# IS THIS REALLY A CLUSTER?: SDSS-III/APOGEE CLUSTER TARGET SELECTION

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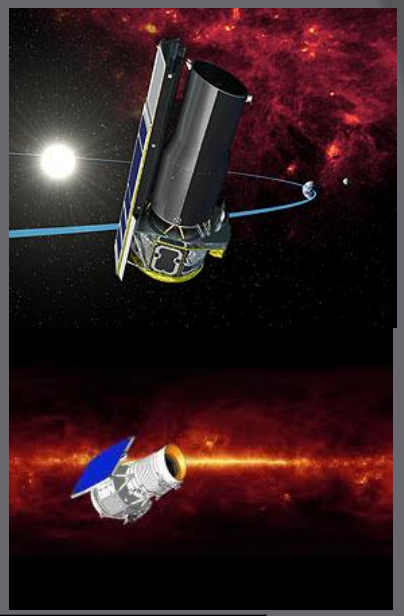
# Why star clusters?

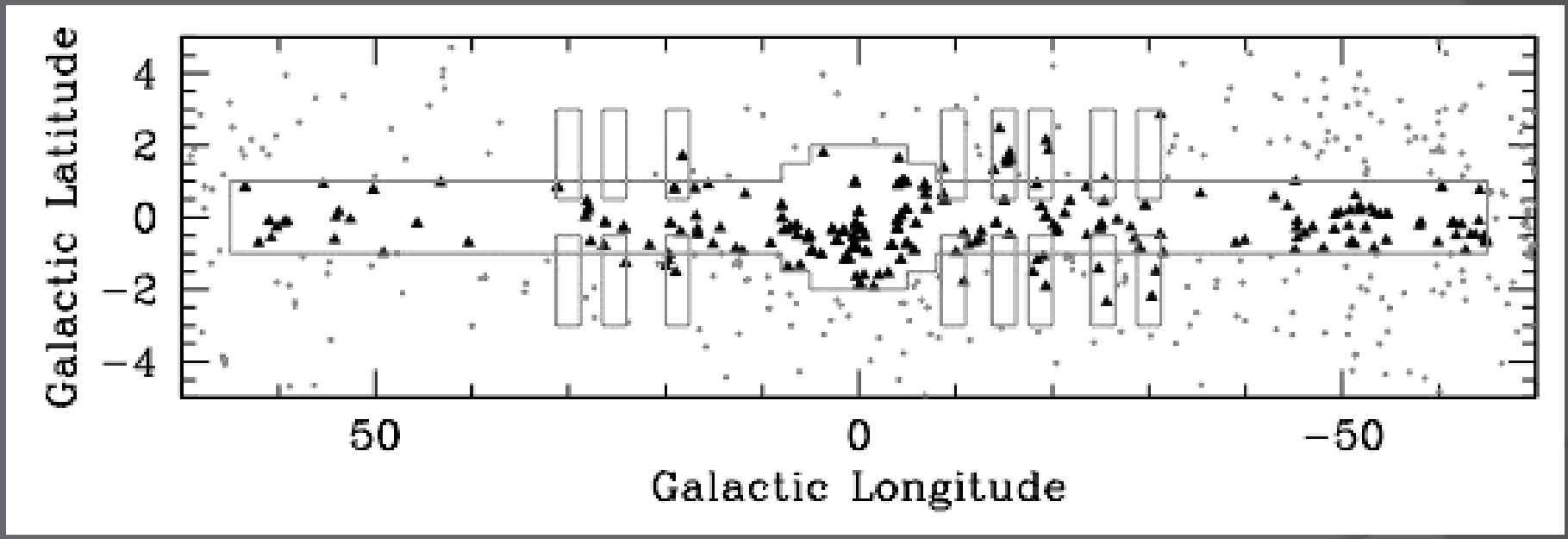
- Open cluster - 100s to 1000s of stars that formed at the same time from the same cloud of interstellar gas and dust
- Stars have the same properties: age, distance from us, metallicity, and extinction value
- Extinction – dimming of starlight due to dust in ISM
- Star clusters are useful for studying stellar evolution and the cluster's surrounding galaxy (e.g. the Milky Way)

- Utilizing near to mid-infrared data collected from:
  - Two Micron All-Sky Survey (2MASS)
  - *Spitzer Space Telescope*/ GLIMPSE-I, II, 3D, & 360 surveys
  - Wide-Field Infrared Survey Explorer (WISE)



| 2MASS | | | GLIMPSE | |
|---|---|---|---|---|
| **J** | **H** | **K** | **3.6** | **4.5** |
| 1.6 μm | 2.1 μm | 2.2 μm | 3.6 μm | 4.5 μm |

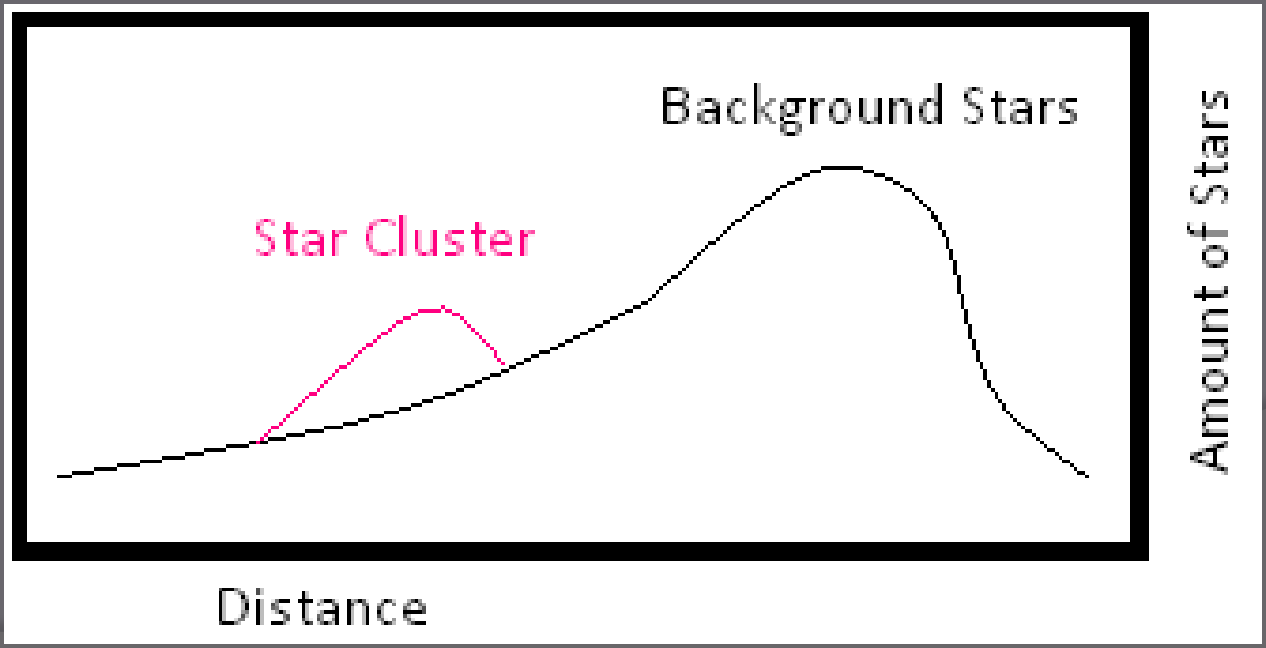
- Areas within the Milky Way that have been covered by GLIMPSE surveys:

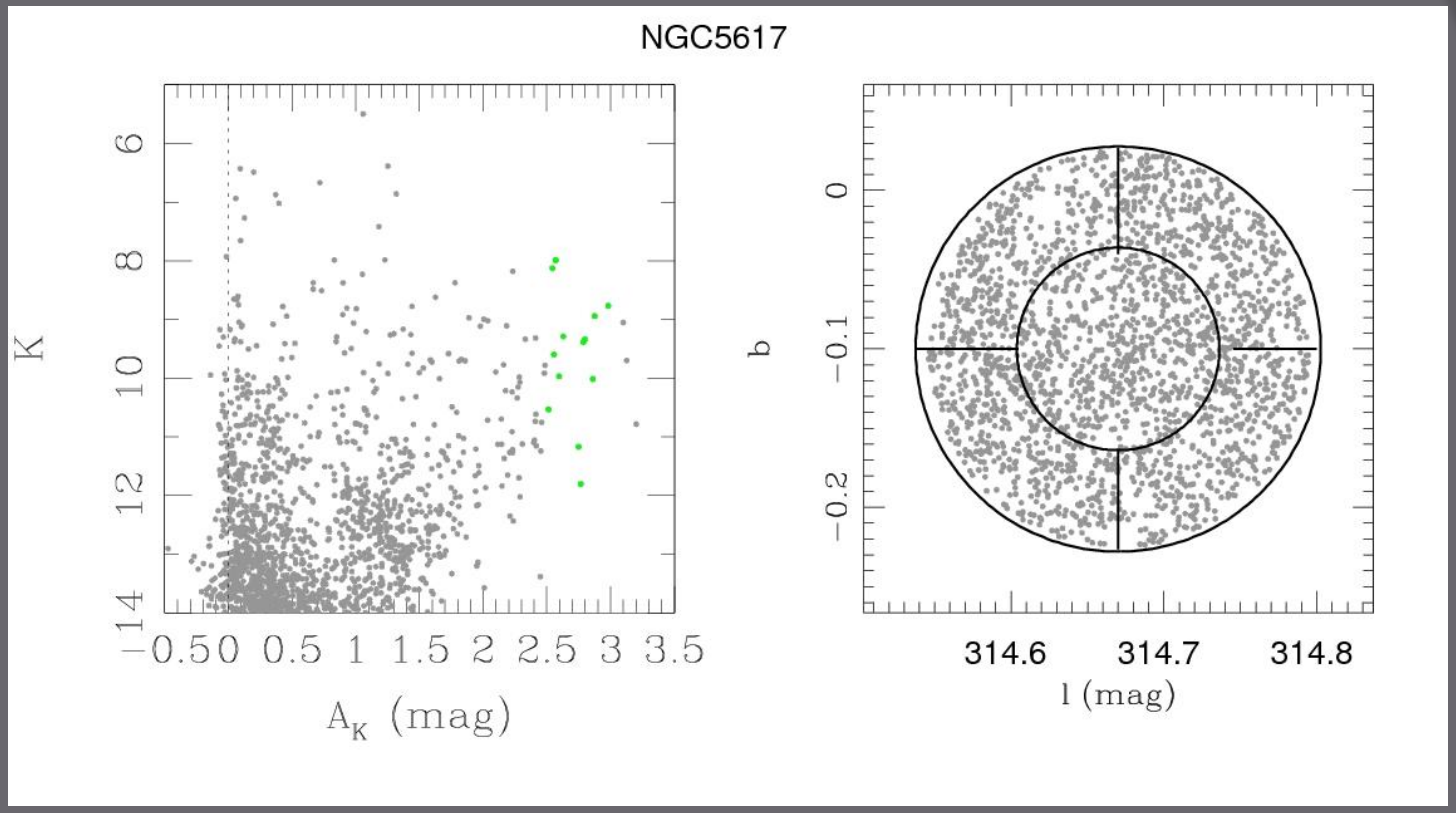


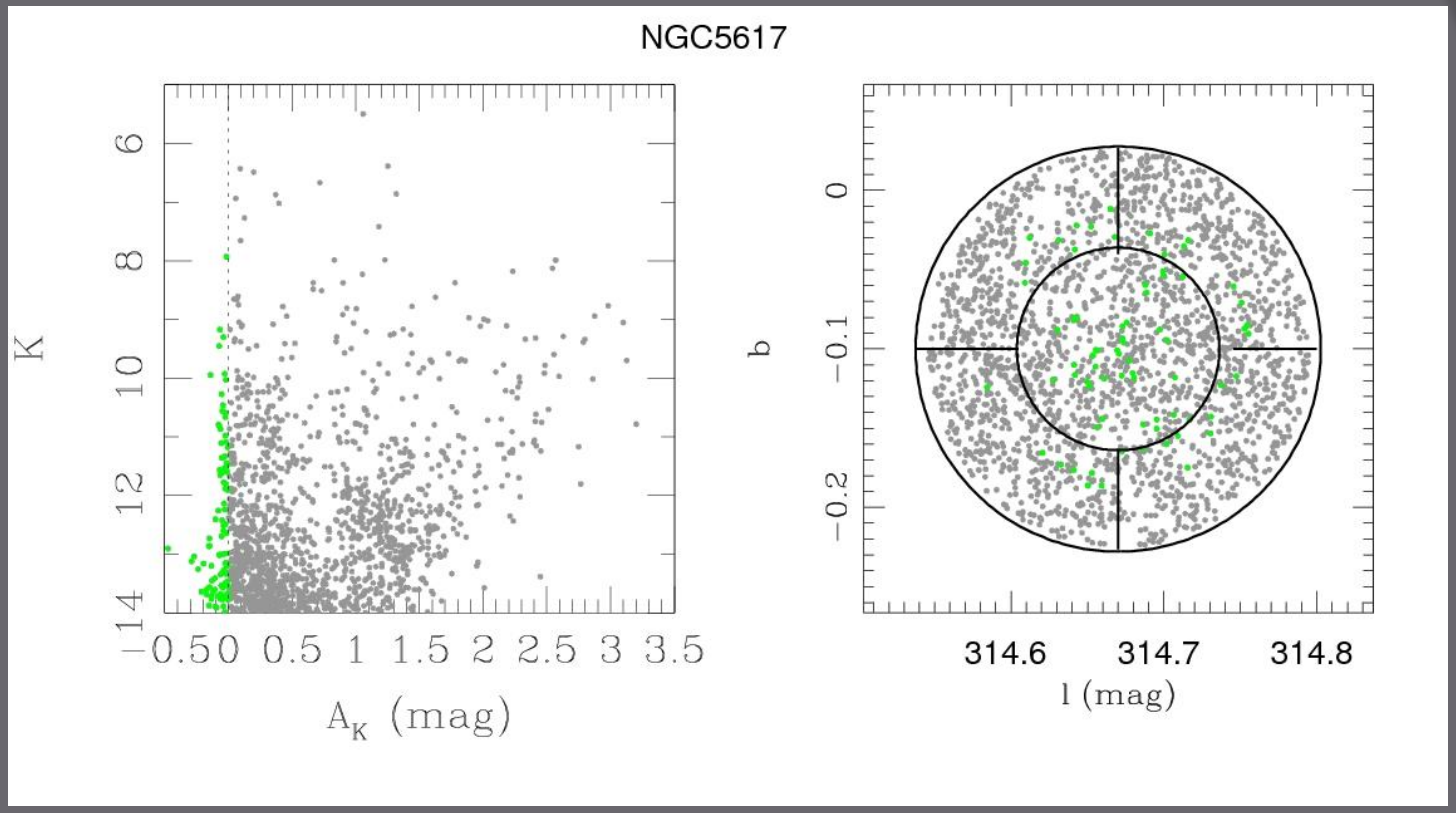
# How to Isolate a Cluster

- Obtain extinction ($A_K$) values for each star in a cluster
  - Raleigh Jeans Color Excess Method (Majewski, Zasowski, & Nidever 2011)
- Isolate area twice the cluster radius and compare stars within the cluster radius to outer “field stars”.
- Windows a range of $A_K$ and step through the $A_K$ values.

- Compare normalized ratio of stars within cluster radius to background at each step through $A_K$ values
- Identify overdensity in $A_K$ space




NGC5617
K
6
8
10
12
14
−0.50 0.5 1 1.5 2 2.5 3 3.5
$A_K$ (mag)
b
0
−0.1
−0.2
314.6
314.7
314.8
l (mag)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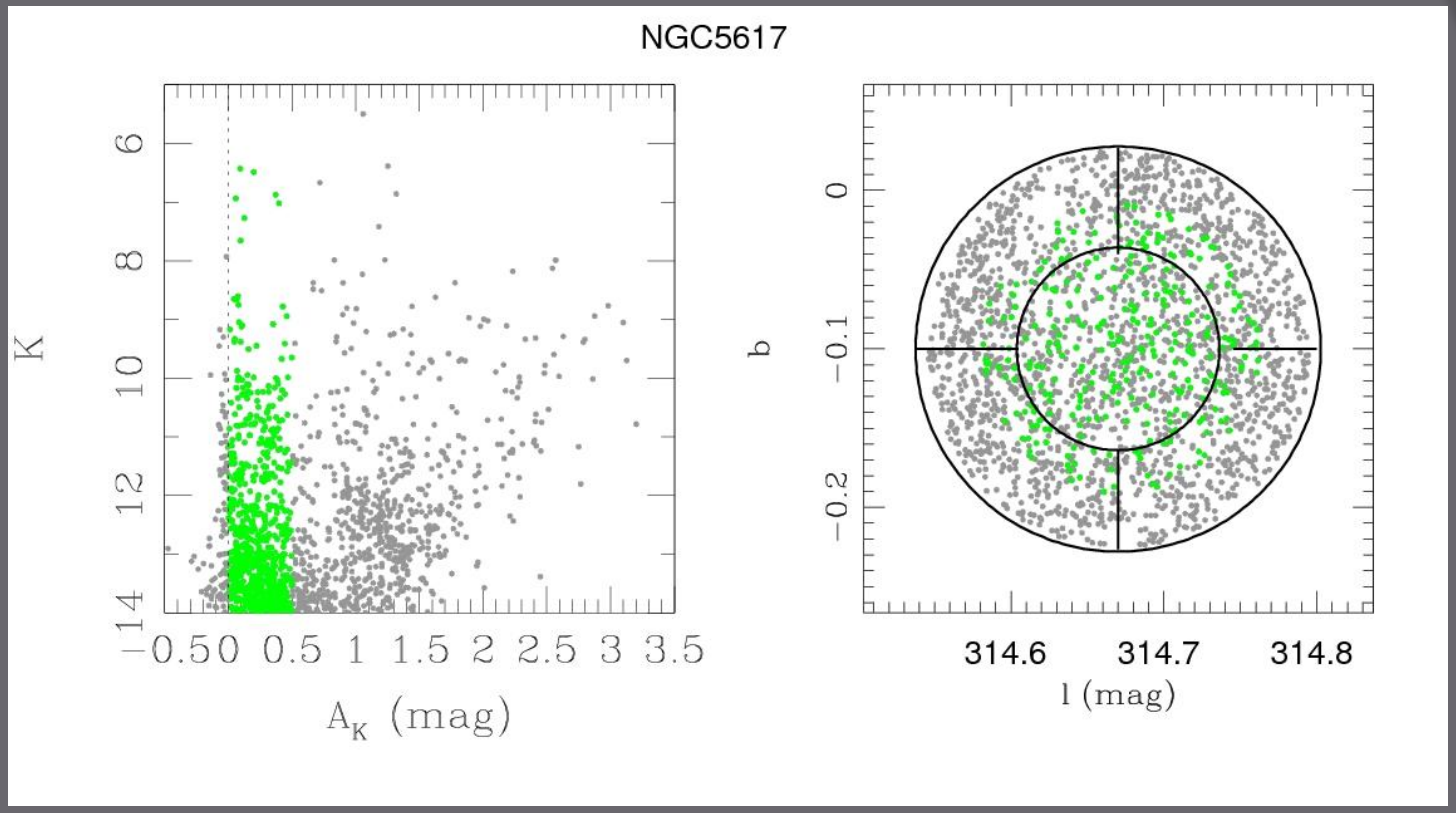
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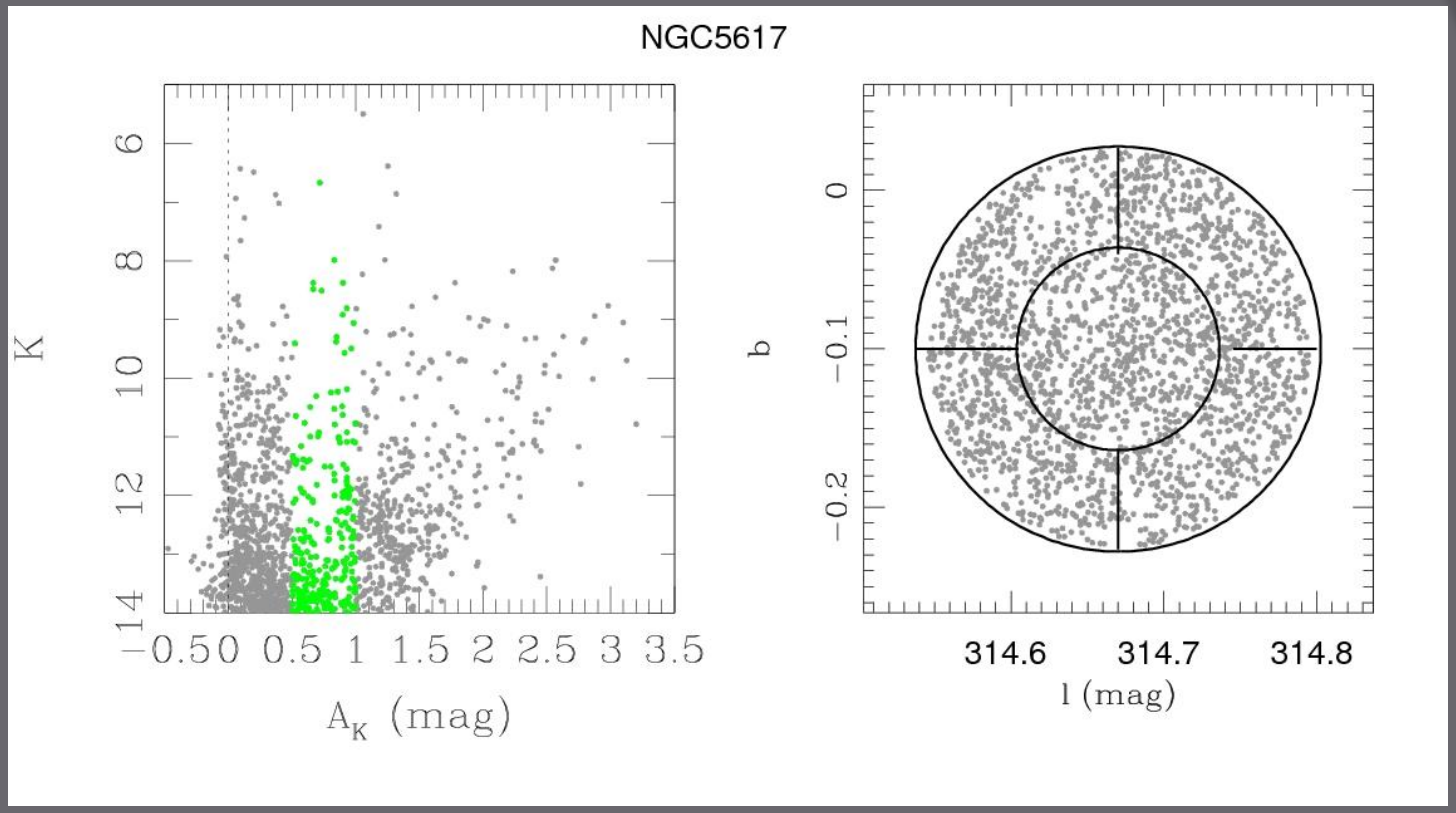
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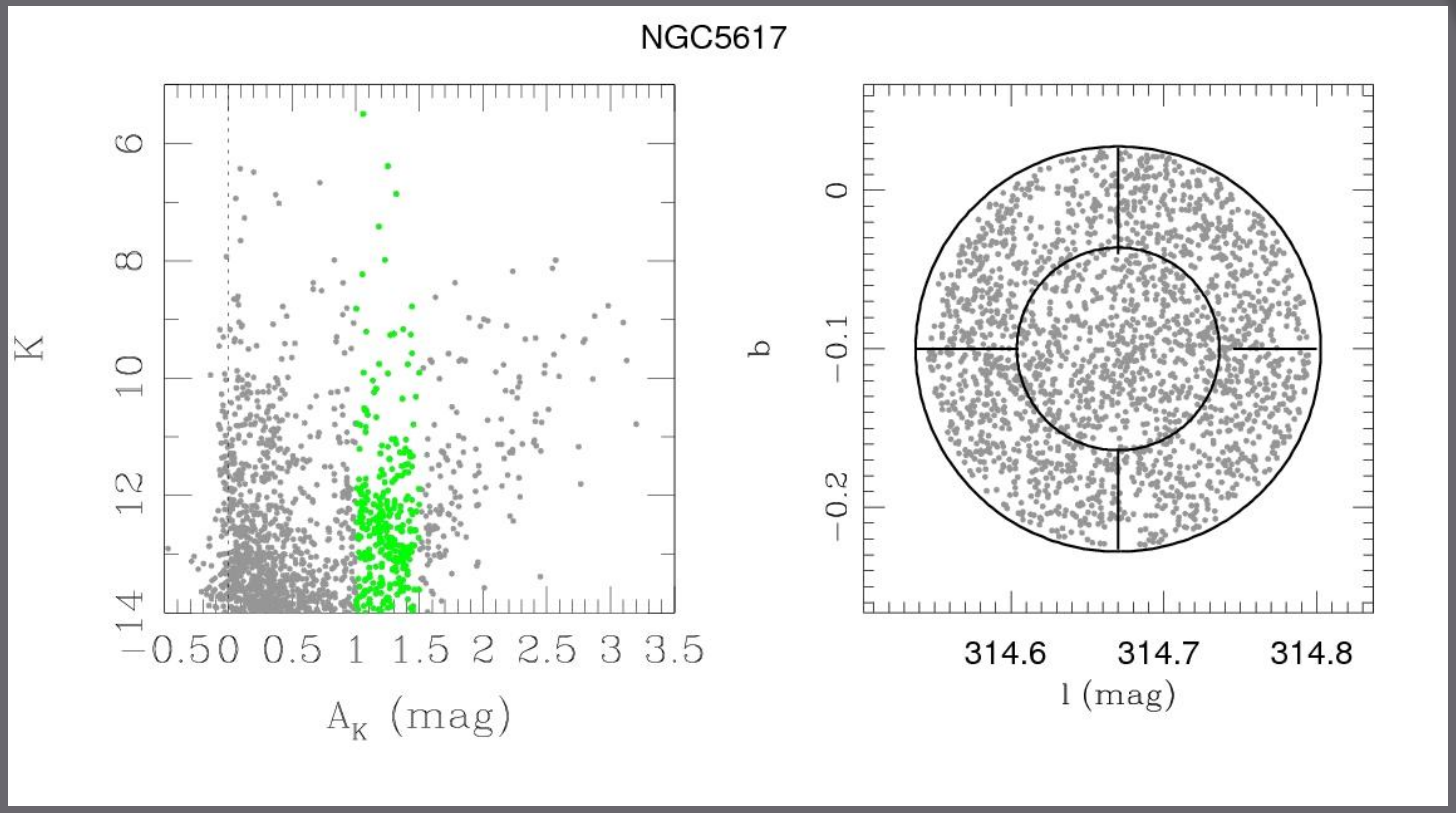
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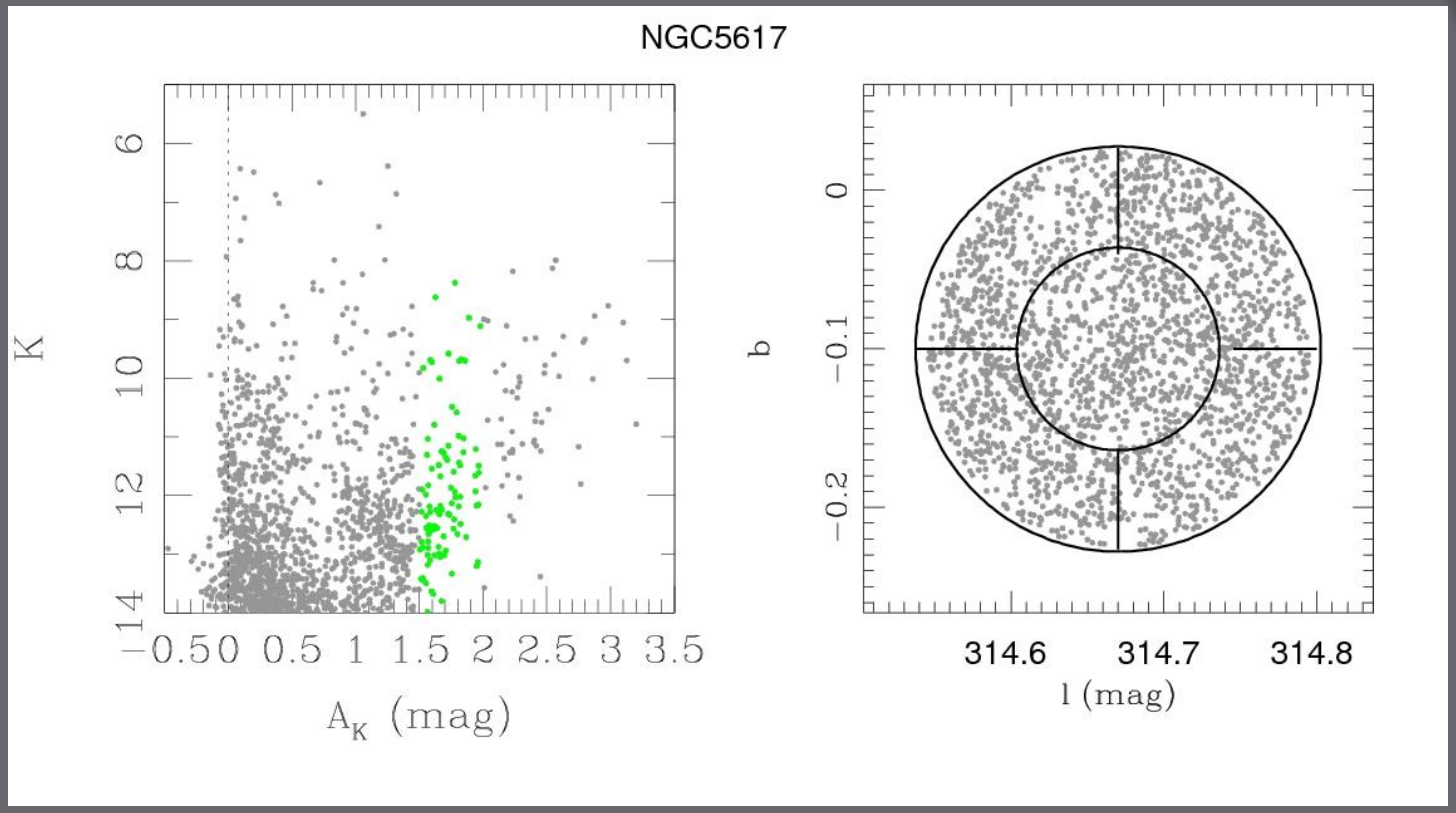
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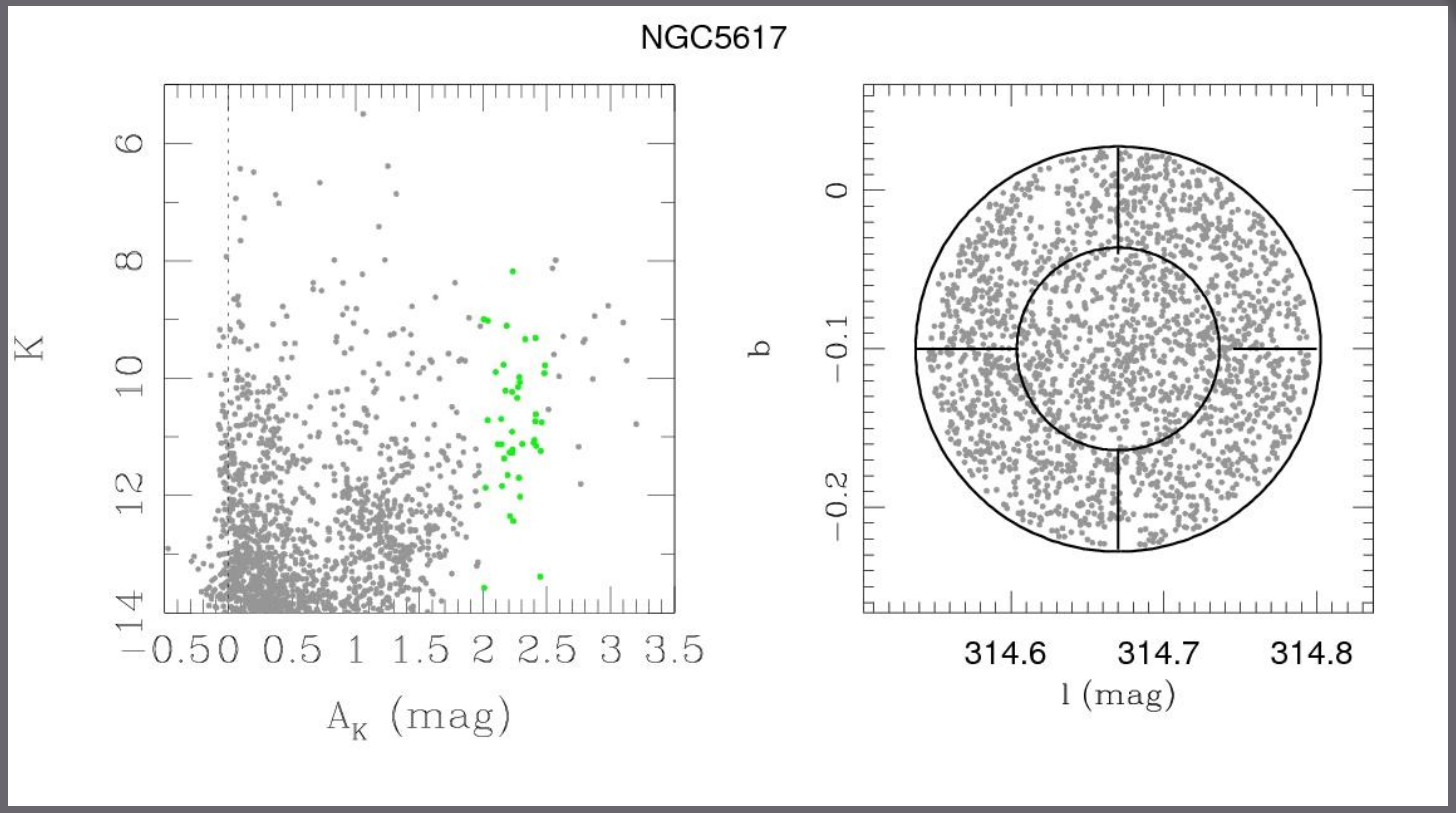
314.7
314.8
l (mag)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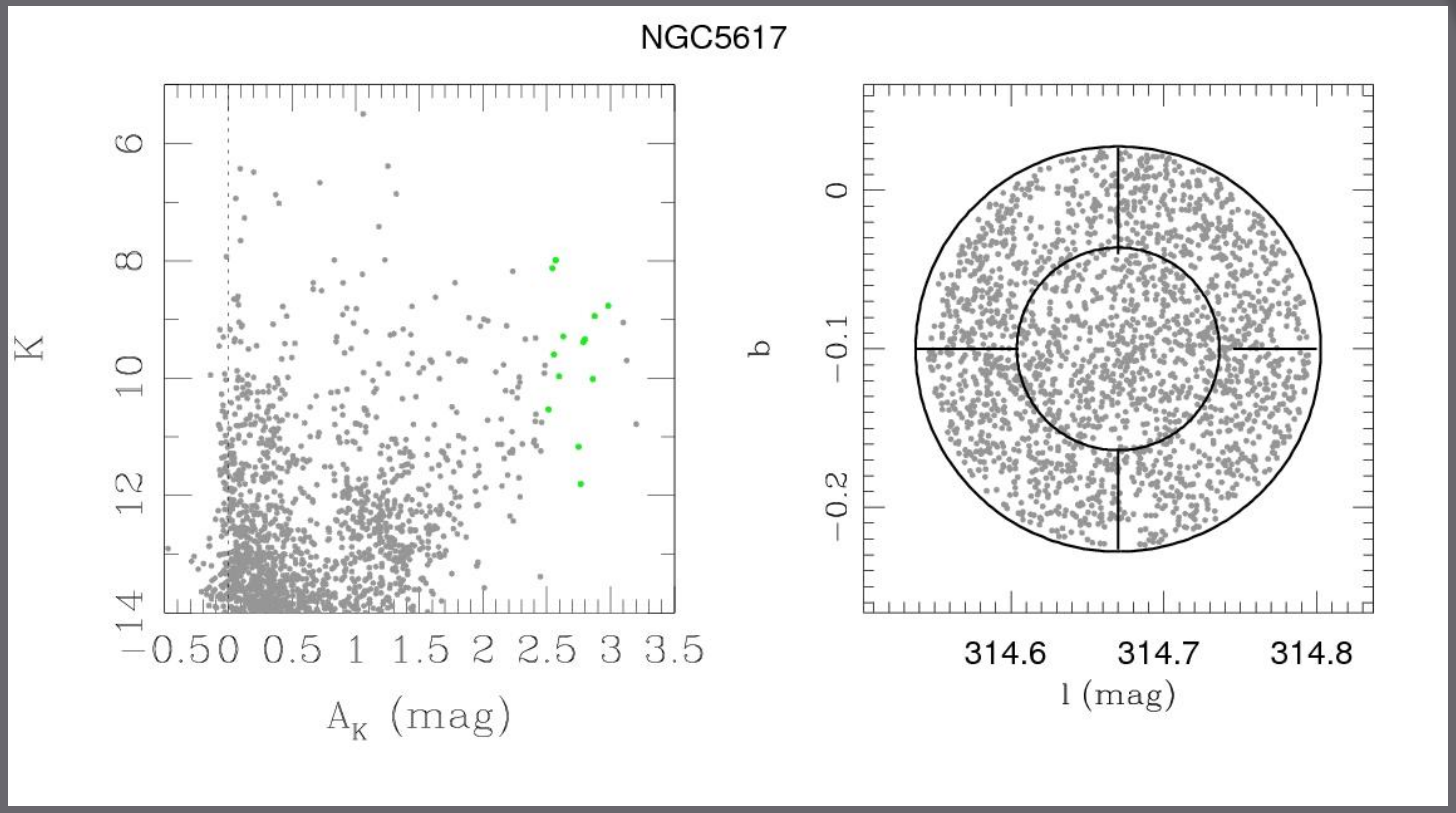
l (mag)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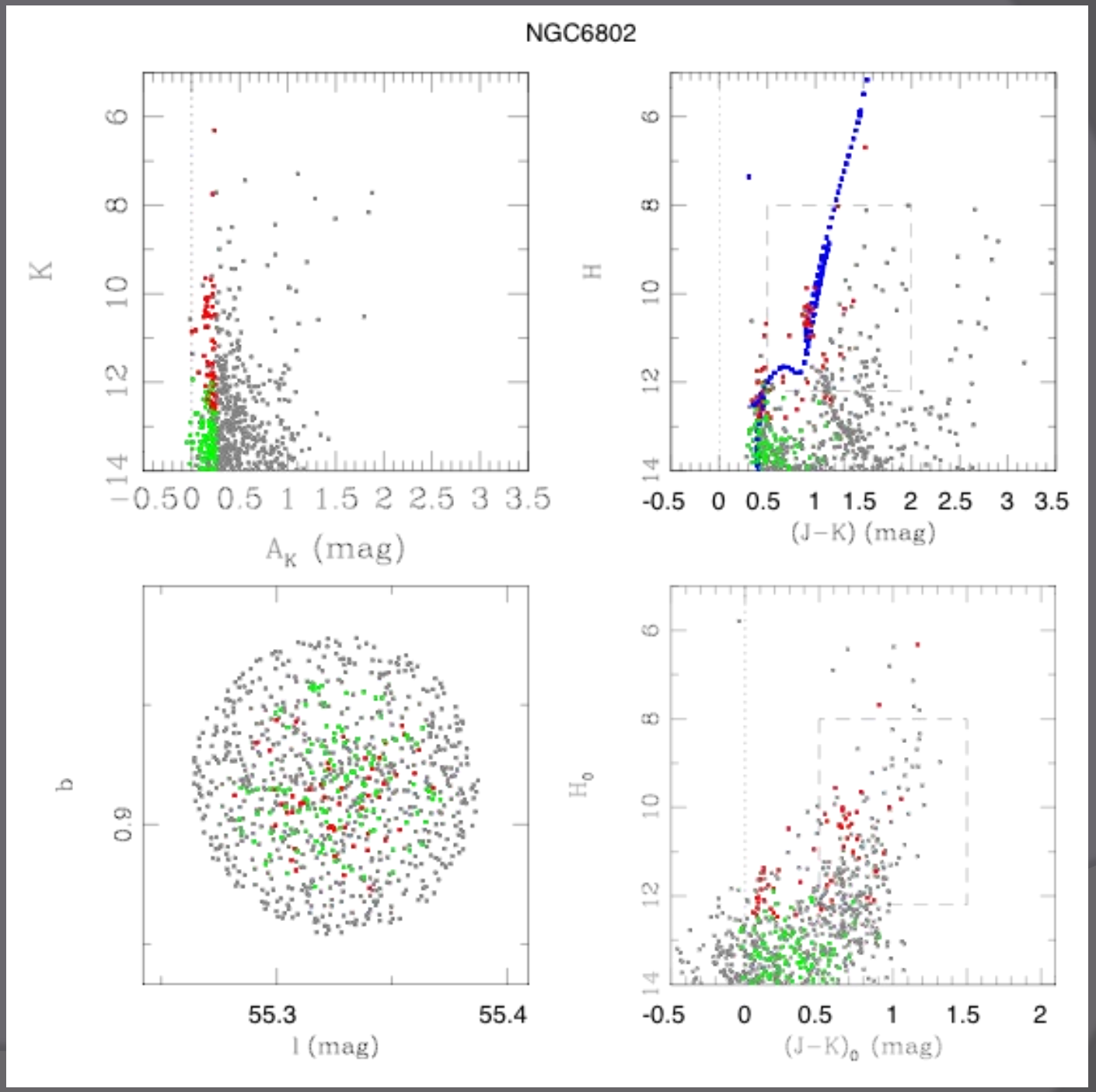
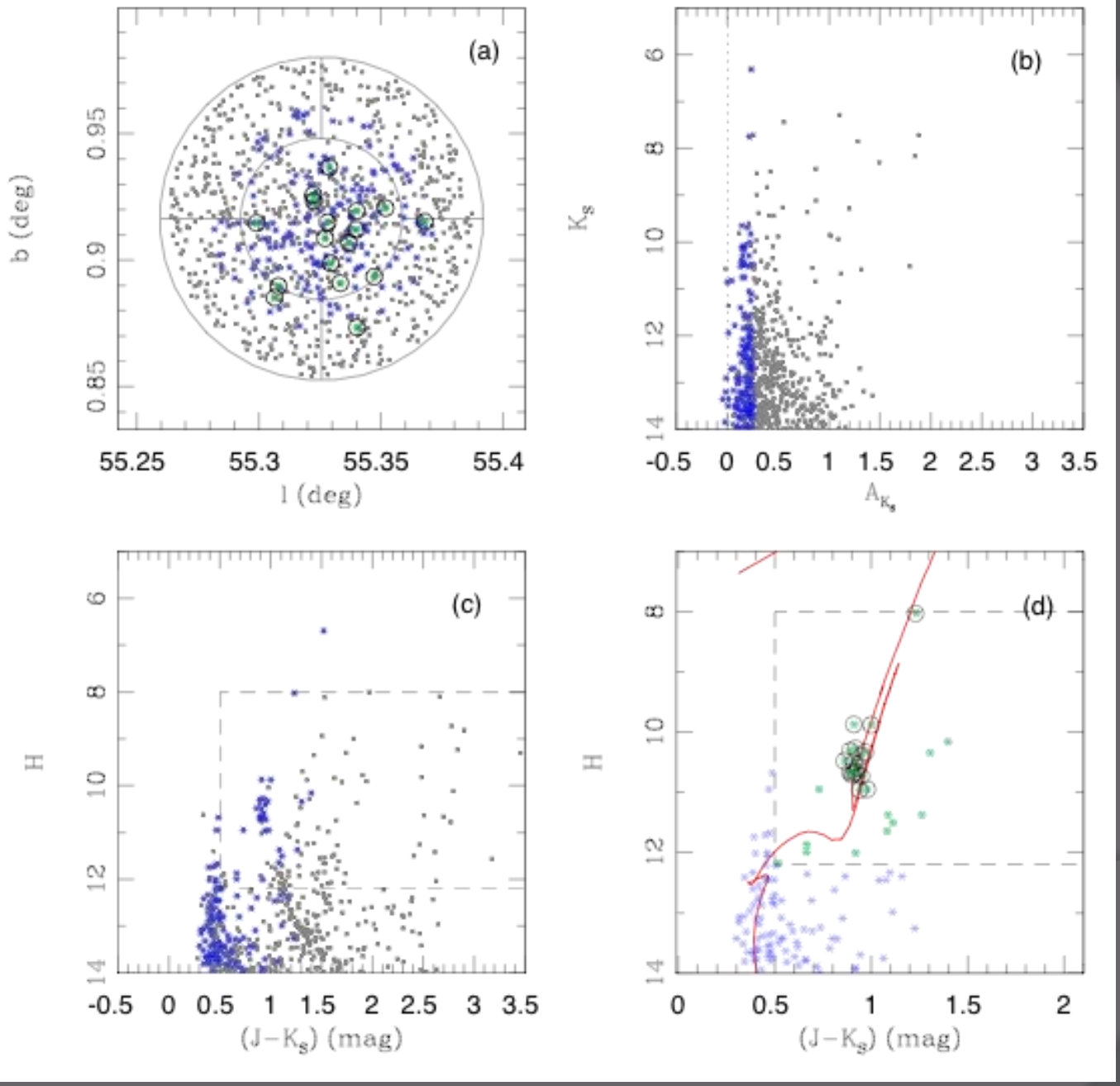
K
6
8
10
12
14
−0.50 0.5 1 1.5 2 2.5 3 3.5
$A_K$ (mag)
b
0
−0.1
−0.2
314.6
314.7
314.8
l (mag)


NGC6802
K
6
8
10
12
14
−0.5 0 0.5 1 1.5 2 2.5 3 3.5
$A_K$ (mag)
H
6
8
10
12
14
-0.5 0 0.5 1 1.5 2 2.5 3 3.5
(J−K) (mag)
b
0.9
55.3
55.4
l (mag)
$H_o$
6
8
10
12
14
-0.5 0 0.5 1 1.5 2
$(J-K)_o$ (mag)


(a)
b (deg)
0.95
0.9
0.85
55.25
55.3
55.35
55.4
l (deg)
(b)
$K_s$
6
8
10
12
14
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
$A_{K_s}$
(c)
H
6
8
10
12
14
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
(J−$K_s$) (mag)
(d)
H
8
10
12
14
0
0.5
1
1.5
2
(J−$K_s$) (mag)

# Application to APOGEE


- APOGEE - large-scale spectroscopic survey of Galactic stars.
  - *H*-band (1.5-1.7μm), R ~ 25,000, $\sigma_{RV}$ ~ 300 m/s.
  - 100,000 stars, *S/N* = 100/pixel, 15 elements/star.
- Will utilize star clusters in order to explore Galactic evolution
  - Can directly link age and chemistry
- Isolated cluster members (especially red-giants) in targeted fields are submitted as high-priority targets.

# Future Work

- Complications arise from wide range of cluster sizes and distances
  - Problematic small, distant clusters and large, nearby clusters
- Need to determine what parameters work best for the majority of clusters
- Soon will utilize more WISE fields and UKIDSS to get deeper data

# Acknowledgements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**Thank You!!**