

Ultra-diffuse galaxies:
nature vs. nurture

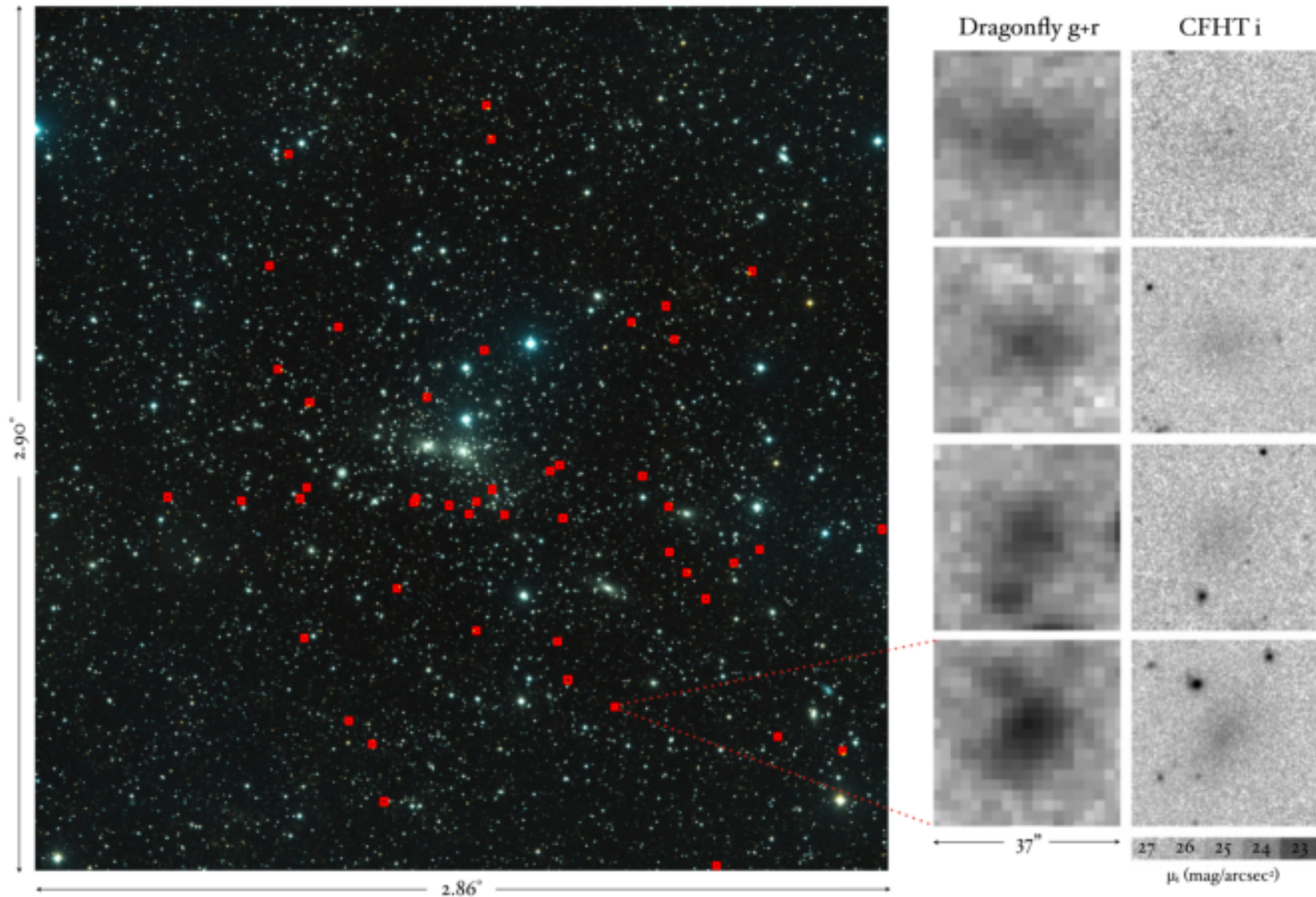
Elisa Toloba

(University of the Pacific)

Peng, Sales, Lim, Guhathakurta, Mihos,
Cote, Boselli, Ferrarese, NGVS team

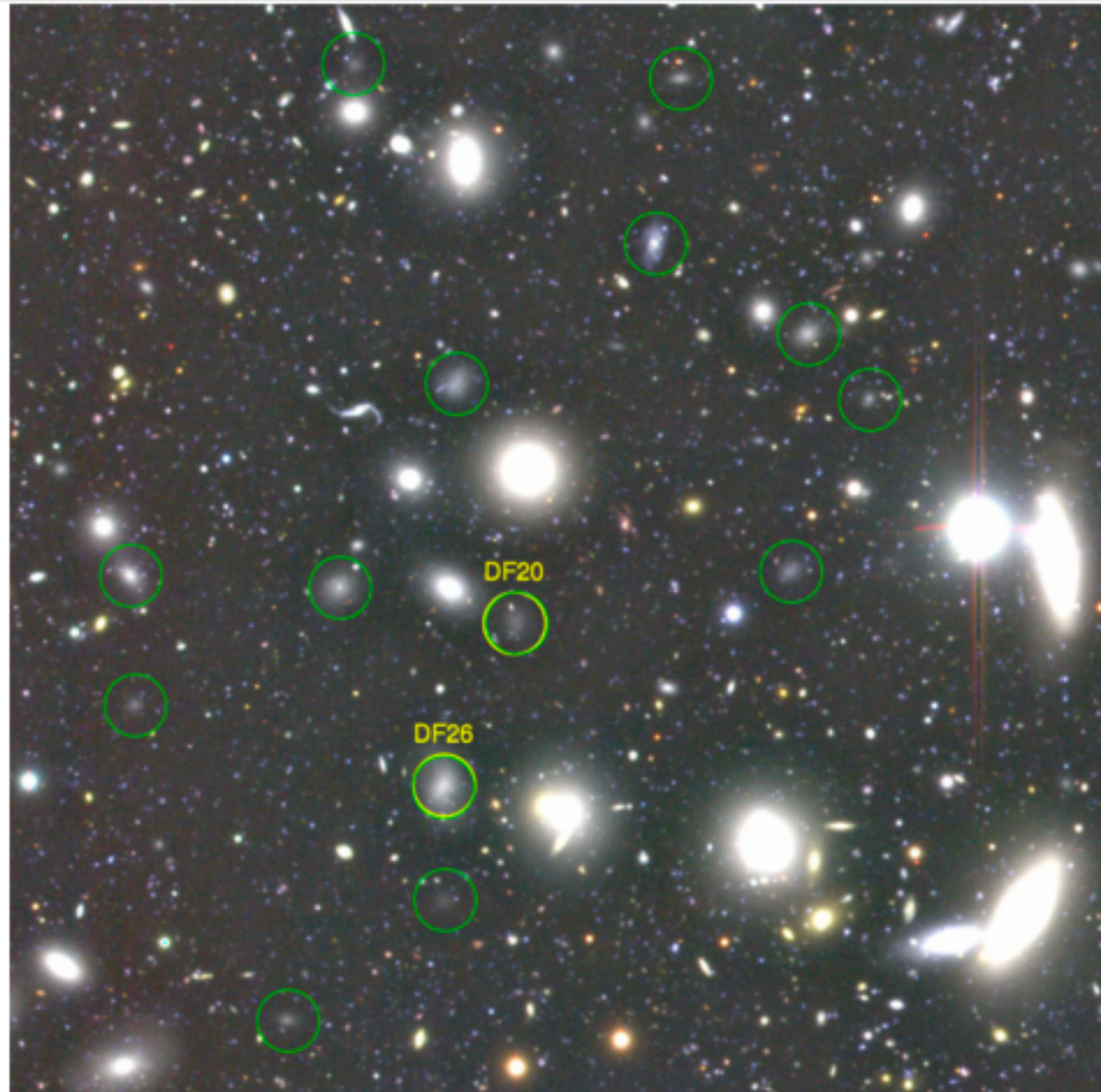
Ultra-diffuse galaxies in the Coma cluster

van Dokkum et al. (2015)



Ultra-diffuse galaxies in the Coma cluster

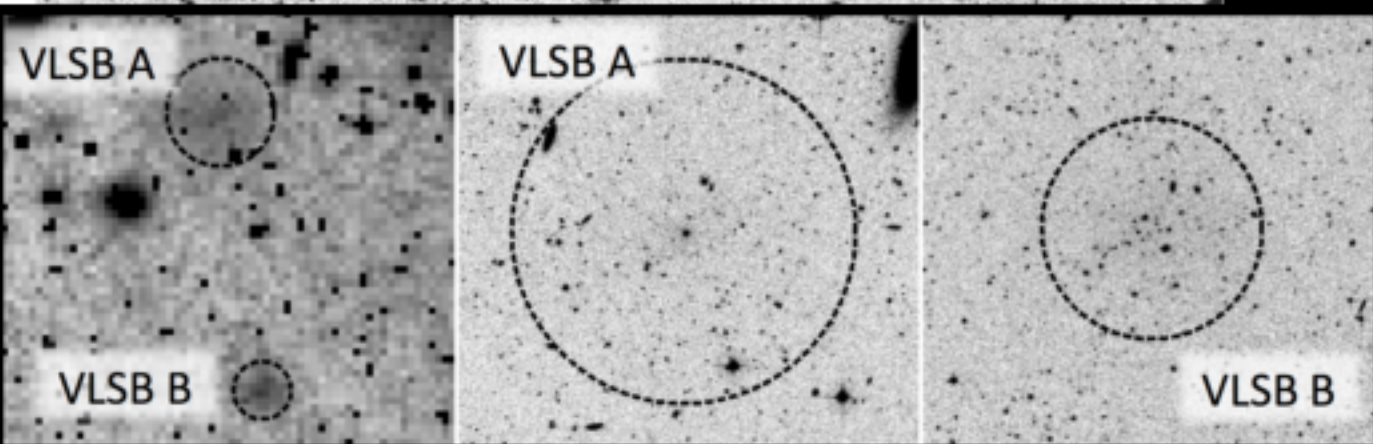
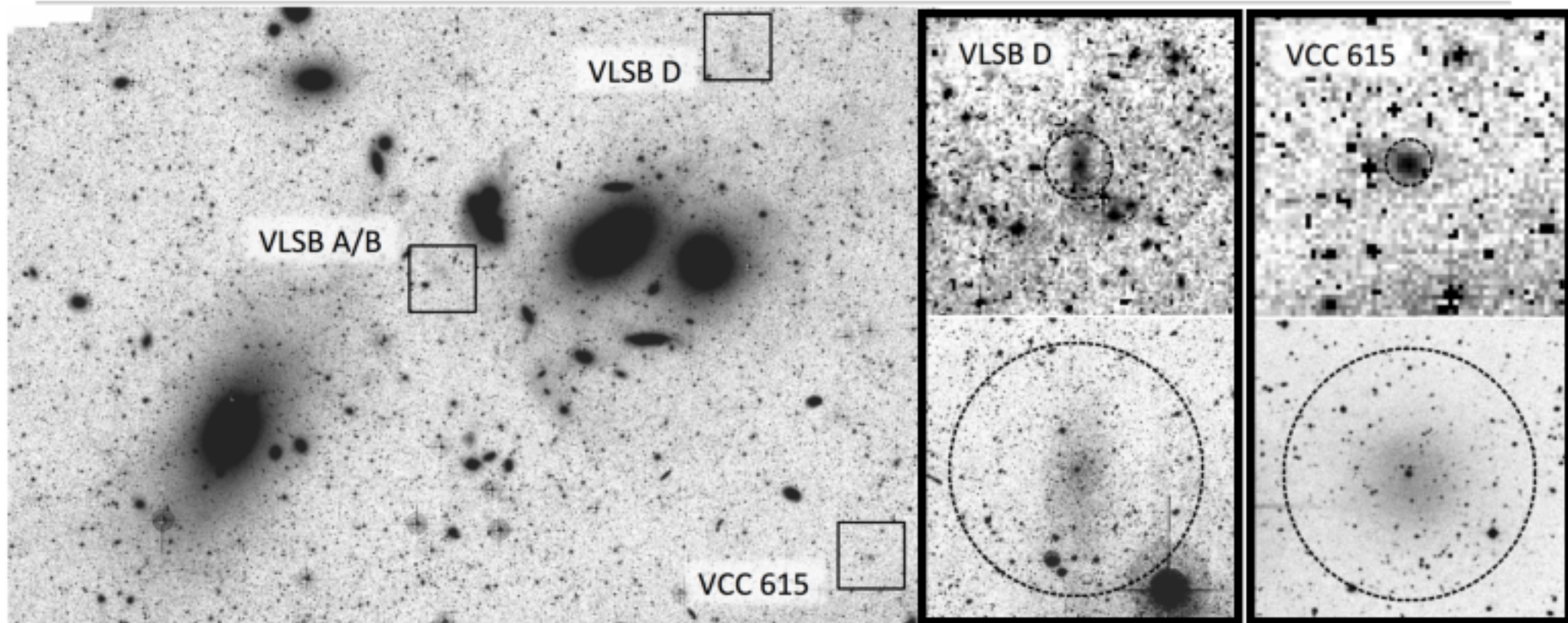
Koda et al. (2015)



Thousands of
UDGs in Coma?

CFHT archive images
of Coma

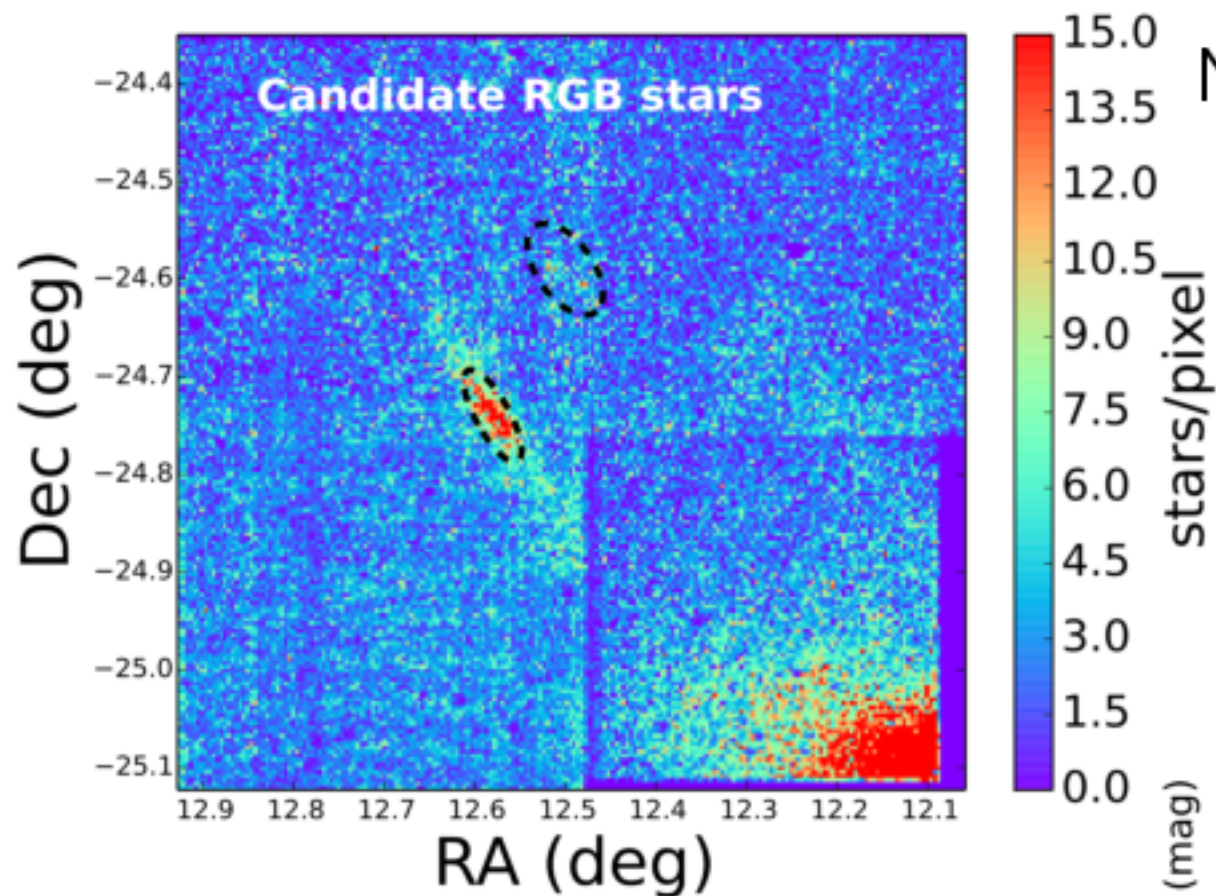
Ultra-diffuse galaxies in the Virgo cluster



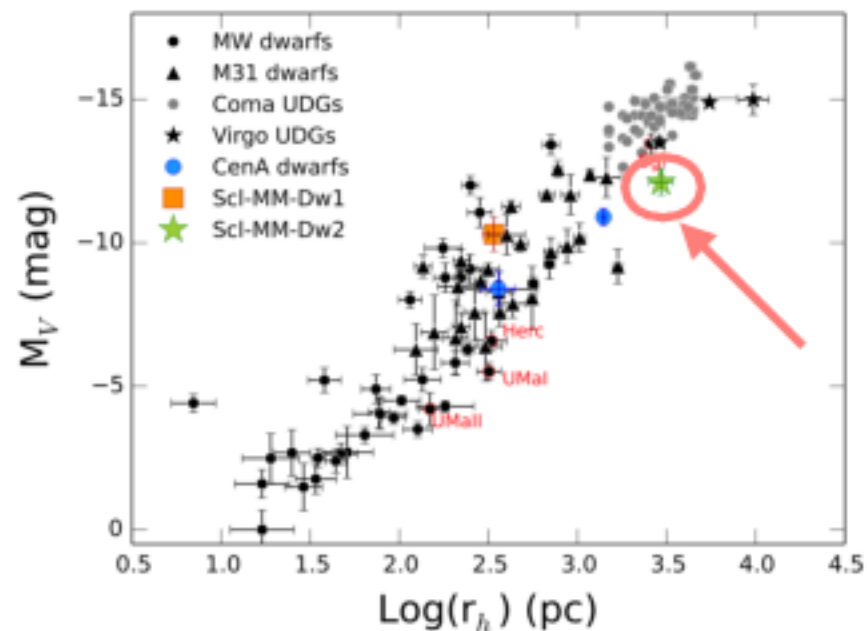
Mihos et al. (2015,
2017)

In the core of the
Virgo cluster

Ultra-diffuse galaxies elsewhere

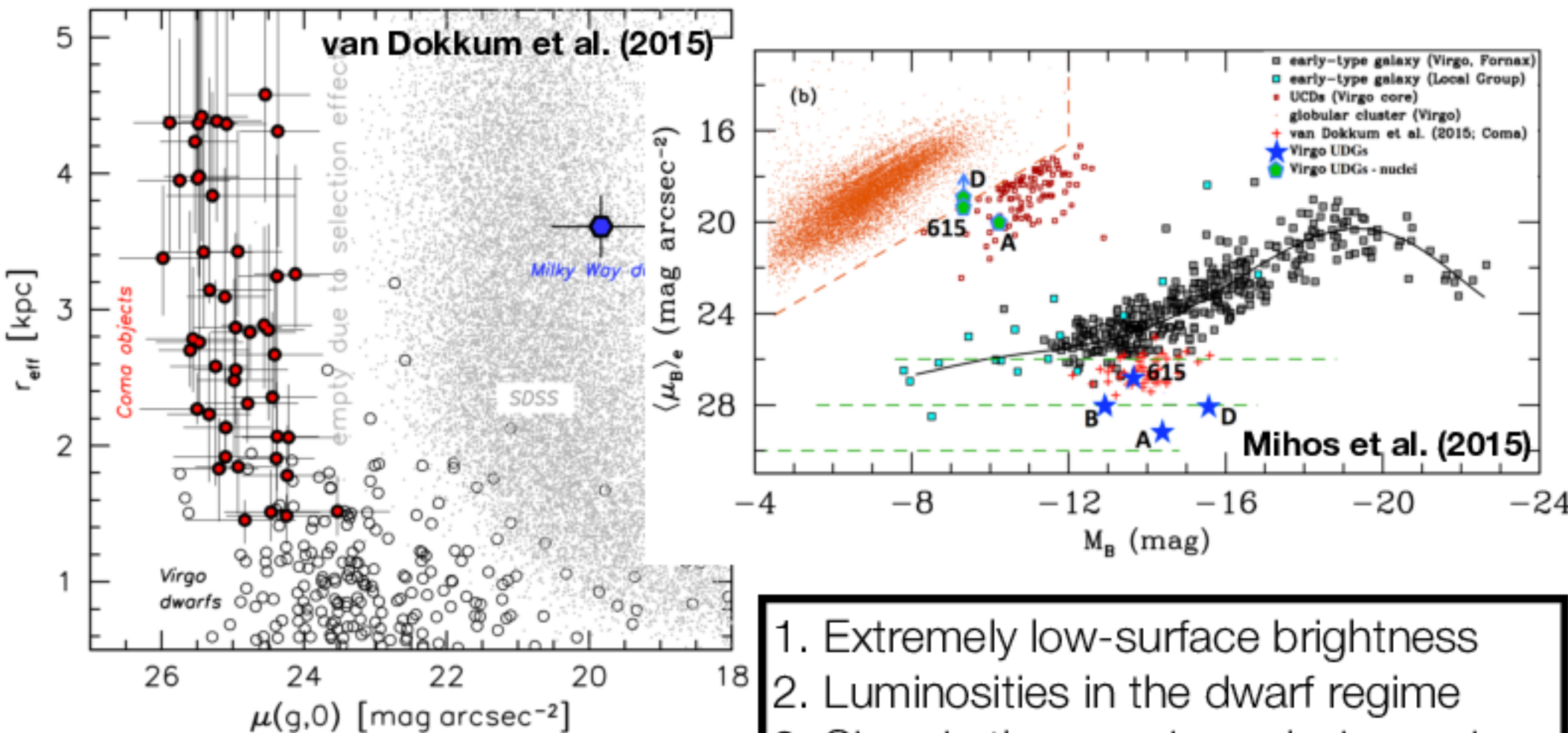


NGC253: MW-like galaxy
4 Mpc away



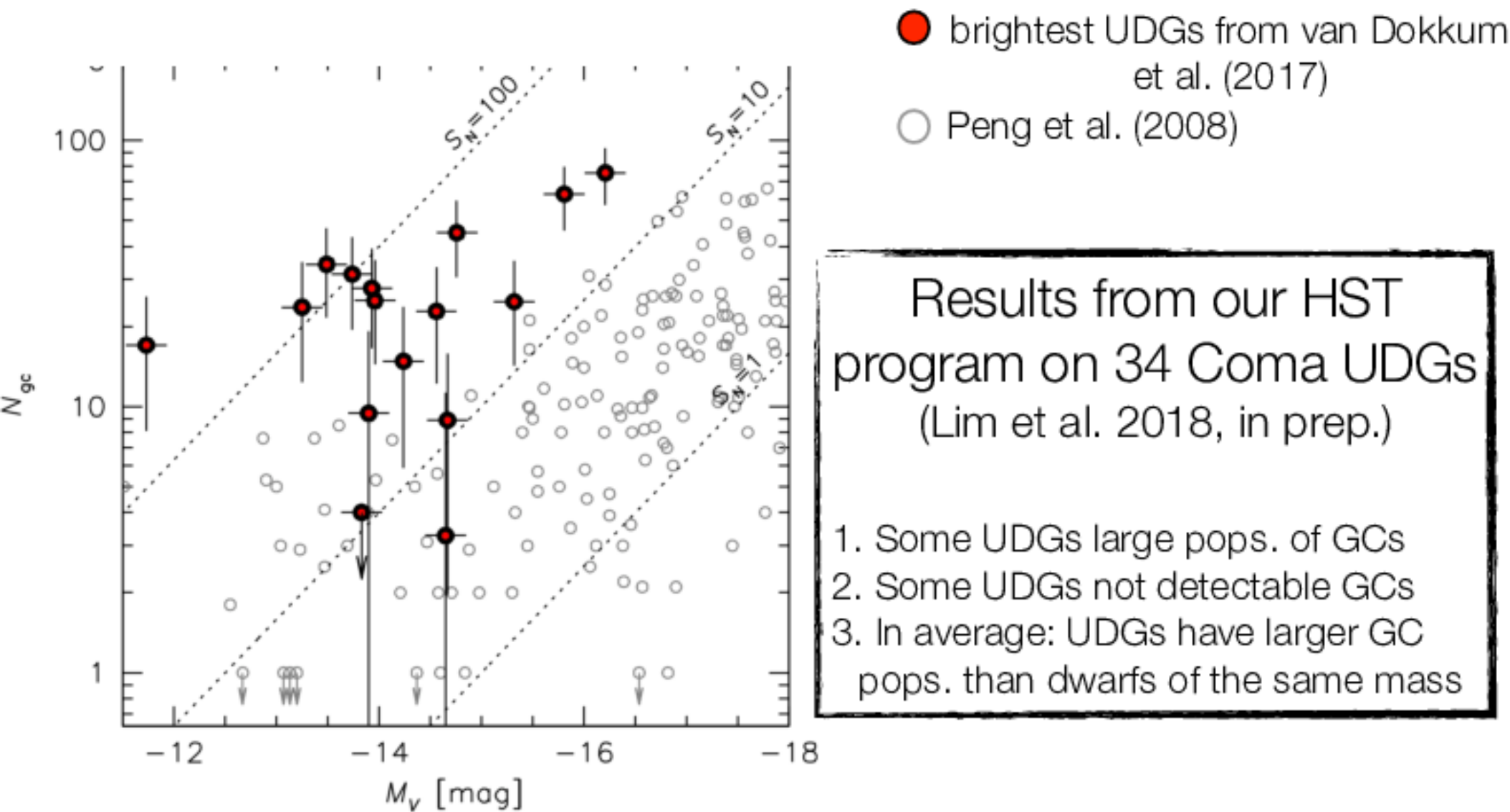
Toloba et al. (2016c)

Properties of ultra-diffuse galaxies

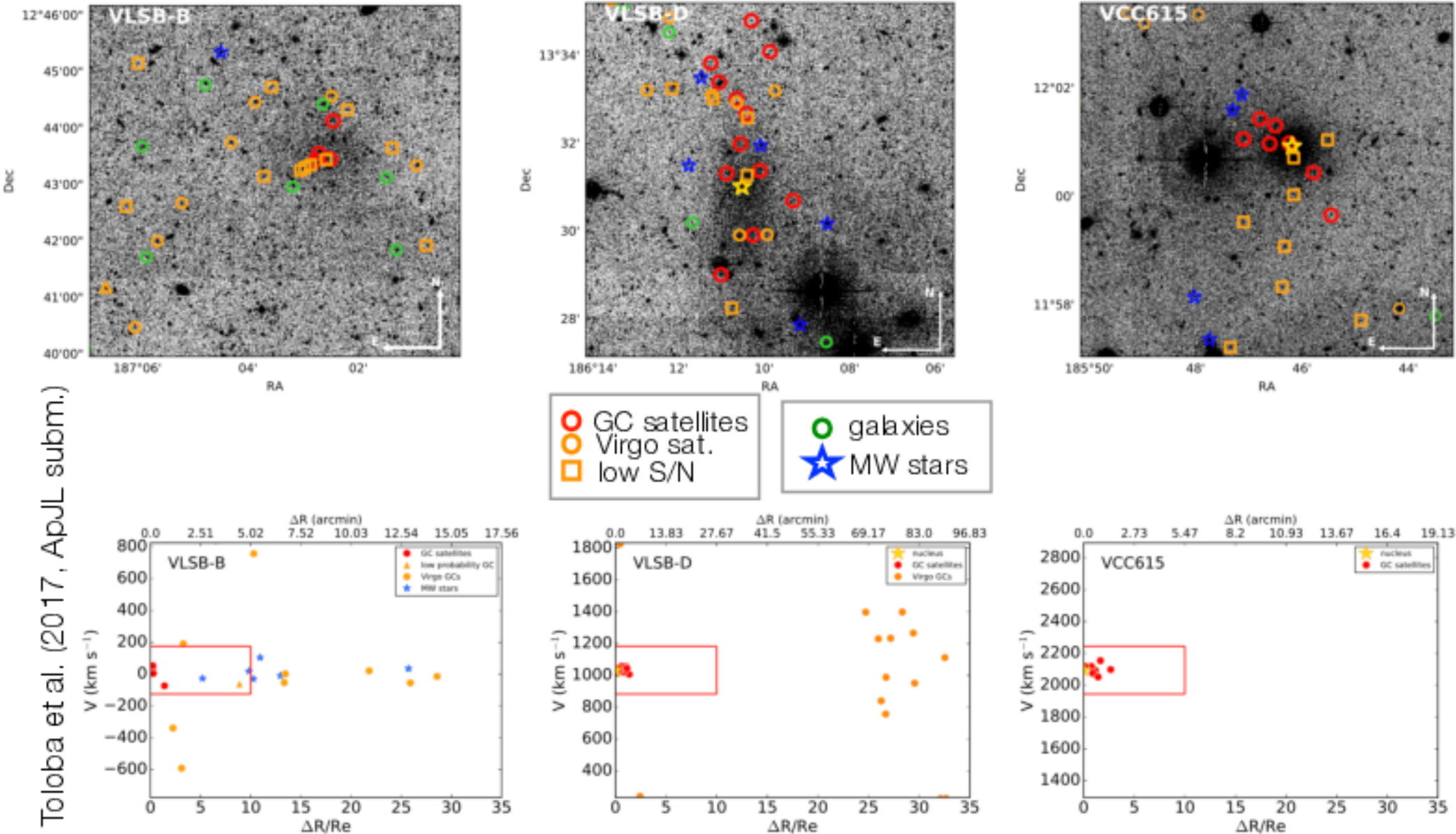


1. Extremely low-surface brightness
2. Luminosities in the dwarf regime
3. Sizes in the massive galaxies regime
4. Nearly exponential SB profiles
5. Quenched stellar populations

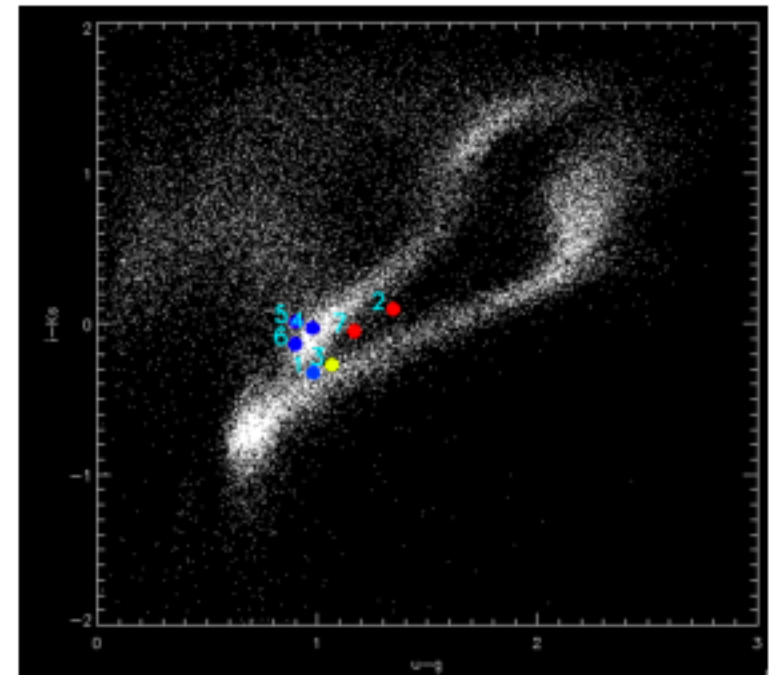
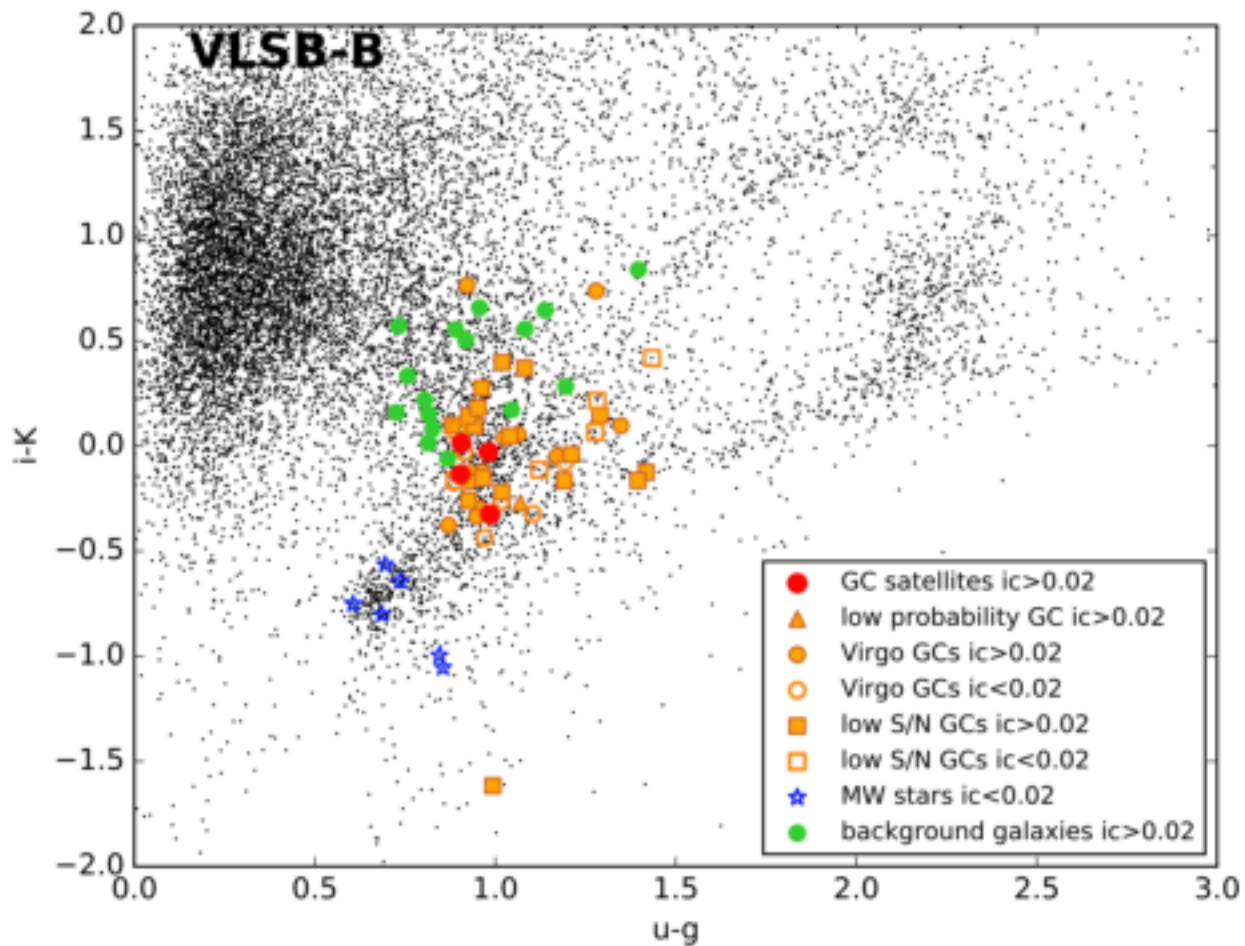
Ultra-diffuse galaxies: massive or dwarf-like?



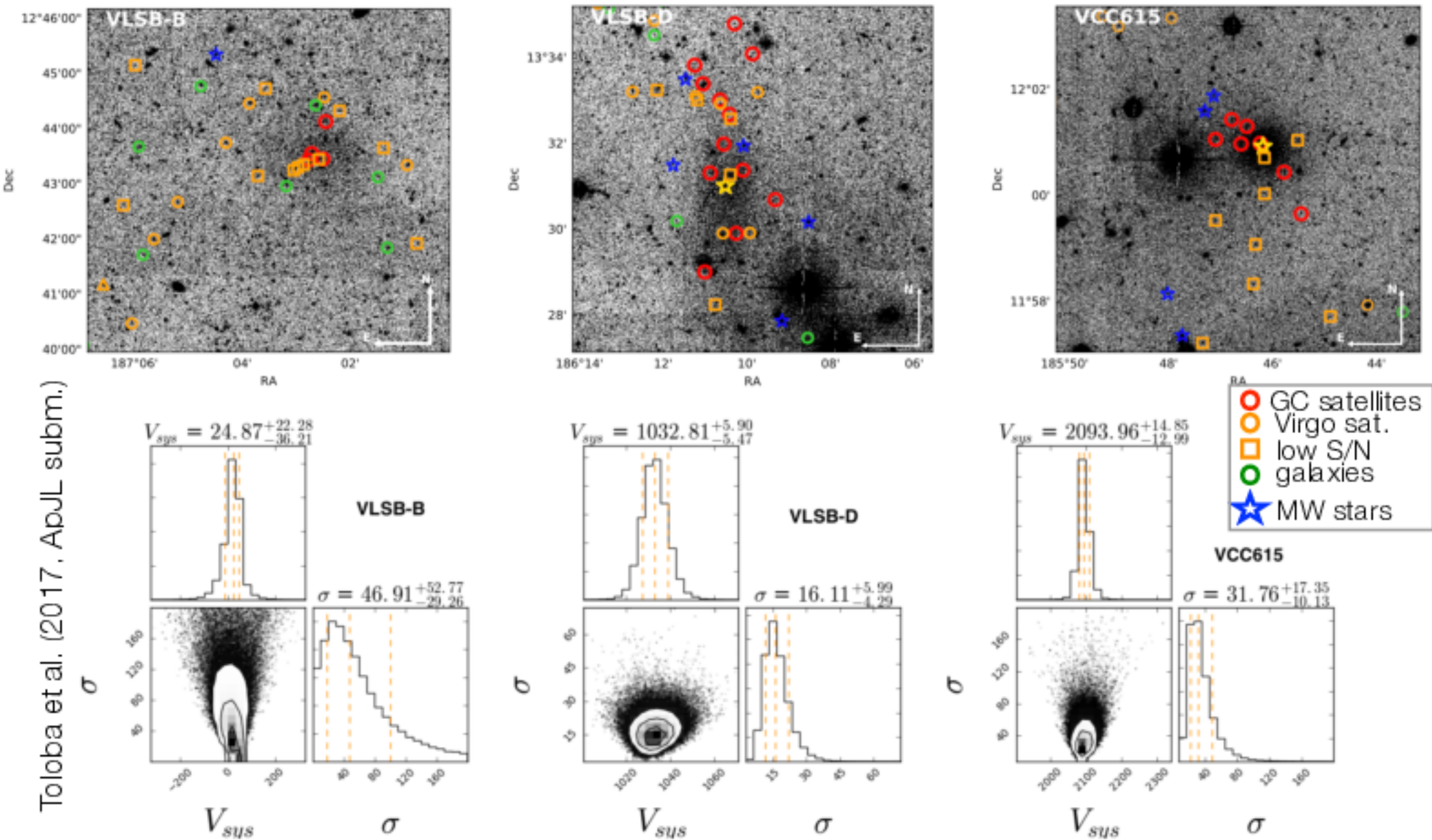
GC satellites of Virgo ultra-diffuse galaxies



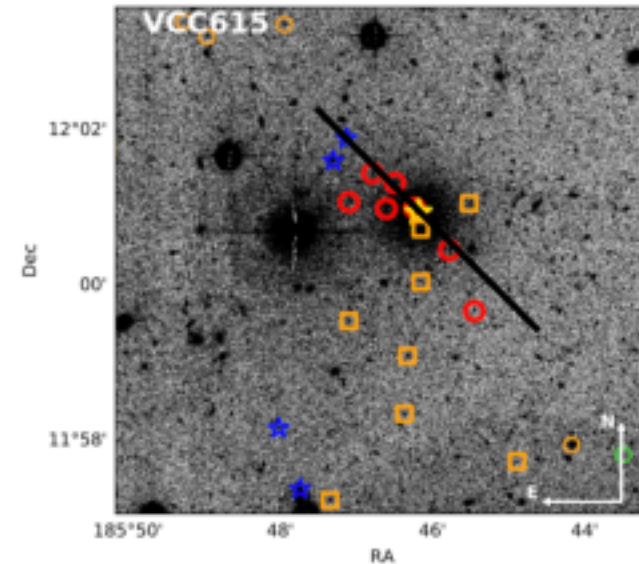
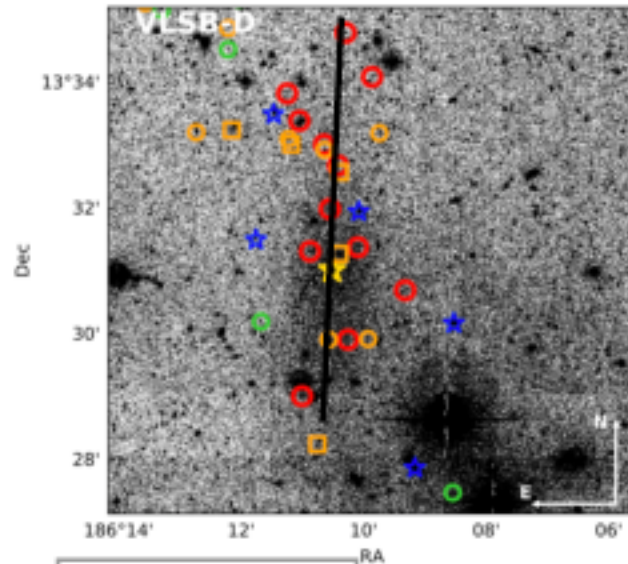
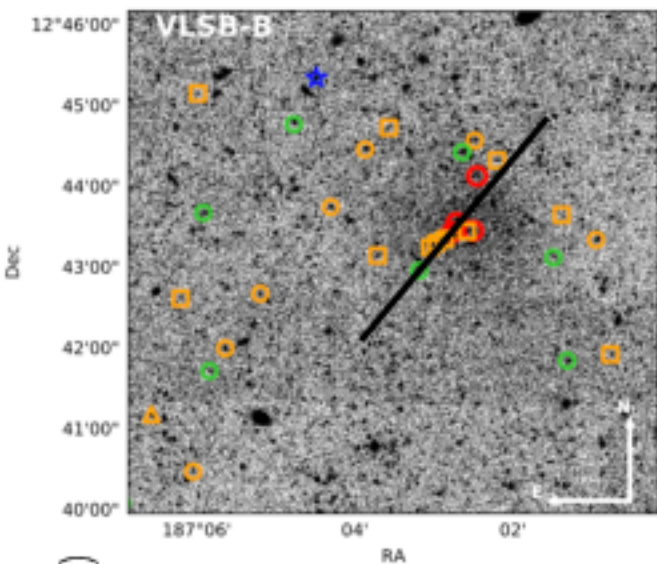
GC satellites in VLSB-B



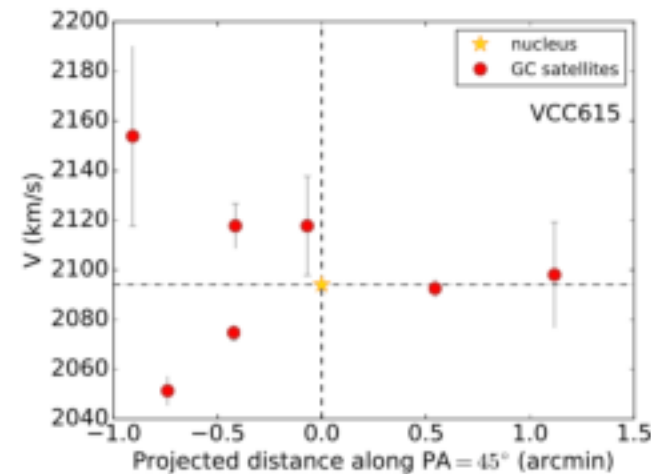
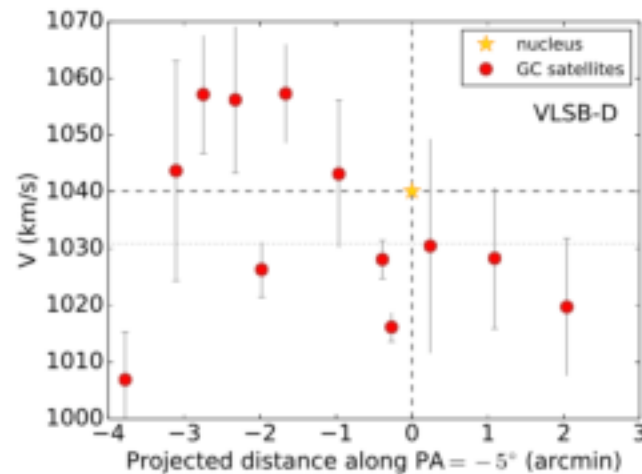
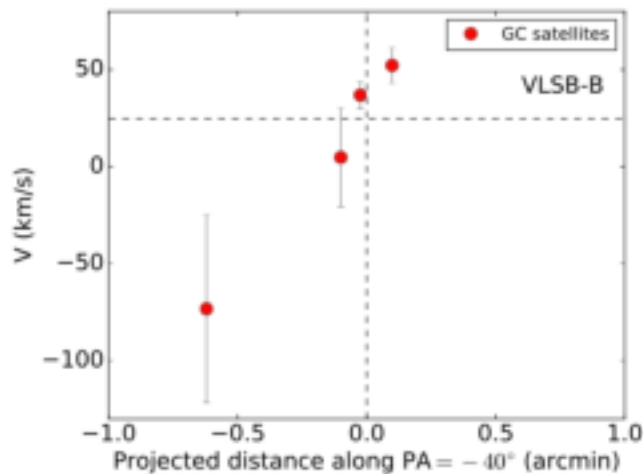
Internal kinematics of ultra-diffuse galaxies



Rotation in ultra-diffuse galaxies?

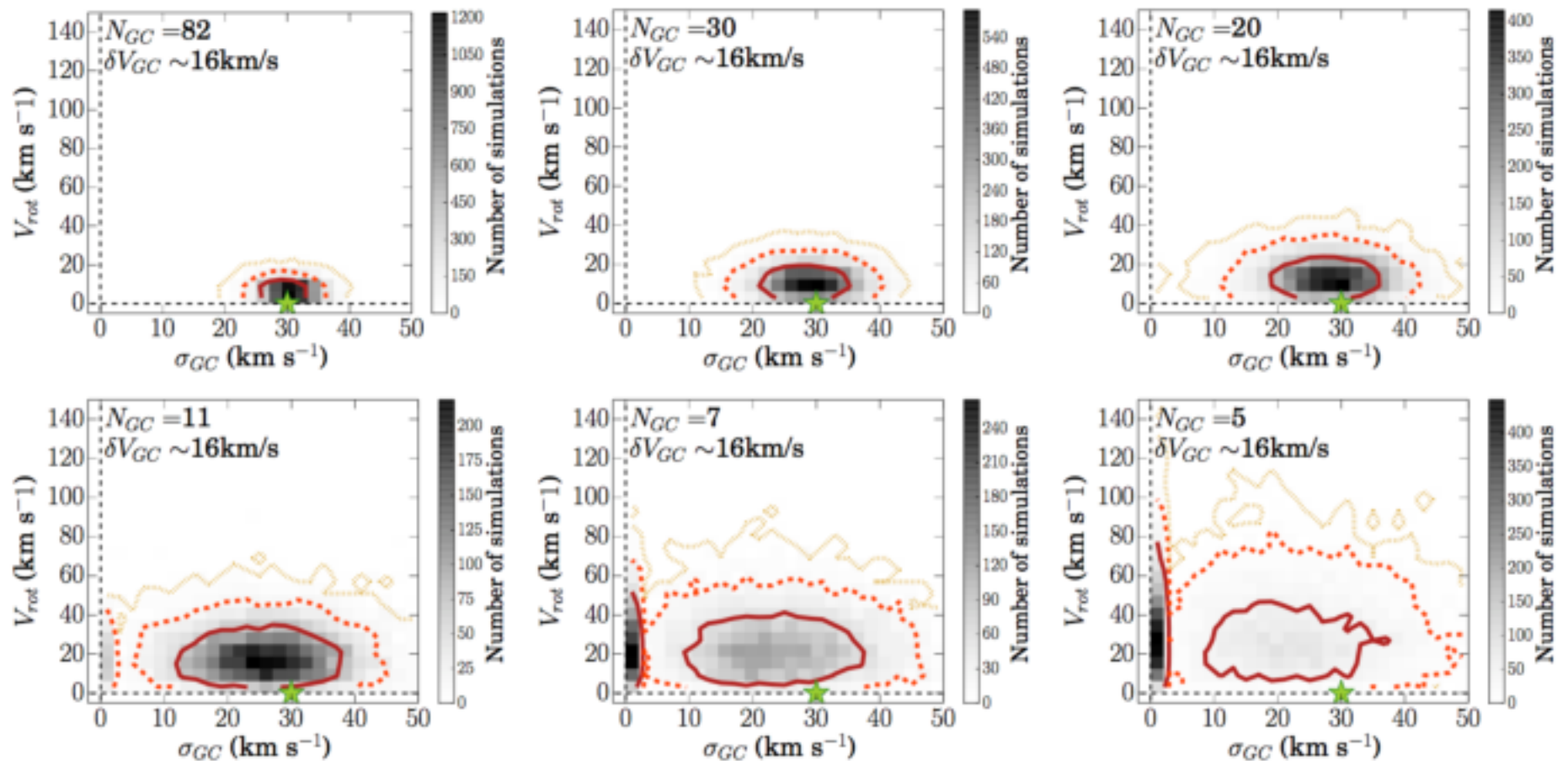


Toloba et al. (2017, ApJL subm.)



Statistical significance in rotation

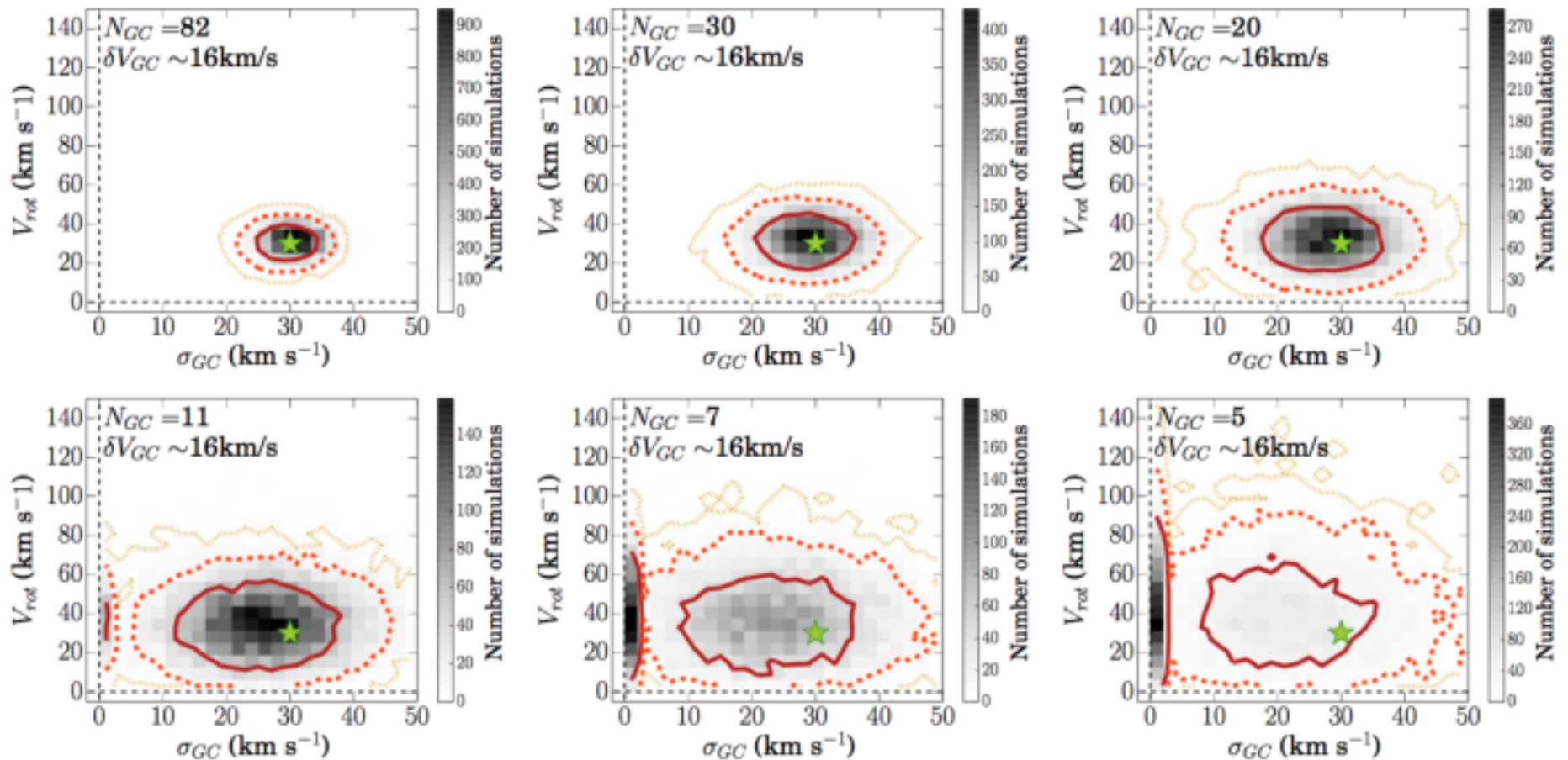
Simulations using Keck/DEIMOS GCs in Virgo (Toloba et al. 2016d)



Simulated galaxy with 0 rotation
Velocity errors comparable to those in the Virgo UDGs

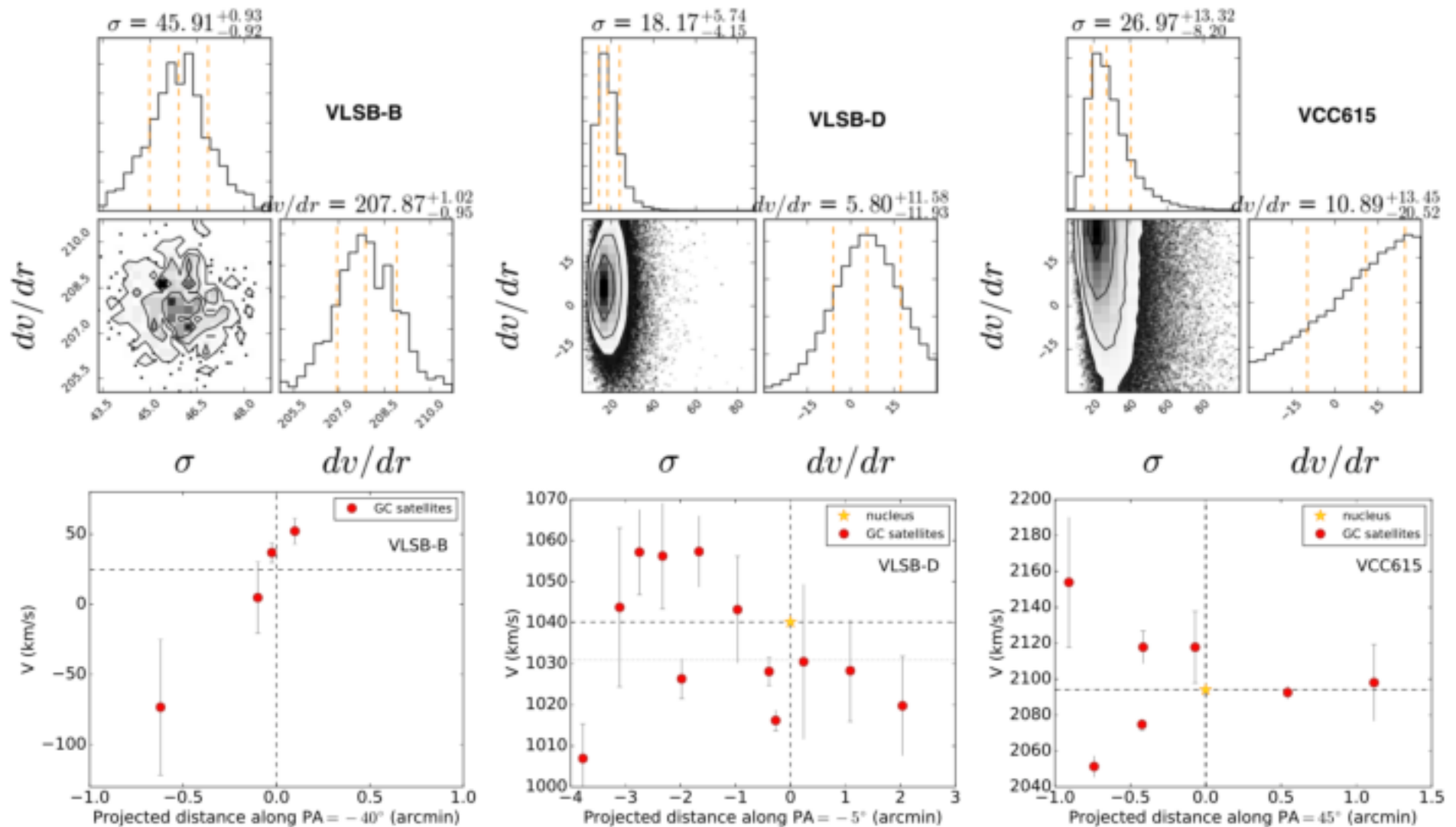
Statistical significance in rotation

Simulations using Keck/DEIMOS GCs in Virgo (Toloba et al. 2016d)



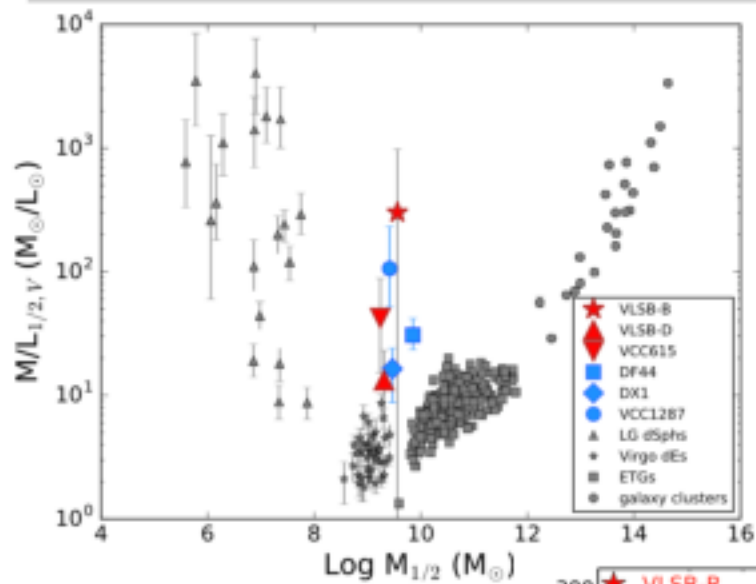
Simulated galaxy with $v/\sigma=1$
Velocity errors comparable to those in the Virgo UDGs

More Keck/DEIMOS observations in Spring '18

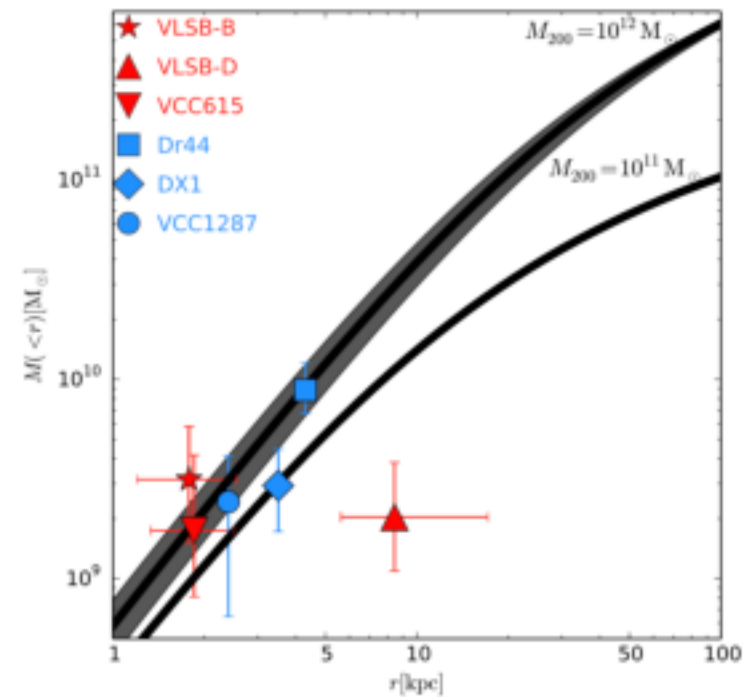
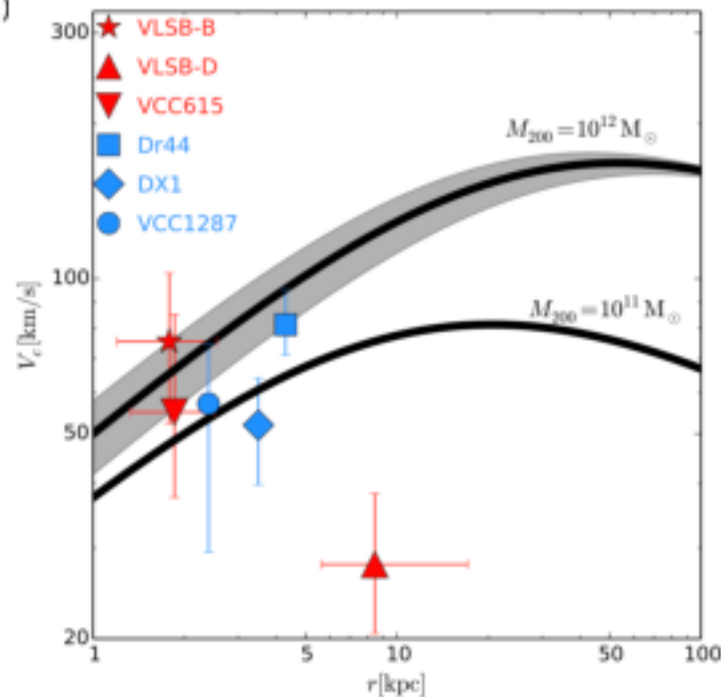


Current rotation needs further confirmation

Dark matter content

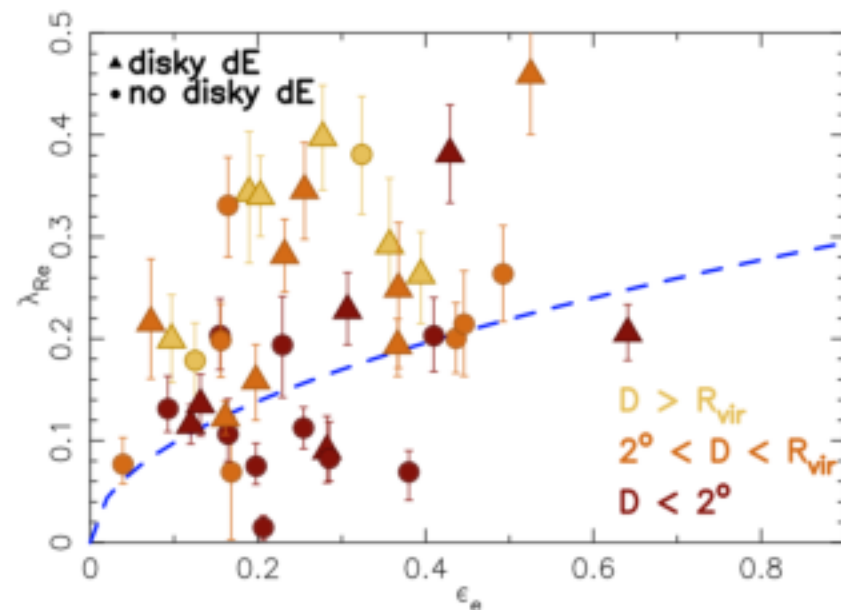
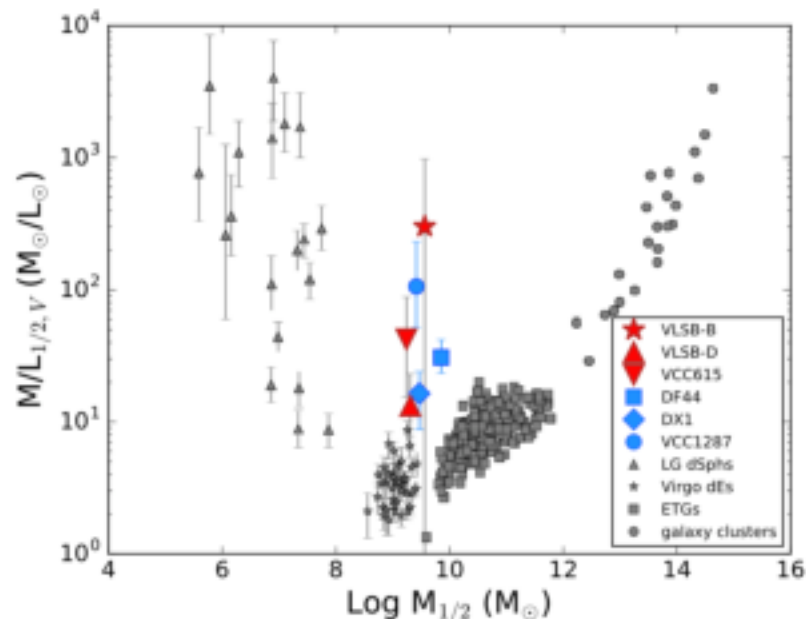


Very high dynamical masses for their stellar mass
 Correspond to dark matter halos of $10^{12} M_{\odot}$
 Large variety of properties for a very small sample



Origin of UDGs: nature vs nurture

- Large low stellar mass objects in clusters: they must have large dark matter halos
- UDGs have exponential surface brightness profiles as dEs
- Large version of dEs? dEs in the Virgo cluster with similar stellar masses do not show that large dark matter halos.
- dEs in Virgo show rotation-clustercentric distance relation (Toloba et al. 2009, 2011). How do UDGs fit here? Need larger sample.
- VLSB-D seems to be tidally perturbed -> being transformed from what kind of object? Nurture?



Coming soon

- New Keck/DEIMOS observations of UDGs (spring '18):
 - More GCs in the 3 UDGs presented here
 - More UDGs in Virgo
- Resolved stars in UDGs:
 - Recently completed (Nov. '17) Keck/DEIMOS observations of the UDG in NGC253

