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Authors	ANNIBALI, FRANCESCA
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The connection between star formation and accretion phenomena in local star-forming dwarf galaxies

Francesca Annibali

INAF – Osservatorio Astronomico di Bologna- Italy

IN COLLABORATION WITH:

Felice Cusano (INAF-OABO)
Michele Bellazzini (INAF-OABO)
Monica Tosi (INAF-OABO)
Diego Paris (INAF-OAR)

Carlo Nipoti (UNIBO-DIFA)
Luca Ciotti (UNIBO-DIFA)
Michele Cignoni (UNI Pisa)
Elena Sacchi (INAF-OABO)
Alessandra Aloisi (STScI)

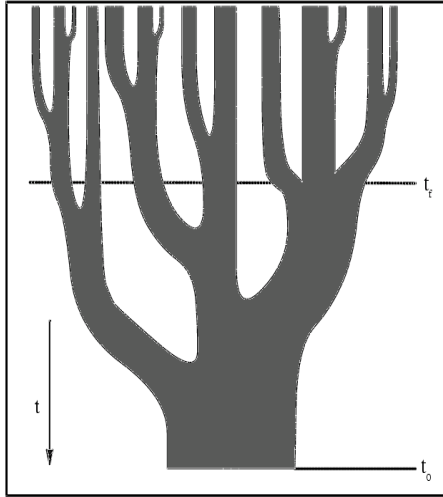


*Linking Observations and Theory
Across the Scales of Star Formation in Galaxies
July 12th – Sexten*

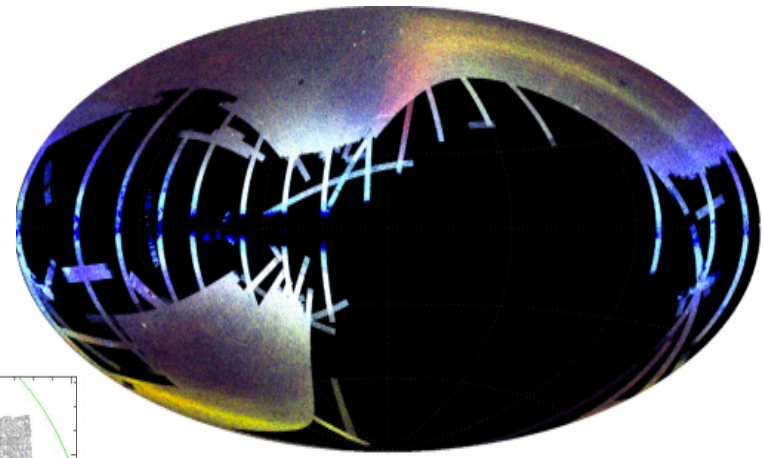
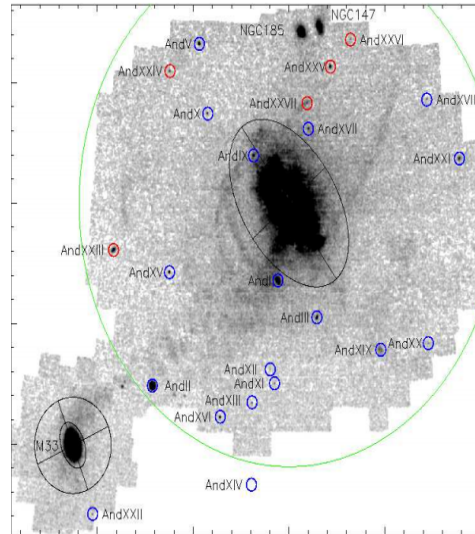


Λ CDM - Hierarchical structure formation

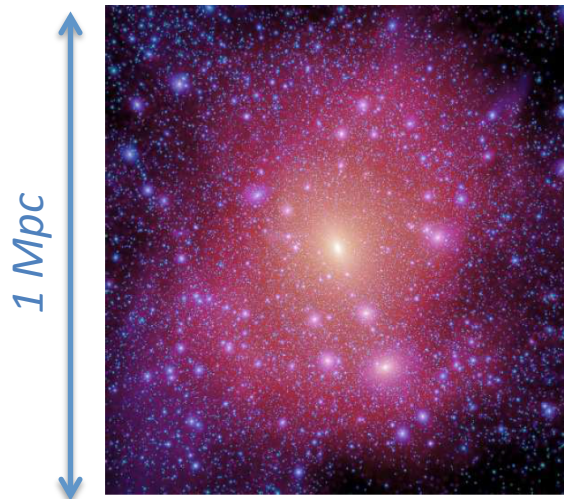
Lacey & Cole (1993)



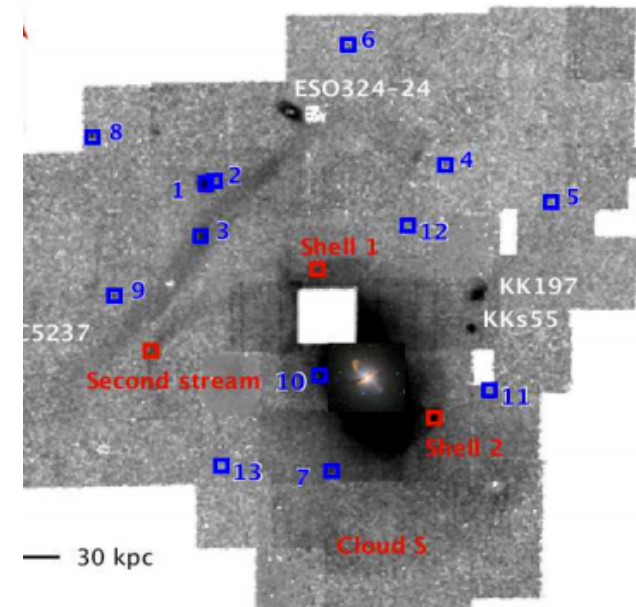
Milky Way
(Belokurov + 06)



Aquarius simulation



M31 spiral
(Richardson + 11)

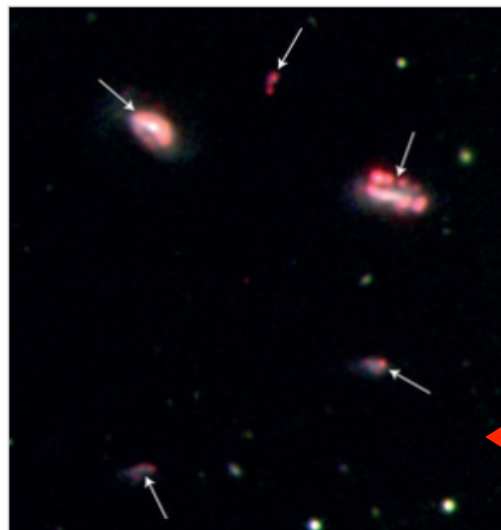
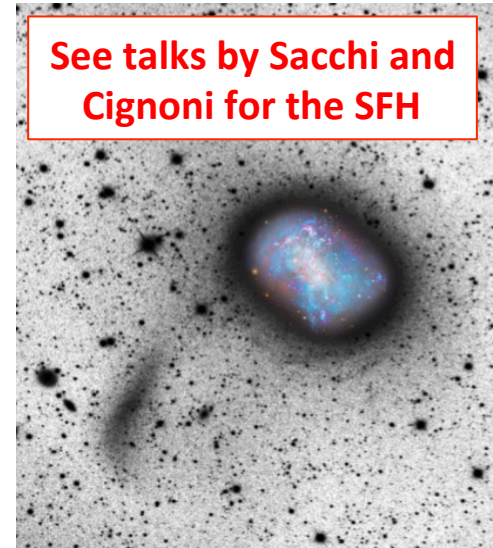
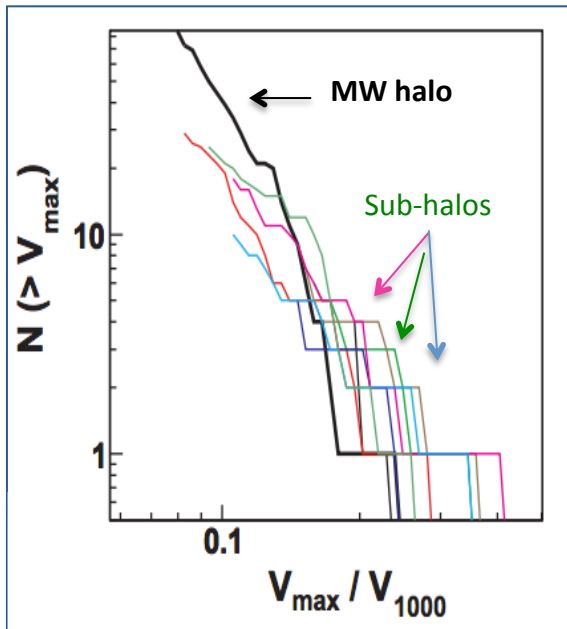


CenA elliptical
(Crnojevic' + 16)

Hierarchical assembly at small galaxy scales

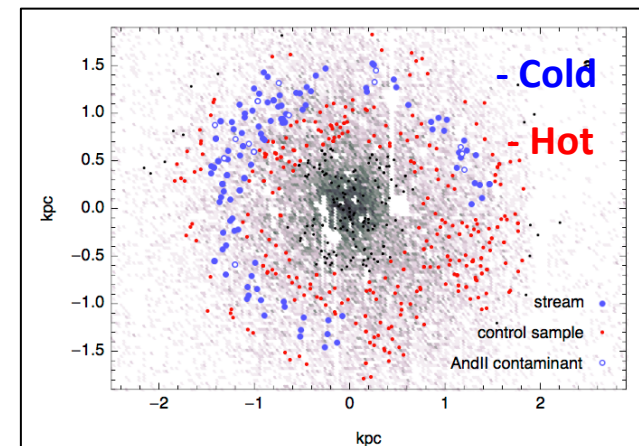
DM halos and sub-halos have the same relative abundance of substructures
 (Diemand + 08, Nature 454, 735)

NGC 4449 (Martinez-Delgado + 12; Rich + 12)

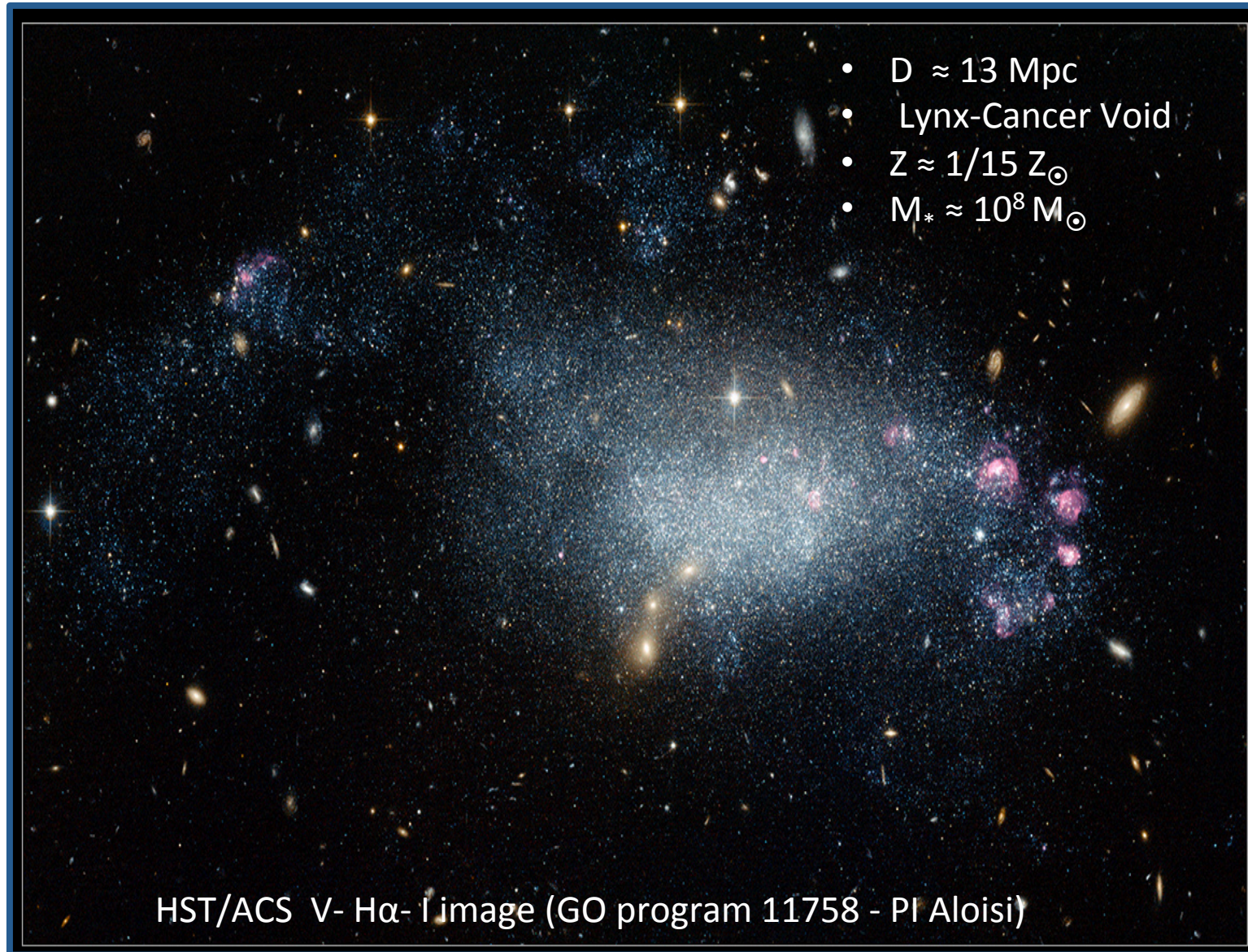


Groups of only dwarfs (Stierwalt + 17)
 (see also loose associations of LG dwarfs by Tully+ 06)

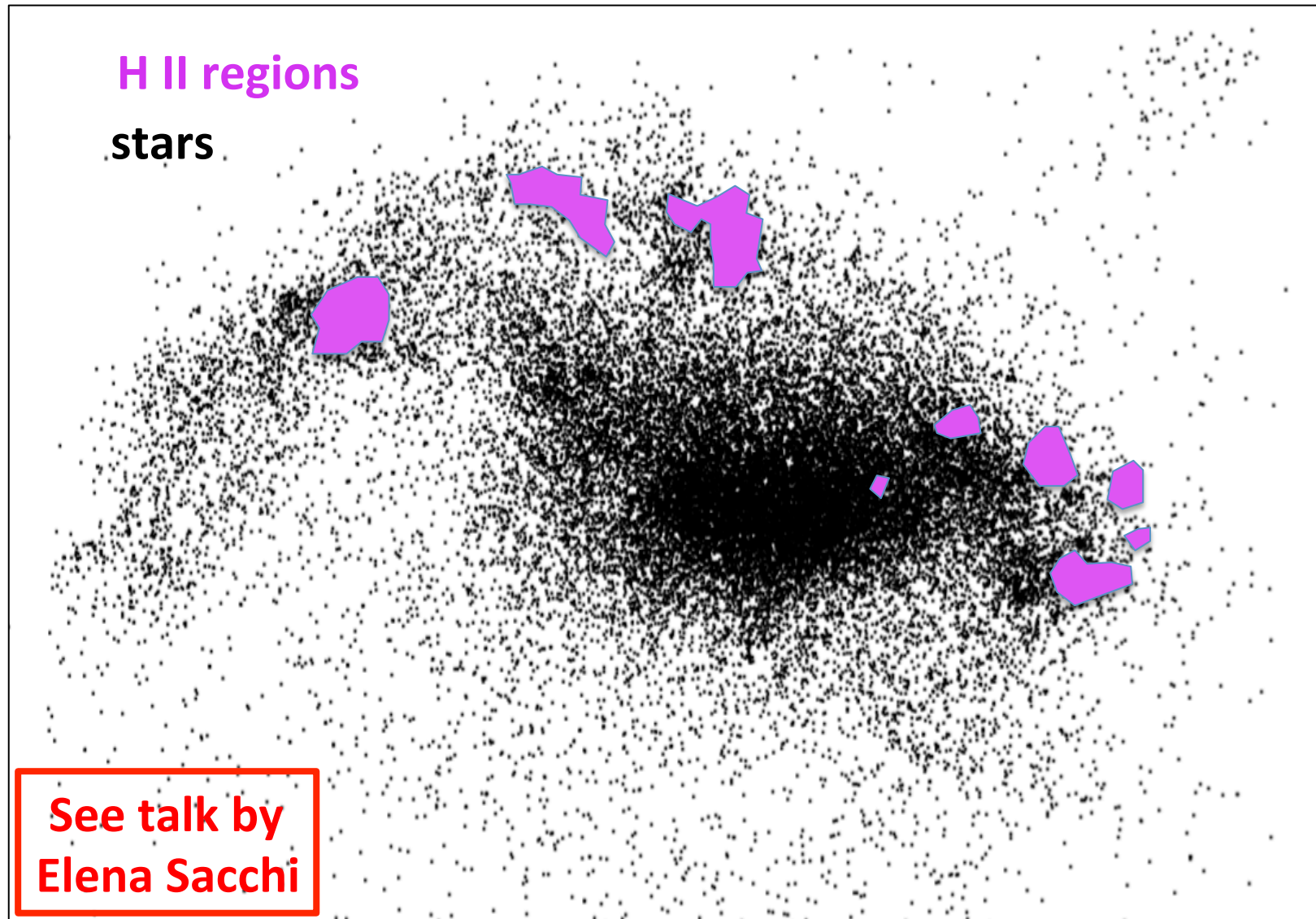
“kinematical stream” in AndII,
 with $10^7 M_{\star}$ (Amorisco +14)



First evidence of multiple merging at very low galactic scales: **DDO 68**



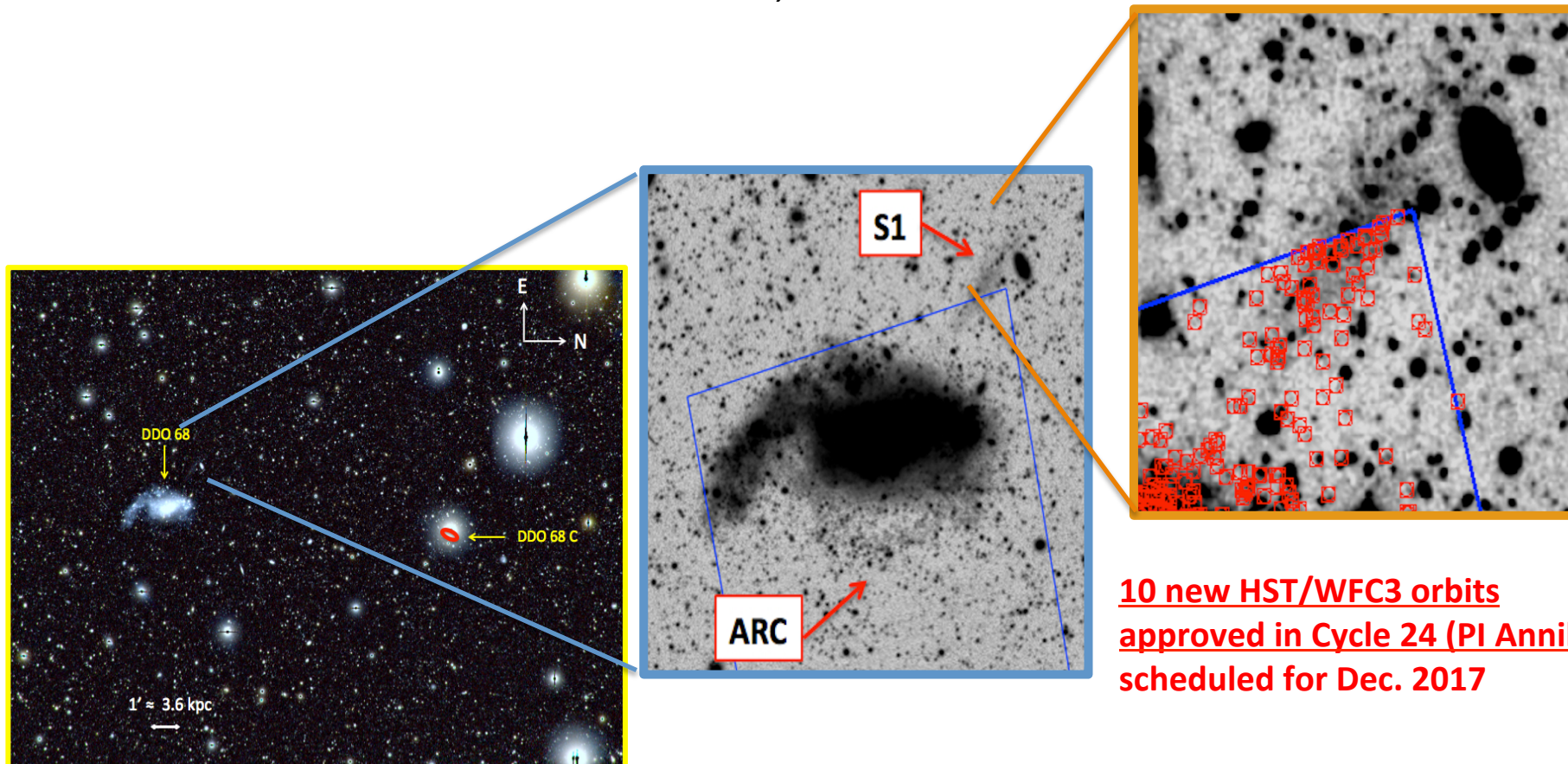
First evidence of multiple merging at very low galactic scales: **DDO 68**





New LBT / LBC imaging of DDO 68 (PI Annibali)

- Annibali *et al.*, ApJ 826, L27, 2016:
DDO 68: A Flea with Smaller Fleas that on Him Prey

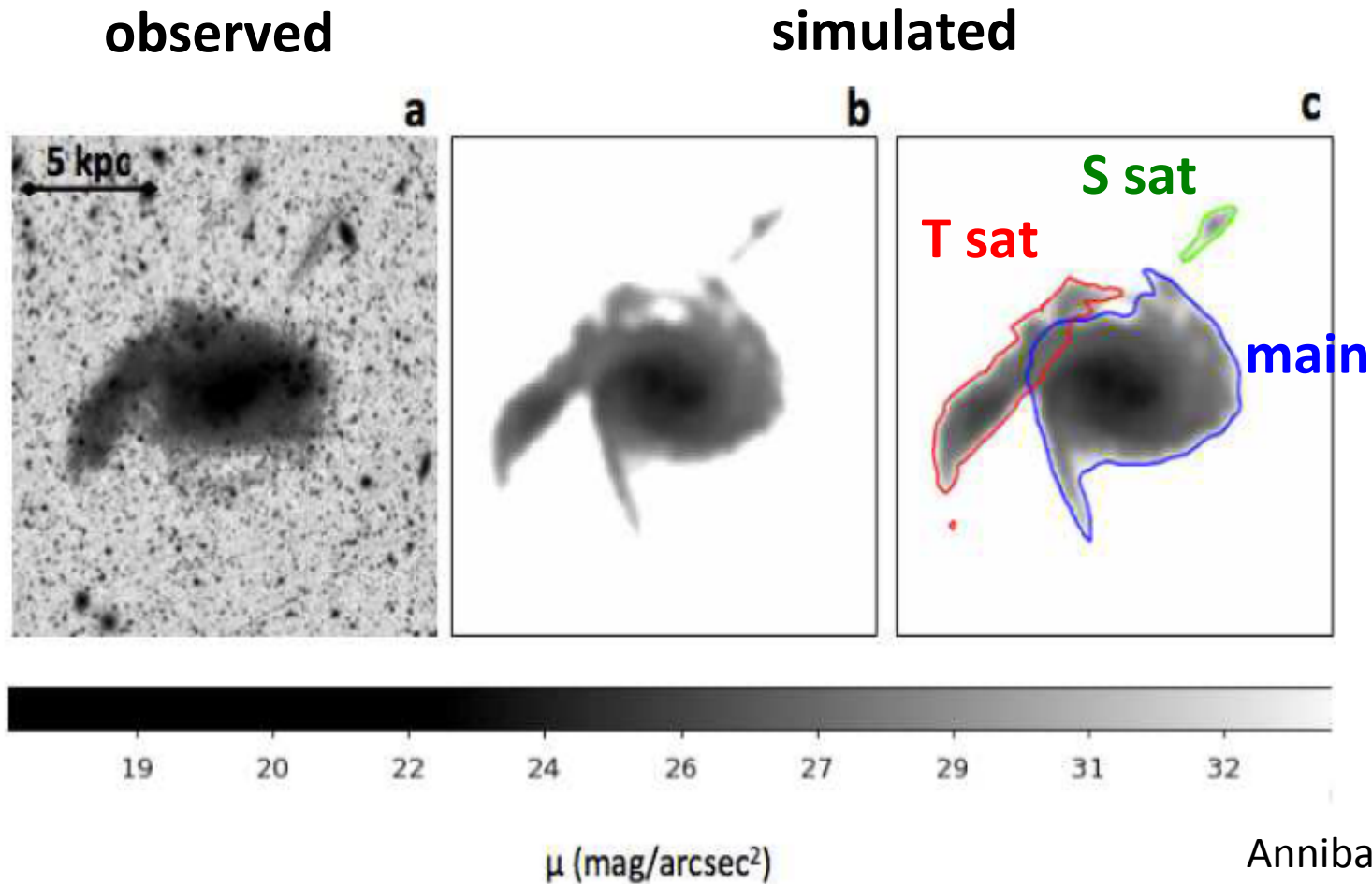


10 new HST/WFC3 orbits approved in Cycle 24 (PI Annibali)-scheduled for Dec. 2017

N-body simulations of DDO 68' s system

- Collisionless N-body code by Nipoti, Londrillo & Ciotti (2003)

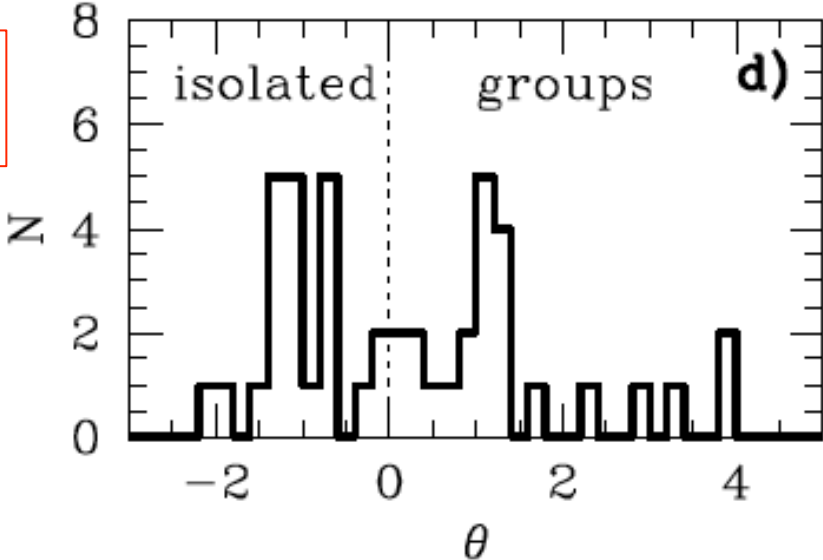
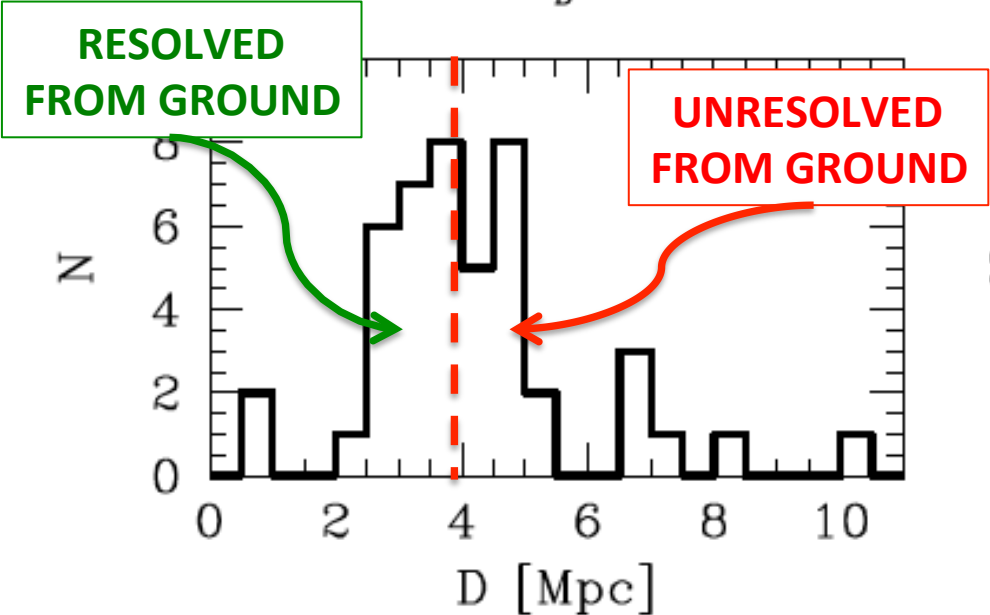
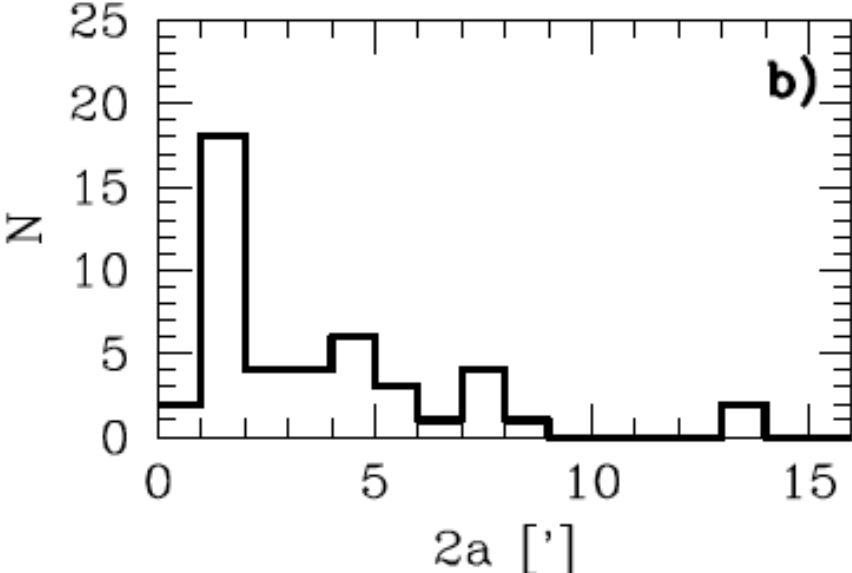
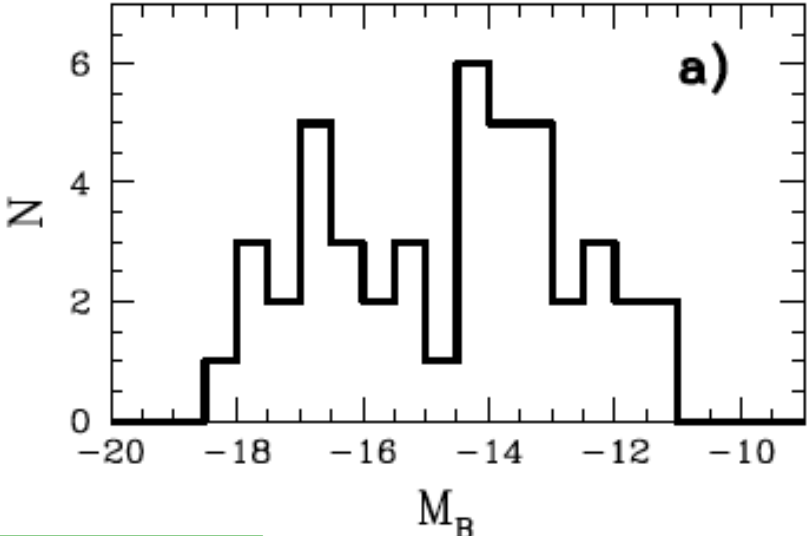
$$M_{\text{tot}} \approx 10^{10} M_{\odot}; \text{ T sat: } M_{\text{tot}}/10; \text{ S sat: } M_{\text{tot}}/150$$



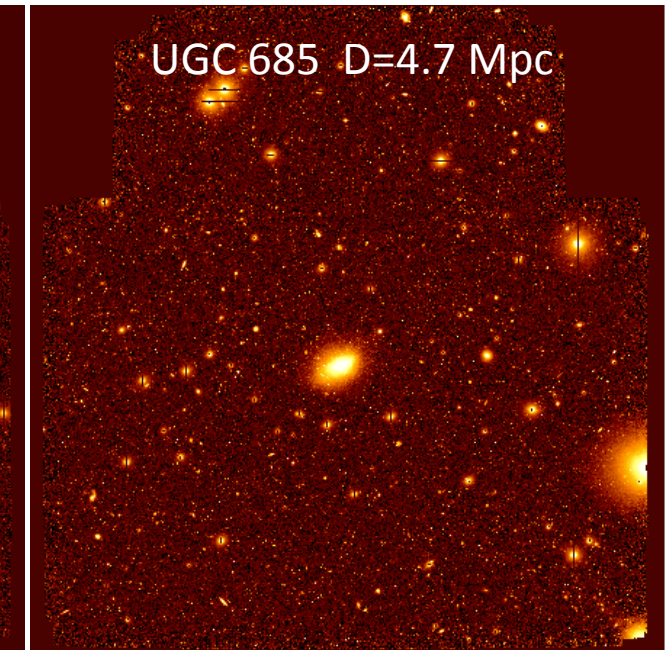
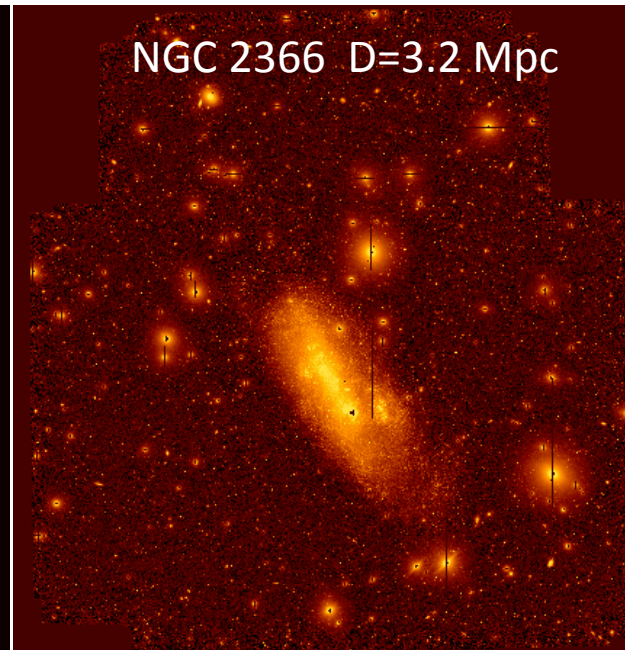
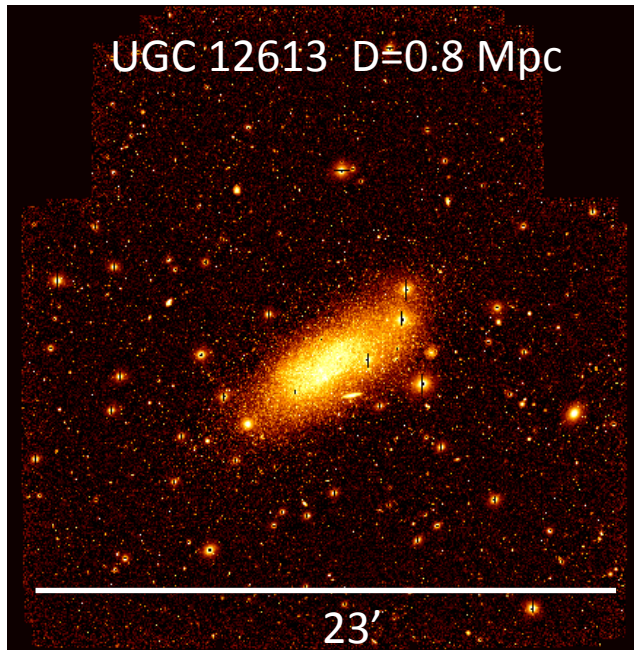
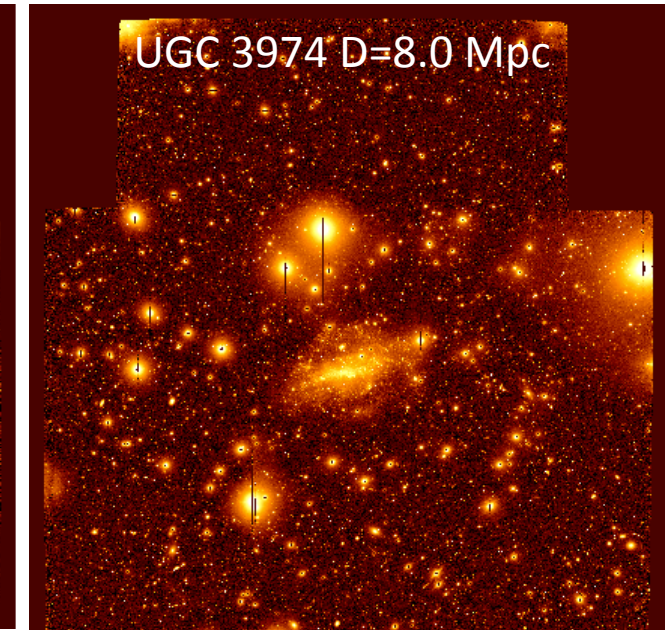
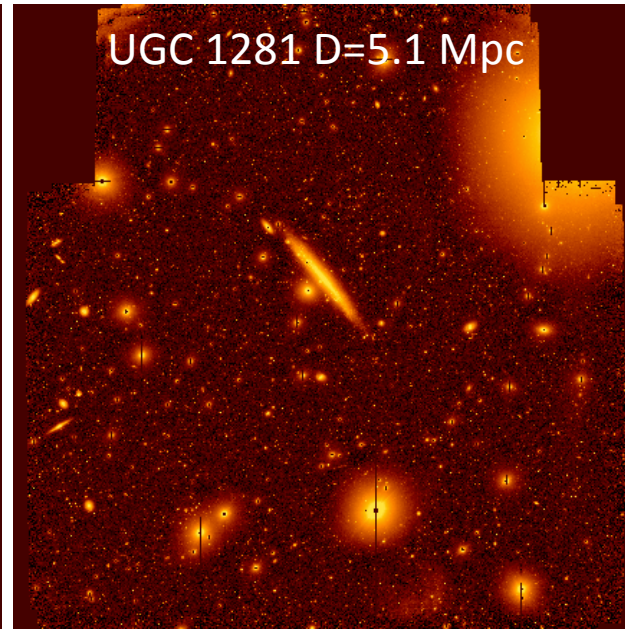
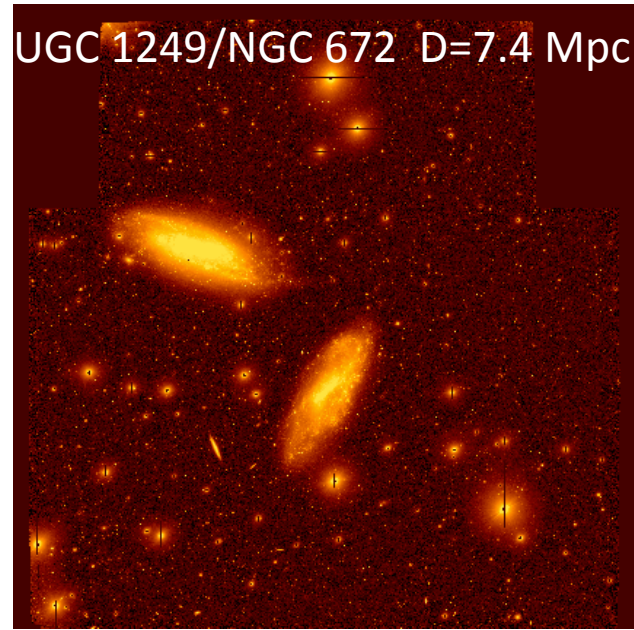
SSH: The Smallest Scale of Hierarchy Survey

- Two-year **Strategic Program** with LBT/LBC (approved in 2016) to get **deep wide-field** imaging in g and r of ≈ 50 local late-type dwarfs to study the **hierarchical formation at small galaxy scales** and the **connection between SF and accretion events** (PI Annibali).
- The **sample** was selected from the Updated Nearby Galaxy Catalog of Karachentsev + 13 ($D < 11$ Mpc) according to the following criteria:
 - galaxies in the northern hemisphere;
 - with distance from Tip of the RGB;
 - with HST – **WFPC2/ACS/WFC3** data;
 - with low foreground extinction ($A_V < 0.5$);
 - with morphological type $T \geq 6$ (late spirals and irregulars);
 - with magnitudes $-11 < M_B < -19$
 - with apparent major axis ($2a$) in the range 1-15 arcmin.
- **Surface brightness limit:**
 - Where stars resolved down to $1 \approx$ mag below TRGB $\rightarrow \mu_r \approx 32$ mag arcsec $^{-2}$
 - Otherwise $\rightarrow \mu_r \approx 29$ mag arcsec $^{-2}$

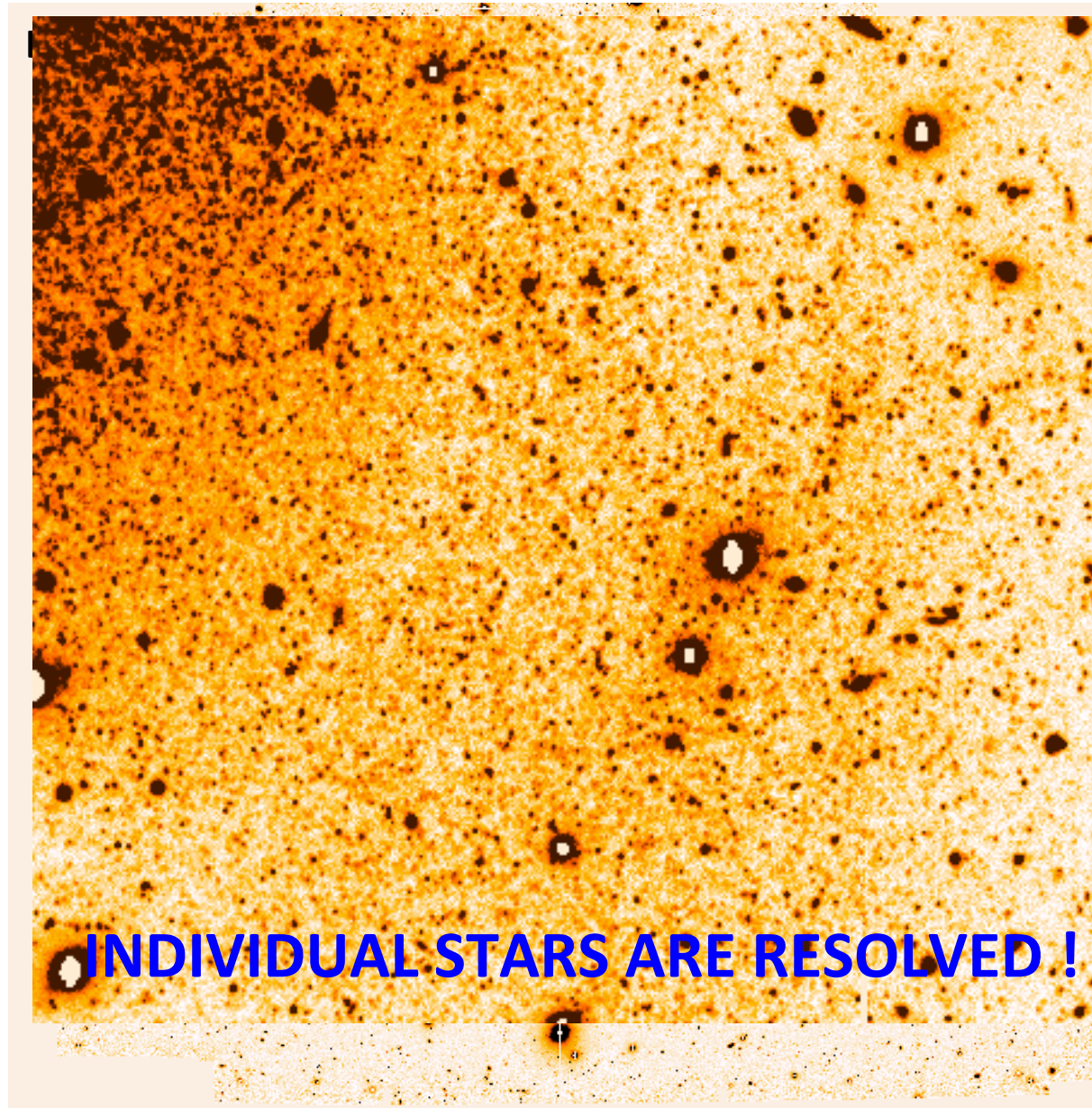
SSH: The Smallest Scale of Hierarchy Survey



A gallery of SSH images . . .

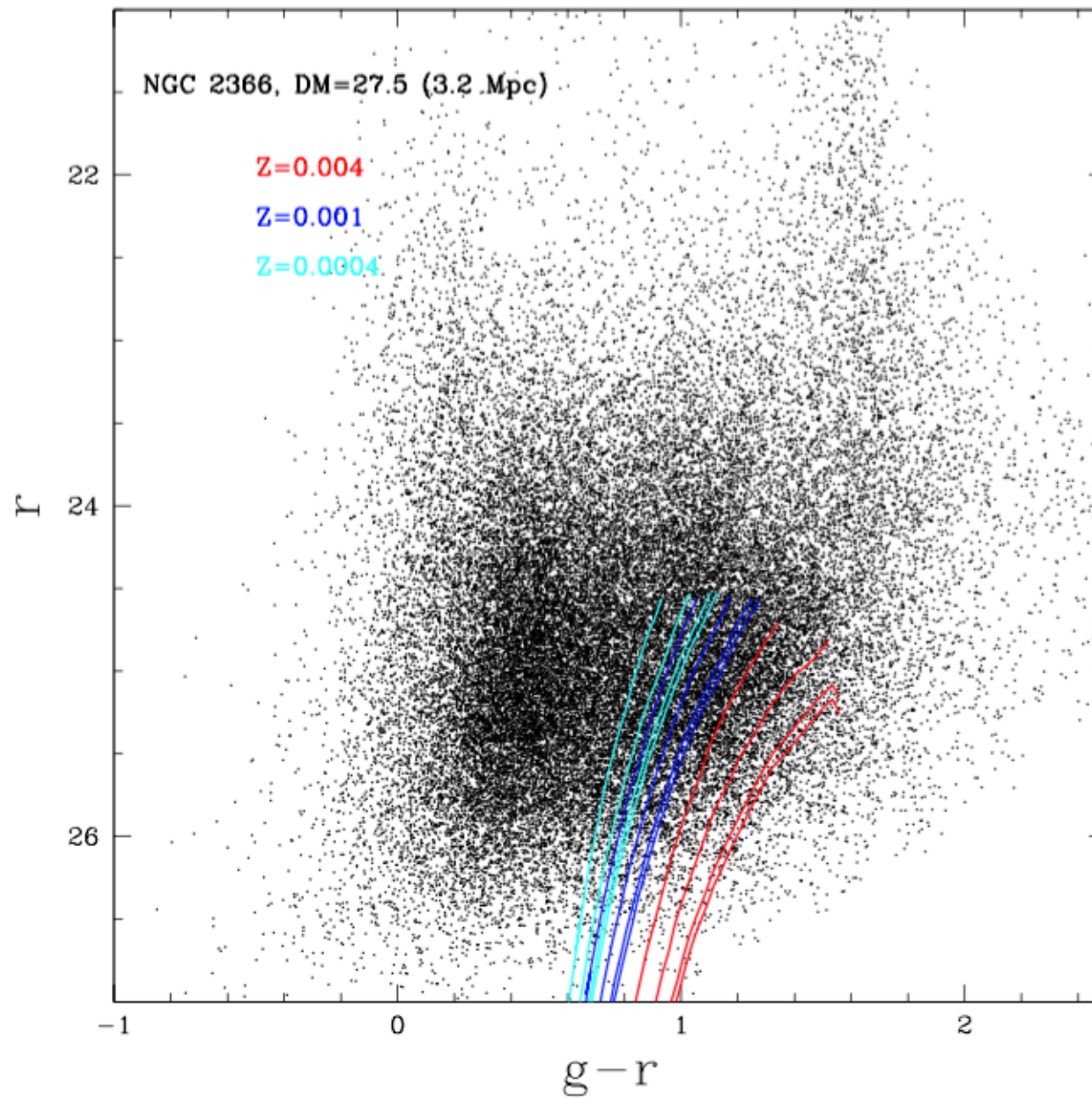


NGC 2366 – D=3.2 Mpc, $M_B \approx -16$

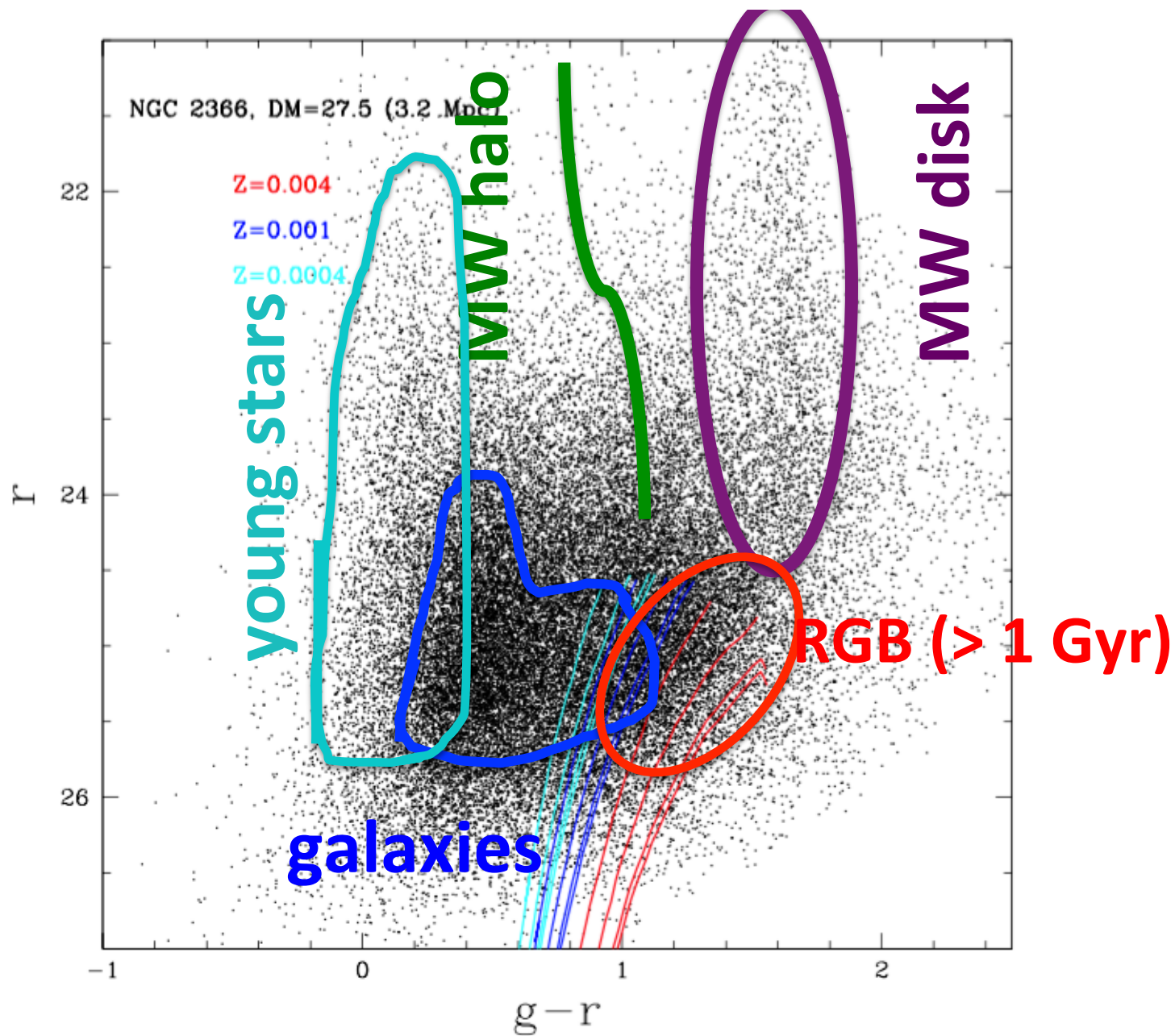


INDIVIDUAL STARS ARE RESOLVED !

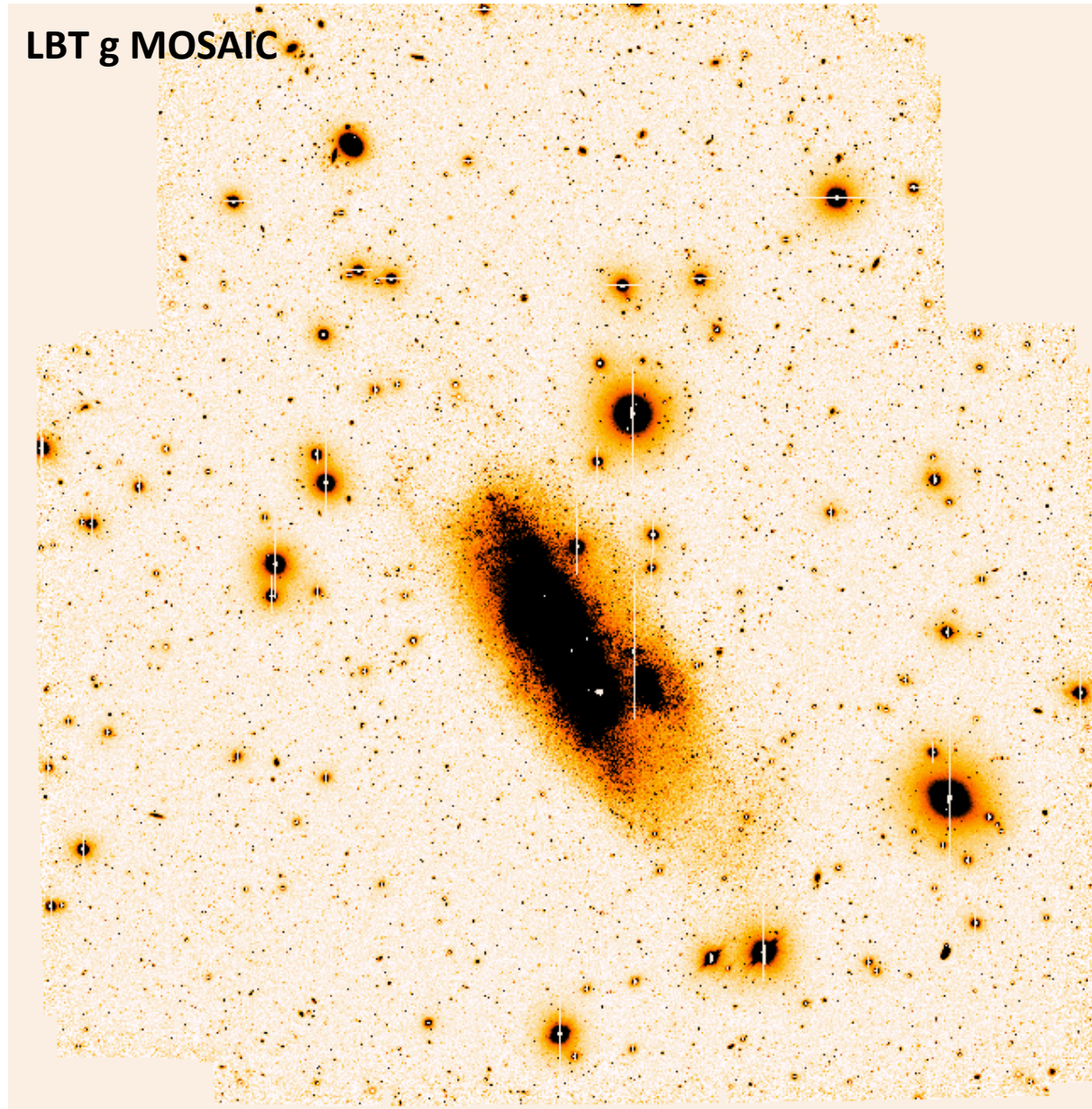
NGC 2366: Color–Magnitude Diagram



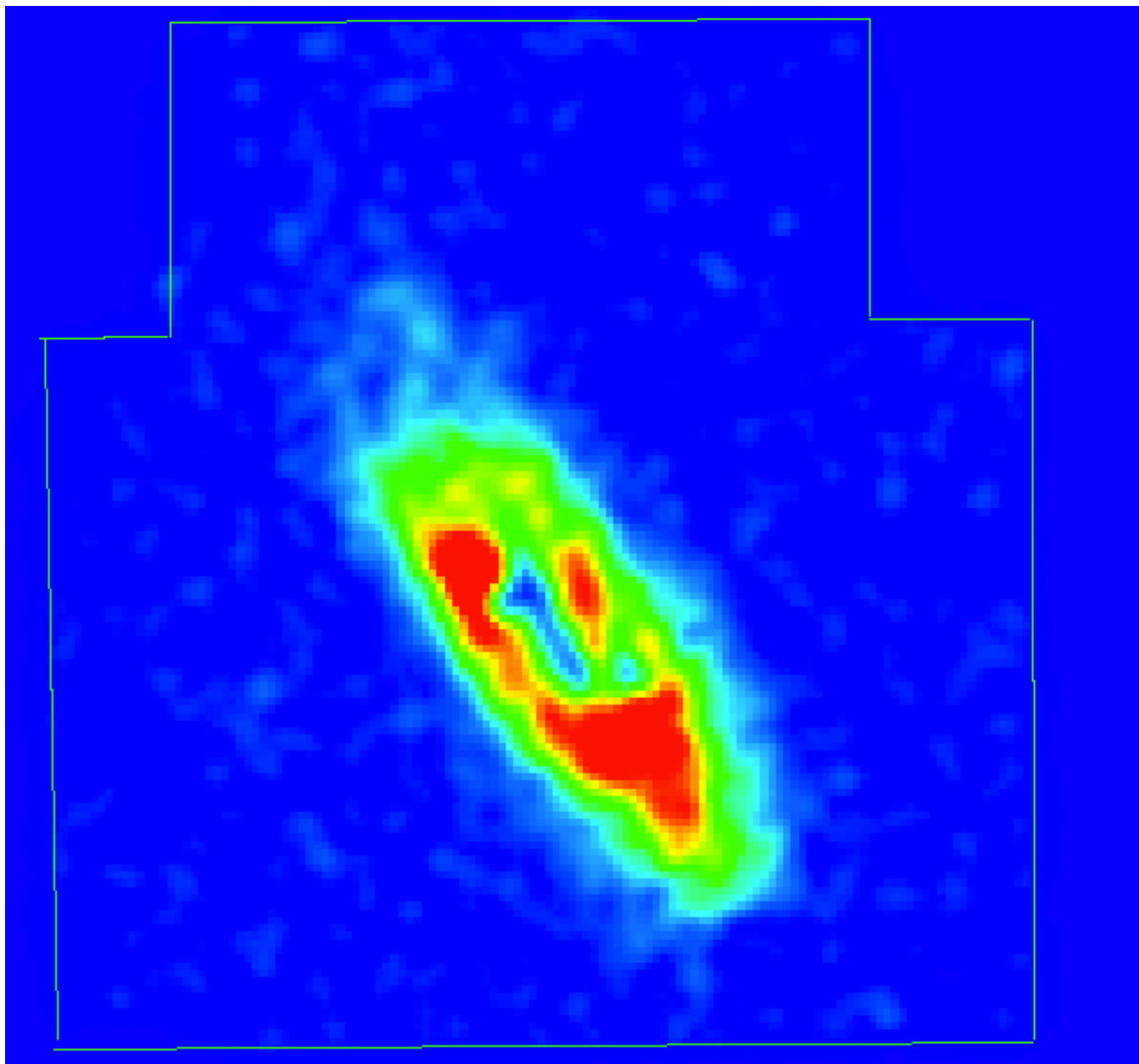
NGC 2366: Color–Magnitude Diagram



NGC 2366 – $D=3.2$ Mpc, $M_B \approx -16$



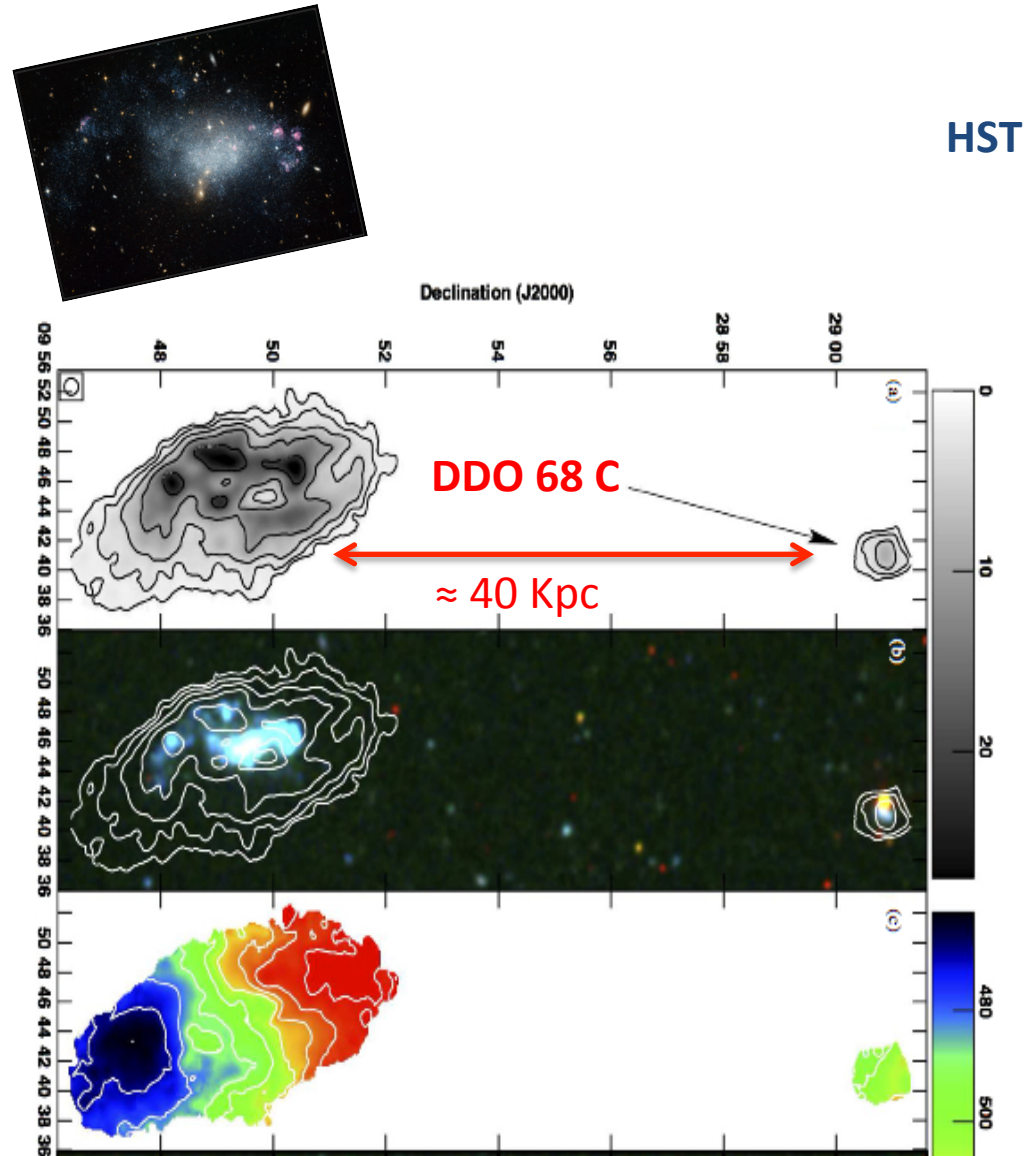
NGC 2366 – MAP of the resolved RGB STARS



SSH: Concluding Remarks and Perspectives

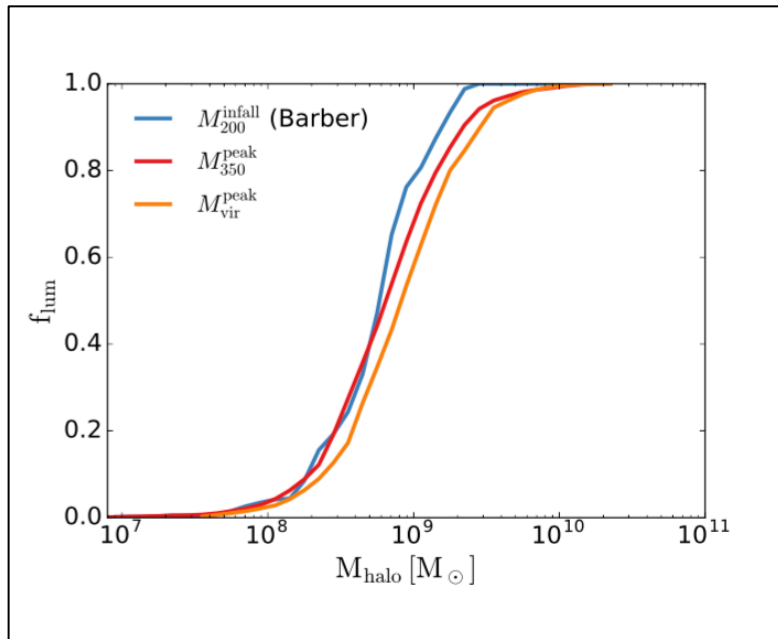
- About **10 targets** observed during the first year of the survey. . . **HOPE TO BE MORE LUCKY DURING NEXT YEAR!!!**
- At completion, SSH will provide:
 - statistics on number and mass of satellites/streams around dwarf galaxies
 - dependence with environment
- N-body simulations to infer properties and timescales of the interaction events
- Galaxy Star Formation History from HST/LBT color-magnitude diagram → CONNECTION BETWEEN SF AND INTERACTION

First evidence of multiple merging at very low galaxy scales: **DDO 68**

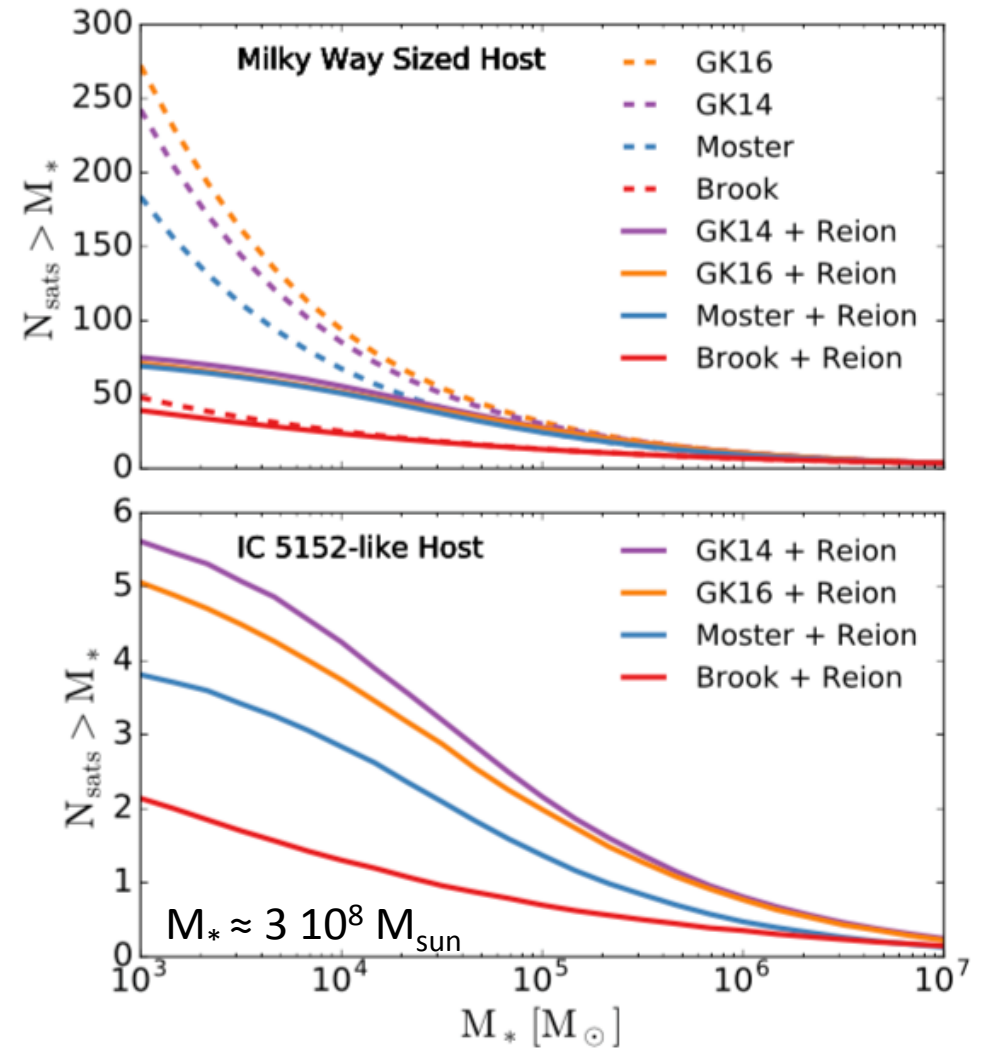


Predictions for satellite abundance

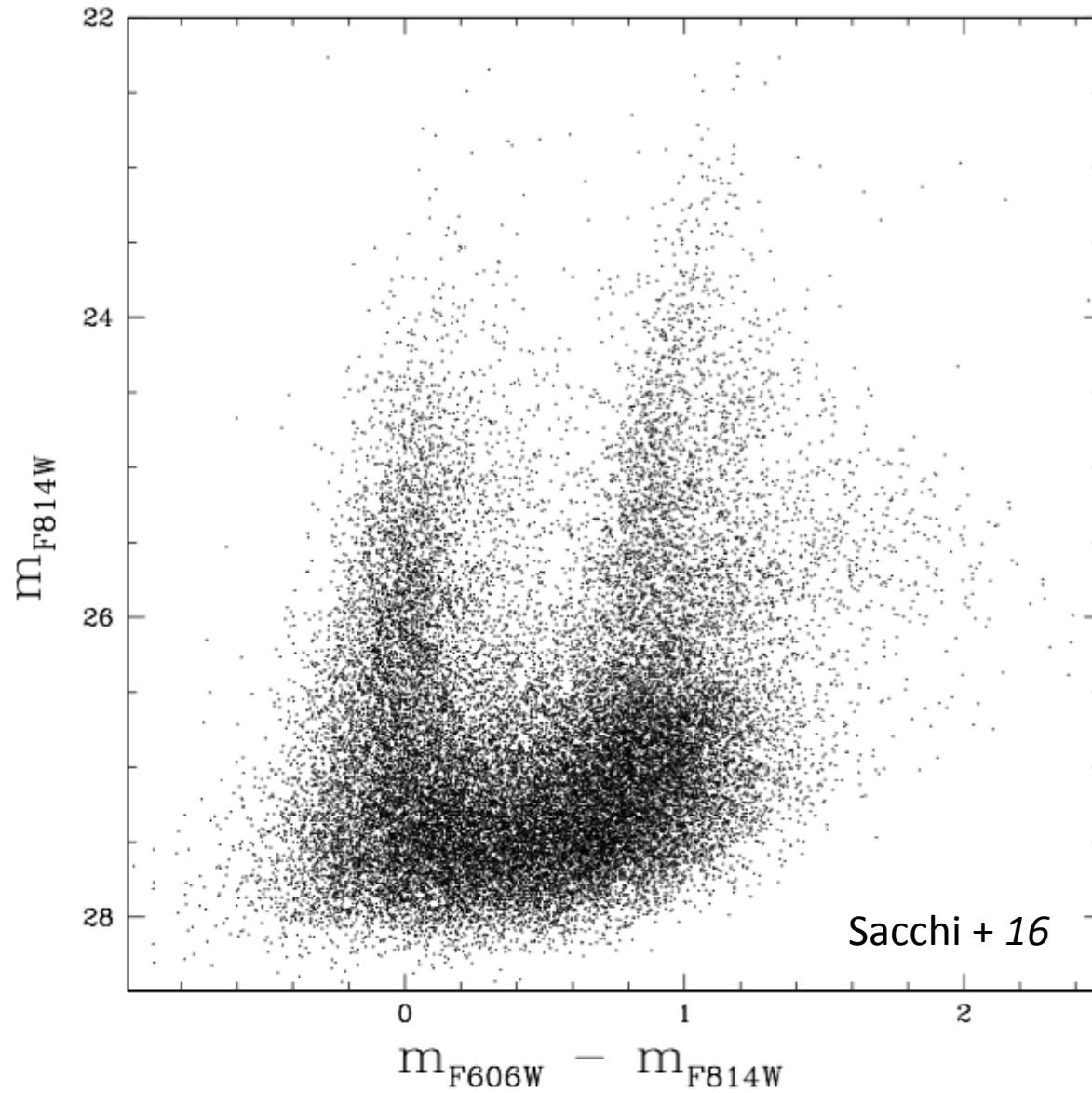
Dooley et al. 2016



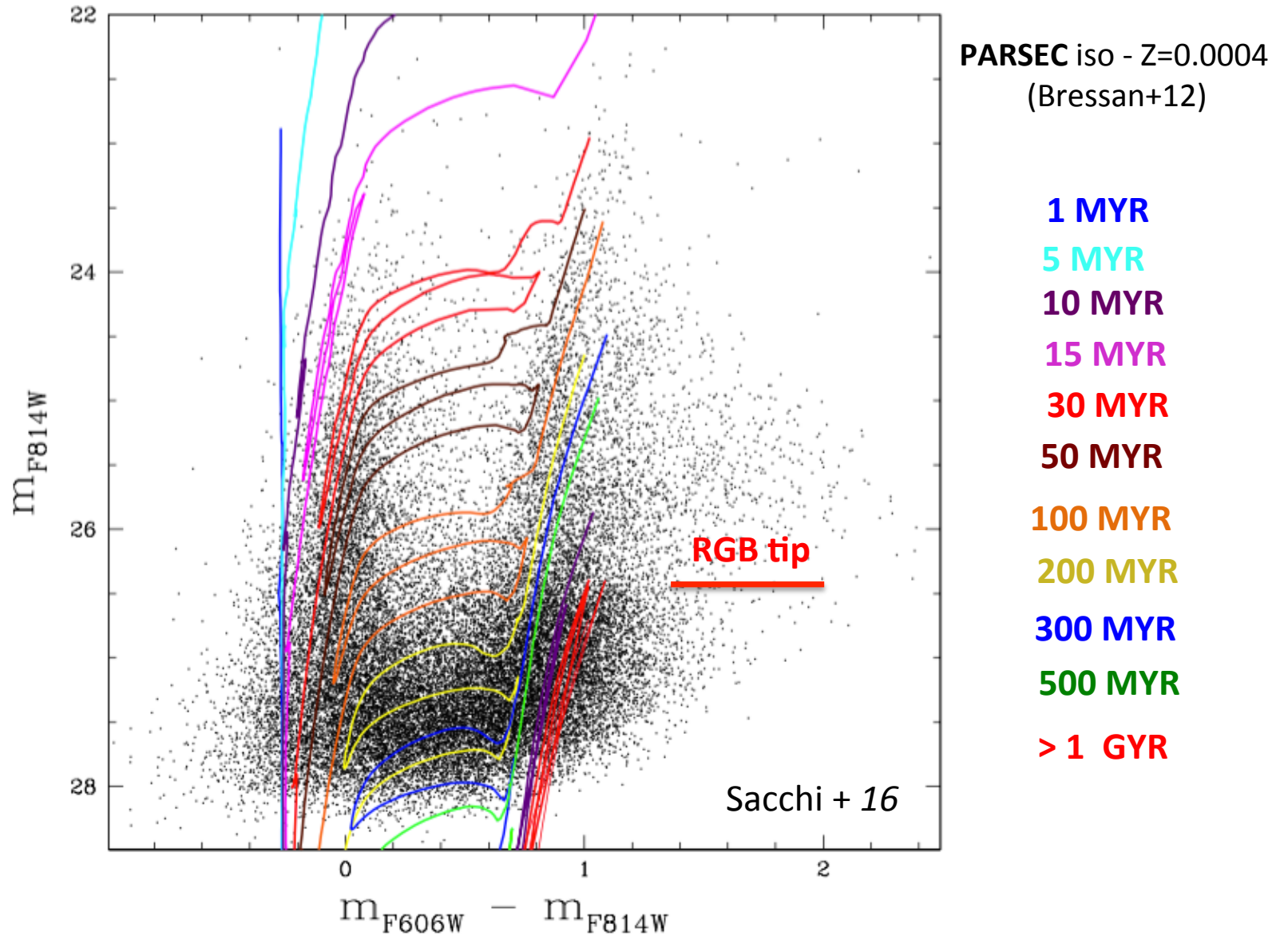
Fraction of dark matter halos that host luminous satellites at $z=0$



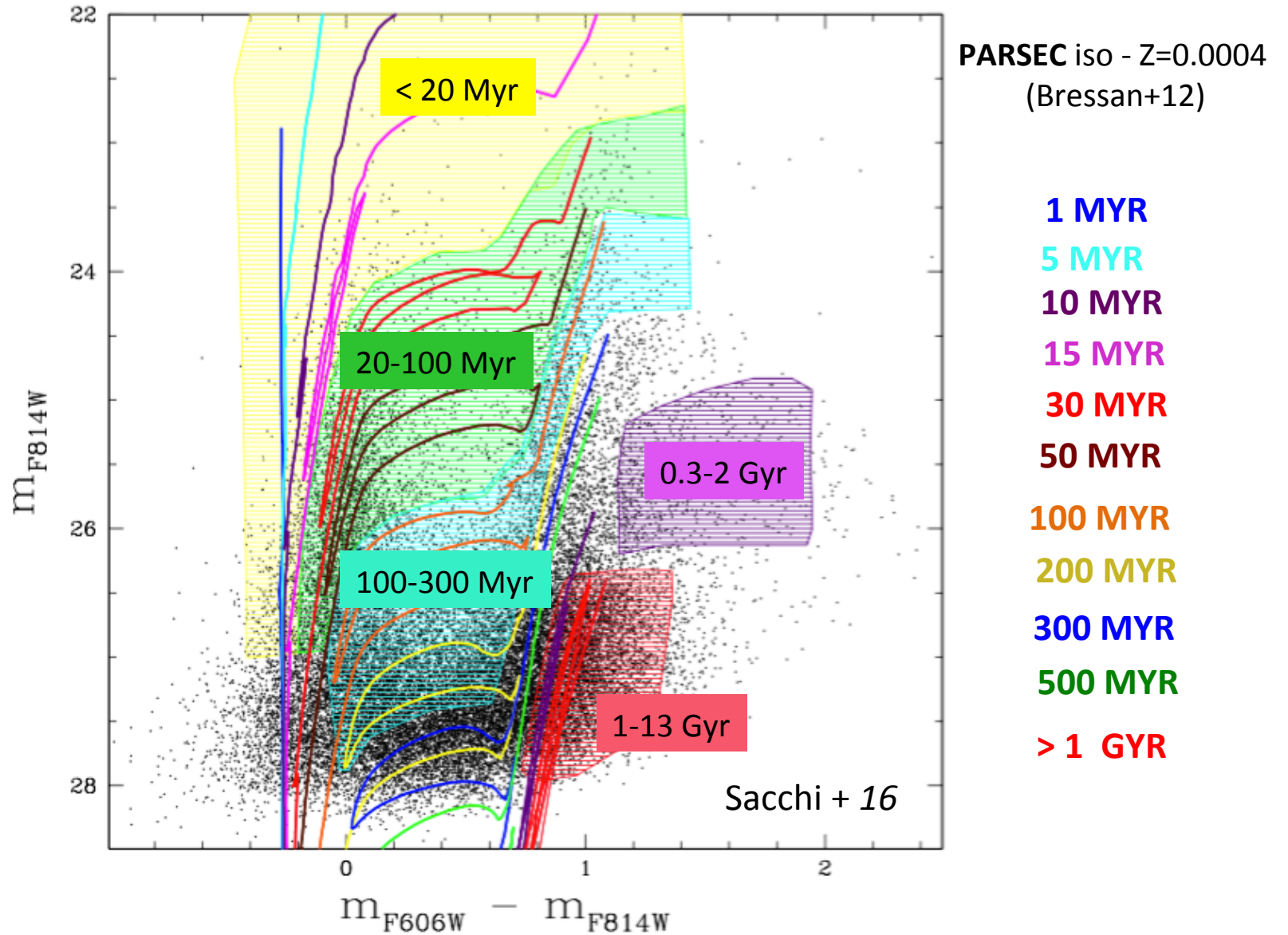
DDO 68: CMD of stars resolved with HST/ACS



DDO 68: CMD of stars resolved with HST/ACS



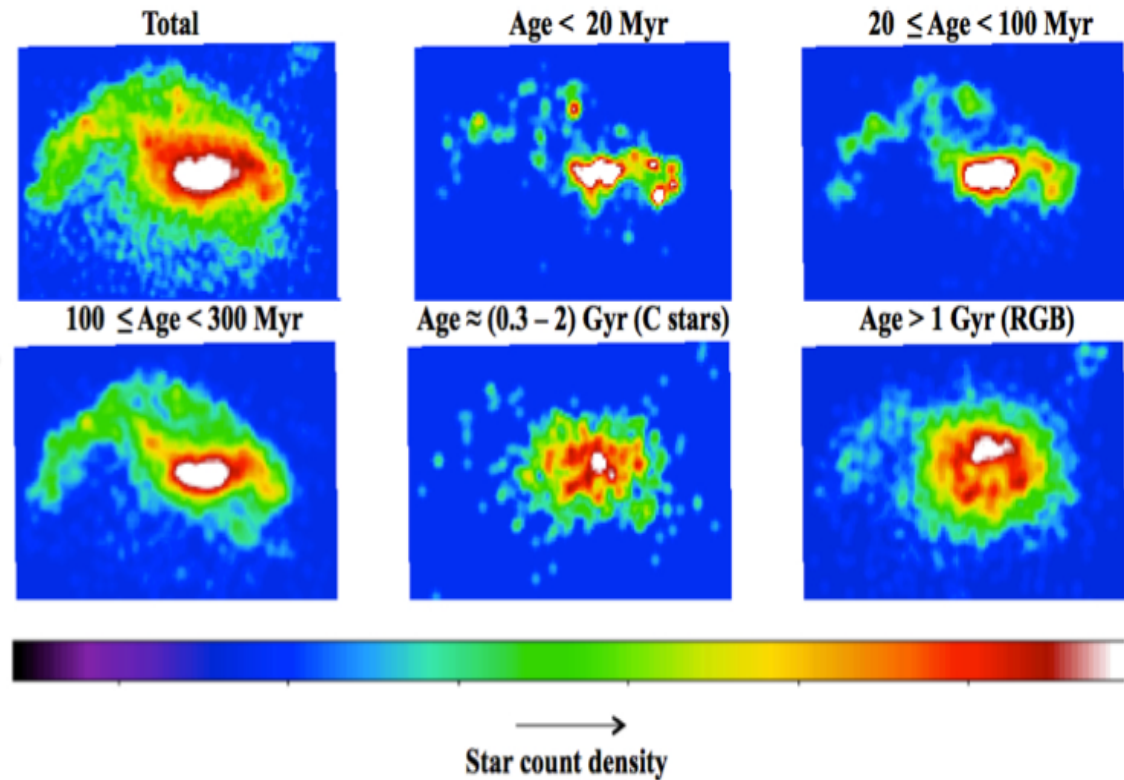
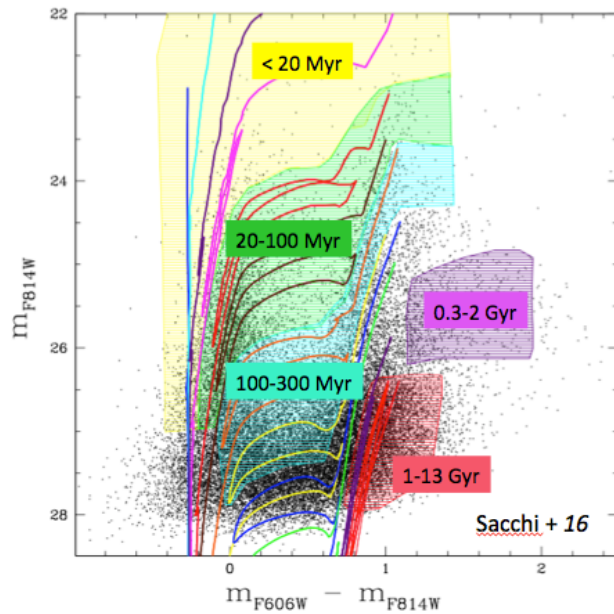
DDO 68: CMD of stars resolved with HST/ACS



DDO 68: Stellar populations from HST/ACS

Density maps for different age bins

CMD of stars resolved with HST



Sacchi + 16