Configure XML Definition

Project name WEAVE

Release Draft/~~Final:~~ Version 8.00
Date: 29 April 2020

Author(s):	D Terrett S Jin D Murphy L Peralta de Arriba
Owner:	Kevin Middleton
Client:	WEAVE Consortium
Document Number:	WEAVE-ICD-025

Document History

Document Location	Printed on Wednesday, 22 July 2020. The document can be found at : https://bscw.ing.iac.es/bscw/bscw.cgi/412176

Revision History

Revision date	**Version**	**Summary of Changes**	**Changes marked**
11-Dec-13	0.10	Document created	
24-Oct-14	0.11	Added target brightness specification	**Error! Reference source not found.**
		Corrected names of program and catalogue elements	**Error! Reference source not found.**
13-Mar-15	0.12	Add calibration target type and limits on calibration and sky fibres.	
11-May-15	0.13	Add source list	
02-Jun-15	0.14	Renamed program survey and survey program	
04-Apr-16	0.15	Renamed sky_goal to num_sky_fibres and removed max_sky. Add conditions and HA limits to configure output Add achieved RA/Dec of each fibre to positioner output Add units of focal plane coordinates Removed items not to relevant to the positioner	
04-Jan-17	0.17	Replaced “survey” by “program” in the configure element in the examples. Add configure_version and config_file_version Define target orientation Catalogue and exposure_time removed photometry element added to target Renamed id to targid obscontraints, dithering and offsets added	
23-March-17	0.18	Document the “x” and “y” target attributes Corrected the name of the “fibre” attribute	

31-May-17	0.19	max_guide attribute added	
07-Nov-17	0.20	max_sky reintroduced.	
06-Mar-18	0.21	attributes renamed to match FITS keywords	
31-May-18	0.22	Minor typographical corrections	
04-Mar-19	0.23	Additional setup element attributes added	
16-Jan-20	6.99 (pre-SPAM10)	Synchronise with WEAVE data model, updates based on v7.00 of BlankXMLTemplate.xml, explanatory text for many elements and XML structure. New elements added. Headings nested to mimic XML hierarchy.	Sec 1 to 6.
19-Feb-20	7.00	Several updates based on SPAM10 discussions. Ongoing, rolling updates tied to WEAVESPA-369	All
11-Mar-20	7.10	Audit of propagated keywords, reconciliation with XML template. Section 7 added with action linkage to WEAVE systems.	All
17-Mar-20	7.20	Small tweaks to remove redundant config file version, dithering definitions	3, 5.2, 7.2
29-Mar-20	7.30	maximum_gate_angle removed (WEAVESPA-426) and tac_alloc added (WEAVESPA-353). Content revision based on LPdA comments.	4.2.1, 4.2, various for revision
29-Apr-20	7.40	DT, LPdA & DM joint telecon revisions. Items highlighted in red are required revisions subject to RFC to OCS.	All
30-Apr-20	8.00	Synced WEAVE Data Model v8.00	--

Approvals This document requires the following approvals.

Name	Title	Approval Date	Issue Date	Version

Distribution This document has been distributed to:

Name	Title	Issue Date	Version

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 expected to be on-sky by 2017 to 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

The purpose of this document is to define the XML that is prepared by the survey teams to describe a field they wish to observe and then flows through the configure tool, the survey planning system, the fibre positioner and the observatory control system. Information that defines the assignment of fibres to targets and then actual configuration of the fibres is added at the appropriate stage. No information is deleted so that the document retains a complete history of the field configuration process.

The XML document is permitted to contain additional elements not described in this document and these will be preserved throughout the processing chain.

Those not familiar with XML should note that the names of elements and attributes 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.

This document uses the terms survey and programme with very specific meanings.

A **programme** is a set of fields that share a common set of scheduling criteria and spectrograph configuration.

A **survey** is a set of target objects that are being observed to satisfy some common scientific goal. A single field may contain targets from more than one survey and the targets from a single survey will typically appear in many different fields.

1.3 References

[RD01] WEAVE-MAN-001	Abbreviations and Definitions
[RD02] WEAVE-ICS-011	FITS File Description of WEAVE Observations
[RD03] WEAVE-SPA-008	The WEAVE SPA data model
[RD04] WEAVE-ICD-027	The SPA Interface Control Document
[RD05] WEAVE-ICD-030	The SPA/SWG interface

2 INFORMATION FLOW

Each field that a survey preparation team want to observe will be described by an XML document that defines the RA and Dec of the field centre (or centres if dithering between exposures is specified) and lists all the candidate science targets and guide stars and defines the position and sizes of objects to be avoided when allocating sky background fibres. The list of science targets will, quite probably, not contain all the possible targets in the field in order to keep the run time and memory consumption of the configure tool within reasonable limits – the practical maximum number of targets (including sky samples) is likely to be around 2000.

The only celestial coordinate system supported by WEAVE is the International Celestial Reference System (ICRS[1]) in the Gaia frame (as per GAIA_RA and GAIA_DEC in [RD05] for in the input FITS catalogues). This matches FK5/J2000 to within about 0.1 arcsec which is more than sufficient for configure, however ICRS – which is the system used by the GAIA catalogues – should be used if available. *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*.

Each target is defined by a target element that specifies the object's name, position, proper motions etc., the type of the target (science, calibration, sky or guide star), the name of the survey it comes from and a priority that is used when selecting the optimum fibre allocation.

The areas of sky to be avoided when searching for positions for background sky fibres is defined by a list of masks (called the avoidance list). The only type of mask currently supported is a circle; these are similar to targets but can also define a radius. If not specified, a radius of 3 arcsec is used. The configure tool can read a list of masks from a separate file containing just masks in which case the masks are added to the output file. Science and calibration targets are not automatically avoided so the avoidance list would normally include masks corresponding to all the targets.

The document is then processed by the configure tool and the identifier of the fibre allocated to the target added to each target definition.

The SWG then submits the output from configure to the WEAVE Automated Submission Platform (WASP), where it is verified by the XMLChecker (and iterated through the SWG again if necessary). The verified XML files, as a tarball, are then passed to the OCS, where the OB manager takes the XML tarball and converts it into corresponding OBs. When the observation block is executed, the XML document is passed from the OCS to the fibre positioner. The positioner calculates the position of each fibre in the focal plane (taking account of the predicted zenith distance at the mid-point of the observation and current

[1] http://aa.usno.navy.mil/faq/docs/ICRS_doc.php

meteorological conditions) and adds it, and the actual position (as measured by the positioner robots after the fibre has been placed on the plate), to the document. When the configuration of the plate is complete, the document is passed back to the OCS which uses it to prepare the FITS headers and fibre information table for the images from the spectrographs.

A series of tables in Sections 4, 5 and 6 describe the structure and content of the XML document. Within these tables, all attributes that **must be present** for the successful allocation of fibres and use of the positioner are defined as "mandatory".

The assembly of the raw FITS headers and fibre information table also requires information stored in the XML document. In this ICD we define these as "propagated attributes", indicated with *italics*. In some cases, these quantities have been propagated through the XML files in order to provide information downstream to the data management system (DMS), but serve no purpose for the fibre allocation nor positioner. Failure to include these attributes does not impact the functioning of the positioner, but does impede processing and analysis of the data by the L1 and L2 pipelines.

As a result of this, there are potential requirement discrepancies between what (for example) configure requires of an XML document versus what the Data Management System requires of an XML document. *The guidance in this ICD is to include all elements and populate all attributes within the specification we describe below*. Where it is noted in the following sections that certain duplicate elements are silently ignored, we refer to Configure's behaviour, rather than that of DMS validation.

3 INPUT TO CONFIGURE

The input to the configure tool is structured as follows: the document must contain a <weave> element with a child element named <observation>. The <observation> element must itself contain a child element named <configure> that defines the plate that the field should be configured for and other parameters that control the behaviour of the configure tool, a non-mandatory <surveys> element that lists the surveys that the targets come from and one or more <field> elements that lists the targets.

Surveys are described by <survey> elements, and targets by <target> elements grouped by <field> elements. All parameters are encoded as attribute values; there are no text elements defined.

Each element is described in detail in the following tables (with propagated attributes in *italics*). The "default" column in the tables indicates the value that Configure will use in the event the attribute is missing from the element. A default value of *none* indicates an empty string ("") would be used (*but not necessarily written in the output*) for the value of that missing attribute. In the exceptional cases of *pmra*, *pmdec* and *targparal* (the <target> element, sec. 4.2.5.1.1) a "none" value is interpreted by configure as 0.0. More information

on the way the configure tool uses the individual attributes can be found in the configure user manual.

Elements designated as *containers* do not themselves contain attributes, but are used to group child elements.

4 XML STRUCTURE – THE ROOT <WEAVE> ELEMENT

We describe the structure of the XML document in this section, with the heading/sub heading structure indicating the hierarchy of elements within the document.

Attribute name	Data type	Mandatory	Meaning	Default	Doc/ Param
author	string	No	Author email address		
cc_report	string	No	CSV-separated additional email addresses to send the WASP report		
datamver	string	Yes	Data model version		RD02 DATAMVER
report_verbosity	integer	No	Verbosity (0,1) of the WASP validation report		

4.1 The <programme> element (container)

4.1.1 The <spectrograph> element (container)

4.1.1.1 The <red_Arm> and <blue_Arm> elements

Attribute name	Data type	Mandatory	Meaning	Default	Doc/ Param
binning_X	int	No	Spatial binning (1-4) (pixels)		RD02 CCDXBIN
binning_Y	int	No	Spectral binning (1-4)		RD02

			(pixels)		CCDYBIN
resolution	string	No	Arm resolution “low”/“high”		RD02 MODE
speed	string	No	Readout speed “slow”/“fast”		RD02 CCDSPEED
VPH	string	No	Arm grating “n/a”, “VPH1” “VPH2”, “VPH3”		RD02 VPH

4.1.2 The <exposures> element (container)

4.1.2.1 The <exposure> element

Attribute name	Data type	Mandatory	Meaning	Default	Doc/ Param
arm	string	No	Spectrograph arm “red”/“blue”/“both”		
cal_lamp	string	No	Calibration lamp chosen: ‘None, ‘Hg’, ‘Ne’, ‘He’, ‘Zn’, ‘Cd’, ‘ThAr’, ‘ThArCr’, 'QTH', ’W’		*See 7.1.1*
cal_lamp_filter_A	string	No	Calibration lamp filter used in position A: "W??_clear", “Empty”, "WYC_ND0.5", "ND1.0", "WYC_ND2.0", "WYC_ND3.0", "DARK"		RD02 TBD CALFLTA
cal_lamp_filter_B	string	No	Calibration lamp filter used in position B: "Empty", "WYC_GG395", "WYC_BG38", “RED”		RD02 TBD CALFLTV
exp_time	int	No	Exposure time (in seconds)		RD02 REQTIME

ff_ilu_*n*[1,2,3]	int	No	Intensity of the 3 flat field LEDs (0-100)		RD02 FLILU*n*
order	int	No	The sequence in which the exposures are taken (1-…)		
type	string	No	The type of exposure: "arc","bias","dark", "fibre_lampflat", "fibre_twiflat", "fibre_skyflat", "detector_flat", "science", "salsa_lampflat, "salsa_twiflat", “salsa_skyflat”, "salsa_arc”, "stdfibre_arc", “stdfibre_lampflat”, “stdfibre_skyflat”, “stdfibre_twiflat”		*See 7.1.1*

For XMLs with dithered observations, the order attribute of <exposure type=”science”> elements matches the order attribute of the counterpart <field> element.

4.2 The <observation> element

Attribute name	Data type	Mandatory	Meaning	Default	Doc/ Param
casuid	int	No	CASU reference ID. Populated by WASP		RD02 CASUID
chained	bool	No	Defines if this OB is probabilistically linked to cloned versions of itself.		RD02 CHAINED
coordinate_system	string	No	“ICRS”		RD02

					RADECSYS
linkedgroup	string	No	Linking pointer for intra-survey grouping of OBs. Populated by SWG		RD02 LNKGROUP
name	string	No	Observing block name.		RD02 CAT-NAME
ob_class	string	No	Type of observation “science”, “engineering”, “commissioning”, “calibration”		RD02 OBCLASS??
ob_priority	float	No	observing block priority		RD02 OBPRIORI
obsgroup	string	No	Linking pointer for OB groupings that can permit prioritisation over other surveys. Populated by SWG.		RD02 OBSGROUP
obsgroup_validity	int	No	Lifetime (days) of *obsgroup* OB priority boost once 1st OB is observed. Populated by SWG.		
obstemp	string	No	Observing constraints template code		RD02 OBSTEMP
obs_mode	string	No	“MOS”,”mIFU” or “LIFU”		RD02 OBSMODE
pa	float	Yes	Requested position angle of the whole observing block. ‘0.0’ for MOS and mIFU.	0.0	

progtemp	string	No	Instrument configuration template code		RD02 PROGTEMP
tac_alloc	string	No	TAC time allocation code		(from) RD05 TACALLOC
tac_id	string	No	TAC proposal identifier for this observation		RD02 PROPOSAL
trimester	string	No	Trimester of the requested observation, e.g. “2020A1”		RD02 TRIMESTE

The observing block *name* is an arbitrary character string to help identify the observation in printed reports, interactions between the survey preparation team and survey manager etc. The *progtemp* code is used to implicitly define things like the spectrograph configuration etc. in order to configure the WEAVE instrument. Similarly, the *obstemp* code defines the seeing limits etc required to construct the observing schedule. Both of these attributes are short-hand descriptions of attribute values that are found in the <spectrograph> (Section 4.1) and <obsconstaints> (Section 4.2.2) elements respectively. The coordinate system attribute defines the coordinate system of all the RA/Dec’s in the file. The only supported value is “ICRS”. As discussed in Section 2, the WEAVE project uses the Gaia reference frame.

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

	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 [RD05]
4	TAC allocation	_xxxy	Time (hours) awarded by each TAC to 0.5hr precision, by defining y=0,5 e.g 0025 = 2.5 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)

Working example: WS2020A1N0015P0005C0200I0005

This is a (W)EAVE (S)ervice mode observation for 2020A1, awarded 1.5hrs from the Netherlands, 0.5hrs from PATT, 20hrs from CAT and 0.5hrs via the ITP. This code will be shortened in instances where a TAC awards no time (eg N0000 would be omitted from the tac_alloc).

There should only be one <observation> element in the document. Any duplicates may be silently ignored.

4.2.1 The <configure> element

Attribute name	Data type	Mandatory	Meaning	Default
max_calibration	non-negative integer	No	Maximum number of calibration stars to allocate fibre to	25
max_guide	non-negative integer	No	Maximum number of guide stars to allocate fibre to. This is set to 1 for the LIFU	8
max_sky	non-negative integer	No	Maximum number of sky fibres to allocate	100
num_sky_fibres	non-negative integer	No	Number of fibres to reserve for sky	0
plate	string	Yes	Plate name “PLATE_A”, “PLATE_B”, “LIFU”	

There should only be one configure element in an observation. Any duplicates may be silently ignored. Note, that once an observation has been processed by configure, the plate cannot be changed. If a survey team wants a field to be observable by either plate it will have to define two observations with the same field centre.

4.2.1.1 The <conditions> element

Attribute name	Data type	Meaning
epoch	float	Epoch as a Julian Year
ha	float	Hour Angle (hours) used in refraction calculations
pressure	float	pressure (mBar) used in refraction calculations
relative_humidity	float	relative humidity used in refraction calculations
temperature	float	temperature (K) used in refraction calculations
tlr	float	tropospheric lapse rate used in refraction calculations

The conditions element (if present) specifies the observing conditions to be used in configure's astrometric and refraction calculations. These can be overridden with command line arguments or from the GUI (except for the tropospheric lapse rate, temperature and humidity which have a negligible effect on the differential refraction).

4.2.2 The <obsconstraints> element

Attribute name	Data type	Mandatory	Meaning	Default
elevation_min	float	No	minimum acceptable elevation (deg)	
moondist_min	float	No	minimum acceptable distance from the moon (deg)	
seeing_max	float	No	maximum acceptable seeing (arcsec)	
skybright_max	float	No	maximum acceptable sky brightness (AB Vmag/arcsec^2)	
transparency_min	float	No	minimum acceptable transparency (0.0-1.0)	

4.2.3 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 (**Error! Reference source not found.**) 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 guidecam field of view. A value of 0 indicates no dither. This is the default 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.

4.2.4 The <surveys> element (container)

There should be either zero or one <surveys> element in an observation. Any duplicates may be silently ignored.

4.2.4.1 **The <survey> element**

Attribute name	**Data type**	**Mandatory**	**Meaning**	**Default**	**Doc/ Param**
name	string	Yes	survey name		(from) RD05 TARGSRVY
priority	float	No	survey priority	1.0	
max_fibres	non-negative integer	No	Maximum number of fibres to allocate to this survey	no limit	

The priority is used to scale the priorities of each target that belongs to the survey. This enables the relative priorities of different surveys to be adjusted in order to get the desired balance of targets without having to edit the priorities of every individual target.

4.2.5 The <fields> element (container)

There should be either zero or one <fields> element in an observation. Any duplicates may be silently ignored.

4.2.5.1 **The <field> element**

Attribute name	**Data type**	**Mandatory**	**Meaning**	**Default**	**Doc/ Param**
RA_d	float	Yes	ICRS Right ascension of field centre in degrees		RD02 FLDRA

Dec_d	float	Yes	ICRS Declination of field centre in degrees		RD02 FLDDEC
order	integer	Yes	Order in the exposure sequence (mandatory if dithering). Starting value 1. If undithered, this should be blank (“”)		

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 will be one <field> element for each dither position. The order attribute of these elements corresponds to the order attribute of the <exposure> elements, thus defining the sequence in which the observations occur.

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.

4.2.5.1.1 The <target> element

Attribute name	**Data type**	**Mandatory**	**Meaning**	**Default**	**Doc/ Ref**
cname	string	No	Target CNAME identifier		RD02 CNAME
targcat	string	No	Catalogue name and version		RD02 TARGCAT
targclass	string	No	Target classification. Refer to [ICD-030] for full list		RD02 TARGCLASS
targdec	float	Yes	ICRS Declination of object in degrees		RD02 TARGDEC
targepoch	float	Yes, For non-zero proper motion	Epoch of observation in Julian years. Mandatory for non-zero proper motions	2015.5	RD02 TARGEPOCH
targid	string	No	Target identifier	none	RD02 TARGID
targname	string	No	target name		RD02 TARGNAME
targparal	float	No	parallax in mas	0.0	RD02

					TARGPARAL
targpmdec	float	No	proper motion in Declination in mas/yr	0.0	RD02 TARGPMDEC
targpmra	float	No	Proper motion in RA in mas/yr. This is the true angular motion on-sky, not rate of change of RA.	0.0	RD02 TARGPMRA
targprio	float	No	Target priority (1.0-10.0), 1.0 is lowest priority.	1.0	RD02 TARGPRIO
targprog	string	No	Sub-programme name within the survey		RD02 TARGPROG
targra	float	Yes	ICRS Right ascension of object in degrees		RD02 TARGRA
targsrvy	string	No	Survey name	*none*	RD02 TARGSRVY
targuse	string	No	"T" (science target), "C" (calibration), "S" (sky), "R" (random) or "G" (guide)	T	RD02 TARGUSE

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.

4.2.5.1.1.1 The <photometry> element

For "science", "calibration" and guide-star targets (targuse="T","C","G") photometric data may be added for a target. Inclusion of extinction-**un**corrected g, r and i-band magnitudes **are** required for effective fibre throughput estimates at point of observation.

Attribute name	**Data type**	**Mandatory**	**Meaning**	**Default**	**Doc/ Param**
mag_g	float	No	AB magnitude estimate for the target in the SDSS(like) g band.		RD02 MAG_G

emag_g	float	No	The error in the magnitude estimate for the target in the SDSS(like) g band.		RD02 EMAG_G
mag_r	float	No	AB magnitude estimate for the target in the SDSS(like) r band		RD02 MAG_R
emag_r	float	No	The error in the magnitude estimate for the target in the SDSS(like) r band.		RD02 EMAG_R
mag_i	float	No	AB magnitude estimate for the target in the SDSS(like) i band		RD02 EMAG_I
emag_i	float	No	The error in the magnitude estimate for the target in the SDSS(like) i band.		RD02 EMAG_I
mag_gg	float	No	Gaia G band magnitude estimate (Vega)		RD02 MAG_GG
emag_gg	float	No	Error on Gaia G band		RD02 EMAG_GG
mag_bp	float	No	Magnitude estimate for the target in the Gaia BP band (Vega)		RD02 MAG_BP
emag_bp	float	No	The error in the magnitude estimate for the target in the Gaia BP band.		RD02 EMAG_BP
mag_rp	float	No	Magnitude estimate for the target in the Gaia RP band (Vega)		RD02 MAG_RP
emag_rp	float	No	The error in the magnitude estimate for the target in the Gaia RP band.		RD02 EMAG_RP

By the point WEAVE is commissioned, users will only have access to Gaia DR2 photometry. These magnitudes are defined in the Vega system. The forthcoming Gaia DR3 release should feature AB magnitudes, so care must be taken to ensure this element is correctly populated.

4.2.5.2 **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.

4.2.5.2.1 The <mask> element

Attribute name	Data type	Mandatory	Meaning	Default
Dec_d	float	Yes	ICRS Declination of source in degrees	
RA_d	float	Yes	ICRS Right Ascension of source	
radius	float	No	radius of object (arcsec)	3.0

4.2.5.3 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.

5 OUTPUT FROM CONFIGURE

The XML document output by the configure tool is a copy of the input file, with new elements and attributes added.

The version number of the configure program, its configuration file and the plate files are added to the <configure> element. When run in batch mode, the number used to seed the random number generator used by the annealing is also added to this element.

An <hour_angle_limits> element is added (as a child of the <configure> element) that contains the hour angle limits in which the configuration is valid. These limits indicate the "earliest" and "latest" hour angle that the configuration can be used at without the repositioning of fibres due to refraction changes and field rotation causing any fibre collisions.

The <field> element may have additional sky targets added that have been created automatically by configure and missing attributes may get added and set to their default values.

A unique "*configid*" attribute, generated internally by configure, is added to each <target> element. This is used internally by configure and the positioner software and must not be altered. A "*fibreid*" attribute is also added to each <target> to which a fibre has been

allocated. A "*targx*" and a "*targy*" attribute containing the position of the target on the plate (mm) for the hour angle and atmospheric conditions the plate was configure for is added to each target. The ifu_pa and ifu_spaxel attributes are also added, but written as blank for MOS observations.

5.1 The <configure> element (additional attributes)

Attribute name	Data type	Meaning	Doc/ Param
configure_version	string	Configure program version number	RD02 CFGVER
seed	integer	Random number seed	

5.1.1 The <telescope> sub element

Attribute name	Data type	Meaning
east_longitude	float	Telescope location (degrees)
latitude	float	Telescope location (degrees)
height	float	Telescope location (metres)

5.1.2 <focal_plane_map> subelement

Attribute name	Data type	Meaning
focal_length	float	Actual focal length (mm)
nominal_focal_length	float	Nominal focal length (mm)

5.1.2.1 <optical_axis> subelement

Attribute name	Data type	Meaning	Doc/ Param
r0	float	Plate rotation (degrees)	
x0	float	Optical axis (mm; plate coordinates)	
y0	float	Optical axis (mm; plate coordinates)	

5.1.2.2 **<distortion_coefficients> subelement**

Attribute name	**Data type**	**Meaning**	**Doc/ Param**
c1	float	1st order polynomial model coefficient	
c3	float	3rd order polynomial model coefficient	
c5	float	5th order polynomial model coefficient	
c7	float	7th order polynomial model coefficient	

5.2 The <hour_angle_limits> element (new element under <configure>)

Attribute name	**Data type**	**Meaning**
earliest	float	Earliest HA (hours) that the field can be configured for without any fibre collision
latest	float	Latest HA (hours) that the field can be configured for without any fibre collision

5.3 The <offsets> element (new element under <configure>)

Attribute name	**Data type**	**Mandatory**	**Meaning**	**Default**
offset_step_dec	string	No	offset steps in declination (arcsec)	
offset_step _ra	string	No	offset steps in true angular size in RA (arcsec)	

The offset_step attributes are string representations of the dither pattern, with offsets *defined from the initial position*, measured in arcseconds.

The initial value is always zero, and subsequent values are space-separated, eg:

offset_step_ra = “0.0 5.0 -5.0” indicates a 3-dither pattern with the two final exposures dithering +5 and -5 arcseconds from the original position. The sequence (0, 5.0, -5.0) corresponds to the exposure order as defined in the <exposure> element (section 4.1.2.1) and the <field> element (section 4.2.5.1). These offsets are set to the default when apply_dither=0 in the <dithering> element.

5.4 The <target> element (additional attributes)

Attribute name	Data type	Meaning	Doc/ Param
automatic	integer	0, 1. Value is 1 if target element created by Configure, else 0.	
configid	integer	configure identifier (internal use only)	
fibreid	integer	fibre identifier	RD02 FIBREID
ifu_pa	float	The position angle (LIFU) or bundle angle (mIFU) this fibre was observed with. (*None* for MOS observations).	
ifu_spaxel	string	The alphanumeric fibre identifier code. (*None* for MOS observations)	
targx	float	x-position (mm) of the target on the plate, or extrapolated position of the LIFU guide star	
targy	float	y-position (mm) of the target on the plate, or extrapolated position of the LIFU guide star	

The *ifu_pa* attribute indicates a position angle. This has different meanings depending on the instrument mode. Because rotated MOS observations are prohibited, this value is always 0.0 for MOS fibres. For the LIFU, this value matches that of the "pa" attribute in the <observation> element (Section 4.2), and should be the same value for all fibres. For the mIFU, this value corresponds to the bundle rotation angle. All fibres within the same bundle will share a common ifu_pa, though the centre of rotation is of course the central fibre.

The *ifu_spaxel* attribute uses the fibre identifiers referenced in LIFUfibreTable.dat [RD03] For the LIFU, this takes the form of a 3-character string (e.g. "C14" represents the central fibre of the LIFU). For mIFU, the identifiers in [mIFUfibreTable.dat] are prepended by the mIFU bundle number mXX (e.g. "m05C04 represents the central fibre of the fifth mIFU bundle).

6 OUTPUT FROM POSITIONER – THE <POSITIONER_SETUP> ELEMENT

When the positioner has finished configuring a plate it generates an XML document with a root element named <positioner_setup> which contains the entire document generated by configure, as well as a <conditions> element describes the hour angle etc. used to

calculate the fibre positions. The <fibres> container element provides child <fibre> elements that describe the position etc. of every fibre.

Note that the field orientation and other parameters may be different from that in the <configure> element because small adjustments to the orientation are used to minimize the difference in fibre positions between those calculated by configure for the nominal observing conditions and the positions calculated using the actual conditions.

Attribute name	**Data type**	**Meaning**	
date	double	Date used for configuration (MJD)	RD02 CONFMJD
pa	double	The field position angle(degrees) for which the plate was configured. 0.0 for MOS and mIFU.	RD02 FLORIENT
plate	string	Plate name	RD02 PLATE
plate_temp_end	double	Plate temperature at end of configuration (degC)	RD02 CONFTEME
plate_temp_start	double	Plate temperature at start of configuration (degC)	RD02 CONFTEMB
zenith_distance	double	The zenith distance (degrees) for which the plate was configured	

The plate_temp_start and plate_temp_end attributes are not set for the large IFU, so therefore will be absent.

6.1 The <conditions> element

Attribute name	**Data type**	**Meaning**	**Doc/ Param**
epoch	double	Epoch of configuration (Julian Year)	RD02 CAT-EPOC
ha	double	Hour angle of the configuration	
humidity	double	Relative humidity used for refraction calculations	
pressure	double	Pressure used for refraction calculations (mBar)	
temperature	double	Temperature used for refraction calculations (K)	
tlr	double	Tropospheric lapse rate used for refraction calculations	

6.2 The <telescope> element

Attribute name	Data type	Meaning
east_longitude	float	Telescope location (degrees)
height	float	Telescope location (metres)
latitude	float	Telescope location (degrees)

6.3 <focal_plane_map> element

Attribute name	Data type	Meaning	Doc/ Param
focal_length	float	Actual focal length (mm)	RD02 CFGFOCUS
nominal_focal_length	float	Nominal focal length (mm)	RD02 CFGNMFOC

6.3.1.1 <optical_axis> subelement

Attribute name	Data type	Meaning	Doc/ Param
r0	float	Plate rotation (degrees)	RD02 PLATER0
x0	float	Optical axis (mm; plate coordinates)	RD02 PLATEX0
y0	float	Optical axis (mm; plate coordinates)	RD02 PLATEY0

6.3.1.2 <distortion_coefficient> subelement

Attribute name	Data type	Meaning	Doc/ Param
c1	float	1st order polynomial model coefficient	RD02 FLDISTN1
c3	float	3rd order polynomial model coefficient	RD02 FLDISTN3
c5	float	5th order polynomial model coefficient	RD02 FLDISTN5

c7	float	7th order polynomial model coefficient	RD02 FLDISTN7

6.4 The <fibres> element (container)

The fibres element is a container for fibre elements. It has no attributes.

6.4.1 The <fibre> element

A fibre element describes the status and position of a fibre.

Attribute name	**Data type**	**Meaning**	**Doc/ Param**
enabled	integer	0 if the fibre has been disabled, 1 if it has not	
fibredec	float	ICRS Declination in degrees of the fibre as actually positioned	RD02 FIBREDEC
fibreid	integer	fibre identifier	RD02 FIBREID
fibrera	float	ICRS RA in degrees of the fibre as actually positioned	RD02 FIBRERA
orientation	float	The orientation (deg) of the fibre with respect to the radial direction.	RD02 ORIENTAT
parked	integer	Indicated whether the fibre is parked (1) or not (0)	RD02 STATUS “P”
retries	integer	The number of times the fibre had to be re-positioned to get it within the position tolerance	RD02 RETRIES
target	integer	the identifier of the target the fibre has been allocated to	
targx	float	The x position (mm) on the plate of the target	RD02 TARGX
targy	float	The y position (mm) on the plate of the target	RD02 TARGY
type	string	The type of the fibre “Spectrograph”, “Guider”, “mIFU”, “LIFU”	
xposition	float	The x position (mm) of the fibre as measured by the positioner	RD02 XPOSITION
yposition	float	The y position (mm) of the fibre as measured by the positioner	RD02 YPOSITION

The attributes contained within a <fibre> element depend on the state of the fibre once the positioner has finished operations.

- **Fibre placed** onto target:
  - all attributes in above table
- **Fibre collision** resulting in a parked fibre:
  - retries (0, as no attempts to position were made)
  - enabled, parked, fibreid, type
  - orientation, xposition, yposition
  - target, targx, targy (for the proposed target that could not be observed)
- **Parked fibre**:
  - retries
  - enabled, parked, fibreid, type
  - orientation, xposition, yposition

7 ACTIONS AND BEHAVIOURS SUMMARY

The XML file encodes many instructions to the WEAVE instrument (including the OCS and positioner) and data management system. We provide a summary of each of these in this section.

7.1 Instructions to OCS (TCS, instrument, sequencer etc.)

<element attribute>	**Action**
<red/blue_Arm binning_X>	Apply this spatial binning mode
<red/blue_Arm binning_Y>	Apply this spectral binning mode
<red/blue_Arm resolution>	Observe in this resolution
<red/blue_Arm speed>	Read out with this speed
<red/blue_Arm VPH>	Use this grating, set the VPH header entry to ‘N/A’, ‘LowRes’, ‘HighRes1’ or ‘HighRes2’
<positioner_setup pa>	Rotate to this PA. Record requested as FLORIENT.
<positioner_setup plate>	Use this plate for observations
<offsets offset_step_ra/dec>	Apply this series of offsets for each exposure

7.1.1 Exposures

Exposures are a complicated case – we map the input and output permutations in the table below:

Input (XML <exposure> element)				>	Output (Raw PHU)				
type	**cal_lamp**	**ff_ilu**	**texp**		**OBJECT**	**OBSTYPE**	**IMAGETYP**	**ARCSRC**	**FLATSRC**
arc	Any !=None, W, QTH	0 0 0	> 0		ARC	ARC	arc	Any != "None"	"NONE"
bias	"None"	0 0 0	0		BIAS	BIAS	zero	"None"	"NONE"
dark	"None"	0 0 0	> 0		DARK	DARK	dark	"None"	"NONE"
fibre_lampflat	"QTH"	0 0 0	> 0		FIBRE_LAMPFLAT	FIBRE_FLAT	fibre_flat	"None"	"QTH"
fibre_lampflat	"W"	0 0 0	> 0		FIBRE_LAMPFLAT	FIBRE_FLAT	fibre_flat	"None"	"W"
fibre_twiflat	"None"	0 0 0	> 0		FIBRE_TWIFLAT	FIBRE_FLAT	fibre_flat	"None"	"TWILIGHT"
fibre_skyflat	"None"	0 0 0	> 0		FIBRE_SKYFLAT	FIBRE_FLAT	fibre_flat	"None"	"DARK_SKY"
detector_flat	"None"	Any >0	> 0		DETECTOR_FLAT	DETECTOR_FLAT	detector_flat	"None"	"nnn"
Unsupported in XML						FOCUS	focus		
						GLANCE	object		
						SCRATCH	object		
						SKY	sky		
						FLAT	flat		
science	"None"	0 0 0	> 0		<observation.name>	TARGET	object	"None"	"NONE"
Unsupported in XML						RV_STD	rv_std		
						FLUX_STD	flux_std		
salsa_lampflat	"W"	0 0 0	> 0		SALSA_LAMPFLAT	SALSA_FLAT	salsa_flat	"None"	"W"
salsa_twiflat	"None"	0 0 0	> 0		SALSA_TWIFLAT	SALSA_FLAT	salsa_flat	"None"	"TWILIGHT"
salsa_skyflat	"None"	0 0 0	> 0		SALSA_SKYFLAT	SALSA_FLAT	salsa_flat	"None"	"DARK_SKY"
salsa_arc	Any !=None, W, QTH	0 0 0	> 0		SALSA_ARC	SALSA_ARC	salsa_arc	Any != "None"	"NONE"
stdfibre_lampflat	QTH", "W"	0 0 0	> 0		STDFIBRE_LAMPFLAT	FIBRE_FLAT	fibre_flat	"None"	"QTH", "W"
stdfibre_twiflat	"None"	0 0 0	> 0		STDFIBRE_TWIFLAT	FIBRE_FLAT	fibre_flat	"None"	"TWILIGHT"
stdfibre_skyflat**	"None"	0 0 0	> 0		STDFIBRE_SKYFLAT	FIBRE_FLAT	fibre_flat	"None"	"DARK_SKY"

7.2 Instructions to Configure / POS

<element attribute>	**Action**
<dithering apply_dither>	Implement the pre-defined dither sequence.
<offsets offset_step_ra/dec>	Define the dithering pattern (as inferred from <field Ra_d Dec_d>

7.3 Instructions to Scheduler (via OB database)

<element attribute>	**Action**
<observation chained>	Apply probabilistic linking to clones of this OB
<observation linkedgroup>	Add this OB to the linked group with this name
<observation obsgroup>	Add this OB to the obsgroup with this name
<observation obsgroup_validity>	Drop temporary priority boost after this number of days

7.4 Instructions to DMS

<element attribute>	**Action**
<weave report_verbosity>	Set the level of WASP validation report verbosity
<weave cc_report>	cc copies of the WASP validation report to these
<observation casuid>	Associate the [RD02] OBID to this casuID
<tac_alloc>	Associate this OB with the provided TAC code in the database

Reference files and resources

We refer users to the WEAVE Operational Repository[2] for access to reference and parameter files, as well as the Blank XML template used to construct OBs.

Appendix A -

[2] http://casu.ast.cam.ac.uk/weave/datamodel