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.
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dwarf satellites around M.W.

- Most numerous system in the Universe
- Building block of massive galaxy in $\Lambda$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?

A lack of metal-deficient $[\text{Fe/H}] < -3$ is common in the “classical” dSph. The progenitors of the “classical” dSph appear to have been different from the building blocks!!

systematically lower than the M.W. halo stars

$[\alpha/\text{Fe}]$ timescale:
SFH / IMF / SNe / mixing ...

(Helmi+2006)
Ultra faint dwarf galaxies

- **Ursa Major I**
  - Distance: 96kpc

- **Bootes I**
  - Distance: 60kpc

- **Canes Venatici I**
  - Distance: 220kpc

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**References**

(SO+2008)
Are UFdS galaxies the building blocks?

- UFdS has stars of $[\text{Fe/H}] < -3$
- MDF of UFdS reaches nearly as low as that of M.W. halo

Sample is restricted to the inner part of a galaxy...

\[(\text{Kirby+2008})\]
Questions

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

Q4. Star formation and evolution of each galaxies with the different conditions and environments.
common mass scale for the satellite galaxies?

DM halo $\sim 10^6 M_\odot$?  

(Diemand+2007; Via Lactea I)

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

(Diemand+2007; Via Lactea I)

(Strigari+2008)

(Mw satellites)

Mass < 0.6 kpc [M_\odot]

(Strigari+2007; Via Lactea I)

(Strigari+2008)

galaxy $> 10^7 M_\odot$?
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<table>
<thead>
<tr>
<th>Name</th>
<th>$M_V$[mag]</th>
<th>$D$[kpc]</th>
<th>$\mu_0 \nu$</th>
<th>Main Pop</th>
<th>SFH</th>
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<td>Sgr</td>
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<td>25.4</td>
<td>inter-age</td>
<td>Extended SF</td>
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<tr>
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<td>Simple SF ?</td>
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<td>25.3</td>
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<td>220 / 94</td>
<td>28.2 / -</td>
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<td>44 / 42</td>
<td>- / 27.7</td>
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</table>
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 ? (>21mag... )
Stage 1) 3 nearby dSph of M.W.

Low Resolution Mode (17mag < V < 21mag, R~5000, 3 hour/filed) :
- RGB candidates in the 9FoV of Sextans/Draco/Ursa Minor
  - distributions of metallicity (CaII T 8150-8850A), and radial velocities
  - membership confirmation (→ 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 < 17mag, R~40000) :
- bright RGB stars in the 3 dSphs
  - derive individual elemental abundances (cf. Galactic halo stars)
  - the evolutorial history of stellar components
  - the nucleosynthesis in a faint, low-mass, low-metallicity galaxy
  - spatial variation of abundance pattern?
Stage 1) 3 nearby dSph of M.W.

Targets: 9FoV of Sextans, Draco, Ursa Minor

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

e.g.) Sextans dSph <1kpc (~1FoV)
RGB(>21mag): 1100
HB: 650
Stage II) all dwarf satellites of M.W.

Low Resolution Mode (17mag < V < 22mag, R~1800) :

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

• membership confirmation (HSC→WFMOS→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 UFdS 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)