm:ss.sss] RA of LIFU guide star.
LFUGSDEC	character	[sdd:mm:ss.ss] Dec of LIFU guide star.
OBSTEMPB	real	[degC] Temperature of observing plate at the beginning of observation.
OBSTEMPE	real	[degC] Temperature of observing plate at the end of observation. t matches positioner_setup.plate_temp_end on the XML.
CONFTEMB	real	[degC] Temperature of observing plate at the beginning of configuration. It matches positioner_setup.plate_temp_start on the XML.
CONFTEME	real	[degC] Temperature of observing plate at the end of configuration.
CONFMJD	real	[days] MJD of the Mid-point time of observation that the field was actually configured for. It matches positioner_setup.date on the XML.
TELALTCB	real	Elevation of telescope at the beginning of the configuration.
TELALTCE	real	Elevation of telescope at the end of the configuration.

ROTANGCB	real	Rotator angle at start of configuration.
ROTANGCE	real	Rotator angle at end of configuration.
PLTTEMPA	real	[degC] Current temperature on PLATE A.
PLTTEMPB	real	[degC] Current temperature on PLATE B.
CFGFOCUS	real	Actual focal length (mm)output from configure. Matches the focal_plane_map.focal_length attribute in the XML file.
CFGNMFOC	real	Nominal focal length (mm) output from configure. Matches the focal_plane_map.nominal_focal_length attribute in the XML file.
CCNAMEn[1-20]	character	The Central CNAME (only for IFU observations, empty string for non IFU observations).It matches selected target.cname attributes, depending on the target.fibreid .
IFUPAn[1-20]	real	The orientation ofthe 20 mIFU bundles or (for LIFU; IFUPA1) the PA of the array

2.2 The Fibre FITS Table Extension

The information associated with the fibre configuration will be stored in a FITS binary table extension having the name **FIBTABLE**. Each FITS file will only have one such table, containing all the fibre information associated with the exposure. It is important to note that a unknown or undefined value will be represented by the FITS NULL value (empty string for strings, NaN for floats; for the integer fields, TNULL n will be explicitly defined as -1).

The HDU of the extension will contain the header integrity keywords **CHECKSUM** (ASCII character string whose value forces the 32-bit 1's complement checksum accumulated over all the 2880-byte FITS logical records in the HDU to equal negative zero) and **DATASUM** (character string containing the unsigned integer value of the 32-bit 1's complement checksum of the data records in the HDU).

The details of the proposed binary table are given below.

FIBRERA, FIBREDEC, TARGRA and TARGDEC are defined in the same RADECSYS and EQUINOX as the RA and DEC in the TCS packet.

The RA, Dec to X, Y mapping is defined by the POS software. (See [WEAVE-POS-007](#) Section 5).

*TTYPE n names corresponds with the the attributes of **target** element of the same name in lowercase, with the exception of ORIENTAT which corresponds with 'orientation' and STATUS which is composed by the OCS using the 'parked' and 'enabled' attribute.*

n	TTYPE n	TFORM n	TDIM n	TUNIT n	Bytes	Width (bytes)	Meaning
1	FIBREID	1I			0-1	2	Fibre id.
2	CNAME	20A	(20)		2-21	20	Unique target identifier throughout the WEAVE system.
3	FIBRERA	1D		deg	22-29	8	RA position of fibre.
4	FIBREDEC	1D		deg	30-37	8	Dec position of fibre.
5	XPOSITION	1E		mm	38-41	4	[mm] Fibre position x.
6	YPOSITION	1E		mm	42-45	4	[mm] Fibre position y.
7	STATUS	1A	(1)		46	1	The status of the fibre. Possible values are: 'P' for parked, 'A' for

							'allocated', 'D' for 'disabled', 'B' for broken.
8	TARGID	30A	(30)		47-76	30	The identifier of the target, as assigned by the survey, being covered by the current fibre.
9	TARGX	1E		mm	77-80	4	[mm] The x position on the plate of the target.
10	TARGY	1E		mm	81-84	4	[mm] The y position on the plate of the target.
11	TARGSRVY	15A	(15)		85-99	15	The survey to which the target belongs.
12	ORIENTAT	1E		deg	100-103	4	[deg] The orientation of the fibre.
13	RETRIES	1I			104-105	2	The number of times the fibre had to be re-positioned to get it within positional tolerance.
14	TARGNAME	30A	(30)		106-135	30	The target name.
15	TARGRA	1D		deg	136-143	8	[deg] Right ascension of object.
16	TARGDEC	1D		deg	144-151	8	[deg] Declination of object.
17	TARGEPOCH	1E		yr	152-155	4	[year] Catalogue epoch.
18	TARGCAT	30A	(30)		156-185	30	Catalogue name.
19	TARGPMRA	1E		mas/yr	186-189	4	[mas/yr] Proper motion in RA (this is the true angular motion on the sky, not a rate of change in RA).
20	TARGPMDEC	1E		mas/yr	190-193	4	[mas/yr] Proper motion in DEC.
21	TARGPARAL	1E		mas	194-197	4	[mas] Parallax.
22	TARGUSE	1A	(1)		198	1	'T' => target, 'S' => sky, 'G' => guide, 'C' =>

							calibration standard (usually white dwarfs to be used for flux and telluric calibration), 'R' => random. Empty when STATUS != 'A'.
23	TARGPROG	40A	(40)		199-238	40	The sub-programme name within the survey.
24	TARGCLASS	12A	(12)		239-254	16	Input target classification: (see ICD-030 for authorized list).
25	TARGPRIO	1E			255-258	4	Target relative priority within a survey (1-10, where 1 is the lowest priority).
26	MAG_G	1E		mag	259-262	4	[AB mag] Target brightness in SDSS g band.
27	EMAG_G	1E		mag	263-266	4	[mag] Error estimated in SDSS g band.
28	MAG_R	1E		mag	267-270	4	[AB mag] Target brightness in SDSS r band.
29	EMAG_R	1E		mag	271-274	4	[mag] Error estimated in SDSS r band.
30	MAG_I	1E		mag	275-278	4	[AB mag] Target brightness in SDSS i band.
31	EMAG_I	1E		mag	279-282	4	[mag] Error estimated in SDSS i band.
32	MAG_GG	1E		mag	283-286	4	[Vega mag] Target brightness in Gaia G band.
33	EMAG_GG	1E		mag	287-290	4	[mag] Error estimated in Gaia G band.
34	MAG_BP	1E		mag	291-294	4	[Vega mag] Target brightness in Gaia BP band.

35	EMAG_BP	1E		mag	295-298	4	[mag] Error estimated in Gaia BP band.
36	MAG_RP	1E		mag	299-302	4	[Vega mag] Target brightness in Gaia RP band.
37	EMAG_RP	1E		mag	303-306	4	[mag] Error estimated in Gaia RP band.

2.3 The Guiding Errors FITS Table Extensions

In order to accomplish the requirement COP-613 (see [WEAVE-SCI-006](#) and [EAVE-SCI-004](#), A.7.4), the information associated with the guiding error sent from the autoguider subsystem to the TCS will be stored in a single FITS binary table extension having the name **GUIDINFO**. See [WEAVE-DAS-002](#), section 5.14, for details regarding its implementation.

It is important to note that an unknown or undefined value will be represented by the FITS NULL value (empty string for strings, NaN for floats).

The HDU of the extension will contain the header integrity keywords **CHECKSUM** (ASCII character string whose value forces the 32-bit 1's complement checksum accumulated over all the 2880-byte FITS logical records in the HDU to equal negative zero) and **DATASUM** (character string containing the unsigned integer value of the 32-bit 1's complement checksum of the data records in the HDU).

The details of the proposed binary table are given below.

n	TTYPE _n	TFORM _n	TUNIT _n	Bytes	Width (bytes)	Meaning
1	AGUT	12A		0-11	12	[hh:mm:ss.sss] Timestamp.
2	AGDX	E	arcsec	12-15	4	[arcsec] AG error in x.
3	AGDY	E	arcsec	26-29	4	[arcsec] AG error in y.
4	AGDROT	E	deg	20-23	4	[deg] AG error for rotator angle.

2.4 The Meteorological FITS table extension

In order to accomplish the requirement COP-906 (see [WEAVE-SCI-006](#)), the information collected from the meteorology, sky brightness and seeing monitors will be stored in a single FITS binary table extension having the name **METINFO**. The content of this table will be a subset of the aforementioned data corresponding to the exposure time.

It is important to note that an unknown or undefined value will be represented by the FITS NULL value (empty string for strings, NaN for floats; for the integer fields, TNULL n will be explicitly defined as -1).

The HDU of the extension will contain the header integrity keywords **CHECKSUM** (ASCII character string whose value forces the 32-bit 1's complement checksum accumulated over all the 2880-byte FITS logical records in the HDU to equal negative zero) and **DATASUM** (character string containing the unsigned integer value of the 32-bit 1's complement checksum of the data records in the HDU).

The details of the proposed binary table are given below. Data within each row corresponds to values sampled every 1 minute.

n	TTYPE n	TFORM n	TUNIT n	Bytes	Width (bytes)	Meaning
1	METUT	12A		0-11	12	[hh:mm:ss.sss] Timestamp.
2	WINDSP	E	km/h	12-15	4	[km/h] Wind Speed.
3	WINDDIR	I	deg	16-17	2	[deg] Wind Direction.
4	LOCPRES	E	mbar	18-21	4	[mbar] On-site Air pressure.
5	LOCTEMP	E	degC	22-25	4	[degC] on-site temperature.
6	TELTEMP	E	degC	26-29	4	[degC] Telescope temperature.
7	MIRTEMP	E	degC	30-33	4	[degC] Primary mirror temperature.
8	LOCHUM	E	%	34-37	4	[%] on-site relative Humidity.
9	TELHUM	E	%	38-41	4	[%] Telescope relative humidity.
10	SKYBRTEL	E	mag/arcsec ²	42-45	4	[mag/arcsec ²] Sky brightness measured at the telescope pointing.
11	SKYBRZEN	E	mag/arcsec ²	46-49	4	[mag/arcsec ²] Sky brightness measured at zenith.
12	SEEING	E	arcsec	50-53	4	[arcsec] Measured seeing.

2.5 The Image Extensions

Each of the science cameras will contain two imaging. The images that are read out from each of the detectors will be stored in two individual FITS image extensions, containing image-specific header information.

The names of the image extensions will be <detector1>_DATA and <detector2>_DATA (where <detector1> and <detector2> can be “RED1”/“RED2” or “BLUE1”/“BLUE2”).

The details of the headers that are currently provided by the ING DAS system are provided below.

Keyword	Value	Data type	Meaning
XTENSION	'IMAGE'	character	Name of the extension.
BITPIX	16	integer	Specify the number of bits that represent a data value.
NAXIS	2	integer	Number of axes.
NAXISn		integer	Number of elements along axis n of a data array. $n=1,2$.
PCOUNT	0	integer	Number of pixels following data.
GCOUNT	1	integer	Number of groups.
BZERO	32768	real	Pixel-data have 32K offset.
BSCALE	1	real	Pixel-data are not scaled.
INHERIT	T	boolean	Extension inherits primary HDU.
EXTNAME		character	Indicates the association between the extensions. Possible values are: 'BLUE1_DATA', 'BLUE2_DATA', 'RED1_DATA', 'RED2_DATA'.
EXTVER		integer	Extension version number.
IMAGEID		integer	Number of the image in the file.
DASCHAN		integer	Number of readout channel (1+).
WINNO		integer	Number of window (1+).
CHIPNAME		character	Name of detector chip. Possible values: “CCDWEAVERED1”, “CCDWEAVERED2”, “CCDWEAVEBLUE1”, “CCDWEAVEBLUE2”
CCDNAME		character	Same as CHIPNAME.
CCDCHIP		character	Same as CHIPNAME.
CCDTYPE		character	Type of detector, e.g. <i>EEV42</i> .
CCDXPIXE		real	[m] Size of pixels in the x axis of the CCD frame.
CCDYPIXE		real	[m] Size of pixels in the y axis of the CCD frame.
AMPNAME		character	Name of readout amplifier.
GAIN		real	[electrons per ADU] Gain of

		amplifier.
READNOIS	real	[electrons] Readout noise of amplifier.
SATURATE	real	[ADU] Highest data value that is good data.
MAXBIAS	real	[ADU] Highest data value that is good data for a bias observation.
BIASSEC	character	Image section in image coordinates holding only bias values. Not present for WEAVE.
TRIMSEC	character	Image section in image coordinates that excludes all bias areas and includes all illuminated areas. Not present for WEAVE.
BIASSECn[1-F, 0]	character	Image section in image coordinates holding only bias values. n can take hexadecimal values between 1 and F, and 0 (for “16”). Only non-null sections are written, therefore while n can in principle take values between 1 and 16, it will typically be 1 or 2 (for 8 amplifiers).
TRIMSECn[1-4]	character	Image sections in image coordinates holding only illuminated areas. Only non-null sections are written, therefore while n can in principle take values between 1 and 4, it will typically be 1 or 2 (for 8 amplifiers).
RTDATSEC	character	Location in d-space for RTD.
BIASOFFn[1-4]	integer	Software bias offsets applied to the output of each of the four amplifiers, as per WEAVESPE-74 .
DATE-OBS	character	Date of observation in the FITS-approved format. Not present for WEAVE (use value in the Camera packet).
UTSTART	character	[hh:mm:ss.sss] UTC of start of observation (same as UT). Not present for WEAVE (use value in the Camera packet).
EXPOSED	real	[s] Length of exposure, excluding pauses, from the first opening of the shutter to its final closing. Not present for WEAVE (use value in the Camera packet).
EXPTIME	real	[s] Same as EXPOSED. Not present for WEAVE (use value in the Camera packet).
ELAPSED	real	[s] Length of exposure, including

			pauses, from end of clearing to start of readout. Not present for WEAVE (use value in the Camera packet).
DARKTIME		real	[s] Same as ELAPSED. Not present for WEAVE (use value in the Camera packet).
CRVAL1		real	Value at reference pixel on 1st axis in primary WCS.
CRVAL2		real	Value at reference pixel on 2nd axis in primary WCS.
CRPIX1		real	Reference pixel on 1st axis in primary WCS.
CRPIX2		real	Reference pixel on 2nd axis in primary WCS.
CUNIT1	pixel	character	Units of 1st axis in primary WCS.
CUNIT2	pixel	character	Units of 2nd axis in primary WCS.
CTYPE1	"	character	Type of 1st axis in primary WCS.
CTYPE2	"	character	Type of 2nd axis in primary WCS.
CD1_1		real	Transformation matrix from image coordinates to primary WCS.
CD1_2		real	Transformation matrix from image coordinates to primary WCS.
CD2_1		real	Transformation matrix from image coordinates to primary WCS.
CD2_2		real	Transformation matrix from image coordinates to primary WCS.
PROJP1		real	Projection coefficient for primary WCS: linear term. Not present for WEAVE.
PROJP3		real	Projection coefficient for primary WCS: cubic term. Not present for WEAVE.
PV1_1		real	Projection coefficient for primary WCS: linear term. Not present for WEAVE.
PV1_2		real	Projection coefficient for primary WCS: cubic term. Not present for WEAVE.
PV2_1		real	Projection coefficient for primary WCS: linear term. Not present for WEAVE.
PV2_2		real	Projection coefficient for primary WCS: cubic term. Not present for WEAVE.
BUNIT	'adu'	character	Physical units in which the quantities in the array are expressed.
CHECKSUM		character	Header integrity keyword
DATASUM		character	Data integrity keyword

Appendix A - Revision history up to v6.0

Revision date	Ver.	Summary of Changes	Changes marked
17/09/12	0.10	Document created.	Bevil
11/04/14	0.20	Updated following input from Chris Benn Configure tool definition	Picó
28/05/14	1.0	<ul style="list-style-type: none"> • Fixed doc link • Changed Ownership to Chris Benn • Updated list of Approvals • Updated list of Distribution • Changed 'CAT-*' headers for 'TILE-*' in tcs packet • Added mandatory headers • Erased Target binary tablet and added targets to fibres Table • Changed OBJECT Header description • Changed Differential Refraction headers • Added SURVEYID header • Erased SKYGOAL and MAXFIBRE • Reordered field index in FITS table 	Picó
24/02/15	1.1	Updated 2.3 according with Section 5.1 of WEAVE-SPE-017	Picó
10/03/15	1.2	<ul style="list-style-type: none"> • Updated LATITUDE and LLONGITUDE • Added more values to OBSTYPE • Added possible values to DETECTOR Header • Updated CCDXBIN and CCDYBIN • Added DETECTORLIVE header • Added EXTNAME header 	Picó
11/03/15	1.3	<ul style="list-style-type: none"> • Clarified headers for 8 Guide fibres at 2.1.7 • Deleted duplicated header CCDTEMP2 	Picó
11/03/15	1.4	Recovered CCDTEMP1 and CCDTEMP2	Picó
25/03/15	1.5	<ul style="list-style-type: none"> • Added possible values to CALIBSRC header • Added OBSMODE header • Moved CCDLIVE to image extension • MJD_OBS and JD changed to double • Removed dummy-bias from OBSTYPE's possible values 	Picó
25/03/15	1.6	<ul style="list-style-type: none"> • Added FLATSRC header • Changed CALIBSRC for ARCSRC 	Picó
25/03/15	1.8	<ul style="list-style-type: none"> • Completed approvals list • Completed distribution list 	Picó
26/03/15	1.9	Removed 'W' from ARCSRC	Picó
30/03/15	2.0	<ul style="list-style-type: none"> • Added RV_STD, FLUX_STD to OBSTYPE • Removed FIBROLE (2.2) 	Picó

		<ul style="list-style-type: none"> • TRAGRA&TARGDEC become Double • Created TARMAG (Target Brightness) • TARGPM1 and TARGPM2 become TARGPMRA and TARGPMDEC, representing proper motion in mas/yr in RA and DEC (respectively) • Created MASGSYS and MAGPASSB headers at 2.1.11 (System of targets mags and Passband of target mags respectively) 	
30/03/15	2.1	<ul style="list-style-type: none"> • Camera Packet; Moved CCDSPEED, CCDXBIN, CCDYBIN to Image Extension (They are per CCD, not per Camera) • Camera Packet. Renamed DETECTOR as CAMERA • Camera Packet; renamed CCDtemXX headers AS CAMERATXX • Image extension; BIASSEC and TRIMSEC become BIASSECn and TRIMSECn. where n = 1 to 4. • Quadrant 1 is the lower left on the drawing, quadrant 2 is the lower right, quadrant 3 is the upper left and quadrant 4 is the upper right • Image Extension: Added CENWAVE and DISPERSI headers 	Picó
30/03/15	2.2	<ul style="list-style-type: none"> • Added FIBREID header • Changed TARGUSE possible values: Target('T'), sky('S'), guide('G'), Flux ('F') 	Picó
04/02/16	2.3	<ul style="list-style-type: none"> • Added SALSA_FLAT and SALSA_ARC to OBSTYPE • Added salsa_flat and salsa_arc to IMAGETYP • Removed flash and pupil from OBSTYPE and IMAGETYP • Added NSALSA and SALSA_I headers • Removed MOSAG and LIFUAG from CAMERA • Fibre table: RA and DEC double, Enabled integer, TARMAG to TRAMAG G,R,I • Added values for VPH 	Picó
22/02/16	2.4	<ul style="list-style-type: none"> • Unified SPE headers (section 2.1.5) • Added CNAME in 2.2 	Picó
08/03/16	2.5	<ul style="list-style-type: none"> • Some headers where more than 8 chars: fixed DUSTCOVR , AGEXPMGn, TILE-EQU, TILE-EPO, SKYBRGHT • SIMPLE header Substituted by XTENSION 	Picó
16/05/16	2.6	Added AG binary table	Picó
01/06/16	2.7	<ul style="list-style-type: none"> • Added possible values for MODE & DUSTCOVR headers • Removed VPHTHR header • Removed ROTANGLE header 	Picó
06/09/16	2.8	<ul style="list-style-type: none"> • Fixed a typo in doc date • Completed distribution list • Specified values for FSTATION header • Fixed DUSTCOVR possible values • Fixed a double comma in OBSTYPE • FLTLMP. Leading upper letter for all values(On/Off) • FLATSRC : Added 'NONE' value • New header, OBSTART at OB Packet. • OBSMODE. Added data type (Char) • CUNIT1& CUNIT2 headers. Capitalized values (PIXEL) • XPOSITION&YPOSITION becomes Real 	Picó

		<ul style="list-style-type: none"> • TARGPRIO becomes Integer • Added TELFOCUS ,CAT-DEC, CAT-EPO, CAT-EPO, CAT-EQU headers for compatibility with current TCS packet definition 	
15/09/16	2.9	<ul style="list-style-type: none"> • Type changed to <u>double</u> for headers CRVAL1, CRVAL2, CD1_1, CD1_2, CD2_1, CD2_2, PROJP1, PROJP3, PV1_1,PV1_2, PV2_1, PV2_2 • Added values for CCDSPEED • OBSTYPE:FLAT value now is FIBRE_FLAT and LED_FLAT is now DETECTOR_FLAT • FLATSRC now holds a new value 'DARK_SKY' • IMAGETYP updated accordingly with OBSTYPE • CUNIT1& CUNIT2 headers. Back to lowercase for consistence with existing WHT published headers • ARCSRC header: Added 'Cr-Th-Ar ' • Extended EXTNAME possible values • ENABLED header changed for STATUS 	Picó
28/09/16	3.0	<p>According with the ICD-025 update (V0.15):</p> <ul style="list-style-type: none"> • TARGSURVEY has been included in the Fibre FITS table extension • SURVEYID from OB packet has been 'swapped' by PROGRAMID • PROGNAME and PROGPRIO headers from the Fibre positioner Packet are redundant and have be removed • MAGSYS and MAGPASSB removed since the equivalent XML attributes are no longer available <p>Other changes:</p> <ul style="list-style-type: none"> • Added Gaia BP ad RP as target Brightness: MAG_BP and MAG_RP • TARGMAG_<Band> headers now become MAG_<band>. F.e MAG_G instead of TARGMAG_G • Added headers for errors estimated in the above bands: EMAG_G, EMAG_R, EMAG_I, EMAG_BP, EMAG_RP • ICRS value added for RADECSYS header • Possible values for CWAVE • Possible values for LINEMM • Possible values for SLITILL • Possible values for LIGHTMON • Distribution list updated 	Picó
28/10/16	3.1	<p>Accordingly with ICD-025 V.015:</p> <ul style="list-style-type: none"> • Changed SURVEY by PROGRAME header in Fibre positioner Packet • Changed TARGPROG • By TARGSRVY header in fibre extension header <p>Other changes:</p> <ul style="list-style-type: none"> • Added the Meteorological FITS table extension. Section 2.4 • Added units (degrees) to TARGRA and TARGDEC • Fixed a typo in page 13 (OPBSTYPE) • OBSTART goes Double 	Picó

		<ul style="list-style-type: none"> • Fixed a typo in CCDXBIN • Fixed reference to COP-013 in Guiding error table extension • Added GUIDETABLE to the possible values of EXTNAME header 	
04/11/16	3.2	Added OBSCOMME header to the Observation Packet	Picó
15/11/16	3.3	<ul style="list-style-type: none"> • Added 'GUIDEINFO', 'METINFO' to EXTNAME header • Changed "GUIDETABLE" by "GUIDEINFO" in EXTANME header 	Picó
04/01/17	3.4	Updated approvals list	Picó
13/01/17	3.5	<ul style="list-style-type: none"> • Adopted Don's changes • Addressed Don's comments: <ul style="list-style-type: none"> ○ Added Frank to the authors list ○ INSTRUME header recovered ○ Duplicated some SPE packet headers to store both arms information (VPH, MODE) ○ Deleted some SPE headers, since they don't have equivalent in SPE ctrl system design doc (ICS-017):LIGHTMON,SPETMPB ○ PFC packet completely rewritten to accomplish TCS-004 ○ Flat ilu header changed. Now split in a INTEGER header for each led in both arms (FLILUR/B_n) ○ Deleted duplicated TARGSRVY header in section 2.2 • Addressed Jim's comments: <ul style="list-style-type: none"> ○ TARGID – Now a character string ○ TARGPRIO -- the range of values should be between 1 and 10 with 1 being the lowest priority. ○ TARGUSE -- instead of 'F' for 'flux standard' 'C' for 'calib'. 	Picó
13/01/17	3.6	<ul style="list-style-type: none"> • More typos fixed • Following SPE headers deleted: LIGHTMON, SPECTMPB, SPECTMPE, SPECHUMB, SPECHUME (currently, no sensors for measuring them) • Now TIP/TILT for both arms (SPE packet) • mass/yr typo fixed • Updated Global Status Cache section 	Picó
19/01/17	3.7	<ul style="list-style-type: none"> • Recovered previous definition of TARGSRVY (list of surveys separated by commas) • Renamed field RA And Dec as FIBRERA and FIBREDEC headers to avoid confusions with RA,DEC from TCS • Added D.Terret on distribution list 	Picó
23/01/17	3.8	<ul style="list-style-type: none"> • SPE packet rolled back to show information (only) for the current arm • TARGSRVY header data type change changed to 1PJ() 	Picó
27/01/17	3.9	Document approved for OCS FDR	PSO
13/02/17	4.0	<ul style="list-style-type: none"> • Only one Fibre FITS binary table extension • TILTCORR header. Now Boolean (was real by mistake) 	Picó

		<ul style="list-style-type: none"> • AGUT header format specified (YYYY-MM-DDThh:mm:ss[.sss. . .]) 	
02/06/17	4.1	<ul style="list-style-type: none"> • Added standardized units/format to description of the headers, when applicable, as required by WAS team. See JIRA ticket WEAVEWAS-1 for details • SKYCMX and SKYCMY become Real • TARGSRVY is now 'Character'. It will contain the list of surveys-subsurveys to which the target belongs, separated by comma, for example: "GA-HR,WC" 	Picó
02/06/17	4.2	<ul style="list-style-type: none"> • Deleted TILE_* headers from TCS packet • Changes in Env packet to match with meteo table: <ul style="list-style-type: none"> ○ AIRPRES->PRESSURE, ○ TEMPB->LOCTEMPB, ○ TEMPE->LOCTEMPE, SKYBRGHT -> SKYBRTEL & SKYBRZEN • New headers in Env. Packet: <ul style="list-style-type: none"> ○ TELTEMPB, TELTEMPE, MIRTEMPB,MIRTEMPE,HUMIDTEL,SEEING,AGSEE,A GTRAN • OB packet: Added OBPRIORI • Fibre positioner packet: <ul style="list-style-type: none"> ○ Deleted NAME ○ Deleted PROGRAME ○ Added INFILE ○ Added OUTFILE ○ Deleted CAT* headers ○ Added reference to XML attributes in all columns • Fibre table: <ul style="list-style-type: none"> ○ Added TARGEPOC ○ Fixed TARGPARAL, now TARGPARL ○ Added MAG_GG ○ Added EMAG_GG • Meteo table: <ul style="list-style-type: none"> ○ HUMIDITY now HUMID ○ WINDSPD now WINDSP ○ MIRRTEMP now MIRTEMP ○ TELRH now HUMID ○ SKBRTTEL now SKYBRTEL ○ SKBRTZTH now SKYBRZEN 	Picó
04/07/17	4.3	<ul style="list-style-type: none"> • Fixed a few typos • Reordered and modified fibre table to synchronise it with ICD-027 	JRL
31/01/18	4.4	Addressed FDR action WEAVEFDR-24	Picó
06/03/18	4.5	Addressed FDR action WEAVEFDR-117	Picó

18/09/18	4.51	<ul style="list-style-type: none"> • Suggested (but not exhaustive) updates in light of OpR3a and OpR3b • Comments from spico to David's comments • Added TRAGCLAS header on binary table (spico) 	Murphy
25/03/19	4.6	<ul style="list-style-type: none"> • Deleted addressed comments • Added possible values for HART • Added possible values for SLITEX • Deleted PROGID • SEMESTER changed to TRIMESTE. Added format • Deleted XFERTIME • CHAINIDENTIFIER change to CHAINID. Description updated • TARGPROG deleted from fibres table • Fixed indexes in fibre table • XTENSION changed for SIMPLE (See WEAVEOCS-414) • CCDXBIN, CCDYBIN and CCDSUM moved back to camera packet (see WEAVEOCS-414) • BIASSECn and TRIMSECn are now BIASSEC and TRIMSEC (see WEAVEOCS-414) • CAMERAT and CAMERATn back to CCDTEMP and CCTEMPn (see WEAVEOCS-414) • Deleted CCDLIVE (see WEAVEOCS-414) • FOCUS from real to double (SPE) • Added FOCUSMTA, FOCUSMTB, MAITSLIT (see WEAVEOCS-411) • FPMODE added (see WEAVESPA-173) • Added GHRILTE (see WEAVEOCS-411) • Added in POS: OBSTEMPB, OBSTEMPE, CONFTEMB, CONFTEME, CONFMJD, TELALTCB TELALTCE, ROTANGCB, ROTANGCE (See WEAVEOCS-412) • OBPRORI becomes double • EQUINOX becomes character • Redefined fibre binary table in terms of valid TFORM formats. • Redefined guiding error binary table in terms of valid TFORM formats. • Redefined met binary table in terms of valid TFORM formats. • Fixed possible values of PLATE 	Picó/ Gafton
08-04-19	4.7	<ul style="list-style-type: none"> • CHAINIDENTIFIER now is CHAINID • Deleted word ' Values' from RADECSYS • Fixed superscripted 2 in SKYBRTEL • Fixed values of INSTRUME (WEAVE) • Fixed description of XPOSITION and YPOSITION(deleted microns) • Reverted XTENSION to image extension)instead of SIMPLE) • Changed CAMERA by DETECTOR • Moved CCDSPEED from image ext to camera packet • Deleted CTYPE1 and CTYPE2 (see WEAVEOCS-414) • Deleted CENWAVE from image extension. Moved disperse to 	Picó/ Lewis/ Peralta

		<p>SPE packet (see WEAVEOCS-414)</p> <ul style="list-style-type: none"> • Fixed TELSTAT description “..end of observation” • CAT-EQU is now CAT-EQUI and CAT-EPO is CAT-EPOC (WHT standard) • ‘A’ added to CAT-EQUI • Added ARCHIVEB and ARCHIVEE (new headers since TCS upgraded) 	
14/06/19	5.0	<p>All the changes below described in WEAVEOCS-420</p> <ul style="list-style-type: none"> • RUNSET moved to OBSERVATION • RUN and INTEGRATION packets disappear and their headers are now under CAMERA packet • OBSCOMME -> In fact, there are 9 OBSCOMMn (n∈[1,9]) comment placeholders • Added missing headers in camera Packet according with WHT standard • Added missing headers in Image extension according with WHT standard • NAXIS goes to camera packet (from Image extension) 	Picó/ Gafton
07/11/19	5.1	<p>Most changes below described in WEAVESPA-288</p> <ul style="list-style-type: none"> • Camera packet is now first (Sec. 2.1.1 instead of 2.1.7), and Observation packet is second, as in all FITS files • Reordered Camera, Observation, image extension keywords as written by UltraDAS • Fixed typo in OBSCOMME_n, removed the E • Now using WINSEC_n instead of 4 WINSEC keywords • Changed format of UT, UTSTART, UT-MID according to how it is written by UltraDAS (ms precision) • Type of EQUINOX, M1PETALS changed to REAL • Added type (character) to ORIGIN and OBSERVER • Fixed typo in WINDSP's TUNIT • Added NAXIS to image extension (in addition to NAXIS_n) • Added BZERO, BSCALE to image extension keywords • CCDSPEED only appears in the Camera packet, not in the image extension (UltraDAS writes it into the main HDU) • Corrected possible values of EXTNAME for the image extensions • General: updated KEYW_n syntax to KEYW_n[1-2], as was done in the Autoguider packet, to signify that (in the above example) <i>n</i> can take values from 1 to 2 • Interchanged columns Bytes and Width (bytes) in Meteo bin table, to make it consistent with the other two • Changed references of “Global status cache” to “Parameter Notice Board”, which is the formal name at the WHT • TARGPRIO becomes integer (this also decreases all following bytes in the binary table by 2) • Units for TARGEPOCH changed from year to yr • Changed CCNAME_n to CCNAME_n[1-20] • Changed AGMAGOF to AGMAGOFF 	Gafton/ Picó/ Peralta

	<ul style="list-style-type: none"> • Changed meteorological keywords as per WEAVEOCS-528 • Fixed typo in meaning column for AGUT and METUT • Fixed values for SLITEX • Fixed Values for SLITILL • Fixed Values for FLATSCR • Added LNKGROUP header (OB packet) • Moved CCNAMEn to POS packet • AGTRANS is now AGMRMS<i>n</i>. • Changes described in WEAVEOCS-528 • Met Table: <ul style="list-style-type: none"> • HUMID and AIRTEMP disappears(duplicated) • Fixed description for HUMIDLOC, HUMIDTEL, • LOCTEMPB LOCTEMPE ,PRESSURE • Deleted HUMID in Met Table and bytes info readjusted • Reordered fields and readjusted bytes • Env Packet: <ul style="list-style-type: none"> • All headers duplicated for beginning (B) and end (E) of the observation, with the exception of the average fields. • Change header names to match Met table related fields • Updated descriptions to clarify the meaning (LOC=on-site) • (Candidate 2) <ul style="list-style-type: none"> • Recovered TARGPROG. Table reformatted • TARGCLAS is back to TRAGCLASS • M1PETALS description updated • LINEMM description updated • SLITEX . mIFU fixed • LOCHUMID is now LOCHUM • TELHUMID is now TELHUM • WINDDIRB and WINDDIRE now integer • LOCPRESSB is now LOCPRESB • LOCPRESSE is now LOCPRESE • PRESSURE is now LOCPRESS • LOCPRESB/E units now mbar • Updated LOCTEMPB/E description (on-site) • Fixed typo SEEINGB/E • Fixed units in GHRILTMB • AGSEE is now AGXSEE • Added AGYSEE • Reordered Env packet to match Met bin table order • Added PLTTEMPA and PLTTEMPB in FPS packet • From the JIRA epic WEAVESPA-288: <ul style="list-style-type: none"> • Specified possible values for INSTRUME (WEAVERED, WEAVEBLUE) • Added CAMERA as duplicate of INSTRUME (!) at the request of the CPS/SPA team • Changed double to real in ASCII headers • CWAVE changed to CENWAVE • FFLAT in OBSTYPE is now FIBRE_FLAT for congruency 	
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		<p>with the rest of values</p> <ul style="list-style-type: none">• Fflat in IMAGETYP is now fibre_flat for congruency with the rest of values• LOCPRESS changed to LOCPRES• Removed Sec. 2.6 (Parameter Notice Board) <p>(Candidate 4)</p> <ul style="list-style-type: none">• LOCPRESS is now LOCPRES• Added DETECTOR_FLAT in OBSTYPE and IMAGETYP• Removed PNB section• Fixed preamble in ‘Fibre FITS table extension’ section. Only one bin table per exposure• Updated 2.2,2.4 and 2.3 to clarify Null values• TARGPRIO is now E• Erratum from WEAVESPA-332 fixed :• Added DATAMVER (WEAVESPA-334)• Updated definition of AGBUNDLE• NSALSA and SALSA_I restored• OBID and CHAINID (OB Packet) updated to integer• Added DATAMVER (WEAVESPA-334)• Added CFGVER (WEAVESPA-338)	
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