Satellite Candidates Around Low-Mass Hosts

Laura Congreve Hunter[1], Burçin Mutlu-Pakdil[1], Paul Bennet[2], David Sand[3,4], Donghyeon "Jeff" Khim[3], Michael Jones[3], Kristin Spekkens[5], Anathan Karunakaran[6], Dennis Zaritsky[3,4], Denija Crnojevic[7], Catherine Fielder[3]

[1]Dartmouth College, [2]Space Telescope Science Institute, [3] University of Arizona University, [4] Steward Observatory, [5]Royal Military College of Canada, [6]University of Toronto, [7]University of Tampa

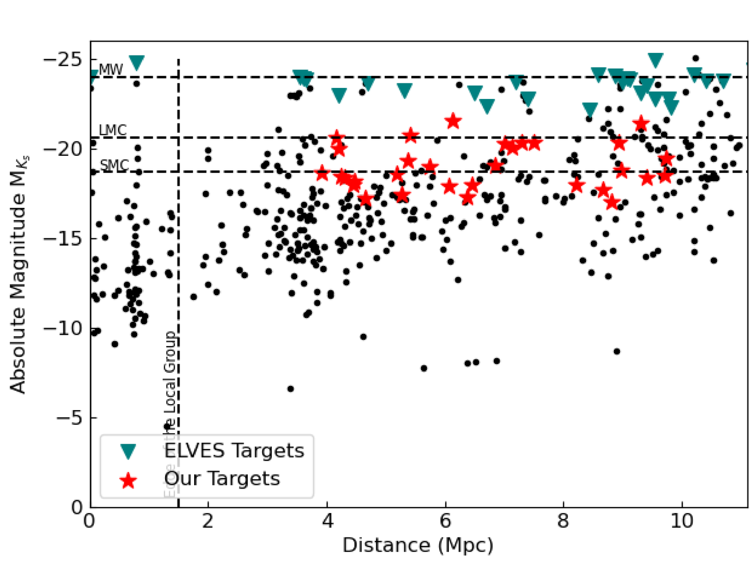
Introduction

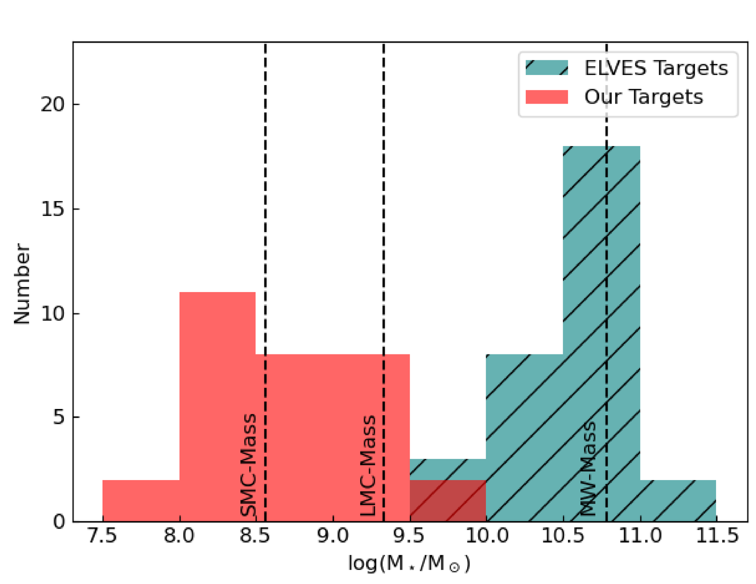
The dominant cosmological model (Λ Cold Dark Matter; CDM) predicts a hierarchy of dark matter halos in which galaxies form and reside [13]. To test ΛCDM on the smallest scales, a statistical sample of the satellite galaxies around diverse hosts in a variety of environments is required. Recently, significant progress have been made in identifying and confirming satellite candidates around Milky Way-mass ($M_\star \simeq 10^{10}\ M_\odot$) galaxies through surveys such as ELVES [3] and SAGA [10].

Utilizing population statistics of satellites around MW-like hosts, simulations have made clear predictions of the number and mass of satellites around low-mass hosts [4, 8]. The predicated satellite mass functions demonstrate large variations depending on baryonic and dark matter physics [5, 12].

To compare with the simulations, we are completing the most extensive semi-automated search for unresolved satellite galaxies around LMC and SMC-mass hosts. This survey compliments other ongoing surveys such as MADCASH [2] and DELVE-DEEP [6, 7] which concentrate on resolved satellite galaxies around nearby (D<4 Mpc) low-mass hosts. By focusing on the unresolved regime, our survey covers the full virial volume of 31 hosts with distances between 4 and 10 Mpc.

Host Selection





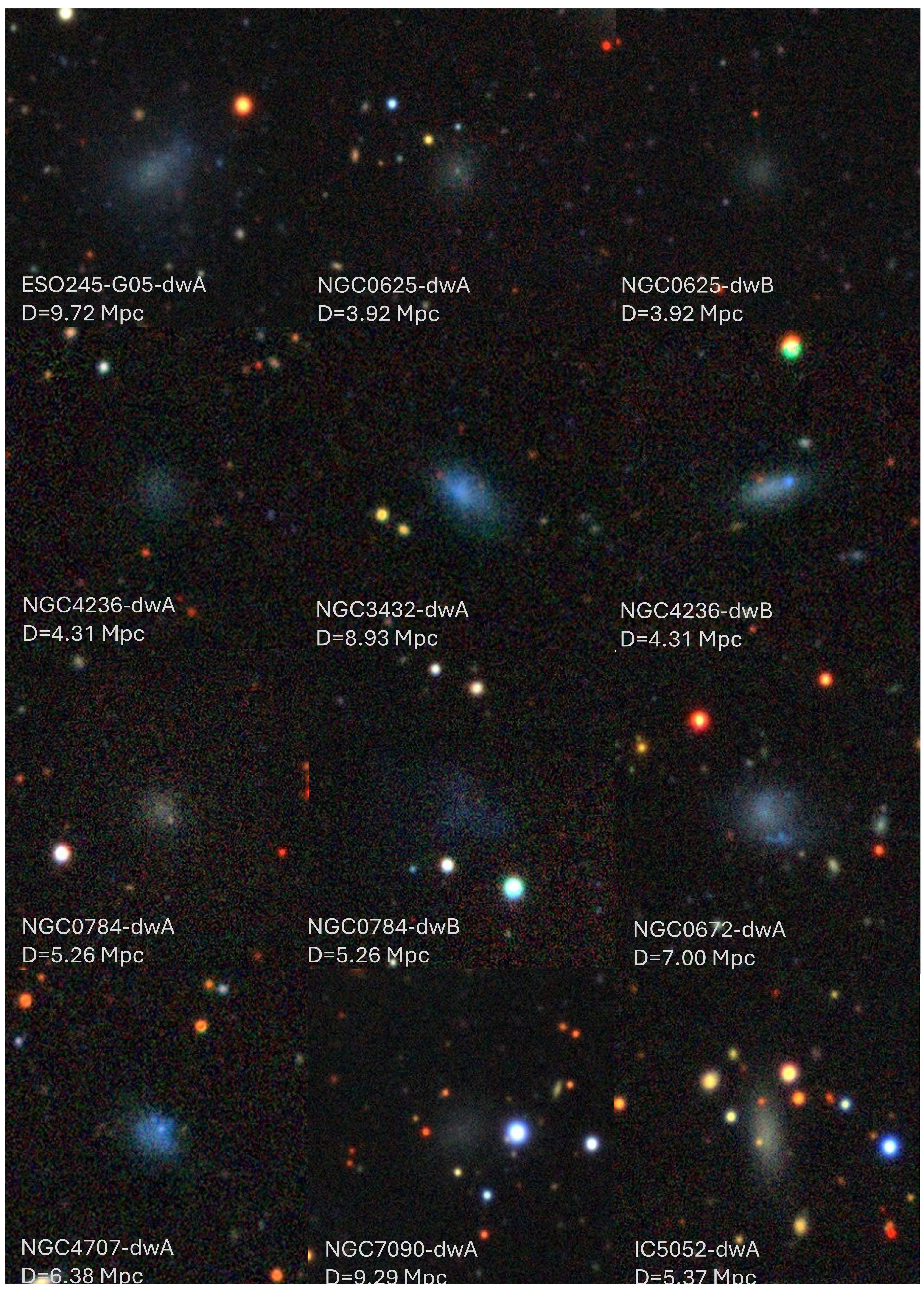
Distance: 3.9<D<10 Mpc
Host Luminosity : -22<M_k <-17
Galactic Latitude : $|b|$ >17°

Summary

Our survey is the most extensive search for unresolved satellite galaxies around LMC and SMC-mass hosts ($4 \lesssim D \lesssim 10$ Mpc). So far, we have identified over 100 high likelihood candidates as well as over 250 more objects of interest. In order to better constrain the satellite galaxy population around the 31 hosts, we are pursuing an extensive follow-up observation program to determine distances.

Newly Discovered Candidates

1.25 arcminute cutouts of newly discovered candidate satellite galaxies.

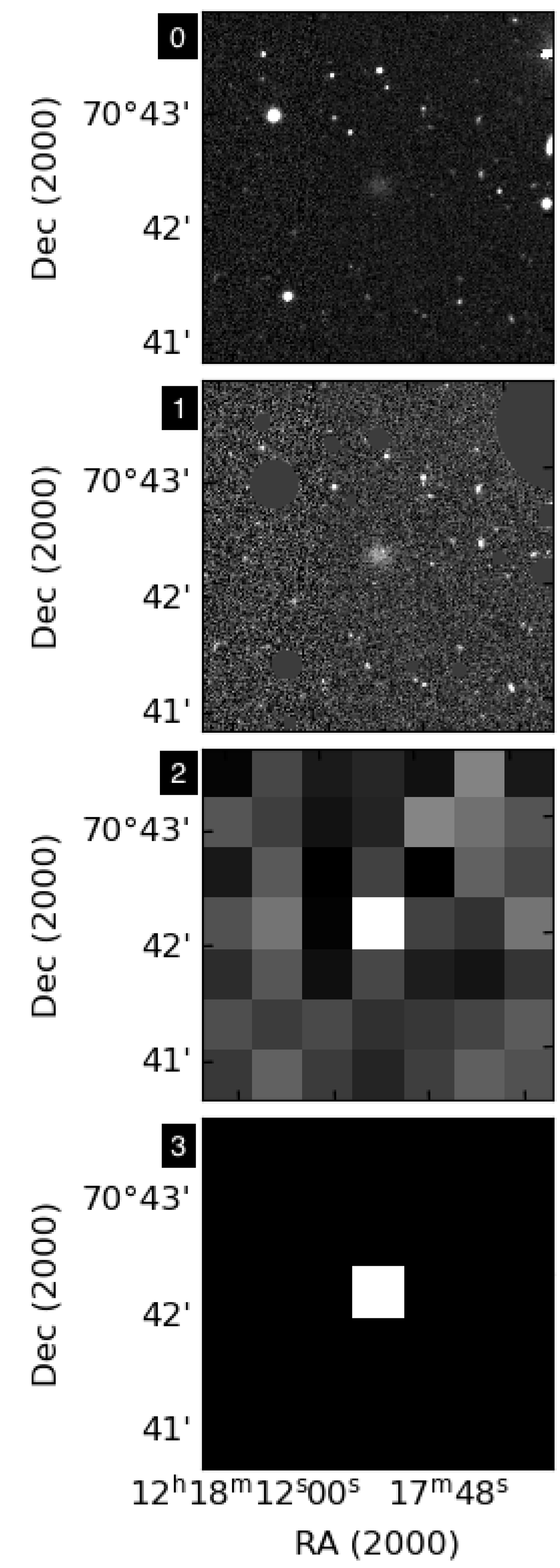


Results from Partial Sample

Analysis of initial sample of primarily higher surface brightness candidates was completed with ongoing work on the lower surface brightness candidates

- Completing GALFIT [11] g and r-band photometry on all candidate satellites
- For high surface brightness candidates, identified a clear central concentration of around LMC-mass hosts
- Approximately 3 high likelihood candidate satellites with M_g<-9 per LMC-mass host in line with predictions presented in [4]
- High likelihood targets and many objects of interest scheduled for follow-up observations to determine distances from spectroscopy or surface brightness fluctuations

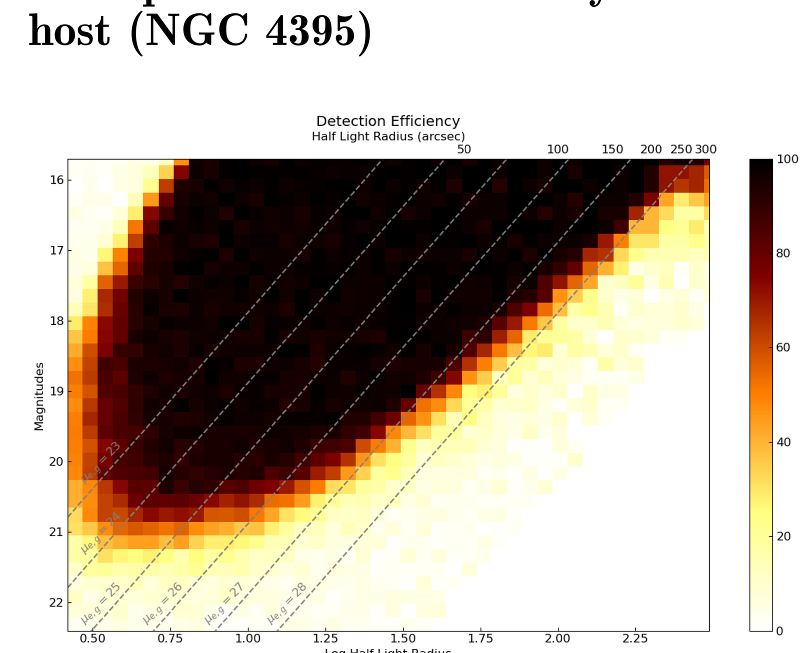
Detection Algorithm



The detection algorithm was utilized detailed in [1] and is illustrated in the figure above. The figures numbers correspond to the steps itemized below. The algorithm began with a g-band image of part or all the virial volume of a host from the DESI Legacy Imaging Survey.

1. Mask foreground stars and bright background galaxies based on a bright star catalog [9]
2. Spatially binning the masked image by 100×100 pixels to identify diffuse objects
3. SExtractor is run on the binned image and pixels above the detection threshold were forwarded for visual inspection
4. Visual inspection to remove image defects and clear false detections and again on Zooniverse where co-authors rated the quality of each satellite candidate

Example detection efficiency for one host (NGC 4395)



The effectiveness of the detection algorithm was determined through artificial injection. The artificial dwarfs were used to test both the algorithm's detection limits as well as the visual inspection's recovery.

References

References

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For more information contact laura.c.hunter@dartmouth.edu