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Cosmic Ray + Bright Stars Masking

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DES Algorithms meeting



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Introduction

Masking implemented for following cases

- Cosmic Rays
- Bright Stars
- Bleeding Trails (both horizontal and vertical). Horizontal not used anymore.

Most of this talk recycled from DC4 review talk in Feb 09 and summarizes how we did masking for DC5A and 2009-2010 Mosaic processing



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Bright Star Masking

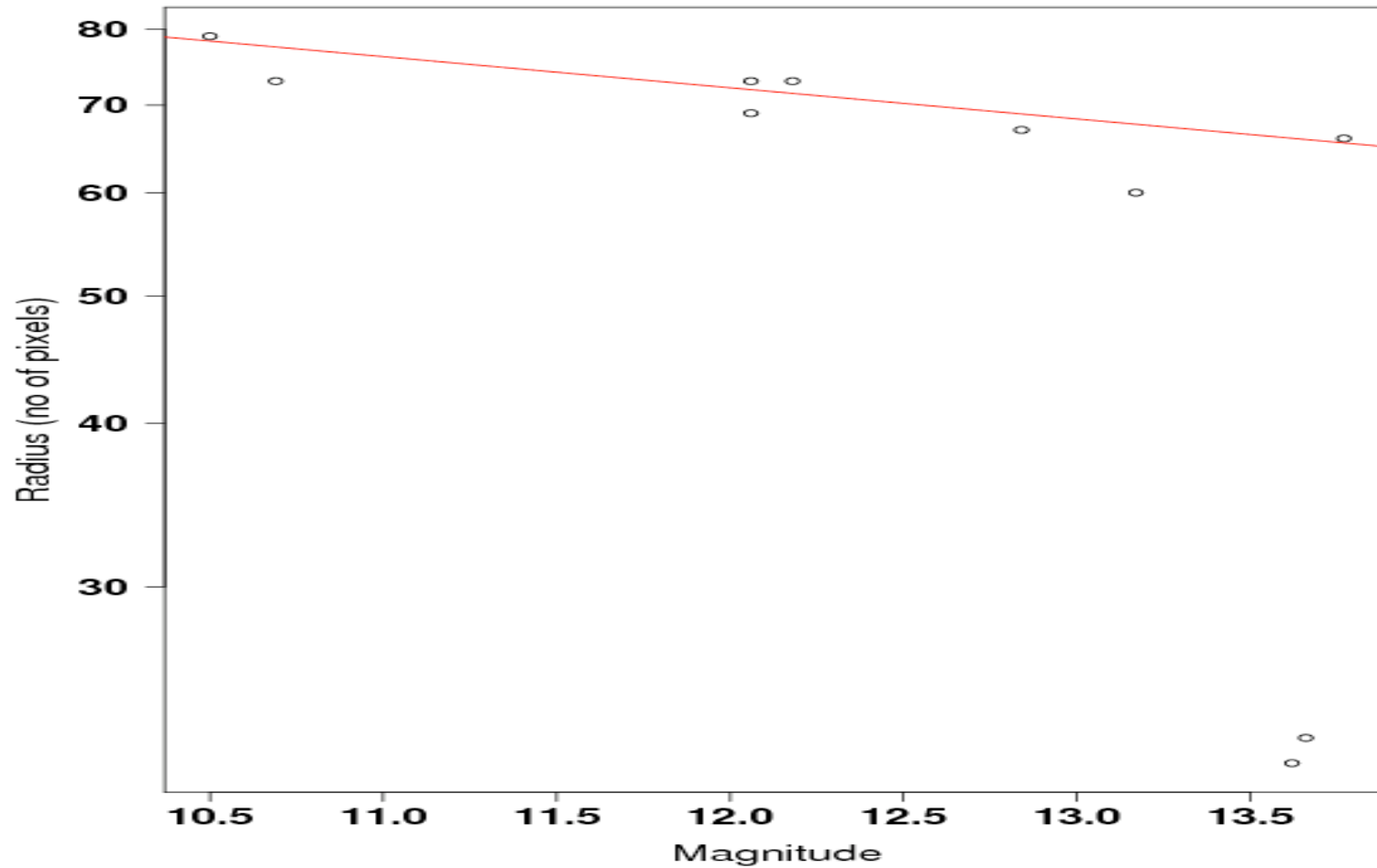
- Find positions of USNOB stars in the image with magnitude < 13 , by using the positions of USNOB stars from astrostds file (during *astrorefine*).
- Convert USNOB- magnitudes to *grizY* magnitudes using transformations provided by Huan Lin and use an empirical radius versus magnitude relations.

$$\begin{aligned}g &= B2 - 0.15 \\r &= R2 + 0.2 \\i &= N \\z &= i - 0.025 - (0.8/1.9)*(r - i) \\Y &= z + 0.22 - 0.408*(i - z + 0.5)\end{aligned}$$



Radius vs Magnitude Curve

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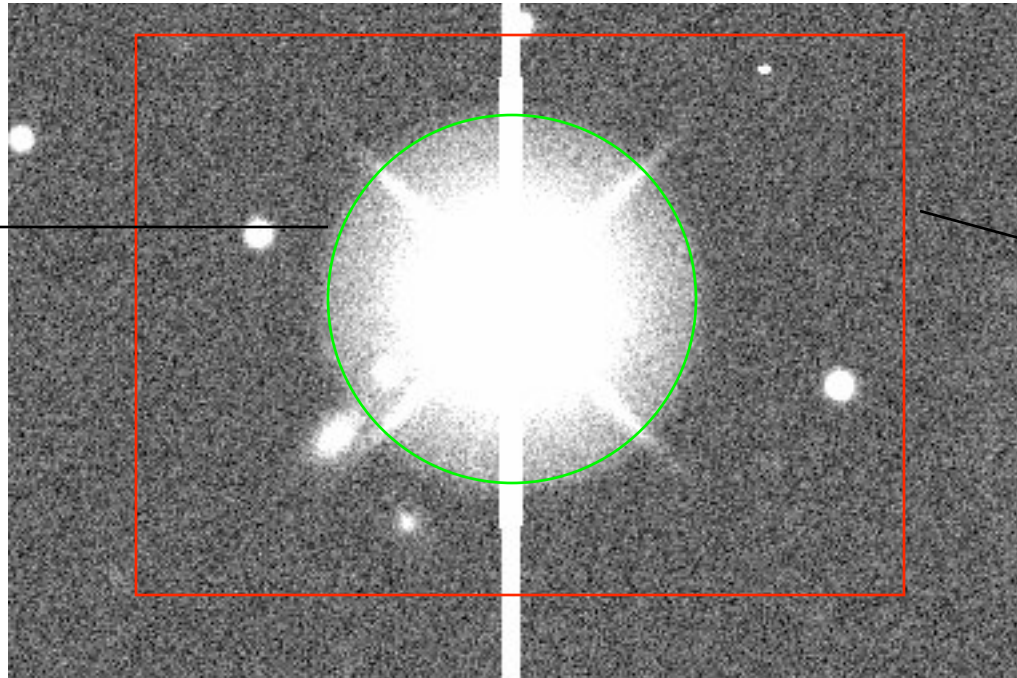




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Bright Star Masking

Location
and size of
circle from
USNOB
catalog and
using a
empirical
fit



Grid around
circle used
to calculate
Median and
Sigma.

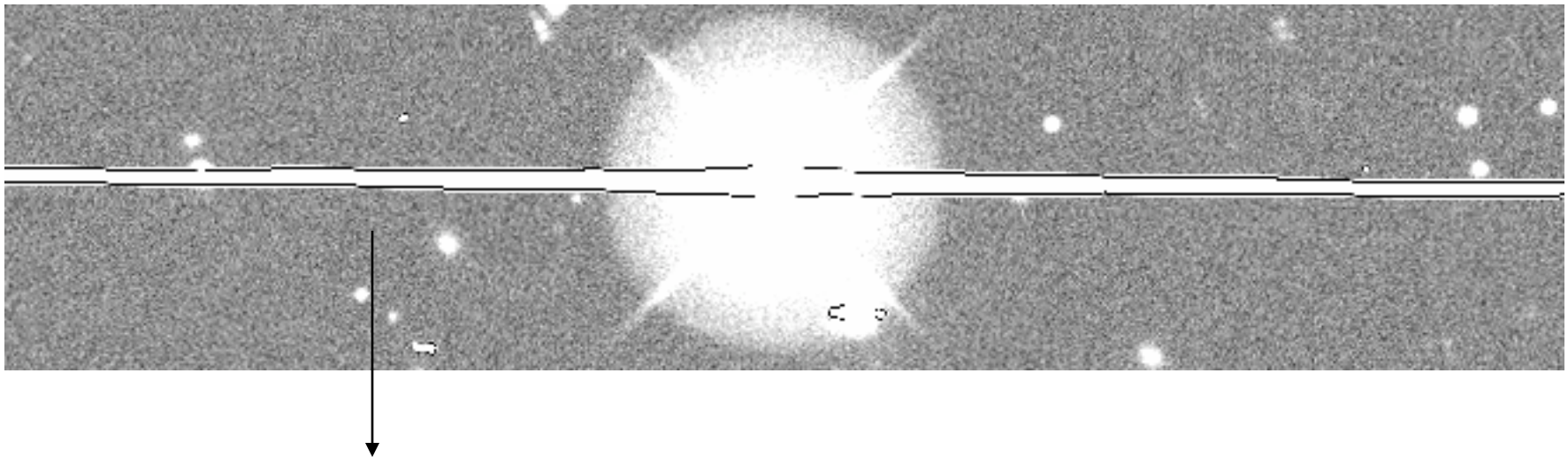
Replace the pixel values in the circle with Gaussian noise
with mean and sigma that of a square grid around the circle



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Bleed Trails Masking

- Use a simple grid-based iterative search for both vertical (reduced images) and horizontal (remap images) bleed trails based on radius of estimated circle and comparing pixel values and replacing the bleed-rails pixels with Gaussian noise (same as bright stars).

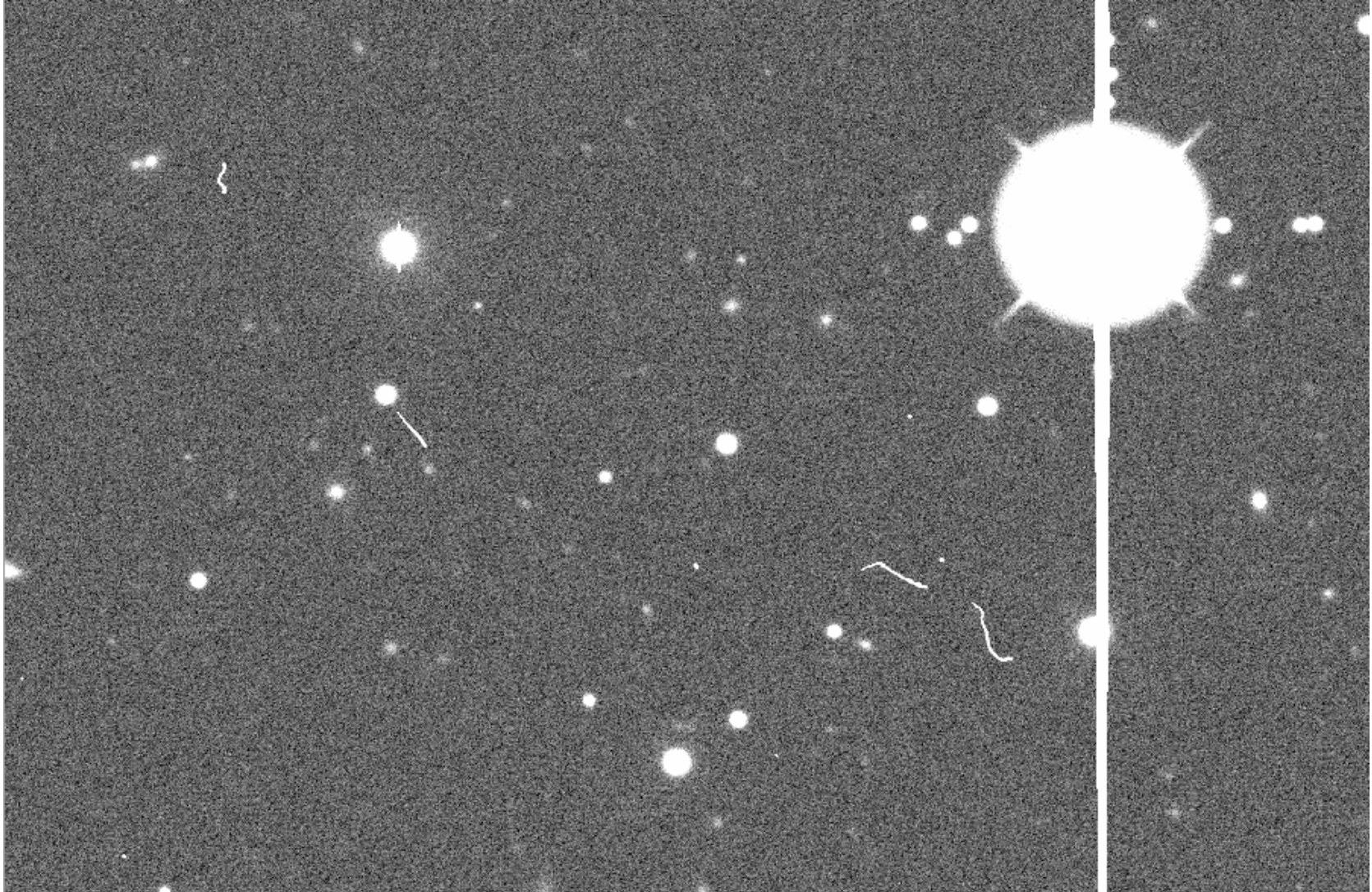


A horizontal bleed-trails from DC4 in a remap image



Original Unmasked Image

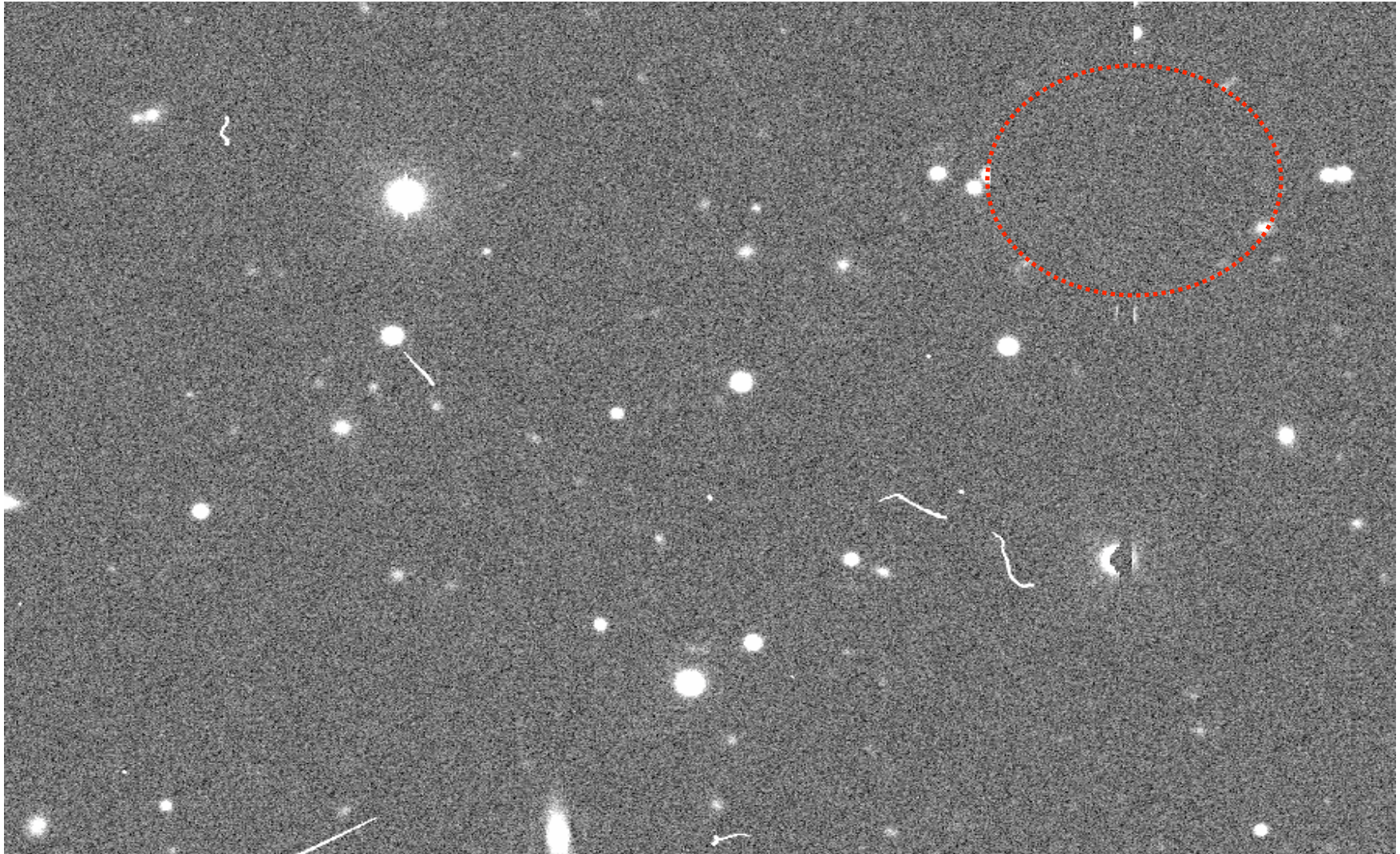
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Masked Image

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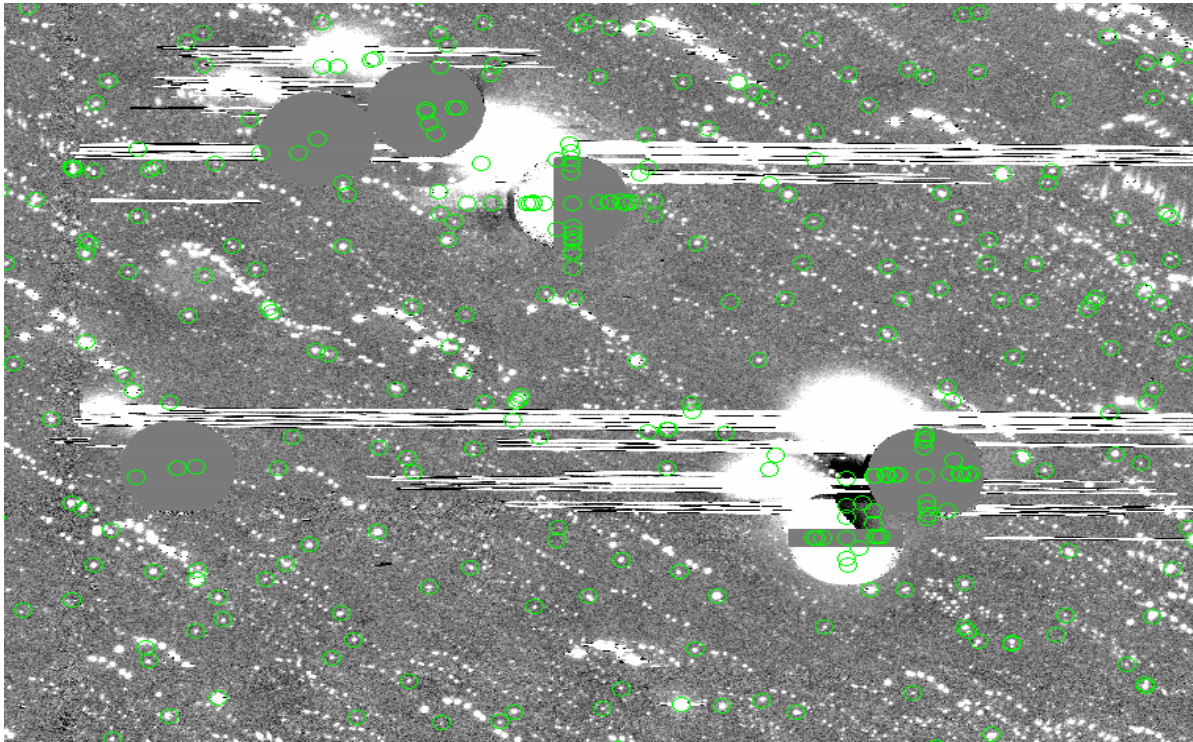




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Sensitivity to SCAMP solution

If SCAMP solution is bad it causes problems to bright star and bleed trail masking



BCS remap image which had SCAMP problems



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Cosmic-Ray Masking

- Use **eye** program to create a retina file to model the cosmic rays defects (use **RPROP** neural-network algorithm) by supplying a file with and without cosmic rays. Run **SExtractor** using this retina file to produce a cosmic ray only image.



Cosmic ray
Identified by
SExtractor



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Cosmic Ray Masking-II

- Using the cosmic ray image as a template identify masked pixels in the original image and replace them .
- Originally used a 2-D interpolation scheme, but replaced it with the same masking technique used for bright star and bleed trails masking. by using median and variance of the entire image.
- Also added a `-srcgrowrad` option to increase the size of the masked region around each cosmic ray-interpolated pixel.

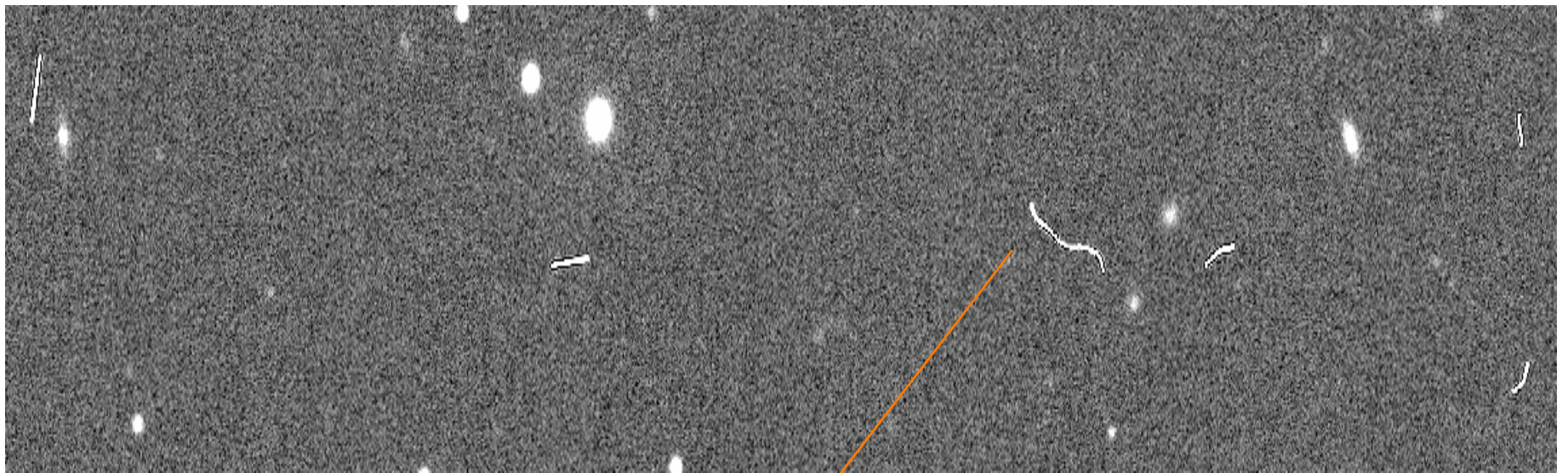
No Cosmic ray masking implemented for Mosaic processing because of no training data.



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Image with Cosmic Rays

Example of Remap Image with cosmic rays



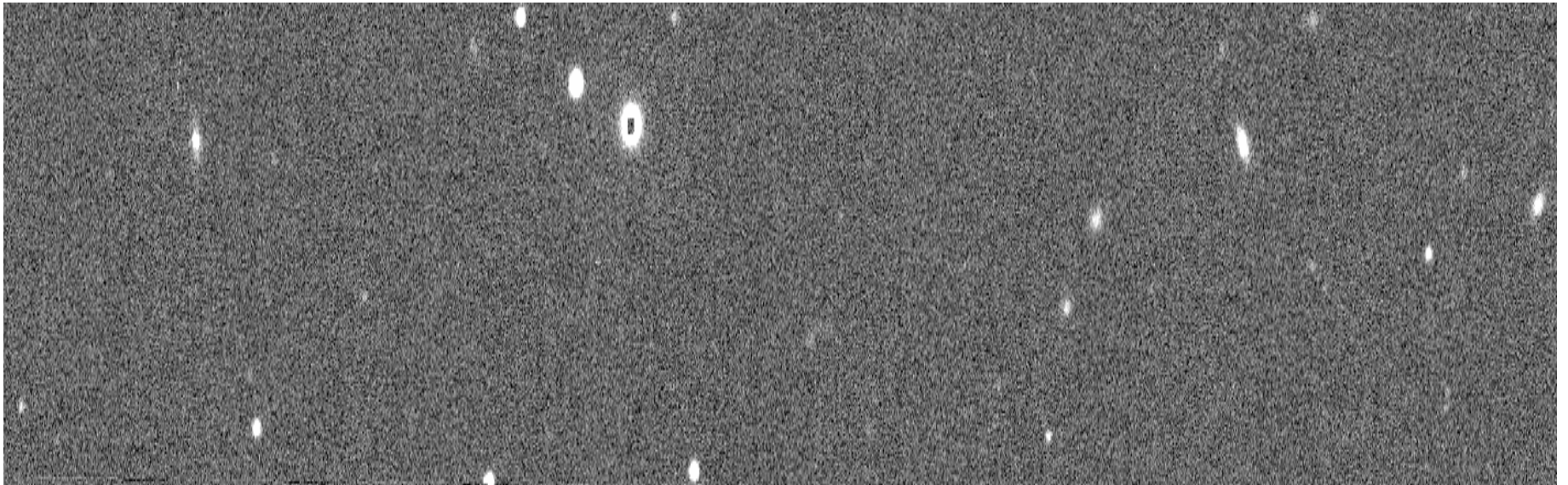
Cosmic Ray



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Image without Cosmic rays

Example of Remap image with cosmic rays masked

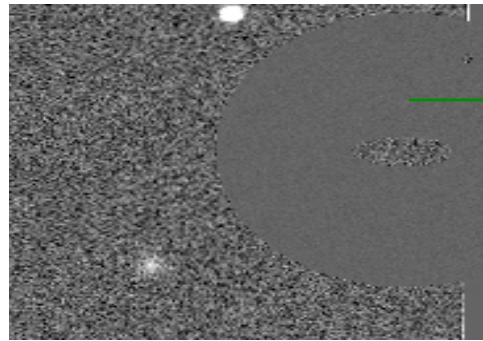




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Unanticipated problems

- Variance turns out to be small for bright circles near corners of remaps.

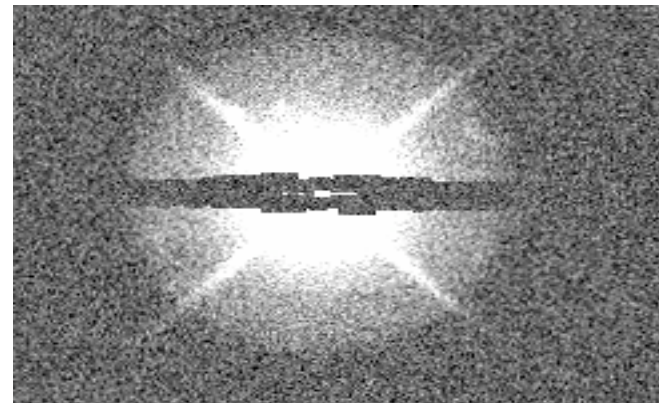


Masked circle with
small values of sigma

- Some bleed-trails masquerade as cosmic rays according to **sextractor**



Cosmic ray defects file

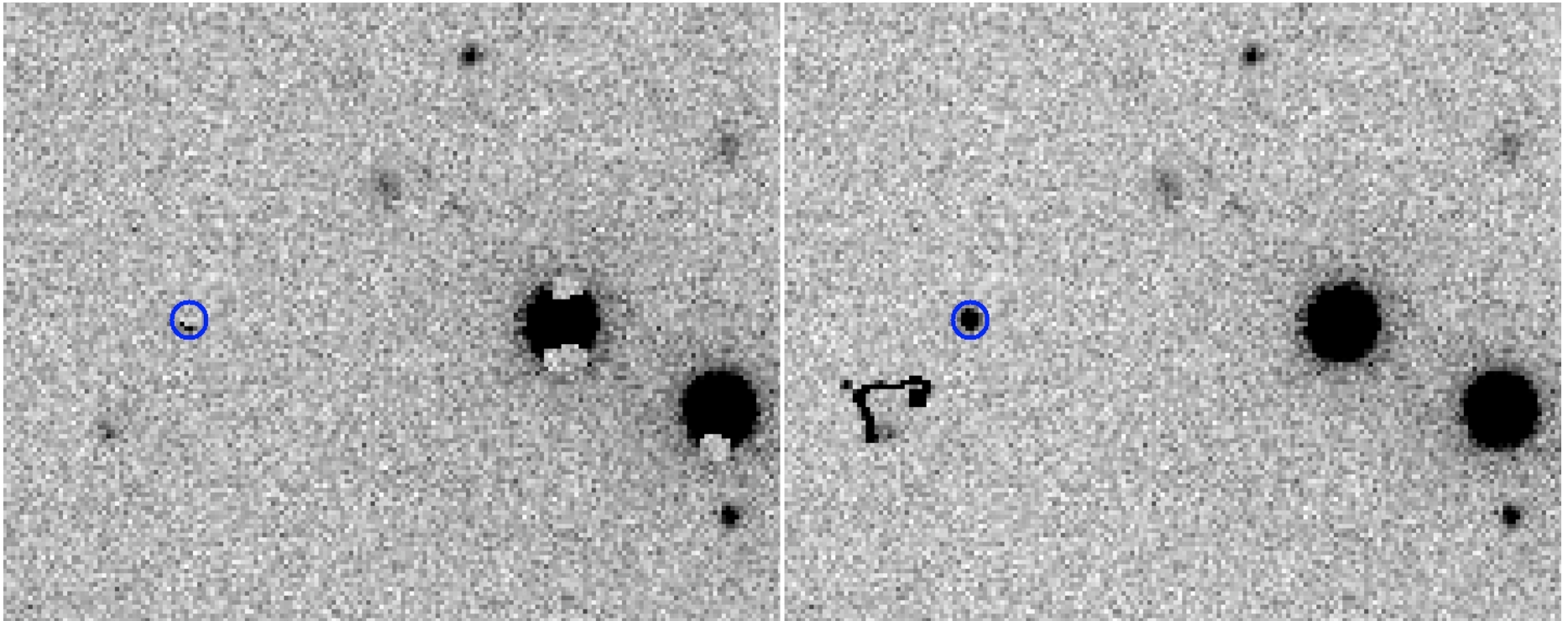


Masked output file with cosmic
rays removed.



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Pacman effect



Faint stars masqueraded as cosmic rays due to very low SExtractor thresholds.



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Changes to DC5B Processing

- Cosmic Ray masking

Use higher `sextractor` thresholds to get rid of PACMAN effect.

- Bright stars/bleed trails masking.

Original image unchanged. Only set BPM and variance map



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Still to do

- Convert information about bright stars/bleed trails masks into mangle format
- Better scaling with exposure (issue for BCS)
- Edge effects (for bright stars near corners of images)
- Use PSF interpolation
- Cosmic ray masking for BCS



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