



GODDARD SPACE FLIGHT CENTER

Status and improvements of J1 OMPS pre-launch calibration

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14 May 2014





Outline

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- **Instrument design changes**
 - Wavelength coverage
 - QVD
- **Calibration test phase summary**
- **Calibration issues**
 - Diffuser stability
 - G/I and R recalibration summary
- **Summary**

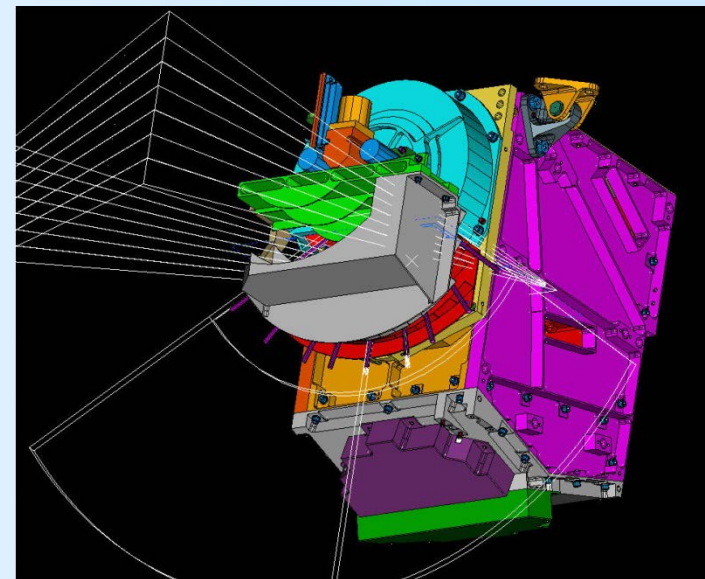




JPSS OMPS instrument design changes

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- **No Limb sensor**
 - **J1 Nadir instrument overview**
 - 110deg FOV
 - Nadir Profiler: 250-310nm
 - Total Column: 305-380, **417nm***
 - **Enhanced spatial resolution with new timing patterns***
 - Nadir Profiler: 250km to TBD
 - TC Mapper: 50km to 15km
 - **2 quasi-volume diffusers***
 - **TC slit redesigned to reduce “puckering”***
 - **Optical mounts redesigned to improve boresight stability***
- *Differences wrt NPP OMPS**



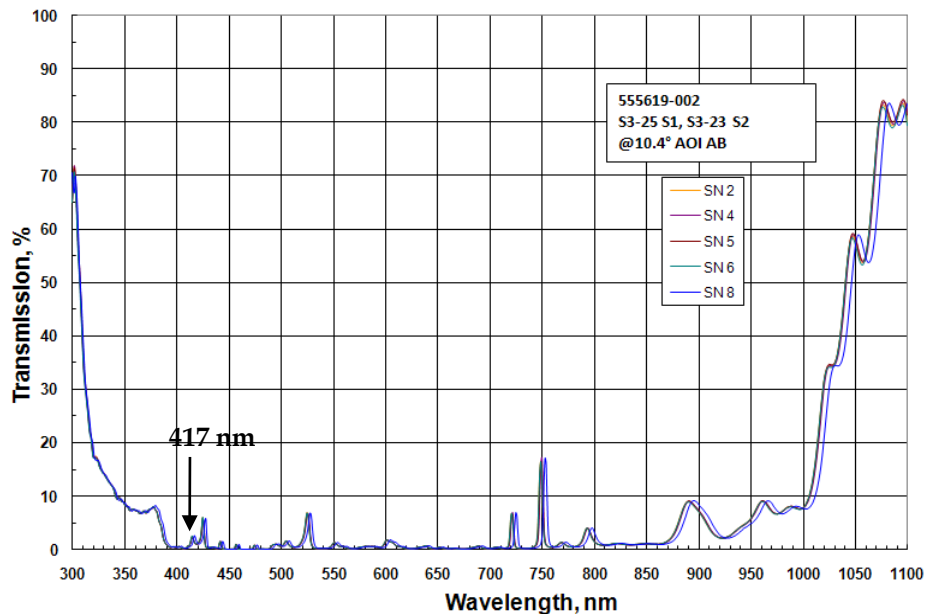


J1 OMPS TC wavelength coverage

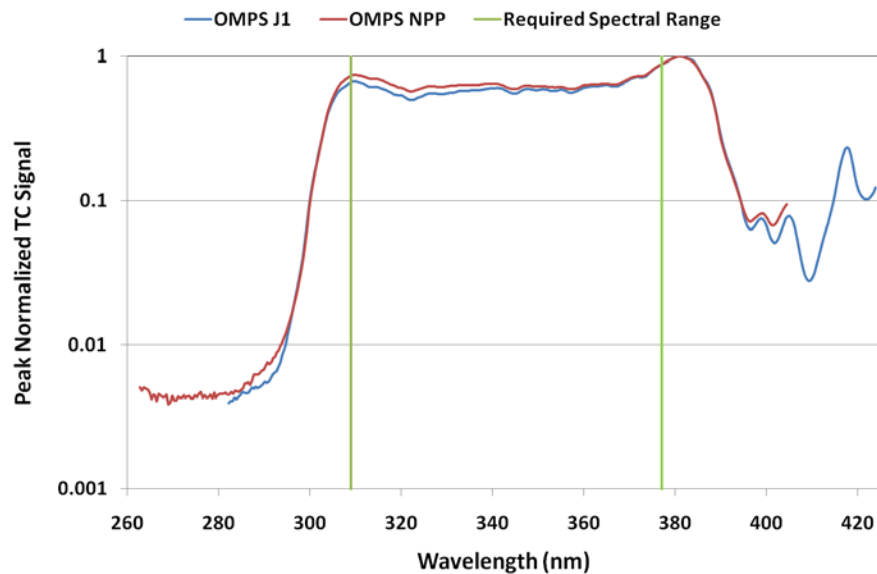
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- J1 Total Column (TC) modified optical alignment permits wavelengths up to ~420nm to be measured.

Total Column Filter Transmittance



Comparison of OMPS NPP and OMPS J1 TC Spectral Range
(Based on IM2 Images)



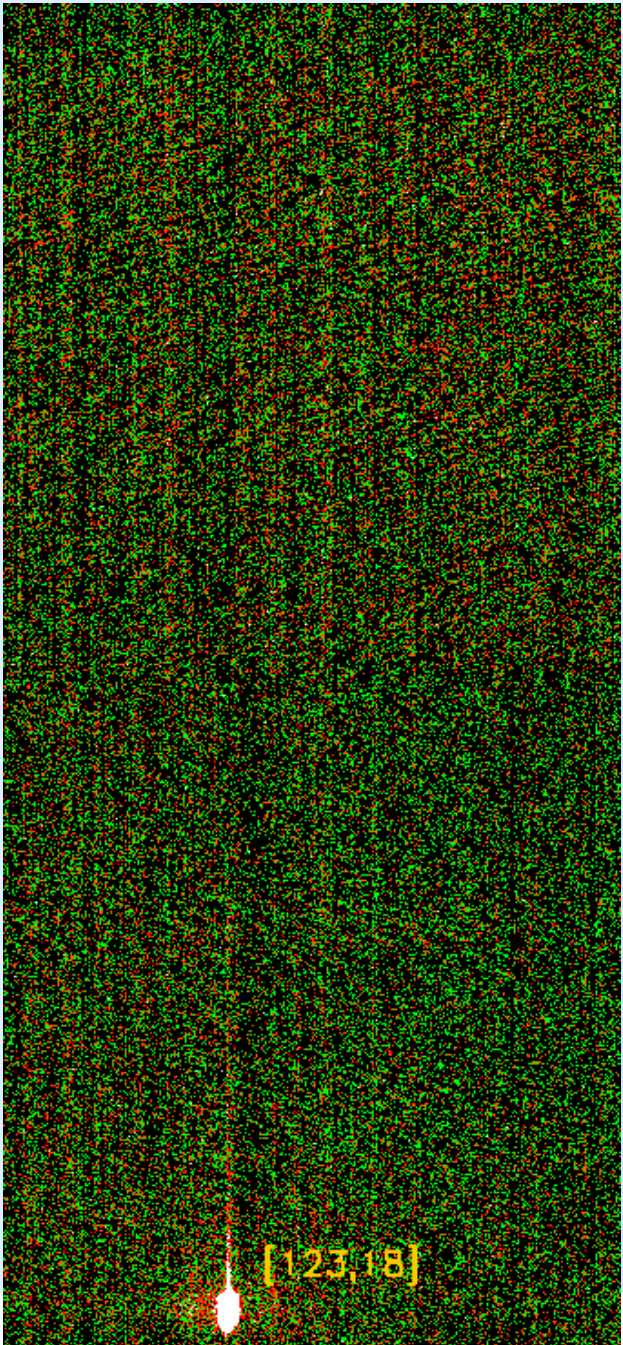
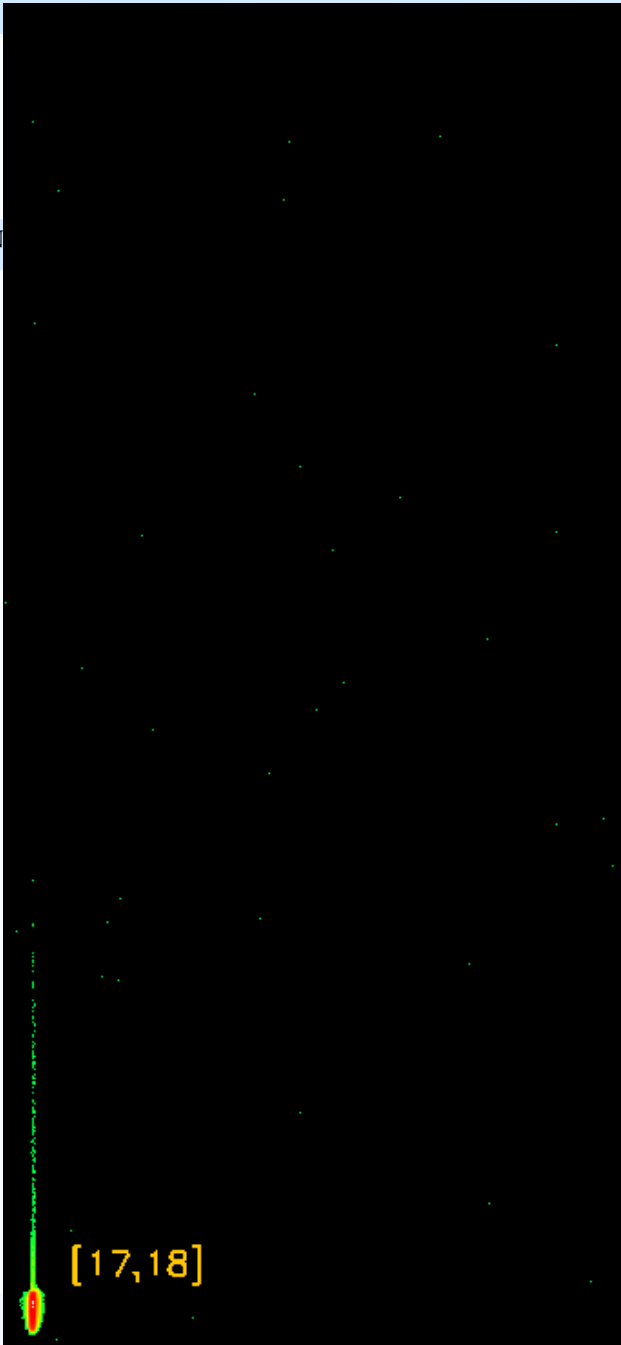


GODDARD SPACE FLIGHT CEN

OGTC
Az: -54deg

Left: 417nm

Right:372nm



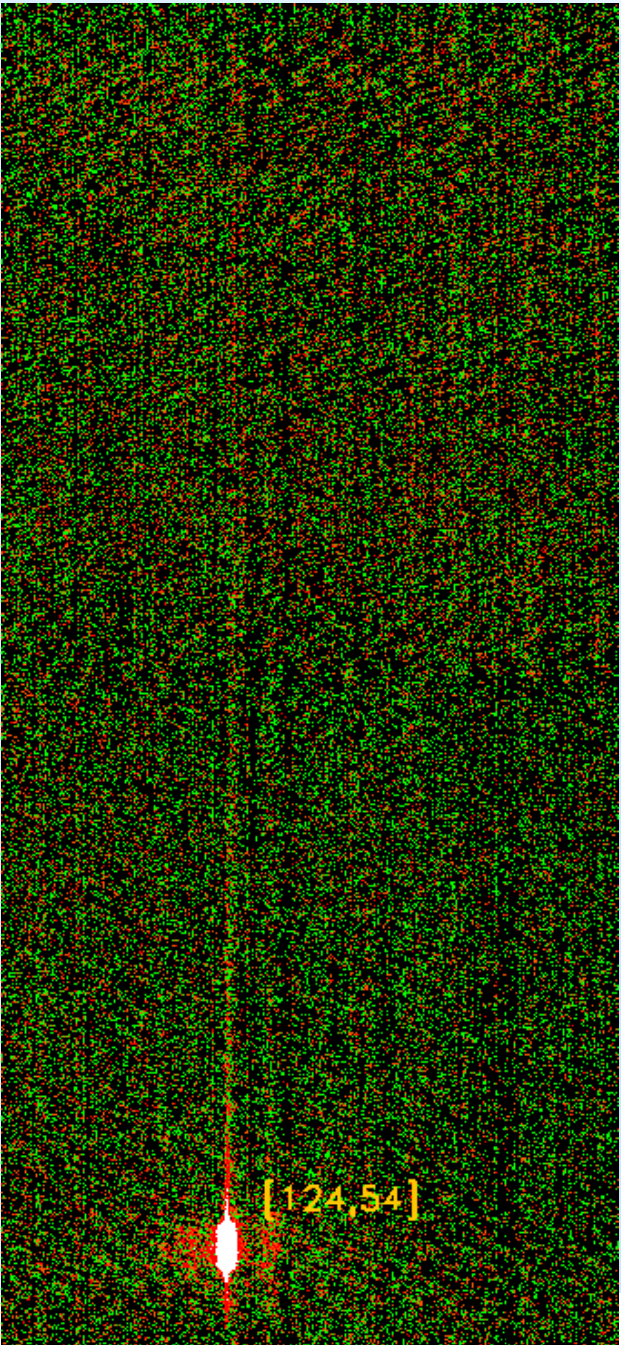
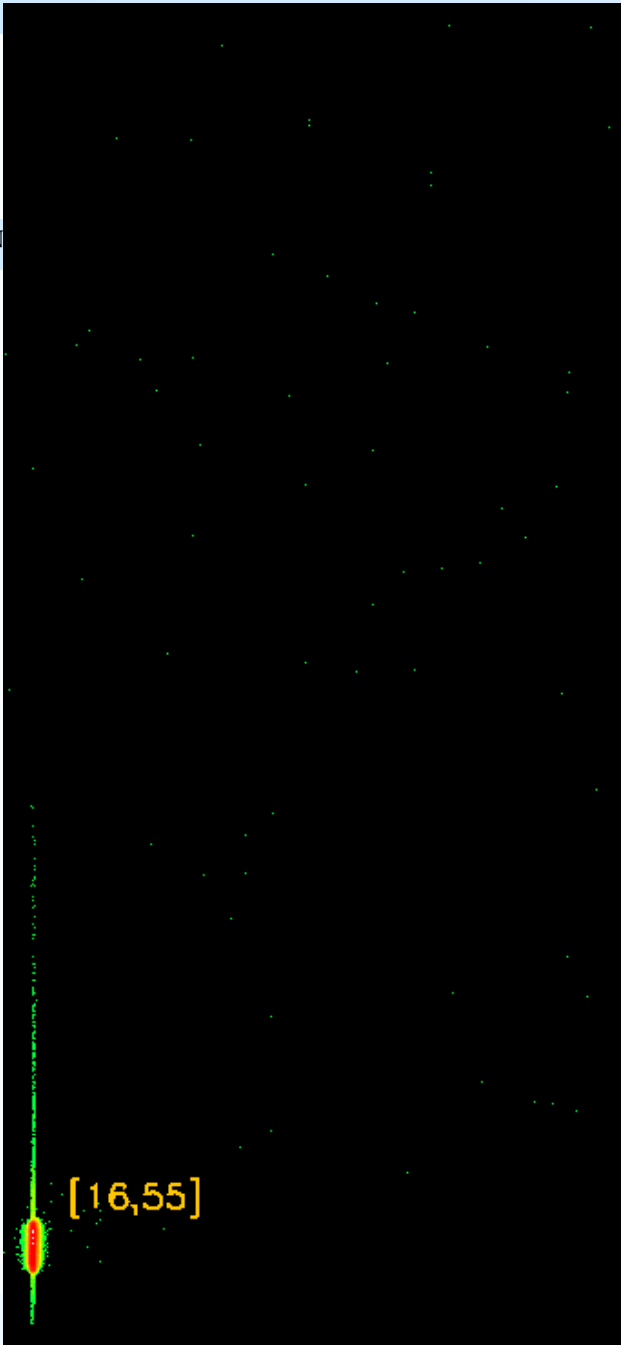


GODDARD SPACE FLIGHT CEN

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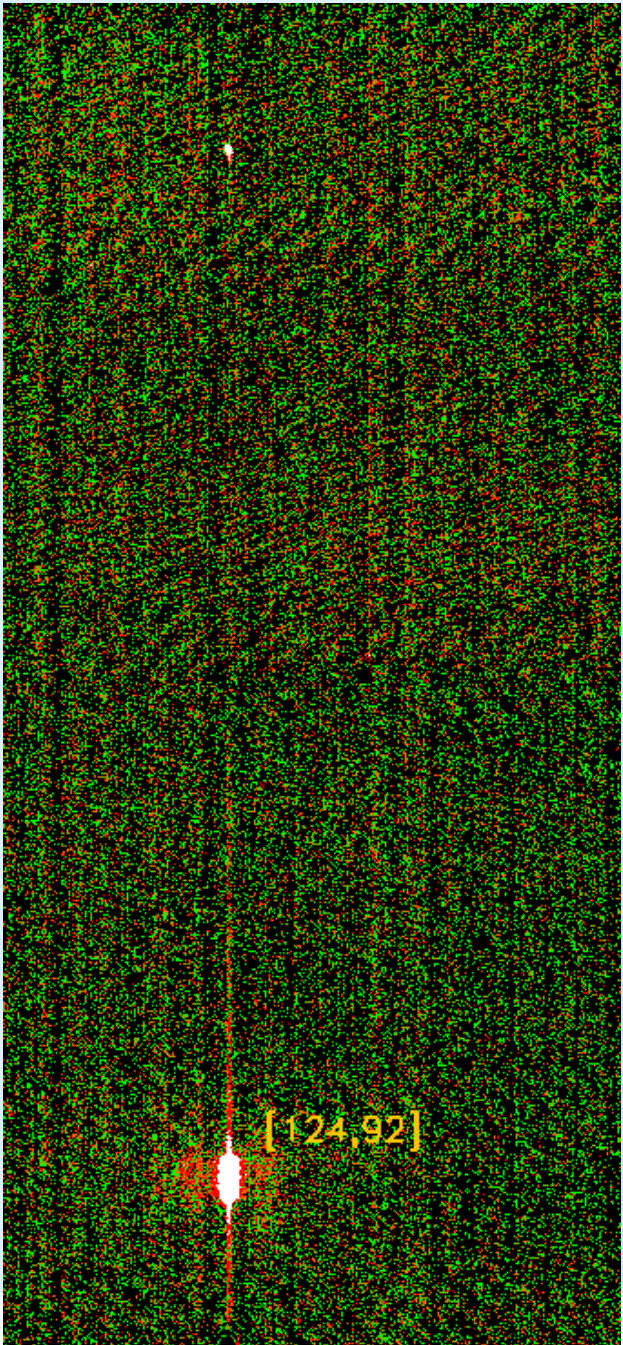
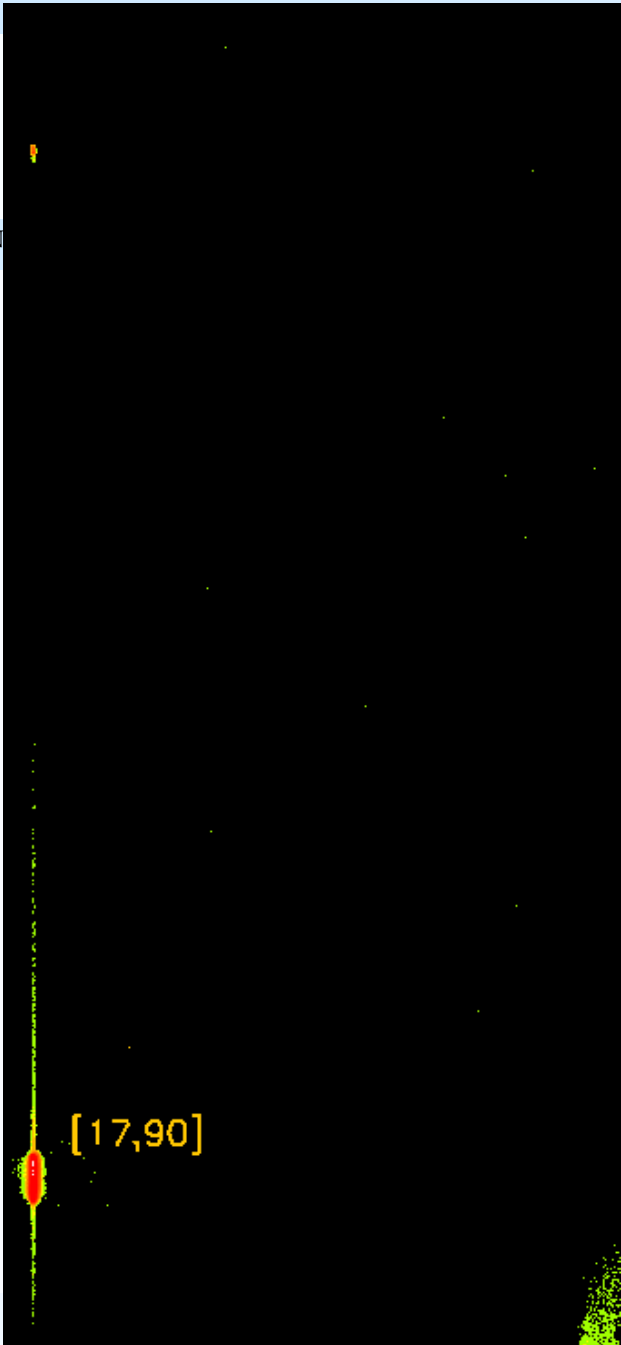


GODDARD SPACE FLIGHT CEN

OGTC
Az: -43deg

Left: 417nm

Right:372nm



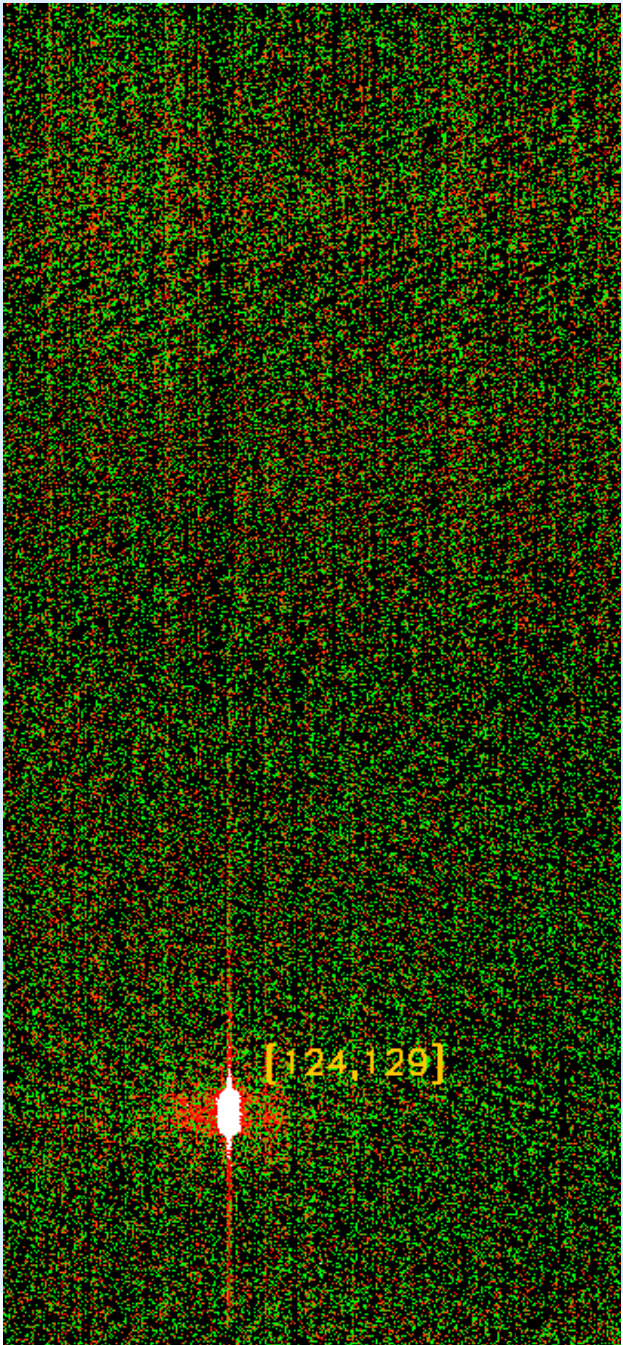
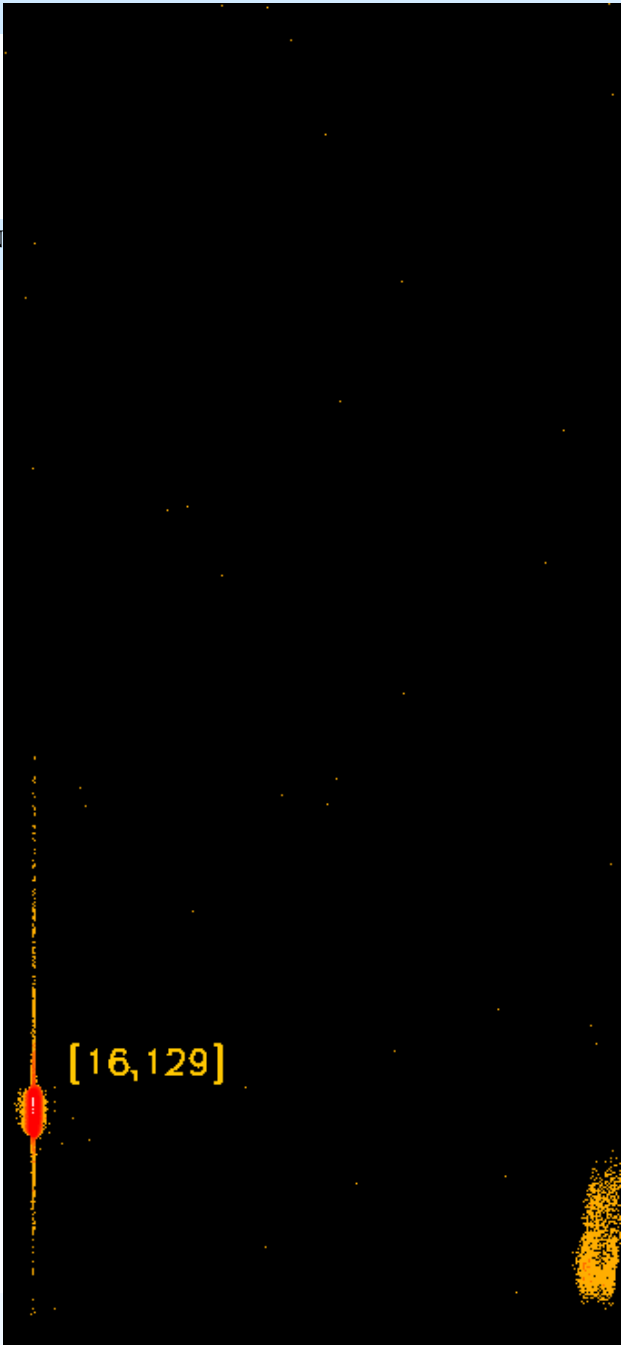


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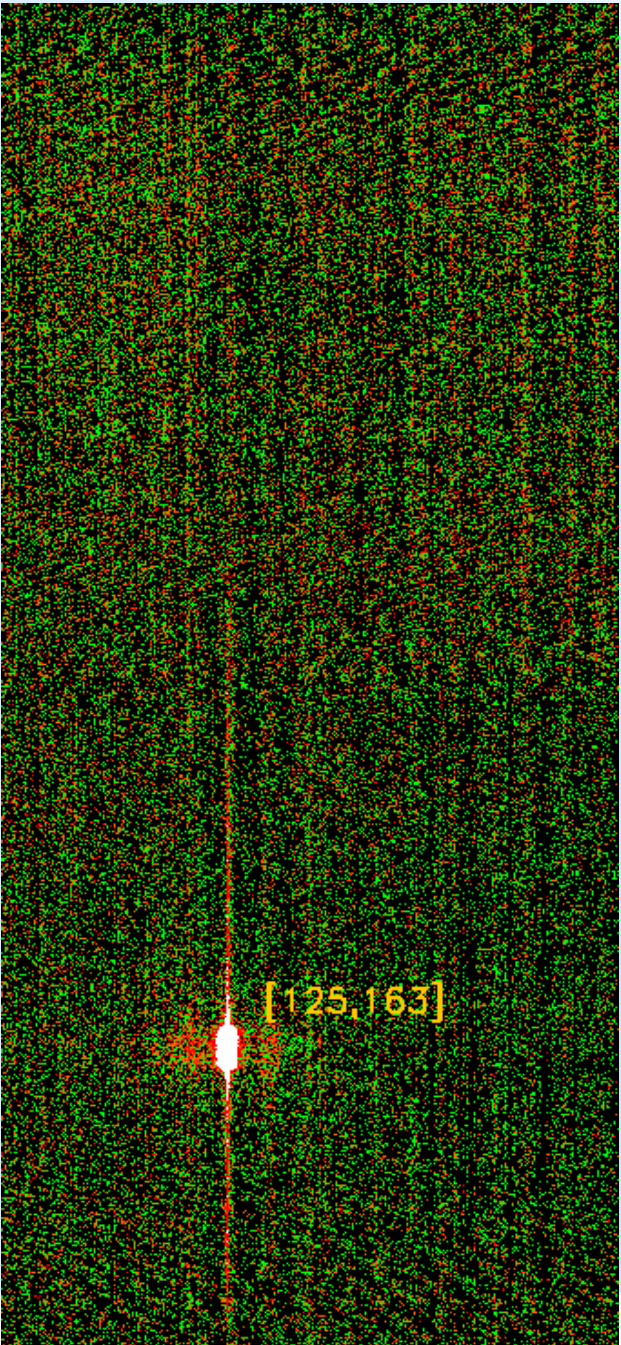
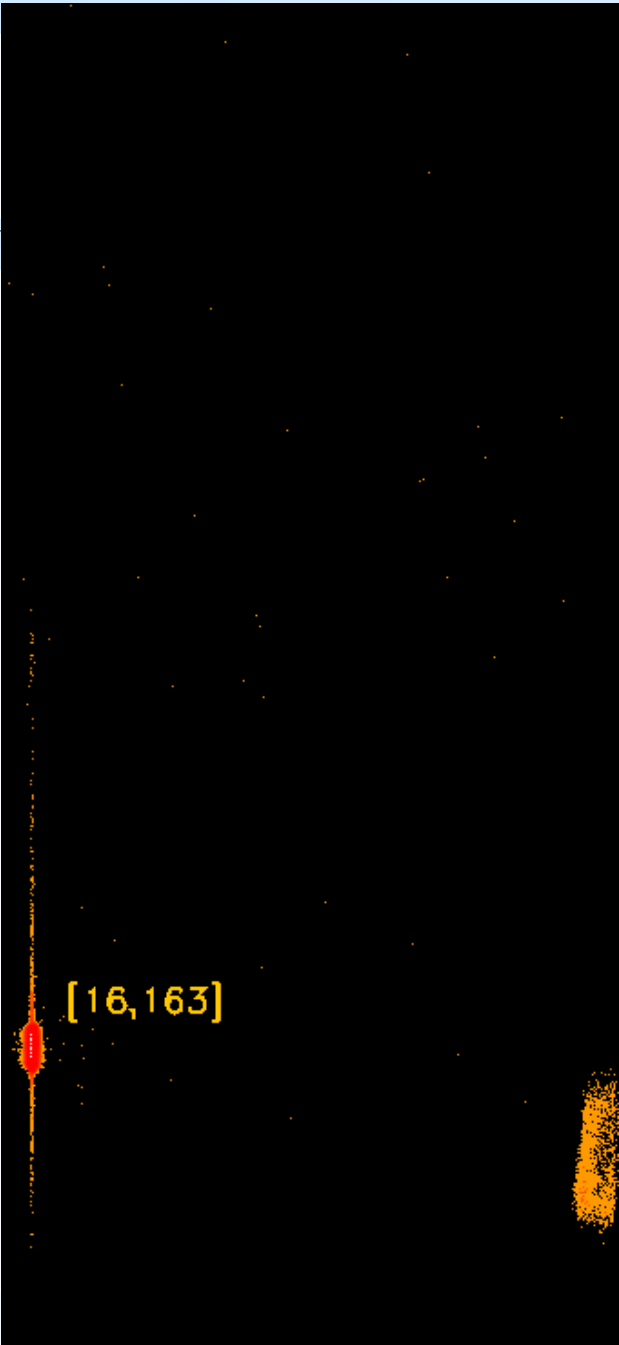


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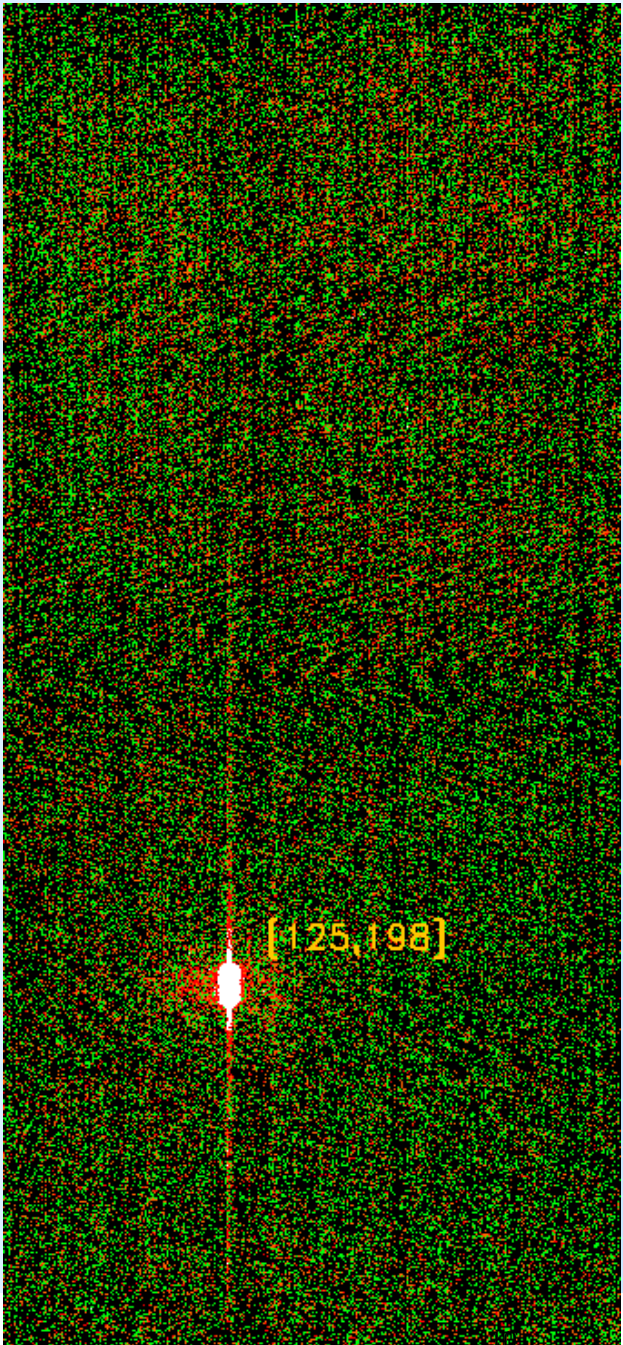
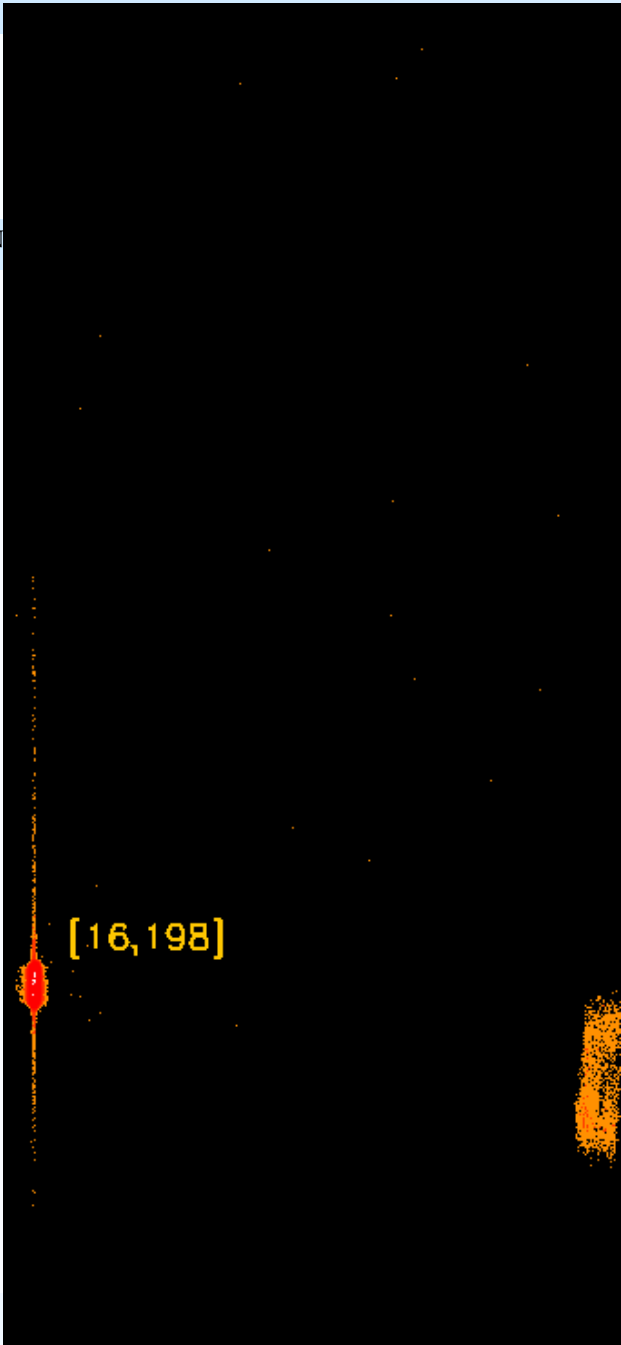
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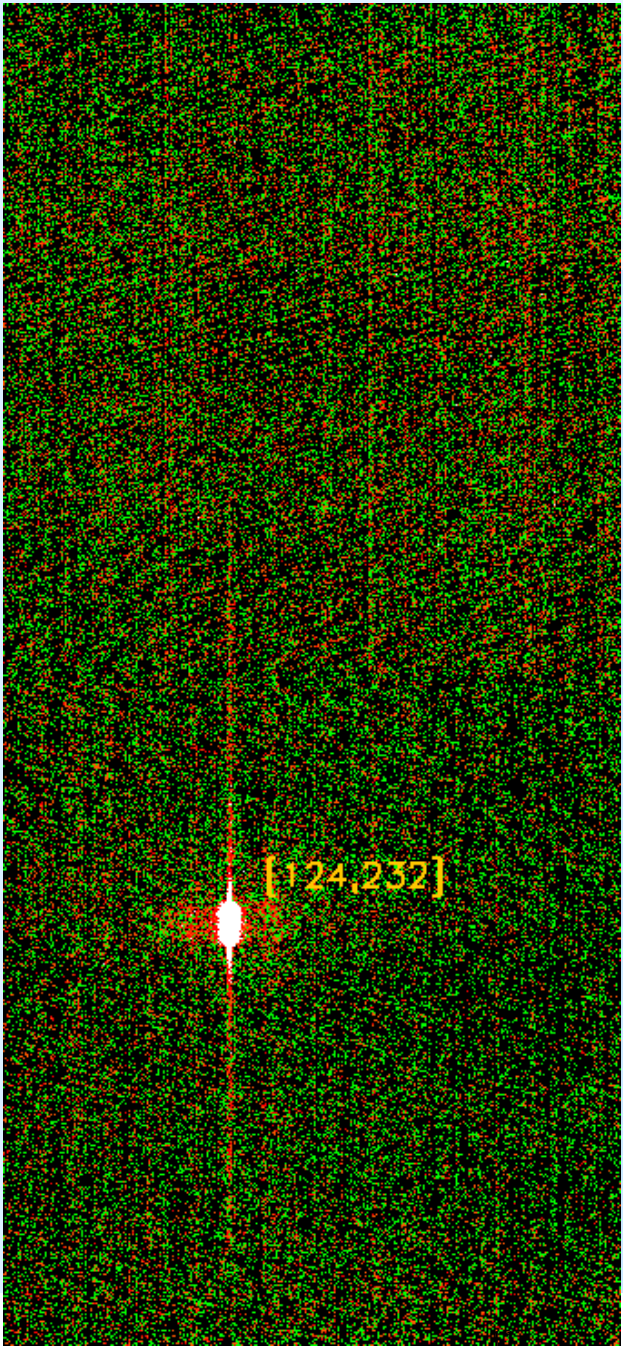
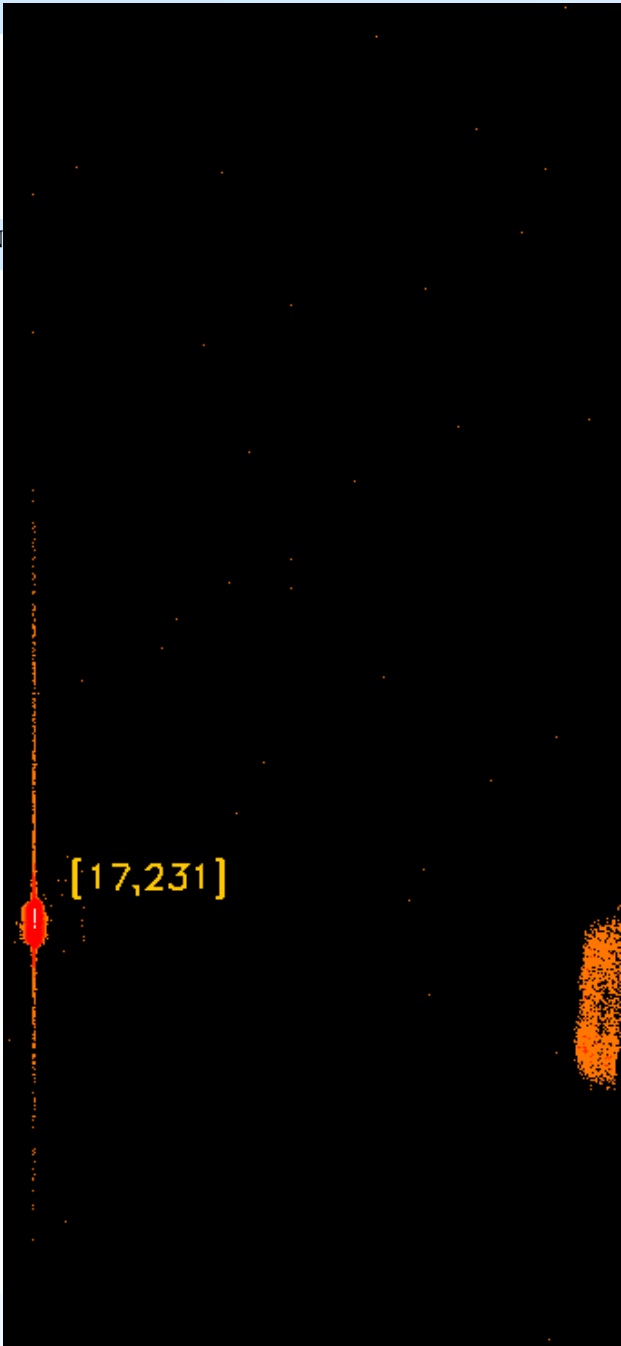


GODDARD SPACE FLIGHT CEN

OGTC
Az: -21deg

Left: 417nm

Right:372nm



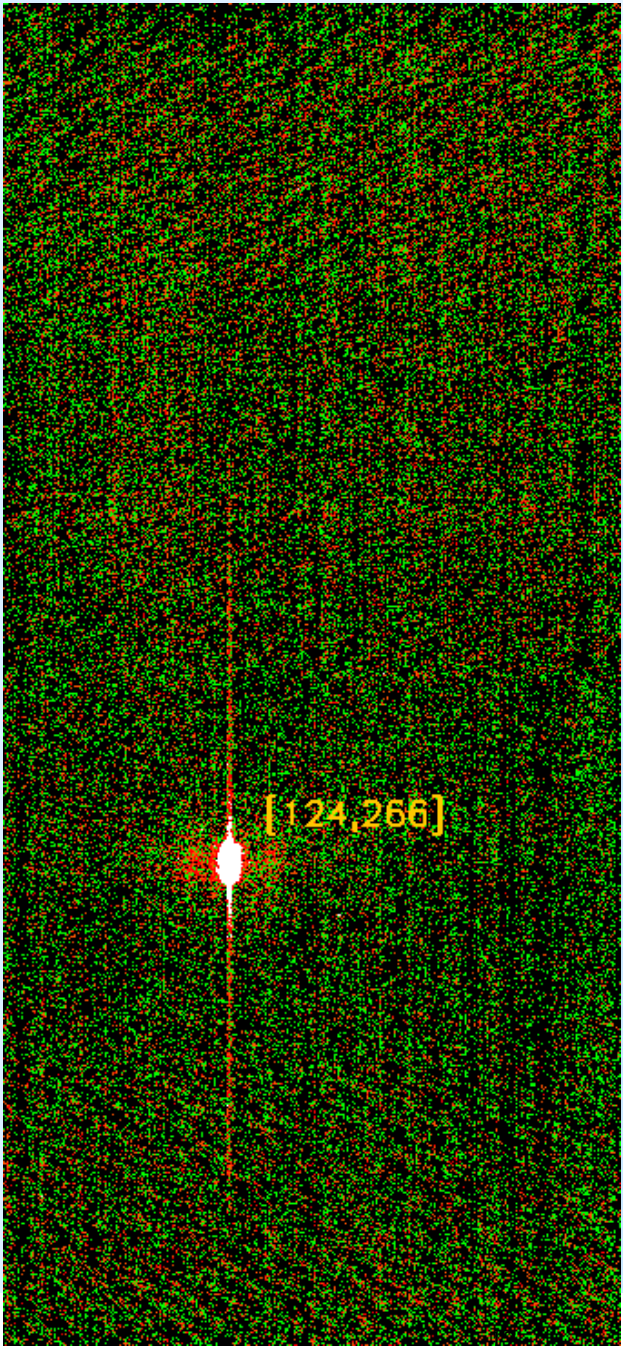
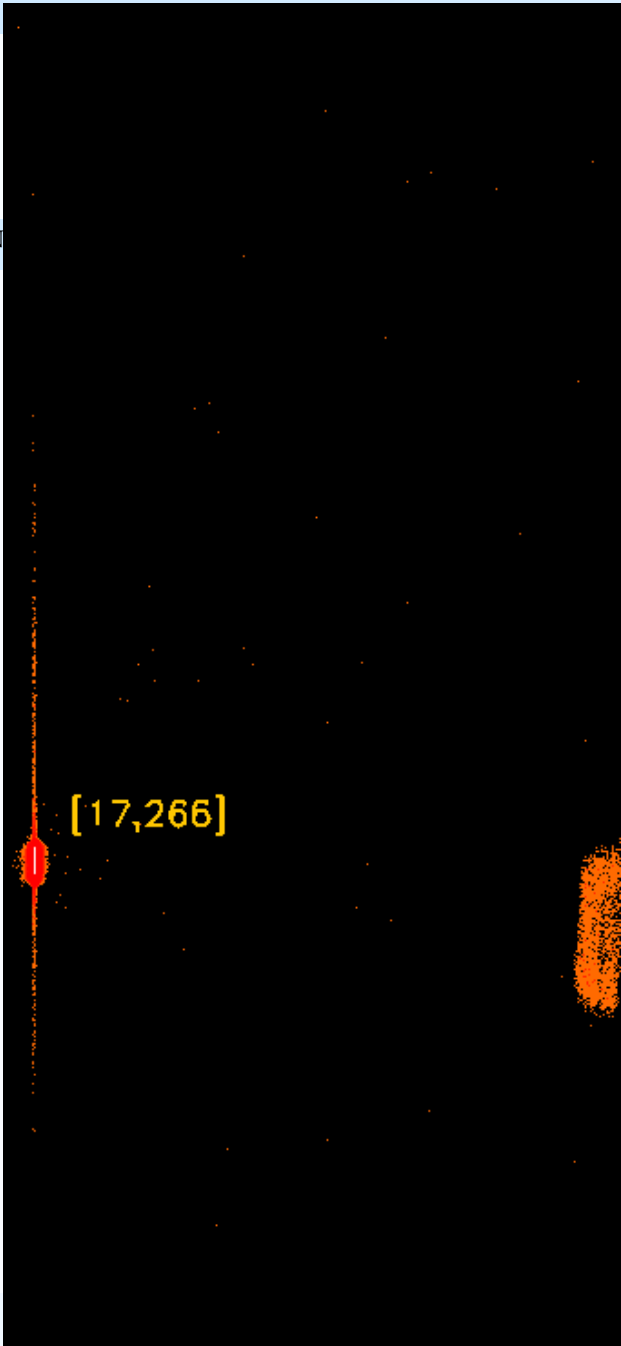


GODDARD SPACE FLIGHT CEN

OGTC
Az: -16deg

Left: 417nm

Right:372nm



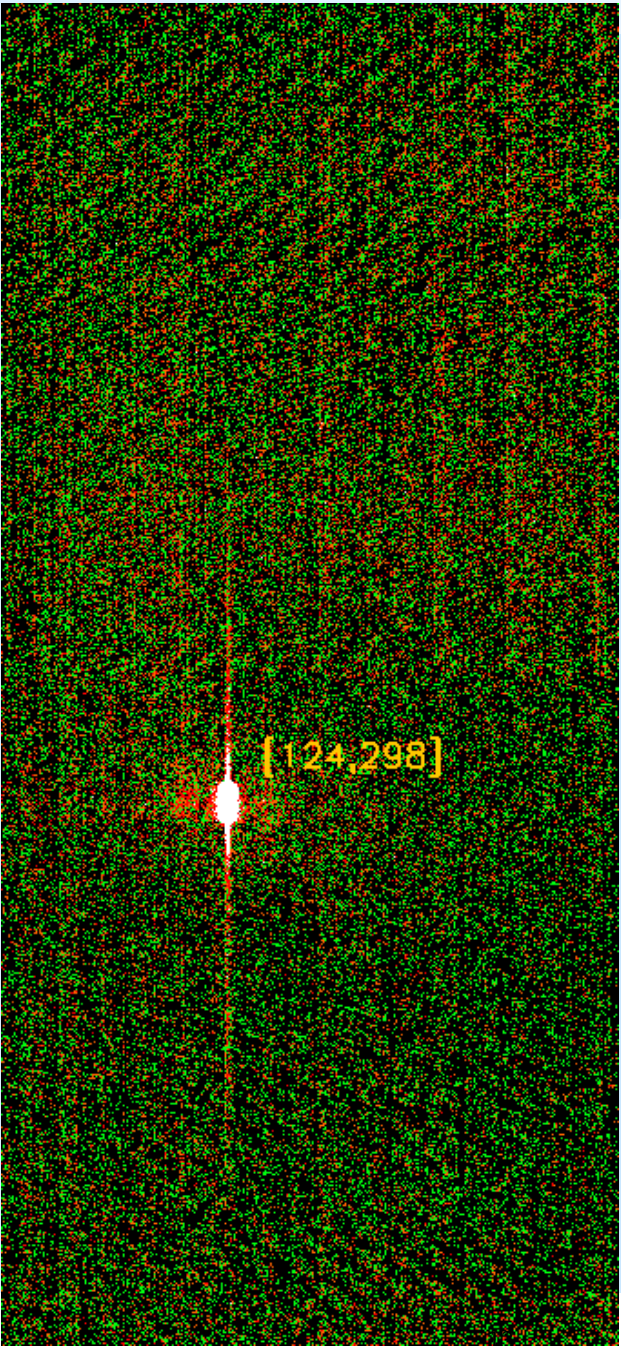
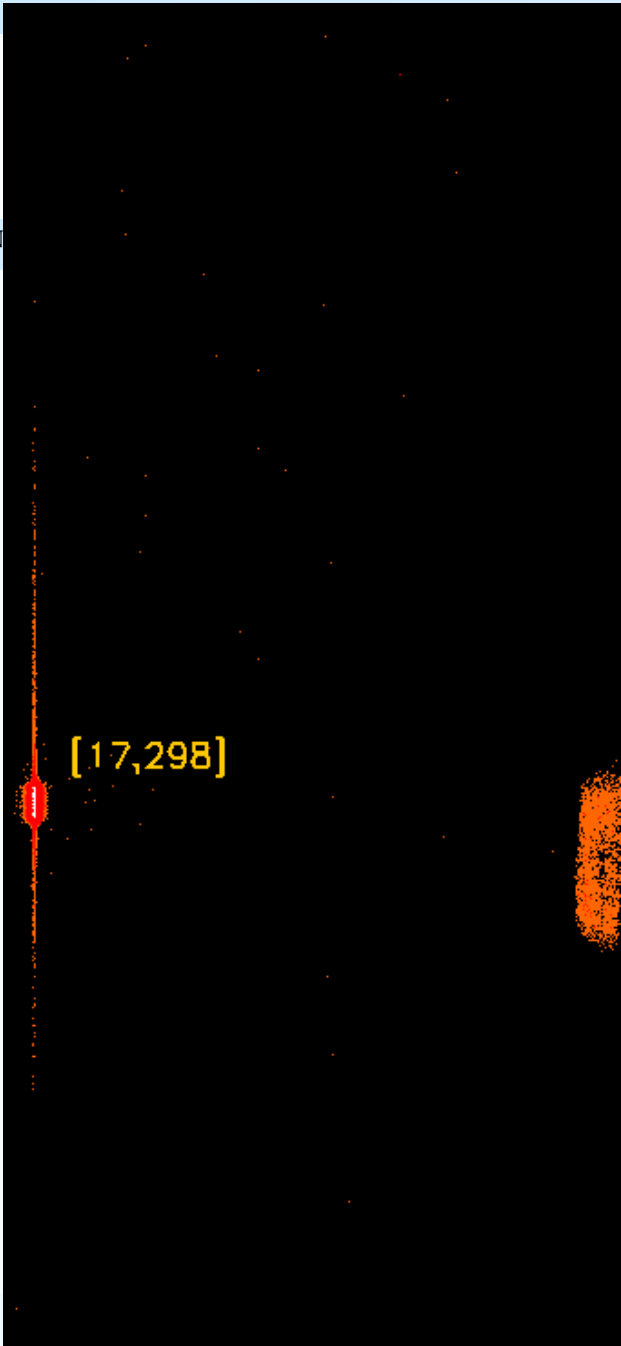


GODDARD SPACE FLIGHT CEN

OGTC
Az: -10deg

Left: 417nm

Right:372nm





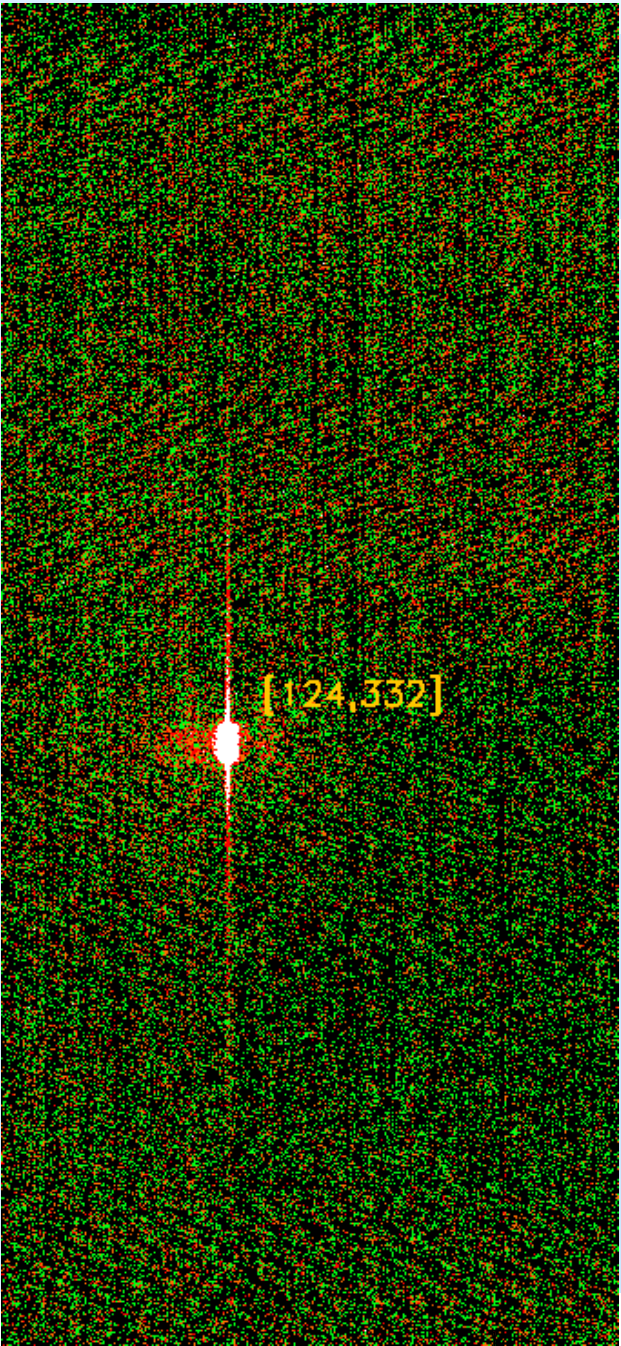
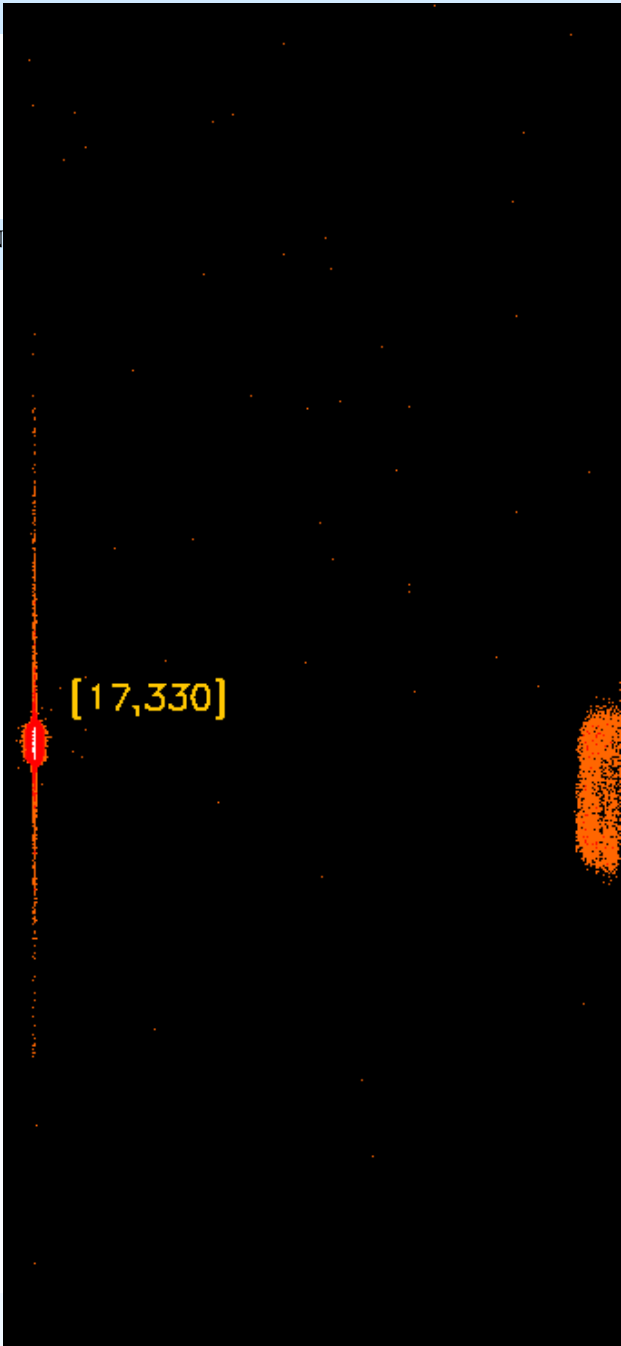
GODDARD SPACE FLIGHT CEN

OGTC

Az: -5deg

Left: 417nm

Right:372nm



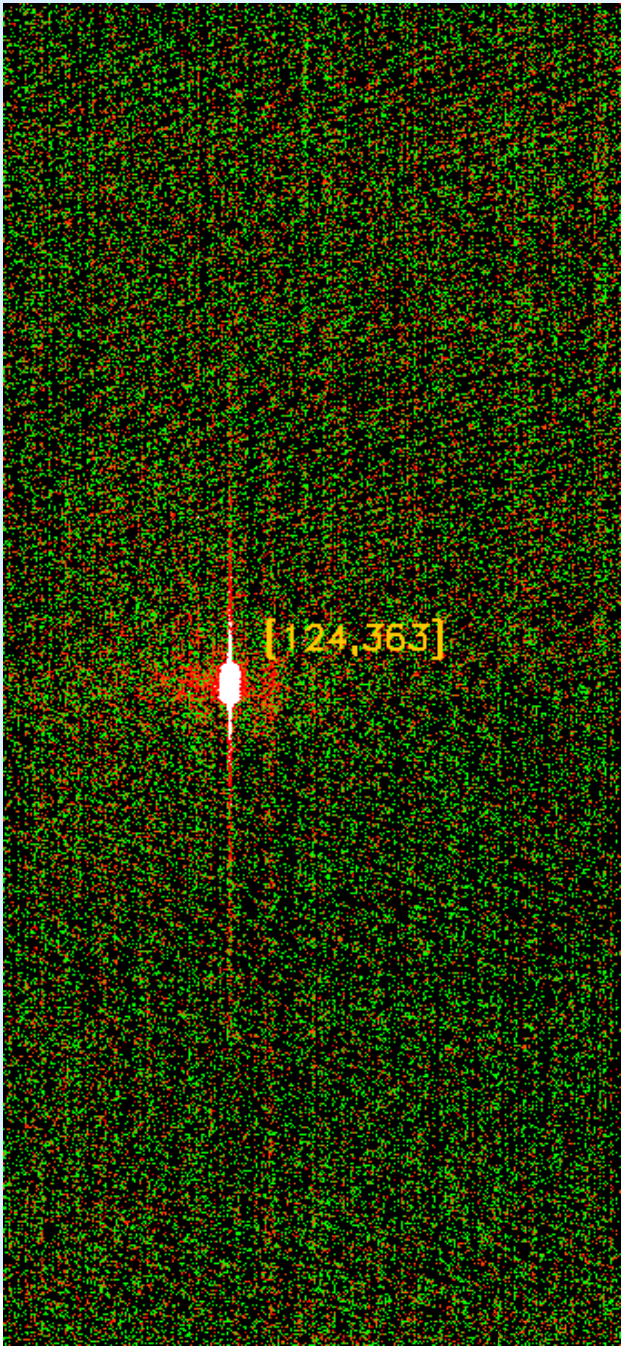
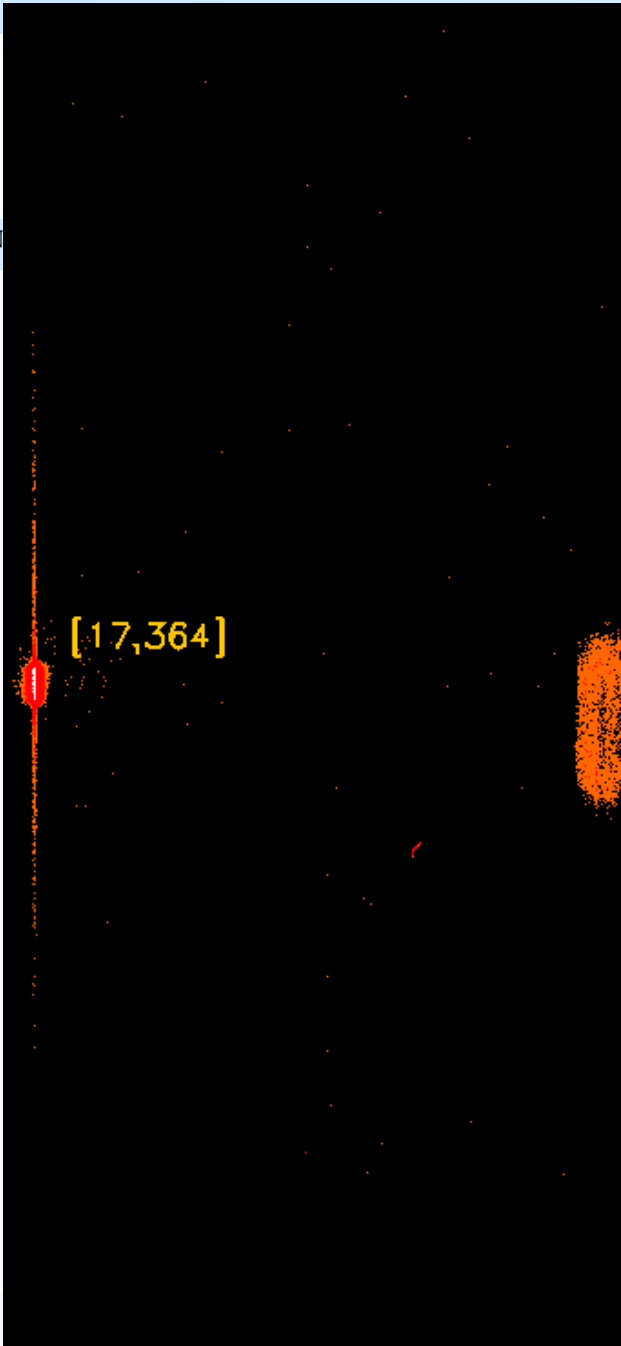


GODDARD SPACE FLIGHT CEN

OGTC
Az: 0deg

Left: 417nm

Right:372nm





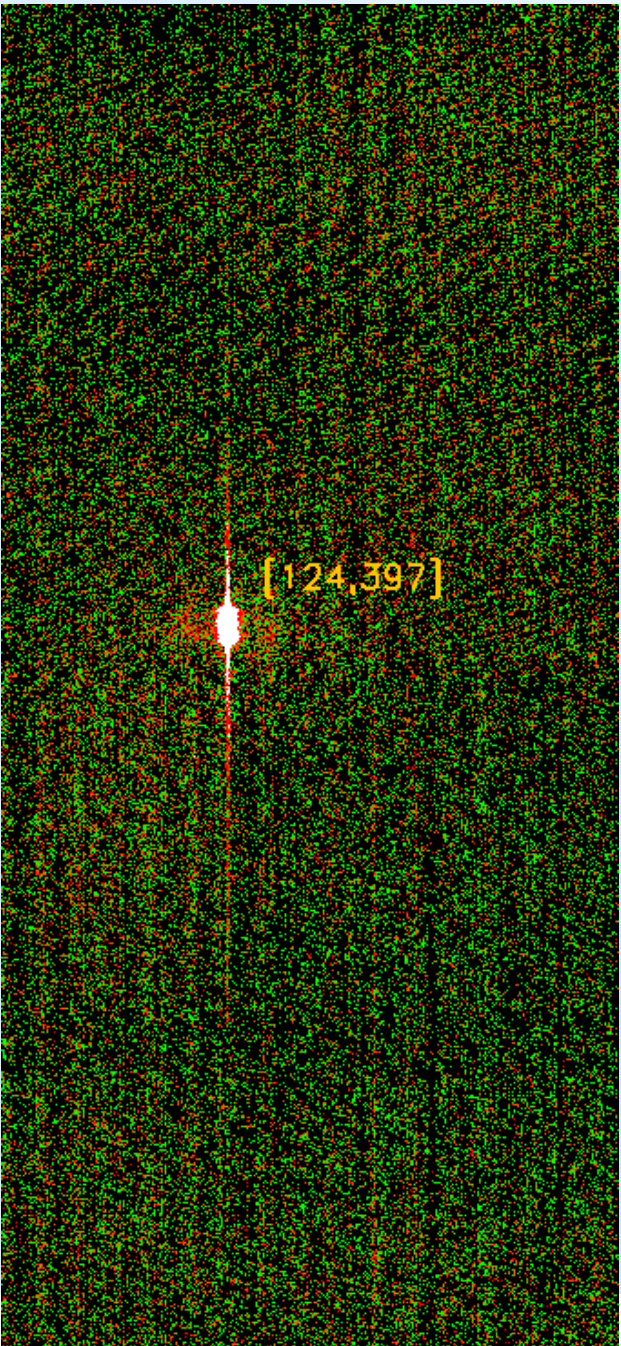
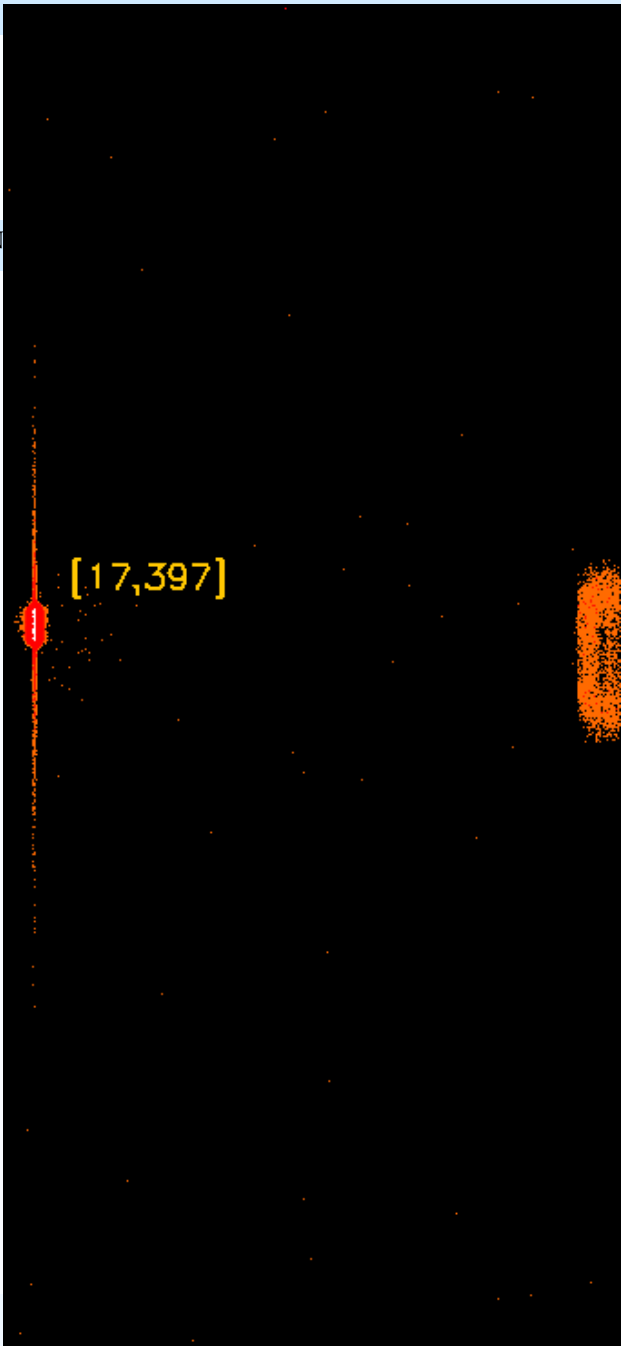
GODDARD SPACE FLIGHT CEN

OGTC

Az: +5deg

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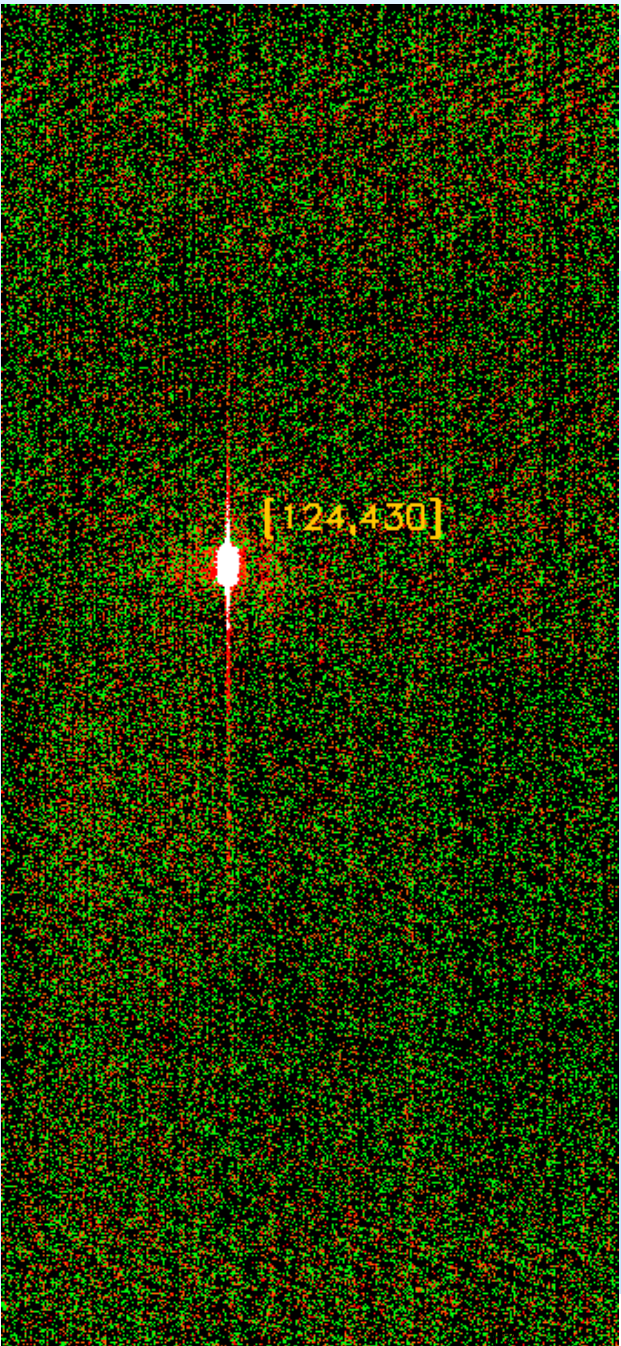
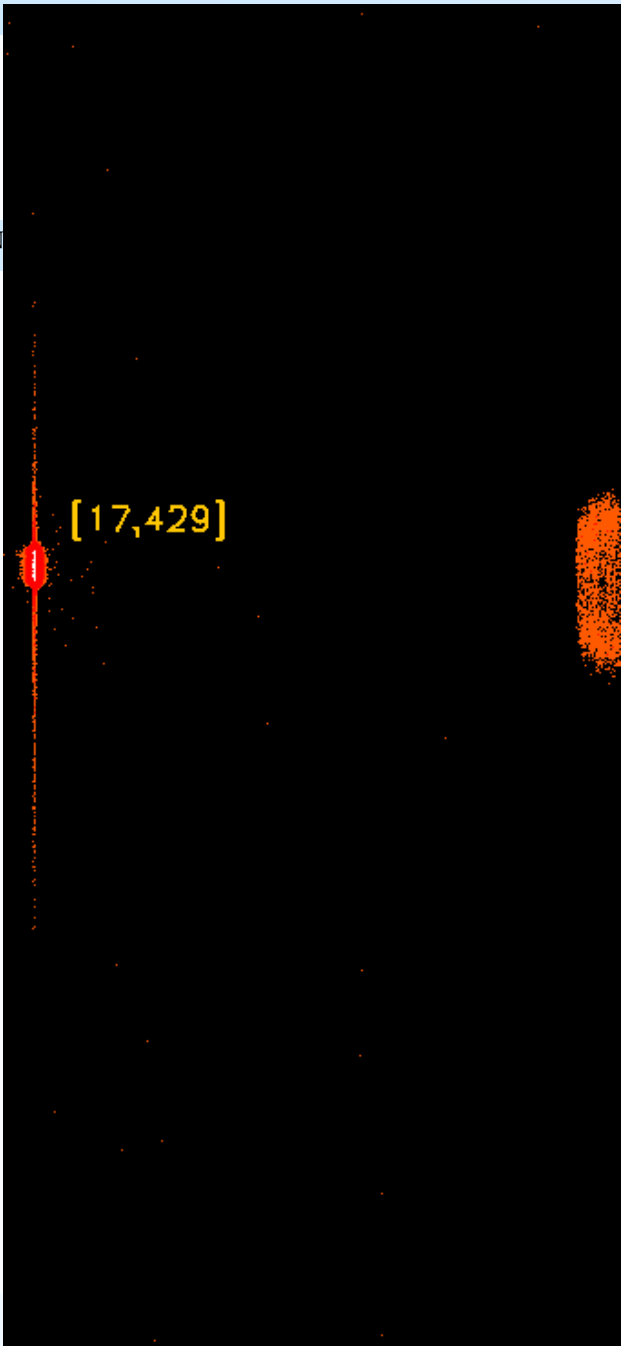


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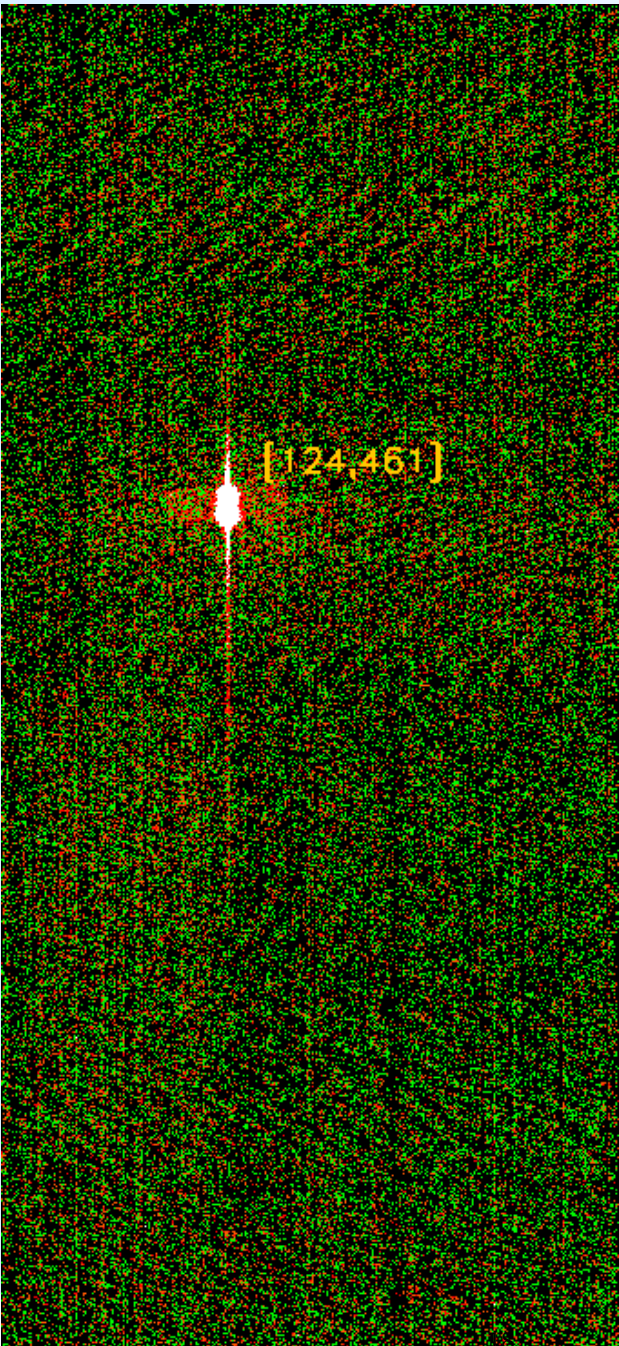
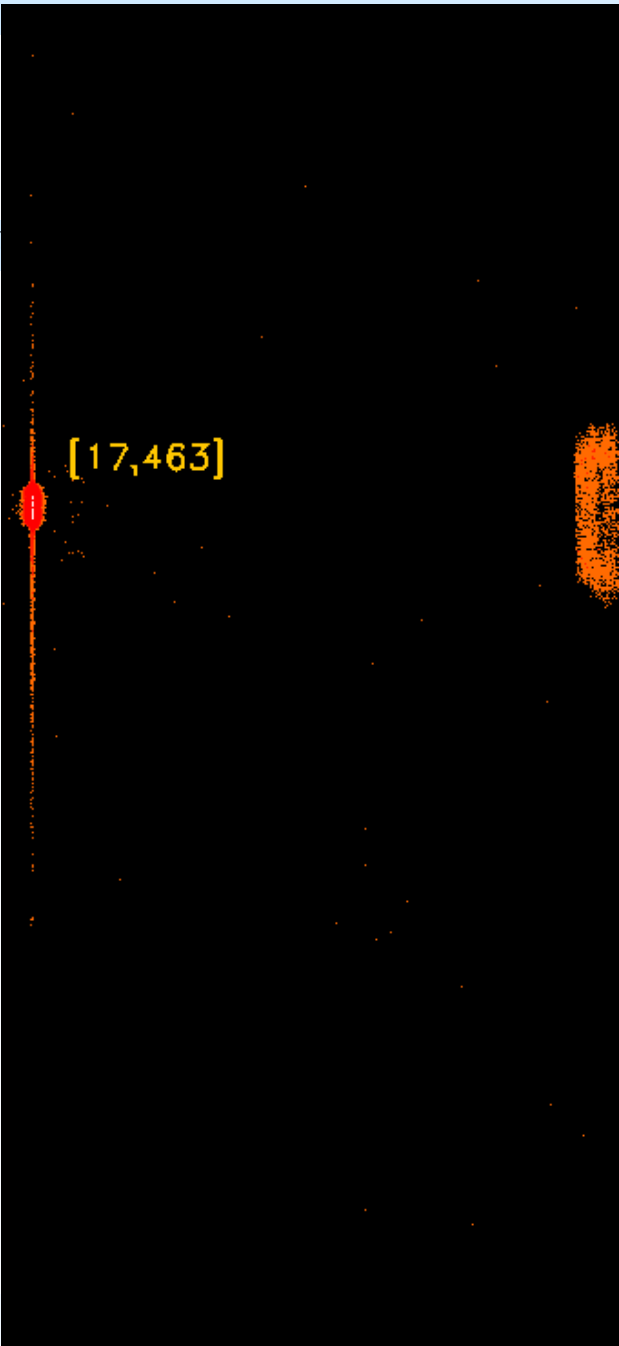


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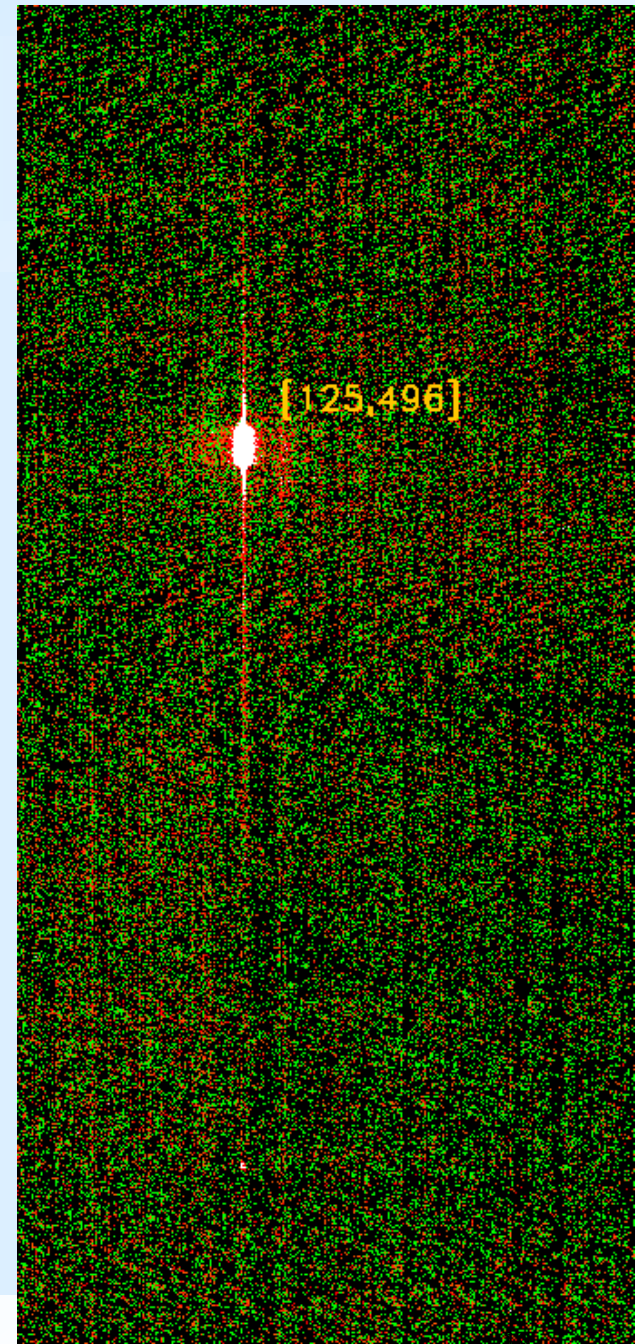
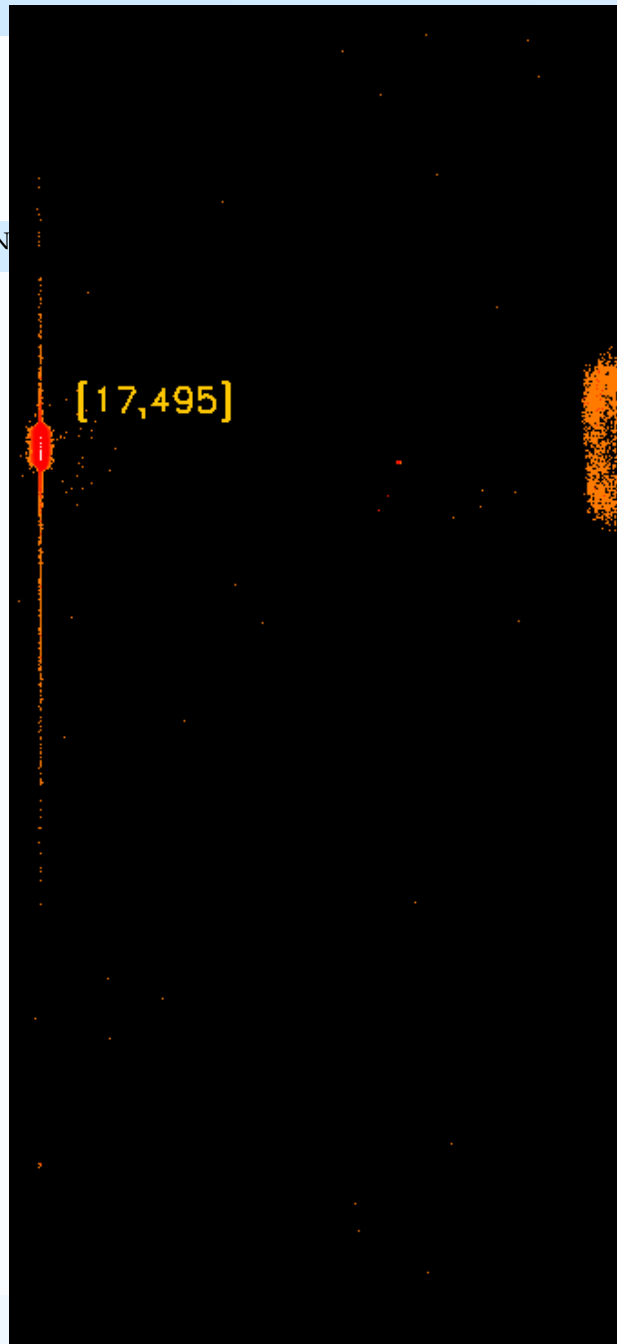
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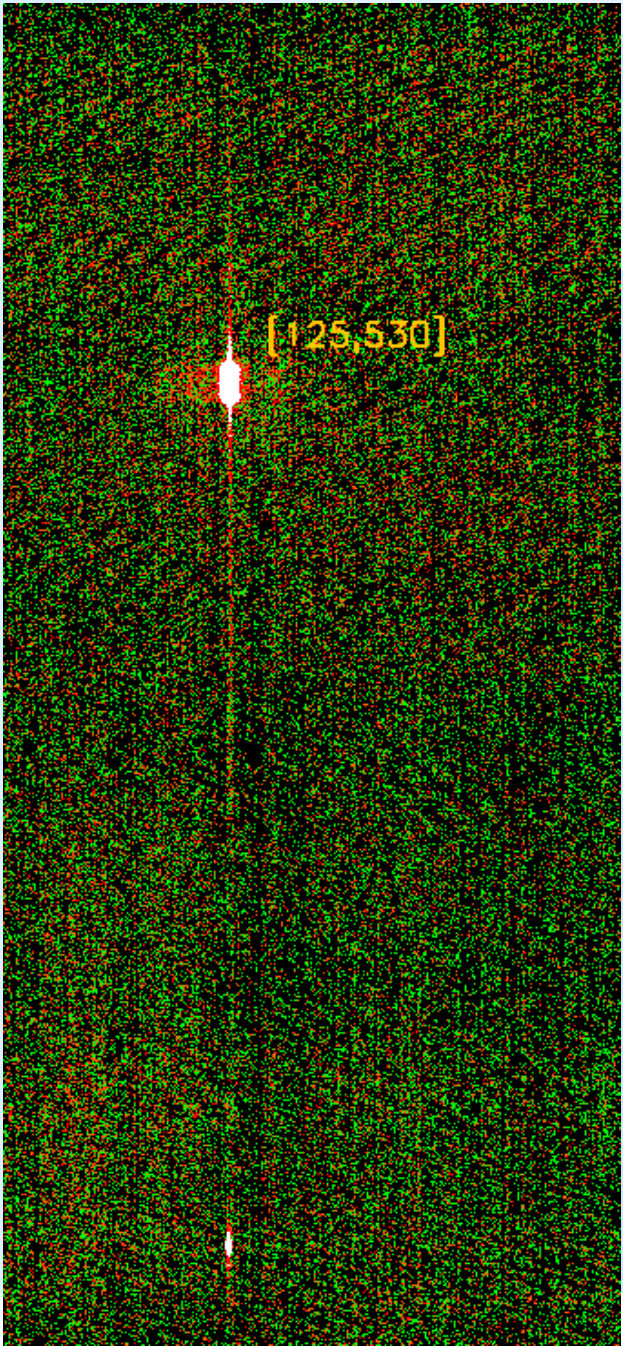
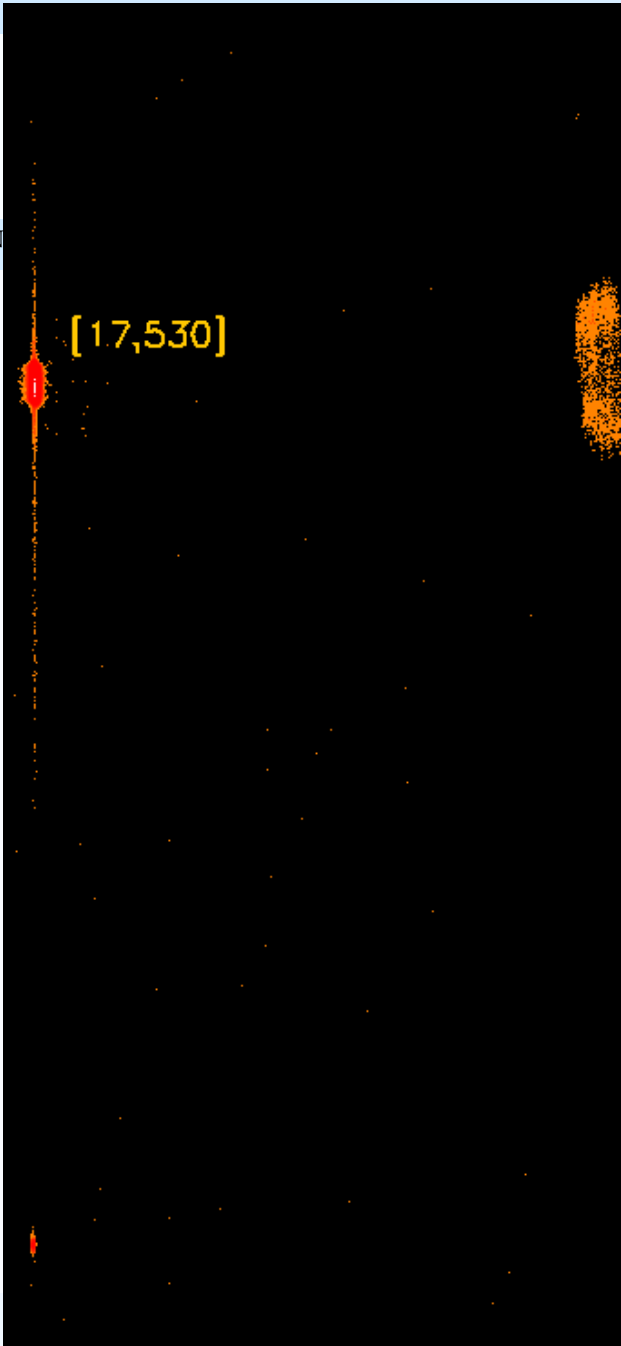


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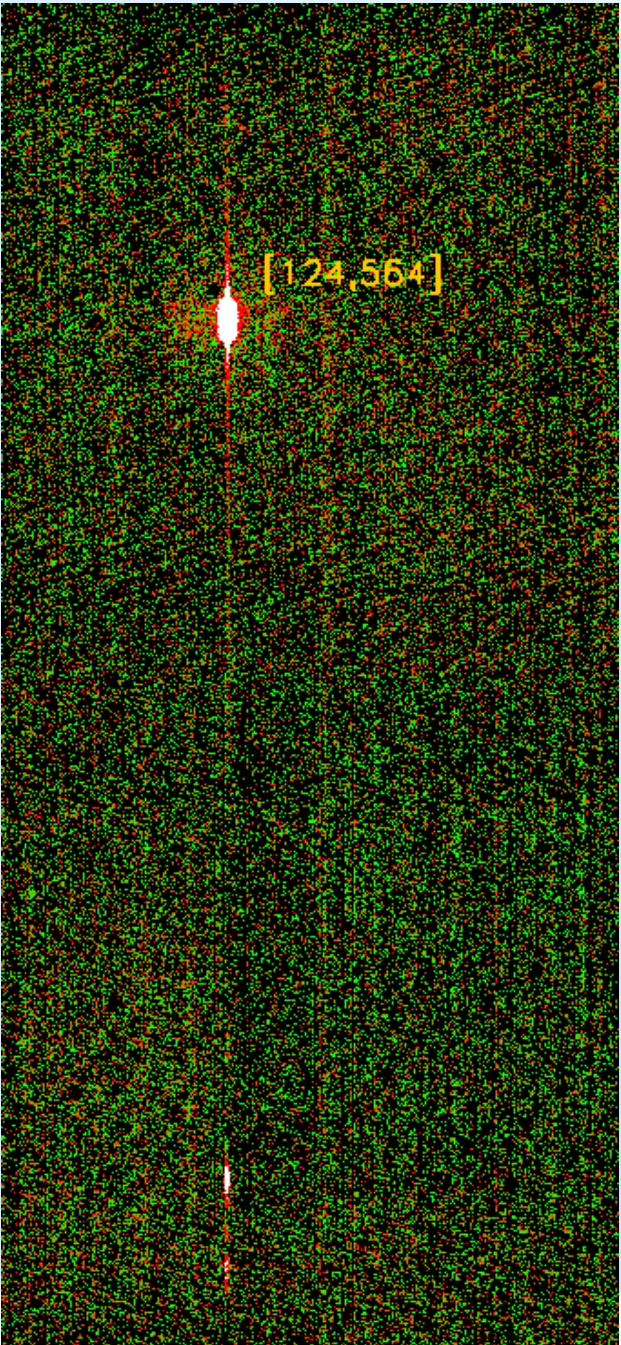
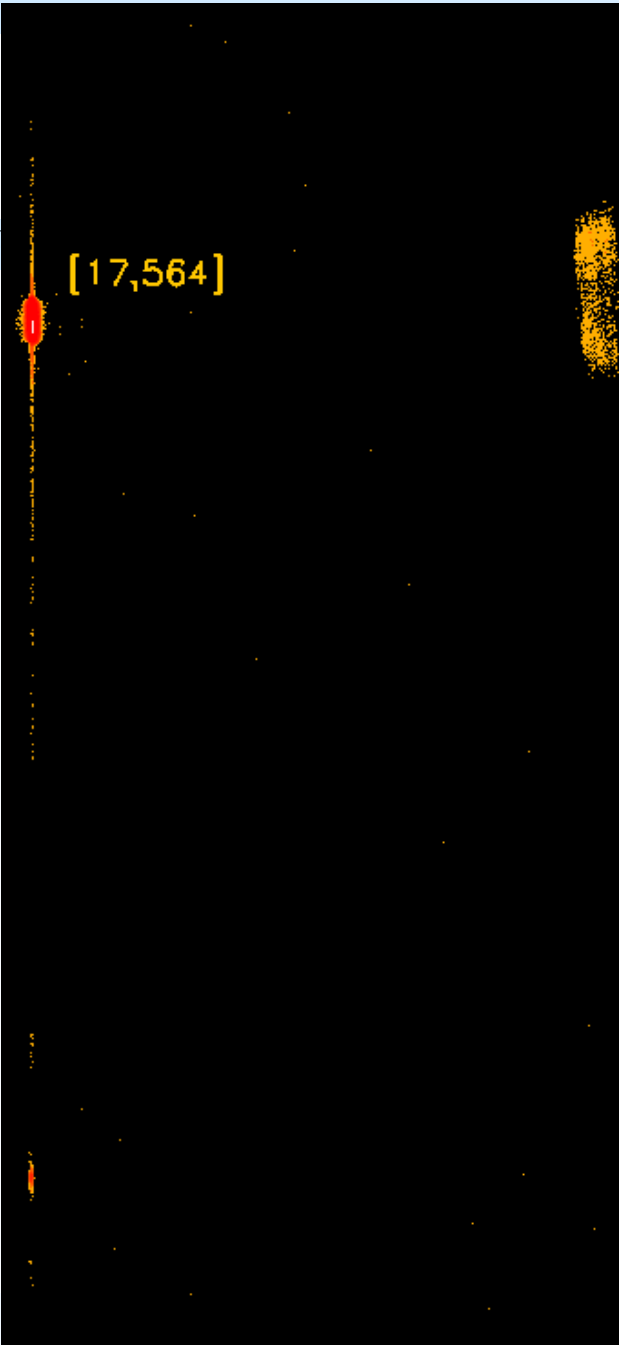


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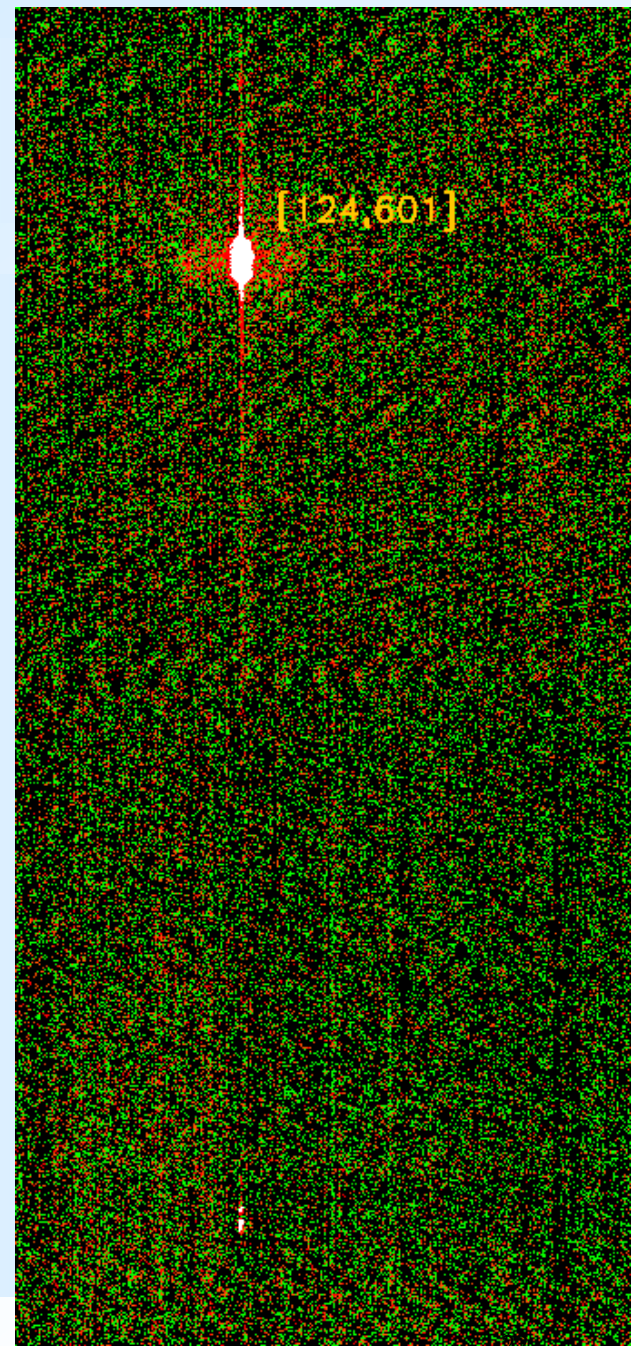
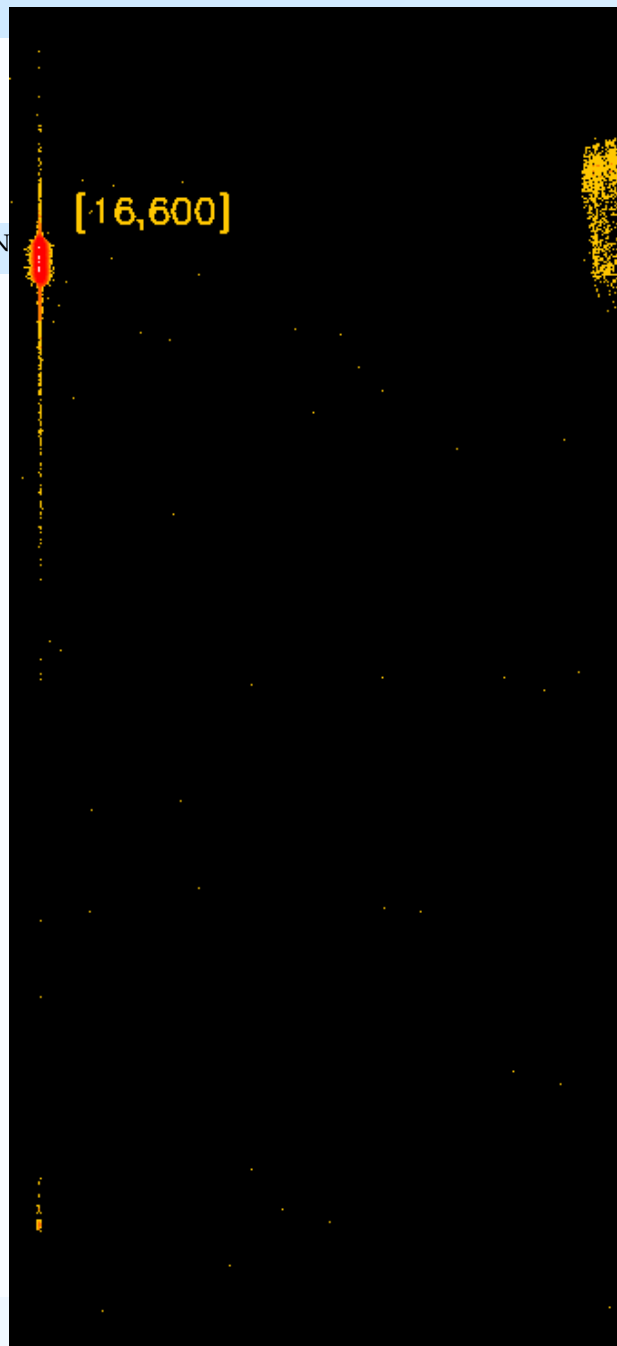
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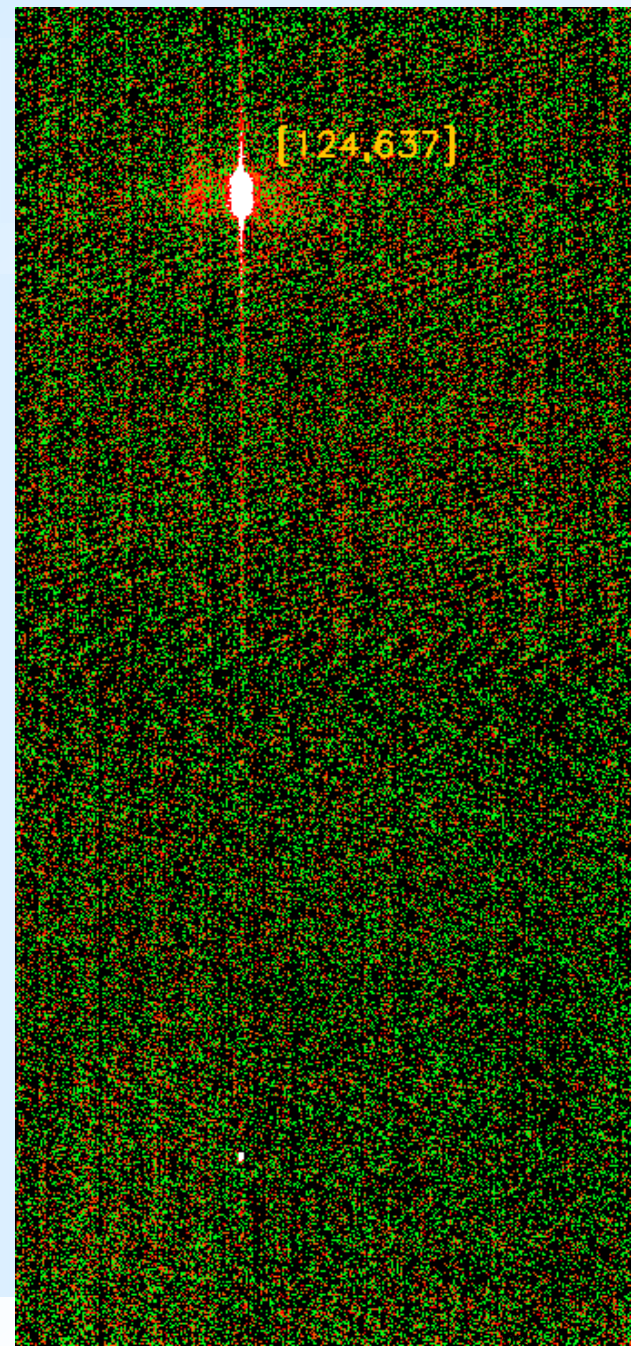
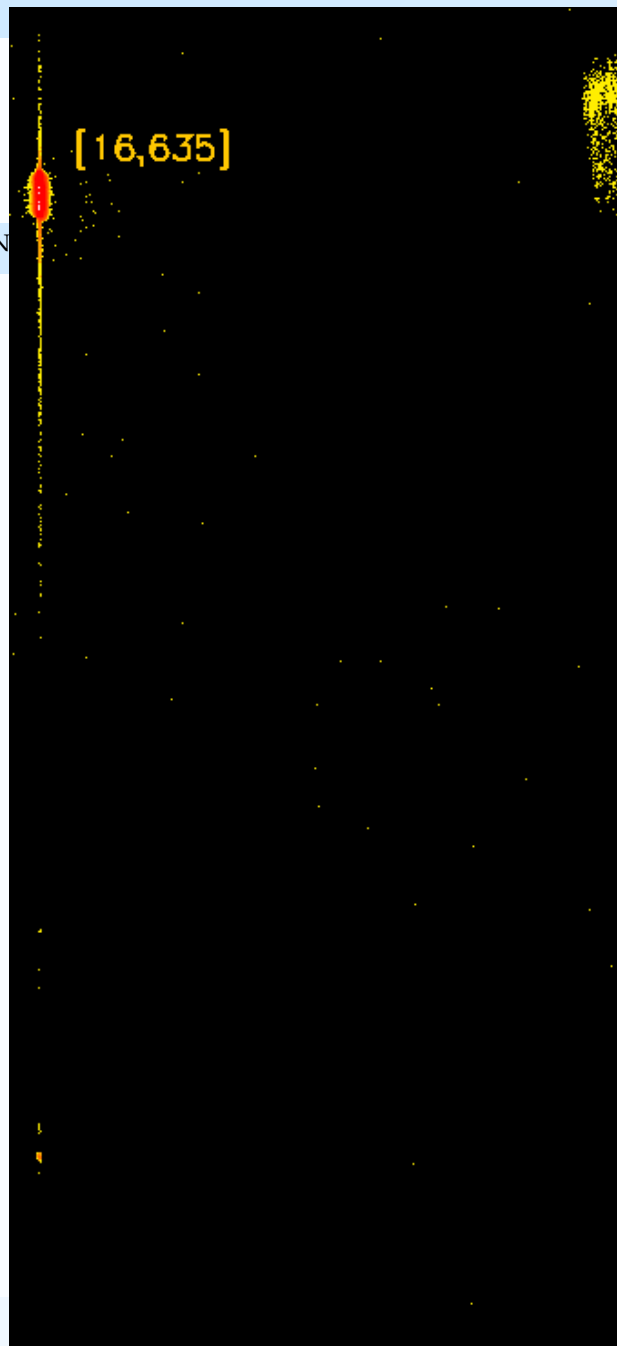
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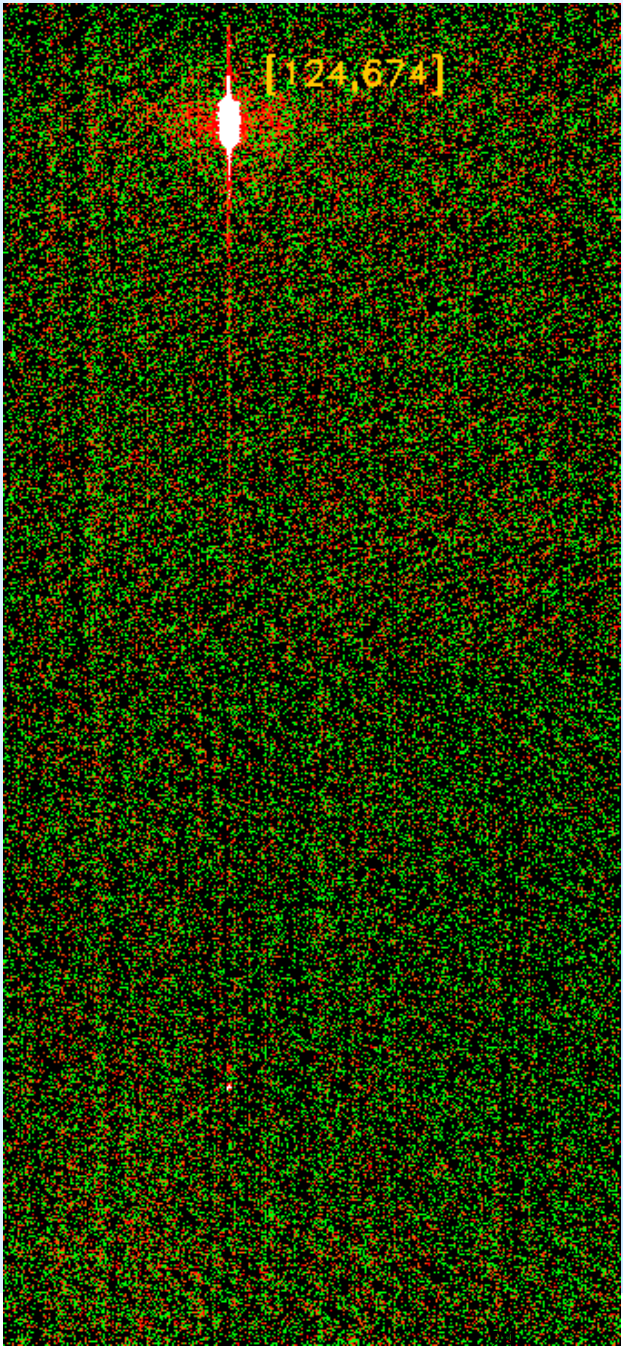
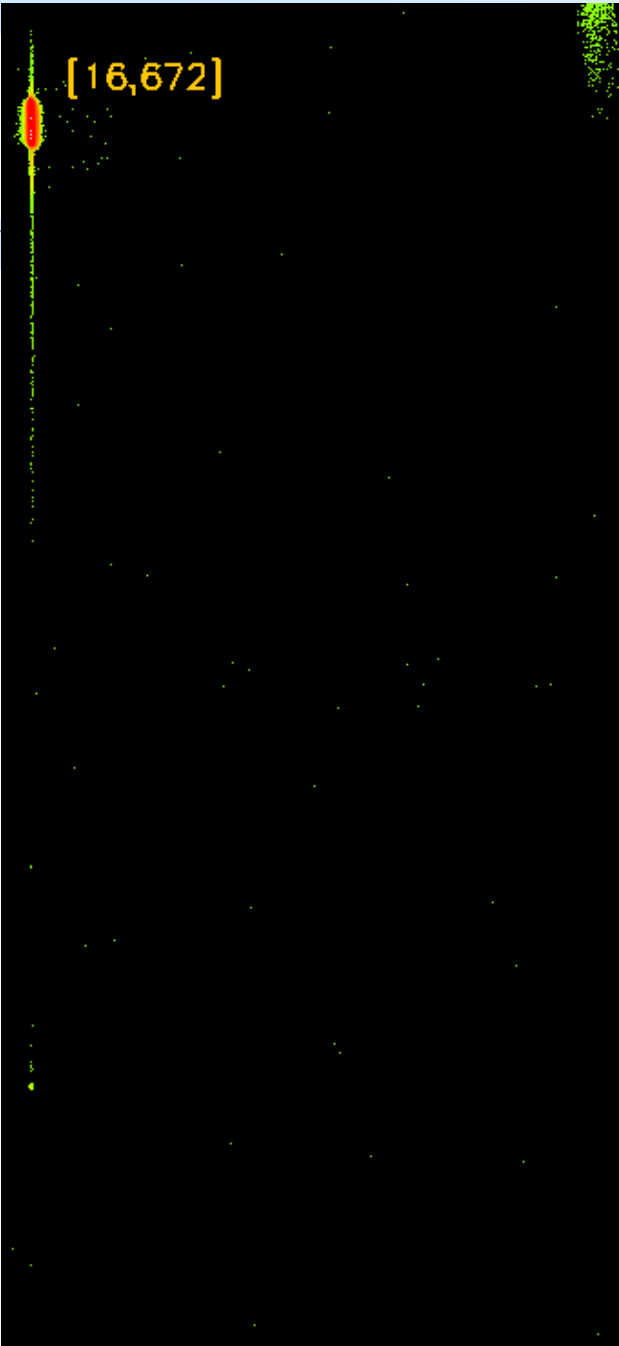


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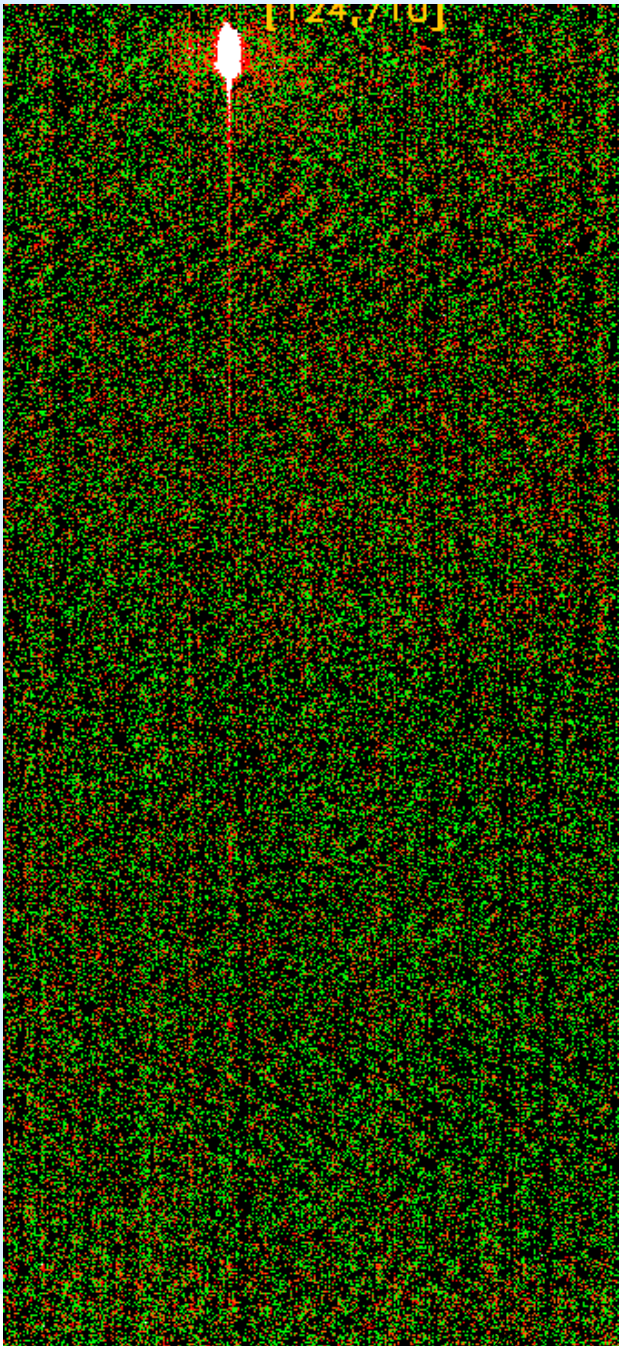
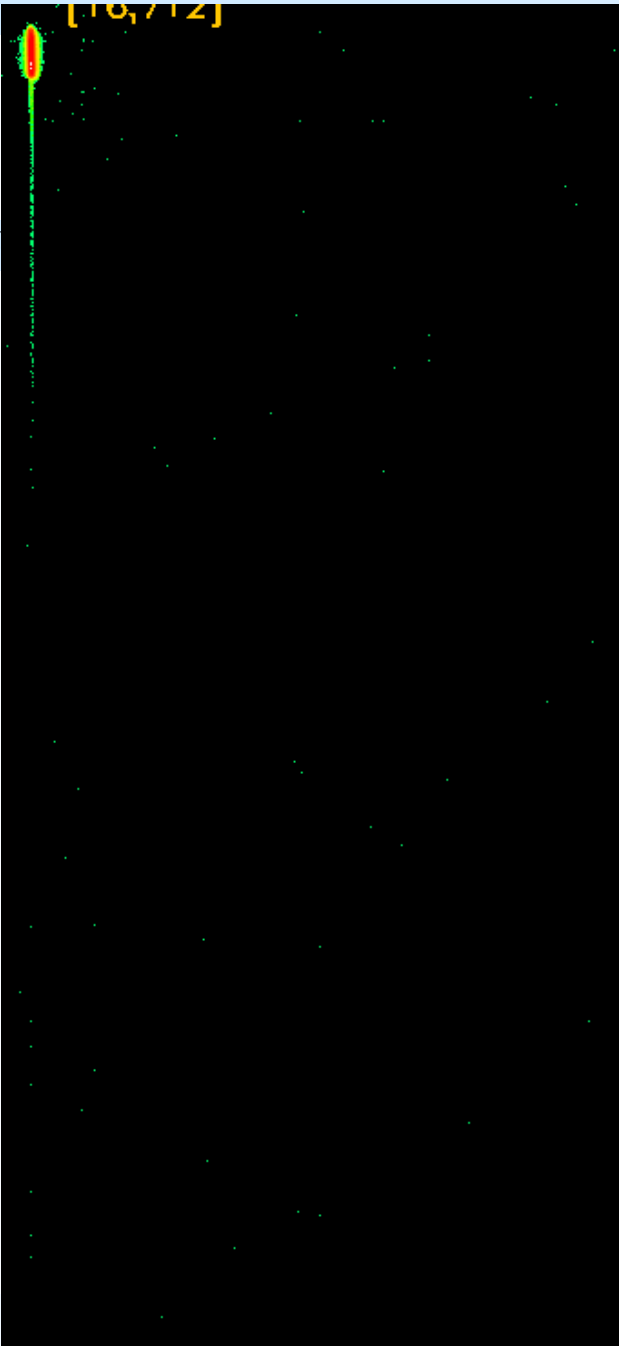


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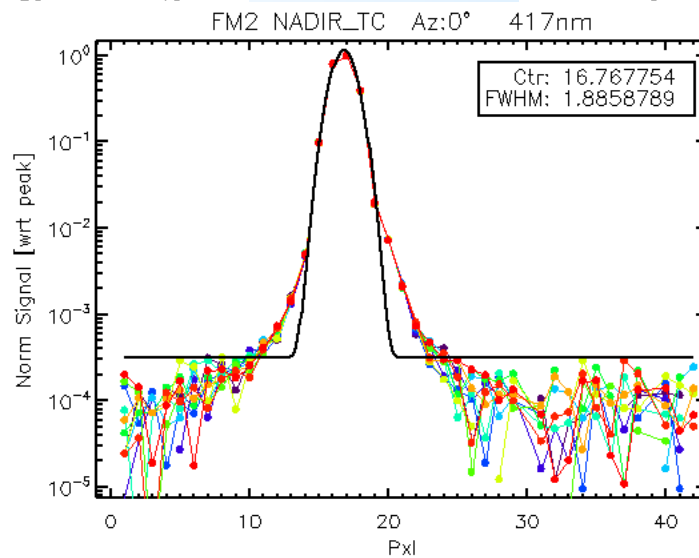
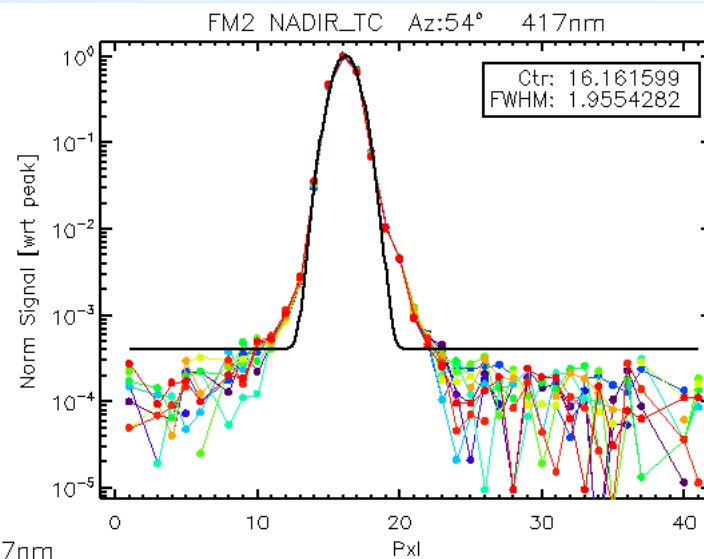
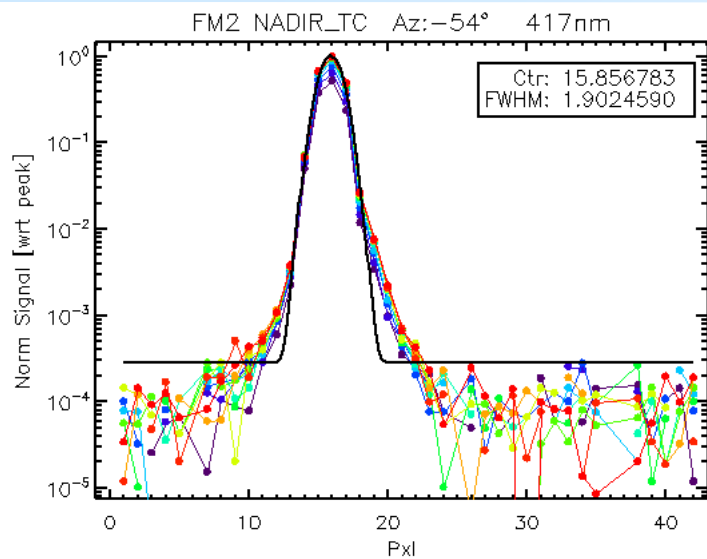
Right:372nm





417nm Line Fits

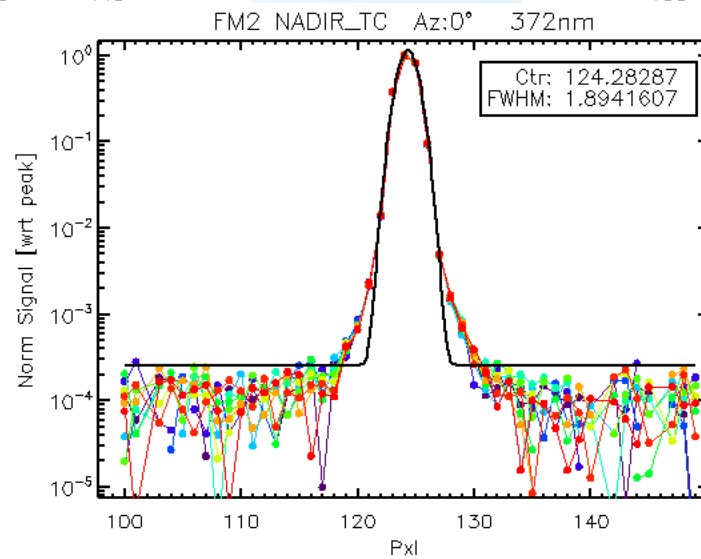
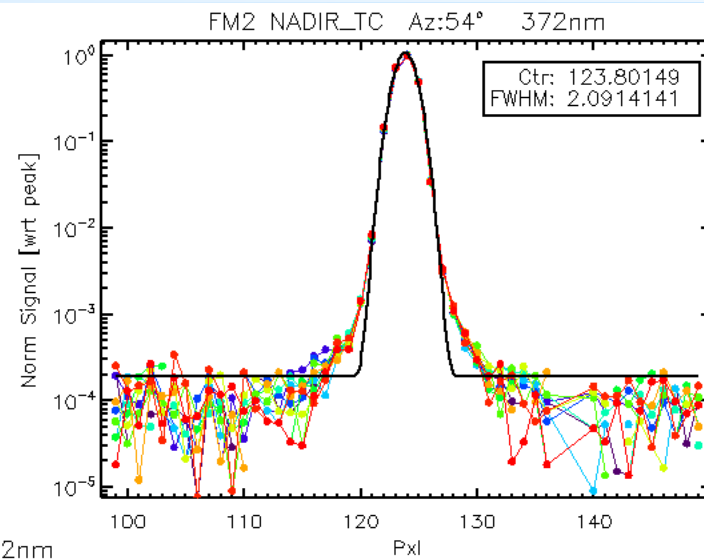
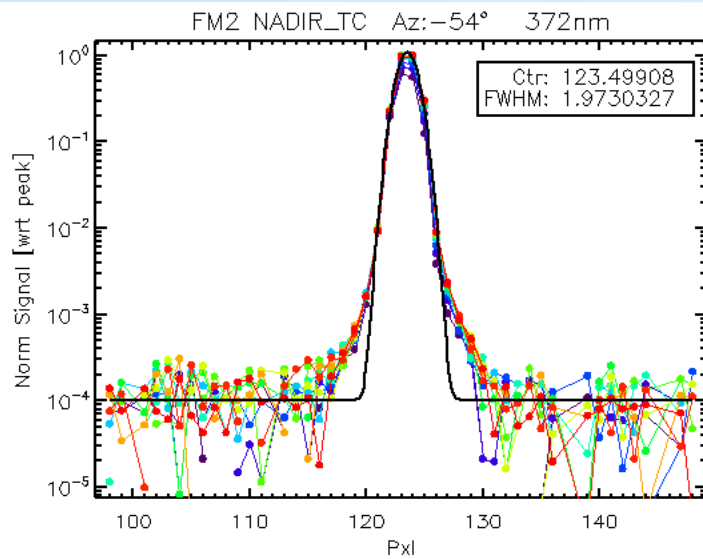
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372nm Line Fits

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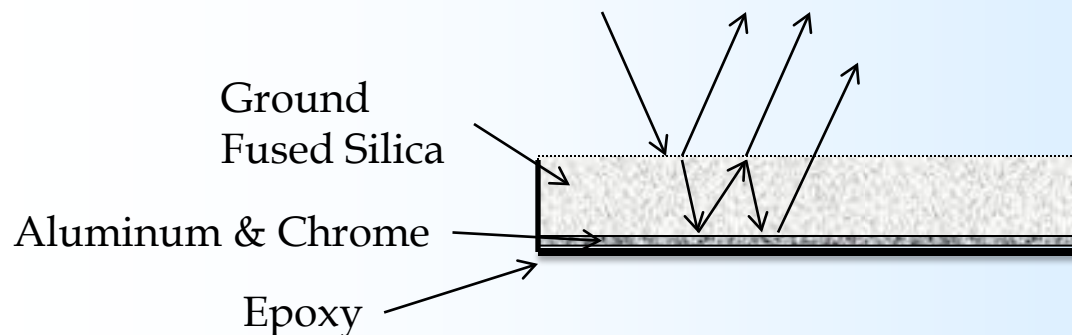


J1 OMPS QVD

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- **NPP OMPS utilized ground aluminum diffusers.**
- **New diffuser (QVD) design implemented in order to minimize spectral features in solar calibrations.**
 - Reduces wavelength dependent albedo calibration uncertainty.
 - Reduces time required for ground characterization.

- **Design**

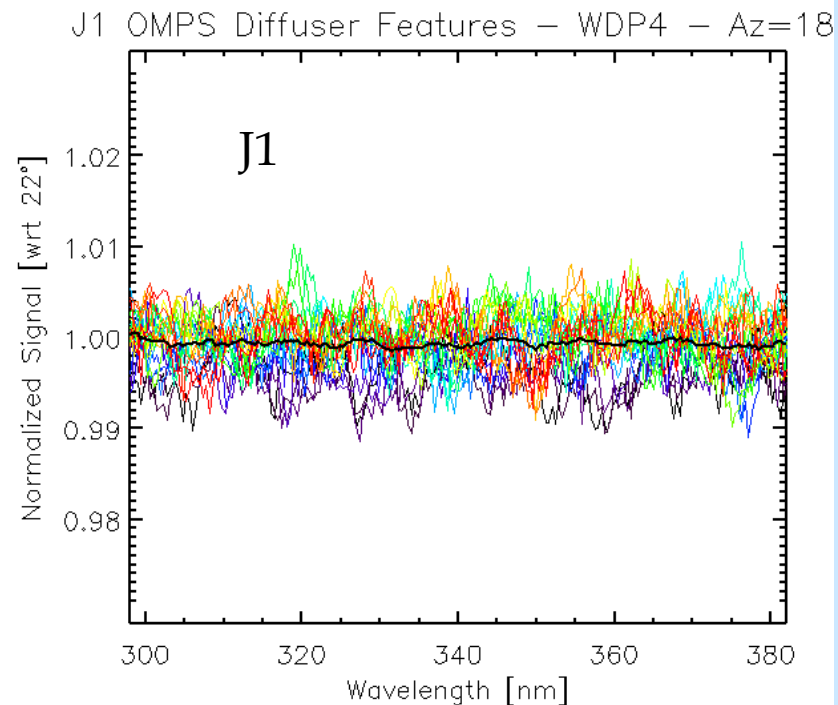
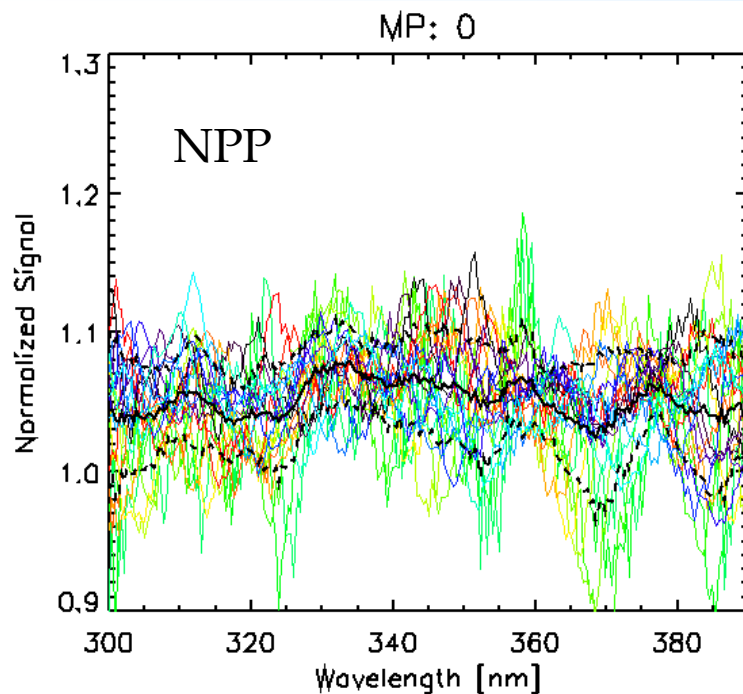


Flight 1 Diffusers/Wipers



J1 OMPS QVD – Diffuser Features

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- Diffuser features significantly reduced in J1 QVD.
- Colored lines are individual rows.
- Solid black is the macro-pixel average.





Outline

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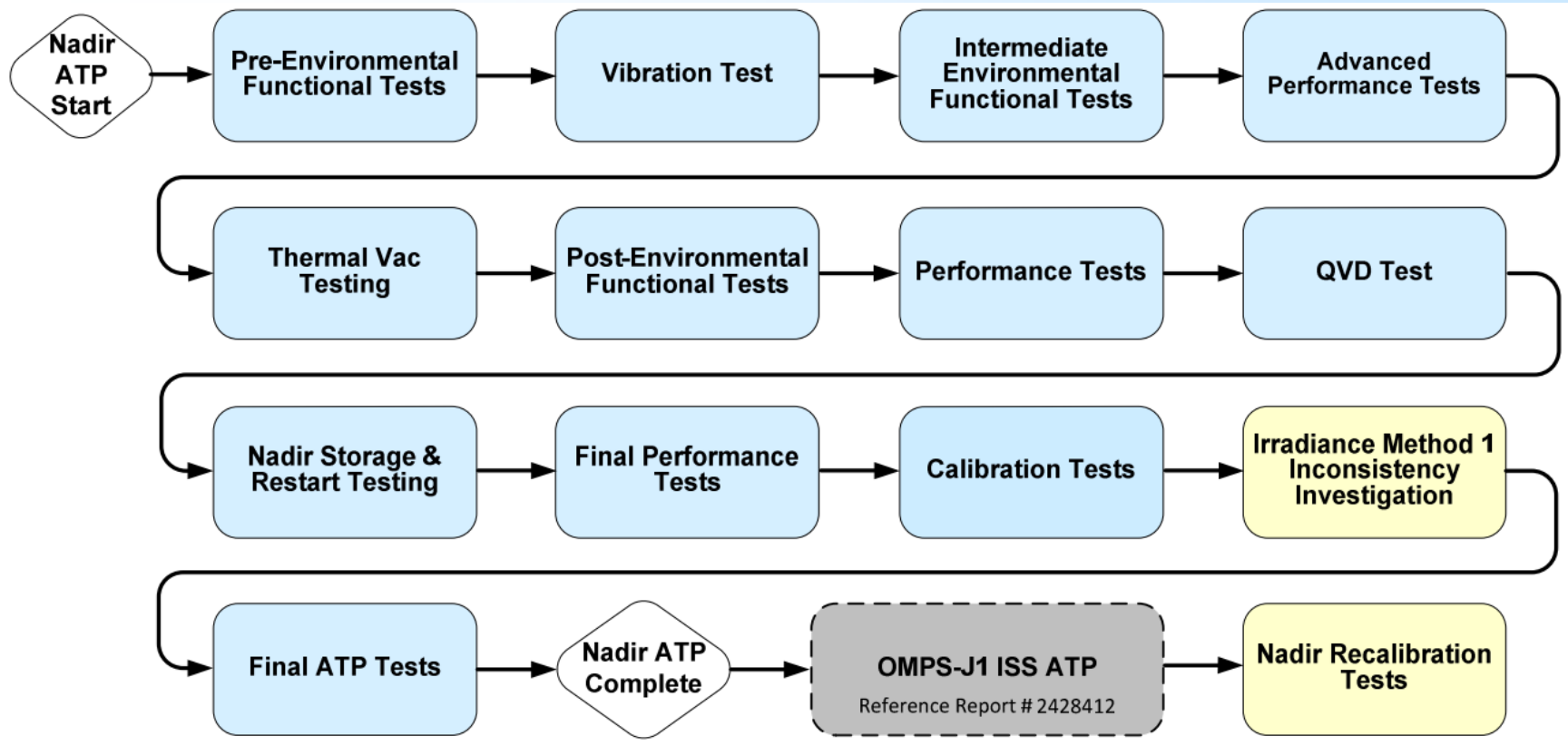
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Calibration test phase summary

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reference: IN0092-TST2-054



Calibration test phase highlights

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- **No significant changes to performance requirements.**
- **QVD**
 - Smaller goniometry step size: was 0.5deg; is 1deg
 - Reflectivity changes and conditioning necessitated goniometry, irradiance, and radiance calibration checks after ISS TVAC.
- **Wavelength coverage**
 - Band pass measurements at 417nm
 - Stray light PSF measurements at 417nm (TBC)
- **Air to vacuum albedo check**
 - Verify instrument albedo calibration consistent in air and vacuum conditions.
 - Performed during ISS TVAC testing.





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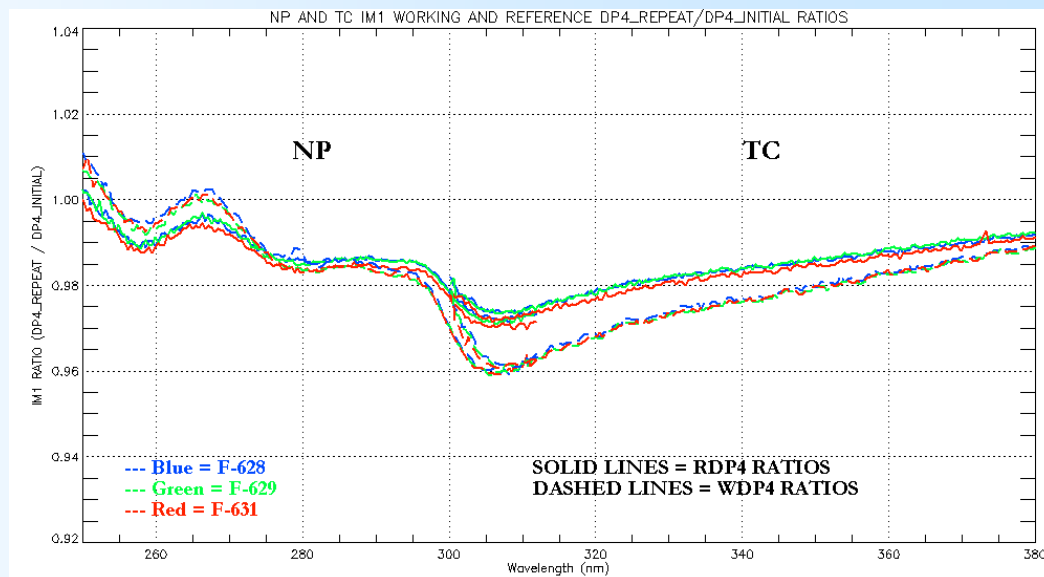




J1 OMPS QVD

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- QVDs experienced optical degradation over course of ground testing.
 - Failure Review Board found that epoxy exposure to UV light caused change in its optical characteristics.
 - Aluminum coating on back side of diffuser did not fully cover roughened back surface, thus allowing UV light to interact with epoxy.
- BATC performed “conditioning” of diffusers in order to stabilize reflectivity.
- Verification tests performed after conditioning.
 - Goniometry and absolute irradiance calibration
 - Absolute radiance calibration



c/o BATC



J1 OMPS QVD – Verification Tests

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- **Irradiance and Goniometry**
 - Repeated goniometry at 3 diffuser positions to verify that QVD characterization from 2012 still valid.
 - 2012 and 2014 goniometry matched to within about 0.5% for repeated diffuser positions.
 - Correction methodology developed using 2014 data.
 - Repeated absolute irradiance calibration at all positions for most accurate albedo calibration.
- **Radiance Check and ReTest**
 - Subset of radiance calibration performed to verify 2012 characterization still valid.
 - Differences $\sim 2\%$ seen, prompting repeat of full radiance calibration.

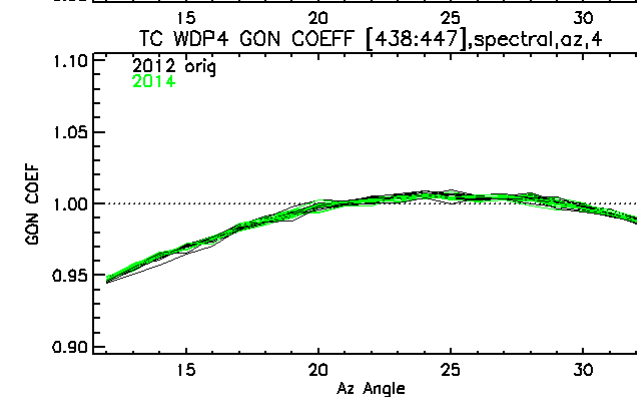
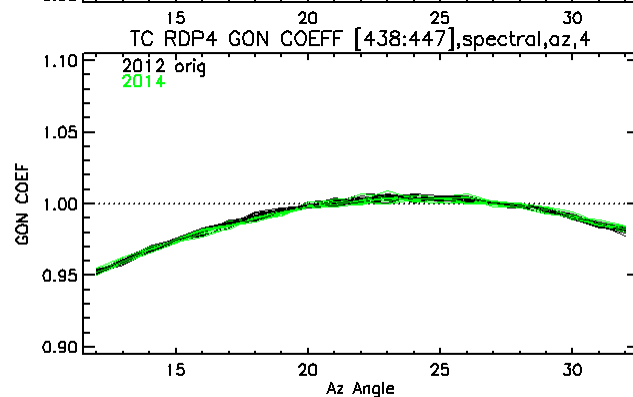
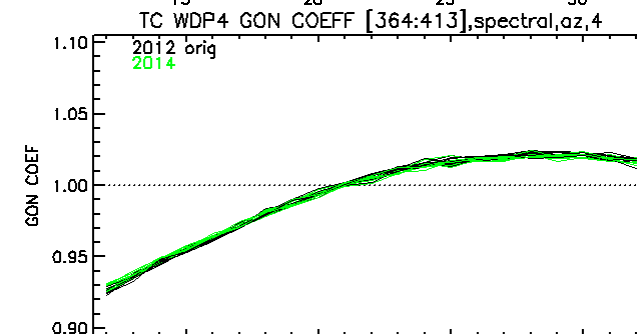
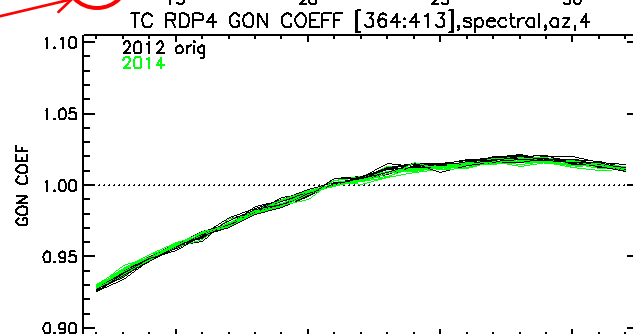
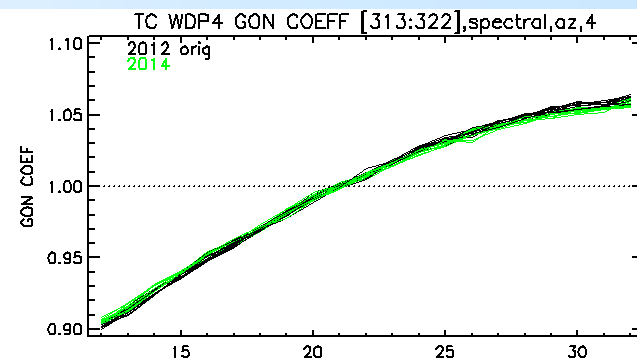
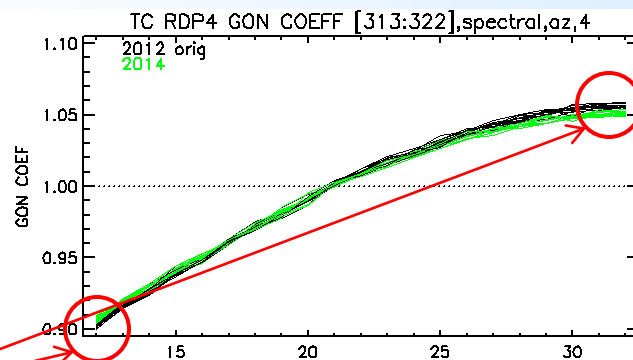




J1 OMPS QVD - TC Goniometry Comparison

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- Plots at right compare azimuthal dependence of Total Column flight diffuser goniometry before (black) and after (green) “conditioning”.
- Differences are relatively small ($\sim 0.25\%$).
- Effect of this error would be to cause season dependence in derived ozone.



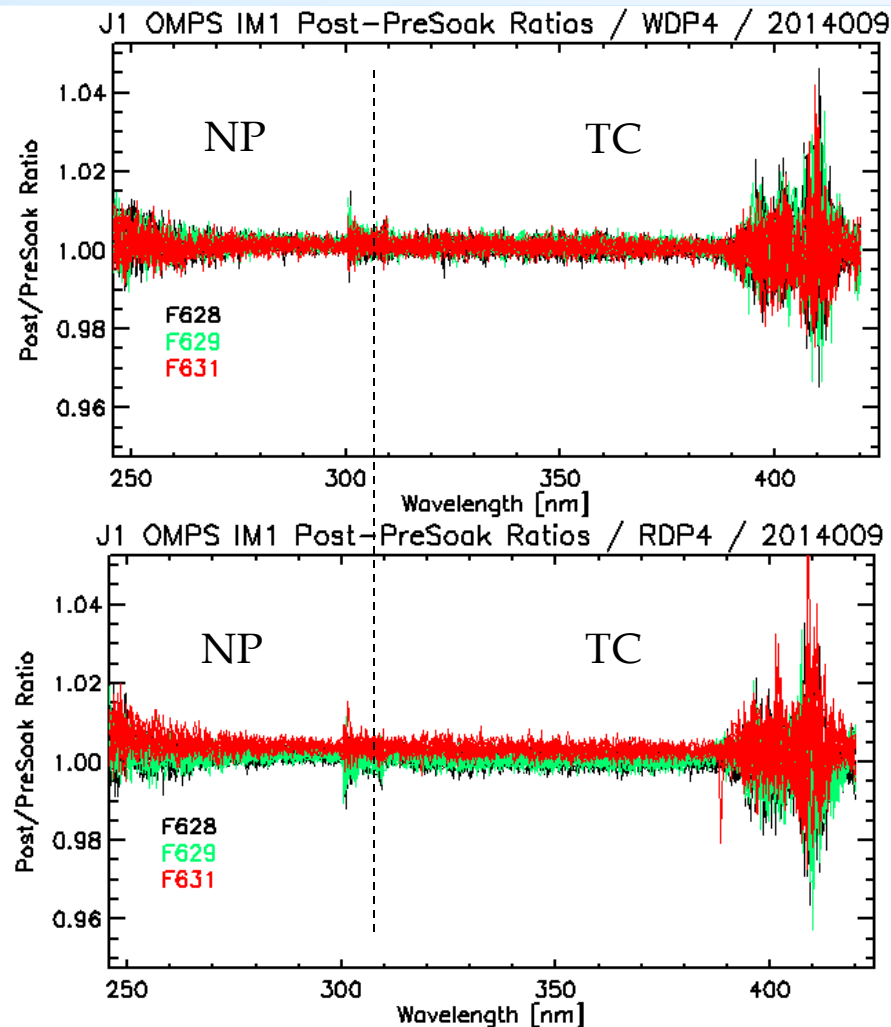


J1 OMPS QVD Stability

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- Final UV soak of both flight diffusers performed to ensure stability.
- Plots at right show comparison between pre- and post-soak absolute irradiance calibration measurements.
 - Multiple light sources used (colors).
 - Time separation between measurements approximately 8 hours xenon arc exposure.
- Results demonstrate stability in both diffusers to within measurement uncertainty (~ 0.75).

Conclusion: J1 OMPS calibration stability and accuracy meets science requirements.





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Summary

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- **QVD implementation yields improvements in the albedo uncertainty budget.**

	Radiance		Irradiance		Albedo – Wvl Independent		Albedo – Wvl Dependent	
	NP	TC	NP	TC	NP	TC	NP	TC
NPP Goniometry	0	0	0.38	0.41	0.38	0.41	0.15	0.36
J1 Goniometry	0	0	0.21	0.21	0.21	0.21	0.1	0.11
NPP OMPS	3.383	3.067	3.499	3.194	1.653	1.717	0.426	0.497
J1 OMPS (Est)	2.36	1.81	2.57	2.04	1.62	1.71	0.29	0.31
Requirement	8	8	7	7	2	2	0.5	0.5

- **Extended wavelength coverage potentially enhances science return and no significant stray light effects.**
- **No major differences in Acceptance Test Program.**

