Telescope time at the WHT in the WEAVE survey years

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SUMMARY

We describe how WEAVE surveys and open-time programmes share the WHT during the WEAVE survey years.

WEAVE surveys, open time, ITP and discretionary time take 226, 97, 17 and 25 nights per year, respectively. ING initial planning calls for WEAVE and non-WEAVE instruments to be mounted on the WHT following a nine-month cycle.

WEAVE is offered to successful open-time programmes, which are selected by the national TACs. WEAVE open-time OBs are scheduled together with survey OBs and have the entire La Palma sky accessible to them every year. Non-WEAVE instruments see a varying 75% of the La Palma sky each calendar year, and the non-accessible 25% always becomes observable one year later. Which non-WEAVE instruments continue to be offered will depend on demand and on the feasibility of the instrument changes. It is envisaged that a fraction ~40% of ISIS projects may be competitively done on WEAVE. Rules for data proprietary periods and data releases are provided.

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1 PURPOSE OF THE DOCUMENT

This document is written in order to provide detail about the scheduling rules for the WHT during the years of the WEAVE surveys, with an emphasis on how the time is shared between WEAVE surveys and open time (OT) observations, the latter made either with WEAVE or with non-WEAVE instruments.

Excluded here is the problem of how the different WEAVE surveys share the survey time, which is addressed by the WEAVE survey working group.

The document contains the ruling approved by the ING Board (Board meeting of 19 May 2020) after inputs received from the WEAVE Survey Executive[1] and the national time allocation committees (TACs) of the three national partners of the ING.

2 WHT TIME SPLIT

During the era of the WEAVE surveys, the breakdown of time on the WHT will be as shown in Table 1, discussed further in in Sec. 2.2.

2.1 Glossary

1. **WEAVE survey years (WSY):** the time period agreed by the ING Board to be assigned to carrying out WEAVE Surveys. At the time of first issue of this ruling, it is agreed to be 5 years after start of surveys.

2. **Discretionary time:** time allocated at the discretion of ING to carry out instrument changes, quality control, technical verifications and maintenance activities.

3. **International time programme (ITP):** time for collaborative projects of astronomers of the signatory countries of the 1979 International Agreements for Cooperation in Astrophysics [2]; managed by the CCI of the Canarian Observatories.

4. **Spanish site quota (ES site):** telescope time reserved to Spain by the International Agreements for Cooperation in Astrophysics [2].

5. **Open time (OT):** telescope time distributed by each ING partner for its astronomical community, typically for PI-driven science allocated by national TACs.

6. **WEAVE Surveys (WS):** telescope time allocated by the ING Board to carry out massive pre-defined surveys with WEAVE.

[1] The Survey Executive is defined in the WEAVE Partnership Agreement [1].

2.2 Overall time split

Table 1. Time breakdown during WEAVE surveys

Time block	Total (nights)	Total (%)
Available	**365.0**	**100%**
Discr (ING) [1]	**24.6**	**6.7%**
ITP 5% [2]	**17.0**	**4.7%**
ES 20% site: open frac [3]	**20.4**	**5.6%**
ES open [4]	**14.3**	**3.9%**
UK open [5]	**32.4**	**8.9%**
NL open [6]	**29.9**	**8.2%**
Total open+site	**97.0**	**26.6%**
Surveys [7]	**226.4**	**62.0%**

[1] Instrument changes and scheduled maintenance.

[2] ITP time is 5% after subtracting Discretionary time.

[3] Spanish site quota is 20% after subtracting Discretionary time. Thirty percent of Spanish site quota goes to Spanish OT.

[4,5,6] The time remaining after subtracting discretionary time, ITP and ES site time, is split among the three partners in proportion to their funding contribution to ING as reflected in 2017's ING Scientific Exploitation Agreement. Thirty percent of each national share is offered as OT.

[7] Seventy percent of ES site quota, and of each of the three national shares is given to WS's.

The ING partners have agreed that, during the period of the WEAVE surveys, up to 70% of the non-discretionary, non-ITP time will be devoted to WS's, while 30% will be made available for OT. Making provision for 5% for ITP, and top-slicing 25 discretionary nights per year, WS's receive 226.4 nights, and OT gets 97 nights (62.0% and 26.6%, respectively). The WHT yearly night breakdown is as shown in Table 1.

3 WEAVE ON AND OFF THE TELESCOPE: CADENCE, DATES, DURATION

The default cadence for when WEAVE comes off the telescope has been chosen as a compromise between the need to offer access to the whole sky in open time, and the practicalities, and the risk of the very complex instrument change. Largely driven by the latter, a default cadence of 9 months has been adopted.

Adopting a nine-month cadence for non-WEAVE periods at the WHT, 30% non-WS time means that each non-WEAVE period would last at most 2.36 months (~ 71 nights), less if part of the 30% OT is for observations with WEAVE (see Secs. 4.1, 4.4). The time counter would tick off at the

start of the WSs. The exact dates will be tuned to approximate a natural mix of lunar phases. Overall, the sky visible in each non-WEAVE period would be offset relative to that visible in the previous period. Over the period 2021 to 2029, the distribution of non-WEAVE sky access might be as in Table 2, graphically depicted in Figure 1. We have chosen an initial date of 15 June 2021 for the WEAVE surveys (for illustration purposes only), which corresponds to a first non-WEAVE date of 1 Jan 2022.

Table 2. Dates and middle-of-night local sidereal times at start and end of each non-WEAVE period, for years 2021 to 2027, when the start of non-WEAVE periods are spaced by nine months from each other.

Year	Date WEAVE off	Date WEAVE on	LST midnight start (hr)	LST midnight end (hr)
2021		15-06-2021		
2022	01-01-2022	12-03-2022	6.5	11.2
2022	28-09-2022	07-12-2022	0.2	4.9
2023	25-06-2023	03-09-2023	18.0	22.6
2024	21-03-2024	30-05-2024	11.8	16.4
2025	16-12-2024	24-02-2025	5.5	10.0
2025	12-09-2025	21-11-2025	23.2	3.8
2026	09-06-2026	18-08-2026	17.0	21.6
2027	06-03-2027	15-05-2027	10.8	15.4
2028	01-12-2027	09-02-2028	4.4	9.0
2028	27-08-2028	05-11-2028	22.2	2.8

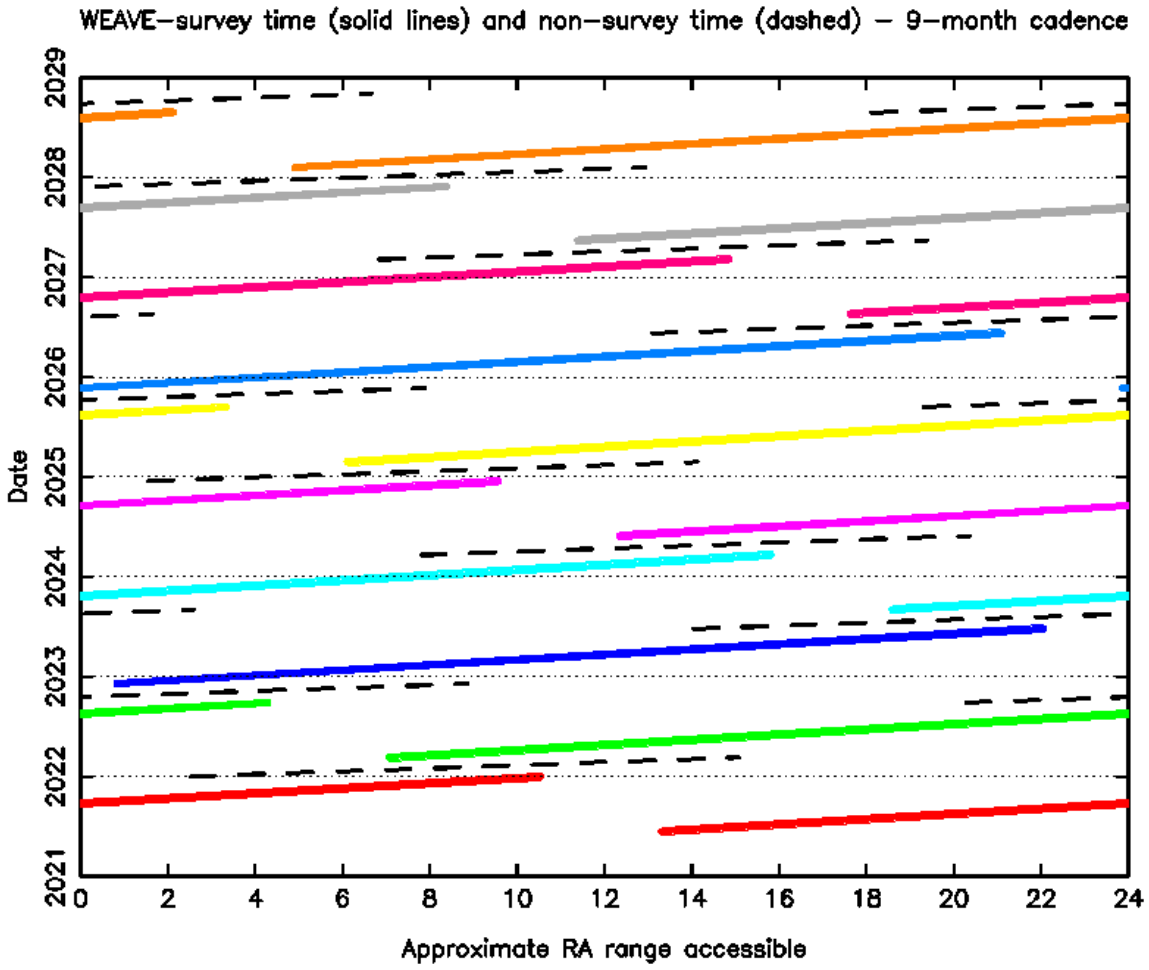

Figure 1. Approximate RA range visible during each of a series of WEAVE (colour solid lines) and non-WEAVE open-time periods (black dashed lines), when instrument changes follow a 9-month cadence, from 2021 to 2028, as listed in Table 2. In this graph, visibility is approximated as 4 hr East and West of LST at the middle of the night. For the non-WEAVE periods some regions of the sky are visible on two consecutive years and then are inaccessible in the third.

Table 2 and Figure 1**Error! Reference source not found.** show that the nine-month cadence provides an incomplete sky coverage for non-WEAVE periods: some RA are inaccessible one every three consecutive years. For most RA and Dec, observations in service mode will allow observations of a given position on the sky at more frequent intervals.

Additional limitations in the access to particular parts of the sky come from the RA pressure distribution from the WEAVE surveys. The approximate RA distribution of WEAVE surveys, measured in 1-hr OBs, is shown in the histogram of Figure 2. Because WEAVE surveys encompass

a combination of Milky Way and extragalactic programmes, the targets are not strongly concentrated at any particular range of RA, other than a broad peak at RA~18h.

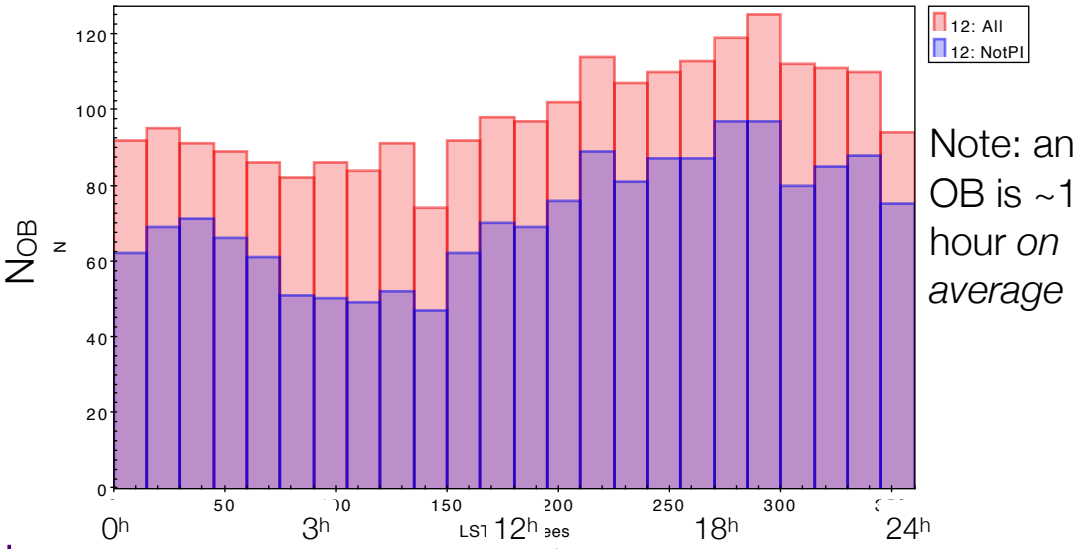

Figure 2. Number of OBs in a simulation of 18 months of WEAVE surveys shown against LST of the observation. The distribution shows a broad peak centerd on RA~18h. Purple is WEAVE Survey OBs. Salmon is OT OBs.

4 WHT OPEN TIME

4.1 Instrumentation

In open time ING plans to offer:

a. WEAVE
b. ISIS
c. LIRIS
d. ACAM
e. Visitor instruments
f. CANARY

Each period with non-WEAVE instrumentation lasts up to 71 continuous nights, or 2.4 months. In order to optimise the use of time with different lunar phases (dark time is for ISIS and PAUcam, and bright time for LIRIS and CANARY), ING would need to change instruments more than once during one non-WEAVE period, including back-and-forth changes of Cassegrain instruments. This will not always be feasible, because ING engineering staff will need to devote time to maintenance of the WEAVE instrument. ING will do its best to mount all non-WEAVE instruments offered in the announcement of opportunity, but, given the above uncertainties, availability of all instruments is not guaranteed.

4.2 Service vs visitor observing

For open-time programmes using non-WEAVE facility instruments, the default observing mode will be visitor observing. Service mode leads to more efficient use of the available dark time, and better RA access, but visitor mode allows more control of the observing by the PI. ING will also consider offering service observing if requested. Open-time programmes with WEAVE will always be done in service mode.

In visitor mode observing, ING will provide the same standard of support at the telescope as at present: one telescope operator, and one support astronomer during the first night.

In support of ING's strategic objective of training the next generation of astronomers, ING will continue to encourage visitor mode for open-time non-WEAVE programmes, and will seek to implement schemes to give PhD students from the partner countries the opportunity to observe during service nights.

4.3 Obtaining WHT open time

In the years of the WEAVE surveys, astronomers can apply for WHT open time through four main channels: the three national TACs and the international time programme of the Canarian Observatories (ITP). Available numbers of nights are given in Table 1. Each channel has its own rules regarding eligibility and timing of the calls.

The ITP offers the opportunity to obtain as many as 17 nights per year, and hence allows for moderately large WEAVE programmes, intermediate in scope between the WEAVE Surveys and OT programmes.

ING does not plan to offer WHT nights to the OPTICON trans-national access (TNA) programme. ING does not plan either to maintain an ING service programme, during both WEAVE-on and WEAVE-off periods.

The national TACs are in charge of selecting observing programmes in open time. The standard 6-month TAC calls continue to be appropriate during the WEAVE years, given that the WEAVE instrument is on offer and accessible during a large fraction of each year. But given the 9-month cadence of non-WEAVE periods, not all instrumentation will be on offer at every TAC meeting.

Open-time non-WEAVE PIs will need to be aware that, if there are too few successful proposals for a given non-WEAVE period, that period might have to be cancelled and WEAVE left on the telescope; open time that year would have to be used for OT WEAVE proposals only. Likewise, as now, if there are too few proposals for a given instrument, the cost of making the instrument changes might be too high to justify mounting the instrument and, consequently, the instrument will not be offered.

4.4 WEAVE open-time programmes

By offering WEAVE in open time, ING will provide the entire ING communities with access to the entire northern sky throughout the year. There will not be separate nights devoted to surveys and to open time. Rather, the observing queue will be populated with all eligible OBs, from surveys and from open time, hence any night may accommodate OBs from both. The particulars of how priorities and accounting will be carried out are outlined in Sec. 5 below.

ING will aim to start offering OT with WEAVE in the first WEAVE on-sky period after commissioning. ING's practice of offering instruments only after commissioning will be followed, and, if needed, time will be announced via a special call for proposals.

4.4.1 WEAVE for single point-source observations

The demand of our communities for ISIS observations has been consistently high. ING will as far as is possible continue to cater for this demand during the WEAVE years, when the number of nights when ISIS will be mounted on the telescope will be much smaller than in the pre-WEAVE years. To that end, we encourage potential ISIS applicants to use WEAVE instead whenever the characteristics of the observations allow it: single point-sources (MOS, mIFU or LIFU), and extended objects that fit within the footprint of either the small or the large IFUs. The performances of ISIS and WEAVE for single point sources have been shown to be very similar (ING Technical Note 137, [3]). While ISIS offers a wider range of spectral resolutions and its data are easier to reduce, WEAVE has high throughput, reaches higher spectral resolution, has wider spectral coverage, and has a robust pipeline which delivers data already processed. Of course, some observations currently carried out with ISIS (e.g. spectroscopic and imaging polarimetry) cannot be carried out with WEAVE.

ING will encourage the TACs to allow ISIS proposals to be observed with WEAVE if feasible, and if the proposers agree.

4.4.2 Treatment of WEAVE open-time data

As established in the WEAVE Data Policy [4], open-time data are proprietary to the PI for one year after the CPS-reduced data are made available to the PI. The length of this period can be negotiated with the Observatory in extraordinary cases. After the expiry of the proprietary period, WEAVE open-time data are available world-wide in the WAS.

By default, WEAVE open-time data are processed by the WEAVE CPS and APS in the same way as WEAVE survey data, and are ingested into the WEAVE archive where the PI accesses raw, CPS-processed and APS-processed data.

4.5 Observations with non-standard scheduling requirements

There is strong community demand for target-of-opportunity (ToO) observations, and these potentially have high scientific impact. ING plans to make these available with WEAVE MOS, mIFU and LIFU as soon as possible, but this will probably not be during the first on-sky science run with WEAVE, in order to allow time for the relevant infrastructure to be put in place.

Likewise, there is community demand for time-critical observations, monitoring programmes, long-term programmes and community fibres (access to fibres not used in another observer or survey configuration), and it's likely that at least some of these (depending on demand) will be offered once the WEAVE surveys are running smoothly.

4.6 Science of open-time WEAVE proposals

The responsibility for the allocation of WEAVE open time rests with the TACs. Avoiding duplications with WEAVE survey science is understood to be desirable but complicated in practice, given the sheer size of the surveys. Therefore, neither the ING nor the WEAVE Survey Exec will aim at preventing PI projects from pre-empting or replicating science from the WEAVE surveys. However, OT data which pre-empt or replicate survey data will be flagged in the WAS in such a way that, in addition to the PI, WAS users with access rights to WEAVE survey data will have access to these data as if it were WEAVE survey data. Such data will not be released to the world after one year after reception by the PI but later, as part of the next WEAVE survey data release. The WEAVE Survey Executive will flag what constitutes pre-emption or replication of WEAVE survey data, with the ING Director deciding over any disputes.

To help in this process, a page in the ING web site will maintain a description of the WEAVE surveys updated by the WEAVE science teams.

5 WEAVE OBSERVATION QUEUE: BALANCING SURVEYS AND OPEN TIME

5.1 Timescale for balancing the survey vs open-time fractions

The procedures for balancing time devoted to WEAVE surveys and open time assume the goal of reaching the 70% - 30% fractions at the end of every semester, but not on shorter timescales. From ING's experience in distributing telescope time into national quotas, it is clear that small imbalances are likely to occur at the end of each semester; these will be readily compensated in the following semester or year, as agreed with the party who receives the compensation. We expect the TACs to meet according to the standard A/B semester scheme used before WEAVE, and ING will provide the status of the survey-OT balance in time for each TAC meeting.

5.2 RA pressure and moon phase

The problem of ensuring a fair share of telescope time will be addressed by ING staff, to first degree, using the methods ING has implemented to control the use of the WHT service queue. The approach is to start with the priorities set by the WEAVE survey-working group (for WEAVE surveys), and those set by the TACs (for open-time OBs), to watch the allocations evolve and tweak the priorities of the open-time OBs so that the overall-semester count matches the expectation.

Moon phases are to be shared evenly between surveys and open time. Each side has a given quota of dark and bright hours, and it is their responsibility to fill their shares with OBs.

5.3 Filler programmes

After the scheduler factors in RA pressure and moon phase, there remains the issue of poor observing conditions: the demand will be lower for periods with bad seeing, low transparency due to cloud or dust. Clearly, the more demanding the requested conditions, the slower the programme will advance. It is therefore conceivable that, at the end of a semester, either WEAVE surveys or open-time cannot reach their expected quota because there were not sufficient nights matching the demanded conditions.

ING will ask both the WEAVE survey teams and the open-time TACs to define 'filler' programmes that can be carried out in poor conditions. When filler programmes are not available for, say, the open-time quota, but are available for the WEAVE-surveys quota, the latter will have access to this extra time free of charge. The reverse also applies.

This rule reflects the principle, established in the 1979 International Agreement and Protocol on Cooperation in Astrophysical Research in Spain [2], that unused observing time in one scheduling period is automatically made available to other parties, and the losing party does not have the right to request that time in a future scheduling period.

5.4 Discretionary nights and technical downtime

Discretionary time above or below the envisaged 25 nights per year (Table 1) will lead to a straightforward recalculation of the time split in Table 1. In many situations, any resulting imbalances can be compensated during the same semester. When this is not feasible, compensation will be effected during the next semester.

Technical downtime will not penalise the instrument causing the downtime. That is, a WEAVE technical downtime of 3 weeks, in which the telescope has to sit idle (because there is no time for changing instruments) is not counted against the 70% time share of the WEAVE surveys, rather it will be top-sliced from the accounting of WHT total available nights. Similarly, it does not reduce the 5 years of observing time granted to WEAVE surveys by 3 weeks.

6 WHT TIME ACCOUNTING SYSTEM

Telescope time accounting will be the responsibility of the on-island survey management team. The information kept in the time accounting system will be available to the WEAVE Survey Executive and to the open-time TAC chairs throughout the semester.

Reports on WHT telescope usage by WEAVE surveys and by open-time programmes will be routinely presented at the ordinary meetings of the ING Board.

7 COMMUNITY ACCESS TO WEAVE SCIENCE VERIFICATION TIME

Immediately after WEAVE on-sky commissioning (and, probably, partly-overlapping with it) the WEAVE team will conduct science verification (SV) and early-science (ESci) programmes. The goals of SV and ESci are understood as follows:

- **Science Verification:** programmes aimed at verifying/demonstrating the scientific performance of a given WEAVE instrumental mode.
- **Early Science:** scientific programmes to produce scientific results.

While the goal of ESci is to generate results for scientific publications, that of SV is to test *all of the instrumental modes* of the instrument.

The WEAVE science teams are planning both ESci and SV programmes, largely based on the science cases of the WEAVE surveys. However, there are certain WEAVE instrument modes that are not used in any of the WEAVE surveys. In order to ensure that all instrumental modes are tested during SV, ING has opened the SV phase to the community through short, shared-risk projects.

Community SV projects are required to:

- have specific science goals not duplicating those tested by the WEAVE teams;
- be dominantly aimed at testing instrumental modes not tested by the WEAVE teams: high-resolution with mIFUs, and low-resolution LIFU.

Data from community SV projects is to be made public immediately after processing by the WEAVE CPS and APS systems.

9 REFERENCES

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[3] Karjalainen, Marie; Balcells, Marc; Benn, Chris R., "ING La Palma Technical Note No. 137. Comparison of WEAVE and ISIS for single-target, point-source observations," Isaac Newton Group of Telescopes, 23 Oct 2019. [Online]. Available: http://www.ing.iac.es/astronomy/observing/manuals/ps/tech_notes/tn137.pdf.

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[5] Trager, Scott; Dalton, Gavin, "The WEAVE Publication Policy," 22 January 2019. [Online]. Available: https://ingconfluence.ing.iac.es:8444/confluence/download/attachments/7668297/WEAVE-EXE-004%20The%20WEAVE%20Publication%20Policy%20v1.2-final.pdf.

ABBREVIATIONS

ACAM	WHT's Cassegrain Auxiliary Camera
AF2	WHT's AutoFib2
APS	Advanced Processing System (for WEAVE)
CCI	'Comité Cientifico Internacional' of the Canarian Observatories
CPS	Core Processing System (for WEAVE)
ES	España
ESci	Early science
ING	Isaac Newton Group of Telescopes
ISIS	WHT's Intermediate dispersion Spectrograph and Imaging System
ITP	International Time Program of the Canary Islands Observatories
mIFU	Mini integral-field unit
LIFU	Large integral-field unit
LIRIS	WHT's Long-slit InfraRed Imaging Spectrograph
LST	Local sidereal time
MOS	Multi-object spectrograph, multi-object spectroscopy
NL	Netherlands
OB	Observing block
OT	Open time
PI	Principal Investigator
RA	Right ascension
SV	Science verification
SWG	(WEAVE's) Survery Working Group
TAC	Time Allocation Committee
WEAVE	WHT Enhanced Aperture Velocity Explorer
WHT	William Herschel Telescope