



DARK ENERGY  
SURVEY



# *DC4 SN WG Image Subtraction Results*

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SN WG





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# *Main Points*

- Brief Description of Process.
- Problems that occurred with, apparently, with DC4
- Problems that occurred as a consequence of the Pipeline.

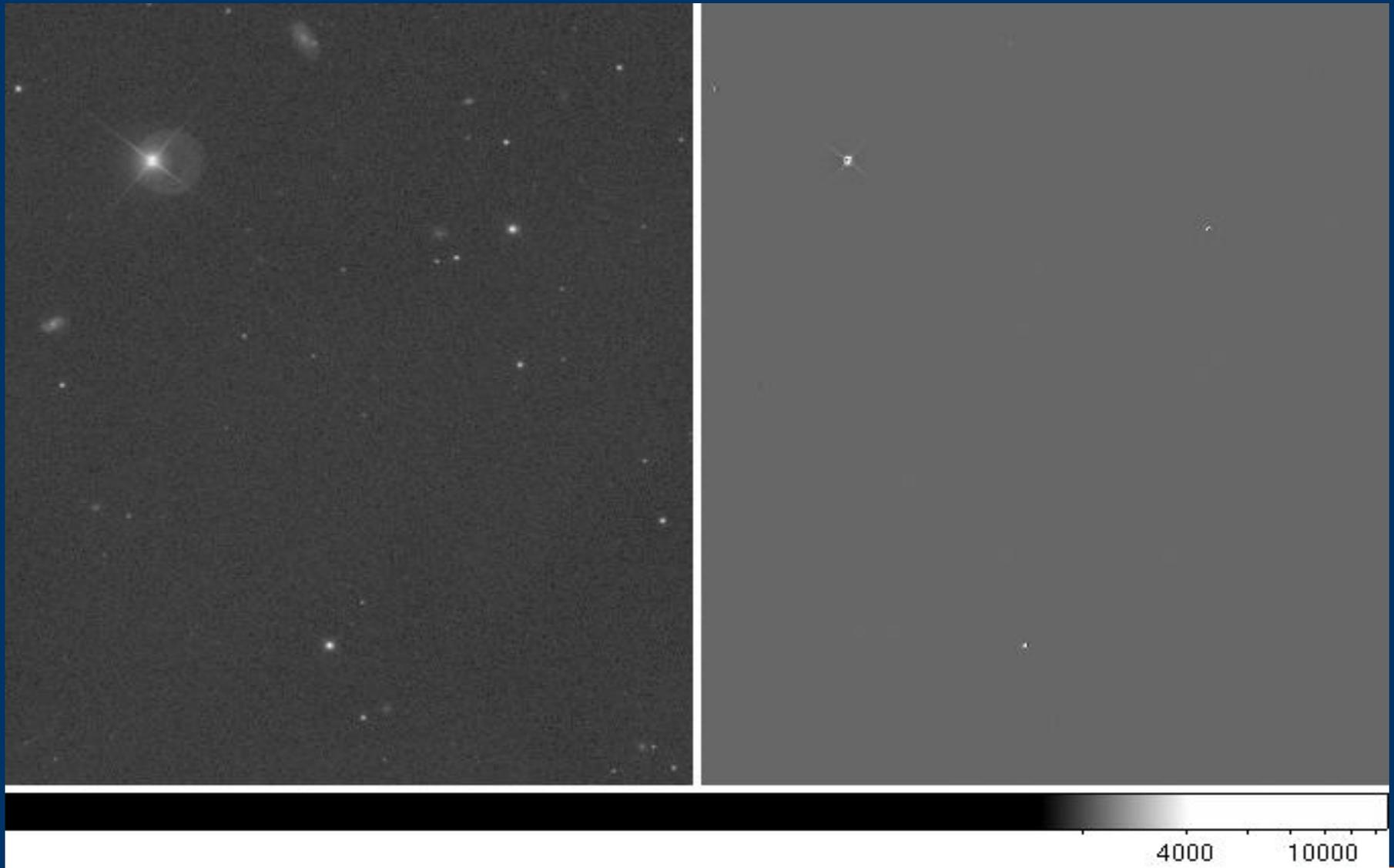


# *Where is the Supernova?*

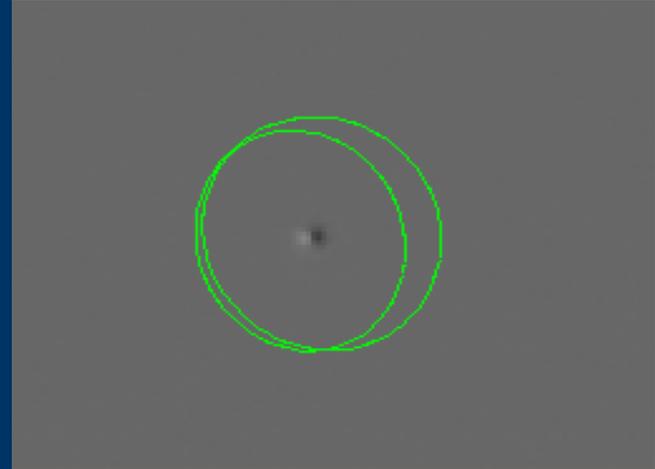
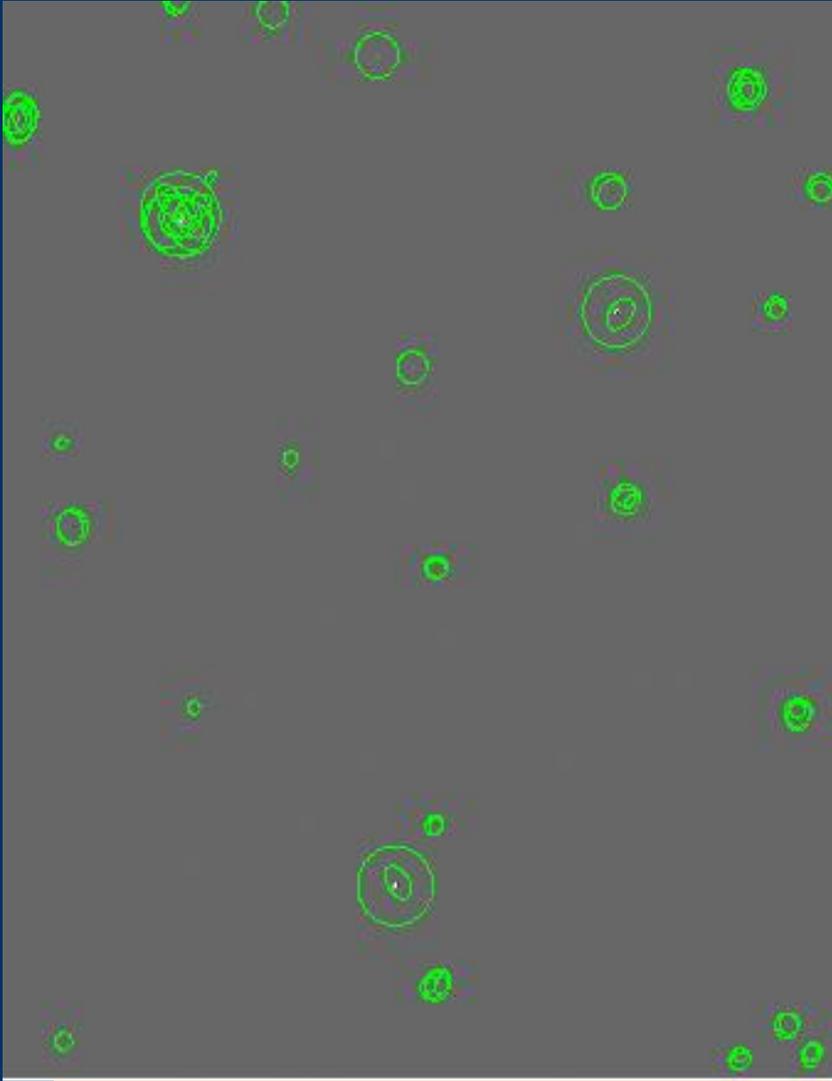


10000 20000

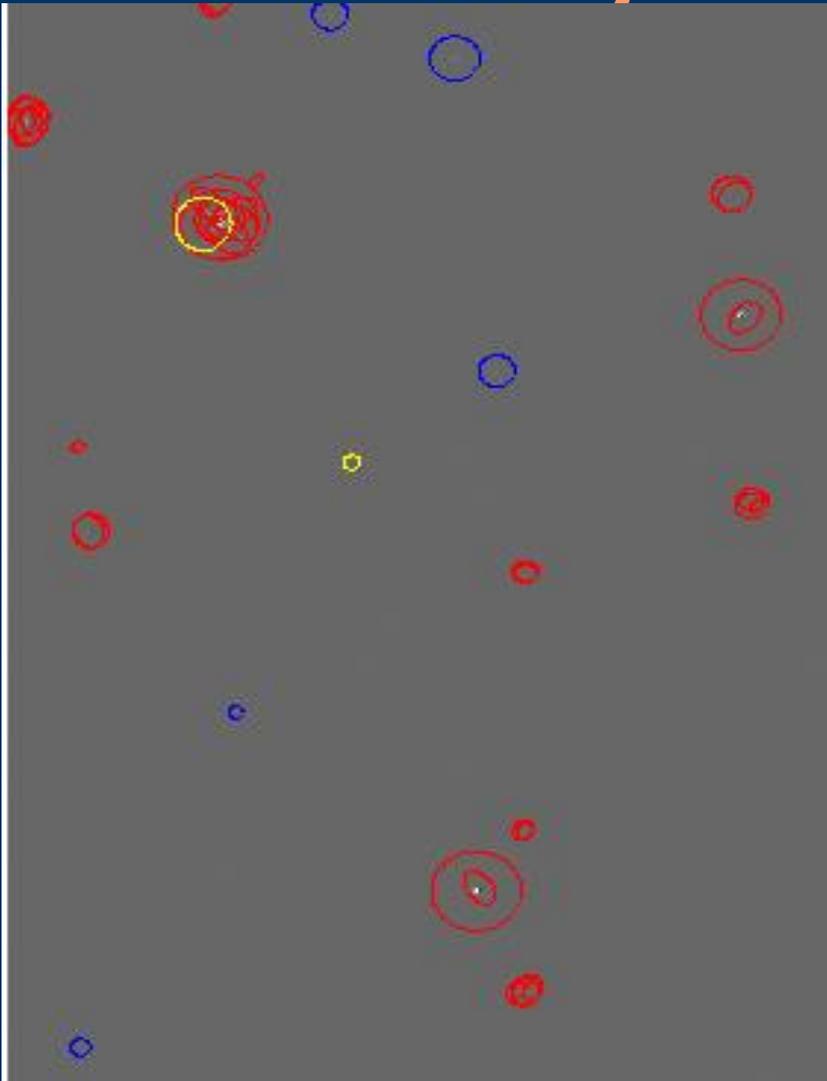
# *How About Now?*



# *Initial Object Detection*



# Object Rejection



Removed Object in  
Red

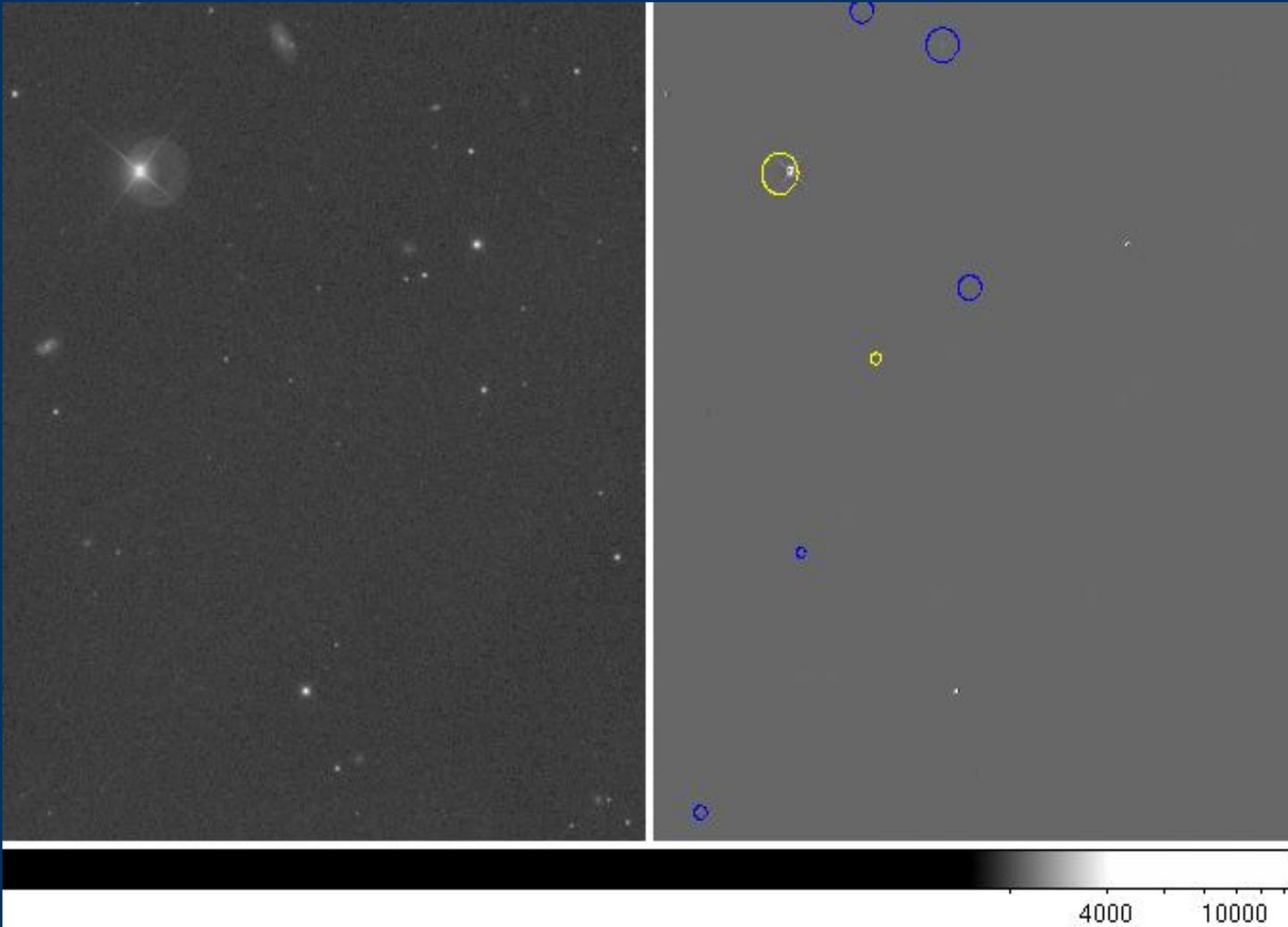
Positive (Search) in  
Blue

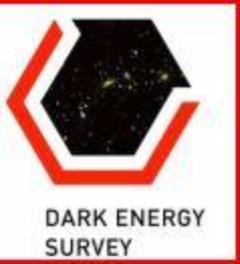
Negative (Template) in  
Yellow



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# *Now It's Much Easier*





# Problems

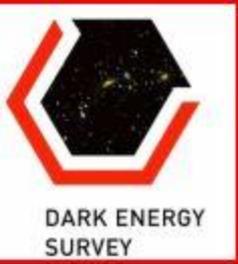
- Actual Problem: Didn't find dim SN
  - Too high S/N for found objects
    - Two controlling keywords
      - Too large a threshold ->  $3.5 \times \text{sigma}$  to 3.0 or 2.5
      - Too large a minarea -> 5 pixels to 2 or 3
    - Not sure which keyword to change, simple monte carlo should determine which to reduce and how much.
  - psf SExtractor photometry not used.





# *“Sort of” Problems*

- No ksum images:
    - “kernel sum”
    - Some images have ksum of zero -> shouldn't be possible
  - Mis-subtracted images
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# *KSUM00 issues*

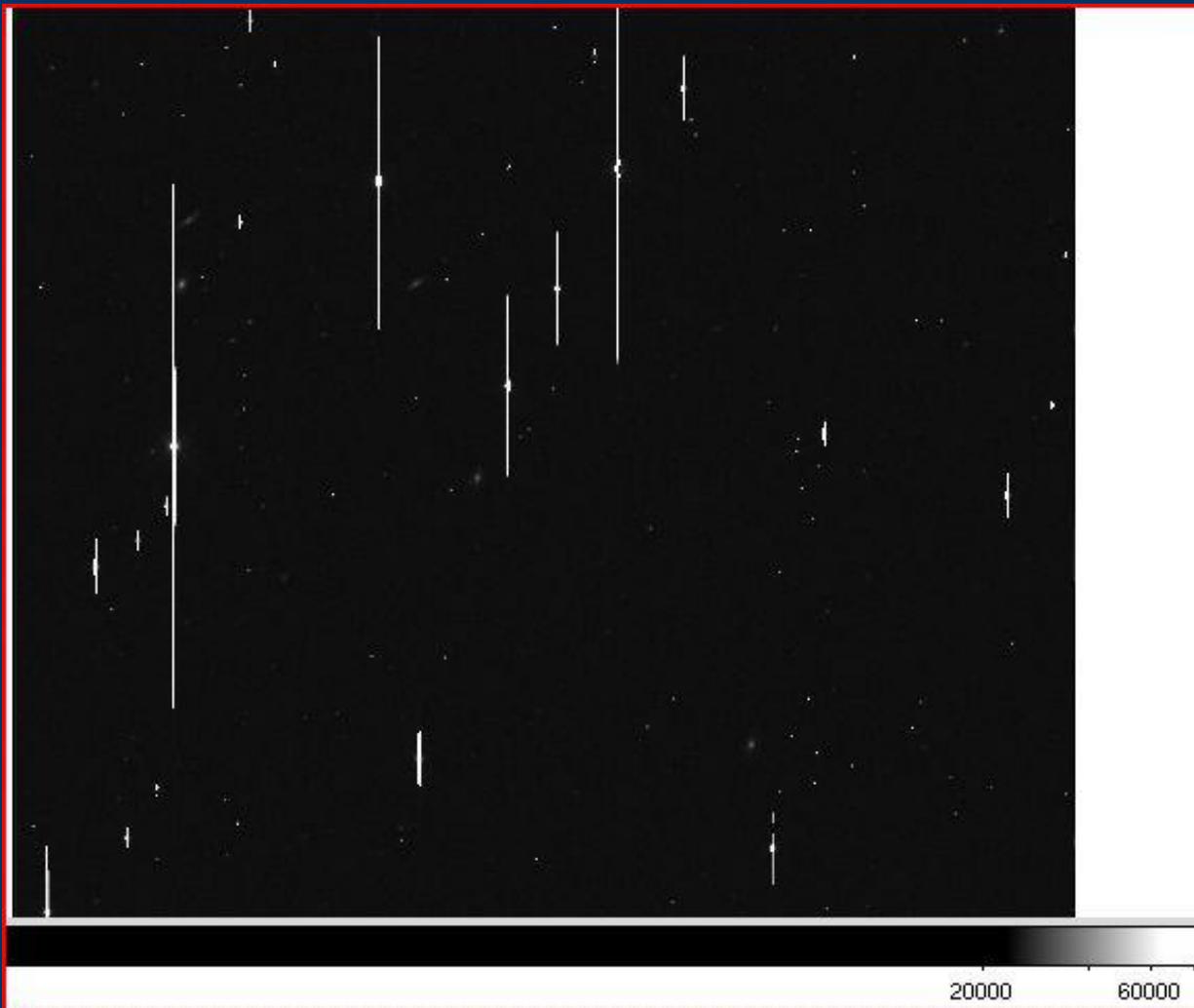
- These search images have many saturated stars.
    - Not sure how realistic these images are with so many saturated stars.
  - “Current” saturation level of hotpants too low anyway. → Was 25000 for DC4
    - Increasing saturation level “fixes” the no ksum problem.
    - However, increasing it improperly creates a new problem
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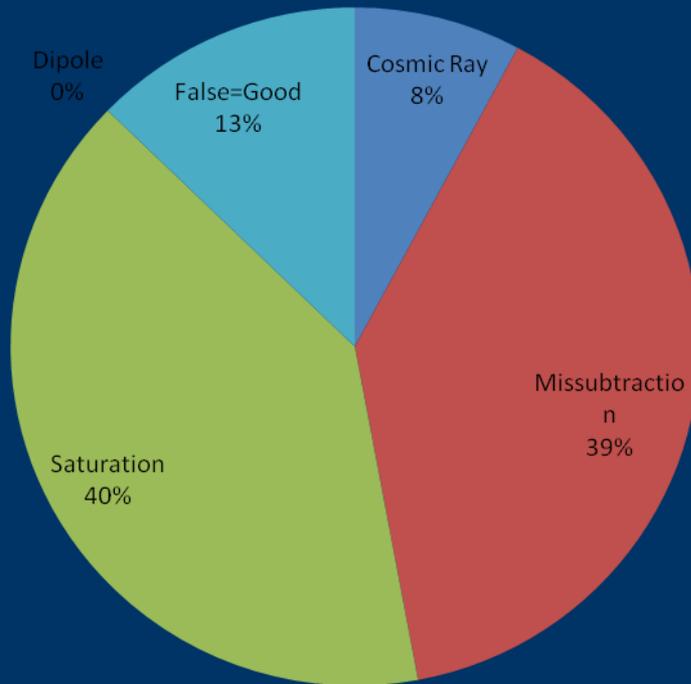
# *A lot of Saturation*



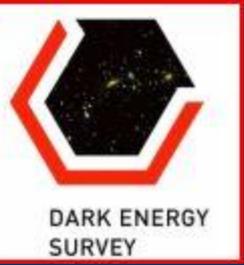


# “Detections”

Sample of Detections



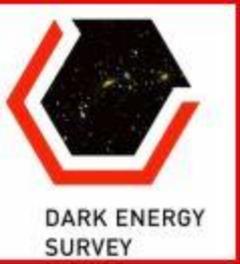
- The types of detection represented within first 100 detections of ~ 6800.
- There is a distinct lack of things we expect.
  - Dipoles
  - Normal Looking Diffraction Spikes.



# *Mis-subtracted images*

- Also caused by saturated stars
  - In this case there are a large number of stars that are saturated.
- Two possible issues:
- others that hotpants attempts to use are not
  - Much more realistic problem.



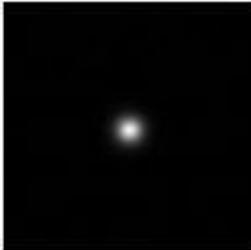
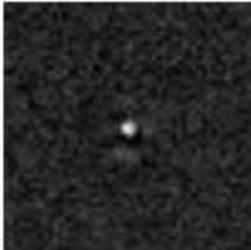
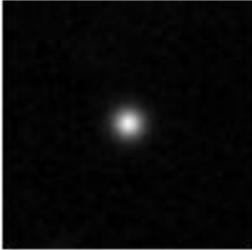
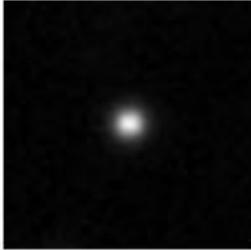
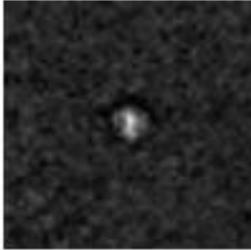
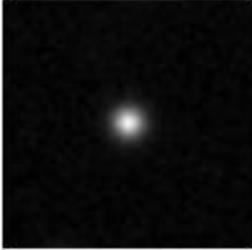
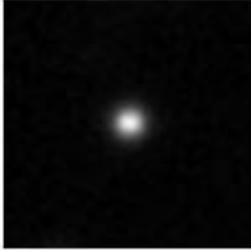
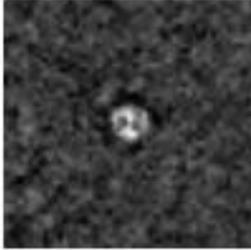


# *Mis-subtracted Images*

- Also caused by saturated stars.
  - In this case there are a large number of saturated stars among the test stars.
- Two possible problems
  - hotpants doesn't consider the saturated stars to be saturated OR
  - More likely there is just a mixture



# *What this issues look like*

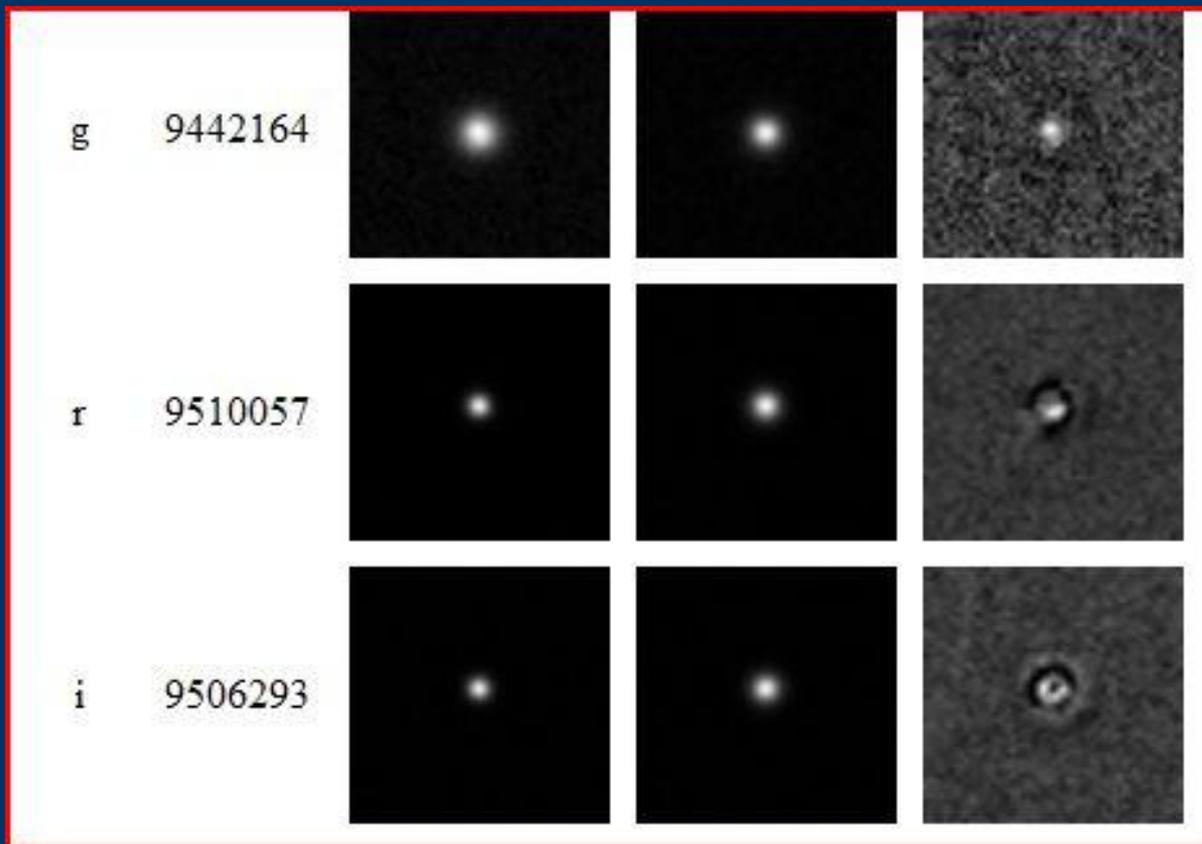
Filter	Object ID	Search	Template	Subtracted
i	9144132			
z	9145407			
z	9185090			

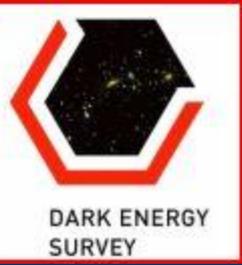


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# *A More Sinister Example*

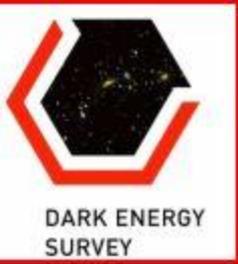




# *Mis-subtraction Solutions*

- If it is then a good choice of saturation level should fix the problem.
  - Otherwise masking or some other solution might be necessary.





# *Everything Else*

- DC4 doesn't seem to have most of the “noise” we would expect
    - Dipoles
      - no proper motions
      - No astrometric misalignments
    - Diffraction spikes
      - If these are supposed to be diffraction spikes, they don't look like it.
    - So, it seems that we really didn't get to see the efficiency of the code with the problems we expect.
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# *Saturation Spikes*

- Masking done by hotpants.

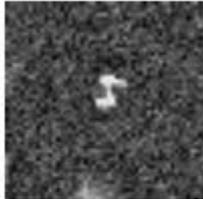
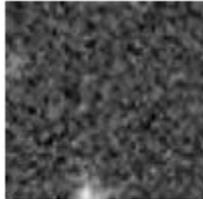
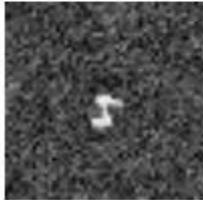
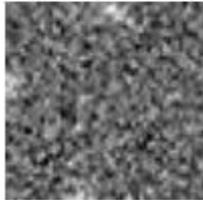
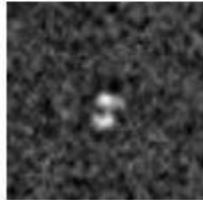


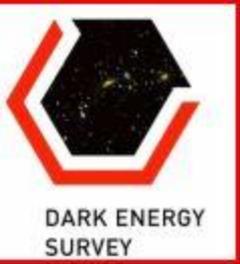


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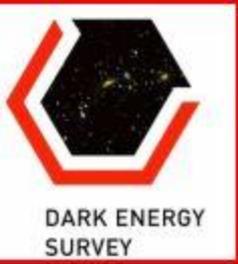
# *Cosmic Ray?*

Filter	Object ID	Search	Template	Subtracted
z	9144981			
z	9144984			



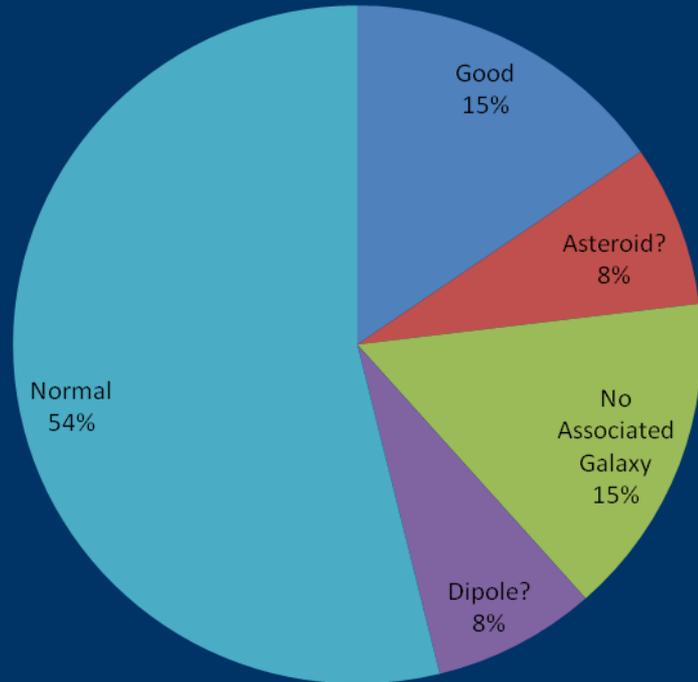
# *“False” positives*

- Final apparent issue
    - Only one of the actual SN implanted into the simulations was found -> S/N limits were too high.
    - However, a number of apparent point sources were found that seem fine.
      - Not sure who/what code put these variable sources into the simulation.
      - Have associated Galaxies
      - Occupy about 10% of detected objects.
      - This would be pretty good, if they were “supposed” to be there...
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# A "Good False" Detection

False Positive Types



Filter	Object ID	Search	Template	Subtracted
z	9146273			
i	9148502			
r	9166467			

# *Future Improvements*

- Usage of Saturation keyword with hotpants
  - Improved masks
  - Decreased Detection Limits
  - PSF photometry
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