WEAVE SPA to SWG and QAG
Interface Control Document

Project name	WEAVE
Release	Draft/~~Final~~: Version 8.00 Date: 26th Oct 2022

Author(s):	C. Clare Worley David Murphy Luis Peralta de Arriba Alireza Molaeinezhad
Owner:	Georgia Bishop
Client:	WEAVE Consortium
Document Number:	WEAVE-ICD-030

Document History

Document Location The document can be found at : http://bscw.ing.iac.es/bscw/bscw.cgi/1067798

Revision History

Revision date	Version	Summary of Changes	Changes marked
02-Jul-2019	0.0	DM: Document created	
05-Jul-2019	0.1	CW: Section 3 on Catalogues	Sect 3
21-Jan-2020	0.2	CW: Updates from Catalogue Review – Sept 2019	Sect 3
04-Feb-2020	0.25	CW: Comments from M. Monguio Montells. Updated catalogue filename for SV/OT proposals	Sect 1 & 3
29-Feb-2020	0.3	CW: Updates from SPAM10	Sect 3, App A
25-Mar-2020	0.35	CW: Updates in on Catalogues for Data Model	Sect 3, App A
20-Apr-20	7.00	DM: Edits / new content to most of document up to Section 6: • Expanded on interface overview (Sec2), • Updated TARGSRVYs (5.2.1) • TACALLOC now defined (5.2.2.1) • PI FITS template building (5.2.4) • TARGNAME / TARGID (5.4.3.1) • IFU case for TARGPRIO (5.4.3.2) • PROGTEMP defined (5.4.3.5) • OBSTEMP defined (5.4.3.6) • IFU-specific columns defined (5.4.3.8) • FITS -> WASP described (5.5) • Section 6 started, in draft. • Section 9 started, in draft	Secs. 2, 5.2, 5.4, 5.5, 6, 9
29-Apr-20	7.10	DM: New content to Sections 6-9 for XML data specification. This should now provide full spec required for v8.00 of the data model for both FITS and XML.	Secs 6,7,8,9
30-Apr-20	7.20	Merge between CCW review (WDM repository commit 2a833a23) and DM updates in 7.10 (c69e8ce5)	All
30-Apr-20	8.00	Synced WEAVE Data Model v8.00	--
04-May-20	8.00	Final CS packages added. Defined QAG-OR module information and requirements. Updated TLMIN/MAX → TLMIN/MAX	Table 23. Sec. 9

29-Jul-20	8.00	Updates to dithering description (LPdA). Document title change, updates to QAG module	
21-Sep-20	8.00	Update to TACALLOC time resolution (0.1hrs), screenshots for WASP tools.	5.2.1.1, 5.4.3.5, 5.4.3.6
28-Sep-2020	8.00	CCW final updates to Catalogue templates, including clarification on IFU keywords, UHS UCD update, clarifications on MAG_G/R/I definition.	
29/30-Sep-2020	8.00	Merge with missing content replaced accidentally in previous commit to gitlab. Added WASP screenshots. Fixed duplicate AD reference assignment. Small typo and referencing fixes. Captions for figures. Update to IFU workflow description.	
24-Nov-2020	8.00	1/ GENCAT_VAL4, _INFOR, _UNIT added to Table 30 Appendix A 2/ Table 14- 6x10m mode changed to orange 3/ Table 20- added Sky brightness = 20.5 4/ Table 10- TARGPROG: TFORM= 40A, delimitor=`|' 5/ Section 5.4.5.4 includes example allowing EBVCAT_EBV in MAG_X_CM 6/ Table 30- switched TUCD for GAIA_GAL_LONG and GAIA_GAL_LAT 7/ Section 5.4.3.3 added subsections regarding use of Skies and the White Dwarfs IFU exception 8/ Table 10-TARGNAME is mandatory for IFU 9/ Table 10- Gaia DR2/3 reference epoch is 2015.5/2016.0 10/ Section 5.4.3.7 clarified use of Gaia data.	Table 30, Table 14, Table 20, Table 10, Sec 5.4.5.4, Sec 5.4.3.3, Sec 5.4.3.7
21-Dec-2020	8.00	AM: Clarifying notes added to Table 22	Table 22
27-Jan-2021	8.00	DM: Additional JPAS i-mag and COORDCAT columns specified (parallaxes, proper motions, errors) in Appendix A. New sections with WASP expectations from IFU workflow. IFU dither patterns redefined.	Appendix A Sec 8.1 Table 21
17-Feb-2021	8.00	TUCD for WISE_ID corrected	Appendix A Table 30
26-May-2021	8.00	DM: GAIA_EPOCH max value updated to 2016.0 ML: New Section 10, placeholder for CNAME/WNAME. WAS data cycle description. DM: Updated LIFU weightmaps	Appendix A Table 30 Sec 10.1,10.2 Appendix C
08-Jul-2021	8.00	Added missing TACID to FITS catalogue header, updated TACALLOC description	Sec 5.3
18-Oct-2021	8.00	ML: Added WNAME documentation. DM: Migrated SPA-005 to section 10.1	Sec 10.1, Sec. 10.2
21-Feb-2022	8.00	DM: Cleared some outstanding red/yellow flags based on updated SPA policy	All

28-Apr-2022	8.00	CCW: Added clarification text regarding usage of catalogue columns	Sec 5
31-May-2022	8.00	AM: Update to section 5.4.3.9 to clarify the way APS handles APS_FLAGS	Sec 5
6-Jun-2022	8.00	ML: Added section 10.4 about downloads	
25-Sep-2022	8.00	SCT: Many small edits. Section renumbering. New section 5.4.3.1 on TARGPROG and bad weather (filler) observations	All
26-Oct-2022	8.00	DM: Fixed HEALPix definition. CNAME quantisation described. Cleared & resolved remaining WDM8 comments. Freeze for WDM8.	Tables 11, 31 Sec 11.1.1, Comments

Approvals This document requires the following approvals.

Name	Title	Approval Date	Issue Date	Version
Nicholas Walton	CPS System Manager			0.0

Distribution This document has been distributed to:

Name	Title	Issue Date	Version
SWG	SWG	05-Jul-2019	0.1
M. Monguio Montells	SCIP	21-Jan-2020	0.2

TABLE OF CONTENTS

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 now on-sky, and it will provide spectroscopic sampling of the fainter end of the Gaia astrometric catalogue, chemical labelling of stars to V~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

This document describes the interface between the SPA Operational nodes and the survey-related teams (SWG, QAG, Survey science teams). This also serves as a reference guide for WEAVE Open-time PI surveys.

We first lay out the operational components of preparing for the observation of a trimester of data. The data exchanges defined in this section are then defined in detail in later sections.

The full description of the WEAVE Data Model can be found in [AD20].

1.3 References

1.3.1 Applicable Documents

Document Identifier	Document Title
[AD01] WEAVE-APS-001	APS Requirements and Technical Description
[AD02] WEAVE-APS-002	APS Management Description
[AD03] WEAVE-APS-003	APS Development Plan
[AD04] WEAVE-APS-004	APS Hardware Plan
[AD05] WEAVE-CPS-001	CPS Requirements and Technical Description
[AD06] WEAVE-CPS-002	CPS Management Description
[AD07] WEAVE-CPS-003	CPS Development Plan
[AD08] WEAVE-CPS-004	CPS Hardware Plan
[AD09] WEAVE-ICD-027	SPA Interface Control Document
[AD10] WEAVE-SPA-001	SPA System Description and Overview
[AD11] WEAVE-SPA-002	SPA Commissioning Plan
[AD12] WEAVE-SPA-003	SPA Risk Management Plan
[AD13] WEAVE-SPA-004	SPA Operations and Maintenance Plan
[AD14] WEAVE-SYS-010	Survey Information and Data Flow
[AD15] WEAVE-WAS-001	WAS Requirements and Technical Description
[AD16] WEAVE-WAS-002	WAS Management Description
[AD17] WEAVE-WAS-003	WAS Development Plan

[AD18] WEAVE-ICD-025	Configure XML Definition
[AD19] WEAVE-SPA-006	CNAMES for IFU targets
[AD20] WEAVE-SPA-008	WEAVE Data Model
[AD21] WEAVE-EXE-005	The WEAVE Publication Policy

1.3.2 Reference Documents

[RD01] WEAVE-DET-004	WEAVE UltraDAS Initial Investigations
[RD02] WEAVE-ICD-008	Interface Control Document Master List
[RD03] WEAVE-ICD-022	Top level N-squared diagram
[RD04] WEAVE-ICS-011	FITS File Description of WEAVE Observations
[RD05] WEAVE-MAN-001	Abbreviations and Definitions
[RD06] WEAVE-MAN-004	Product Breakdown Structure
[RD07] WEAVE-MAN-005	Work Package Assignments
[RD08] WEAVE-MAN-006	WEAVE Risk Management Plan
[RD09] WEAVE-MAN-007.2	Log Files – Risk Log
[RD10] WEAVE-MAN-009	Project Management Team Responsibilities
[RD11] WEAVE-MAN-013	WEAVE instrument block diagram
[RD12] WEAVE-MAN-016	Executive Summary
[RD13] WEAVE-MAN-023	Stage Plan: Final Design Stage (Third Stage)
[RD14] WEAVE-MAN-024	Stage Plan: Manufacturing, Assembly, Integration and Testing (Fourth Stage)
[RD15] WEAVE-MAN-037	Activity Network Diagram, Gantt Chart and Task Sheet
[RD16] WEAVE-MAN-039	WEAVE Project Costs and Schedule
[RD17] WEAVE-OCS-004	Observatory Control System PDR Document
[RD18] WEAVE-SCI-001	WEAVE Science Requirements
[RD19] WEAVE-SCI-002	WEAVE Science Case
[RD20] WEAVE-SCI-003	WEAVE Operational Constraints and Operational Requirements
[RD21] WEAVE-SCI-004	WEAVE Operations Concept
[RD22] WEAVE-SCI-006	Requirements from the Concept of Operations Document
[RD23] WEAVE-SYS-001	Instrument Development Specification
[RD24] WEAVE-SYS-002	Requirements Engineering Procedure
[RD25] WEAVE-SYS-009	Preliminary Commissioning Plan
[RD26] WEAVE-WPD-009.01	WPD for the WEAVE Archive System
[RD27] WEAVE-WSF-003	Preliminary design of the focal plane calibration module
[RD28] WEAVE-MAN-002	Change Management Procedures

2 INTERFACE OVERVIEW

The primary access points for interfacing with the SPA are two facilities hosted at CASU, Cambridge.

1. The WEAVE Automated Submission Platform (WASP) is an online observation preparation tool. It is the gateway for WEAVE users to validate and submit FITS target catalogues and later XML Observing Blocks

   http://wasp.ast.cam.ac.uk/

2. The Operational Repository (OR) permits low-latency (generally 24 hours) access to raw, L1 and (on a higher latency) L2 data products. The OR also allows users to monitor survey progress, Quality Control data, and for some management-level users instrument health

   http://casu.ast.cam.ac.uk/weave/

Importantly, the OR also provides access to some assets defined under the WEAVE data model [AD20]. This model encompasses documentation and example WEAVE data product templates to allow end-users to explore the various files they may come into contact with whilst using WEAVE. Not all files tracked by the data model are provided, as they do not have direct relevance to the end-users. *WEAVE users should familiarise themselves with the contents of the Data Model prior to raising any support issues.*

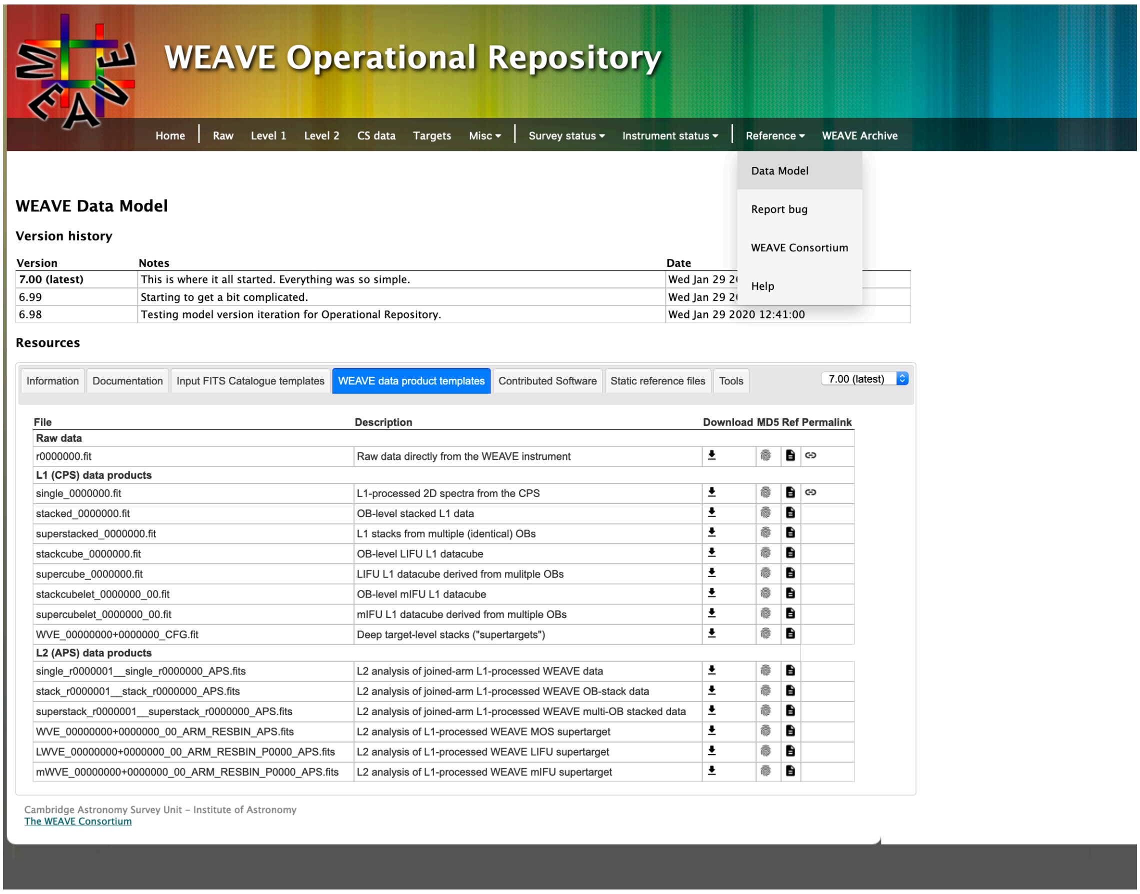


Figure 1 - The WEAVE data model page hosted on the Operational Repository. This page provides access to all assets within the Data Model as described in [AD20]

Open Time users, upon award of WEAVE time, will have WASP and OR accounts generated automatically, based on the email address provided during Phase 1 of WEAVE observations. [eventually: cite ING URL].

The overview of the SWG to SPA interfaces, associated data products and governing documents is provided in Table 1. The key interfaces in which the SWG is not involved are also listed.

Table 1 SWG to SPA Interfaces and Data products

Interface	Source	Destination	Product	Document
1	Survey Science Teams	WASP	Catalogues (.fits)	ICD-030
2	SWG	WASP	Observing Blocks (.xml)	ICD-030
3	OR	SWG	L1 (.fits), L2 (.fits), Survey progress metrics, quality control information	ICD-030
4	OR	QAG	Survey progress metrics, quality control information	ICD-030
5	OR/WASP	OCS	Validated Observing Blocks (.xml), Operational Catalogues (.fits), OB retraction data (OR database), Management-level access to OR and WASP	ICD-025 [AD18] ICD-027 [RD04] ICD-030
6	Configure	SWG	Unvalidated Observing Blocks (.xml)	ICD-025 [AD18]

3 TRIMESTER NOTATION CONVENTION

WEAVE surveys will submit catalogues on the Trimester (3 month) schedule.
The notation convention for Trimesters is **XXXXYZ**

- XXXX = the year as four digits
- Y = A or B
- Z = 1 or 2

Open Time proposals are expected to submit catalogues on a semesterly (6 month) basis within the trimesterly WEAVE schedule. The same notation convention is used as for Trimesters except the value for Z will not change. This value will depend on when WEAVE observing commences. This means that the sequence of Open Time observations will be (for example)

2023A2
2023B2
2024A2 etc

4 OPERATIONS SUBMISSION TIMETABLE

Table 2 sets out the key interfaces between SPA and SWG/QAG, the data products being delivered within the interface, the frequency of delivery and submission timeframe for a Trimester T+1 where appropriate.

Table 2 Trimester Submission Timetable per SWG to SPA Interface and per data product.

Interface	Data product	Frequency	Submission Timeframe for Trimester T+1
WASP to PI Programme	Catalogue Templates	Once per programme	--
WASP to (D)PS	End-of-trimester OB report	Trimesterly	15:00 GMT on the Wednesday (or two hours following close of XML submissions), two weeks before T+1 starts observations
WASP to (D)PS	Trimester schedule, flow control, limited submission window modification	Ongoing	--
Survey Science Team to WASP	Catalogues	Once per trimester (except WD, GS, CCG)	Duration = 2 weeks For catalogues for T+1: Start = 9.00 GMT Monday of the week before T starts. End = 9.00 GMT Monday of the week after T has started. WEAVESPA-214
PI Programme to WASP	Catalogues	Once per semester	Duration = 2 weeks For catalogues for T+1: Start = 9.00 GMT Monday of the week before T starts.

Interface	Data product	Frequency	Submission Timeframe for Trimester T+1
			End = 9.00 GMT Monday of the week after T has started. WEAVESPA-214
SWG to WASP	XMLs	Once per trimester	Duration = 5 days For XMLs for T+1: Start = 12.00 GMT on the Friday three weeks before the week that T+1 starts. End = 12.00 GMT following Wednesday (two weeks before the week that T starts) WEAVESPA-214
PI Programme to WASP	XMLs	Once per trimester	Duration = 5 days For XMLs for T+1: Start = 12.00 GMT on the Friday three weeks before the week that T+1 starts. End = 12.00 GMT following Wednesday (two weeks before the week that T starts) WEAVESPA-214
OR to SWG	L1	Open availability	--
OR to SWG	L2	Open availability	--
OR to SWG/QAG	Survey progress metrics*	Open availability	--
OR to SWG/QAG	Quality control information*	Open availability	--
OR to (D)PS	Consortium / TAC fibre usage report	Six months	--

We note that the dates particularly relevant to preparing for an upcoming trimester can be found under the "Trimesters" page of the WASP.

5 SURVEY SCIENCE TEAMS → WASP

The catalogue provider(s) of each WEAVE Survey Science Team will submit their catalogues to the WASP for validation and delivery to the SWG (and within SPA to WAS and APS). The following sections describe the structure and content standard for these catalogues.

5.1 Overview of Catalogue FITS File Structure

An input catalogue FITS file will comprise the Primary Header in the empty Extension 0, and a Binary table containing the catalogue data in Extension 1 as shown in Table 3.

Table 3 Catalogue FITS File Structure

Index	Extension Name	Type	Dimensions
0	Primary	Image	0
1	<TARGSRVY> Catalogue	Binary	N cols x M rows

5.1.1 IAU FITS Standards

The following descriptions aim to follow the IAU FITS Standard as held at: https://fits.gsfc.nasa.gov/fits_standard.html

5.2 Catalogue FITS Filename

The catalogues need to follow a standard file naming convention for ease of automated ingestion into the WASP. This depends on the type of survey (WEAVE consortium or Open Time), and the trimester of proposed observation.

5.2.1 WEAVE TARGSRVY Catalogues

The standard filename for the WEAVE Science Team catalogues contains TARGSRVY and TRIMESTE[1] only as follows: <TARGSRVY>_<TRIMESTE>.fits

The current list for TARGSRVY are given in Table 4. Entries for TARGSRVY must be upper case.

Table 4 TARGSRVY List

TARGSRVY	Description		TARGSRVY	Description
GA-LRDISC	Galactic Archaeology Low Resolution Disc		WC	WEAVE Clusters
GA-LRHIGHLAT	Galactic Archaeology Low Resolution High Latitude		WL-WIDE	WEAVE LOFAR wide
GA-HR	Galactic Archaeology High Resolution		WL-MID	WEAVE LOFAR mid
GA-OC	Galactic Archaeology Open Clusters		WL-DEEP	WEAVE LOFAR deep
GA-CALIB	Galactic Archaeology Calibrations		WQ	WEAVE QSOs
STEPS	Stellar Populations at intermediate redshifts Survey (StePS)		ASTRO-CALIB	Calibration catalogue
SCIP-AC	Galactic Plane Stellar, Circumstellar and Interstellar Physics (SCIP) Anti-Centre field		WD	White Dwarf
SCIP-CYG	SCIP Cygnus field		GS	Guide Star
SCIP-LR	SCIP Low-Resolution		ING-SYSCAT	ING's system catalogue
WA	WEAVE Aperitif			

For example, in the case of TARGSRVY = STEPS and TRIMESTE = 2023B2 the corresponding catalogue file name would be: STEPS_2023B2.fits

5.2.2 Science Verification and Open Time Catalogues

The standard filename for the Science Verification and Open Time catalogues will follow this structure: <TARGSRVY>.fits.

[1] This is a FITS Primary Header Keyword for which only 8 characters are allowed. Hence TRIMESTE, not TRIMESTER.

The TARGSVY for Science Verification and Open Time proposals will be constructed as follows:

W<S/V><YEAR><A/B><1/2>-<XXX>

Where:

- W stands for 'WEAVE'
- S for Service or V for Visitor,
- YEAR is the observing year,
- A or B depending on the observing semester,
- 1 or 2 depending on the observing trimester, and
- <XXX> is the three digit running integer assigned to the proposal by the ING.

Thus, for example, in the case of TARGSRVY = WS2022B1-002 the corresponding catalogue filename would be: WS2022B1-002.fits.

<TRIMESTE> is not required as part of the filename, as for the WEAVE TARGSRVY catalogues, as the observing semester is encoded in the TARGSRVY.

5.2.2.1 ING Proposal Identifier: TACALLOC

TACALLOC is a shorthand code that specifies the type of Open Time observation, when it should be observed, and through which TAC(s) it was awarded.

Table 5 TACALLOC code structure

	Data	Component	Information
1	Instrument name	W	WEAVE
2	Service / Visitor mode	S/V	Time awarded as either Service (via ING scheduler) or Visitor mode
3	Trimester	YYYY[A/B][1/2]	As defined in Section 3
4	TAC allocation	_xxxy	Time (hours) awarded by each TAC to 0.1hr precision, by defining y=0,1,2,3 etc e.g 0024 = 2.4 hrs
		Nxxxy	Time awarded by the Netherlands TAC
		Pxxxy	Time awarded by PATT (UK)
		Cxxxy	Time awarded by CAT (Spain)
		Ixxxy	ITP (International Time Program)
		Dxxxy	Director's discretionary time

Working example: WS2023B1N0015P0005C0200I0005D0015

This is a (W)EAVE (S)ervice mode observation for 2023B1, awarded 1.5hrs from the Netherlands, 0.5hrs from PATT, 20hrs from CAT, 0.5hrs via the ITP and finally 1.5hrs via DDT. This code will be shortened in instances where a TAC awards no time (e.g. N0000 would be omitted from the TACALLOC).

5.2.3 Master Catalogue Template FITS File

The WASP and WAS will hold the master list of all permitted catalogue columns in FITS format such that all standards relating to the columns and their definitions are fixed to the WEAVE Data Model [AD20]. The list of all columns is given in Table 31.

The filename is Master_CatalogueTemplate.fits.

Each WEAVE TARGSRVY catalogue, and each Open Time proposal catalogue, will contain some approved subset of these columns. The approved set of columns will be issued as an empty FITS Template that must be filled in and submitted to the WASP as the associated input catalogue.

5.2.4 Catalogue Template FITS File

The WASP will test compliance of each submitted catalogue FITS file against the catalogue template associated with the respective TARGSVY (and Open Time proposal). For Open Time proposals, the WASP provides a web-form for PIs to select desired columns from the Master Catalogue FITS template. The catalogue template is then stored on their WASP account and also provided as a download. Changes to this template are permitted up to the point the WASP opens for FITS submissions.

Each catalogue template is therefore held in the WASP as a FITS file in which all the columns of the catalogue are fully specified following the standards described in the following sections. The structure of these templates adheres to the WEAVE data model standard as defined by the DATAMVER FITS Primary Header keyword, which has the form 'X.xx' to represent the version number. In the case of WEAVE science teams, the catalogue template file is also change controlled under the data model itself: any changes to the template must be made through an official change request.

Each TARGSRVY and Open Time proposal is issued the respective catalogue FITS template to use as the basis for input catalogue FITS files that are submitted to the WASP.

The filename for the catalogue template for both WEAVE TARGSRVY and WEAVE Open Time is defined as: <TARGSRVY>_CatalogueTemplate.fits

5.3 Catalogue FITS File: Extension 0 Primary Header

The Primary Header should contain the keywords in Table 6 which are additional to the standard header keywords that are generated automatically when a FITS file is created.

Table 6 WEAVE-specific keywords for the Catalogue Primary Header

Keyword	Description in FITS file	Contains
COMMENT		<TARGSRVY> Catalogue
DATAMVER	WEAVE Data Model Version	'X.xx'
TRIMESTE	Observing Trimester	Fill in with current trimester i.e. 2023B1. *Note that Maximum keyword character length is 8*

Keyword	Description in FITS file	Contains
TACALLOC	Proposal identifier	TAC allocation code (only filled for SV/Open Time programmes). See Section 5.2.2.1
TACID	TAC identifiers	Identifier the TAC used for the proposal (only filled for SV/Open Time programmes). If there are multiple sources then use "|" to delimit them.
MAG_G_CM	Survey-Specific magnitude column(s) used to fill MAG_G	Provide list of which **Survey-Specific** photometric columns have been used to fill the MAG_G columns. These need to be uncorrected for extinction SDSS-like on the AB system. FYI: Useful colour transformations http://www.ast.cam.ac.uk/~mike/wfcsur/technical/photom/colours/ If there is more than one source columns then use '|' to delimit the column names.
MAG_R_CM	Survey-Specific magnitude column(s) used to fill MAG_R	Provide list of which **Survey-Specific** photometric columns have been used to fill the MAG_R columns. These need to be uncorrected for extinction SDSS-like on the AB system. If there is more than one source column then use '|' to delimit the column names.
MAG_I_CM	Survey-Specific magnitude column(s) used to fill MAG_I	Provide list of which **Survey-Specific** photometric columns have been used to fill the MAG_I columns. These need to be uncorrected for extinction SDSS-like on the AB system. If there is more than one source column then use '|' to delimit the column names.
STL_NME1	Science Team Lead (or PI) forename	Fill with the STL/PI's first name
STL_NME2	Science Team Lead (or PI) surname(s)	Fill with the STL/PI's second name(s)
STL_MAIL	Science Team Lead (or PI) email	Fill with the STL/PI's email address
CAT_NME1	Catalogue submitter forename	Fill with the first name of the person submitting this file to the WASP.
CAT_NME2	Catalogue submitter surname(s)	Fill with the second name(s) of the person submitting this file to the WASP.
CAT_MAIL	Catalogue submitter email	Fill with the email address of the person submitting this file to the WASP.
CAT_CC	Catalogue report cc list	Optionally fill with email addresses (CSV with no spaces) for the WASP validation FITS report to be sent to. *Please note the report is always sent to STL_MAIL and CAT_MAIL*. Please be careful not to exceed the string length (<60A) and truncate email addresses. Two should be possible, or three short addresses.
DATETIME	Datetime file created	
CHECKSUM		
DATASUM		

There should be **NO DATA** in Extension 0. The WASP will test that this is an empty extension and will reject the catalogue submission if the extension is found to be non-empty.

5.4 Catalogue FITS File: Extension 1

The TARGSRVY and Open Time catalogue values are provided in Extension 1 as a binary table. The column properties of the binary table are fully specified by keywords in the extension header.

5.4.1 Extension 1 Header Keywords

The keywords in Table 7 are required to fully specify the columns in the catalogue binary table. The conventions used to define these are explained also.

Table 7 Catalogue FITS File Extension 1 Header Keywords

Keyword	Value	Keyword Comment	Notes
TTYPE	Name of column - Survey-specific column names should follow standard scheme with these rules: • Upper case names only • Delimiter if needed is the underscore '_' • Photometry names constructed as 'CAT_MAG_X' & 'CAT_EMAG_X', where CAT is general or a specific catalogue name, and X is the letter or number of specific pass band as per mandatory column scheme for SDSS and Gaia above.	Description of column value	Please keep to 47 characters or less
TFORM	A=string, E=floating point, D= double precision, I=integer	Data format of field: *(standard description)*	See example files below
TDISP	Xx.x	Display format for column	Recommended print format for the binary data and to be used to check data precision for WASP and for display in the archive by WAS. See legal values in above table.
TUCD	string.string	UCD for column	A UCD does not define the units nor the name of a quantity, but rather "*what sort of quantity is this?*"; for example **phys.temperature** represents a temperature, without implying a particular unit. Select from the list in WD-UCDlist-1.3-20170502.pdf. Build and Validate the UCD at http://cdsweb.u-strasbg.fr/UCD/
TUNIT	Measurement unit of column value	physical unit of field	Do not provide if measurement is unitless.

Keyword	Value	Keyword Comment	Notes
TNULL	Value which FITS interprets as NULL. FITS Default: Empty string {‘’} for strings, floating point NULL for real (default) Recommended Default for positive integers is -1.	NULL value for field	Only include if specifying different TNULL from the FITS default for float and string. Needs to be specified for integer columns.
TPROP	0 1	Public column Proprietary column	If Value=0 then the column contains public data. If Value=1 then the column contains proprietary data and so will have restricted access in WAS.
TLMIN	min(Data)	Minimum value expected for field	This will be used in quality control tests to ensure columns are filled in correctly. Do not include if limits are infinity or string.
TLMAX	max(Data)	Maximum value expected for field	This will be used in quality control tests to ensure columns are filled in correctly. Do not include if limits are infinity or string.

Further information for using these keywords is provided in the following sections.

5.4.1.1 TTYPE

This keyword provides the name of the column in the binary table. The FITS Standard[2] recommends that only letters, digits, and the underscore character be used in column names with no embedded spaces. It is recommended that all the column names in a given table be unique within the first 8 characters. This recommendation has not proven possible for naming the WEAVE catalogue columns but great effort has been made to group sets of columns to be logically displayed and in an easily searchable way.

5.4.1.2 TFORM

This keyword specifies the data type for the column in the binary table. The legal formats for TFORM for BINARY TABLES are given in Table 8 where r=vector length and the default is r =1.

Table 8 Legal formats for TFORM and entries for TFORM comment

TFORM	Description	TFORM comment
rA	character string	data format of field: ASCII Character
rAw	array of strings, each of length w	data format of field: ASCII Character
rL	logical	
rX	bit	
rB	unsigned byte	
rI	signed 16-bit integer	data format of field: 2-byte INTEGER

[2] https://fits.gsfc.nasa.gov/fits_standard.html

TFORM	Description	TFORM comment
rJ	signed 32-bit integer	data format of field: 4-byte INTEGER
rK	signed 64-bit integer	data format of field: 8-byte INTEGER
rE	32-bit floating point	data format of field: 4-byte REAL
rD	64-bit floating point	data format of field: 8-byte DOUBLE
rC	32-bit complex pair	
rM	64-bit complex pair	

https://heasarc.gsfc.nasa.gov/docs/software/fitsio/quick/node10.html

If TFORM specifies a character string (A) then the number of characters in the string (if r>1) should also be specified.

5.4.1.3 **TUNIT**

This keyword specifies the physical units for the values in the column. Please inspect the entries for the SPA columns to understand the appropriate usage. Usage has been standardised across the Survey-Specific catalogue columns. Please consult the FITS standard (https://fits.gsfc.nasa.gov/fits_standard.html) to revise best practice.

5.4.1.4 **TNULL**

This keyword specifies the value used to indicate a NULL value. A common mistake is to create a vector which defines 0 as the NULL by default, but 0 is actually a valid entry for the column e.g. Metallicity. A floating point NULL is available in most computing languages and should be used for floating point data formats, in which case TNULL is not required. Please consult the FITS standard to ensure best practice.
(https://fits.gsfc.nasa.gov/fits_standard.html)

Similarly the default NULL value for string columns is the empty string ‘’. This does not need to be specified by TNULL.

There is no equivalent NULL for integer columns. Thus a default value has been specified using TNULL such that it can be interpreted as NULL. It lies outside the expected range of values, e.g. if the expected range of values is positive real, then using -1 is the recommended choice for TNULL.

5.4.1.5 **TPROP**

This is a WEAVE specific keyword designed to provide information on the proprietary nature of the data in a column. On a per column basis, data that is provided within an MOU may have restrictions on who can have access to it in WAS. This keyword defines that proprietary nature per column. There are no targets that are proprietary, thus no per object proprietary definition.

The Master Catalogue template specifies all columns as public so TPROP=0. WEAVE surveys had the option to specify a column as proprietary so TPROP=1. Open Time proposals cannot specify TPROP=1 – all columns will have TPROP=0. By default, all Open Time proposal catalogues, observations and data products are proprietary within WAS for 1 year: only the Open Time proposal team will have access to these observations within this one-year period.

5.4.1.6 **TLMIN, TLMAX**

These keywords specify the minimum and maximum allowed value for a numeric column. Please consult the FITS standard (https://fits.gsfc.nasa.gov/fits_standard.html) to ensure best practice. If the data limits are +/- infinity, or the data type is string, then these are not included.

5.4.1.7 **TDISP**

This keyword provides a recommended print format for the binary data and may be used to check data precision for WASP@CPS and for display in the archive by WAS. Please consult the FITS standard (https://fits.gsfc.nasa.gov/fits_standard.html) to ensure best practice.

TDISP should be consistent with the data type in TFORM. Two exceptions are:

- For double precision, the CFITSIO fitsverifier seems to have issues with the Dw.dEe format. Thus for TFORM=D please use TDISP=FXX.X instead. The WASP allows for this.
- If TFORM is E then the equivalent floating point TDISP is F. The WASP allows for this.

Table 9 Legal formats for TDISP

Legal format	Description		Legal format	Description
Aw	character string		Zw.m	Hexadecimal integers
Lw	logical (T, F or U (undefined))		Fw.d	Floating-points
Iw.m	integers		Ew.dEe, ENw.d, ESw.d	Exponential form
Bw.m	Binary integers		Gw.dEe	Floating-points form or exponential form
Ow.m	Octal integers		Dw.dEe	Double precision

Here “w” is the width of the displayed value in characters, “m” is the minimum number of digits to display (filled with leading 0s), “d” is the number of digits after the decimal point, and “e” is the number of digits in the exponent. See https://heasarc.gsfc.nasa.gov/ftools/fv/doc/displayFormat.html

5.4.1.8 **TUCD**

UCD stands for Unified Content Descriptor and is a convention used by CDS and governed by the IAU. A UCD does not define the units nor the name of a quantity, but rather "*what sort of quantity is this?*"; for example *phot.mag* represents a *photometric magnitude*, without implying a particular unit.
See http://www.ivoa.net/documents/UCD1+/20170502/index.html and http://wiki.ivoa.net/bin/view/IVOA/IvoaSemantics for more information. There are tools available which can be used to build and validate UCDs under ‘**UCD Tools**’ on this website: http://cdsweb.u-strasbg.fr/UCD/.

The UCDs used in the WEAVE catalogue columns have been reviewed to meet the IAU standards and to be consistent between source catalogues.

5.4.2 Extension 1 Binary Table

The target information comprising the catalogue is contained in a binary table in Extension 1. The binary table has two sections:

1. SPA Columns: these are the same for all catalogues and contains the information essential for observation and processing by OCS, CPS and APS.
2. Survey-Specific Columns: these contain supplementary information per target that the survey wants to be included in the WEAVE Archive System (WAS).

These are described in the following sections.

5.4.3 SPA Columns

The SPA columns must be included in all TARGSRVY catalogues. The data for some of these columns will not be available for some or many of the targets of particular surveys and so they will necessarily be NULL. In this context these are designated as 'desirable' by SPA. However they are 'mandatory' in the sense that if these data are available, even if just for a subset of targets, then each survey must report them.

The categories of the SPA columns and which team uses them are listed in Table 10.

Table 10 SPA Column Categories

Categories	Used by
Naming & Priority	SWG, OCS, WAS, OR
Observing Mode and Conditions	SWG, OCS
Coordinates in the Gaia Reference Frame	SWG, OCS, WAS
IFU Specific	SWG, OCS
Photometry for Spectral Reduction	CPS
General APS Settings	APS
PPXF Settings	APS
GANDALF Settings	APS
Line Strength Settings	APS
SSP Settings	APS
IFU Settings	APS
CS/CDP Settings	APS

The SPA columns are listed in the following table:

Table 11 SPA Columns

SPA Columns	Column Name (TTYPE)	TTYPE Comment (*additional information*)	Maps to FIBINFO[3]
Naming & Priority			
Mandatory	CNAME	WEAVE object name from coordinates *(assigned by WASP)*	CNAME
Mandatory	TARGSRVY	The Survey where the target belongs *(See authorised list in Table 4)*	TARGSRVY

[3] These are passed through to OCS/CPS/APS data products (see [RD04], [AD09]), or in some cases only the XML files (see [AD18], in which case we indicate via the nomenclature element:attribute).

SPA Columns	Column Name (TTYPE)	TTYPE Comment *(additional information)*	Maps to FIBINFO[3]
Mandatory	TARGPROG	Optional description of (sub-) survey/programme. To delimit sub-descriptions please `|'. The full description cannot exceed 40 characters. *(See Section 5.4.3.1 below)*	TARGPROG
Mandatory	TARGCAT	Catalogue filename *(See Section 5.2 above)*	TARGCAT
Mandatory	TARGID	The identifier of the target assigned by survey *(For IFU usage, see Section 5.4.3.2 below)*	TARGID
Mandatory for IFU	TARGNAME	The target name *(Optional for MOS, Mandatory for LIFU and mIFU. See Section 5.4.3.2 below)*	TARGNAME
Mandatory	TARGPRIO	Target relative priority within a survey *(MOS/mIFU: 1.0= lowest, 10.0=highest; LIFU: 10.0*	TARGPRIO
Mandatory	TARGUSE	T=target, S=sky, G=guide, C=calib., R=random.	TARGUSE
Mandatory	TARGCLASS	Classification of the target assigned by survey *(See Table 12 for authorised list)*	TARGCLASS
Observing Mode and Observing Constraints			
Mandatory	PROGTEMP	Observing Programme Template *(see Section 5.4.3.6)*	configure input
Mandatory	OBSTEMP	Observing Conditions Template *(see Section 5.4.3.7)*	configure input
Coordinates in Gaia Reference Frame			
Mandatory if available	GAIA_ID	Gaia Source Identifier	
Mandatory	GAIA_DR	Gaia Data Release *(Gaia Reference Frame. Permitted data releases are Gaia DR2 and Gaia (e)DR3. Please specify here as '2' and '3'. Do not use 'DR'.)*	
Mandatory	GAIA_RA	Gaia RA of target in decimal degrees *(in Gaia Reference Frame specified in GAIA_DR)*	TARGRA (need for CNAME assignment)
Mandatory	GAIA_DEC	Gaia Dec of target in decimal degrees *(in Gaia Reference Frame specified in GAIA_DR)*	TARGDEC (need for CNAME assignment)
Mandatory	GAIA_EPOCH	Gaia Epoch of target in (Julian) decimal years *(2015.5 for Gaia DR2, 2016.0 for Gaia (e)DR3)*	TARGEPOCH (need for CNAME assignment)
Mandatory if available	GAIA_PMRA	Gaia Proper Motion of target in mas/yr in RA	TARGPMRA (need for CNAME assignment)
Desirable	GAIA_PMRA_ERR	Error on GAIA_PMRA	
Mandatory if available	GAIA_PMDEC	Gaia Proper Motion of target in mas/yr in Dec	TARGPMDEC (need for CNAME assignment)
Desirable	GAIA_PMDEC_ERR	Error on GAIA_PMDEC	
Mandatory if available	GAIA_PARAL	Gaia Parallax of target in mas	TARGPARAL
Desirable	GAIA_PARAL_ERR	Error on GAIA_PARAL	
Mandatory	HEALPIX	ID for res=19 nested HEALPix scheme *(leave empty for submission, values are assigned by WASP)*	
IFU Specific Mandatory Columns			
Mandatory	IFU_SPAXEL	Identifier for spaxel within IFU *(assigned by configure – see Section 5.4.3.9, MOS = '' for all targets)*	IFU_SPAXEL [XML only, target:ifu_spaxel]
Mandatory	IFU_PA	Position Angle of IFU bundle *(mIFu - Assigned by configure LIFU - Assigned based on Guide star position - see IFU workflow, Section 9 MOS=0.0 for all targets)*	IFU_PA [XML only, observation:pa, target:ifu_pa]
Mandatory	IFU_DITHER	IFU dither pattern code (-1,0,-3,3,4,5,6) *(MOS/TNULL=0. Assigned by TARGSRVY team)*	IFU_DITHER [XML only dithering:apply__dither]
Photometry - Ideal set for CPS (see Section 5.4.3.11)			
Mandatory if available	MAG_G	Magnitude for target in SDSS-like g band (AB) *(Note: must be uncorrected for extinction)*	MAG_G
Mandatory if available	MAG_G_ERR	Error on MAG_G	EMAG_G
Mandatory if available	MAG_R	Magnitude for target in SDSS-like r band (AB) *(Note: must be uncorrected for extinction*	MAG_R
Mandatory if available	MAG_R_ERR	Error on MAG_R	EMAG_R

SPA Columns	Column Name (TTYPE)	TTYPE Comment (*additional information*)	Maps to FIBINFO[3]
Mandatory if available	MAG_I	Magnitude for target in SDSS-like i band (AB) *(Note: must be uncorrected for extinction)*	MAG_I
Mandatory if available	MAG_I_ERR	Error on MAG_I	EMAG_I
Mandatory if available	GAIA_MAG_G	Magnitude for target in Gaia G band (Vega) *Provide Gaia Vega magnitudes as-supplied by Gaia archive*	MAG_GG
Mandatory if available	GAIA_MAG_G_ERR	Error on MAG_G	EMAG_GG
Mandatory if available	GAIA_MAG_BP	Magnitude for target in Gaia BP band (Vega) *Provide Gaia Vega magnitudes as-supplied by Gaia archive*	MAG_BP
Mandatory if available	GAIA_MAG_BP_ERR	Error on GAIA_MAG_BP	EMAG_BP
Mandatory if available	GAIA_MAG_RP	Magnitude for target in Gaia RP band (Vega) *Provide Gaia Vega magnitudes as-supplied by Gaia archive*	MAG_RP
Mandatory if available	GAIA_MAG_RP_ERR	Error on GAIA_MAG_RP	EMAG_RP

5.4.3.1 TARGPROG

TARGPROG is an optional column, to be filled out at the discretion of the catalogue creator (typically in coordination with SPA). If this column includes the entry "|BW", however, then the target is assumed to be *filler* (bad-weather) target. In this case, any XML generated with this target will given an overall priority of 0.1 rather than the default priority of 1.0, significantly reducing the probability of this OB being observed unless no other OB is available in the conditions specified by the OBSTEMP (Section 5.4.3.7) of the observation.

5.4.3.2 TARGNAME and TARGID

Whilst for MOS observations, these values have no operational / CPS implications, this is not the case for IFU modes. Care should therefore be taken by IFU users to ensure that their use of these values reflects the desired outcomes from CPS. *No retrospective re-processing of data can occur due to incorrect use of TARGNAME and TARGID.*

See also Section 5.4.4 for how Target Uniqueness is defined for MOS and IFU observations.

TARGNAME is optional for MOS observations so it can be left as an empty string (‘’). TARGID is mandatory for MOS and must be the unique identifier for that object within a TARGSRVY.

TARGNAME is mandatory for IFU observations. This parameter is used to group IFU observations of the same target, in cases where stacks are required. This helps CPS identify cases where the same astrophysical target is observed but the OBs executed were not related (via for example the "chained" directive - see Section 7 and [AD18]).

We refer readers to [AD19] for specifics, but an example would be LIFU observations of the core of M33. If a user requires 3 OBs, each with different dither positions, then the CPS could not ordinarily stack these data, because they do not share the same Central

CNAME (CCNAME). We illustrate this here, with red, blue and yellow signifying each OB starting position:

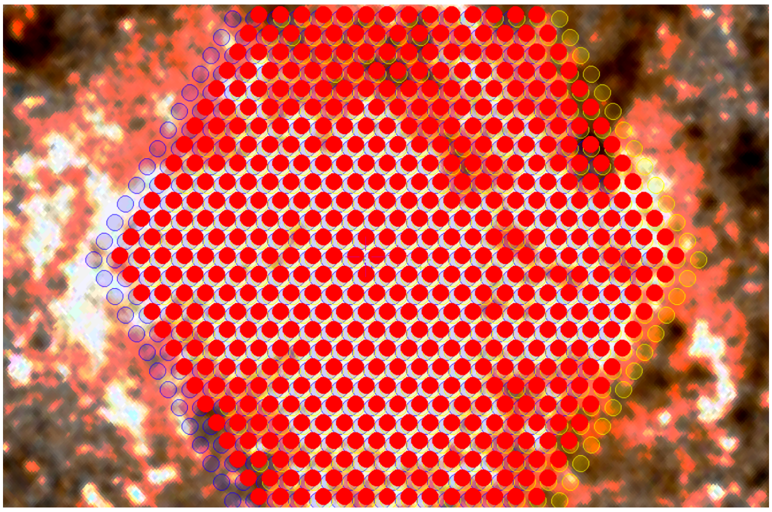


Figure 2 - Three LIFU dither positions centred on a putative target. This information must be encoded in the input FITS catalogue, but grouped by common TARGNAME.

In the input FITS catalogue, these observations are represented by 5,427 rows: 603 fibres, dithered 3 times for 3 OBs (for readers baulking at this, please consider it an advertisement for the IFU workflow package described in Section 9).

Each of these rows must be tied together by a common TARGNAME, e.g. "M33bulge". This indicates to the CPS that these observations should be evaluated for stacking. It is not always true that IFU observations with common TARGNAME will be stacked – the below example, with a TARGNAME="M33" would not be stacked, as this is in effect a mosaic. Only common TARGNAMEs with sufficient overlap will be stacked by the CPS. However, if Contributed Data Products exist to create larger mosaics from these data, then they should use the common TARGNAME to group L1 products.

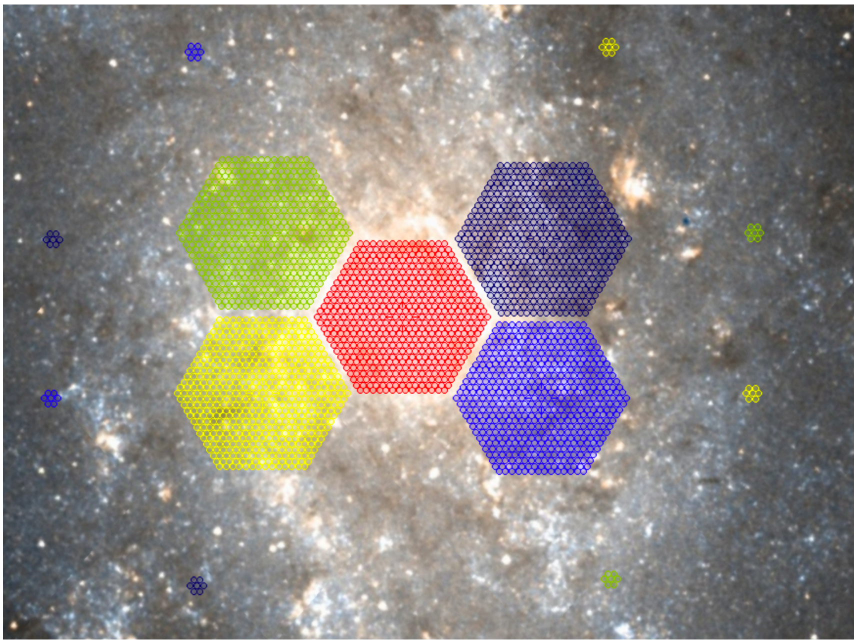


Figure 3 - Example LIFU coverage of an extended source. Each colour here represents an OB. Within each pointing there would be a series of dithers (as per previous Figure). Whilst these pointings might share the same TARGNAME ("M33"), the CPS would recognise these as a mosaic and not stack them into a single LIFU data cube.

This principle similarly applies to individual mIFU bundles.

The TARGID is the target identifier assigned by the survey. It is mandatory that this column is filled in.

For MOS this is unique within the TARGSRVY for the object.

For IFU fields, this is the OB-specific descriptor of the field. In the first example above, this could be a simple numerical identifier for each OB:

- OB1: TARGNAME = "M33bulge" TARGID = "M33bulge1"
- OB2: TARGNAME = "M33bulge" TARGID = "M33bulge2"
- OB3: TARGNAME = "M33bulge" TARGID = "M33bulge3"

For the second example, TARGID could be more descriptive:

- OB1: TARGNAME = "M33" TARGID = "M33 bulge"
- OB2: TARGNAME = "M33" TARGID = "M33 disc NE"
- OB3: TARGNAME = "M33" TARGID = "M33 disc NW"
- etc

For MOS, the same TARGID (object) may get observed multiple times with different observing conditions. See Section 5.4.4 for further details on how this is defined.

5.4.3.3 TARGPRIO

TARGPRIO is used to provide a weight to the target for priority of observation selection for MOS targets. 1.0 is the lowest priority, 10.0 is highest priority. This corresponds to a positive weighting in Configure [See ICD-025]. The data type for TARGPRIO is float. The precision of TARGPRIO is to 1 decimal place (X.x) as defined in the TDISP keyword (F4.1) for this column in the FITS binary table.

For LIFU fibres within a single exposure, all have equal (and redundant) priority so this column should be filled with value 10.0.

For mIFU targets, all fibres within the same bundle should have the same TARGPRIO. Bundles within the same (putative) mIFU field (i.e. a WEAVE FOV) can have different priorities, and this should be used as a guide for deciding which bundles should be placed down onto the field during the Configure stage. Because mIFU bundle allocation within a field is an interactive and manual process, it is for the end-user to use TARGPRIO as an indicator of the relevance of a putative target within the field.

We urge users to take care in choosing values for TARGPRIO, particularly for MOS targets. These values cannot be changed at point of fibre allocation, meaning (for example) an inappropriately low TARGPRIO could result in a target never being allocated a fibre. We refer readers to Section 7.1.7.1.1 for further discussion on this.

5.4.3.4 **TARGUSE**

There are five uses for TARGUSE: T=target, S=sky, G=guide, C=calibration standard, R=random. G, C and R are reserved for SWG/operational use only. These will not be accepted within a TARGSRVY catalogue (see exception in Section 5.4.3.4.2).

5.4.3.4.1 Skies

Specific sky positions (S) can be provided in a TARGSRVY catalogue. Please consult with the SWG for best practice on this. The same conditions as to what is filled or not of the SPA column still apply with these specifics:

1. TARGSRVY and TARGCAT match the rest of the targets
2. TARGCLASS can be any within the accepted list (Section 5.4.3.5), and APS modules can be added. TARGCLASS=SKY has a particular set of APS modules activated (See Section 5.4.3.10.1).
3. For MOS and mIFU Sky targets: GAIA_PMRA, GAIA_PMRA_ERR, GAIA_PMDEC, GAIA_PMDEC_ERR, GAIA_PARAL and GAIA_PARAL_ERR must all be set to 0.0. Do not use floating point(NULL).
4. For LIFU Sky targets: GAIA_EPOCH, GAIA_PMRA, GAIA_PMRA_ERR, GAIA_PMDEC, GAIA_PMDEC_ERR, GAIA_PARAL and GAIA_PARAL_ERR must inherit the corresponding values from the central fibre. Do not use floating point(NULL).

5.4.3.4.2 IFU White Dwarfs

The only exception when TARGUSE = ‘C’ or ‘R’ is permitted is when white dwarfs are extracted from the White Dwarf operational catalogue (WD.fits) as part of the construction of mIFU or LIFU bundles.

The TARGSRVY, TARGCAT and TARGCLASS must match that in the WD.fits. The user can specify TARGUSE=‘C’ or ‘R’. This is an outcome of using the IFU Workflow whereby the user wishes to adopt within their catalogue some of the additional output from configure run within the workflow.

IFU users are strongly encouraged to use the IFU Workflow, as considerable work has been undertaken to ensure that configure, the IFU Workflow and the WASP are consistent.

5.4.3.5 TARGCLASS

This is the classification of the target as assigned by the survey. The valid values provide for both general classification (e.g. "STAR") and more granular assignment ("STAR_FGK"). We list these values in Table 12.

Table 12 List of TARGCLASS Categories

TARGCLASS	Definition
GALAXY	Galaxy
MASK	Mask
NEBULA	Nebula
QSO	Quasar
SKY	Sky
STAR	Star
STAR_BHB	Blue Horizontal Branch
STAR_CEP	Cepheids
STAR_EM	Emission Line star
STAR_EMP	Extremely Metal Poor
STAR_FGK	FGK Spectral Type
STAR_IB	Interacting Binary
STAR_MLT	MLT Spectral Type
STAR_MLUM	Luminous M Star
STAR_OB	OB Spectral Type
STAR_BA	BA Spectral Type
STAR_RRL	RR Lyrae
STAR_VAR	Variable
STAR_WD	White Dwarf
STAR_YSO	Young Stellar Object
UNKNOWN	Unknown

APS will use this list to direct how targets are analysed, via a mapping between TARGCLASS and the APS_FLAG described in Section 5.4.3.10.1. Please note that it is possible to specify preferred sky positions in the input FITS catalogue. In this instance, we recommend setting the TARGCLASS to "SKY", but please consult the APS_FLAG section to understand the processing implications of doing so.

5.4.3.6 **PROGTEMP**

The PROGTEMP code is an integral part of describing a WEAVE target. This parameter encodes the requested instrument configuration, OB length, exposure time, spectral binning, cloning requirements and probabilistic connection between these clones. We describe the PROGTEMP code fully here, but we also refer registered WEAVE users to the PROGTEMP form in WASP.

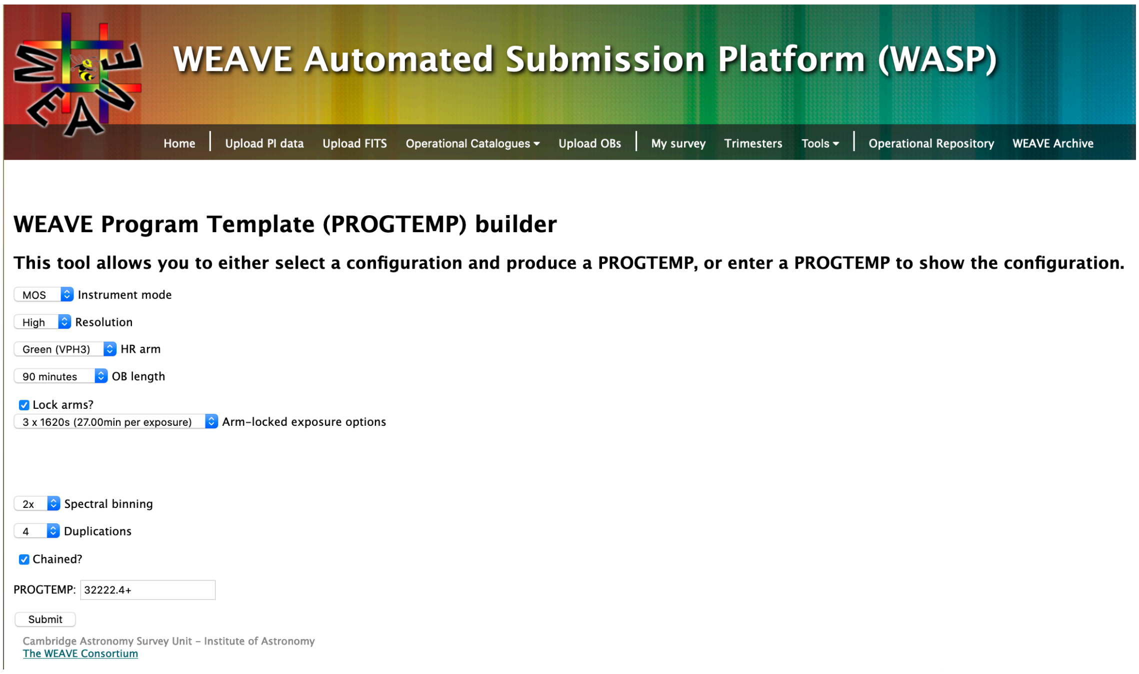


Figure 4 - The WASP's PROGTEMP tool. Users can select the desired instrument configuration and the tool will output the associated PROGTEMP code. Alternatively, users may enter a code and the form will be updated to reflect the configuration associated to this code.

This tool allows users to generate the correct PROGTEMP code for their desired observation. The WEAVE Data Model [AD20] also provides a lookup table (*progtemp.dat*) to permit scripted use of the PROGTEMP scheme – a tool to build a PROGTEMP is in the WASP (http://wasp.ast.cam.ac.uk/progtemp).

NB: whilst this description of PROGTEMP is complete, be aware that only limited functionality described within this system is available to WEAVE Science Teams. In constructing a PROGTEMP code, it is useful to think of the mnemonic "NORBI.X":

PROGTEMP = "NORBI.X(+)"

- **N** = i(**N**)strument configuration
- **O** = (**O**)B length
- **R** = (**R**)ed arm exposure code
- **B** = (**B**)lue arm exposure code
- **I** = B(**I**)nning in the spectral direction
- **X** = Clone this Observing Block (**X**) times

If “X” is used, it may be followed with a "+" to “chain” these cloned OBs so that completion of one in the chain boosts the weights (within a survey) of the remaining OBs.

Because WEAVE can only observe one instrument configuration at a time, ***only targets with the exact same PROGTEMP can be observed within the same OB***. We now detail the individual components described above.

5.4.3.6.1 i(N)strument configuration:

This initial integer (1–9) sets the configuration of the spectrograph, according to the following table

Table 13 The available WEAVE instrument modes under the PROGTEMP scheme

N	Type	Resolution	Red arm	Blue arm
1****.*	MOS	LR	Red (VPH1)	Blue (VPH1)
2****.*	MOS	HR	Red (VPH2)	Blue (VPH2)
3****.*	MOS	HR	Red (VPH2)	Green (VPH3)
4****.*	LIFU	LR	Red (VPH1)	Blue (VPH1)
5****.*	LIFU	HR	Red (VPH2)	Blue (VPH2)
6****.*	LIFU	HR	Red (VPH2)	Green (VPH3)
7****.*	mIFU	LR	Red (VPH1)	Blue (VPH1)
8****.*	mIFU	HR	Red (VPH2)	Blue (VPH2)
9****.*	mIFU	HR	Red (VPH2)	Green (VPH3)

5.4.3.6.2 (O)B length specifier

This PROGTEMP component specifies the overall OB length (inclusive of overheads). Whilst we provide the option of setting the following OB lengths, please be aware that not all OB lengths are available to WEAVE science teams.

Table 14 Options for total OB length under the PROGTEMP scheme

O	OB length (mins)
*0***.*	30
*1***.*	60
*2***.*	90
*3***.*	120
*9***.*	custom

Where O=9, then the RB component of PROGTEMP (below) is ignored, and the user sets exposure times manually. This mode is not available to WEAVE science teams.

5.4.3.6.3 (R)ed or (B)lue arm exposure code

The RB component of PROGTEMP's NO**RB**I.X defines how the time within the OB that you wish to observe the target is divided up, by specifying the number of exposures within the OB length stipulated above.

In principle, it is possible to provide different codes for the different arms. It is WEAVE policy to "lock" the arms: i.e., the Red and Blue arms must be observed with the same exposures within an OB. No such restriction is placed on Open Time, beyond cases where it adversely affects instrument efficiency (for example, requesting one exposure in Red, and 12 in Blue would cause a significant mismatch in overheads between the two arms).

The T_{exp} column in the below table is for approximate guidance only (and is approximately 60 minutes / exposure code). T_{exp} includes overheads, meaning actual time on-target will be less. Similarly, the exposure times provided for each OB length are inclusive of overheads, meaning on-target time will be less.

WEAVE science teams are permitted a limited subset of the below exposure options for MOS / IFU (coloured green), or IFU-mode only for options coloured orange. Exposure options for which fixed dither patterns are available in IFU modes are indicated in ***bold-italic***.

Open time surveys may use other combinations at their own risk, notwithstanding forbidden combinations arising from mixing different exposure codes for the two arms. The exception here is OB length O=0 (30 minutes) options *cannot* be used for MOS observations. We advise users to check their desired combination in the WASP PROGTEMP tool.

Table 15 The number and length of exposures within an OB for different OB lengths and exposure codes. Exposure codes may be specified on a per-arm basis, subject to comparable overhead penalties.

Exposure code	Typical T_{exp}	(O)B length specifier			
R , B (or union)	(min)	O = 0	O = 1	O = 2	O = 3
0.* , ***0*.*, **00*.*	-	1x30m	1x60m	1x90m	1x120m
1.* , ***1*.*, **11*.*	60	--	--	--	2x60m
2.* , ***2*.*, **22*.*	30	--	2x30m	***3x30m***	***4x30m***
3.* , ***3*.*, **33*.*	20	--	***3x20m***	***4x20m***	***6x20m***
4.* , ***4*.*, **44*.*	15	2x15m	***4x15m***	***6x15m***	8x15m
5.* , ***5*.*, **55*.*	12	--	***5x12m***	--	10x12m
6.* , ***6*.*, **66*.*	10	***3x10m***	***6x10m***	9x10m	12x10m
7.* , ***7*.*, **77*.*	8.55	--	7x8.55m	10x8.55m	14x8.55m
8.* , ***8*.*, **88*.*	7.5	***4x7.5m***	8x7.5m	12x7.5m	16x7.5m
9.* , ***9*.*, **99*.*	6	***5x6m***	9x6m	15x6m	20x6m

5.4.3.6.4 B(I)nning in the spectral direction

To request spectral binning, users can use the following codes within PROGTEMP:

Table 16 Spectral binning options available under the PROGTEMP scheme

I	Spectral binning
****1.*	1x
****2.*	2x
****4.*	4x
****9.*	custom

All other values are forbidden. Custom (9) spectral binning is not available to WEAVE science teams, and for all other cases must be agreed with ING in advance.

As an aside, we note that there is no facility to request spatial binning in WEAVE. Such a mode would compromise the spectral extraction performance and crosstalk characterisation within the L1 pipeline.

5.4.3.6.5 Duplicate this OB (X) times

This component is entirely optional – validation checks will not fail if there is no X value in the PROGTEMP. If a survey wishes to duplicate the observations of this target, then they can add the .X directive onto the end of the PROGTEMP code. This would result in the OB this target lives in being duplicated X times.

Furthermore, if users want to "chain" these cloned OBs together, such that the observation of one of these clones increases the chance that the remaining OBs in this group are observed, then a "+" can be added to the end of PROGTEMP.

The "+" instructs the WEAVE Scheduler to increase the (internal, survey-specific) weight of all OBs in this group. This provides a mechanism to ensure that once a series of observations are started, completion of the chain becomes a progressively higher priority above other OBs from this survey.

5.4.3.6.6 PROGTEMP examples

PROGTEMP = **11331**: MOS, LR, Red arm: 3x20mins, Blue arm: 3x20mins
PROGTEMP = **23331**: MOS, HR-Blue, Red arm: 6x20mins, Blue arm: 6x20mins
PROGTEMP = **32332**: MOS, HR-Green, Red arm: 5x18mins, Blue arm: 5x18mins, x2 spectral binning
PROGTEMP = **11331.4**: Observe this target in 4 identical OBs.
PROGTEMP = **11331.4+**: As above, but probabilistically link the OBs to maximise the chance this target is fully observed if started.
PROGTEMP = **23601**: MOS, HR-Blue, R:12x10mins, B:1x120m - FORBIDDEN
The red arm would incur a significant overhead readout penalty. The blue arm would complete long before the red arm.

5.4.3.7 OBSTEMP

Whilst PROGTEMP deals with “how” a target is observed, OBSTEMP deals with “when” a target is observed – namely setting the observational constraints required to optimally extract scientific information from the observation. We note that these constraints represent “worst-case” observing parameters – targets will be observed under these conditions or better. Observers should note that the probability of observing targets with highly restrictive OBSTEMP codes (e.g. “A***A”) may be quite low.

We describe the OBSTEMP code fully here, but again we refer registered users to the OBSTEMP form in WASP.

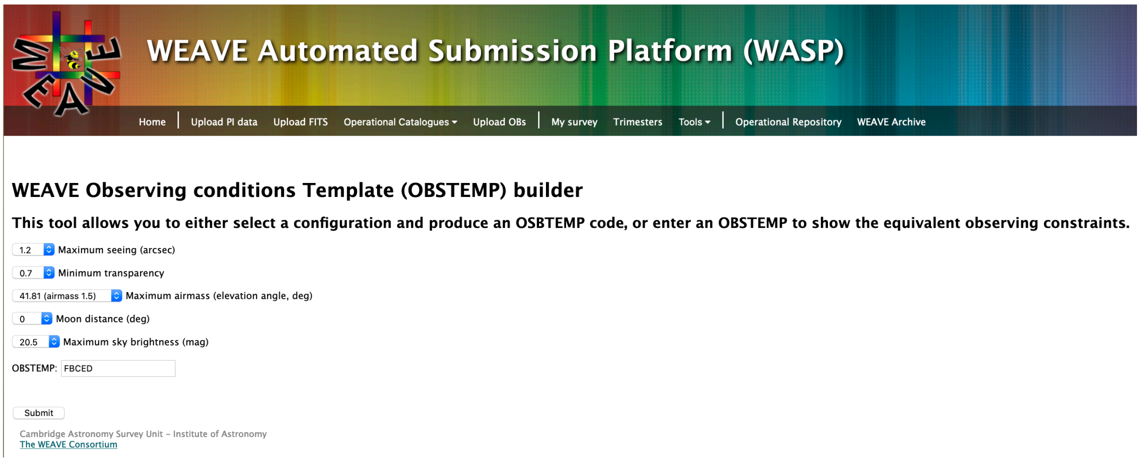


Figure 5 - The WASP's OBSTEMP tool. Users can select their desired observing constraints, and the tool will generate the corect OBSTEMP code. Alternatively, if users supply a code, the form will update to the corresponding constraints.

Within this form, users are able to select their desired observing conditions, and these will be translated into an OBSTEMP code. The mnemonic WEAVE uses for the OBSTEMP code is "STAMB":

OBSTEMP = "STAMB"

- **S** = (**S**)eeing
- **T** = (**T**)ransparency
- **A** = Elevation (**A**)ngle [(**A**)irmass]
- **M** = (**M**)oon distance
- **B** = Sky (**B**)rightness

Each of these components are divided into grades ("A", "B", "C", "D", "E"...) with "A" being the best. For input FITS catalogues, we require that the OBSTEMP be valid, as per the options detailed below. For the construction of XML OBs, the values entered into the [AD18] <obsconstraints> element must:

1. Match the values derived from the following tables for each OBSTEMP component.
2. Correspond to the OBSTEMP code written into the [AD18] <observation> element.

As per [AD20], the discrete values for each component are provided in digital form via the *obstemp.dat* lookup table. A tool to build an OBSTEMP is in the WASP (http://wasp.ast.cam.ac.uk/obstemp).

In some instances, there are potential clashes between competing constraints (e.g. selecting a small moon-distance, but also stipulating a dark sky). WASP will warn users of these clashes.

Unlike PROGTEMP, targets with different OBSTEMP can in principle share the same OB. However, the constraints of the most stringent observation must be applied (permitting, for example, observation of a bright-time target in dark-time, but not vice-versa).

We now detail the individual components of the OBSTEMP code.

5.4.3.7.1 (S)eeing

This grade sets the maximum seeing (as evaluated by the ING) required to successfully observe the target.

Table 17 Seeing options available under the OBSTEMP scheme

S	Max seeing (arcsec)		S	Max seeing (arcsec)
A____	0.7		M____	1.9
B____	0.8		N____	2.0
C____	0.9		O____	2.1
D____	1.0		P____	2.2
E____	1.1		Q____	2.3
F____	1.2		R____	2.4
G____	1.3		S____	2.5
H____	1.4		T____	2.6
I____	1.5		U____	2.7
J____	1.6		V____	2.8
K____	1.7		W____	2.9
L____	1.8		X____	3.0

General guidance for MOS observers is to request seeing not much worse than the diameter of the fibres (1.3”). mIFU and LIFU observations are more tolerant of poorer seeing. During winter nights, the seeing is worse than 1.3” on a substantial fraction of the nights[4]. An instrument-level limit of seeing <3” is adopted due to degradation of guiding quality in poorer seeing.

5.4.3.7.2 Sky (T)ransparency

This component defines the minimum transparency (as defined by ING) required for the observation.

Table 18 Sky transparency options available under the OBSTEMP scheme

T	Minimum Transparency
_A___	0.8
_B___	0.7
_C___	0.6
_D___	0.5
_E___	0.4

[4] http://www.ing.iac.es/astronomy/observing/conditions/#seeing

In the absence of cloud and Saharan dust, the V-band transparency (i.e. the fraction of top-of-the-atmosphere light reaching the WHT) is ~ 0.88, and likely scales as (0.88)^airmass (i.e. T ~ 0.83 at airmass 1.5, T~ 0.77 at airmass 2).

Extinction due to Saharan dust rarely exceeds a few tenths of a magnitude (i.e. reduces transparency by <~ a few tenths) and varies little with position on the sky. Thin cloud, reducing transparency by a few tenths, can be patchy, so only an all-sky average can be predicted (based on the guide-star signal from previous observations).

A survey-wide limit on transparency (T > 0.4) is adopted to avoid various performance degradations such as guidance on attenuated guide stars, delivery of science data with significantly reduced SNR and increased risk of precipitation on the telescope optics.

5.4.3.7.3 Elevation (A)ngle [(A)irmass]

Users may set the minimum elevation angle (and thus airmass) that their targets should be observed with.

Table 19 Elevation angle / airmass options available under the OBSTEMP scheme

A	Minimum Elevation (deg)	Airmass
__A__	50.28	1.3
__B__	45.58	1.4
__C__	41.81	1.5
__D__	35.68	1.6
__E__	33.75	1.8
__F__	25.00	2.4

An instrument-wide limit of airmass < 3 will be set due to several effects degrading the quality of data at higher airmass: increasing differential refraction; higher extinction; worse light pollution.

5.4.3.7.4 (M)oon distance

Users may specify the minimum angular distance between the moon and the target. Observations under low moon distance may suffer from sky background light gradients across the field, as well as higher levels of reflected light causing spurious signals within the focal plane.

Table 20 Moon distance options available under the OBSTEMP scheme

M	Moon Distance (deg)
___A_	90
___B_	70
___C_	50
___D_	30
___E_	0 (no constraint)

An instrument-wide lower limit of 30 degrees ensures sky brightness gradients and scattered light effects are kept to a minimum. This limit applies to any observations set with “no constraint” (M=“E”).

5.4.3.7.5 Sky (B)rightness

The maximum V-band surface brightness of the sky (mag / sq. arcsec) required to observe the target.

Table 21 Sky brightness options available under the OBSTEMP scheme

B	Sky Brightness (V mag / sq arcsec)	
____A	21.7	
____B	21.5	Dark
____C	21.0	
____D	20.5	
____E	19.6	Grey
____F	18.5	Bright
____G	17.7	

The dark-of-moon sky brightness varies by a few tenths of a mag depending on ecliptic and galactic latitude and phase of the solar cycle.

With the moon up, the sky can be up to ~4 mag brighter than dark-of-moon, depending on lunar phase, elevation and angular distance from the target: these are therefore only rough characterisations in the above table.

The sky brightness for any phase of the moon, and anywhere on the sky, can be predicted with accuracy ~20%.

Science observations are carried out mainly during astronomical night, but those OBs tolerating moonlit skies can also use the latest bit of evening twilight, or the earliest bit of morning twilight – the only relevant criterion is sky surface brightness. No observations will be carried out when the sky brightness exceeds that at full moon.

5.4.3.8 Gaia Specific Columns

All input targets must be on the Gaia Reference Frame. WEAVE currently accepts either Gaia DR2 or DR3 data with reference epoch as 2015.5 or 2016.0 respectively[5]. Thus in the catalogue binary table, GAIA_DR= ‘2’ or ‘3’ (do not include ‘DR’ in the string) and GAIA_EPOCH= 2015.5 or 2016.0 respectively. These two columns MUST be filled regardless of whether or not the object has been detected by Gaia..

We note that, with the release of Gaia DR3 before the start of WEAVE commissioning, we strongly urge observers to use the DR3 reference epoch for WEAVE targets.

[5] See https://www.cosmos.esa.int/web/gaia/earlydr3#datamodel

Objects that are NOT detected by Gaia MUST have their coordinates converted onto the Gaia Reference Frame (DR2 or DR3) to ensure all fibres are placed correctly. It is the responsibility of the observer to verify that their provided coordinates are both consistent with the ICRS and internally consistent within a configured field to within a few mas. Further details can be found in [AD18], as well as the Gaia DR2 astrometric paper[6].

If any Gaia information relating to parallax, proper motion and photometry in the G, BP and RP bands is available for a target then it must be included. This is because the more information the better for successful and optimal observations and spectral processing. Parallax and proper motions are particularly important for construction of the WEAVE CNAME, to ensure that successive observations (with varying separation in time) of the same target are correctly attributed to the same CNAME.

Information from Gaia is expected to be provided exactly as it is retrieved from the Gaia archive, so parameter definitions, data formats and units remain the same. Please consult the Gaia webpages[7] to further understand their data model.

The Gaia magnitudes are currently provided on the Vega system. Please report them in the GAIA_MAG columns as Vega. All other photometry sources must be reported on the AB system.

5.4.3.9 **IFU Specific Columns**

There are three columns used to specify IFU observations. Due to the complex nature of the IFU observation preparation workflow[8], we refer users to the documentation therein, but summarise the parameters here. MOS users should set IFU_SPAXEL to an empty string (‘’), IFU_PA to 0.0 and IFU_DITHER to 0 for all MOS targets.

IFU_SPAXEL provides an identifier that allows identification of the fibre within the IFU array, and consequently where it contributes to the construction of the data cube. The mapping between fibre and IFU_SPAXEL is determined by two lookup tables within the WEAVE Data model. In the case of the mIFU, IFU_SPAXEL also describes which bundle the fibre belongs to. These values are typically filled out by the IFU workflow software. Users wishing to populate these manually are referred to the *LIFUfibreTable.dat* and *mIFUfibreTable.dat* files under the WEAVE Data model hosted at the Operational Repository.

IFU_PA allows the catalogue provider to specify a rotation angle of the LIFU (not mIFU) if required. The default value is zero. Rotation is generally used in cases where the default PA results in no viable guide stars falling within the autoguider FOV or when the rotation during an exposure is likely to exceed the angular limits of the rotator. Any dithering requested for the field is applied to the rotated LIFU frame. During the IFU observation preparation workflow, an analysis is performed on putative LIFU pointings to determine if a rotation is required and provides the optimal value IFU_PA should take. Fibres within the same LIFU pointing must have the same IFU_PA.

[6] https://ui.adsabs.harvard.edu/abs/2018A%26A...616A...2L%2F
[7] https://gea.esac.esa.int/archive/documentation/GDR2/Gaia_archive/chap_datamodel/sec_dm_main_tables/ssec_dm_gaia_source.html
[8] https://ingbitbucket.ing.iac.es/projects/WVSWG/repos/ifu/browse/workflow

IFU_DITHER allows the user to specify the dithering strategy for their observations. LIFU observations may use a custom dither pattern. This should be reflected in the positions of LIFU fibres sharing common TARGNAME and TARGID within the input FITS catalogue, as described in Section 5.4.3.2. This mode is not available for mIFU observations. IFU users may alternatively request not to dither their observations, with the understanding that this will not provide full spatial coverage of their requested field. Finally, users may request the preset 3,4,5 and 6-dither patterns. We refer users to the *configure.cfg* file that is used by the Configure fibre allocation tool for the dither patterns adopted under these presets. A copy of this file is available under the WEAVE Data Model hosted at the Operational Repository.

Table 22 Dither modes available for IFU observations

Dither code	Description	Allowed modes		Dither pattern (coordinates given in arcsec)						
-1	Custom dither	LIFU		Defined by users via the RA and Dec of each position, as described in the OB <field> element (Section)						
0	No dither	MOS	LIFU	x	0.0000					
				y	0.0000					
			mIFU	x	0.0000					
				y	0.0000					
3	3-dither preset	LIFU		x	0.0000	-1.9494	-0.9747			
				y	0.0000	0.0000	-1.6882			
		mIFU		x	0.0000	0.0000	-0.9208			
				y	0.0000	1.0632	0.5316			
4	4-dither preset	LIFU		x	0.0000	-1.9494	-0.9747	-0.9747		
				y	0.0000	0.0000	-1.6882	1.6882		
		mIFU		x	0.0000	0.0000	-0.9208	0.9208		
				y	0.0000	1.0632	0.5316	0.5316		
5	5-dither preset	LIFU		x	0.0000	-1.9494	-0.9747	-0.9747	0.9747	
				y	0.0000	0.0000	-1.6882	1.6882	1.6882	
		mIFU		x	0.0000	0.0000	-0.9208	0.9208	0.9208	
				y	0.0000	1.0632	0.5316	0.5316	-0.5316	
6	6-dither (3 and -3 combined)	LIFU		x	0.0000	-1.9494	-0.9747	-0.9747	0.9747	-2.9240
				y	0.0000	0.0000	-1.6882	1.6882	1.6882	1.6882
		mIFU		x	0.0000	0.0000	-0.9208	0.9208	0.9208	0.0000
				y	0.0000	1.0632	0.5316	0.5316	-0.5316	-1.0632
-3	3-dither alt preset	LIFU		x	-0.9747	0.9747	-2.9240			
				y	1.6882	1.6882	1.6882			
		mIFU		x	0.9208	0.9208	0.0000			
				y	0.5316	-0.5316	-1.0632			

For custom dither patterns, constraints on the dither step size are imposed by the WASP to ensure that the guide star remains within the GuideCam field of view.

From the perspective of IFU users, careful consideration of the dithering options should be made.

This is especially true of mIFU observations, where the bundle rotation angle (which cannot be set by the user) impacts the filling factor of the reconstructed image. Furthermore, selection of certain dither patterns with the mIFU implies in some cases the White Dwarf calibration star will not lie within any of the fibres of the calibration bundle fibres. Whilst the 4-dither pattern is safe from this effect, other carefully constructed custom dither patterns should be check to ensure the WD can be observed.

It is worth noting that the -3 dither modes do not contain a null offset exposure, which means that the calibration bundles will not contain any exposure with a calibration star centred in its central fibre.

One important difference between LIFU and mIFU observations is the following: The LIFU preset patterns will be properly rotated according to the position angle of the observation; nevertheless, this will not happen in the mIFU observations (because in this case there will be a different position angle for each mIFU bundel and so makes no sense).

In Appendix C, we represent the pre-set patterns and their weight maps.

5.4.3.10 APS Specific Columns

The keywords with prefix APS_ are input parameters that APS will automatically read and adjust the values of corresponding modules in the APS processing. NULL values for any column correspond to the default values for the APS processing. If the default APS processing is preferred, then the TARGSRVY should leave these columns alone.

Table 23 Default Parameters for APS inputs

TTYPE	TTYPE comment	Default value	Options	TUCD	TUNIT	TLMIN	TLMAX
APS_WL_MIN	Min observed wavelength considered	Minimum available		em.wl	Angstrom	0	--
APS_WL_MAX	Max observed wavelength considered	Maximum available		em.wl	Angstrom	0	--
APS_Z	Redshift of system (heliocentric corrected)	0.0		src.redshift	--	--	--
APS_SIGMA	Initial guess of velocity dispersion	200.0		phys.veloc.dispersion	km/s	0	--
APS_TEMPL_LIB	Library of spectral templates	"XSL"		stat.fit.param	--	--	--
APS_TEMPL_LIB_NORM	Normalise spectral template library	0	0="LIGHT" 1="MASS"	meta.code	--	0	1
APS_PPXF_WL_MIN	Min rest-frame wavelength for use by pPXF	Minimum available		em.wl	Angstrom	0	--
APS_PPXF_WL_MAX	Max rest-frame wavelength for use by pPXF	Maximum available		em.wl	Angstrom	0	--
APS_PPXF_MOM	No. of kinematic moments to be extracted	4		stat.fit.dof	--	0	--
APS_PPXF_DEG_ADD	Deg. of additive Legendre polynomial Set to -1 not to include any additive polynomial	-1		stat.fit.dof	--	0	--
APS_PPXF_DEG_MULT	Deg. of multiplicative Legendre polynomial	4		stat.fit.dof	--	0	--
APS_PPXF_NUM_MC	No. of MC simulations to extract pPXF errors	0		meta.code.multip	--	0	--
APS_GAND_MODE	Run GANDALF to extract emission-line kinematics	1	0=skip GANDALF 1=run normal procedure; 2=run other procedure	meta.code	--	0	2
APS_GAND_ERR	Derive errors on emission-line analysis	1	0= no error; 1=normal procedure	meta.code	--	0	1
APS_GAND_RED1	Initial estimate for reddening by dust	0.0		meta.code	--	0	1
APS_GAND_RED2	Second estimate for reddening by dust	0.0		meta.code	--	0	1
APS_GAND_EBV	De-redden spectra for galactic extinction	0	0=do not de-redden; 1=deredden using RED1, RED2 above	meta.code	--	0	1
APS_LS_MODE	Extract indices and convert them to SSP prop. Note: mode 2 is only available as an extra feature (e.g. for CS developers), not available for the main APS analysis	1	1=perform normal extraction; 2=perform extra process (CS only)	meta.code	--	0	1
APS_LS_RES	Spectral resolution (FWHM) of index measrmnt	Nominal spectral resolution		spect.resolution	Angstrom	0	1000

TTYPE	TTYPE comment	Default value	Options	TUCD	TUNIT	TLMIN	TLMAX
APS_LS_NUM_MC	No. of MC simulations to extract errors	30		meta.code.multip	--	0	--
APS_SSP_NUM_WLKR	No. of walkers for the SP MCMC algorithm	100		meta.code.multip	--	0	--
APS_SSP_NUM_CHAIN	No. of iterations in the SP MCMC algorithm	1000		meta.code.multip	--	0	--
APS_IFU_MASK	Mask this fibre in IFU analysis	0	0=no mask; 1=mask	meta.code	--	0	1
APS_IFU_TSSL_TYPE	Type of spatial binning for data	"VORONOI"		meta.code	--	--	--
APS_IFU_TSSL_TARG_SNR	Target SNR per pix for spat. bin.	40.0		stat.snr	--	--	--
APS_IFU_TSSL_MIN_SNR	Min SNR per pix for spat. bin.	2.0		stat.snr	--	--	--
APS_IFU_TSSL_COVAR	Correct for spatial correlations	0	0=don't correct; 1=correct	meta.code	--	0	1
APS_IFU_SRC_ID	Identifier for sources within IFU mosaic	Null		meta.code	--	--	--
APS_IFU_SRC_RA	RA of centre of its IFU source	Null		pos.eq.ra	deg	0	360
APS_IFU_SRC_DEC	Dec of centre of its IFU source	Null		pos.eq.dec	deg	-90	90
APS_FLAG	Bit mask activating APS-CS-CDP modules	See Section 5.4.3.10.1		meta.code	--	--	--

5.4.3.10.1 APS_FLAG

APS_FLAG will be used to trigger the analysis of a target using a specific APS module or Contributed Software (CS) code. The flag will be as a bit mask where the length of the bit mask, N, is the number of core APS modules + CS modules. Each bit corresponds to a single APS module or CS module. When filling in APS_FLAG, for every position in the bitmask that is the digit 0, the corresponding APS/CS module is *not* activated. For every position in the bit mask that is the digit 1, the corresponding module is activated.

Users can “supplement” the default APS_FLAG for any TARGCLASS they specify by converting a 0 to 1. Users will not, however, be permitted to alter modules within the APS_FLAG from 1 to 0. In other words, where an APS_FLAG value is provided, it will override the TARGCLASS (though an APS_FLAG should be "additive" with respect to the TARGCLASS).

If the requested APS_FLAGs are inconsistent with the prediction of APS classifier (STAR/GALAXY/QSO) all APS/CS modules set by APS_FLAGs, as well as the default set of modules for that specific class of target (evaluated by APS classifier) will be activated as a precautionary measure. For Unknown sources (e.g. community surveys), APS will only run the default basic core APS modules.

In some cases, some modifications will be applied to the final APS_FLAG by the core APS system:

1. If running a CS module depends on an APS (main) module, APS will run that specific APS module regardless of the status of its APS_FLAG set by the user.

2. If a target is shared among two or more surveys, APS will apply the union of APS FLAGs set by different surveys.

Table 24 provides the default bitmask for each APS/CS module under the different TARGCLASS values. In case no APS_FLAG is provided, the APS core system will adopt the bit mask associated with the TARGCLASS value provided in this table.

Table 24 APS_FLAG Bitmask Definition

		Classifier				APS stellar modules								APS extragalactic modules								Contributed Software							
TARGCLASS	**Definition**	REDROCK	RESV1	RESV2	RESV3	RVSPECFIT (RV)	RVSPECFIT (ATMOS)	FERRE	RESV4	RESV5	RESV6	RESV7	RESV8	AT	PPXF	GANDALF	LS (LINE INDICES)	RESV9	RESV10	RESV11	RESV12	ALFA-NEAT	FESWI	SPAce	SQUEEZE	AMY	SAPP	RRLGV	RRLEW
GALAXY	Galaxy	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
MASK	Mask	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NEBULA	Nebula	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
QSO	Quasar	1	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0
SKY	Sky	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
STAR	Star	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
STAR_BHB	Blue Horizontal Branch	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
STAR_CEP	Cepheids	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
STAR_EM	Emission line star	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STAR_EMP	Extremely Metal Poor	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
STAR_FGK	FGK Spectral Type	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
STAR_IB	Interacting Binary	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STAR_MLT	MLT Spectral Types	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
STAR_MLUM	Luminous M star	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
STAR_OB	OB Spectral Type	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STAR_BA	BA Spectral Type	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
STAR_RRL	RR Lyrae	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1
STAR_VAR	Variable star	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STAR_WD	White Dwarf	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STAR_YSO	Young Stellar Object	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
UNKNOWN	Unknown	1	0	0	0	1	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0

5.4.3.11 **MAG_G, MAG_R, and MAG_I**

These columns were originally designed to report the SDSS *g*, *r* and *i* band photometry for CPS to use in the spectral processing and quality control checks.

However, SDSS photometry is either not necessarily available for every target or is not the preferred photometry for all surveys. Therefore these can be filled with alternate photometry provided they meet the following conditions:

1. UNCORRECTED for extinction
2. SDSS-like on the AB system
   a. Equivalent to the Gunn filters (e.g. PS1 filters, CFHT MegaPrime or MegaCam filters) but not the SDSS Fiber Magnitudes (wrong size fibres).
   b. Assumed below atmosphere at airmass of ~1.3 (canonical SDSS)
3. Also specified in TARGSRVY catalogue as **Survey-Specific columns** (see Section 5.4.5).

Ideally this is the photometry used as the basis for target selection, but this is not a formal requirement.

Therefore the preferred photometry that is reported in MAG_G, MAG_R and MAG_I should be included also as Survey-Specific columns where SDSS-like on the AB System is the main column.

Warning 1: if photometry is calibrated to Vega and/or corrected for extinction, and then passed into the MAG_G, MAG_I or MAG_R columns, the fibre throughput estimates in Quick-Look and L1 processing will be incorrectly reported. This may impact WEAVE observations during the night, as the On-Island Survey Management Team may waste time assessing the scientific viability of an OB based on incorrect assumptions.

Warning 2: If you are only using Gaia photometry (G, BP, RP) please only fill the GAIA_MAG_GG, GAIA_MAG_BP, GAIA_MAG_RP columns. Do not convert the Gaia photometry to then also fill MAG_G, MAG_R, MAG_I. The Gaia columns are not Survey-Specific columns. Please provide all three Gaia magnitudes where possible. G+BP+RP is optimal, BP+RP is better than only G, but only G is better than nothing.

Warning 3: The WASP will report warnings if you do not fill any of the mandatory photometry columns (MAG_G, MAG_R, MAG_I, GAIA_MAG_GG, GAIA_MAG_BP, GAIA_MAG_RP). Your catalogue will not be rejected by the WASP but you will be warned that your data will not be processed optimally. Please make all effort to provide useful photometry as specified above in some or all of these columns.

5.4.4 Target Uniqueness

The PROGTEMP and OBSTEMP columns in the binary table provide the observing programme and the observing conditions respectively per target.

WASP validation prevents the submission of multiple instances of the same target in the same catalogue, where the definition of "same" is defined below. This does not prevent users from using the same row entry in the FITS catalogue and passing through multiple OBs. To observe the same target in the same fibre configuration multiple times please change the PROGTEMP ".X(+)" component as per Section 5.4.3.6.

The same target within a catalogue can be observed with a different PROGTEMP and OBSTEMP, e.g. as Low Resolution (LR) and High Resolution (HR), and so the same target can appear multiple times within a single catalogue.

For MOS targets, the uniqueness of a row in the catalogue is set by a combination of:

- TARGID+PROGTEMP+OBSTEMP.

For IFU targets, this depends also on whether it is LIFU or mIFU. For the LIFU, the uniqueness combination is

- PROGTEMP+OBSTEMP+TARGNAME+TARGID+IFU_PA+IFU_SPAXEL+IFU_DITHER

For mIFU it is

- PROGTEMP+OBSTEMP+TARGID+IFU_PA+IFU_SPAXEL+IFU_DITHER

See also Section 5.4.3.1 for usage of TARGID and TARGNAME for MOS and IFU.

5.4.5 Survey-Specific Columns

These columns will generally vary between the surveys. In compiling the list of Survey-Specific columns the following guidelines were considered:

1. Columns used for target selection of the survey targets, such that the selection function can be reproduced in WAS;
2. Columns providing photometry by default must the AB system.
3. Columns of ancillary data for use within the limits and tools provided by WAS.

The catalogue template per survey is defined and fixed within this ICD as part of the version controlled WEAVE Data Model. Changes to the catalogue templates can only be made via a format change request (see [AD20] for further details).

For PI Surveys we provide a tool through the WASP (see Section 8) to generate fits catalogue templates from the predefined list of Survey-Specific columns (see appendix)

The requirements of the surveys and the archive teams were balanced in each case.

5.4.5.1 FITS Binary Table Keywords per Survey -Specific Column

Key information per column is needed for that column to be included in the Binary Table of the FITS template. The standard use of these is described in Section 5.4.1 but in summary the information is as shown in Table 25.

Table 25 Binary Table Keywords – Survey -Specific Columns

Keyword	Description/Usage

TTYPE	Name of column. See Section 5.4.1.1. Survey-Specific column names should follow standard scheme with these rules: • Upper case names only • Delimiter if needed is the underscore '_' • Photometry names constructed as 'CAT_MAG_X' & 'CAT_MAG_X_ERR', where CAT is general or a specific catalogue name, and X is the letter or number of specific pass band as per SPA column scheme for SDSS and Gaia above.
TFORM	Data format – A=string, E=floating point, D=double precision, I=integer. See Section 5.4.1.2.
TUNIT	Measurement unit of column value. Not present if no units needed. See Section 5.4.1.3.
TNULL	Value which FITS interprets as NULL. Empty string {''} for strings, floating point NULL (NaN) for real, and -1 for positive integer. See Section 5.4.1.4.
TLMIN, TLMAX (Data Range)	Range of expected values: alphanumeric, real, positive real, integer, positive integer. Assumes (-inf,inf) or (0,inf). If range is more restricted than infinity then include (min:max) for restrictions. See Section 5.4.1.6.
TPROP (Proprietary)	If column should be restricted access in WAS due to MOU with external organisation use '1', otherwise '0'. See Section 5.4.1.5.
TDISP	Precision of value for checking and display. See Section 5.4.1.7.
TUCD	Unified content descriptor. See summary in Section 5.4.1.8.

As an example, key information for the SPA columns is provided Table 31.

5.4.5.2 Column Naming Scheme

Columns from photometric catalogues other than SDSS and Gaia that are included by a TARGSRVY should be correctly referenced in the FITS file. The full list of available columns is provided in (Appendix A - Table 31).

There are two schemes to include these data, each of which needs to use a specific format for column naming:

1. Single catalogue named explicitly in the column name as for Gaia.

   This table provides the generic set of four columns, where <> is replaced by the catalogue name and X is the associated pass band(s).

Table 26 Column Name Set for specific Photometric Source Catalogue

TTYPE	TTYPE Comment	Notes
<>_ID	Target Identifier of the X,Y,Z bands	For example, for Pan-STARRS the naming used already is PS_ID etc
<>_DR	Data release of <>_ID	
<>_MAG_X	<> magnitude in X band.	Repeat for each associated band.
<>_MAG_X_ERR	Error on <>_MAG_X	Repeat for each associated band.

   Examples used so far include: Pan-STARRS = PS, JPAS=JPAS, IGAPS=IGAPS, VPHAS=VPHAS. Please consult the full list in Table 31.

2. Multiple catalogues are used for the same photometric bands

This table provides the generic set of five column where == refers to the type of photometry e.g. NIR, OPT ..., and X is the associated pass band(s).

Table 27 Column Name Set for generic Photometric Source Catalogue

TTYPE	TTYPE Comment	Notes
==CAT	Catalogue associated with the X,Y,Z bands	For instance, if using the J,H,K bands of either 2MASS or UKIDSS, then the column name would be NIRCAT for Near Infra-Red Catalogues.
==CAT_ID	Target Identifier associated with ==CAT	
==CAT_DR	Data release of ==CAT_ID	
==CAT_MAG_X	Magnitude in the X band for ==CAT_ID	Repeat for each associated band
==CAT_MAG_X_ERR	Error on ==CAT_MAG_X	Repeat for each associated band

Examples used so far are IRCAT for IRAC1, IRAC2, IRAC3, IRAC4; NIRCAT for Y, J, H, K, Ks bands; OPTCAT for U, B, V, R, I, u, g, i, r, z, y bands.

For OPTCAT, this means that U can be either U or u, R can be R or r, I can be I or i.

The current set of all Survey-Specific columns based on the current versions of the TARGSRVY catalogue templates are listed in Table 31. Open-time observers can inspect a thematically grouped list of columns under the WASP's Template Builder tool (Section 8.1).

All column names have been consolidated and made consistent between surveys.

3. Additional columns that may also be present are:

- _FLAG for flag columns,
- _MAG_X_AX for photometry in the X band corrected for extinction

5.4.5.3 Which Photometric System can I use: AB or Vega?

All the photometric columns are assumed by default to be on the AB-system.

The only exceptions are the Gaia magnitudes in the SPA columns (GAIA_MAG_G, GAIA_MAG_BP, GAIA_MAG_RP) as these are provided in the Gaia Archive as calibrated to Vega. Do NOT convert the Gaia magnitudes to the AB-system.

The final set of photometric columns as defined by the TARGSRVYs does not include any photometric columns specifically for Vega. Please convert all photometry to the AB-system.

5.4.5.4 Tracking the source data for MAG_G, MAG_R, MAG_I

To record which **Survey-Specific** columns were used to fill MAG_G, MAG_R and/or MAG_I, three keywords are required in the Primary Header (MAG_G_CM, MAG_R_CM, MAG_I_CM). See the Primary Header section above for further instructions.

The columns listed in the Primary Header keywords much be entered with these two criteria:

1. Must match a **Survey-Specific** column present in the catalogue AND
2. Must be an SDSS-like on the AB system column

If multiple source columns are listed then used the pipe '|' as the delimiter.

If the source photometry in the **Survey-Specific** column that you want used by SPA is corrected for extinction and you have provided the extinction correction in the EBVCAT columns, you can combine these in the MAG_<G,R,I>_CM keyword to indicate that the two are applied together to supply the SPA-required extinction UNCORRECTED photometry.

For example, if you've put extinction-corrected photometry in OPTCAT_MAG_G and you've put the extinction correction in EBVCAT, then MAG_G_CM = `OPTCAT_MAG_G|EBVCAT_EBV' and MAG_G must then contain the extinction UNCORRECTED G band magnitude in the SDSS-like AB system.

5.4.5.5 Why provide these MAG_G, MAG_R, MAG_I columns?

Why is it important to do this?

1. MAG_G, MAG_R and MAG_I values will be used by CPS to monitor the throughput of the fibres, i.e. to test that the signal received is the signal expected.
2. MAG_G, MAG_R and MAG_I values are necessary to perform the best possible flux calibration
3. MAG_G, MAG_R and MAG_I values will be used to monitor positioning of the fibres to test they are being accurately placed.

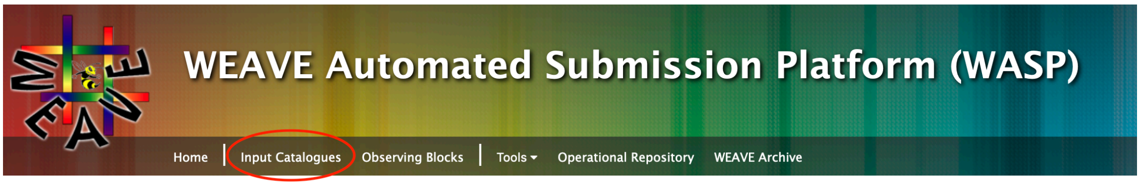
In summary, MAG_G, MAG_R and MAG_I values are critical within the data flow to carry out quality control and optimal spectral extraction. This will ensure that surveys get the best observations and data products possible of their targets. Without these values properly set on the SDSS-like AB system, the quality of the reduced data cannot be guaranteed.

5.5 Submission of catalogues to WASP

One of the primary roles of the WASP is to act as a validation platform for users to submit FITS catalogues that will be checked against the WEAVE data model. Users must have a user account in WASP to permit upload of their test products to the platform.

WASP accounts operate on a per-TARGSRVY basis. If users have been delegated responsibility within their WEAVE science team for the submission of FITS catalogues, then they should request WASP access from their STL. Open-time PI surveys will have accounts automatically generated once time allocation information is sent from the ING to CASU – an email will be sent providing authentication details.

Once logged in, users can select "Input Catalogues" from the top menu bar:



This provides them with a form that allows for the upload of a FITS file:

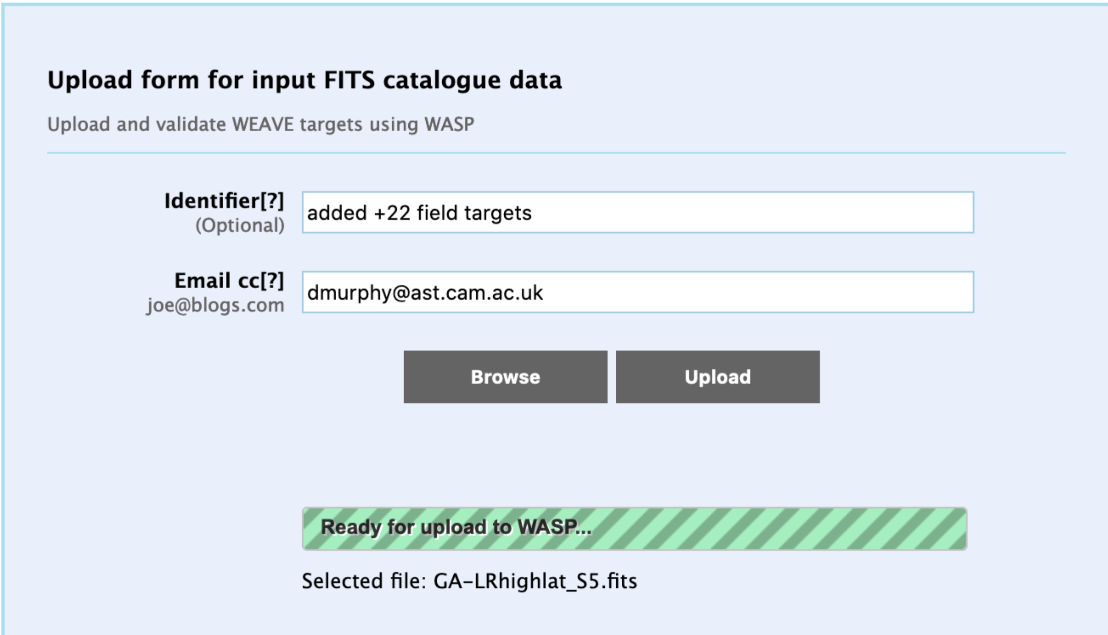


Figure 6 - The WASP FITS catalogue upload form.

Users can add a short optional description for their submission, as well as provide an additional email address where the validation report will be sent.

Click "Browse" to choose the file, and then Upload. Users will then be taken to the processing screen, where they can see the status of their submission.

There are two modes of operation for FITS catalogue submission. At all times, the WASP will provide a "test channel" that allows users to submit putative WEAVE catalogues for validation. These will not be stored in the system but will allow users to build catalogues and test them periodically to ensure they still conform to the required standards. The test channel allows users to select the observing trimester they want to test against.

Once validation is complete, if successful, users can download the validated catalogue with CNAMES added to the targets. This catalogue can be used as the basis for the creation of XML Observing Blocks based on the specification laid out in [AD18] and using the base XML template available from the Data Model hosted on the Operational Repository.

5.5.1 Irregularly submitted catalogues

In the case of Operational Catalogues (ASTRO-CALIB, WD, WG, ING-SYSCAT), the WASP does not expect submissions for each trimester. This is because these catalogues provide a static list of targets that are used in calibration, guidance and WHT observing routines.

Within the WASP, we identify the TARGSRVYs associated with these catalogues as *irregular* surveys. The assigned owners of these catalogues will therefore not receive the regular notifications and emails from WASP to prepare materials leading up to observation of an upcoming trimester.

When irregular surveys need to be updated, the owners should contact CASU to arrange for submission of new data products. Depending on the case, this may involve validation outside of the WASP environment, so sufficient lead time should be provided to ensure updates can be made in good time. Furthermore, these updates should consider the community use of these catalogues to ensure end-users are best served with the appropriate data.

5.5.2 Carryover Open-Time catalogues

In some instances, open-time proposals are awarded time spanning multiple observing trimesters. Within WASP, we define these as *carryover* surveys. Carryover surveys are assigned a TARGSRVY in the same manner as before (5.2.2), and this TARGSRVY remains with them throughout the programme. The trimester identifier in a carryover survey's TARSRVY *refers to the first trimester they will observe in*, not the current trimester.

Carryover surveys must define their FITS catalogue template in their first trimester. This template *cannot* be changed for subsequent trimesters. When the WASP switches operations to the next trimester, PIs of carryover surveys will receive a notification that their FITS catalogue template has been carried over from the previous trimester.

Carryover survey PIs will then upload targets for the new trimester using the same catalogue filename as

For example, a survey has been awarded time extending over semester 2024A (ie. Trimesters 2024A1, 2024A2). WASP expects the following:

Trimester 2024A1
TARGSRVY: WS2024A1-001
FITS catalogue template: WS2024A1-001_CatalogueTemplate.fits
Target FITS catalogue: WS2024A1-001.fits
XML files: user-defined

Trimester 2024A2
TARGSRVY: WS2024A1-001
FITS catalogue template: WS2024A1-001_CatalogueTemplate.fits (carried over from 2024A1)
Target FITS catalogue: WS2024A1-001.fits (the same filename as for 2024A1)
XML files: user-defined

Carryover surveys may use the WASP test channel for validation in the same way other users do, meaning the above survey can test validation of their 2024A2 targets during 2024A1.

6 WASP → SURVEY SCIENCE TEAMS

The WASP will test a submitted input FITS catalogue file against the standards and restrictions detailed within this document, perform certain logic checks (e.g. "are there 603 LIFU fibre entries in this field?") and ensure that the submitted values fall within expected numerical ranges (e.g. "does the target RA lie between 0 and 360 degrees?").

The *FITSChecker* module within the WASP will compile a report indicating, where relevant, warnings and failures. Submissions that return failures (designated in the report as INVALID) will not have passed WASP validation – the errors must be addressed and the file re-submitted. Upon upload of the FITS file to the WASP, the user will be redirected to a status page that provides a real-time update on the validation process.

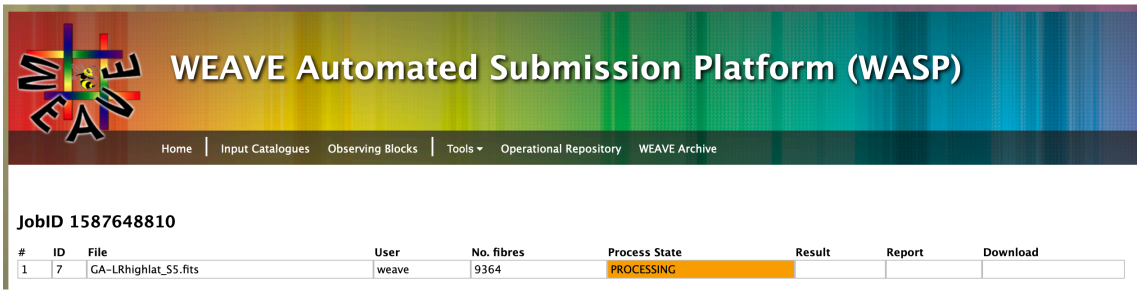


Figure 7 - Validation status of a FITS catalogue submission to the WASP. This upload is currently being processed by the FITSChecker.

In addition to this per-submission status page, users can find their previous submissions under the "Submission Management" option in the user drop-down menu on the right-hand side of the menu bar. The WASP validation outcome for each submission will also be emailed to the email address registered to the WASP account, the email in the header of the FITS file (if this differs), in addition to addresses defined in the "Email cc" field in the upload form.

Upon successful validation, a new copy of the catalogue is generated by the WASP. This new catalogue will feature:

1. Updated timestamps
2. CHECKSUM and DATASUM values for both the PHU and table HDU
3. CNAMES for each target provided

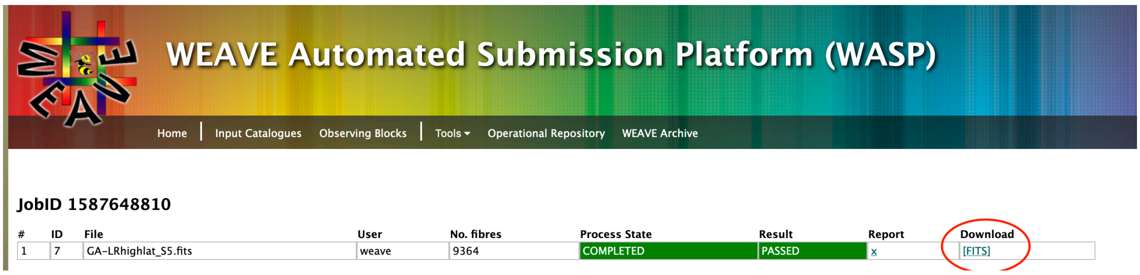


Figure 8 - Once the validation process has completed, the outcome will be displayed in the results table. Users may then download the CNAME'd version of the catalogue (downloads are not available for test-channel submissions)

Under the submission status screen, users are provided with the option to view the WASP validation report or download the updated FITS catalogue file. If the submission has been made outside of the test channel, users will also be able to designate this submission as their chosen catalogue for the trimester.

As the deadline for FITS catalogue submission deadline approaches, the WASP will warn users (by email, and by notification within the WASP interface) if no valid FITS catalogue has been submitted or no designation has been made for a given trimester. Under these circumstances:

1. If only one successful submission is made to the WASP at point of deadline, this shall be used as the TARGSRVY submission.
2. If multiple submissions have been made to the WASP, but none designated for the trimester, WASP will use the latest submission (and warn in advance that it will do so).
3. If no submission has been made, it will provide a final warning 24 hours prior to the deadline, copied to the (D)PS. In some instances, science teams purposely will not submit catalogues for a given trimester. They will, however, receive these warnings.

If no valid submission has been made by the WASP catalogue submission deadline, then no further submissions will be accepted without written permission from the Science Executive (which will only be granted in exceptional circumstances).

6.1.1 Access to validated product

DM: TO-DO

7 SWG / PI SURVEYS → WASP

This section details the interface between the Survey Working Group (SWG) or Open-time PI surveys and the WASP. This involves the submission of XML-based Observing Blocks (OBs). The WASP acts as a validation layer between the science teams / observers and the Observatory Control System (OCS). To ensure that WEAVE Observing Blocks do not contain errors that would prevent correct use of the instrument, the WASP performs a series of checks along similar lines to those performed on the input FITS Catalogues [ref].

Individual Observing Blocks define:

1. How: the instrumental setup requested for the observation
2. When: the conditions requested to observe under
3. What: information about the target(s) required to position fibres etc

Within the context of the overall dataflow, Observing Blocks are derived from information in the input FITS catalogue. They are built from the base "BlankXMLTemplate.xml" file, with data added by the "Configure" fibre configuration utility. Additional information must be added to the XML for it to be sufficient for WEAVE Observations. In some cases (e.g. the IFU workflow system), this information is added for you. In other cases, you must add this information either manually, or via the use of tools developed by the SWG.

We refer users to the manual for Configure, as well as [AD18] (where available) and the base XML template. The latter two are available at the WEAVE Data Model page for selected users in the Operational Repository.

In this section we will refer entirely to the XML template file and describe the content users should fill in. Those not familiar with XML should note that the names of elements (<**element**>) and attributes (<element **attribute**="apple">) are case-sensitive and must be exactly as shown in this document. In XML, attributes are order-independent. Within this document (with the exception of a few cases), we list the attributes in alphabetical order to aid location of these for reference purposes.

N.B. XML comments (anything delimitated by <!-- and --!>) are not formally part of the XML content and may be removed at the whim of an XML parser so should not be used for anything that needs to be preserved by the processing chain.

We differentiate between three types of data within the XML template file:

1. Immutable: these attributes are pre-set in the template and **cannot be altered**. Any attempt to change the contents of these attributes will result in validation failure.
2. User-mutable: these attribute values are denoted by "%%%" and **must be filled out prior to WASP submission**. These attributes provide information is required by the instrument. In some cases, it is valid to set these as blank (''). Generally, the user will fill these in.

3. Configure-mutable: these attribute values are also denoted by "%%%" and also **must be filled out prior to WASP submission**. The fibre configuration utility writes these attributes to the XML file upon completion of fibre allocation.

In the following sections, we detail only the *user-mutable* attributes that must be filled out by the end-user. We refer those wishing to understand the significance of the immutable attributes to [AD18]. We strongly encourage the use of utility scripts to generate the attributes and insert the content required to create Observing Blocks that adhere to the WEAVE standards laid out in this document.

The following section headings mimic the underlying hierarchy of the XML template.

7.1 The root <weave> element

Attribute name	Meaning
author	Author email address
cc_report	CSV-separated additional email addresses to send the WASP report. This can be supplemented further in the WASP upload form.
report_verbosity	Verbosity (0,1) of the WASP validation report. 0 is less verbose than 1.

7.1.1 The <programme> element (container)

7.1.1.1 The <spectrograph> element (container)

7.1.1.1.1 The <red_Arm> and <blue_Arm> elements

These elements reflect the "N" and "I" values encapsulated in the PROGTEMP code.

Attribute name	Meaning
binning_X	Spatial binning (1-4) (pixels). Unless approved by the Science Executive, this value must **always** be "1"
binning_Y	Spectral binning (1-4) (pixels). This should reflect the PROGTEMP value used in this OB. See Section 5.4.3.6.4
resolution	Arm resolution "low"/"high". This should reflect the PROGTEMP value in Section 1.1.1.1.1
VPH	Arm grating used. For Low Resolution, this is "VPH1". For High Resolution, this is either "VPH2" (Blue and Red arm), **or** "VPH3" (Green; use for blue_Arm only). See Table 13.

7.1.1.2 The <exposures> element (container)

7.1.1.2.1 The <exposure> element

These elements reflect the values encapsulated in the 'RB' component of the PROGTEMP code.

Attribute name	Meaning
arm	Spectrograph arm the exposure is taken with. This can be either “red”, “blue” or “both”. Unless otherwise defined (where the R and B PROGTEMP components differ), ‘both’ should be used. See Table 15.
exp_time	Exposure time (in seconds). This should reflect the values defined in *progtemp.dat* within the WEAVE data model [AD20].
order	The sequence in which the exposures are taken (1,…). These should be monotonically increasing, initially picking up the index from the calibration exposure preceding the first science exposure. When arms are specified separately (‘red’ and ‘blue’ rather than ‘both’), the order should be shared between both elements for each requested exposure. For XMLs with dithered observations, the order attribute of <exposure type=“science”> elements must match the order attribute of the counterpart <field> element.

7.1.2 The <observation> element

Attribute name	Meaning
chained	“True” or “False”. Defines if this OB is probabilistically linked to cloned versions of itself and should reflect the presence of the “+” component in the PROGTEMP code (see Section 5.4.3.6.5)
linkedgroup	Linking pointer for intra-survey grouping of OBs. All OBs with the same attribute value will be linked together. Setting this value may impact scheduling operations, and may require approval from the D/PS.
name	Observing block name.
obsgroup	Linking pointer for OB groupings that can permit prioritisation over other surveys. All OBs with the same attribute value will be linked together. Setting this value may impact scheduling operations, and may require approval from the D/PS.
obsgroup_validity	Lifetime (days) of *obsgroup* OB priority boost once 1st OB is observed. Setting this value may impact scheduling operations, and may require approval from the D/PS.
obstemp	Observing constraints template code (OBSTEMP)
obs_type	“MOS”, “mIFU” or “LIFU”
pa	Requested position angle of the whole observing block. This must be 0.0 for MOS and mIFU. For the LIFU it should reflect the IFU_PA value specified in the FITS catalogue.
progtemp	Instrument configuration template code (PROGTEMP)

tac_alloc	For WEAVE Open time surveys, the TAC proposal identifier for this observation (see Section 5.2.2.1, stored in the catalogue PHU). This code encapsulates time awarded from all TACs for the current trimester. Be sure that the tac_id supplied in the next field is current[9] for the trimester and falls within the award of time as described by tac_alloc. For WEAVE science teams, this is blank (‘’).
tac_id	For WEAVE Open time surveys, the TAC time allocation code this Observing Block will be costed to. Please take care to provide the correct code as per the time awarded under the different TACs (eg., do not use an UK TAC code when tac_alloc does not indicate award by PATT). For WEAVE science teams, this is blank (‘’).
trimester	Trimester of the requested observation, e.g. “2023A1”

[Further explanatory text about linking OBs here: Scott / Shoko to write.]

7.1.3 The <configure> element

Attribute name	Meaning
max_calibration	Maximum number of calibration stars to allocate fibre to
max_guide	Maximum number of guide stars to allocate fibre to
max_sky	Maximum number of sky fibres to allocate
num_sky_fibres	Number of fibres to reserve for sky
plate	Plate name “PLATE_A”, “PLATE_B”, “LIFU”. Note that the mIFU should be set to “PLATE_B”.

We refer users to the Configure manual [cite] for guidance on the values these attributes should take to optimise fibre configuration in WEAVE.

7.1.4 The <obsconstraints> element

Numerical values representing each element of the OBSTEMP (Section 5.4.3.7) code must be entered into these attributes. The numerical values should match those provided in Section 5.4.3.7 (or alternatively the obstemp.dat lookup file available within the WEAVE Data Model [AD20]).

Attribute name	Meaning
elevation_min	The minimum acceptable elevation angle (deg) as defined by the “A” component of OBSTEMP (5.4.3.7.3)
moondist_min	The minimum acceptable distance from the moon (deg) as defined by the “M” OBSTEMP component (5.4.3.7.4)
seeing_max	The maximum acceptable seeing (arcsec) as per the “P” OBSTEMP component (5.4.3.7.1)
skybright_max	The maximum acceptable sky brightness (B; 5.4.3.7.5) (AB Vmag/arcsec^2)
transparency_min	The minimum acceptable transparency (0.0-1.0) (T; 5.4.3.7.2)

[9] Older codes *may* check out. https://www.youtube.com/watch?v=4HJ-Y8YTo8Q

7.1.5 The <dithering> element

Attribute name	Meaning
apply_dither	Define the dithering strategy (-1,0,-3,3,4,5,6), as detailed below. This should match the IFU_DITHER value (5.4.3.9) supplied in the input FITS catalogue.

Dither code	MOS	LIFU	mIFU
-1			
0			
-3			
3			
4			
5			
6			

The *apply_dither* attribute indicates which dithering strategy the user requires for this observation. A value of -1 permits the user to specify their own dithering sequence (for LIFU only). Constraints on the dither step size are imposed by the WASP to ensure that the guide star remains within the autoguider field of view. A value of 0 indicates no dither. This is also the default ("null") value for the MOS (where dithering is not permitted). Values of -3, 3, 4, 5 or 6 indicate use of the fixed dither patterns as described in the configure configuration file (available for download under the WEAVE Data Model). These fixed dither patterns can be used by both the LIFU and mIFU modes, but the exact patterns themselves may vary according to the mode. We refer users to the configure.cfg file (within the WEAVE Data Model) for the particular dither patterns. We refer users to Appendix C - for graphical representations of these dither patterns.

7.1.6 The <surveys> element (container)

7.1.6.1 The <survey> element

Attribute name	Meaning
name	This is your TARGSRVY (see Section 5.2.1)
priority	This has no effect unless you are sharing this field with other surveys. This adjusts the relative priorities of different surveys in order to get the desired balance of targets
max_fibres	Maximum number of fibres to allocate to this survey

7.1.7 The <fields> element (container)

This container can hold a multiple number of <field> elements.

7.1.7.1 The <field> element

Attribute name	Meaning
RA_d	ICRS Right ascension of field centre in decimal degrees
Dec_d	ICRS Declination of field centre in decimal degrees

order	Order in the exposure sequence (mandatory if dithering)

There should only be one <field**s**> element in an observation, but this may contain multiple <field> elements each requiring an RA_d and a Dec_d attribute.

For cases where observations are dithered, there must be one <field> element for each dither position. The order attribute of these elements corresponds to the order attribute of the <exposure **type='science'>** elements, thus defining the sequence in which the dithered observations occur.

For non-dithered observations, there must be only one <field> element. The order attribute is left blank (''), as it does not connect to any one particular <exposure **type="science"**> element.

7.1.7.1.1 The <target> element

Each <field> element contains targets (which are candidates for fibre placements) and an "avoidance_list" which defines places that are to be avoided when positioning sky fibres.

Note that we list here only the user-mutable attributes. As can be seen in *BlankXMLTemplate.xml*, the <target> attribute includes other attributes that are filled by the configure utility. We refer users to [ICD-025] for a description of these additional attributes.

Many of these attributes should be ***directly*** transferred from the input FITS catalogue with no alterations. The WASP will perform a series of consistency checks between the entries in the FITS catalogue and <target> entries in the Observing Block. Any discrepancies between the two will result in rejected OBs. This is a requirement because the information within <target> is written into the raw FITS file [RD04]. This is then propagated through the data management system into the WEAVE Archive System (WAS). The archive matches the fibres observed within WEAVE to the input FITS catalogue entries.

The key issue arising from this constraint is the choice of TARGPRIO in the input FITS catalogue, and the requirement this remain fixed in the XML file as it passes through the Configure fibre allocation utility. In cases where users have set the TARGPRIO too low, one (unsupported) option would be to "spam" the XML with the same target element many times (though beware of non-linear increases in annealing time) and remove the surplus duplicates from the XML file prior to submitting to WASP. An alternative is to temporarily change the TARGPRIO of the desired target(s) in the XML prior to configure, and then revert them back to the original (FITS) values after fibres have been allocated. This may however have an effect on your survey's selection function. We provide no warranty for either approach!

Attribute name	Meaning

*cname**	Target CNAME identifier. This should correspond to the CNAME entry generated by the WASP for this target after FITS catalogue validation (5.5)
targcat	Catalogue filename – this should correspond to TARGCAT (5.2)
targclass	Target classification. Refer to Table 12 for full list, and Section 5.4.3.10.1 for usage instructions.
targdec	ICRS Declination of object in degrees. This should correspond to GAIA_RA in Section 5.4.3.
targepoch	Epoch of observation (in years). Mandatory for non-zero proper motions. This corresponds to GAIA_EPOCH in Section 5.4.3
targid	Target identifier, as per TARGID in 5.4.3
targname	target name, as entered for TARGNAME in Section 5.4.3 (specifically Section 5.4.3.1 for IFU)
targparal	Parallax in mas, corresponding to GAIA_PARAL in Section 5.4.3
targpmdec	Proper motion in Declination in mas/yr, as recorded by GAIA_PMDEC in 5.4.3. Non-zero values of this must also include values for *targparal* and *targepoch*.
targpmra	Proper motion in RA in mas/yr. This is the true angular motion on-sky, not rate of change of RA. This corresponds to GAIA_PMRA in 5.4.3. Non-zero values of this must also include values for *targparal* and *targepoch*
targprio	Target priority (1.0-10.0), where 1.0 is the lowest priority. This should be the value defined in the input FITS catalogue as TARGPRIO (5.4.3.3)
targprog	Sub-programme name within the survey, as defined by TARGPROG in Section 5.4.3.
targra	ICRS Right ascension of object in degrees. This corresponds to GAIA_RA in the input FITS catalogue
targsrvy	Survey name, as defined in Section 5.2.1
targuse	"T" (science target), "C" (calibration), "S" (sky) or "G" (guide). In some instances, these will be generated for the user. For IFU users, we **strongly** suggest inspecting the placement of the fibre arrays onto the sky. In cases where parts of the IFU are clearly sampling the sky, these can be re-assigned from "T" to "S". This will provide more sky data for the L1 pipeline to calculate a better sky subtraction.

XXX note about ifu_spaxel and ifu_pa: remove from input to Configure (ie: XML template is template input to WASP, not Configure)

The priority (*targprio*) is used by the configure process. The higher the priority of a target the more likely it is to have a fibre allocated to it.

7.1.7.1.1.1 The <photometry> element

For "science", "calibration" and guide-star targets (targuse="T","C","G") photometric data should be added for a target, as provided in the input FITS catalogue. *Inclusion of these extinction-uncorrected g, r and i-band magnitudes are required for effective fibre throughput estimates at point of observation on-summit via the Quick-Look pipeline.*

Attribute name	Meaning	Table **11 Reference**
mag_g	Magnitude estimate for the target in the SDSS(like) g band (AB).	MAG_G
emag_g	The error in the magnitude estimate for the target in the SDSS(like) g band.	EMAG_G
mag_r	Magnitude estimate for the target in the SDSS(like) r band (AB).	MAG_R
emag_r	The error in the magnitude estimate for the target in the SDSS(like) r band.	EMAG_R
mag_i	Magnitude estimate for the target in the SDSS(like) i band (AB).	EMAG_I
emag_i	The error in the magnitude estimate for the target in the SDSS(like) i band.	EMAG_I
mag_gg	Gaia G band magnitude estimate (Vega).	MAG_GG
emag_gg	Error on Gaia G band	EMAG_GG
mag_bp	Magnitude estimate for the target in the Gaia BP band (Vega).	MAG_BP
emag_bp	The error in the magnitude estimate for the target in the Gaia BP band.	EMAG_BP
mag_rp	Magnitude estimate for the target in the Gaia RP band (Vega).	MAG_RP
emag_rp	The error in the magnitude estimate for the target in the Gaia RP band.	EMAG_RP

7.1.7.2 **The <avoidance_list> element (container)**

The avoidance list element contains mask elements that define areas of sky to be avoided when automatically placing sky fibres. The only shape of mask supported is a circle.

Configure can read an avoidance list from a separate file from the field definition and it will replace any existing list defined inside the field. When configure writes its output the list will be embedded in the field.

If this feature is not used, observers should remove the placeholder element from the XML template.

7.1.7.2.1 The <mask> element

Attribute name	Meaning
Dec_d	ICRS Declination of source in degrees
RA_d	ICRS Right Ascension of source in degrees
radius	radius of object (arcsec). If no radius is specified, a default for 3.0 is used.

If this feature is not used, observers should remove the placeholder element from the XML template.

7.1.7.3 The <group> element

A group element is used to group together a set of targets so that configure will only ever allocate one fibre to the group. This is typically used to define a group of close-together sky targets.

If this feature is not used, observers should remove the placeholder element from the XML template.

7.2 Submitting to the WASP

As with FITS submissions, the WASP provides a web form that allows you to upload your submissions. These should either be individual XML files or (preferably) .tar tarballs containing multiple XMLs.

Single XML files will only be permitted for the test channel, otherwise a tarball must be supplied.

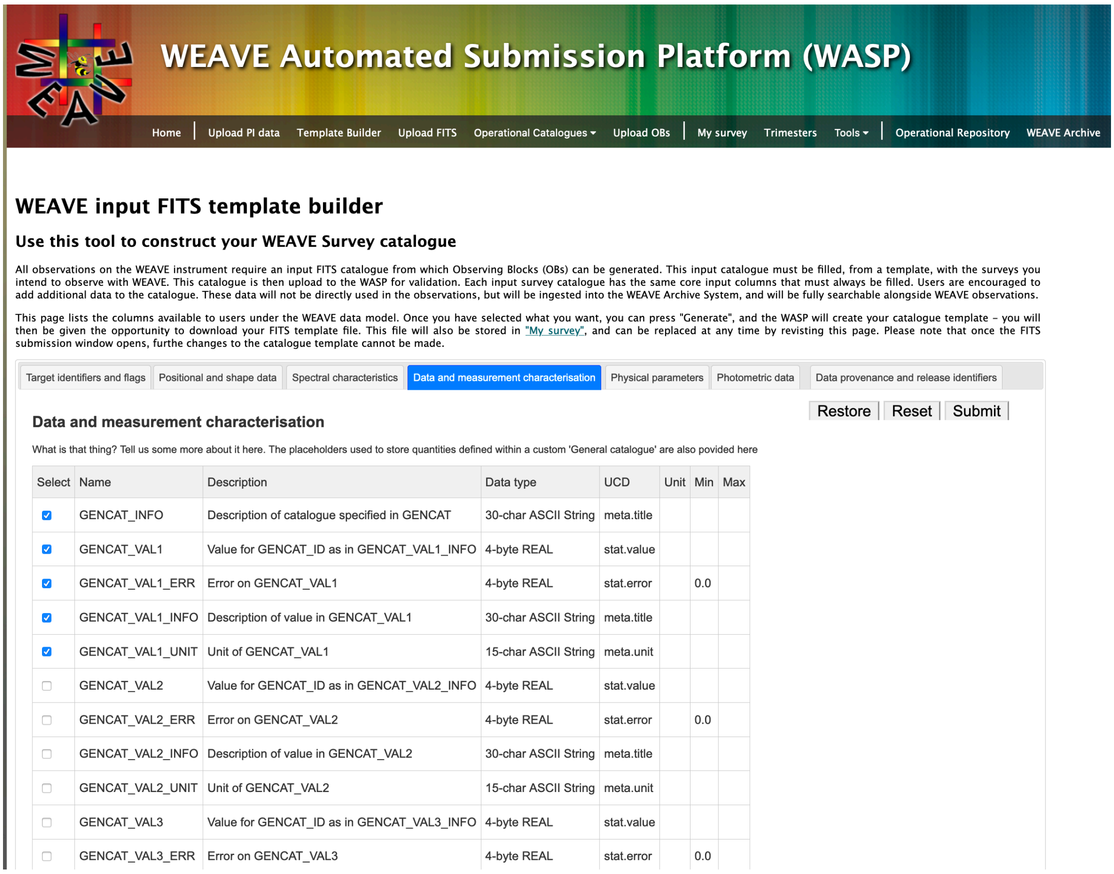
Once these have been uploaded to the WASP, users will be able to check the status of their submission, or of historical submissions, including access to the reports generated.

8 WASP → SWG / PI SURVEYS

The WASP provides three types of information to the SWG and PI Surveys.

8.1 Open-time FITS catalogue templates

Once WEAVE open-time has been allocated to PIs, they will receive authentication details to gain access to the WASP. From here, they can generate (via a web-form) a template FITS catalogue that includes the mandatory "SPA columns" (Section 5.4.3), in addition to the full range of "Survey-Specific columns" listed in Appendix A.



WEAVE Automated Submission Platform (WASP)

Home | Upload PI data | Template Builder | Upload FITS | Operational Catalogues | Upload OBs | My survey | Trimesters | Tools | Operational Repository | WEAVE Archive

WEAVE input FITS template builder

Use this tool to construct your WEAVE Survey catalogue

All observations on the WEAVE instrument require an input FITS catalogue from which Observing Blocks (OBs) can be generated. This input catalogue must be filled, from a template, with the surveys you intend to observe with WEAVE. This catalogue is then upload to the WASP for validation. Each input survey catalogue has the same core input columns that must always be filled. Users are encouraged to add additional data to the catalogue. These data will not be directly used in the observations, but will be ingested into the WEAVE Archive System, and will be fully searchable alongside WEAVE observations.

This page lists the columns available to users under the WEAVE data model. Once you have selected what you want, you can press "Generate", and the WASP will create your catalogue template – you will then be given the opportunity to download your FITS template file. This file will also be stored in "My survey", and can be replaced at any time by revisting this page. Please note that once the FITS submission window opens, furthe changes to the catalogue template cannot be made.

Target identifiers and flags | Positional and shape data | Spectral characteristics | Data and measurement characterisation | Physical parameters | Photometric data | Data provenance and release identifiers

Restore | Reset | Submit

Data and measurement characterisation

What is that thing? Tell us some more about it here. The placeholders used to store quantities defined within a custom 'General catalogue' are also povided here

Select	Name	Description	Data type	UCD	Unit	Min	Max
☑	GENCAT_INFO	Description of catalogue specified in GENCAT	30-char ASCII String	meta.title			
☑	GENCAT_VAL1	Value for GENCAT_ID as in GENCAT_VAL1_INFO	4-byte REAL	stat.value			
☑	GENCAT_VAL1_ERR	Error on GENCAT_VAL1	4-byte REAL	stat.error		0.0	
☑	GENCAT_VAL1_INFO	Description of value in GENCAT_VAL1	30-char ASCII String	meta.title			
☑	GENCAT_VAL1_UNIT	Unit of GENCAT_VAL1	15-char ASCII String	meta.unit			
☐	GENCAT_VAL2	Value for GENCAT_ID as in GENCAT_VAL2_INFO	4-byte REAL	stat.value			
☐	GENCAT_VAL2_ERR	Error on GENCAT_VAL2	4-byte REAL	stat.error		0.0	
☐	GENCAT_VAL2_INFO	Description of value in GENCAT_VAL2	30-char ASCII String	meta.title			
☐	GENCAT_VAL2_UNIT	Unit of GENCAT_VAL2	15-char ASCII String	meta.unit			
☐	GENCAT_VAL3	Value for GENCAT_ID as in GENCAT_VAL3_INFO	4-byte REAL	stat.value			
☐	GENCAT_VAL3_ERR	Error on GENCAT_VAL3	4-byte REAL	stat.error		0.0	

Figure 9 - The FITS catalogue template builder. For Open-Time surveys, users must define the contents of their FITS catalogues ahead of submitting targets to the WASP for validation. This tools provides access to all Survey-Specific columns. The template by default includes the SPA columns that must be present in any WEAVE FITS catalogue.

Once this form is submitted, the user will be provided with a FITS template that conforms to the WEAVE standard, including all columns that were requested. This template shall be stored in their WASP account for later retrieval and can be replaced by filling in the web form again. To save time, users can opt to restore their previous selections and adjust from that point. Beyond the most recent submission, the WASP does not keep a historical record of the survey templates generated.

8.2 Validated FITS catalogues

Once the PI / Survey Science Team has submitted an input FITS catalogue that has been successfully validated, the WASP will provide (at latest following the close of the submission window) an authorised copy of the FITS catalogue that includes target CNAMES and additional metadata. This catalogue (and no other) should be used for the production of XML OB files.

8.3 OB validation reports: per submission, per trimester

The WASP will provide a validation report for each submission made by the user. This will be provided via email, as well as via the web interface.

At the end of the trimester, additional checks are performed on the entire submission, prior to final acceptance of the full set of OBs. This ensures there are no consistency errors, duplications etc. An end-of-trimester report will be generated after these checks. If successful, the OBs are transmitted to the OISMT at ING. If errors arise, then there is a window of opportunity to correct these and re-submit, triggering a new end-of-trimester report.

9 THE IFU WORKFLOW

Due to the complicated nature of IFU observation preparation, a WEAVE IFU workflow has been developed to facilitate the production of input FITS catalogues and XML Observing Blocks.

A full description of this process is outside of the scope of this document, but we refer users to documentation within the online repository[10] where the workflow is hosted. There is also a link to the IFU workflow within the WASP.

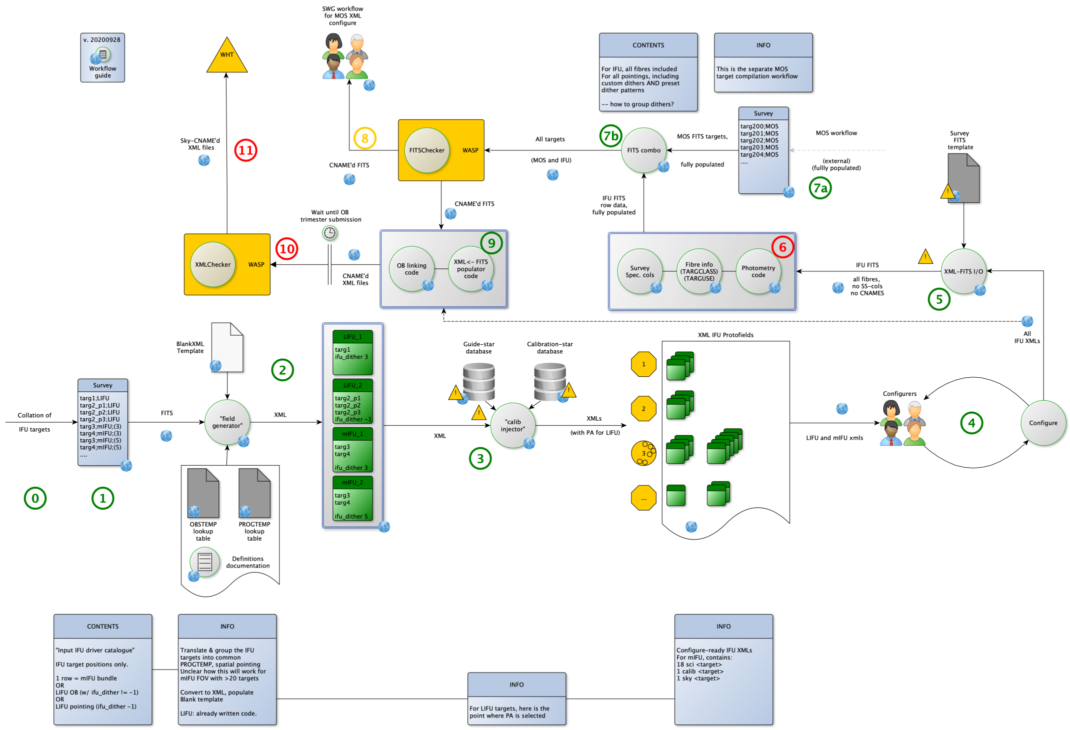


Figure 10 - The WEAVE IFU workflow. This is a software package designed to help users prepare observations for the IFU modes of WEAVE.

Figure 10 shows an overview of the IFU workflow. This workflow consists of a series of interconnected modules designed to take the output of the previous stage and perform a series of tasks that ultimately generate both the input FITS catalogue and the XMLs. The workflow provides an example of the input "driver file" at stage 0 that initiates the full construction of the output products. Part of this process involves use of an external utility (Configure), and users are responsible for running this utility and providing the workflow with the outputs for onwards processing.

[10] https://ingbitbucket.ing.iac.es/projects/WVSWG/repos/ifu/browse/workflow

Users are required to submit the FITS catalogue to the WASP during the open window (and can of course make test submissions via the test channel in advance of this). The collection of XML files should be retained until the OB submission window opens (though once again, test channel submissions can be made to the WASP to ensure the OBs correctly validate).

The workflow is designed as a tool to facilitate preparation of IFU observations with WEAVE. *It remains the responsibility of the end-user to verify the output of the workflow meets the requirements and expectations of the planned observations.*

9.1 Specific information on IFU data provided in FITS catalogues

We detail here specific information on what information should be included in IFU FITS catalogues, from the perspective of WASP validation. In general, the IFU workflow handles the specifics of these requirements, but we provide additional information here to allow users to better understand any failures in validation that may arise from providing additional information at Stage 6 of the workflow (where modifications to the fibre-level information such as TARGUSE might cause non-compliant data products).

For each exposure (dithered or otherwise), for both LIFU and mIFU, the WASP expects the full complement of fibres for the LIFU (603 fibres) or any given mIFU bundle. For the latter, this means the WASP expects an integer number of 37 fibres submitted with mIFU PROGTEMP codes.

Cases where certain TARGUSE entries appear in a FITS catalogue:

9.1.1 TARGUSE=”G” Guide stars

Never included for LIFU, nor mIFU

9.1.2 TARGUSE=”C” White Dwarf

9.1.2.1 **LIFU**

In cases where the LIFU FOV includes a white dwarf target from the WD catalogue, users may assign fibres as WD targets. These should use all values (TARGNAME, TARGID etc) from the WD catalogue (excluding the CNAME), and no changes to the APS_FLAG values are allowed. The TARGCAT should be “WD.fits”. Because it is unlikely that the WD position coincides exactly with the position of the LIFU fibre (unless the WD itself is the specific target of the LIFU pointing), the CNAME returned by WASP in the validated FITS file will not be that of the WD. WASP expects that these fibres shall be assigned targuse=”R”.

9.1.2.2 **mIFU**

Whilst the IFU workflow will generate a calibration bundle (centred on a WD, with sky fibres in the outer ring(s) of the bundle), this should not be included in the input FITS catalogue. APS will process this bundle based on the information provided in the WD catalogue.

Because this bundle is not included in the FITS catalogue, the sky fibres it contains cannot be customised such that different APS analysis pathways are used.

In the niche case that users require a specialised treatment and analysis of the sky (via one or multiple sky bundles), and do not wish to use the peripheral sky fibres around the edge of the calibration bundle, we suggest the following approach:

1. Deploy dedicated sky bundles as detailed in the next section
2. Ensure the required TARGCLASS, APS_FLAG, TARGID are set for all fibres in these bundles
3. In the XML file, change the instances of targuse=”S” to targuse=’T” for all sky fibres in the calibration bundle
4. Do not (as described above) include the calibration bundle in the FITS catalogue

Because the WASP XML validator does not cross-check the sky fibres in the calibration bundle during against the (non-existent) FITS catalogue for consistency of TARGUSE etc, the user is free to set these at their own risk. Assigning them a targuse=”T” ensures they will not be used in the sky subtraction routines.

9.1.3 TARGUSE=”S” Sky fibres

9.1.3.1 LIFU

The IFU workflow populates the “satellite” bundles (around the periphery of the main LIFU array) as dedicated sky fibres. Users are of course encouraged to update these (in workflow stage 6) to reflect cases where the fibres happen to lie on a source that could impact sky subtraction. We also encourage users to update fibres in the main LIFU array that can also be assigned as sky fibres – this will improve the sky subtraction routines in the L1 pipeline processing. Users are also able to update the TARGCLASS and APS_FLAG should they require a special APS treatment of these fibres (this has no effect on L1 sky subtraction), but the TARGUSE value must remain the same.

The WASP will issue a warning (at XML validation stage) if there are too few sky fibres in the LIFU pointing.

9.1.3.2 mIFU

In general, sky bundles are not to be included in the input FITS catalogue: cases where these bundles are “factory default” – with each fibre assigned TARGCLASS=”SKY”, and with no APS_FLAG can be omitted.

However, if users require a special treatment of the sky bundle (i.e. a change in the TARGCLASS or APS_FLAG), then they ***should*** provide this bundle in the FITS catalogue, as this information needs to be communicated to the APS.

10 OR → SWG / QAG

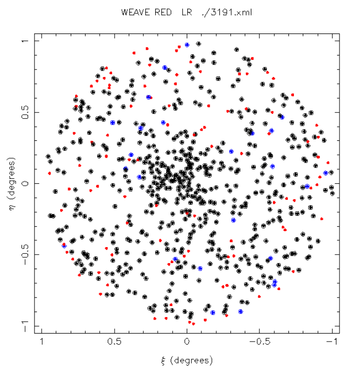
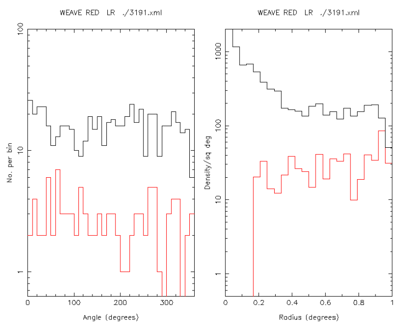
The Operational Repository (OR) provides diagnostic information on the L1 (CPS) and L2 (APS) data products and survey progress information based on the observations and data held in the OR. This information is based on the quality assurance and monitoring activities undertaken during the Operational Rehearsals.

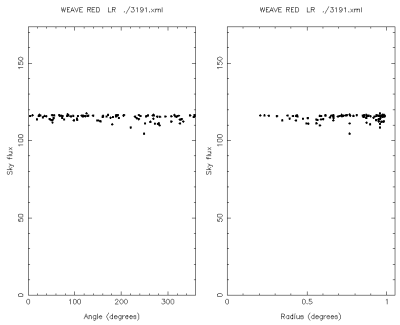
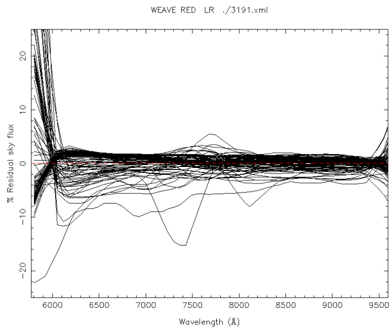
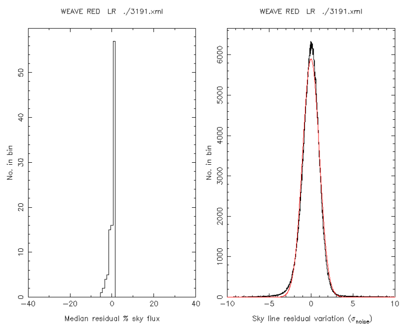
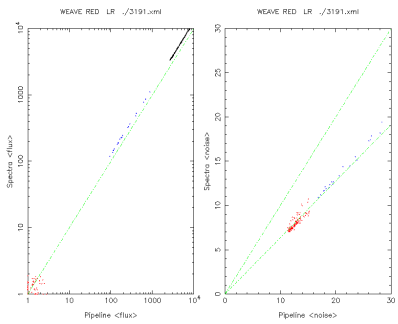
The OR also provides the facility for the QAG team to provide code for the generation of a limited number of figures and tables that can be viewed and downloaded from the Operational Repository.

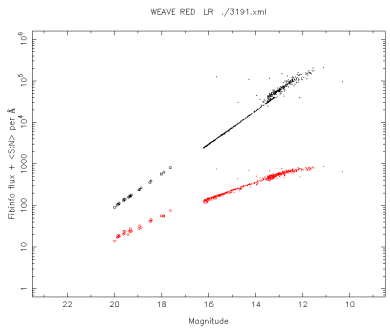
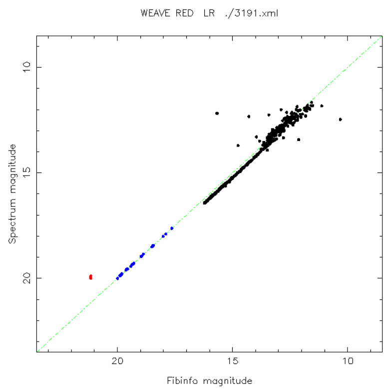
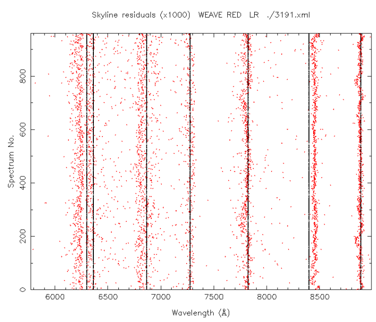
10.1 CASU L1 and L2 Diagnostics

The first section below provides plots and tables currently being produced by CASU in OpR3 for L1 QA. For each plot, further quantities which could be useful output and thresholds for testing are suggested. After collating all of OpR3 S4, S5 and S6 outputs should have a better idea of what thresholds/criteria to use for alerts.

10.1.1 MOS QA plots, description and thresholds

QA Name	Plot/Table	Description	Thresholds to apply in QC module tests
fibrpos.gif		Location of targets (black), calibration (blue) and sky fibres (red) using a standard coordinate projection with tangent point the field centre. (add no. of targets, skies, calibrators, parked? to table output)	1. Min/Max number of targets 2. Min/Max number of skies 3. Min/Max number of calibrators
posstat.gif		The angle and radial distributions show targets (black) and skies (red) and are used as input to KS tests to assess similarity of distributions of sky ∀ targets.	Thresholds on the KS statistics. The statistics are listed in the .table as log10(probabilities) that the fibre distributions come from the same underlying parent distribution. Although the absolute value of these probabilities is too extreme for simple use, the relative log scores of different configurations provides a benchmark for setting useful test statistics.

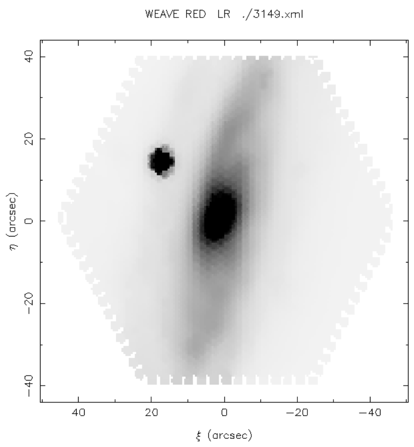
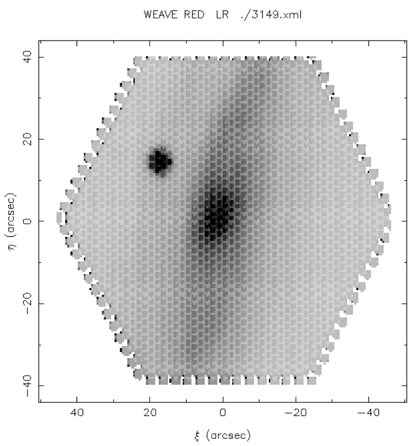
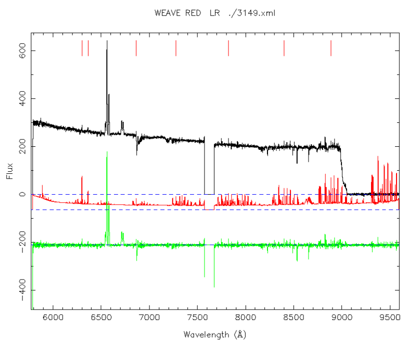
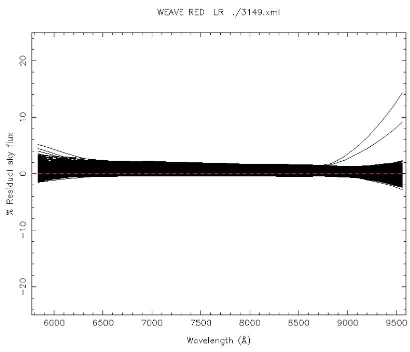
QA Name	Plot/Table	Description	Thresholds to apply in QC module tests
skyflux.gif		Distribution of average (median) sky flux in sky fibres as a function of radial distance from centre and azimuthal angle. These can be used to assess issues with sky continuum variation or badly contaminated sky spectra.	These distributions form the basis for the reported numbers of sky fibres with "extremely" low flux in the .table files and provides a useful test statistic
delskys.gif		Heavily smoothed and resampled plots of the run of sky-subtracted sky fibre flux as a function of wavelength. These are expressed as a % of the average (median) sky level. This works well as a diagnostic of issues with the master sky subtraction. HR data taken in dark sky looks worse as a % but the variation in sky level here is typically +/-1ADU	Could set some thresholds on dispersion of lines as function of wavelength.
skystat.gif		Left panel shows the median sky-subtracted sky level as a % of the average sky level. With a robust master sky and good subtraction, the distribution should be centred on zero. Outliers usually correspond to contaminated sky spectra but may also be caused by a poor master sky. Right panel shows the sigma (noise) normalised distribution of sky residuals leftover at locations of sky emission lines. Black is actual distribution, red is theoretical if Poisson noise limits are attained.	Summary nos. for left hand plot reported in table could use as threshold. Could base residuals threshold based on comparison of black to red distributions.
flxnois.gif		Black points are targets and red are sky-subtracted sky spectra, blue are WD calibrators. The pipeline <flux> is estimated in the nearest passband, whilst the y-axis average is a median of the 10%-90% range of the spectra. The pipeline pixel-to-pixel <noise> estimate is based on the inverse variance array and is reported as sqrt(median variance). The spectrum <noise> is estimated directly from the pixel-to-pixel noise in the spectrum. Note that noise estimates direct from spectra are generally lower due to noise covariance caused by resampling but can be corrupted (higher) by "forests" of absorption lines, particularly in blue LR. Dashed lines are	Not clear yet how to use these. Left hand plot is simple sanity check on fib info value whilst right hand plot checks reported variance. Could set thresholds on both.

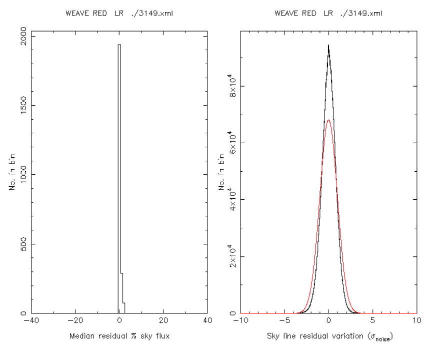
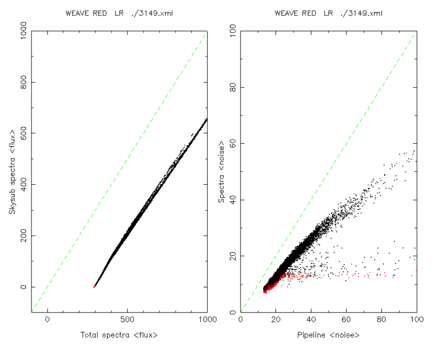
QA Name	Plot/Table	Description	Thresholds to apply in QC module tests
		1:1 and predicted slope from noise covariance analysis.	
magflsn.gif		Throughput checks from comparing <average> spectral flux (black - should have asymptotic log10 slope of -0.4) and signal:noise (red - should have bright end asymptotic slope of -0.2 when Poisson noise dominates) versus nearest appropriate magnitude in fibinfo table. Open circles are calibrators and black are other targets with magnitudes available.	Threshold to do with linearity? amount of offset between red and black? curvature/scatter of red, and black
magplot.gif		Y-axis: magnitudes computed directly from spectra after multiplying by the sensitivity function in extension#5, in *g*, *r* or *i* SDSS passband as appropriate, and based on the SDSS sensitivity curves X-axis: closest magnitude available in fibinfo table (extension#6) - in this case *i*-band red - estimates of sky brightness in band from all sky fibres compared to *V*-band sky brightness value in PHDU blue - WD calibrators black - science targets	
skyline.gif		Measured positions of selected isolated skylines (red) compared to fiducial values (black) for all allocated fibres. The differences have been scaled by x1000 for better visualisation. For example: an apparent offset of 100A in the plot corresponds to a 100mA shift. The typical rms error in measuring a skyline position is around 15mA (see QA table below for a summary).	

10.1.2 MOS QA table summary

<table>
<tr><th>Sample table contents</th><th>Description</th></tr>
<tr><td>
WEAVE RED LR ./3191.xml
<table>
<tr><th>No.</th><th>Mag</th><th><flux>s</th><th><flux>p</th><th><flux>t</th><th><sigma></th><th>sqrt<var></th><th>s:n</th><th>targUSE</th><th>nused</th></tr>
<tr><td>1</td><td>16.069</td><td>2689.7</td><td>2206.7</td><td>2821.1</td><td>54.6</td><td>40.0</td><td>134.6</td><td>T</td><td>11975</td></tr>
<tr><td>2</td><td>16.089</td><td>2693.7</td><td>2163.0</td><td>2793.2</td><td>55.9</td><td>47.3</td><td>113.8</td><td>T</td><td>12423</td></tr>
<tr><td>3</td><td>13.486</td><td>41529.4</td><td>32972.4</td><td>40508.2</td><td>365.2</td><td>159.8</td><td>519.8</td><td>T</td><td>10752</td></tr>
<tr><td>6</td><td>13.844</td><td>21645.4</td><td>17110.9</td><td>21331.6</td><td>182.6</td><td>110.0</td><td>393.6</td><td>T</td><td>11022</td></tr>
<tr><td>7</td><td>15.799</td><td>3630.1</td><td>2936.1</td><td>3719.9</td><td>63.7</td><td>45.9</td><td>158.1</td><td>T</td><td>11904</td></tr>
<tr><td>9</td><td>15.229</td><td>6032.8</td><td>4784.8</td><td>6081.6</td><td>77.1</td><td>57.4</td><td>210.3</td><td>T</td><td>11736</td></tr>
<tr><td>10</td><td>14.339</td><td>13671.5</td><td>10741.4</td><td>13513.9</td><td>127.8</td><td>89.5</td><td>305.6</td><td>T</td><td>11428</td></tr>
<tr><td>11</td><td>-1.000</td><td>1.1</td><td>0.7</td><td>115.8</td><td>7.3</td><td>8.9</td><td>0.2</td><td>S</td><td>13129</td></tr>
<tr><td>12</td><td>14.898</td><td>8198.8</td><td>6442.8</td><td>8191.7</td><td>93.0</td><td>66.5</td><td>246.4</td><td>T</td><td>11789</td></tr>
<tr><td>14</td><td>12.586</td><td>86312.3</td><td>67770.3</td><td>84359.3</td><td>564.9</td><td>254.5</td><td>678.2</td><td>T</td><td>10517</td></tr>
<tr><td>18</td><td>16.055</td><td>2800.8</td><td>2243.6</td><td>2912.3</td><td>47.1</td><td>38.9</td><td>144.0</td><td>T</td><td>12068</td></tr>
<tr><td>20</td><td>14.287</td><td>108218.1</td><td>85043.2</td><td>105872.1</td><td>709.0</td><td>304.3</td><td>711.2</td><td>T</td><td>10562</td></tr>
<tr><td>21</td><td>14.930</td><td>7919.6</td><td>6340.8</td><td>7942.3</td><td>104.4</td><td>75.6</td><td>209.6</td><td>T</td><td>11716</td></tr>
<tr><td>23</td><td>14.777</td><td>9260.6</td><td>7385.4</td><td>9225.8</td><td>106.9</td><td>73.1</td><td>253.4</td><td>T</td><td>11389</td></tr>
<tr><td>24</td><td>-1.000</td><td>1.1</td><td>0.2</td><td>116.1</td><td>7.9</td><td>9.7</td><td>0.2</td><td>S</td><td>13148</td></tr>
<tr><td>25</td><td>13.380</td><td>44133.5</td><td>34610.6</td><td>43163.9</td><td>317.3</td><td>170.3</td><td>518.4</td><td>T</td><td>10779</td></tr>
<tr><td>26</td><td>13.182</td><td>52829.1</td><td>41352.3</td><td>51559.2</td><td>373.7</td><td>200.1</td><td>527.9</td><td>T</td><td>10752</td></tr>
<tr><td>28</td><td>-1.000</td><td>0.8</td><td>0.3</td><td>115.5</td><td>9.0</td><td>10.8</td><td>0.2</td><td>S</td><td>13320</td></tr>
<tr><td>29</td><td>-1.000</td><td>0.9</td><td>0.1</td><td>115.8</td><td>6.7</td><td>8.5</td><td>0.2</td><td>S</td><td>12944</td></tr>
<tr><td>30</td><td>-1.000</td><td>1.0</td><td>0.2</td><td>115.8</td><td>7.2</td><td>8.9</td><td>0.2</td><td>S</td><td>13086</td></tr>
<tr><td>31</td><td>15.800</td><td>3539.9</td><td>2832.2</td><td>3630.9</td><td>56.2</td><td>47.2</td><td>149.9</td><td>T</td><td>12014</td></tr>
<tr><td>32</td><td>-1.000</td><td>0.8</td><td>0.1</td><td>115.9</td><td>6.8</td><td>8.3</td><td>0.2</td><td>S</td><td>13114</td></tr>
</table>
....
</td><td>
1. Columns:
2. **No.** spectrum no. (row omitted if parked)
3. **Mag** nearest useful magnitude -1.0 if null
4. **Flux_S** median flux over 10% - 90% of wavelength range
5. **Flux_P** reported flux from fibinfo table
6. **Flux_T** median flux as for **3.** but before sky subtraction
7. **<sigma>** pixel-to-pixel noise estimate from spectra
8. **sqrt<var>** from median pipeline variance from extension #2
9. **s:n** median pixel flux from **3.** / pixel noise from **7.** then converted to <s:n>/Angstrom
10. **targUSE** target, sky, calibrator, parked
11. **nused** no. spectral pixels used in estimates
</td></tr>
<tr><td>
<table>
<tr><th>Offset:</th><th>-4</th><th>-3</th><th>-2</th><th>-1</th><th>0</th><th>+1</th><th>+2</th><th>+3</th><th>+4</th></tr>
<tr><td>Sky covariance:</td><td>0.002</td><td>-0.015</td><td>0.087</td><td>0.515</td><td>1.000</td><td>0.514</td><td>0.087</td><td>-0.016</td><td>0.001</td></tr>
<tr><td>Noise factor :</td><td>1.485</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td><td>
vector of noise covariance measured from sky subtracted skies, i.e. normalised correlation in noise between pixels offset as indicated
noise factor is an estimate of the apparent reduction in *rms* noise arising from this covariance
</td></tr>
<tr><td>
log10(KS) stats sky -v- targets = -0.21 -4.67
Average sky flux and no. of sky = 115.71 100
Residual median sky sigma and % = 1.59 1.37
No. of fibres with extremely low flux = 0
Skyline residual rms & kurtosis = 0.96 1.12
</td><td>
log10(KS) scores for (dis)similarity of sky and targets azimuthal and radial distributions from skypos.gif
Summary of scatter about zero of histogram left hand panel of skystat.gif
No. of sky fibres with suspiciously low flux and spectrum #s of them. More than a "few" usually indicates a problem
Summary stats of normalised skyline residuals in terms of "rms" and "extent" of wings (perfect would be 1.0 and 1.0)
Note: Add nos. of T,C,S,P here
</td></tr>
<tr><td>
<table>
<tr><th></th><th>Skyline</th><th><offset></th><th>rms</th><th><FWHM></th><th>rms</th></tr>
<tr><td>[OI]</td><td>6300.304</td><td>-0.053</td><td>0.013</td><td>1.461</td><td>0.019</td></tr>
<tr><td>[OI]</td><td>6363.780</td><td>-0.043</td><td>0.014</td><td>1.487</td><td>0.020</td></tr>
<tr><td>72Q1</td><td>6863.955</td><td>-0.054</td><td>0.014</td><td>1.690</td><td>0.152</td></tr>
<tr><td>83Q1</td><td>7276.405</td><td>0.029</td><td>0.011</td><td>1.667</td><td>0.138</td></tr>
<tr><td>94P1</td><td>7821.503</td><td>-0.005</td><td>0.017</td><td>1.525</td><td>0.077</td></tr>
<tr><td>62P1</td><td>8399.170</td><td>0.055</td><td>0.009</td><td>1.462</td><td>0.095</td></tr>
<tr><td>73P1</td><td>8885.850</td><td>-0.012</td><td>0.010</td><td>1.410</td><td>0.053</td></tr>
</table>
</td><td>
Independent check on wavelength solution and FWHM using strong well isolated sky lines. Offsets are consistent in all OBs for a given setup whilst scatter about offset is at the ~1kms level. Two of these skylines have a weak secondary component which inflates the FWHM slightly, otherwise these look good quality indicators.
</td></tr>
</table>

10.1.3 LIFU stackcube QA plots and description

QA name	Plot	Description
spatial.gif		Median spectral flux in each spaxel analysed using complete wavelength range. Orientation is N to the top and E to the left. Test: Is it worth generating emission line region equivalent spatial distributions?
		Median spectral rms noise map in each spaxel from full wavelength range. Test: Black points around edges of coverage are the culprits causing horizontal scatter in flxnoise.gif (see below)
avespec.gif		Average spaxel spectrum from regions illuminated by target fibre bundle. Black is sky-subtracted average spectrum (note the lack of flux above 9000A is present in raw input data) - blue dashed line true "zero" Red is average noise in spectrum as a function of wavelength - shift denoted by blue dashed "zero" line Green continuum-subtracted average spectrum and likewise shift denoted by blue dashed line
delskys.gif		Testing the consistency of the sky continuum subtraction as a function of wavelength in a similar manner to that used for MOS. As these "skies" are selected in the outer regions of target they could well be contaminated with low surface brightness flux from primary target - hence general +ve trend.

QA name	Plot	Description
skystat.gif		Similar diagnostic plots as for MOS i.e. histogram of "sky" fibre median spectral offsets and normalised residual distribution around strong sky emission lines.
flxnois.gif		Black points are sky subtracted target spaxel spectra, red are pseudo sky spectra generally from around edges of illuminated region. Total spectral <flux> before sky subtraction; skysub <flux> after. Slight trend in difference with increasing object flux needs investigating further. Pipeline <noise> is based on average variance; spectral noise is as measured directly from spectra and shows increased covariance with respect to MOS. Not clear what is cause of horizontal scatter in RHS plot but is probably bug in incomplete edge spaxels.

10.1.4 LIFU stackcube QA table summary

Sample table contents	Description	Comments
WEAVE RED LR ./3149.xml Average "target" flux, <s:n>/A and no. used = 550.00 14.68 19935 Average "sky" flux and no. used = 293.29 2306 Residual median sky sigma and % = 0.38 0.13 No. of active spaxels with extremely low flux = 0 Skyline residual rms & kurtosis = 0.76 1.09 Skyline <offset> rms <FWHM> rms [OI] 6300.304 0.084 0.082 2.829 0.038 [OI] 6363.780 0.068 0.085 2.900 0.093 72Q1 6863.955 -0.009 0.074 3.114 0.234 83Q1 7276.405 -0.062 0.058 3.016 0.150 94P1 7821.503 0.062 0.049 2.863 0.073 62P1 8399.170 0.062 0.042 2.834 0.043 73P1 8885.850 0.080 0.056 2.782 0.033	Analysis based on all "illuminated" spaxels i.e. ignoring spaxels outside of FoV of main fibre bundle Average sky subtraction spectral flux and s:n/A in target region and verage flux in regions dominated by sky together with no. of spaxels Summary of scatter about zero of average sky-subtracted spectral flux in sky dominated regions (see also delskys.gif) Check to assess if any "illuminated" spaxels show suspiciously low flux Summary stats of normalised sky line residuals in terms of "rms" and "extent" of wings As for MOS, independent check on wavelength solution and FWHM of strong well isolated sky lines. rms columns are scatter about <...> values.	The detailed table equivalent to the MOS version for LIFU has around 30,000 rows hence the more succinct summary.

10.2 QAG products generated by the Operational Repository

The QAG may provide code that generates QA data in the OR. This then eases the demand for frequent download of large data volumes from the OR to perform QA tasks. Table 28 shows the modules currently running in the OR, what data products they are run on, and samples of their output.

Table 28 Current QAG modules in the OR

Module Name	File suffix / Extension	Input data	Plot/Table	Description
wq_z_module	.aps_wq_z_module.dat	L2 stacked_*	See Table 29	APS redshifts and classifications of quasar targets and fibers classified as quasars. The last 4 columns of the table are taken from the ZZ HDU of the L2 data products.
ga_module	.aps_ga_module.dat	L2 stacked_*	See Table 30	Module fetches information from the different extensions in L2 and merges them on a target-basis per line. It computes SNR in dedicated wavelength windows defined by the QAG

10.2.1 QAG Module output descriptions

This section describes the output generated by the modules described in Table 28.

Table 29 - Output of the wq_z_module QAG module

Name	Class	Description
CNAME	String	CNAME as in the Class table extension
TARGID	String	Target ID as in Class table extension
TARGSRVY	String	Survey of the target as in Class table extension
CLASS	String	Spectral classification from APS as in Class table extension (STAR, GALAXY or QSO)
SUBCLASS	String	Spectral sub-classification from APS as in Class table extension
Z	Double	Best fit Barycentric Redshift from APS as in Class table extension
Z_ERR	Double	Uncertainty on best fit redshift based upon fit to $\chi 2$ minimum from APS as in Class table extension
CHI2	Double	Best fit $\chi 2$ from APS as in Class table extension
ZWARNING	Integer	Redshift Warning flags (BIT-MASK) from APS as in Class table extension

Table 30 Output of the ga_module QAG module

Name	Class	Description
OBID	String	OB ID (example: 4011)
NAME	String	OB name (example: WG036+21)
MODE	String	MOS mode (LOWRES or HIGHRES)
PTYPE	String	Stacked only for now
NARMS	Long	Number of arms combined (1 or 2)
FILENB_1	String	FILE number of arm1 (Example: 1004074)
CAMERA_1	String	Camera WAVEBLUE or WAVERED
FILENB_2	String	FILE number of arm2 (Example: 1004073 or 0 when NARMS=1)
CAMERA_2	String	WAVERED or None when NARMS=1
VPH	String	Grating used (LowRes, HighRes1 or HighRes2)
BINFACT	Long	Binning factor in case of binning data (currently not recorded?)

Name	Class	Description
TARGID	String	Target ID as in table extension
CNAME	String	CNAME as in the table extension
FIBREID	Short	Fibre ID as in table extension
NSPEC	Integer	NSPEC as in table extension
TARGSRVY	String	Survey of the target as in table extension (example GA_HR)
TARGPROG	String	Target Prog as in Table extension (in GA_HR this describes type of target, i.e. MSTO, giant, etc)
TARGRA	Double	RA coordinates of target
TARGDEC	Double	DEC coordinates of target
MAG_G	Float	Target Magnitude in G (-99.99 when not available)
MAG_R	Float	Target Magnitude in R (-99.99 when not available)
MAG_I	Float	Target Magnitude in I (-99.99 when not available)
MAG_GG	Float	Target Magnitude in G_Gaia (-99.99 when not available)
MAG_BP	Float	Target Magnitude in BP_gaia (-99.99 when not available)
MAG_RP	Float	Target Magnitude in RP_gaia (-99.99 when not available)
RMS_ARC1	Double	RMS of ARC1 from CASU QC in fibre table
RMS_ARC2	Double	RMS of ARC2 from CASU QC in fibre table
WAVE_COR1	Double	Wavelength COR1 from CASU QC in fibre table
WAVE_COR2	Double	Wavelength COR2 from CASU QC in fibre table
SKYLINE_OFF1	Double	Skyline offset 1 from CASU QC in fibre table
SKYLINE_OFF2	Double	Skyline offset 1 from CASU QC in fibre table
RESOL	Float	Resolution from CASU QC in fibre table
SNR_CASU	Float	Signal-to-noise from CASU QC in fibre table
SKYBRGHT	Double	Sky brightness (mags)
AIRMASS	Double	Airmass of observation
SEEING	Double	Seeing of observation
SNR_blue_QAG	Double	Signal to noise computed in QAG defined window
SNR_green_QAG	Double	Signal to noise computed in QAG defined window
SNR_red_QAG	Double	Signal to noise computed in QAG defined window
VRAD_RVS	Float	Radial Velocity computed by RVS module (-999.99 when not available)
VRAD_ERR_RVS	Float	Radial Velocity error computed by RVS module (-999.99 when not available)
SNR_FERRE	Float	signal-to-noise computed by FERRE module (-999.99 when not available)
VRAD_FERRE	Float	Radial Velocity computed by FERRE module (-999.99 when not available)
VRAD_FERRE_ERR	Float	Radial Velocity error computed by FERRE module (-999.99 when not available)
TEFF_FERRE	Float	Effective Temperature computed by FERRE module (-999.99 when not available)
TEFF_ERR_FERRE	Float	Effective Temperature error computed by FERRE module (-999.99 when not available)
LOGG_FERRE	Float	Surface gravity computed by FERRE module (-999.99 when not available)
LOGG_ERR_FERRE	Float	Surface gravity error computed by FERRE module (-999.99 when not available)
MH_FERRE	Float	Metallicity computed by FERRE module (-999.99 when not available)
MH_ERR_FERRE	Float	Metallicity error computed by FERRE module (-999.99 when not available)
ALPHA_FERRE	Foat	Global alpha computed by FERRE module (-999.99 when not available)
ALPHA_ERR_FERRE	Float	Global alpha error computed by FERRE module (-999.99 when not available)
MT_FERRE	Float	Microturbulence velocity computed by FERRE module (-999.99 when not available)
MT_ERR_FERRE	Float	Microturbulence velocity error computed by FERRE module (-999.99 when not available)
input_template	String	Input Template (only valid during OPRs)
TEFF_INPUT	Double	Input Effective Temperature (only valid during OPRs)
LOGG_INPUT	Double	Input surface gravity (only valid during OPRs)
MH_INPUT	Double	Input Metallicity (only valid during OPRs)
ALPHA_INPUT	Double	Input Alpha (only valid during OPRs)
VRAD_INPUT	Float	Input Radial Velocity (only valid during OPRs)

10.3 Adding new QAG modules to the OR

The QAG codes are run in a modular fashion, each derived from the same common python template. Adding further QAG modules to the OR requires a Request For Change (RFC; [RD28]), as per the procedures laid out in the WEAVE Data Model (WDM; [AD20]). Those requesting a new module must:

1. Read and understand the change request procedure detailed in [AD20] for the WEAVE Data Model.
2. Prepare an RFC document as per [RD28] that includes
    a. What the expected input data is (L1, L2, single / stacks / supertargets etc)
    b. What files will be generated
    c. Why the module is required (ie., that other modules do not provide the same information, or cannot be trivially updated to do so)
    d. The "name" of the module doing the work (eg "qaga_tables")
    e. The "description" of the module (eg. "QAG GA metadata tables")
    f. Agreement that the code be provided in Python and provided in the form of the template in Section 10.4.
    g. Agreement that the code uses no more than numpy, astropy and matplotlib for plots, tables etc.
    h. Example output data / plots from running the code on sample data.
3. Provide, along with the RFC document, a copy of their python module, as derived from the code in Section 10.4.

10.4 Python template module for QAG product generation in the OR

The *make_tables* function should be used as a basis for the generation of QAG modules in the OR. This can be renamed as appropriate but should be correctly called from the main function *runPlugin*. Multiple functions along these lines can be created, as long as they are run in the correct order from the main function.

```
import os
from astropy.io import fits as pyfits
import logging
from yapsy.IPlugin import IPlugin
from verify.base import Verify


class TableMaker(Verify):
    def subclass_init(self):
        self.file_search = ['*.fit']
        self.terminal_mode = False
        return

    def printName(self):
        self.log.info("This is tablemaker")

    def getName(self):
        return "tablemaker"

    def runPlugin(self, dirName):
        #set the initial state to "PASS"
        self.status = self.OK

        #get all files that we should be working on
        self.getFitsFiles(dirName,search=self.file_search)

        #do the "work" - ie generate the tables for these files
        self.make_tables()

        #if it failed, then report this in the log
        if self.status != self.OK:
            self.log.error('Tables could not be made for this night')

        return self.status


    def make_tables(self):
        try:
            for fname in self.fitsfiles:
                #open the file, grab what you need, write a table
                fits = = pyfits.open(fname)
                #..
                #..
                #..
                fits.close()

                #... now write a table
                outname = fname.replace('.fit','_%s.dat'%(self.getName()))
                file = open('%s/%s'%(self.dirName,outname),'w')
                file.writelines('Some output \n')
                file.close()
        except:
            self.status = self.ERROR
```

10.5 Survey Progress Monitoring

The OR will provide diagnostics of survey progress. These will include measures of OB progression, target progression, and the number of hours observed relative to those allocated.

[more details here: Scott to specify requirements]

11 WAS → SWG, QAG, ARCHIVE USERS

In this section we provide supplemental information about the CNAME identifier, the WNAME identifier (and how they differ), and define the data release cycle.

11.1 The CNAME identifier

Every target observed by WEAVE will be assigned a unique CNAME based on its coordinates, as well as a specification of instrument and standard epoch. Once assigned, a CNAME will remain static for the duration of the WEAVE survey.

11.1.1 The CNAME format

Regardless of the type of observation (MOS, mIFU or LIFU), the CNAME is a fixed-length character string of length 20 = 4(**WVE_**) + 8(**RA**)+1(+/–)+7(**Dec**)

WVE = WEAVE in the Gaia epoch
RA = Right Ascension in hours, minutes and seconds (to 2 decimal places)
Dec = Declination in degrees, arcminutes and arcseconds (to 1 decimal place)

e.g. an object at RA = 3h40m21.767s and Dec = –31d20m32.71s will have the CNAME WVE_03402177–3120327. Decimal places will be rounded and not truncated.

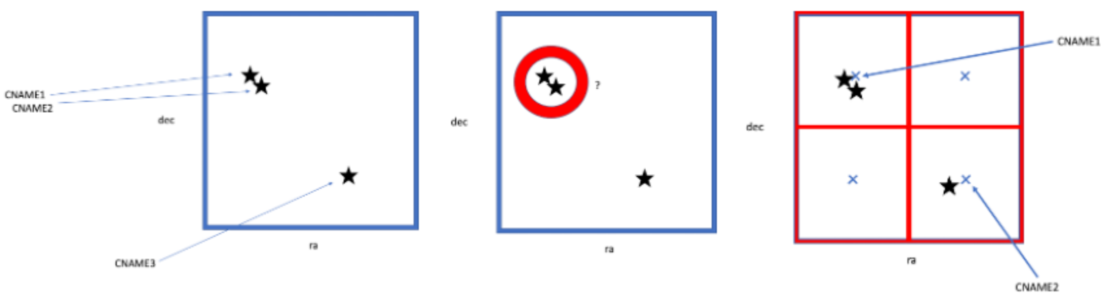
Coordinates will be zero-padded when necessary, e.g. if Dec = +05d20m10.03s, then the CNAME is WVE_xxxxxxxx+0520100.

For all WEAVE targets, astrometry will be with respect to the Gaia DR3 reference frame (ICRS 2016.0).

The CNAME for a target with non-zero proper motion will be defined as above, using its coordinates at the first instance of its inclusion in its respective catalogue. Its CNAME will remain constant regardless of the target's change in coordinates over the survey period.

Note: *TARGRA and TARGDEC for targets with non-zero proper motion will reflect the actual RA and Dec of the target, taking its proper motion into account. GaiaID can be used to check consistency of a high-proper-motion target.*

Internal to CPS/OR, the string-based CNAME is derived from the quantisation of the sky using HEALPix nested-scheme cells at resolution 19. This divides up the sky into approximately 3.3×10^{12} pixels with separations of 0.23".



Any source within this HEALPix cell will map to the same CNAME, corresponding to the position of the centre of the cell.

11.1.2 MOS targets

For a MOS target, the CNAME refers to the individual object and its coordinates.

11.1.3 IFU targets

A typical IFU target will potentially have 4 hierarchical levels of data:

1. **Spaxels** – the "spatial pixels" that, in bundle form, comprise the IFU – either as a large contiguous array (LIFU) or a set of smaller arrays (mIFU). Each spaxel can be thought of as a MOS fibre in a fixed position relative to other fibres.
2. **Dithers** – these are individual exposures with (small) offsets relative to a base pointing position.
3. **Pointings** – these comprise potentially one of many stacked dithers.
4. **Mosaics** – these are sets of pointings that cover the whole object (where that object extends beyond the footprint of a single pointing).

Both (2) and (3) will be produced by the SPA from (1). Mosaics are outside the scope of SPA, and should be considered Contributed Data Products (CDPs) for submission to WAS.

Each of these hierarchies must be linked to each other so that:

- end-users can search for a target, and have access to the mosaic (where produced), pointings and individual dithers;
- the CPS knows what should be stacked, and what should not be stacked;
- a CNAME retains its status as indicating which part of the sky photons were taken from.

Any spaxel within the IFU maps to an RA and Dec on the sky. This RA and Dec can be transformed to a CNAME. As such, *each spaxel has a unique CNAME within the IFU*. Because dithers change the IFU's position on the sky, spaxel CNAMES are not conserved – i.e. *a spaxel will have a different CNAME for each dither*.

We assign a "Central CNAME" (CCNAME) to each dither. This is the CNAME of the *central spaxel* of the array. This is stored in the Primary header of the raw FITS file as "CCNAME". In the case of the mIFU, multiple entries of the form CCNAME1, CCNAME2, …CCNAMEN will correspond to the central spaxels of each of the IFU bundles. **NB**: this requires some knowledge, via the fibinfo table or otherwise, of which spaxels belong to which bundle — or at the very least a way to identify the central spaxel each time.

Further details pertaining to IFU data management are described in [AD19].

11.1.4 CNAME assignment

CNAME assignment is performed at CASU, once a catalogue has been submitted by the SWG to CASU/OR and it has been successfully verified. If FITS verification fails, no CNAME assignment occurs and the SWG must resubmit the catalogue until FITS verification is successful.

Because of the quantised nature of CNAMEs described above, care must be taken by end-users to ensure that any changes in position, observation epoch, proper motion and measured parallax do not shift an already-observed WEAVE source into a neighbouring HEALPix cell – this would result in different CNAMES being assigned to the same source, and therefore no stacking occurring. We recommend that surveys use the same positional/kinematic data throughout the lifetime of their survey.

11.1.5 CNAME stakeholders and associated data flow

SWG/catalogue producer/open-time PI: submits FITS catalogue to CASU/OR via WASP for CNAME assignment
WASP: performs FITS verification and CNAME assignment if successfully verified
SWG/open-time PI: retrieves resulting FITS file from OR via WASP
SWG/open-time PI: submits XML output from configure to OR via WASP
WASP: performs final verification of XML output from SWG against input FITS files to check for any invalid CNAMEs in XML files before OCS retrieves XML from OR for creation of OBs
WAS: retrieves final FITS catalogues (i.e. after CNAME assignment) via WASP
OCS: retrieves XML via WASP and performs checks to ensure integrity of the data
OISMT: raw data generated with CNAMES entered into fibre information table
CASU/OR: raw data ingested and L1 processed, with CNAMES propagated into L1 fibre information table
APS: L1 data transferred and analysis performed, with binary table output including CNAME column for reference
WAS: data transferred to WAS and ingested, with CNAME used as an identifier for searches. WNAMES optionally generated (see Section 11.2)

11.2 The WNAME identifier

11.2.1 WNAME purpose

WNAME is an extended superset of the CNAME identifier. An example use case (and the origin of the WNAME concept) is that of QSO absorption systems, in which multiple objects at different redshifts lie along the same line-of-sight. The CNAME concept (WEAVE-SPA-005) assigns a single CNAME to the target QSO, but the intervening absorbers are unique systems that need to be identified and searchable in WAS. These absorbers are given individual WNAMEs based on the parent CNAME of the target (QSO) object.

Any CNAME can be extended with a WNAME after agreement with WAS.

11.2.2 WNAME assignment and format

WNAMEs will only be assigned by Contributed Data Product (CDP) producers or by WAS itself. CPS and APS will not create WNAMEs, nor will they be required to distinguish between WNAME'd objects.

WNAMES are "children" of a CNAME "parent". They therefore inherit the CNAME of the parent object as the base of the name.

CDP producers should choose a format for their WNAMEs in consultation with WAS. All WNAME formats must be agreed with WAS; otherwise they will be rejected during the WAS ingestion process.

A WNAME must not exceed 40 characters. Characters allowed in a valid WNAME are:

- alphanumeric characters [a-z][A-Z][0-9]
- -, + as special characters

An example WNAME for the QSO absorber case might be "WVE_034021783+31203275MgIIz2p2098" for an Mg II absorber with a redshift of z=2.2098 along the line of sight to the QSO WVE_034021783+31203275. (Of course, the WEAVE-QSO CDP producers may choose a different WNAME format; this is merely a suggestion.)

A WNAME will be generated starting from a CNAME for each object/target sent to WAS if the WNAME is missing. When this occurs, the WNAME is identically the CNAME. From the archive point of view, this information is stored locally but never transferred to the FITS files (or catalogues). The only time that WAS will receive files already containing WNAME information is when CDP producers have supplied the WAS with WNAMEs in cases where the CNAME is not sufficient to uniquely identify the objects in question.

11.3 Data release cycle

The WEAVE data are produced and distributed on a regular basis to honour the WEAVE data policy described in (WEAVE-EXE-005). This section describes the data flow and the data availability to the users. Three types of data release have been defined:

- Internal data release candidate (iDRC)
- Internal data release (iDR)
- Public data release (DR)

The WEAVE archive receives the raw data (from the telescope) and the reduced data from the official pipelines whenever they are available. Under normal circumstances, fresh raw data should be pushed to WAS once a day, while the L1-processed, L2-analysed and Contributed Software (CS) data coming from the Operational Repository (OR) should be transferred on a daily basis with a latency of [TBD] no more than 5 days. The OR only provides data to the archive once all elements (CPS, APS, CS) are available.

The data products pushed to WAS populate the internal data release candidate. These data are subject to change and only a limited number of people may access the data with strong access restrictions. In particular, the internal data release candidate may only be accessed by:

- Open-time PIs
- WEAVE Survey Contributed Data Product (CDP) producers
- WEAVE Survey Science Team Leads (STLs)
- WEAVE Survey Quality and Assurance Group (QAG) members
- WEAVE Project Scientist and Deputy Project Scientist
- On-Island Survey Management Team members
- SPA team members

Data products within an iDRC are subject to change without notice through re-processing of the CPS, APS or CS products. Whenever the data products change in an internal data release candidate, it is the responsibility of the user to download the most up-to-date products when they become available. This means that products from the internal data release candidate cannot be used in any published work (as set out in [AD21]).

CDP producers may access and use the data from an internal data release candidate for the purposes of testing their codes, but they must re-download and re-analyse the data once they are formally released as an iDR.

Although the data continually trickle into the archive on a daily basis, the archive considers the data to be managed in time slots. The minimum time slot is a period of three months; the data publication in the iDR is therefore aligned to trimesters and always refers to a particular trimester. The starting and ending dates of each trimester are defined and available in WASP, although the information will probably be made available through the WAS as well.

WAS considers a trimester closed once it receives all the data from the telescope and the official pipelines (matching the dates which define that trimester for a given iDR).

The WEAVE data transferred to the archive day-by-day are not considered definitive until the trimester closes, as they may change due to the retraction of data. Data retraction may happen for reasons external to the archive. Moreover, CASU will generate supertargets on a monthly basis, which can lead to the pushing of these data products to WAS some days after the closing date of the trimester. This can lead to a delay regarding when the data become available to the community.

Once the trimester closes, the data of an iDRC are considered definitive and relabelled as an iDR. They may now be accessed by a larger group of users through the WAS. In particular, all users that are part of the WEAVE Consortium and those that are External Collaborators as defined in the Publication Policy and approved by the WEAVE Project Executive or Science Executive (or are included through a Memorandum of

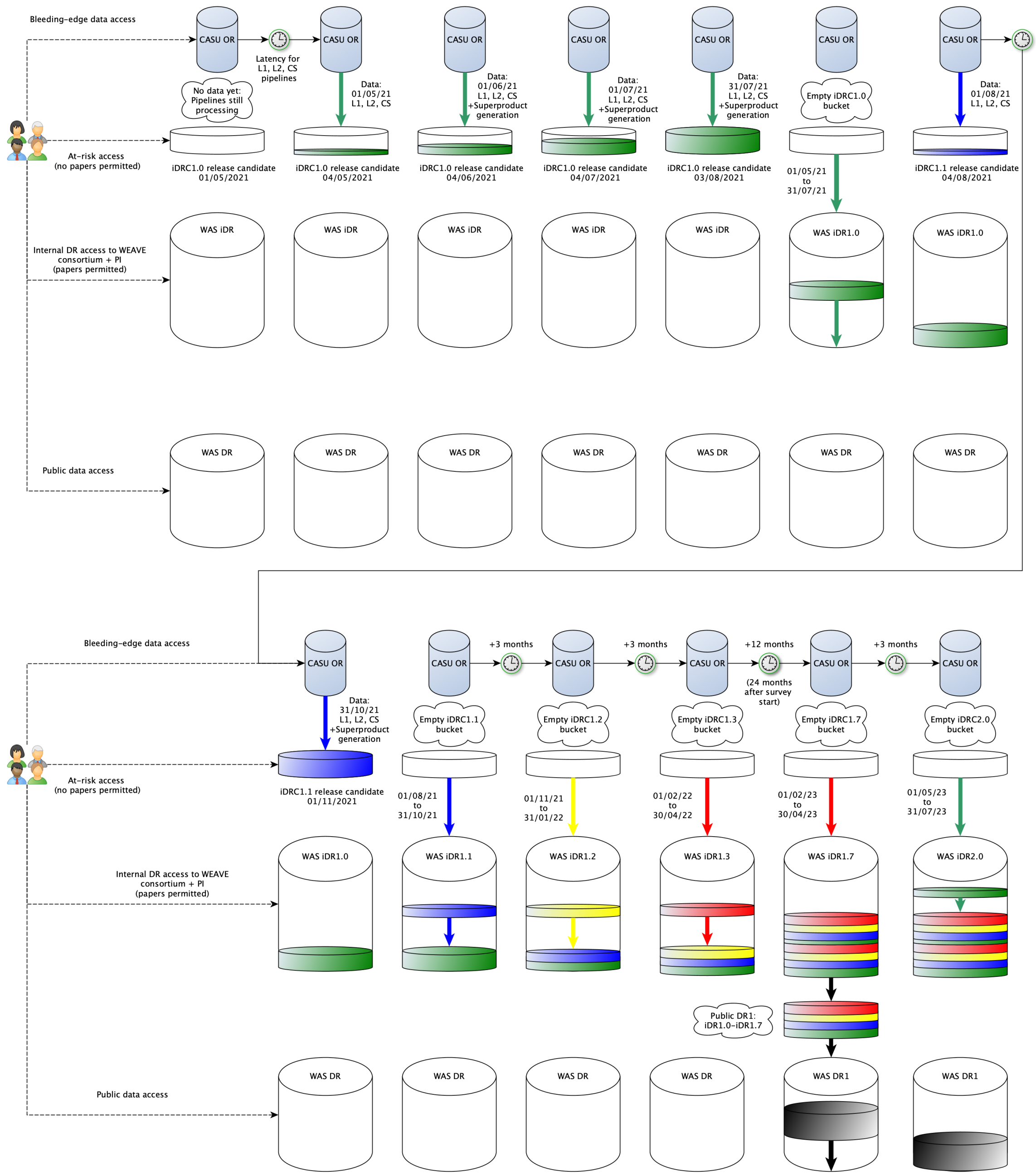
Understanding with the Project) may access the data. These data constitute an iDR, and they are reliable – only under exceptional circumstances would changes be made to an iDR.

Internal Data Releases have a numbering system that comprise two parts: iDRm.n, where m and n are integers, with m starting at 1 and n starting at 0. The very first iDR with “normal” data (i.e. not from Science Verification) is iDR1.0, and all iDRs up to the point where the first public Data Release (DR) is published has m=1, while n increases sequentially: iDR1.0, iDR1.1, iDR1.2, etc.

Every year starting 24 months after survey start, the WEAVE Consortium publishes a public Data Release. DRs are identified by a single integer as DRn, where n is an integer starting at 1. As an example, DR1 = iDR1.x and DR2 = iDR2.y, where x and y can be different integers, depending on how many iDRs have occurred before the publication of the next public DR. Once DR1 has been published, the next internal Data Release will therefore have the identifier iDR2.0.

Note that an exception to the above system is DR0, through which Science Verification (SV) data will be published. The stages of the internal data releases can be tested using SV data, in which case iDRs will be numbered as iDR0.0, etc., but this must be for testing purposes only, as they are not intended as actual iDRs for scientific purposes ahead of DR0.

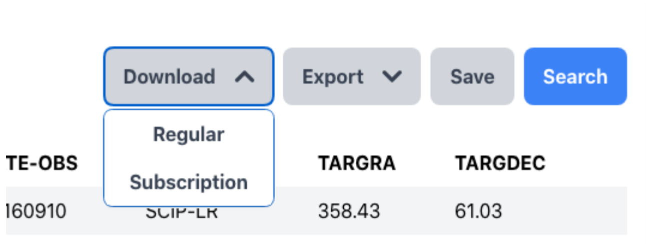
The figure below represents the different stages of the internal data releases:



11.4 Data downloads

The download feature can be used to get the data of every data release: public data releases, internal data releases and internal data release candidates.

Depending on the user rights, the archive offers two ways to download the fits data. The classical download mechanism (Regular) and the Subscription service.



While the Regular download is used for retrieving the data from the public data releases and the internal data releases, the Subscription service is used for downloading the data which have not been released yet (or in other words, the data that are part of an internal data release candidate).

Both the Regular download and the Subscription service permit downloading of

- targets, where every target is split into a separate file (i.e. one file contains only one target)
- OBs, where each file contains all the targets configured by a single OB

11.4.1 Regular downloads

This is the easiest way to get a filtered data set. The user applies the filters from the web user interface and uses the Download (Regular) button to get the results.
The download procedure triggers a one-time job that notifies the user once the results are ready to be downloaded. The job takes care to create a workspace where the original files are linked and presented to the user (the user never get access to the original files).

The data set resulting from a regular download job can be downloaded in different ways:

- via rsync protocol
- via https protocol through clients like (for example)
  - wget
  - curl
  - aria2

Both protocols have pros and cons. Some test has been performed with different programs. Here are a few points to consider when choosing a protocol to download WEAVE data:

- wget and curl are sequential (i.e. they handle one file at time); they do not work with delta transfers (that is, only downloading files that have not only already been downloaded, which is the default rsync behaviour); but they can download directory trees as they preserve the hierarchical directory structure.
- aria2 permits parallelized downloads but cannot handle files which are spread over a directory hierarchy. If aria2 is used to download the data, in case of the presence of super products (e.g. multiple files with the same name), they will be renamed by appending to the file name a sequential number. The data sets for downloads are organized in directory trees for two reasons:
  - to handle the file name duplication of super products
  - to group the targets that are part of a same OB

In absence of file duplication, the aria2 program gives the best results in terms of transfer rate.

A caveat: “super” (combined) data products generated by CASU are updated over the time. The same file can then be pushed to the archive every time a deeper instance of a stack is available. This means that the filenames for super targets are not unique. The archive preserves every version of a file which has been ingested in different internal data releases. The download process permits users to retrieve all versions of a target. If two or more files with the same filename are to be written (from the download job) in a flat space, the files would be overwritten. This means that, when a download job is executed, it is necessary to store the results into a hierarchical structure to preserve all the versions of a super target.

11.4.2 Subscription service

The Subscription service is available only to the users which may access the internal data release candidate. This is a facility intended for users who need to repeatedly and frequently download a data set from the iDRC.

A Subscription is an automated job executed every day and may alert the user of its execution. The job can be paused or resumed by the user at their own convenience.

The steps to activate a new Subscription job are the same as a regular download. The user has first to filter a data set from the iDRC. Once the data set has been identified, it can be downloaded as a Subscription. The user is notified when the job completes.

The data are *only* available via the rsync protocol when using the Subscription service.

Appendix A - **List of SPA & Survey-Specific Columns**

Table 31 SPA and SS Catalogue Columns

Column	Description	Format	UCD	Unit	Min	Max
CNAME	WEAVE object name from coordinates	ASCII Character	meta.id;meta.main	--	--	--
TARGSRVY	The Survey where the target belongs	ASCII Character	meta.id.parent	--	--	--
TARGPROG	Optional description of (sub-)survey/programme	ASCII Character	meta.id.part	--	--	--
TARGCAT	Catalogue filename	ASCII Character	meta.dataset	--	--	--
TARGID	The identifier of the target assigned by survey	ASCII Character	meta.id	--	--	--
TARGNAME	The target name	ASCII Character	meta.id	--	--	--
TARGPRIO	Target relative priority within a survey (1-10)	4-byte REAL	meta.code	--	1	10
TARGUSE	T=target, S=sky, G=guide, C=calib., R=random	ASCII Character	meta.code.class	--	--	--
TARGCLASS	Classification of the target assigned by survey	ASCII Character	src.class	--	--	--
PROGTEMP	Observing Programme Template	ASCII Character	instr.setup	--	--	--
OBSTEMP	Observing Constraints Template	ASCII Character	obs.param	--	--	--
GAIA_ID	Gaia Source Identifier	ASCII Character	meta.id	--	--	--
GAIA_DR	Gaia Data Release	ASCII Character	time.release	--	--	--
GAIA_RA	Gaia RA of target in decimal degrees	8-byte DOUBLE	pos.eq.ra;meta.main	deg	0	360
GAIA_DEC	Gaia Dec of target in decimal degrees	8-byte DOUBLE	pos.eq.dec;meta.main	deg	-90	90
GAIA_EPOCH	Gaia Epoch of target in (Julian) decimal years	4-byte REAL	time.epoch	yr	2015.5	2016.0
GAIA_PMRA	Gaia Proper Motion of target in mas/yr in RA	4-byte REAL	pos.pm	mas/yr	--	--
GAIA_PMRA_ERR	Error on GAIA_PMRA	4-byte REAL	stat.error;pos.pm	mas/yr	0	--
GAIA_PMDEC	Gaia Proper Motion of target in mas/yr in Dec	4-byte REAL	pos.pm	mas/yr	--	--
GAIA_PMDEC_ERR	Error on GAIA_PMDEC	4-byte REAL	stat.error;pos.pm	mas/yr	0	--
GAIA_PARAL	Gaia Parallax of target in mas	4-byte REAL	pos.parallax	mas	--	--
GAIA_PARAL_ERR	Error on GAIA_PARAL	4-byte REAL	stat.error;pos.parallax	mas	0	--
HEALPIX	ID for res=19 nested HEALPix scheme	2-byte INTEGER	pos.healpix	--	0	3298534883327
IFU_SPAXEL	Identifier for spaxel within IFU	ASCII Character	meta.id;instr	--	--	--
IFU_PA	Position Angle of IFU bundle	8-byte DOUBLE	pos.posAng	deg	-180	180
IFU_DITHER	IFU dither pattern code -1, 0 (MOS), -3, 3, 4, 5, 6	2-byte INTEGER	meta.code.multip;obs.sequence	--	-1	5
MAG_G	Magnitude for target in SDSS-like g band (AB)	4-byte REAL	phot.mag;em.opt	mag	--	--

Column	Description	Format	UCD	Unit	Min	Max
MAG_G_ERR	Error on MAG_G	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
MAG_R	Magnitude for target in SDSS-like r band (AB)	4-byte REAL	phot.mag;em.opt	mag	--	--
MAG_R_ERR	Error on MAG_R	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
MAG_I	Magnitude for target in SDSS-like i band (AB)	4-byte REAL	phot.mag;em.opt	mag	--	--
MAG_I_ERR	Error on MAG_I	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
GAIA_MAG_G	Magnitude for target in Gaia G band (Vega)	4-byte REAL	phot.mag;em.opt	mag	--	--
GAIA_MAG_G_ERR	Error on GAIA_MAG_G	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
GAIA_MAG_BP	Magnitude for target in Gaia BP band (Vega)	4-byte REAL	phot.mag;em.opt	mag	--	--
GAIA_MAG_BP_ERR	Error on GAIA_MAG_BP	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
GAIA_MAG_RP	Magnitude for target in Gaia RP band (Vega)	4-byte REAL	phot.mag;em.opt	mag	--	--
GAIA_MAG_RP_ERR	Error on GAIA_MAG_RP	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
APS_WL_MIN	Min observed wavelength considered	4-byte REAL	em.wl	Angstrom	0	--
APS_WL_MAX	Max observed wavelength considered	4-byte REAL	em.wl	Angstrom	0	--
APS_Z	Redshift of system (heliocentric corrected)	4-byte REAL	src.redshift	--	--	--
APS_SIGMA	Initial guess of velocity dispersion	4-byte REAL	phys.veloc.dispersion	km/s	0	--
APS_TEMPL_LIB	Library of spectral templates	ASCII Character	stat.fit.param	--	--	--
APS_TEMPL_LIB_NORM	Normalise spectral template library	2-byte INTEGER	meta.code	--	0	1
APS_PPXF_WL_MIN	Min rest-frame wavelength for use by pPXF	4-byte REAL	em.wl	Angstrom	0	--
APS_PPXF_WL_MAX	Max rest-frame wavelength for use by pPXF	4-byte REAL	em.wl	Angstrom	0	--
APS_PPXF_MOM	No. of kinematic moments to be extracted	2-byte INTEGER	stat.fit.dof	--	0	--
APS_PPXF_DEG_ADD	Deg. of additive Legendre polynomial	2-byte INTEGER	stat.fit.dof	--	0	--
APS_PPXF_DEG_MULT	Deg. of multiplicative Legendre polynomial	2-byte INTEGER	stat.fit.dof	--	0	--
APS_PPXF_NUM_MC	No. of MC simulations to extract pPXF errors	2-byte INTEGER	meta.code.multip	--	0	--
APS_GAND_MODE	Run GANDALF to extract emission-line kinematics	2-byte INTEGER	meta.code	--	0	2
APS_GAND_ERR	Derive errors on emission-line analysis	2-byte INTEGER	meta.code	--	0	1
APS_GAND_RED1	Initial estimate for reddening by dust	4-byte REAL	meta.code	--	0	1
APS_GAND_RED2	Second estimate for reddening by dust	4-byte REAL	meta.code	--	0	1

Column	Description	Format	UCD	Unit	Min	Max
APS_GAND_EBV	De-redden spectra for galactic extinction	2-byte INTEGER	meta.code	--	0	1
APS_LS_MODE	Extract indices and convert them to SSP prop.	2-byte INTEGER	meta.code	--	0	1
APS_LS_RES	Spectral resolution (FWHM) of index measrmnt	4-byte REAL	spect.resolution	Angstrom	0	1000
APS_LS_NUM_MC	No. of MC simulations to extract errors	2-byte INTEGER	meta.code.multip	--	0	--
APS_SSP_NUM_WLKR	No. of walkers for the SP MCMC algorithm	2-byte INTEGER	meta.code.multip	--	0	--
APS_SSP_NUM_CHAIN	No. of iterations in the SP MCMC algorithm	2-byte INTEGER	meta.code.multip	--	0	--
APS_IFU_MASK	Mask this fibre in IFU analysis	2-byte INTEGER	meta.code	--	0	1
APS_IFU_TSSL_TYPE	Type of spatial binning for data	ASCII Character	meta.code	--	--	--
APS_IFU_TSSL_TARG_SNR	Target SNR per pix for spat. bin.	4-byte REAL	stat.snr	--	--	--
APS_IFU_TSSL_MIN_SNR	Min SNR per pix for spat. bin.	4-byte REAL	stat.snr	--	--	--
APS_IFU_TSSL_COVAR	Correct for spatial correlations	2-byte INTEGER	meta.code	--	0	1
APS_IFU_SRC_ID	Identifier for sources within IFU mosaic	ASCII Character	meta.code	--	--	--
APS_IFU_SRC_RA	RA of centre of its IFU source	8-byte DOUBLE	pos.eq.ra	deg	0	360
APS_IFU_SRC_DEC	Dec of centre of its IFU source	8-byte DOUBLE	pos.eq.dec	deg	-90	90
APS_FLAG	Bit mask activating APS-CS-CDP modules	ASCII Character	meta.code	--	--	--
COORDCAT	Provenance of target coordinates	ASCII Character	meta.dataset	--	--	--
COORDCAT_DEC	COORDCAT_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
COORDCAT_DR	Data release of COORDCAT_ID	ASCII Character	time.release	--	--	--
COORDCAT_EPOCH	Epoch of COORDCAT_ID	4-byte REAL	time.epoch	yr	0	--
COORDCAT_EQUINOX	Equinox of COORDCAT_ID	4-byte REAL	time.equinox	yr	0	--
COORDCAT_ID	Target identifier associated with COORDCAT	ASCII Character	meta.id	--	--	--
COORDCAT_PARAL	Target COORDCAT_ID parallax in mas	4-byte REAL	pos.parallax	mas	--	--
COORDCAT_PARAL_ERR	Error on COORDCAT_PARAL	4-byte REAL	stat.error;pos.parallax	mas	0	--
COORDCAT_PMDEC	COORDCAT_ID Proper Motion in mas/yr in Dec	4-byte REAL	pos.pm	mas/yr	--	--
COORDCAT_PMDEC_ERR	Error on COORDCAT_PMDEC	4-byte REAL	stat.error;pos.pm	mas/yr	0	--
COORDCAT_PMRA	COORDCAT_ID Proper Motion in mas/yr in RA	4-byte REAL	pos.pm	mas/yr	--	--
COORDCAT_PMRA_ERR	Error on COORDCAT_PMRA	4-byte REAL	stat.error;pos.pm	mas/yr	0	--
COORDCAT_RA	COORDCAT_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360

Column	Description	Format	UCD	Unit	Min	Max
EBVCAT	Provenance of Colour Excess	ASCII Character	meta.dataset	--	--	--
EBVCAT_DEC	EBVCAT Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
EBVCAT_DR	Data release for EBVCAT	ASCII Character	time.release	--	--	--
EBVCAT_EBV	Colour Excess (Reddening) in B-V	4-byte REAL	phot.color.excess	mag	--	--
EBVCAT_EBV_ERR	Error on EBVCAT_EBV	4-byte REAL	stat.error;phot.color.excess	mag	0	--
EBVCAT_RA	EBVCAT Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
FEHCAT	Provenance of Metallicity ([Fe/H])	ASCII Character	meta.dataset	--	--	--
FEHCAT_DEC	FEHCAT_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
FEHCAT_DR	Data release of FEHCAT_ID	ASCII Character	time.release	--	--	--
FEHCAT_FEH	Metallicity ([Fe/H]) for FEHCAT_ID	4-byte REAL	phys.abund.Fe	Sun	--	--
FEHCAT_FEH_ERR	Error on FEHCAT_FEH	4-byte REAL	stat.error;phys.abund.Fe	Sun	0	--
FEHCAT_ID	Target identifier associated with FEHCAT	ASCII Character	meta.id	--	--	--
FEHCAT_RA	FEHCAT_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
GA_TARGBITS	LRHIGHLAT: Bits reflecting why object targeted	8-byte INTEGER	meta.code	--	0	--
GA_TARGDATE	LRHIGHLAT: Date when targeting software was run	ASCII Character	time.creation;meta.software	--	--	--
GA_TARGREV	LRHIGHLAT: Revision of targeting software	ASCII Character	meta.version;meta.software	--	--	--
GAIA_GAL_LAT	Gaia galactic latitude in decimal degrees	8-byte DOUBLE	pos.galactic.lat	deg	-90	90
GAIA_GAL_LONG	Gaia galactic longitude in decimal degrees	8-byte DOUBLE	pos.galactic.lon	deg	0	360
GAIA_MAG_QSO	QSO selected Ly-alpha mag: Gaia selection	4-byte REAL	phot.mag;em.opt	mag	--	--
GAIA_MAG_QSO_ERR	Error on GAIA_MAG_QSO	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
GALEX_COMP	Source compilation (bibcode) for GALEX_ID	ASCII Character	meta.bib.bibcode	--	--	--
GALEX_DEC	GALEX_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
GALEX_DR	GALEX data release	ASCII Character	time.release	--	--	--
GALEX_ID	GALEX target identifier	ASCII Character	meta.id	--	--	--
GALEX_MAG_FUV	GALEX magnitude in FUV band	4-byte REAL	phot.mag;em.UV	mag	--	--
GALEX_MAG_FUV_ERR	Error on GALEX_MAG_FUV	4-byte REAL	stat.error;phot.mag;em.UV	mag	0	--
GALEX_MAG_NUV	GALEX magnitude in NUV band	4-byte REAL	phot.mag;em.UV	mag	--	--

Column	Description	Format	UCD	Unit	Min	Max
GALEX_MAG_NUV_ERR	Error on GALEX_MAG_NUV	4-byte REAL	stat.error;phot.mag;em.UV	mag	0	--
GALEX_RA	GALEX_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
GENCAT	Catalogue/Source described in GENCAT_INFO	ASCII Character	meta.dataset	--	--	--
GENCAT_DEC	GENCAT_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	--	-90	90
GENCAT_DR	Data release of GENCAT_ID	ASCII Character	time.release	--	--	--
GENCAT_ID	Target identifier associated with GENCAT	ASCII Character	meta.id	--	--	--
GENCAT_INFO	Description of catalogue specified in GENCAT	ASCII Character	meta.title	--	--	--
GENCAT_RA	GENCAT_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	--	0	360
GENCAT_VAL1	Value for GENCAT_ID as in GENCAT_VAL1_INFO	4-byte REAL	stat.value	--	--	--
GENCAT_VAL1_ERR	Error on GENCAT_VAL1	4-byte REAL	stat.error	--	0	--
GENCAT_VAL1_INFO	Description of value in GENCAT_VAL1	ASCII Character	meta.title	--	--	--
GENCAT_VAL1_UNIT	Unit of GENCAT_VAL1	ASCII Character	meta.unit	--	--	--
GENCAT_VAL2	Value for GENCAT_ID as in GENCAT_VAL2_INFO	4-byte REAL	stat.value	--	--	--
GENCAT_VAL2_ERR	Error on GENCAT_VAL2	4-byte REAL	stat.error	--	0	--
GENCAT_VAL2_INFO	Description of value in GENCAT_VAL2	ASCII Character	meta.title	--	--	--
GENCAT_VAL2_UNIT	Unit of GENCAT_VAL2	ASCII Character	meta.unit	--	--	--
GENCAT_VAL3	Value for GENCAT_ID as in GENCAT_VAL3_INFO	4-byte REAL	stat.value	--	--	--
GENCAT_VAL3_ERR	Error on GENCAT_VAL3	4-byte REAL	stat.error	--	0	--
GENCAT_VAL3_INFO	Description of value in GENCAT_VAL3	ASCII Character	meta.title	--	--	--
GENCAT_VAL3_UNIT	Unit of GENCAT_VAL3	ASCII Character	meta.unit	--	--	--
GENCAT_VAL4	String value as in GENCAT_VAL4_INFO	ASCII Character	src.class	--	--	--
GENCAT_VAL4_INFO	Description of value in GENCAT_VAL4	ASCII Character	meta.title	--	--	--
GENCAT_VAL4_UNIT	Unit of GENCAT_VAL4	ASCII Character	meta.unit	--	--	--
HRSHL_DEC	HRSHL_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
HRSHL_DR	Herschel data release	ASCII Character	time.release	--	--	--
HRSHL_ID	Herschel target identifier	ASCII Character	meta.id	--	--	--
HRSHL_MAG_PACS1	Magnitude in PACS 60-85um band for HRSHL_ID	4-byte REAL	phot.mag;em.IR.FIR	mag	--	--
HRSHL_MAG_PACS1_ERR	Error on HRSHL_MAG_PACS1	4-byte REAL	stat.error;phot.mag;em.IR.FIR	mag	0	--
HRSHL_MAG_PACS2	Magnitude in PACS 85-125um band for HRSHL_ID	4-byte REAL	phot.mag;em.IR.FIR	mag	--	--
HRSHL_MAG_PACS2_ERR	Error on HRSHL_MAG_PACS2	4-byte REAL	stat.error;phot.mag;em.IR.FIR	mag	0	--

Column	Description	Format	UCD	Unit	Min	Max
HRSHL_MAG_PACS3	Magnitude in PACS 125-210um band for HRSHL_ID	4-byte REAL	phot.mag;em.IR.FIR	mag	--	--
HRSHL_MAG_PACS3_ERR	Error on HRSHL_MAG_PACS3	4-byte REAL	stat.error;phot.mag;em.IR.FIR	mag	0	--
HRSHL_MAG_SPR1	Magnitude in SPIRE 250um band for HRSHL_ID	4-byte REAL	phot.mag;em.IR.FIR	mag	--	--
HRSHL_MAG_SPR1_ERR	Error on HRSHL_MAG_SPR1	4-byte REAL	stat.error;phot.mag;em.IR.FIR	mag	0	--
HRSHL_MAG_SPR2	Magnitude in SPIRE 350um band for HRSHL_ID	4-byte REAL	phot.mag;em.IR.FIR	mag	--	--
HRSHL_MAG_SPR2_ERR	Error on HRSHL_MAG_SPR2	4-byte REAL	stat.error;phot.mag;em.IR.FIR	mag	0	--
HRSHL_MAG_SPR3	Magnitude in SPIRE 500um channel for HRSHL_ID	4-byte REAL	phot.mag;em.IR.FIR	mag	--	--
HRSHL_MAG_SPR3_ERR	Error on HRSHL_MAG_SPR3	4-byte REAL	stat.error;phot.mag;em.IR.FIR	mag	0	--
HRSHL_RA	HRSHL_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
IGAPS_DR	IGAPS data release	ASCII Character	time.release	--	--	--
IGAPS_ID	IGAPS target identifier	ASCII Character	meta.id	--	--	--
IGAPS_MAG_G	IGAPS g magnitude	4-byte REAL	phot.mag;em.opt	mag	--	--
IGAPS_MAG_G_ERR	Error on IGAPS_MAG_G	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
IGAPS_MAG_HA	IGAPS Halpha magnitude	4-byte REAL	phot.mag;em.opt	mag	--	--
IGAPS_MAG_HA_ERR	Error on IGAPS_MAG_HA	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
IGAPS_MAG_I	IGAPS i magnitude	4-byte REAL	phot.mag;em.opt	mag	--	--
IGAPS_MAG_I_ERR	Error on IGAPS_MAG_I	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
IGAPS_MAG_R_I	IGAPS r magnitude (IPHAS)	4-byte REAL	phot.mag;em.opt	mag	--	--
IGAPS_MAG_R_I_ERR	Error on IGAPS_MAG_R_I	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
IGAPS_MAG_R_U	IGAPS r magnitude (UVEX)	4-byte REAL	phot.mag;em.opt	mag	--	--
IGAPS_MAG_R_U_ERR	Error on IGAPS_MAG_R_U	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
IGAPS_MAG_U	IGAPS U magnitude	4-byte REAL	phot.mag;em.opt	mag	--	--
IGAPS_MAG_U_ERR	Error on IGAPS_MAG_U	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
IRCAT	Source of the mid IR observations	ASCII Character	meta.dataset	--	--	--
IRCAT_DEC	IRCAT_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
IRCAT_DR	Data release of IRCAT_ID	ASCII Character	time.release	--	--	--
IRCAT_ID	Target identifier associated with IRCAT	ASCII Character	meta.id	--	--	--
IRCAT_MAG_BD1	Magnitude in Band 1 for IRCAT_ID	4-byte REAL	phot.mag;em.IR	mag	--	--

Column	Description	Format	UCD	Unit	Min	Max
IRCAT_MAG_BD1_ERR	Error on IRCAT_MAG_BD1	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
IRCAT_MAG_BD1_FILT	Filter used for IRCAT_MAG_BD1	ASCII Character	meta.ref;instr.filter	--	--	--
IRCAT_MAG_BD2	Magnitude in Band 2 for IRCAT_ID	4-byte REAL	phot.mag;em.IR	mag	--	--
IRCAT_MAG_BD2_ERR	Error on IRCAT_MAG_BD2	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
IRCAT_MAG_BD2_FILT	Filter used for IRCAT_MAG_BD2	ASCII Character	meta.ref;instr.filter	--	--	--
IRCAT_MAG_BD3	Magnitude in Band 3 for IRCAT_ID	4-byte REAL	phot.mag;em.IR	mag	--	--
IRCAT_MAG_BD3_ERR	Error on IRCAT_MAG_BD3	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
IRCAT_MAG_BD3_FILT	Filter used for IRCAT_MAG_BD3	ASCII Character	meta.ref;instr.filter	--	--	--
IRCAT_MAG_BD4	Magnitude in Band 4 for IRCAT_ID	4-byte REAL	phot.mag;em.IR	mag	--	--
IRCAT_MAG_BD4_ERR	Error on IRCAT_MAG_BD4	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
IRCAT_MAG_BD4_FILT	Filter used for IRCAT_MAG_BD4	ASCII Character	meta.ref;instr.filter	--	--	--
IRCAT_RA	IRCAT_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
JPAS_DEC	JPAS_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
JPAS_DR	J-PAS data release	ASCII Character	time.release	--	--	--
JPAS_EPOCH	J-PAS epoch of the object (decimal years)	4-byte REAL	time.epoch	yr	0	--
JPAS_ID	J-PAS target identifier	ASCII Character	meta.id	--	--	--
JPAS_MAG_10069	Magnitude in the J-PAS 10069 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_10069_ERR	Error on JPAS_MAG_10069	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_3518	Magnitude in the J-PAS 3518 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_3518_ERR	Error on JPAS_MAG_3518	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_3785	Magnitude in the J-PAS 3785 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_3785_ERR	Error on JPAS_MAG_3785	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_3900	Magnitude in the J-PAS 3900 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_3900_ERR	Error on JPAS_MAG_3900	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_4000	Magnitude in the J-PAS 4000 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_4000_ERR	Error on JPAS_MAG_4000	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_4100	Magnitude in the J-PAS 4100 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_4100_ERR	Error on JPAS_MAG_4100	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--

Column	Description	Format	UCD	Unit	Min	Max
JPAS_MAG_4200	Magnitude in the J-PAS 4200 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_4200_ERR	Error on JPAS_MAG_4200	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_4300	Magnitude in the J-PAS 4300 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_4300_ERR	Error on JPAS_MAG_4300	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_4400	Magnitude in the J-PAS 4400 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_4400_ERR	Error on JPAS_MAG_4400	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_4500	Magnitude in the J-PAS 4500 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_4500_ERR	Error on JPAS_MAG_4500	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_4600	Magnitude in the J-PAS 4600 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_4600_ERR	Error on JPAS_MAG_4600	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_4700	Magnitude in the J-PAS 4700 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_4700_ERR	Error on JPAS_MAG_4700	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_4800	Magnitude in the J-PAS 4800 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_4800_ERR	Error on JPAS_MAG_4800	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_4900	Magnitude in the J-PAS 4900 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_4900_ERR	Error on JPAS_MAG_4900	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_5000	Magnitude in the J-PAS 5000 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_5000_ERR	Error on JPAS_MAG_5000	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_5100	Magnitude in the J-PAS 5100 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_5100_ERR	Error on JPAS_MAG_5100	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_5200	Magnitude in the J-PAS 5200 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_5200_ERR	Error on JPAS_MAG_5200	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_5300	Magnitude in the J-PAS 5300 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_5300_ERR	Error on JPAS_MAG_5300	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_5400	Magnitude in the J-PAS 5400 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_5400_ERR	Error on JPAS_MAG_5400	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_5500	Magnitude in the J-PAS 5500 band	4-byte REAL	phot.mag;em.opt	mag	--	--

Column	Description	Format	UCD	Unit	Min	Max
JPAS_MAG_5500_ERR	Error on JPAS_MAG_5500	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_5600	Magnitude in the J-PAS 5600 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_5600_ERR	Error on JPAS_MAG_5600	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_5700	Magnitude in the J-PAS 5700 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_5700_ERR	Error on JPAS_MAG_5700	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_5800	Magnitude in the J-PAS 5800 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_5800_ERR	Error on JPAS_MAG_5800	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_5900	Magnitude in the J-PAS 5900 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_5900_ERR	Error on JPAS_MAG_5900	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_6000	Magnitude in the J-PAS 6000 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_6000_ERR	Error on JPAS_MAG_6000	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_6100	Magnitude in the J-PAS 6100 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_6100_ERR	Error on JPAS_MAG_6100	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_6200	Magnitude in the J-PAS 6200 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_6200_ERR	Error on JPAS_MAG_6200	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_6300	Magnitude in the J-PAS 6300 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_6300_ERR	Error on JPAS_MAG_6300	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_6400	Magnitude in the J-PAS 6400 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_6400_ERR	Error on JPAS_MAG_6400	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_6500	Magnitude in the J-PAS 6500 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_6500_ERR	Error on JPAS_MAG_6500	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_6600	Magnitude in the J-PAS 6600 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_6600_ERR	Error on JPAS_MAG_6600	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_6700	Magnitude in the J-PAS 6700 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_6700_ERR	Error on JPAS_MAG_6700	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_6800	Magnitude in the J-PAS 6800 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_6800_ERR	Error on JPAS_MAG_6800	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--

Column	Description	Format	UCD	Unit	Min	Max
JPAS_MAG_6900	Magnitude in the J-PAS 6900 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_6900_ERR	Error on JPAS_MAG_6900	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_7000	Magnitude in the J-PAS 7000 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_7000_ERR	Error on JPAS_MAG_7000	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_7100	Magnitude in the J-PAS 7100 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_7100_ERR	Error on JPAS_MAG_7100	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_7200	Magnitude in the J-PAS 7200 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_7200_ERR	Error on JPAS_MAG_7200	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_7300	Magnitude in the J-PAS 7300 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_7300_ERR	Error on JPAS_MAG_7300	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_7400	Magnitude in the J-PAS 7400 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_7400_ERR	Error on JPAS_MAG_7400	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_7500	Magnitude in the J-PAS 7500 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_7500_ERR	Error on JPAS_MAG_7500	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_7600	Magnitude in the J-PAS 7600 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_7600_ERR	Error on JPAS_MAG_7600	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_7700	Magnitude in the J-PAS 7700 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_7700_ERR	Error on JPAS_MAG_7700	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_7800	Magnitude in the J-PAS 7800 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_7800_ERR	Error on JPAS_MAG_7800	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_7900	Magnitude in the J-PAS 7900 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_7900_ERR	Error on JPAS_MAG_7900	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_8000	Magnitude in the J-PAS 8000 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_8000_ERR	Error on JPAS_MAG_8000	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_8100	Magnitude in the J-PAS 8100 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_8100_ERR	Error on JPAS_MAG_8100	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_8200	Magnitude in the J-PAS 8200 band	4-byte REAL	phot.mag;em.opt	mag	--	--

Column	Description	Format	UCD	Unit	Min	Max
JPAS_MAG_8200_ERR	Error on JPAS_MAG_8200	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_8300	Magnitude in the J-PAS 8300 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_8300_ERR	Error on JPAS_MAG_8300	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_8400	Magnitude in the J-PAS 8400 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_8400_ERR	Error on JPAS_MAG_8400	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_8500	Magnitude in the J-PAS 8500 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_8500_ERR	Error on JPAS_MAG_8500	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_8600	Magnitude in the J-PAS 8600 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_8600_ERR	Error on JPAS_MAG_8600	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_8700	Magnitude in the J-PAS 8700 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_8700_ERR	Error on JPAS_MAG_8700	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_8800	Magnitude in the J-PAS 8800 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_8800_ERR	Error on JPAS_MAG_8800	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_8900	Magnitude in the J-PAS 8900 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_8900_ERR	Error on JPAS_MAG_8900	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_9000	Magnitude in the J-PAS 9000 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_9000_ERR	Error on JPAS_MAG_9000	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_9100	Magnitude in the J-PAS 9100 band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_9100_ERR	Error on JPAS_MAG_9100	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_G	Magnitude in the J-PAS g band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_G_ERR	Error on JPAS_MAG_G	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_QSO	JPAS magnitude for QSO selection	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_QSO_ERR	Error on JPAS_MAG_QSO	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_QSO_FILT	JPAS filters used to determine JPAS_MAG_QSO	ASCII Character	meta.ref;instr.filter	--	--	--
JPAS_MAG_R	Magnitude in the J-PAS r band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_R_ERR	Error on JPAS MAG_R	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_I	Magnitude in the J-PAS i band	4-byte REAL	phot.mag;em.opt	mag	--	--

Column	Description	Format	UCD	Unit	Min	Max
JPAS_MAG_I_ERR	Error on JPAS MAG_I	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_MAG_U	Magnitude in the J-PAS u band	4-byte REAL	phot.mag;em.opt	mag	--	--
JPAS_MAG_U_ERR	Error on JPAS_MAG_U	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
JPAS_RA	JPAS_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
LOFAR_CLASS	Radio source classification	ASCII Character	meta.code.class	--	--	--
LOFAR_CLASS_XID	Radio-optical cross-ID class	ASCII Character	meta.code.class	--	--	--
LOFAR_DEC	LOFAR_ID Declination	8-byte DOUBLE	pos.eq.dec	deg	-90	90
LOFAR_DEC_ERR	Uncertainty on LOFAR_DEC	8-byte DOUBLE	stat.error;pos.eq.dec	deg	0	--
LOFAR_DR	Data release of LOFAR HBA identifier (LOFAR_ID)	ASCII Character	time.release	--	--	--
LOFAR_FIELD	LOFAR field name	ASCII Character	pos;obs.field	--	--	--
LOFAR_FLUX_PEAK	Peak flux estimate LOFAR HBA band	4-byte REAL	phot.flux.density;em.radio.100-200MHz	Jy	--	--
LOFAR_FLUX_PEAK_ERR	Error on LOFAR_FLUX_PEAK	4-byte REAL	stat.error;phot.flux.density;em.radio.100-200MHz	Jy	0	--
LOFAR_FLUX_TOTAL	Total flux estimate LOFAR HBA band	4-byte REAL	phot.flux.density;em.radio.100-200MHz	Jy	--	--
LOFAR_FLUX_TOTAL_ERR	Error on LOFAR_FLUX_TOTAL	4-byte REAL	stat.error;phot.flux.density;em.radio.100-200MHz	Jy	0	--
LOFAR_ID	Official LOFAR HBA radio target identifier	ASCII Character	meta.id	--	--	--
LOFAR_ID_SUBCAT	LOFAR sub-catalogue radio target identifier	ASCII Character	meta.id	--	--	--
LOFAR_LBA_CAT	LOFAR LBA catalogue	ASCII Character	meta.dataset	--	--	--
LOFAR_LBA_DR	Data release of LOFAR_LBA_ID	ASCII Character	time.release	--	--	--
LOFAR_LBA_FLUX_PEAK	Peak flux estimate in the LOFAR LBA band	4-byte REAL	phot.flux.density;em.radio.20-100MHz	Jy	--	--
LOFAR_LBA_FLUX_PEAK_ERR	Error on LOFAR_LBA_FLUX_PEAK	4-byte REAL	stat.error;phot.flux.density;em.radio.20-100MHz	Jy	0	--
LOFAR_LBA_FLUX_TOTAL	Total flux estimate in the LOFAR LBA band	4-byte REAL	phot.flux.density;em.radio.20-100MHz	Jy	--	--
LOFAR_LBA_FLUX_TOTAL_ERR	Error on LOFAR_LBA_FLUX_TOTAL	4-byte REAL	stat.error;phot.flux.density;em.radio.20-100MHz	Jy	0	--

Column	Description	Format	UCD	Unit	Min	Max
LOFAR_LBA_ID	LOFAR LBA catalogue target identifier	ASCII Character	meta.id	--	--	--
LOFAR_LBA_RMS	Local RMS estimate for LOFAR LBA band	4-byte REAL	stat.rms;phot.flux.density;em.radio.20-100MHz	Jy	0	--
LOFAR_LUM	Total LOFAR HBA luminosity estimate	4-byte REAL	phys.luminosity;em.radio.100-200MHz	W/Hz	--	--
LOFAR_LUM_ERR	Error on LOFAR_LUM	4-byte REAL	stat.error;phys.luminosity;em.radio.100-200MHz	W/Hz	0	--
LOFAR_MAJ	FWHM of the major axis of the source	8-byte DOUBLE	phys.angSize.smajAxis	deg	0	--
LOFAR_MAJ_ERR	RMS uncertainty on LOFAR_MAJ	8-byte DOUBLE	stat.error;phys.angSize.smajAxis	deg	0	--
LOFAR_MIN	FWHM of the minor axis of the source	8-byte DOUBLE	phys.angSize.sminAxis	deg	0	--
LOFAR_MIN_ERR	RMS uncertainty on LOFAR_MIN	8-byte DOUBLE	stat.error;phys.angSize.sminAxis	deg	0	--
LOFAR_PA	Pos. angle of fitted major axis (east of north)	8-byte DOUBLE	pos.posAng	deg	0	360
LOFAR_PA_ERR	Uncertainty on LOFAR_PA	8-byte DOUBLE	stat.error;pos.posAng	deg	0	--
LOFAR_POINTING	LOFAR pointing ID	ASCII Character	pos;obs.field	--	--	--
LOFAR_RA	LOFAR_ID Right Ascension	8-byte DOUBLE	pos.eq.ra	deg	0	360
LOFAR_RA_ERR	Uncertainty on LOFAR_RA	8-byte DOUBLE	stat.error;pos.eq.ra	deg	0	--
LOFAR_RMS	Local RMS estimate for LOFAR HBA band	4-byte REAL	stat.rms;phot.flux.density;em.radio.100-200MHz	Jy	0	--
LOGGCAT	Provenance of surface gravity (log g)	ASCII Character	meta.dataset	--	--	--
LOGGCAT_DEC	LOGGCAT_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
LOGGCAT_DR	Data release of LOGGCAT_ID	ASCII Character	time.release	--	--	--
LOGGCAT_ID	Target identifier associated with LOGGCAT	ASCII Character	meta.id	--	--	--
LOGGCAT_LOGG	Surface gravity (log g) for LOGGCAT_ID	4-byte REAL	phys.gravity	log(cm/s^2)	--	--
LOGGCAT_LOGG_ERR	Error on LOGGCAT_LOGG	4-byte REAL	stat.error;phys.gravity	log(cm/s^2)	0	--
LOGGCAT_RA	LOGGCAT_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
NIRCAT	Source of the YJHKKs (NIR) observations	ASCII Character	meta.dataset	--	--	--
NIRCAT_DEC	NIRCAT_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90

Column	Description	Format	UCD	Unit	Min	Max
NIRCAT_DR	Data release of NIRCAT_ID	ASCII Character	time.release	--	--	--
NIRCAT_ID	Target identifier associated with NIRCAT	ASCII Character	meta.id	--	--	--
NIRCAT_MAG_H	Magnitude in the H band for NIRCAT_ID	4-byte REAL	phot.mag;em.IR.NIR	mag	--	--
NIRCAT_MAG_H_ERR	Error on NIRCAT_MAG_H	4-byte REAL	stat.error;phot.mag;em.IR.NIR	mag	0	--
NIRCAT_MAG_J	Magnitude in the J band for NIRCAT_ID	4-byte REAL	phot.mag;em.IR.NIR	mag	--	--
NIRCAT_MAG_J_ERR	Error on NIRCAT_MAG_J	4-byte REAL	stat.error;phot.mag;em.IR.NIR	mag	0	--
NIRCAT_MAG_K	Magnitude in the K or Ks band for NIRCAT_ID	4-byte REAL	phot.mag;em.IR.NIR	mag	--	--
NIRCAT_MAG_K_ERR	Error on NIRCAT_MAG_K	4-byte REAL	stat.error;phot.mag;em.IR.NIR	mag	0	--
NIRCAT_MAG_Y	Magnitude in the Y band for NIRCAT_ID	4-byte REAL	phot.mag;em.IR.NIR	mag	--	--
NIRCAT_MAG_Y_ERR	Error on NIRCAT_MAG_Y	4-byte REAL	stat.error;phot.mag;em.IR.NIR	mag	0	--
NIRCAT_RA	NIRCAT_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
OPTCAT	Source of the UBVRIugirzy (OPT) observations	ASCII Character	meta.dataset	--	--	--
OPTCAT_DEC	OPTCAT_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
OPTCAT_DR	Data release of OPTCAT_ID	ASCII Character	time.release	--	--	--
OPTCAT_ID	Target identifier associated with OPTCAT	ASCII Character	meta.id	--	--	--
OPTCAT_MAG_B	Magnitude in the B band for OPTCAT_ID	4-byte REAL	phot.mag;em.opt	mag	--	--
OPTCAT_MAG_B_ERR	Error on OPTCAT_MAG_B	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
OPTCAT_MAG_G	Magnitude in the g band for OPTCAT_ID	4-byte REAL	phot.mag;em.opt	mag	--	--
OPTCAT_MAG_G_ERR	Error on OPTCAT_MAG_G	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
OPTCAT_MAG_I	Magnitude in the I or i band for OPTCAT_ID	4-byte REAL	phot.mag;em.opt	mag	--	--
OPTCAT_MAG_I_ERR	Error on OPTCAT_MAG_I	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
OPTCAT_MAG_R	Magnitude in the R or r band for OPTCAT_ID	4-byte REAL	phot.mag;em.opt	mag	--	--
OPTCAT_MAG_R_ERR	Error on OPTCAT_MAG_R	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
OPTCAT_MAG_U	Magnitude in the U or u band for OPTCAT_ID	4-byte REAL	phot.mag;em.opt	mag	--	--
OPTCAT_MAG_U_AU	OPTCAT_MAG_U corrected for Extinction	4-byte REAL	phot.color.excess	mag	--	--
OPTCAT_MAG_U_ERR	Error on OPTCAT_MAG_U	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
OPTCAT_MAG_V	Magnitude in the V band for OPTCAT_ID	4-byte REAL	phot.mag;em.opt	mag	--	--
OPTCAT_MAG_V_ERR	Error on OPTCAT_MAG_V	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--

Column	Description	Format	UCD	Unit	Min	Max
OPTCAT_MAG_Y	Magnitude in the y band for OPTCAT_ID	4-byte REAL	phot.mag;em.opt	mag	--	--
OPTCAT_MAG_Y_ERR	Error on OPTCAT_MAG_Y	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
OPTCAT_MAG_Z	Magnitude in the z band for OPTCAT_ID	4-byte REAL	phot.mag;em.opt	mag	--	--
OPTCAT_MAG_Z_AZ	OPTCAT_MAG_Z corrected for Extinction	4-byte REAL	phot.color.excess	mag	--	--
OPTCAT_MAG_Z_ERR	Error on OPTCAT_MAG_Z	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
OPTCAT_RA	OPTCAT_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
PAU_DEC	PAU_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
PAU_DR	PAU data release	ASCII Character	time.release	--	--	--
PAU_ID	PAU target identifier	ASCII Character	meta.id	--	--	--
PAU_MAG_G	Magnitude in the PAU g band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_G_ERR	Error on PAU_EMAG_G	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_I	Magnitude in the PAU i band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_I_ERR	Error on PAU_EMAG_I	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB455	Magnitude in the PAU NB455 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB455_ERR	Error on PAU_MAG_NB455	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB465	Magnitude in the PAU NB465 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB465_ERR	Error on PAU_MAG_NB465	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB475	Magnitude in the PAU NB475 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB475_ERR	Error on PAU_MAG_NB475	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB485	Magnitude in the PAU NB485 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB485_ERR	Error on PAU_MAG_NB485	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB495	Magnitude in the PAU NB495 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB495_ERR	Error on PAU_MAG_NB495	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB505	Magnitude in the PAU NB505 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB505_ERR	Error on PAU_MAG_NB505	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB515	Magnitude in the PAU NB515 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB515_ERR	Error on PAU_MAG_NB515	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--

Column	Description	Format	UCD	Unit	Min	Max
PAU_MAG_NB525	Magnitude in the PAU NB525 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB525_ERR	Error on PAU_MAG_NB525	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB535	Magnitude in the PAU NB535 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB535_ERR	Error on PAU_MAG_NB535	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB545	Magnitude in the PAU NB545 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB545_ERR	Error on PAU_MAG_NB545	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB555	Magnitude in the PAU NB555 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB555_ERR	Error on PAU_MAG_NB555	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB565	Magnitude in the PAU NB565 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB565_ERR	Error on PAU_MAG_NB565	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB575	Magnitude in the PAU NB575 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB575_ERR	Error on PAU_MAG_NB575	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB585	Magnitude in the PAU NB585 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB585_ERR	Error on PAU_MAG_NB585	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB595	Magnitude in the PAU NB595 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB595_ERR	Error on PAU_MAG_NB595	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB605	Magnitude in the PAU NB605 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB605_ERR	Error on PAU_MAG_NB605	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB615	Magnitude in the PAU NB615 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB615_ERR	Error on PAU_MAG_NB615	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB625	Magnitude in the PAU NB625 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB625_ERR	Error on PAU_MAG_NB625	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB635	Magnitude in the PAU NB635 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB635_ERR	Error on PAU_MAG_NB635	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB645	Magnitude in the PAU NB645 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB645_ERR	Error on PAU_MAG_NB645	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB655	Magnitude in the PAU NB655 band	4-byte REAL	phot.mag;em.opt	mag	--	--

Column	Description	Format	UCD	Unit	Min	Max
PAU_MAG_NB655_ERR	Error on PAU_MAG_NB655	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB665	Magnitude in the PAU NB665 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB665_ERR	Error on PAU_MAG_NB665	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB675	Magnitude in the PAU NB675 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB675_ERR	Error on PAU_MAG_NB675	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB685	Magnitude in the PAU NB685 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB685_ERR	Error on PAU_MAG_NB685	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB695	Magnitude in the PAU NB695 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB695_ERR	Error on PAU_MAG_NB695	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB705	Magnitude in the PAU NB705 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB705_ERR	Error on PAU_MAG_NB705	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB715	Magnitude in the PAU NB715 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB715_ERR	Error on PAU_MAG_NB715	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB725	Magnitude in the PAU NB725 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB725_ERR	Error on PAU_MAG_NB725	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB735	Magnitude in the PAU NB735 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB735_ERR	Error on PAU_MAG_NB735	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB745	Magnitude in the PAU NB745 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB745_ERR	Error on PAU_MAG_NB745	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB755	Magnitude in the PAU NB755 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB755_ERR	Error on PAU_MAG_NB755	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB765	Magnitude in the PAU NB765 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB765_ERR	Error on PAU_MAG_NB765	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB775	Magnitude in the PAU NB775 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB775_ERR	Error on PAU_MAG_NB775	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB785	Magnitude in the PAU NB785 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB785_ERR	Error on PAU_MAG_NB785	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--

Column	Description	Format	UCD	Unit	Min	Max
PAU_MAG_NB795	Magnitude in the PAU NB795 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB795_ERR	Error on PAU_MAG_NB795	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB805	Magnitude in the PAU NB805 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB805_ERR	Error on PAU_MAG_NB805	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB815	Magnitude in the PAU NB815 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB815_ERR	Error on PAU_MAG_NB815	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB825	Magnitude in the PAU NB825 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB825_ERR	Error on PAU_MAG_NB825	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB835	Magnitude in the PAU NB835 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB835_ERR	Error on PAU_MAG_NB835	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_NB845	Magnitude in the PAU NB845 band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_NB845_ERR	Error on PAU_MAG_NB845	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_R	Magnitude in the PAU r band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_R_ERR	Error on PAU_EMAG_R	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_U	Magnitude in the PAU u band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_U_ERR	Error on PAU_EMAG_U	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_MAG_Z	Magnitude in the PAU z band	4-byte REAL	phot.mag;em.opt	mag	--	--
PAU_MAG_Z_ERR	Error on PAU_EMAG_Z	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PAU_RA	PAU_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
PHOT_LOGG	Photometric surface gravity	4-byte REAL	phys.gravity	log(cm/s^2)	0	0
PHOT_LOGG_ERR	Error on PHOT_LOGG	4-byte REAL	stat.error;phys.gravity	log(cm/s^2)	0	0
PHOT_TEFF	Photometric Effective Temperature	4-byte REAL	phys.temperature.effective	K	0	0
PHOT_TEFF_ERR	Error on PHOT_TEFF	4-byte REAL	stat.error;phys.temperature.effective	K	0	0
PHOTOZCAT	Provenance of photometric redshift	ASCII Character	meta.dataset	--	--	--
PHOTOZCAT_DEC	PHOTOZCAT_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
PHOTOZCAT_DR	Data release of PHOTOZCAT_ID	ASCII Character	time.release	--	--	--
PHOTOZCAT_ID	Target identifier associated with PHOTOZCAT	ASCII Character	meta.id	--	--	--

Column	Description	Format	UCD	Unit	Min	Max
PHOTOZCAT_RA	PHOTOZCAT_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
PHOTOZCAT_Z	Photometric redshift for PHOTOZCAT_ID	4-byte REAL	src.redshift.phot	--	--	--
PHOTOZCAT_Z_CHISQ	Chi square of PHOTOZCAT_Z	4-byte REAL	stat.fit.chi2;src.redshift.phot	--	--	--
PHOTOZCAT_Z_ERR	Error on PHOTOZCAT_Z	4-byte REAL	stat.error;src.redshift.phot	--	0	--
PHOTOZCAT_Z_GALTEMP	Photometric redshift assumes source = galaxy	4-byte REAL	src.redshift.phot	--	--	--
PHOTOZCAT_Z_SEC	Secondary photometric redshift for PHOTOZCAT	4-byte REAL	src.redshift.phot	--	--	--
PHOTOZCAT_Z_SEC_ERR	Error on PHOTOZCAT_Z_SEC	4-byte REAL	stat.error;src.redshift.phot	--	0	--
PS_DEC	PS_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
PS_DR	PanSTARRS data release	ASCII Character	time.release	--	--	--
PS_ID	PanSTARRS target identifier	ASCII Character	meta.id	--	--	--
PS_MAG_G	PanSTARRS magnitude in the G band	4-byte REAL	phot.mag;em.opt	mag	--	--
PS_MAG_G_ERR	Error on PS_MAG_G	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PS_MAG_I	PanSTARRS magnitude in the i band	4-byte REAL	phot.mag;em.opt	mag	--	--
PS_MAG_I_ERR	Error on PS_MAG_I	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PS_MAG_R	PanSTARRS magnitude in the r band	4-byte REAL	phot.mag;em.opt	mag	--	--
PS_MAG_R_ERR	Error on PS_MAG_R	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PS_MAG_Y	PanSTARRS magnitude in the y band	4-byte REAL	phot.mag;em.opt	mag	--	--
PS_MAG_Y_ERR	Error on PS_MAG_Y	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PS_MAG_Z	PanSTARRS magnitude in the z band	4-byte REAL	phot.mag;em.opt	mag	--	--
PS_MAG_Z_ERR	Error on PS_MAG_Z	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
PS_RA	PS_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
QSOSRC	Source catalogue for QSO selection	ASCII Character	meta.dataset	--	--	--
QSOSRC_DEC	QSOSRC_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
QSOSRC_PROB	Probability of QSO from source	8-byte DOUBLE	stat.probability	--	0	--
QSOSRC_RA	QSOSRC_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
QSOSRC_Z	Redshift for QSO selection	4-byte REAL	src.redshift	--	--	--
QSOSRC_Z_ERR	Error on QSOSRC_Z	4-byte REAL	stat.error;src.redshift	--	0	--

Column	Description	Format	UCD	Unit	Min	Max
S1400_CAT	Source of the 1400MHz radio observations	ASCII Character	meta.dataset	--	--	--
S1400_DR	Data release of S1400_ID	ASCII Character	time.release	--	--	--
S1400_FLUX_PEAK	Peak flux estimate at 1400MHz	4-byte REAL	phot.flux.density;em.radio.750-1500MHz	Jy	--	--
S1400_FLUX_PEAK_ERR	Error on S1400_FLUX_PEAK	4-byte REAL	stat.error;phot.flux.density;em.radio.750-1500MHz	Jy	0	--
S1400_FLUX_TOTAL	Total flux estimate at 1400MHz	4-byte REAL	phot.flux.density;em.radio.750-1500MHz	Jy	--	--
S1400_FLUX_TOTAL_ERR	Error on S1400_FLUX_TOTAL	4-byte REAL	stat.error;phot.flux.density;em.radio.750-1500MHz	Jy	0	--
S1400_ID	1400MHz radio target identifier	ASCII Character	meta.id	--	--	--
S1400_RMS	Local RMS estimate at 1400MHz	4-byte REAL	stat.rms;phot.flux.density;em.radio.750-1500MHz	Jy	0	--
S3000_CAT	Source of the 3000MHz radio observations	ASCII Character	meta.dataset	--	--	--
S3000_DR	Data release of S3000_ID	ASCII Character	time.release	--	--	--
S3000_FLUX_PEAK	Peak flux estimate at 3000MHz	4-byte REAL	phot.flux.density;em.radio.1500-3000MHz	Jy	--	--
S3000_FLUX_PEAK_ERR	Error on S3000_FLUX_PEAK	4-byte REAL	stat.error;phot.flux.density;em.radio.1500-3000MHz	Jy	0	--
S3000_FLUX_TOTAL	Total flux estimate at 3000MHz	4-byte REAL	phot.flux.density;em.radio.1500-3000MHz	Jy	--	--
S3000_FLUX_TOTAL_ERR	Error on S3000_FLUX_TOTAL	4-byte REAL	stat.error;phot.flux.density;em.radio.1500-3000MHz	Jy	0	--
S3000_ID	3000MHz radio target identifier	ASCII Character	meta.id	--	--	--
S3000_RMS	Local RMS estimate at 3000MHz	4-byte REAL	stat.rms;phot.flux.density;em.radio.1500-3000MHz	Jy	0	--
S325_CAT	Source of the 625MHz radio observations	ASCII Character	meta.dataset	--	--	--
S325_DR	Data release of S325_ID	ASCII Character	time.release	--	--	--
S325_FLUX_PEAK	Peak flux estimate at approximately 325MHz	4-byte REAL	phot.flux.density;em.radio.200-400MHz	Jy	--	--
S325_FLUX_PEAK_ERR	Error on S325_FLUX_PEAK	4-byte REAL	stat.error;phot.flux.density;em.radi	Jy	0	--

Column	Description	Format	UCD	Unit	Min	Max
			o.200-400MHz			
S325_FLUX_TOTAL	Total flux estimate at approximately 325MHz	4-byte REAL	phot.flux.density;em.radio.200-400MHz	Jy	--	--
S325_FLUX_TOTAL_ERR	Error on S325_FLUX_TOTAL	4-byte REAL	stat.error;phot.flux.density;em.radio.200-400MHz	Jy	0	--
S325_ID	325MHz radio target identifier	ASCII Character	meta.id	--	--	--
S325_RMS	Local RMS estimate at 325MHz	4-byte REAL	stat.rms;phot.flux.density;em.radio.200-400MHz	Jy	0	--
S625_CAT	Source of the 625MHz radio observations	ASCII Character	meta.dataset	--	--	--
S625_DR	Data release of S625_ID	ASCII Character	time.release	--	--	--
S625_FLUX_PEAK	Peak flux estimate at approximately 625MHz	4-byte REAL	phot.flux.density;em.radio.400-750MHz	Jy	--	--
S625_FLUX_PEAK_ERR	Error on S625_FLUX_PEAK	4-byte REAL	stat.error;phot.flux.density;em.radio.400-750MHz	Jy	0	--
S625_FLUX_TOTAL	Total flux estimate at approximately 625MHz	4-byte REAL	phot.flux.density;em.radio.400-750MHz	Jy	--	--
S625_FLUX_TOTAL_ERR	Error on S625_FLUX_TOTAL	4-byte REAL	stat.error;phot.flux.density;em.radio.400-750MHz	Jy	0	--
S625_ID	625MHz radio target identifier	ASCII Character	meta.id	--	--	--
S625_RMS	Local RMS estimate at 625MHz	4-byte REAL	stat.rms;phot.flux.density;em.radio.400-750MHz	Jy	0	--
SCHLGL_AV_TOTAL	Interstellar extinction (Schlegel et al. 1998)	4-byte REAL	phys.absorption.gal	mag	--	--
SDSS_DEC	SDSS_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
SDSS_DR	SDSS data release	ASCII Character	time.release	--	--	--
SDSS_EPOCH	SDSS epoch of the object in decimal years	4-byte REAL	time.epoch	yr	0	--
SDSS_FIBRE_MAG_G	SDSS fibre magnitude in g band	4-byte REAL	phot.mag;em.opt	mag	--	--
SDSS_FIBRE_MAG_G_ERR	Error on SDSS_FIBRE_MAG_G	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
SDSS_FIBRE_MAG_I	SDSS fibre magnitude in i band	4-byte REAL	phot.mag;em.opt	mag	--	--
SDSS_FIBRE_MAG_I_ERR	Error on SDSS_FIBRE_MAG_I	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
SDSS_FIBRE_MAG_R	SDSS fibre magnitude in r band	4-byte REAL	phot.mag;em.opt	mag	--	--

Column	Description	Format	UCD	Unit	Min	Max
SDSS_FIBRE_MAG_R_ERR	Error on SDSS_FIBRE_MAG_R	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
SDSS_ID	SDSS target identifier	ASCII Character	meta.id	--	--	--
SDSS_MAG_G	SDSS magnitude in g band	4-byte REAL	phot.mag;em.opt	mag	--	--
SDSS_MAG_G_ERR	Error on SDSS_MAG_G	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
SDSS_MAG_I	SDSS magnitude in i band	4-byte REAL	phot.mag;em.opt	mag	--	--
SDSS_MAG_I_ERR	Error on SDSS_MAG_I	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
SDSS_MAG_R	SDSS magnitude in r band	4-byte REAL	phot.mag;em.opt	mag	--	--
SDSS_MAG_R_ERR	Error on SDSS_MAG_R	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
SDSS_MAG_U	SDSS magnitude in u band	4-byte REAL	phot.mag;em.opt	mag	--	--
SDSS_MAG_U_ERR	Error on SDSS_MAG_U	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
SDSS_MAG_Z	SDSS magnitude in z band	4-byte REAL	phot.mag;em.opt	mag	--	--
SDSS_MAG_Z_ERR	Error on SDSS_MAG_Z	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
SDSS_PHOTO_Z	Photometric redshift from SDSS	4-byte REAL	src.redshift.phot	--	--	--
SDSS_PHOTO_Z_ERR	Error on SDSS_PHOTO_Z	4-byte REAL	stat.error;src.redshift.phot	--	0	--
SDSS_RA	SDSS_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
SDSS_SPEC_Z	Spectroscopic redshift from SDSS	4-byte REAL	src.redshift;spect	--	--	--
SDSS_SPEC_Z_ERR	Error on SDSS_SPEC_Z	4-byte REAL	stat.error;src.redshift;spect	--	0	--
SPECTRAL_INDEX_144_1400	Spectral index between 144 and 1400MHz	4-byte REAL	spect.index	--	--	--
SPECTRAL_INDEX_144_1400_ERR	Error on SPECTRAL_INDEX_144_1400	4-byte REAL	stat.error;spect.index	--	0	--
SPECZCAT	Provenance of spectroscopic redshift	ASCII Character	meta.dataset	--	--	--
SPECZCAT_DEC	SPECZCAT_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
SPECZCAT_DR	Data release of SPECZCAT_ID	ASCII Character	time.release	--	--	--
SPECZCAT_ID	Target identifier associated with SPECZCAT	ASCII Character	meta.id	--	--	--
SPECZCAT_RA	SPECZCAT_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
SPECZCAT_Z	Spectroscopic redshift for SPECZCAT_ID	4-byte REAL	src.redshift;spect	--	--	--
SPECZCAT_Z_ERR	Error on SPECZCAT_Z	4-byte REAL	stat.error;src.redshift;spect	--	0	--
SPECZCAT_Z_FLAG	Flag on SPECZCAT_Z	4-byte REAL	meta.code;src.redshift;spect	--	--	--

Column	Description	Format	UCD	Unit	Min	Max
SPTZR_COMP	Source compilation (bibcode) for SPTZR_ID	ASCII Character	meta.bib.bibcode	--	--	--
SPTZR_DEC	SPTZR_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
SPTZR_DR	Spitzer data release	ASCII Character	time.release	--	--	--
SPTZR_ID	Spitzer target identifier	ASCII Character	meta.id	--	--	--
SPTZR_MAG_IRAC1	Magnitude in IRAC 3.6um channel for SPTZR_ID	4-byte REAL	phot.mag;em.IR	mag	--	--
SPTZR_MAG_IRAC1_ERR	Error on SPTZR_MAG_IRAC1	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
SPTZR_MAG_IRAC2	Magnitude in IRAC 4.5um channel for SPTZR_ID	4-byte REAL	phot.mag;em.IR	mag	--	--
SPTZR_MAG_IRAC2_ERR	Error on SPTZR_MAG_IRAC2	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
SPTZR_MAG_IRAC3	Magnitude in IRAC 5.8um channel for SPTZR_ID	4-byte REAL	phot.mag;em.IR	mag	--	--
SPTZR_MAG_IRAC3_ERR	Error on SPTZR_MAG_IRAC3	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
SPTZR_MAG_IRAC4	Magnitude in IRAC 8.0um channel for SPTZR_ID	4-byte REAL	phot.mag;em.IR	mag	--	--
SPTZR_MAG_IRAC4_ERR	Error on SPTZR_MAG_IRAC4	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
SPTZR_MAG_MIPS1	Magnitude in MIPS 24um band for SPTZR_ID	4-byte REAL	phot.mag;em.IR	mag	--	--
SPTZR_MAG_MIPS1_ERR	Error on SPTZR_MAG_MIPS1	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
SPTZR_MAG_MIPS2	Magnitude in MIPS 70um band for SPTZR_ID	4-byte REAL	phot.mag;em.IR	mag	--	--
SPTZR_MAG_MIPS2_ERR	Error on SPTZR_MAG_MIPS2	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
SPTZR_MAG_MIPS3	Magnitude in MIPS 160um band for SPTZR_ID	4-byte REAL	phot.mag;em.IR	mag	--	--
SPTZR_MAG_MIPS3_ERR	Error on SPTZR_MAG_MIPS3	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
SPTZR_RA	SPTZR_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
STEPS_PHOT_FLAG	StePS: Masked areas, bright stars, Star/Galaxy	2-byte INTEGER	meta.code; phot.mag;em.opt	--	0	--
STEPS_SELECT_IAB	StePS: Selection on I (AB system) magnitude	4-byte REAL	phot.mag;em.opt	mag	--	--
STEPS_SELECT_Z	StePS: PHOTOZCAT_Z versus SPECZCAT_Z selection	4-byte REAL	src.redshift	--	--	--
STEPS_SELECT_Z_FLAG	StePS: Redshift Selection Flag-phot=0, spec=1	2-byte INTEGER	meta.code;src.redshift	--	0	1
TEFFCAT	Provenance of effective temperature (Teff)	ASCII Character	meta.dataset	--	--	--
TEFFCAT_DEC	TEFFCAT_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
TEFFCAT_DR	Data release of TEFFCAT_ID	ASCII Character	time.release	--	--	--
TEFFCAT_ID	Target identifer associated with TEFFCAT	ASCII Character	meta.id	--	--	--

Column	Description	Format	UCD	Unit	Min	Max
TEFFCAT_RA	TEFFCAT_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
TEFFCAT_TEFF	Effective temperature (Teff) for TEFFCAT_ID	4-byte REAL	phys.temperature.effective	K	0	--
TEFFCAT_TEFF_ERR	Error on TEFFCAT_TEFF	4-byte REAL	stat.error;phys.temperature.effective	K	0	--
UHS_DR	UHS data release	ASCII Character	time.release	--	--	--
UHS_ID	UKIRT Hemisphere Survey target identifier	ASCII Character	meta.id	--	--	--
UHS_MAG_J	UHS magnitude in J band	4-byte REAL	phot.mag;em.IR	mag	--	--
UHS_MAG_J_ERR	Error on UHS_MAG_J	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
VPHAS_DR	VPHAS data release	ASCII Character	time.release	--	--	--
VPHAS_ID	VPHAS target identifier	ASCII Character	meta.id	--	--	--
VPHAS_MAG_G	VPHAS magnitude in g band	4-byte REAL	phot.mag;em.opt	mag	--	--
VPHAS_MAG_G_ERR	Error on VPHAS_MAG_G	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
VPHAS_MAG_HA	VPHAS magnitude in Halpha band	4-byte REAL	phot.mag;em.opt	mag	--	--
VPHAS_MAG_HA_ERR	Error on VPHAS_MAG_HA	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
VPHAS_MAG_I	VPHAS magnitude in i band	4-byte REAL	phot.mag;em.opt	mag	--	--
VPHAS_MAG_I_ERR	Error on VPHAS_MAG_I	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
VPHAS_MAG_R	VPHAS magnitude in r band (red)	4-byte REAL	phot.mag;em.opt	mag	--	--
VPHAS_MAG_R_ERR	Error on VPHAS_MAG_R	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
VPHAS_MAG_R2	VPHAS magnitude in r band (blue)	4-byte REAL	phot.mag;em.opt	mag	--	--
VPHAS_MAG_R2_ERR	Error on VPHAS_MAG_R2	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
VPHAS_MAG_U	VPHAS magnitude in u band	4-byte REAL	phot.mag;em.opt	mag	--	--
VPHAS_MAG_U_ERR	Error on VPHAS_MAG_U	4-byte REAL	stat.error;phot.mag;em.opt	mag	0	--
WD_COM	White Dwarfs: Notes on previously known targets	ASCII Character	meta.note	--	--	--
WISE_DEC	WISE_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
WISE_DR	WISE data release	ASCII Character	meta.id	--	--	--
WISE_ID	WISE source identifier from WISE catalogue	ASCII Character	meta.id	--	--	--
WISE_MAG_W1	WISE magnitude in W1 (3.4um) band	4-byte REAL	phot.mag;em.IR	mag	--	--
WISE_MAG_W1_ERR	Error on WISE_MAG_W1	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--

Column	Description	Format	UCD	Unit	Min	Max
WISE_MAG_W2	WISE magnitude in W2 (4.6um) band	4-byte REAL	phot.mag;em.IR	mag	--	--
WISE_MAG_W2_ERR	Error on WISE_MAG_W2	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
WISE_MAG_W3	WISE magnitude in W3 (12um) band	4-byte REAL	phot.mag;em.IR	mag	--	--
WISE_MAG_W3_ERR	Error on WISE_MAG_W3	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
WISE_MAG_W4	WISE magnitude in W4 (22um) band	4-byte REAL	phot.mag;em.IR	mag	--	--
WISE_MAG_W4_ERR	Error on WISE_MAG_W4	4-byte REAL	stat.error;phot.mag;em.IR	mag	0	--
WISE_RA	WISE_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360
XRYCAT	Source of the X-ray observations	ASCII Character	meta.dataset	--	--	--
XRYCAT_DEC	XRYCAT_ID Declination (decimal degrees)	8-byte DOUBLE	pos.eq.dec	deg	-90	90
XRYCAT_DR	Data release of XRYCAT_ID	ASCII Character	time.release	--	--	--
XRYCAT_ID	Target identifier associated with XRYCAT	ASCII Character	meta.id	--	--	--
XRYCAT_B1_FLUX	X-ray flux in the B1 band	4-byte REAL	phot.flux;em.X-ray	erg/(s*cm^2)	--	--
XRYCAT_B1_FLUX_ERR	Error on XRYCAT_B1_FLUX	4-byte REAL	stat.error;phot.flux;em.X-ray	erg/(s*cm^2)	0	--
XRYCAT_B1_INFO	B1_FLUX info: instrument + energy band (keV)	ASCII Character	meta.title	--	--	--
XRYCAT_B2_FLUX	X-ray flux in the B2 band	4-byte REAL	phot.flux;em.X-ray	erg/(s*cm^2)	--	--
XRYCAT_B2_FLUX_ERR	Error on XRYCAT_B2_FLUX	4-byte REAL	stat.error;phot.flux;em.X-ray	erg/(s*cm^2)	0	--
XRYCAT_B2_INFO	B2_FLUX info: instrument + energy band (keV)	ASCII Character	meta.title	--	--	--
XRYCAT_B3_FLUX	X-ray flux in the B3 band	4-byte REAL	phot.flux;em.X-ray	erg/(s*cm^2)	--	--
XRYCAT_B3_FLUX_ERR	Error on XRYCAT_B3_FLUX	4-byte REAL	stat.error;phot.flux;em.X-ray	erg/(s*cm^2)	0	--
XRYCAT_B3_INFO	B3_FLUX info: instrument + energy band (keV)	ASCII Character	meta.title	--	--	--
XRYCAT_B4_FLUX	X-ray flux in the B4 band	4-byte REAL	phot.flux;em.X-ray	erg/(s*cm^2)	--	--
XRYCAT_B4_FLUX_ERR	Error on XRYCAT_B4_FLUX	4-byte REAL	stat.error;phot.flux;em.X-ray	erg/(s*cm^2)	0	--
XRYCAT_B4_INFO	B4_FLUX info: instrument + energy band (keV)	ASCII Character	meta.title	--	--	--
XRYCAT_B5_FLUX	X-ray flux in the B5 band	4-byte REAL	phot.flux;em.X-ray	erg/(s*cm^2)	--	--
XRYCAT_B5_FLUX_ERR	Error on XRYCAT_B5_FLUX	4-byte REAL	stat.error;phot.flux;em.X-ray	erg/(s*cm^2)	0	--
XRYCAT_B5_INFO	B5_FLUX info: instrument + energy band (keV)	ASCII Character	meta.title	--	--	--
XRYCAT_RA	XRYCAT_ID Right Ascension (decimal degrees)	8-byte DOUBLE	pos.eq.ra	deg	0	360

Appendix B - **Acronyms**

Table 32 Acronyms

Acronym	Definition
APS	Advanced Processing System
CCG	Calibration Coordination Group
CPS	Core Processing System
(D)PS	(Deputy) Project Scientist
GA-LRdisc	Galactic Archaeology – Low Resolution disc
GA-LRhighlat	Galactic Archaeology – Low Resolution high latitude
GA-HR	Galactic Archaeology – High Resolution
GA-OC	Galactic Archaeology – Open Clusters
GS	Guide Star
PHU	Primary Header Unit of the FITS file
StePS	Stellar Populations as intermediate redshifts Survey
SCIP	Stellar, Circumstellar and interstellar Physics
WA	WEAVE Apertif
WAS	WEAVE Archive System
WC	WEAVE Clusters
WD	White Dwarfs
WEAVE	WHT Enhanced Area Velocity Explorer
WL	WEAVE LOFAR
WQ	WEAVE Quasars

Appendix C - **Graphical representations related with the IFU dither patterns**

Figure 11 – Pointing positions for each preset LIFU dither pattern

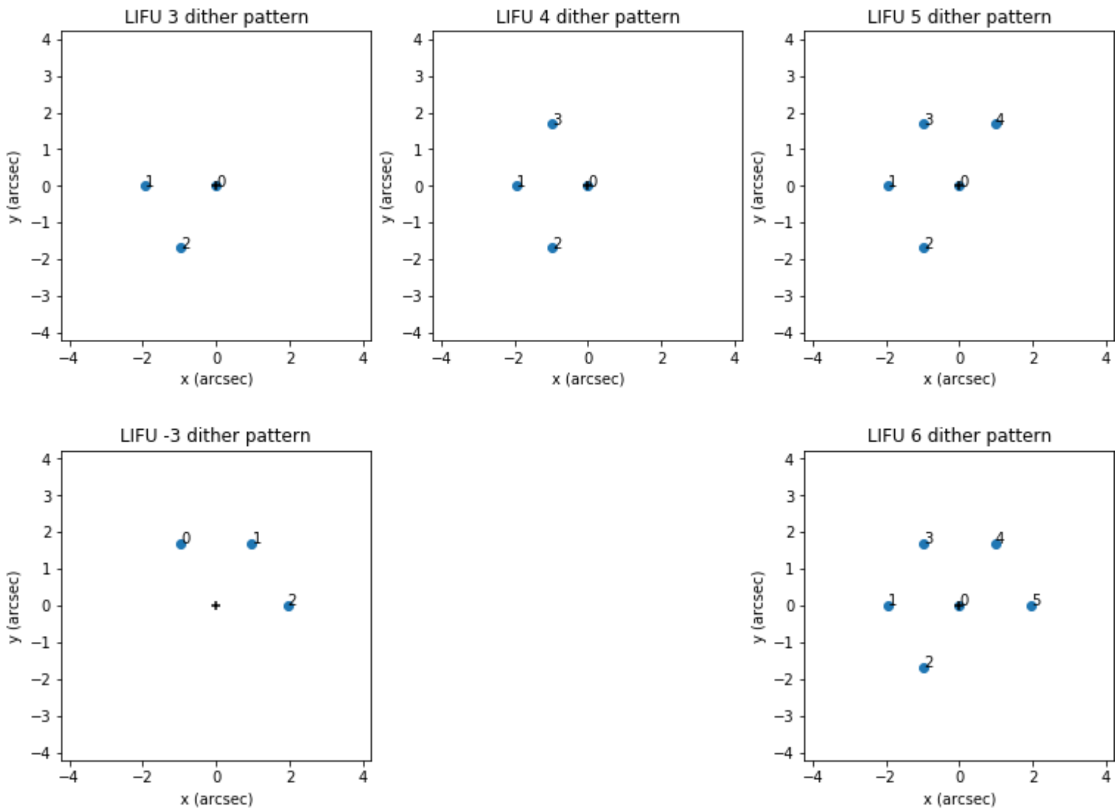


Figure 12 – Weight map corresponding to the LIFU 3 dither pattern

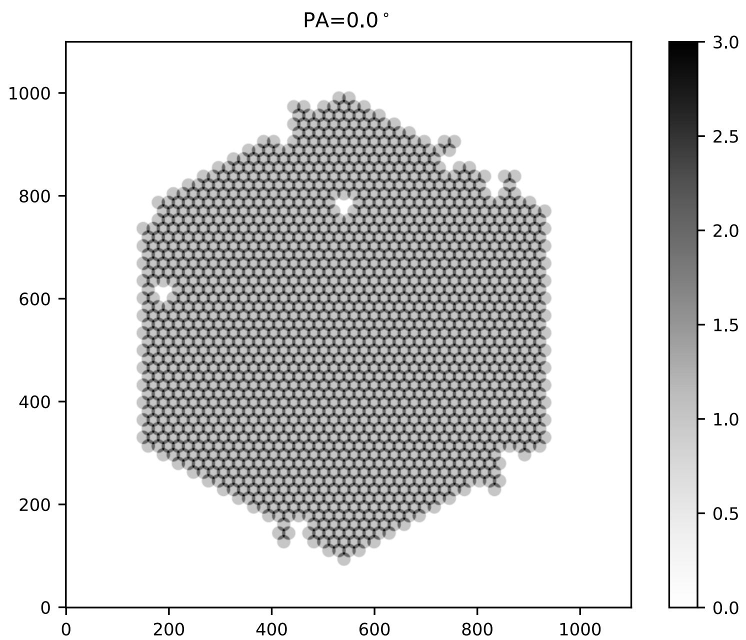


Figure 13 – Weight map corresponding to the LIFU 4 dither pattern

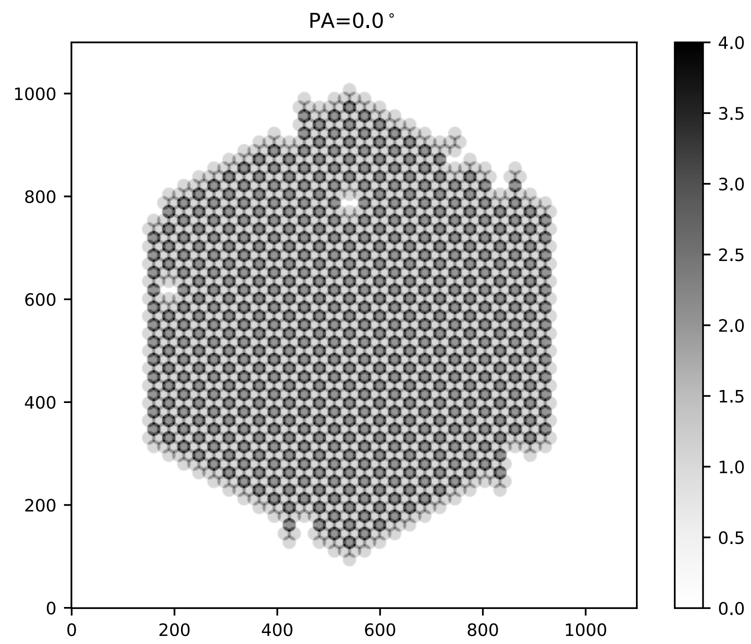


Figure 14 – Weight map corresponding to the LIFU 5 dither pattern

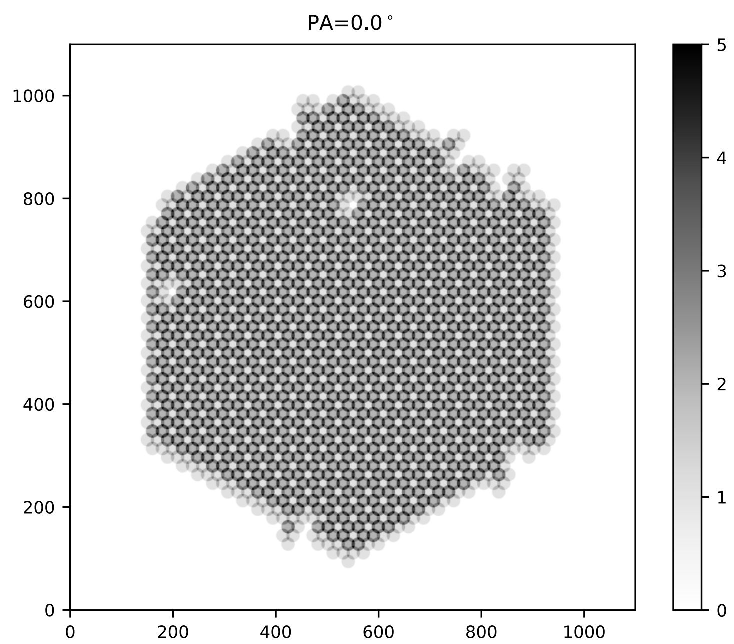


Figure 15 – Weight map corresponding to the LIFU 6 dither pattern

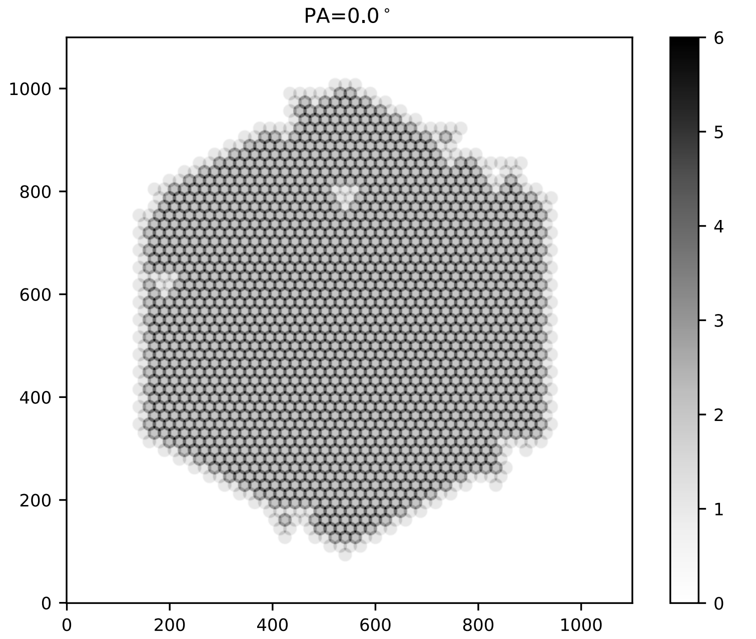


Figure 16 – Weight map corresponding to the LIFU -3 dither pattern

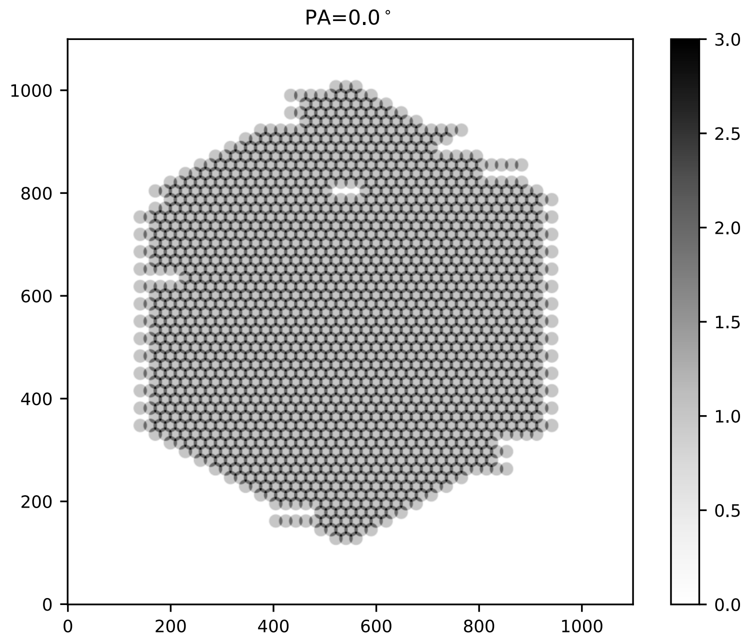


Figure 17 – Pointing positions for each preset mIFU dither pattern

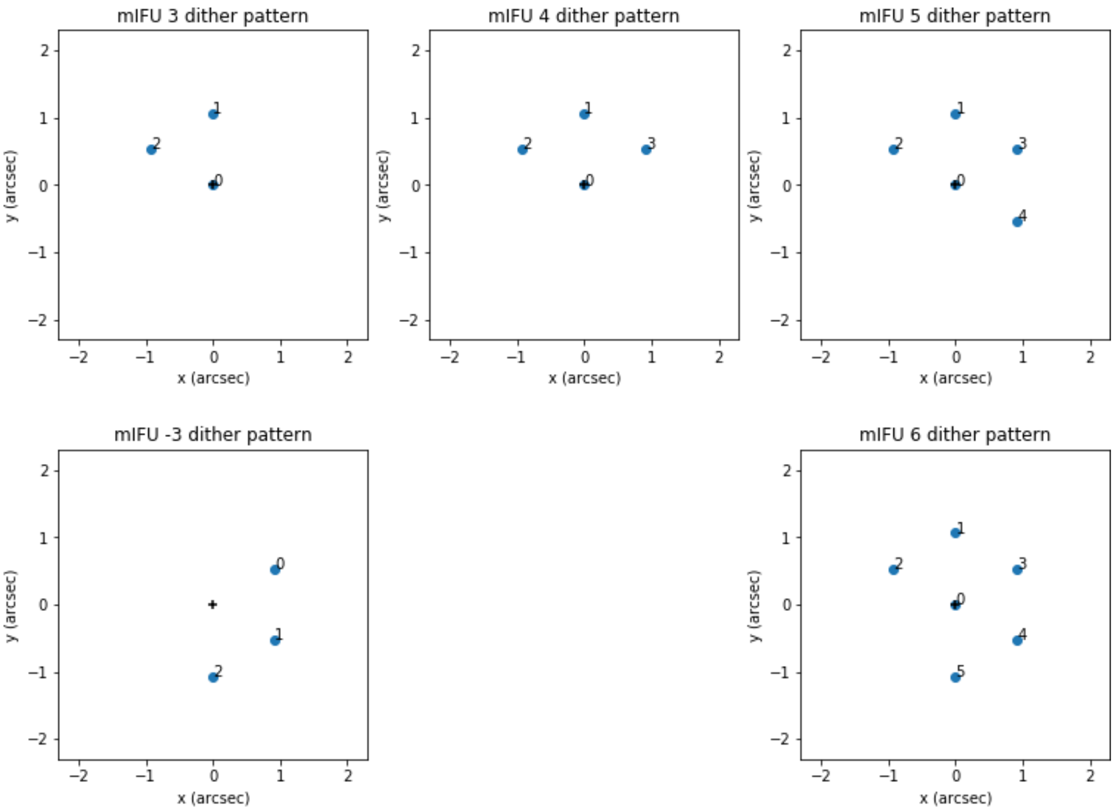


Figure 18 – Weight maps for several position angles corresponding to the mIFU 3 dither pattern

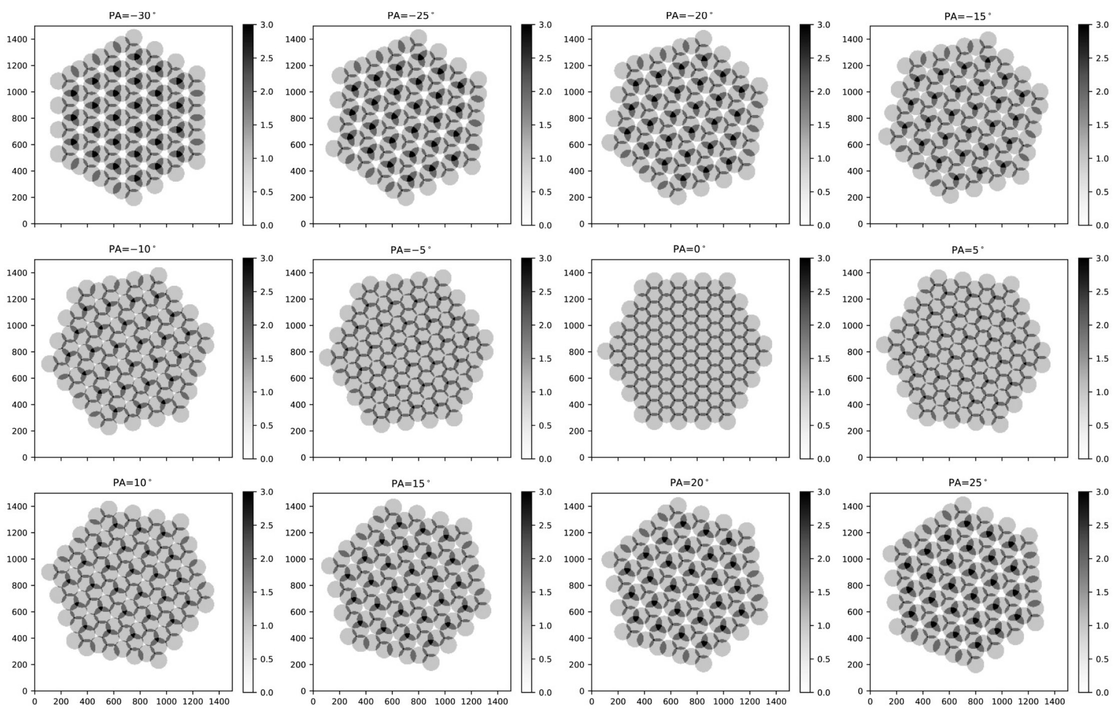


Figure 19 – Weight maps for several position angles corresponding to the mIFU 4 dither pattern

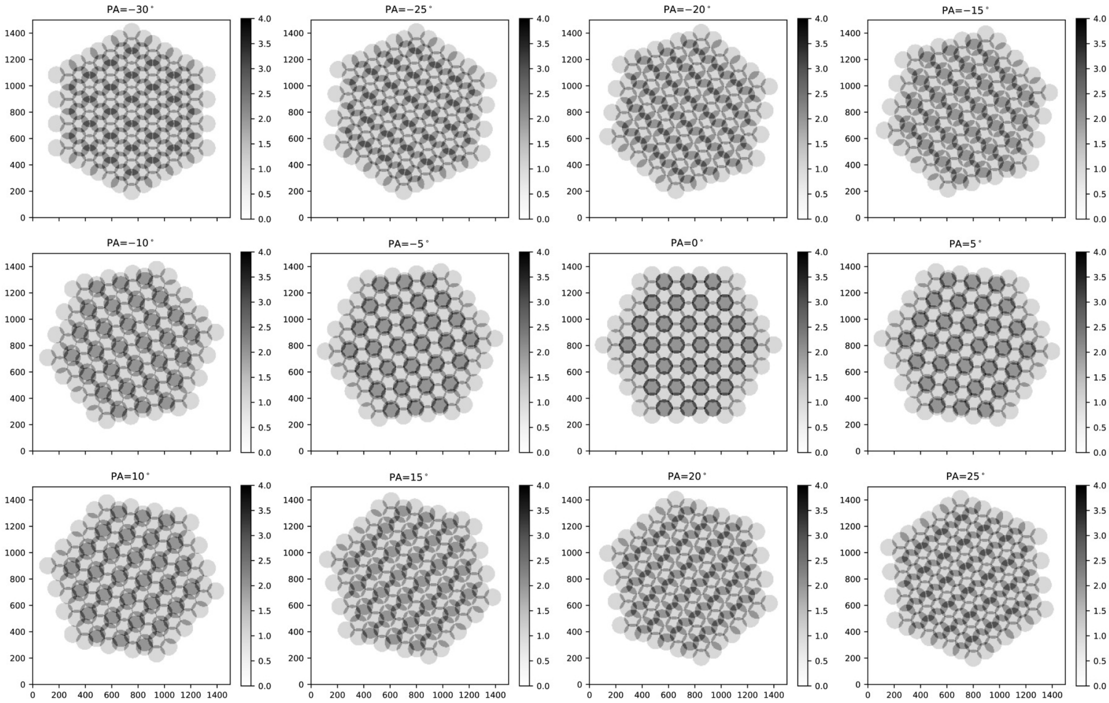


Figure 20 – Weight maps for several position angles corresponding to the mIFU 5 dither pattern

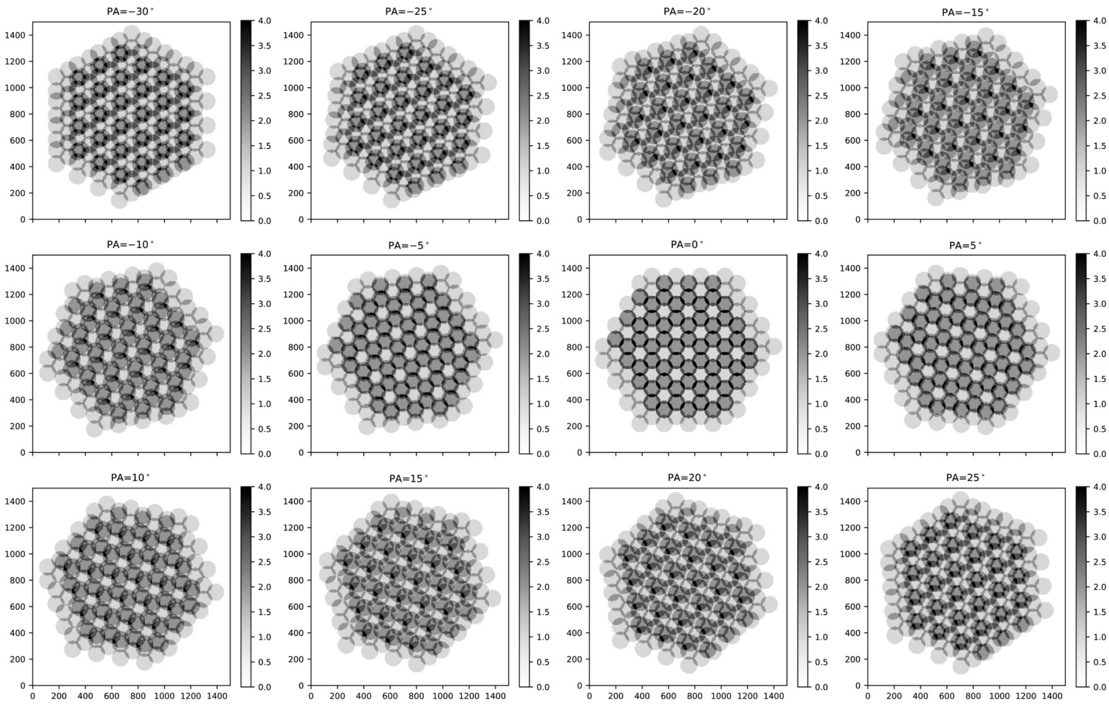


Figure 21 – Weight maps for several position angles corresponding to the mIFU 6 dither pattern

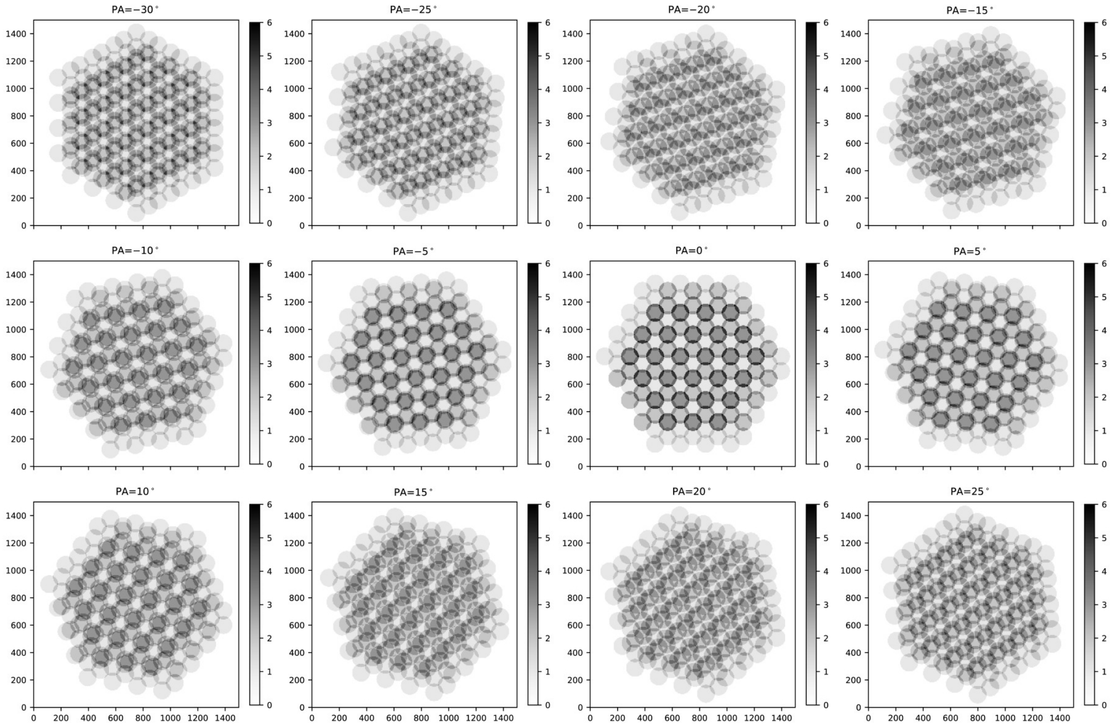


Figure 22 – Weight maps for several position angles corresponding to the mIFU -3 dither pattern