The Structural Properties of Milky Way Dwarf Galaxies

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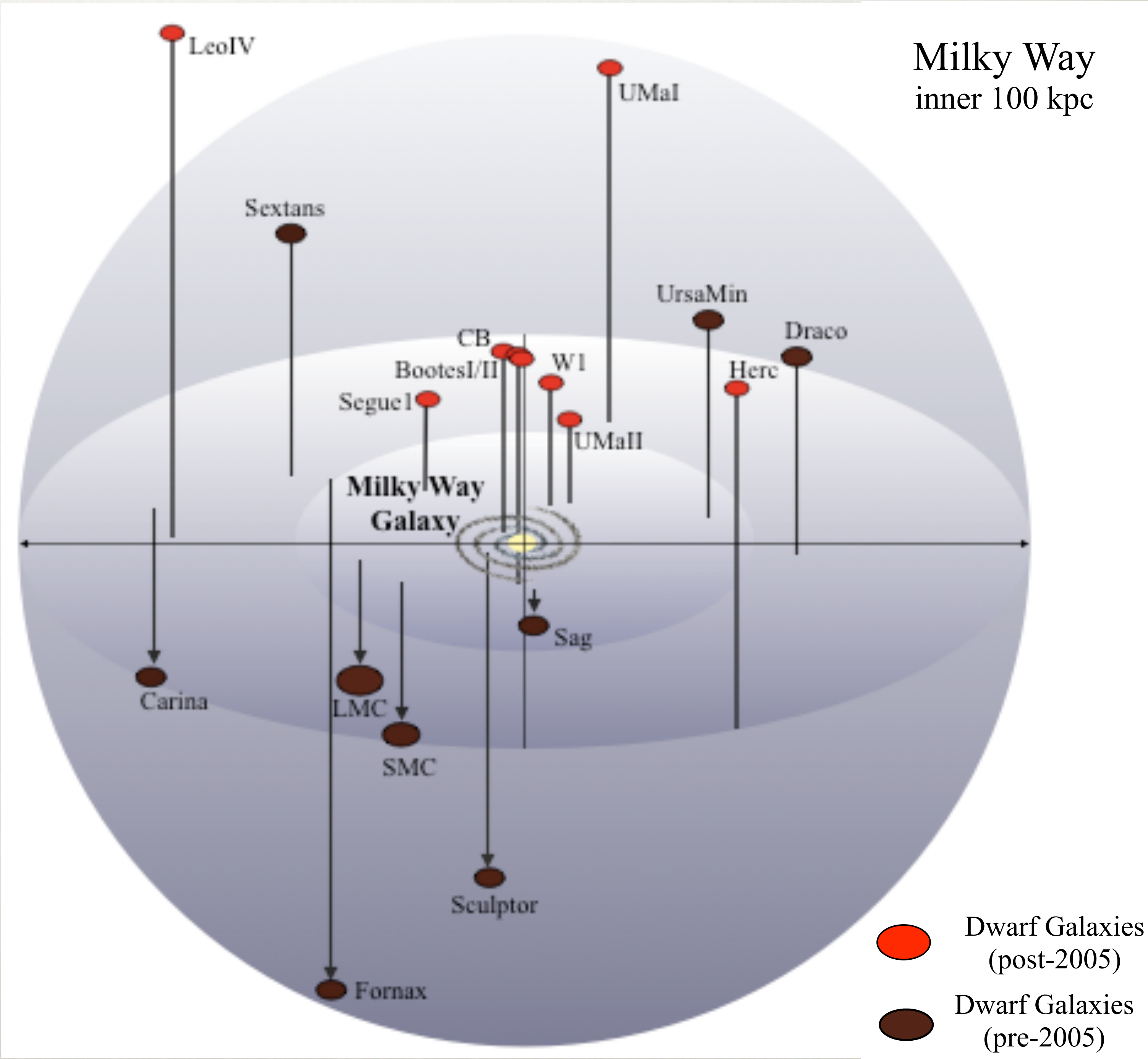
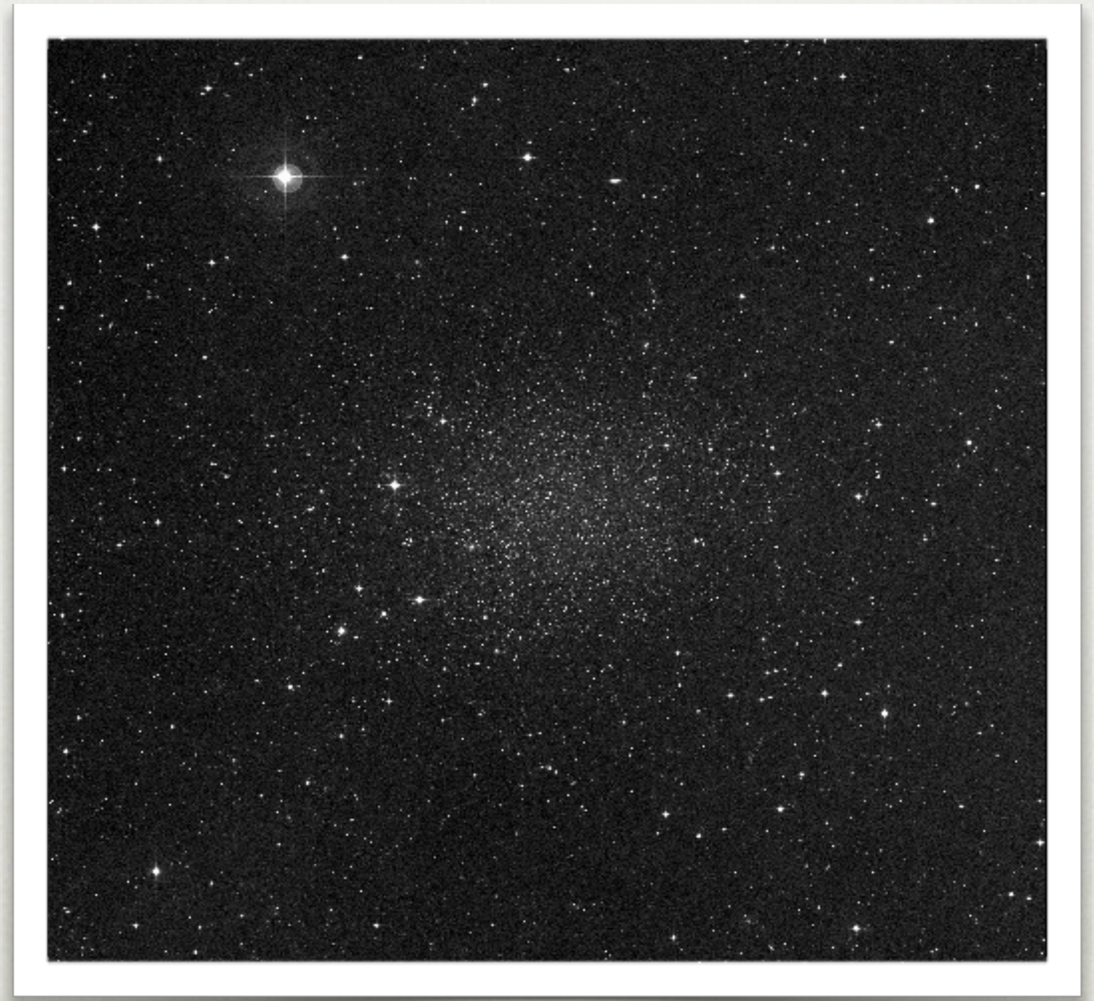
- Patrick Côté (HIA/DAO)
- Peter Stetson (HIA/DAO)
- Josh Simon (Carnegie)
- George Djorgovski (Caltech)
- Felipe Santana (U. de Chile)

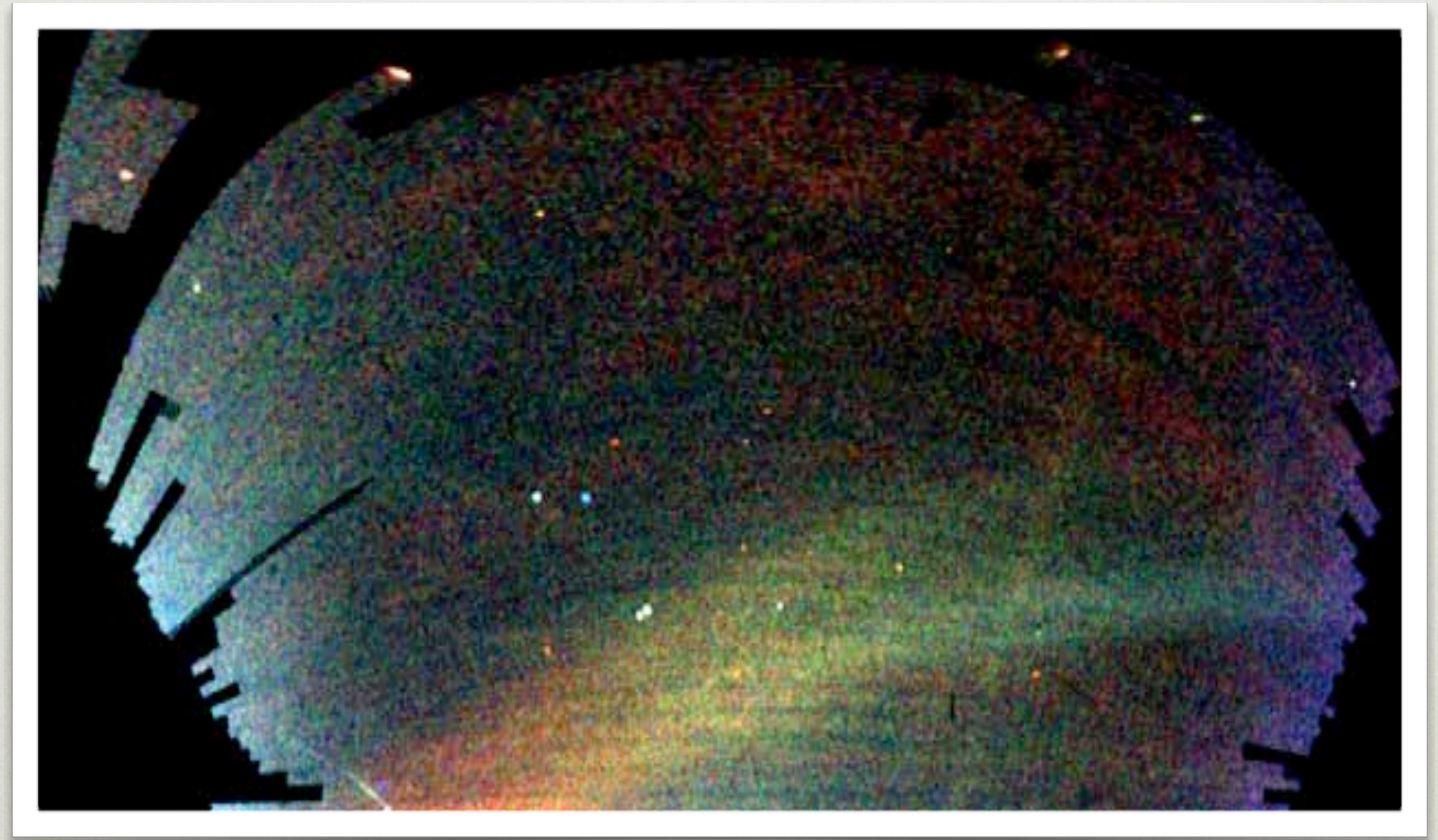


2004: Eleven known Milky Way satellite galaxies. Visual searches provide no evidence for a larger population . . . (Simon & Blitz 2002, Willman et al. 2002, Whiting et al. 2002)



2005-present: SDSS has revolutionized the field

Belokurov et al. (2006)



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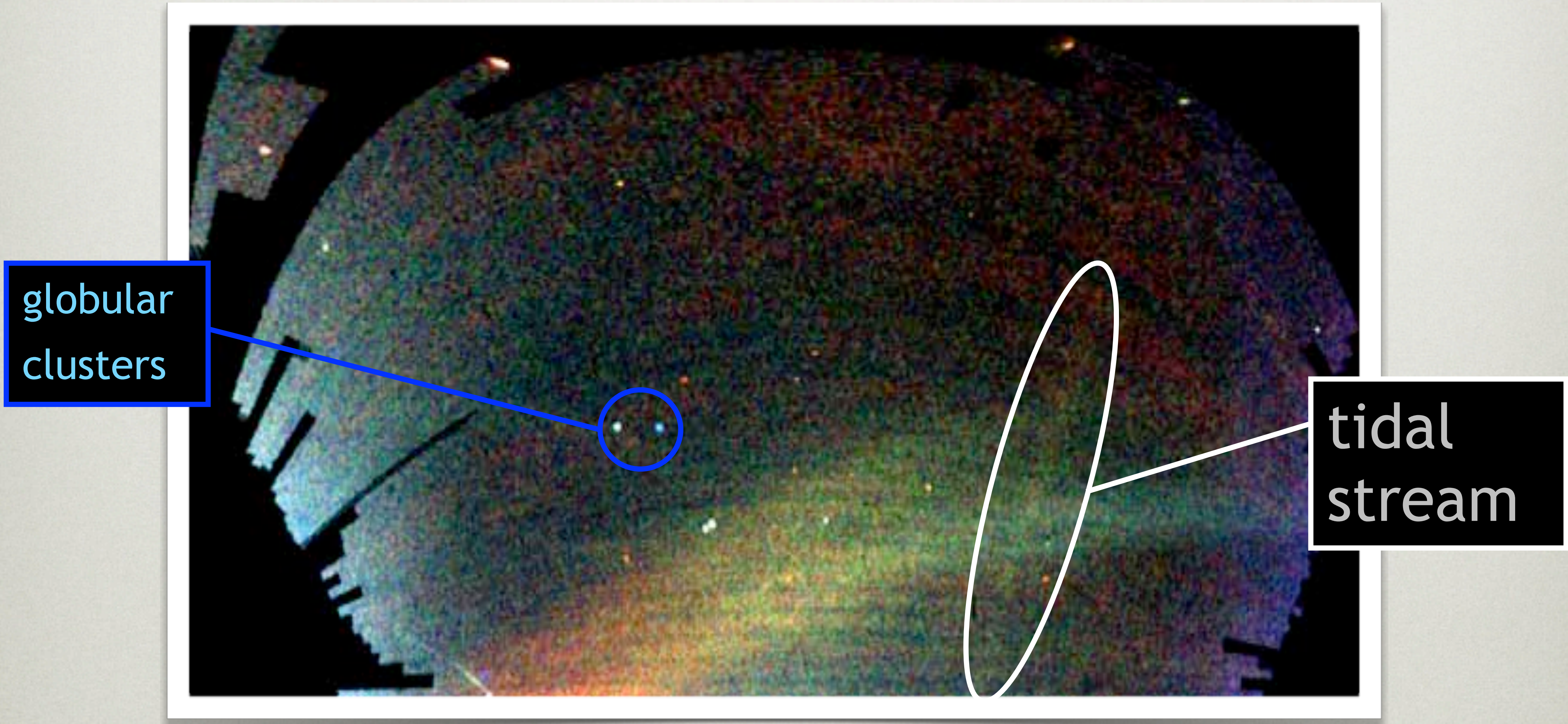

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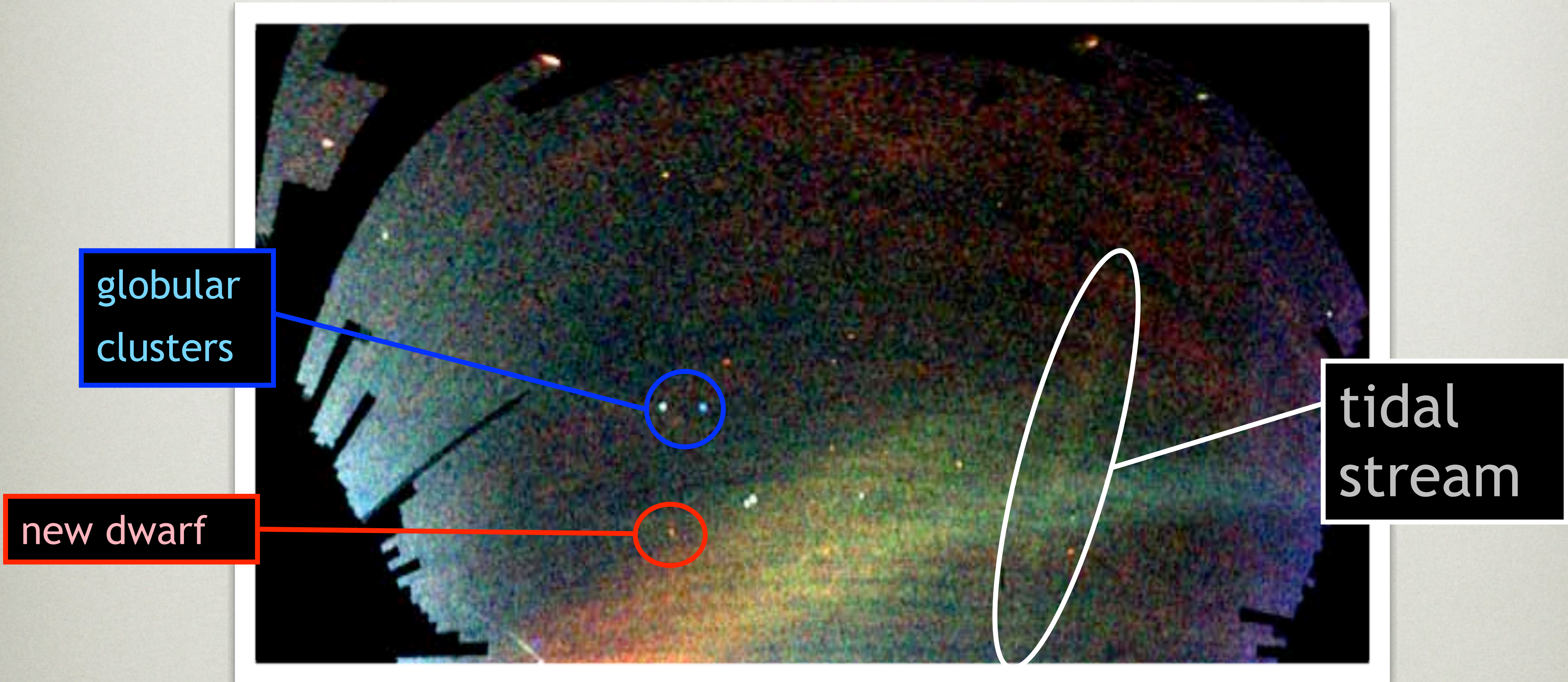
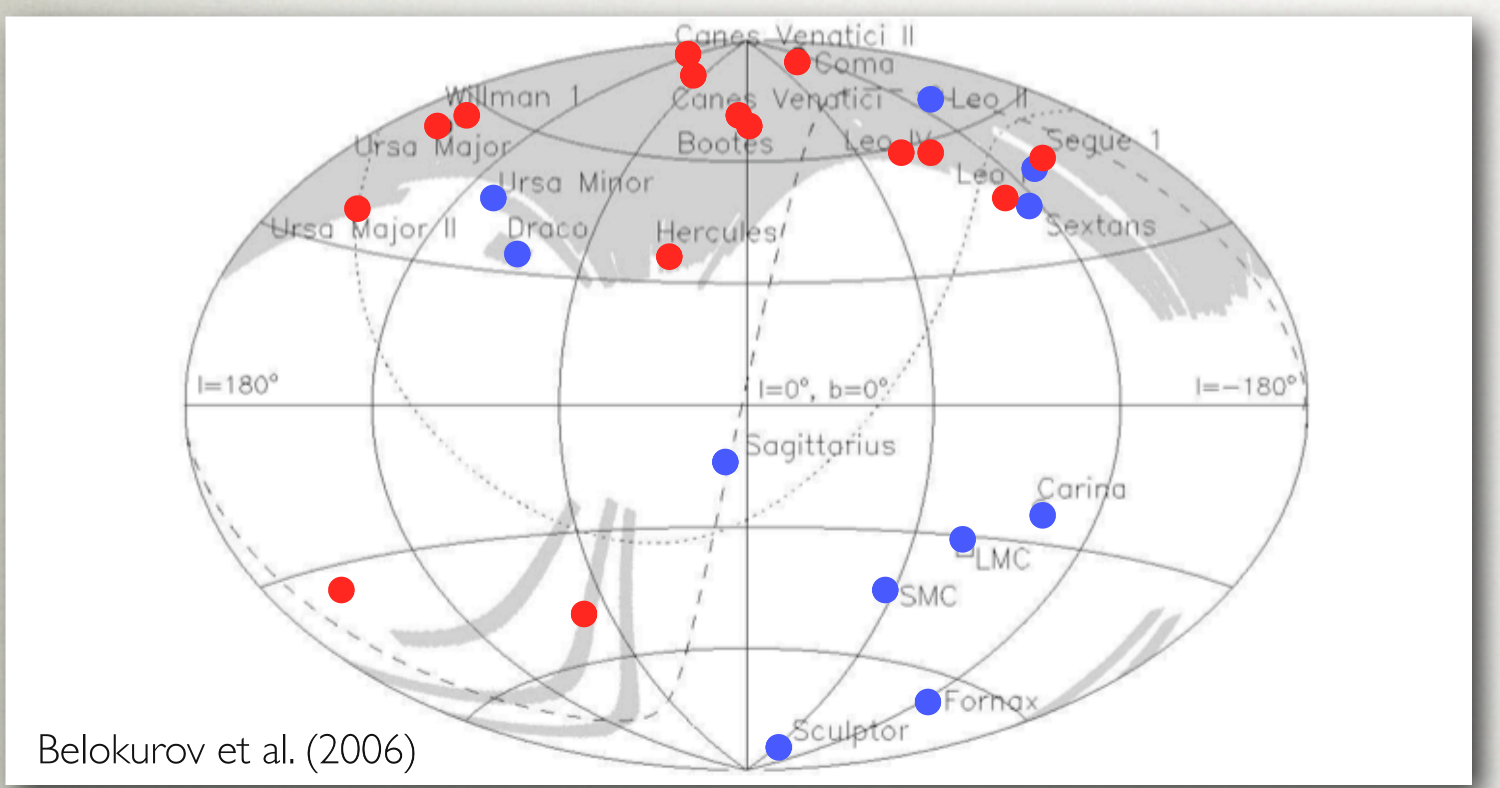


The New Milky Way Dwarf Galaxy Landscape

Sloan Digital Sky Survey (SDSS) coverage



The Satellite Numbers:
Classical dSphs = 11
Ultra-Faint dwarfs = 17

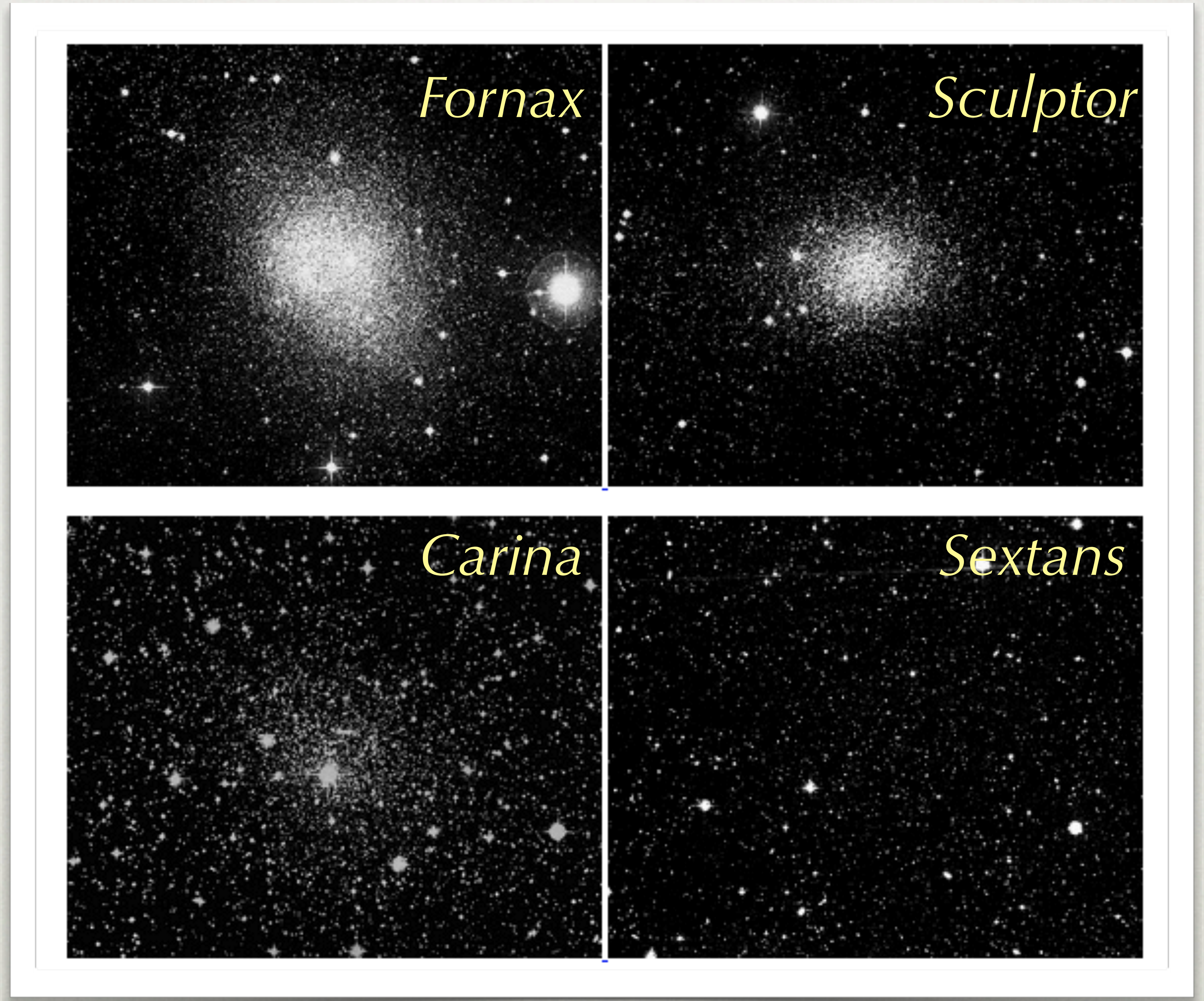
28

To SDSS depth, full sky = 11 + 4x17 ≈ 80

To LSST depth, full sky > 400 MW dwarfs

Name	Year Discovered
LMC	B.C
SMC	B.C
Sculptor	1937
Fornax	1938
Leo II	1950
Leo I	1950
Ursa Minor	1954
Draco	1954
Carina	1977
Sextans	1990
Sagittarius	1994
Ursa Major I	2005
Willman I	2005
Ursa Major II	2006
Bootes I	2006
Canes Venatici I	2006
Canes Venatici II	2006
Coma Berencies	2006
Segue I	2006
Leo IV	2006
Hercules	2006
Leo T	2007
Bootes II	2007
Leo V	2008
Segue II	2009
Pisces I	2009
Bootes III	2009
Pisces II	2010

How faint are the Milky way dwarfs?



from http://chandra.as.utexas.edu/~kormendy/dm.html

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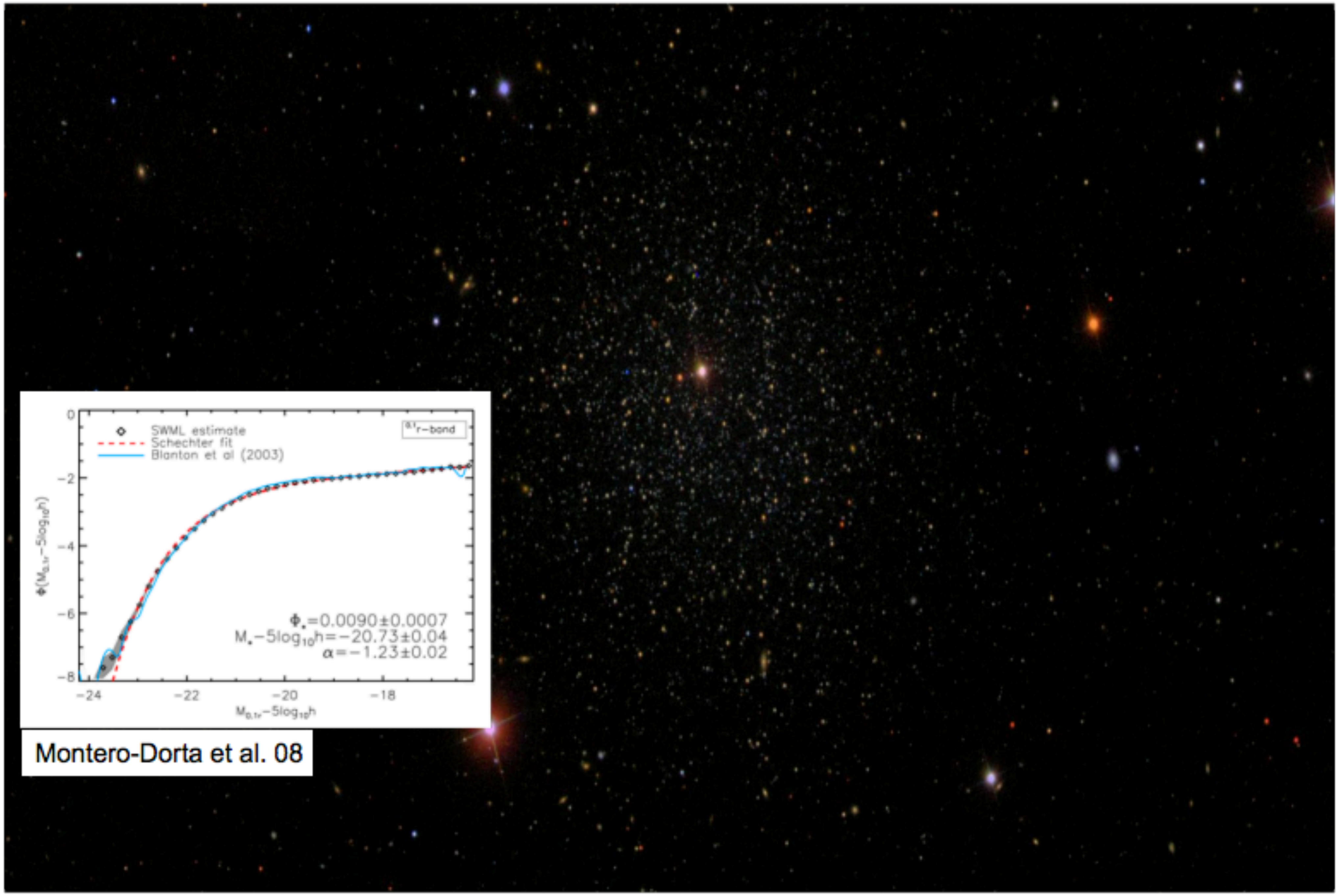

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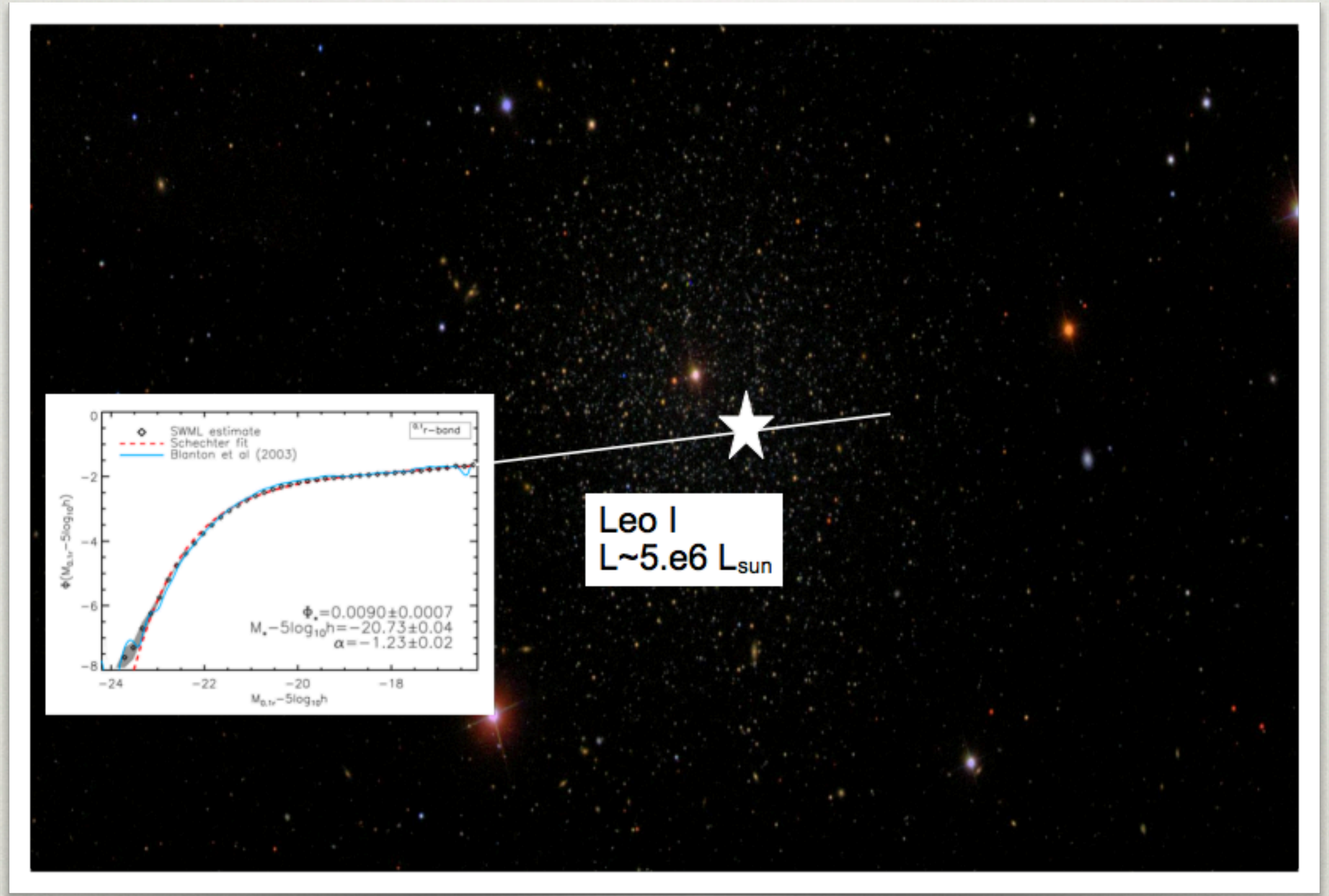

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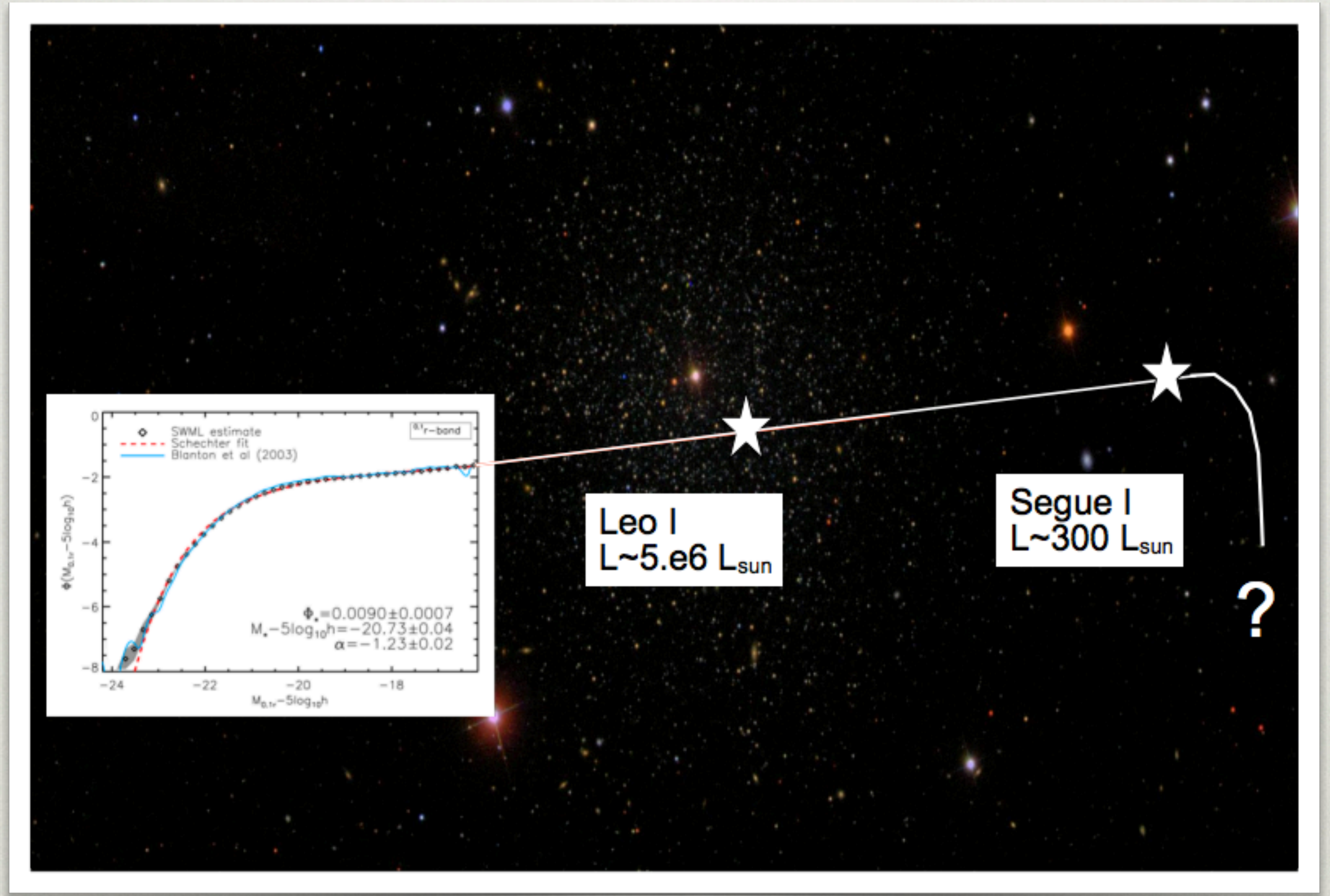
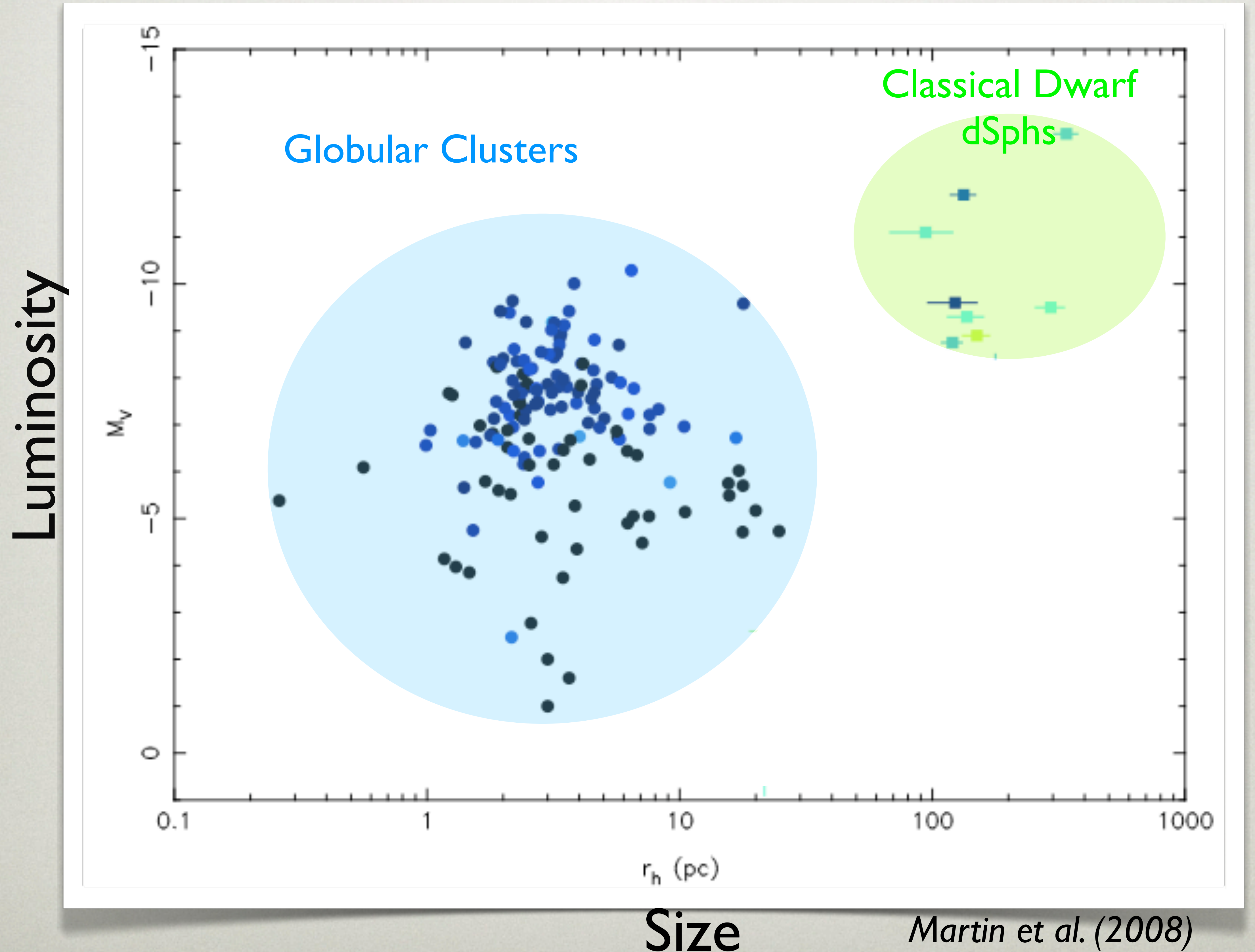


Photometric Properties of Milky Way dwarf galaxies



Martin et al. (2008)

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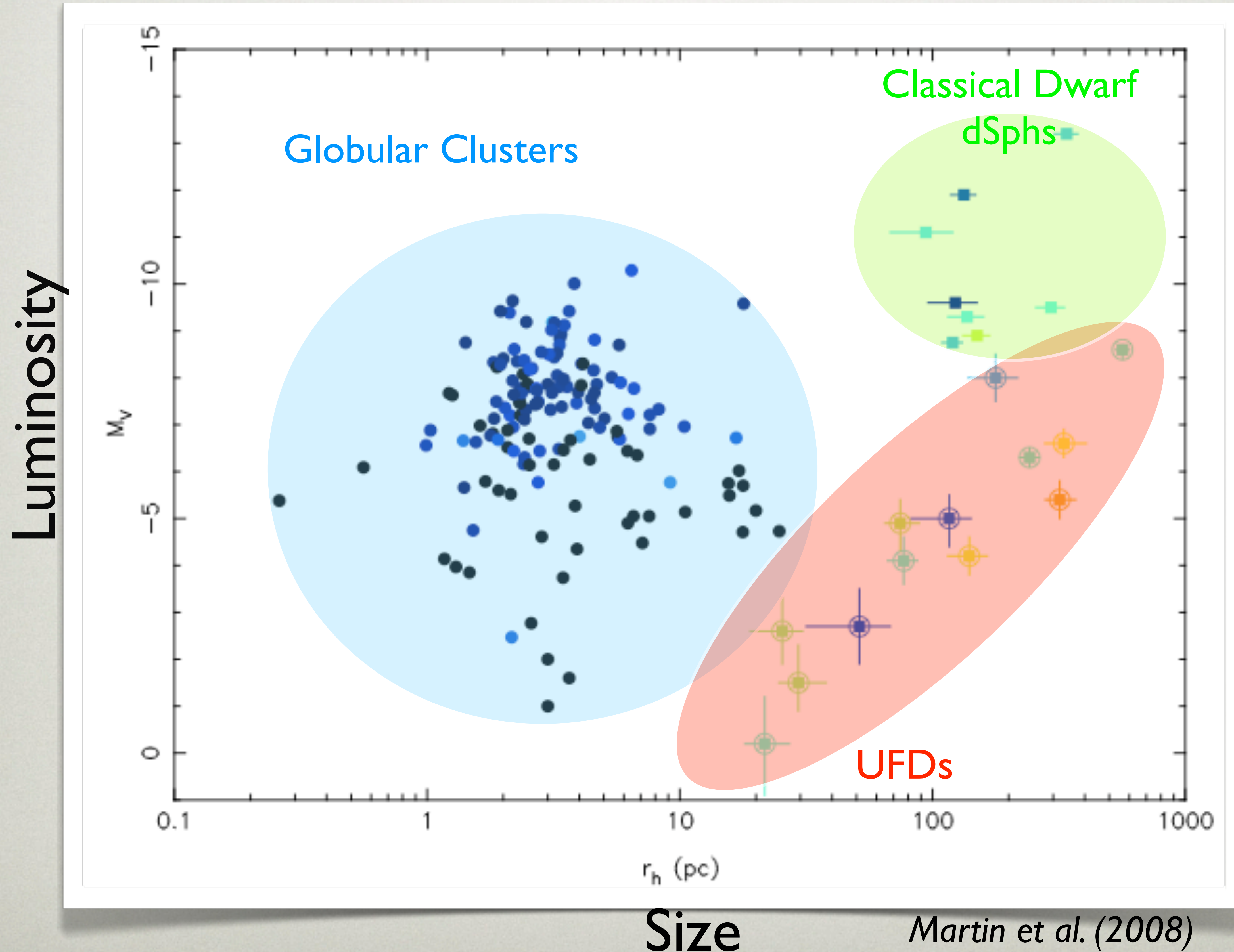
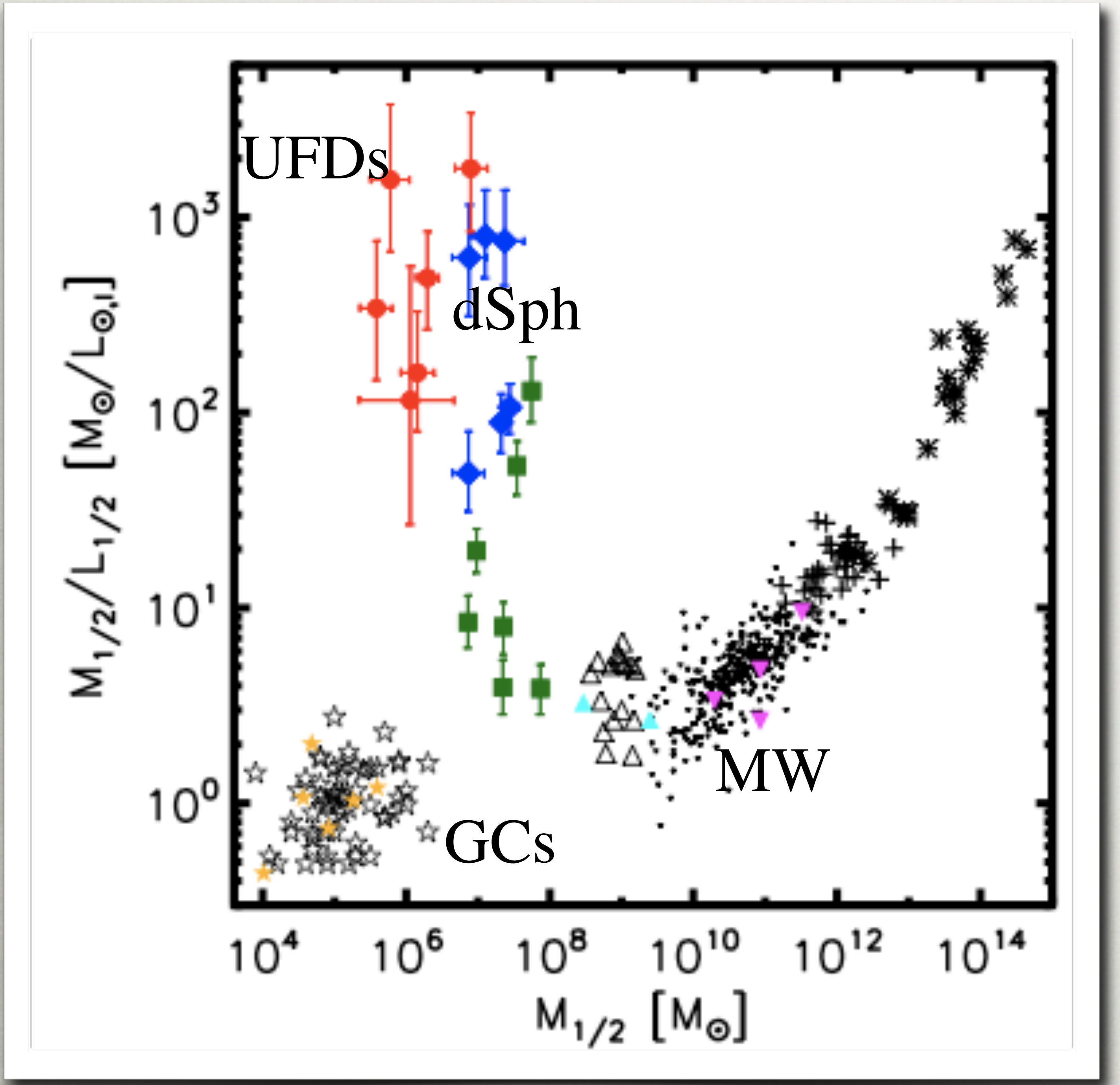


Martin et al. (2008)

Why do we call them galaxies?: kinematics

M/L

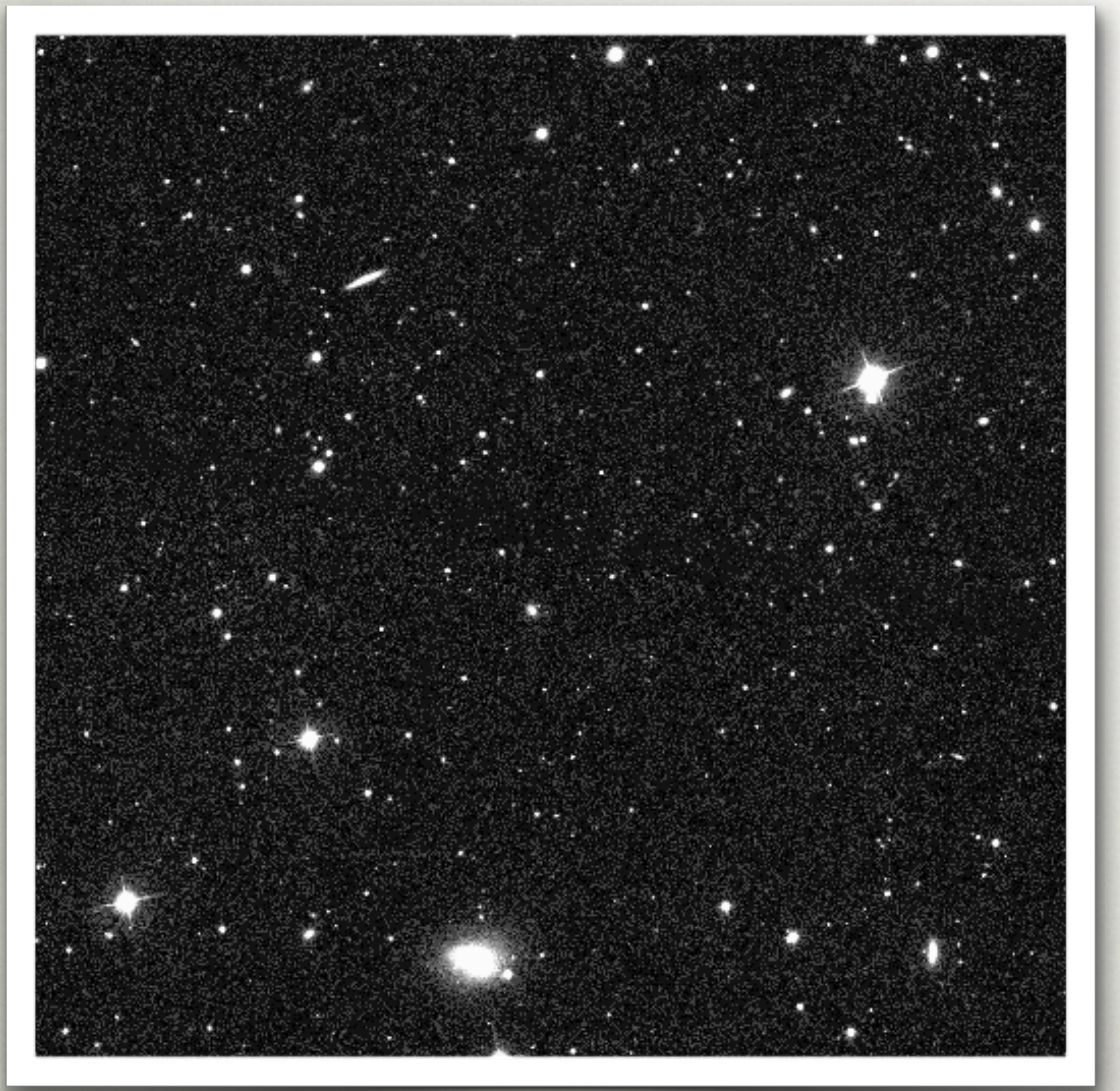


Mass

Wolf et al. (2010)

UFDs seem to be the most dark matter dominated systems in the Universe!

New luminosity regime poses a serious challenge to do a proper photometric characterization.



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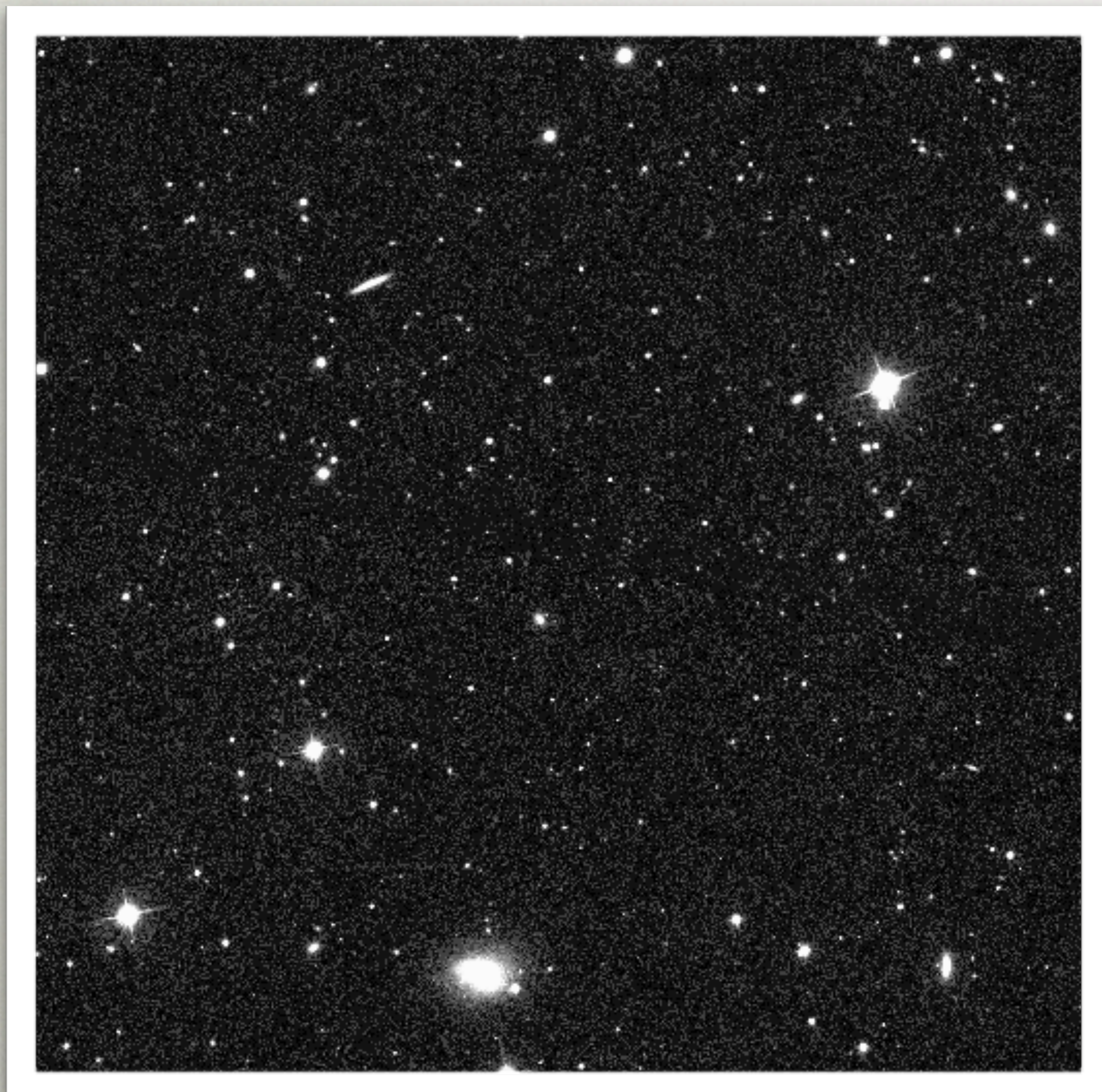
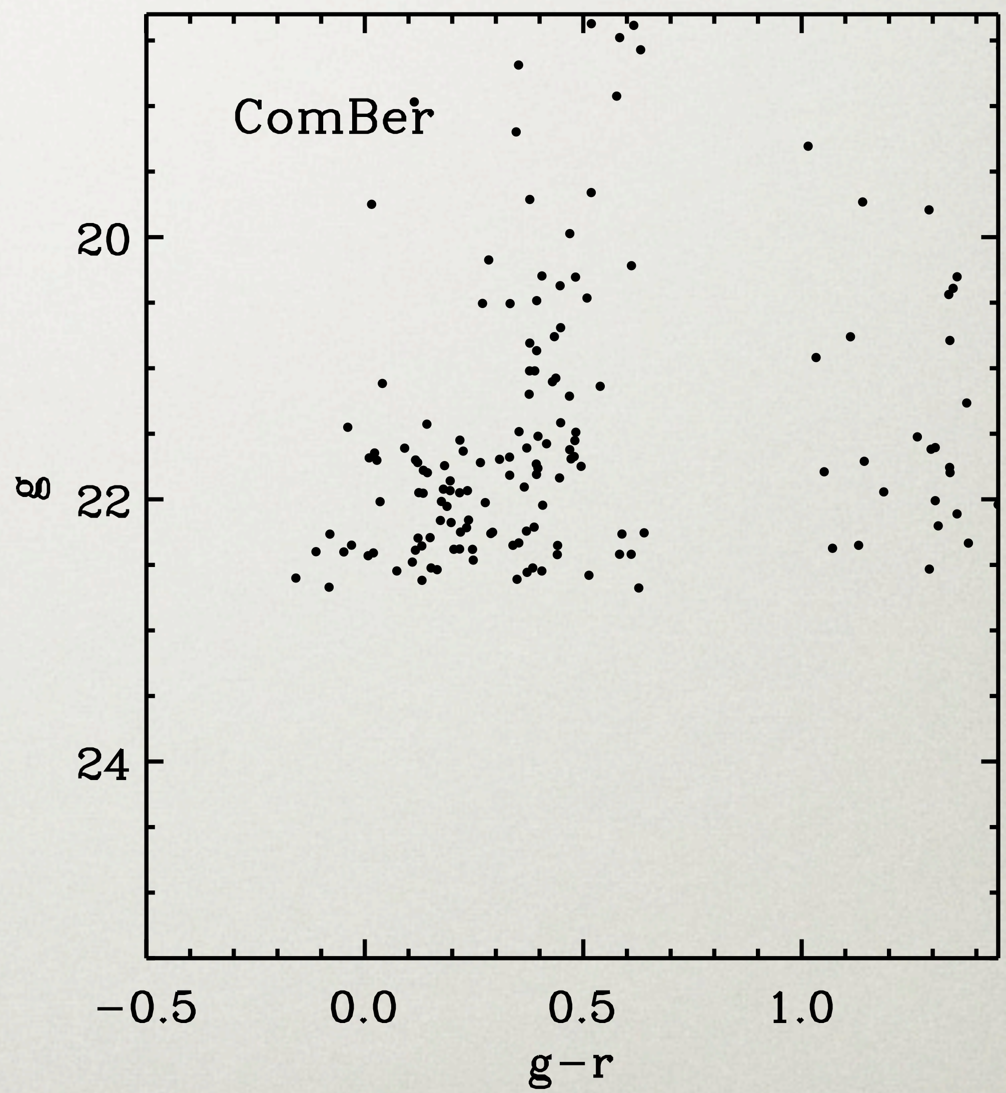
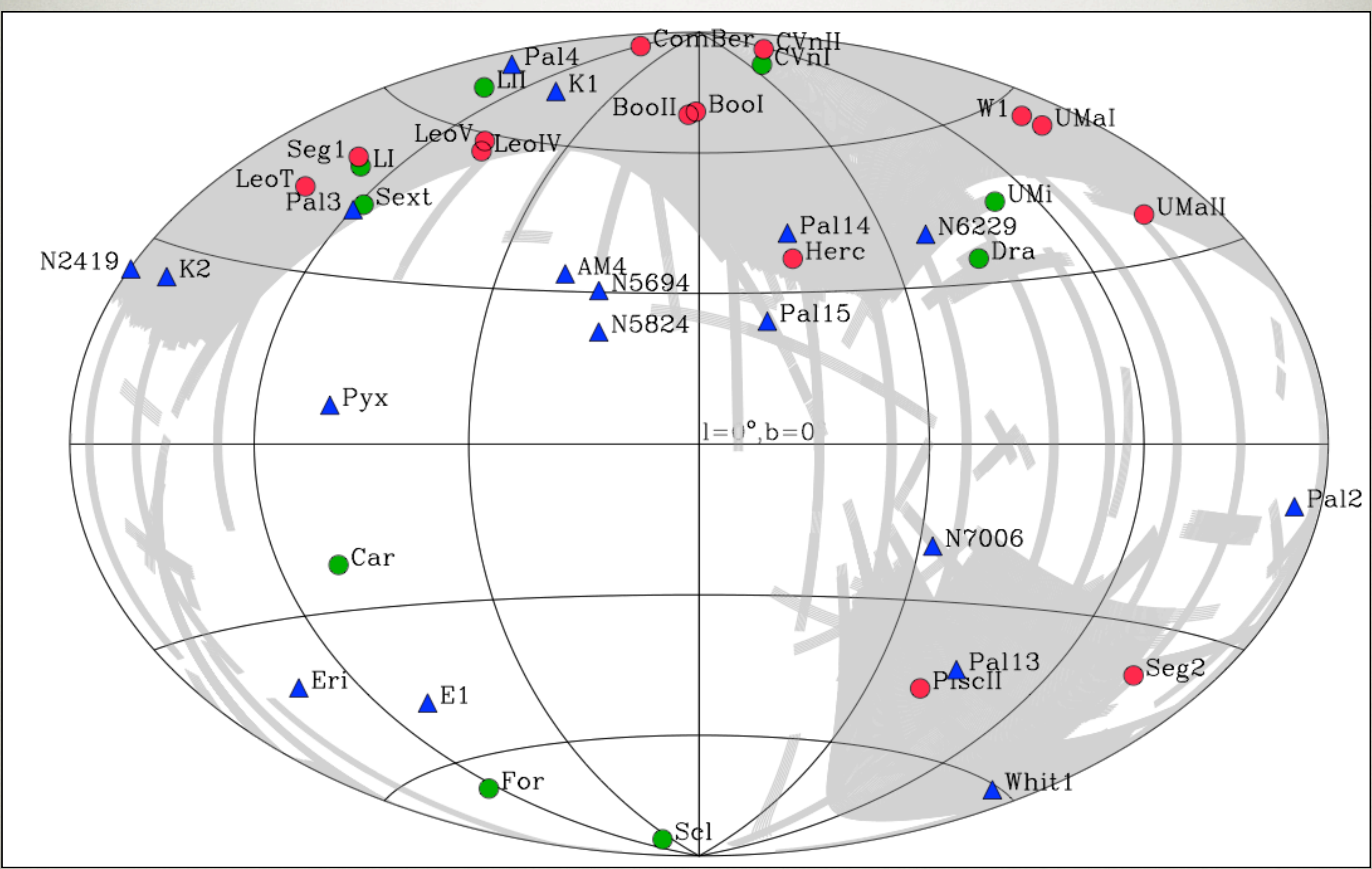


SDSS photometry



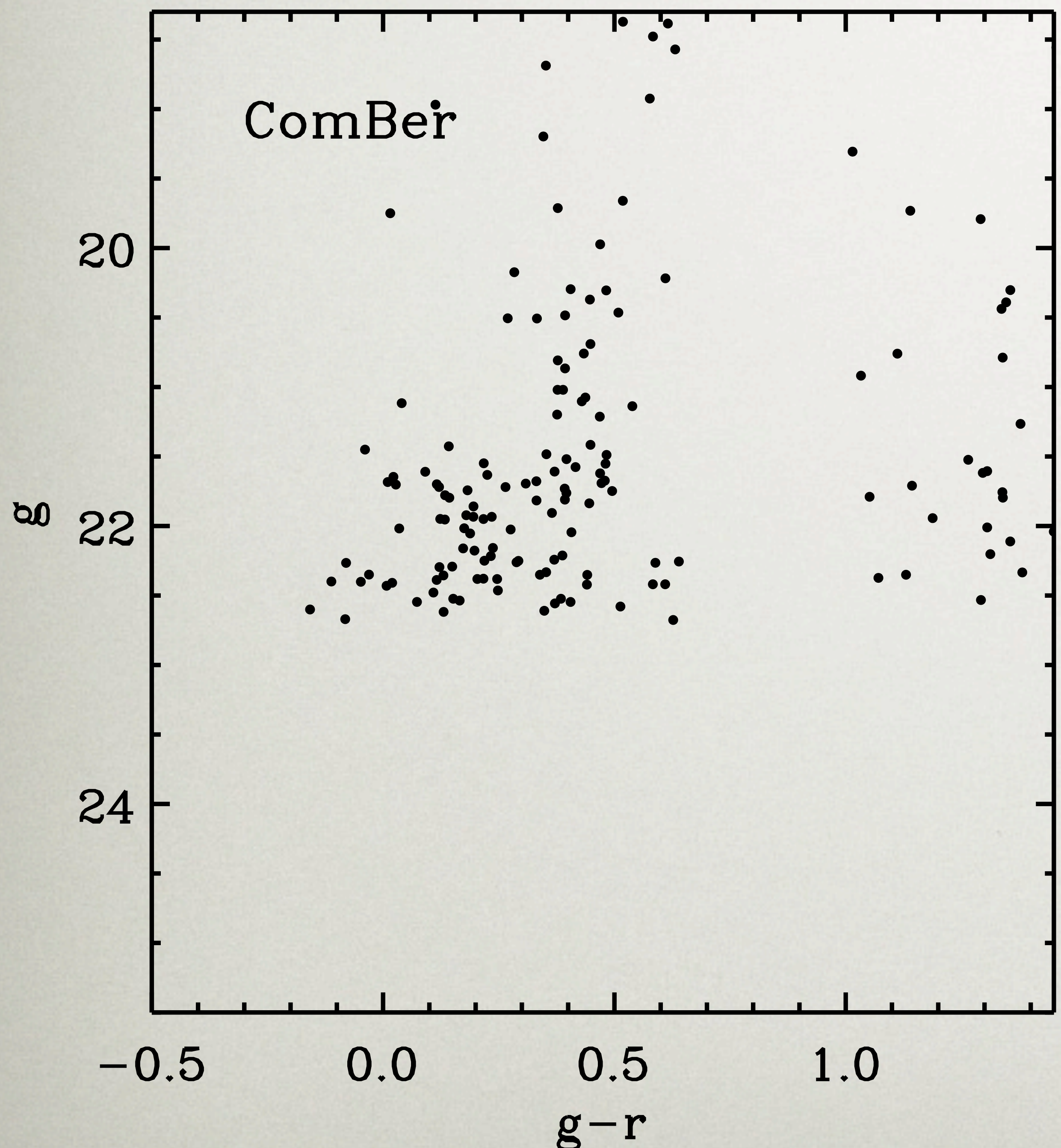
Belokurov et al. (2007)

A New Deep Survey (CFHT/Magellan)



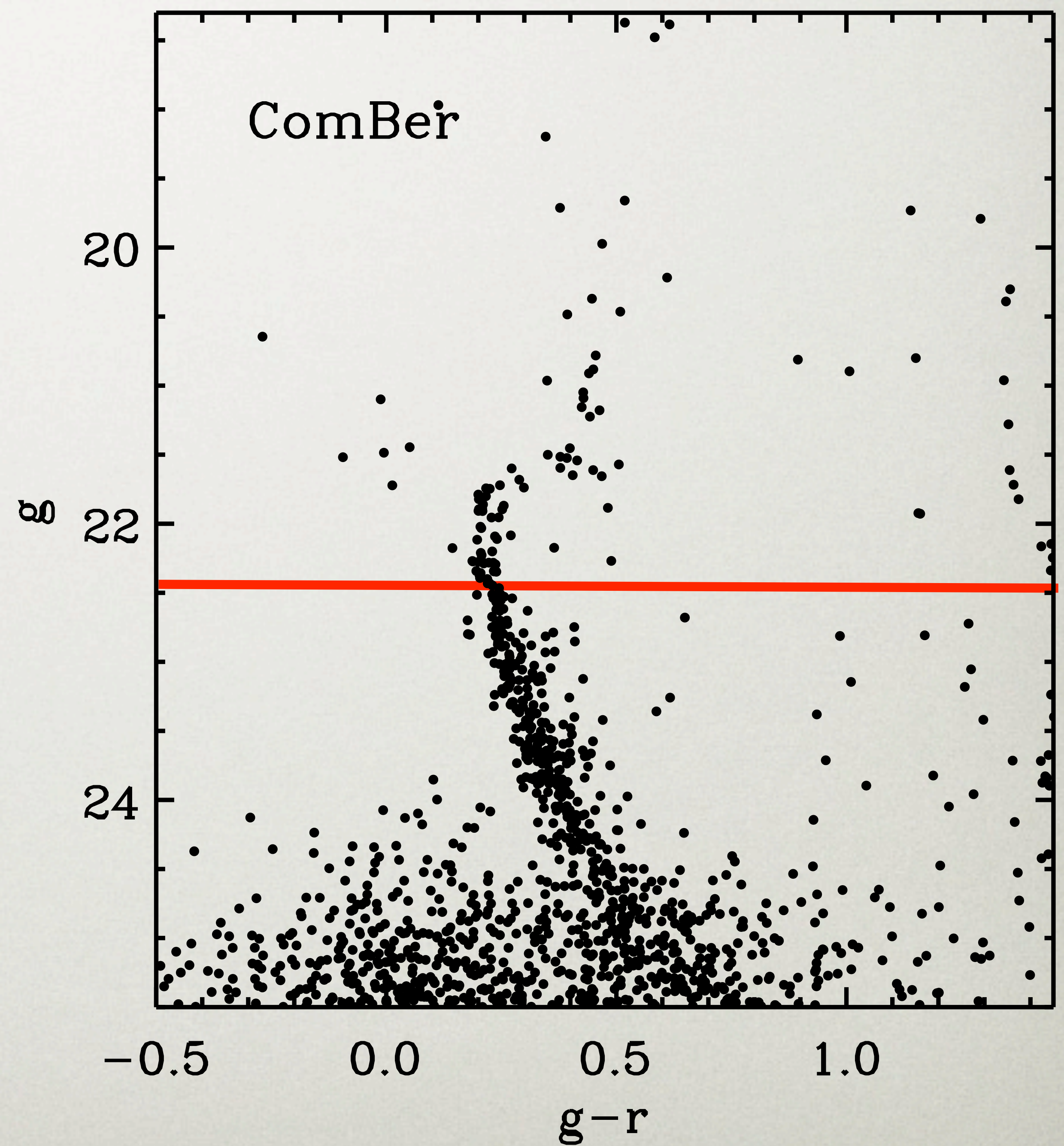
Comparison between SDSS y Megacam

Coma Berenices, *Belokurov et al. (2007)*



SDSS photometry

Muñoz, Geha & Willman (2010)



Megacam photometry

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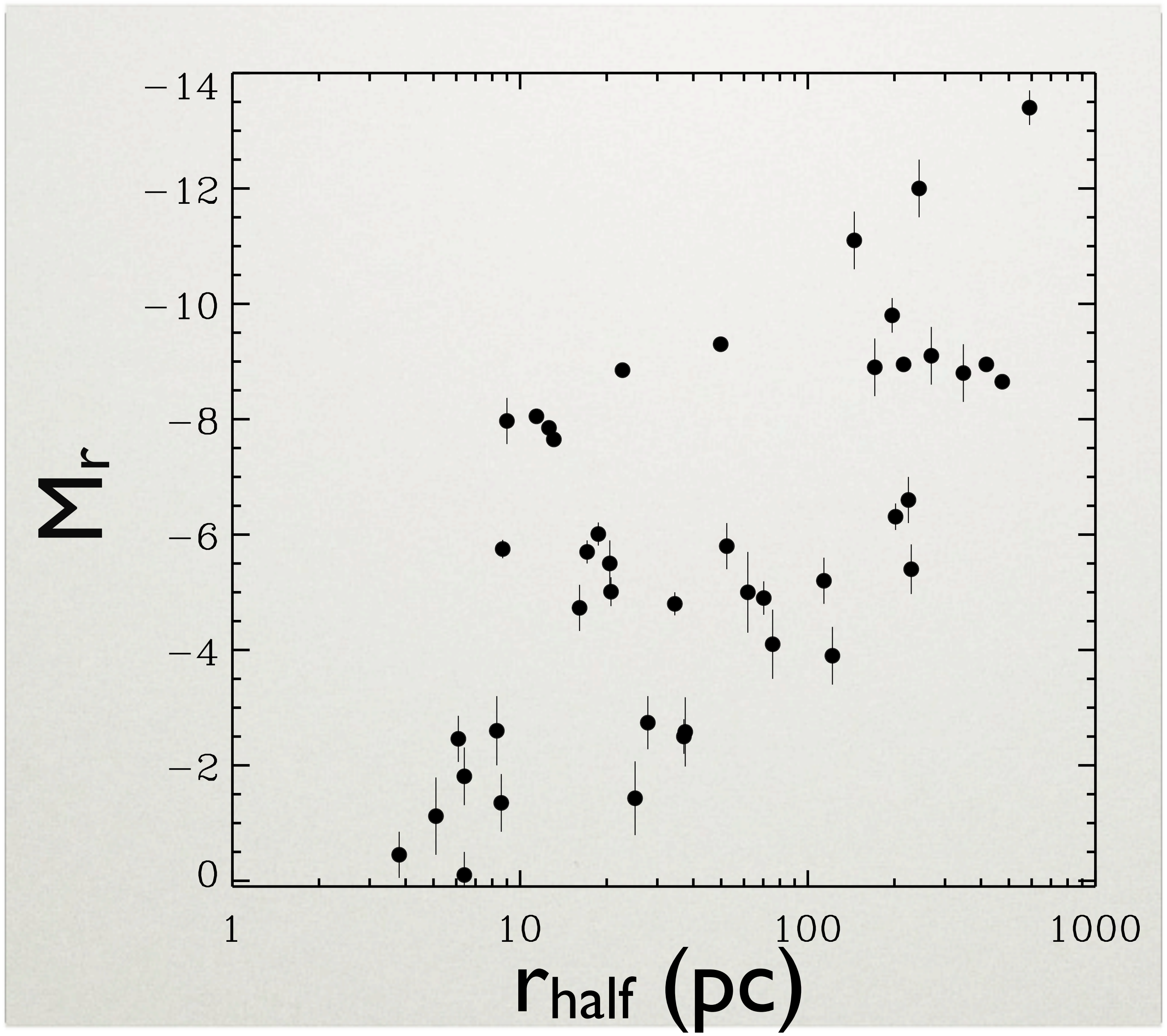
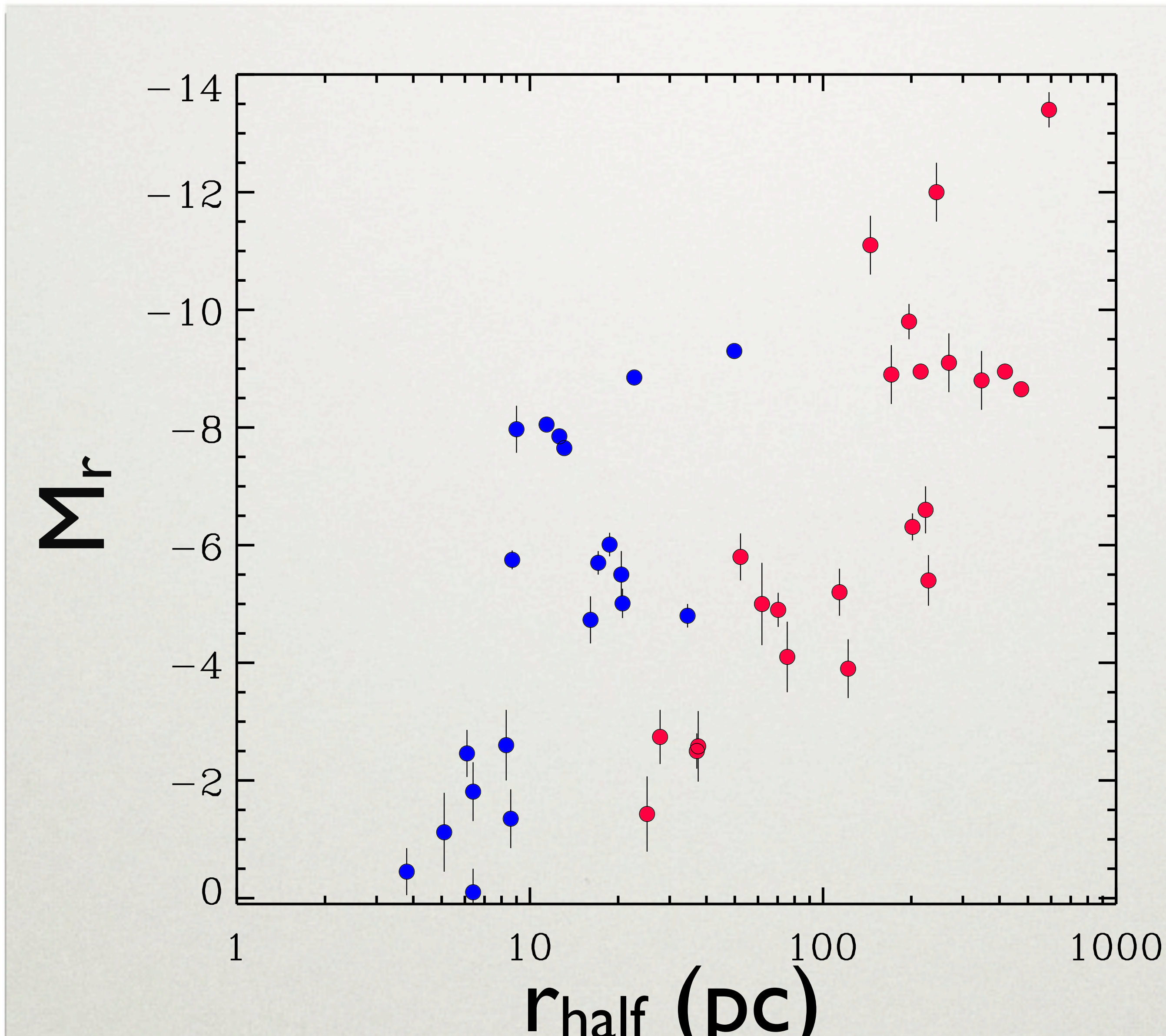


Muñoz et al. (2014)

Photometric Properties of Milky Way dwarf galaxies



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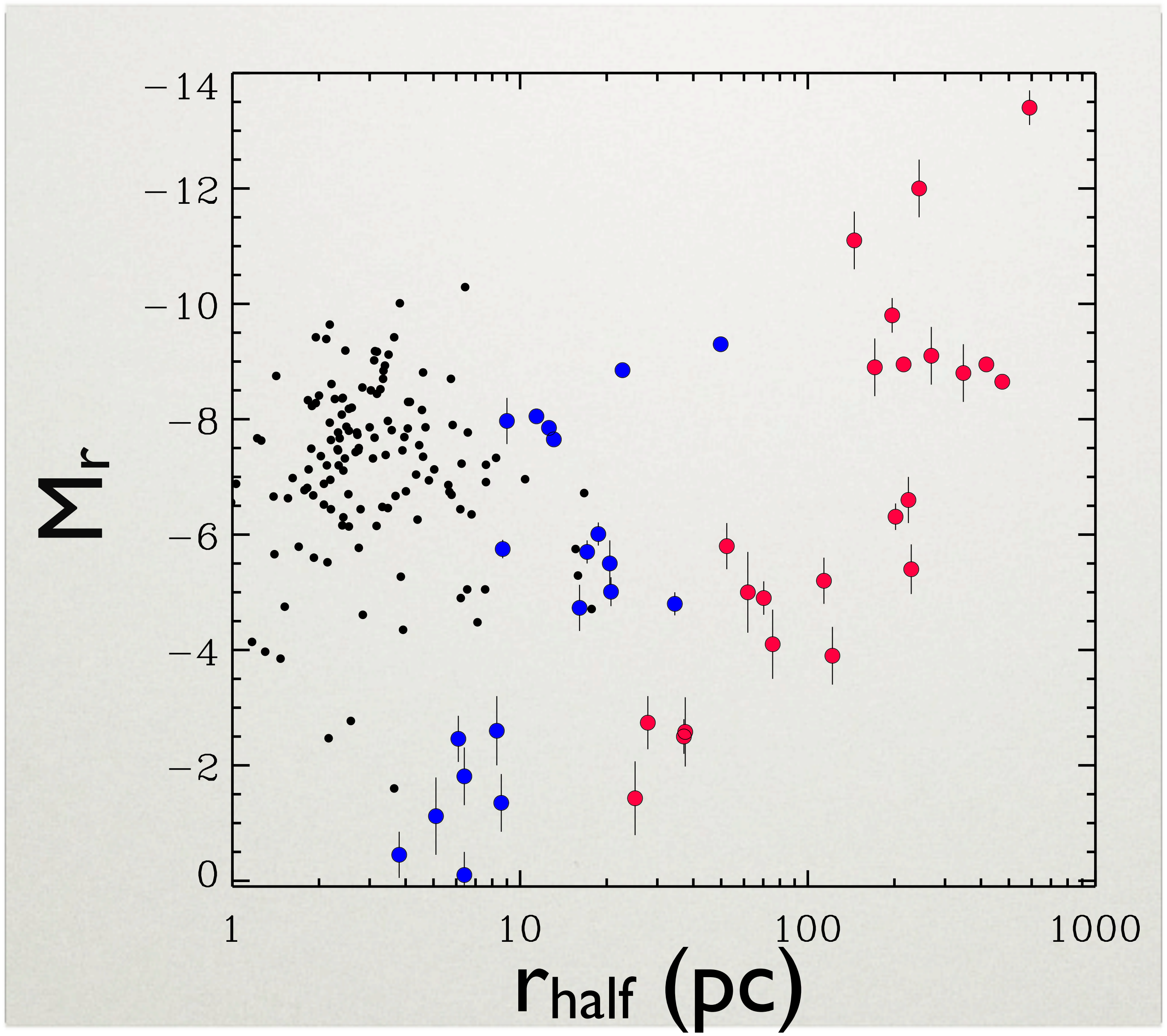

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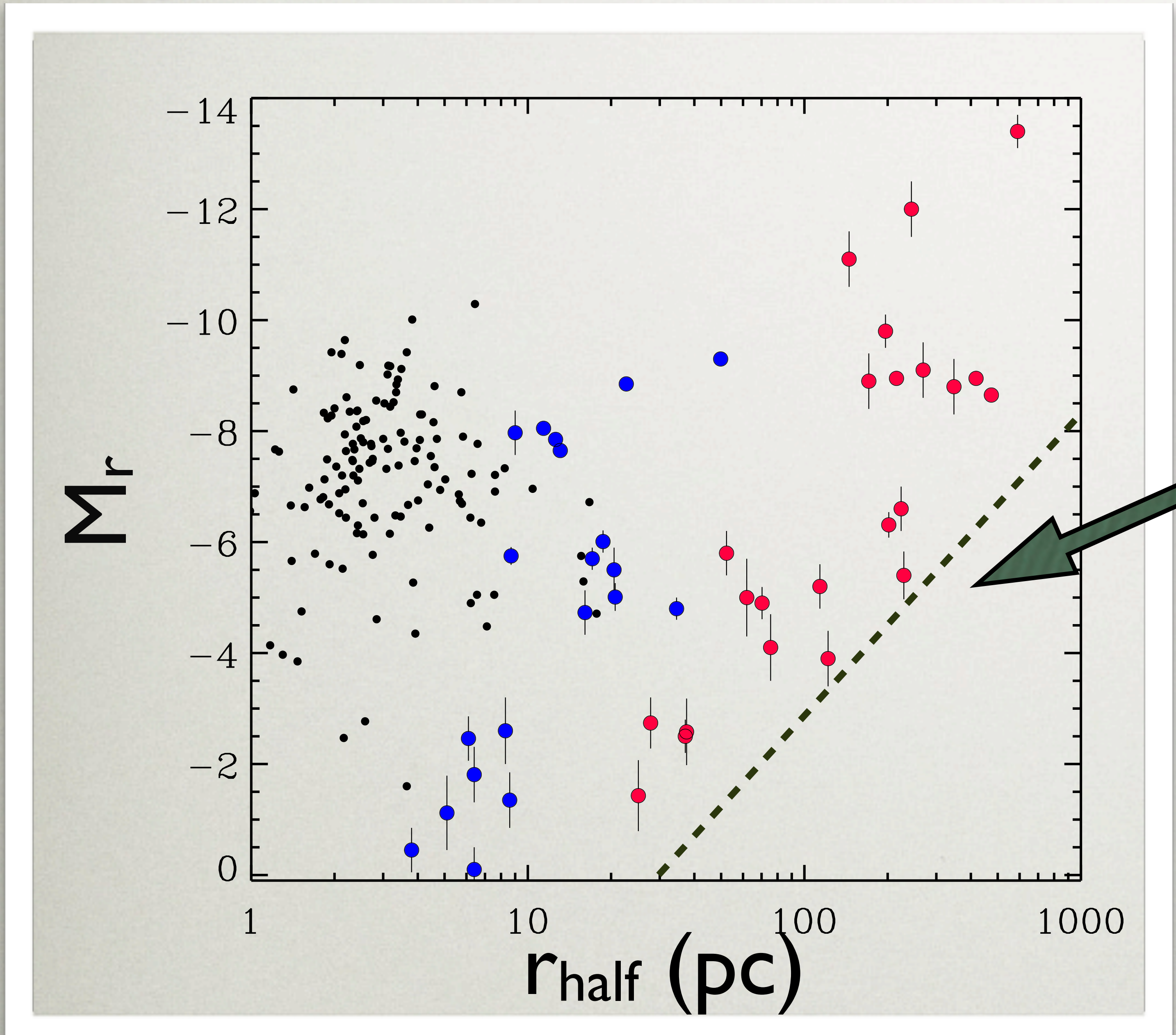
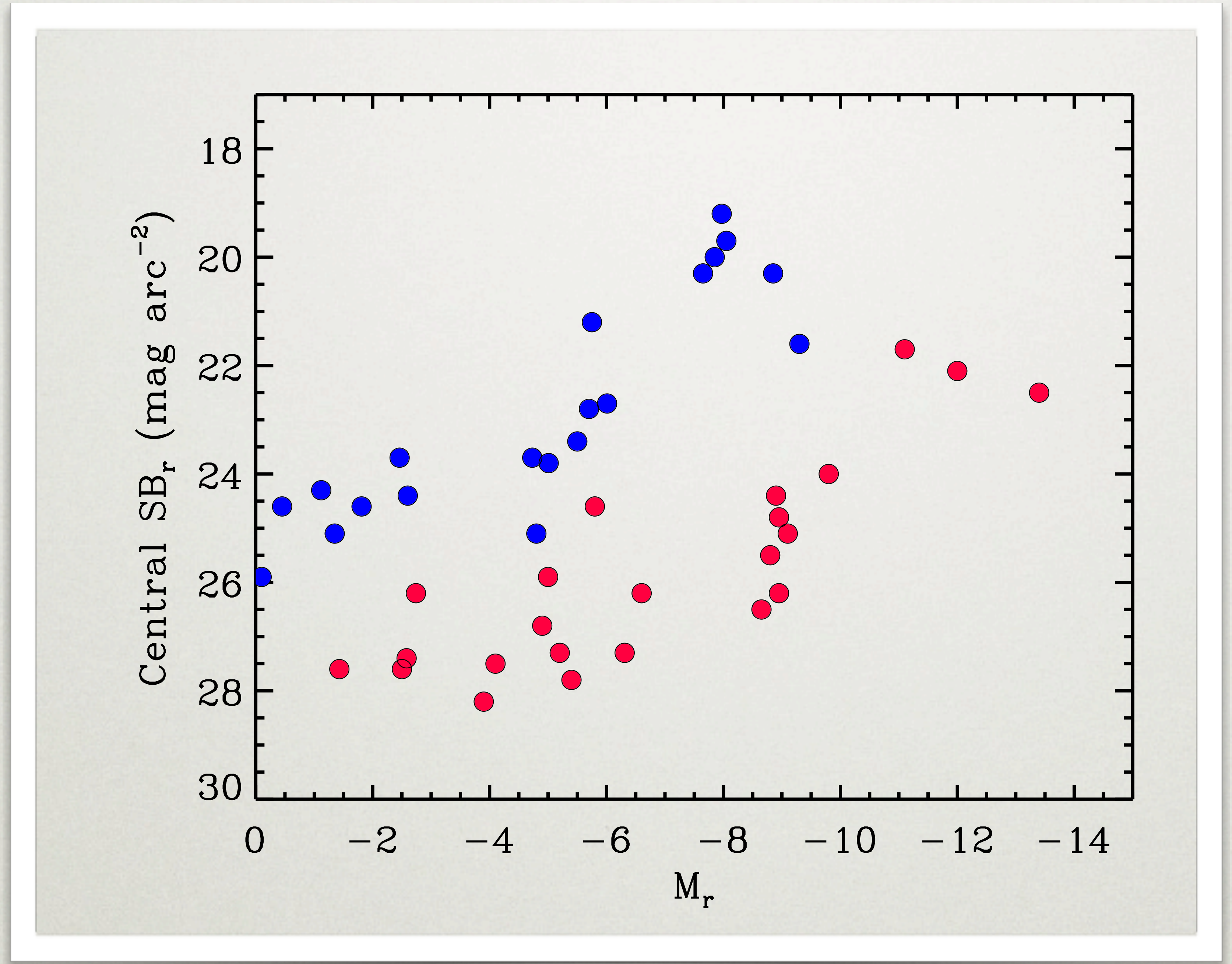


Line of constant surface brightness

Photometric Properties of Milky Way dwarf galaxies



Muñoz et al. (2014)

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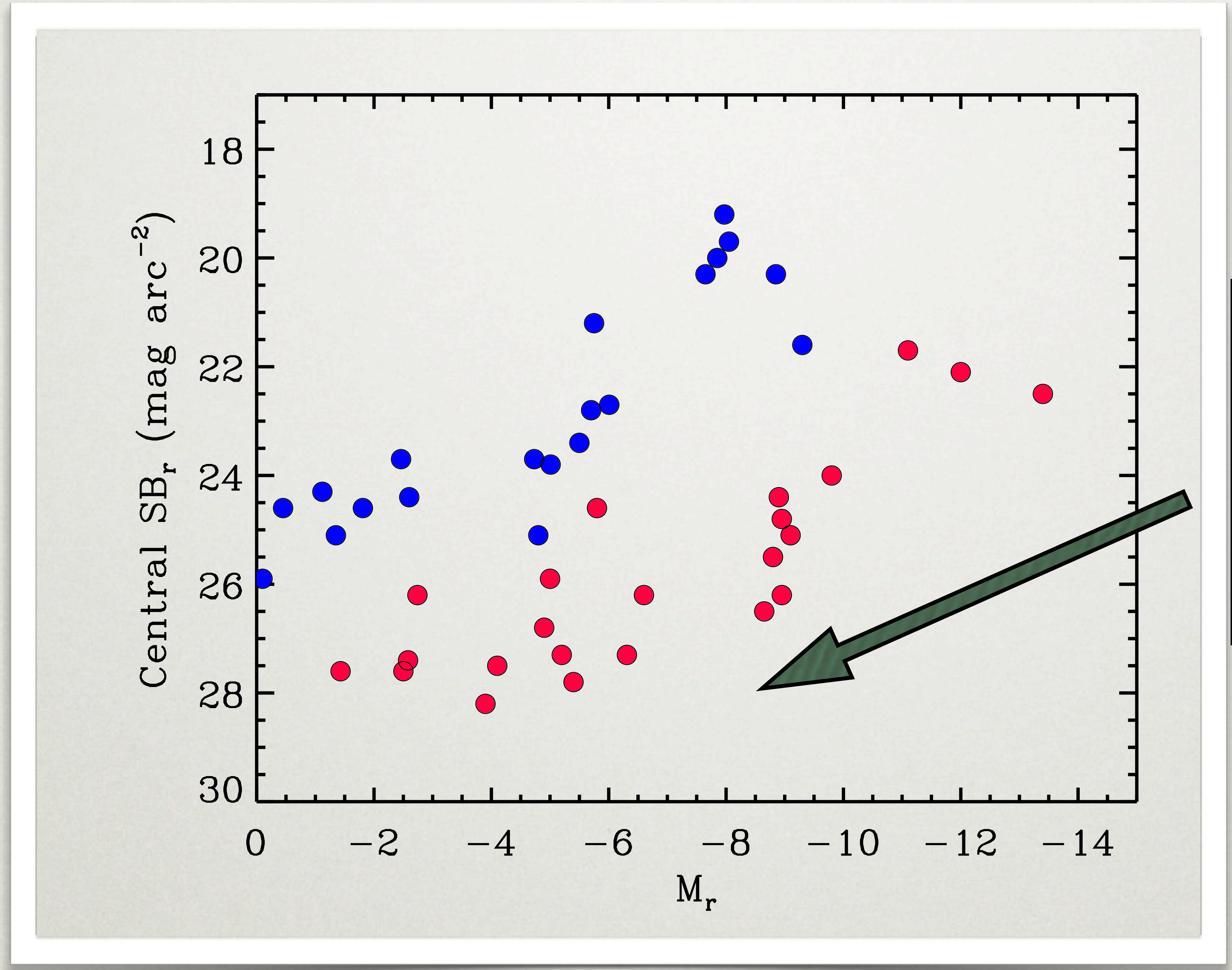
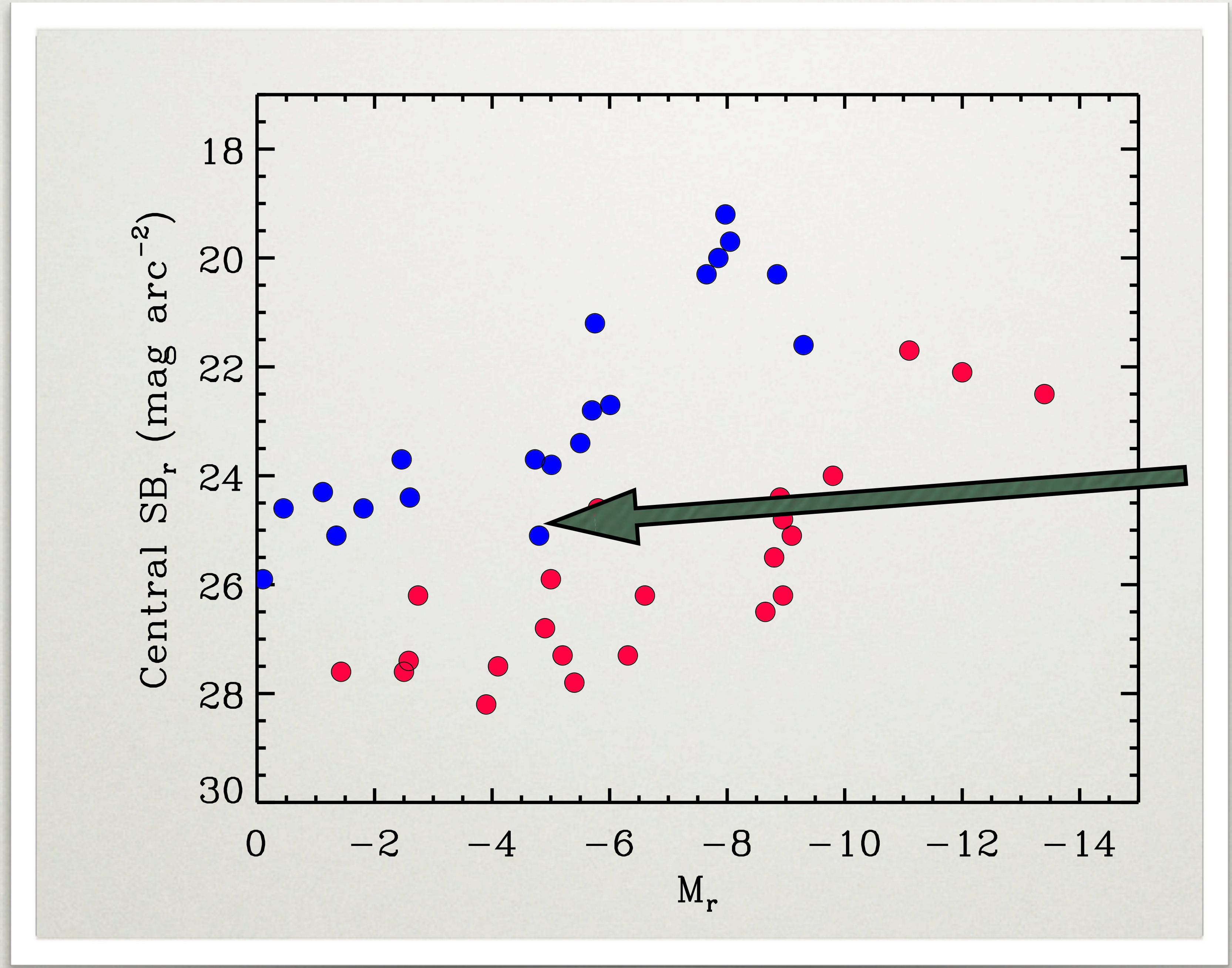


Surface brightness floor probably a selection bias

Muñoz et al. (2014)

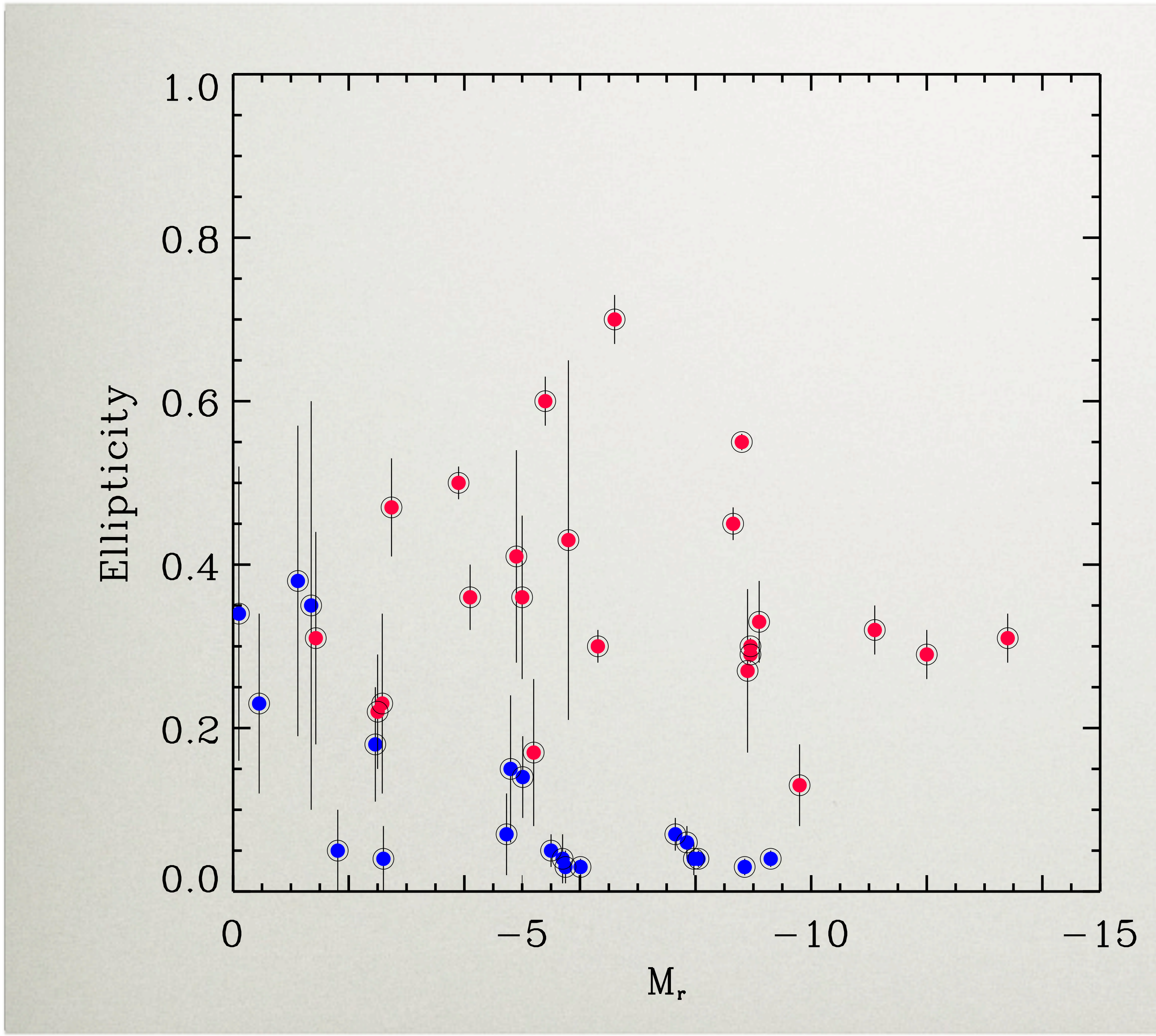
Photometric Properties of Milky Way dwarf galaxies



Surface brightness floor probably real.

Muñoz et al. (2014)

Photometric Properties of Milky Way dwarf galaxies



Muñoz et al. (2014)

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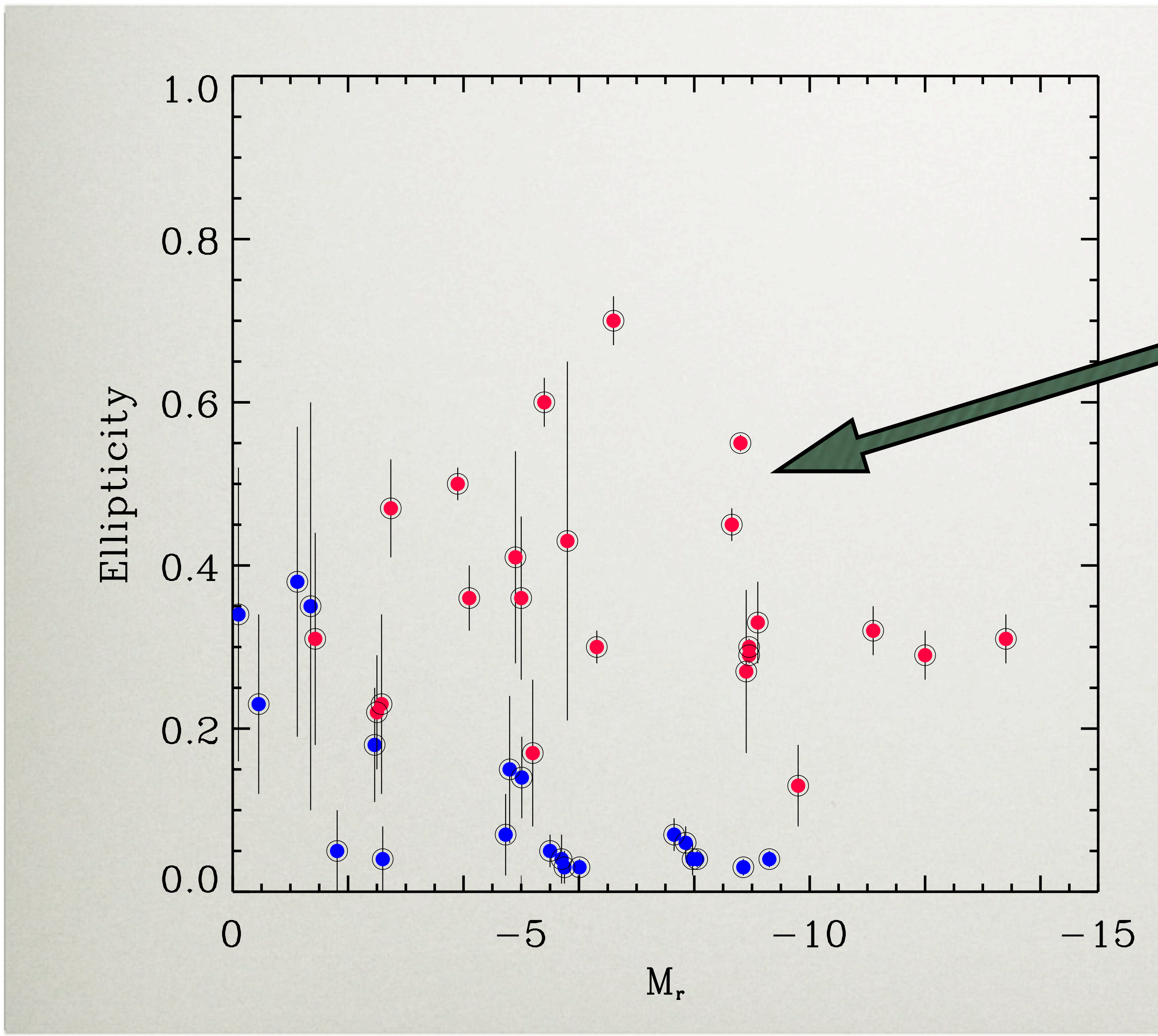
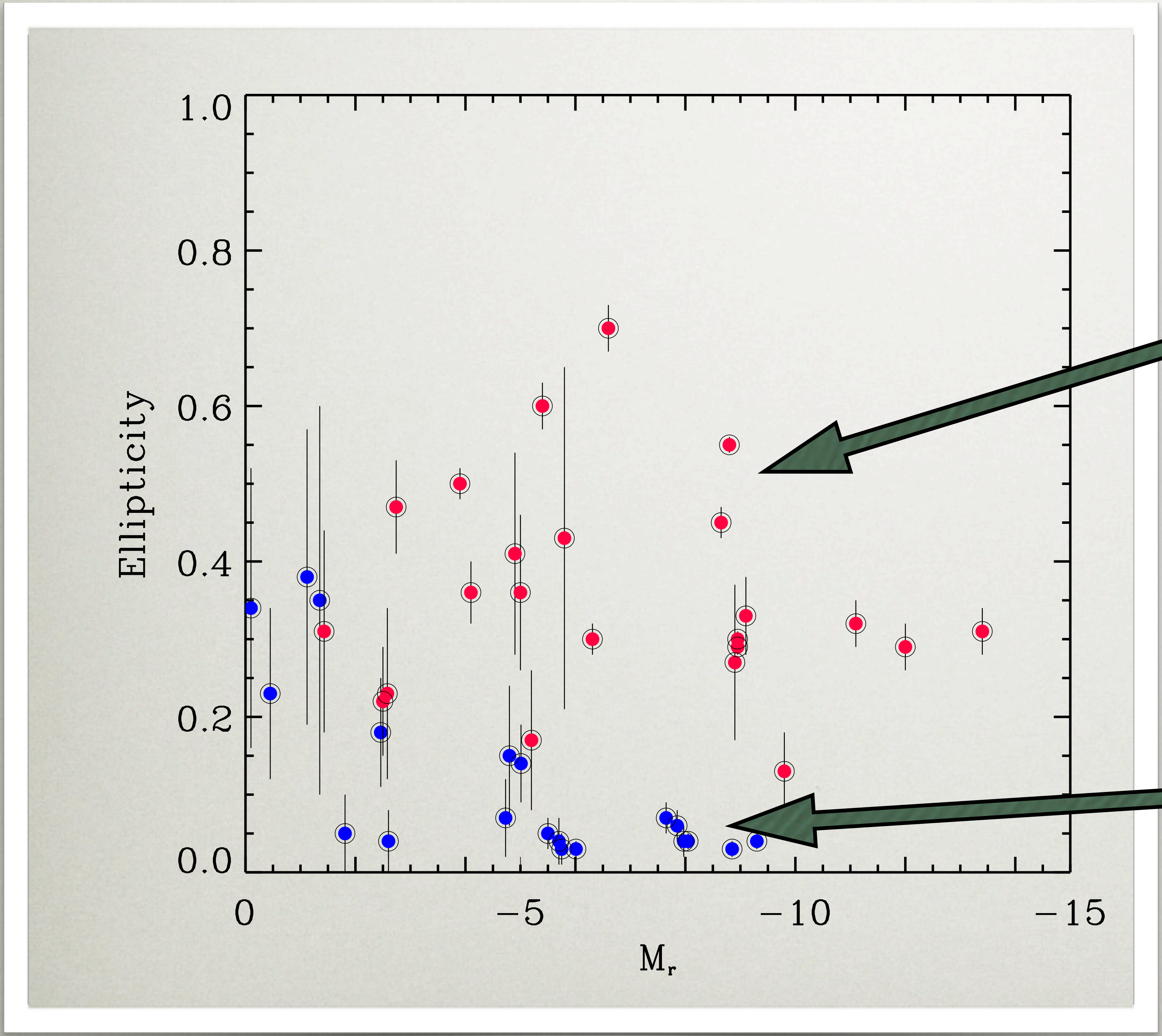


Galaxies are intrinsically elongated

Muñoz et al. (2014)

Photometric Properties of Milky Way dwarf galaxies

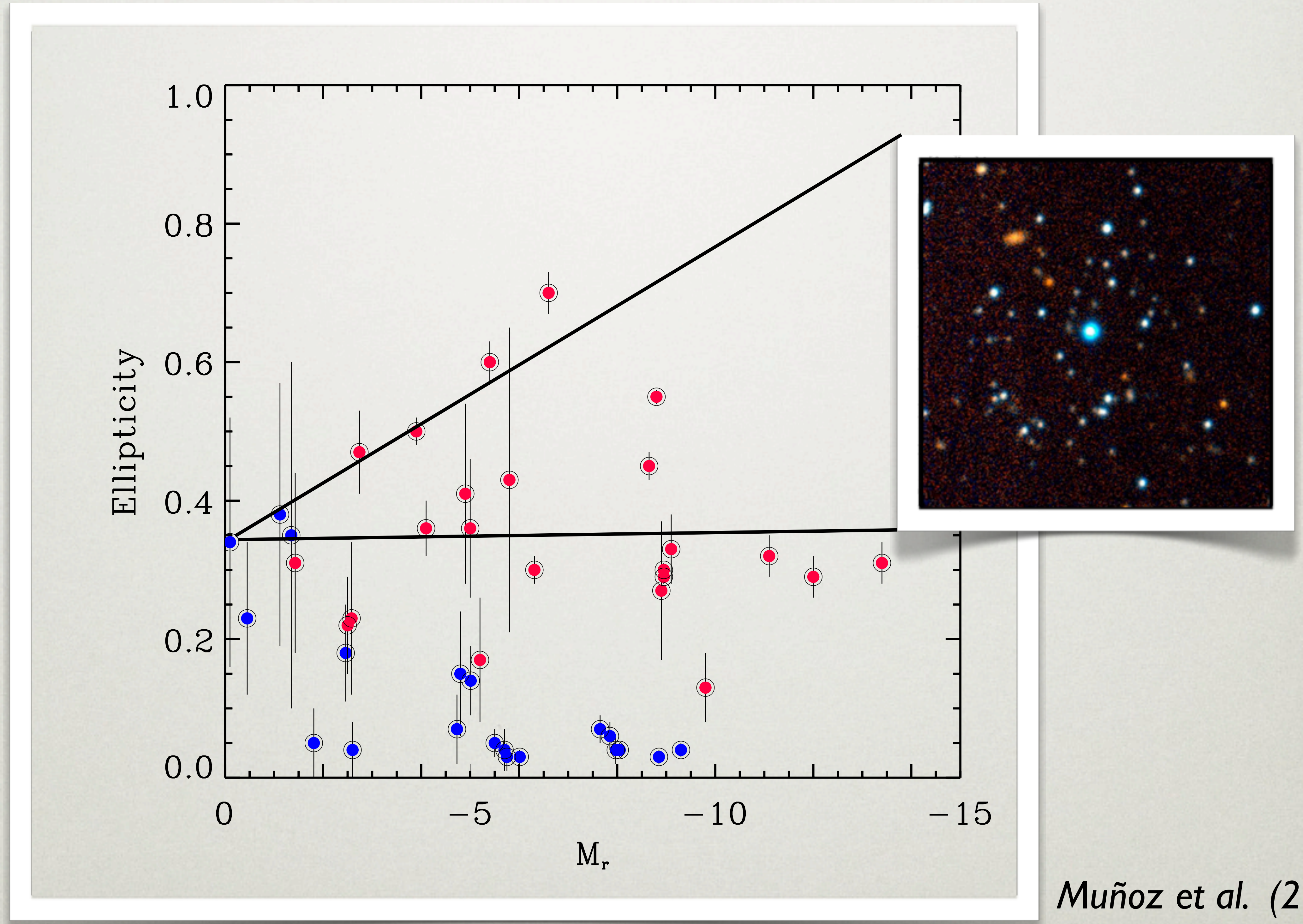


Galaxies are intrinsically elongated

Globular Clusters seem intrinsically round

Muñoz et al. (2014)

Photometric Properties of Milky Way dwarf galaxies



Muñoz et al. (2014)

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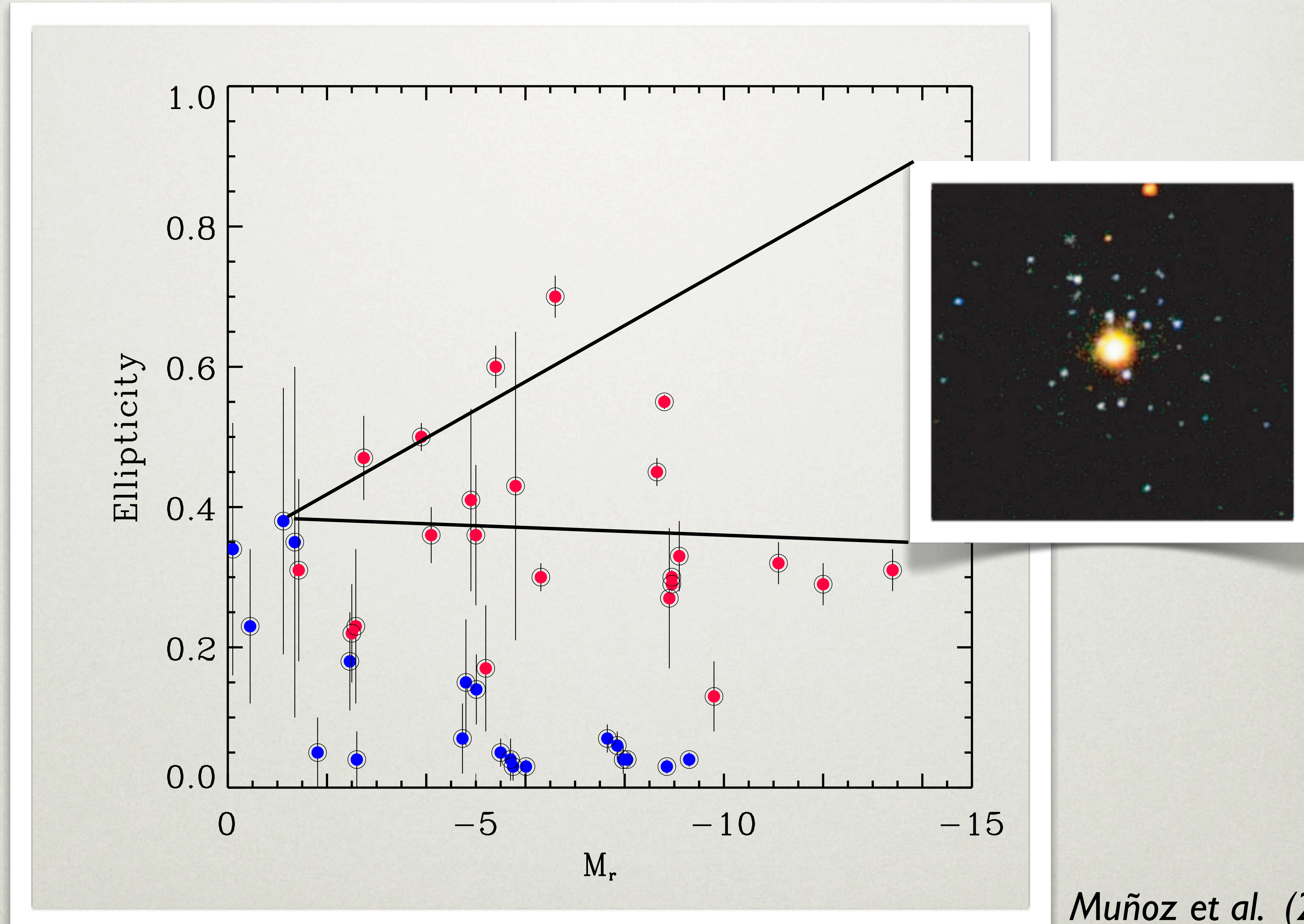

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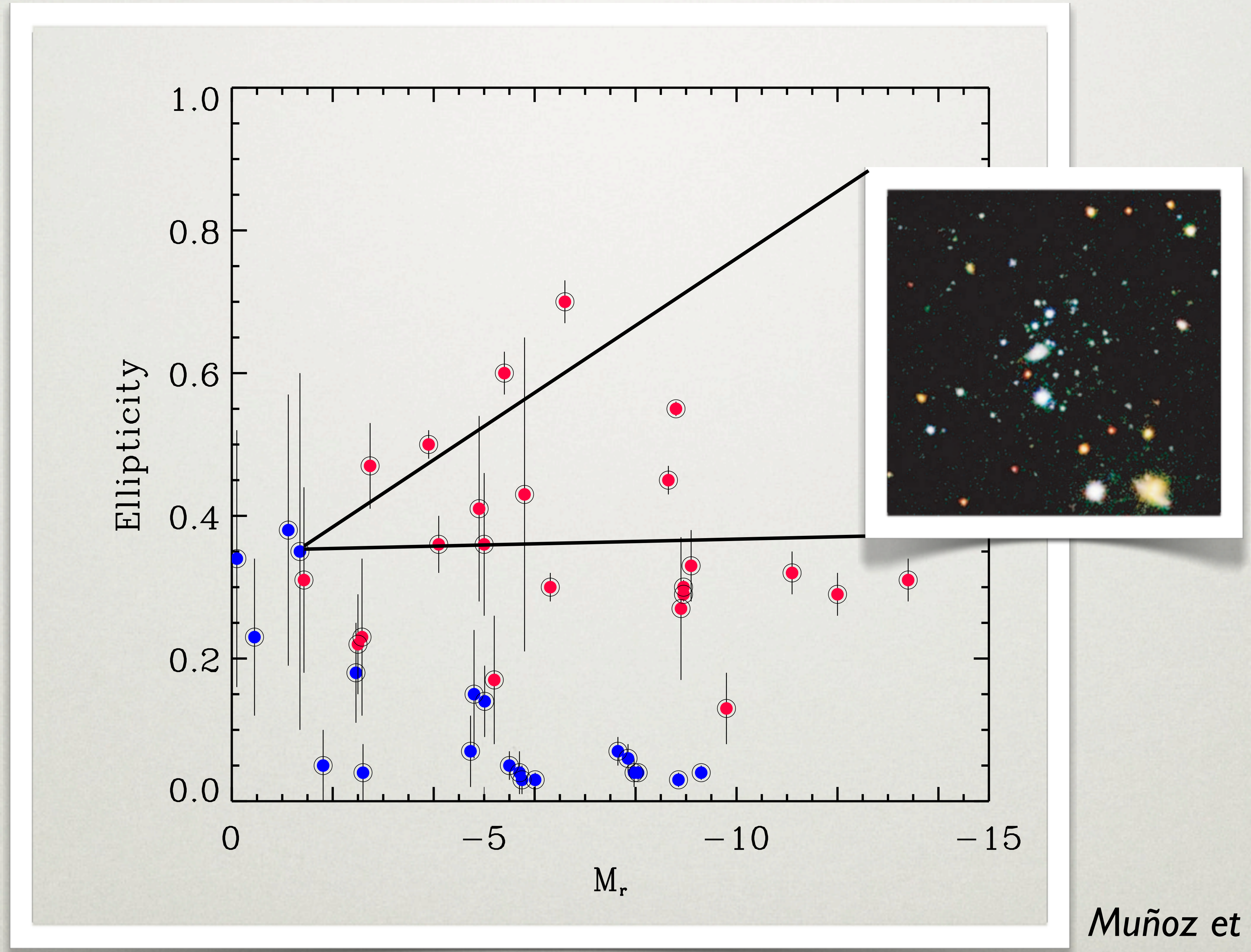
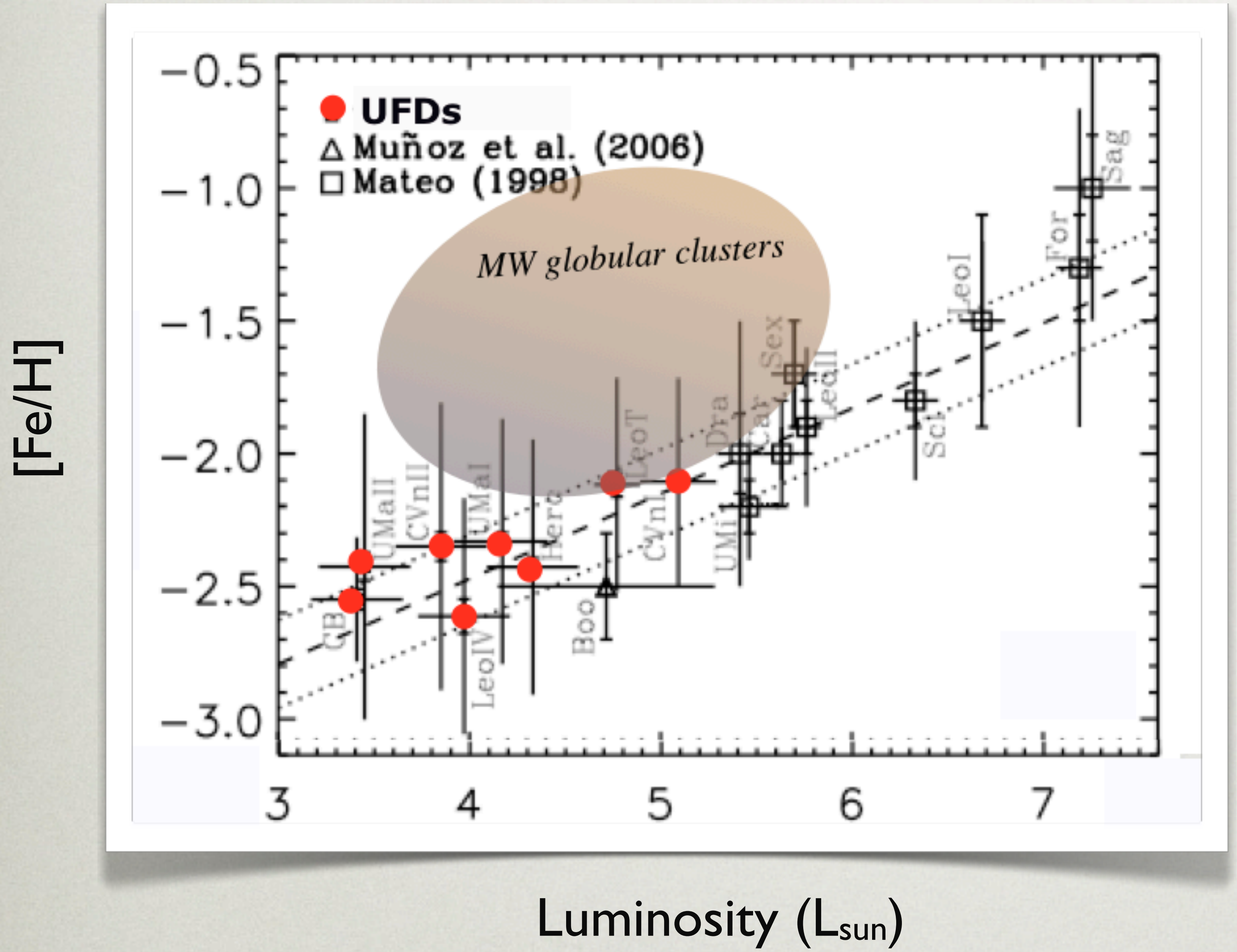


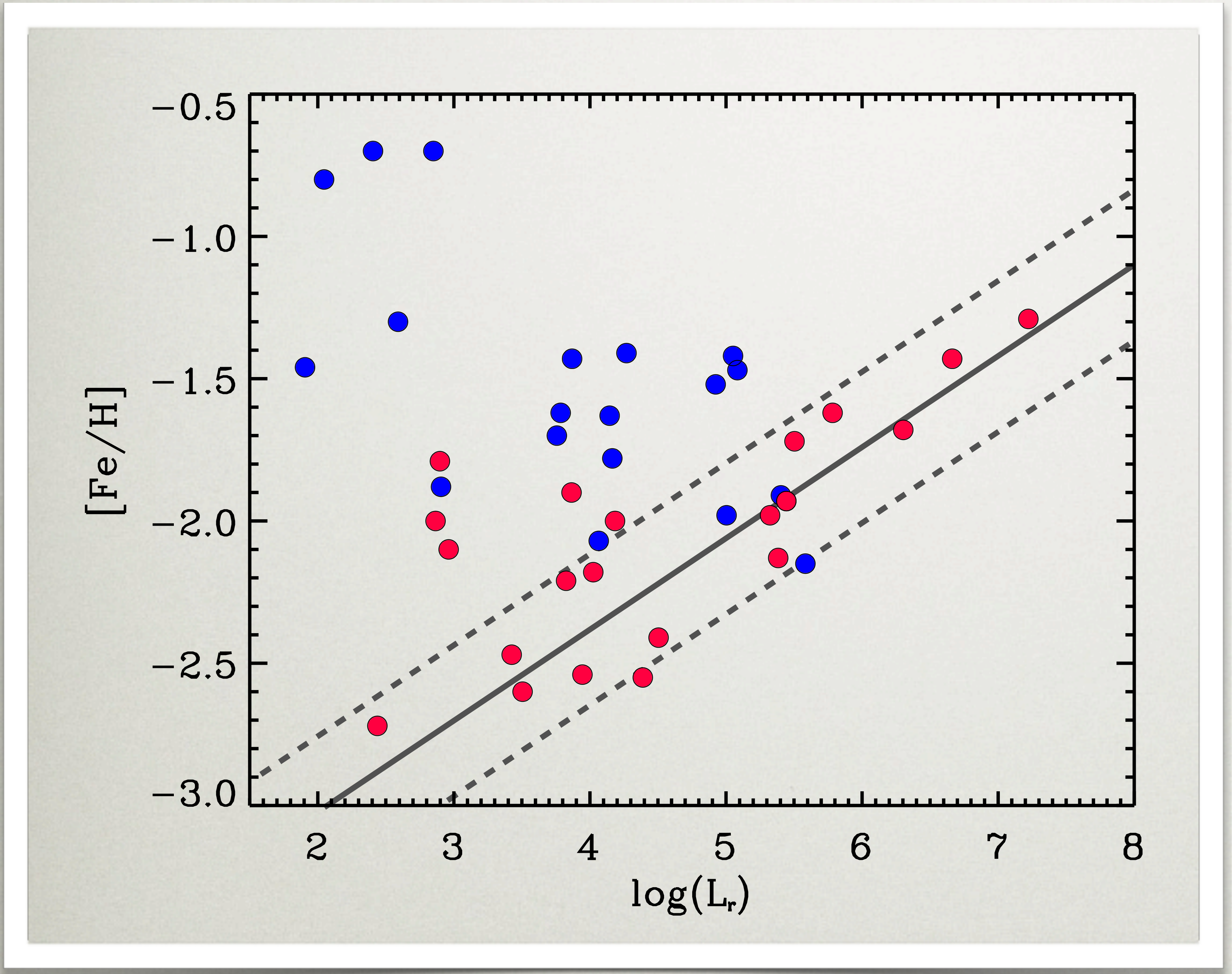
Muñoz et al. (2014)

Metallicity-Luminosity Relationship



Metallicity-Luminosity relationship also suggests that UFDs are indeed galaxies.

Metallicity-Luminosity Relationship



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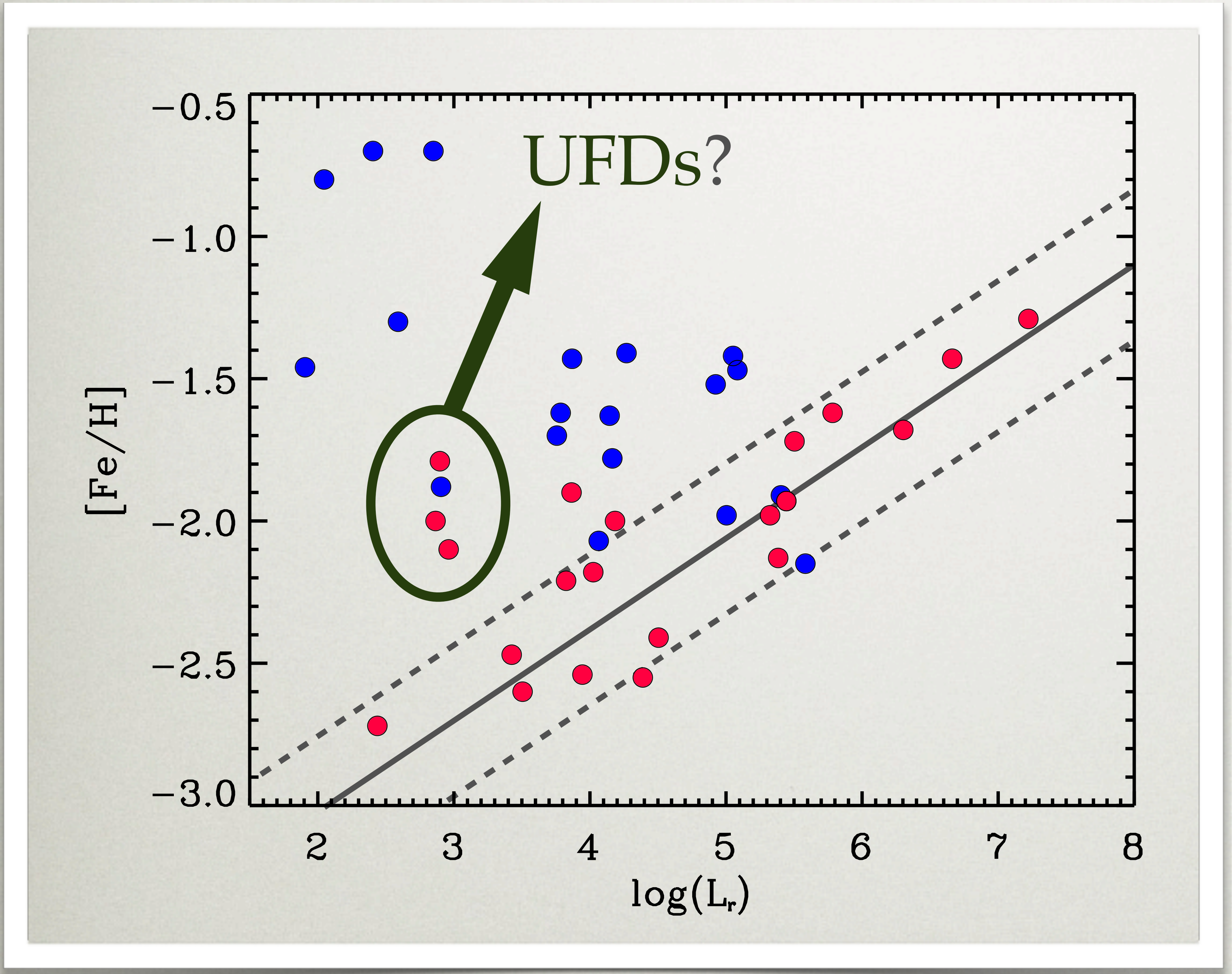

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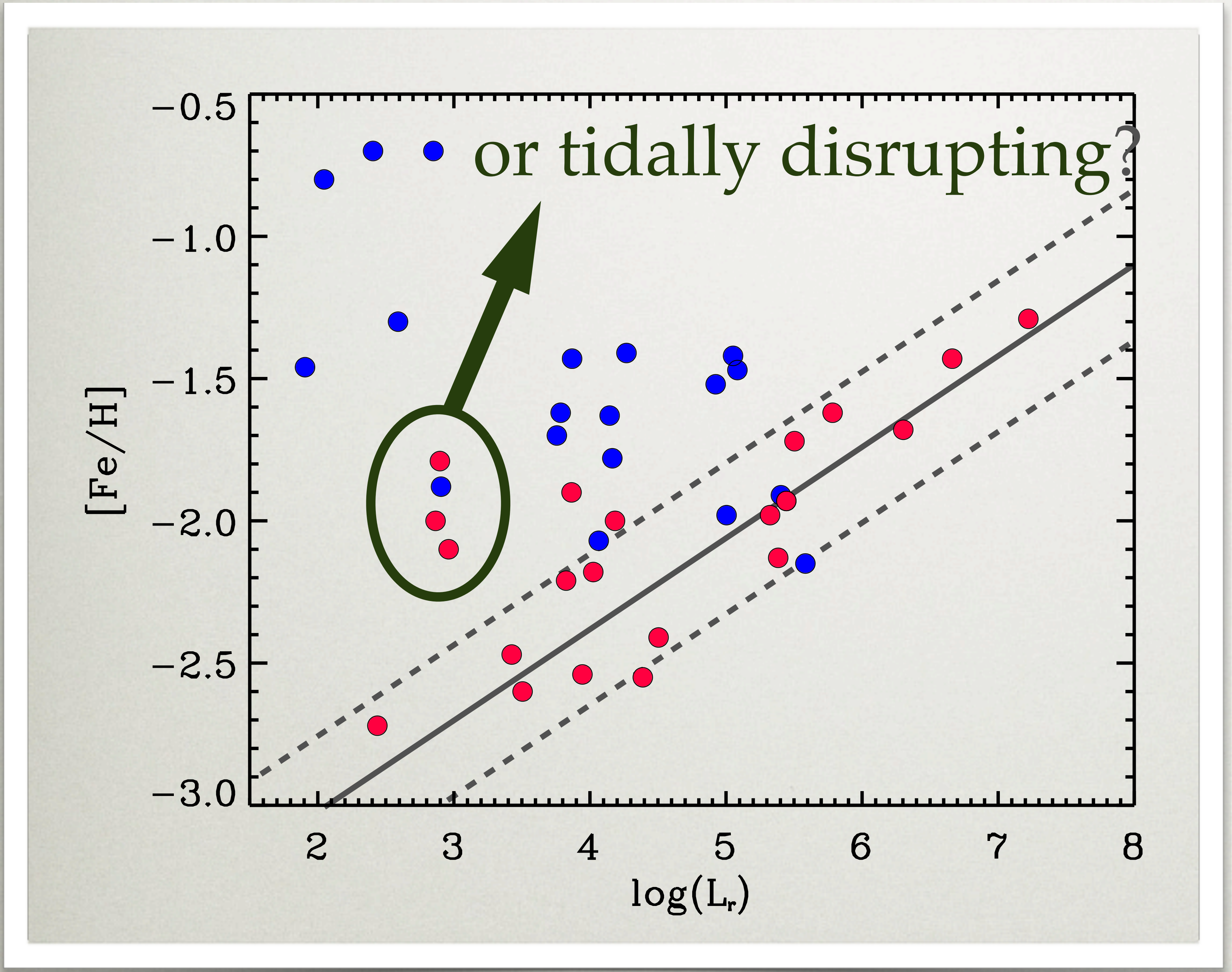

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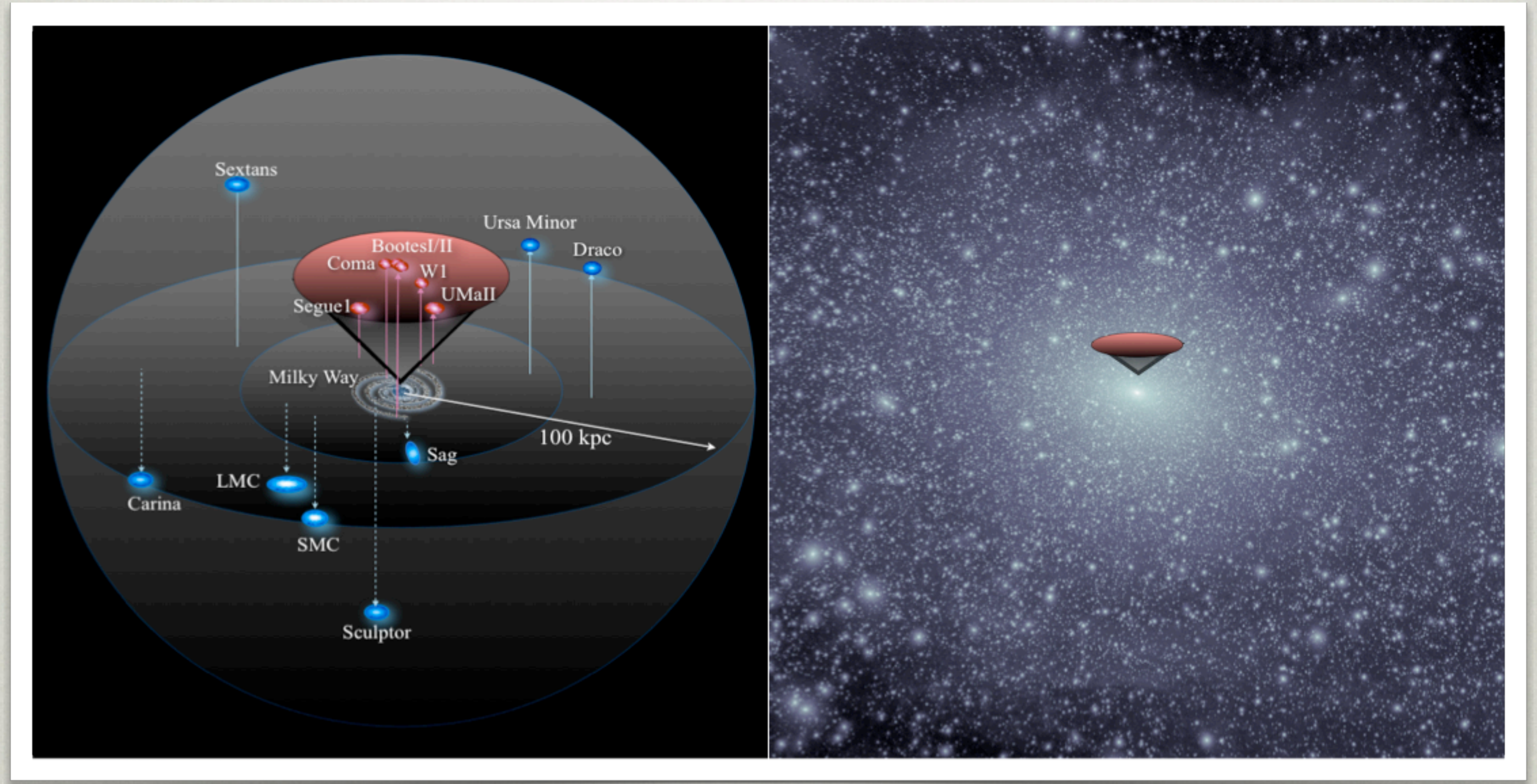
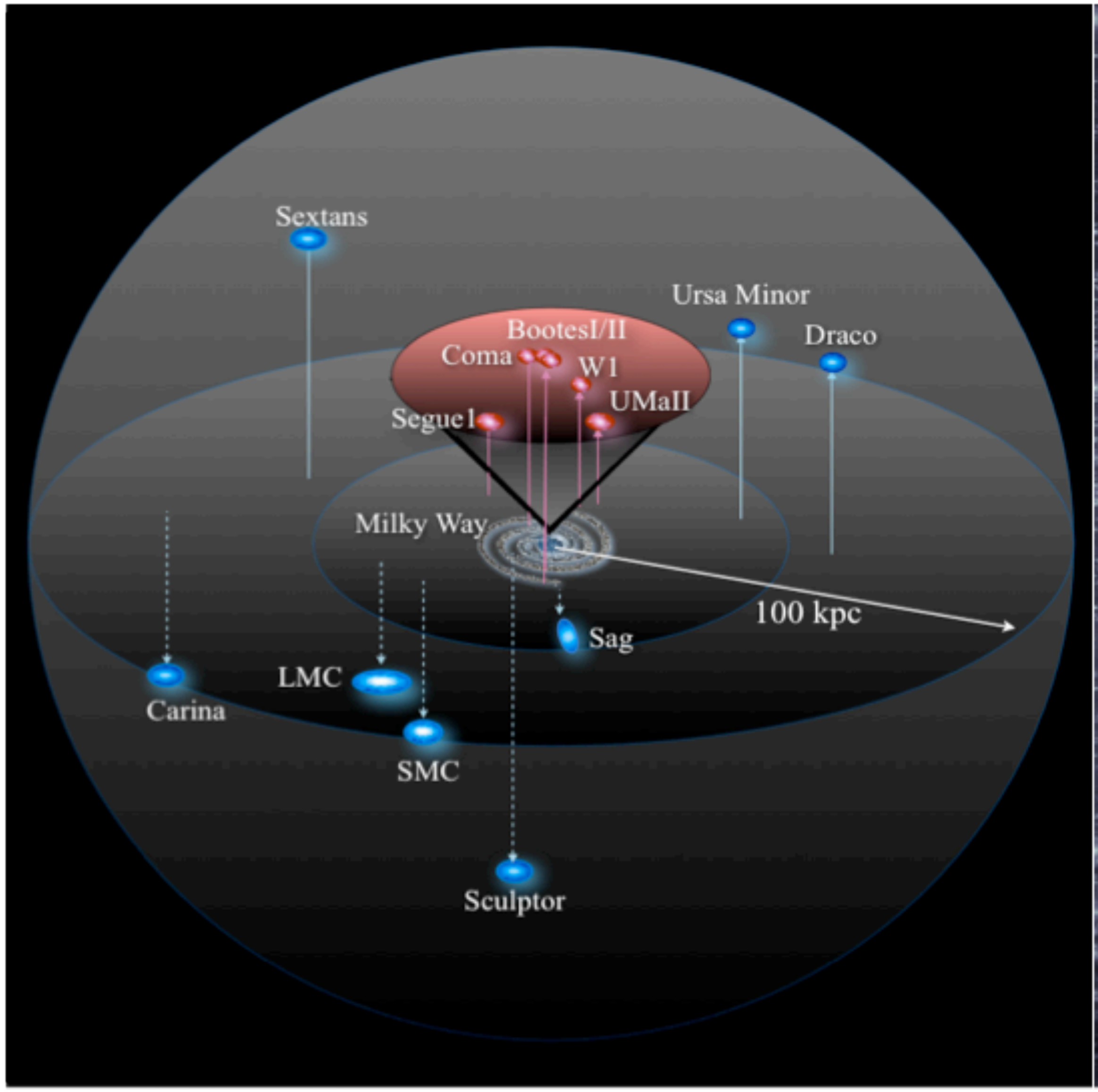
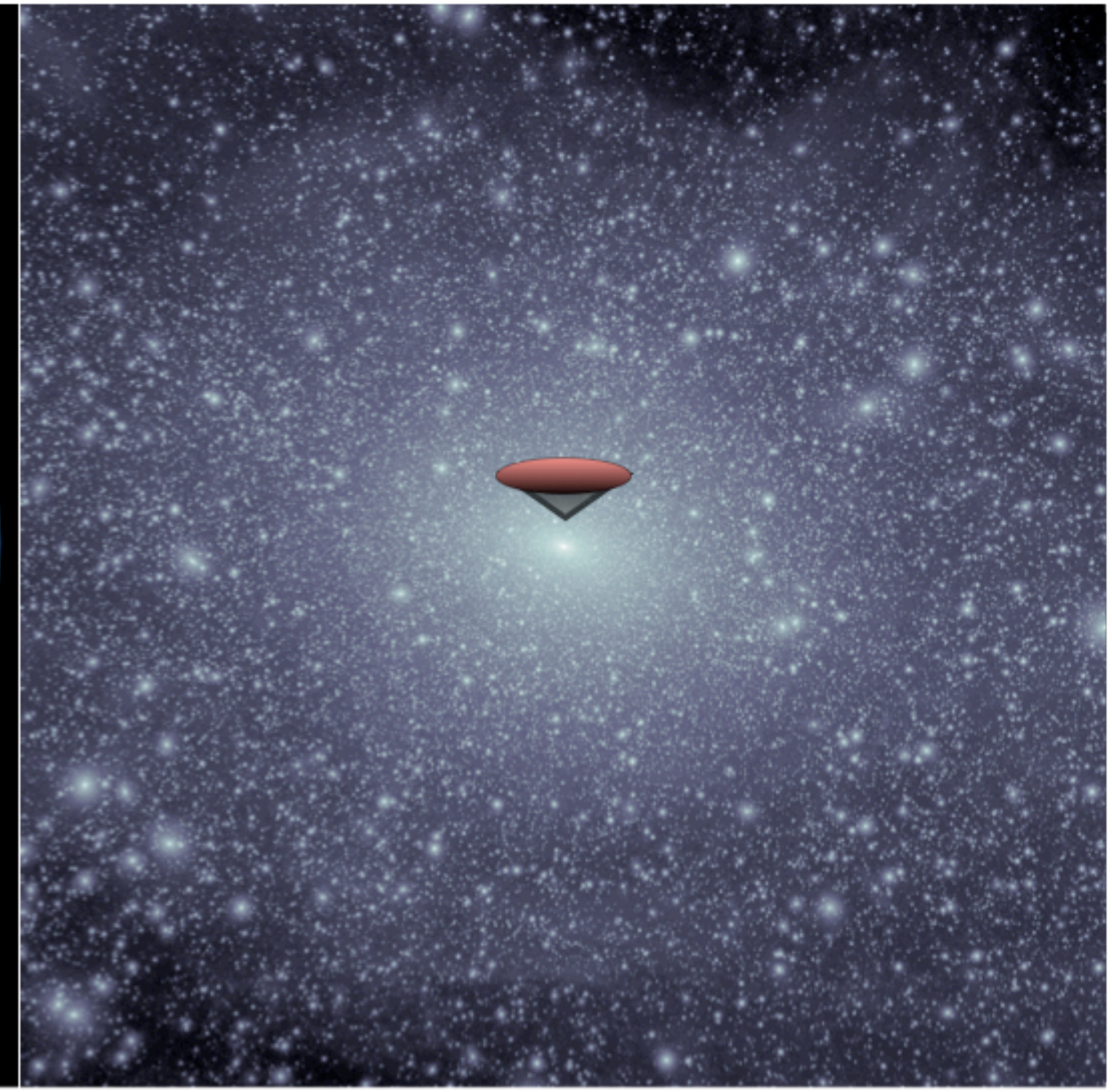
The Future


Sextans
Ursa Minor
BootesI/II
Draco
Coma
W1
UMaII
Segue1
Milky Way
100 kpc
Sag
LMC
Carina
SMC
Sculptor

The Future





Bullock et al. (2009)

Diemand et al. (2008)

FINAL THOUGHTS

Milky Way dwarfs are good probes of dark matter and galaxy formation:

- Good targets for indirect dark matter detection experiments (Fermi, ACTs).
- Phase space density constraints.
- Good for studying galaxy formation thresholds.

However, the UFDs represent a new regime in luminosity that greatly impacts our ability to study them

•High quality, deep photometry is required to determine reliable structural parameters and to investigate their morphologies.

•CFHT/Magellan survey is nearly finished. It represents the deepest and most comprehensive database for outer halo structure. STAY TUNED.

The Future is bright, only 1% of virial volume of Milky Way has been exhaustively searched (and only northern sky)