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SPIRE PFM Filter Configuration

Summary of filter, beam divider, dichroic & lens configuration, and calibration curve index

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1. Scope

This note defines and summarises the filters, beam dividers, dichroics & lenses used for all aspects of the SPIRE FM campaign.

- The actual FM instrument configuration is detailed in section 0.
- The configuration used for PFM1 and PFM2 testing is detailed in section 2
- Test facility filters are detailed in section 3.
- Flight calibration data, and photometer channel calibration curves are presented and indexed in section 6.
- PFM2 test campaign calibration data are presented and indexed in section 7.

For all test data, the calibration curves to be used have been extracted from the as-delivered Microsoft Excel spreadsheets and placed on the accompanying CD-ROM. These curves are standard ASCII text files, where the first column is wavenumbers, and the second column is transmission. All data have been re-binned to a common wavenumber scale, with 0.1 cm^{-1} resolution.

This release does not provide the recommended transmission for the spectrometer detectors, but does provide the index and calibration curves for all components in the spectrometer channels.

The next release will include recommended photometer channel calibration curves for use in situations where the SPIRE detectors are viewing the AIV test laboratory through the AIV cryostat filters and window. At the time of this release, data for the window transmission was not available, although calibration files for the individual AIV filters are provided.

SPIRE FM instrument filters, beam dividers and dichroics

This section details the FM configuration, used from the PFM3 campaign onwards, and reflects the current configuration as at 18th January 2006.

1.1. FM instrument filters

Filter	Reference	Data file	Notes
CFIL1	B723 FILT-PFM-101	pfm-cfil1.txt	
PFIL2	B745 FILT-PFM-102	pfm-pfil2.txt	
PFIL3	W879 FILT-PFM-103	pfm-pfil3.txt	A/R coated component
SFIL2	B705 FILT-PFM-113	pfm-sfil2.txt	
SFIL3S	B655 FILT-PFM-116	pfm-sfil3s.txt	
SFIL3L	B731 FILT-PFM-120	pfm-sfil3l.txt	
PLW 300mK filters	B730 FILT-PFM-230	pfm-plw-stack.txt	300mK PLW filter in mount. Single PFIL4L blocker.
PMW 300mK filters	B734 FILT-PFM-240	pfm-pmw-stack.txt	300mK PMW filter in mount. Single PFIL4M blocker.
PSW 300mK filters	W859, W857, FILT-PFM-250	pfm-psw-stack.txt	300mK PSW filters in mount. W859 – blocker W857 – edge definer Data file is transmission of assembled stack.
SFIL4L	B683#2 FILT-PFM3-214	pfm3-sfil4l.txt	300mK SLW blocker. This component was originally delivered as the flight-spare unit, which was later upgraded to FM once at RAL.
SFIL5L	B675#1 FILT-PFM3-215	pfm3-sfil5l.txt	300mK SLW edge definer. This component was originally delivered as the flight-spare unit, which was later upgraded to FM once at RAL.
SFIL4S	B679#2 FILT-PFM3-224	pfm3-sfil4s.txt	300mK SSW blocker. This component was originally delivered as the flight-spare unit, which was later upgraded to FM once at RAL.
SFIL5S	B650#2 FILT-PFM3-225	pfm3-sfil5s.txt	300mK SSW edge definer. This component was originally delivered as the flight-spare unit, which was later upgraded to FM once at RAL.
SLW Lens	FILT-PFM3-213	pfm3-slw-arc-flight-	Note that this lens is an A/R coated upgrade. It was NOT used

		lens.txt	for campaigns prior to PFM3. The transmission is measured only through the planar part of the lens.
SSW Lens	FILT-PFM3-223	pfm3-ssw-arc-flight-lens.txt	Note that this lens is an A/R coated upgrade. It was NOT used for campaigns prior to PFM3. The transmission is measured only through the planar part of the lens.

1.2. Dichroics

Filter	Reference	Data file	Notes
PDIC1	1489 FILT-PFM3-310	pfm3-pdic1-flight-T.txt	Transmission data. Note – this component was not used prior to PFM3 testing.
		pfm3-pdic1-flight-R.txt	Reflection data. Note – this component was not used prior to PFM3 testing.
PDIC2	1487 FILT-PFM3-320	pfm3-pdic2-flight-T.txt	Transmission data. Note – this component was not used prior to PFM3 testing.
		pfm3-pdic2-flight-R.txt	Reflection data. Note – this component was not used prior to PFM3 testing.

1.3. Beam dividers

Filter	Reference	Data file	Notes
SBS1	FILT-PFM-410	pfm-sbs1-c.txt	Reflection off capacitive grid, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution
		pfm-sbs1-i.txt	Reflection off inductive grid, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution
		pfm-sbs1-t.txt	Transmission, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution
SBS2	FILT-PFM-420	pfm-sbs2-c.txt	Reflection off capacitive grid, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution
		pfm-sbs2-i.txt	Reflection off inductive grid, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution
		pfm-sbs2-t.txt	Transmission, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution

2. SPIRE PFM1 and PFM2 instrument filters, beam dividers and dichroics – NON-FLIGHT CONFIGURATION

This section details the configuration, used for the PFM1 and PFM2 test campaigns. While the majority of components are the same flight components, there were a few non-flight, temporary components, or components that were subsequently upgraded for flight. These components are highlighted in **boldface**.

2.1. PFM1/2 instrument filters

Filter	Reference	Data file	Notes
CFIL1	B723 FILT-PFM-101	pfm-cfil1.txt	
PFIL2	B745 FILT-PFM-102	pfm-pfil2.txt	
PFIL3	W879 FILT-PFM-103	pfm-pfil3.txt	A/R coated component
SFIL2	B705 FILT-PFM-113	pfm-sfil2.txt	
SFIL3S	B655 FILT-PFM-116	pfm-sfil3l.txt	
SFIL3L	B731 FILT-PFM-120	pfm-sfil3s.txt	
PLW 300mK filters	B730 FILT-PFM-230	pfm-plw-stack.txt	300mK PLW filter in mount. Single PFIL4L blocker.
PMW 300mK filters	B734 FILT-PFM-240	pfm-pmw-stack.txt	300mK PMW filter in mount. Single PFIL4M blocker.
PSW 300mK filters	W859, W857, FILT-PFM-250	pfm-psw-stack.txt	300mK PSW filters in mount. W859 – blocker W857 – edge definer Data file is transmission of assembled stack.
SFIL4L	B488 FILT-PFM-214	pfm-sfil4l.txt	These filters were present in the PFM1 and PFM2 builds, but for calculations of total spectrometer band transmission, the transmission curves below should be used, which are the total measured 300mK filter and lens stack transmissions.
SFIL5L	B476 FILT-PFM-215	pfm-sfil5l.txt	
SFIL4S	B679 FILT-PFM-224	pfm-sfil4s.txt	
SFIL5S	B650 FILT-PFM-225	pfm-sfil5s.txt	
SLW 300mK Lens & filter stack	FILT-PFM-210	pfm12-slw-stack.txt	This is the total transmission of the 300mK SLW filter and lens assembly. The transmission is measured only through the planar part of the lens. HDPE lens – non-flight.
SSW 300mK Lens & filter	FILT-PFM-220	pfm12-ssw-stack.txt	This is the total transmission of the 300mK SSW filter and lens assembly.

stack			The transmission is measured only through the planar part of the lens. HDPE lens – non-flight.
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2.2. Dichroics

Filter	Reference	Data file	Notes
PDIC1	1338 FILT-PFM-310	gse-pfm2-pdic1-T.txt	Transmission data. Note – this component was only used for PFM2 testing.
		gse-pfm2-pdic1-R.txt	Reflection data. Note – this component was only used for PFM2 testing.
PDIC2	1459 FILT-PFM-320	gse-pfm2-pdic2-T.txt	Transmission data. Note – this component was only used for PFM2 testing.
		gse-pfm2-pdic2-R.txt	Reflection data. Note – this component was only used for PFM2 testing.

2.3. Beam dividers

Filter	Reference	Data file	Notes
SBS1	FILT-PFM-410	pfm-sbs1-c-w-10-140-1.txt	Reflection off capacitative grid, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution
		pfm-sbs1-i-w-10-140-1.txt	Reflection off inductive grid, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution
		pfm-sbs1-t-w-10-140-1.txt	Transmission, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution
SBS2	FILT-PFM-420	pfm-sbs2-c-w-1-140-1.txt	Reflection off capacitative grid, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution
		pfm-sbs2-i-w-1-140-1.txt	Reflection off inductive grid, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution
		pfm-sbs2-t-w-1-140-1.txt	Transmission, 10-140cm ⁻¹ , 0.1cm ⁻¹ resolution

3. Test facility filters – GSE – NON-FLIGHT

Filter	Reference	Data file	Notes
AIV77K	B648	AIV77.txt	
AIV10K	B635	AIV10.txt	
ND09	ND09	ND09.txt	9.5% ND filter. Uniformity data in CBB data pack (AIV_ND_uniformity.xls).
ND04	ND04	ND04.txt	3.8% ND filter. Uniformity data in CBB data pack (AIV_ND_uniformity.xls).

4. SPIRE filter topology

The general topology of SPIRE optical components is illustrated in Figure 1 and Figure 2. Filters, dichroics and beam-splitters are shown in green.

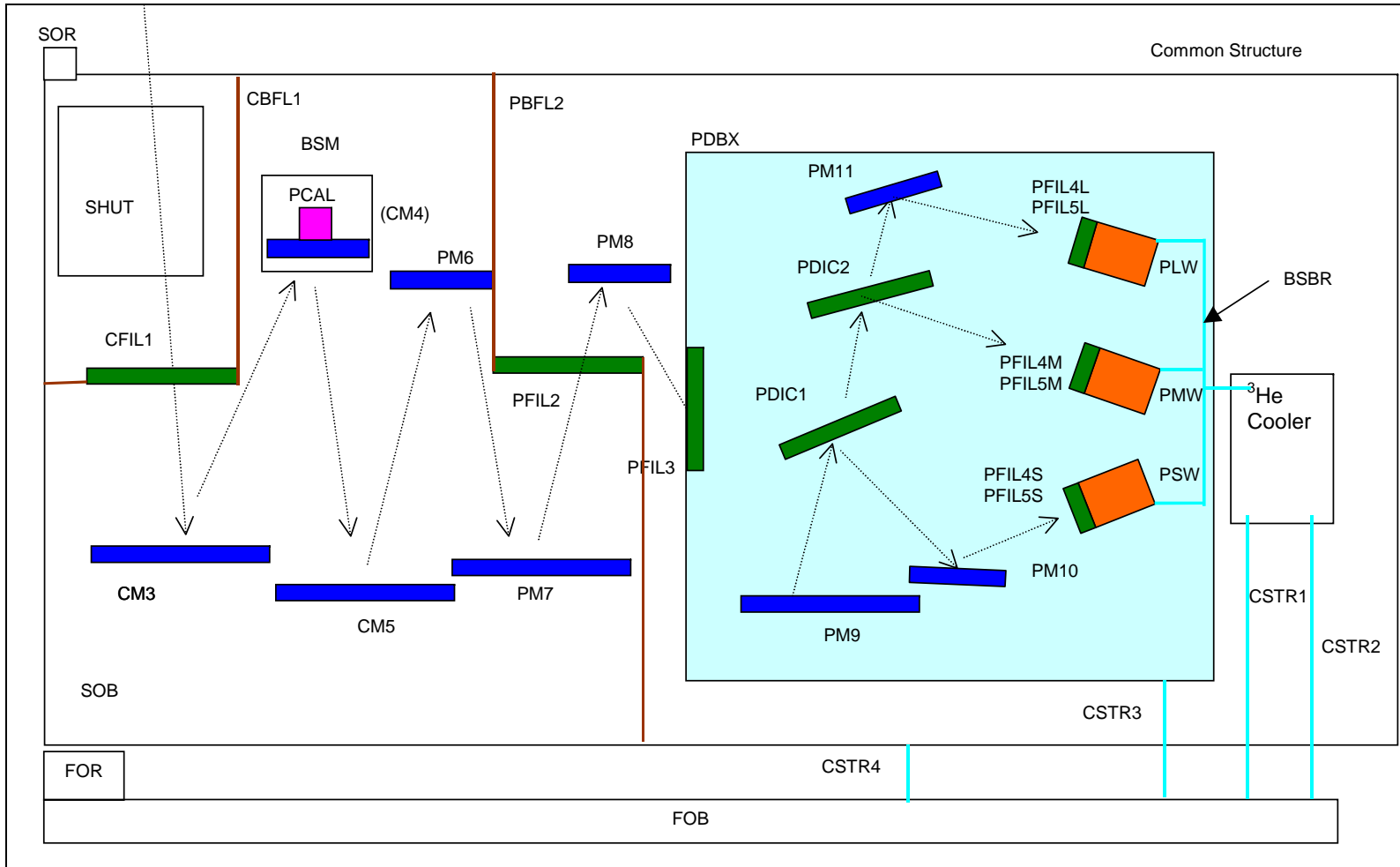


Figure 1 Photometer filter topology

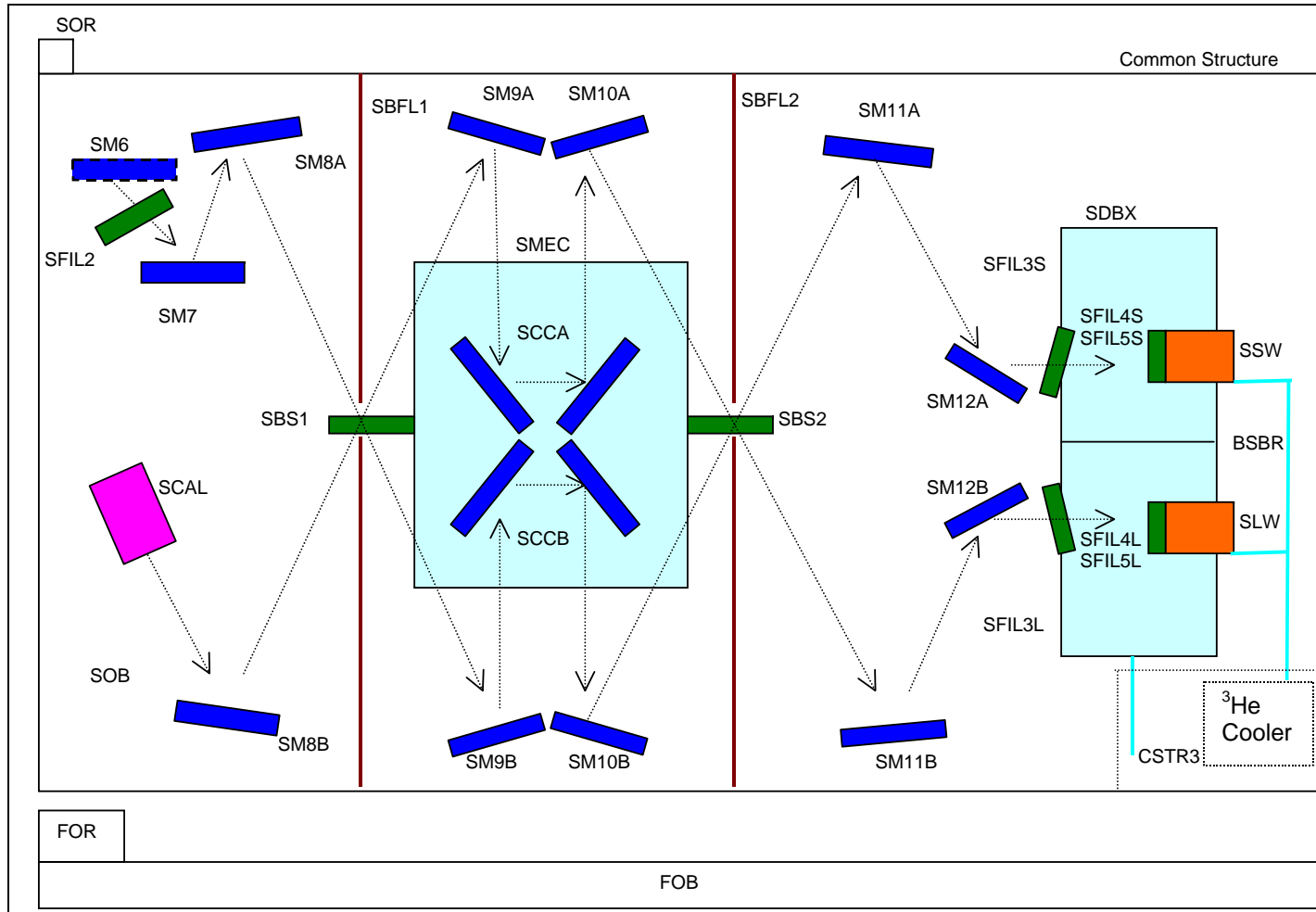


Figure 2 Spectrometer filter topology

5. Beam divider configuration

The beam dividers each consist of two grids, separated by a dielectric layer. There is a capacitive grid pattern on one side, with an inductive grid pattern on the other. The beam dividers are mounted in the instrument such that the capacitive and inductive grids are in opposition, as shown in Figure 3.

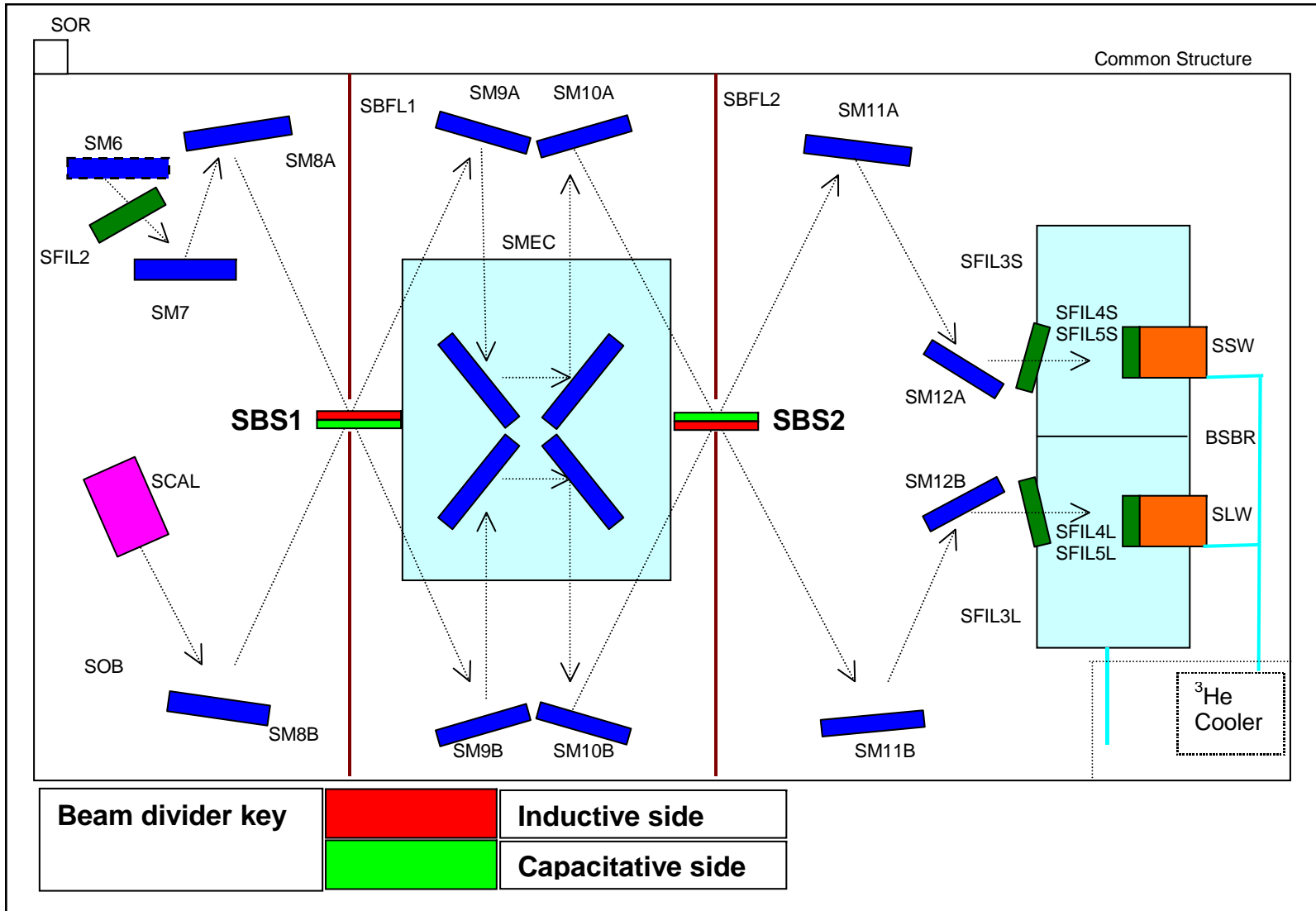


Figure 3 Beam divider mounting guide.

6. Photometer bands – flight configuration

6.1. PSW Channel

Filter configuration for this channel:-

CFIL1	pfm-cfil1.txt	Flight item
PFIL2	pfm-pfil2.txt	Flight item
PFIL3	pfm-pfil3.txt	Flight item
PDIC1R	pfm3-pdic1-flight-R.txt	Flight dichroic – PFM3 tests onwards. Seen by this channel in reflection.
PSWSTACK	pfm-psw-stack.txt	Flight 300mK PSW filter stack.

The recommended calibration file for the PSW channel pass-band is:-

pfm3-psw-channel-calibration.txt

This file includes the waveguide cut-off data for this channel. The value for the cut-off is 34.282 cm^{-1} ($291.7 \text{ }\mu\text{m}$), and comes from the PSW BDA EIDP. The cut-off is modelled in these data as a hard cut-off to zero transmission for frequencies below the cut-off value. These data are shown in Figure 4.

The calibration file to be used for the transmission of all flight filters alone is:-

pfm3-psw-channel-filters-only.txt

This file is the transmission of the filters alone, and does not include the waveguide cut-off.

These data are shown, together with the individual filter traces, in Figure 5.

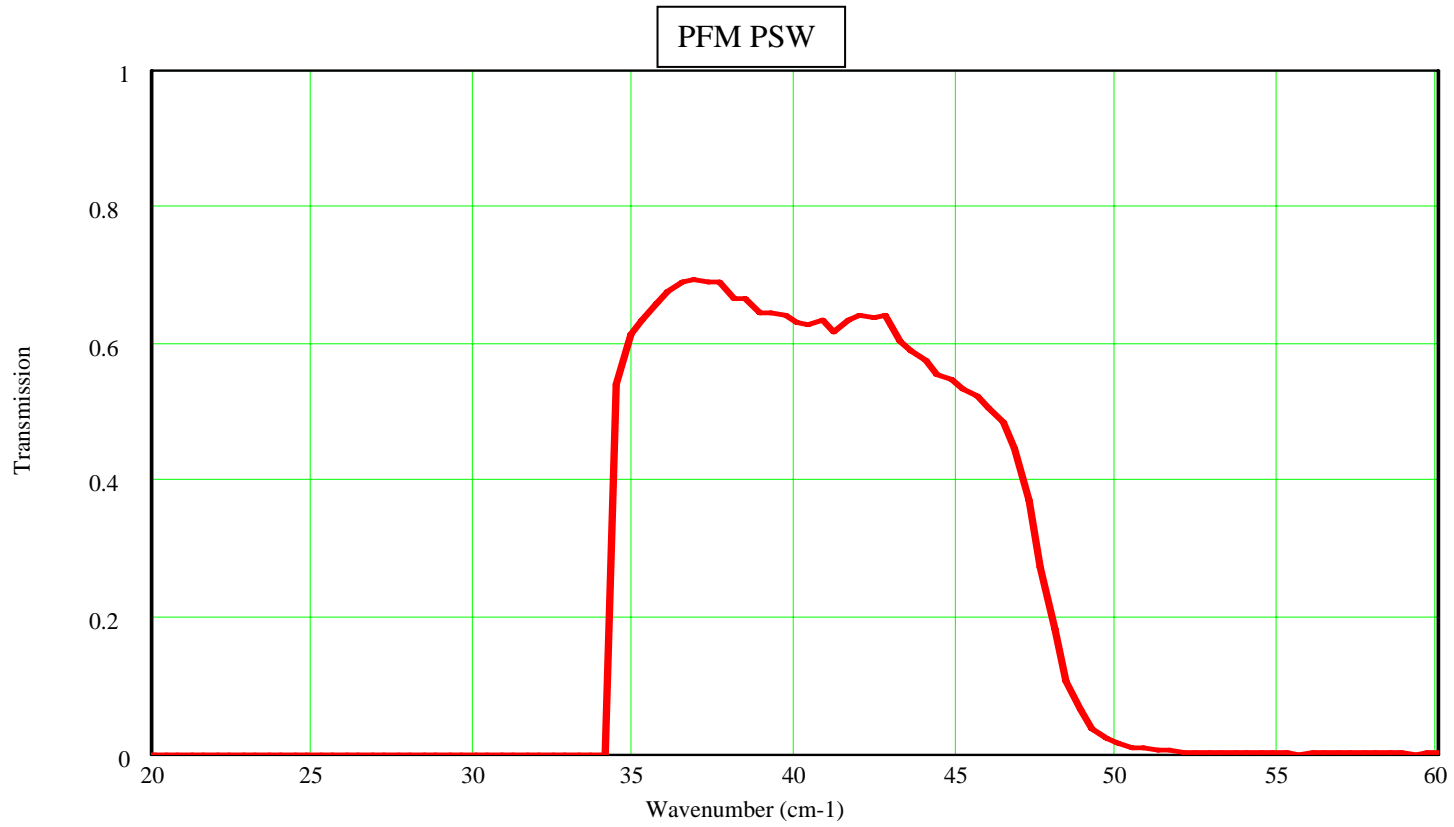


Figure 4 PSW channel calibration data. These data include the waveguide cut-off.

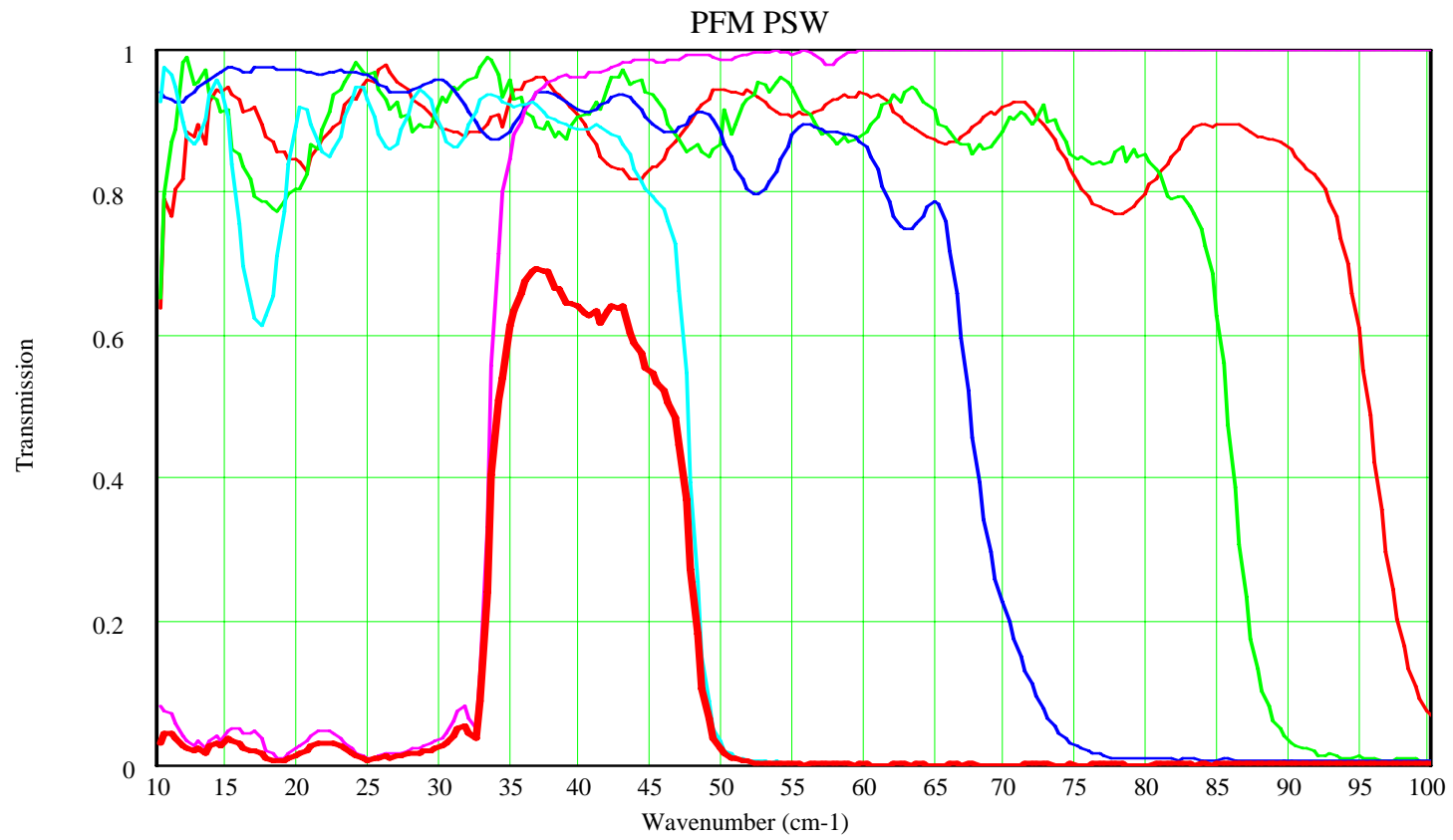


Figure 5 PSW channel filter calibration data. Bold red trace is summation of all components, and is the overall PSW filter transmission function.

6.1.1. PSW PFM3 ground-test calibration data

Need window transmission from Bruce.....

6.2. PMW Channel

Filter configuration for this channel:-

CFIL1	pfm-cfil1.txt	Flight item
PFIL2	pfm-pfil2.txt	Flight item
PFIL3	pfm-pfil3.txt	Flight item
PDIC1T	pfm3-pdic1-flight-T.txt	Flight dichroic – PFM3 tests onwards. Seen by this channel in transmission.
PDIC2R	pfm3-pdic2-flight-R.txt	Flight dichroic – PFM3 tests onwards. Seen by this channel in reflection.
PMWSTACK	pfm-pmw-stack.txt	Flight 300mK PMW filter stack.

The recommended calibration file for the PMW channel pass-band is:-

pfm3-pmw-channel-calibration.txt

This file includes the waveguide cut-off data for this channel. The value for the cut-off is 23.81 cm^{-1} ($420 \mu\text{m}$), and comes from the PMW BDA EIDP. The cut-off is modelled in these data as a hard cut-off to zero transmission for frequencies below the cut-off value. These data are shown in Figure 6.

The calibration file to be used for the transmission of all flight filters alone is:-

pfm3-pmw-channel-filters-only.txt

This file is the transmission of the filters alone, and does not include the waveguide cut-off.

These data are shown, together with the individual filter traces, in Figure 7.

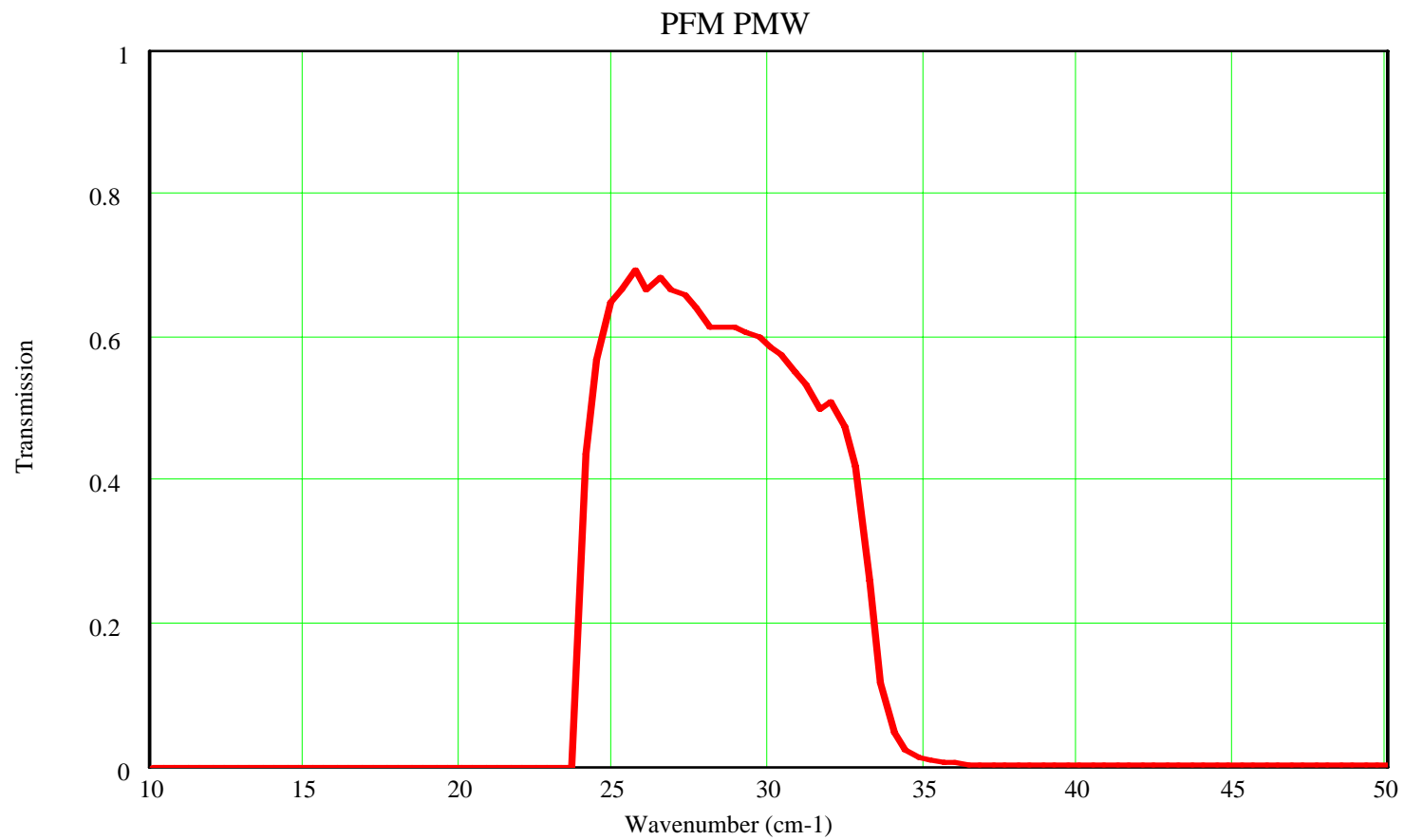


Figure 6 PMW channel calibration data. These data include the waveguide cut-off.

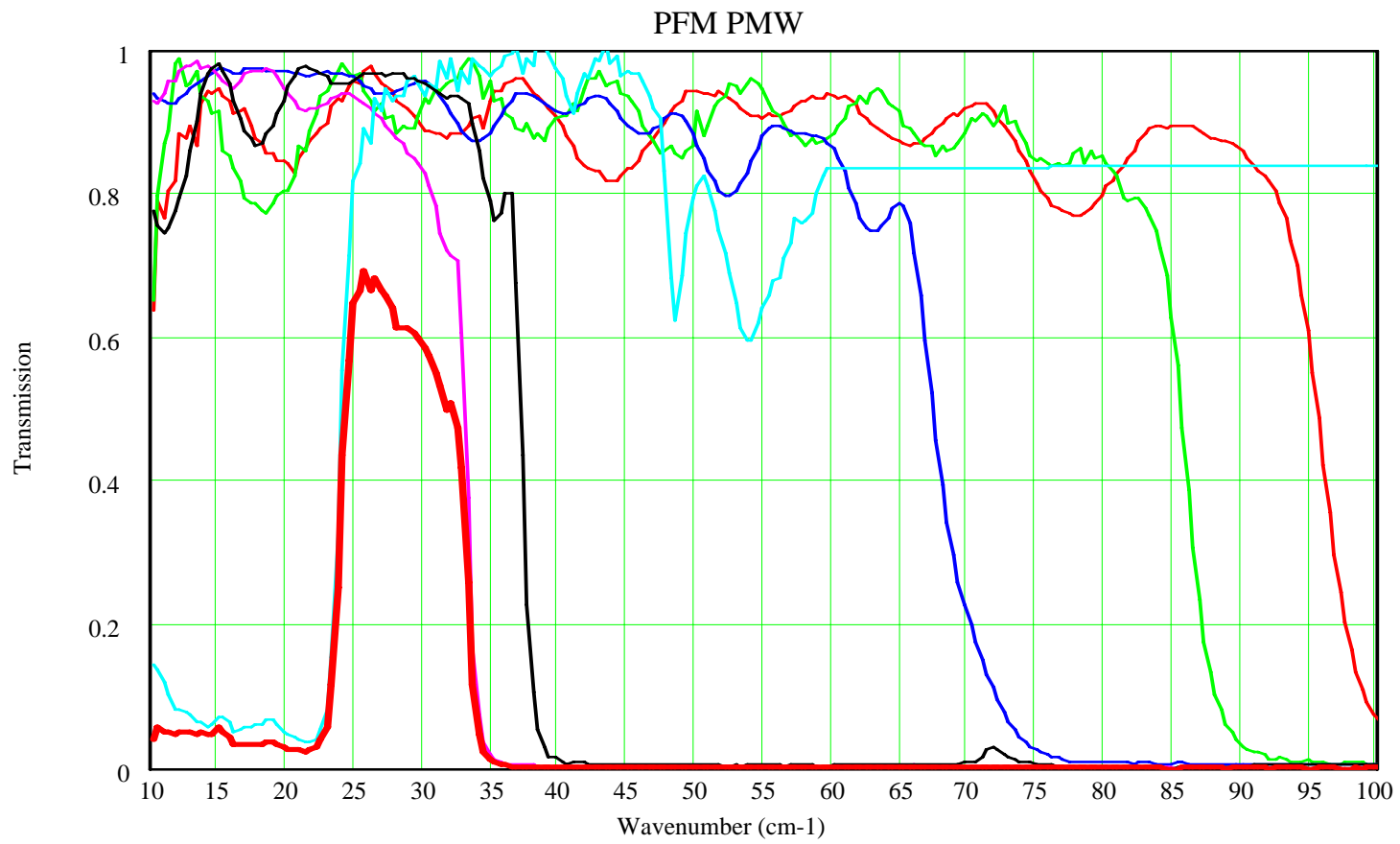


Figure 7 PMW channel filter calibration data. Bold red trace is summation of all components, and is the overall PMW filter transmission function.

6.3. PLW Channel

Filter configuration for this channel:-

CFIL1	pfm-cfil1.txt	Flight item
PFIL2	pfm-pfil2.txt	Flight item
PFIL3	pfm-pfil3.txt	Flight item
PDIC1T	pfm3-pdic1-flight-T.txt	Flight dichroic – PFM3 tests onwards. Seen by this channel in transmission.
PDIC2T	pfm3-pdic2-flight-T.txt	Flight dichroic – PFM3 tests onwards. Seen by this channel in transmission.
PLWSTACK	pfm-plw-stack.txt	Flight 300mK PLW filter stack.

The recommended calibration file for the PLW channel pass-band is:-

pfm3-plw-channel-calibration.txt

This file includes the waveguide cut-off data for this channel. The value for the cut-off is 16.58 cm^{-1} ($603.2 \text{ }\mu\text{m}$), and comes from the PLW BDA EIDP. The cut-off is modelled in these data as a hard cut-off to zero transmission for frequencies below the cut-off value. These data are shown in Figure 8.

The calibration file to be used for the transmission of all flight filters alone is:-

pfm3-plw-channel-filters-only.txt

This file is the transmission of the filters alone, and does not include the waveguide cut-off.

These data are shown, together with the individual filter traces, in Figure 9.

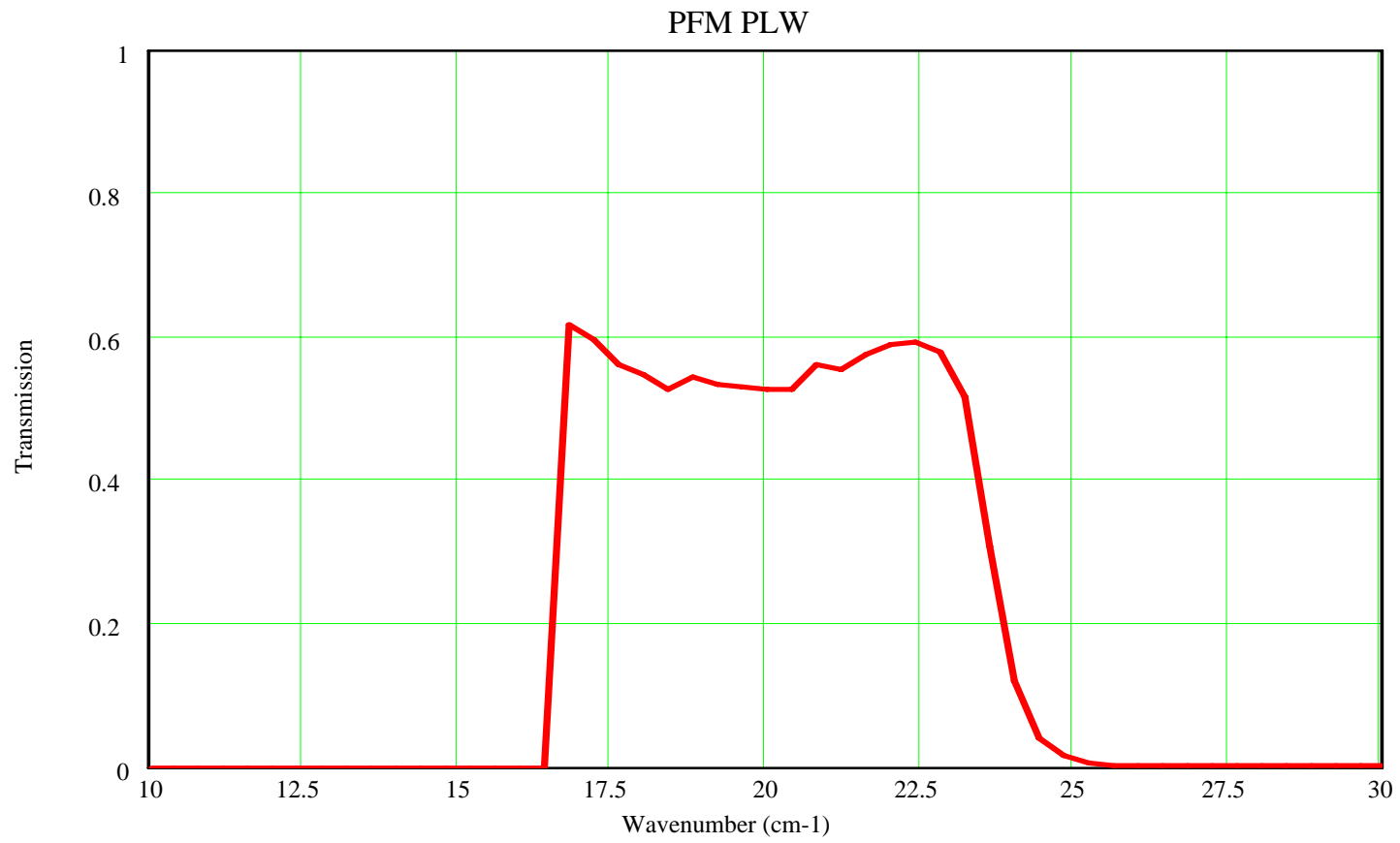


Figure 8 PLW channel calibration data. These data include the waveguide cut-off.

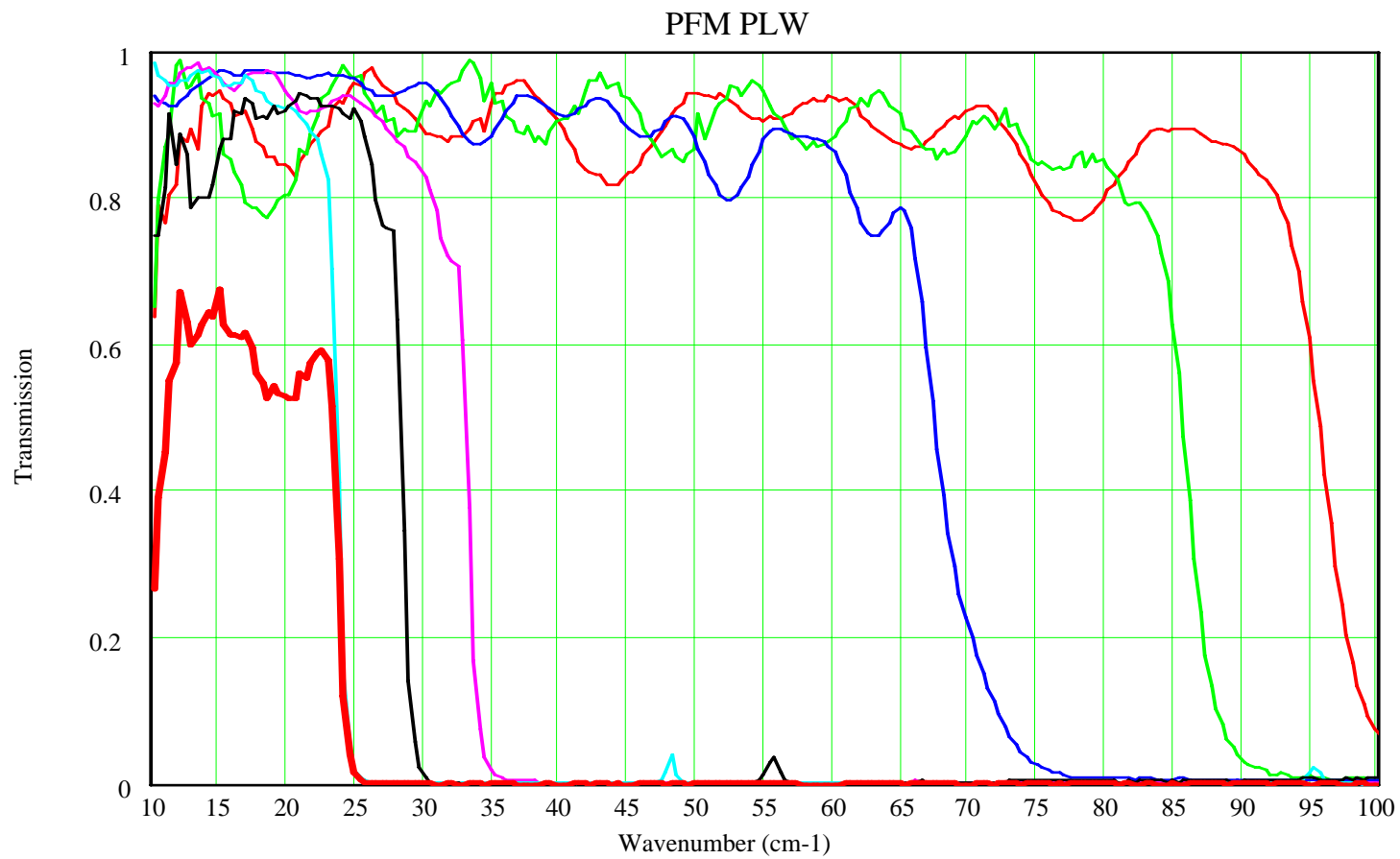


Figure 9 PLW channel filter calibration data. Bold red trace is summation of all components, and is the overall PMW filter transmission function.

7. Photometer bands – PFM2 testing configuration.

The calibration data presented in this section should be used for analysis of data from the PFM2 test campaign ONLY. This test campaign used temporary, non-flight dichroics, which were replaced following this campaign, prior to the PFM3 campaign.

7.1. PSW PFM2 Channel – non-flight

Filter configuration for this channel:-

CFIL1	pfm-cfil1.txt	Flight item
PFIL2	pfm-pfil2.txt	Flight item
PFIL3	pfm-pfil3.txt	Flight item
PDIC1R	gse-pfm2-pdic1-R.txt	Non-flight, temporary dichroic – PFM2 tests only. Seen by this channel in reflection.
PSWSTACK	pfm-psw-stack.txt	Flight 300mK PSW filter stack.

The recommended calibration file for the PSW channel pass-band is:-

pfm2-psw-channel-calibration.txt

This file includes the waveguide cut-off data for this channel. The value for the cut-off is 34.282 cm^{-1} ($291.7 \text{ }\mu\text{m}$), and comes from the PSW BDA EIDP. The cut-off is modelled in these data as a hard cut-off to zero transmission for frequencies below the cut-off value. These data are shown in Figure 10.

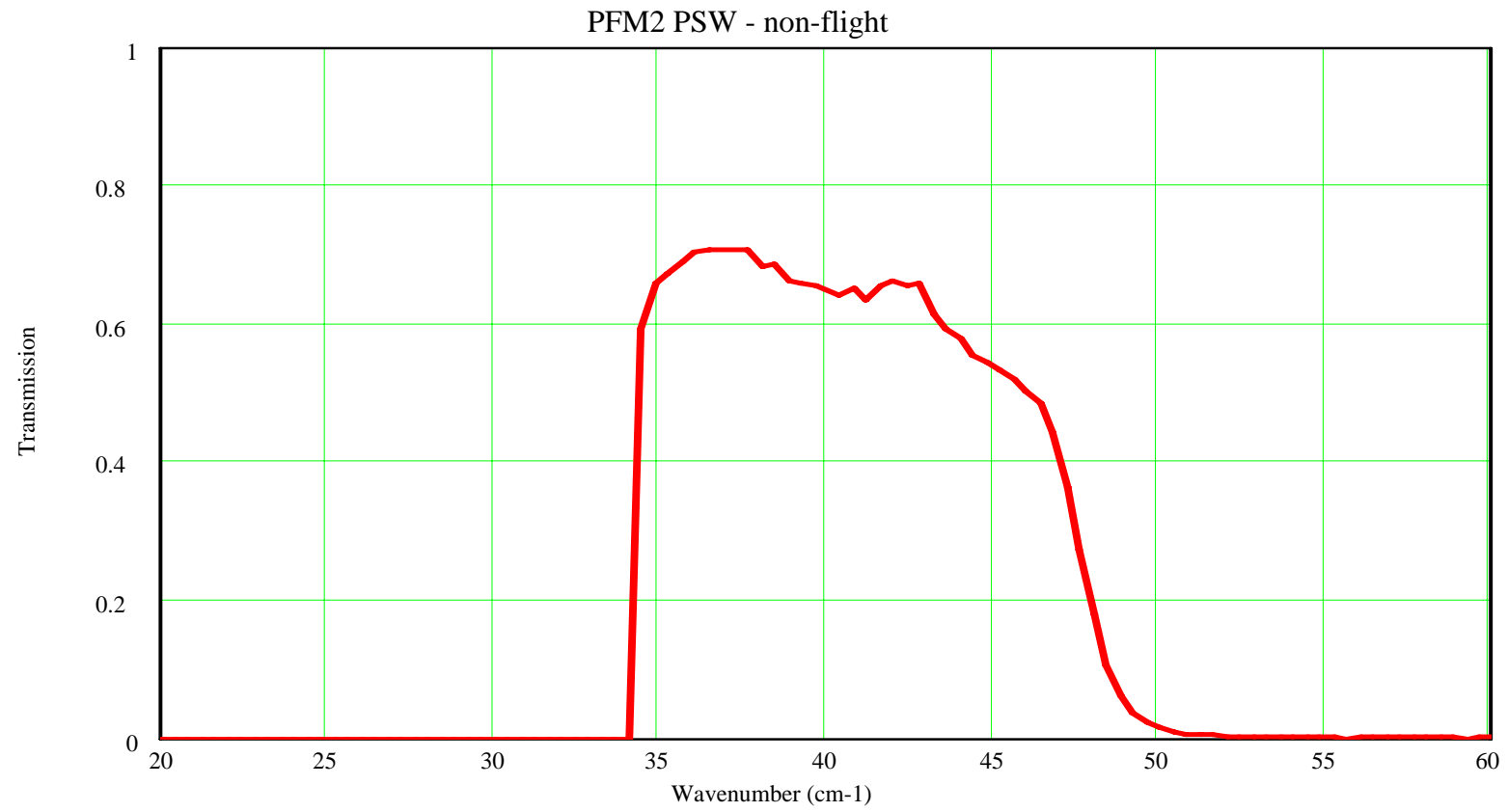


Figure 10 PSW channel calibration data for PFM2 test campaign only. A non-flight dichroic was used for these tests.

7.2. PMW PFM2 Channel – non-flight

Filter configuration for this channel:-

CFIL1	pfm-cfil1.txt	Flight item
PFIL2	pfm-pfil2.txt	Flight item
PFIL3	pfm-pfil3.txt	Flight item
GSEPDIC1T	gse-pfm2-pdic1-T.txt	Non-flight, temporary dichroic – PFM2 tests only. Seen by this channel in transmission.
GSEPDIC2R	gse-pfm2-pdic2-R.txt	Non-flight, temporary dichroic – PFM2 tests only. Seen by this channel in reflection.
PMWSTACK	pfm-pmw-stack.txt	Flight 300mK PMW filter stack.

The recommended calibration file for the PMW channel pass-band is:-

pfm2-pmw-channel-calibration.txt

This file includes the waveguide cut-off data for this channel. The value for the cut-off is 23.81 cm^{-1} ($420 \mu\text{m}$) and comes from the PMW BDA EIDP. The cut-off is modelled in these data as a hard cut-off to zero transmission for frequencies below the cut-off value. These data are shown in Figure 11.

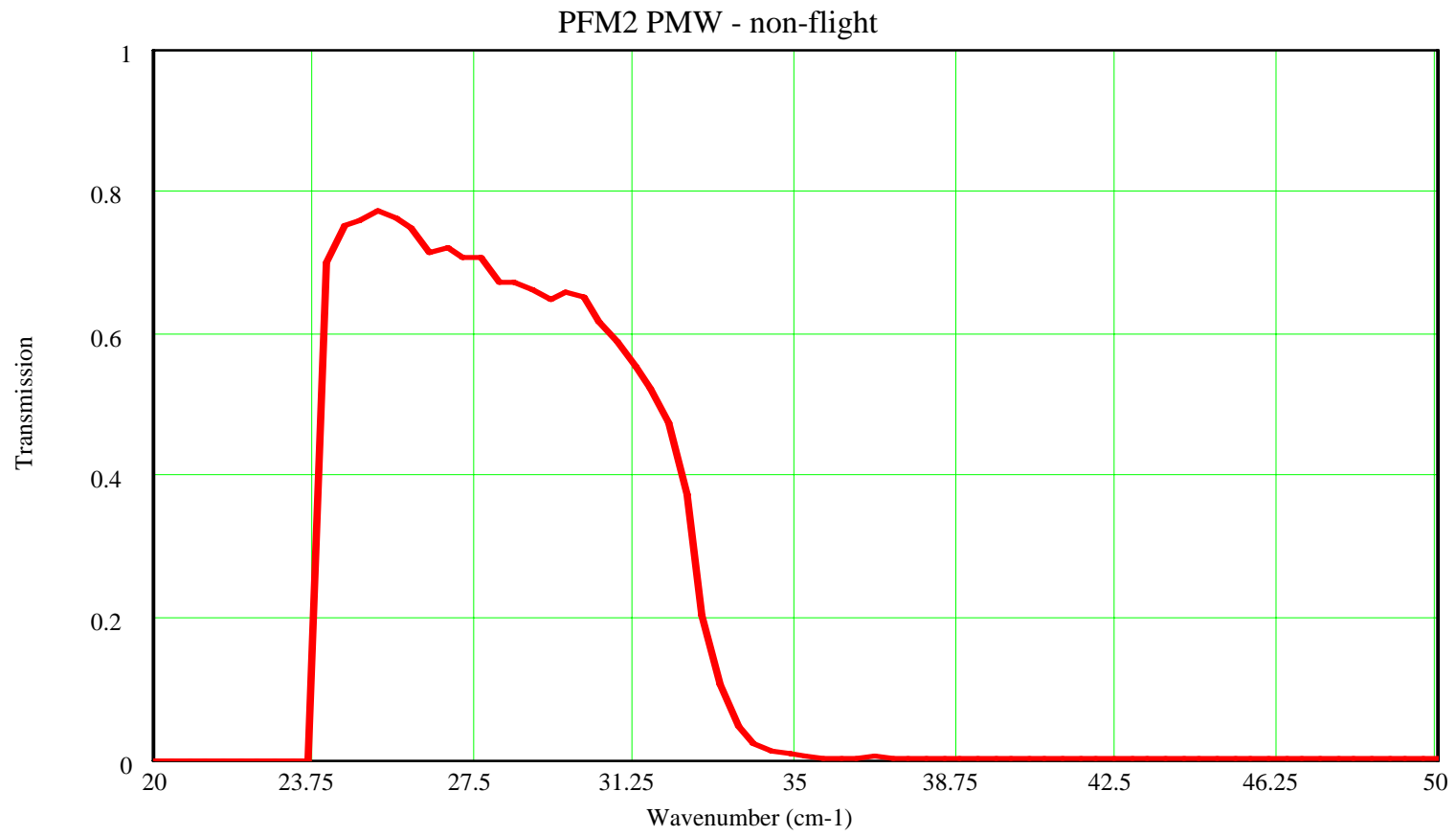


Figure 11 PMW channel calibration data for PFM2 test campaign only. Non-flight dichroics were used for these tests.

7.3. PLW PFM2 Channel – non-flight

Filter configuration for this channel:-

CFIL1	pfm-cfil1.txt	Flight item
PFIL2	pfm-pfil2.txt	Flight item
PFIL3	pfm-pfil3.txt	Flight item
GSEPDIC1T	gse-pfm2-pdic1-T.txt	Non-flight, temporary dichroic – PFM2 tests only. Seen by this channel in transmission.
GSEPDIC2T	gse-pfm2-pdic2-T.txt	Non-flight, temporary dichroic – PFM2 tests only. Seen by this channel in transmission.
PLWSTACK	pfm-plw-stack.txt	Flight 300mK PLW filter stack.

The recommended calibration file for the PLW channel pass-band is:-

pfm2-plw-channel-calibration.txt

This file includes the waveguide cut-off data for this channel. The value for the cut-off is 16.58 cm^{-1} ($603.2 \text{ }\mu\text{m}$), and comes from the PLW BDA EIDP. The cut-off is modelled in these data as a hard cut-off to zero transmission for frequencies below the cut-off value. These data are shown in Figure 12.

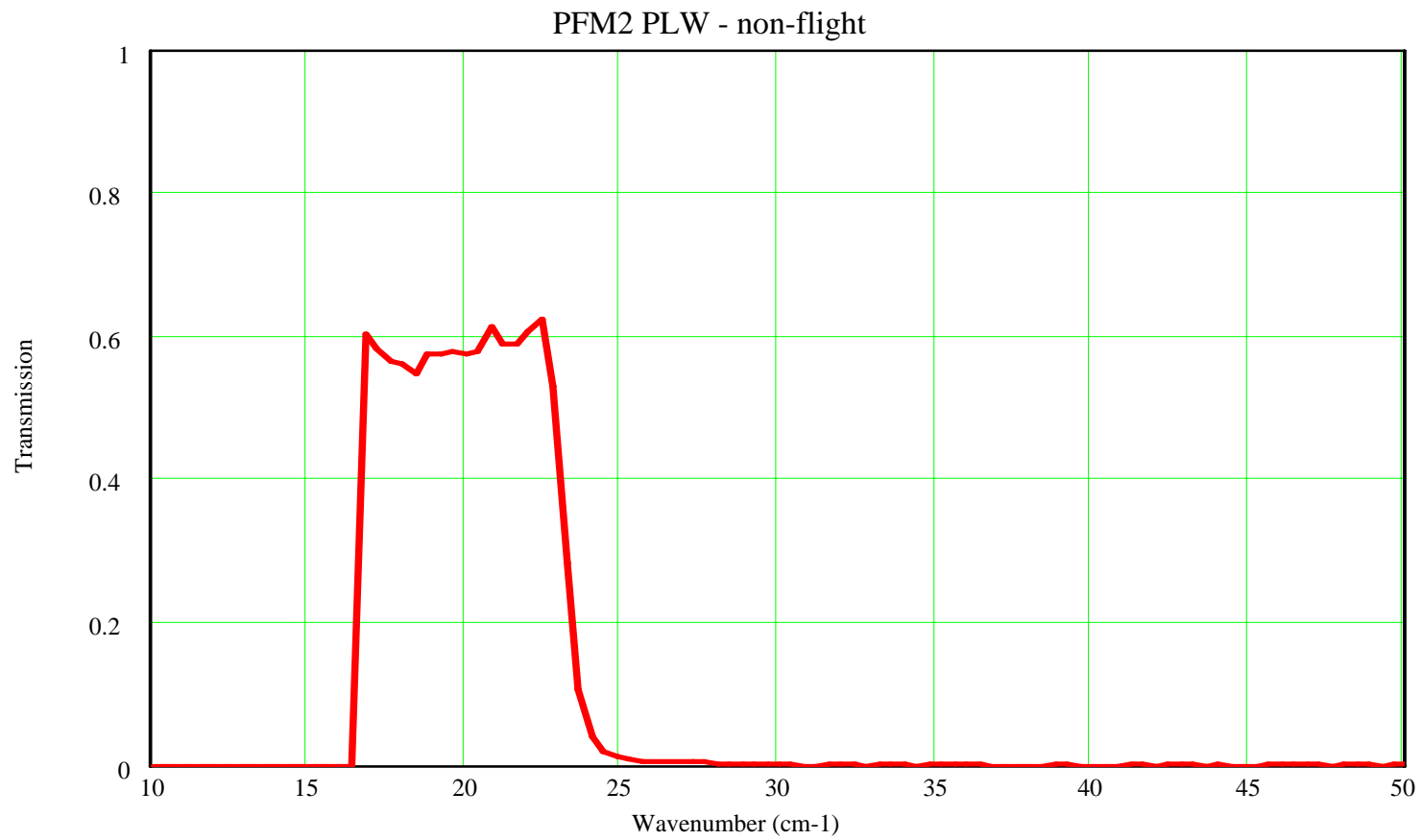


Figure 12 PLW channel calibration data for PFM2 test campaign only. Non-flight dichroics were used for these tests.