

Discovery of a Milky Way dwarf galaxy in the constellation of Crater

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Outline

- ★ Introduction:

- ★ Λ CDM and the missing satellite problem

- ★ Motivation:

- ★ Dwarf galaxies

- ★ Crater 2:

- ★ Discovery: VST ATLAS
 - ★ Stellar and structural properties

- ★ Discussion:

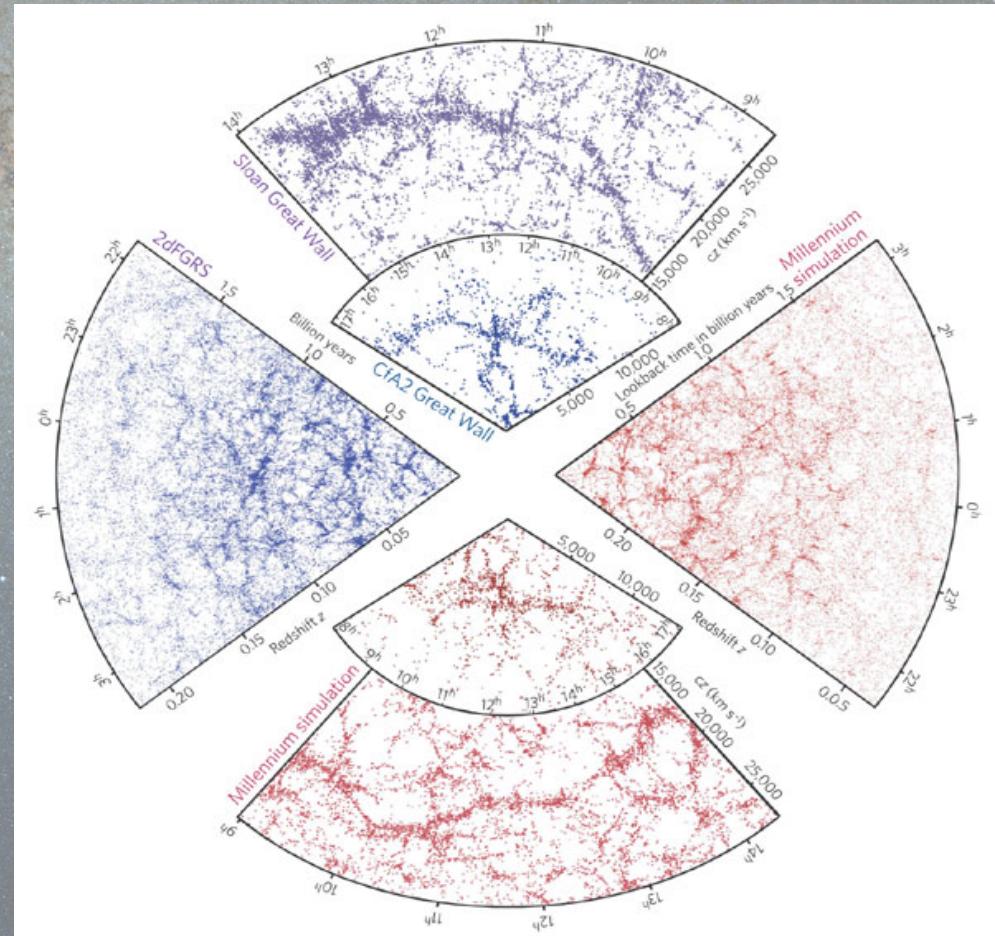
- ★ The Crater-Leo group

- ★ Summary

Λ CDM

- ★ The Λ CDM have been successful explaining cosmic properties in a large range of redshift:

- ★ Existence and polarization of the CMB
- ★ Large scale structure of galaxies
- ★ Primordial H and He abundances

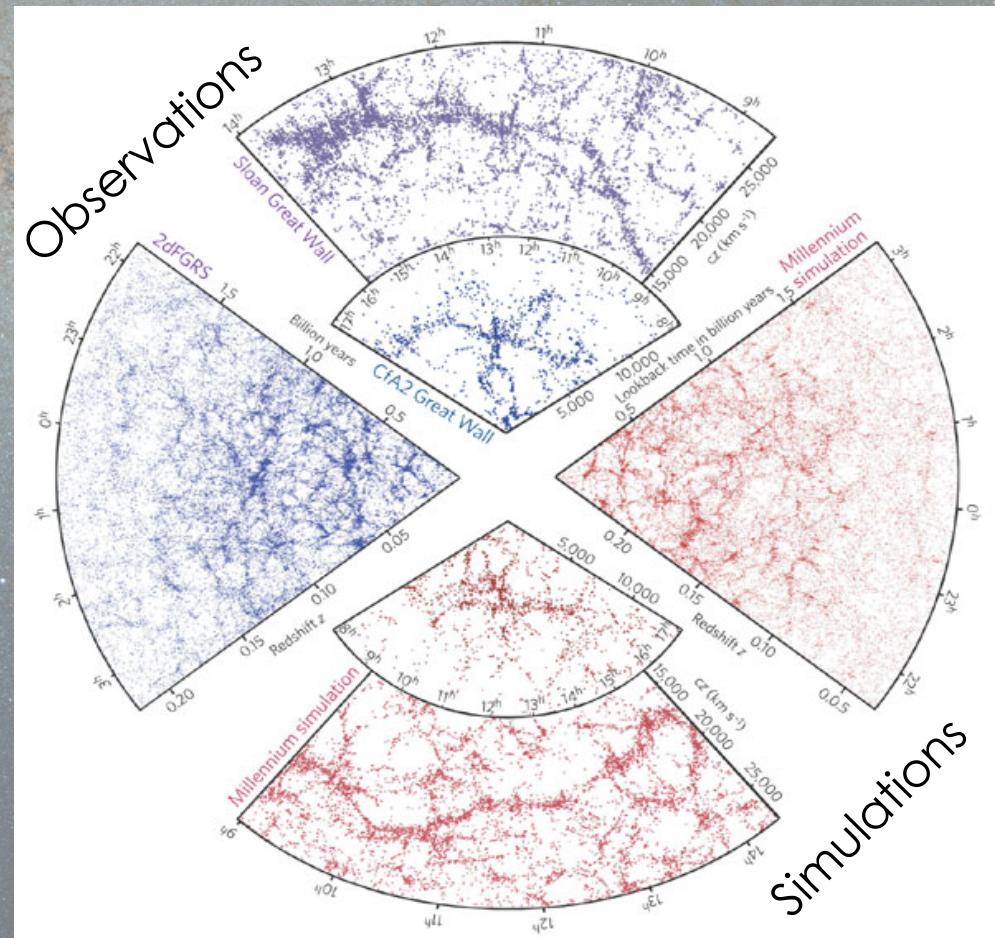


Springel, Frenk & White 2006

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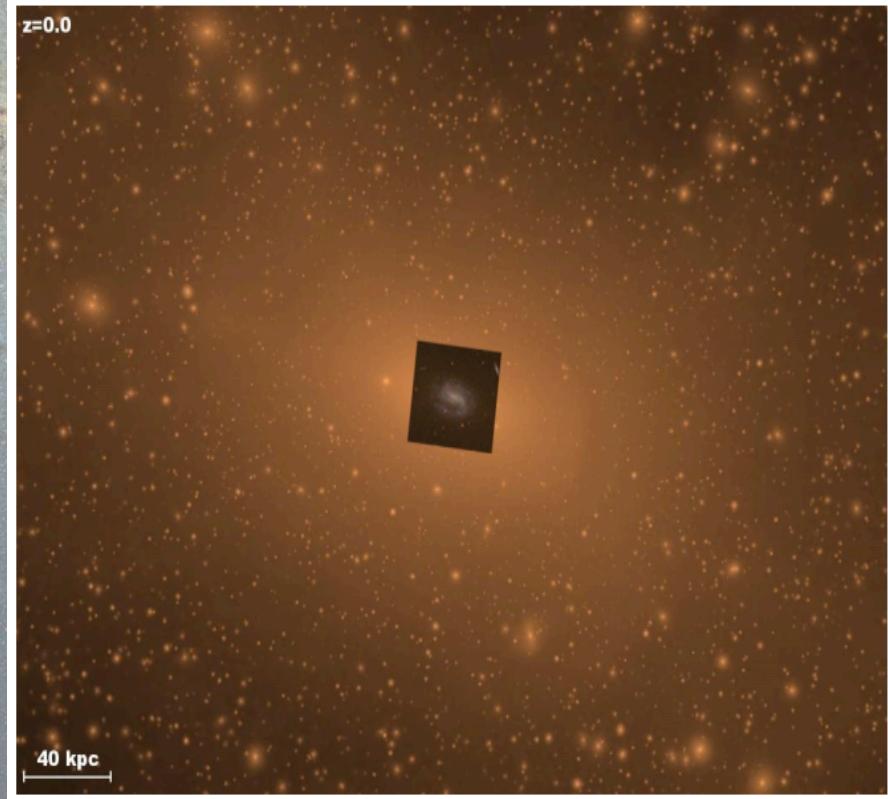
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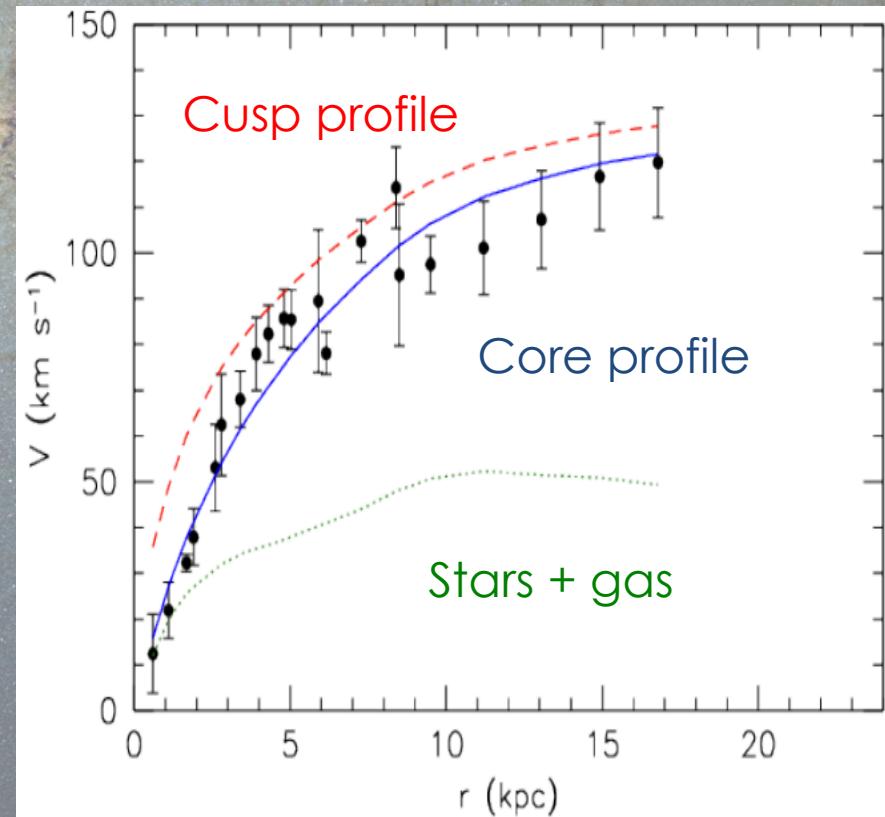
- ★ However Λ CDM is plagued by numerous ‘small-scale problems’:
 - ★ Density peak at the centers of halos (cusp/core)
 - ★ “Too big to fail”
 - ★ **Larger number of sub-halos compared to the observed ones (missing satellite)**



Weinberg et al. 2013

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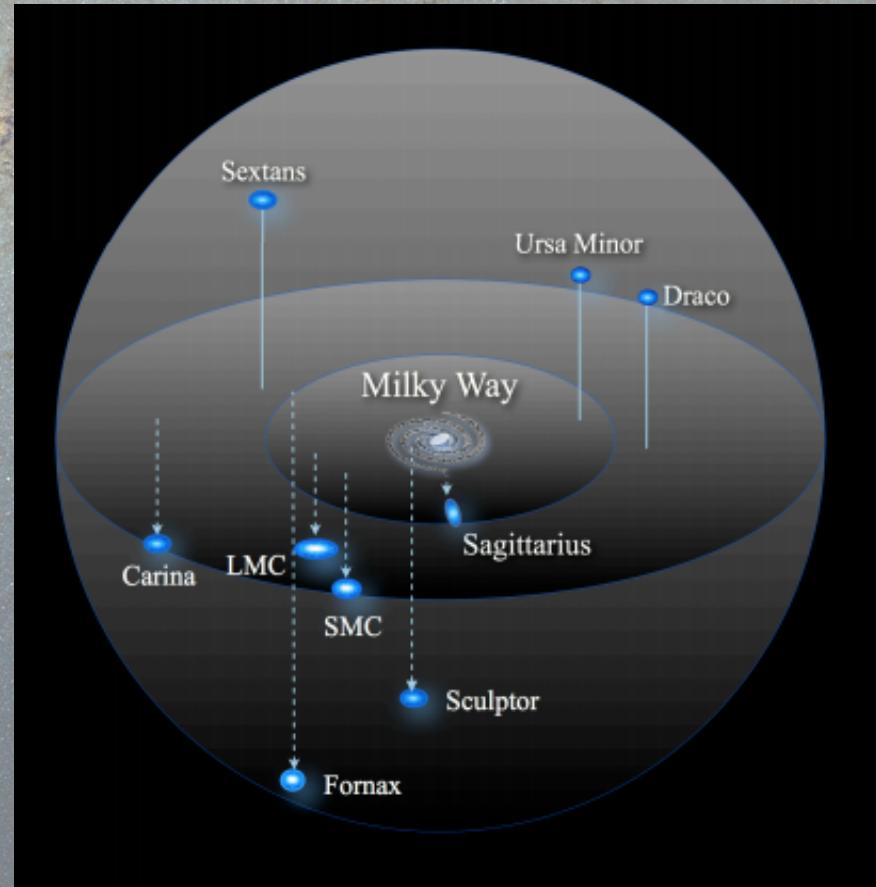


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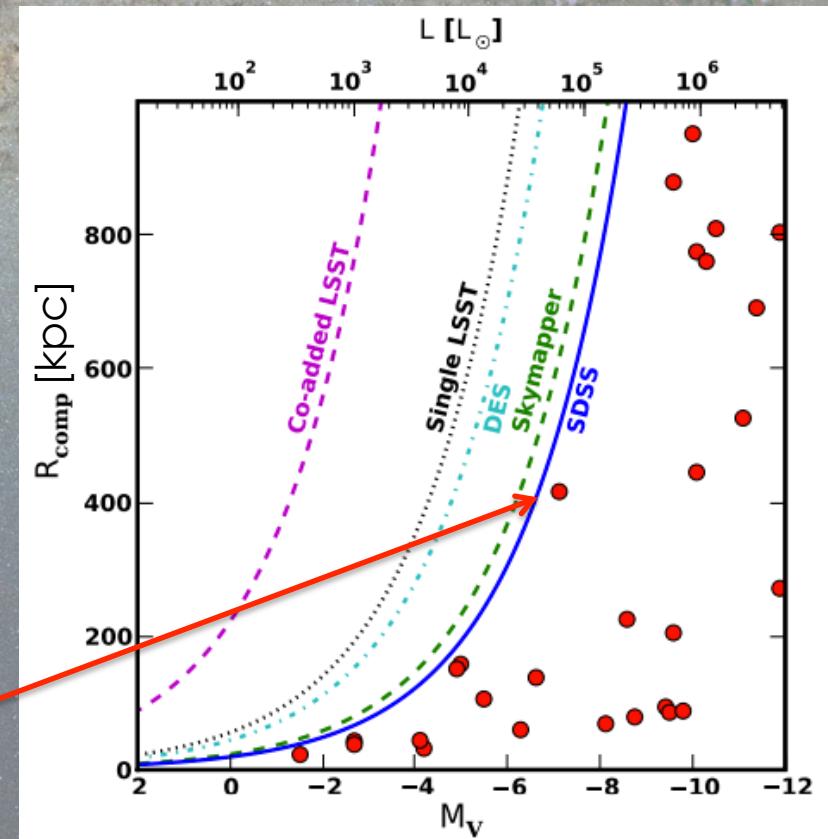
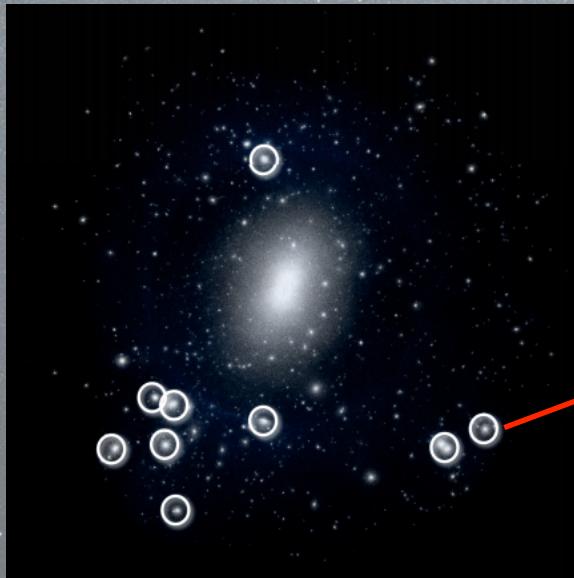
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Missing satellite problem

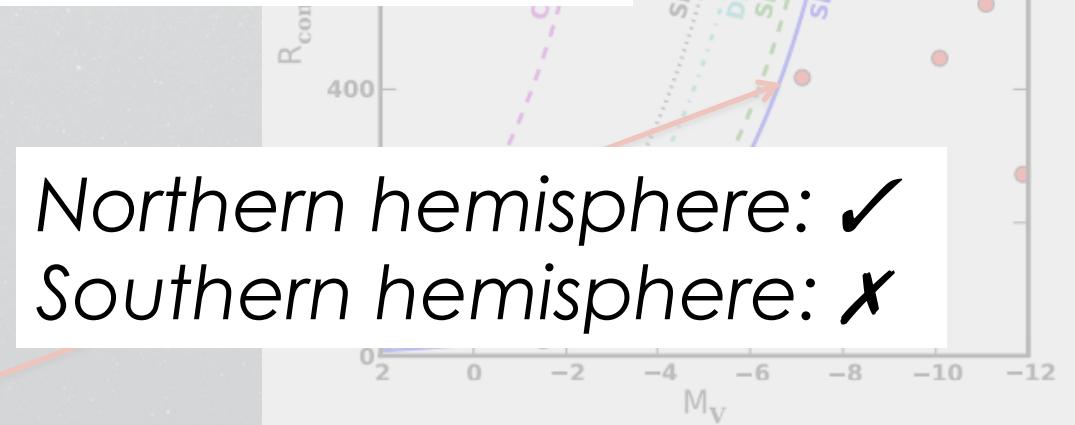
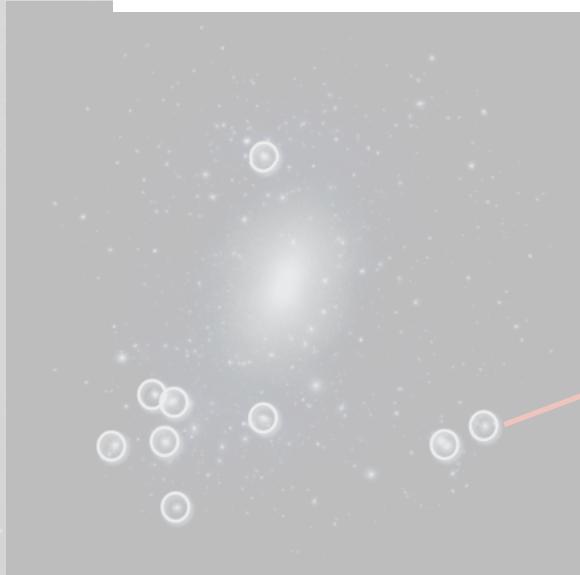
- ★ Simulations predicts a large number ($\sim 300\text{-}600$) of dark matter halos, but observations only find ~ 30 satellites



Moore et al. 1999
Tollerud et al. 2008

Missing satellite problem

- ★ Simulations show that large samples of dwarf galaxies exist but we have only found
- In order to increase the completeness of the sample we need to **search** for more satellite galaxies in unexplored regions of the sky!*



Moore et al. 1999
Tollerud et al. 2008

The feeble giant: Crater 2

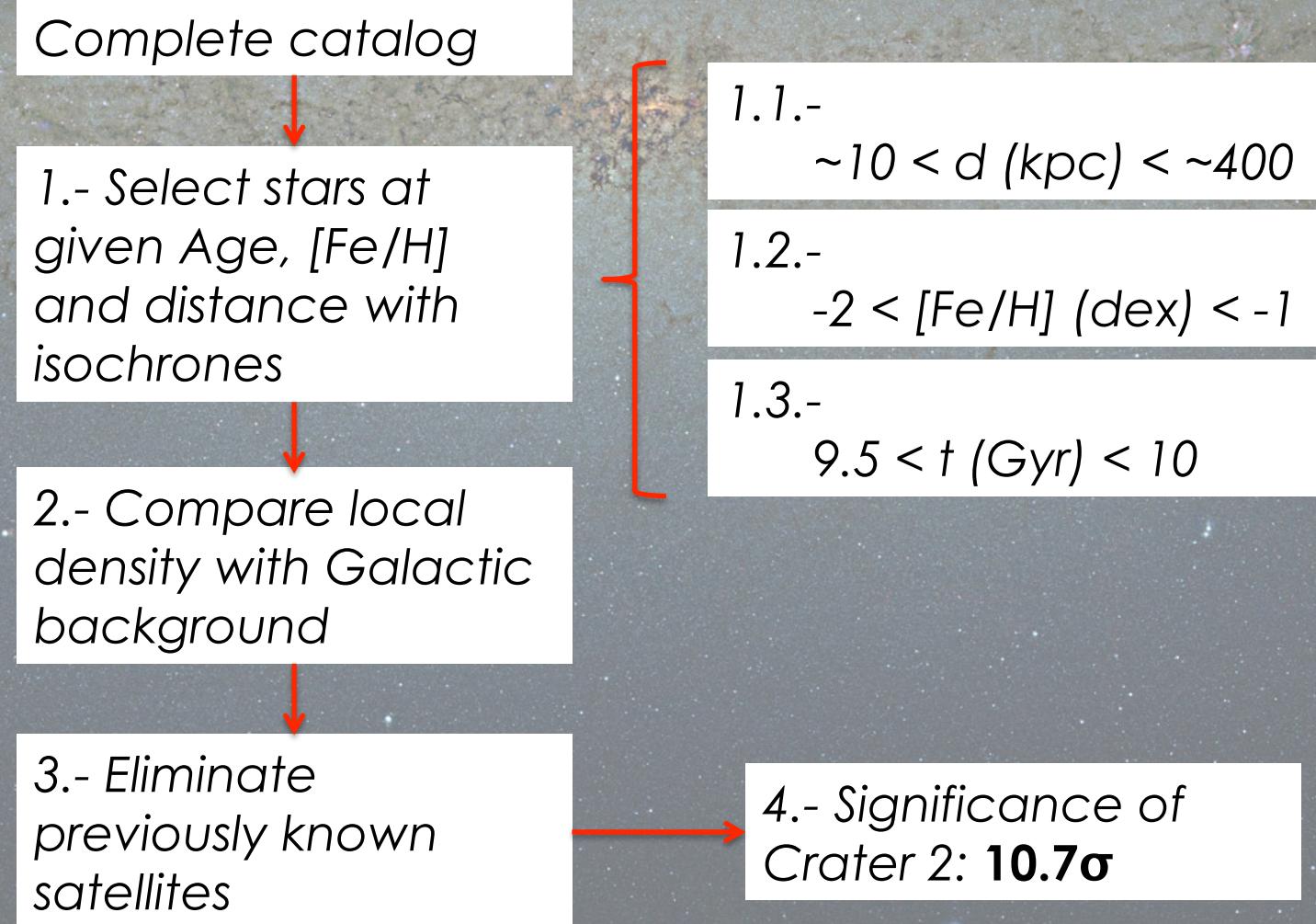
★ Once upon a time...

there was a survey called ATLAS
that observes most of the southern
sky from the VLT Survey Telescope (VST).

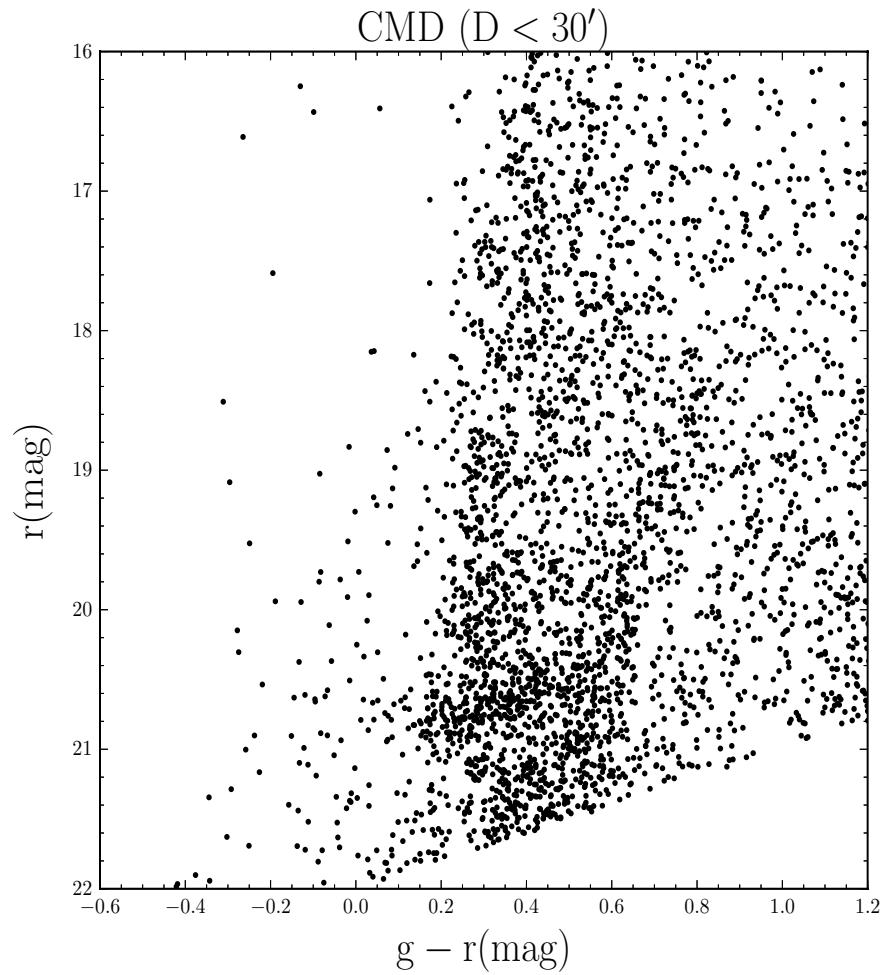
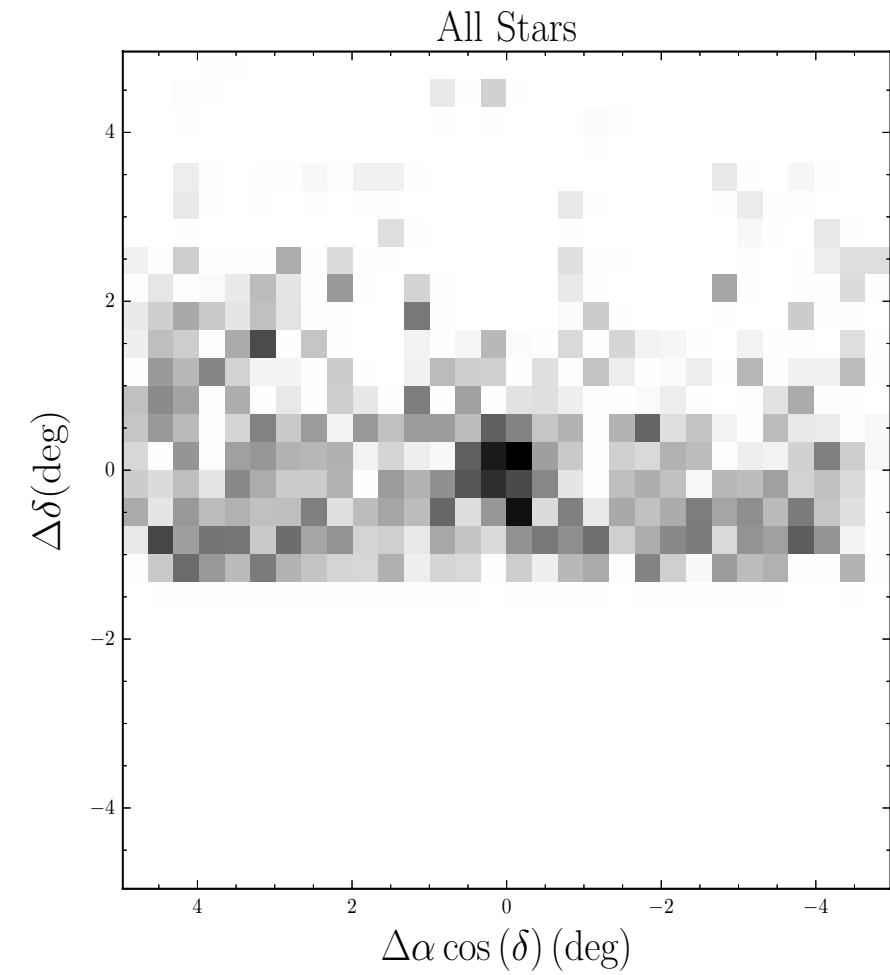
The ATLAS survey: the SDSS of in the south:

- ★ Total area of ~4500 sq deg
- ★ ugriz filters
- ★ 0.21 ''/pix
- ★ Catalog with galaxies+stars

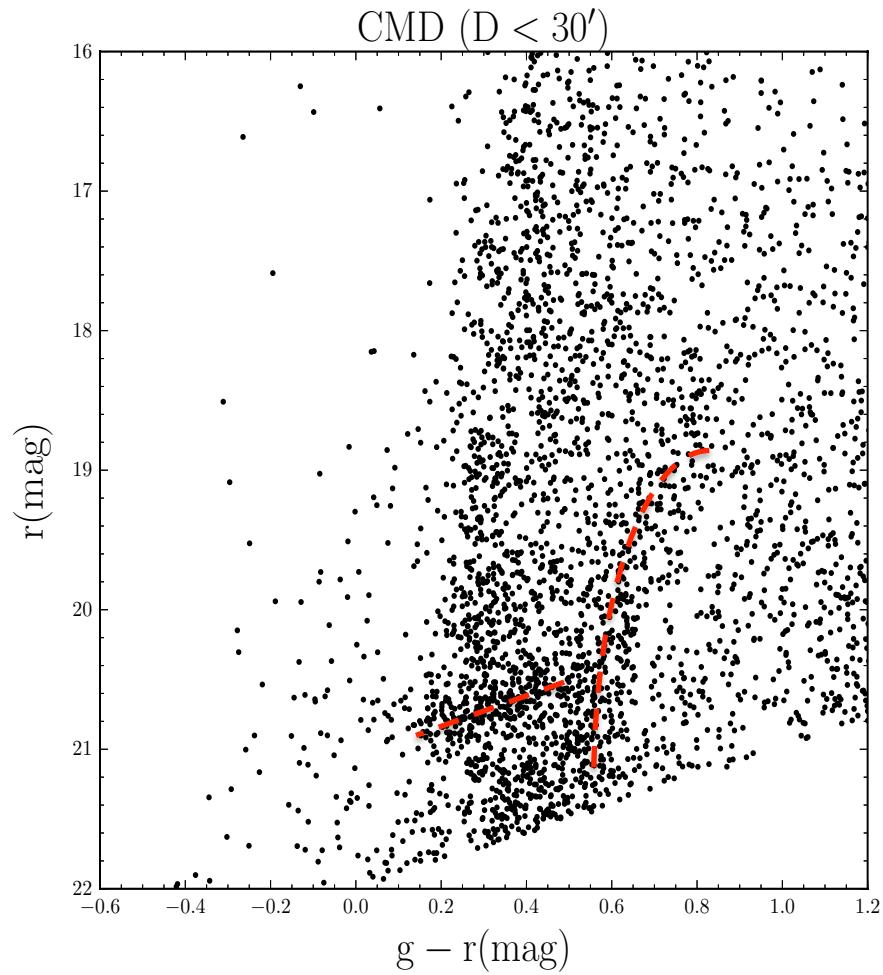
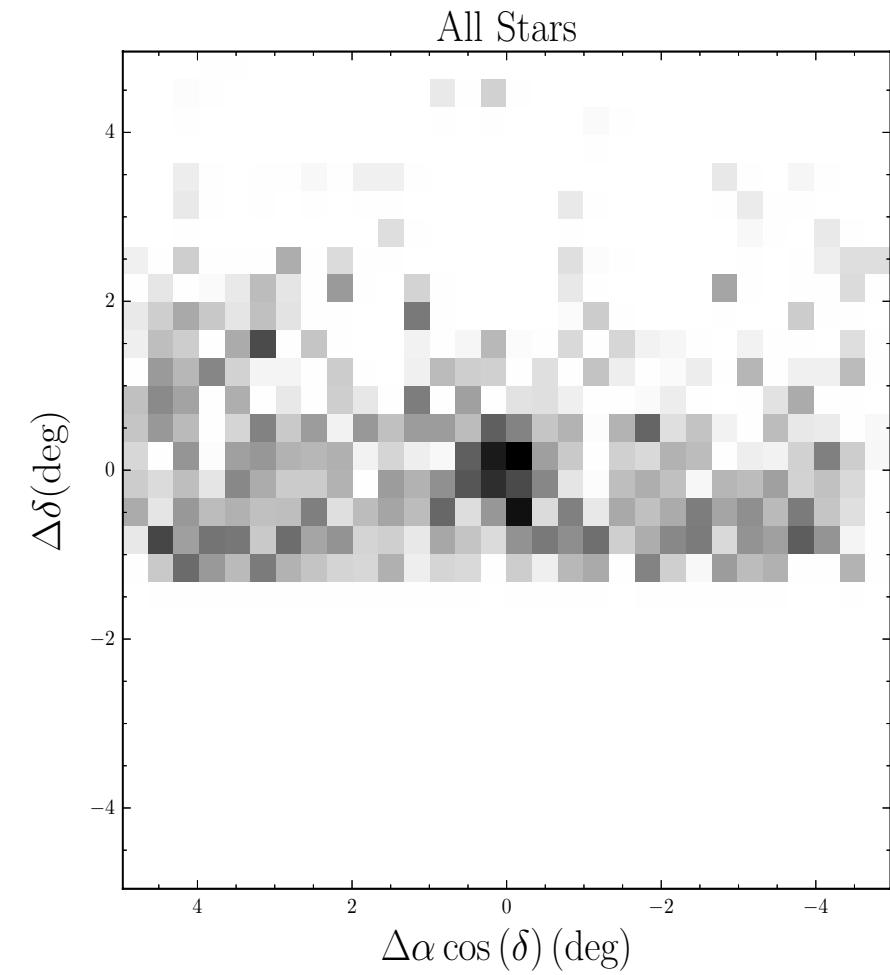
Unveiling Crater 2



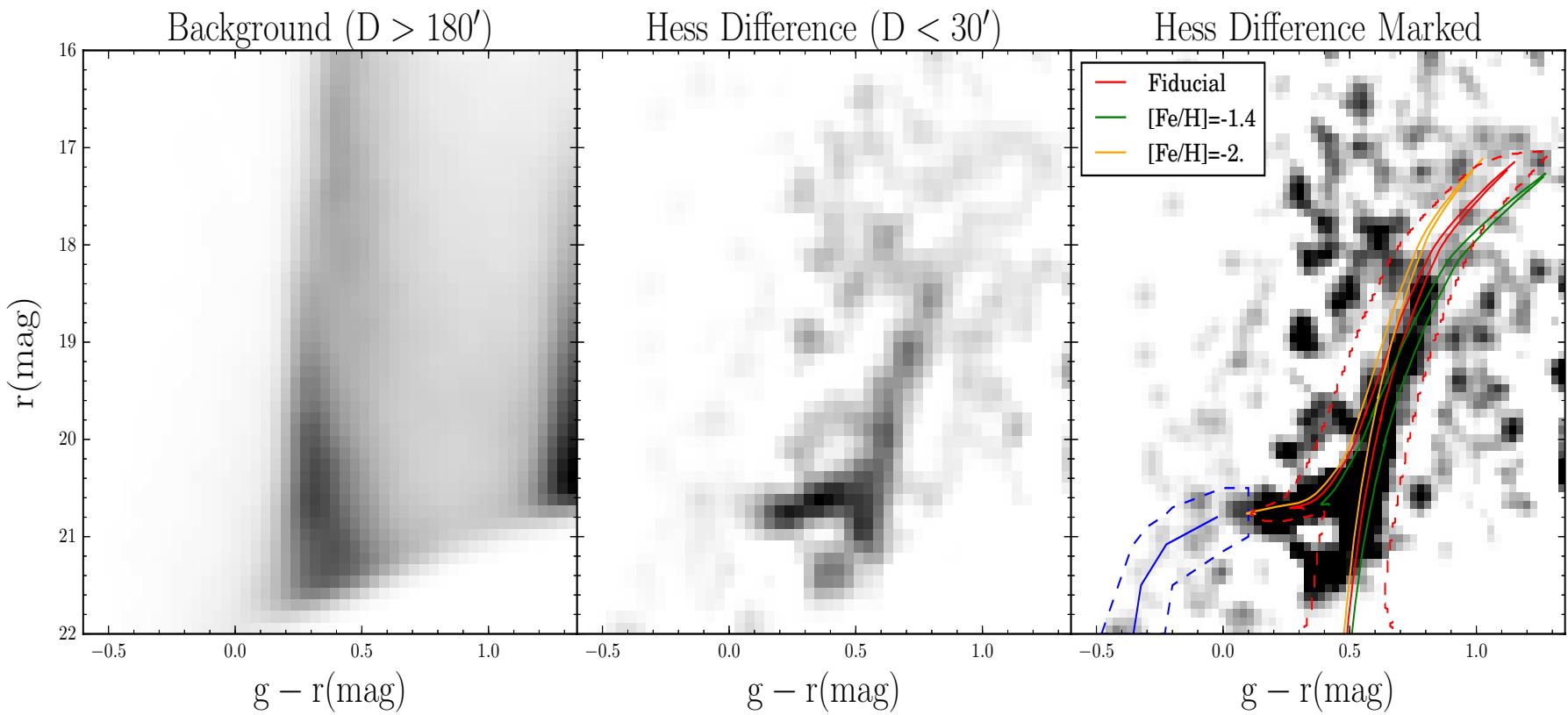
Stellar distribution around Crater 2



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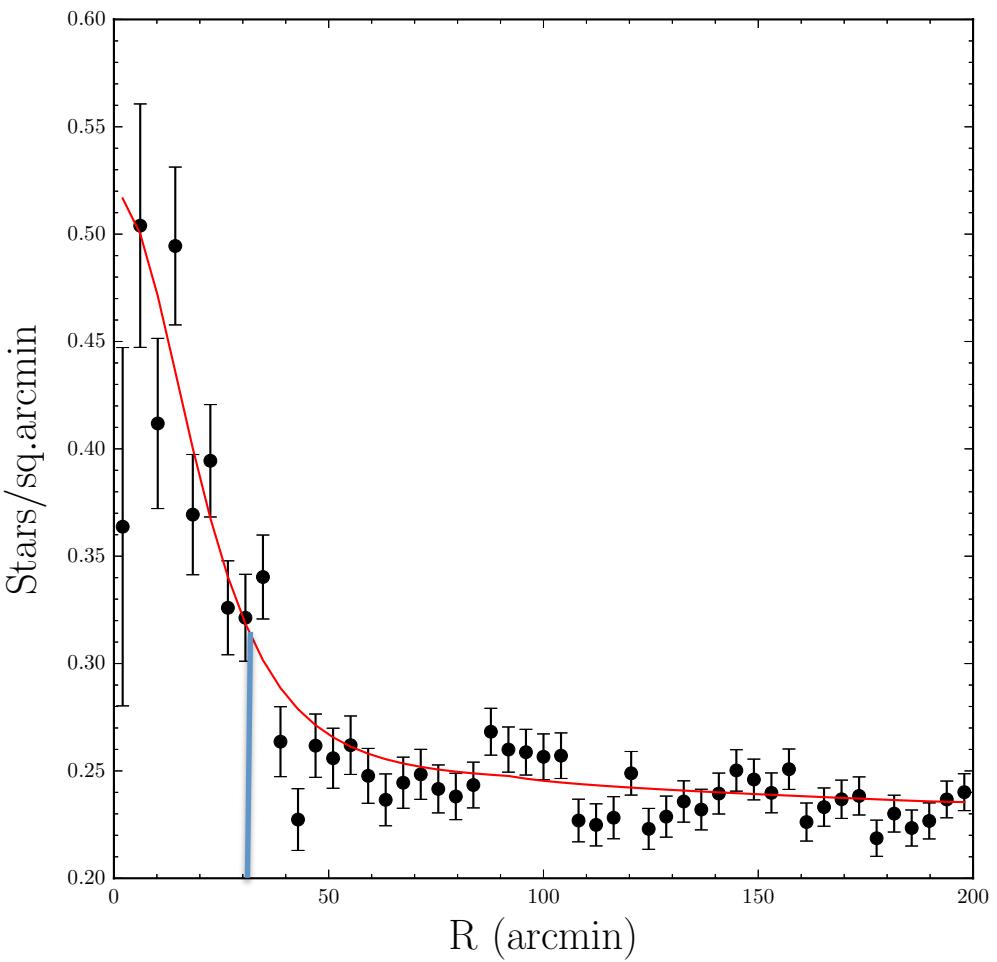


Stellar populations in Crater 2



$d \sim 120$ kpc, $[Fe/H] \sim -1.7$, Age ~ 10 Gyr

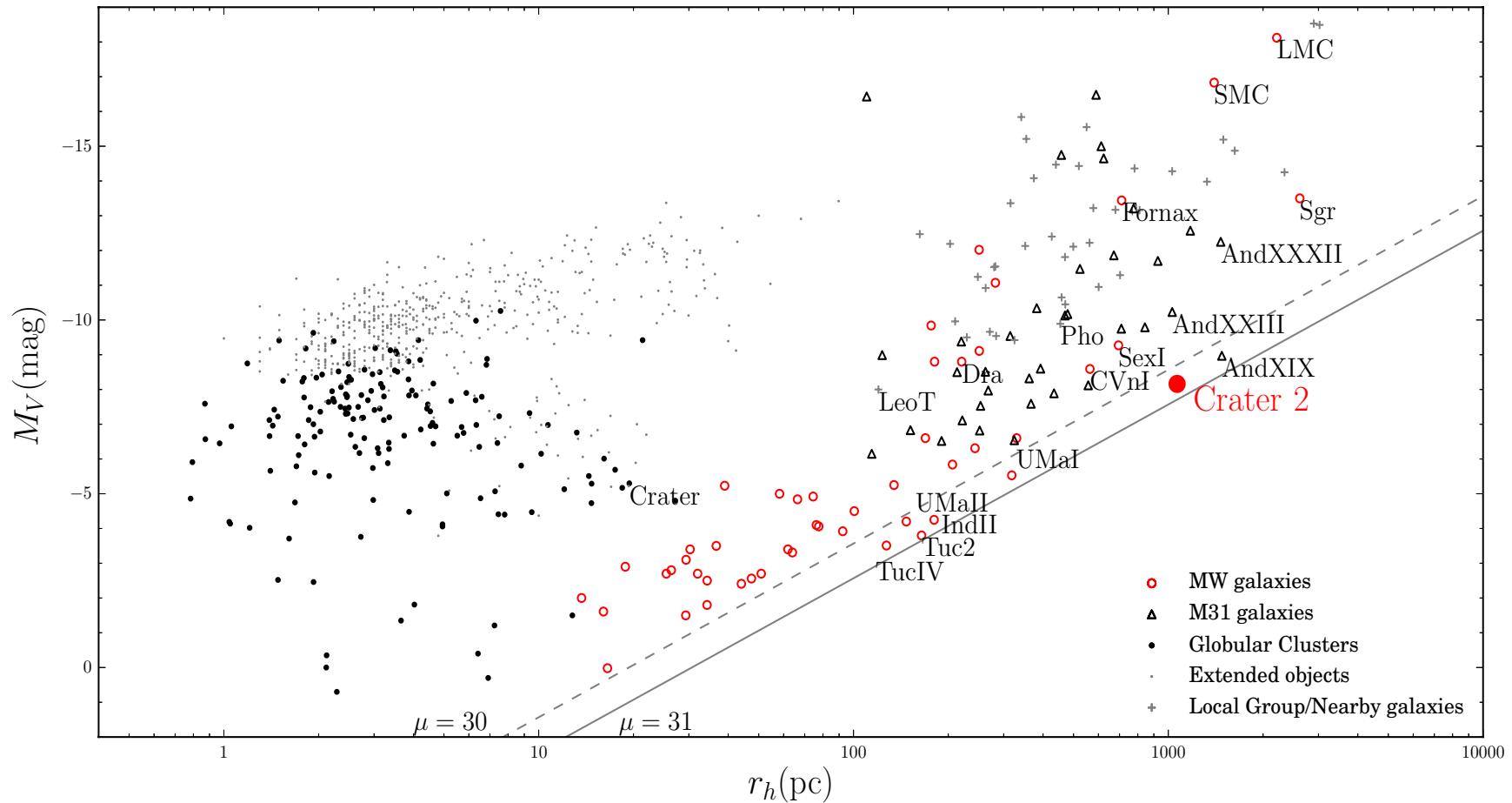
Structural parameters of Crater 2



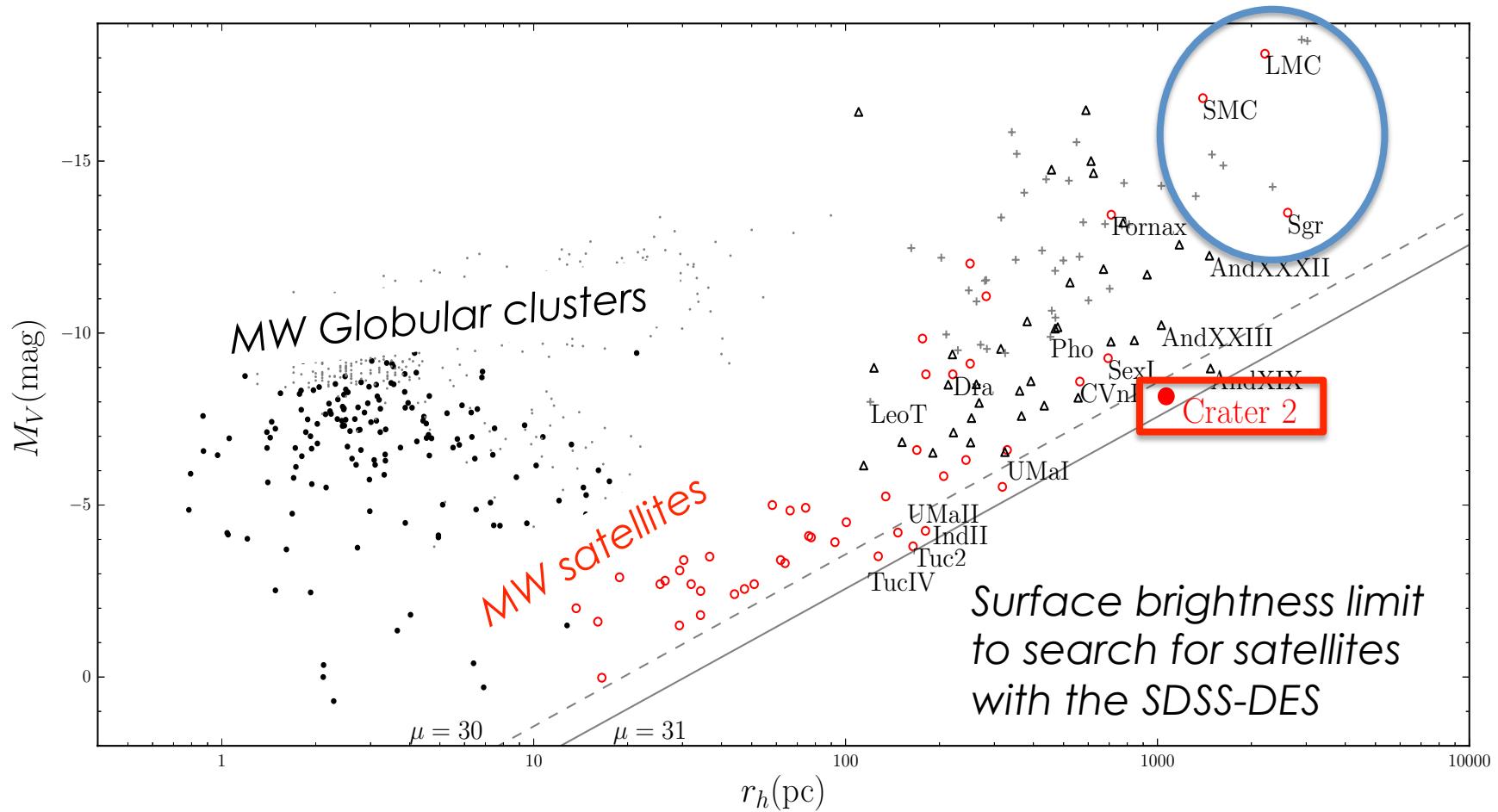
*Star counts + IMF +
stellar parameters*
=
absolute magnitude

Radial profile of Crater 2
with half-light radius of
 $r_h \sim 31'$ that leads to
 $M_v \sim 8.2$

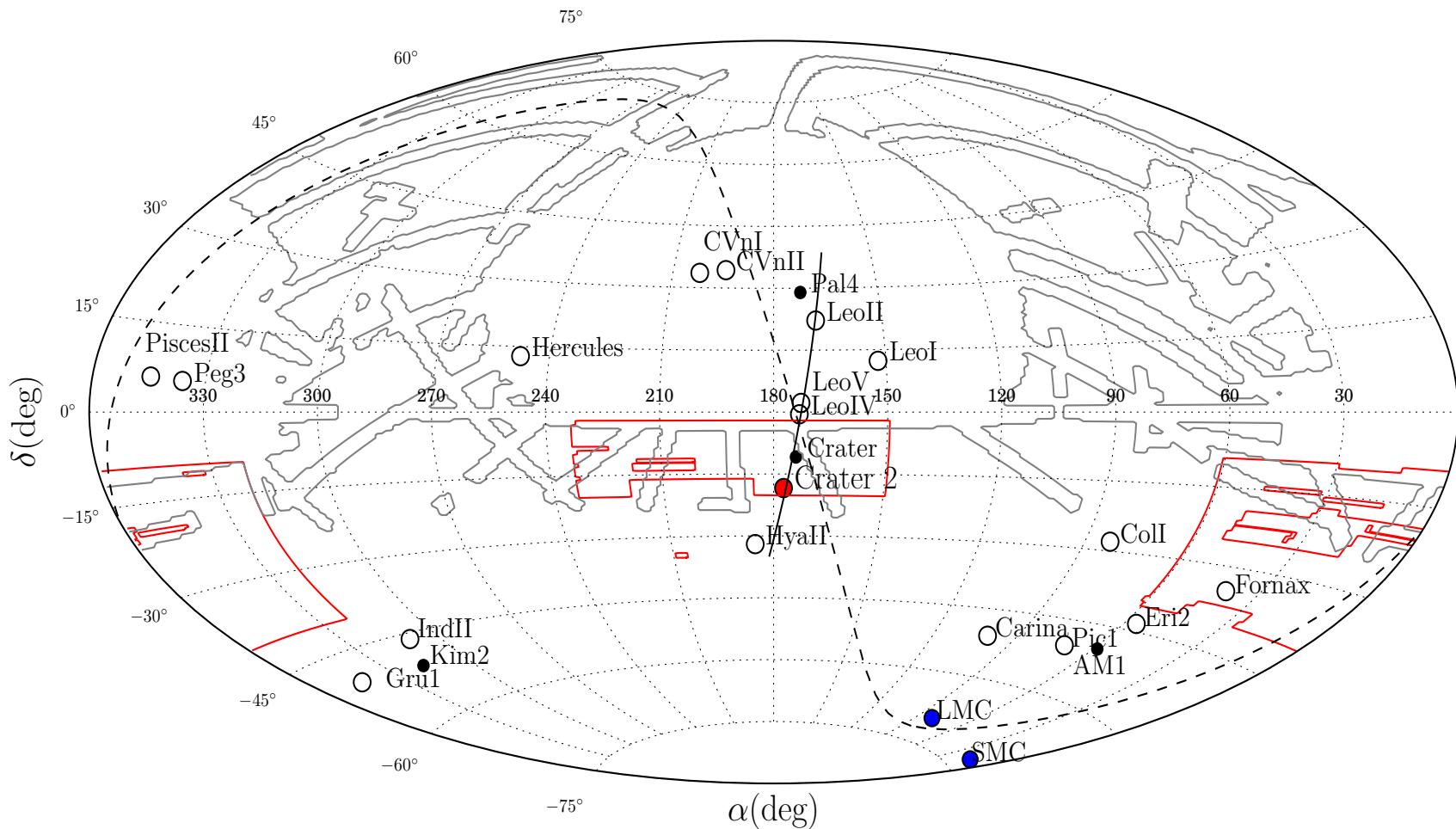
Galactic satellites



Galactic satellites

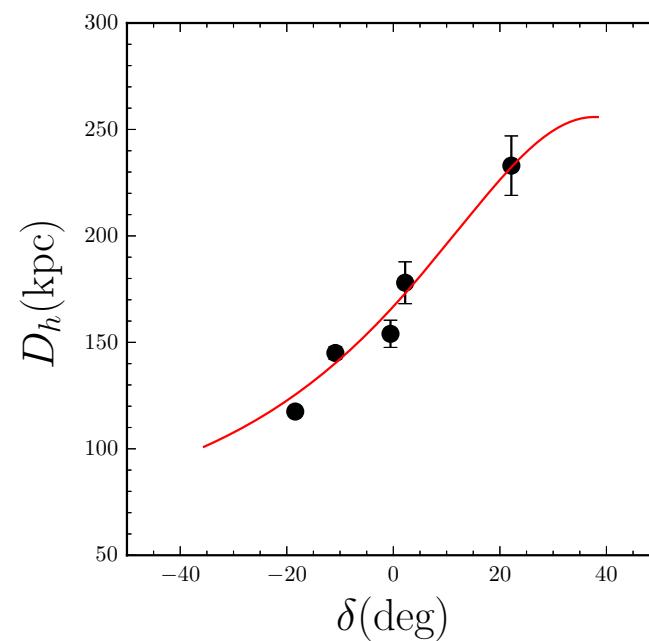
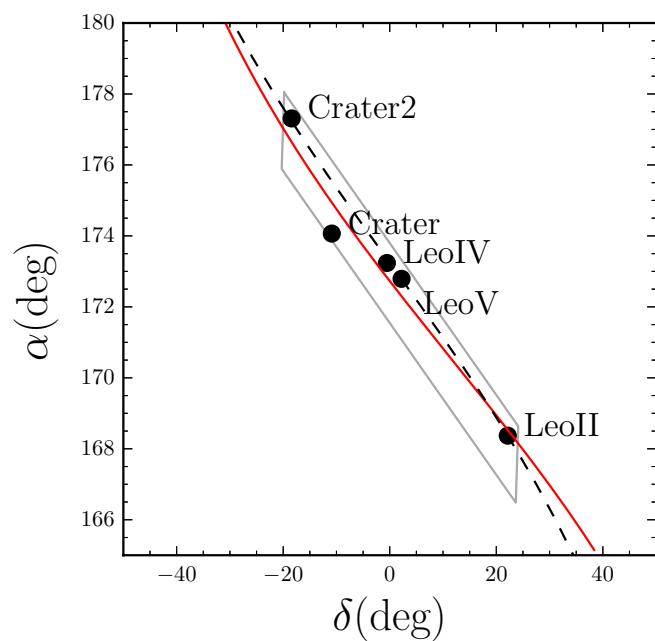


The Crater-Leo group



The Crater-Leo group

The alignment of Crater 2, Leo II, IV and V (dwarf galaxies) and Crater (globular cluster) suggest a common origin prior to falling to the Milky Way



Summary

- ★ We have presented the discovery of the **Crater 2**, identified in the data of the VST ATLAS survey
- ★ Crater 2 is the 4th more extended satellite of the Milky Way ($r_h \sim 31'$ → **~1.1 kpc !!**) after Sgr, the LMC and the SMC
- ★ Evidence suggest that the Leo-Crater group colud have been origniated from the same progenitor