WEAVE on-sky commissioning / science verification

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When?

- On-sky commissioning is now expected to start ~ early August 2020 (following April delivery of PFC then 2 to 3 months for pre-commissioning engineering work). Part of 2020A returned to science.
- Total time required for commissioning tests ~ 25 nights, but allowing 100% for contingency (surprises) + bad weather, and adding time for science verification, 2 – 3 months will be needed.
- For most tests, lunar phase is not critical, but many need seeing < 1 arcsec. Summer is good for commissioning, but seeing will start to degrade after October.

Commissioning vs science verification

- Aim of on-sky commissioning is to make sure that WEAVE meets the science and operational requirements.
- Aim of on-sky science verification is to identify, by carrying out real science programmes, any shortcomings in WEAVE performance which may arise (1) because the requirements were incomplete (i.e. PIs want to do things we hadn't thought of) or (2) because the requirements have been imperfectly tested.

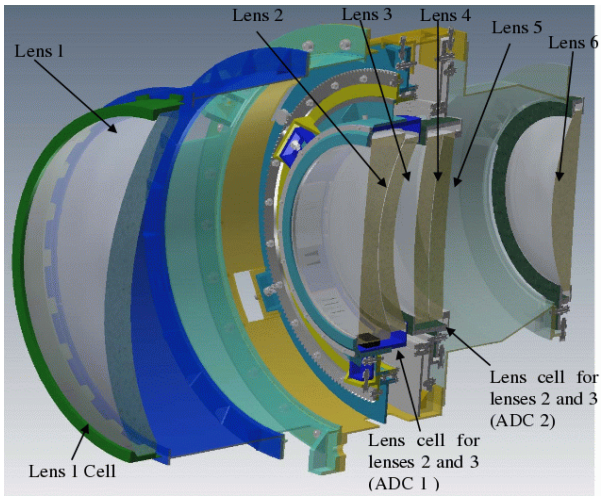
Commissioning

- Commissioning plan comprises ~ 80 tests, designed to make sure that WEAVE meets the science and operational requirements.
- Covers e.g. focal-plane geometry, optical quality, acquisition/guiding, calibration units, spec resolution, throughput, software (e.g. quick-look).
- Commissioning is carried out by ING astronomers (2 shifts per night + daytime shift) and visiting experts from the WEAVE team.

Large parameter space explored by commissioning

Several measurements (e.g. of PSF, throughput, noise) will need to be made as a function of several variables,
e.g. focal-plane mode (MOS-A, MOS-B, mIFU, LIFU), spectrograph mode, wavelength, position in the field of view, telescope elevation, ambient temperature.

E.g. PSF delivered by prime-focus corrector has to be measured as a function of the latter 4 of the above.



Information needed for each test

- Short description of purpose of test and how it is to be carried out.
- Number of hours needed for test.
- Observing conditions required for each test.
- Step-by-step description of what needs to be done at the telescope.
- All the above need to be written in language readily understood by any ING astronomer at 04:00.

WEAVECOMM105 - POINTING

Description; Expected results; Observing conditions; Duration; Detailed instructions

Description

Following installation of WEAVE, the 14-coefficient pointing model for the WHT is updated by positioning at the rotator centre (imaged on the focal-plane imager) each of ~ 100 stars of accurately-known position, distributed across the whole visible sky in azimuth and elevation. For each (centred) star, the azimuth and the elevation of the telescope are logged.

The TPOINT software is used to solve for the new pointing-model coefficients. The coefficients are updated in the telescope-control system and the telescope is pointed at a few stars distributed over the sky to measure the new pointing accuracy.

Accuracy of blind-offsetting is then tested by acquiring a star of accurately known position at a reference point on the detector, and blind-offsetting to another star of accurately known position. This test is repeated for star separations of up to 20 arcmin. The test should be repeated at elevations ~ 80, 50 and 20 deg.

It's envisaged that these tests will be carried out using the focal-plane imager (FPI) as detector, but it could also be carried out using the TV camera of the Shack-Hartmann unit, if the latter is mounted with the PFC (tumbler/positioner not present) prior to the main on-sky commissioning. In that case, if the pointing remains satisfactory when the rest of WEAVE is installed, a full additional test with the FPI would have reduced priority, although it is still desirable, to check that the pointing model is unchanged when the
distribution of mass at the top end is changed.

The tests should be repeated at least once during commissioning, to ensure that the results are as repeatable as at other focal stations.

Expected results: it will be possible to point the WHT with rms accuracy <~ 2 arcsec, i.e. <~ the radius of the guide-fibre bundles.

Observing conditions required: seeing < 2 arcsec, any sky brightness or transparency.

Duration: 6 hours.

WEAVECOMM-105 - POINTING

2	Enter required environmental data (temperature, pressure etc.). Set rotator mount PA = 0 and switch off rotator tracking. Position the FPI at the rotator centre. Put the display in TV mode, i.e. exposing and displaying repeatedly. Alternatively (as discussed above), use the TV camera of the Shack-Hartmann unit show all	
3	Point the WHT to one of the stars in the pointing grid shown on the link given in (1) above.	WHT tracks required position.
4	The WHT pointing at prime-focus is typically accurate to within a few arcsec, so the (bright) star should be visible on the FPI (field of view 2 arcmin) or the Shack-Hartmann TV (field ~ 20 arcsec). If it's not visible, do a spiral search about the current pointing, in steps ~ 1 arcmin.	Star visible near centre of field of view.
5	Offset the position of the telescope in azimuth and elevation to centre the star on the position of the rotator centre. Type POINT NEW to log the position of the telescope as read from the encoders.	Star now at rotator centre.
6	Repeat steps 3 to 5 for ~ 80 - 100 stars well-distributed in azimuth and elevation but with a higher density near the zenith. About half of the stars should be at elevation > 45 deg (see the link in step 1 above for tips on how to do this). Once each star is centred, click the F20 button on the TCS keyboard.	The encoder positions are logged automatically by the TCS to a file.
7	Analayse the log file using TPOINT	New values of the 14 pointing

What affects order of commissioning?

- Probably starts with test of tumbler (if this OK, gives access to LIFU) then FPI, then rest of POS (say first half of each of several nights, Ian).
- Science priority e.g. LIFU then MOS (plate A then B?) then mIFUs.
- Inter-dependencies e.g. pointing model needed first.
- Weather e.g. some things need good seeing, or change of ambient temperature.
- Availability of staff e.g. sub-system experts.
- Disasters e.g. failure of a sub-system.

Results from commissioning

- A commissioning report will summarise the results of each test, and will highlight areas where the science or operational requirements are not fully met (or have been significantly exceeded).

Results from science verification

- Planning, scheduling and carrying out the SV observations, and assessing the quality of the pipeline-reduced data, will highlight any unanticipated shortcomings in WEAVE (some of which it may be possible to address, others will be documented as features).
- The SV observations may also highlight opportunities for using WEAVE to tackle different kinds of problem (not envisaged in the original science case).

Summary

- Commissioning = 70 on-sky tests (preceded by off-sky AIT). Science verification is effected via observation of PI proposals (WEAVE-survey and ‘open time’).
- Some of tests explore a large parameter space e.g. PSF as a function of elevation, temperature, position in field, focal-plane mode, spectrograph mode, wavelength and fibre number.
- Commissioning and science verification are expected to start August 2020, and take 2 – 3 months.
- Up to ~ 100 SA night shifts required to carry out the commissioning and SV, i.e. most ING SAs will be involved.
- Comments, and suggestions for tests, are welcome!