NIST2008_01 MOBY241 Laser Stray light Characterization

Stephanie Flora
June 30, 2008

Mark and Mike took the MOBY241 MOS system out to NIST and the SIRCUS laser lab where Steve Brown, Keith Lykke and Carol Johnson shot lasers into the MOS fibers. Validation data was also collected using colored sources. The data logs are in the docs dir and consist of the Excel spreadsheet (which Mike created along the way) and scanned PDF's of the original log sheets. See Mikes Excel spreadsheet for more detail on data collected and problems during data collection. And the scanned log sheets for all the details.

Note: My day numbering does not match up with Mikes! We are off by one.

The LuTop, Mid, Bot, and MOS, EdTop, Mid, Bot, and MOS and EsSfc sensors were used to collected laser data. Only LuTop and LuMOS has a complete set of laser data the others were sampled approximately every 30 nm.

Colored Source validation data was collected for everyone but LuMOS.

All data shown in converted units were converted using the MOBY241 pre deployment calibration unless I note otherwise. Also the laser data is not thermally corrected but the MOBY, system response and validation data are thermally corrected before they are SLCed. Also the immersion factor is not applied to the validation data. (Note that intially I had forgetten (again) to remove the immersion factor from the system responses used to convert the validation data.

Note from Mike: The fiber-optics used during NIST0801 are all new, and the LuT,B heads have new mirrors, and the EdM head's mirror was knocked off in transit to NIST, so the EdM head mirror was re-epoxied at NIST. So, the MOBY241 system responses are not going to be exactly correct for the NIST-2008-01 data, and perhaps we should note somewhere (at the beginning) what responses were used to convert to uW for data taken during NIST0801 ?

It looks like during NI0801 the aperture was probably set at W6 for Ed and W5 for Lu. I do remember checking that the Distance knob was bottomed-out (maybe locked down) but "I do not recall" checking W.

Notes from Carol: The NIST OL420 was calibrated at S3W6D0 in Feb 2007 for sortie01 "open" and then the BG28, BG39, and PER filters were put in their respective slides and the output calibrated at S2W6D0. These are the data Steph is using for the comparison plot that went out yesterday. I know the names of the slides (labeled A, B etc as we did during the previous HNL work) and I think the filters were the one of the sets we started with (the other is with MEF). Now there is a third set that Bob purchased some replacements and some of these may have been used in SIRCUS08. However, David Allen (I think) measured those transmittances and Bob has the data, or has given it to Steph.

Anyway, my manual for the NIST OL420 gives the aperture sizes in the Wheel:
W5 = 15.87 mm
W6 = 28.57 mm
The ratio in flux should scale like the areas

So the retrieved Lu data do not make sense - the W5 values should be lower than the calibration at W6. This is a concern to me. Sphere loading is the only thing that comes to mind. Or upside down math, or incorrect integration times or bin factors etc.

We can measure this Wheel ratio for the NIST 420 here. Also, Mike has historical values for this ratio since he used to ask the OL to cal. at the two wheel settings (as I recall), and maybe Charles also did this for him in Aug 2000.

Notes from Mark: Are you asking about the pixel level fill factor? Meaning the pixel pitch vs the actual pixel size. If so, there is no specification that I can find for our TK512 CCDs. The specification sheet lists the pixel size as 27 um X 27 um and the image area as 13.8 mm. 27 um x 512 = 13.824 mm. This would imply no gaps between the pixels. For many CCDs the image area as specified is a bit bigger than the multiple of the pixel size which would indicate the pitch vs size. Not for the TK512 - a bit strange I think. I would assume TEK is just including the stop channel region in the pixel size. There is a graphic in the data sheet that implies this is the case. If so, we could assume that 24 um (13.824 - 13.8 image area) is the total separation of the pixels. So, 24 um / 511 gaps is the pixel to pixel dead area, = 0.0469 um (the pixel separation). Also since this is a back lit CCD the image is so blurred going through the silicon that this separation distance is optically meaningless.

Note from Steph: After things slowed down a bit I went through each laser line and removed spikes and other problem scans. I found a few other problems (which I think we have seen before but Mike and I could not remember when). See figures in **Appendix B**. On day 1 32 of the 64 files has problems, on day 2 42 of the 109 files had problems and on day 3 18 of the 61 files had problems. I am not sure if the problems are significant or not but in the future it would be really helpful to take more dark and lite scans on the first few days.

preL159 Mike took Colored Source data for LuMOS and LuTop. Mid and Bot.

Sections:

1) Fibered Arms Stray Light corrections and Colored Source (CS) Validation (CS data collected at NIST, in Hawaii (Jul 08) and in Hawaii (Mar 07))
2) Comparison of changes to the SLC using different in-band are widths
3) Comparison of pulsed and constant wavelength lasers
4) Lu MOS Straylight correction and colored Source Validation
5) Comparison of N0801, Mikes Hawaii data and the Laser dat collected on M217 and 19
6) Graphs of daily Laser data followed by a table of laser wavelength data collected

Appendix A - Processing Programs and Plotting Functions
Appendix B - Problems with Laser data

Fibered Arms SLC and colored source validation

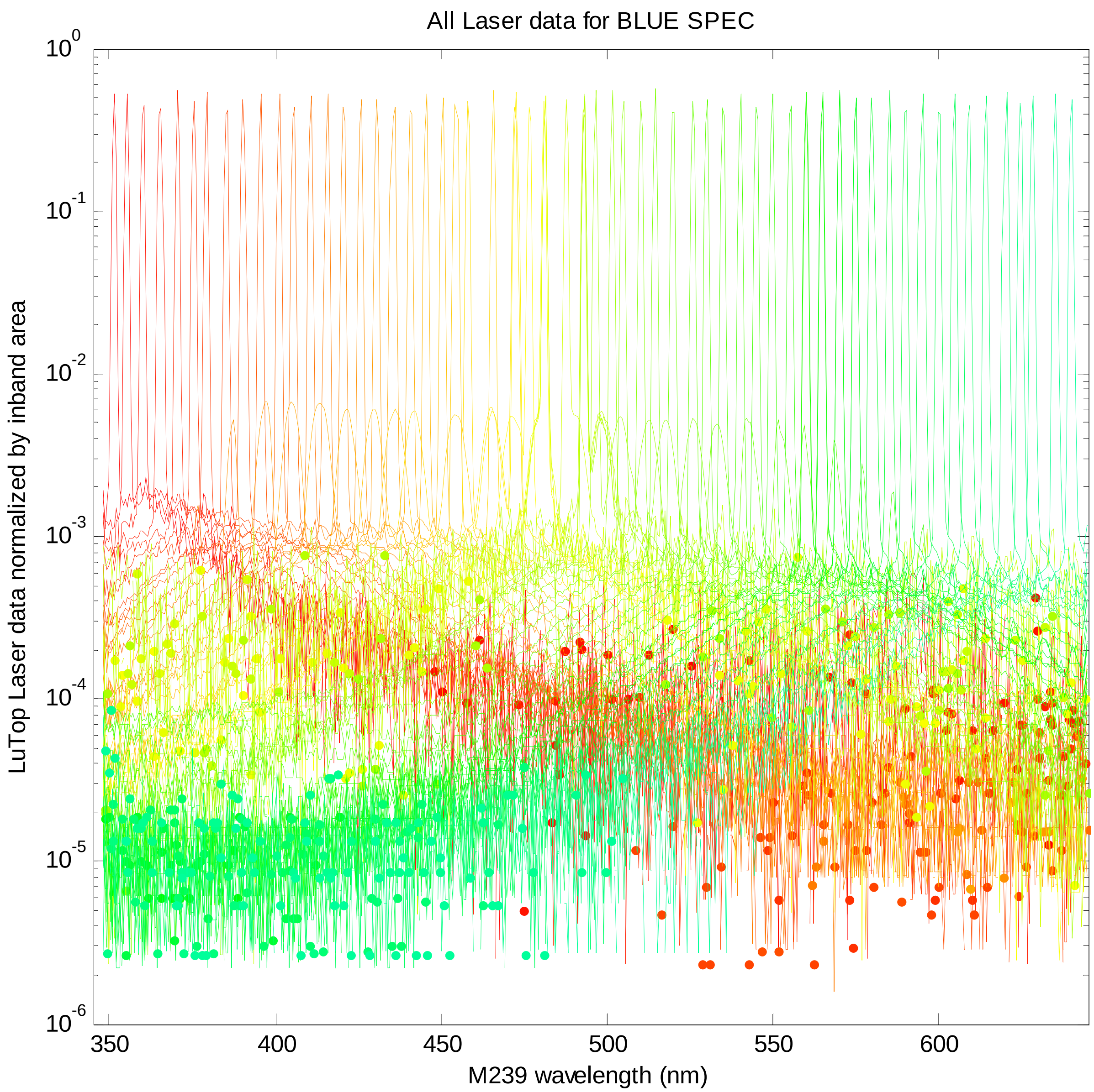


Figure 1. All LuTop Laser data collected for Blue Spectrograph

C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\lasers
allplots_inband_

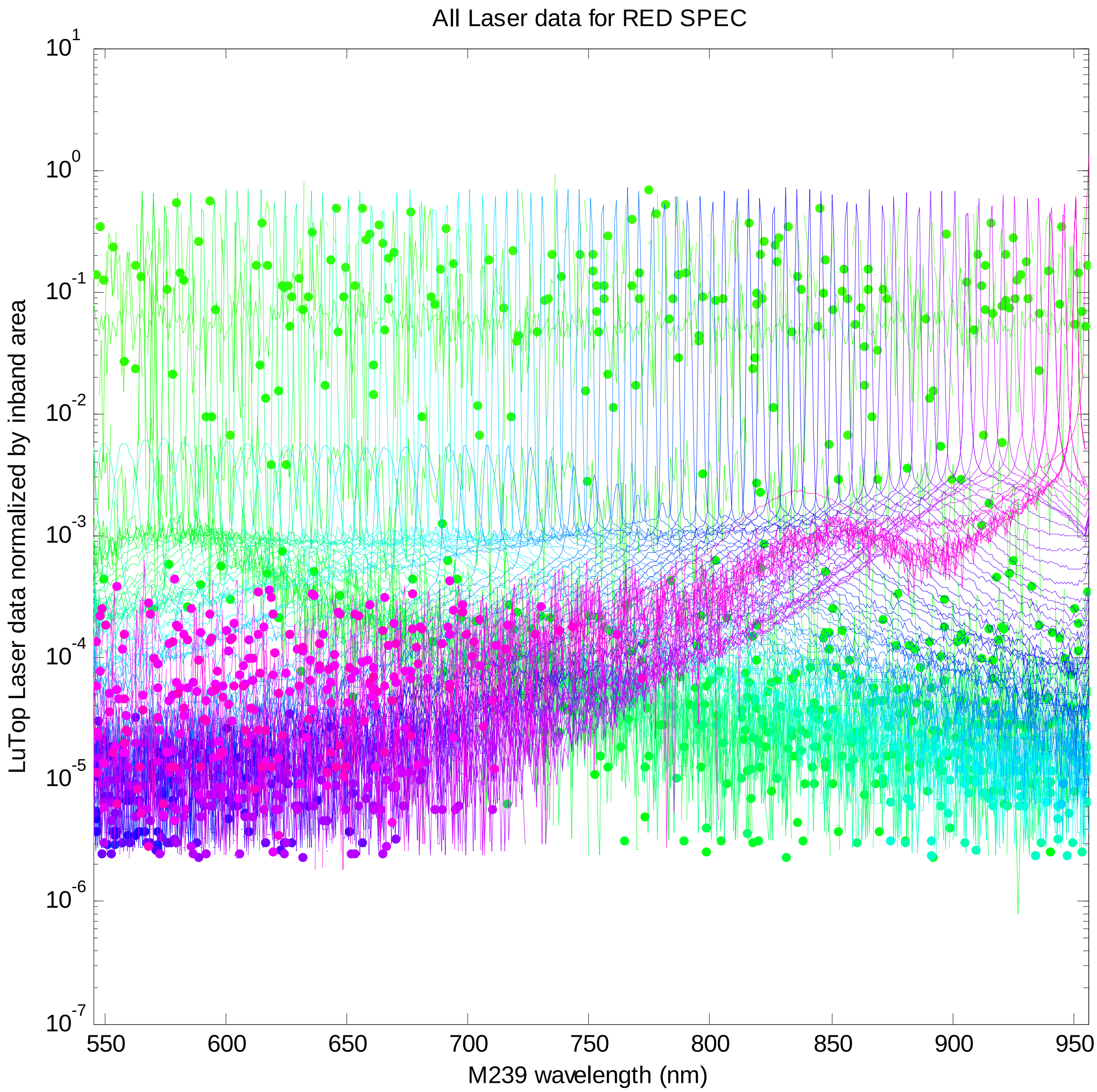


Figure 2. All LuTop Laser data collected for Red Spectrograph

allplots_inband_

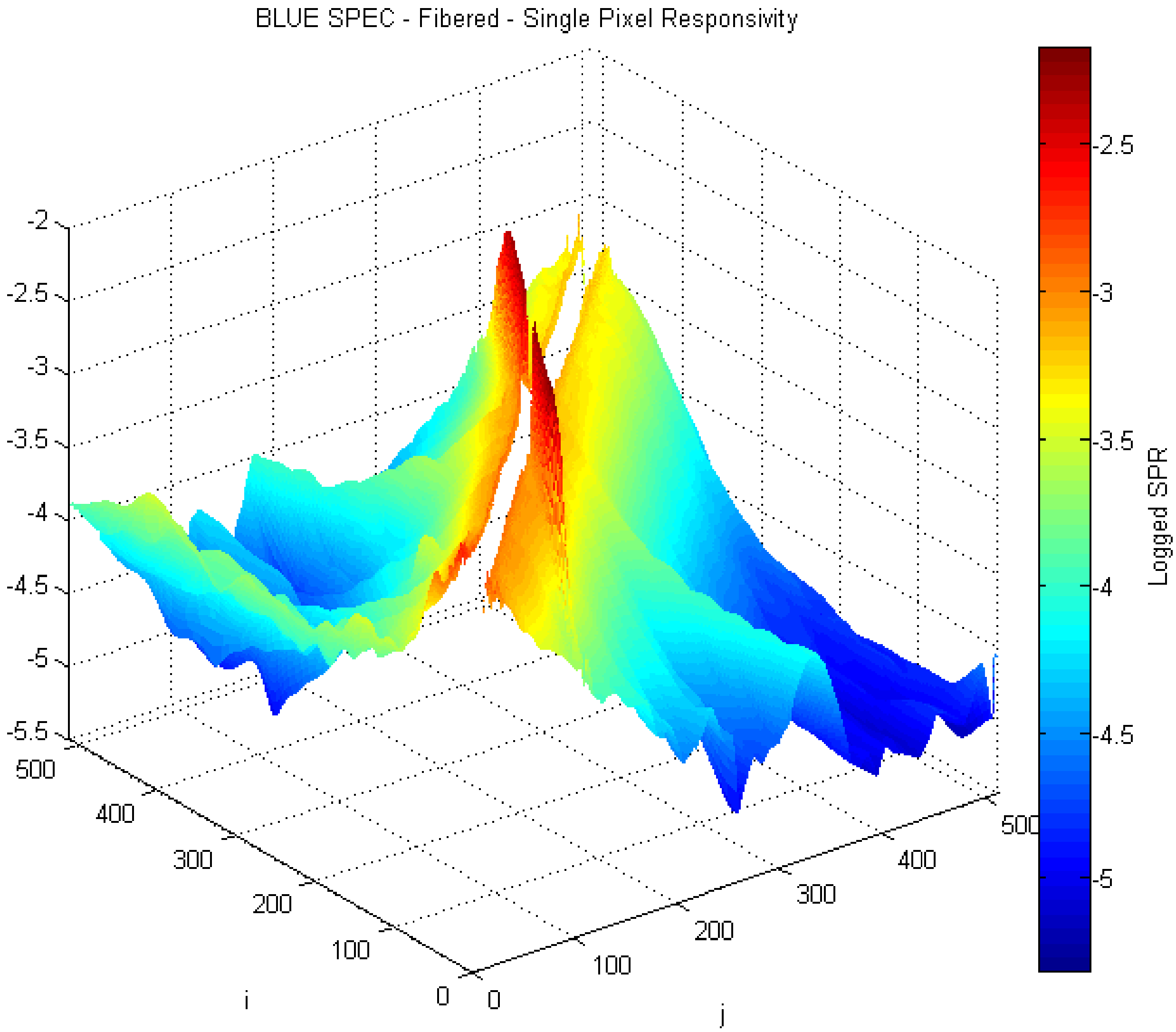


Figure 3. Blue spectrograph Single Pixel Responsivity for the LuTop (all fibered sensors)

```
load MOF_BSG_RPSPEC_N0801_LASEROBS_080911_1546_PIXEL_P9_Z9.mat
surf(log10(Xdat(:,2:end)));shading flat
xlabel('j')
ylabel('i')
AH = colorbar;
set(get(AH,'ylabel'),'String','Logged SPR')
title(['BLUE SPEC - Fibered - Single Pixel Responsivity'],'Interpreter','none')
set(gca,'Xlim',[0 512],'Ylim',[0 512])
set(gca,'Position',[0.060606      0.11     0.78309      0.815])
set(gcf,'Position',[440 208 627 590])
```

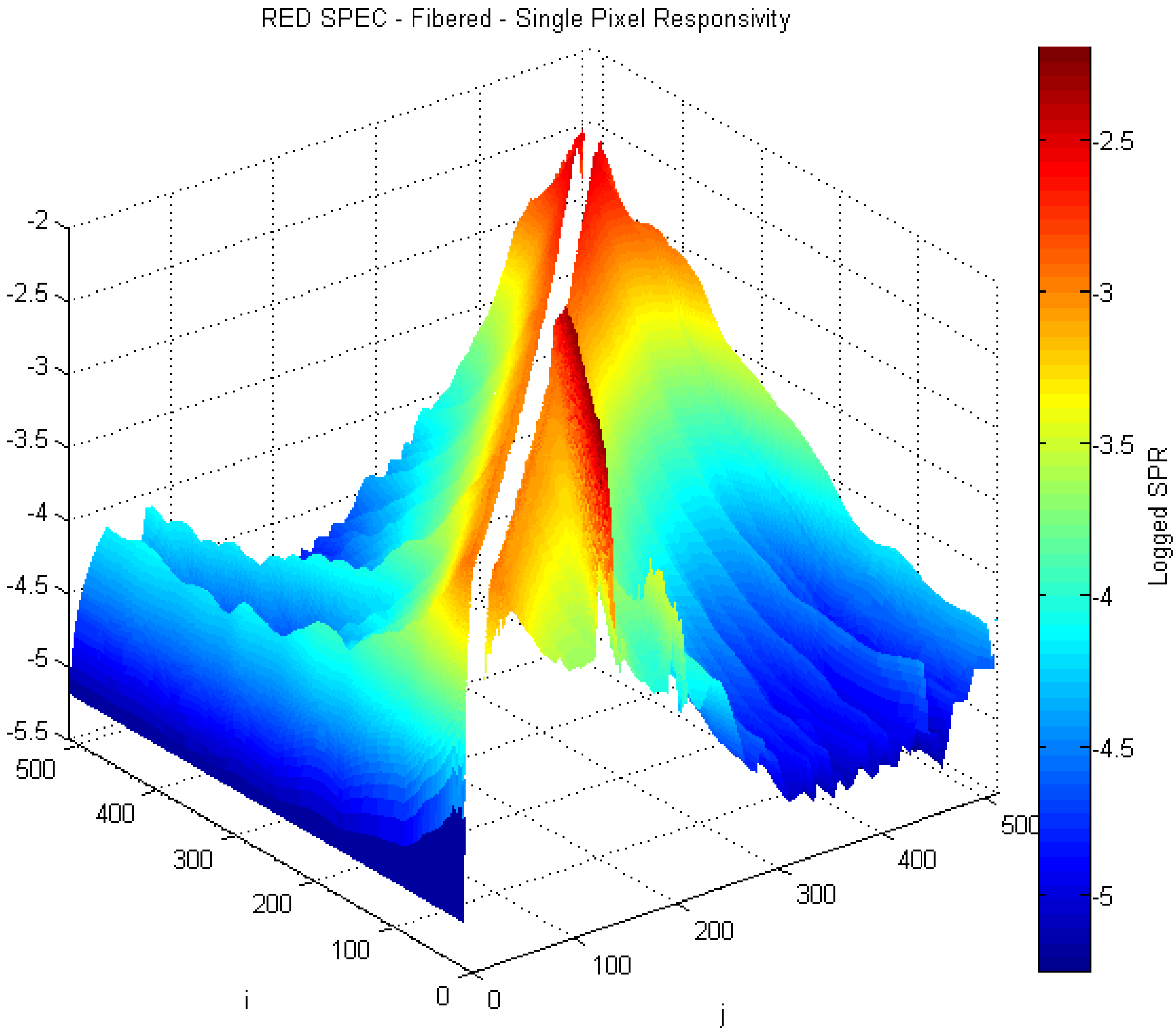


Figure 4. **Red spectrograph Single Pixel Responsivity for the LuTop (all fibered sensors)**

```
load MOF_RSG_RPSPEC_N0801_LASEROBS_080911_1546_PIXEL_P9_Z9.mat
surf(log10(Xdat(:,2:end)));shading flat
xlabel('j')
ylabel('i')
AH = colorbar;
set(get(AH,'ylabel'),'String','Logged SPR')
title(['RED SPEC - Fibered - Single Pixel Responsivity'],'Interpreter','none')
set(gca,'Xlim',[0 512],'Ylim',[0 512])
set(gca,'Position',[0.060606        0.11      0.78309        0.815])
 set(gcf,'Position',[440 208 627 590])
```

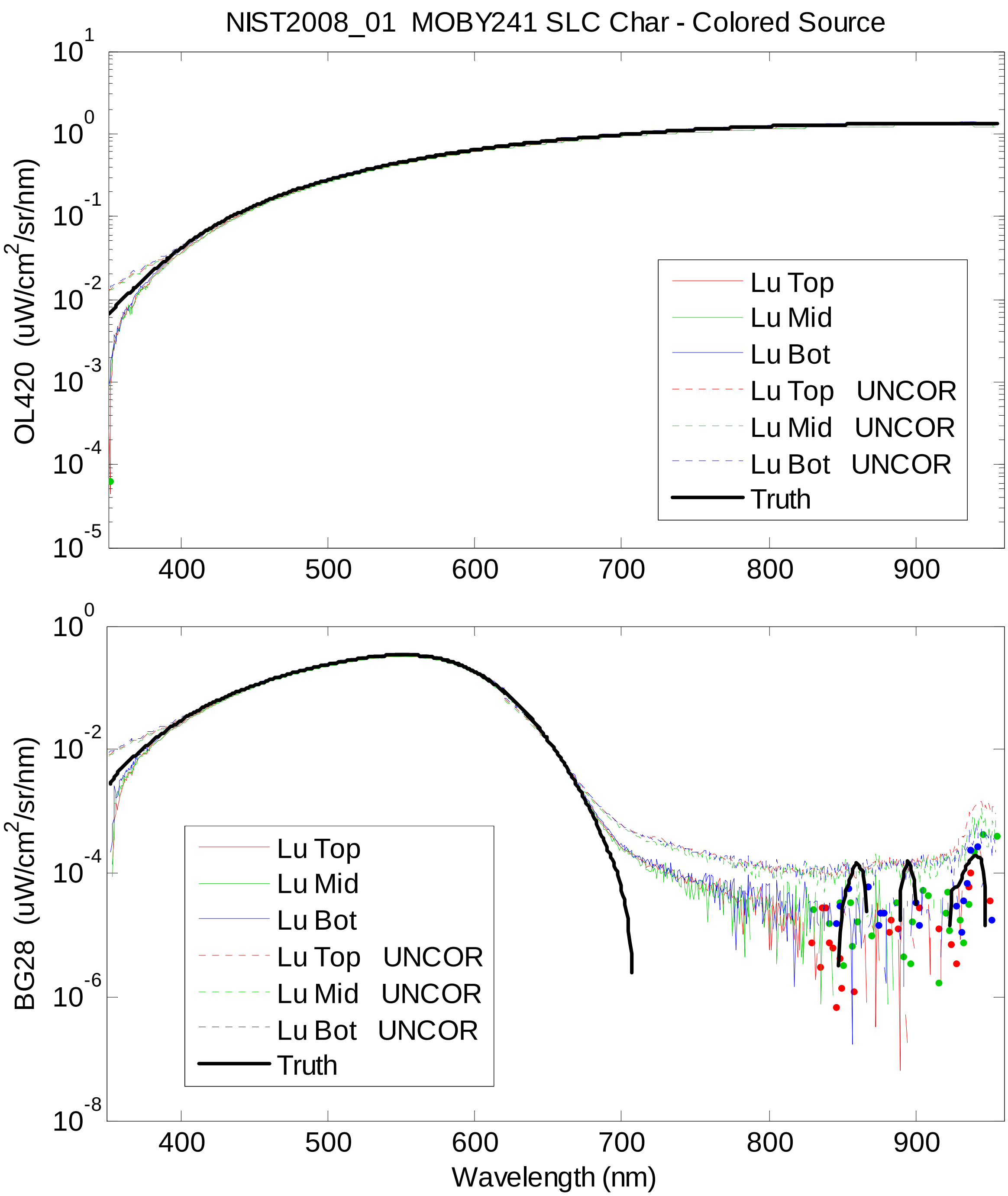
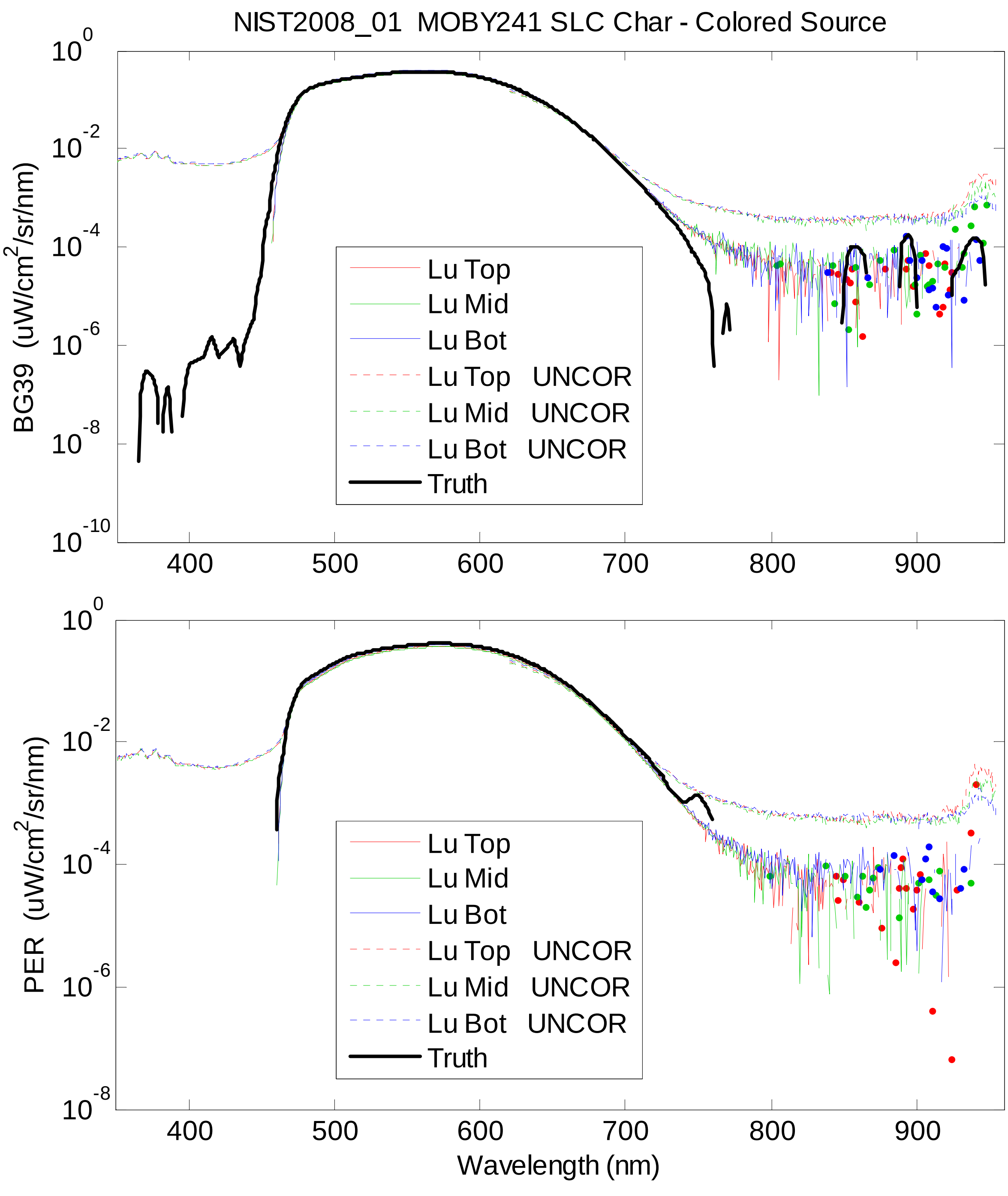


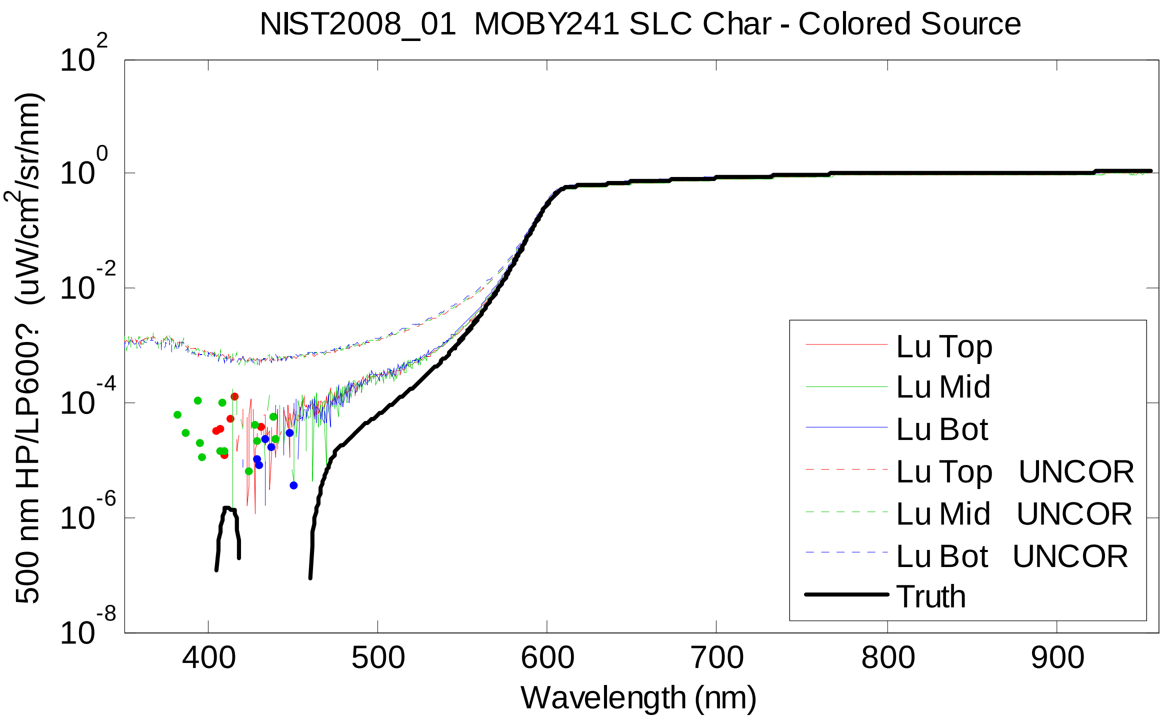
Figure 5

cd C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\validation
pltvaldata_(1)



NIST2008_01 MOBY241 SLC Char - Colored Source
BG39 (uW/cm2/sr/nm)
10^0
10^-2
10^-4
10^-6
10^-8
10^-10
400
500
600
700
800
900
Lu Top
Lu Mid
Lu Bot
Lu Top UNCOR
Lu Mid UNCOR
Lu Bot UNCOR
Truth
PER (uW/cm2/sr/nm)
10^0
10^-2
10^-4
10^-6
10^-8
400
500
600
700
800
900
Wavelength (nm)
Lu Top
Lu Mid
Lu Bot
Lu Top UNCOR
Lu Mid UNCOR
Lu Bot UNCOR
Truth

Figure 6



NIST2008_01 MOBY241 SLC Char - Colored Source
500 nm HP/LP600? (uW/cm2/sr/nm)
Wavelength (nm)
Lu Top
Lu Mid
Lu Bot
Lu Top UNCOR
Lu Mid UNCOR
Lu Bot UNCOR
Truth

Figure 7

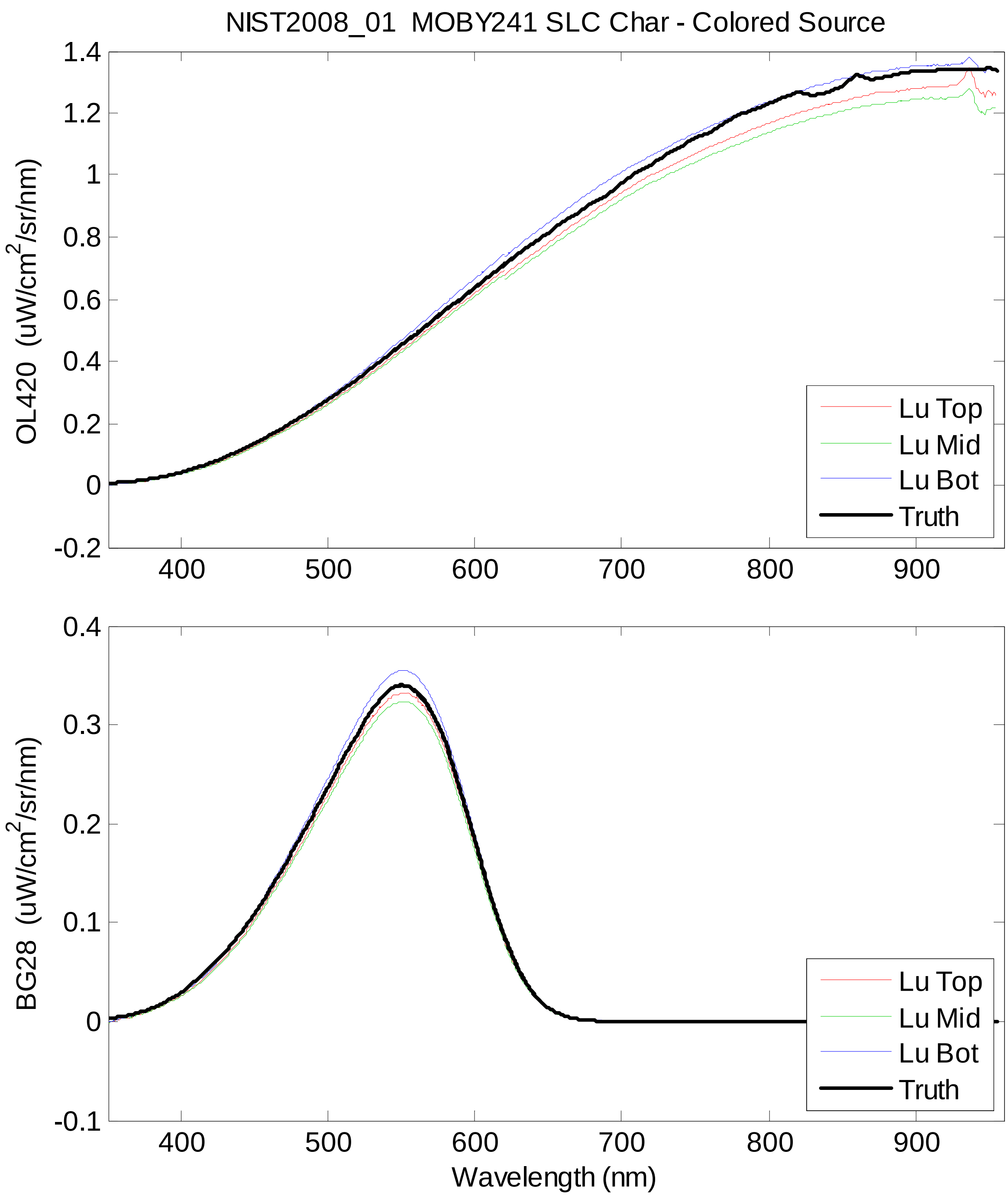


Figure 8

cd C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\validation
pltvaldata_(2)

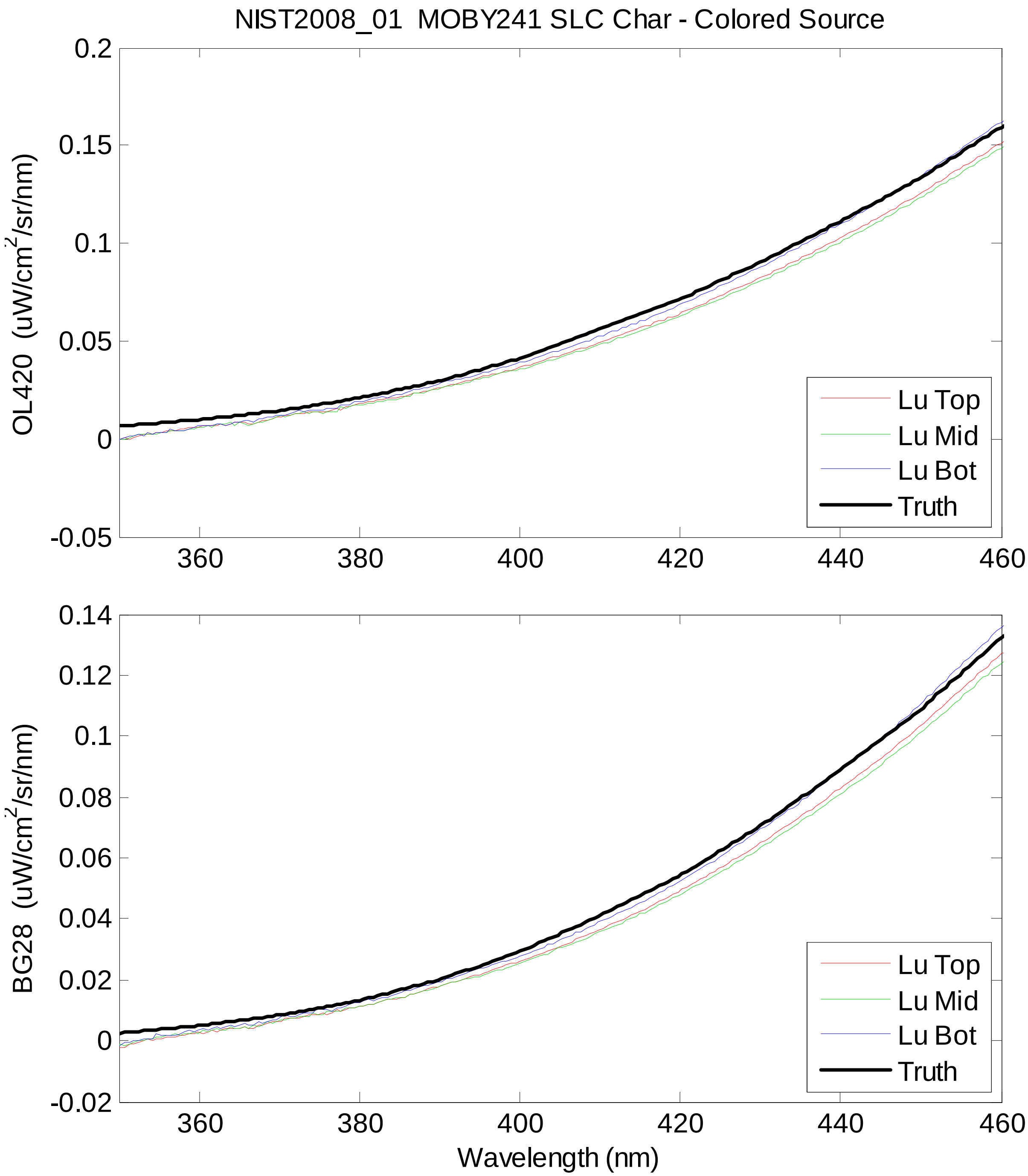


Figure 9

cd C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\validation
pltvaldata_(2)

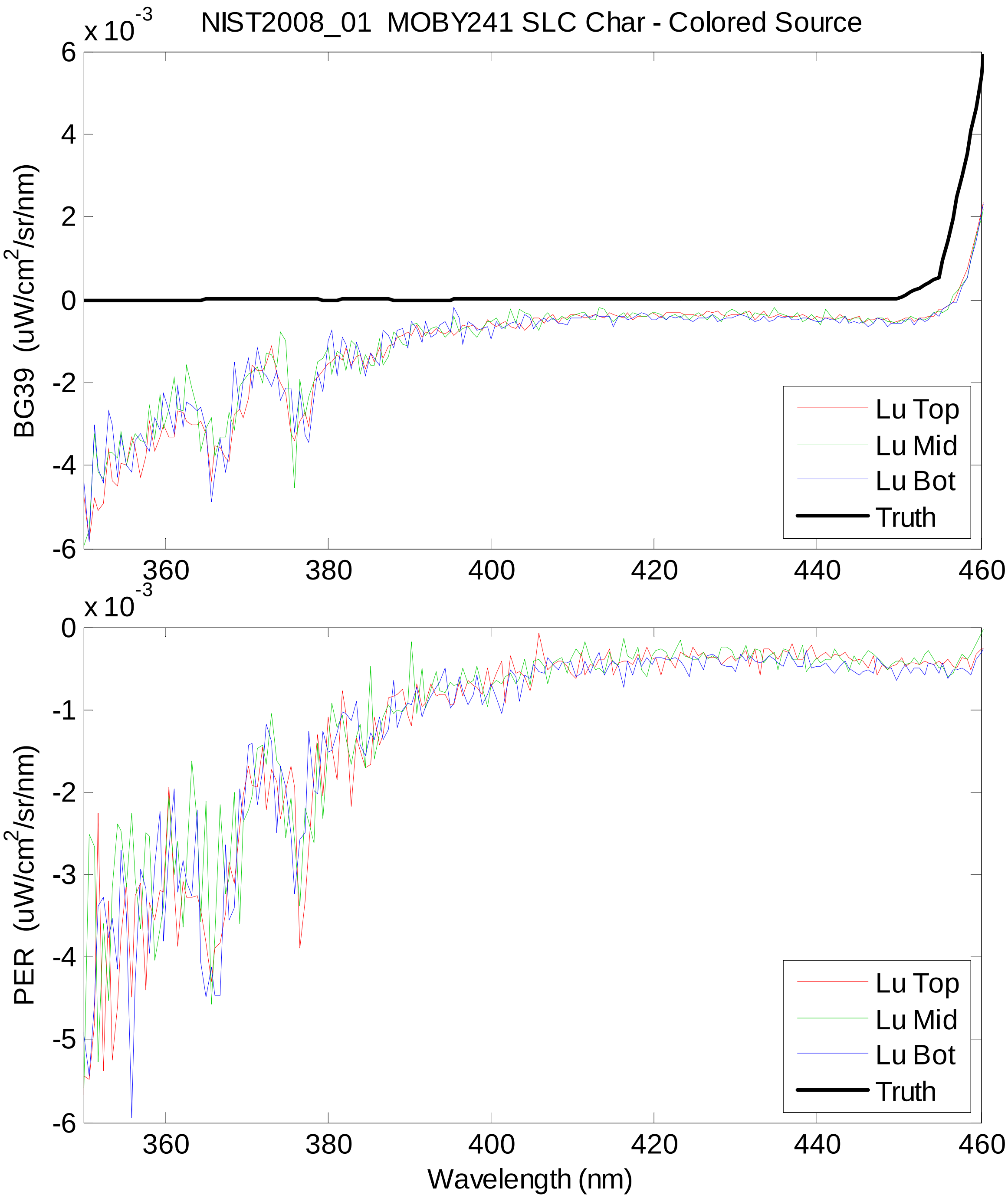


Figure 10

cd C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\validation
pltvaldata_(2)

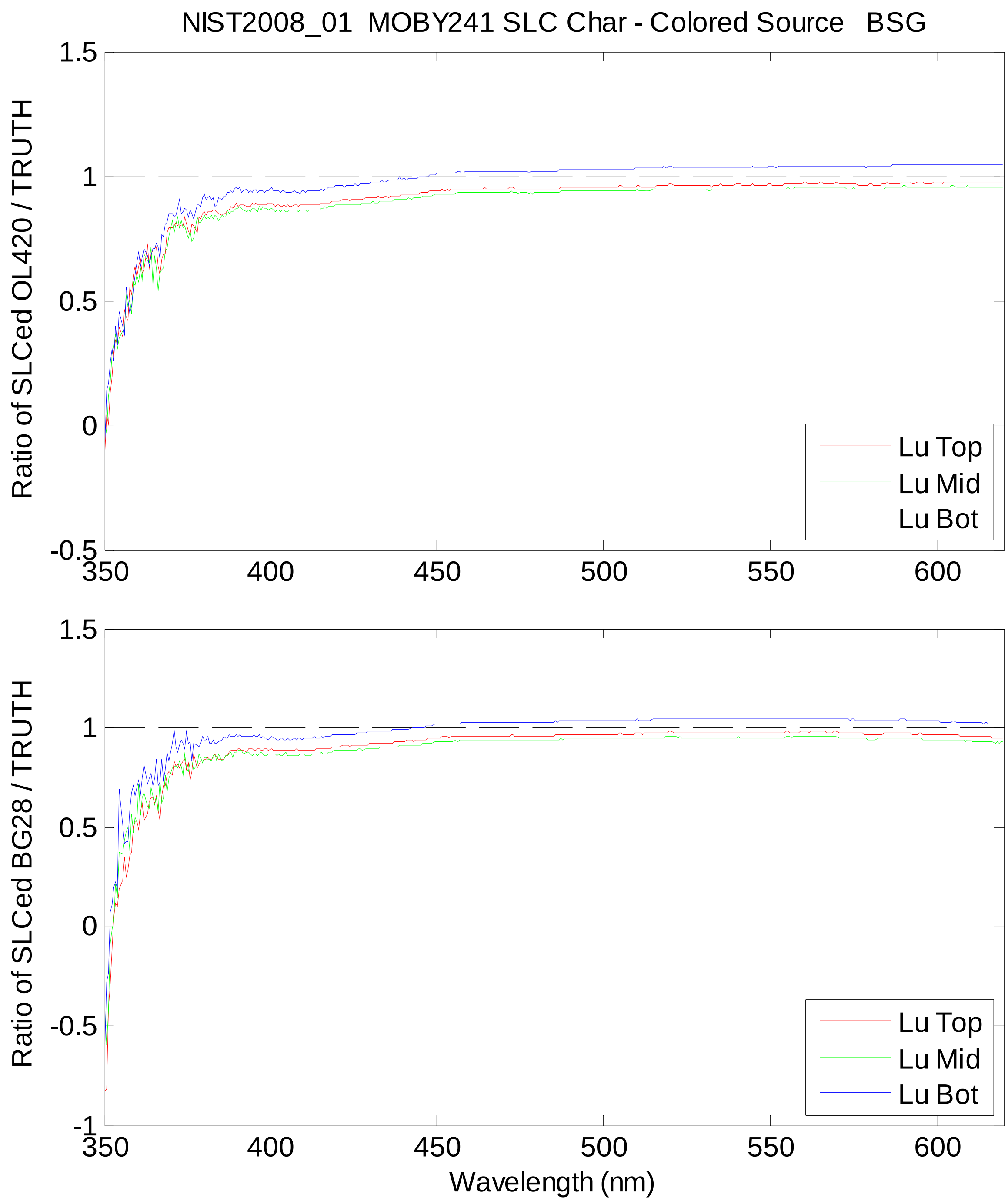
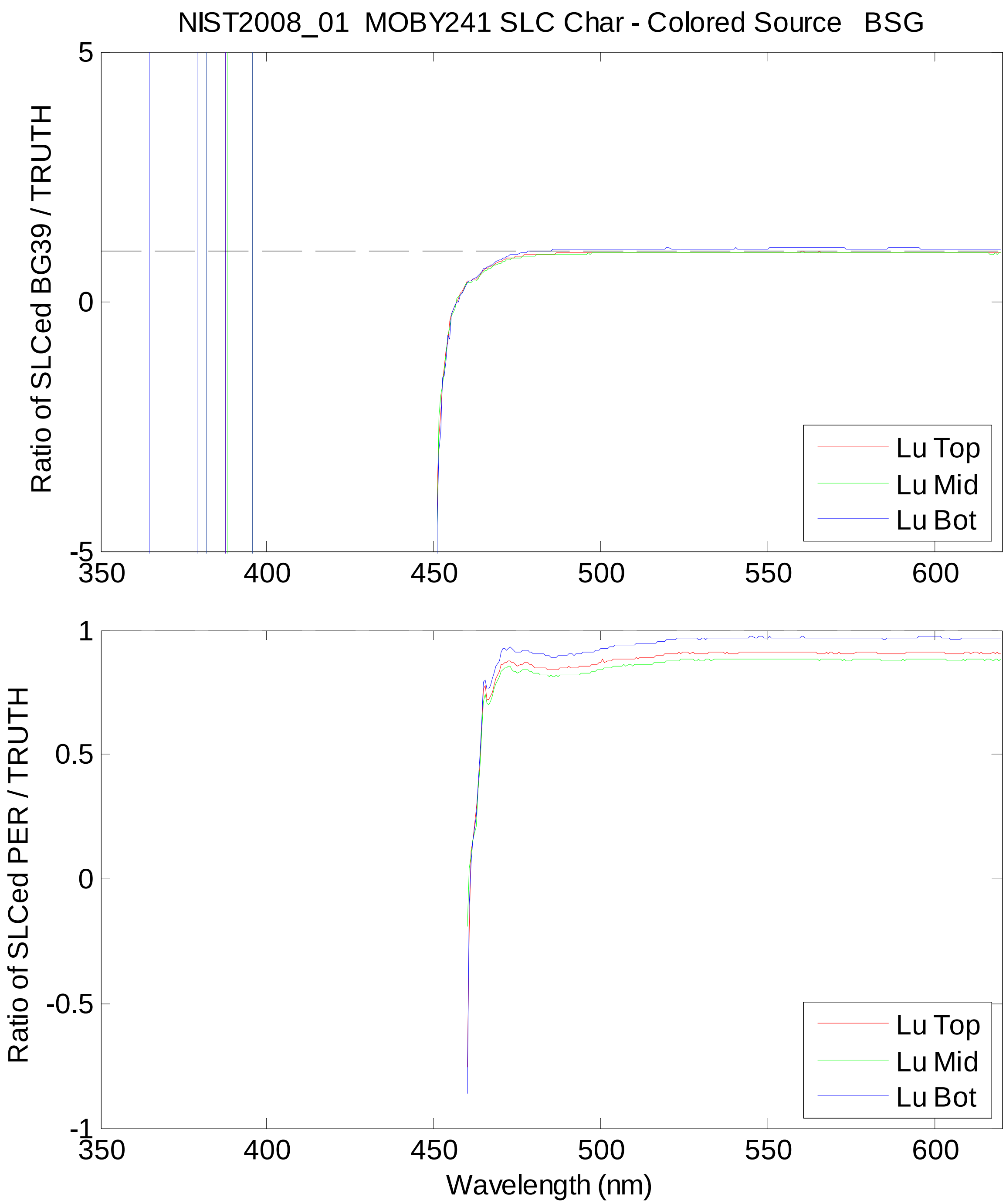


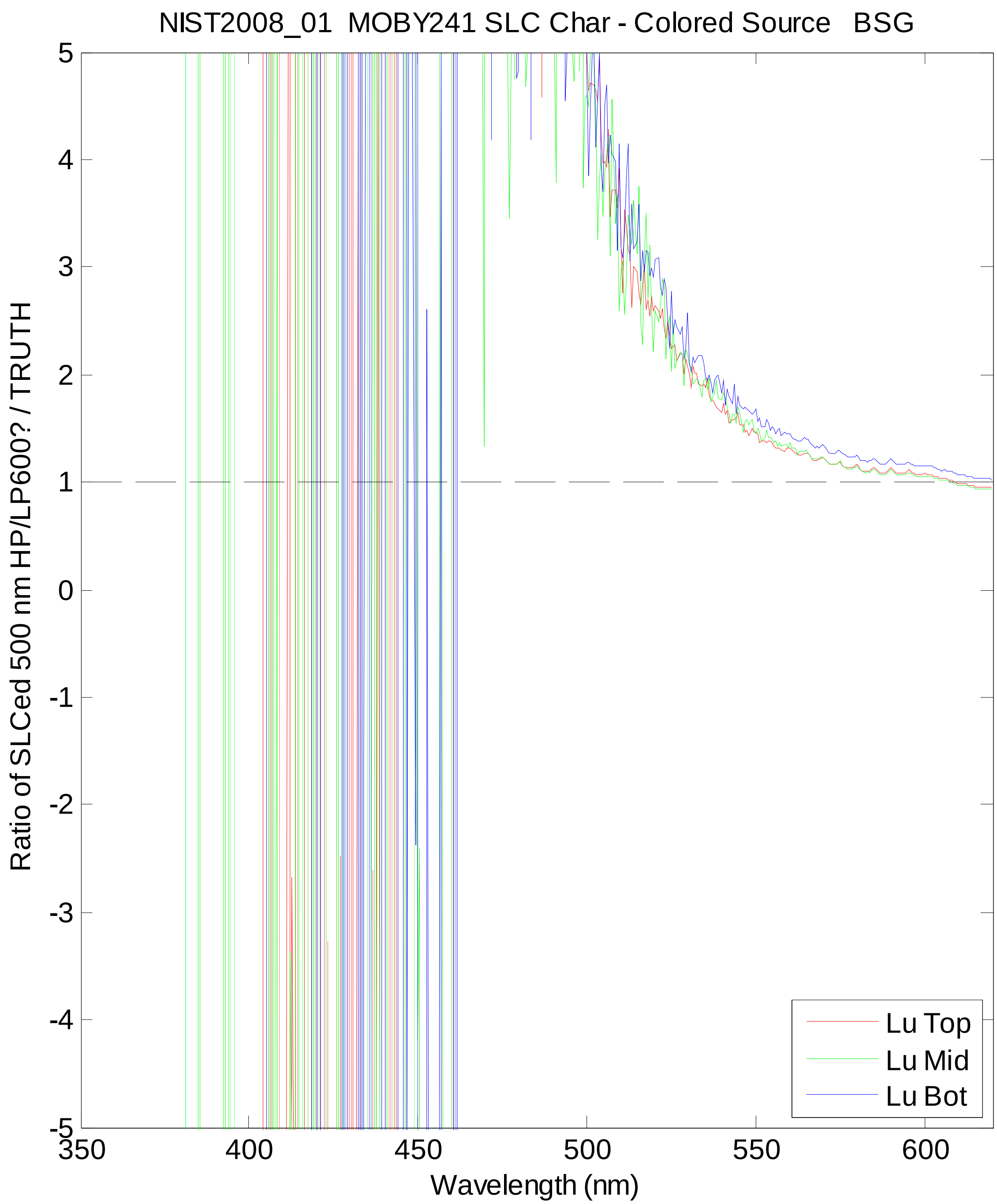
Figure 11

cd C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\validation
pltvaldata_(4)



NIST2008_01 MOBY241 SLC Char - Colored Source BSG
Ratio of SLCed BG39 / TRUTH
5
0
-5
350
400
450
500
550
600
Lu Top
Lu Mid
Lu Bot
Ratio of SLCed PER / TRUTH
1
0.5
0
-0.5
-1
350
400
450
500
550
600
Lu Top
Lu Mid
Lu Bot
Wavelength (nm)

Figure 12



NIST2008_01 MOBY241 SLC Char - Colored Source BSG
Ratio of SLCed 500 nm HP/LP600? / TRUTH
Wavelength (nm)
5
4
3
2
1
0
-1
-2
-3
-4
-5
350
400
450
500
550
600
Lu Top
Lu Mid
Lu Bot

Figure 13

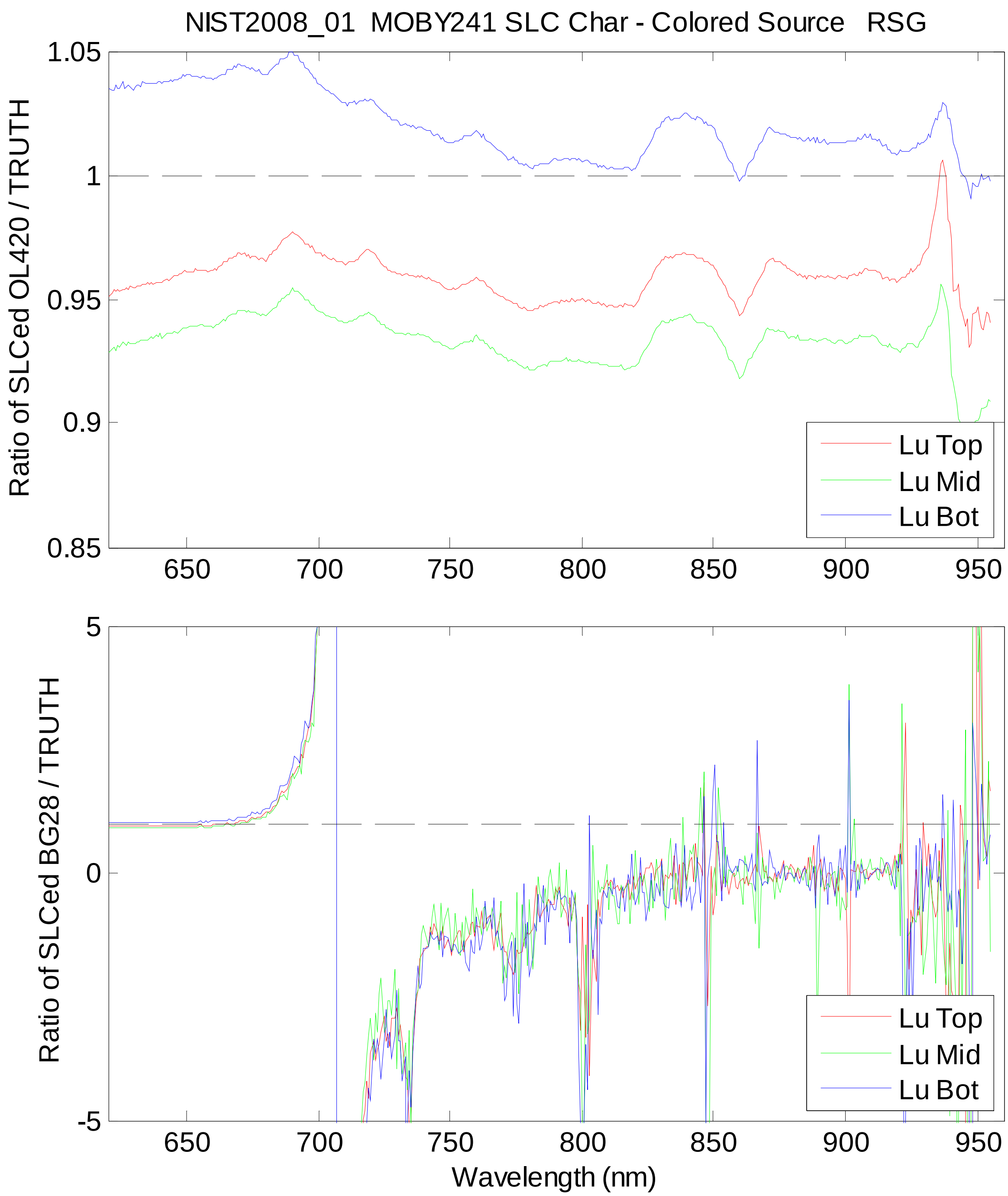
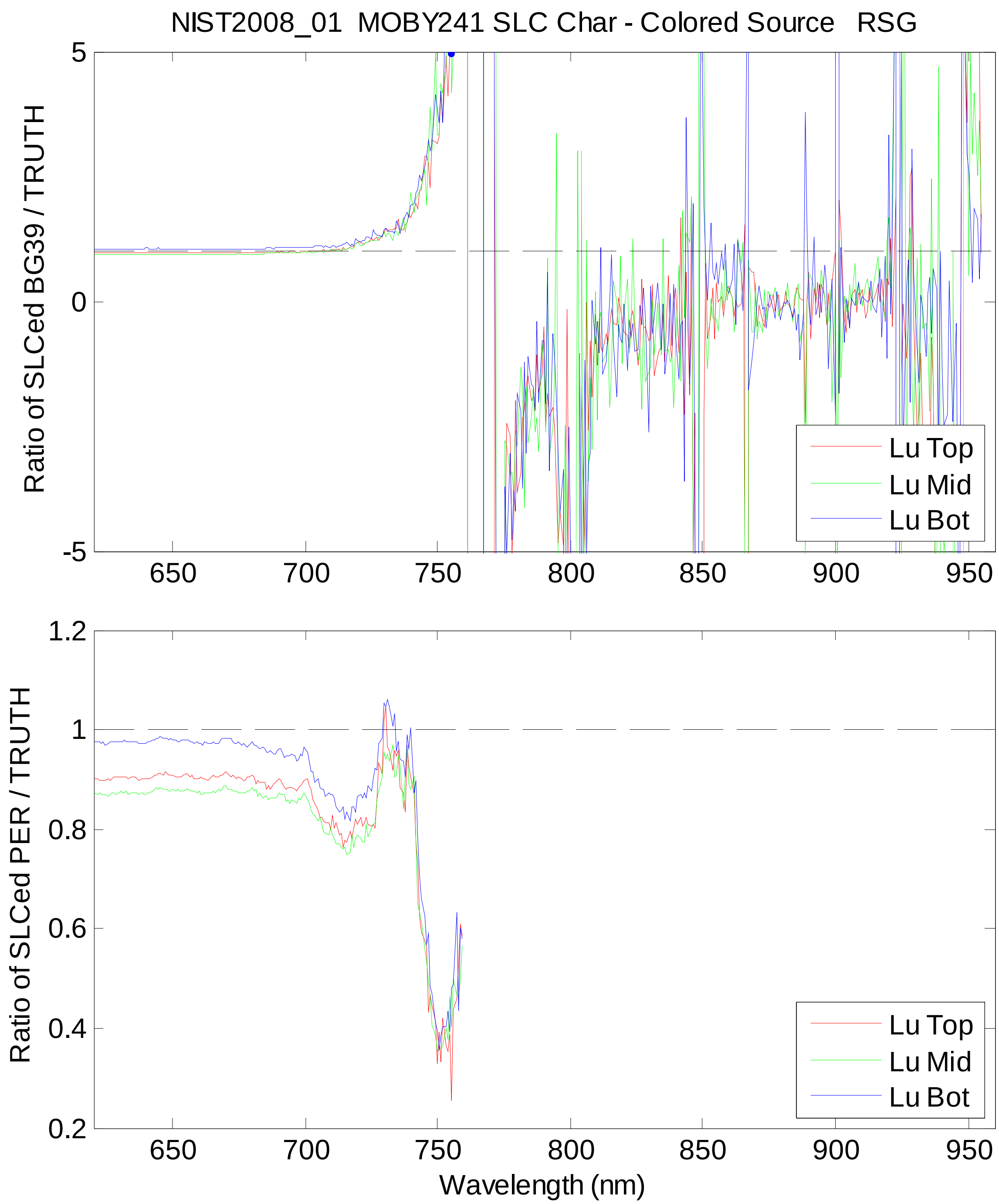


Figure 14

cd C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\validation
pltvaldata_(5)



NIST2008_01 MOBY241 SLC Char - Colored Source RSG
Ratio of SLCed BG39 / TRUTH
5
0
-5
650
700
750
800
850
900
950
Lu Top
Lu Mid
Lu Bot
Ratio of SLCed PER / TRUTH
1.2
1
0.8
0.6
0.4
0.2
650
700
750
800
850
900
950
Wavelength (nm)
Lu Top
Lu Mid
Lu Bot

Figure 15

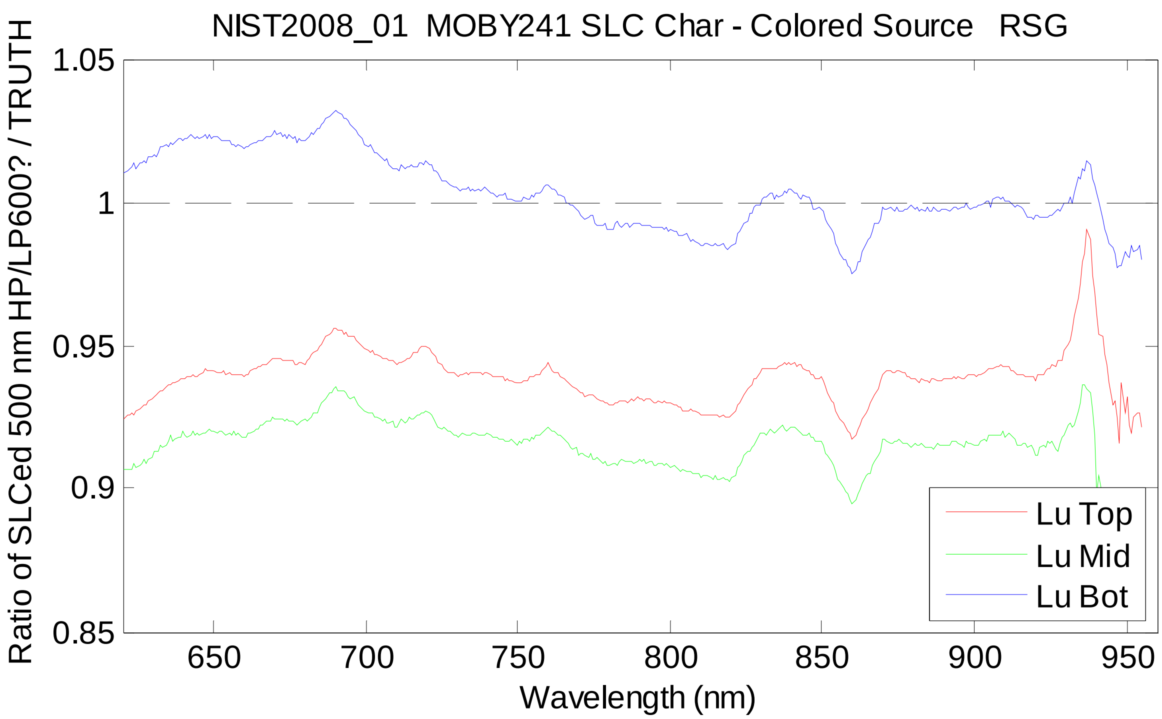

NIST2008_01 MOBY241 SLC Char - Colored Source RSG
Ratio of SLCed 500 nm HP/LP600? / TRUTH
1.05
1
0.95
0.9
0.85
650
700
750
800
850
900
950
Wavelength (nm)
Lu Top
Lu Mid
Lu Bot

Figure 16

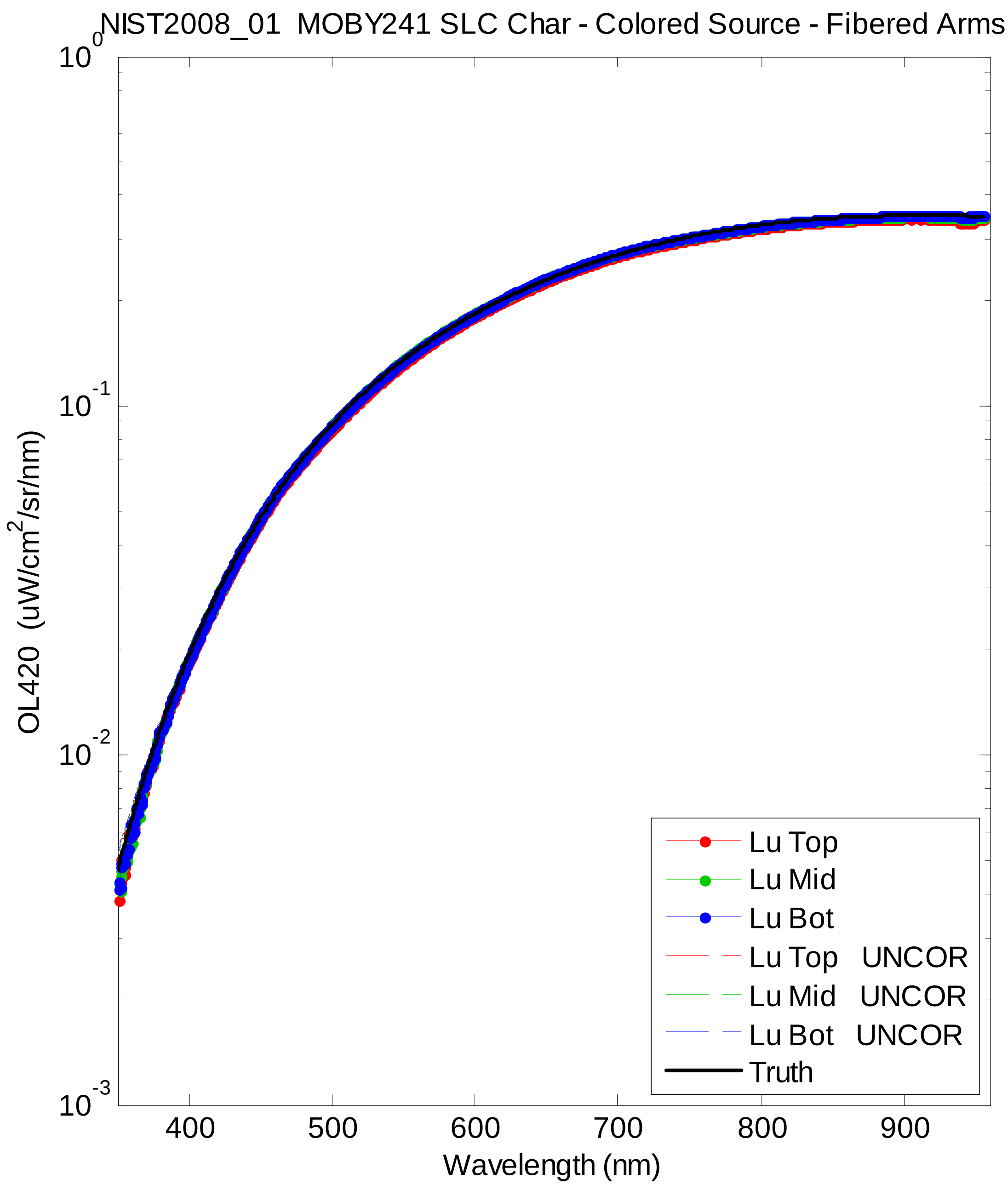
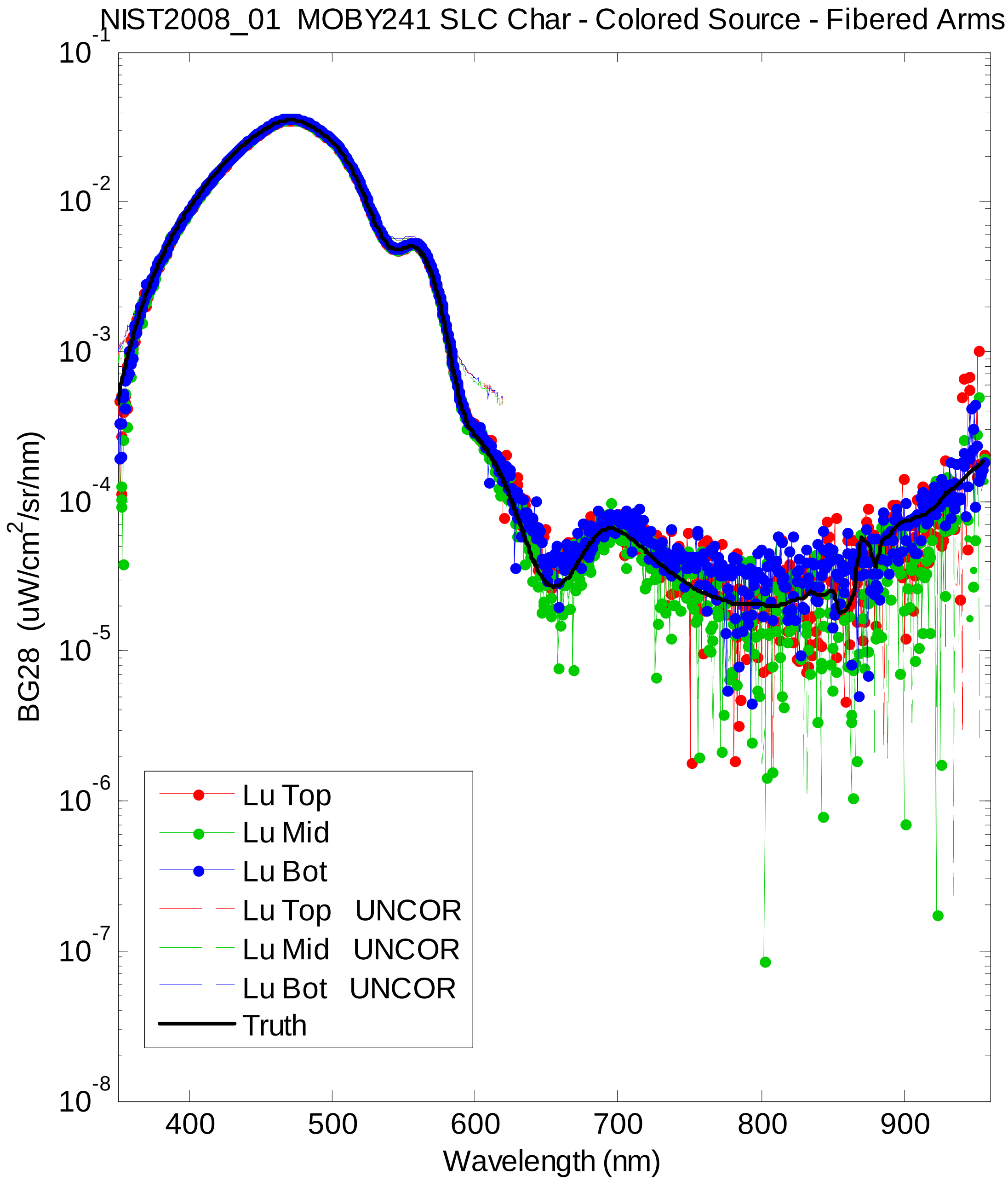


Figure 17

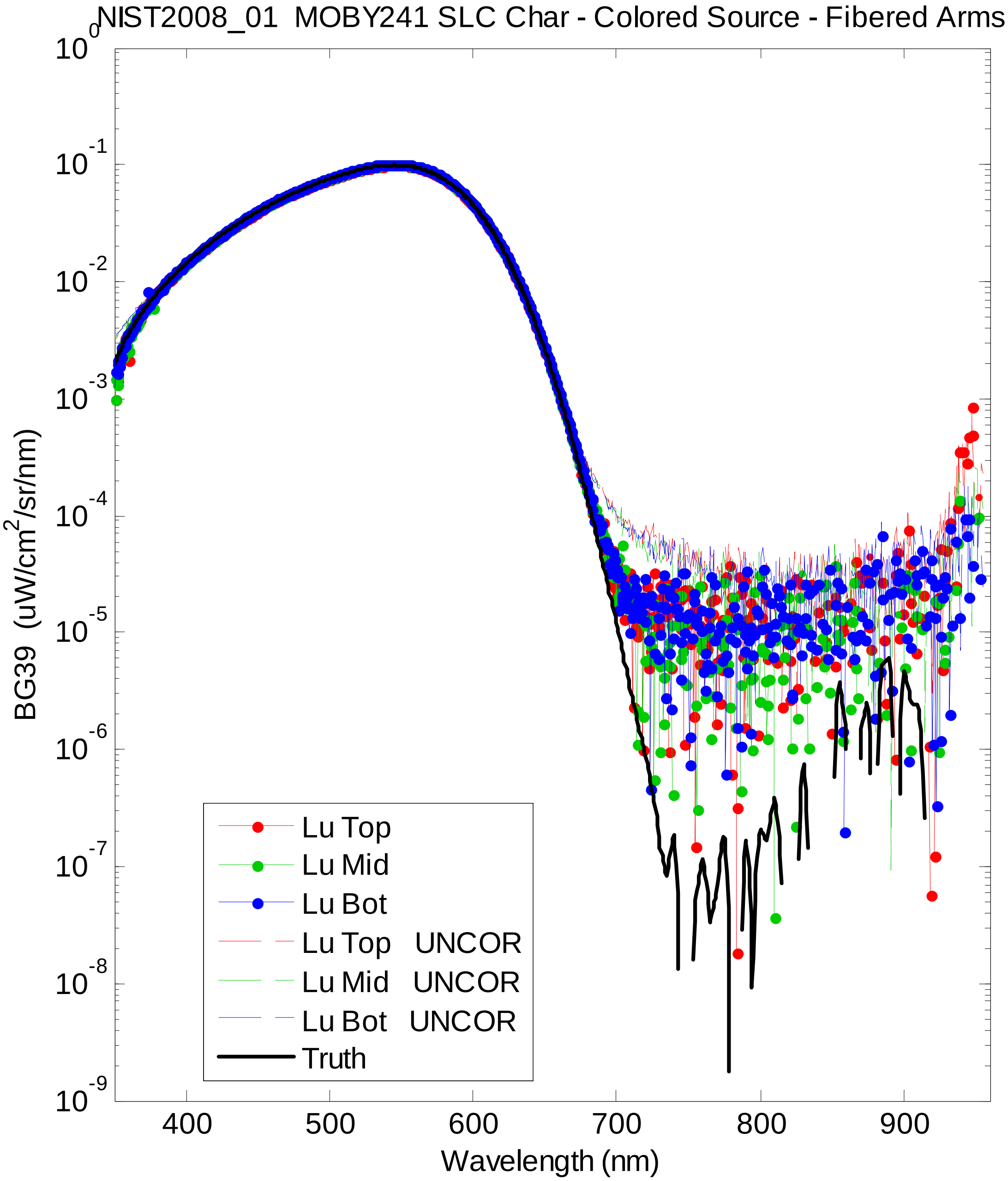
More colored source data but collected by Mike once MOBY was back in Hawaii. Correction appears better.

C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\preL159_fibered_CS
pltvaldata_(1)



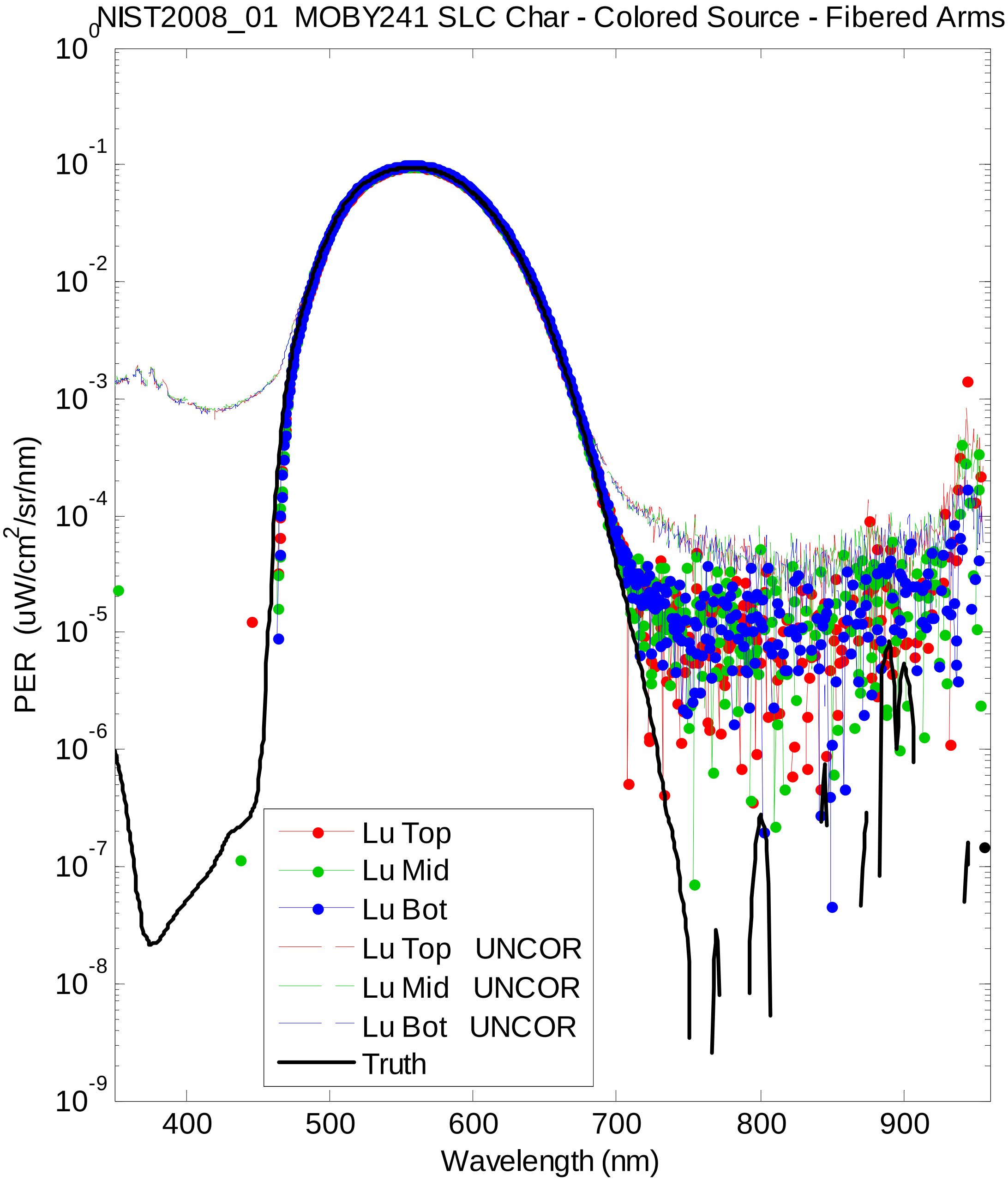
NIST2008_01 MOBY241 SLC Char - Colored Source - Fibered Arms
BG28 (uW/cm2/sr/nm)
Wavelength (nm)
Lu Top
Lu Mid
Lu Bot
Lu Top UNCOR
Lu Mid UNCOR
Lu Bot UNCOR
Truth

Figure 18



NIST2008_01 MOBY241 SLC Char - Colored Source - Fibered Arms
BG39 (uW/cm²/sr/nm)
Wavelength (nm)
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
10^-7
10^-8
10^-9
400
500
600
700
800
900
Lu Top
Lu Mid
Lu Bot
Lu Top UNCOR
Lu Mid UNCOR
Lu Bot UNCOR
Truth

Figure 19



NIST2008_01 MOBY241 SLC Char - Colored Source - Fibered Arms
PER (uW/cm2/sr/nm)
Wavelength (nm)
Lu Top
Lu Mid
Lu Bot
Lu Top UNCOR
Lu Mid UNCOR
Lu Bot UNCOR
Truth

Figure 20

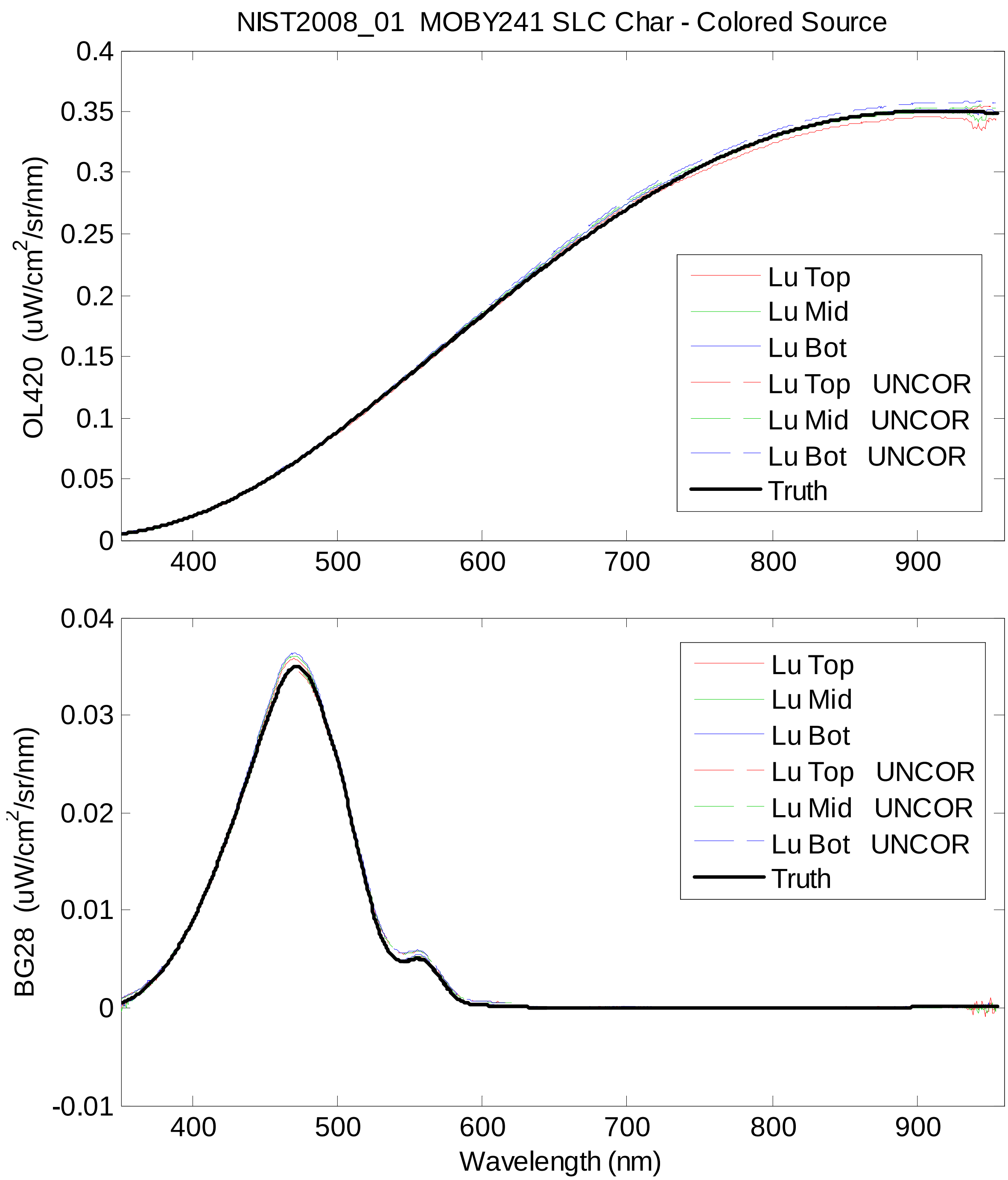


Figure 21

C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\preL159_fibered_CS
pltvaldata_(2)

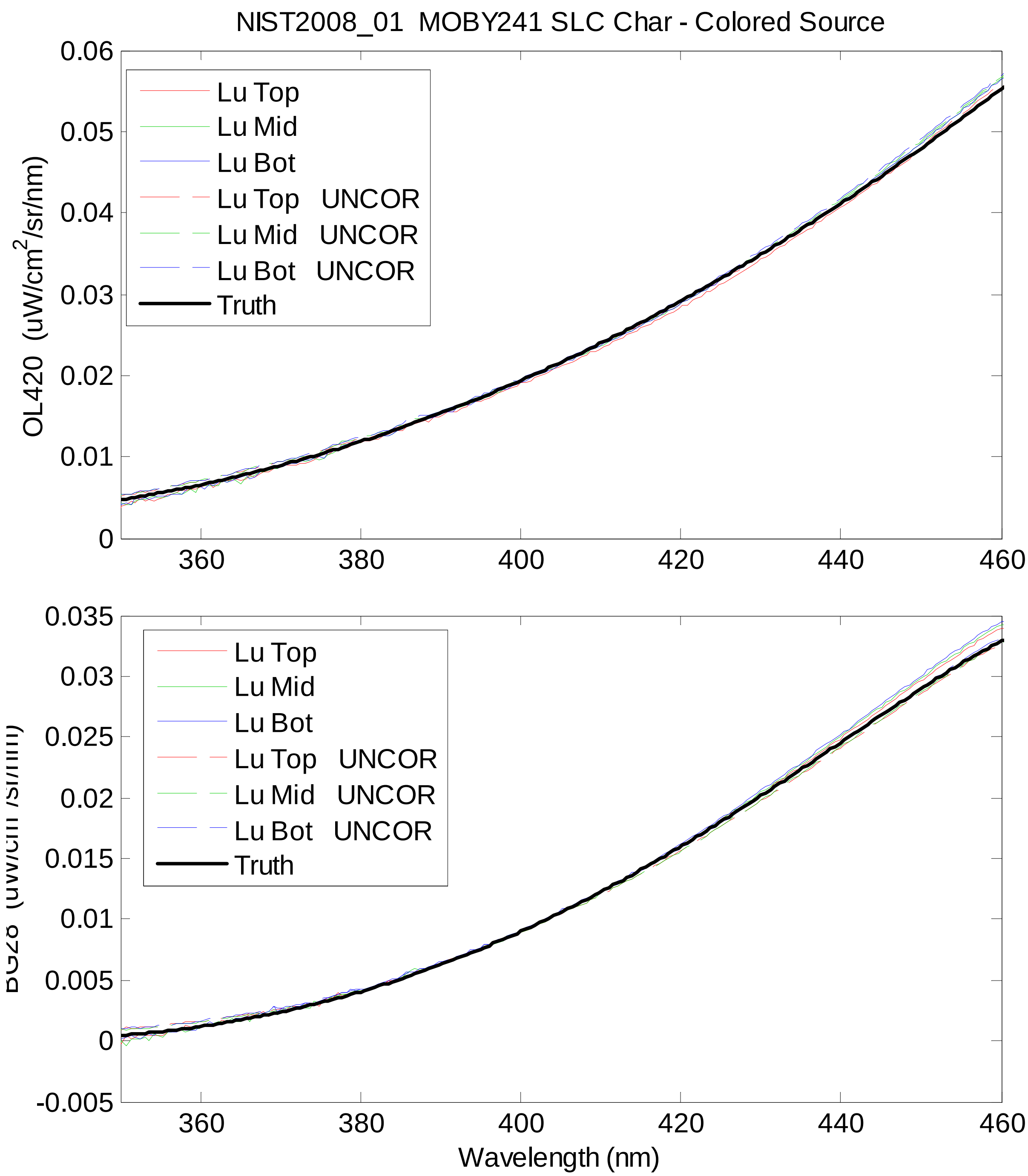
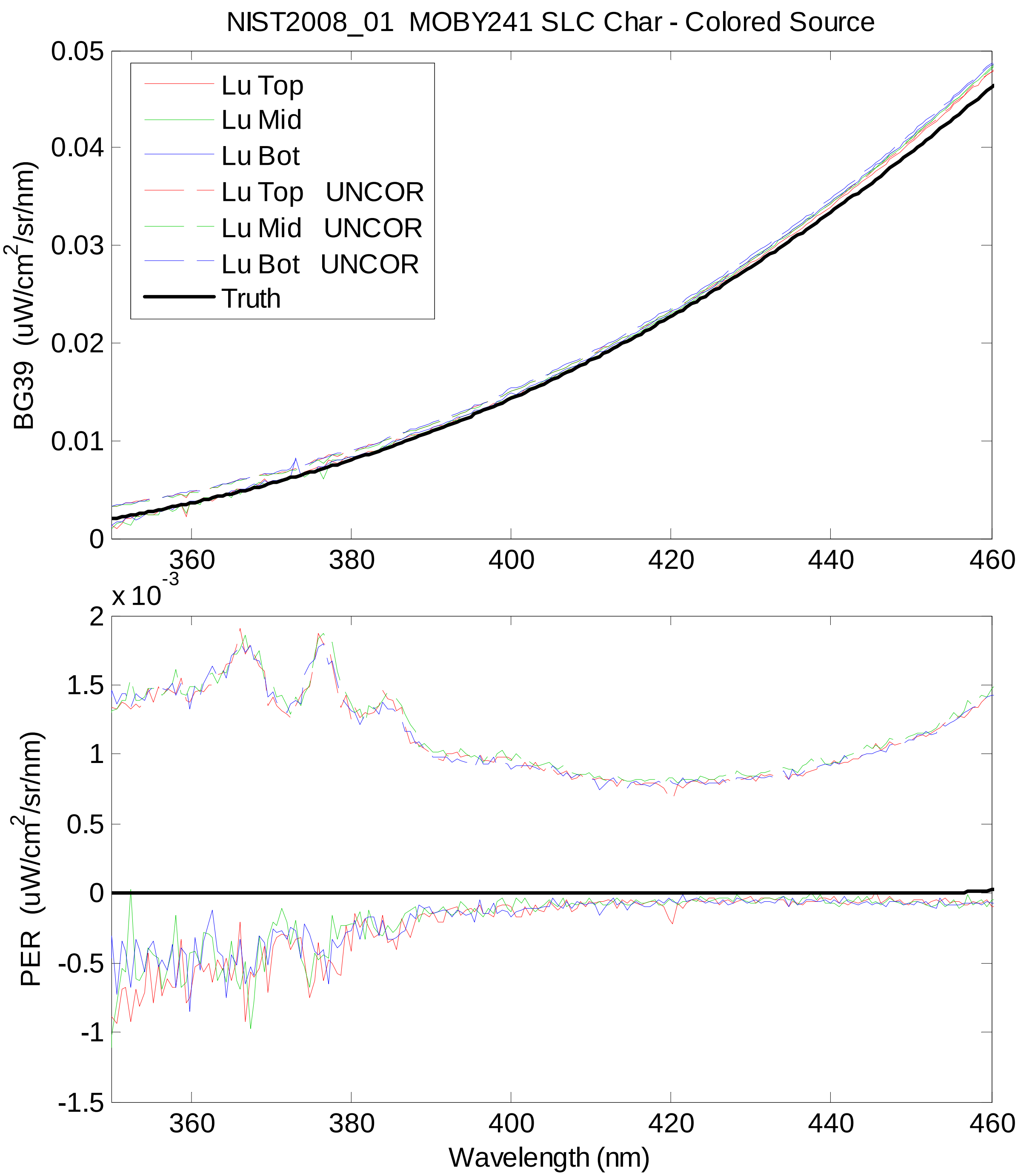

NIST2008_01 MOBY241 SLC Char - Colored Source
OL420 (uW/cm2/sr/nm)
Lu Top
Lu Mid
Lu Bot
Lu Top UNCOR
Lu Mid UNCOR
Lu Bot UNCOR
Truth
0.06
0.05
0.04
0.03
0.02
0.01
0
360
380
400
420
440
460
Lu Top
Lu Mid
Lu Bot
Lu Top UNCOR
Lu Mid UNCOR
Lu Bot UNCOR
Truth
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
-0.005
360
380
400
420
440
460
Wavelength (nm)

Figure 22



NIST2008_01 MOBY241 SLC Char - Colored Source
Lu Top
Lu Mid
Lu Bot
Lu Top UNCOR
Lu Mid UNCOR
Lu Bot UNCOR
Truth
BG39 (uW/cm^2/sr/nm)
0.05
0.04
0.03
0.02
0.01
0
360
380
400
420
440
460
x 10^{-3}
2
1.5
1
0.5
0
-0.5
-1
-1.5
PER (uW/cm^2/sr/nm)
Wavelength (nm)

Figure 23

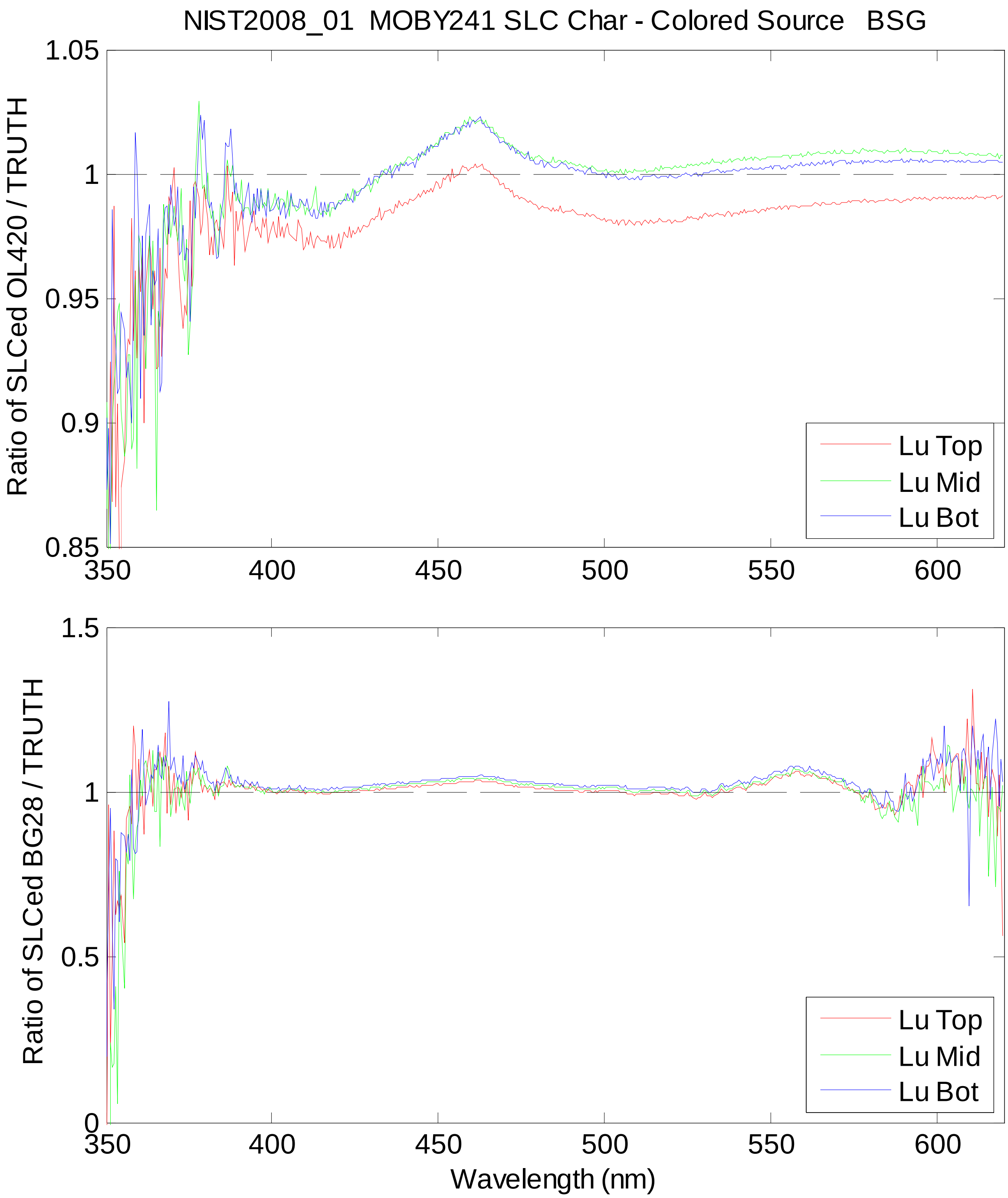


Figure 24

C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\preL159_fibered_CS
pltvaldata_(4)

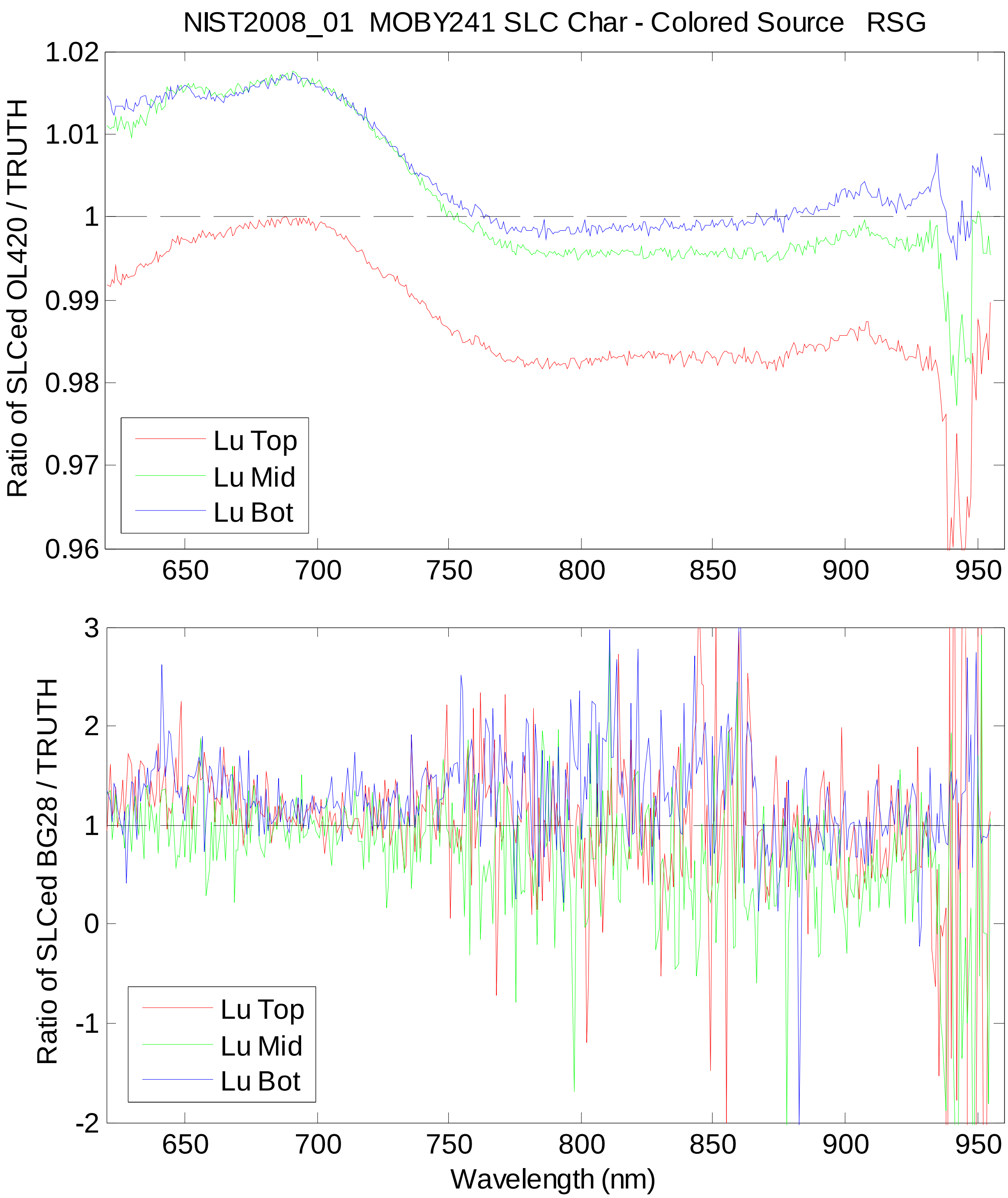


Figure 25

C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\preL159_fibered_CS
pltvaldata_(5)

Mike’s Colored Source data collected during SORTIE1 (MOBY237)

During the SORTIE-1 Experiment in Mar 2007 Colored source data was collected. Mike Feinholz applied the new SLC to the M237 data, the following graphs show the results.

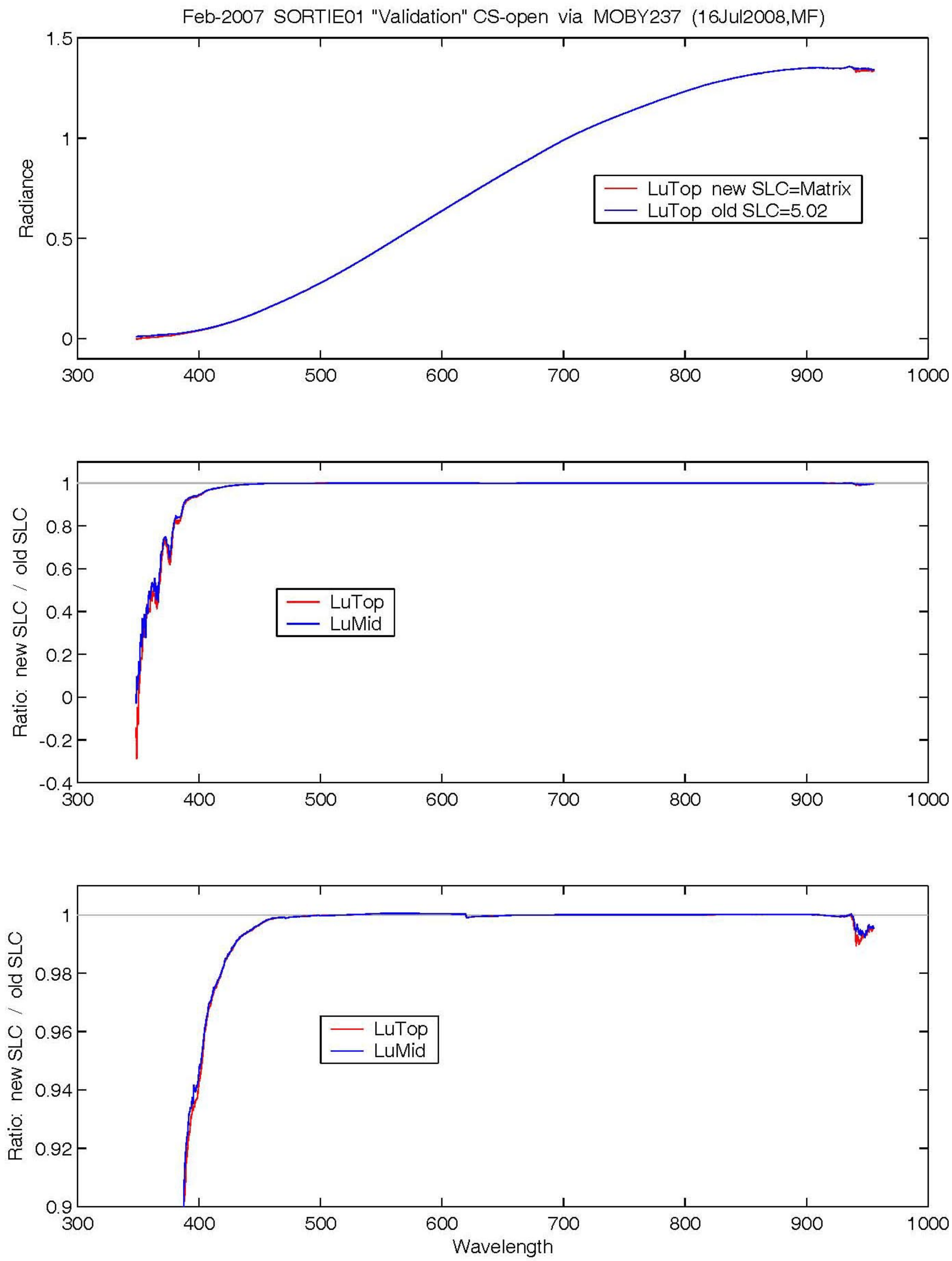


Figure 26. OL420 radiance data and ratios of the radiance data SLCed with the old and new SLC.

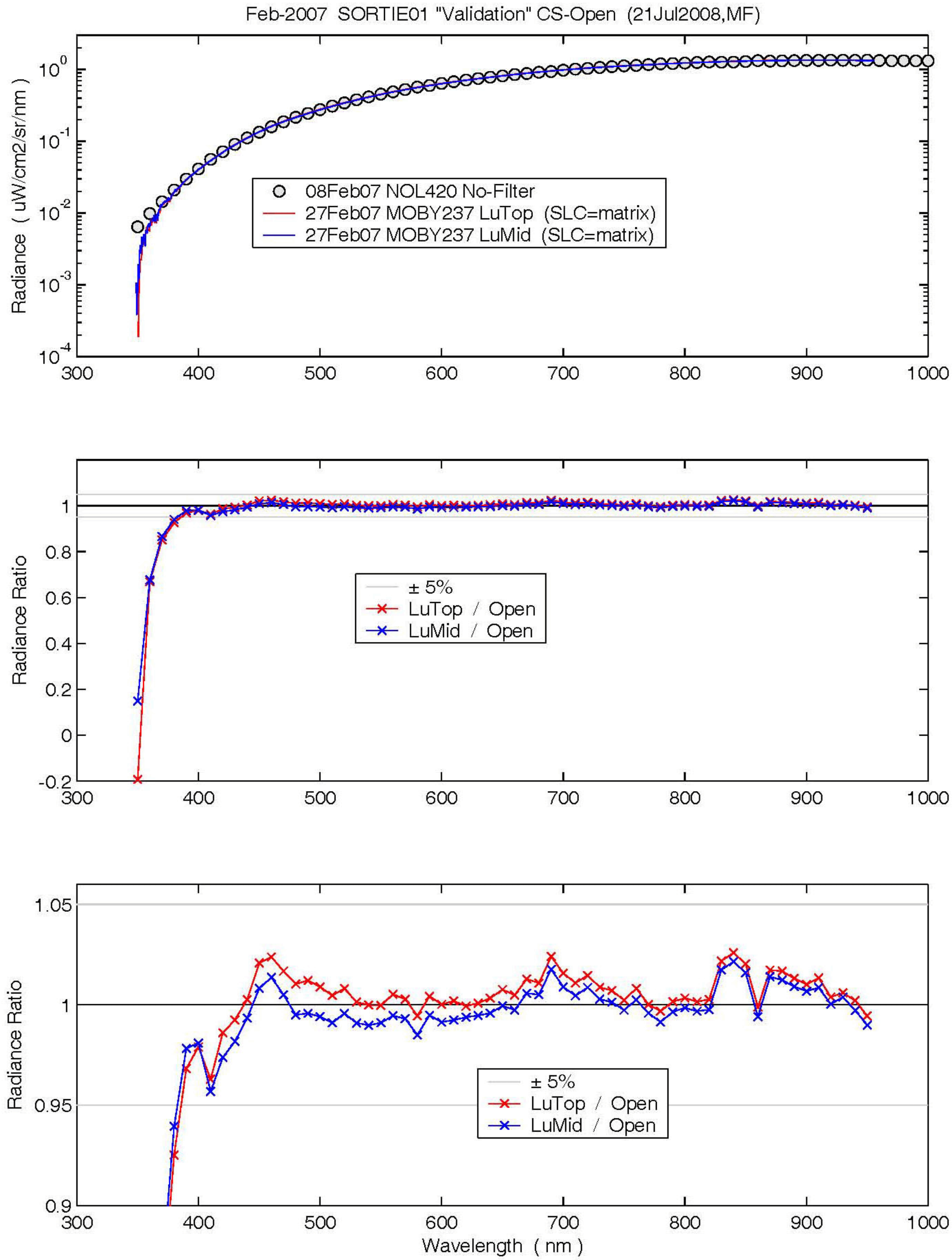
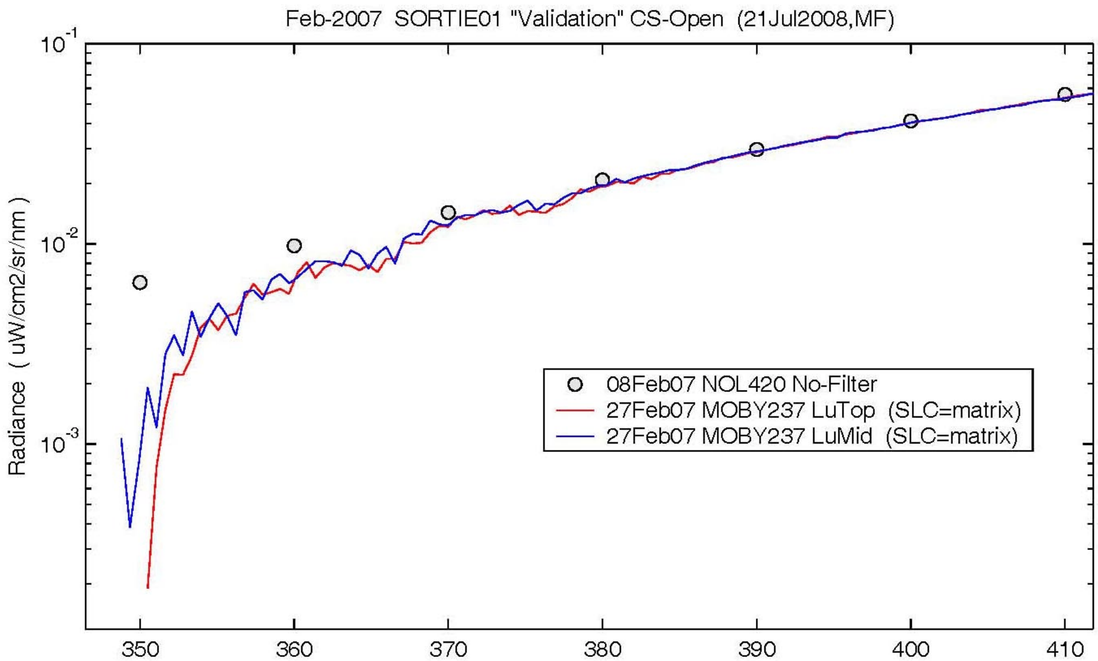


Figure 27. OL420radiance data and ratios of the radiance data SLCed with new SLC.over the lamp values.



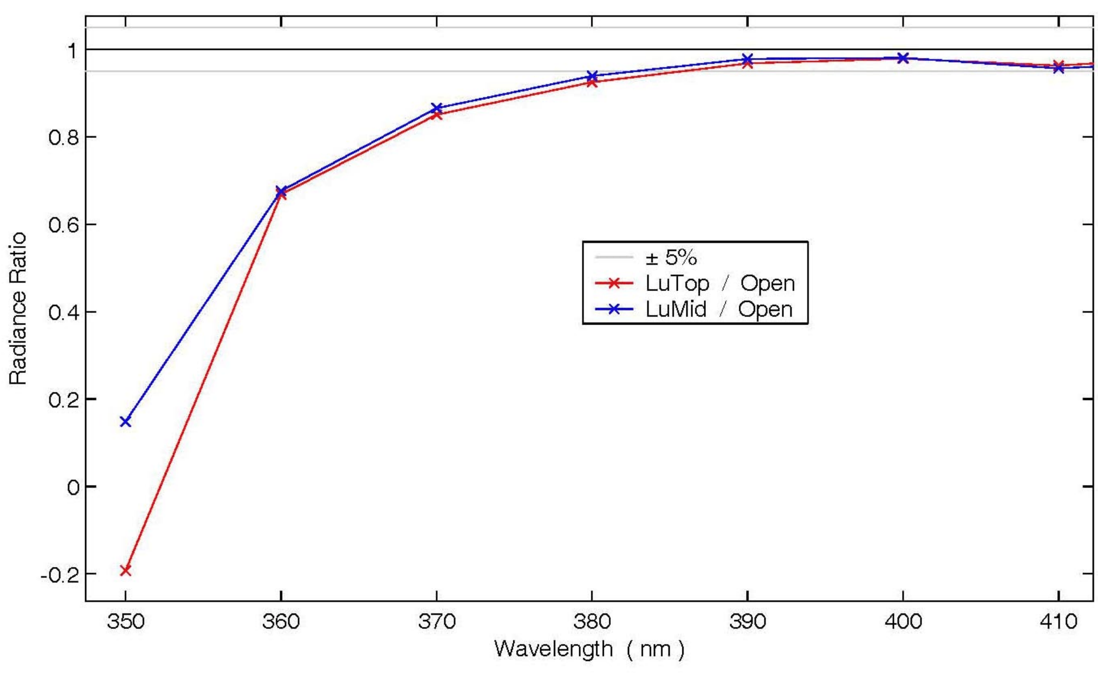


Figure 28. Zoomed in view of OL420 Lu data showing the slight over correction in the UV

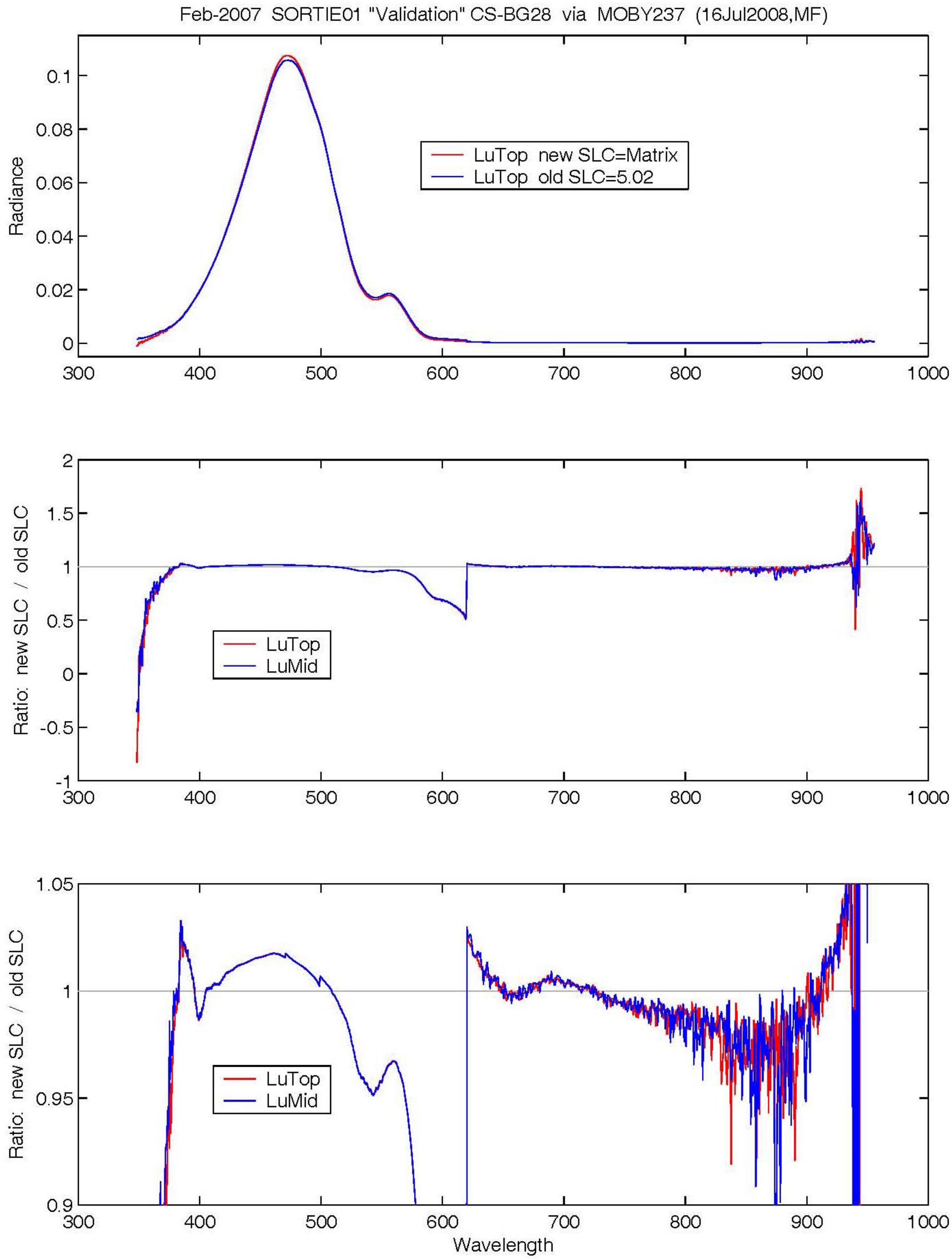


Figure 29 BG28 Colored Source filter radiance data and ratios of the radiance data SLCed with the old and new SLC.

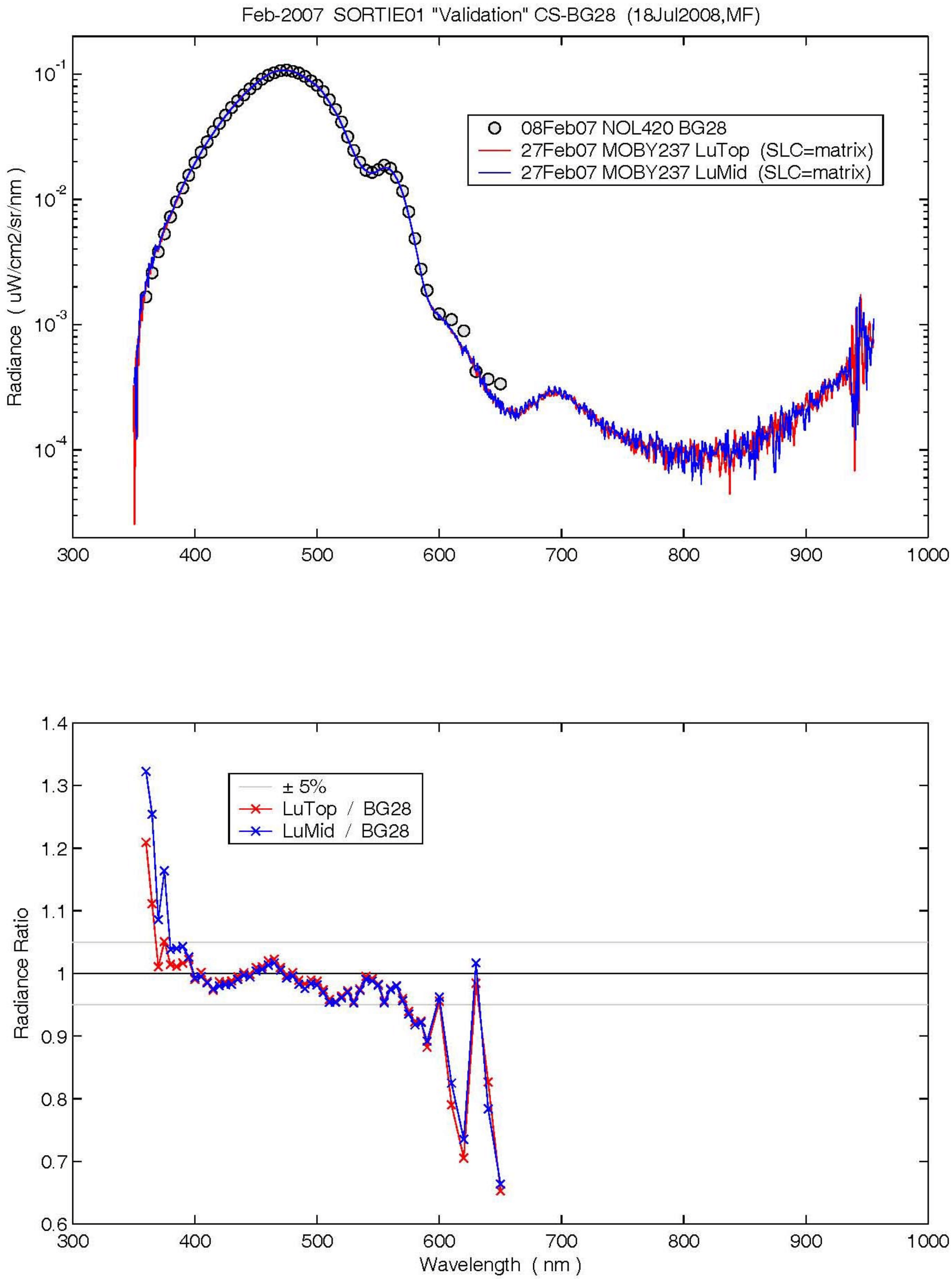


Figure 30. BG28 radiance data compared to the NIST BG28 filters raadiance

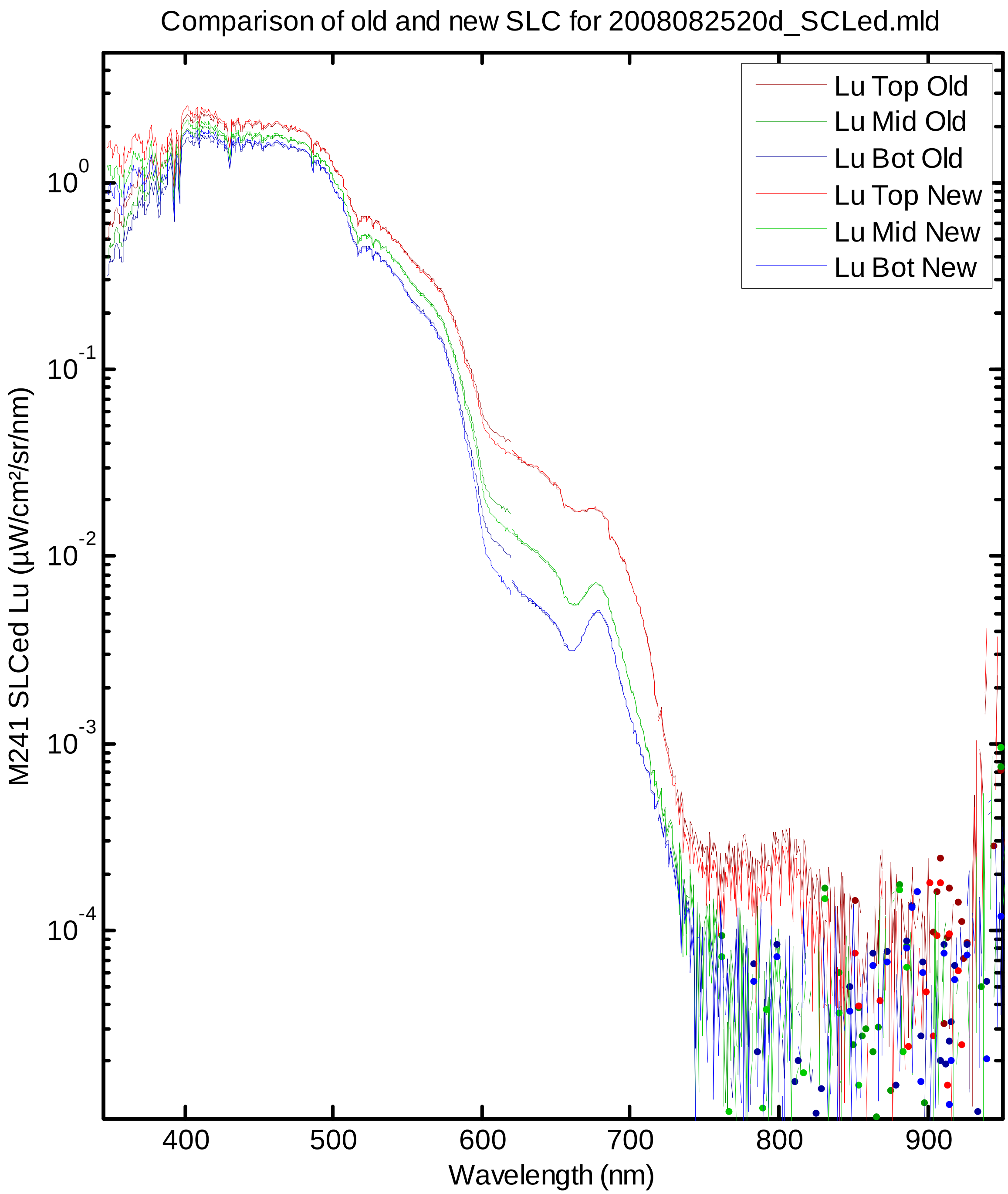


Figure 31

Fig Cap: Comparison of the MOBY241 Lu data processed with the new and old SLC algo.

Interestingly the reg spectrograph changed very little, the largest changes are seem on the blue spec size, mainly at the edges of the CCD.
cd C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\M241_mobytests
plotm241data_(1)

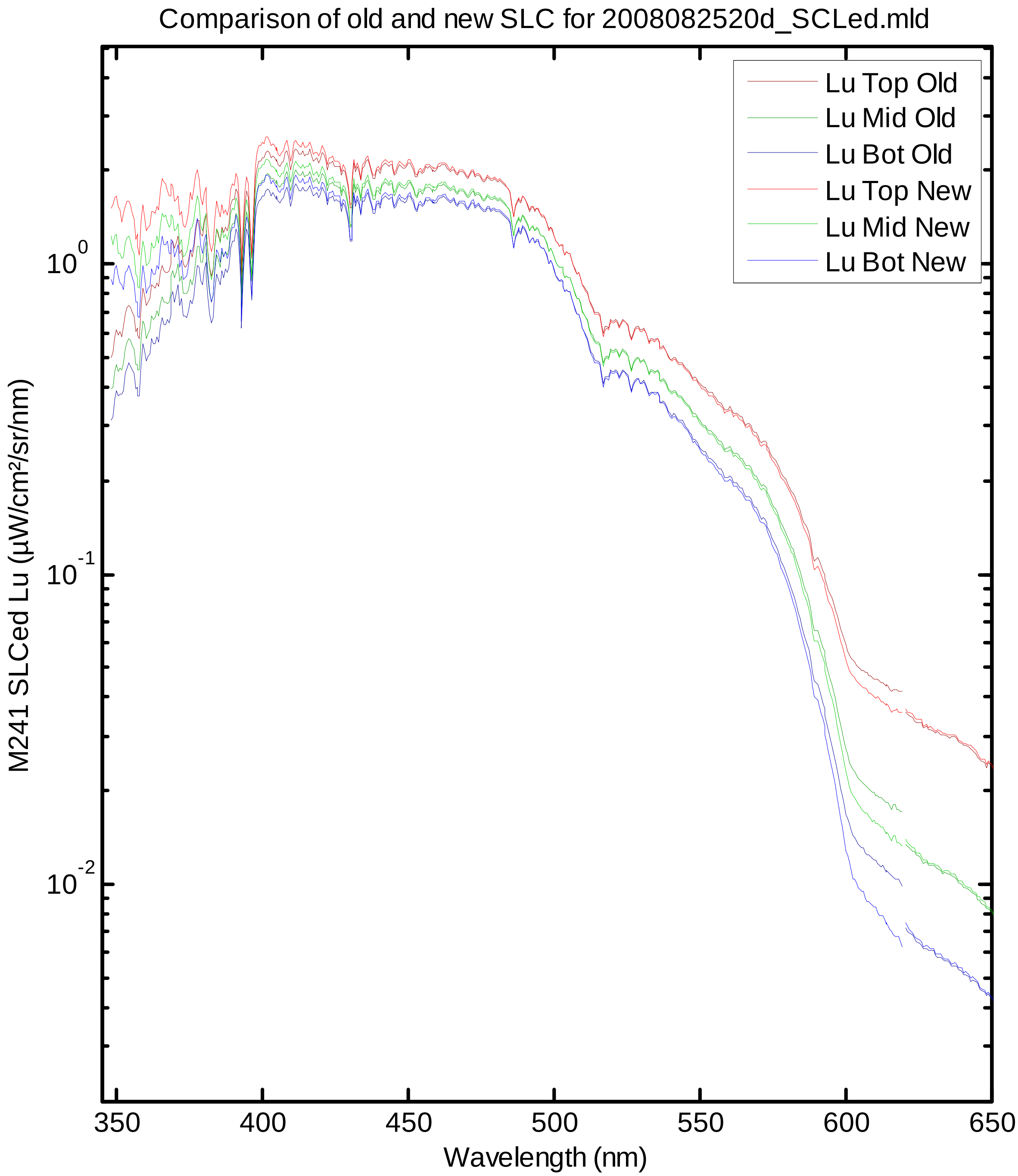


Figure 32

Fig Cap: Same MOBY241 data SLCed with the old and new algo. Note the improvment in the blue red overlap region and the large change in the UV. The Lutop and Mid look really good in the overlap area, the LuBot overcorrects on the blue spectrograph red side.

plotm241data_(1,1)

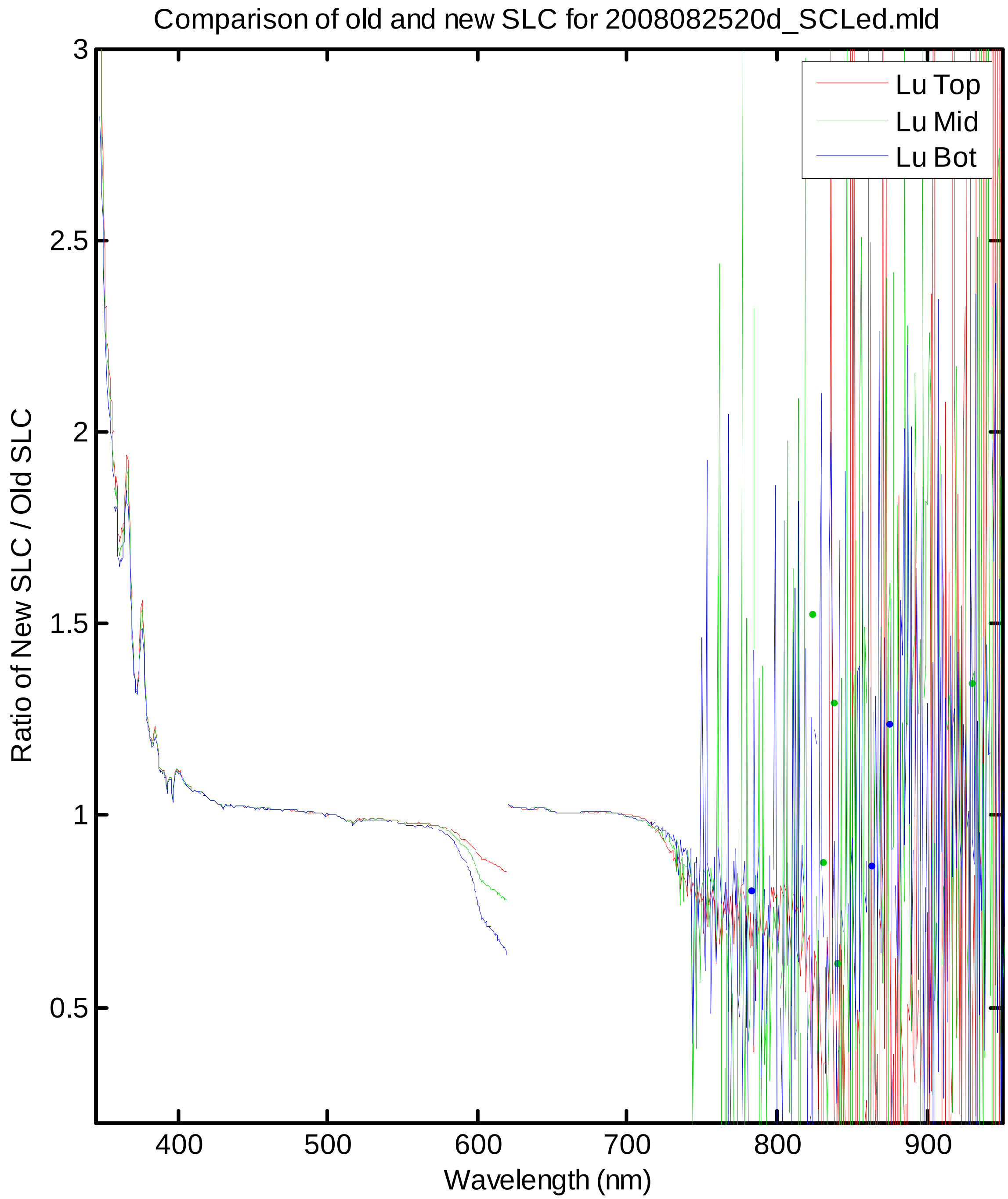


Figure 33

Fig Cap: Ratio of New to Old SLC

plotm241data_(2)

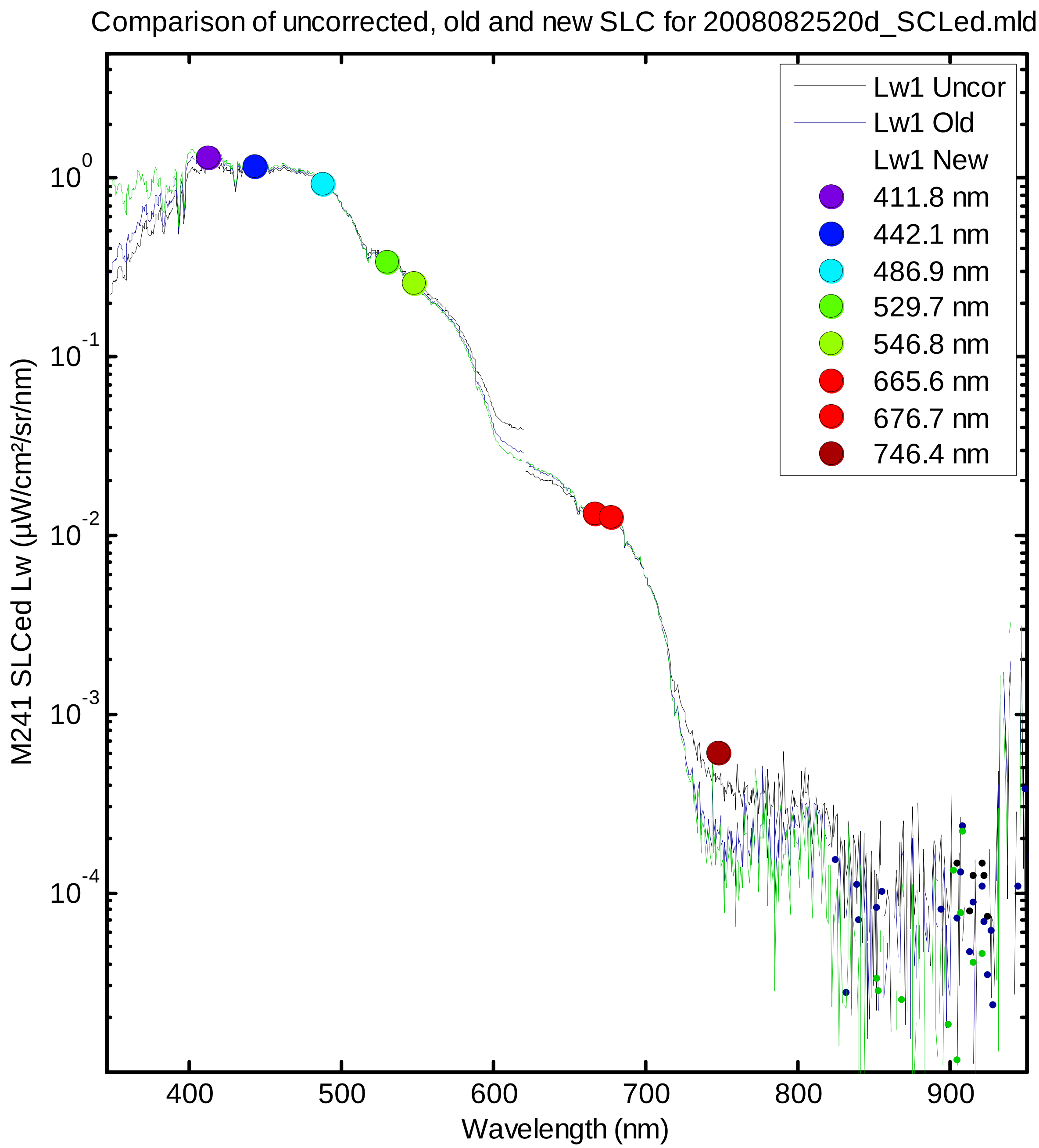


Figure 34

Fig Cap: Comparison of water-leaving Radiance (Lw1) SLCed using the new and old algo. With MODIS- Terra bands shown (bands 8 - 15). L is calculated using the LuTop arm and Kls calculated from the top and mid arm

C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\M241_mobytests
plotm241data_(7)

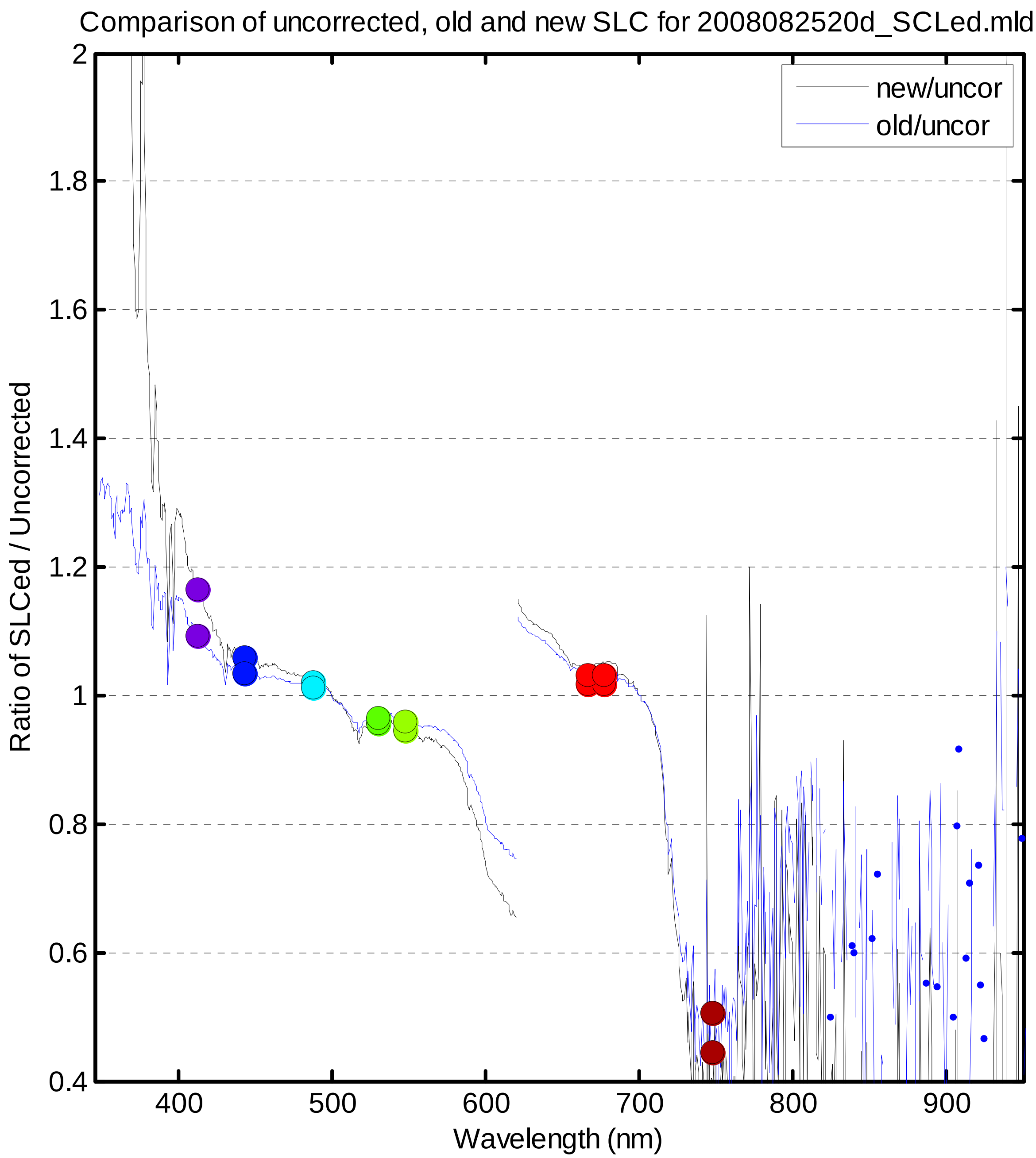


Figure 35

Fig Cap: Ratio of new Lw1 over the old Lw1. Note the large change in the 411.8 nm band, 6 % plus.

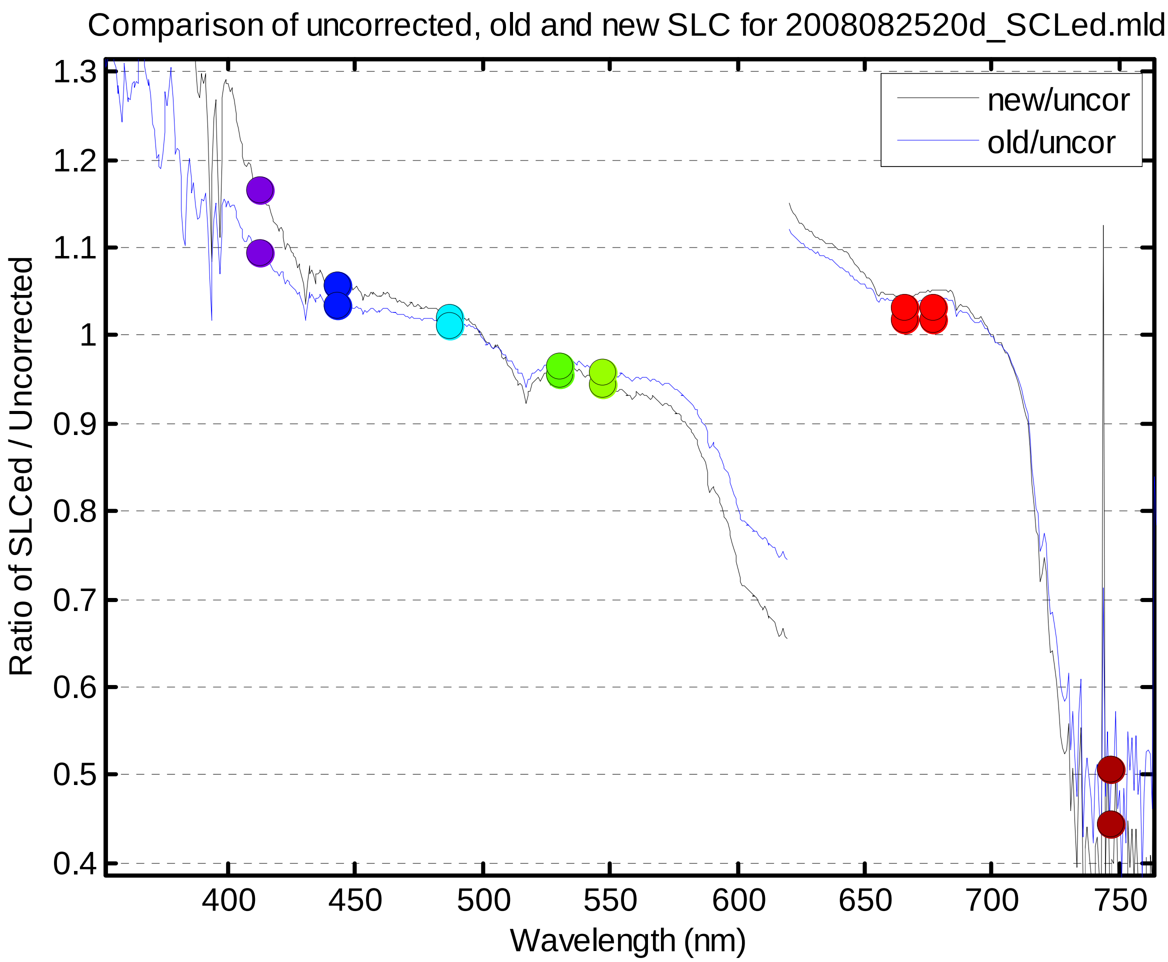


Figure 36

Fig Cap: Same as the previous graph, but zoomed in to show the ratio os Lw1 for bands 8-14.

MODIS-Terra bands for the MOBY data shown above								
Bands	8	9	10	11	12	13	14	15
Wavelength (nm)	411.8	442.1	486.9	529.7	546.8	665.6	676.7	746.4
% Diff of Old /Uncor	9.50	3.63	1.35	-3.31	-3.98	3.28	3.38	-49.18
% Diff of New/Uncor	16.7	6.0	2.2	-4.3	-5.4	2.0	1.9	-55.4
% Diff from old cor	7.23	2.35	0.84	0.97	1.39	1.27	1.43	6.25

I have not redone this section using the newly QCHKd laser data since it is unlikely to make any changes

Comparison of changes to the SLC using different in-band are widths

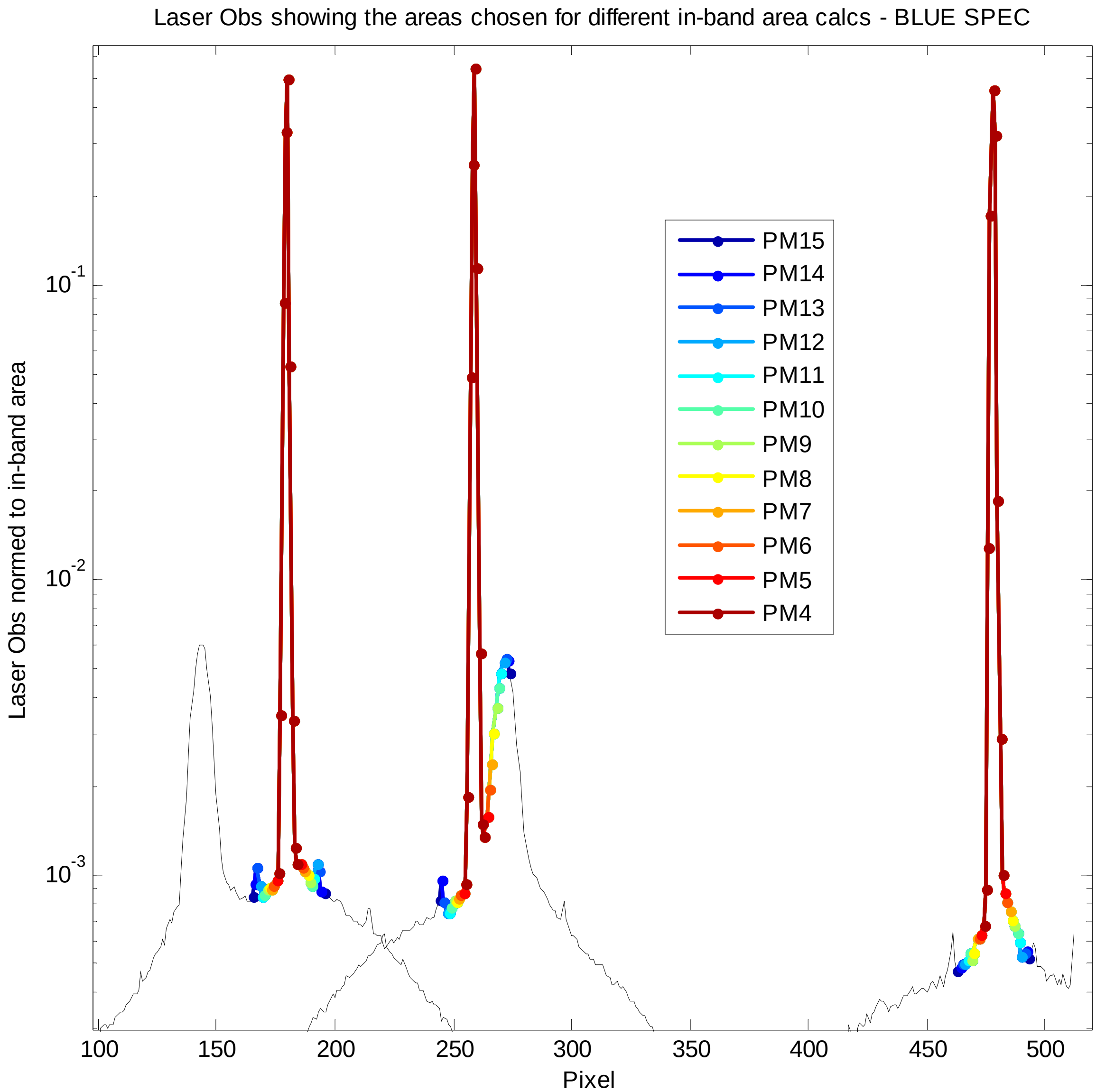
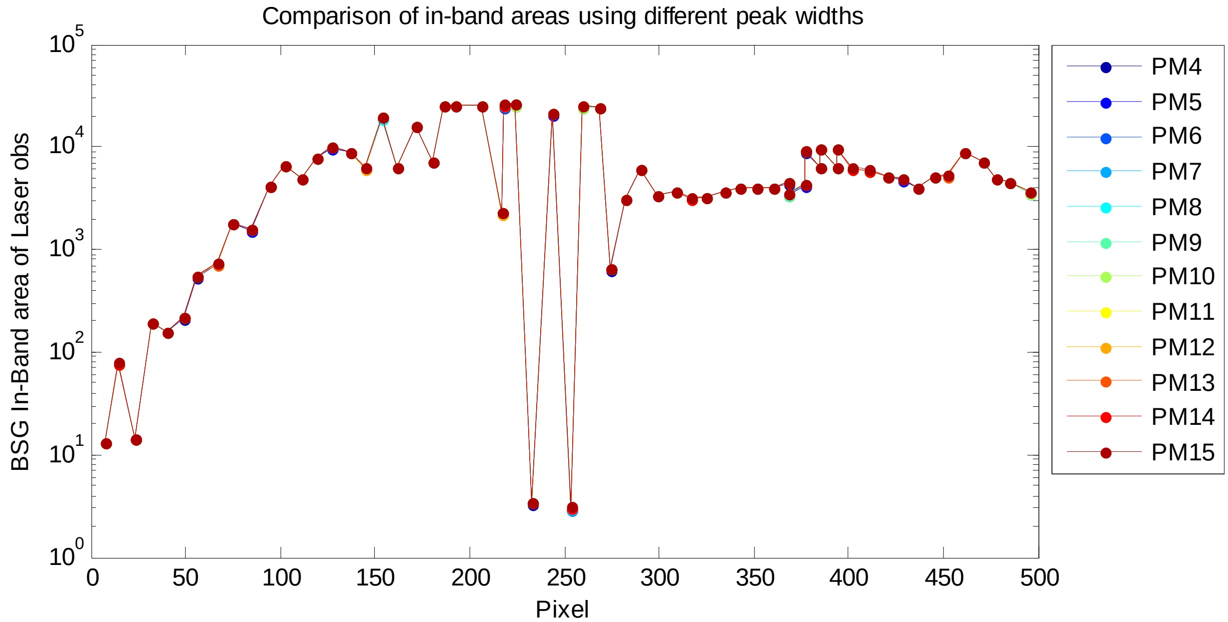


Figure 37. Laser Obs on Blue spec showing the pixels included in depending on the number of pixels included in the in-band area. PM # is the number of pixels on the right and left of the main peak used to calculate the in-band area and removed from the SPR.

Aside from the effects on the SPR and SLCed data the issue is what to do when the laser obs goes through the reflection peak if anything?



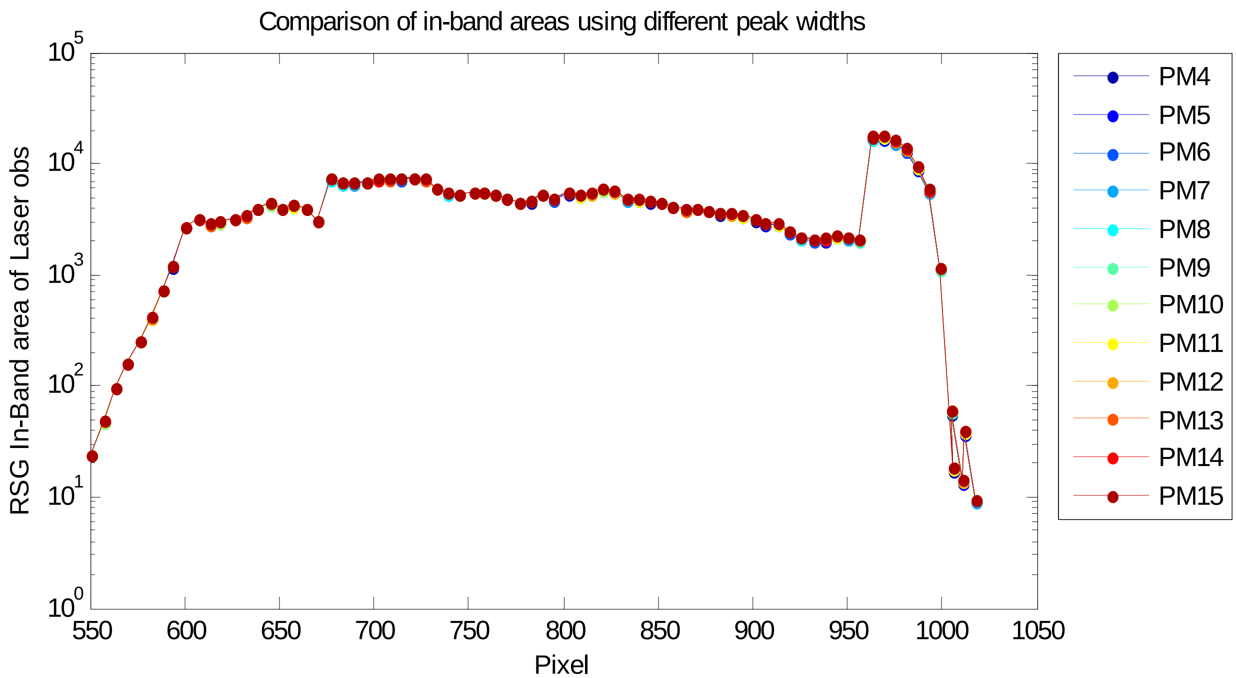


Figure 39. In-band areas for the blue and red spectrographs were the number of pixels from the main peak was varied from 4- 15.

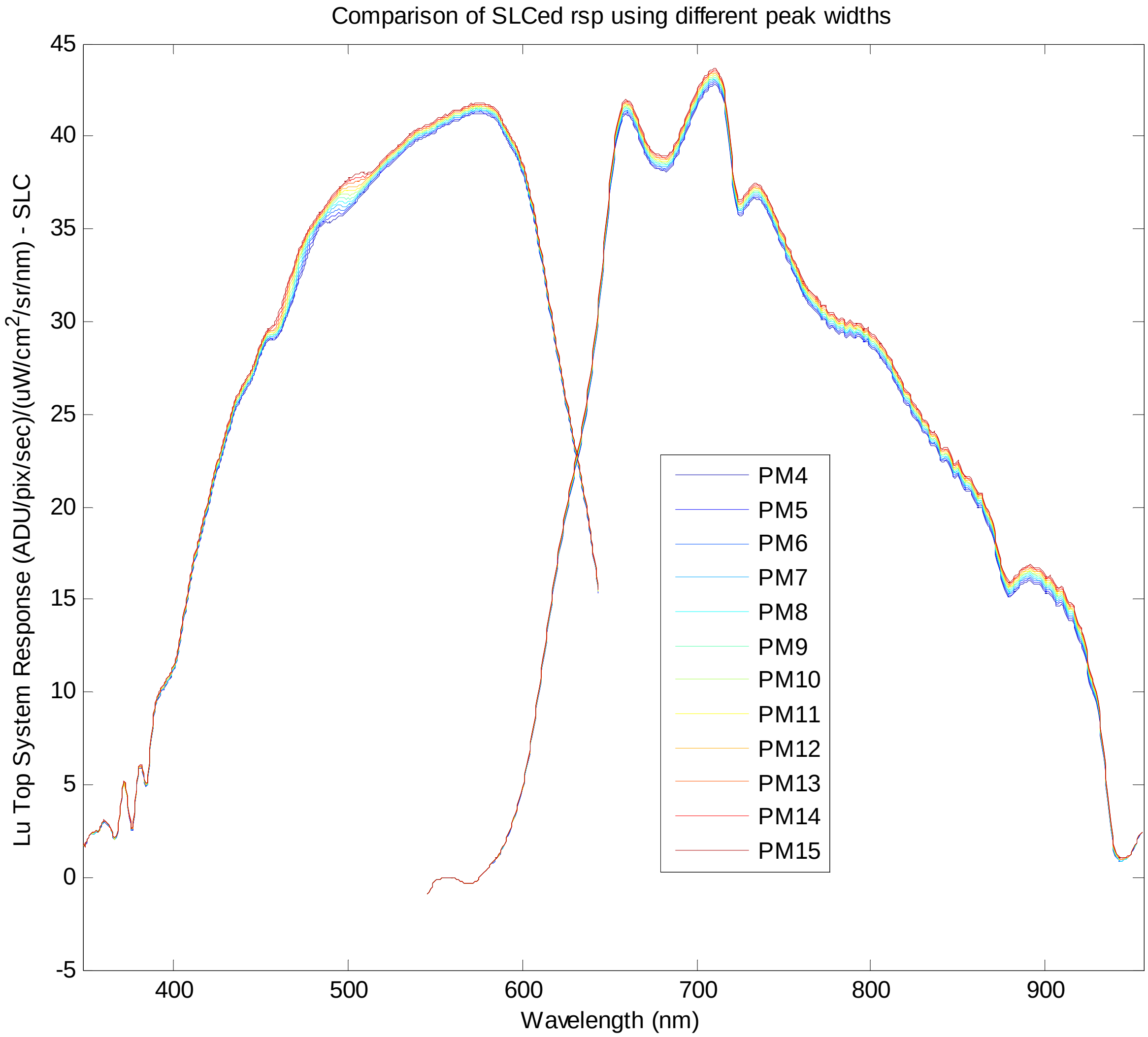


Figure 40. LuTop system response, SLCed using different widths for the in-band area.

The purpose of this graph is to show the affect of changing the width if the "in-band" area of the laser peaks. This affects 2 parts of the SPR, 1) the area used to calculate the in-band area which each laser obs is divided by and 2) the number of pixels around the laser peak set to zero in the SPR. The system response is lower when the in-band area is smaller (ie PM 4) because more straylight is being removed, or more light is begin considered stray light. When plus or minus 15 (PM15) is used to then more light is considered in-band or not stray light and so less light is removed and the response is higher.

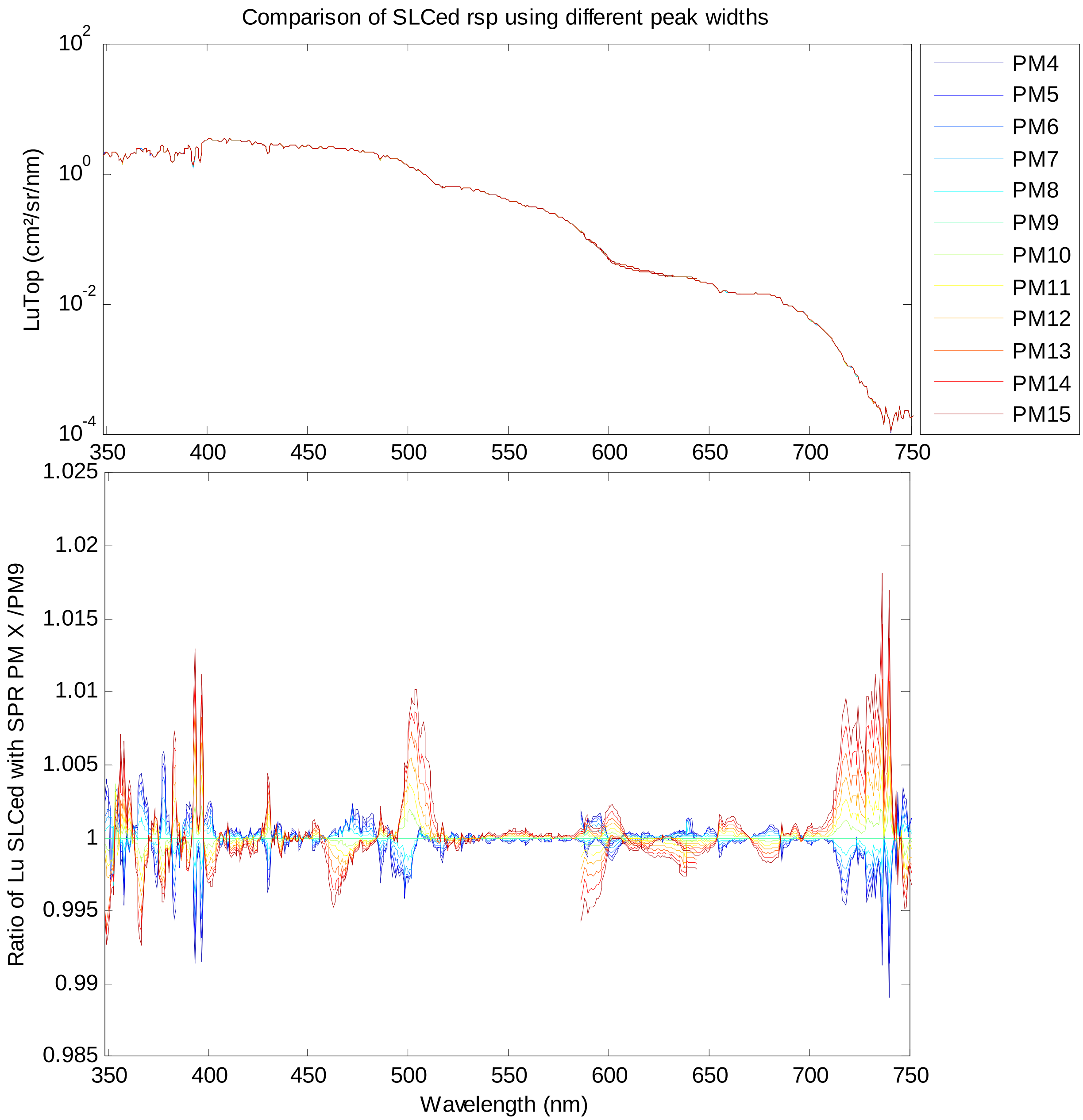


Figure 41. The effect on LuTop when SLCed with the different SPR with difference in-band area widths. The lower graphs ratios are normalized to the plus or minus 9 which is the number we have been using for MOBY and MOS since time in memorial.

Comparison of pulsed and constant wavelength lasers

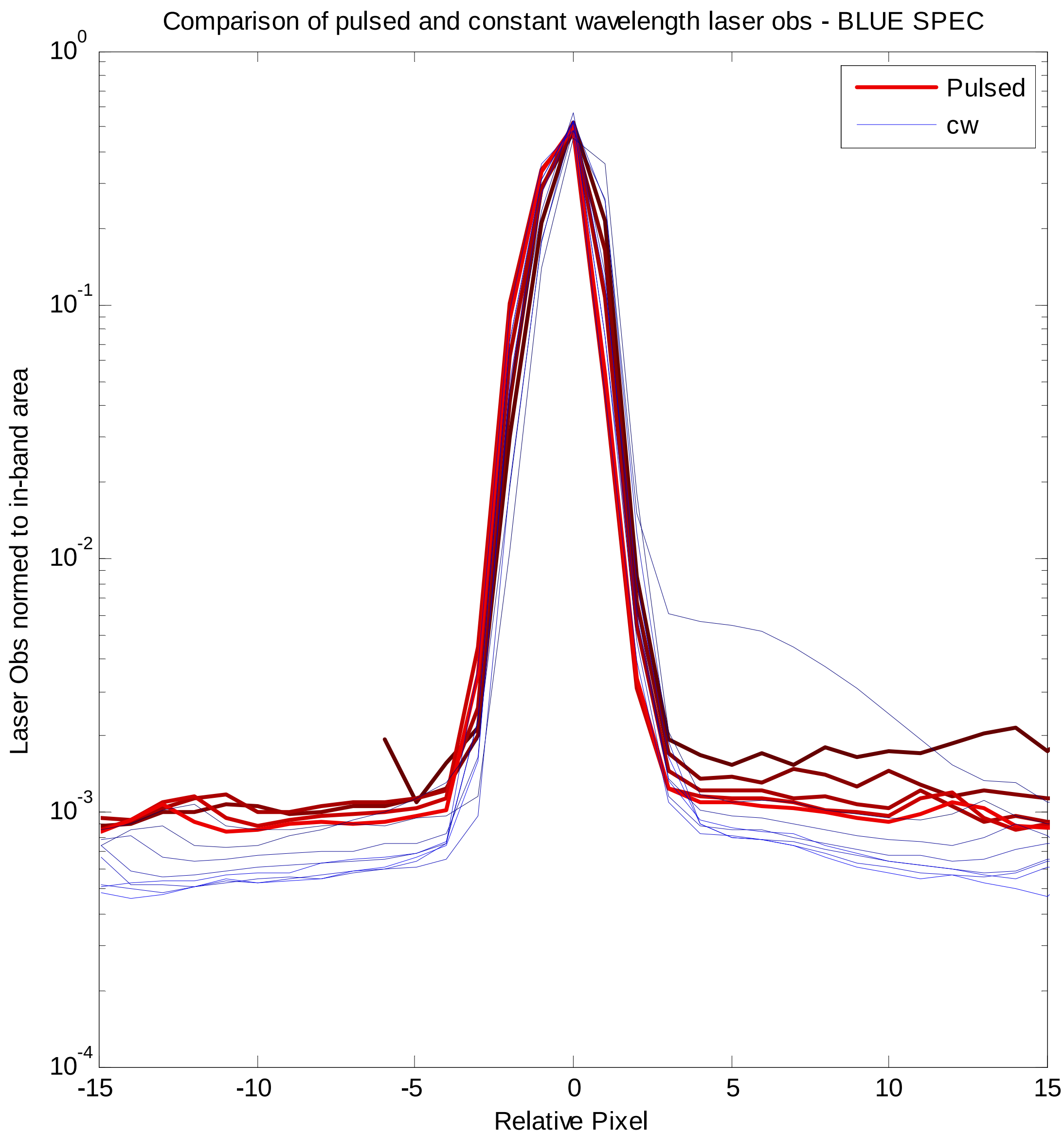


Figure 42. Comparison of pulsed and continuous wavelength laser obs.

Steve was worried that the pulsed and continuos laser would have different widths so this graph proves they are both the same.

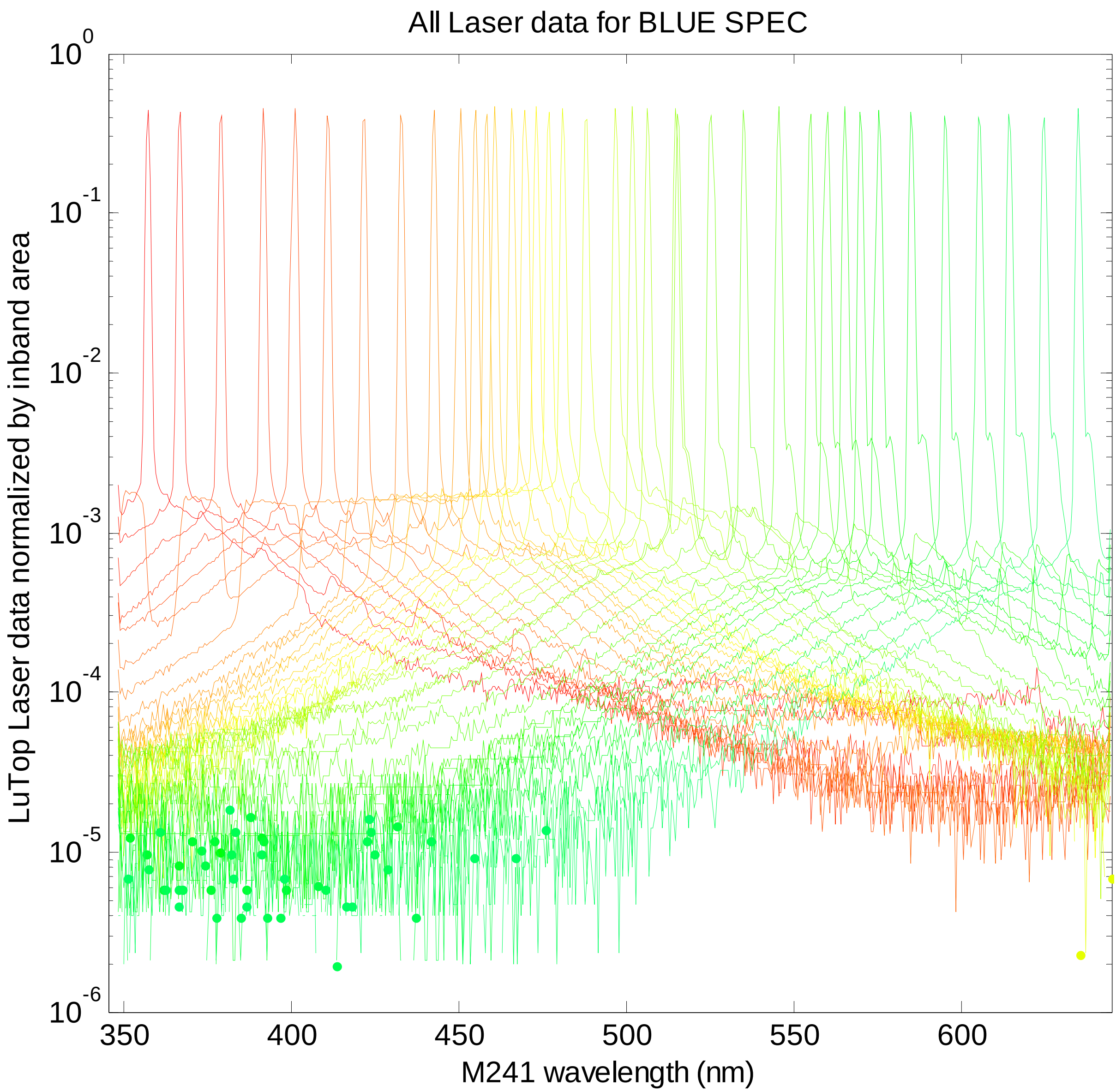


Figure 43

Fig Cap: **All LuMOS Laser data collected for Blue Spectrograph**

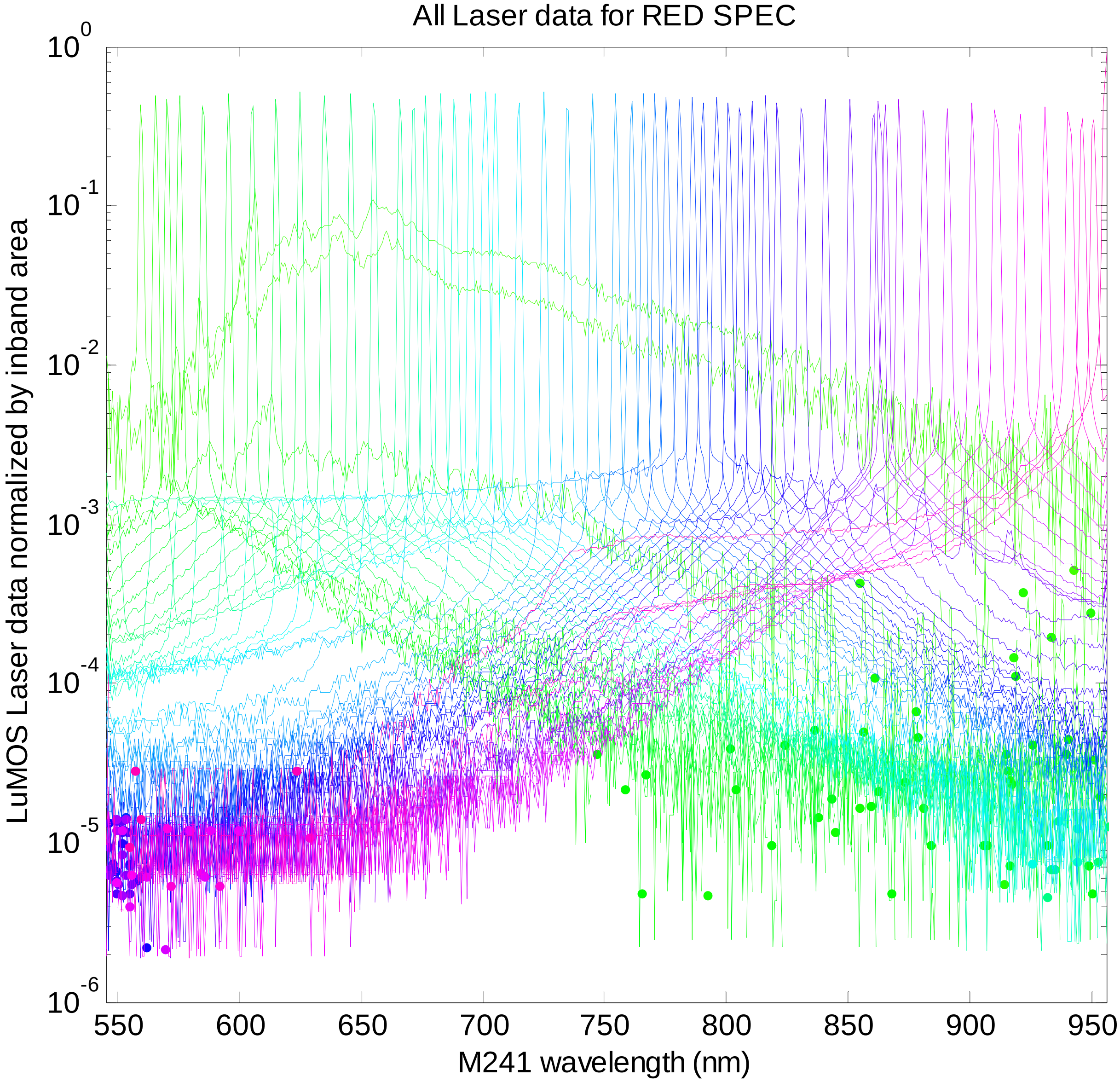


Figure 44

Fig Cap: **All LuMOS Laser data collected for Red Spectrograph**

Lu MOS Straylight correction (with newly processed laser data)

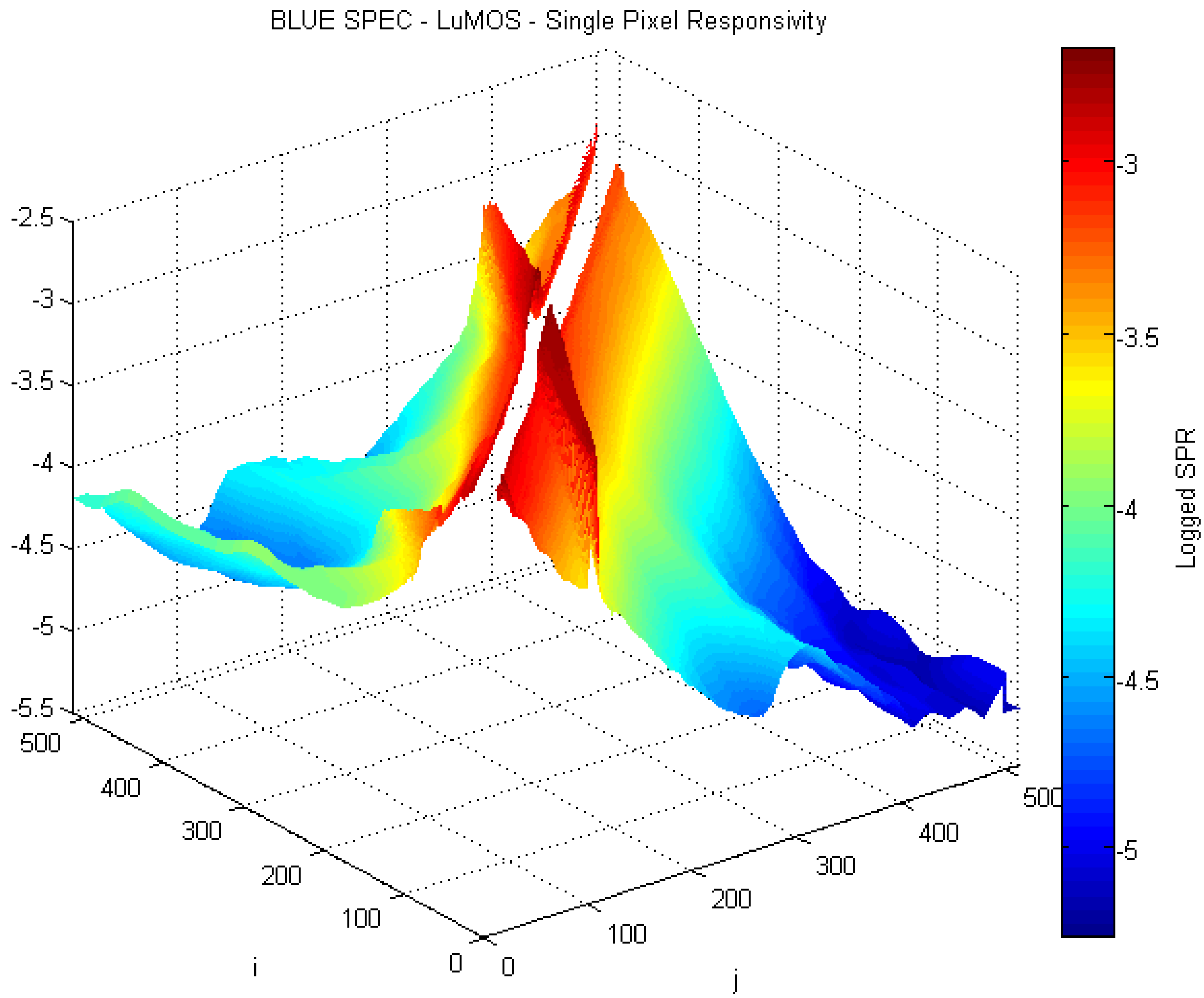


Figure 45

Fig Cap: **Blue spectrograph Single Pixel Responsivity for the LuMOS**

```
load MOLUMOS_BSG_RPSPEC_N0801_LASEROBS_080911_1546_PIXEL_P9_Z9.mat
surf(log10(Xdat(:,2:end)));shading flat
xlabel('j');ylabel('i');AH = colorbar;
set(get(AH,'ylabel'),'String','Logged SPR')
title(['BLUE SPEC - LuMOS - Single Pixel Responsivity'],'Interpreter','none')
set(gca,'Position',[0.063796    0.060606    0.77831    0.86439],'Xlim',[0 512],'Ylim',[0 512])
set(gcf,'Position',[440  270  627  528])
```

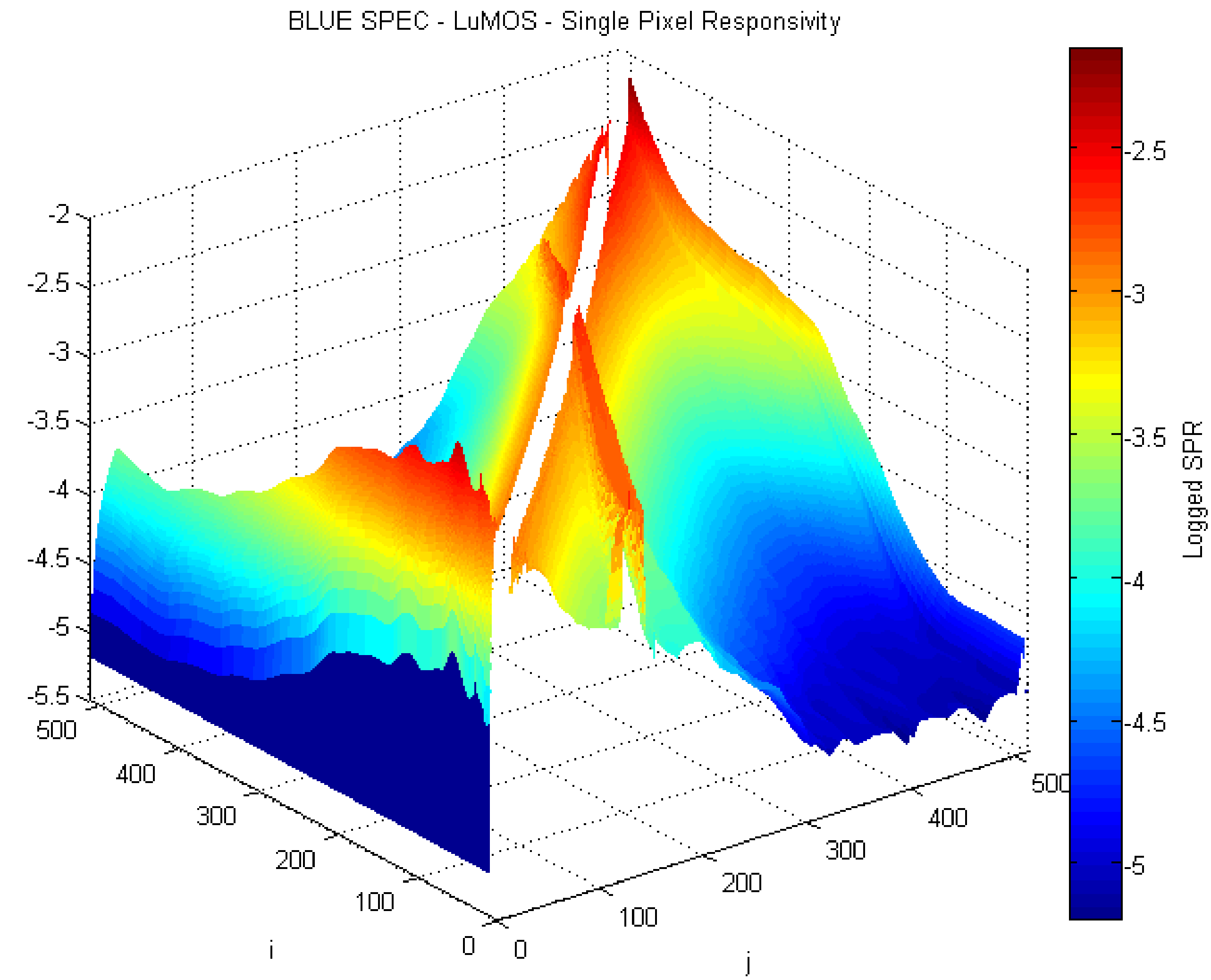


Fig Cap: **Red spectrograph Single Pixel Responsivity for the LuMOS**

```
load MOLUMOS_RSG_RPSPEC_N0801_LASEROBS_081017_1110_PIXEL_P9_Z9.mat
surf(log10(Xdat(:,2:end)));shading flat
xlabel('j');ylabel('i');AH = colorbar;
set(get(AH,'ylabel'),'String','Logged SPR')
title(['BLUE SPEC - LuMOS - Single Pixel Responsivity'],'Interpreter','none')
set(gca,'Position',[0.063796    0.060606     0.77831     0.86439],'Xlim',[0 512],'Ylim',[0 512])
set(gcf,'Position',[440  270  627  528])
```

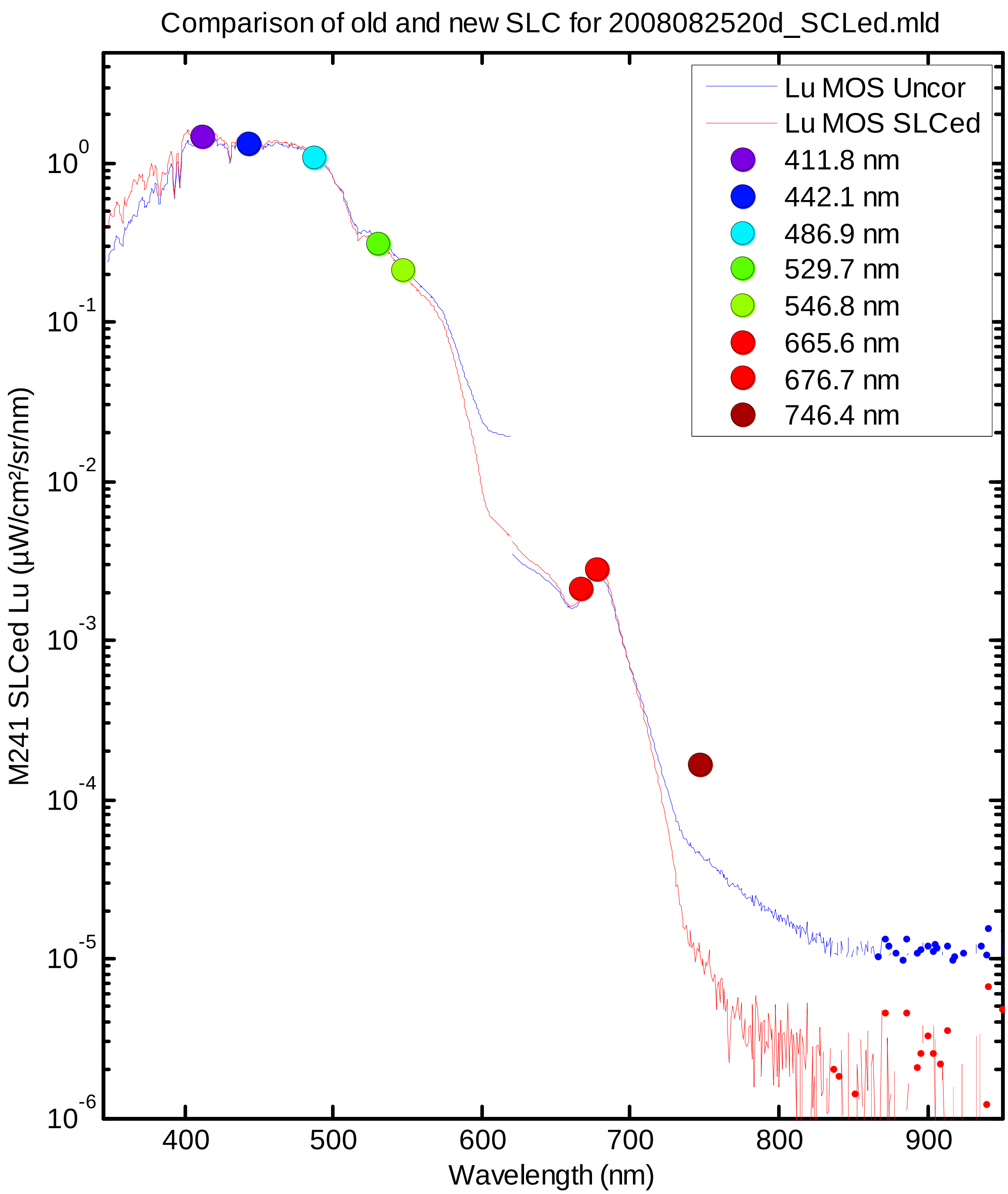


Figure 47

MOBY data SLCed, the red line shows the corrected and blue line uncorrected data.

There are no validation data for LuMOS was collected at NIST. Mike did collected colored source data in Hawaii once MOS was back.

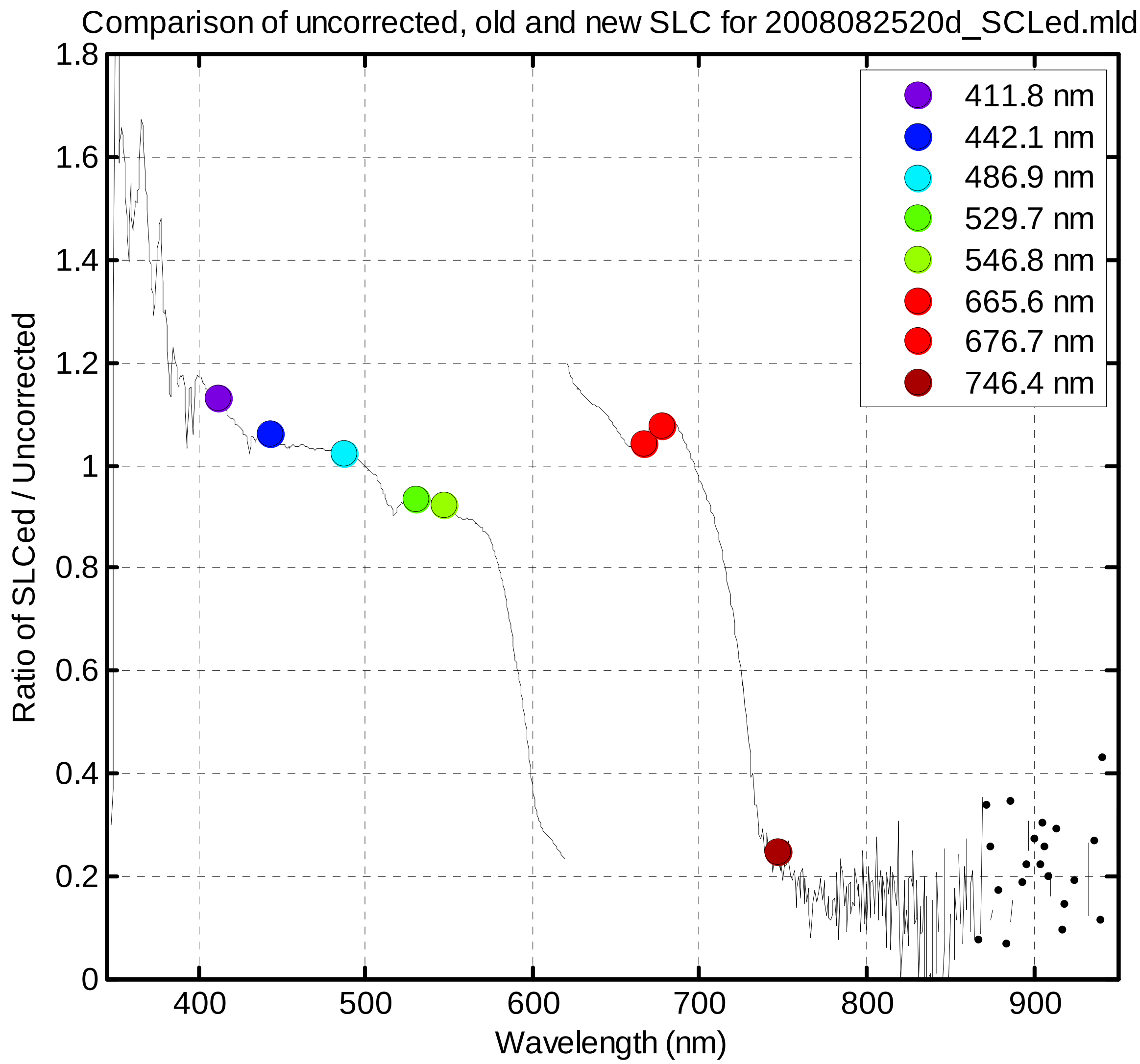


Figure 48

Fig. Cap: Ratio showing the change in the LuMOS after Straylight corrections have been applied.

MODIS-Terra Bands for the LuMOS data shown above								
Bands	8	9	10	11	12	13	14	15
Wavelength	411.8	442.1	486.9	529.7	546.8	665.6	676.7	746.4
% Diff of Old/Uncor	13.39	6.44	2.68	-6.27	-7.47	4.61	7.81	-75.02

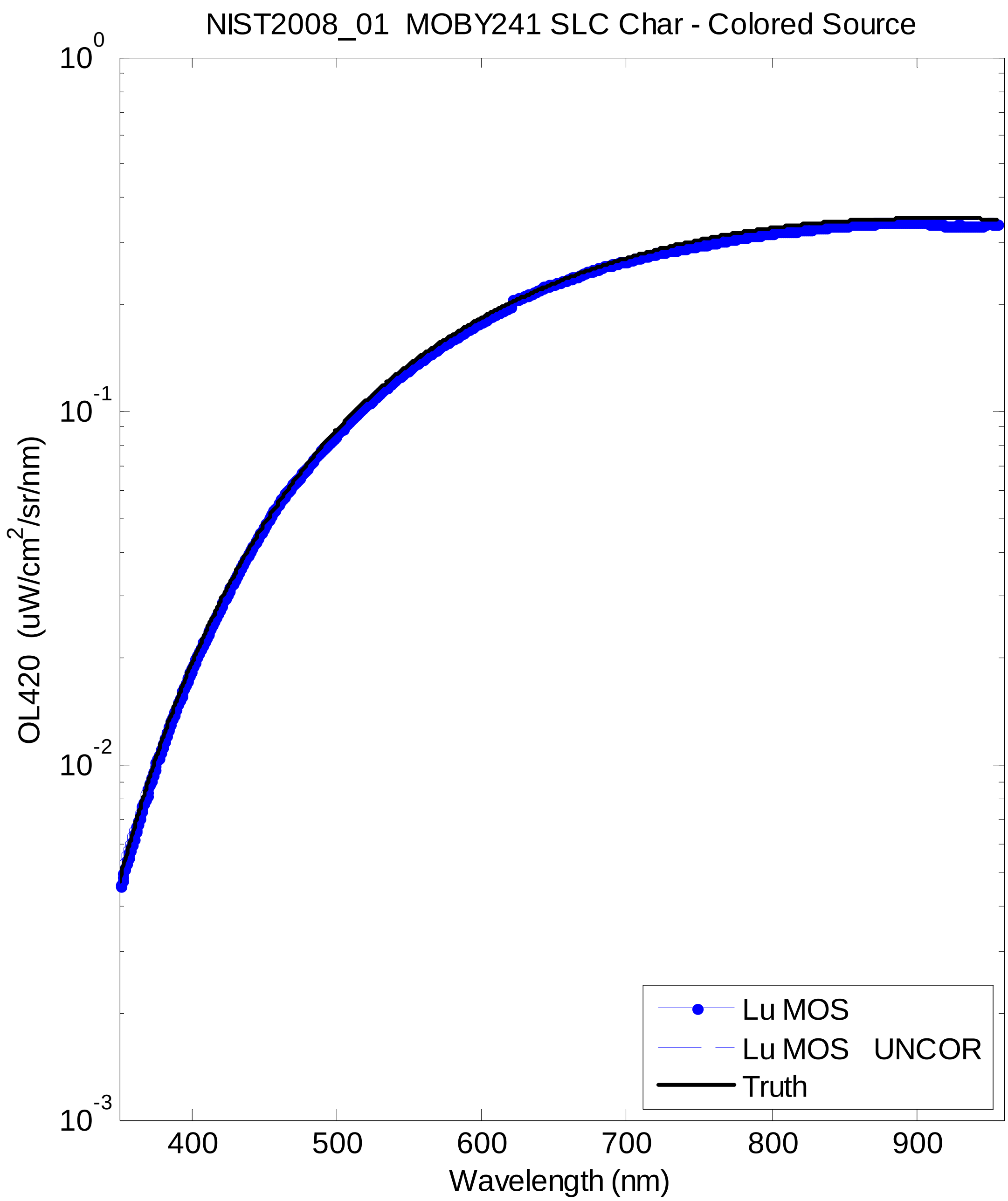


Figure 49

Fig. Cap: Comparison of SLC LuMOS verse Nist Lamp values and LuMOS uncorrected data. These are data collected by Mike once MOBY was back in Hawaii.

Cd C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\preL159_LuMOS_CS
pltvaldata_(1)

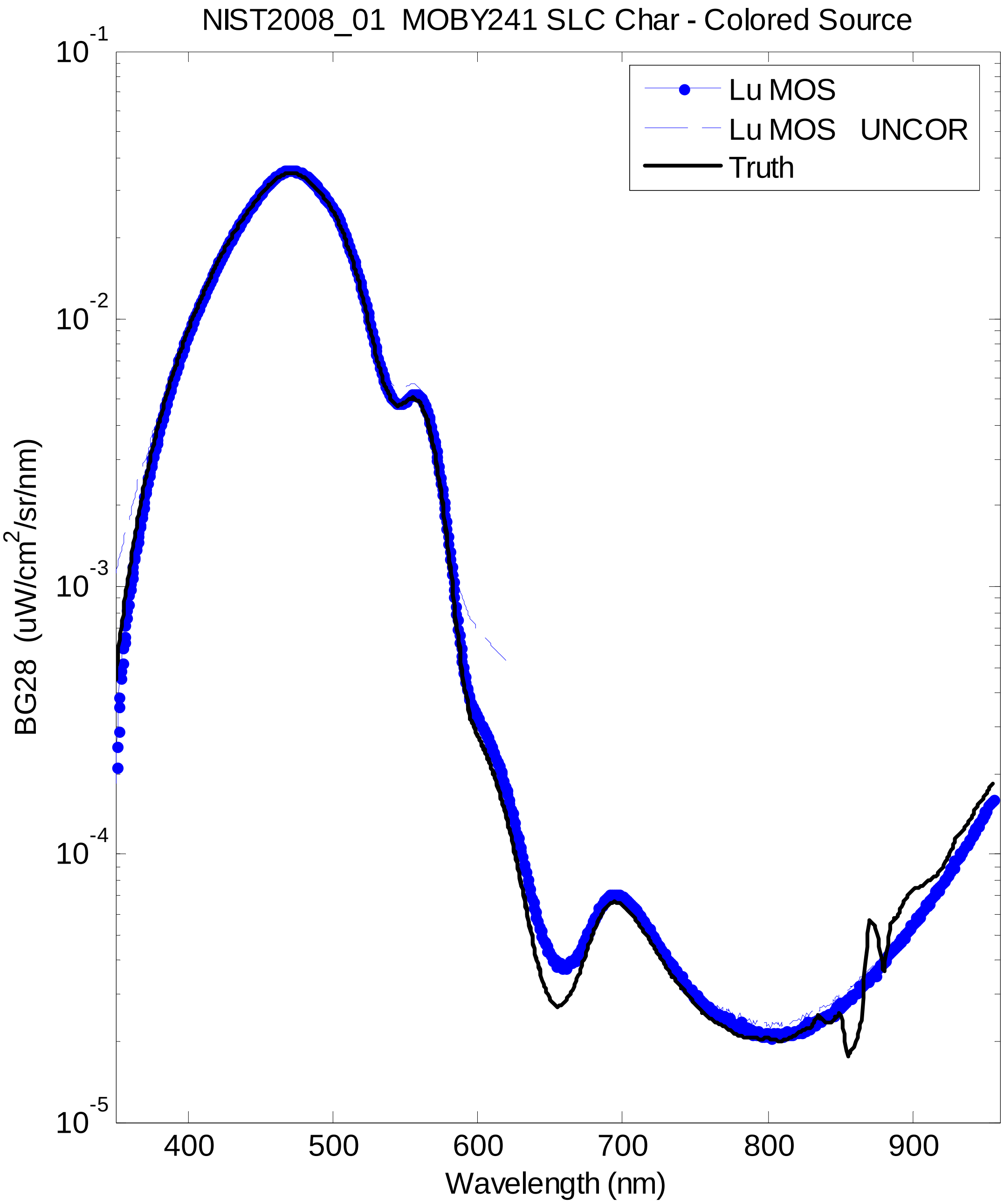


Figure 50

Fig. Cap: Comparison of SLC LuMOS verse Nist Lamp values and LuMOS uncorrected data

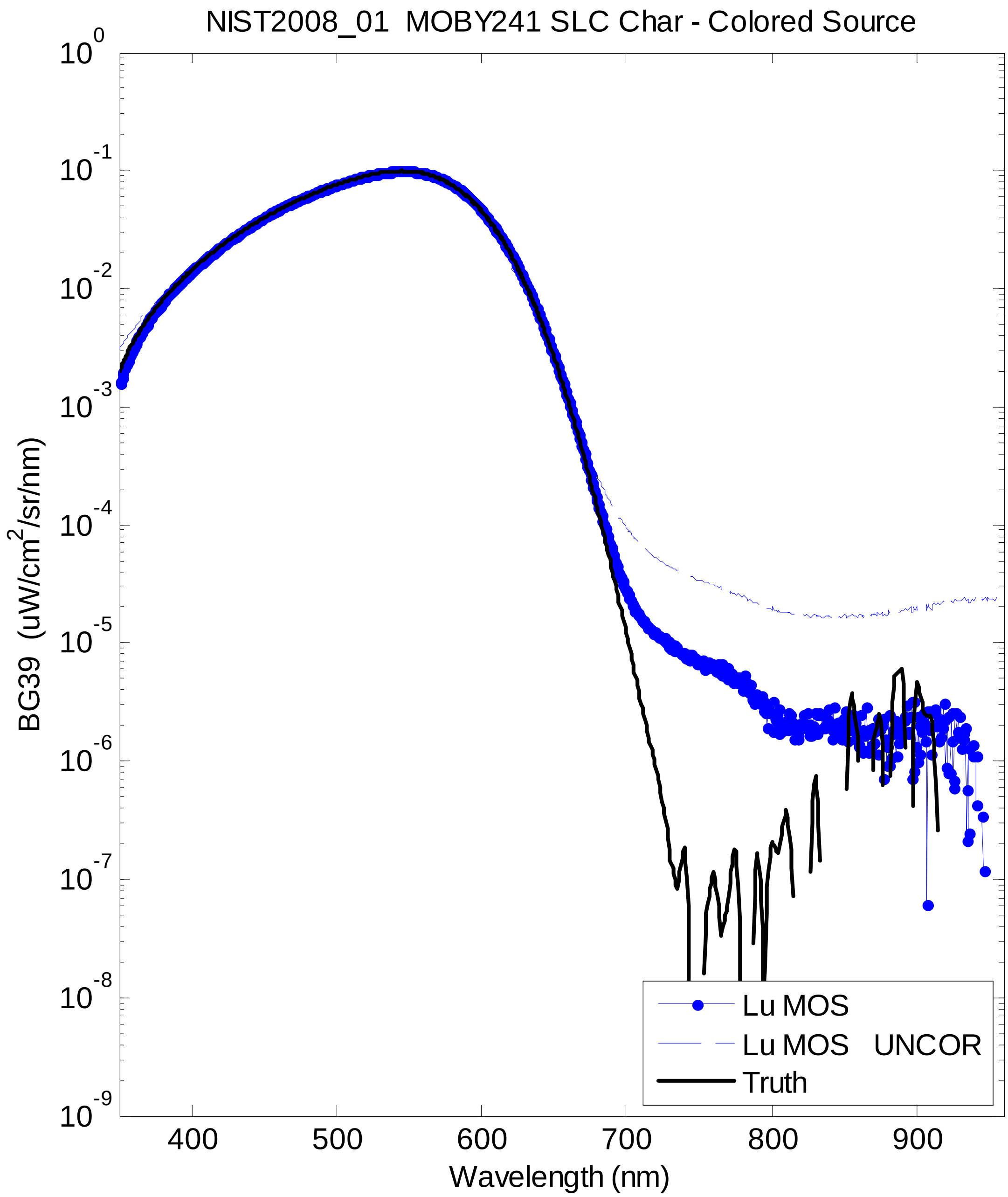


Figure 51

Fig. Cap: Comparison of SLC LuMOS verse Nist Lamp values and LuMOS uncorrected data

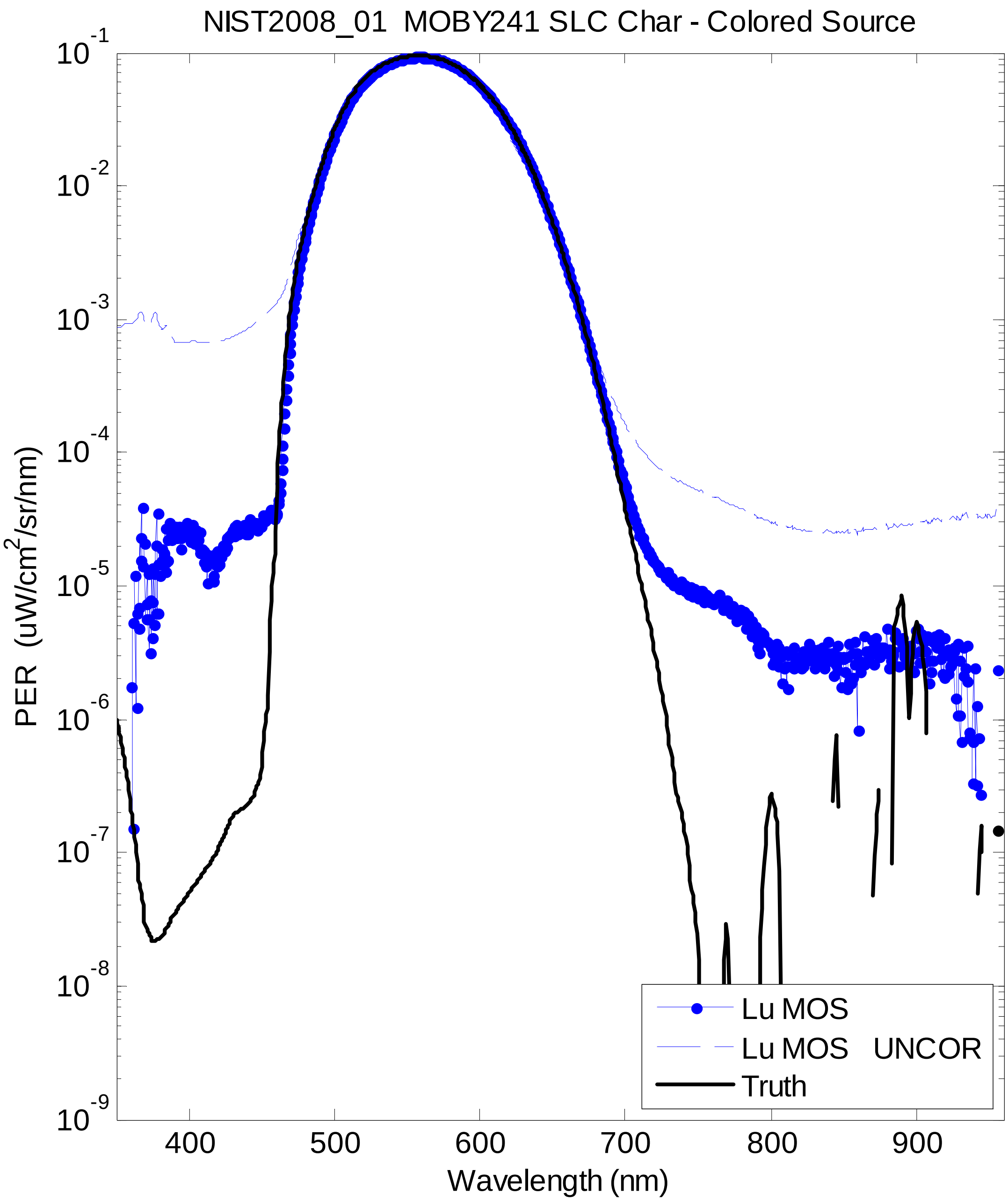


Figure 52

Fig. Cap: Comparison of SLC LuMOS verse Nist Lamp values and LuMOS uncorrected data

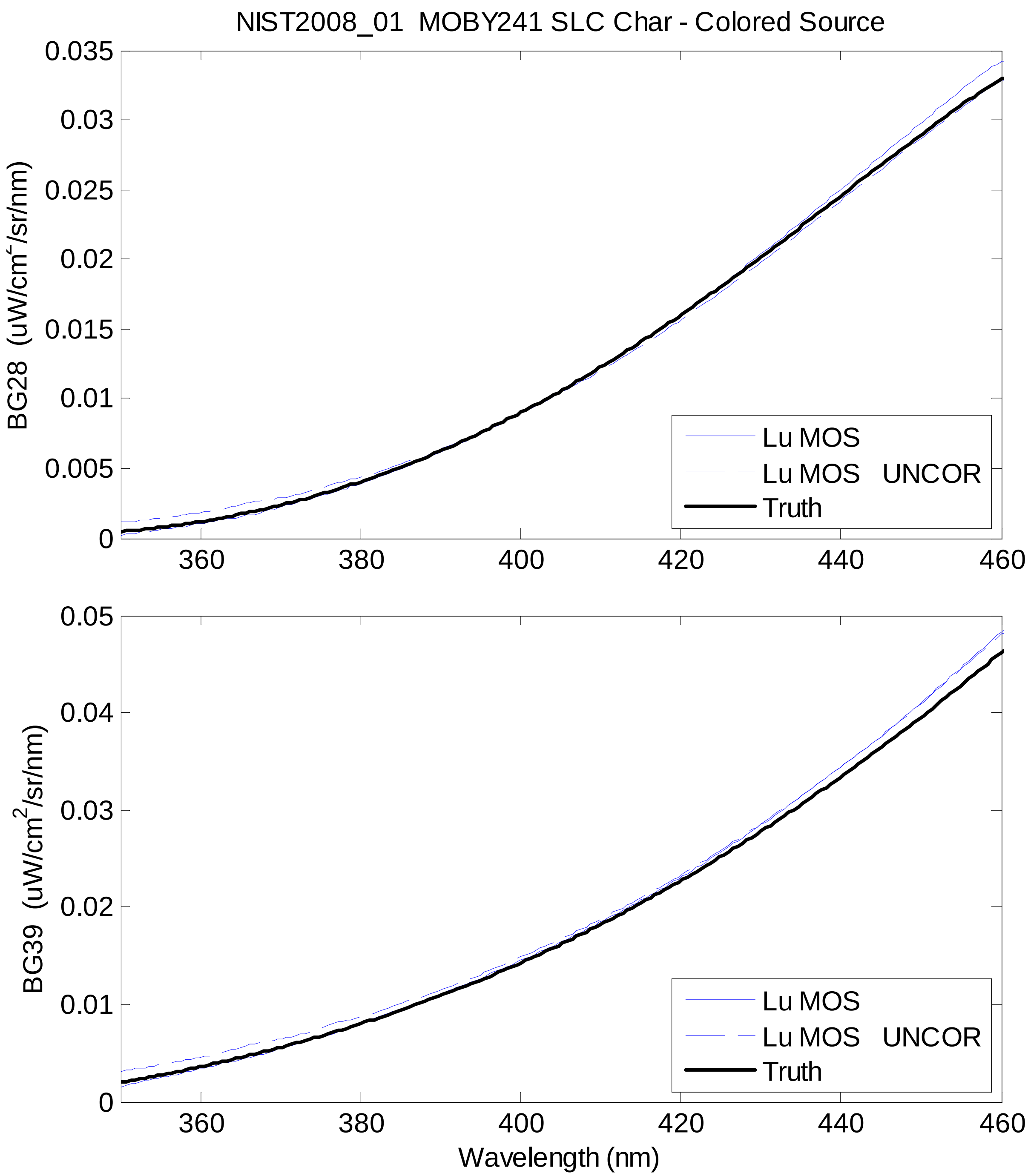
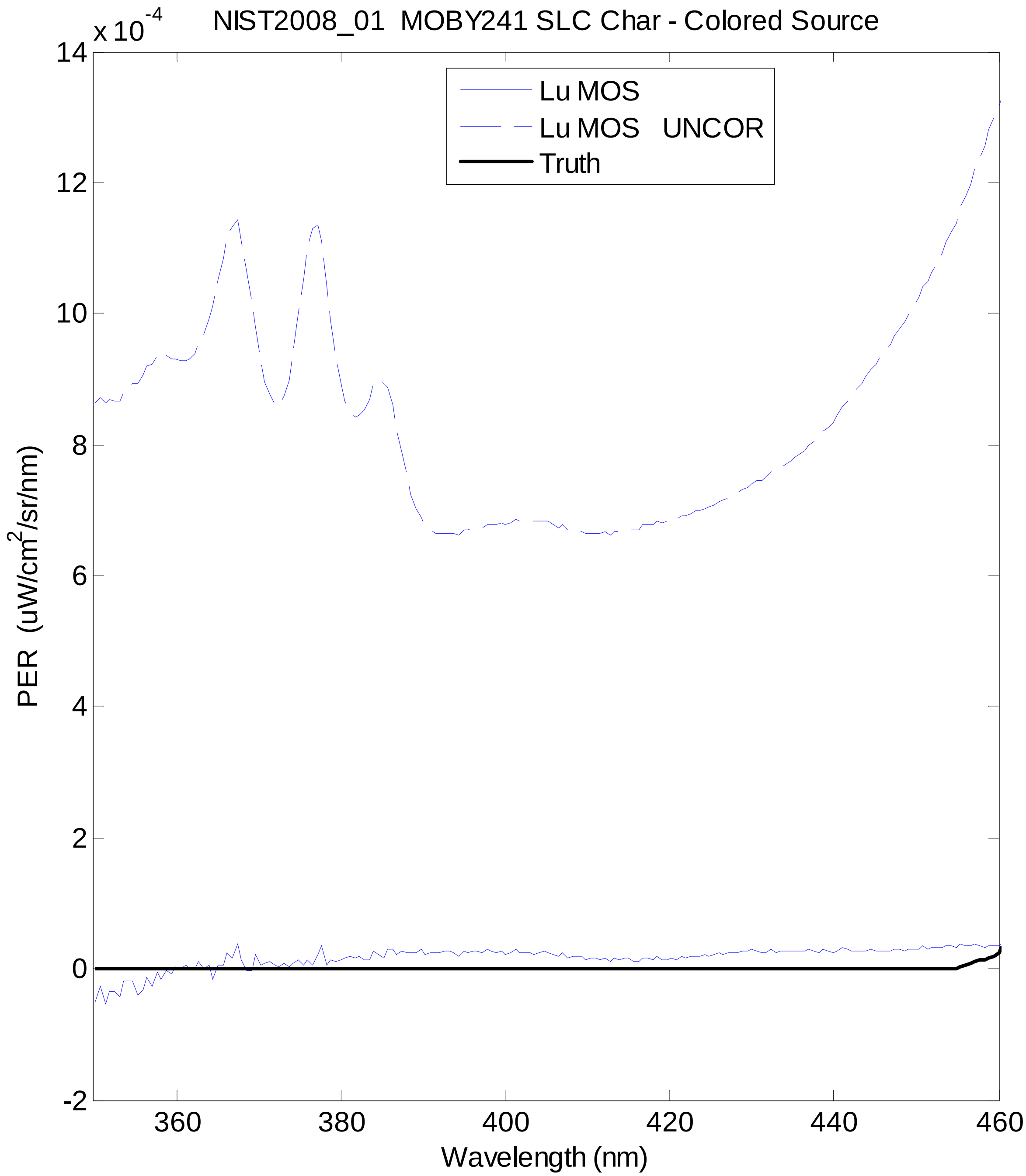


Figure 53

Fig. Cap: Linear zoomed in view of UV section of comparison of SLC LuMOS verse Nist Lamp values and LuMOS uncorrected data

Cd C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\preL159_LuMOS_CS
pltvaldata_2)



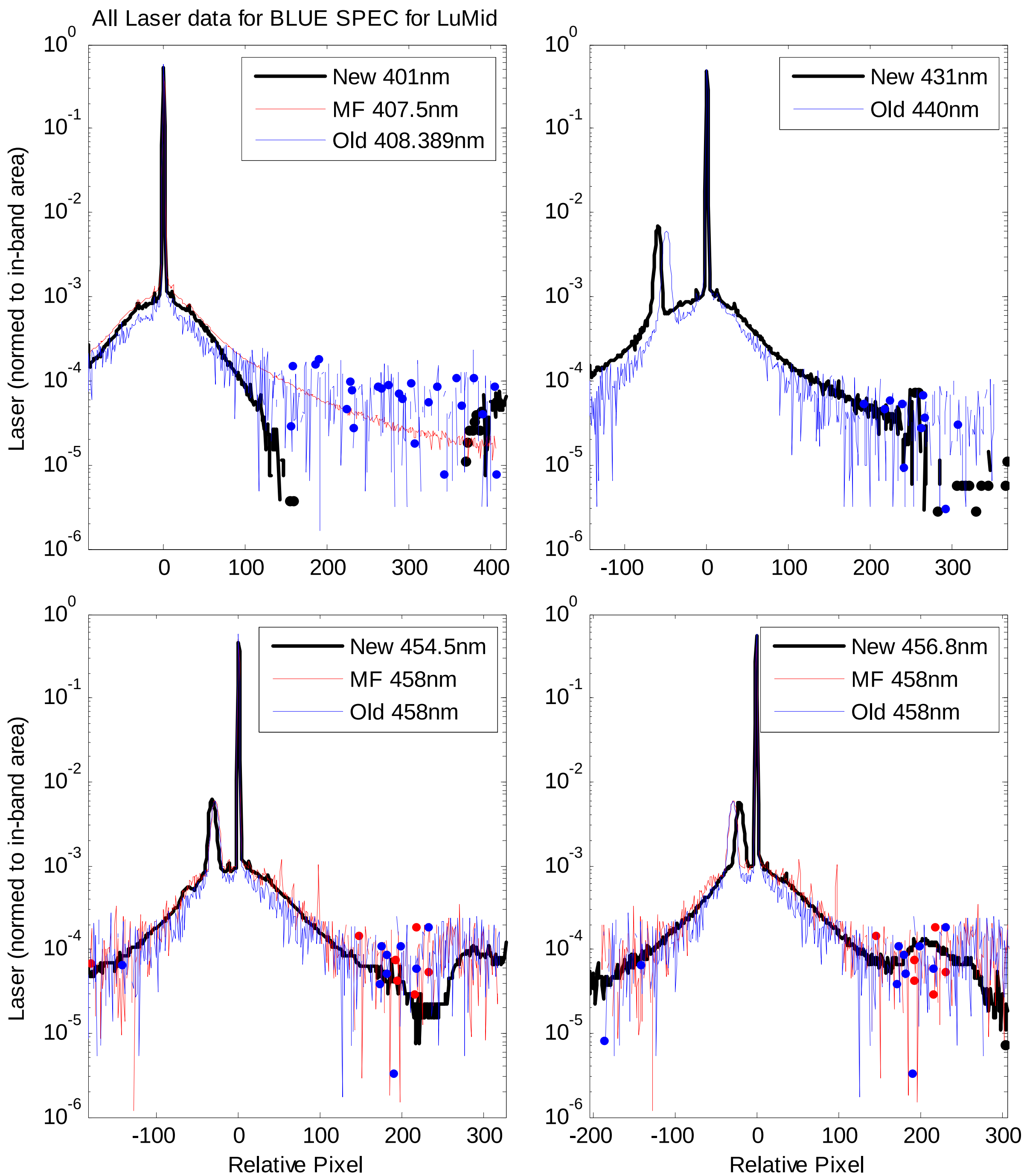
NIST2008_01 MOBY241 SLC Char - Colored Source
x 10^-4
Lu MOS
Lu MOS UNCOR
Truth
PER (uW/cm^2/sr/nm)
Wavelength (nm)
14
12
10
8
6
4
2
0
-2
360
380
400
420
440
460

Figure 54

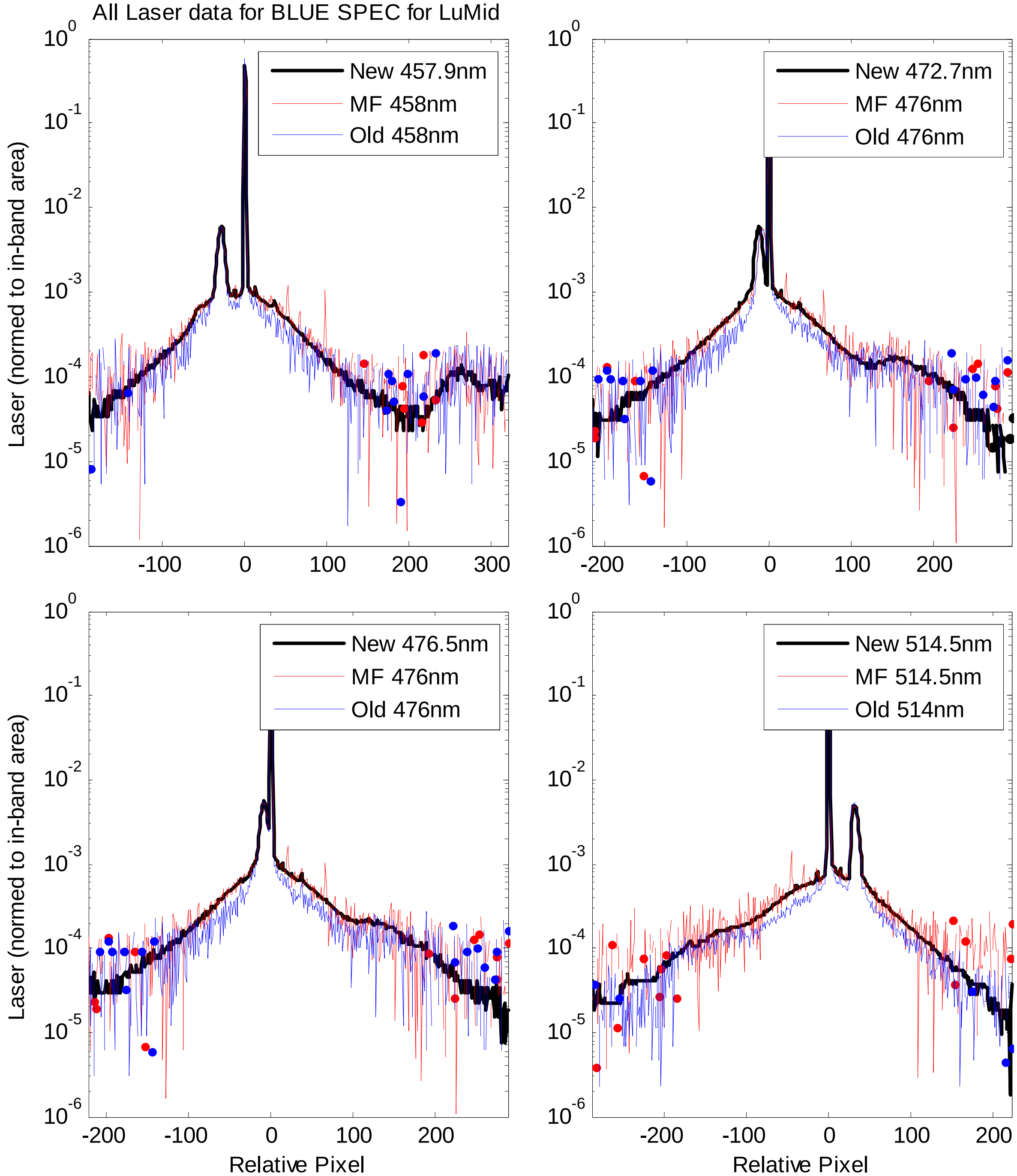
Comparison of NIST0801, Mikes Hawaii data and the Laser dat collected on M217 and 19

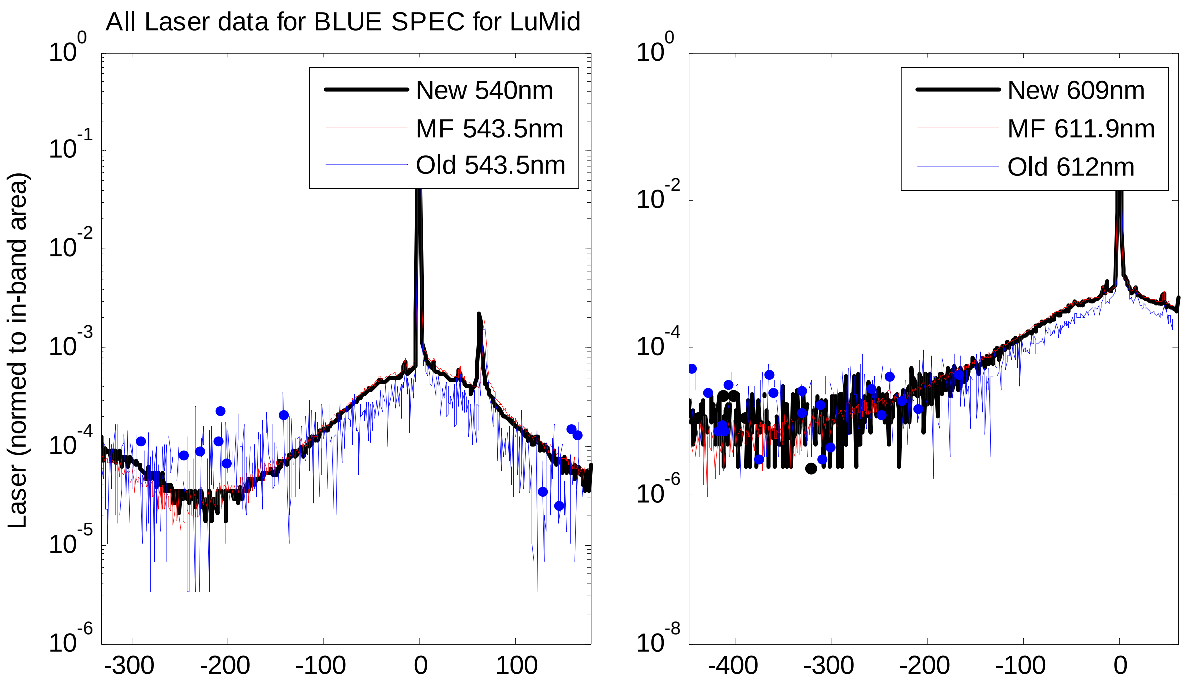
The following graphs show the comparison of the New (NIST 2008 01 data), MF (Mikes data taken a month or 2 before the nist data) and Old the M217 and 219 data taken in 2001 and 2002.

Table of the laser shown in the following LuMid laser comparisons New = NIST2008_01 laser data, MF - Mike's data a few months before, and Old = traveling sircus from 2002					
SPEC	**fig#**	**New λ**	**New laser**	**Mike laser**	**Old Laser**
BSG	1	401	Doubled Ti-Saphire	Discrete Lasers	Doubled Ti-Saphire
BSG	1	431	Doubled Ti-Saphire		Diode Laser
BSG	1	454.5	Argon Ion Laser	Argon Ion Laser	Argon Ion Laser
BSG	1	456.8	Argon Ion Laser	Argon Ion Laser	Argon Ion Laser
BSG	2	457.9	Argon Ion Laser	Argon Ion Laser	Argon Ion Laser
BSG	2	472.7	Argon Ion Laser	Argon Ion Laser	Argon Ion Laser
BSG	2	476.5	Argon Ion Laser	Argon Ion Laser	Argon Ion Laser
BSG	2	514.5	Argon Ion Laser	Argon Ion Laser	Argon Ion Laser
BSG	3	540	Coumarin	HeNe Laser	HeNe Laser
BSG	3	609	DCM Dye	HeNe Laser	HeNe Laser
RSG	4	609	DCM Dye	HeNe Laser	HeNe Laser
RSG	4	660	DCM Dye	HeNe Laser	Diode Laser
RSG	4	660	DCM Dye	Discrete Lasers	Diode Laser
RSG	4	705	Ti-Saphire Laser		Ti-Saphire Laser
RSG	5	705	Ti-Saphire Laser		Ti-Saphire Laser
RSG	5	745	Ti-Saphire Laser		Ti-Saphire Laser
RSG	5	745	Ti-Saphire Laser		Ti-Saphire Laser
RSG	5	745	Ti-Saphire Laser		Ti-Saphire Laser
RSG	6	745	Ti-Saphire Laser		Ti-Saphire Laser
RSG	6	776	Ti-Saphire Laser	Discrete Lasers	Ti-Saphire Laser
RSG	6	776	Ti-Saphire Laser	Discrete Lasers	Ti-Saphire Laser

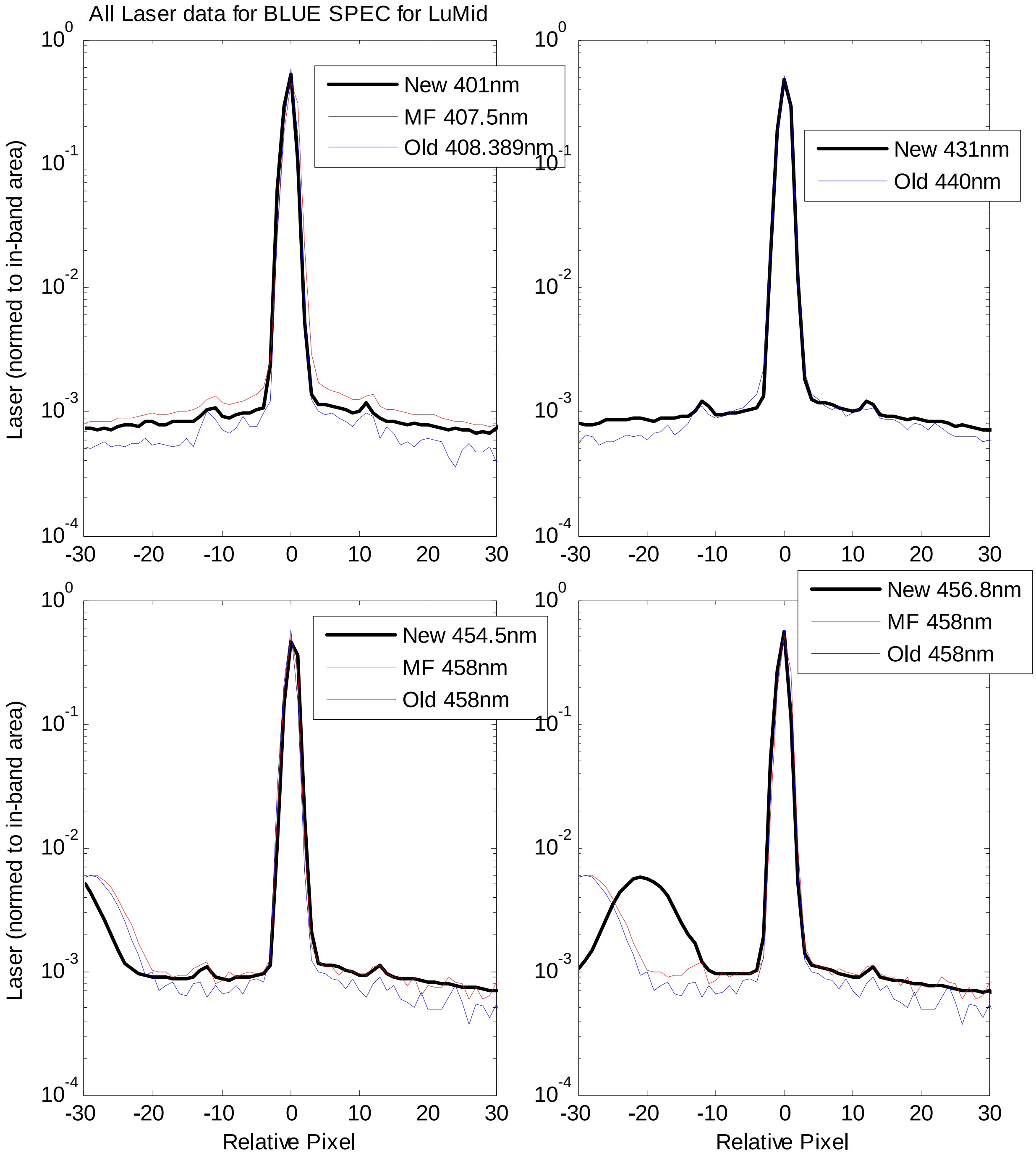


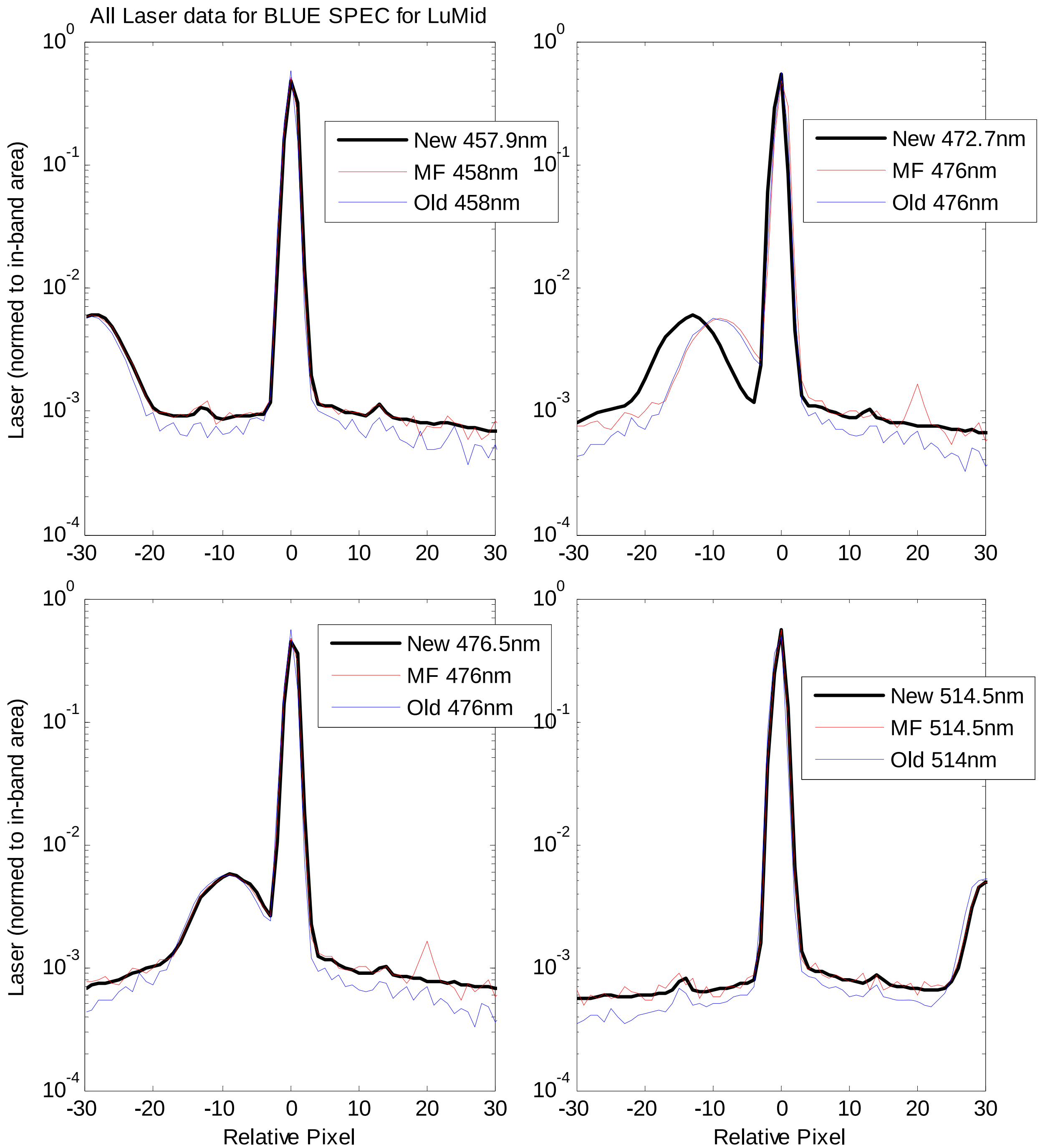
All Laser data for BLUE SPEC for LuMid
Laser (normed to in-band area)
New 401nm
MF 407.5nm
Old 408.389nm
New 431nm
Old 440nm
New 454.5nm
MF 458nm
Old 458nm
New 456.8nm
MF 458nm
Old 458nm
Relative Pixel
Relative Pixel


All Laser data for BLUE SPEC for LuMid
Laser (normed to in-band area)
Relative Pixel
New 457.9nm
MF 458nm
Old 458nm
New 472.7nm
MF 476nm
Old 476nm
New 476.5nm
MF 476nm
Old 476nm
New 514.5nm
MF 514.5nm
Old 514nm

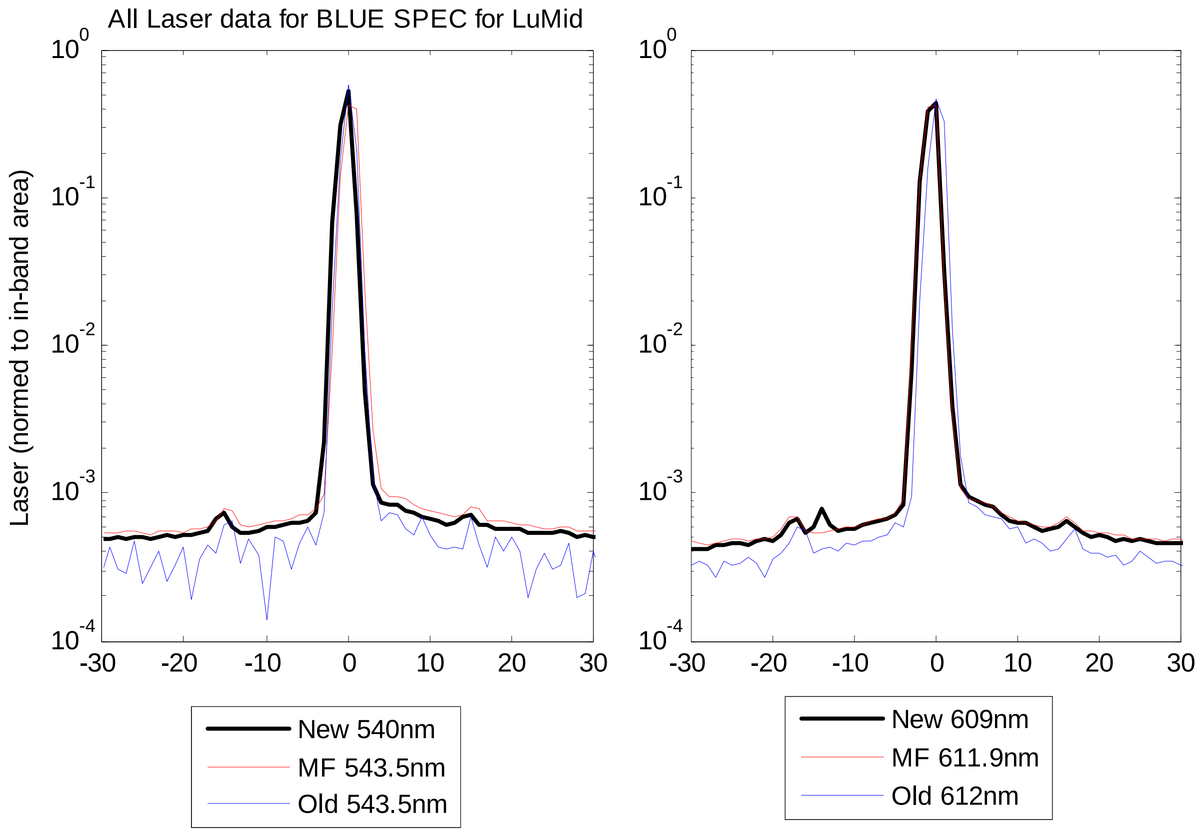

All Laser data for BLUE SPEC for LuMid
Laser (normed to in-band area)
New 540nm
MF 543.5nm
Old 543.5nm
New 609nm
MF 611.9nm
Old 612nm

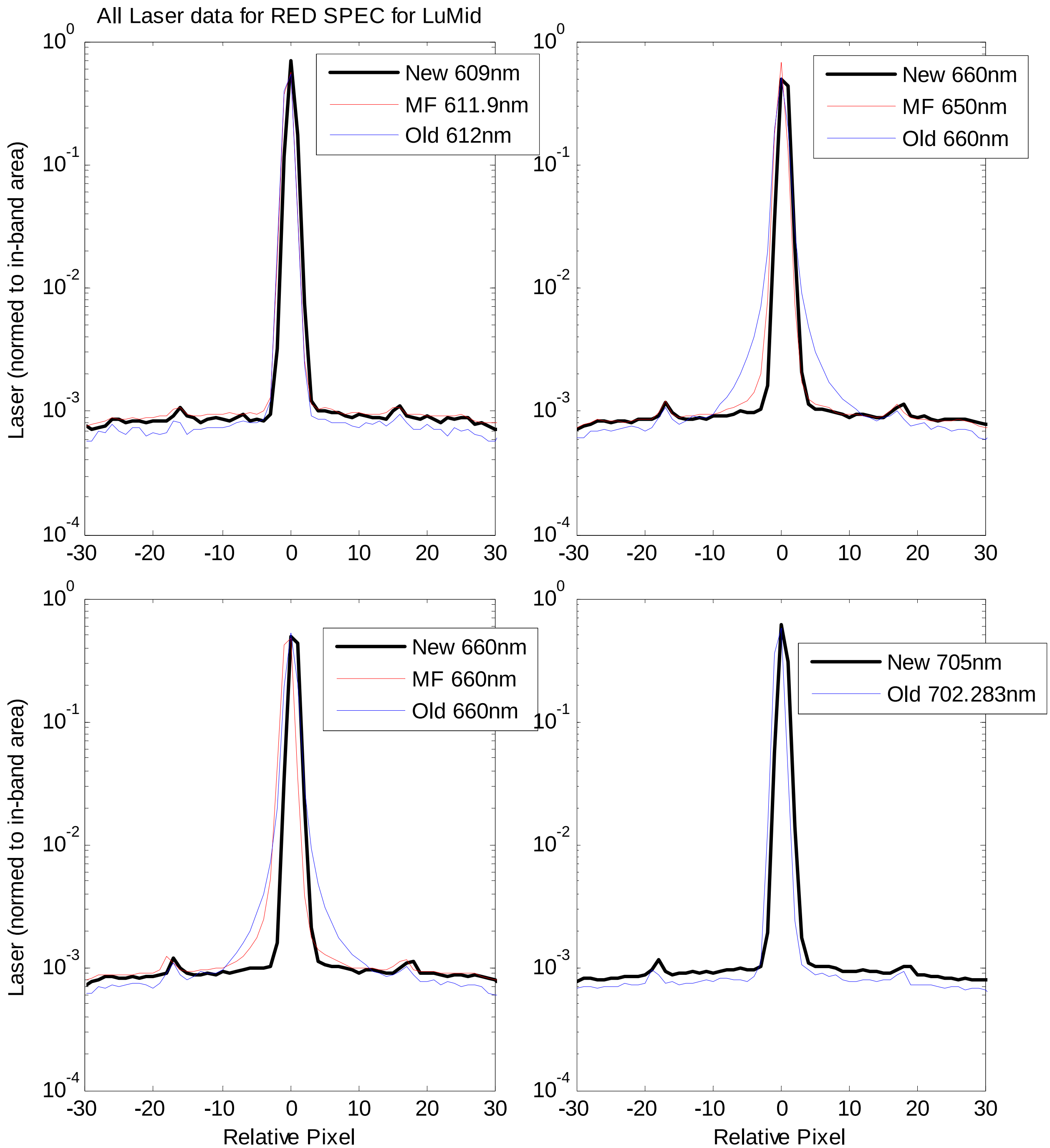
Zoomed in view of the same graphs

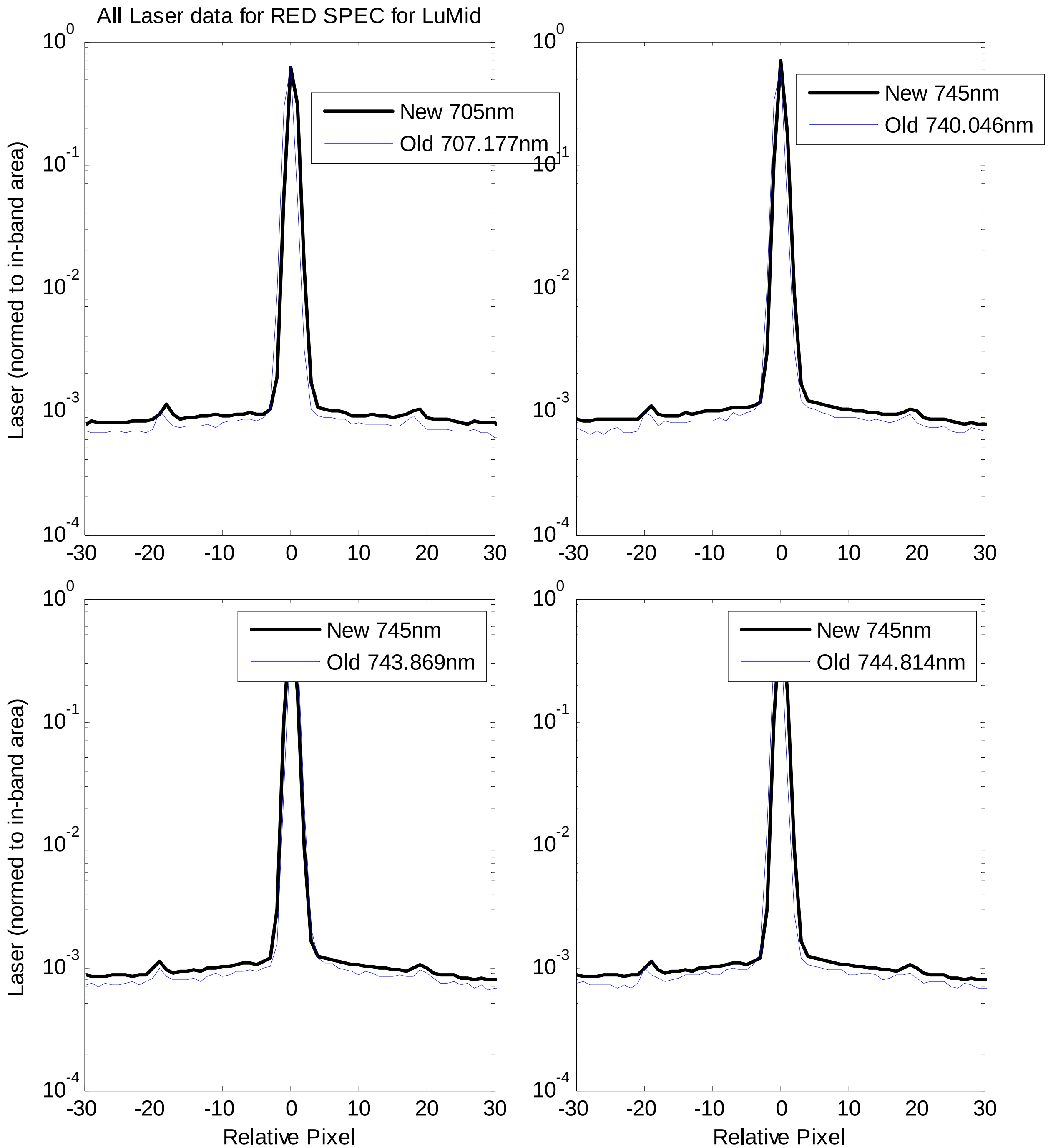


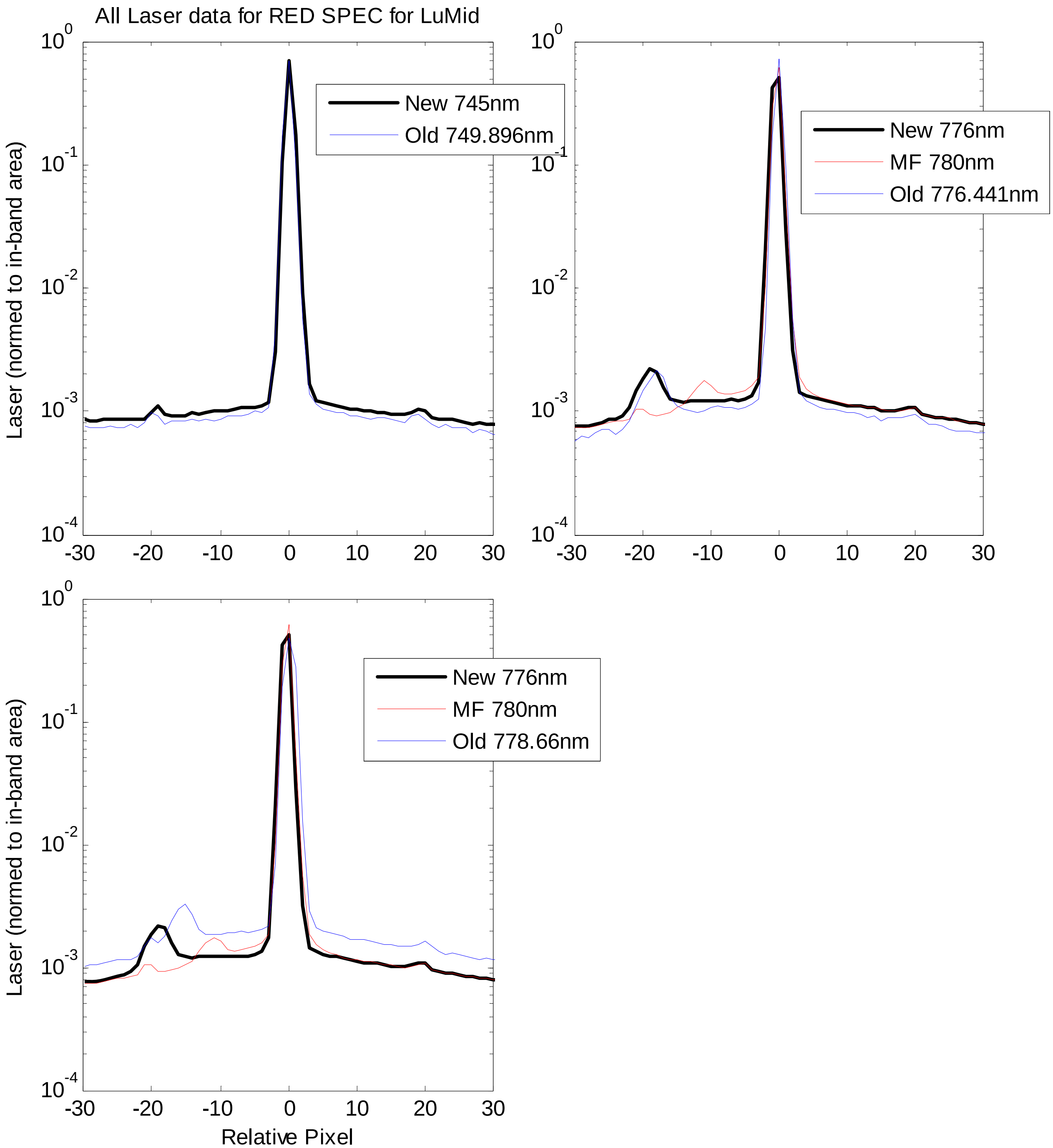


All Laser data for BLUE SPEC for LuMid
Laser (normed to in-band area)
New 457.9nm
MF 458nm
Old 458nm
New 472.7nm
MF 476nm
Old 476nm
New 476.5nm
MF 476nm
Old 476nm
New 514.5nm
MF 514.5nm
Old 514nm
Relative Pixel

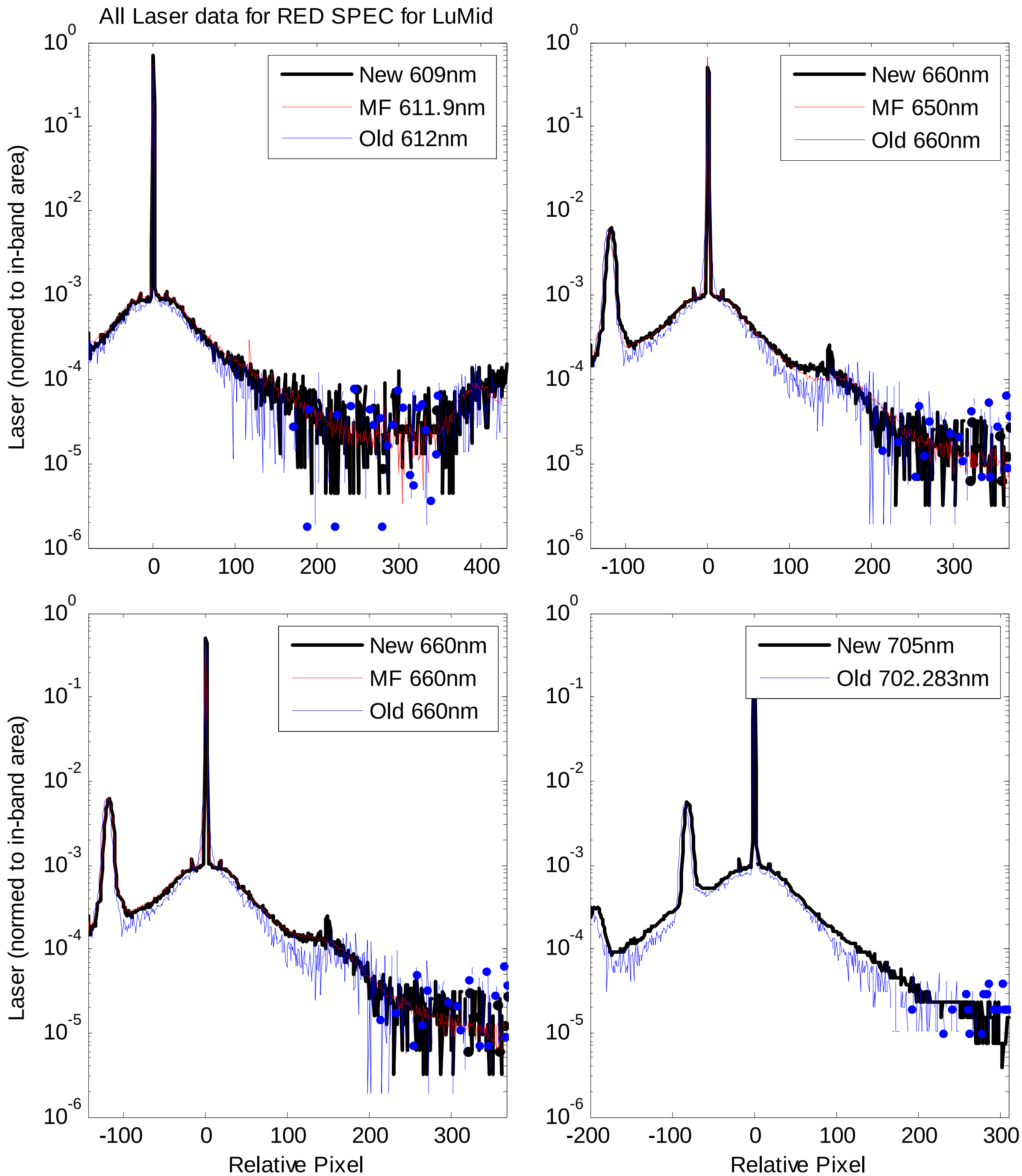

All Laser data for BLUE SPEC for LuMid
Laser (normed to in-band area)
10^0
10^-1
10^-2
10^-3
10^-4
-30
-20
-10
0
10
20
30
New 540nm
MF 543.5nm
Old 543.5nm
New 609nm
MF 611.9nm
Old 612nm

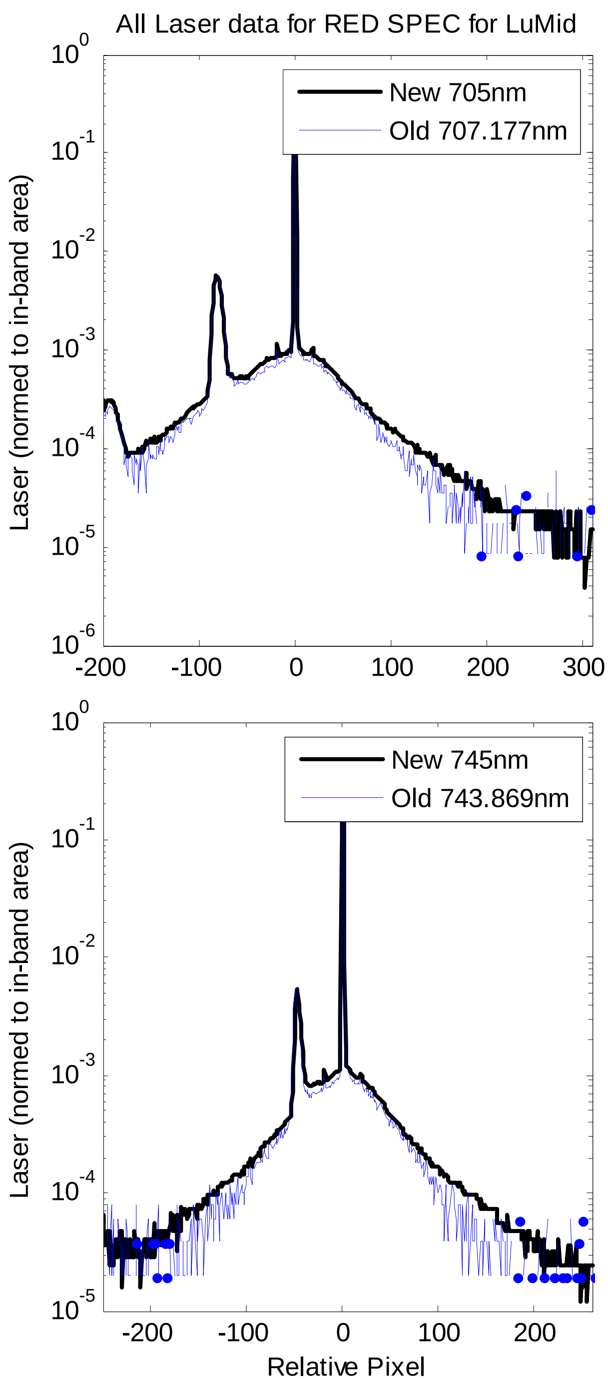

All Laser data for RED SPEC for LuMid
Laser (normed to in-band area)
New 609nm
MF 611.9nm
Old 612nm
New 660nm
MF 650nm
Old 660nm
New 660nm
MF 660nm
Old 660nm
New 705nm
Old 702.283nm
Relative Pixel
Relative Pixel


All Laser data for RED SPEC for LuMid
Laser (normed to in-band area)
New 705nm
Old 707.177nm
New 745nm
Old 740.046nm
New 745nm
Old 743.869nm
New 745nm
Old 744.814nm
Relative Pixel
Relative Pixel



All Laser data for RED SPEC for LuMid
Laser (normed to in-band area)
New 745nm
Old 749.896nm
New 776nm
MF 780nm
Old 776.441nm
New 776nm
MF 780nm
Old 778.66nm
Relative Pixel


All Laser data for RED SPEC for LuMid
Laser (normed to in-band area)
New 609nm
MF 611.9nm
Old 612nm
New 660nm
MF 650nm
Old 660nm
New 660nm
MF 660nm
Old 660nm
New 705nm
Old 702.283nm
Relative Pixel
Relative Pixel


All Laser data for RED SPEC for LuMid
Laser (normed to in-band area)
New 705nm
Old 707.177nm
New 745nm
Old 740.046nm
New 745nm
Old 743.869nm
New 745nm
Old 744.814nm
Relative Pixel
Relative Pixel

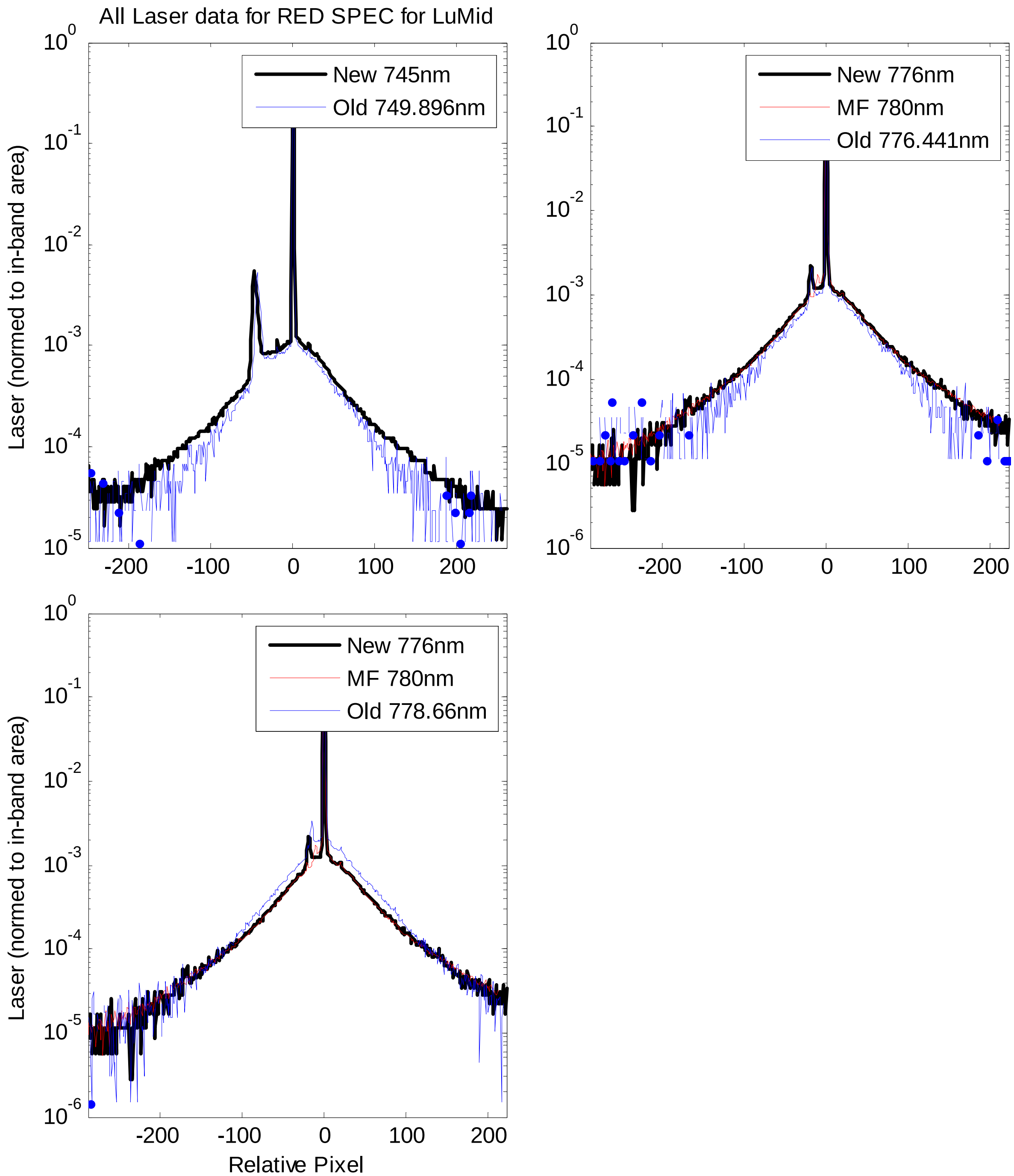
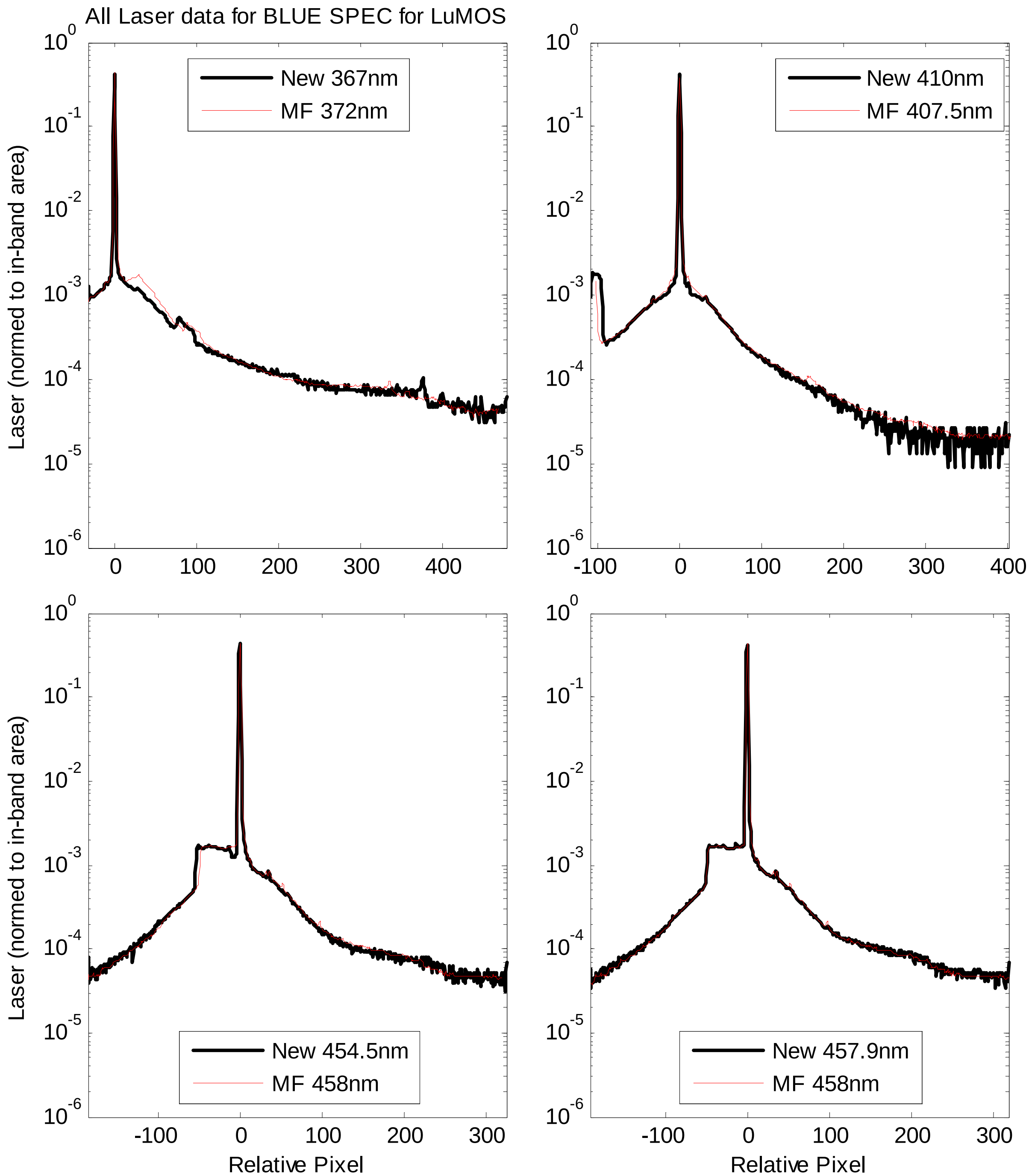
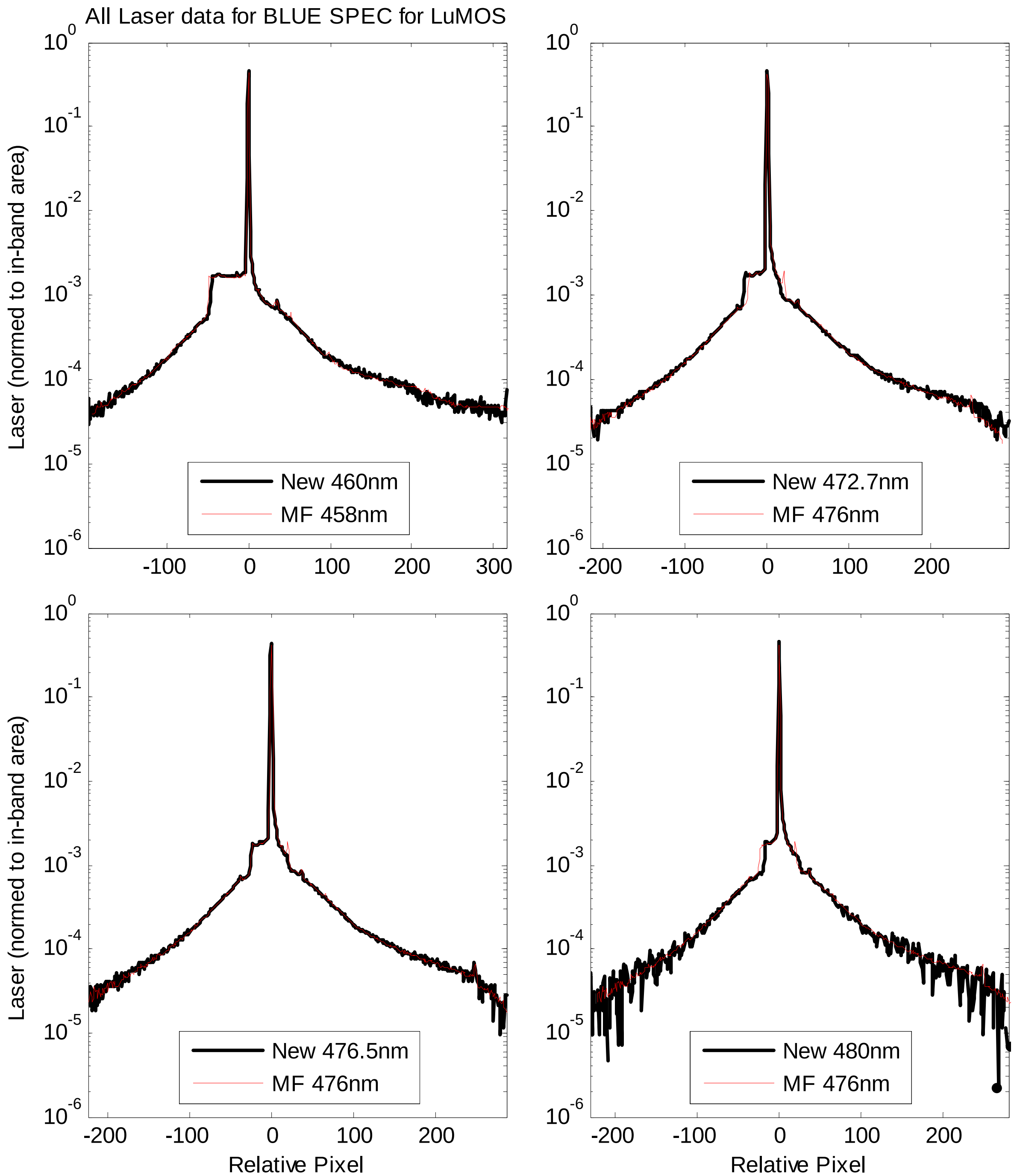

All Laser data for RED SPEC for LuMid
New 745nm
Old 749.896nm
Laser (normed to in-band area)
New 776nm
MF 780nm
Old 776.441nm
New 776nm
MF 780nm
Old 778.66nm
Relative Pixel

Table of the laser shown in the following **LuMOS laser comparisons**
New = NIST2008_01 laser data, MF - Mike's data a few months before, and Old = traveling sircus from 2002

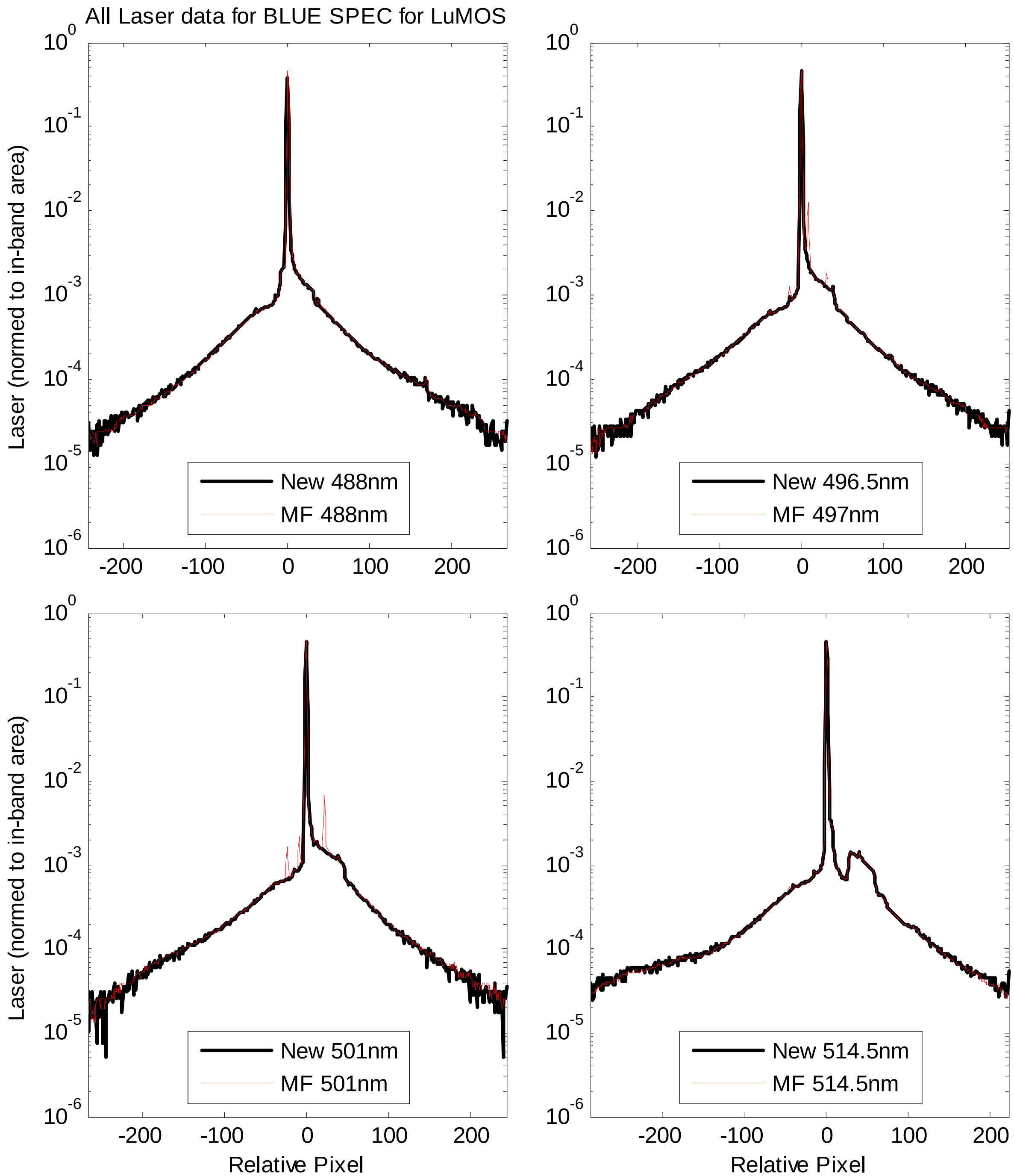
SPEC	**fig#**	**New λ**	**New laser**	**MF laser**	**Old Laser**
BSG	1	367	Doubled Ti-Saphire	Discrete Lasers	
BSG	1	410	Doubled Ti-Saphire	Discrete Lasers	
BSG	1	454.5	Argon Ion Laser	Argon Ion Laser	
BSG	1	457.9	Argon Ion Laser	Argon Ion Laser	
BSG	2	460	Doubled Ti-Saphire	Argon Ion Laser	
BSG	2	472.7	Argon Ion Laser	Argon Ion Laser	
BSG	2	476.5	Argon Ion Laser	Argon Ion Laser	
BSG	2	480	Doubled Ti-Saphire	Argon Ion Laser	
BSG	3	488	Argon Ion Laser	Argon Ion Laser	
BSG	3	496.5	Argon Ion Laser	Argon Ion Laser	
BSG	3	501	Argon Ion Laser	Argon Ion Laser	
BSG	3	514.5	Argon Ion Laser	Argon Ion Laser	
BSG	4	515.2	Coumarin	Argon Ion Laser	
BSG	4	545.2	Coumarin	HeNe Laser	
BSG	4	595	R6G Dye Laser	HeNe Laser	
BSG	4	605	R6G Dye Laser	HeNe Laser	
BSG	5	614.5	DCM Dye	HeNe Laser	
BSG	5	634.85	DCM Dye	HeNe Laser	
RSG	6	595	R6G Dye Laser	HeNe Laser	
RSG	6	605	R6G Dye Laser	HeNe Laser	
RSG	6	614.5	DCM Dye	HeNe Laser	
RSG	6	634.85	DCM Dye	HeNe Laser	
RSG	7	645.5	DCM Dye	Discrete Lasers	
RSG	7	655.3	DCM Dye	Discrete Lasers	
RSG	7	665.6	DCM Dye	Discrete Lasers	
RSG	7	671.4	DCM Dye	Discrete Lasers	
RSG	8	688	DCM Dye	Discrete Lasers	
RSG	8	695	Ti-Saphire Laser	Discrete Lasers	

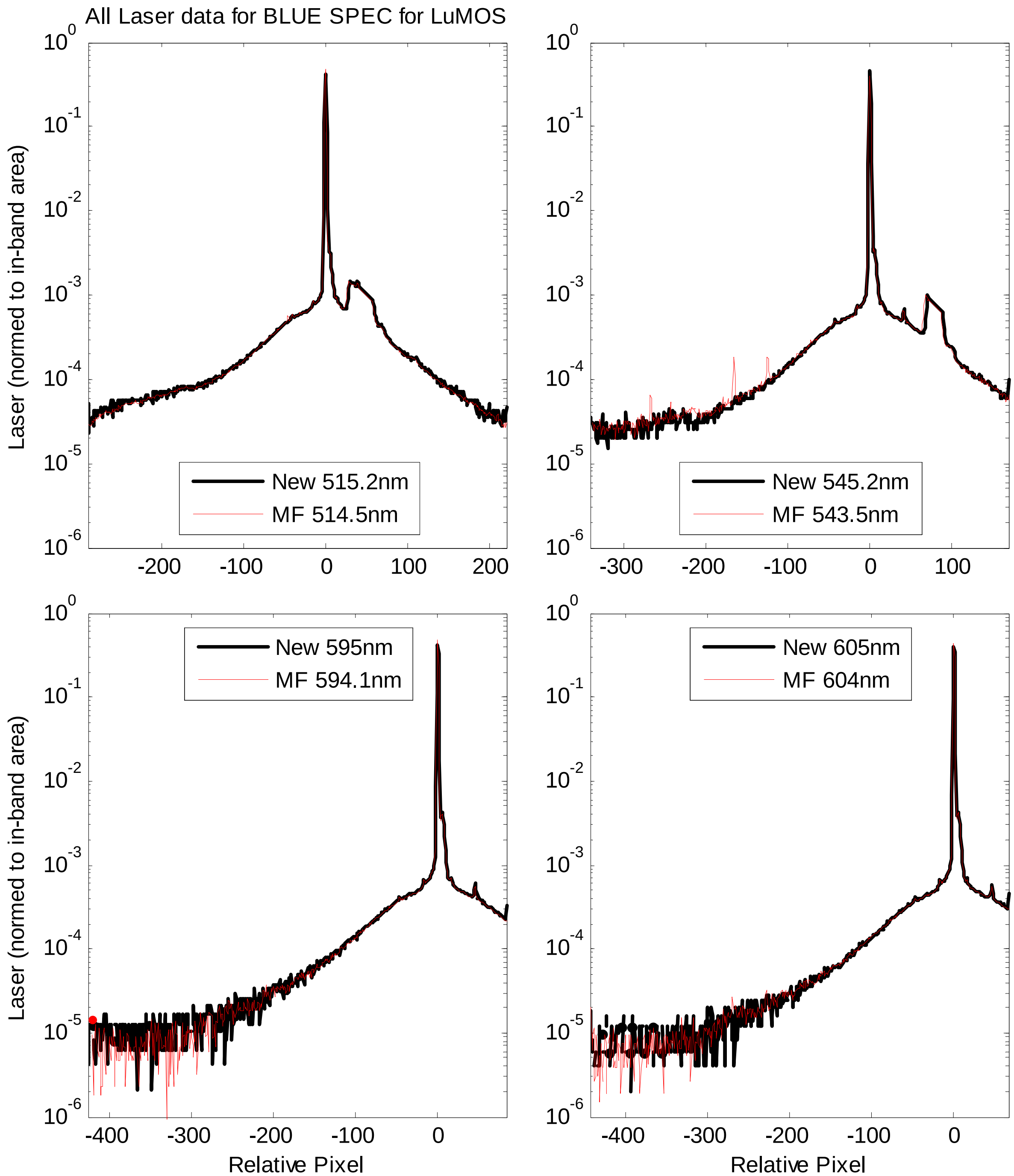
RSG	8	775	Ti-Saphire Laser	Discrete Lasers	Ti-Saphire Laser
RSG	8	780	Ti-Saphire Laser	Discrete Lasers	Ti-Saphire Laser
RSG	9	785	Ti-Saphire Laser	Discrete Lasers	Ti-Saphire Laser
RSG	9	805	Ti-Saphire Laser	Discrete Lasers	Ti-Saphire Laser
RSG	9	810	Ti-Saphire Laser	Discrete Lasers	Ti-Saphire Laser
RSG	9	850	Ti-Saphire Laser	Discrete Lasers	Ti-Saphire Laser
RSG	10	900	Ti-Saphire Laser	Discrete Lasers	
RSG	10	910	Ti-Saphire Laser	Discrete Lasers	
RSG	10	920	Ti-Saphire Laser	Discrete Lasers	

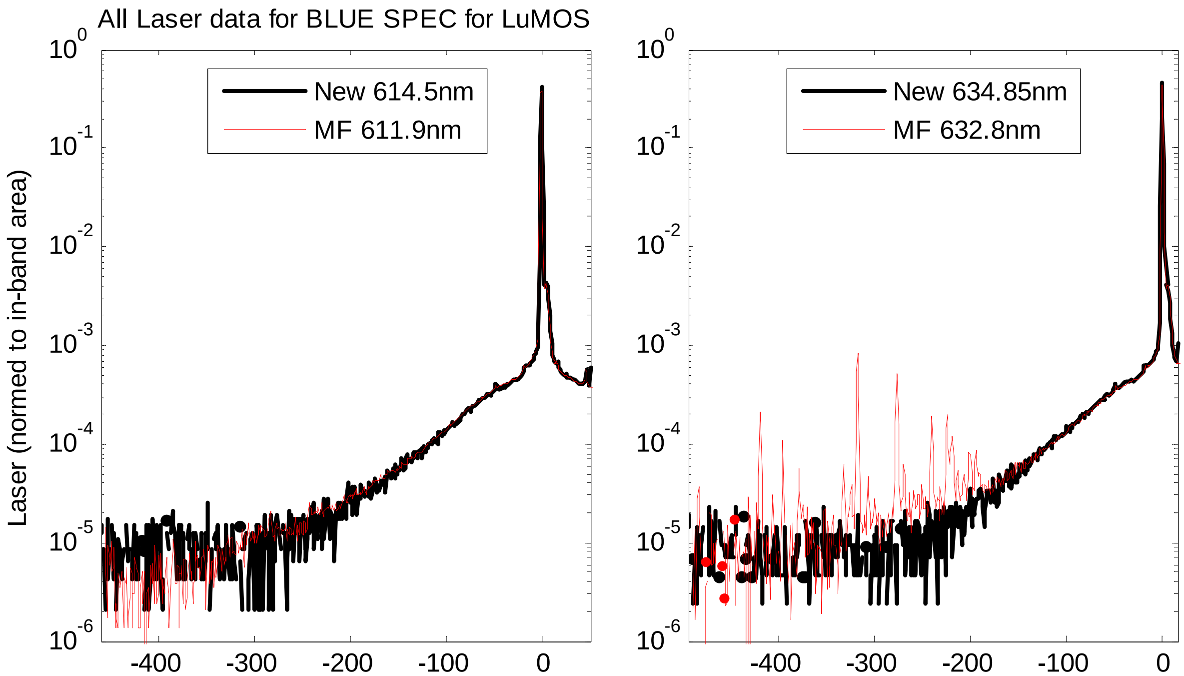

All Laser data for BLUE SPEC for LuMOS
Laser (normed to in-band area)
New 367nm
MF 372nm
New 410nm
MF 407.5nm
New 454.5nm
MF 458nm
New 457.9nm
MF 458nm
Relative Pixel
Relative Pixel



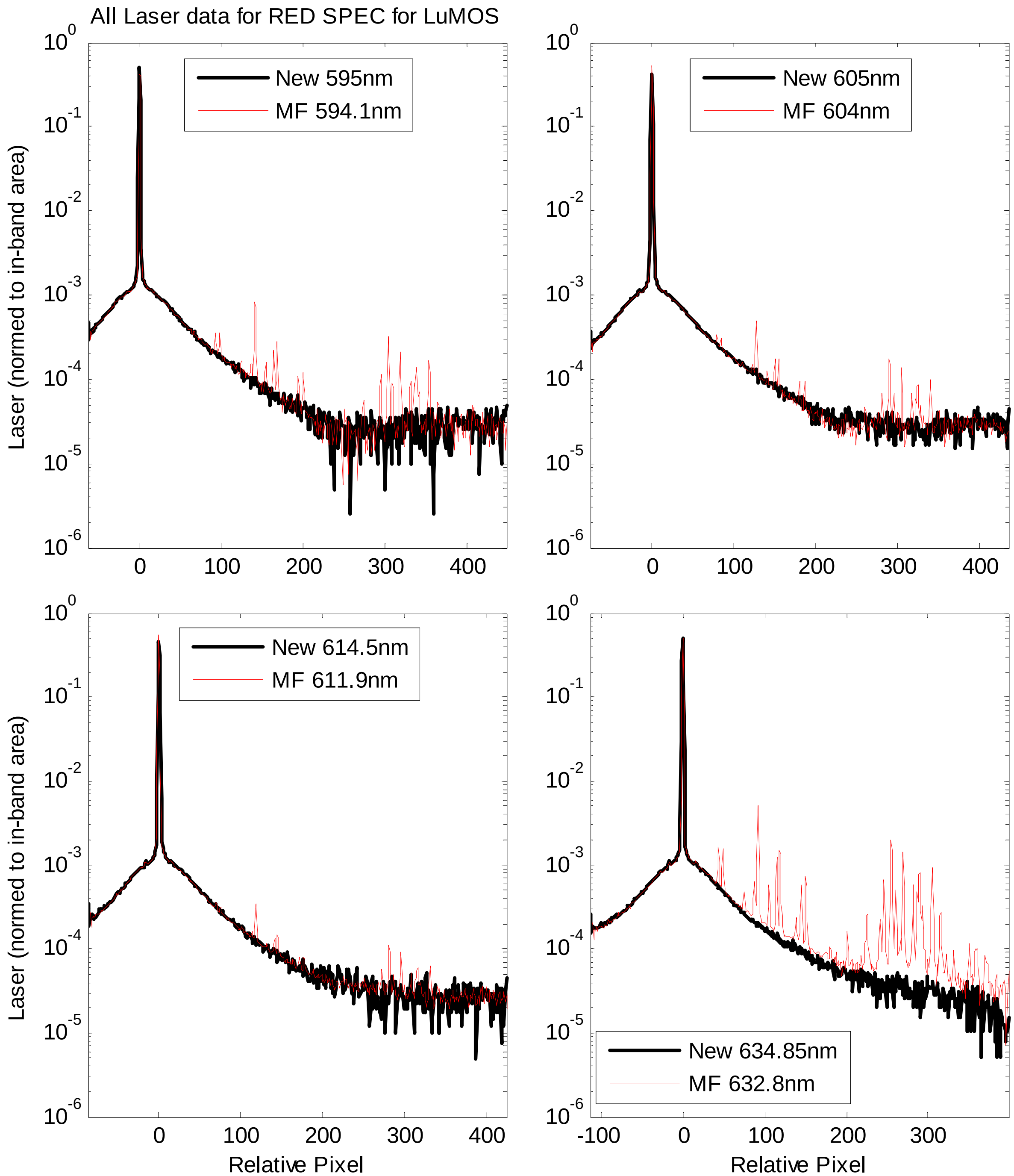
All Laser data for BLUE SPEC for LuMOS
Laser (normed to in-band area)
Relative Pixel
New 460nm
MF 458nm
New 472.7nm
MF 476nm
New 476.5nm
MF 476nm
New 480nm
MF 476nm


All Laser data for BLUE SPEC for LuMOS
Laser (normed to in-band area)
New 488nm
MF 488nm
New 496.5nm
MF 497nm
New 501nm
MF 501nm
New 514.5nm
MF 514.5nm
Relative Pixel

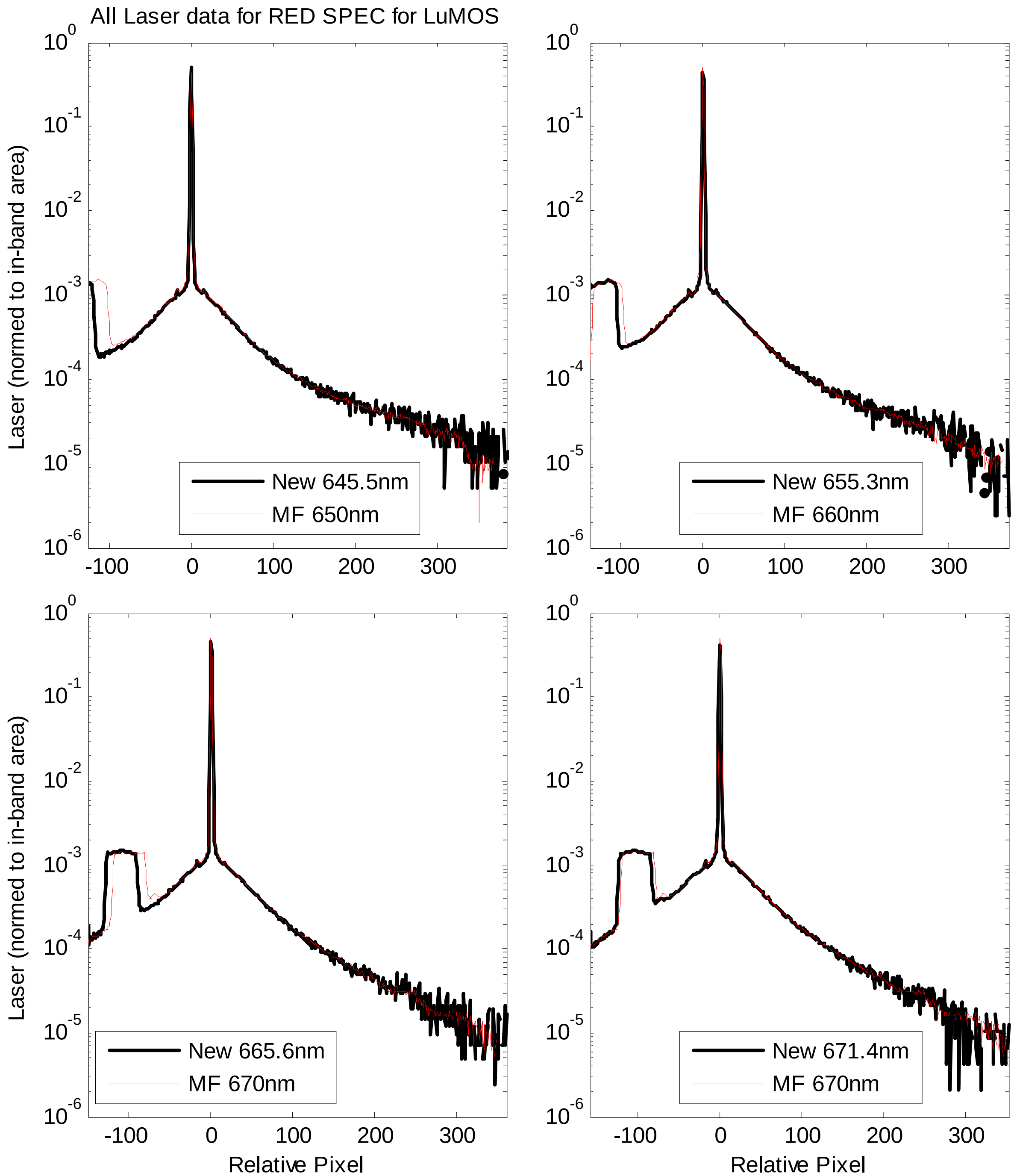

All Laser data for BLUE SPEC for LuMOS
Laser (normed to in-band area)
New 515.2nm
MF 514.5nm
New 545.2nm
MF 543.5nm
New 595nm
MF 594.1nm
New 605nm
MF 604nm
Relative Pixel

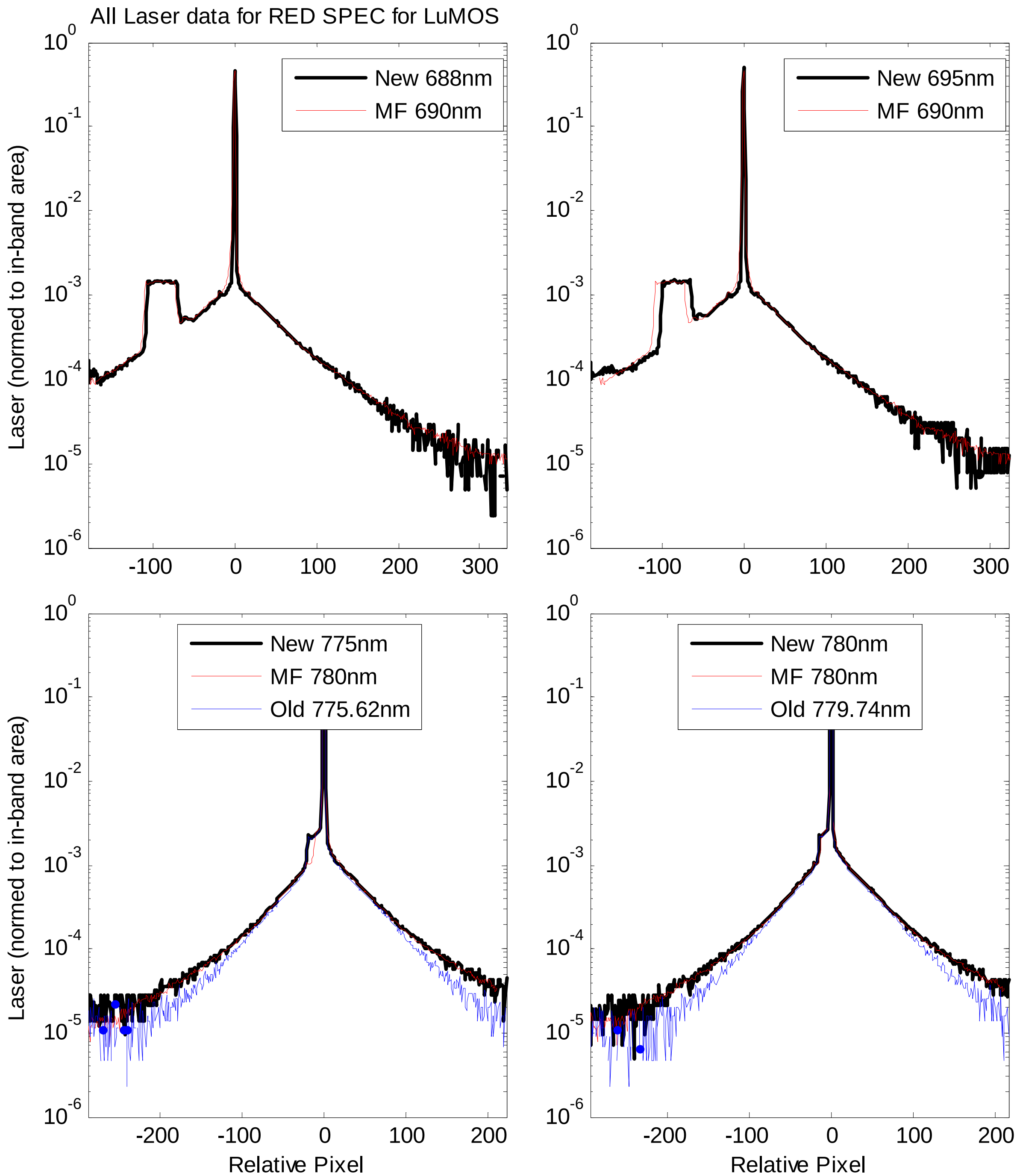


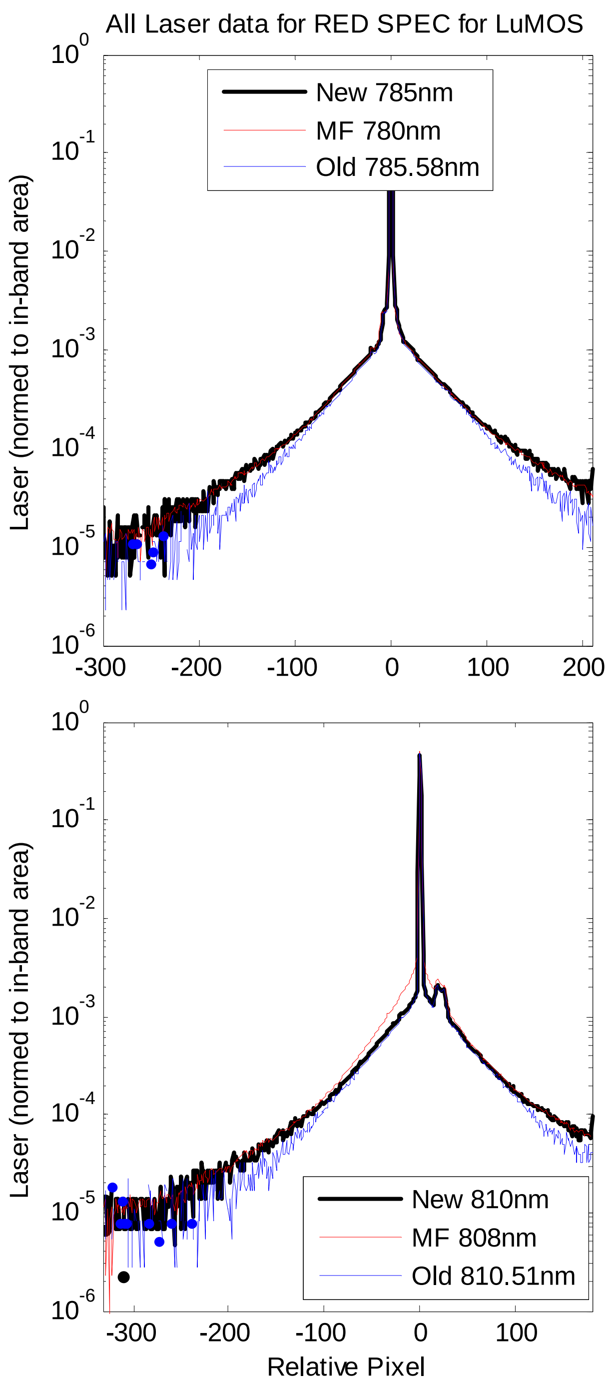
All Laser data for BLUE SPEC for LuMOS
Laser (normed to in-band area)
New 614.5nm
MF 611.9nm
New 634.85nm
MF 632.8nm
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
-400
-300
-200
-100
0

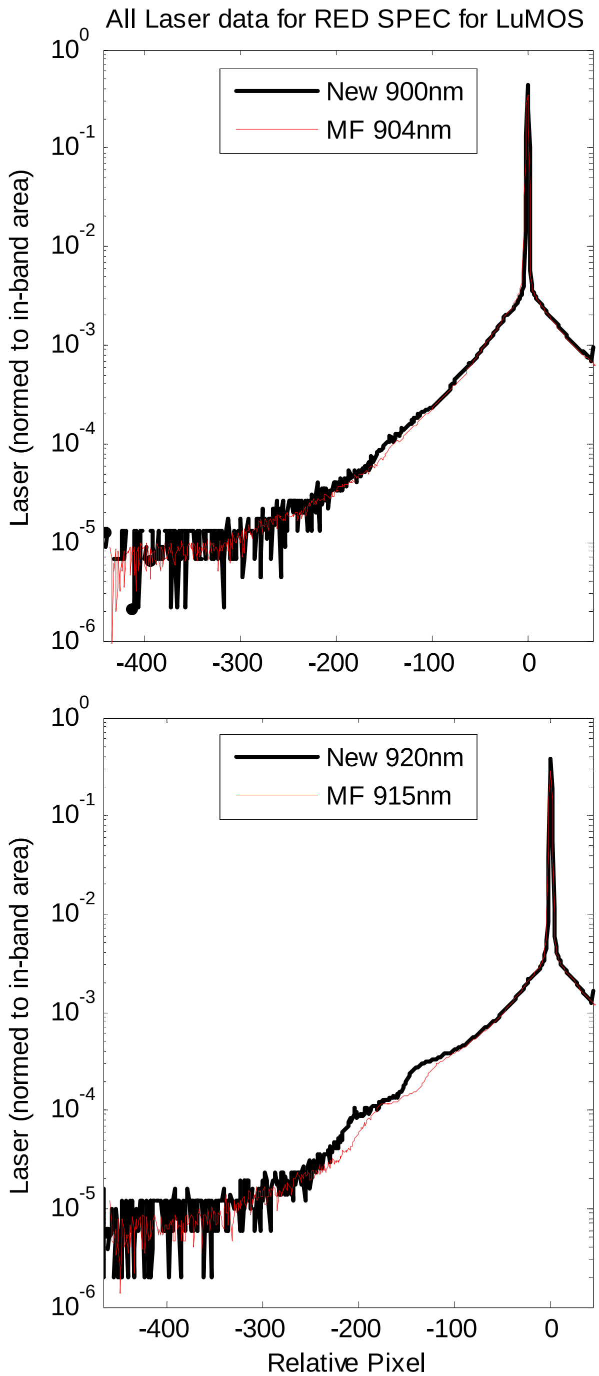


All Laser data for RED SPEC for LuMOS
Laser (normed to in-band area)
New 595nm
MF 594.1nm
New 605nm
MF 604nm
New 614.5nm
MF 611.9nm
New 634.85nm
MF 632.8nm
Relative Pixel
Relative Pixel


All Laser data for RED SPEC for LuMOS
Laser (normed to in-band area)
New 645.5nm
MF 650nm
New 655.3nm
MF 660nm
New 665.6nm
MF 670nm
New 671.4nm
MF 670nm
Relative Pixel
Relative Pixel


All Laser data for RED SPEC for LuMOS
Laser (normed to in-band area)
New 688nm
MF 690nm
New 695nm
MF 690nm
New 775nm
MF 780nm
Old 775.62nm
New 780nm
MF 780nm
Old 779.74nm
Relative Pixel
Relative Pixel


All Laser data for RED SPEC for LuMOS
Laser (normed to in-band area)
New 785nm
MF 780nm
Old 785.58nm
New 805nm
MF 808nm
Old 804.73nm
New 810nm
MF 808nm
Old 810.51nm
New 850nm
MF 850nm
Old 850.18nm
Relative Pixel


All Laser data for RED SPEC for LuMOS
Laser (normed to in-band area)
New 900nm
MF 904nm
New 910nm
MF 915nm
New 920nm
MF 915nm
Relative Pixel

Laser data collected on each day

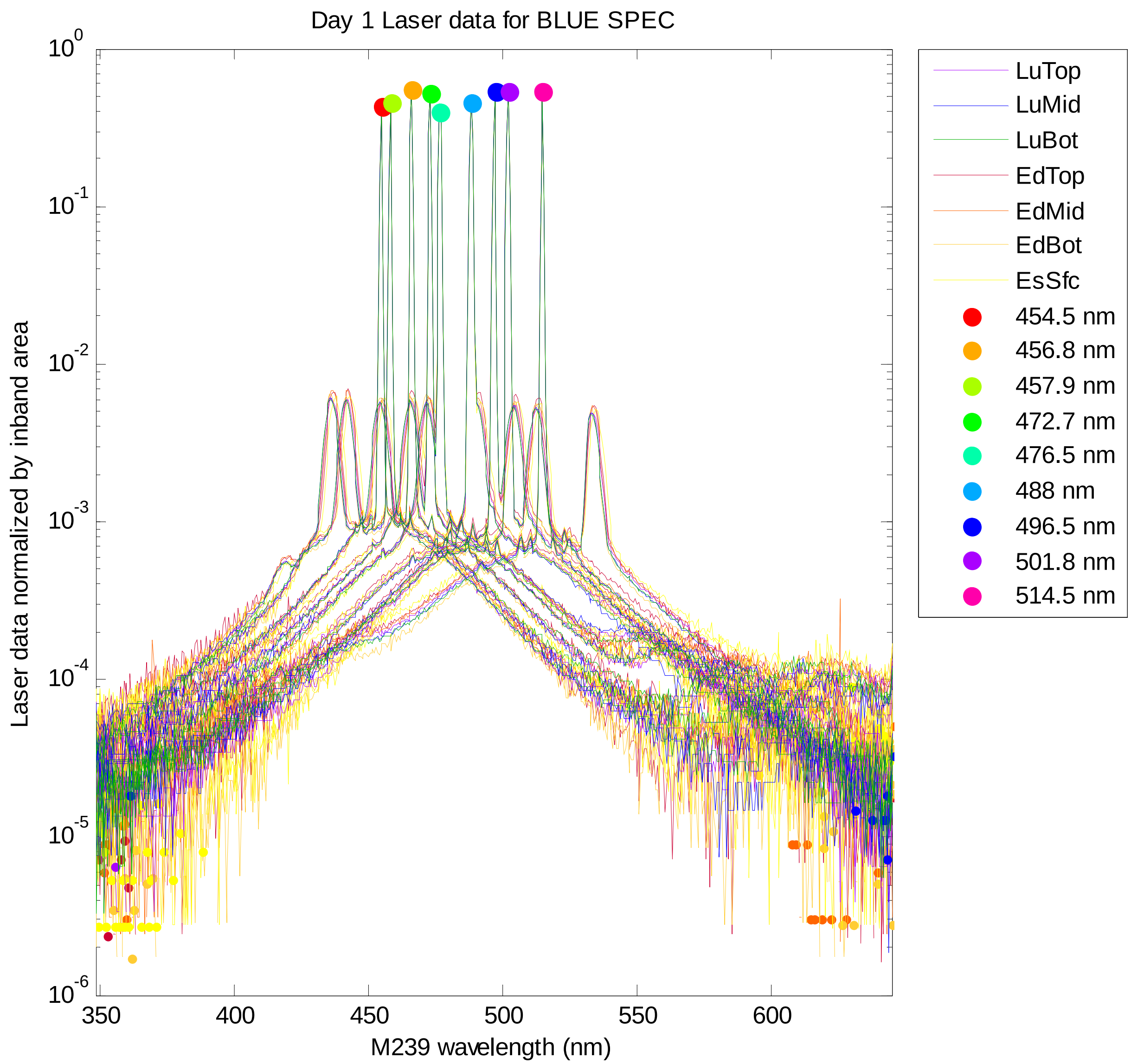


Figure 77

Day 1 was laser data taken on 19-Jun, Mike's day 2

Mikes info.

Schedule:	**λ range :**
Day#2 = Thursday 19-Jun-2008 = Ar at 9 waves via all 7 collectors (Es,t,m,b, Lt,m,b)	**455-515**

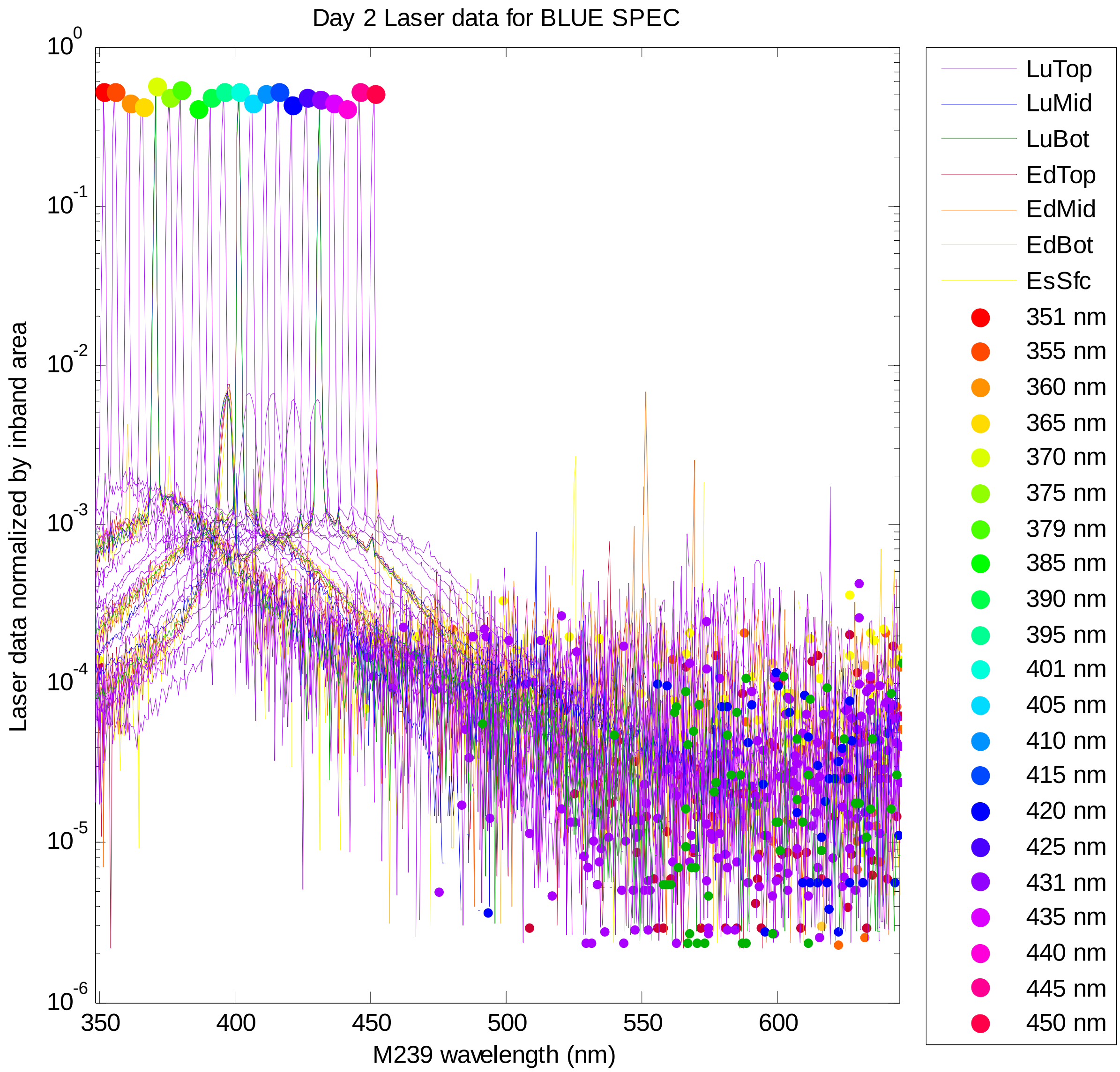


Figure 78

Day 2

Mikes info.

Schedule:	λ range :
Day#3 = Friday 20-Jun-2008 = doubled Ti:S 351:5:450 nm via Lt + all E & L at 370,401,431	**350-450**
Day#3 = Friday 20-Jun-2008 = Ti:S 675:5:900 nm via Lt + all E & L at 675,705,745,776	**675-900**

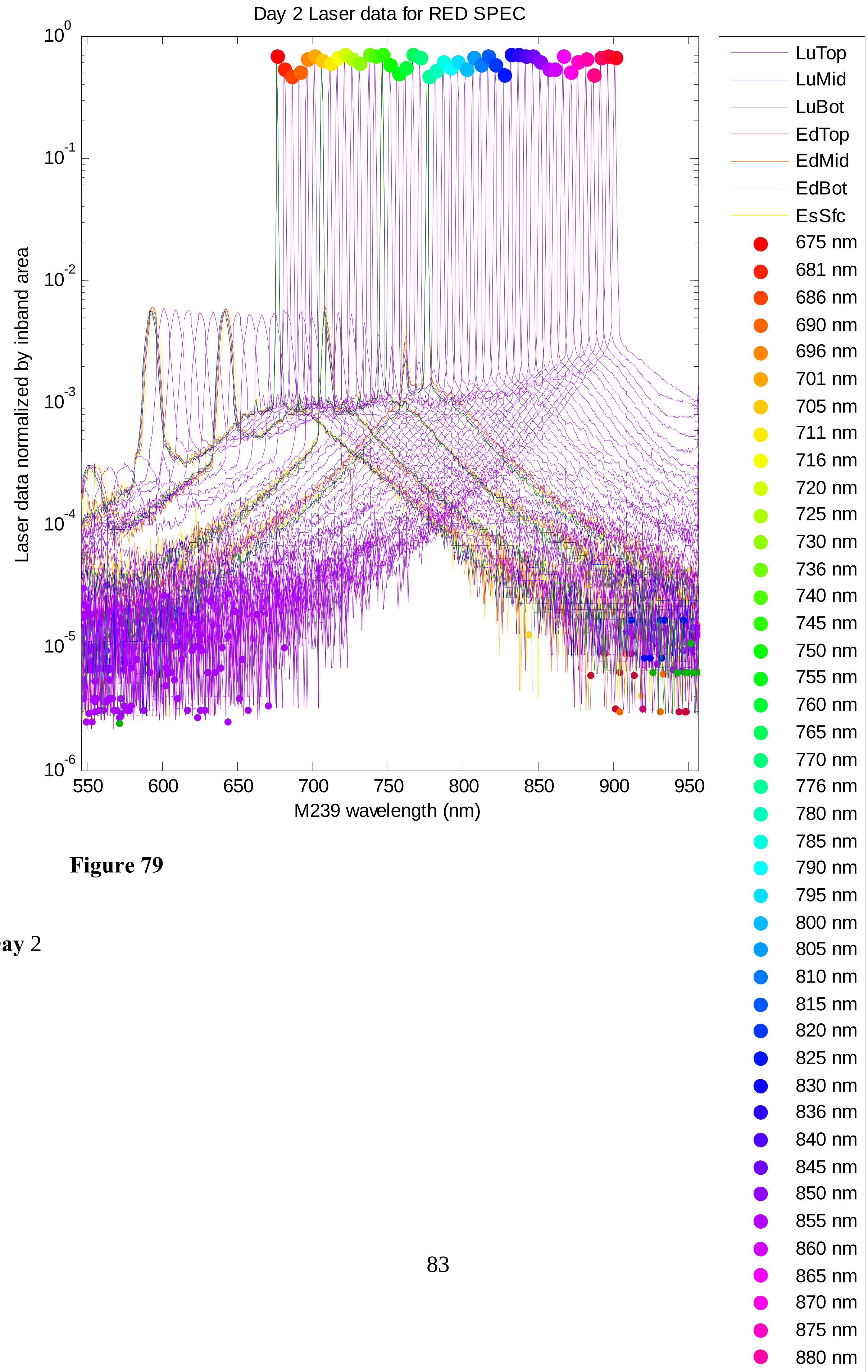


Figure 79

Day 2

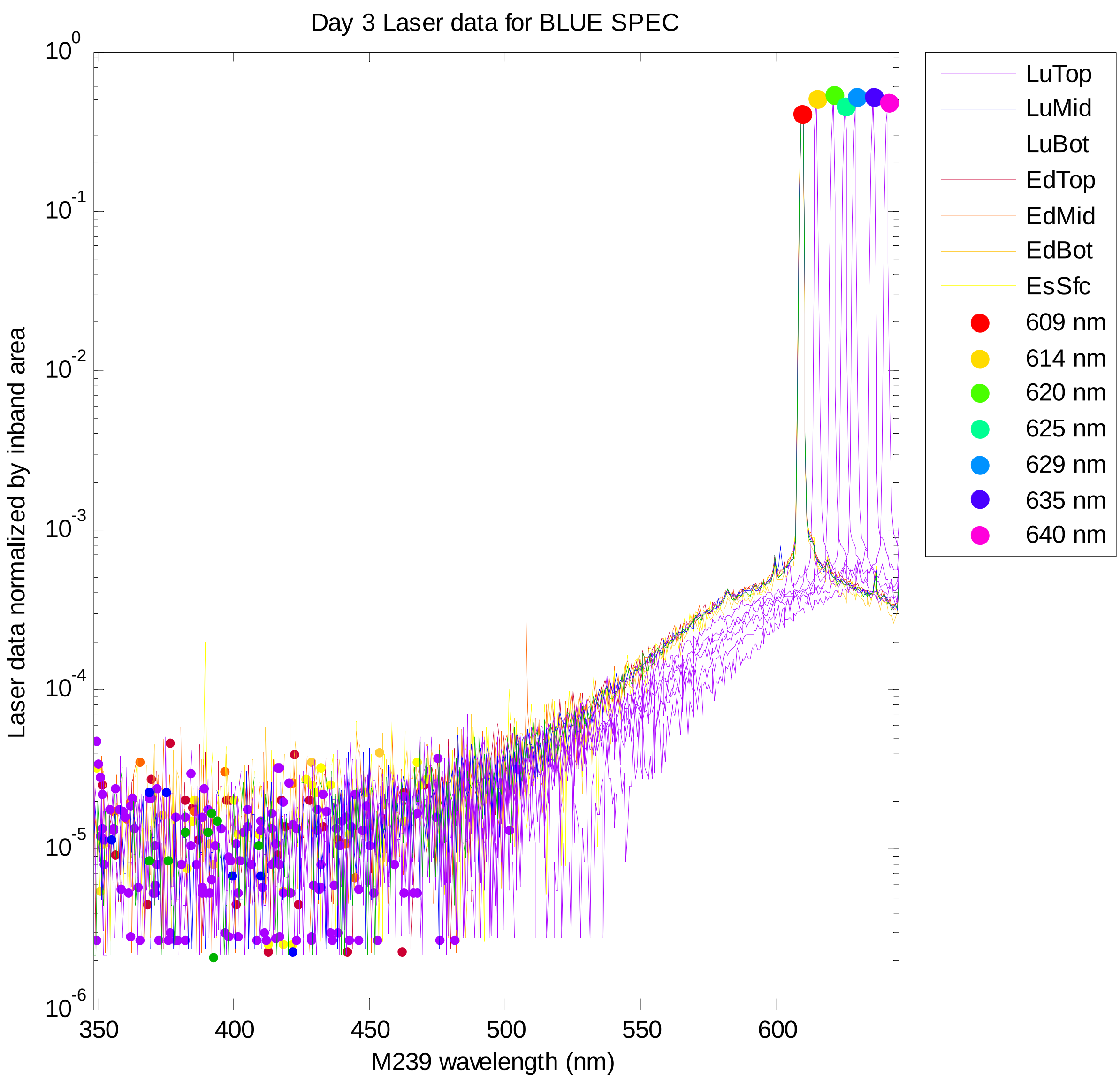


Figure 80

Day 3

Mike's Info

Schedule:	**λ range :**
Day#4 = Saturday 21-Jun-2008 = Ti:S 1000:10:950 945:5:905 nm via Lt + all E & L at 905 nm	**905-1000**
Day#4 = Saturday 21-Jun-2008 = DCM dye 610:5:670 nm via Lt + all E & L at 609,660 nm	**610-670**

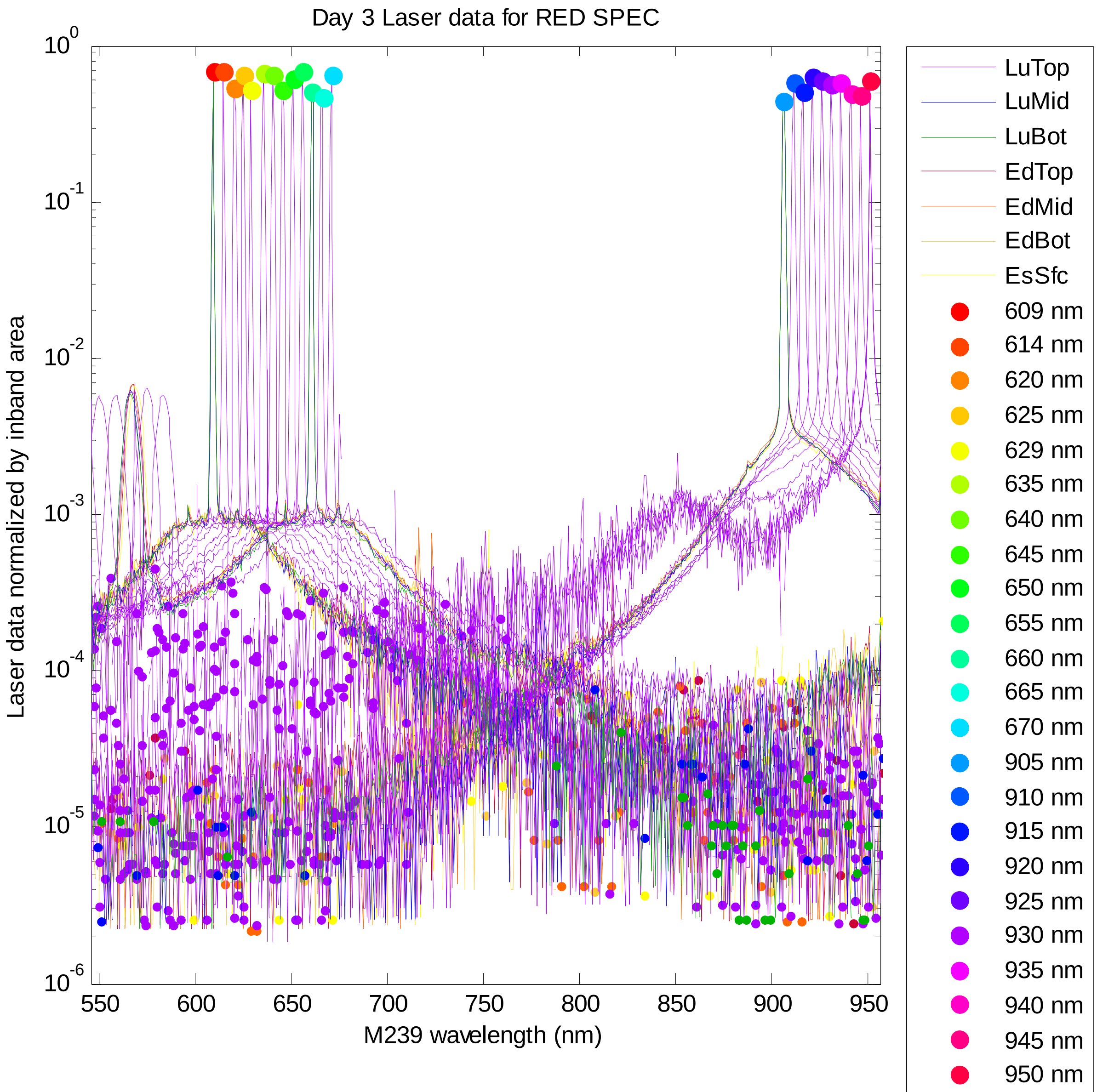


Figure 81

Day 3

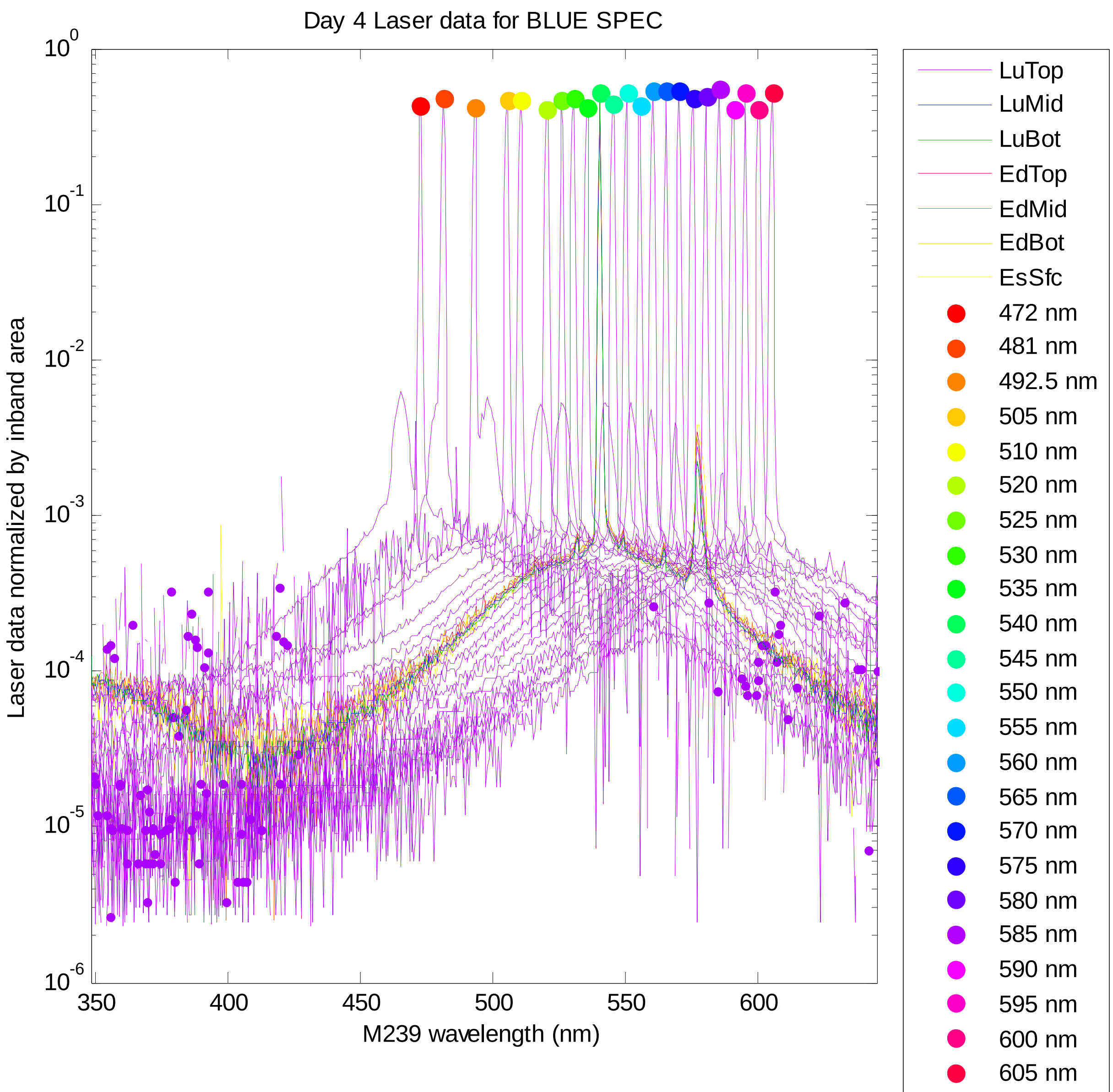


Figure 82

Day 4

Schedule:	**λ range :**
Day#5 = Monday 23-Jun-2008 = R6G dye 605:5:565 nm via Lt	**565-605**
Day#5 = Monday 23-Jun-2008 = Coumarin 521 dye 505:560 nm via Lt + all E & L at 540 nm	**505:560**
Day#5 = Monday 23-Jun-2008 = doubled Ti:S 472,480,492.5 nm via Lt	**480,493**
Day#5 = Monday 23-Jun-2008 = CS filt=none,#A(BG28?),#B(?HP),#C(BG39?),PER via Lt,m,b	cs

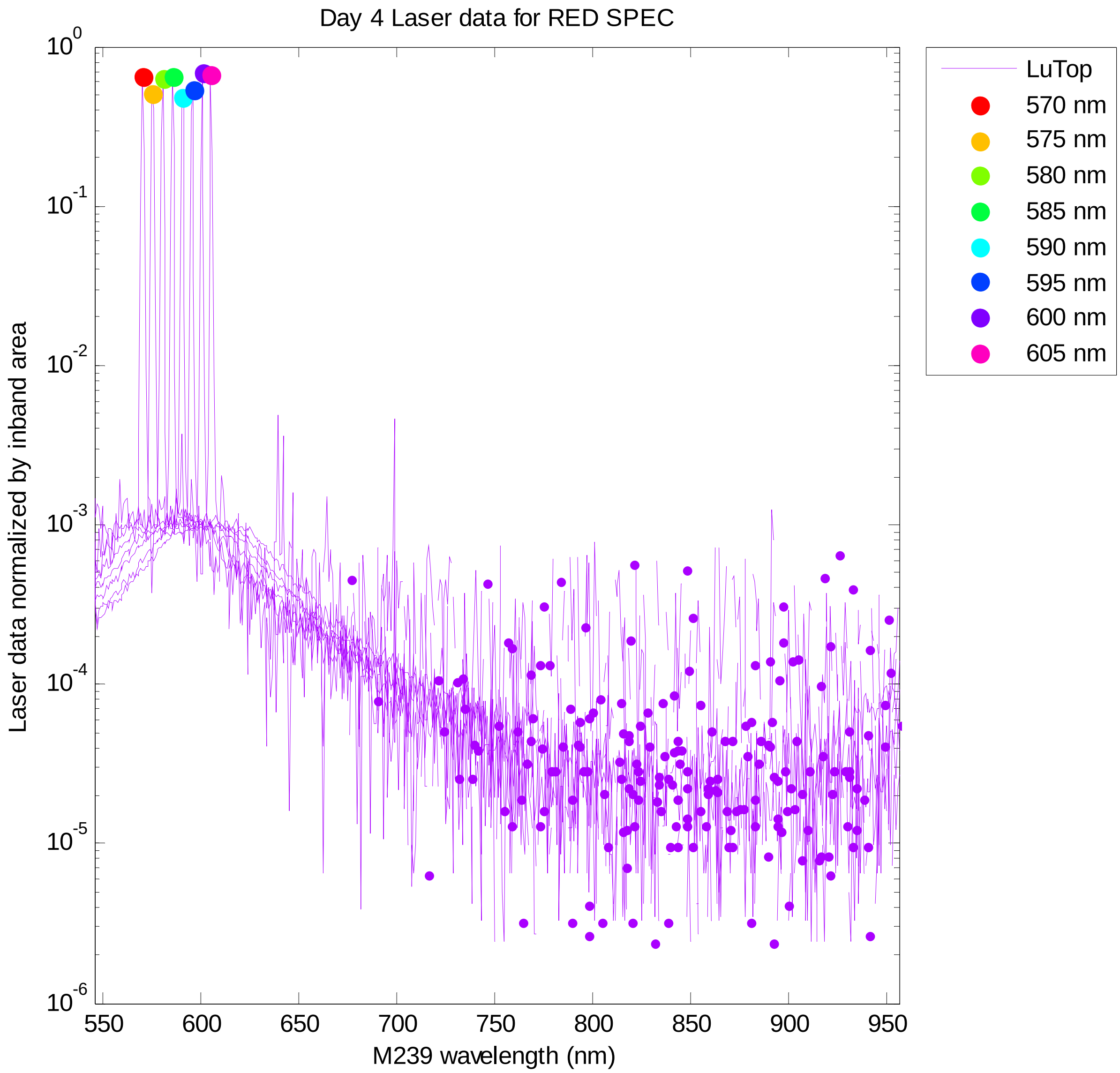


Figure 83

Day 4

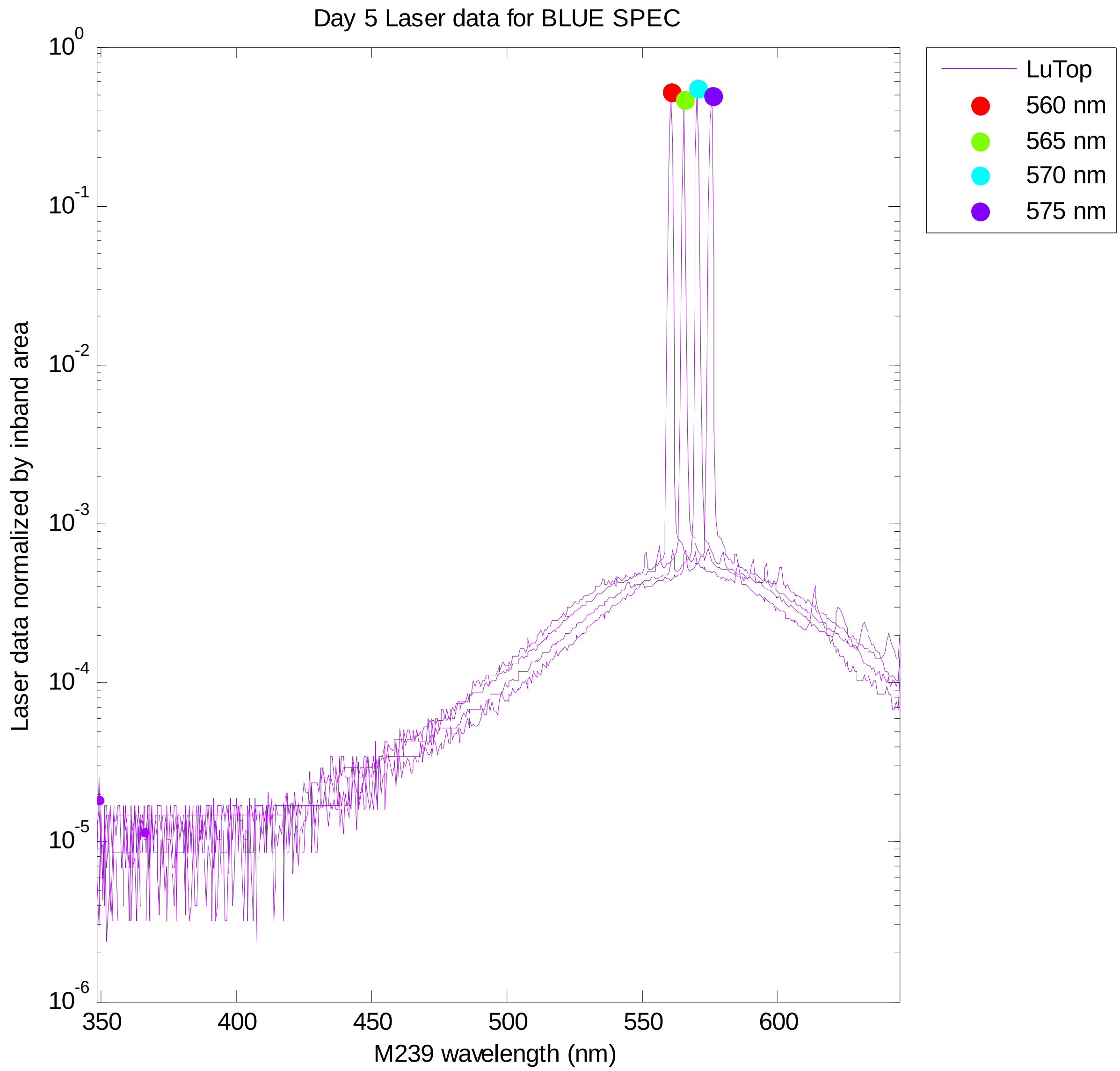


Figure 84

Day 5

Schedule:	**λ range :**
Day#6 = Tuesday 24-Jun-2008 = CS filter=no,#A,#B,#C,PER via Es,t,m,b	cs
Day#6 = Tuesday 24-Jun-2008 = repeat Cou521 560 nm & R6G 565:575 nm RSG lines	**560-575**

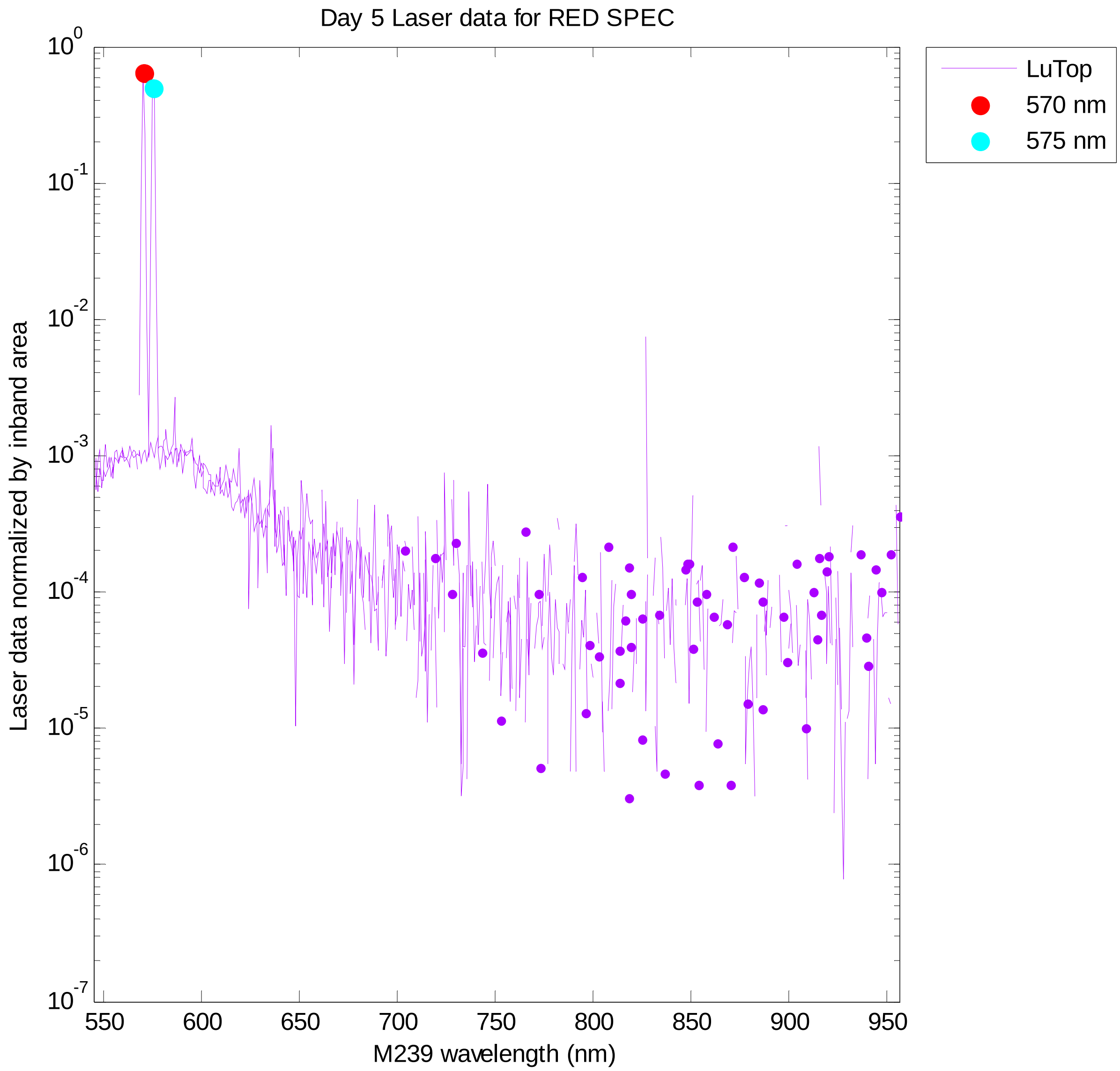


Figure 85

Day 5

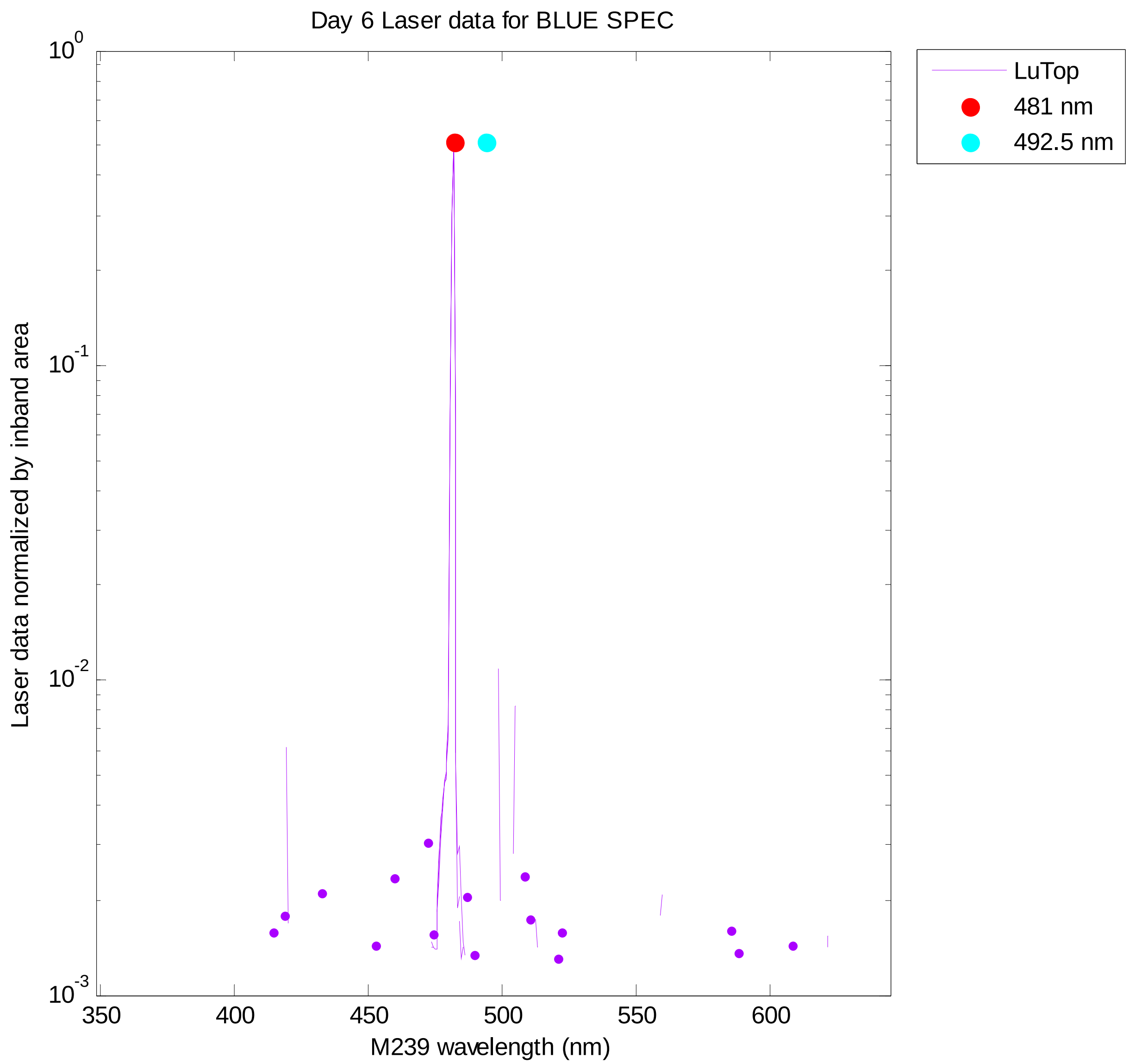


Figure 86

Day 6

Schedule:	**λ range :**
Day#7 = Wednesday 25-Jun-2008 = repeat doubled Ti:S 481, 492.5 nm	**481,493**

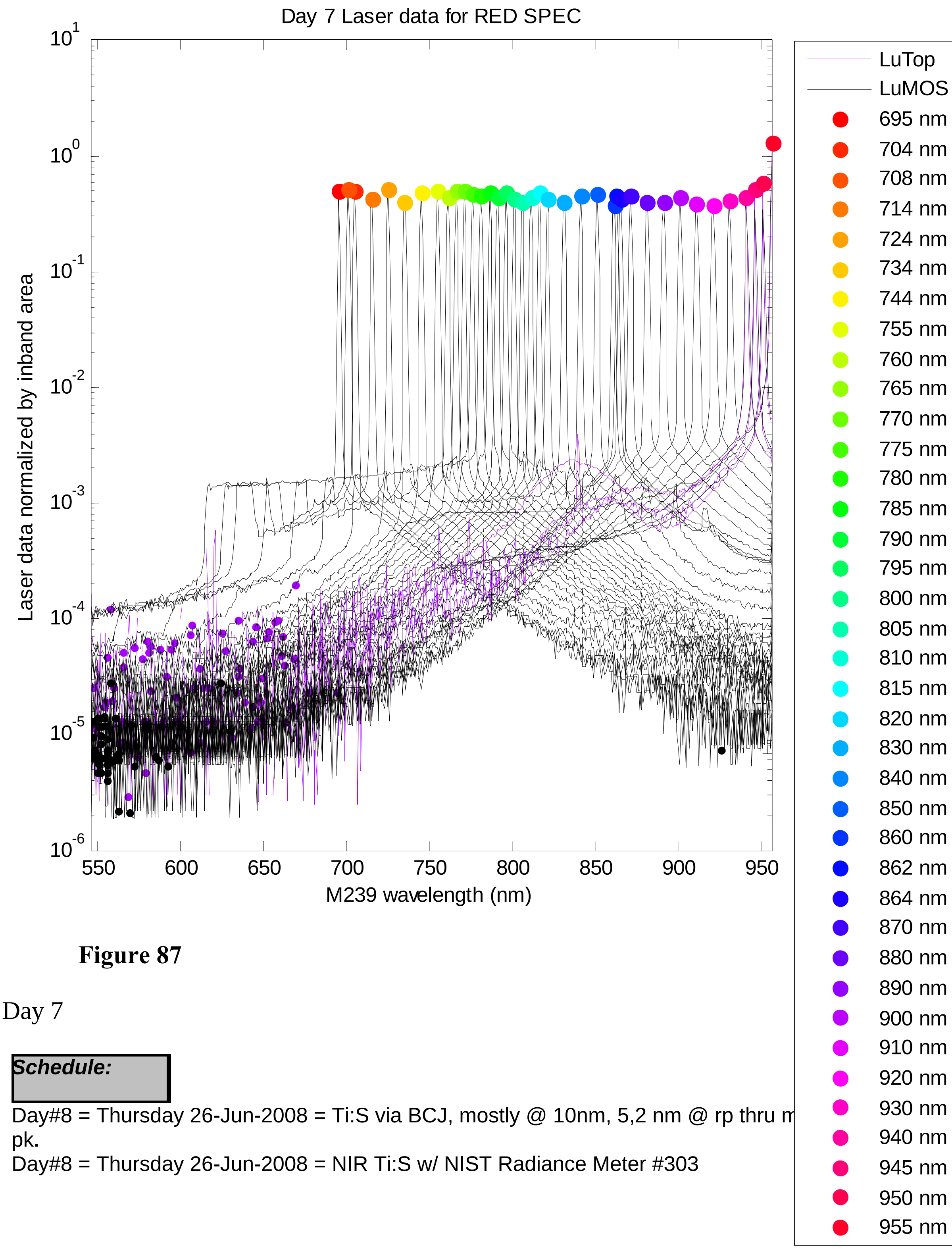


Figure 87

Day 7

Schedule: **ge :**

Day#8 = Thursday 26-Jun-2008 = Ti:S via BCJ, mostly @ 10nm, 5,2 nm @ rp thru m **025**
pk.

Day#8 = Thursday 26-Jun-2008 = NIR Ti:S w/ NIST Radiance Meter #303 **025**

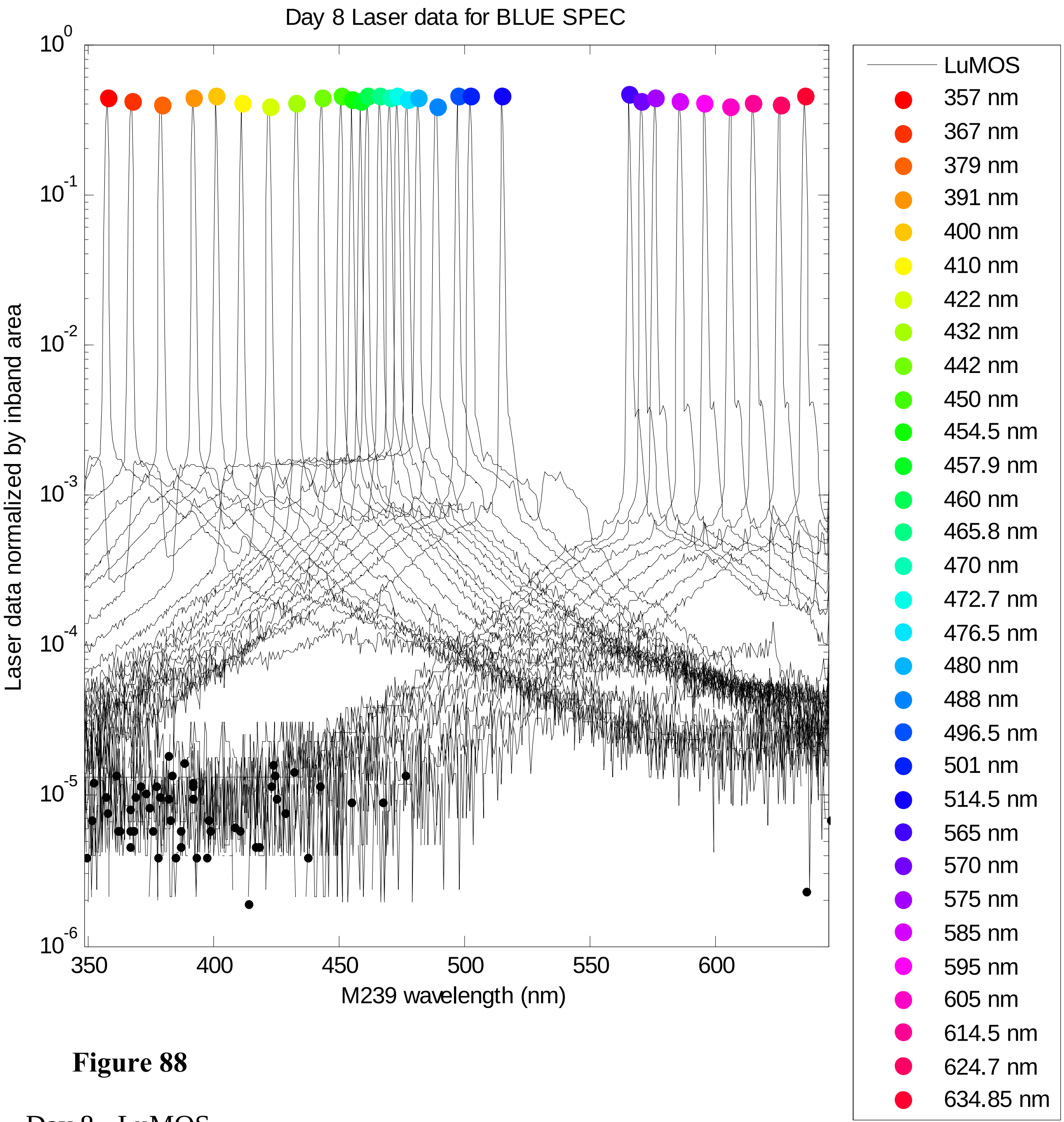


Figure 88

Day 8 - LuMOS

Schedule:	**λ range :**
Day#9 = Friday 27-Jun-2008 = doubled Ti:S	**357:480**
Day#9 = Friday 27-Jun-2008 = Ar ion	**454.5:514.5**
Day#9 = Friday 27-Jun-2008 = Ar ion pumped R6G dye	**565:605**
Day#9 = Friday 27-Jun-2008 = Ar ion pumped DCM dye	**615:688**

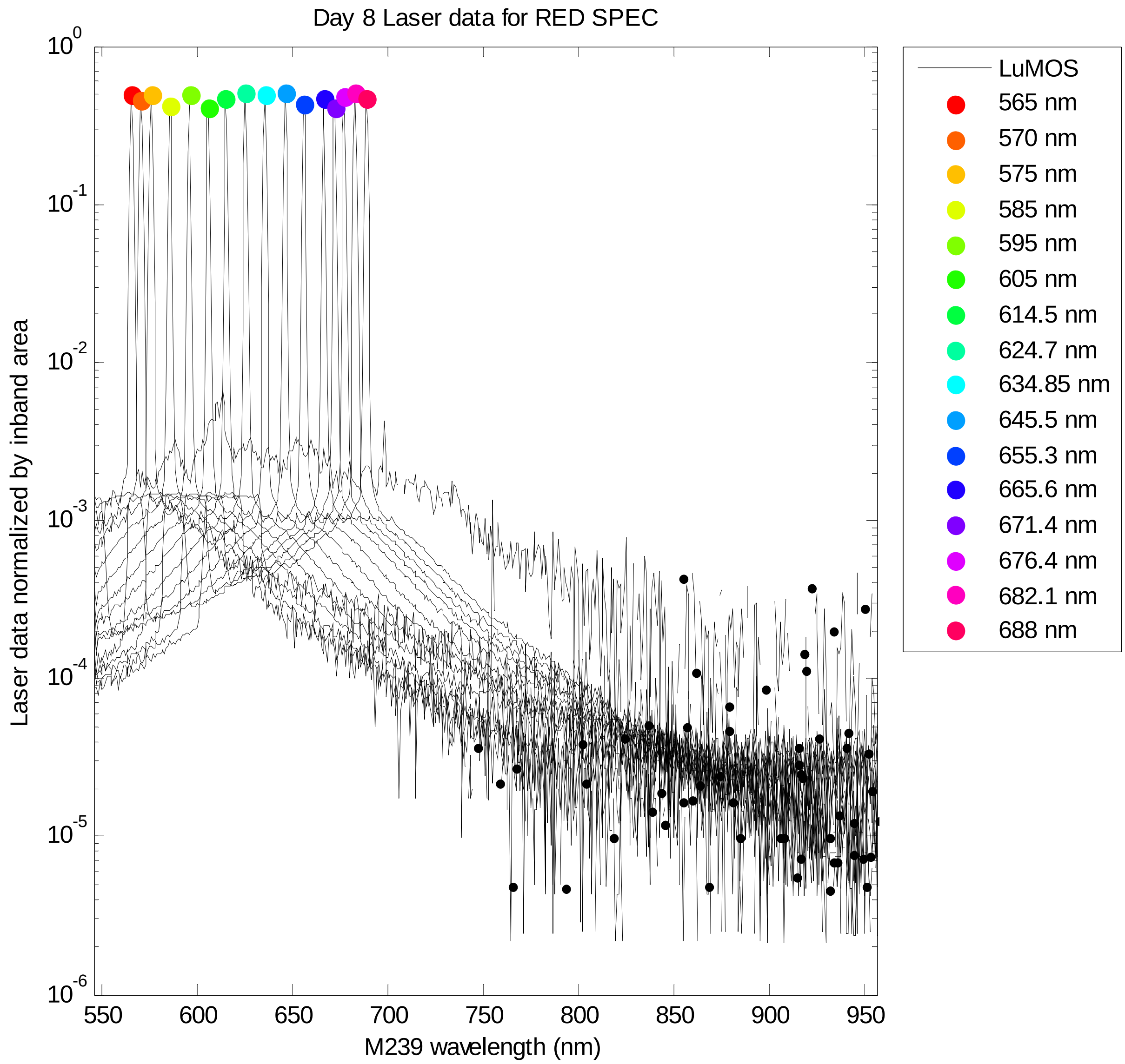


Figure 89

Day 8 - LuMOS

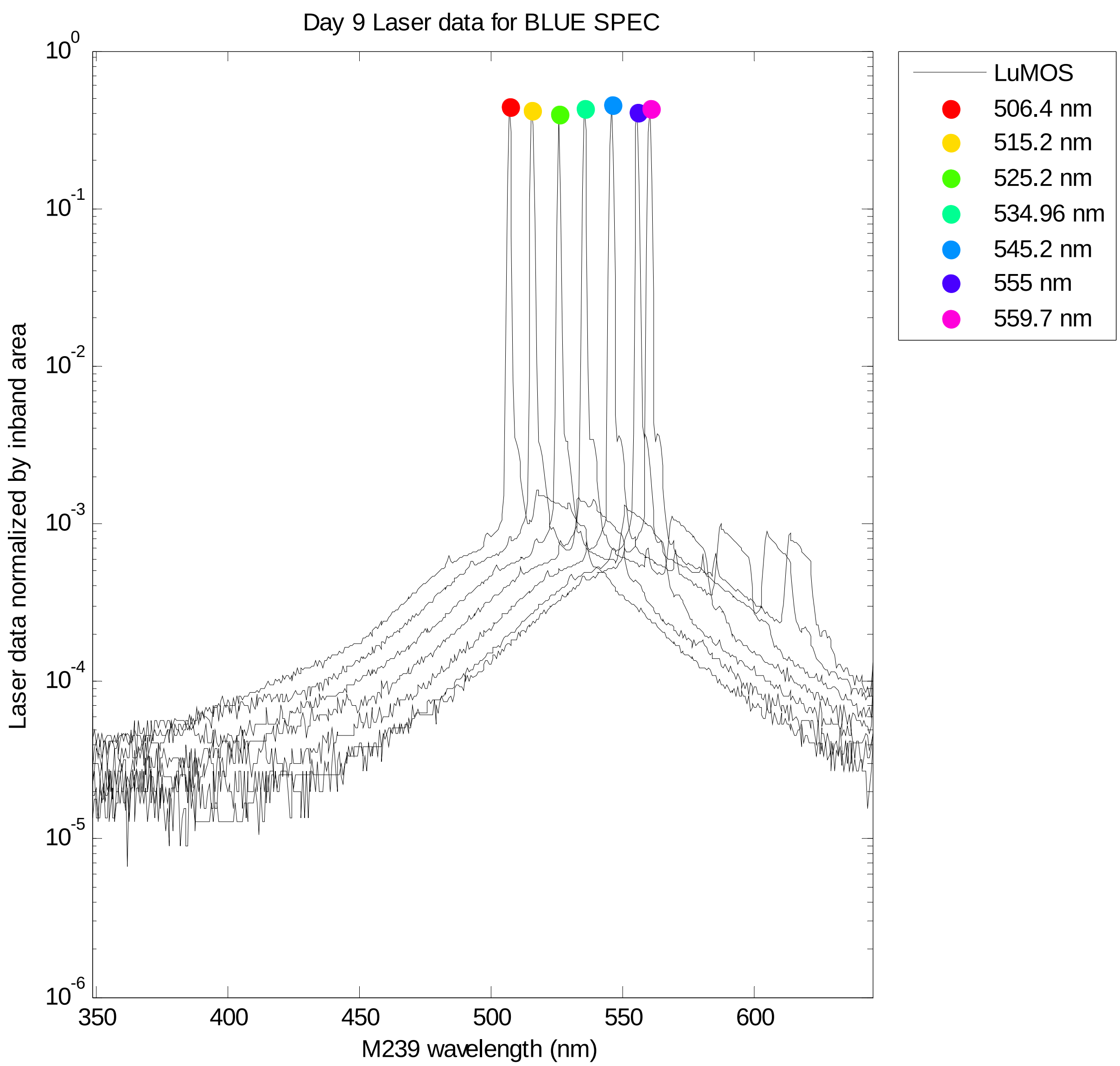


Figure 90

Day 9 - LuMOS

Schedule:	**λ range :**
Day#10 = Saturday 28-Jun-2008 = Ar ion pumped Coumarin 521 dye	**506:565**

Table of laser data collected on June 2008 at NIST SIRCUS facility on MOBY241						
day	**Filename**	**Laser**	**Sensor**	**Wavelength**	**Spec**	**Bad Flag**
1	ar0902	Argon Ion	EdTop	454.5 nm	Blue CCD	
1	ar0702	Argon Ion	EdTop	456.8 nm	Blue CCD	
1	ar0802	Argon Ion	EdTop	457.9 nm	Blue CCD	
1	ar0602	Argon Ion	EdTop	472.7 nm	Blue CCD	
1	ar0502	Argon Ion	EdTop	476.5 nm	Blue CCD	Bad
1	ar0508	Argon Ion	EdTop	476.5 nm	Blue CCD	
1	ar0402	Argon Ion	EdTop	488.0 nm	Blue CCD	
1	ar0302	Argon Ion	EdTop	496.5 nm	Blue CCD	
1	ar0202	Argon Ion	EdTop	501.8 nm	Blue CCD	
1	ar0102	Argon Ion	EdTop	514.5 nm	Blue CCD	
1	ar0903	Argon Ion	EdMid	454.5 nm	Blue CCD	
1	ar0703	Argon Ion	EdMid	456.8 nm	Blue CCD	
1	ar0803	Argon Ion	EdMid	457.9 nm	Blue CCD	
1	ar0603	Argon Ion	EdMid	472.7 nm	Blue CCD	
1	ar0503	Argon Ion	EdMid	476.5 nm	Blue CCD	
1	ar0403	Argon Ion	EdMid	488.0 nm	Blue CCD	
1	ar0303	Argon Ion	EdMid	496.5 nm	Blue CCD	
1	ar0203	Argon Ion	EdMid	501.8 nm	Blue CCD	
1	ar0103	Argon Ion	EdMid	514.5 nm	Blue CCD	
1	ar0904	Argon Ion	EdBot	454.5 nm	Blue CCD	
1	ar0704	Argon Ion	EdBot	456.8 nm	Blue CCD	
1	ar0804	Argon Ion	EdBot	457.9 nm	Blue CCD	
1	ar0604	Argon Ion	EdBot	472.7 nm	Blue CCD	
1	ar0504	Argon Ion	EdBot	476.5 nm	Blue CCD	
1	ar0404	Argon Ion	EdBot	488.0 nm	Blue CCD	

1	ar0304	Argon Ion	EdBot	496.5 nm	Blue CCD	
1	ar0204	Argon Ion	EdBot	501.8 nm	Blue CCD	
1	ar0104	Argon Ion	EdBot	514.5 nm	Blue CCD	
1	ar0901	Argon Ion	EsSfc	454.5 nm	Blue CCD	
1	ar0701	Argon Ion	EsSfc	456.8 nm	Blue CCD	
1	ar0801	Argon Ion	EsSfc	457.9 nm	Blue CCD	
1	ar0601	Argon Ion	EsSfc	472.7 nm	Blue CCD	
1	ar0501	Argon Ion	EsSfc	476.5 nm	Blue CCD	
1	ar0401	Argon Ion	EsSfc	488.0 nm	Blue CCD	
1	ar0301	Argon Ion	EsSfc	496.5 nm	Blue CCD	
1	ar0201	Argon Ion	EsSfc	501.8 nm	Blue CCD	
1	ar0101	Argon Ion	EsSfc	514.5 nm	Blue CCD	
1	ar0905	Argon Ion	LuTop	454.5 nm	Blue CCD	
1	ar0705	Argon Ion	LuTop	456.8 nm	Blue CCD	
1	ar0805	Argon Ion	LuTop	457.9 nm	Blue CCD	
1	ar0605	Argon Ion	LuTop	472.7 nm	Blue CCD	
1	ar0505	Argon Ion	LuTop	476.5 nm	Blue CCD	
1	ar0405	Argon Ion	LuTop	488.0 nm	Blue CCD	
1	ar0305	Argon Ion	LuTop	496.5 nm	Blue CCD	
1	ar0205	Argon Ion	LuTop	501.8 nm	Blue CCD	
1	ar0105	Argon Ion	LuTop	514.5 nm	Blue CCD	
1	ar0906	Argon Ion	LuMid	454.5 nm	Blue CCD	
1	ar0706	Argon Ion	LuMid	456.8 nm	Blue CCD	
1	ar0806	Argon Ion	LuMid	457.9 nm	Blue CCD	
1	ar0606	Argon Ion	LuMid	472.7 nm	Blue CCD	
1	ar0506	Argon Ion	LuMid	476.5 nm	Blue CCD	
1	ar0406	Argon Ion	LuMid	488.0 nm	Blue CCD	
1	ar0306	Argon Ion	LuMid	496.5 nm	Blue CCD	

1	ar0206	Argon Ion	LuMid	501.8 nm	Blue CCD	
1	ar0106	Argon Ion	LuMid	514.5 nm	Blue CCD	
1	ar0907	Argon Ion	LuBot	454.5 nm	Blue CCD	
1	ar0707	Argon Ion	LuBot	456.8 nm	Blue CCD	
1	ar0807	Argon Ion	LuBot	457.9 nm	Blue CCD	
1	ar0607	Argon Ion	LuBot	472.7 nm	Blue CCD	
1	ar0507	Argon Ion	LuBot	476.5 nm	Blue CCD	
1	ar0407	Argon Ion	LuBot	488.0 nm	Blue CCD	
1	ar0307	Argon Ion	LuBot	496.5 nm	Blue CCD	
1	ar0207	Argon Ion	LuBot	501.8 nm	Blue CCD	
1	ar0107	Argon Ion	LuBot	514.5 nm	Blue CCD	
2	dt0302	Doubled Ti-Saphire	EdTop	370.0 nm	Blue CCD	
2	dt0102	Doubled Ti-Saphire	EdTop	401.0 nm	Blue CCD	
2	dt0602	Doubled Ti-Saphire	EdTop	431.0 nm	Blue CCD	
2	ts0102	Ti-Saphire	EdTop	675.0 nm	Red CCD	
2	ts0302	Ti-Saphire	EdTop	705.0 nm	Red CCD	
2	ts0502	Ti-Saphire	EdTop	745.0 nm	Red CCD	
2	ts0702	Ti-Saphire	EdTop	776.0 nm	Red CCD	
2	dt0303	Doubled Ti-Saphire	EdMid	370.0 nm	Blue CCD	
2	dt0103	Doubled Ti-Saphire	EdMid	401.0 nm	Blue CCD	
2	dt0603	Doubled Ti-Saphire	EdMid	431.0 nm	Blue CCD	
2	ts0103	Ti-Saphire	EdMid	675.0 nm	Red CCD	
2	ts0303	Ti-Saphire	EdMid	705.0 nm	Red CCD	
2	ts0503	Ti-Saphire	EdMid	745.0 nm	Red CCD	
2	ts0703	Ti-Saphire	EdMid	776.0 nm	Red CCD	
2	dt0304	Doubled Ti-Saphire	EdBot	370.0 nm	Blue CCD	
2	dt0104	Doubled Ti-Saphire	EdBot	401.0 nm	Blue CCD	
2	dt0604	Doubled Ti-Saphire	EdBot	431.0 nm	Blue CCD	

2	ts0104	Ti-Saphire	EdBot	675.0 nm	Red CCD	
2	ts0304	Ti-Saphire	EdBot	705.0 nm	Red CCD	
2	ts0504	Ti-Saphire	EdBot	745.0 nm	Red CCD	
2	ts0704	Ti-Saphire	EdBot	776.0 nm	Red CCD	
2	dt0301	Doubled Ti-Saphire	EsSfc	370.0 nm	Blue CCD	
2	dt0101	Doubled Ti-Saphire	EsSfc	401.0 nm	Blue CCD	
2	dt0601	Doubled Ti-Saphire	EsSfc	431.0 nm	Blue CCD	
2	ts0101	Ti-Saphire	EsSfc	675.0 nm	Red CCD	
2	ts0301	Ti-Saphire	EsSfc	705.0 nm	Red CCD	
2	ts0501	Ti-Saphire	EsSfc	745.0 nm	Red CCD	
2	ts0701	Ti-Saphire	EsSfc	776.0 nm	Red CCD	
2	dt0404	Doubled Ti-Saphire	LuTop	351.0 nm	Blue CCD	
2	dt0403	Doubled Ti-Saphire	LuTop	355.0 nm	Blue CCD	
2	dt0402	Doubled Ti-Saphire	LuTop	360.0 nm	Blue CCD	
2	dt0401	Doubled Ti-Saphire	LuTop	365.0 nm	Blue CCD	
2	dt0305	Doubled Ti-Saphire	LuTop	370.0 nm	Blue CCD	
2	dt0205	Doubled Ti-Saphire	LuTop	375.0 nm	Blue CCD	
2	dt0204	Doubled Ti-Saphire	LuTop	379.0 nm	Blue CCD	
2	dt0203	Doubled Ti-Saphire	LuTop	385.0 nm	Blue CCD	
2	dt0202	Doubled Ti-Saphire	LuTop	390.0 nm	Blue CCD	
2	dt0201	Doubled Ti-Saphire	LuTop	395.0 nm	Blue CCD	
2	dt0105	Doubled Ti-Saphire	LuTop	401.0 nm	Blue CCD	
2	dt0501	Doubled Ti-Saphire	LuTop	405.0 nm	Blue CCD	
2	dt0502	Doubled Ti-Saphire	LuTop	410.0 nm	Blue CCD	
2	dt0503	Doubled Ti-Saphire	LuTop	415.0 nm	Blue CCD	
2	dt0504	Doubled Ti-Saphire	LuTop	420.0 nm	Blue CCD	
2	dt0505	Doubled Ti-Saphire	LuTop	425.0 nm	Blue CCD	
2	dt0605	Doubled Ti-Saphire	LuTop	431.0 nm	Blue CCD	

2	dt0701	Doubled Ti-Saphire	LuTop	435.0 nm	Blue CCD	
2	dt0702	Doubled Ti-Saphire	LuTop	440.0 nm	Blue CCD	
2	dt0703	Doubled Ti-Saphire	LuTop	445.0 nm	Blue CCD	
2	dt0704	Doubled Ti-Saphire	LuTop	450.0 nm	Blue CCD	
2	ts0105	Ti-Saphire	LuTop	675.0 nm	Red CCD	
2	ts0201	Ti-Saphire	LuTop	681.0 nm	Red CCD	
2	ts0202	Ti-Saphire	LuTop	686.0 nm	Red CCD	
2	ts0203	Ti-Saphire	LuTop	690.0 nm	Red CCD	
2	ts0204	Ti-Saphire	LuTop	696.0 nm	Red CCD	
2	ts0205	Ti-Saphire	LuTop	701.0 nm	Red CCD	
2	ts0305	Ti-Saphire	LuTop	705.0 nm	Red CCD	
2	ts0401	Ti-Saphire	LuTop	711.0 nm	Red CCD	
2	ts0402	Ti-Saphire	LuTop	716.0 nm	Red CCD	
2	ts0403	Ti-Saphire	LuTop	720.0 nm	Red CCD	
2	ts0404	Ti-Saphire	LuTop	725.0 nm	Red CCD	
2	ts0405	Ti-Saphire	LuTop	730.0 nm	Red CCD	
2	ts0406	Ti-Saphire	LuTop	736.0 nm	Red CCD	
2	ts0407	Ti-Saphire	LuTop	740.0 nm	Red CCD	
2	ts0505	Ti-Saphire	LuTop	745.0 nm	Red CCD	
2	ts0601	Ti-Saphire	LuTop	750.0 nm	Red CCD	
2	ts0602	Ti-Saphire	LuTop	755.0 nm	Red CCD	
2	ts0603	Ti-Saphire	LuTop	760.0 nm	Red CCD	
2	ts0604	Ti-Saphire	LuTop	765.0 nm	Red CCD	
2	ts0605	Ti-Saphire	LuTop	770.0 nm	Red CCD	
2	ts0705	Ti-Saphire	LuTop	776.0 nm	Red CCD	
2	ts0801	Ti-Saphire	LuTop	780.0 nm	Red CCD	
2	ts0802	Ti-Saphire	LuTop	785.0 nm	Red CCD	
2	ts0803	Ti-Saphire	LuTop	790.0 nm	Red CCD	

2	ts0804	Ti-Saphire	LuTop	795.0 nm	Red CCD	
2	ts0805	Ti-Saphire	LuTop	800.0 nm	Red CCD	
2	ts0806	Ti-Saphire	LuTop	805.0 nm	Red CCD	
2	ts0807	Ti-Saphire	LuTop	810.0 nm	Red CCD	
2	ts0901	Ti-Saphire	LuTop	815.0 nm	Red CCD	
2	ts0902	Ti-Saphire	LuTop	820.0 nm	Red CCD	
2	ts0903	Ti-Saphire	LuTop	825.0 nm	Red CCD	
2	ts0904	Ti-Saphire	LuTop	830.0 nm	Red CCD	
2	ts0905	Ti-Saphire	LuTop	836.0 nm	Red CCD	
2	ts0906	Ti-Saphire	LuTop	840.0 nm	Red CCD	
2	ts0907	Ti-Saphire	LuTop	845.0 nm	Red CCD	
2	ts0908	Ti-Saphire	LuTop	850.0 nm	Red CCD	
2	ts0909	Ti-Saphire	LuTop	855.0 nm	Red CCD	
2	ts0910	Ti-Saphire	LuTop	860.0 nm	Red CCD	
2	ts0911	Ti-Saphire	LuTop	865.0 nm	Red CCD	
2	ts0912	Ti-Saphire	LuTop	870.0 nm	Red CCD	
2	ts0913	Ti-Saphire	LuTop	875.0 nm	Red CCD	
2	ts0914	Ti-Saphire	LuTop	880.0 nm	Red CCD	
2	ts0915	Ti-Saphire	LuTop	885.0 nm	Red CCD	
2	ts0916	Ti-Saphire	LuTop	890.0 nm	Red CCD	
2	ts0917	Ti-Saphire	LuTop	895.0 nm	Red CCD	
2	ts0918	Ti-Saphire	LuTop	900.0 nm	Red CCD	
2	dt0306	Doubled Ti-Saphire	LuMid	370.0 nm	Blue CCD	
2	dt0106	Doubled Ti-Saphire	LuMid	401.0 nm	Blue CCD	
2	dt0606	Doubled Ti-Saphire	LuMid	431.0 nm	Blue CCD	
2	ts0106	Ti-Saphire	LuMid	675.0 nm	Red CCD	
2	ts0306	Ti-Saphire	LuMid	705.0 nm	Red CCD	
2	ts0506	Ti-Saphire	LuMid	745.0 nm	Red CCD	

2	ts0706	Ti-Saphire	LuMid	776.0 nm	Red CCD	
2	dt0307	Doubled Ti-Saphire	LuBot	370.0 nm	Blue CCD	
2	dt0107	Doubled Ti-Saphire	LuBot	401.0 nm	Blue CCD	
2	dt0607	Doubled Ti-Saphire	LuBot	431.0 nm	Blue CCD	
2	ts0107	Ti-Saphire	LuBot	675.0 nm	Red CCD	
2	ts0307	Ti-Saphire	LuBot	705.0 nm	Red CCD	
2	ts0507	Ti-Saphire	LuBot	745.0 nm	Red CCD	
2	ts0707	Ti-Saphire	LuBot	776.0 nm	Red CCD	
3	dc0102	DCM Dye	EdTop	609.0 nm	Red CCD	
3	dc0302	DCM Dye	EdTop	660.0 nm	Red CCD	
3	ts1602	Ti-Saphire	EdTop	905.0 nm	Red CCD	
3	ts1102	Ti-Saphire	EdTop	1000.0 nm	Off Red CCD	
3	dc0103	DCM Dye	EdMid	609.0 nm	Red CCD	
3	dc0303	DCM Dye	EdMid	660.0 nm	Red CCD	
3	ts1603	Ti-Saphire	EdMid	905.0 nm	Red CCD	
3	ts1103	Ti-Saphire	EdMid	1000.0 nm	Off Red CCD	
3	dc0104	DCM Dye	EdBot	609.0 nm	Red CCD	
3	dc0304	DCM Dye	EdBot	660.0 nm	Red CCD	
3	ts1604	Ti-Saphire	EdBot	905.0 nm	Red CCD	
3	ts1104	Ti-Saphire	EdBot	1000.0 nm	Off Red CCD	
3	dc0101	DCM Dye	EsSfc	609.0 nm	Red CCD	
3	dc0301	DCM Dye	EsSfc	660.0 nm	Red CCD	
3	ts1601	Ti-Saphire	EsSfc	905.0 nm	Red CCD	
3	ts1402	Ti-Saphire	EsSfc	945.0 nm	Red CCD	
3	ts1101	Ti-Saphire	EsSfc	1000.0 nm	Off Red CCD	
3	dc0105	DCM Dye	LuTop	609.0 nm	Red CCD	
3	dc0201	DCM Dye	LuTop	614.0 nm	Red CCD	
3	dc0202	DCM Dye	LuTop	620.0 nm	Red CCD	

3	dc0203	DCM Dye	LuTop	625.0 nm	Red CCD	
3	dc0204	DCM Dye	LuTop	629.0 nm	Red CCD	
3	dc0205	DCM Dye	LuTop	635.0 nm	Red CCD	
3	dc0206	DCM Dye	LuTop	640.0 nm	Red CCD	
3	dc0207	DCM Dye	LuTop	645.0 nm	Red CCD	
3	dc0208	DCM Dye	LuTop	650.0 nm	Red CCD	
3	dc0209	DCM Dye	LuTop	655.0 nm	Red CCD	
3	dc0305	DCM Dye	LuTop	660.0 nm	Red CCD	
3	dc0401	DCM Dye	LuTop	665.0 nm	Red CCD	
3	dc0402	DCM Dye	LuTop	670.0 nm	Red CCD	
3	ts1508	Ti-Saphire	LuTop	905.0 nm	Red CCD	
3	ts1605	Ti-Saphire	LuTop	905.0 nm	Red CCD	
3	ts1507	Ti-Saphire	LuTop	910.0 nm	Red CCD	
3	ts1506	Ti-Saphire	LuTop	915.0 nm	Red CCD	
3	ts1505	Ti-Saphire	LuTop	920.0 nm	Red CCD	
3	ts1504	Ti-Saphire	LuTop	925.0 nm	Red CCD	
3	ts1503	Ti-Saphire	LuTop	930.0 nm	Red CCD	
3	ts1502	Ti-Saphire	LuTop	935.0 nm	Red CCD	
3	ts1501	Ti-Saphire	LuTop	940.0 nm	Red CCD	
3	ts1401	Ti-Saphire	LuTop	945.0 nm	Red CCD	
3	ts1205	Ti-Saphire	LuTop	950.0 nm	Red CCD	
3	ts1301	Ti-Saphire	LuTop	950.0 nm	Red CCD	
3	ts1302	Ti-Saphire	LuTop	950.0 nm	Red CCD	
3	ts1303	Ti-Saphire	LuTop	950.0 nm	Red CCD	
3	ts1204	Ti-Saphire	LuTop	960.0 nm	Off Red CCD	
3	ts1203	Ti-Saphire	LuTop	970.0 nm	Off Red CCD	
3	ts1202	Ti-Saphire	LuTop	980.0 nm	Off Red CCD	
3	ts1201	Ti-Saphire	LuTop	990.0 nm	Off Red CCD	

3	ts1105	Ti-Saphire	LuTop	1000.0 nm	Off Red CCD	
3	ts1108	Ti-Saphire	LuTop	1000.0 nm	Off Red CCD	Bad
3	ts1109	Ti-Saphire	LuTop	1000.0 nm	Off Red CCD	
3	dc0106	DCM Dye	LuMid	609.0 nm	Red CCD	
3	dc0306	DCM Dye	LuMid	660.0 nm	Red CCD	
3	ts1606	Ti-Saphire	LuMid	905.0 nm	Red CCD	
3	ts1106	Ti-Saphire	LuMid	1000.0 nm	Off Red CCD	Bad
3	ts1110	Ti-Saphire	LuMid	1000.0 nm	Off Red CCD	
3	dc0107	DCM Dye	LuBot	609.0 nm	Red CCD	
3	dc0307	DCM Dye	LuBot	660.0 nm	Red CCD	
3	ts1607	Ti-Saphire	LuBot	905.0 nm	Red CCD	
3	ts1107	Ti-Saphire	LuBot	1000.0 nm	Off Red CCD	Bad
3	ts1111	Ti-Saphire	LuBot	1000.0 nm	Off Red CCD	
4	co0202	Coumarin	EdTop	540.0 nm	Blue CCD	
4	co0203	Coumarin	EdMid	540.0 nm	Blue CCD	
4	co0204	Coumarin	EdBot	540.0 nm	Blue CCD	
4	co0201	Coumarin	EsSfc	540.0 nm	Blue CCD	
4	dt0801	Doubled Ti-Saphire	LuTop	472.0 nm	Blue CCD	
4	dt0802	Doubled Ti-Saphire	LuTop	481.0 nm	Blue CCD	
4	dt0803	Doubled Ti-Saphire	LuTop	492.5 nm	Blue CCD	
4	co0104	Coumarin	LuTop	505.0 nm	Blue CCD	
4	co0103	Coumarin	LuTop	510.0 nm	Blue CCD	
4	co0102	Coumarin	LuTop	520.0 nm	Blue CCD	
4	co0101	Coumarin	LuTop	525.0 nm	Blue CCD	
4	co0105	Coumarin	LuTop	530.0 nm	Blue CCD	
4	co0106	Coumarin	LuTop	535.0 nm	Blue CCD	
4	co0205	Coumarin	LuTop	540.0 nm	Blue CCD	
4	co0301	Coumarin	LuTop	545.0 nm	Blue CCD	

4	co0302	Coumarin	LuTop	550.0 nm	Red CCD	
4	co0303	Coumarin	LuTop	555.0 nm	Red CCD	
4	co0304	Coumarin	LuTop	560.0 nm	Red CCD	
4	r60109	R6G Dye	LuTop	565.0 nm	Red CCD	
4	r60108	R6G Dye	LuTop	570.0 nm	Red CCD	
4	r60107	R6G Dye	LuTop	575.0 nm	Red CCD	
4	r60106	R6G Dye	LuTop	580.0 nm	Red CCD	
4	r60105	R6G Dye	LuTop	585.0 nm	Red CCD	
4	r60104	R6G Dye	LuTop	590.0 nm	Red CCD	
4	r60103	R6G Dye	LuTop	595.0 nm	Red CCD	
4	r60102	R6G Dye	LuTop	600.0 nm	Red CCD	
4	r60101	R6G Dye	LuTop	605.0 nm	Red CCD	
4	co0206	Coumarin	LuMid	540.0 nm	Blue CCD	
4	co0207	Coumarin	LuBot	540.0 nm	Blue CCD	
5	co0401	Coumarin	LuTop	560.0 nm	Red CCD	
5	r60201	R6G Dye	LuTop	565.0 nm	Red CCD	
5	r60202	R6G Dye	LuTop	570.0 nm	Red CCD	
5	r60203	R6G Dye	LuTop	575.0 nm	Red CCD	
6	dt0901	Doubled Ti-Saphire	LuTop	481.0 nm	Blue CCD	
6	dt0902	Doubled Ti-Saphire	LuTop	481.0 nm	Blue CCD	
6	dt0903	Doubled Ti-Saphire	LuTop	481.0 nm	Blue CCD	
6	dt0904	Doubled Ti-Saphire	LuTop	492.5 nm	Blue CCD	
6	dt0905	Doubled Ti-Saphire	LuTop	492.5 nm	Blue CCD	
6	dt0906	Doubled Ti-Saphire	LuTop	492.5 nm	Blue CCD	
7	ts1701	Ti-Saphire	LuTop	940.0 nm	Red CCD	
7	ts1702	Ti-Saphire	LuTop	945.0 nm	Red CCD	
7	ts1703	Ti-Saphire	LuTop	950.0 nm	Red CCD	
7	ts1704	Ti-Saphire	LuTop	955.0 nm	Red CCD	

7	ts1705	Ti-Saphire	LuTop	960.0 nm	Off Red CCD	
7	ts1706	Ti-Saphire	LuTop	960.0 nm	Off Red CCD	
7	ts1707	Ti-Saphire	LuTop	970.0 nm	Off Red CCD	
7	ts1708	Ti-Saphire	LuTop	980.0 nm	Off Red CCD	
7	ts1709	Ti-Saphire	LuTop	990.0 nm	Off Red CCD	
7	ts1710	Ti-Saphire	LuTop	1000.0 nm	Off Red CCD	
7	ts1711	Ti-Saphire	LuTop	1000.0 nm	Off Red CCD	
7	ts1712	Ti-Saphire	LuTop	1000.0 nm	Off Red CCD	
7	ts1713	Ti-Saphire	LuTop	1000.0 nm	Off Red CCD	
7	ts1716	Ti-Saphire	LuTop	1020.0 nm	Off Red CCD	
7	ts1717	Ti-Saphire	LuTop	1025.0 nm	Off Red CCD	
7	ts1714	Ti-Saphire	LuTop	1100.0 nm	Off Red CCD	
7	ts1715	Ti-Saphire	LuTop	1100.0 nm	Off Red CCD	
7	upts0103	Ti-Saphire	LuMOS	695.0 nm	Red CCD	
7	upts0104	Ti-Saphire	LuMOS	704.0 nm	Red CCD	
7	upts0102	Ti-Saphire	LuMOS	708.0 nm	Red CCD	
7	upts0105	Ti-Saphire	LuMOS	714.0 nm	Red CCD	
7	upts0106	Ti-Saphire	LuMOS	724.0 nm	Red CCD	
7	upts0107	Ti-Saphire	LuMOS	734.0 nm	Red CCD	
7	upts0108	Ti-Saphire	LuMOS	744.0 nm	Red CCD	
7	upts0109	Ti-Saphire	LuMOS	755.0 nm	Red CCD	
7	upts0110	Ti-Saphire	LuMOS	760.0 nm	Red CCD	
7	upts0111	Ti-Saphire	LuMOS	765.0 nm	Red CCD	
7	upts0112	Ti-Saphire	LuMOS	770.0 nm	Red CCD	
7	upts0113	Ti-Saphire	LuMOS	775.0 nm	Red CCD	
7	upts0114	Ti-Saphire	LuMOS	780.0 nm	Red CCD	
7	upts0115	Ti-Saphire	LuMOS	785.0 nm	Red CCD	
7	upts0116	Ti-Saphire	LuMOS	790.0 nm	Red CCD	

7	upts0117	Ti-Saphire	LuMOS	795.0 nm	Red CCD	
7	upts0118	Ti-Saphire	LuMOS	800.0 nm	Red CCD	
7	upts0119	Ti-Saphire	LuMOS	805.0 nm	Red CCD	
7	upts0120	Ti-Saphire	LuMOS	810.0 nm	Red CCD	
7	upts0121	Ti-Saphire	LuMOS	815.0 nm	Red CCD	
7	upts0122	Ti-Saphire	LuMOS	820.0 nm	Red CCD	
7	upts0123	Ti-Saphire	LuMOS	830.0 nm	Red CCD	
7	upts0124	Ti-Saphire	LuMOS	840.0 nm	Red CCD	
7	upts0125	Ti-Saphire	LuMOS	850.0 nm	Red CCD	
7	upts0126	Ti-Saphire	LuMOS	860.0 nm	Red CCD	
7	upts0127	Ti-Saphire	LuMOS	862.0 nm	Red CCD	
7	upts0128	Ti-Saphire	LuMOS	864.0 nm	Red CCD	
7	upts0129	Ti-Saphire	LuMOS	870.0 nm	Red CCD	
7	upts0130	Ti-Saphire	LuMOS	880.0 nm	Red CCD	
7	upts0148	Ti-Saphire	LuMOS	890.0 nm	Red CCD	
7	upts0131	Ti-Saphire	LuMOS	900.0 nm	Red CCD	
7	upts0149	Ti-Saphire	LuMOS	910.0 nm	Red CCD	
7	upts0132	Ti-Saphire	LuMOS	920.0 nm	Red CCD	
7	upts0133	Ti-Saphire	LuMOS	930.0 nm	Red CCD	
7	upts0134	Ti-Saphire	LuMOS	940.0 nm	Red CCD	
7	upts0135	Ti-Saphire	LuMOS	945.0 nm	Red CCD	
7	upts0136	Ti-Saphire	LuMOS	950.0 nm	Red CCD	
7	upts0137	Ti-Saphire	LuMOS	955.0 nm	Red CCD	
7	upts0138	Ti-Saphire	LuMOS	960.0 nm	Off Red CCD	
7	upts0139	Ti-Saphire	LuMOS	960.0 nm	Off Red CCD	
7	upts0140	Ti-Saphire	LuMOS	970.0 nm	Off Red CCD	
7	upts0141	Ti-Saphire	LuMOS	980.0 nm	Off Red CCD	
7	upts0142	Ti-Saphire	LuMOS	990.0 nm	Off Red CCD	

7	upts0143	Ti-Saphire	LuMOS	1000.0 nm	Off Red CCD	
7	upts0144	Ti-Saphire	LuMOS	1000.0 nm	Off Red CCD	
7	upts0145	Ti-Saphire	LuMOS	1010.0 nm	Off Red CCD	
7	upts0146	Ti-Saphire	LuMOS	1021.0 nm	Off Red CCD	
7	upts0147	Ti-Saphire	LuMOS	1025.0 nm	Off Red CCD	
7	upts0101	Ti-Saphire	Ambient	0.0 nm	Blue CCD	
8	updt0105	Doubled Ti-Saphire	LuMOS	357.0 nm	Blue CCD	
8	updt0104	Doubled Ti-Saphire	LuMOS	367.0 nm	Blue CCD	
8	updt0103	Doubled Ti-Saphire	LuMOS	379.0 nm	Blue CCD	
8	updt0102	Doubled Ti-Saphire	LuMOS	391.0 nm	Blue CCD	
8	updt0106	Doubled Ti-Saphire	LuMOS	400.0 nm	Blue CCD	
8	updt0107	Doubled Ti-Saphire	LuMOS	410.0 nm	Blue CCD	
8	updt0108	Doubled Ti-Saphire	LuMOS	422.0 nm	Blue CCD	
8	updt0109	Doubled Ti-Saphire	LuMOS	432.0 nm	Blue CCD	
8	updt0110	Doubled Ti-Saphire	LuMOS	442.0 nm	Blue CCD	
8	updt0111	Doubled Ti-Saphire	LuMOS	450.0 nm	Blue CCD	
8	upar0109	Argon Ion	LuMOS	454.5 nm	Blue CCD	
8	upar0108	Argon Ion	LuMOS	457.9 nm	Blue CCD	
8	updt0112	Doubled Ti-Saphire	LuMOS	460.0 nm	Blue CCD	
8	upar0107	Argon Ion	LuMOS	465.8 nm	Blue CCD	
8	updt0113	Doubled Ti-Saphire	LuMOS	470.0 nm	Blue CCD	
8	upar0106	Argon Ion	LuMOS	472.7 nm	Blue CCD	
8	upar0105	Argon Ion	LuMOS	476.5 nm	Blue CCD	
8	updt0114	Doubled Ti-Saphire	LuMOS	480.0 nm	Blue CCD	
8	upar0104	Argon Ion	LuMOS	488.0 nm	Blue CCD	
8	upar0103	Argon Ion	LuMOS	496.5 nm	Blue CCD	
8	upar0102	Argon Ion	LuMOS	501.0 nm	Blue CCD	
8	upar0101	Argon Ion	LuMOS	514.5 nm	Blue CCD	

8	upr60101	R6G Dye	LuMOS	565.0 nm	Red CCD	
8	upr60106	R6G Dye	LuMOS	570.0 nm	Red CCD	
8	upr60102	R6G Dye	LuMOS	575.0 nm	Red CCD	
8	upr60103	R6G Dye	LuMOS	585.0 nm	Red CCD	
8	upr60104	R6G Dye	LuMOS	595.0 nm	Red CCD	
8	upr60105	R6G Dye	LuMOS	605.0 nm	Red CCD	
8	updc0101	DCM Dye	LuMOS	614.5 nm	Red CCD	
8	updc0102	DCM Dye	LuMOS	624.7 nm	Red CCD	
8	updc0103	DCM Dye	LuMOS	634.9 nm	Red CCD	
8	updc0104	DCM Dye	LuMOS	645.5 nm	Red CCD	
8	updc0105	DCM Dye	LuMOS	655.3 nm	Red CCD	
8	updc0106	DCM Dye	LuMOS	665.6 nm	Red CCD	
8	updc0107	DCM Dye	LuMOS	671.4 nm	Red CCD	
8	updc0108	DCM Dye	LuMOS	676.4 nm	Red CCD	
8	updc0109	DCM Dye	LuMOS	682.1 nm	Red CCD	
8	updc0110	DCM Dye	LuMOS	688.0 nm	Red CCD	
8	updt0101	Doubled Ti-Saphire	Ambient	0.0 nm	Blue CCD	
9	upco0108	Coumarin	LuMOS	506.4 nm	Blue CCD	
9	upco0107	Coumarin	LuMOS	515.2 nm	Blue CCD	
9	upco0106	Coumarin	LuMOS	525.2 nm	Blue CCD	
9	upco0105	Coumarin	LuMOS	535.0 nm	Blue CCD	
9	upco0104	Coumarin	LuMOS	545.2 nm	Blue CCD	
9	upco0102	Coumarin	LuMOS	555.0 nm	Red CCD	
9	upco0103	Coumarin	LuMOS	559.7 nm	Red CCD	
9	upco0101	Coumarin	Ambient	0.0 nm	Blue CCD	

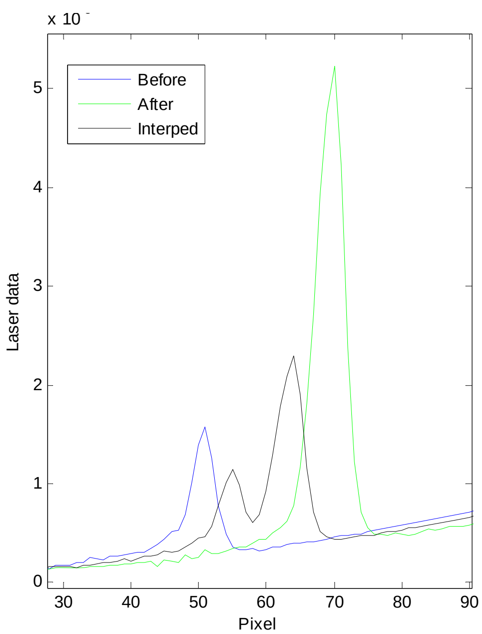
Appendix A - PROCESSING PROGRAMS AND PLOTTING FUNCTIONS

To recreate the NIST2008_01_M241_dayD.mat (where D = the day) file run the process_ function and chose the day to process. The function Lvauxtyp_ will list were the needed info is stored in Vaux. The mosqchk_simple_ program was used to remove spikes, remove bad scans and deal with other problems (see Appendix B).

BSGmat and RSGmat are then run to create the M241_BSG_LuTop.mat and M241_RSG_LuTop.mat MAT-files which contain all the laser data for each spec. This is also were more bad data is removed.

Before the data can be smoothed you must know where the reflection peaks are, smoothing does not include data within plus or minus 30 pixels from the main or reflection peak. getrefl_ is a jury-rigged function that lets you click on the left and right side of the reflection peak when plotted. Then a regression for the left edged and width of the reflection peak is calculated. These regression coefficients are then used to find the reflection peak.

smoothBSG_ and smoothRSG_ are then used to create M241_BSG_LuTop_smoothed.mat and M241_RSG_LuTop_smoothed.mat. A gaussian curve is used to fix the data, the default is gaussian has a FWHM of 5 pixels. As the pixel being smoothed moves farther from the main peak the FWHM increases, 12 pixels is about the max value. This does a good job of smoothing the noisier ends better.



Then BSGcrtspr3_ and RSGcrtspr3_ are used to create the SPR. This function is similar to the one used for the ROV in that the majority of the laser data is interpolated using a linear interpolation from one laser to the next laser, filling in the missing laser data. This method has to be modified because the MOBY reflection peaks are much narrower then the ROV one and the interpolated reflection peaks did not “morphy” smoothly from one peak to the next (see Figure). The solution required extracting the reflection peaks of the two laser, overlay them on top of each other and linearly interpolate. And then put them back into the new laser data at the correct location (ie just because the main peak moved one pixel does not mean the reflection peak need to move 1 pixel). Once this was done the SPR created looked very good. This method results in a much smoother SPR but requires a lot more fiddling than the old method.

These are the SPR created using the new method
MOF_BSG_RPSPEC_N0801_LASEROBS_080625_1705_PIXEL.mat
MOF_RSG_RPSPEC_N0801_LASEROBS_080625_1705_PIXEL.mat
These are the ones created using the OLD method
MOF_BSG_N0801_LASEROBS_080623_1342_PIXEL.mat

MOF_RSG_N0801_LASEROBS_080623_1348_PIXEL.mat

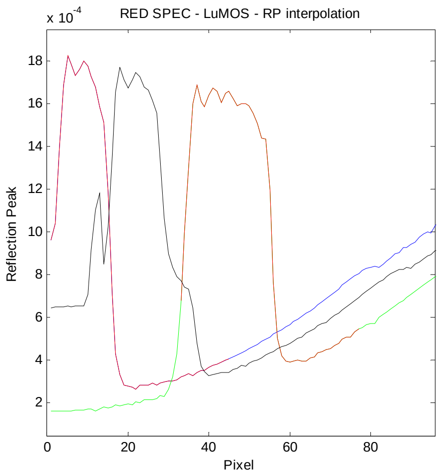
LuMOS
The functions BSGmat_other and RSGmat_other create the MAT-file of laser lines for all the other sensors including LuMOS.

The functions smoothBSG_other_.and smoothRSG_other_.m smooth all the sensors other than LuTop and LuMOS. The reason LuMOS is not done by this function is that the reflection peaks are not in the same place as the fibered data, so I need a separate function to smooth LuMOS.

getrefl_LuMOS_.m is used to get the reflection peaks left edge and width.

Main BSG reflection peak
BSG LE reflection peak regression 1.78537688 -205.51776347
BSG width reflection peak regression -0.00135943 0.62459085 -19.08439034
Secondary BSG reflection peak
BSG LE reflection peak regression 2.21142486 32.49924782
BSG width reflection peak regression -0.00103505 -0.10958523 30.85243325
Main RSG reflection peak
RSG LE reflection peak regression = 1.80854232 -1182.68132467
RSG width reflection peak regression = -0.00040958 0.47622990 -89.73186375
Secondary RSG reflection peak
RSG LE reflection peak regression 3.76521513 -2205.44951087
RSG width reflection peak regression -0.01163849 15.85997002 -5308.42043112

smoothBSG_LuMOS_ and smoothBSG_LuMOS_ smooths the LuMOS laser lines, the above peak coeff were used remove the reflection peaks before smoothing the data.



When I tried to used to method I used for the LuTop on the LuMOS data the reflection peaks were not happy, ARGH! (BSGcrtspr3_LuMOS_.m is the function to see this plot).

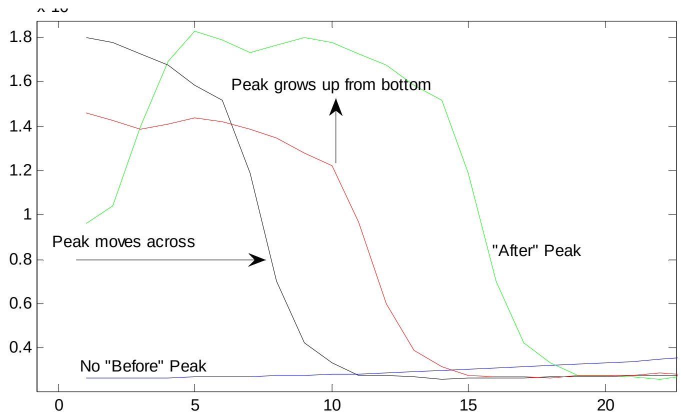
Note the step to the right of the black reflection peak. This is caused because one reflection peak is narrower than the other and the steep sides. This is not what we want this to look like. We want the peak to get progressively wider.

The extra peak on the left side is because the first reflection peak starts off the CCD and is a separate problem to solve. It only affects the first laser obs.

One of the factors making the problem worse that the reflection peaks were being “lined up” by the max value which usually was the left edge of the reflection peak, rather than being centered over each others. So BSGcrtspr4_LuMOS_.m centered the reflection peaks before the linear interp. However when the width of the reflection is not similar the steps still appear. What we want is the reflection peaks to just get wider without the steps.

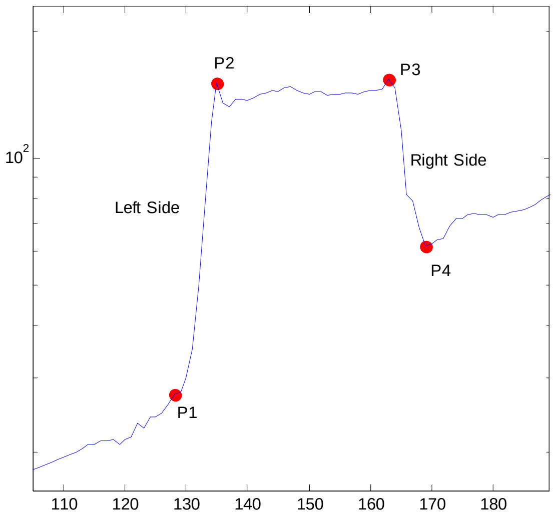
So to that end BSGcrtspr5_LuMOS_.m will attempt to do this.

What a pain in the ass!! ARGH.



The first problem solved is the first peak which did not have an “before” peak when the linear interp is used the peak grows up from the bottom (red line). This is not correct the reflection peak should move in from the side. So I had to add a section whch took the after peak and moved it onto the CCD at the correct rate and at the correct time.

There was a simlar problem of both the before and after peak were both not completely on the array and a separate section needed to be written to deal with this.



So the only way to fix the reflection peaks was to first find all “4 corners” of the reflection peak (P1,2,3,4). So I used ginput to click on each reflection peak to get their positions. The red dot on the figure to the left are and example of the “corners” chosen.

I then had to move the before and after peak so the left sides were aligned and linearly interpolate them. Then the right sides were aligned and interpolated . The right and left side interpolated data when had to be stuck back together correctly. So the width of the new reflection peak had to be calculated and the two halfs (right and left) were put back together. Once you have a completed new peak you need to stick it back into the interpolated SPR at the right spot, by 1) moving it over the correct number of pixels, and 2) finding the correct starting and stopping point for the refleciton peak. This last part was done by hand. I again used ginput to click on the indexs were I wanted the new reflection peak to be input.

I then used the LuTop reflection peak interpolation method to linearly interp the secondary peak found on the blue spec.

LVAUXTYP_ - Explain Variable Auxiliaries for MOBY241 Laser

Each instrument scan or profile may be accompanied by auxiliary data contained in Vaux. The first 30 words are used in common by several instruments. Instrument-specific data may follow. The following gives the meaning of each field. Codes are defined in CODEBK_.M

Vaux [VN,Nscans]	Meaning	Codes in CODEBK_.M
Vaux(01,N) = Vaux Code	Identifying Vaux Data Type	EXTENSIONS
Vaux(02,N) = VVV	Number of values in Vaux	
Vaux(03,N) = VVV	Instrument Type	
Vaux(04,N) = 2.xxx	MOBY/MOS config #	
Vaux(05,N) =		
Vaux(06,N) = 21 or 10	Sensor.DataType	
Vaux(07,N) = 2	Laser	
Vaux(08,N) =		
Vaux(09,N) =		
Vaux(10,N) =		
Vaux(11,N) = YYMMDD.HHMMSS	Observation	Date.Time
Vaux(12,N) =		
Vaux(13,N) =		
Vaux(14,N) =		
Vaux(15,N) =		
Vaux(16.N) =		
Vaux(17.N) = Code	Primary Data Processing	PROCESSING cumulative
Vaux(18,N) = FIXED	1= laser data modifed see BSGmat or RSGmat	
Vaux(19,N) =		
Vaux(20,N) = Time	Blue Integration Time/Gain	
Vaux(21,N) = Time	Red Integration Time/Gain	
Vaux(22,N) =		
Vaux(23,N) =		
Vaux(24,N) = Day Number		
Vaux(25,N) = SubFile Number	the last two digits 01:07 are Es,t,m,b, LuT,m,b	
Vaux(26,N) = File number		
Vaux(27,N) = laser wavelength		
Vaux(28,N) = i	BLUE Peak index	
Vaux(29,N) = Z	BLUE In-band area, plus or minus 9 from i	
Vaux(30,N) = i	RED Peak index	
Vaux(31,N) = Z	RED In-band area, plus or minus 9 from i	
Vaux(32,N) = DCV Day 7 laser		
Vaux(33,N) =		
Vaux(34,N) = Max blue value		
Vaux(35,N) = Max red value		
Vaux(36,N) =		

MOBY processing and validation

I wrote two programs to SLC some MOBY data and system response with the new SLC SPR.

processmoby_ - processes the input adjusted MOBY file
processmobyrsp_ - processes the moby system reponse

M239_mobytests - directory containing the MOBY adjusted data
M239_orig - directory containing the orginally processed MOBY data

A few things are needed to process the data.

1) MOBY files which have already been adjusted (*a.mby), so go to the MOBYxxx\precals dir and open nmoby_ and uncomment out the section which write the *a.mby file. Run nmoby_ on a few files and copy these files to the M239_mobytests dir.

2) open and edit mkmobyrsp_ so that the precursor file is saved and copy that file in to the dir above the M239_mobytests.

You will need to make sure the correct deployment and system response is used in the processmoby_.m and processmobyrsp_.m files before preseding. Also make sure the correct SPR is listing at the top of processmoby_.m. Then run processmoby_(ADJMOBYfile). This will SLC and save the file. A plot may also appear depending on what has been turned off.

Programs which need to be rerun to reprocess the SPR

```
cd C:\zflora\mldata\straylite\NIST_mos\NIST2008_01\lasers

for D = 1:9
  process_(D)
end


BSGmat_LuTop
BSGmat_other
smoothBSG_LuTop_
smoothBSG_LuMOS_
smoothBSG_other_

RSGmat_LuTop
RSGmat_other
smoothRSG_LuTop_
smoothRSG_LuMOS_
smoothRSG_other_


prcallspr_
        BSGcrtspr3_LuTop_
        RSGcrtspr3_LuTop_
        BSGcrtspr5_LuMOS_
        RSGcrtspr6_LuMOS_
```

Processing Steps

A: Create SPR

1.) The net signal is calculated using the averge lites and darks.

net_signal(ADU) = avg lite scans(ADU) - avg dark scans(ADU)
[Nlite=3 or 5, Ndark=2]

2.) Then the intergration times are interpolated to calibrated times and the net signal is divided by the integration time and bin factor.

ADU/pix/sec = net_signal(ADU) / calibrated_integration_time(sec) / nominal_bin_factor(pix)

3.) Create a MAT file of all the Lutop BSG laser data or LuMOS red spec data. So that there is a file for each spectrograph and sensor. At this point any spikes, missing data or problems with the data are either fixed or the data is removed.

4.) The laser observations are then smoothed using a running gaussian weighing function. The full width half max of the gausian curve starts a 5, as the pixel being smoothed gets farther from the main laser peak the width increases upto about 12 pixels wide as the edges. This takes into account the fact that the data is much noisier farther from the main peak. The reflection peaks and main peak are not smoothed and left unchanged in the laser observation. This includes any secondary peaks.

5.) in-band-area = integral (+- 9 pixels about max pix for ADU/pix/sec spectra) (ADU/pix/sec)

6.) norm_responsivity (no units ?) = net_signal(ADU/pix/sec) / in-band-area(ADU/pix/sec)

7.) load norm_responsivity into correct columns of SPR (512x512 pixels for each spec)

8.) Interpolate missing columns of SPR. This is really painful and spiffed for each spectrograph/sensor combination. Features to be interpolate are lined up and then linearly transformed from one to the other. The features (Main laser obs, primary and secondary reflection peak) are them placed back into the SPR with the correct indexes. Since a picture is worth a thousand words some examples are at the end of this section.

B: Apply SLC

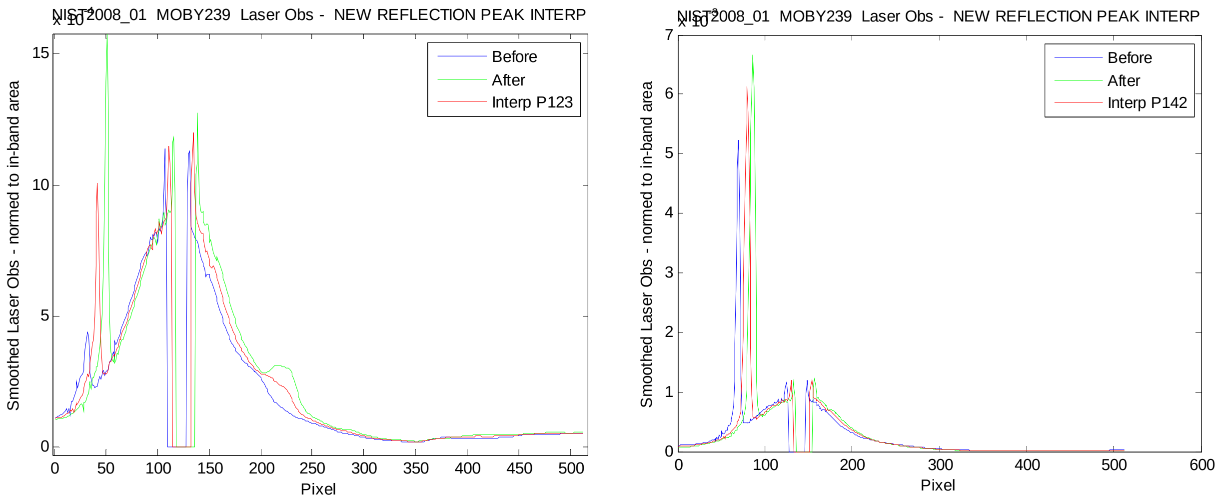
1.) thermal_correct ADU/pix/sec spectra to be SLC'ed (vs 32degC TT7 temperature)
2.) set = zero any NaN in ADU/pix/sec spectra to be SLC'ed
3.) Calculate the identity matrix add that to the SPR and then matrix divide by in-water or calibration signal

slc_corrected(ADU/pix/sec) = (515x512_identity_matrix + SPR) / ADU/pix/sec

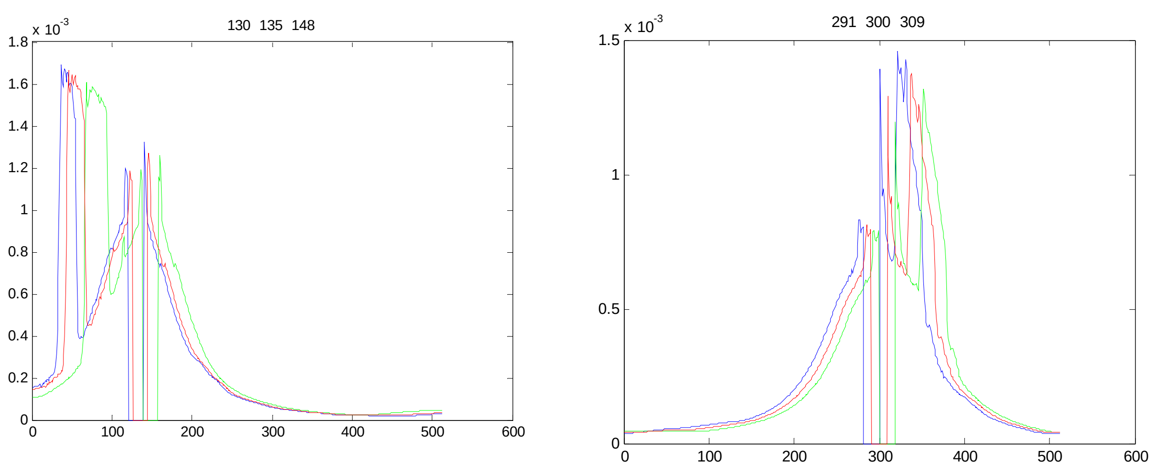
4.) replace zeros removed in step 2 in corrected ADU/pix/sec
5-a.) SLC system response = SLC cal_lamp scan net_signal (ADU/pix/sec) / cal lamp radiance

(uW/cm2/sr/nm)
5-b.) SLC radiance = SLC measured net_signal(ADU/pix/sec) / SLC system response

(ADU/pix/sec / uW/cm2/sr/nm)



Above are examples of the linear inperolation of the LuTop BSG data



Above are examples of the linear inperolation of the LuMOS BSG data

APPENDIX B - Problems with Laser data

The following figures show some of the problems I found in the first few days of laser data. On day 1 32 of the 64 files has problems, on day 2 42 of the 109 files had problems and on day 3 18 of the 61 files had problems.

In may cases I could just remove the offending scan. But this was not always the case of use a fill function to remove the noise event. But when there were level changes things got more compilated. The biggest problem is that may of these are on the edges of the laser data which would affect the level of the diffuse stray light. I am not sure if this is a significant problem or not but in the future it would be really helpful to take more dark and lite scans on the first few days.

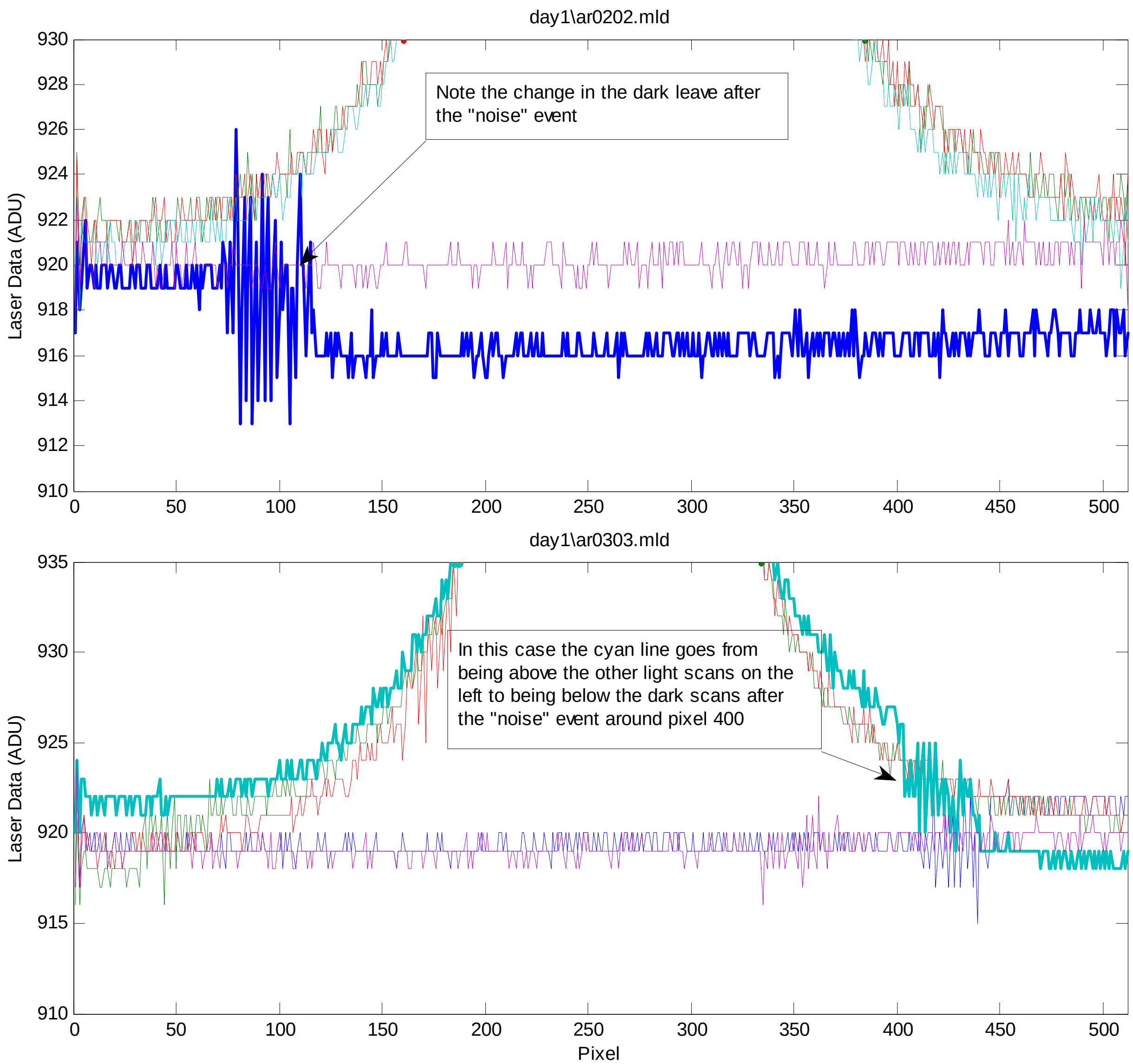


Figure 99

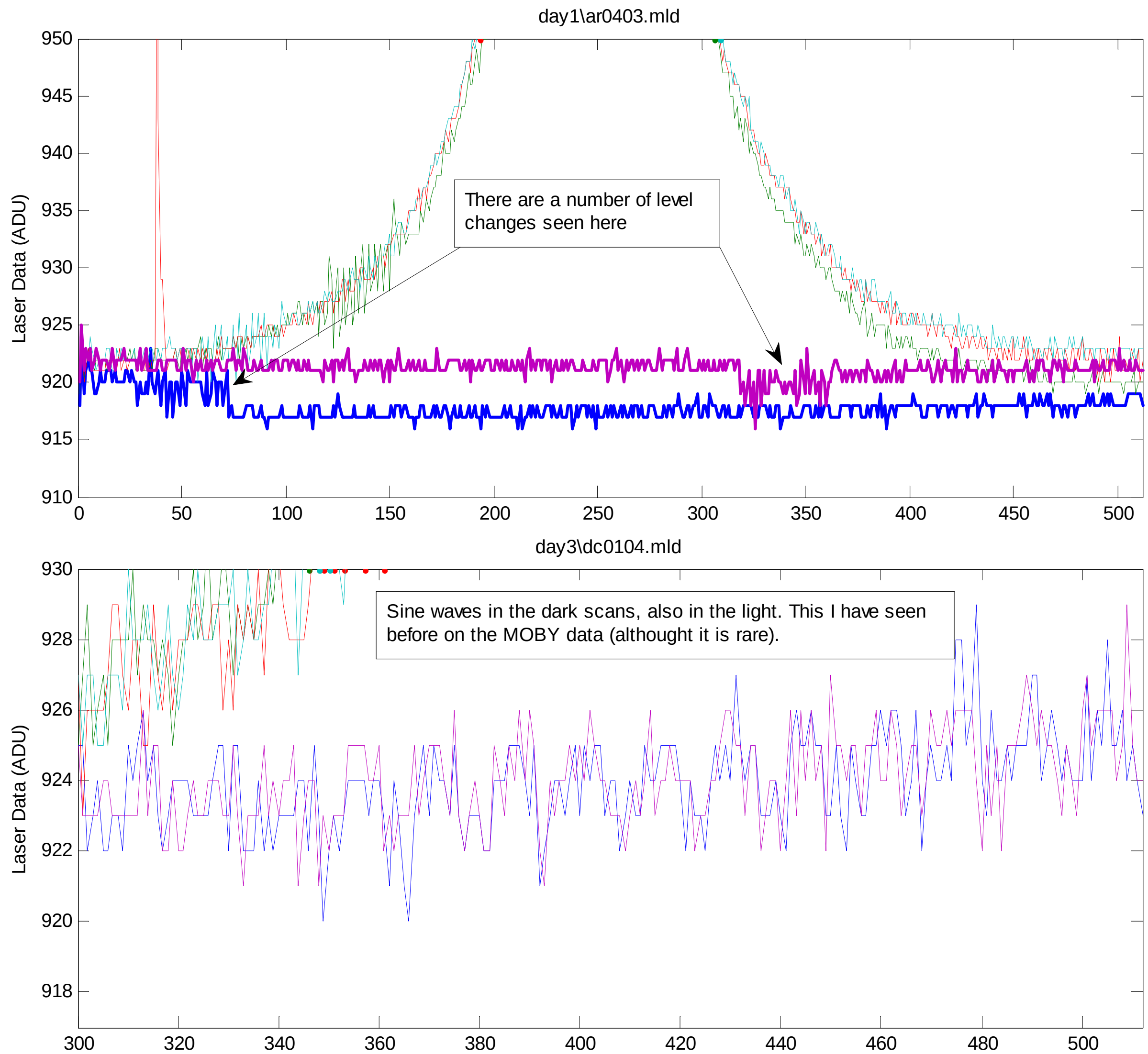

day1\ar0403.mld
Laser Data (ADU)
There are a number of level changes seen here
day3\dc0104.mld
Laser Data (ADU)
Sine waves in the dark scans, also in the light. This I have seen before on the MOBY data (althought it is rare).

Figure 100

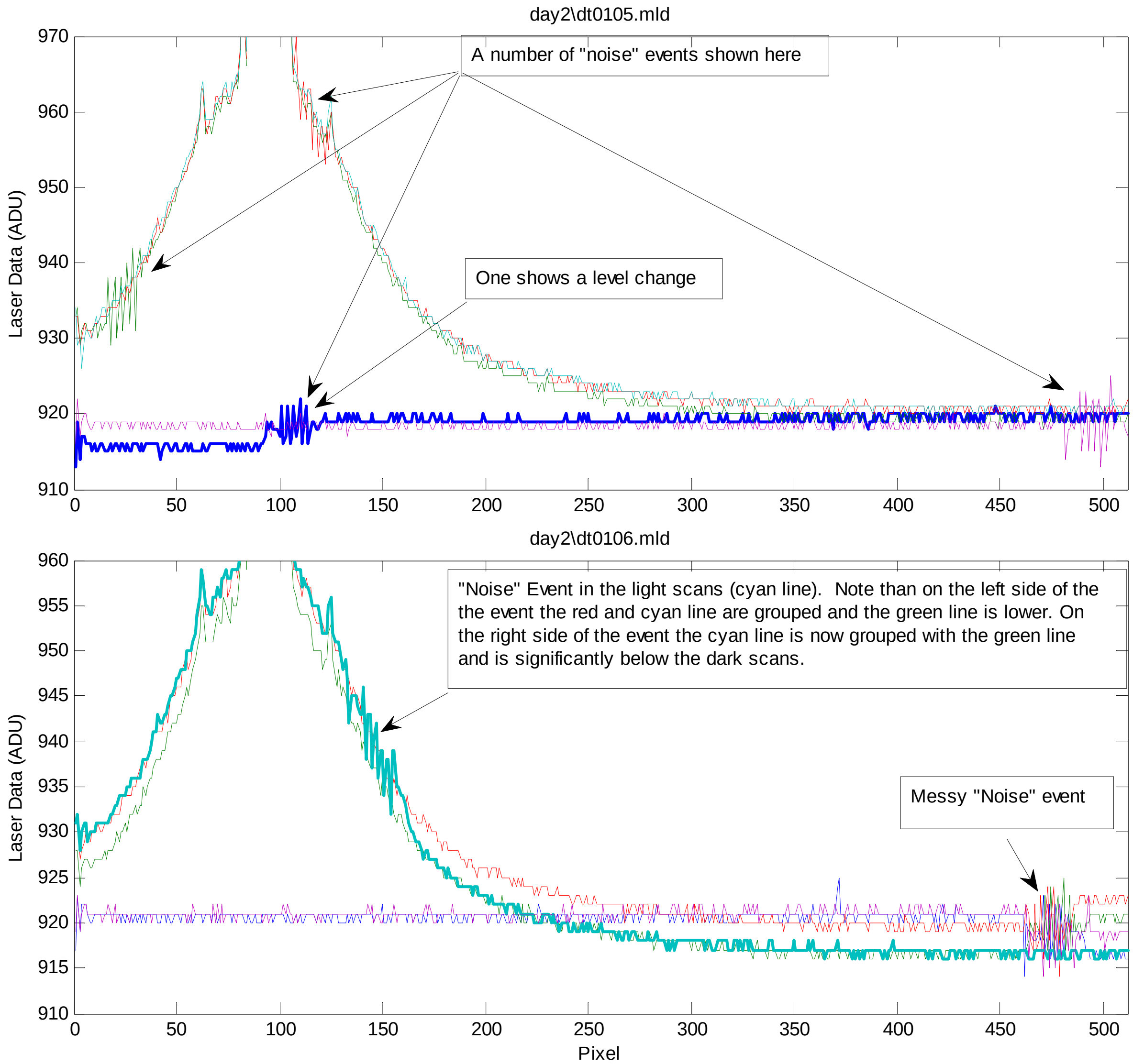

day2\dt0105.mld
A number of "noise" events shown here
One shows a level change
Laser Data (ADU)
970
960
950
940
930
920
910
0
50
100
150
200
250
300
350
400
450
500
day2\dt0106.mld
"Noise" Event in the light scans (cyan line). Note than on the left side of the the event the red and cyan line are grouped and the green line is lower. On the right side of the event the cyan line is now grouped with the green line and is significantly below the dark scans.
Messy "Noise" event
Laser Data (ADU)
960
955
950
945
940
935
930
925
920
915
910
Pixel

Figure 101

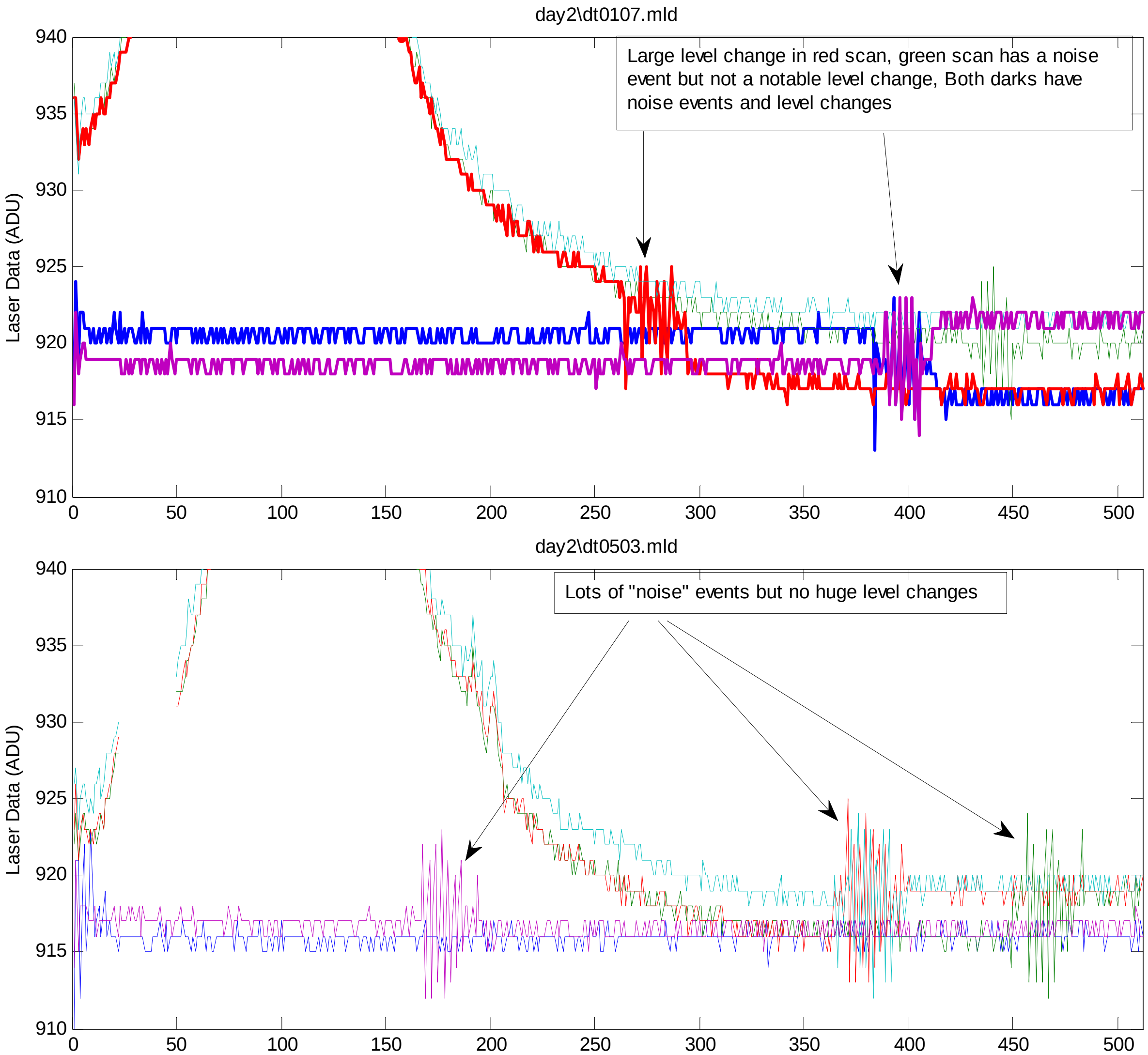

day2\dt0107.mld
Large level change in red scan, green scan has a noise event but not a notable level change, Both darks have noise events and level changes
Laser Data (ADU)
940
935
930
925
920
915
910
0
50
100
150
200
250
300
350
400
450
500
day2\dt0503.mld
Lots of "noise" events but no huge level changes
Laser Data (ADU)
940
935
930
925
920
915
910
0
50
100
150
200
250
300
350
400
450
500

Figure 102