

Study of dwarf satellites with WFMOS

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Questions

Q1. Relation between the present satellites and the M.W.

Q2. Mass contents and profiles of dwarf galaxies

Q3. Low mass threshold to be a galaxy ? ($10^7?$, $10^5?$)

Q4. Star formation and evolution of each galaxies with the different conditions and environments.

Questions

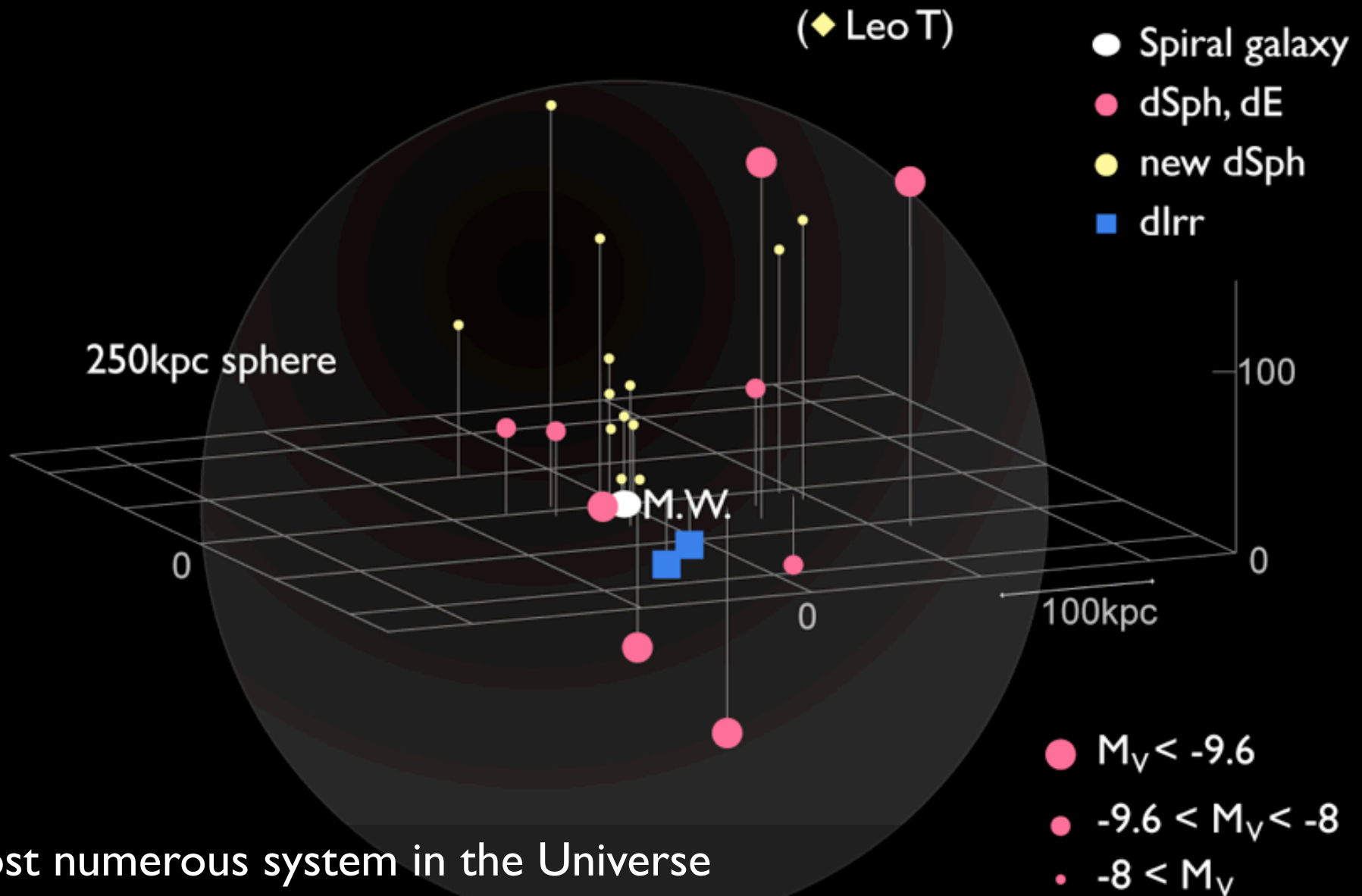
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dwarf satellites around M.W.

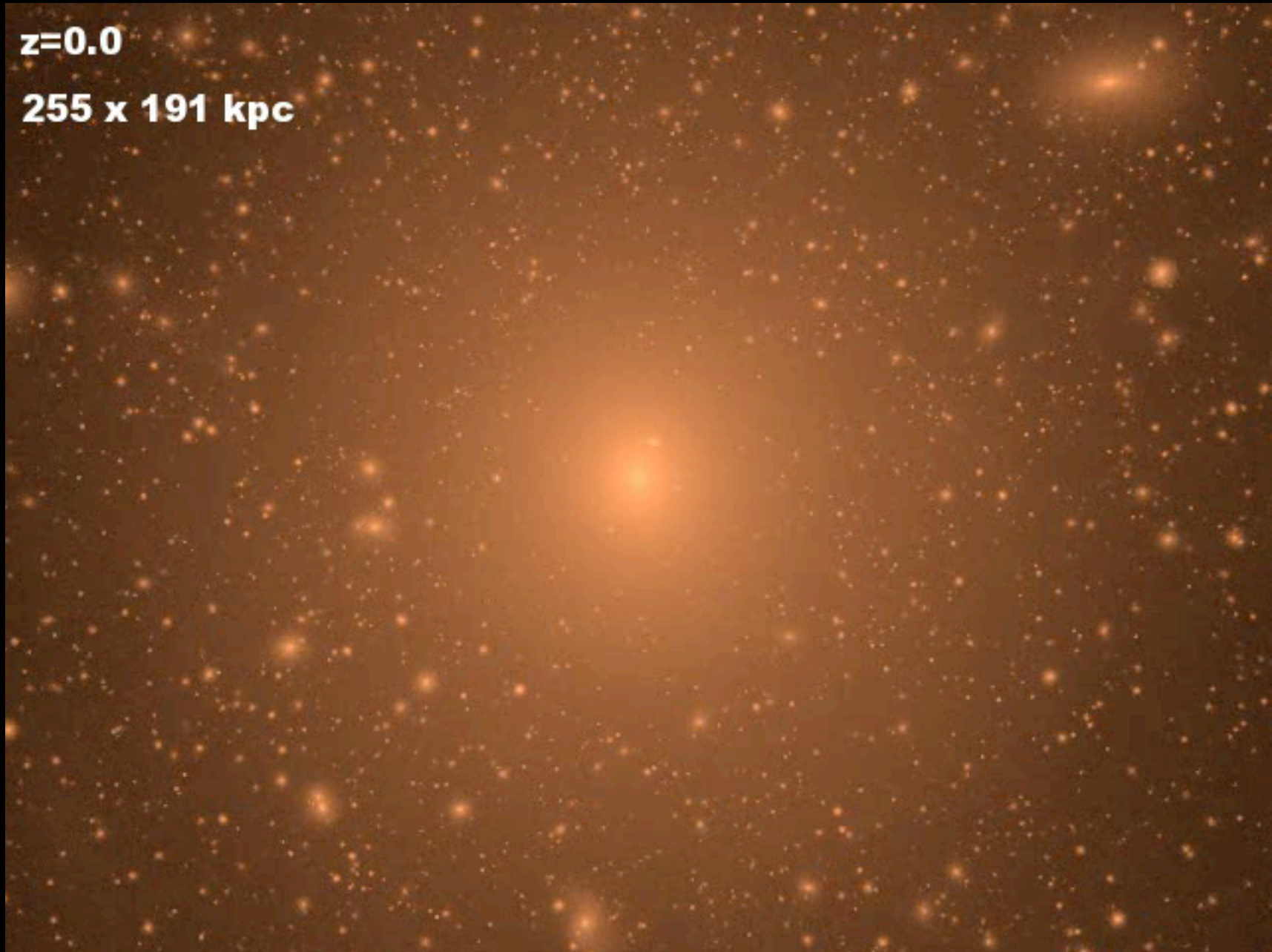


- Most numerous system in the Universe
- Building block of massive galaxy in Λ CDM

dwarf satellites in LCDM

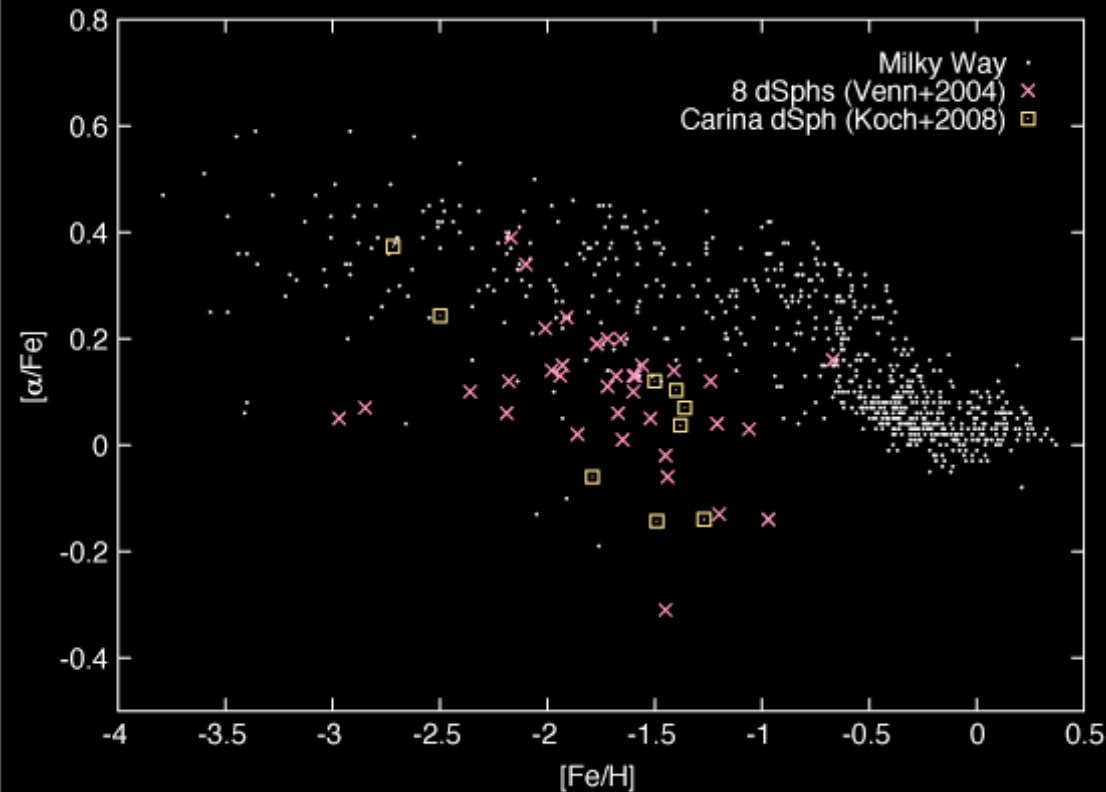
$z=0.0$

255 x 191 kpc



(<http://www.ucolick.org/~diemand/vl/movies.html>)

Are “classical” dSphs the building blocks?

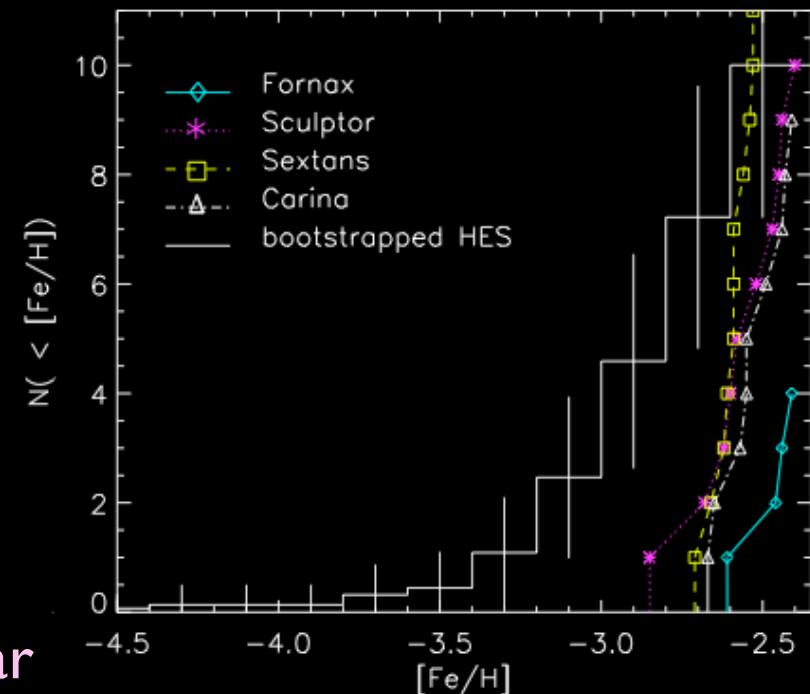


← systematically lower than the M.W. halo stars

[α/Fe] timescale :
SFH / IMF / SNe / mixing ...

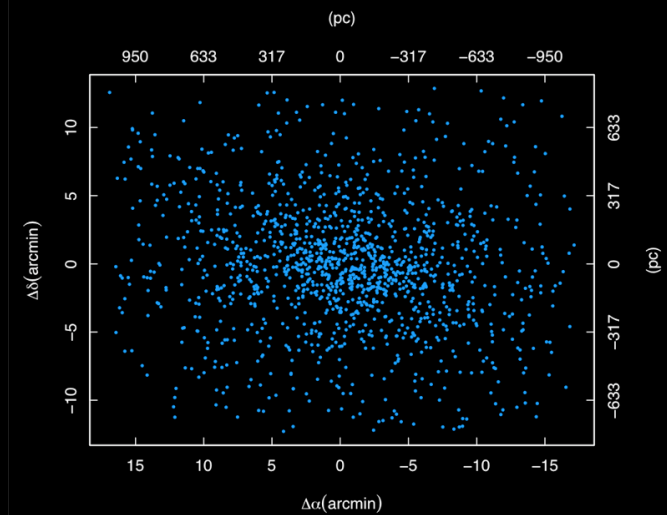
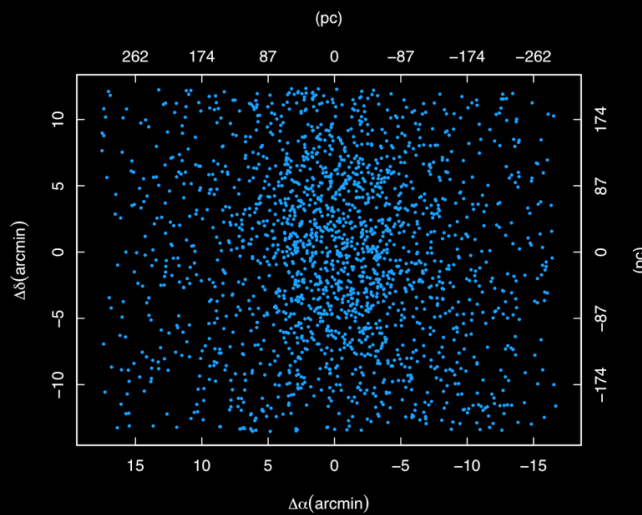
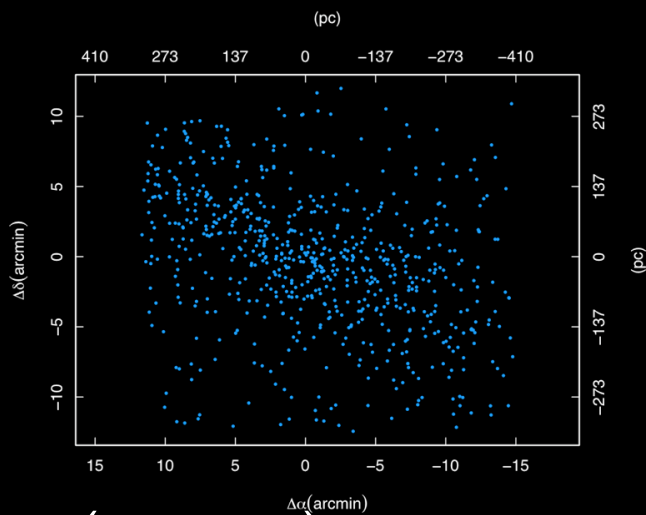
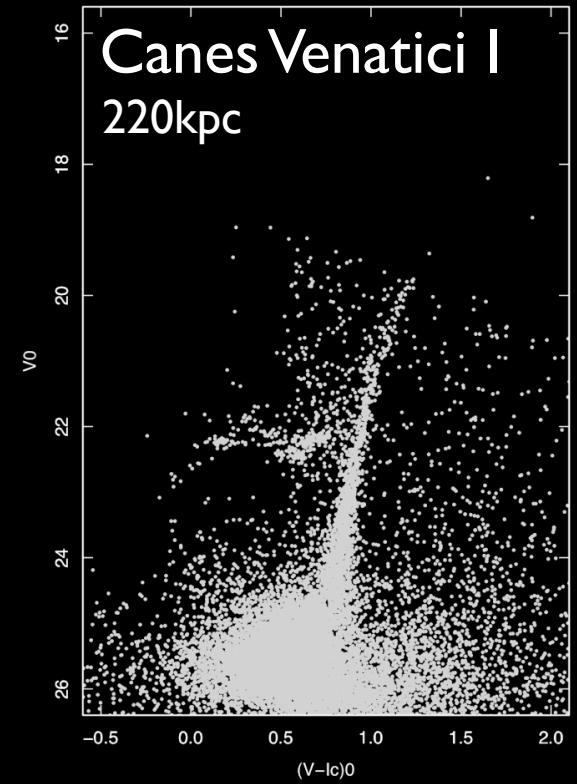
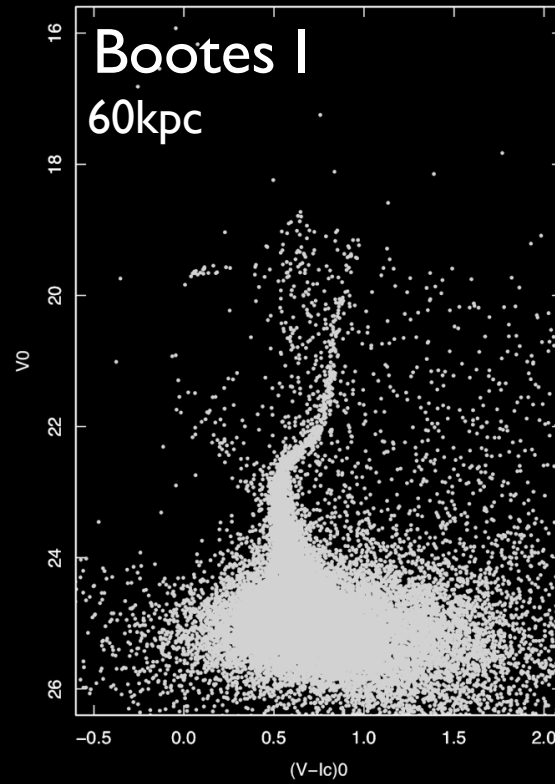
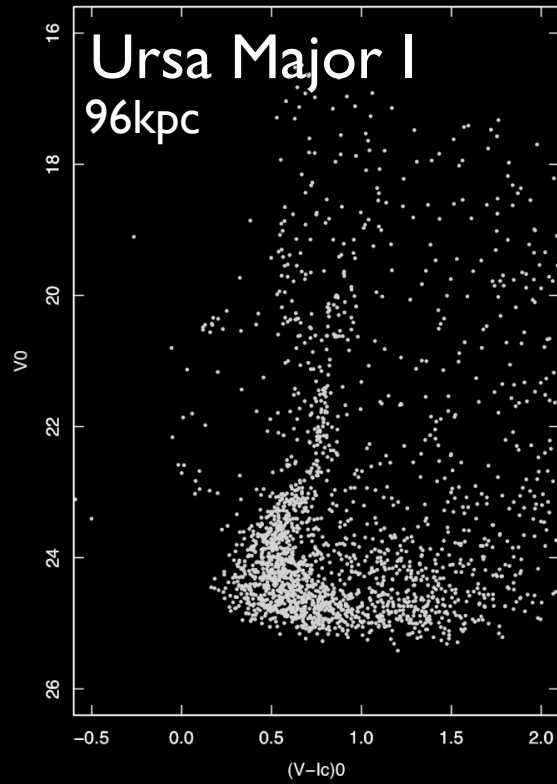
→ a lack of metal-deficient $[\text{Fe}/\text{H}] < -3$ is common in the “classical” dSph

(Helmi+2006)



The progenitors of the “classical” dSph appear to have been different from the building blocks !!

Ultra faint dwarf galaxies



(SO+2008)

Questions

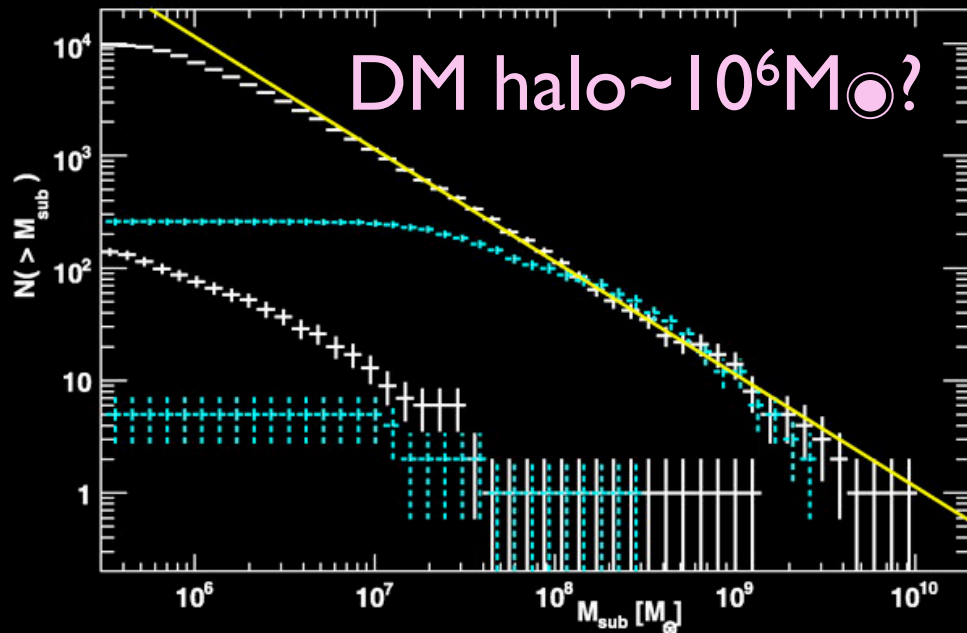
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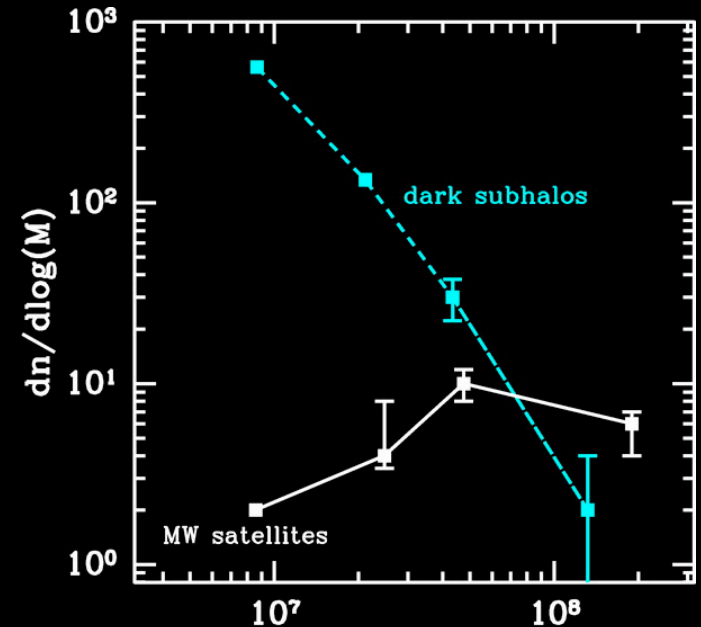
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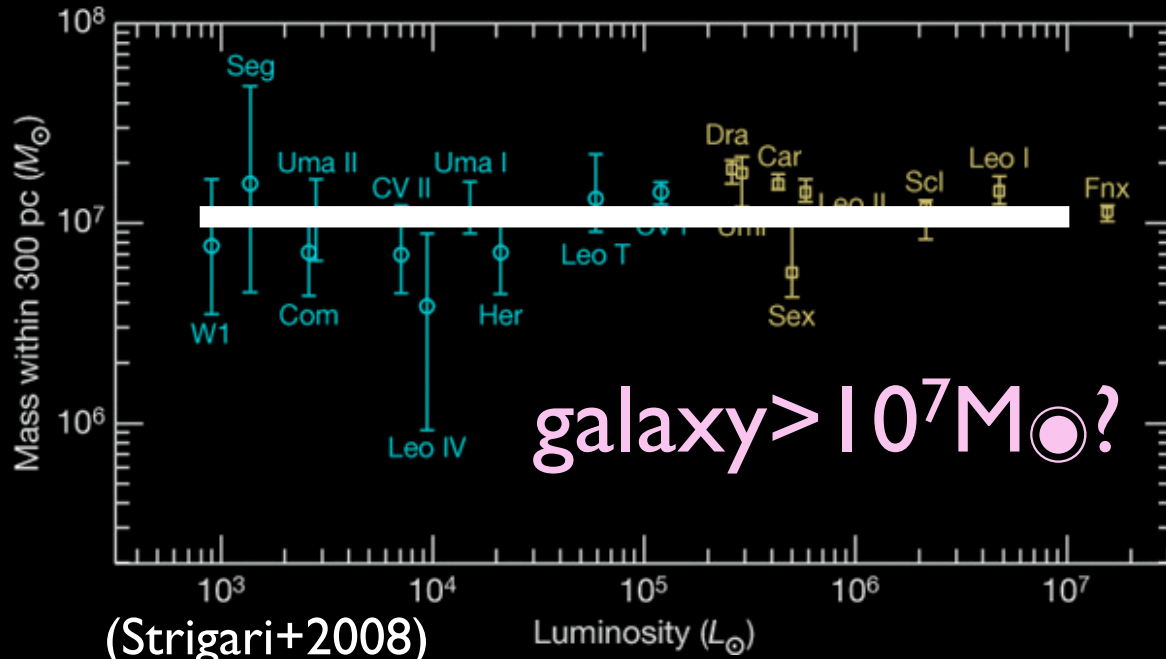
common mass scale for the satellite galaxies ?



(Diemand+2007; Via Lactea I)



Mass < 0.6 kpc [M_{\odot}]
(Strigari+2007; Via Lactea I)



(Strigari+2008)

the mass scale,
the lumpiness,
the extent of
Stars & Dark Matter

Questions

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Name	M_V [mag]	D[kpc]	μ_{0V}	Main Pop	SFH
Sgr	-13.4	24	25.4		
Fornax	-13.0	138	23.4	inter-age	Extended SF
Leo I	-11.9	250	22.4		
Sculptor	-10.7	79	23.7	old	distinct-pop
Leo II	-9.6	204	24.0	inter-age	Extended SF
Carina	-9.3	105	25.5	inter-age	Episodic SF
Sextans	-9.5	87	26.2		
UMi	-8.9	66	25.5	old	Simple SF ?
Draco	-8.8	82	25.3		
CVn I / UMa I	-7.9 / -6.8	220 / 94	28.2 / -		
Her / Boo I	-6.0 / -5.9	140 / 60	- / 28.3		
Leo IV / CVn II	-5.1 / -4.8	160 / 150	- / -	old ?	Simple SF ?
Leo V / UMa II	-4.3 / -3.8	180 / 30	27.5 / -		
Coma / Boo II	-3.7 / -2.3	44 / 42	- / 27.7		

Survey Plan

stage I) LRS & HRS of 3 nearby dSph in the M.W.
radial velocity / metallicity, abundance patterns

stage II) LRS of all satellites around the M.W.
radial velocity / metallicity -> DM halo, substructure

extra) LRS of the satellites around M31 ? (>21 mag...)

Stage I) 3 nearby dSph of M.W.

Low Resolution Mode ($17\text{mag} < V < 21\text{mag}$, $R \sim 5000$, 3 hour/filed) :

RGB candidates in the 9FoV of Sextans/Draco/Ursa Minor

- distributions of metallicity (Call T 8150-8850A), and radial velocities
- membership confirmation (\rightarrow TMT era)
- mass scale & lumpiness of the dSphs ($M = 10^7?$, $10^5?$)
- whether the dark matter halo extend beyond the edge of their main stellar distributions

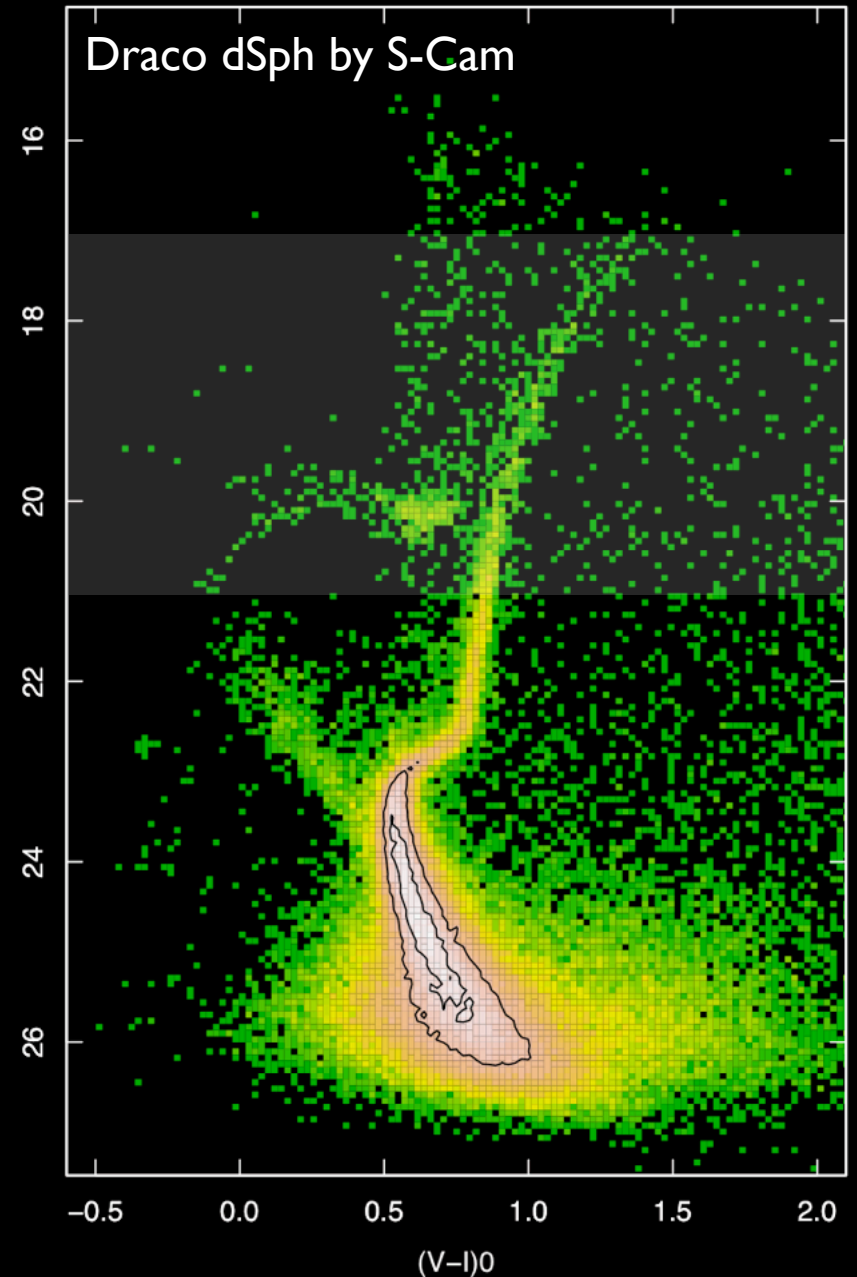
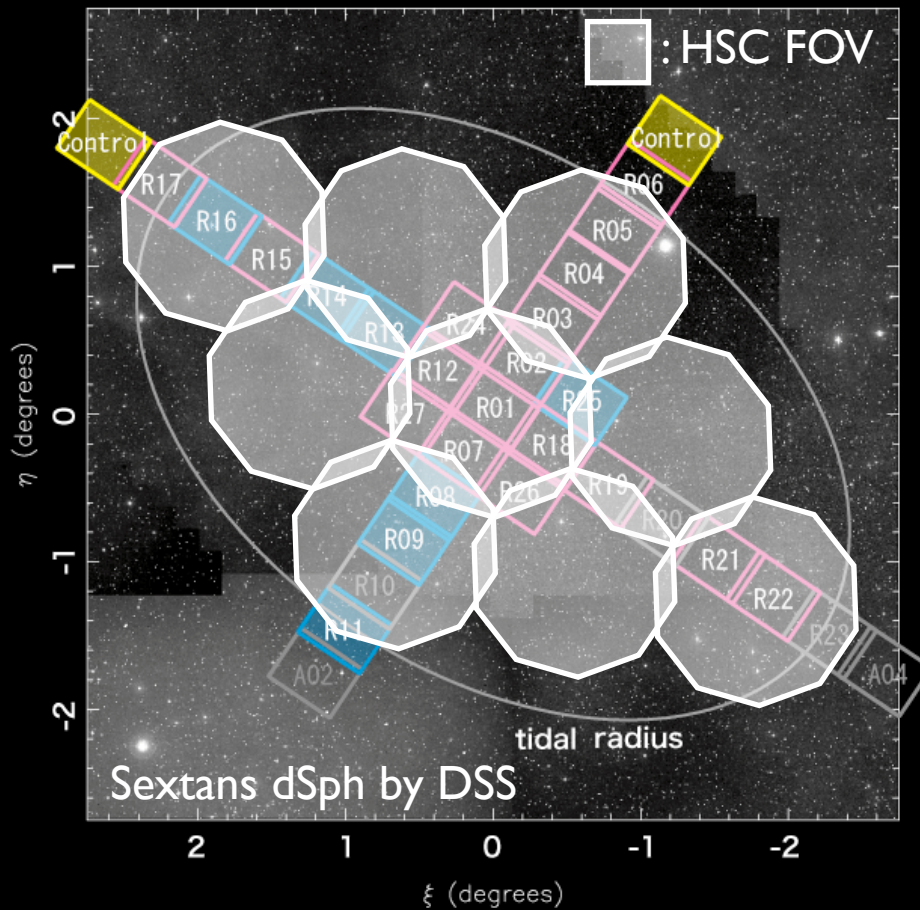
High Resolution Mode ($V < 17\text{mag}$, $R \sim 40000$) :

bright RGB stars in the 3 dSphs

- derive individual elemental abundances (cf. Galactic halo stars)
- the evolutionary history of stellar components
- the nucleosynthesis in a faint, low-mass, low-metallicity galaxy
- spatial variation of abundance pattern ?

Stage I) 3 nearby dSph of M.W.

Targets : 9FoV of Sextans, Draco, Ursa Minor



e.g.) Sextans dSph < 1 kpc (~ 1 FoV)
RGB (> 21 mag) : 1100
HB : 650

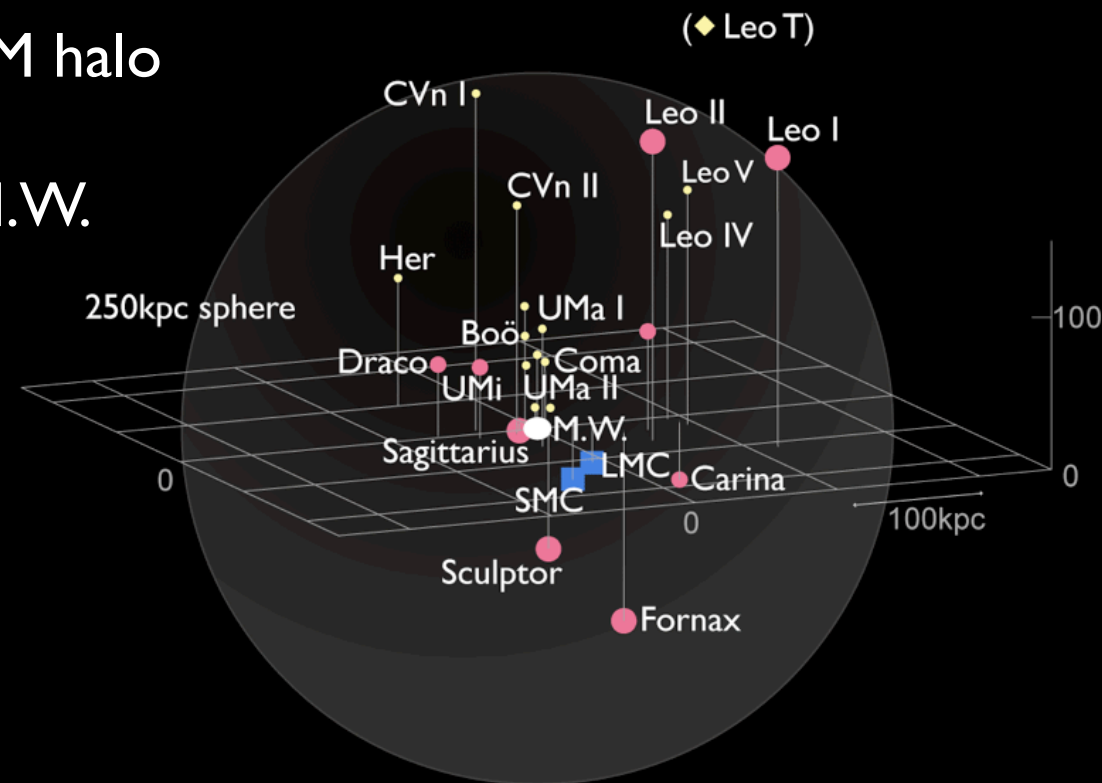
Stage II) all dwarf satellites of M.W.

Low Resolution Mode ($17\text{mag} < V < 22\text{mag}$, $R \sim 1800$) :

RGB stars in all satellites & streams around the M.W.

- membership confirmation (HSC \rightarrow WFMOS \rightarrow TMT)
- tracing the DM halo of the “classical” & “UFdS” galaxies (60kpc-220kpc from M.W.)
- mass scale & lumpiness of the DM halo ($10^7?$ $10^5?$) with a wide range of luminosities and distance from M.W.

The nature of
dark matter sub-halo
from the visible satellites



Answers to the questions

Q1. Relation between the present satellites and the M.W.

stage I: comparison of detailed abundances of dSph with M.W.

stage II: comparison of the metallicity distribution with M.W.

Q2. Mass contents and profiles of dwarf galaxies

stage I+II: tracing dark matter halo of dwarf galaxies

Q3. Low mass threshold to be a galaxy ? ($10^7?$, $10^5?$)

stage II: dark matter contents of UFsS galaxies (with SC/HSC study)

Q4. Star formation and evolution of each galaxies with the different conditions and environments.

stage I+II: metallicity and detailed abundances (with SC/HSC study)