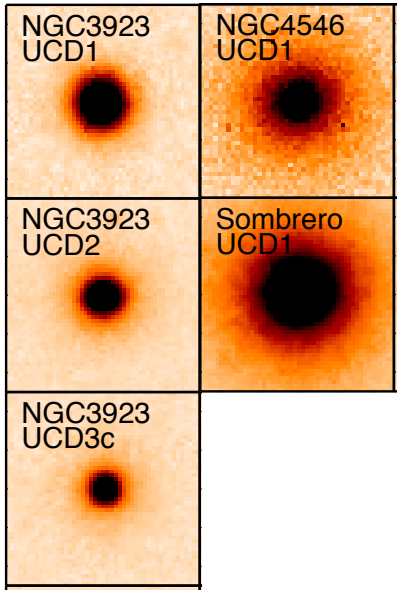
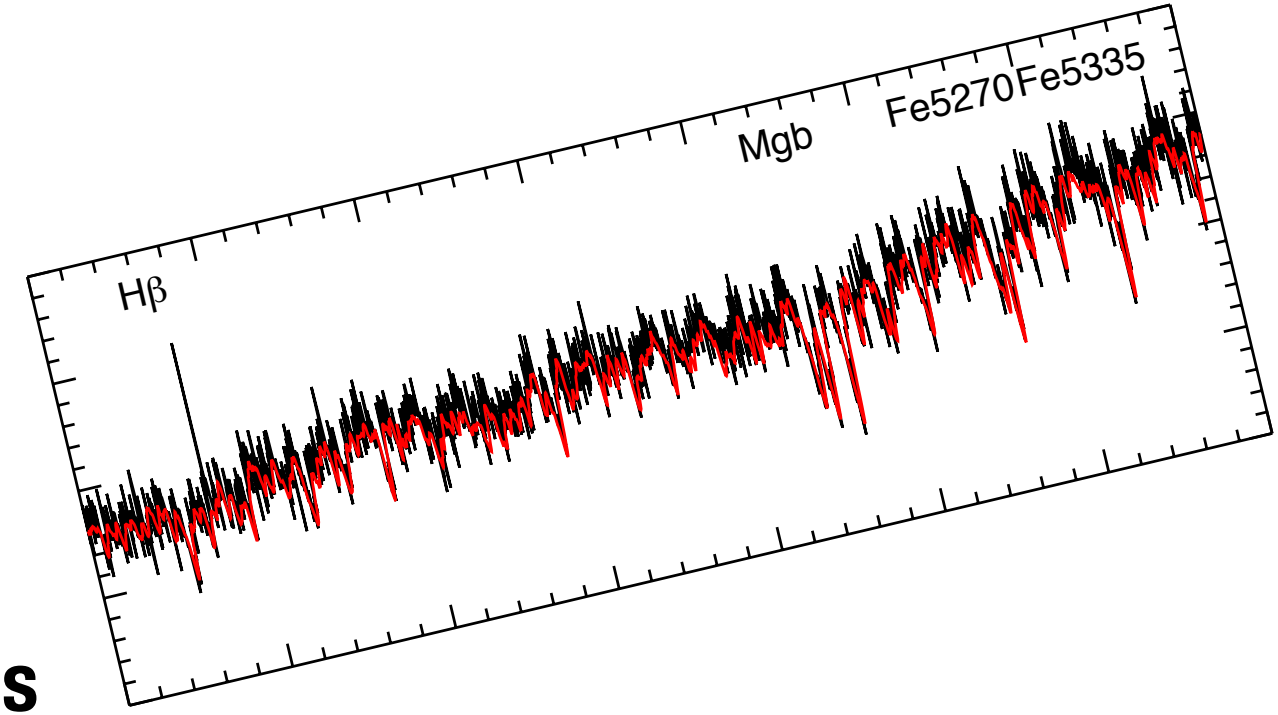
The Dynamics of Field/Group Environment UCDs



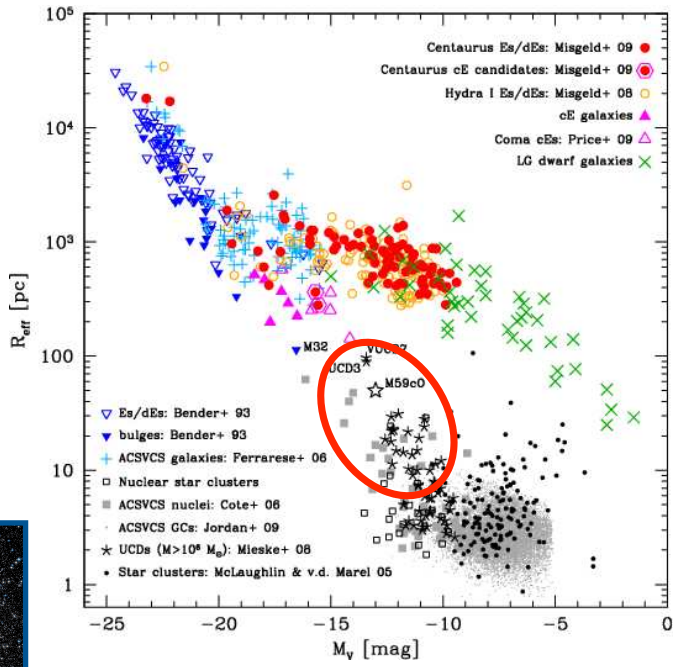


Mark A. Norris
University of North Carolina - Chapel Hill

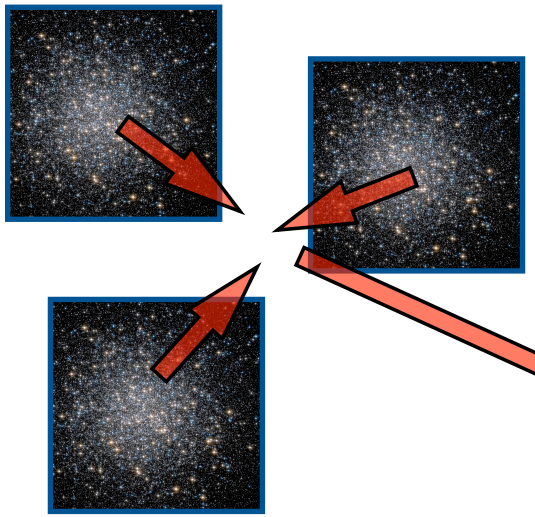
Sheila Kannappan (UNC), Juan Carlos Forte (UNLP), Favio Faifer (CONICET)

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

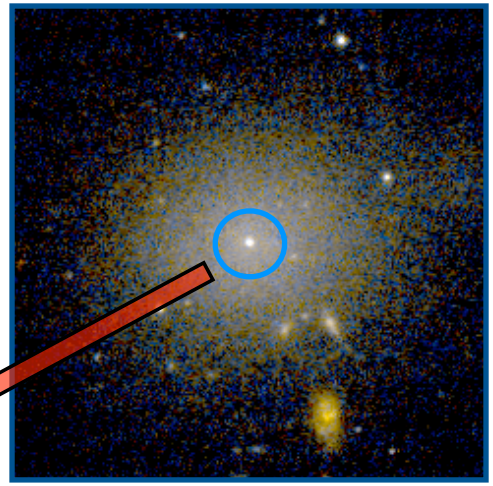
What are UCDs?



Misgeld et al. (2011)



Giant Globular Clusters



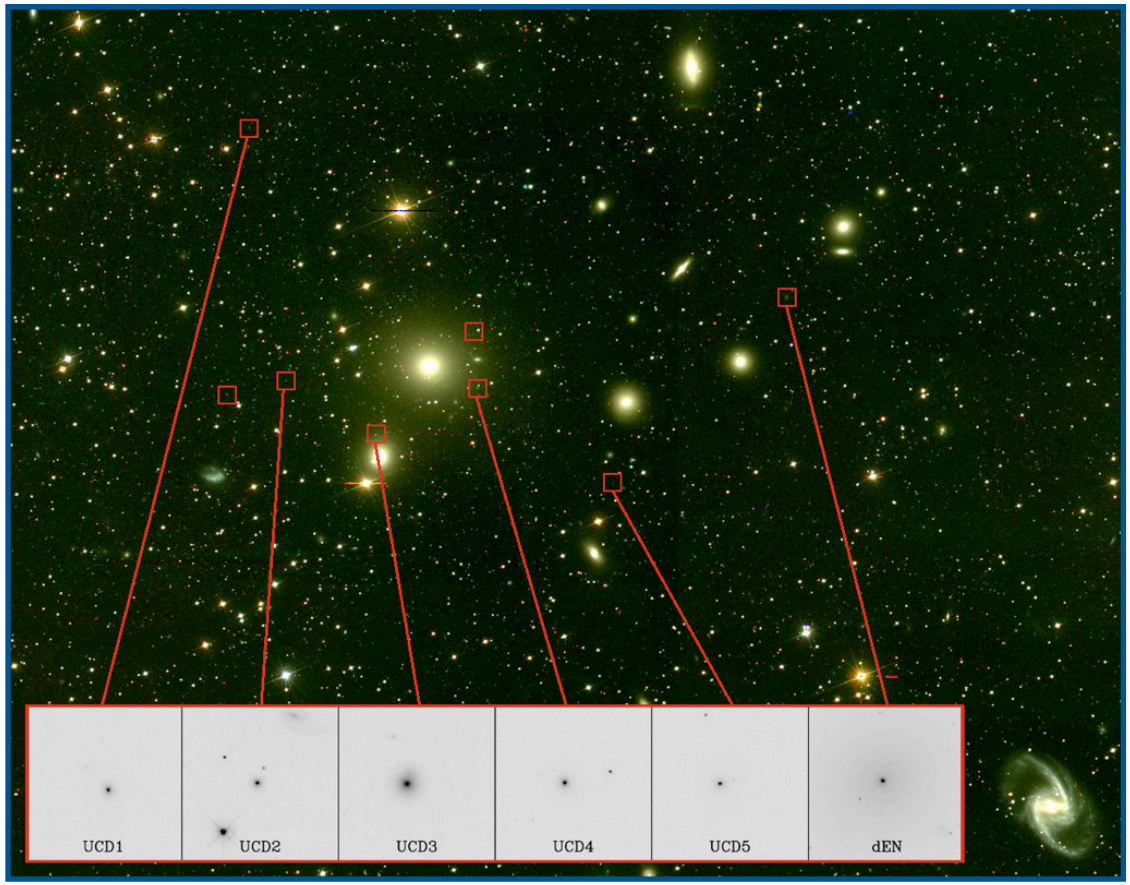
Stripped galaxy nuclei

Why Study Field/Group UCDs?

Until recently almost all UCDs have been found in clusters.

This is partly because the target density is high enough for "blind" spectrographic surveys.

This approach doesn't really work for low density environment UCDs.



Fornax UCDs: Credit: M. Hilker, A. Karick

Why Study Field/Group UCDs?

Fornax:
Hilker et al. (1999), Drinkwater et al. (2000)...

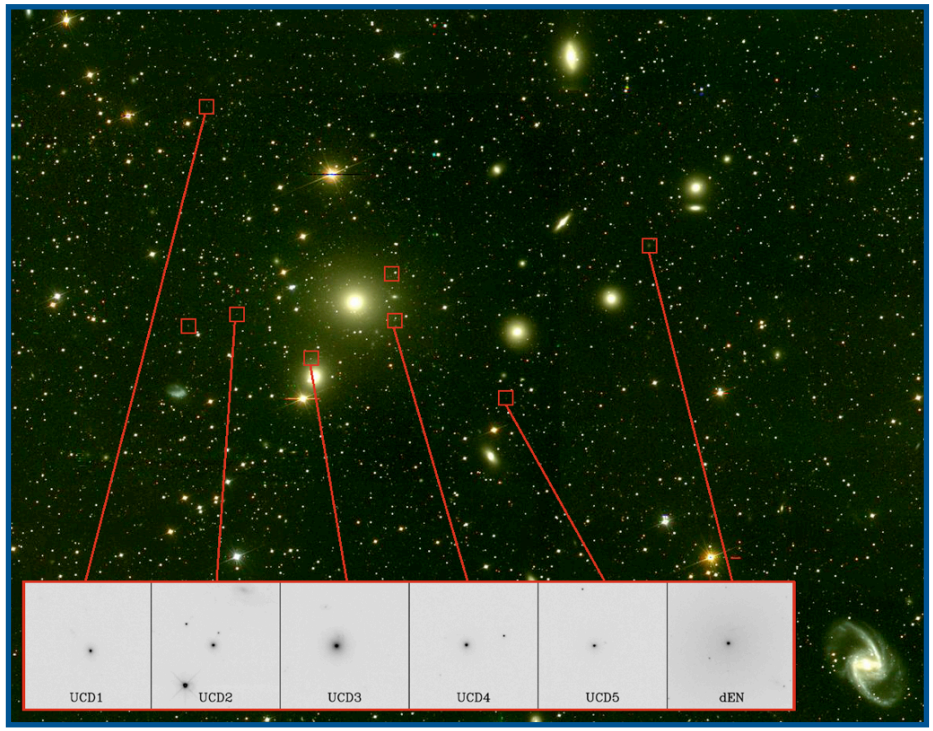
Virgo:
Hasegan et al. (2005), Jones et al. (2006)...

Hydra I:
Wehner & Harris (2007),
Misgeld et al. (2008, 2011)

Centaurus:
Mieske et al. (2009)

Coma:
Price et al. (2009), Madrid et al. (2010)

Antlia:
Poster by Juan P. Caso.



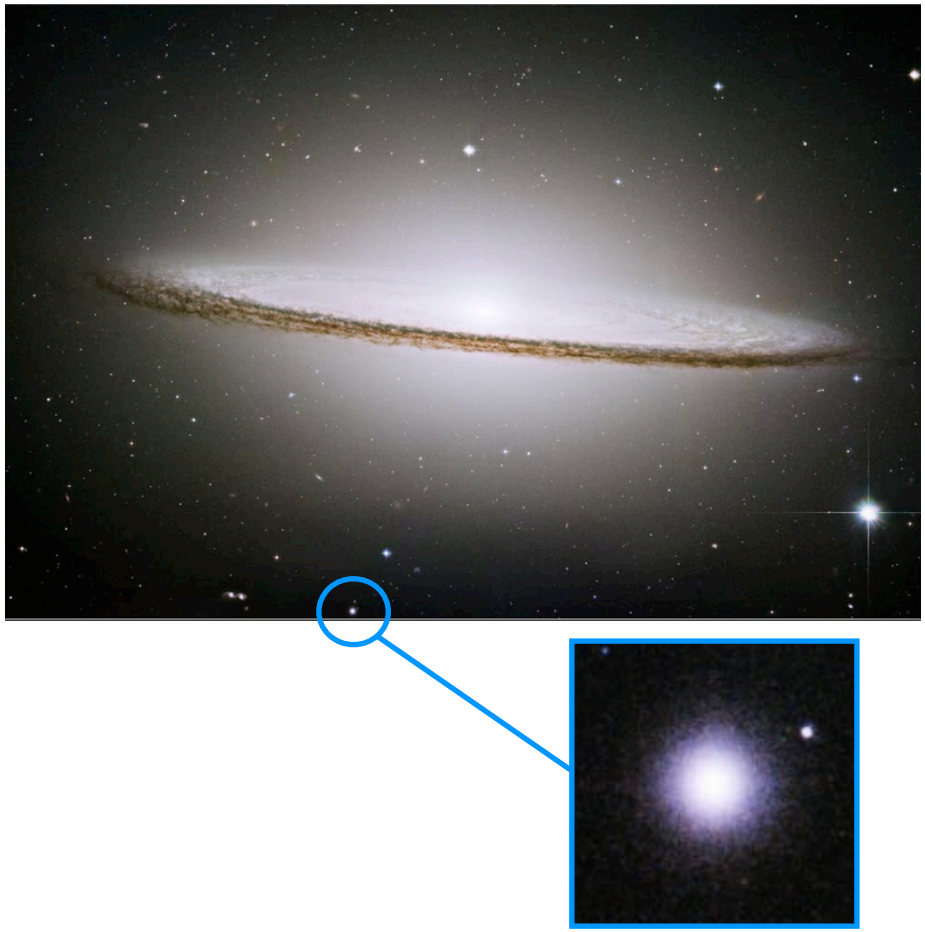
Fornax UCDs: Credit: M. Hilker, A. Karick

Why Study Field/Group UCDs?

Evstigneeva et al. (2007) surveyed 6 galaxy groups finding only 1 definite UCD (but very shallow).

Hau et al. (2009) found one UCD associated with the Sombrero galaxy.

Da Rocha et al. (2011) found 13 UCDs in two Hickson Compact Groups.



Why Study Field/Group UCDs?

There are reasons to believe that field/group UCDs should be particularly interesting:

Younger UCDs could be more common.

In dense environments stripping either occurred long ago, or strips already old objects.

UCD ages similar to GCs

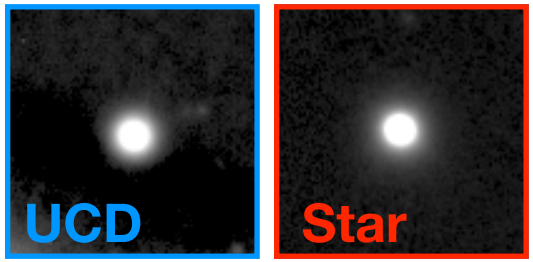
See e.g. Paudel, Lisker & Janz (2010)

In the field stripping of actively star forming objects occurs more commonly.

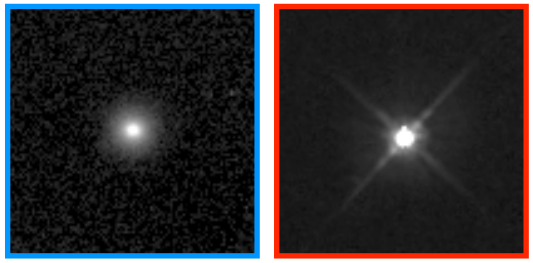
UCDs could be younger than GCs.

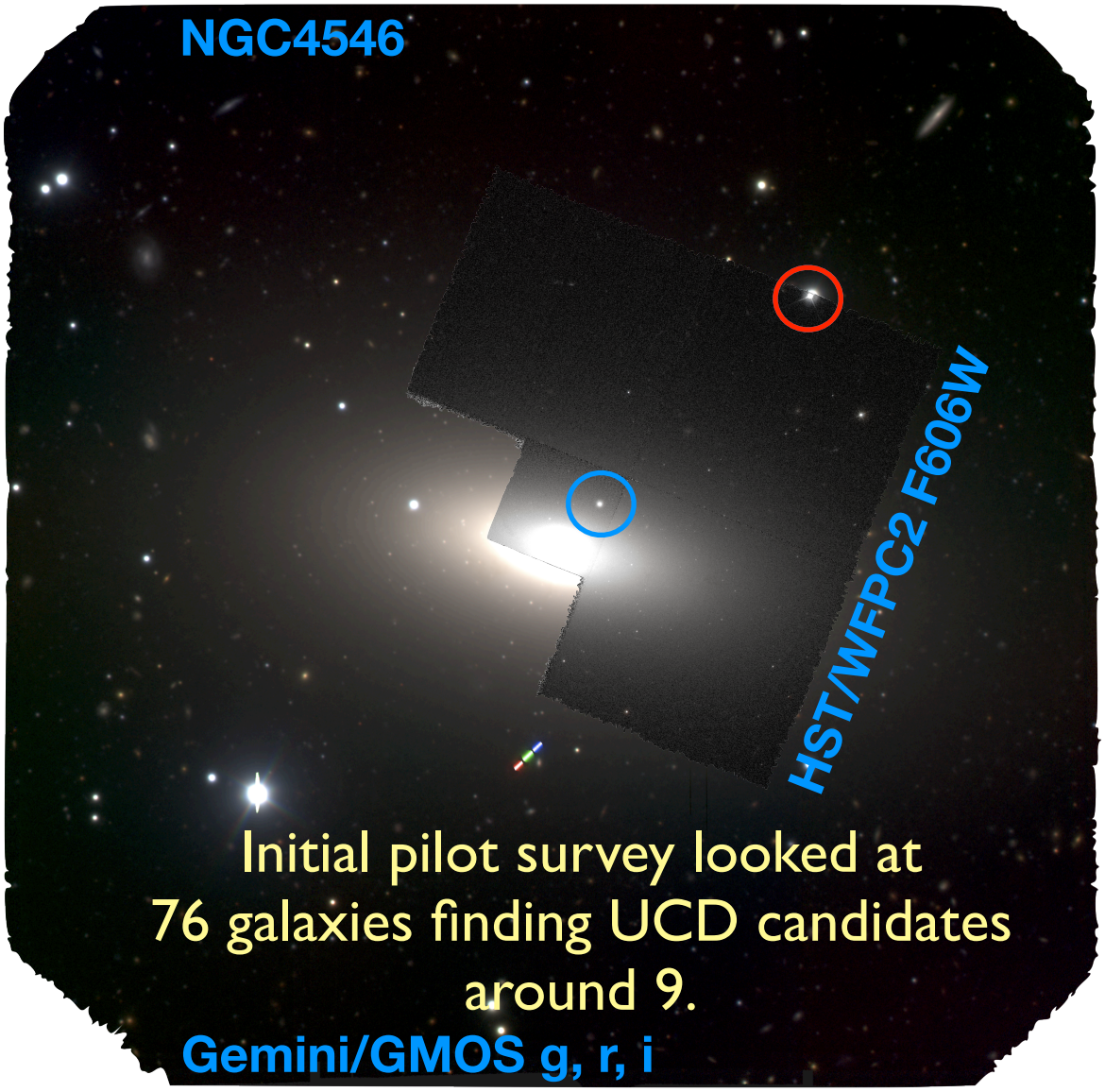
Finding Field/Group UCDs?

Ground Based



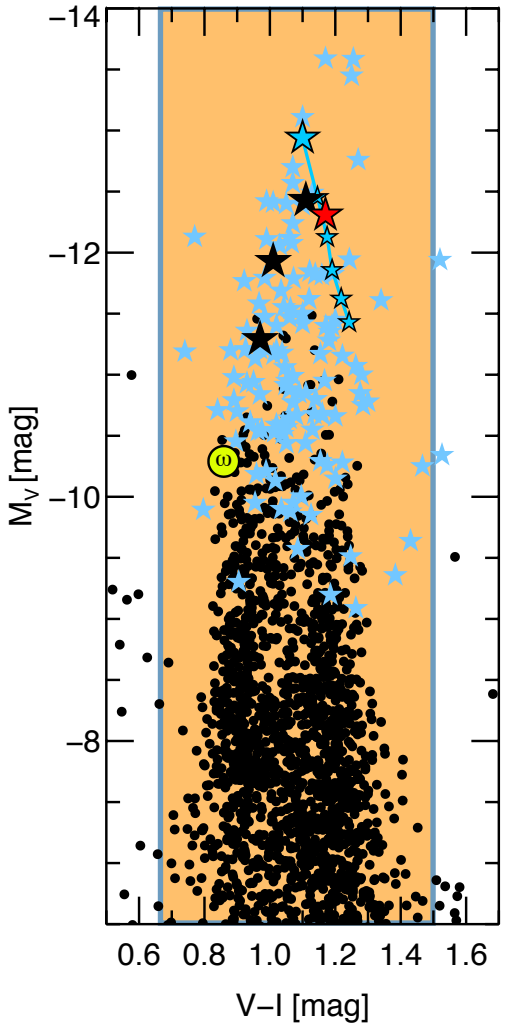
HST Imaging

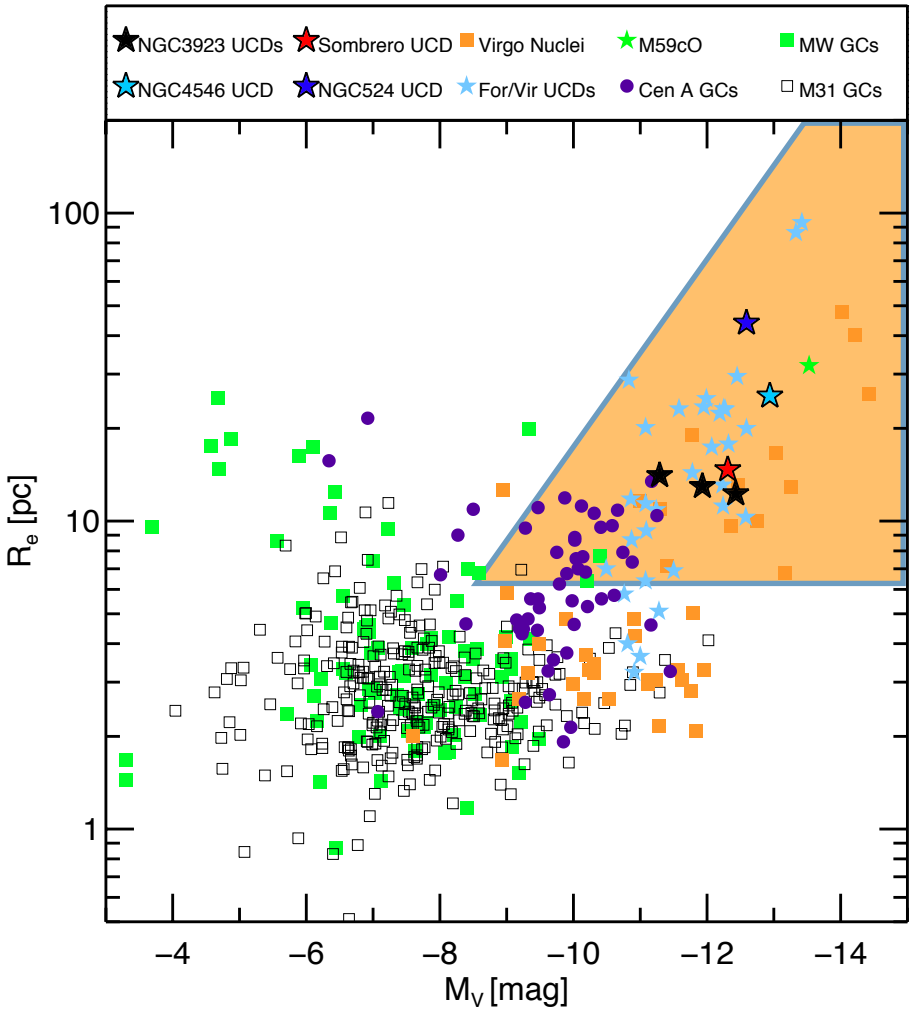




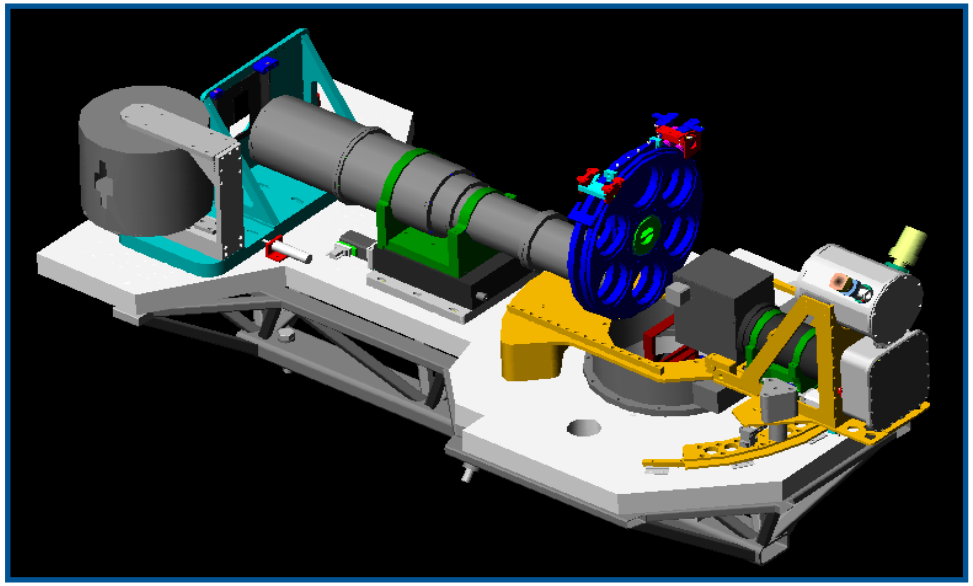
Finding Field/Group UCDs?

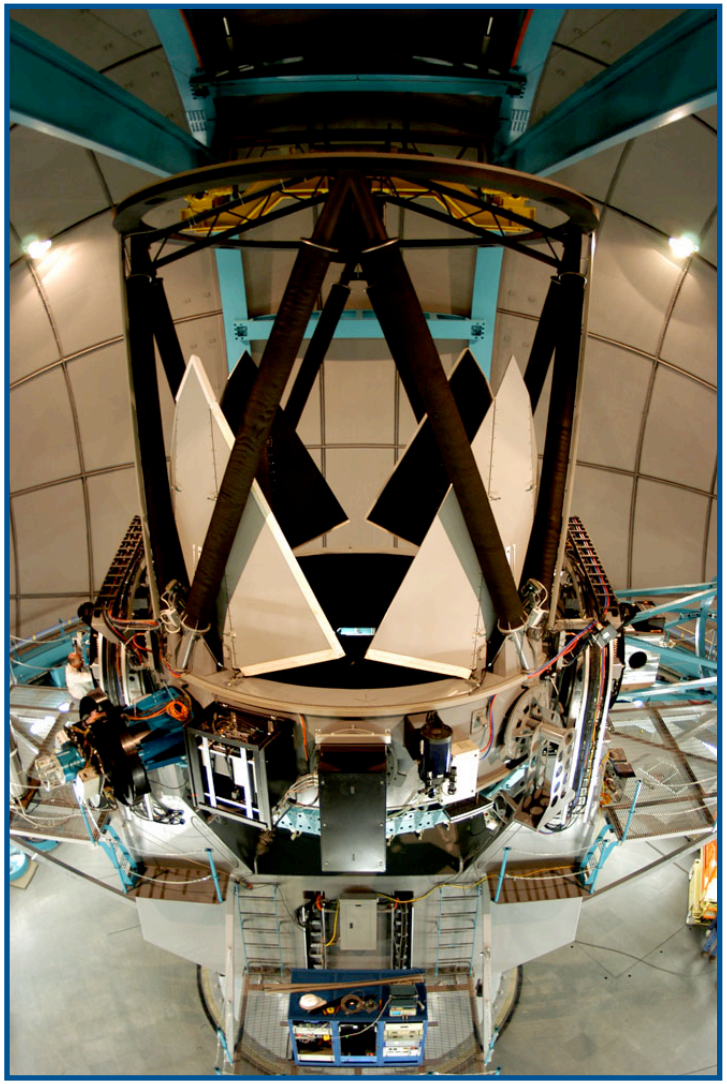
Select UCD candidates based on colour-magnitude, and magnitude-size.





Finding Field/Group UCDs?

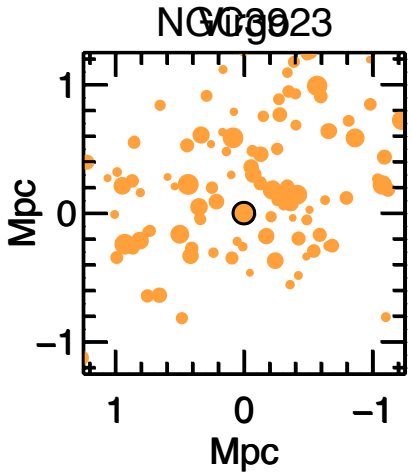


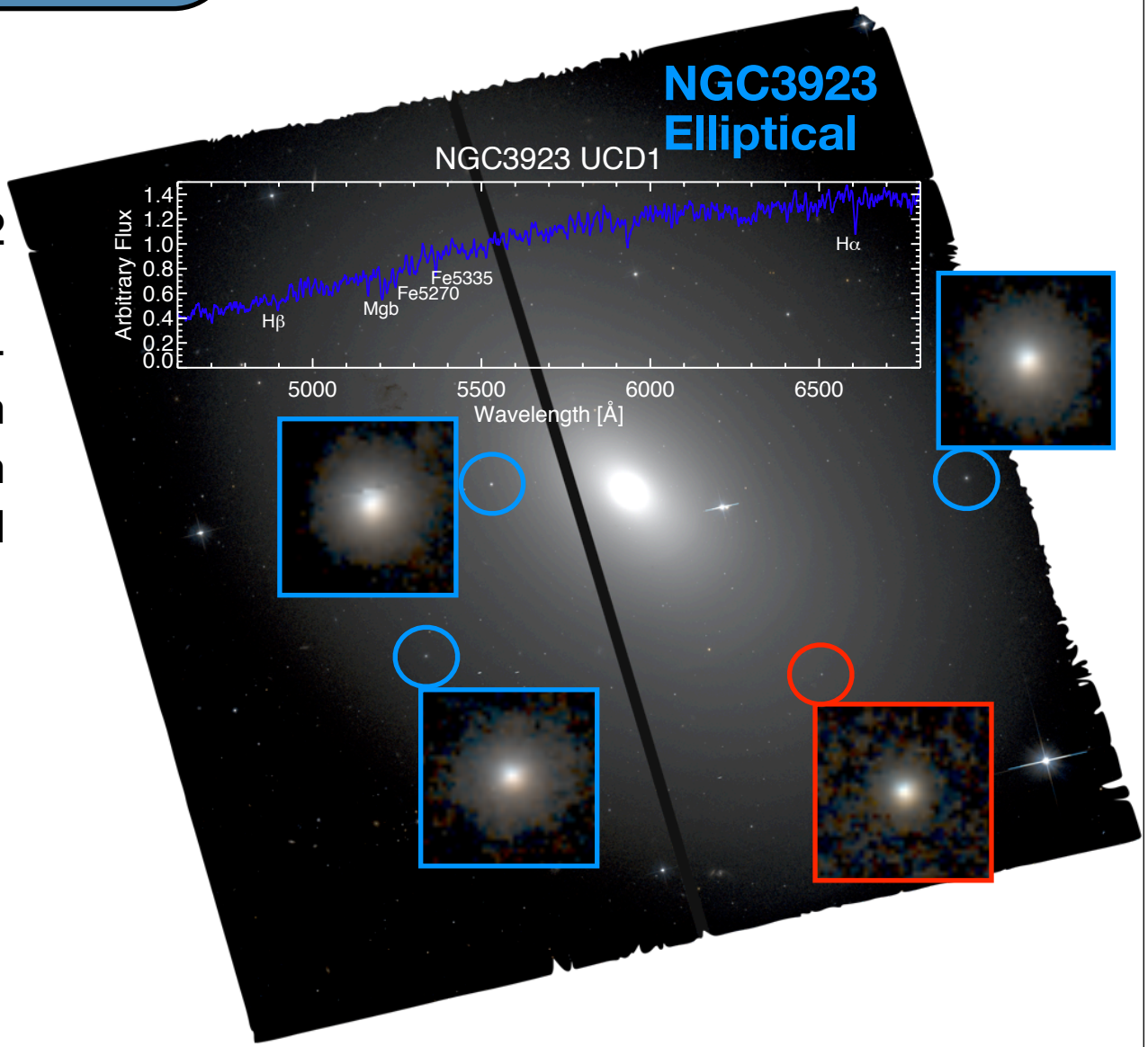


Spectroscopic confirmation using the Goodman Spectrograph on the 4.1m SOAR telescope.

Finding Field/Group UCDs?

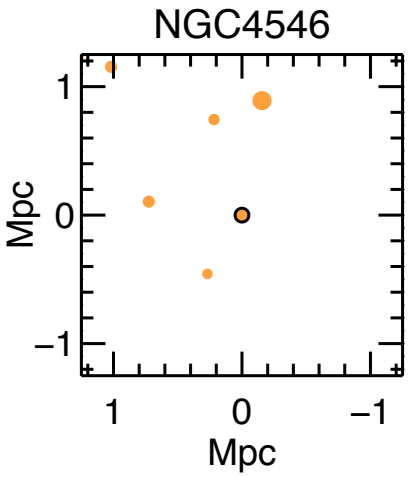
NGC3923: 2 confirmed UCDs, 1 more probable + several large GCs in the transition region between UCDs and GCs.

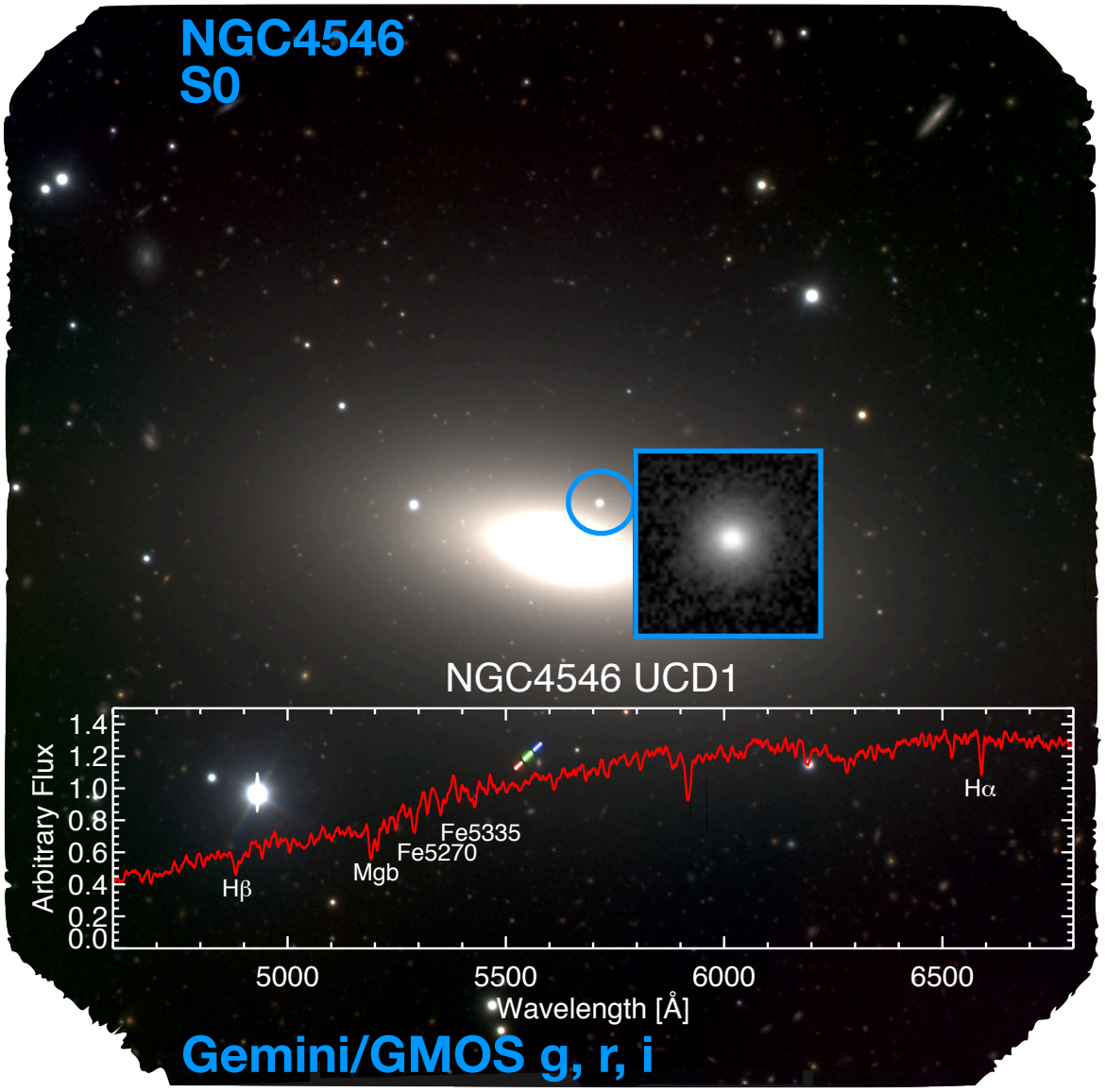




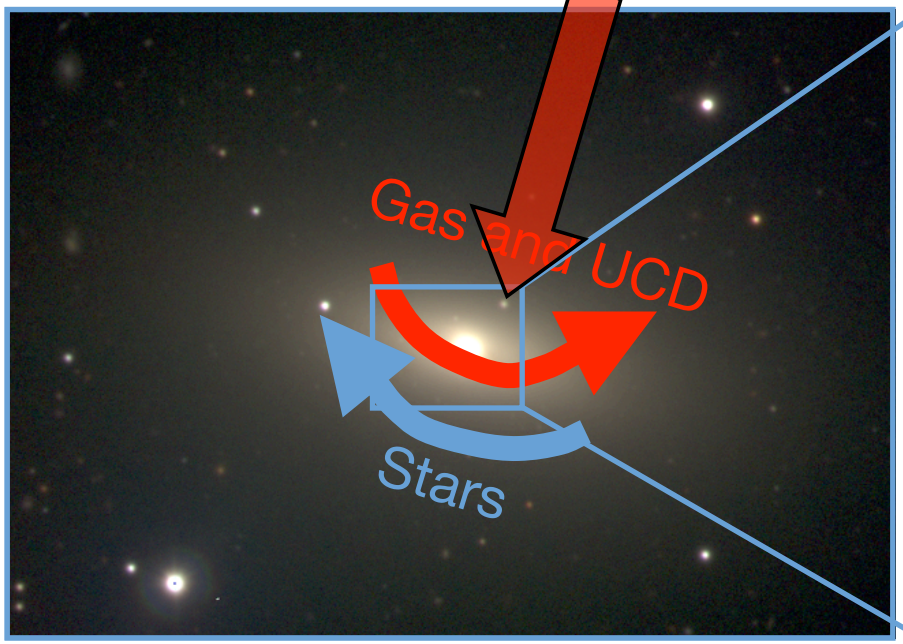
Finding Field/Group UCDs?

NGC4546: 1 very bright UCD.



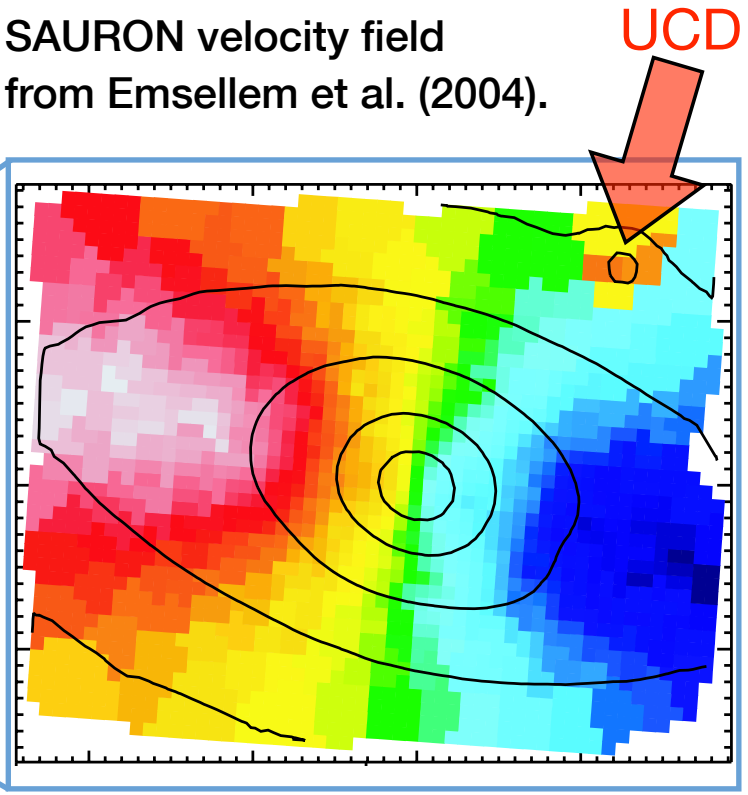


Finding Field/Group UCDs?



The stars and gas (and UCD) rotate in different directions.

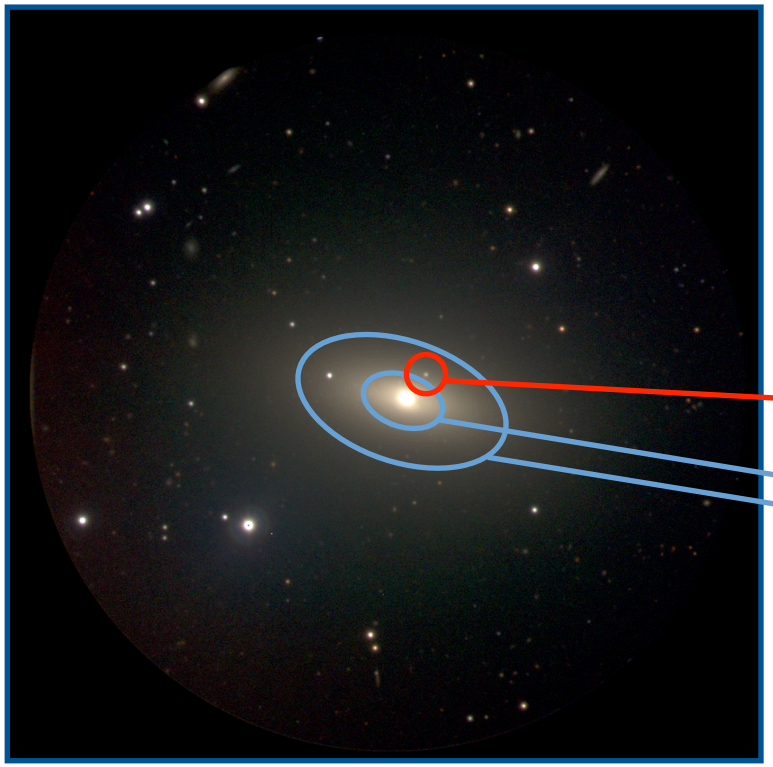
SAURON velocity field from Emsellem et al. (2004).



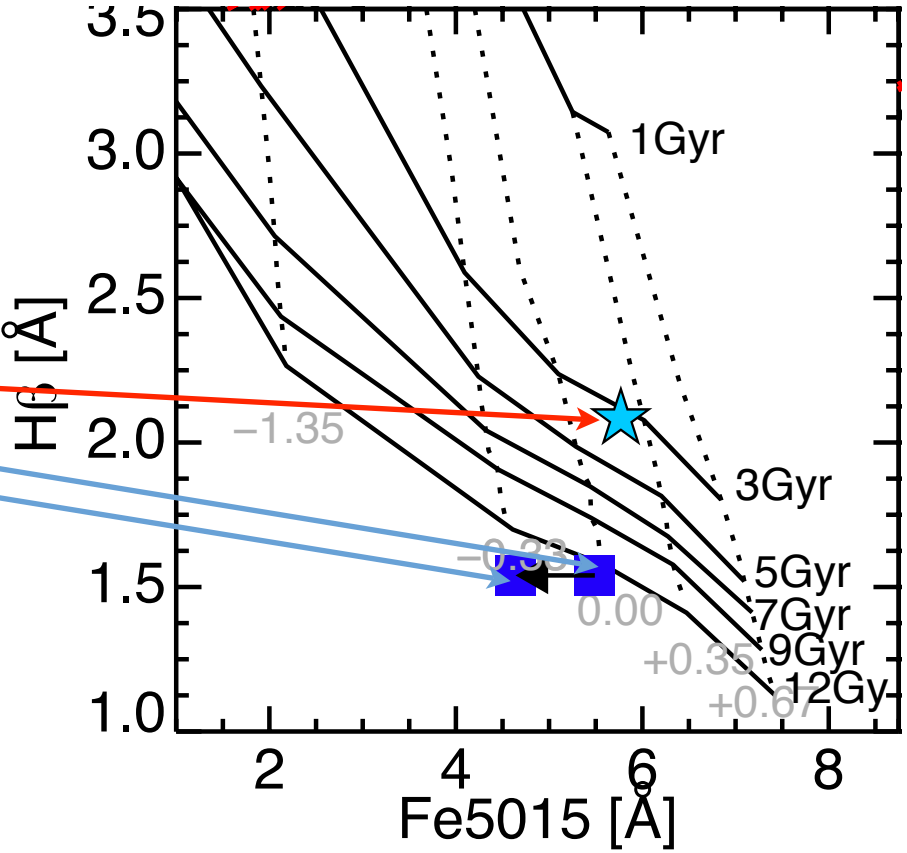
The motions of stars in NGC4546

Finding Field/Group UCDs?

The ages of the UCD and NGC4546

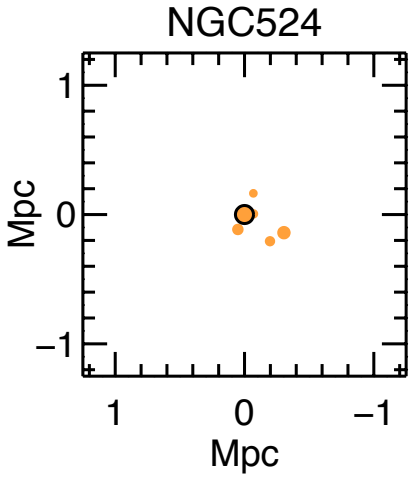


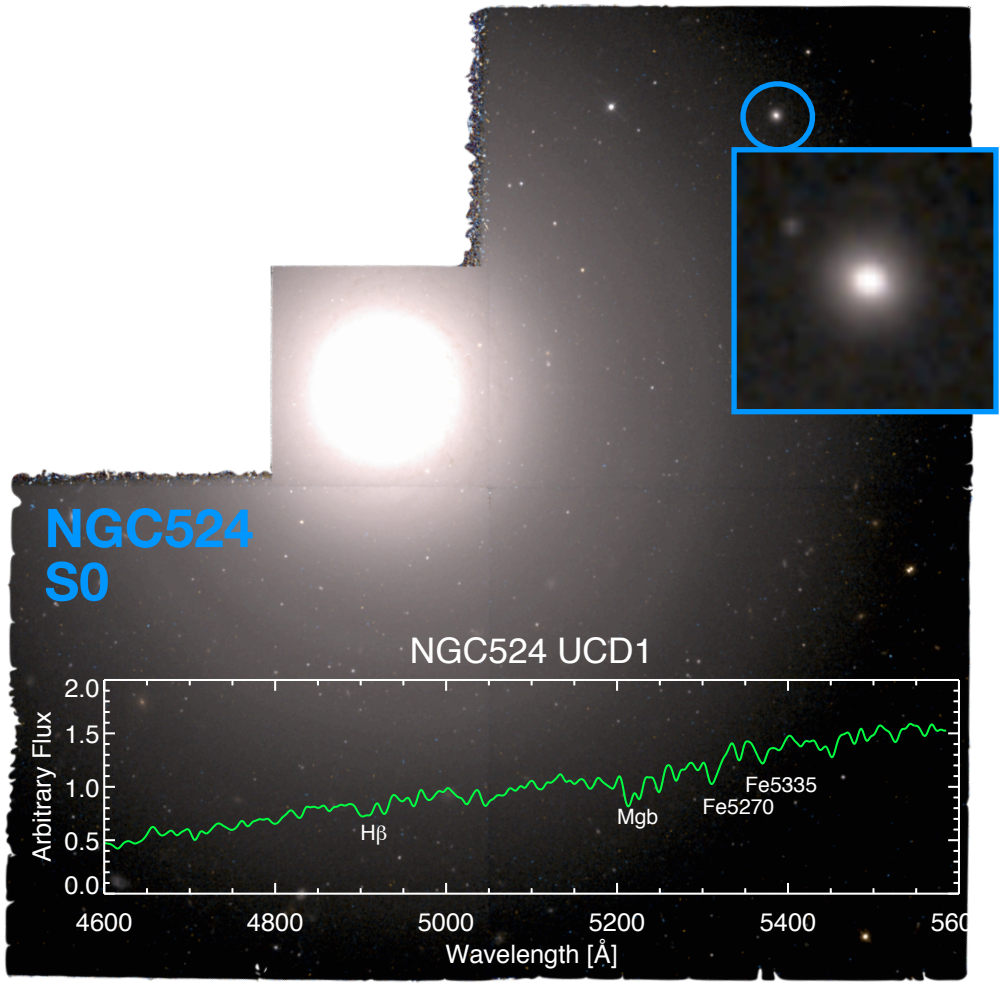
NGC4546



Finding Field/Group UCDs?

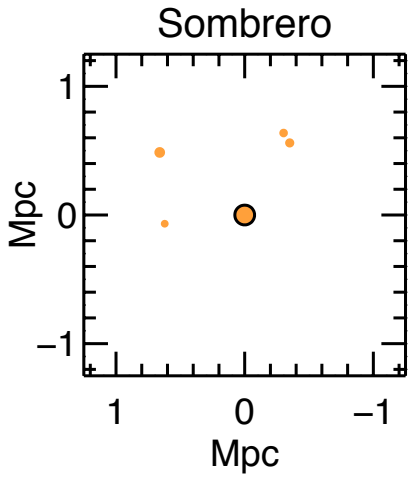
NGC524: 1 very large UCD.

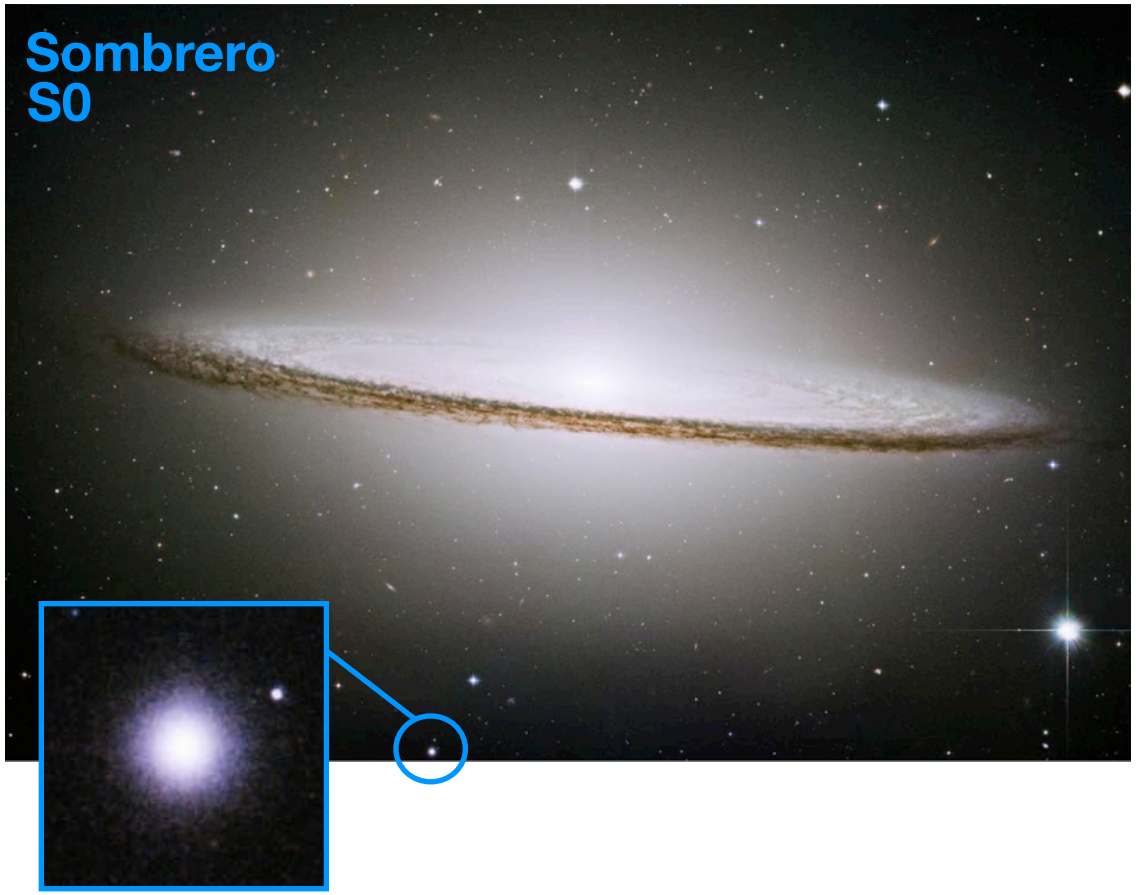




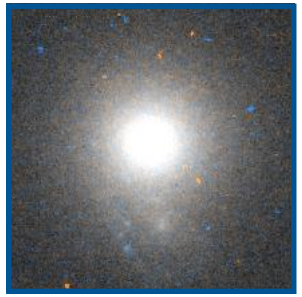
Finding Field/Group UCDs?

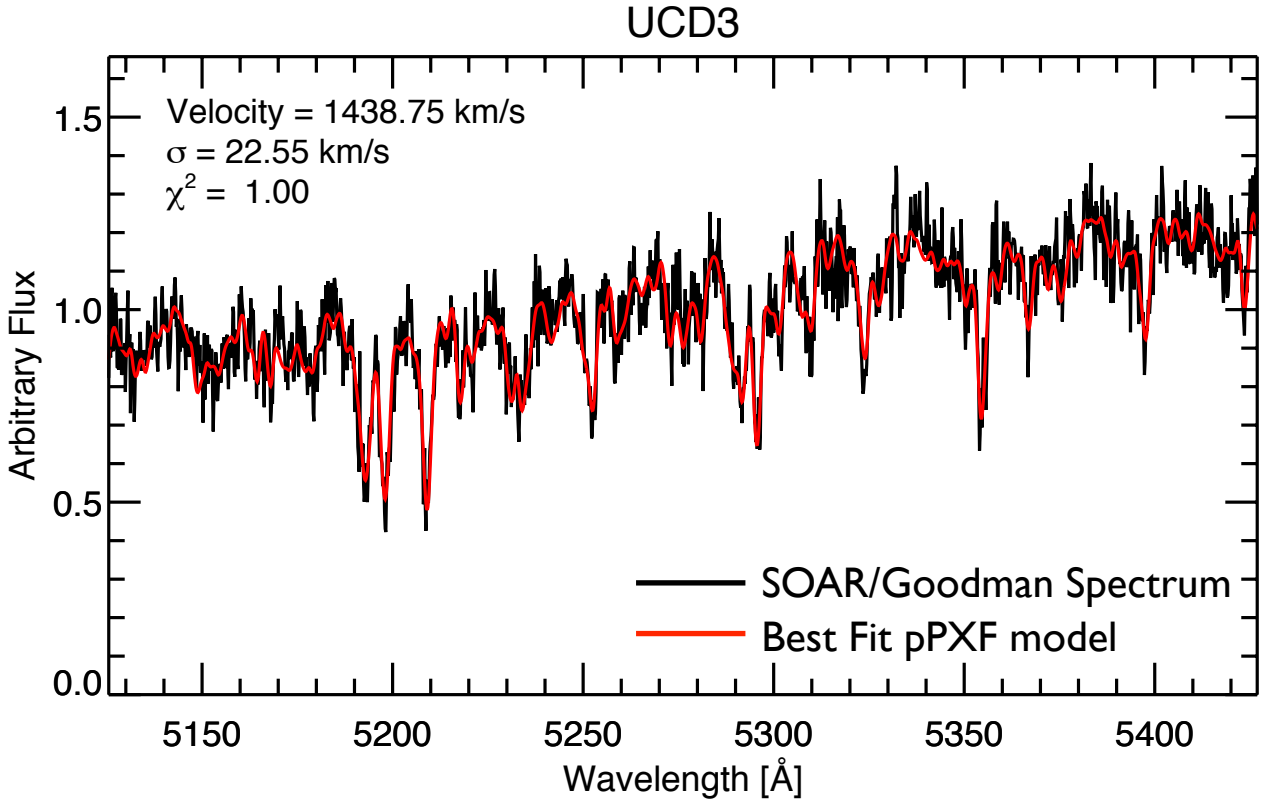
Sombrero: 1 UCD discovered by Hau et al. (2009).





Kinematics of Field/Group UCDs

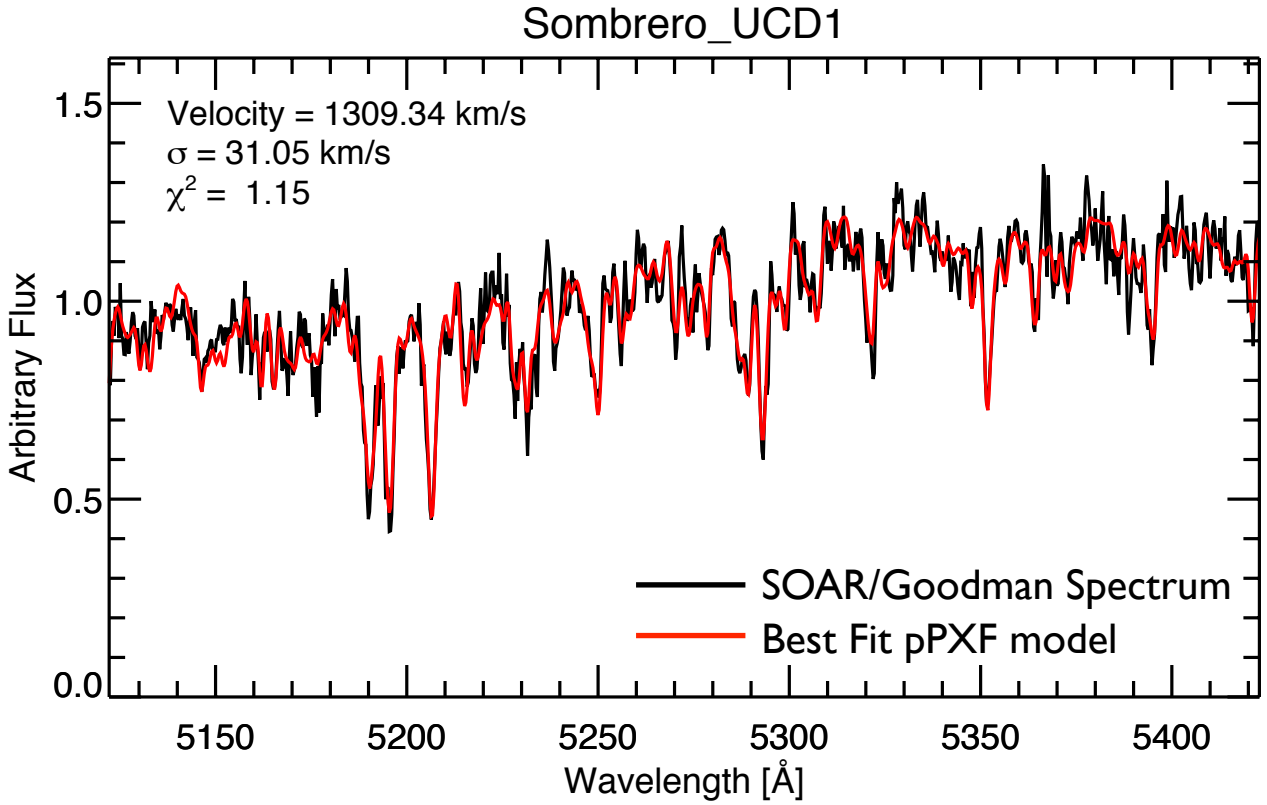




V = 17.87

Exposure time = 1hr

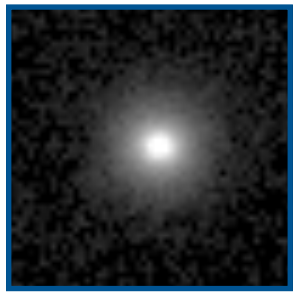
Kinematics of Field/Group UCDs

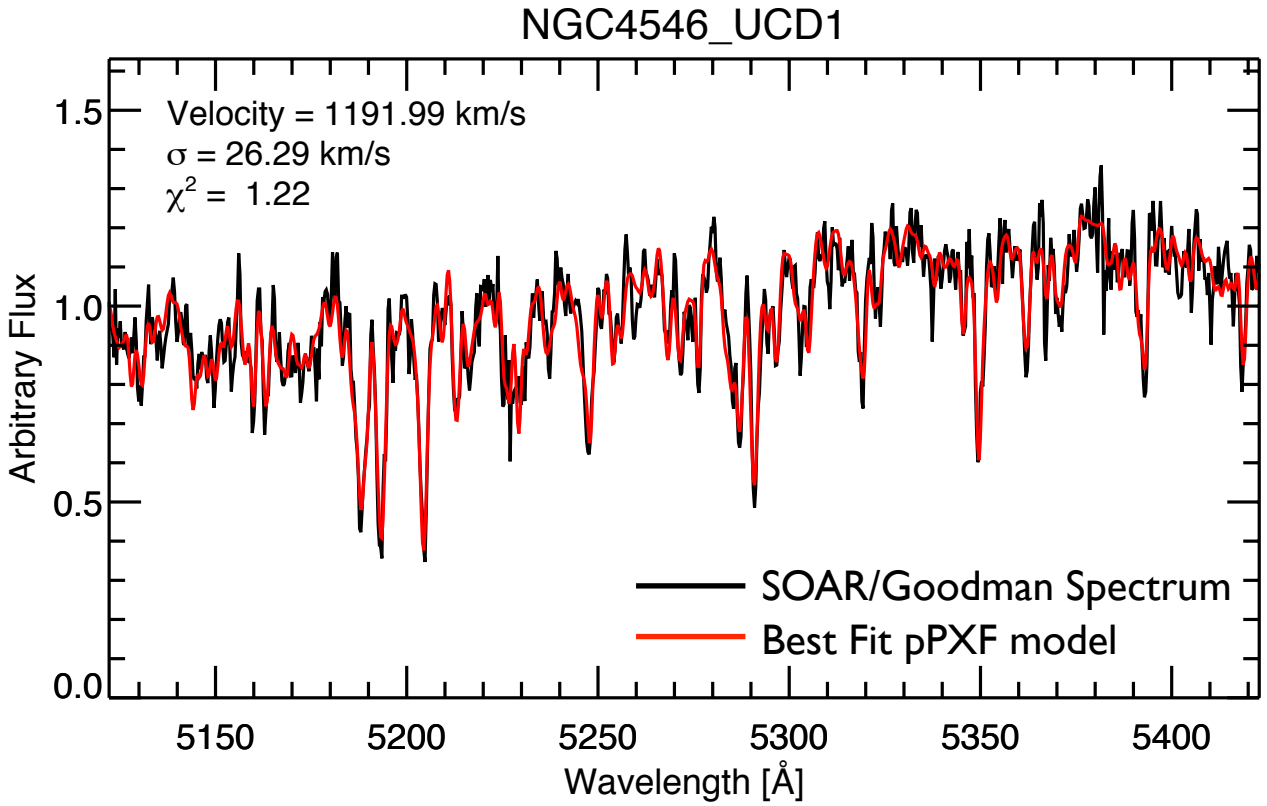


V = 17.46

Exposure time = 45min

Kinematics of Field/Group UCDs

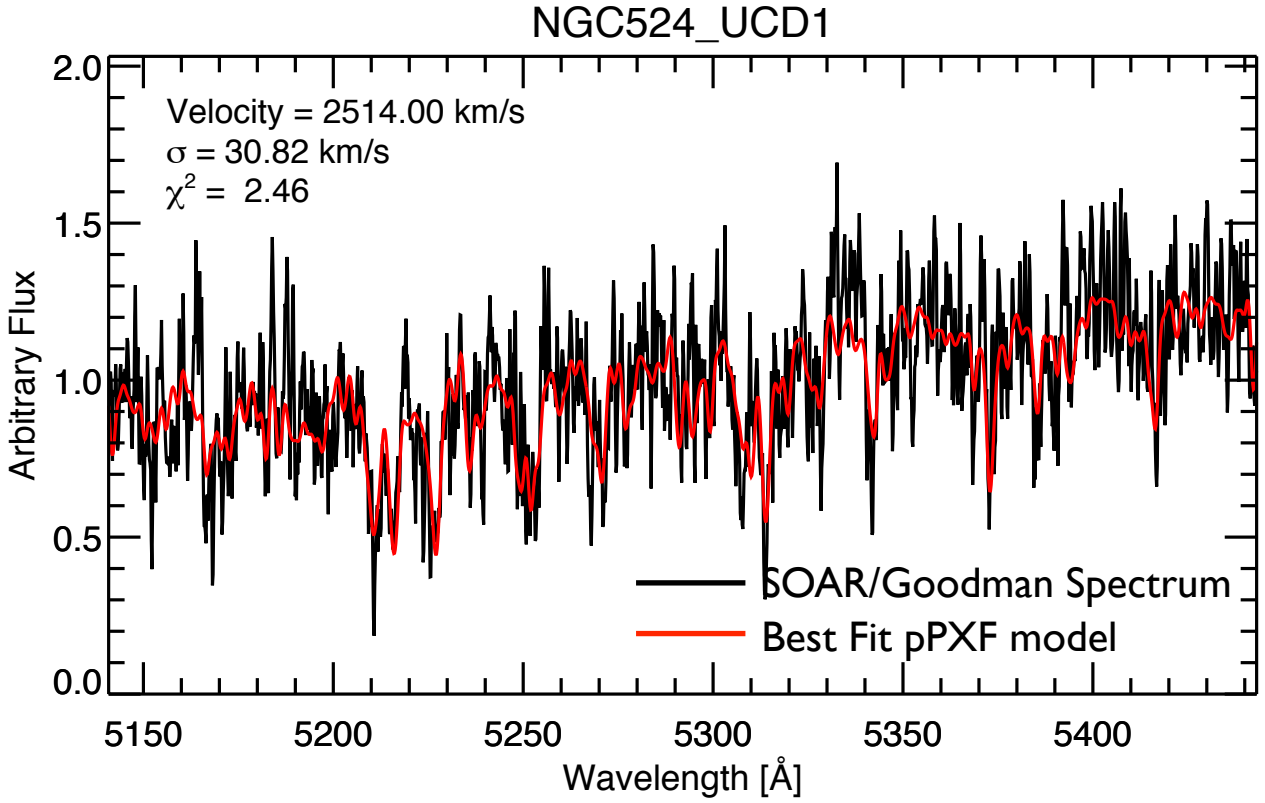




V = 17.64

Exposure time = 1hr

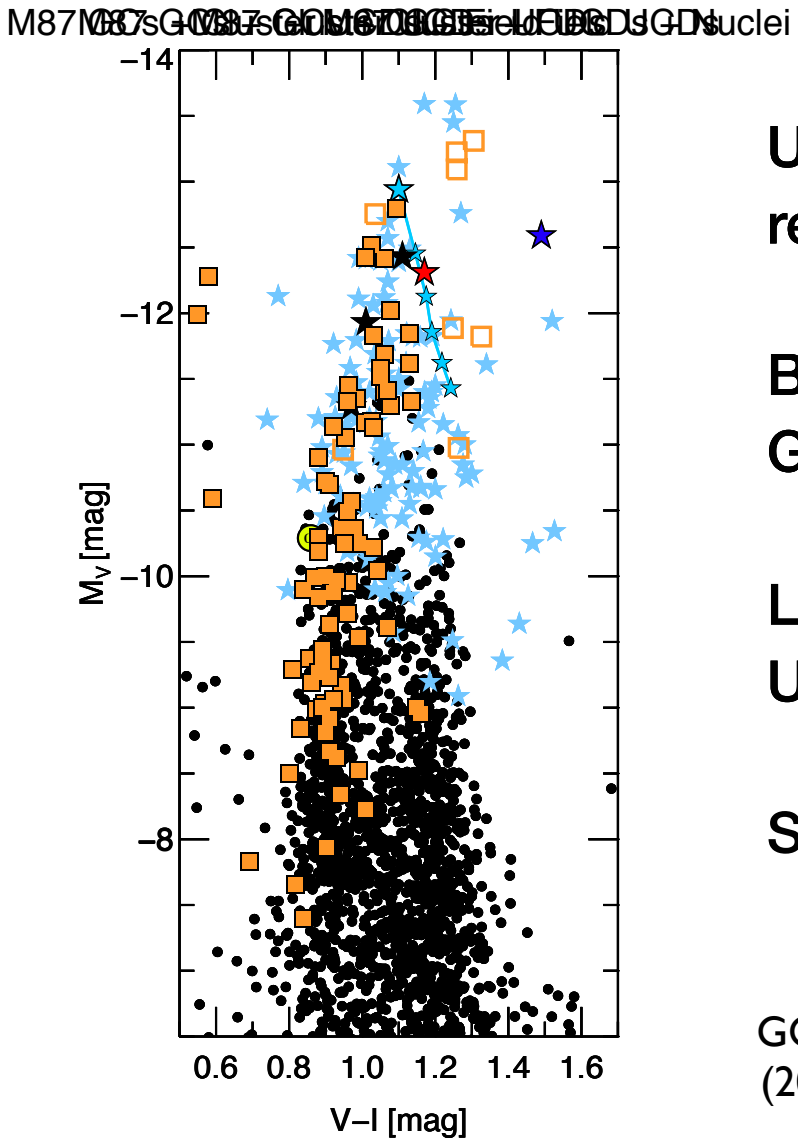
Kinematics of Field/Group UCDs



V = 19.32

Exposure time = 2hr 20min

UCD Properties



UCDs extend the Colour-Magnitude relations of GCs.

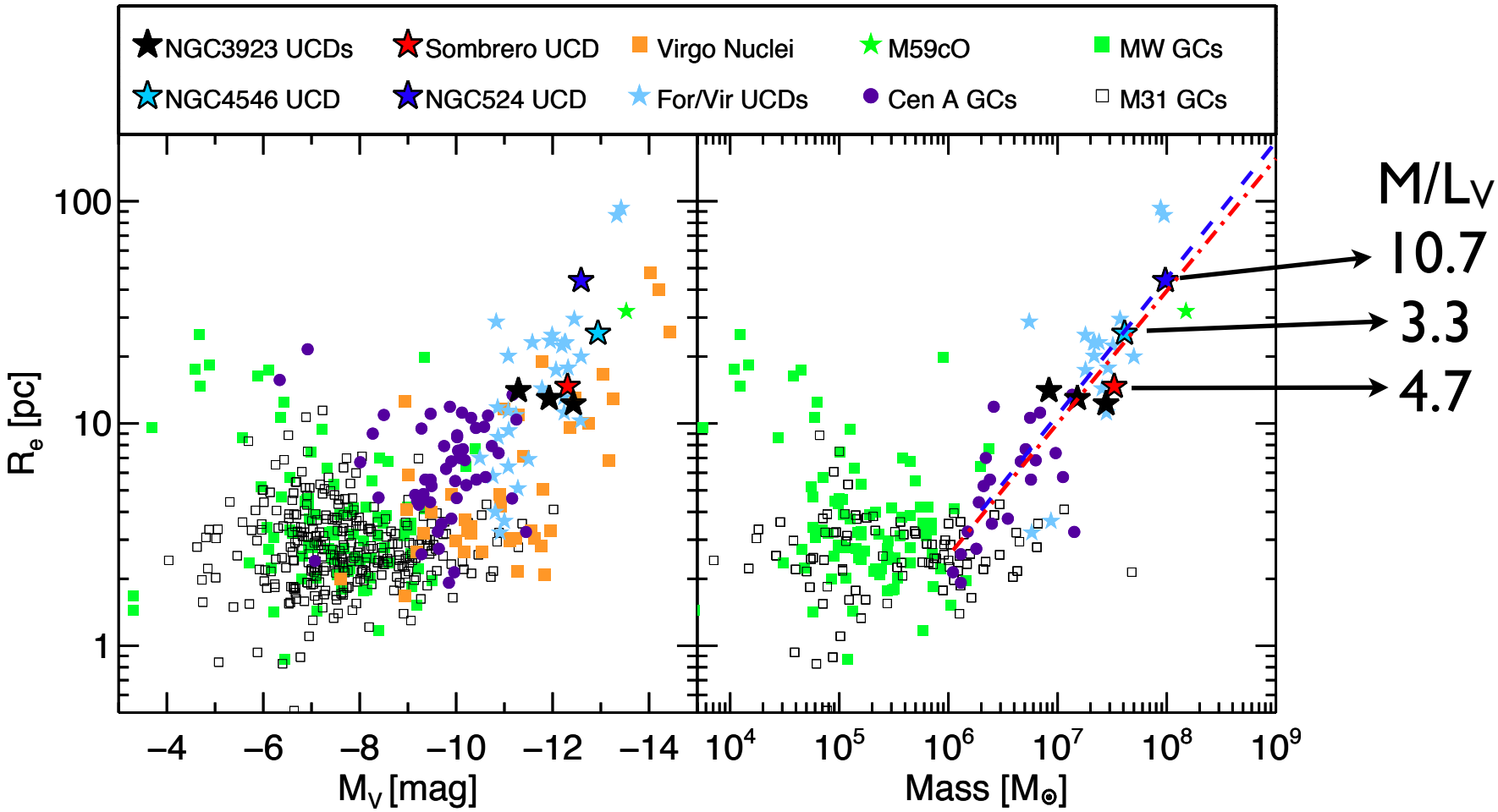
Break in relation apparent for blue GCs/UCDs at M_V ~ -10.5

Low density UCDs follow Cluster UCDs.

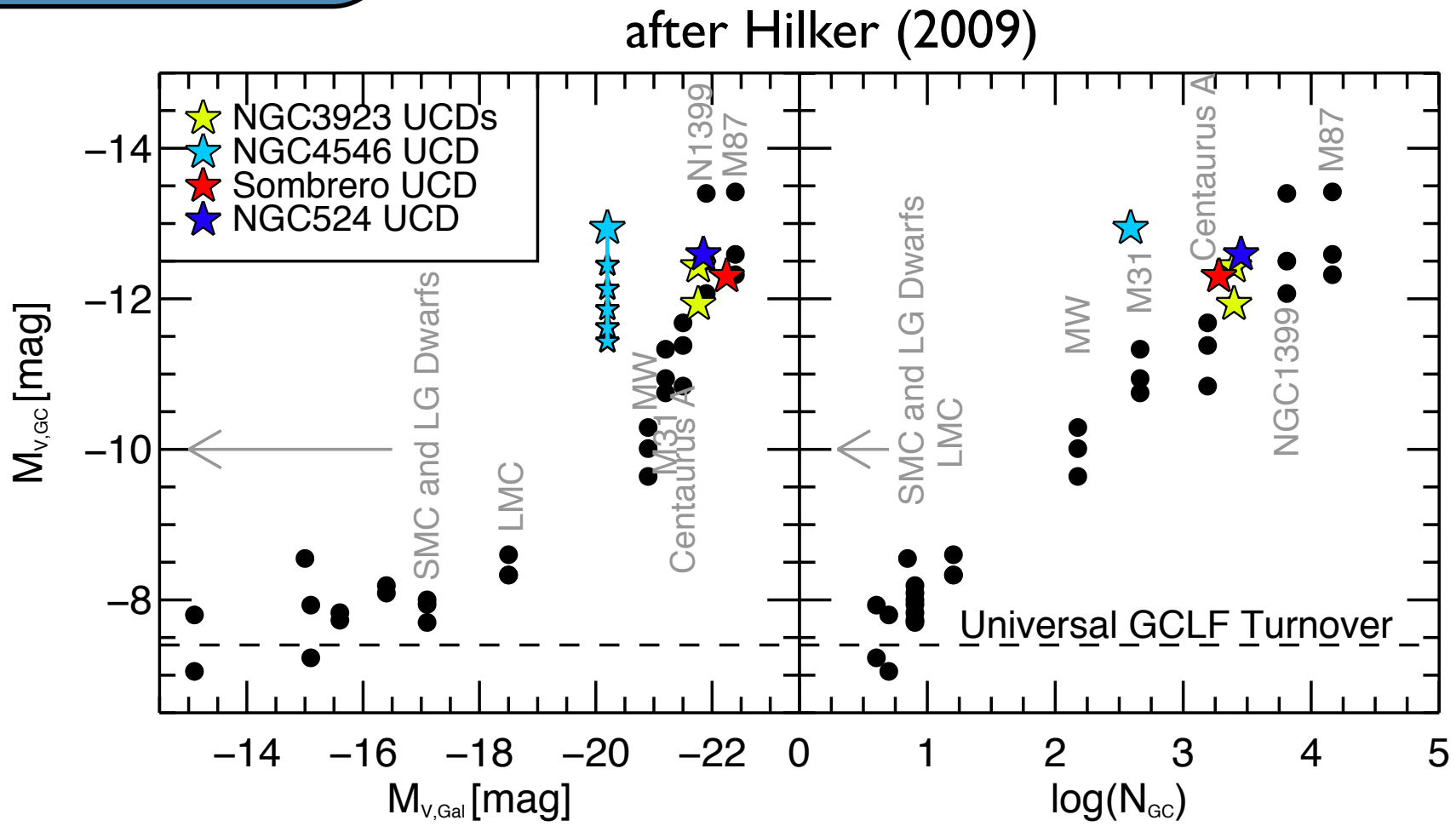
So do dwarf nuclei.

GCs from Peng et al. (2009), Nuclei from Lotz et al. (2004) & Cote et al. (2006), cluster UCDs from half the people in the room.

UCD Properties

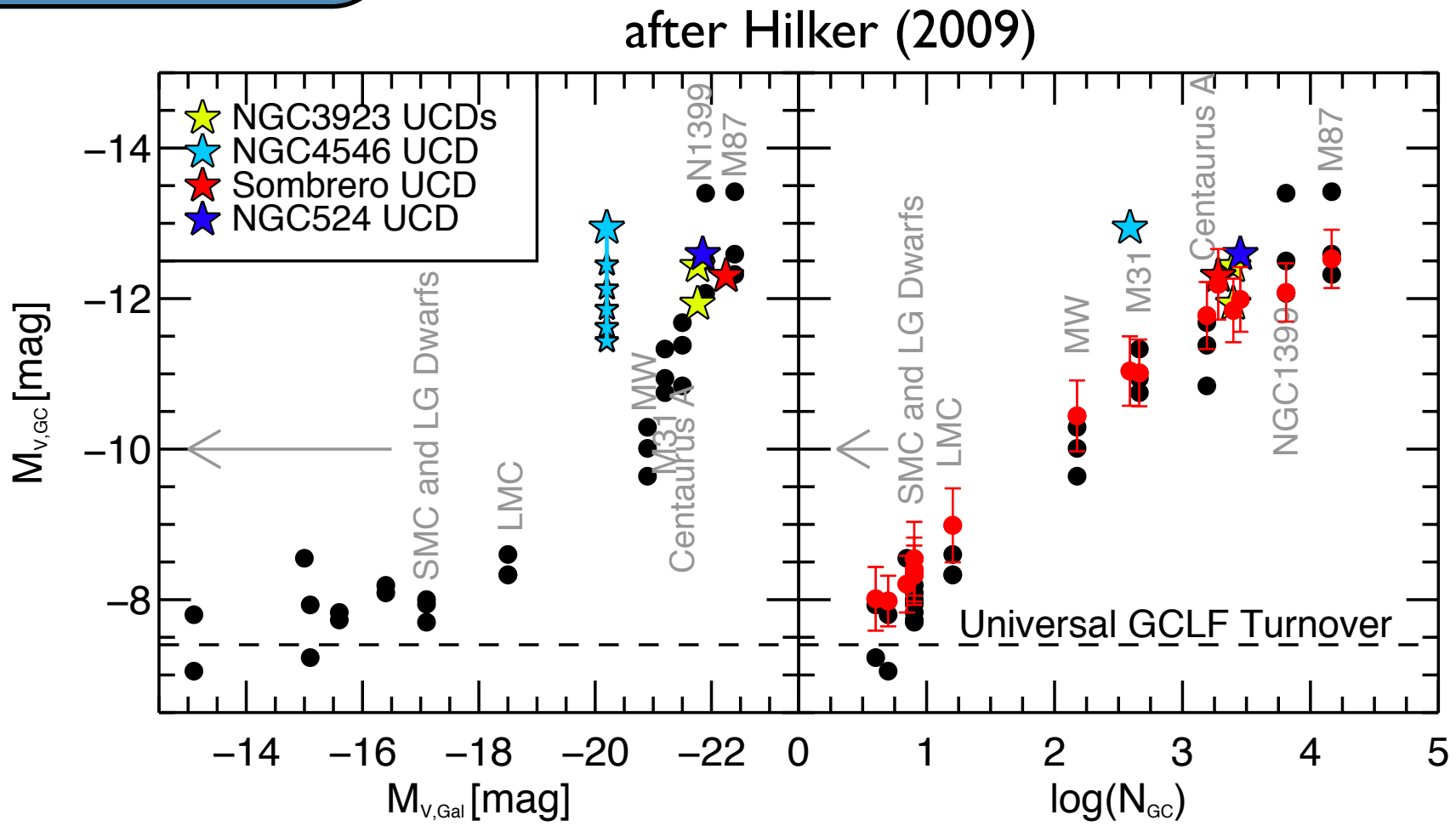


UCD Properties



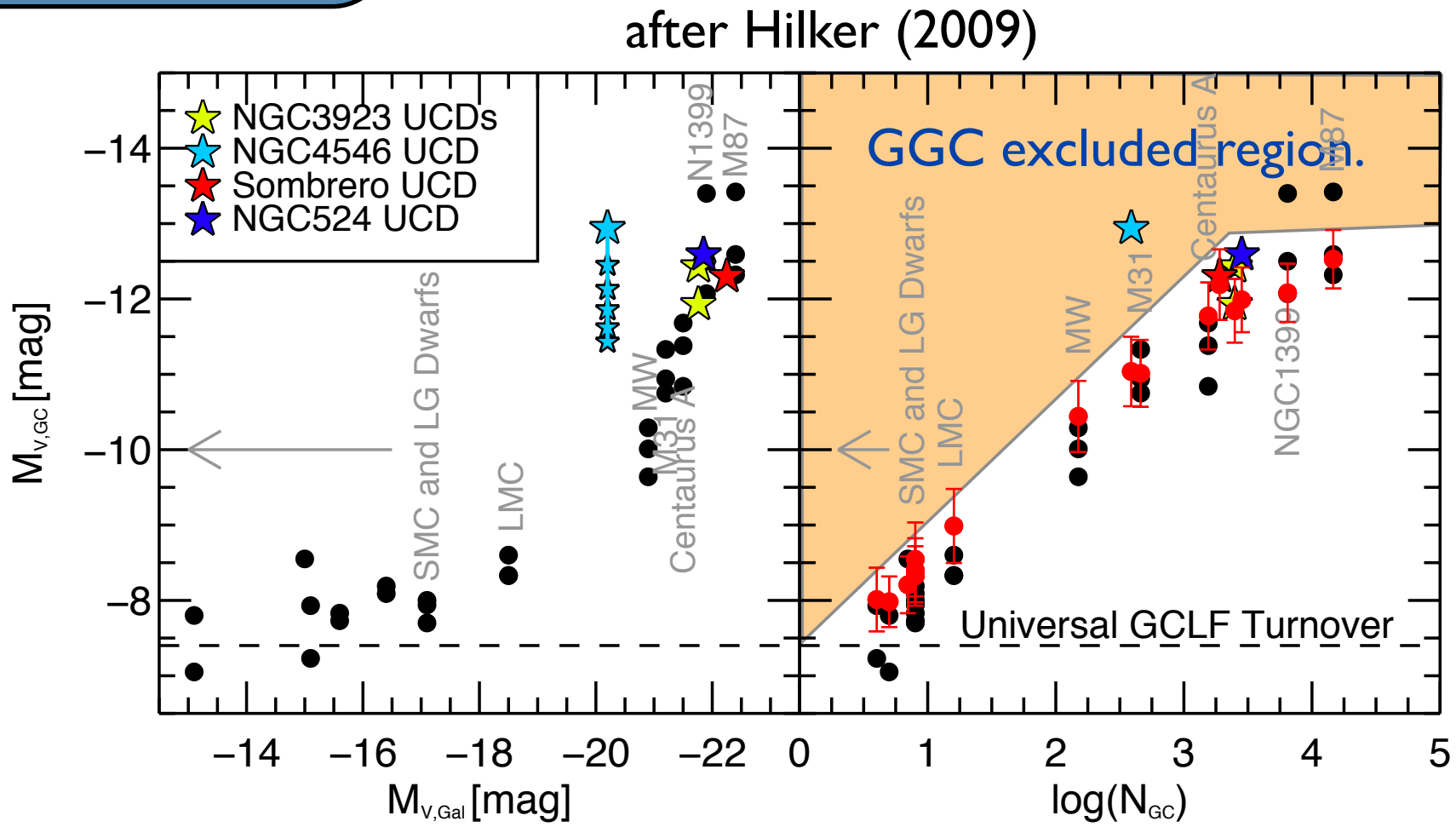
Most UCDs are consistent with being the extreme bright end of the GCLF of their host. The NGC4546 UCD is not.

UCD Properties



Most UCDs are consistent with being the extreme bright end of the GCLF of their host. The NGC4546 UCD is not.

UCD Properties



Most UCDs are consistent with being the extreme bright end of the GCLF of their host. The NGC4546 UCD is not.

Conclusions

1a)UCDs seem to be common in field/group environments.
1b)Their luminosities are generally consistent with those expected from extrapolating the GCLF.

- Most are probably GGCs.

2) Some outliers do exist. The NGC4546 UCD is clearly a recently stripped object.

3) The kinematics of the objects indicates most do not require dark matter to be present. The NGC524 maybe an exception - but a better understanding of the extinction is required.