WEAVE Prime Focus Corrector
Management of the PRI-014 Design Files

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Approvals

This document requires the following approvals.

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1 INTRODUCTION

1.1 Abbreviations

The abbreviations and acronyms used in this document can be found in WEAVE-MAN-001.

1.2 Purpose of the document

The purpose of the document is to describe the dependencies between all the Zemax files generated during the re-optimization processes of the WEAVE Prime Focus Corrector optical designs. For each Zemax file generated, the inputs and outputs are detailed.

1.3 Reference documents

WEAVE-PRI-014 PFC Final Optical Design	• Final Optical Design for the WEAVE PFC
WEAVE-PRI-028 PFC design re-optimizations	• WEAVE Corrector 1st melt-fit re-optimization • WEAVE Corrector 2nd melt-fit re-optimization • Zemax models
WEAVE-PRI-027 PFC Blanks as-built & Lens specifications	• Approved blanks manufacturing drawings • Data Reports of the Blanks As-built

	• Approved blanks manufacturing drawings • PFC error budget updated
WEAVE-PRI-033 PFC Lens as-built data	• Lens Test Reports

1.4 Philosophy to mechanically model the lenses

- The Zemax files WEAVE-PRI-014 contain the optical information of all the lens surfaces.
- STEP files are then generated (one file per telescope elevation).
- Using AutoDesk Inventor, edging of the lenses is modelled (flat, chamfer, outer cylinder…). The optical surfaces are not touched.
    - The surfaces of the as-built ADC lenses are also decentered or tilted by the right amount to represent the polishing strategy.
    - The as-built ADC lenses are also decentered or tilted by the right amount to represent the mounting strategy.
- The CAD file then created (with lenses edged) is imported into Zemax, and image quality is checked.
    - Other check: with AutoDesk, lenses are drawn from scratch using the optical prescriptions and should match the CAD model.

1.5 Time-Frame

The table below indicates when the design re-optimization processes took or will take place.

	Purpose of the re-optimization	Time-Frame
Original files @ FDR	Design Baseline	July 2013
First re-optimization	B3 and B4 melt-fit	December 2014 – January 2015
Second re-optimization	B2 and B5 melt-fit	December 2015 – January 2016
Third re-optimization	L1 to L6 as-built	2016 / 2017

2 DESIGN BASELINE FDR FILES

https://bscw.ing.iac.es/bscw/bscw.cgi/331941

WEAVE-PRI-014.1	Simplified Zemax file that was used to model the baseline design at the time of FDR (July 2013)
WEAVE-PRI-014.2	Zemax file that was used for tolerancing WEAVE-PRI-014.1
WEAVE-PRI-014.3	Zemax file that was used for optimizing WEAVE-PRI-014.1 *Note: file 14.3 contains the merit function that was used to optimize the 14.1 and 14.1 is the final design with the correct apertures (at the time of FDR). Optically the 14.1 and 14.3 files*

Thermal model	*are the same except that the 1040mm diameter baffle in front of L1 is present in 14.1 but not in 14.3.* Thermal model used to tolerance the top-end refocus range (Zemax file called "*WEAVE_FINAL_20130401_thermal_CORR_refocus*")

3 FIRST RE-OPTIMIZATION FILES (B3 AND B4 MELT-FIT)

https://bscw.ing.iac.es/bscw/bscw.cgi/441257

WEAVE-PRI-014.4	Origin: WEAVE-PRI-014.3 - B3 and B4 melt-fit + optical design re-optimization
WEAVE-PRI-014.5	Origin: WEAVE-PRI-014.3 - B3 and B4 melt-fit + optical design re-optimization - Worst ghost focus distance set to 10mm
WEAVE-PRI-014.5_rev1	Origin: WEAVE-PRI-014.5 - Corrected AR coating and SK-1300 pressure data
WEAVE-PRI-014.5_rev1_thermal	Origin: WEAVE-PRI-014.5_rev1 - RoC values of L1, L3, L4 and L6 for every degree between -5 and 25 deg C can be derived Note: the thermal data (CTE and coefficients) of the fitted glasses (B3, B4 and B6) were not updated and were left to 0. Therefore, the RoC values of L3, L4 and L6 do not vary with T changes!

WEAVE-PRI-014.5_rev1 (from WEAVE-PRI-014.3) deals with L3 and L4 glass melt-fit (PBL1Y) and design re-optimization.

Inputs to WEAVE-PRI-014.3:

- B3, B4 and B6 new glass material, fitted with their as-built parameters
- New features added to the design:
  - The limiting aperture just before L1 with an aperture of 1040mm is modelled in the merit function.
  - A secondary obscuration with 1830mm diameter is modelled close to L6.
  - L2-L3 and L4-L5 air gaps increase (from 3mm to 5mm).
  - Double bounce ghost in L4 was modelled and the minimum ghost focus distance (wrt. the focal plane) was set to 10mm.
  - Coating of L1 s1 and s2 removed.
  - Coating of L2s2 and L4s2 set to I99.

Output from WEAVE-PRI-014.5_rev1: new L2, L3, L4 and L5 prescription data

- Parameters that were changed due to re-optimization:
  - L3, L4, L6 fitted glass material (as-built)

  - L2, L3, L4, L5 RoC of both surfaces
  - Aspheric coefficients of L5
  - L2, L3, L4, L5 tilts (wedge angles)
  - ADC rotation angles
  - Clear Aperture diameters of L1 to L6
  - L2-L3 and L4-L5 air gaps (from 3mm to 5mm)
  - M1 – L1 axial separation
  - L1 – L2 axial separation
  - L5 – L6 axial separation
- Parameters that were left unchanged:
  - CT of L1 to L6*
  - L3 – L4 axial separation (95mm)
  - L6 – FP axial separation (BFD remains 250mm)
  - L1 and L6 prescription data (except CA diameters)

**Note that the center thicknesses of the lenses are also expected to change, but very slightly (few microns typically). Then it was decided not relevant to update the values in the drawings, lightening the mechanical design.*

➡ **L3 and L4 now frozen on top of L1 and L6**

4 SECOND RE-OPTIMIZATION FILES (B2 AND B5 MELT-FIT)

https://bscw.ing.iac.es/bscw/bscw.cgi/441257

WEAVE-PRI-014.6	Origin: WEAVE-PRI-014.5_rev1 - B2 and B5 melt-fit + optical design re-optimization
WEAVE-PRI-014.6_rev1	Origin: WEAVE-PRI-014.6 - Thermal data (CTE and coefficients) added to the fitted glasses (catalogue named "*WEAVE_MELT_FIT_FINAL*") - Atmospheric pressure corrected (780mbar=0.77atm) - All variables removed except refocus (surface 10) - Design re-optimized
WEAVE-PRI-014.6_rev2	Origin: WEAVE-PRI-014.6_rev1 - Corrected thermal data (CTE and coefficients) of the fitted glasses (catalogue named "*WEAVE_MELT_FIT_FINAL_EMILIE*") - Worst ghost focus distance monitored in the merit function - All variables back (M1-L1, L1-L2, L5-L6 and all the ADC rotation angles except @ 0deg and 70deg.) - Design re-optimized
WEAVE-PRI-014.6_rev2_thermal	Origin: WEAVE-PRI-014.6_rev2 - RoC values of L1 to L6 for every degree between -5 and 25 deg C can be derived

WEAVE-PRI-014.6_rev3	- Design re-optimized to calculate the refocus range Origin: WEAVE-PRI-014.6_rev2 - As-built transmittance (internal transmission) added to the fitted glasses (design not re-optimized)

WEAVE-PRI-014.6 (from WEAVE-PRI-014.5_rev1) deals with L2 and L5 glass melt-fit (N-BK7) and design re-optimization.

Inputs to WEAVE-PRI-014.5_rev1:

- B2 and B5 new glass material, fitted with their as-built parameters
- L6 center thickness reduction from 100mm to 97mm (-2mm for blemish removal and -1mm for aspherization)

Output from WEAVE-PRI-014.6: new L2 and L5 prescription data

- Parameters that were changed due to re-optimization:
  - L2 and L5 fitted glass material (as-built)
  - L2 and L5 RoC of both surfaces
  - Aspheric coefficients of L5
  - L2 and L5 tilts (wedge angles)
  - ADC rotation angles
  - L6 CT (from 100mm to 97mm)
  - M1 – L1 axial separation
  - L1 – L2 axial separation
  - L5 – L6 axial separation
- Parameters that were left unchanged:
  - CT of L1 to L6*
  - L3 and L4 tilts (wedge angles)
  - Clear Aperture diameters (within margin of first re-optimization)
  - L2-L3 and L4-L5 air gaps (5mm)
  - L3 – L4 axial separation (95mm)
  - L6 – FP axial separation (BFD 250mm)
  - L1, L3, L4 and L6 prescription data

**Note that the center thicknesses of the lenses are also expected to change, but very slightly (few microns typically). Then it was decided not relevant to update the values in the drawings, lightening the mechanical design.*

➡ **L2 and L5 now frozen on top of L1, L3, L4 and L6**

5 THIRD RE-OPTIMIZATION FILES (L1 TO L6 AS-BUILT)

To be carried out in 2016/2017

WEAVE-PRI-014.7	Origin: WEAVE-PRI-014.6_rev3 • Optical design re-optimization (L1 to L6 as-built) Note: the lens semi-diameters should be updated in the LDE and constrained in the MFE, fixing the values to the as-built CMM

WEAVE-PRI-014.7_NSC **WEAVE-PRI-014.7_thermal**	of the blanks. The aperture and location of the baffles should be revised at this stage too. Origin: WEAVE-PRI-014.7 • Non-sequential Zemax model including the as-built parameters of the blanks and lenses. *This file will be used to conduct the stray-light analysis and freeze the baffle specifications.* Note: the tilts of the lenses are not modelled (TBC). Origin: WEAVE-PRI-014.7 • RoC values of L1 to L6 for every degree between -5 and 25 deg C can be derived

WEAVE-PRI-014.8	Origin: WEAVE-PRI-014.2 • AIT tolerances re-optimization accounting for the as-built lens parameters (RoC, CT, wedge angles, diameters…) *This file will be used to conduct a new MC analysis to freeze the AIT tolerances. The MC re-run should include a top-hat distribution and model more cases.*

WEAVE-PRI-014.7 (from WEAVE-PRI-014.6_rev3) accounts for the lens as-built dimensions.

<u>Inputs to WEAVE-PRI-014.6_rev3:</u>

- L1 to L6 as-built outer diameter
- L1 to L6 as-built radii of curvature
- L1 to L6 as-built central thicknesses
- L2 to L4 as-built wedge angle
- L5s2 and L6s2 aspherical data (TBC)

<u>Output from WEAVE-PRI-014.7:</u> new axial separations

- Parameters that were changed due to re-optimization:
  - M1 – L1 axial separation
  - L1 – L2 axial separation
  - L5 – L6 axial separation
  - ADC rotation angles
- Parameters that were left unchanged:
  - Clear Aperture diameters (within margin of first re-optimization) (TBC)
  - L2-L3 and L4-L5 air gaps (5mm)
  - L3 – L4 axial separation (95mm)
  - L6 – FP axial separation (BFD 250mm)
- The refocus (M1-PFC) is kept variable (thermal and flexure compensator).