

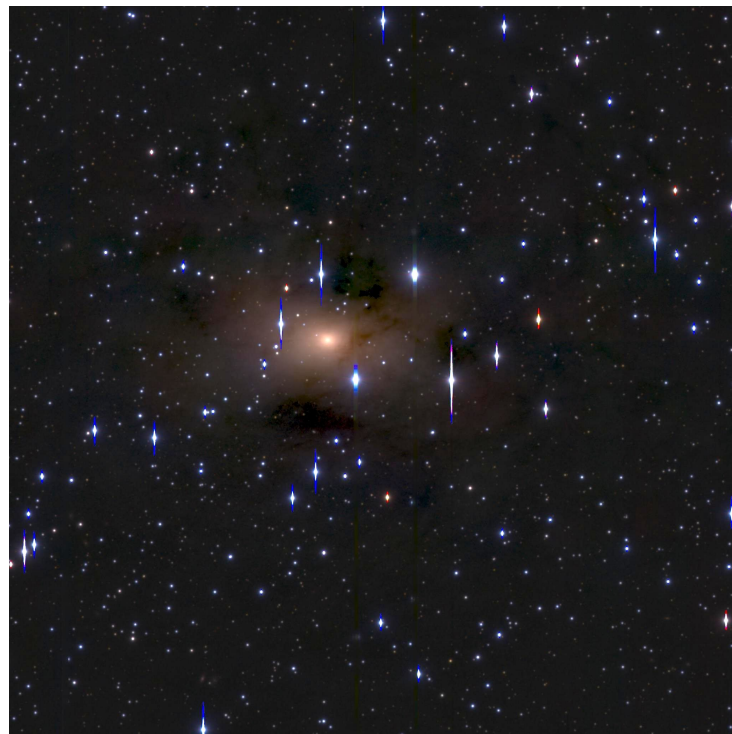
Globular Cluster Candidates in Maffei 1

Samuel Hinton & Ricardo Salinas

Motivations

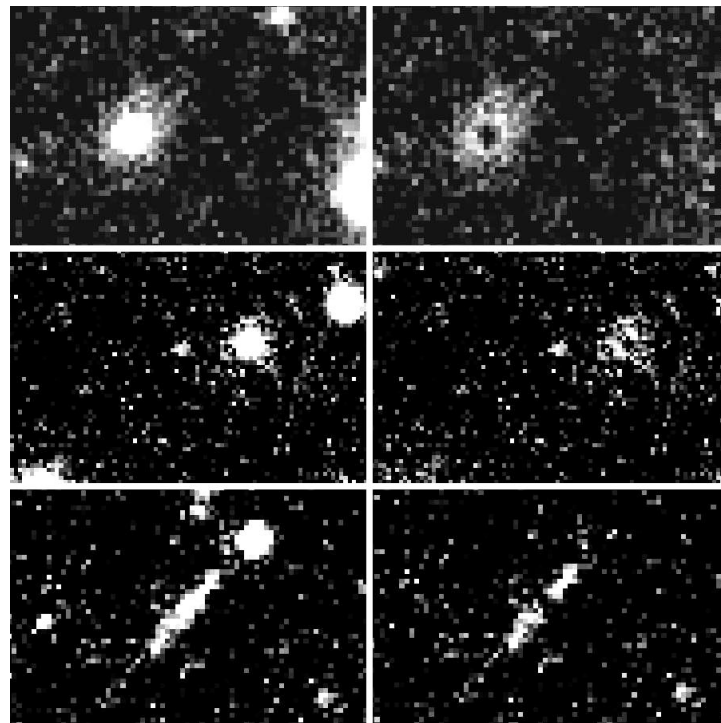
- GCs are excellent tracers
- Maffei 1 is a giant elliptical, estimated to have over a thousand GCs
- Because it is the closest giant elliptical galaxy, at approximately 2.7 Mpc, we can partially resolve GCs

The aim of this project is to use imaging of Maffei 1 from the Subaru Telescope with SUPRIMECAM to select GC candidates for follow up.

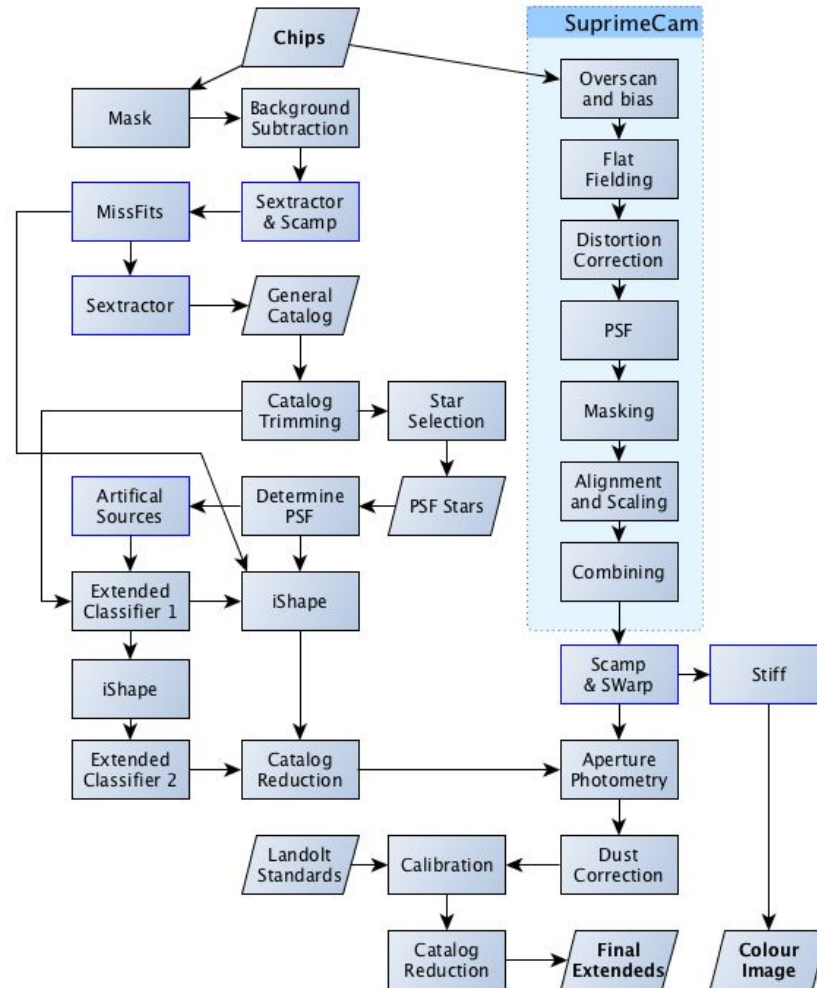


The failure of the naive solution

- Use PSF subtracted photometry to manually classify sources
 - Fairly simple to do
 - Time consuming, but still feasible
 - Except this method cannot determine at all the probability for detecting a source
- Need a solution that can be tested
 - Generate artificial images
 - Determine GCs
 - Use this to quantify probability of detection



The Solution:

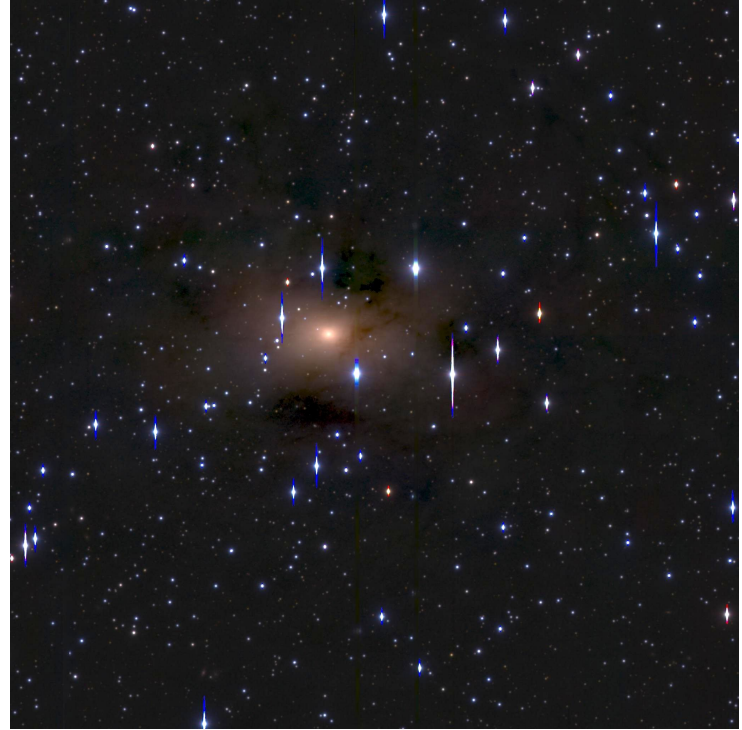


Data reduction:

Mosaics and calibration data use the SDFRED2 pipeline. Output mosaics are Scamped and SWarped to give correct WCS.

Tiles for classification use the z' band image. Scamped to correct WCS. Sources trimmed.

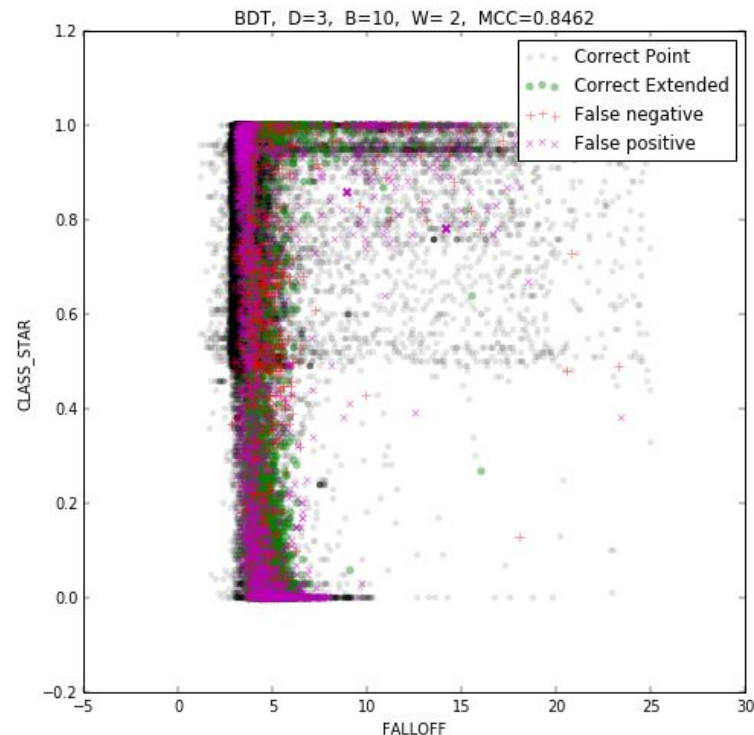
Colour image produced using mosaics and Stiff.



Classification System:

- Data generated using automatically selected PSF stars and BAOlab's `mksynth`
- Machine learning classifier
 - 40% training, 35% test, 25% validation
- Uses 2 simple Boosted Decision Trees
 - Boost number, tree depth and training weights determined by Matthews Correlation Coefficient score against validation data.
 - One for SExtractor, one that also uses `iShape`

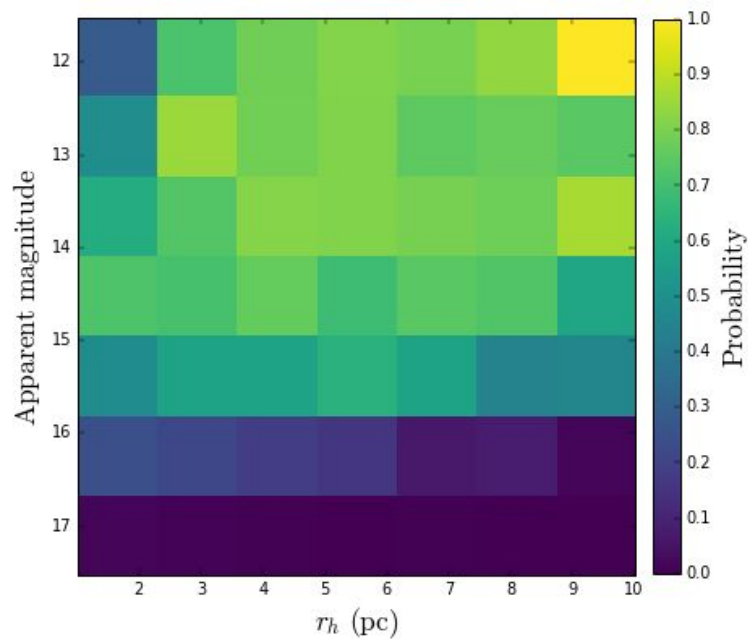
Matthews correlation coefficient: 0.8491
Extended correct: 90.2%
False negative: 9.8%
Point correct: 98.0%
False positive: 2.0%
Num True positive / Num Positive: 0.827
Num True positive / Num Actual Positive: 0.902



Classification System:

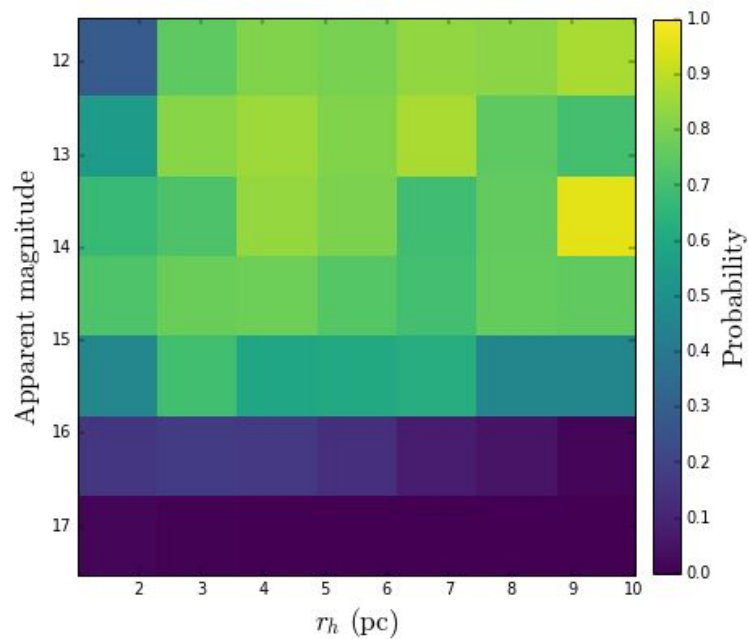
Classifier 1 (SExtractor)

Contamination: 31%



Classifier 2 (+ iShape)

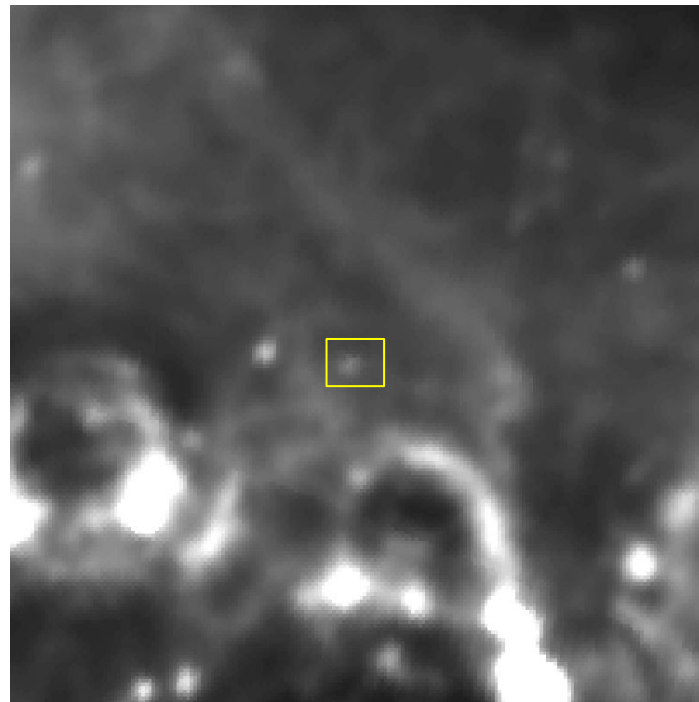
Contamination: 17%



Photometry:

- Performed on final mosaics
- Dust extinction calculated from interpolated IRSA dust map for each target.
- Photometric calibrations calculated from Landolt standards transformed into SDSS bands.

IRSA dust map centered on Maffei 1



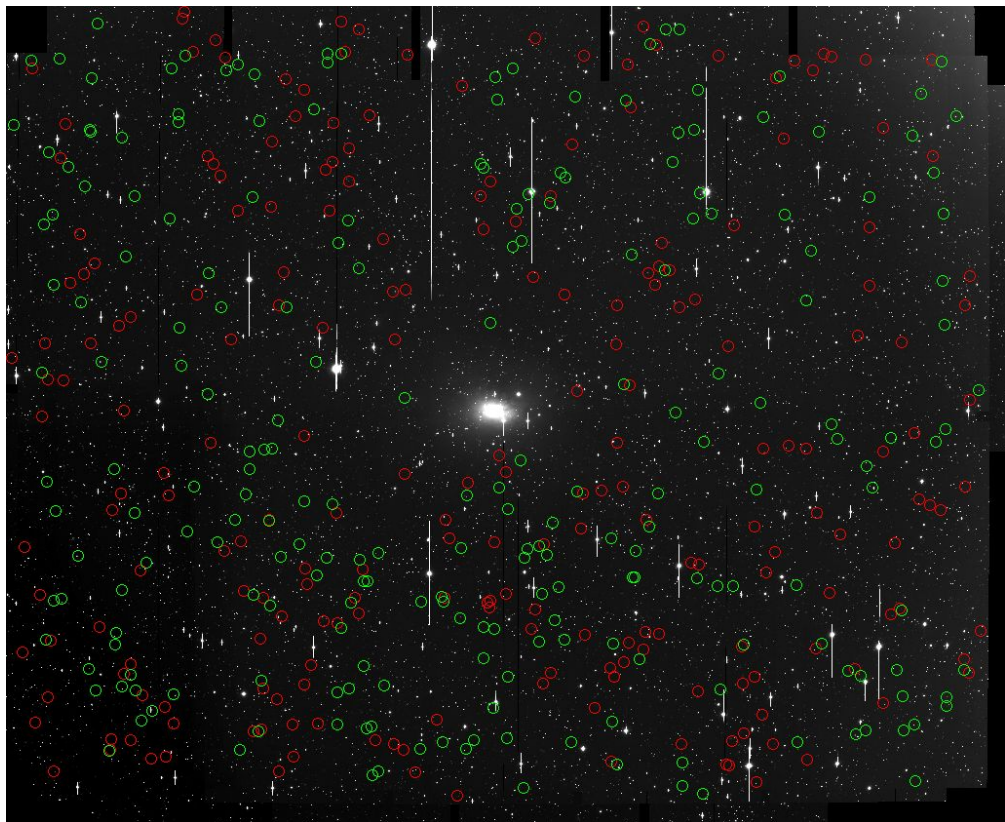
Classification Results:

Add cuts to absolute magnitude, colour deviation, FWHM and χ^2 cuts.

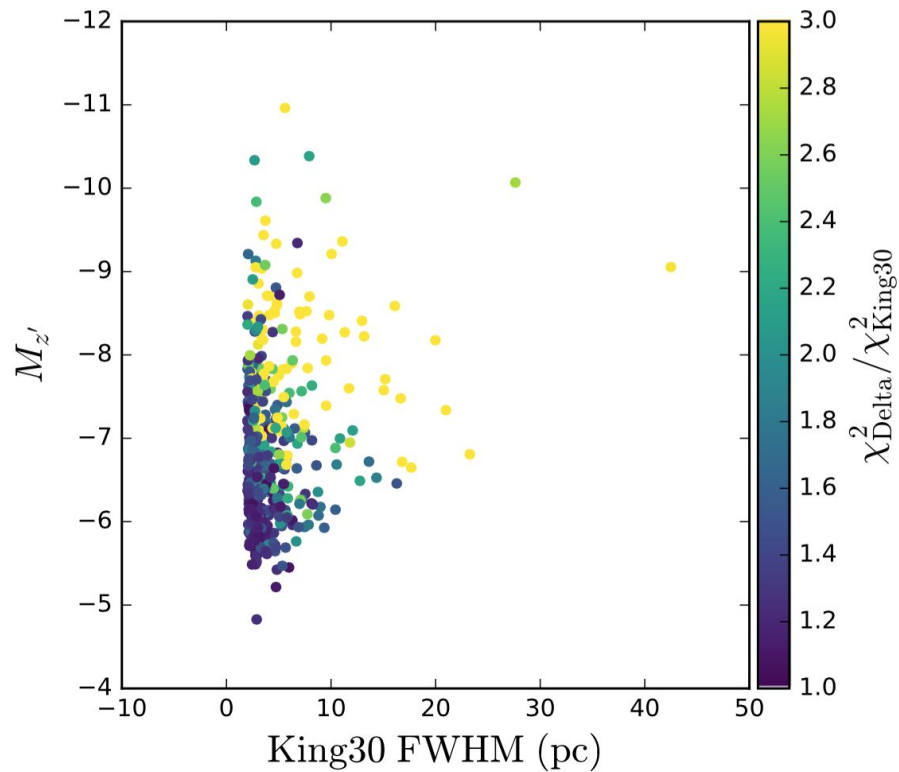
Location of final candidates around Maffei 1.

224 Class A candidates

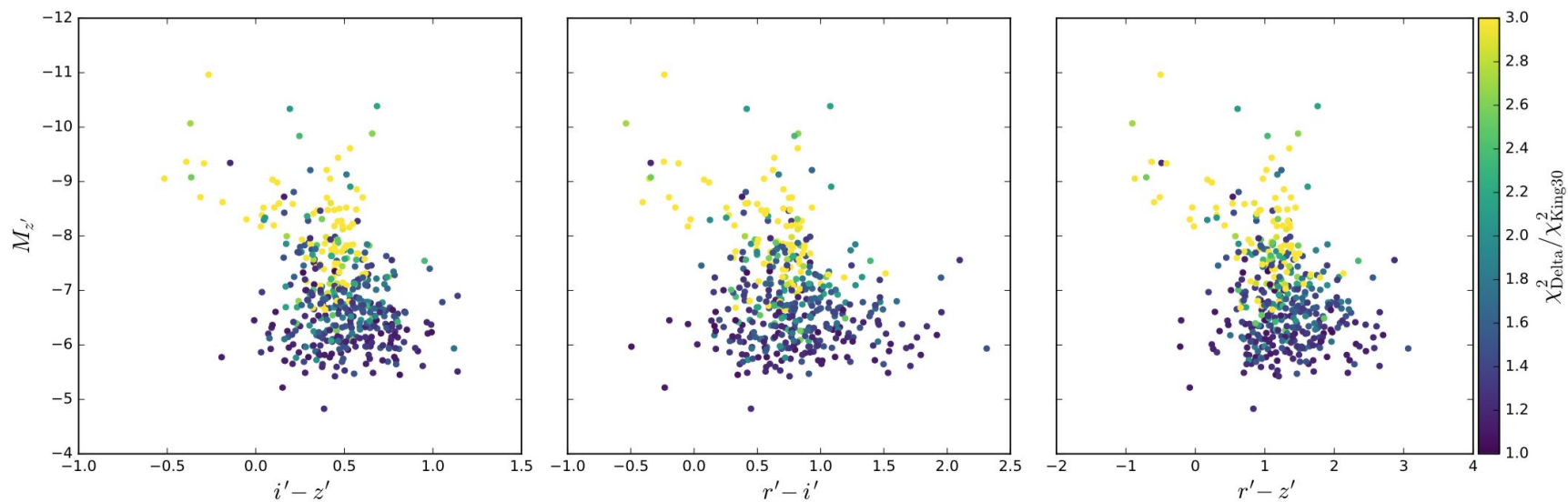
224 Class B candidates



Classification Results:



Classification Results:

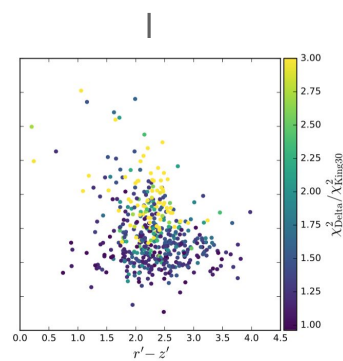
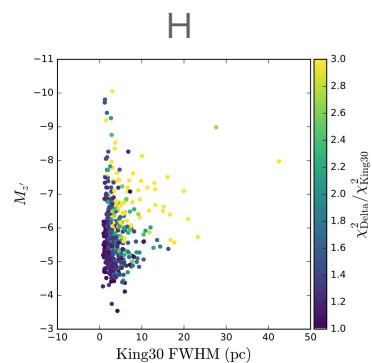
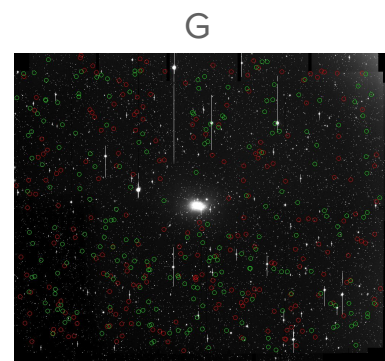
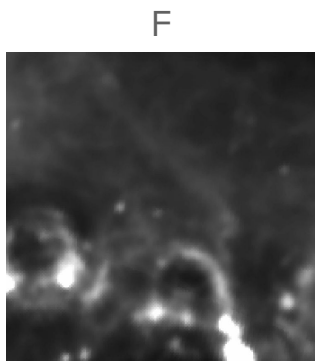
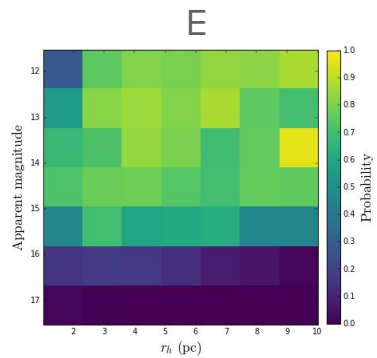
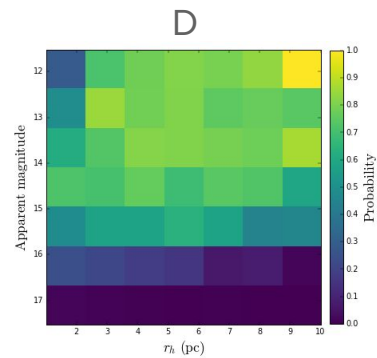
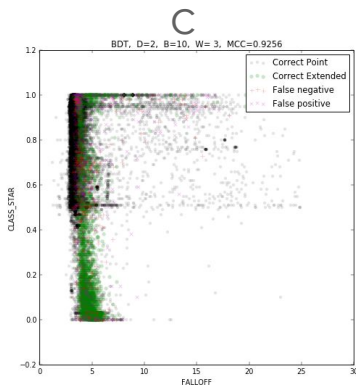
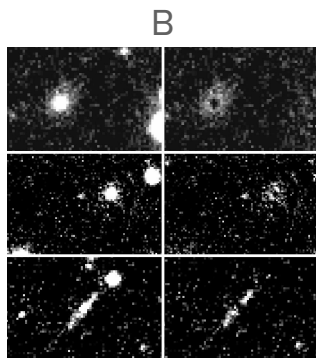
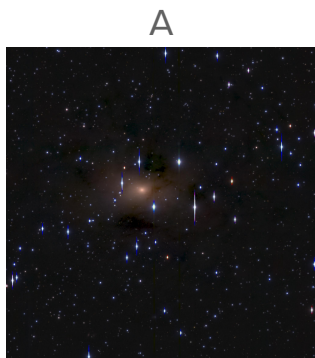


Final Product

224 Class A objects, and 224 Class B objects for spectroscopic follow up.

ID	RA	DEC	ϵ	$M_{z'}$	$m_{z'}$	$r' - z'$	King ₃₀ FWHM (pc)
A1	2 ^h 38 ^m 35.3 ^s	59° 53' 40.45''	0.14	-8.604	18.552	0.878	2.05
A2	2 ^h 38 ^m 8.8 ^s	59° 52' 29.39''	0.10	-7.399	19.757	1.473	4.88
A3	2 ^h 38 ^m 54.9 ^s	59° 52' 15.67''	0.22	-9.129	18.028	1.198	2.80
A4	2 ^h 38 ^m 12.9 ^s	59° 52' 0.73''	0.07	-8.487	18.670	1.363	7.04
A5	2 ^h 37 ^m 56.5 ^s	59° 51' 57.60''	0.25	-8.708	18.449	1.410	4.10
A6	2 ^h 38 ^m 36.6 ^s	59° 51' 36.72''	0.17	-7.123	20.033	1.004	3.64
A7	2 ^h 38 ^m 10.6 ^s	59° 50' 18.02''	0.20	-7.194	19.963	1.281	3.84
A8	2 ^h 38 ^m 10.7 ^s	59° 50' 1.18''	0.24	-8.158	18.999	1.413	6.64
A9	2 ^h 38 ^m 59.8 ^s	59° 49' 49.22''	0.24	-7.544	19.613	0.985	2.71
A10	2 ^h 38 ^m 37.2 ^s	59° 49' 41.20''	0.10	-7.116	20.041	1.513	5.48
A11	2 ^h 38 ^m 37.0 ^s	59° 49' 37.06''	0.16	-6.685	20.471	1.459	10.54
A12	2 ^h 38 ^m 27.5 ^s	59° 49' 23.63''	0.17	-8.271	18.886	1.115	11.32
A13	2 ^h 38 ^m 49.2 ^s	59° 48' 49.93''	0.11	-8.477	18.680	0.920	9.81
A14	2 ^h 38 ^m 43.5 ^s	59° 48' 17.57''	0.18	-7.249	19.908	1.413	4.85
A15	2 ^h 38 ^m 38.6 ^s	59° 47' 33.18''	0.20	-7.096	20.061	2.325	2.19

Questions?



J

ID	RA
A1	2 ^h 38 ^m 8.8 ^s
A2	2 ^h 38 ^m 12.9 ^s
A3	2 ^h 37 ^m 56.5 ^s
A4	2 ^h 38 ^m 36.6 ^s
A5	2 ^h 38 ^m 10.6 ^s
A6	2 ^h 38 ^m 10.7 ^s
A7	2 ^h 38 ^m 37.2 ^s
A8	2 ^h 38 ^m 37.0 ^s
A9	2 ^h 38 ^m 27.5 ^s
A10	2 ^h 38 ^m 49.2 ^s