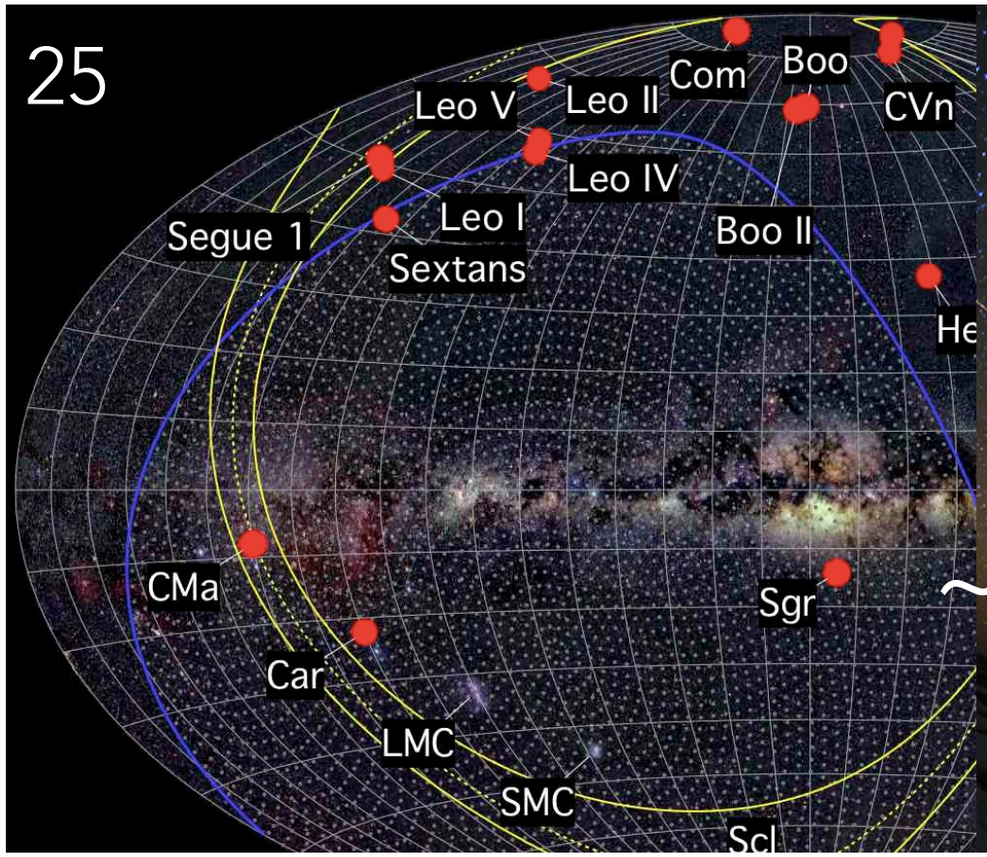
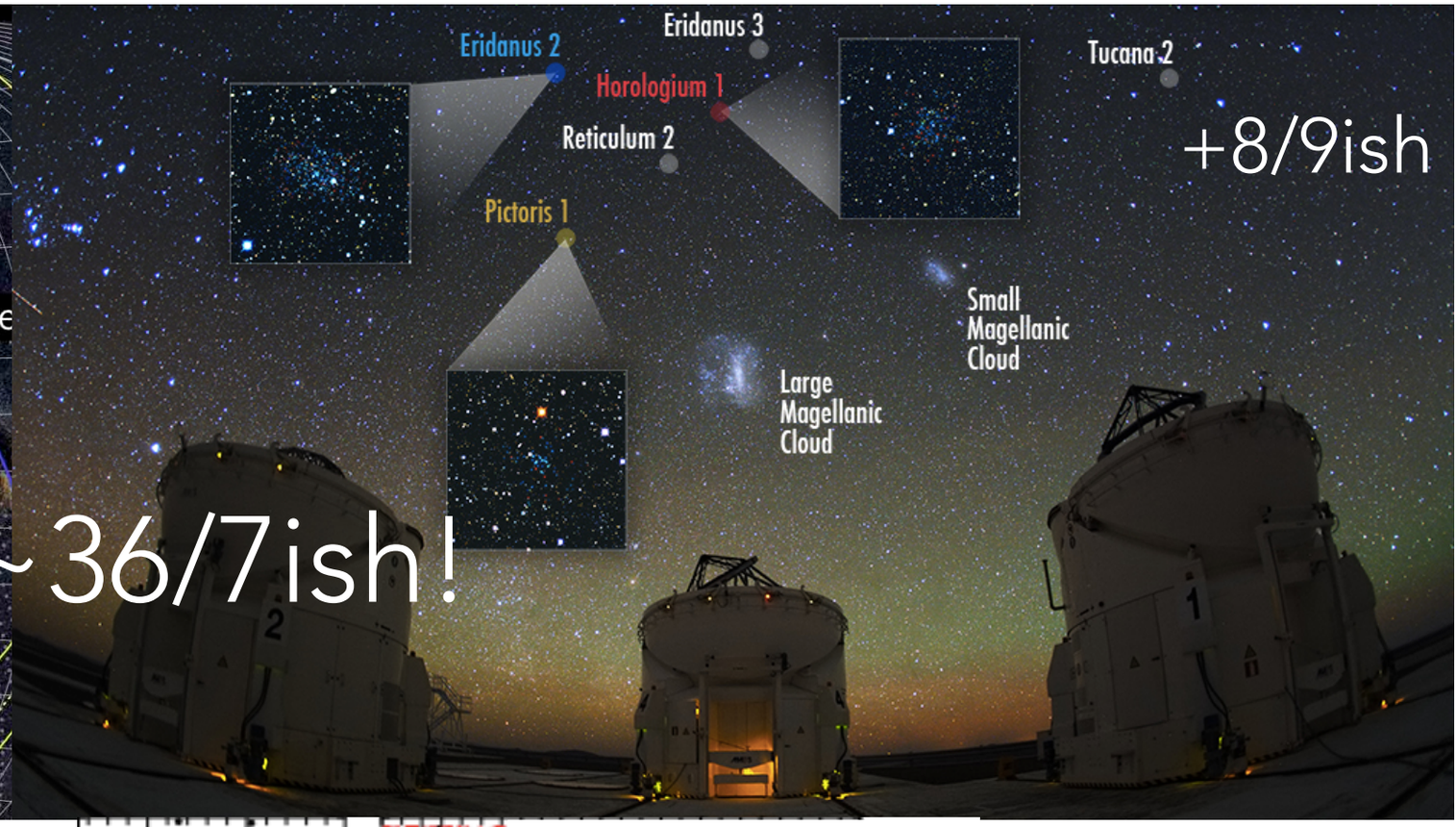
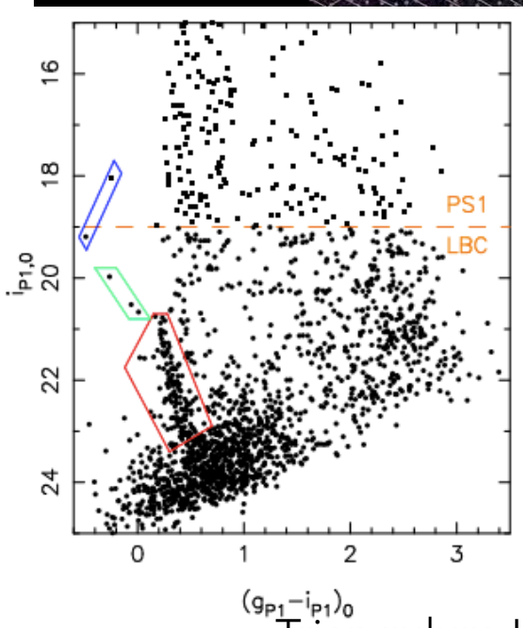
THE INTERNAL DYNAMICS OF DWARF SPHEROIDAL GALAXIES: AN OBSERVATIONAL POINT OF VIEW

MICHELLE COLLINS - HUBBLE FELLOW @ YALE

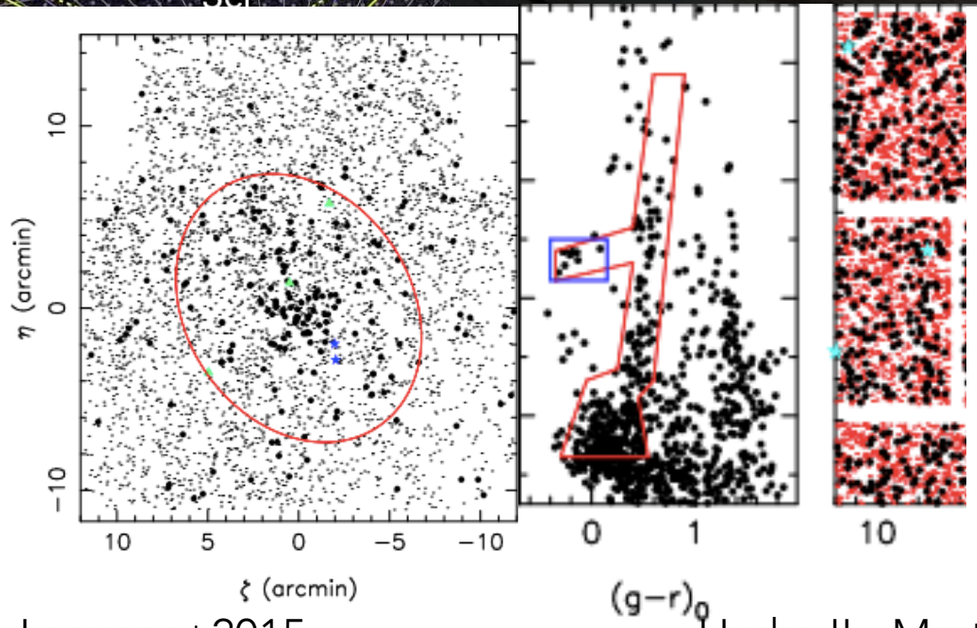
INTRODUCING THE DWARF SPHEROIDALS OF THE MILKY WAY!



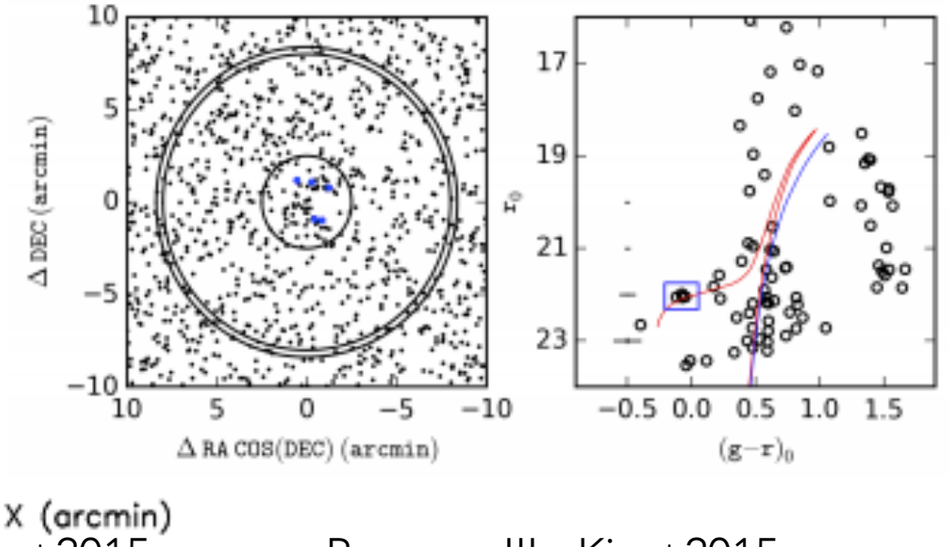




Triangulum II - Laevens+2015



Hydra II - Martin+2015



Pegasus III - Kim+2015

EXPLAINING THE 'ISH'

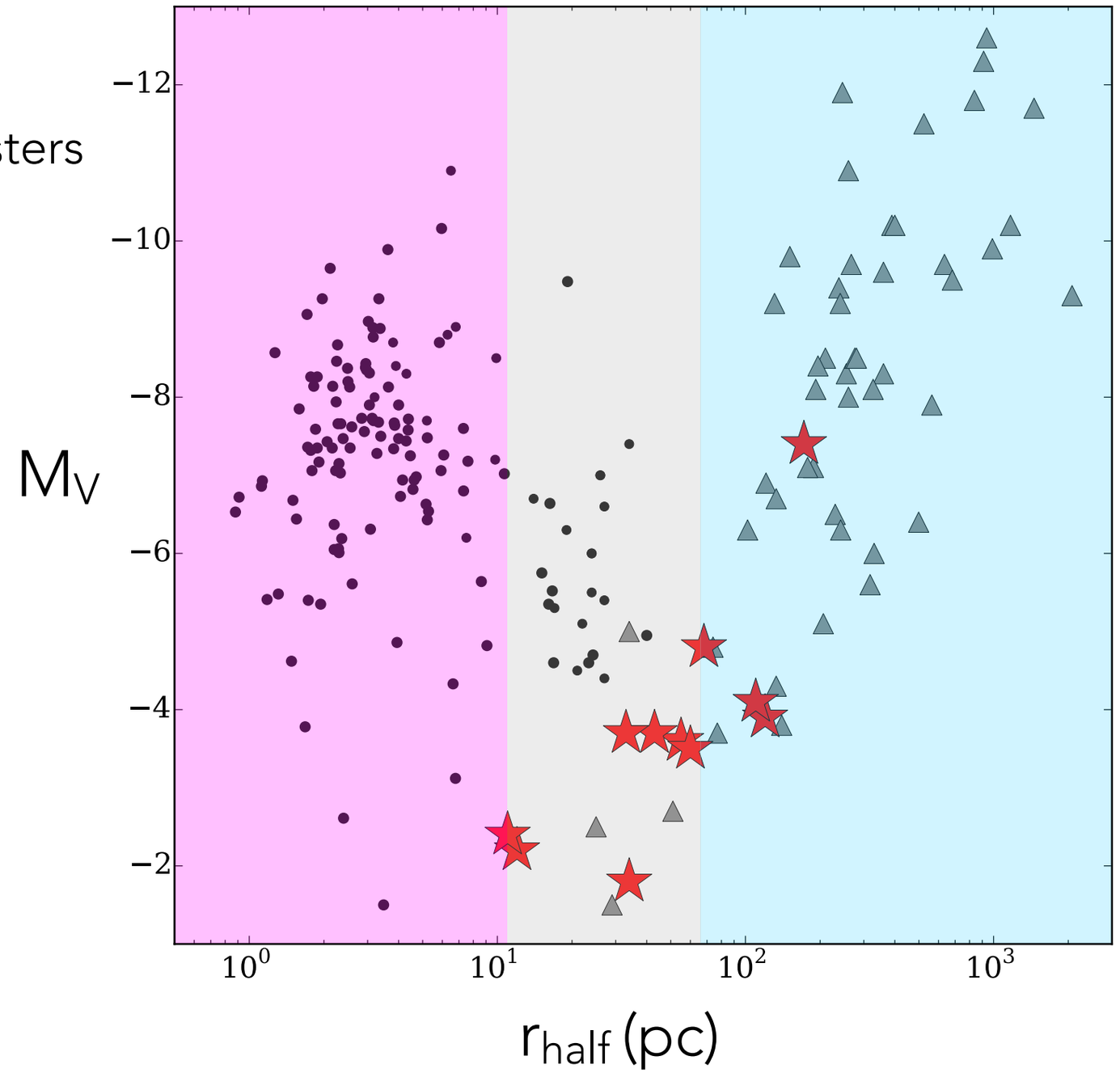
Not all new candidates will be galaxies

Zone of
CONFUSION

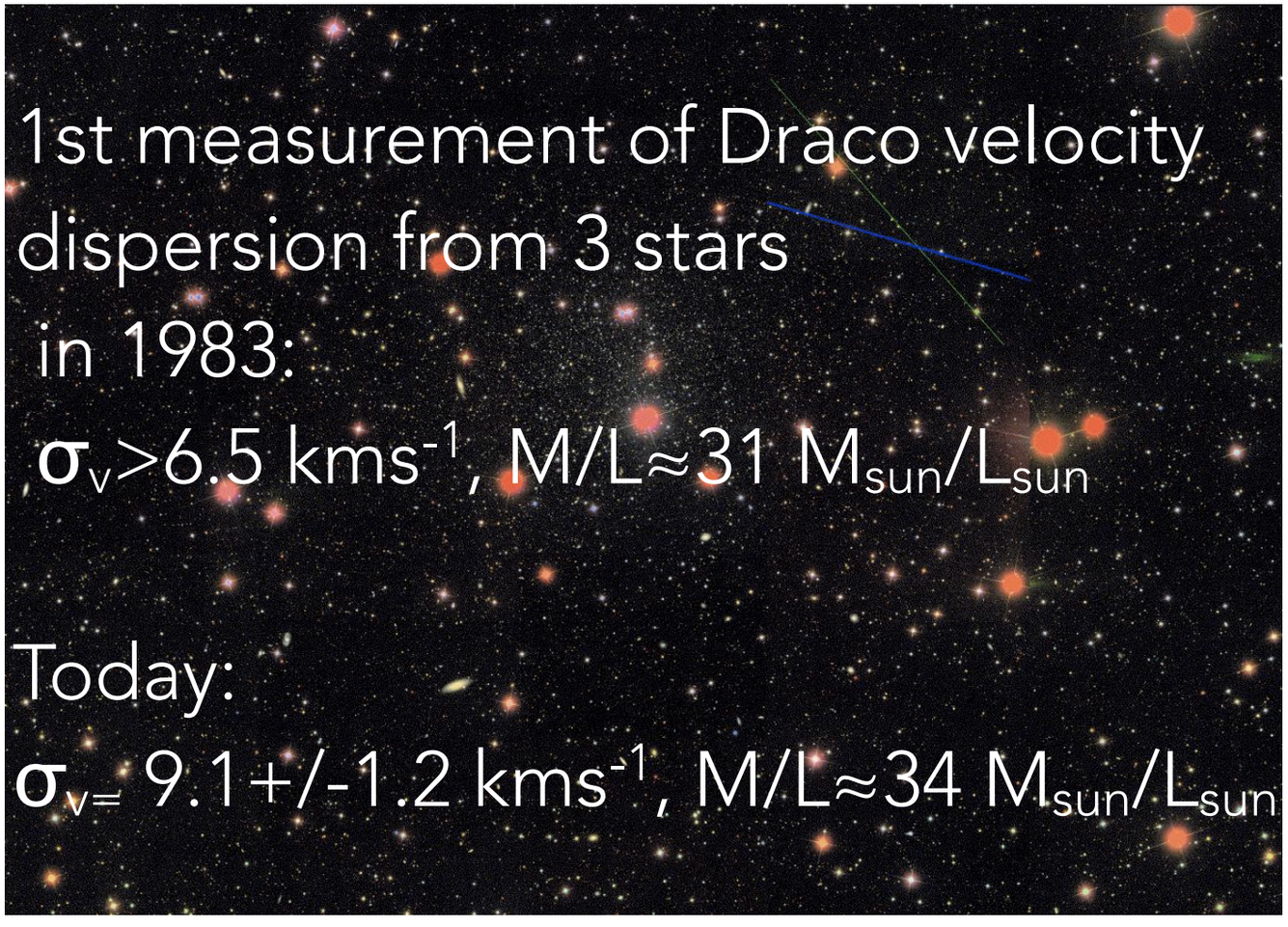
Need (chemo)dynamics!

● Globular clusters

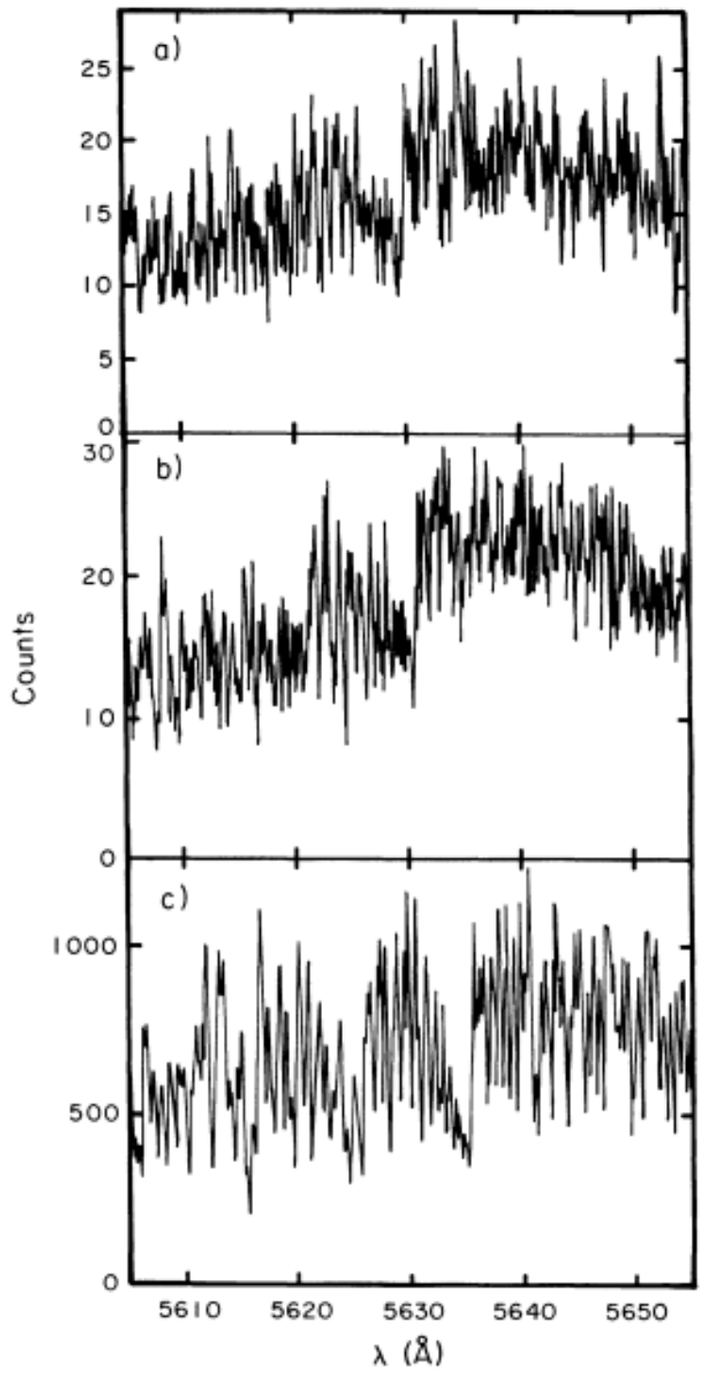
Dwarf galaxies ▲



DWARF GALAXIES LIVE IN DARK MATTER HALOS

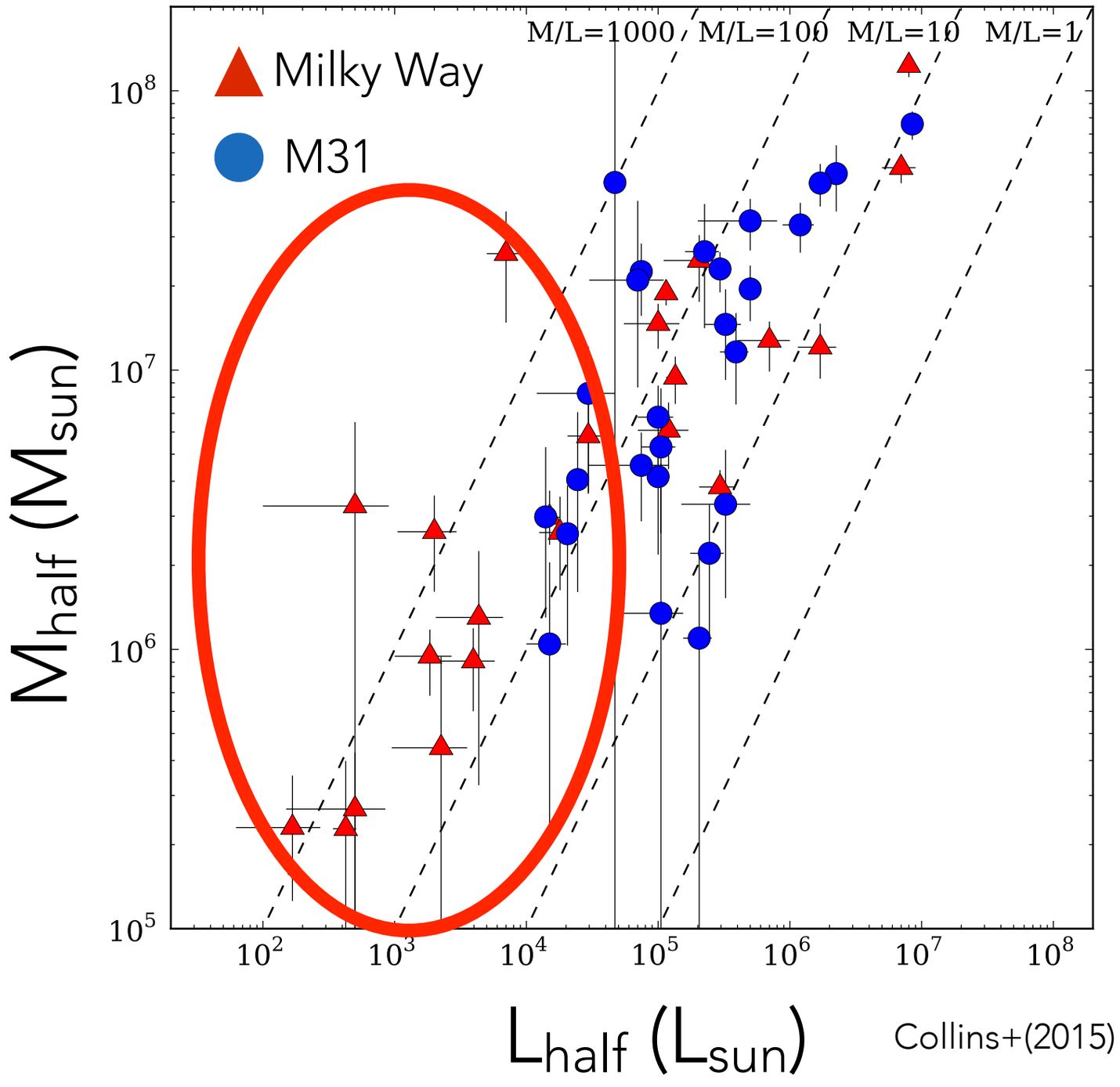


Draco as viewed by SDSS, composite created by Robert Lupton



C stars in Draco, Aaronson 1983

'IDEAL' LABORATORIES FOR STUDYING DARK MATTER

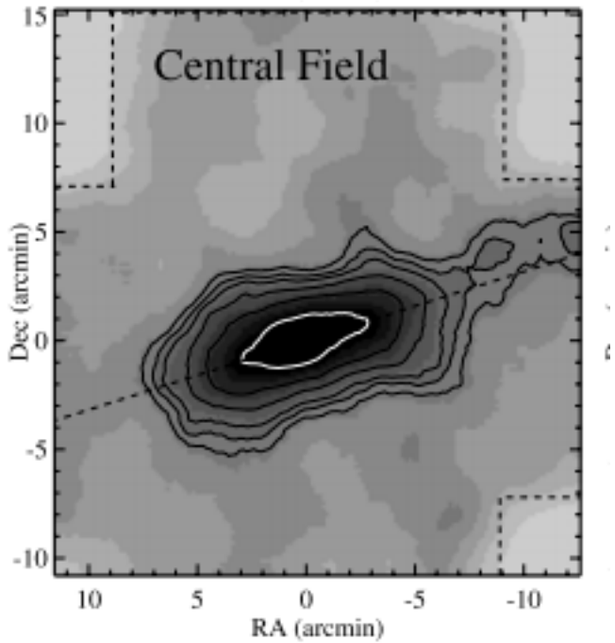


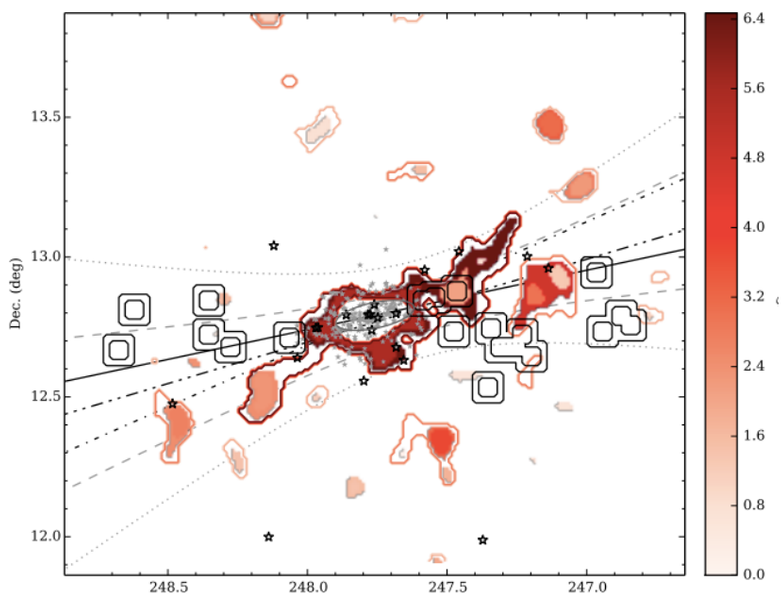
Collins+(2015)

H M M M . . . .

Concerns about the ultra-faints

Hercules - M_V=-6.6

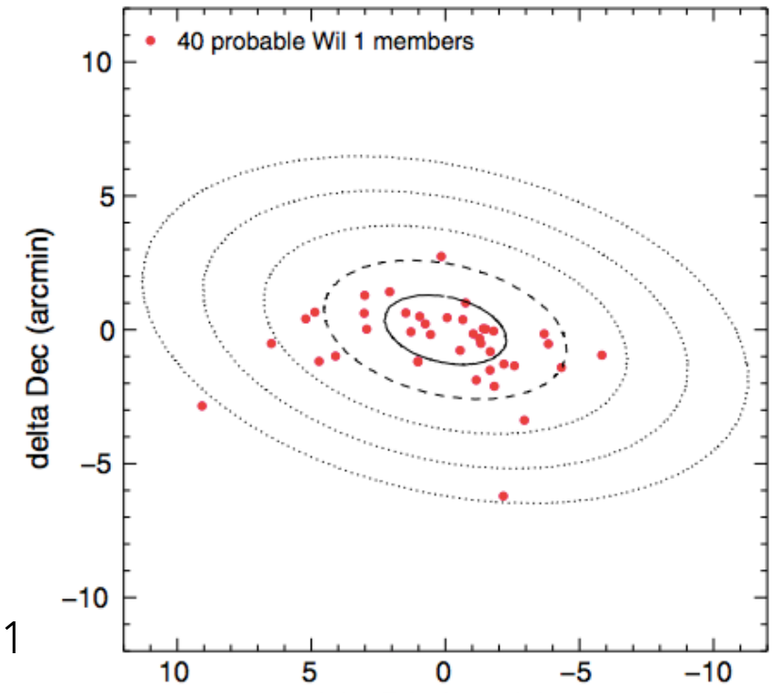




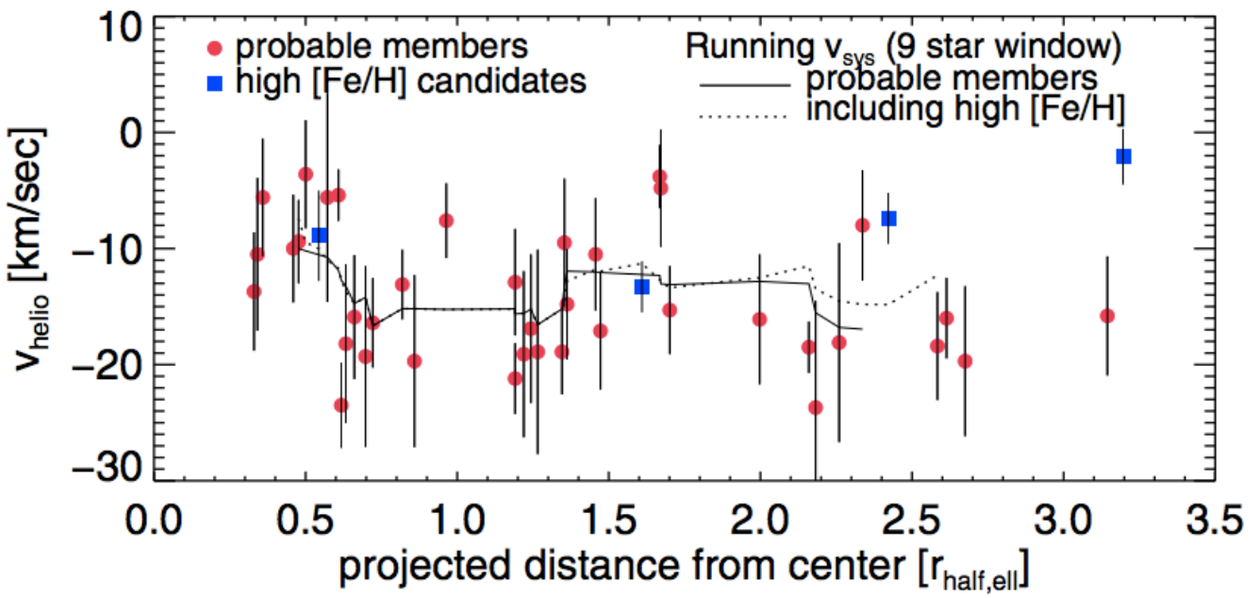
Sand+09, Roderick+15

Plus CVn II & LeoV (Sand+12)

Willman 1 - M_V=-2



Willman+2011



PROBLEM FOR MASS MODELING

- How to interpret ‘mean’ velocity dispersions
- Makes applying normal models tricky (not in dynamical equilibrium)
- May not be best objects for indirect dark matter detection experiments

BUT COULD ALSO TELL US SOMETHING

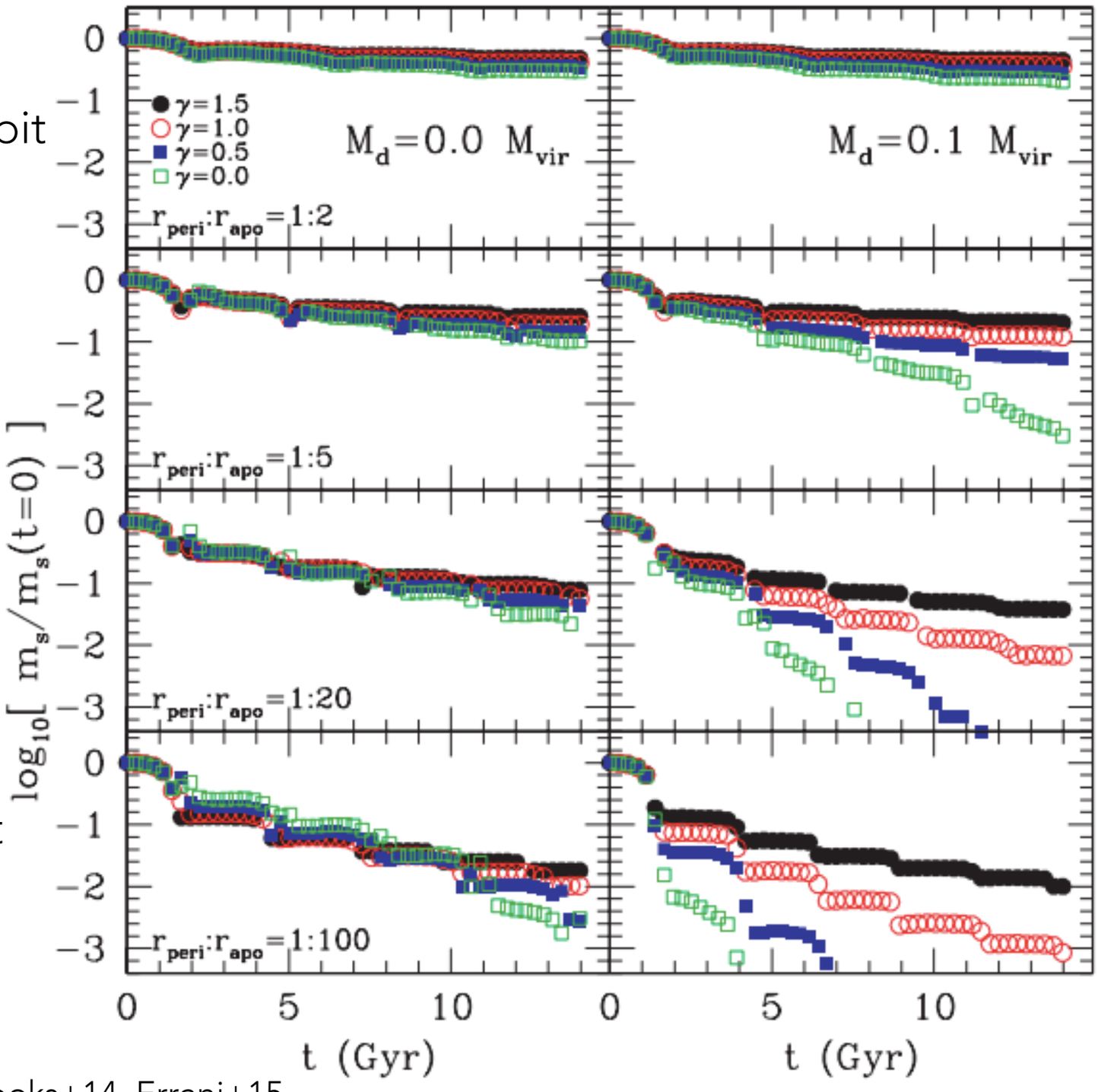
Cusped and cored galaxies disrupt differently

More circular orbit

● Cusped

□ Cored

More radial orbit



From hydro sims: expect brighter systems to be cored, fainter to be cusped

Peñarrubia+10, Brooks+14, Errani+15

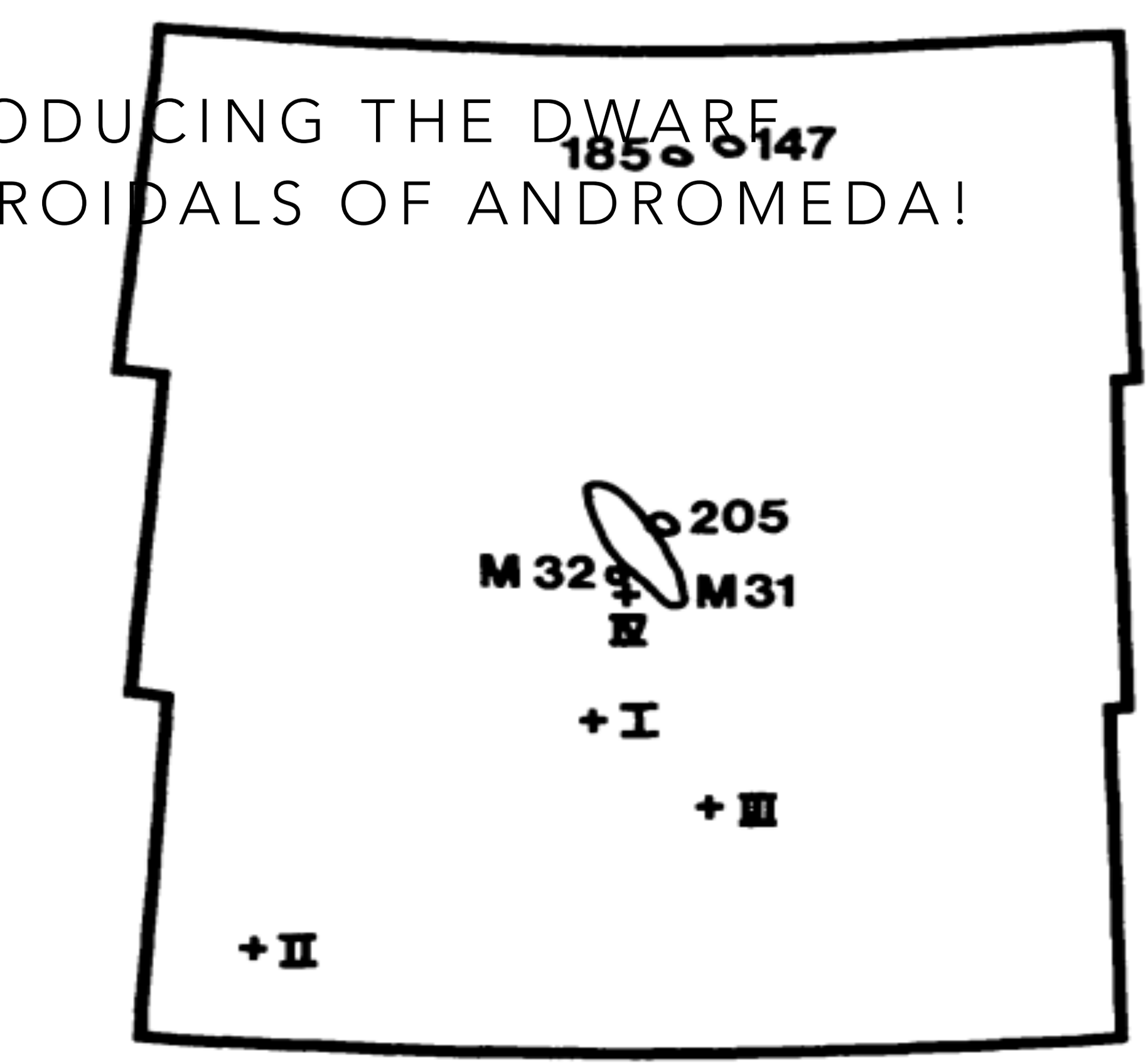
CATAGORISING STRIPPED POPULATION WILL BE INFORMATIVE!

Which dSphs are undergoing tidal interactions/ disruption?

Are their orbits ‘special’?

How does that compare to predictions from simulations?

INTRODUCING THE DWARF SPHEROIDALS OF ANDROMEDA!



First M31 dwarfs - And I-III (and non-dwarf IV) van den Bergh 1972

POSS I/II
SDSS
PAndAS
PS1

Per I

Cas III

And VII

M31

And XXVIII,
Lac I

And VI, XXIX

M33

van den bergh+72, Armandroff+98,99
Karantchentsev+99,Zucker+04,05,
Majewski+,Martin+06,09,13ab,,Ibata+07,
Irwin+08,McConnachie+08,Richardon+10

SPECTROSCOPY

PAndAS

SPLASH

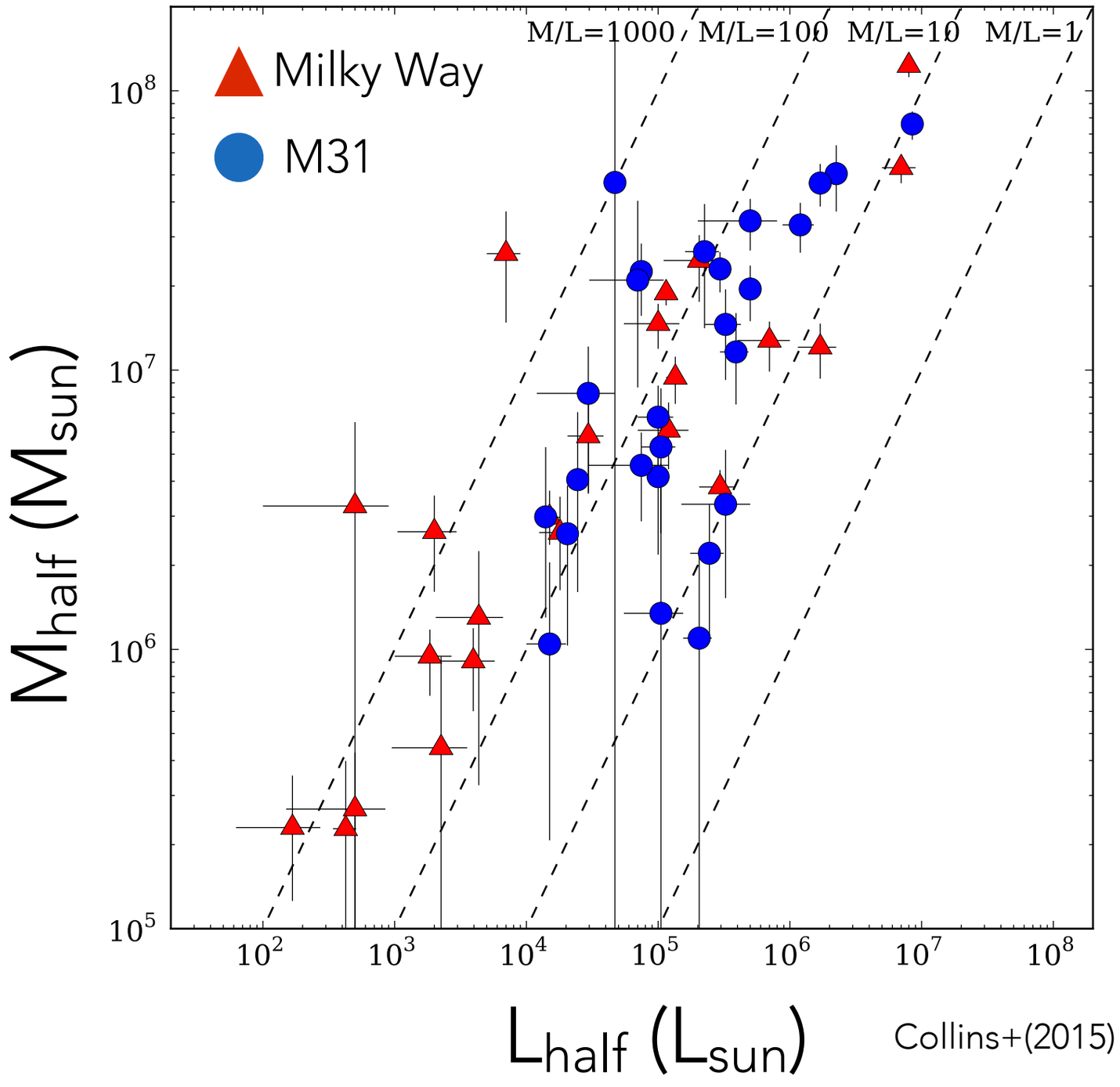
SPLASHing PAndAS

M31

M33

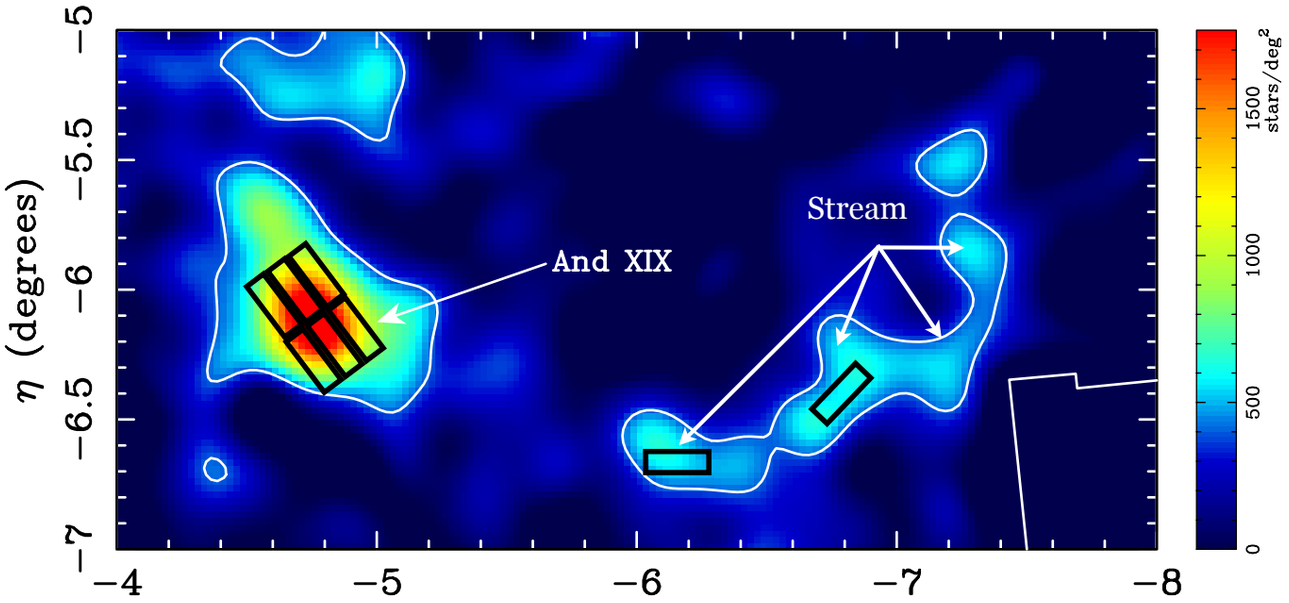
Collins+(2013,2015), Tollerud+(2012, 2013), Ho+(2012, 2014), Martin+(2014)

ALSO DARK MATTER DOMINATED



Collins+(2015)

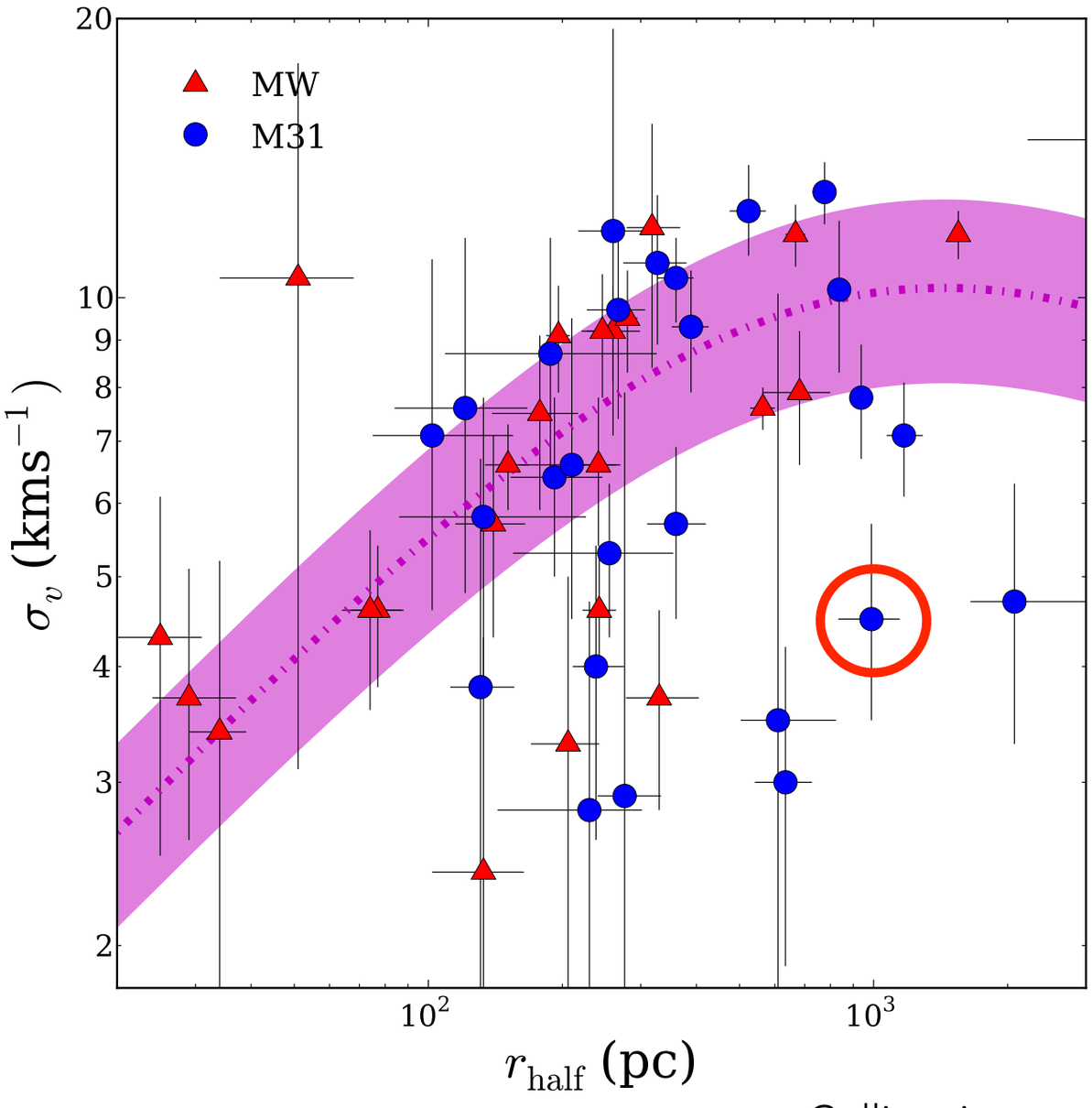
ALSO SOME UNUSUAL OBJECTS...



Collins+14

ANDROMEDA XXI

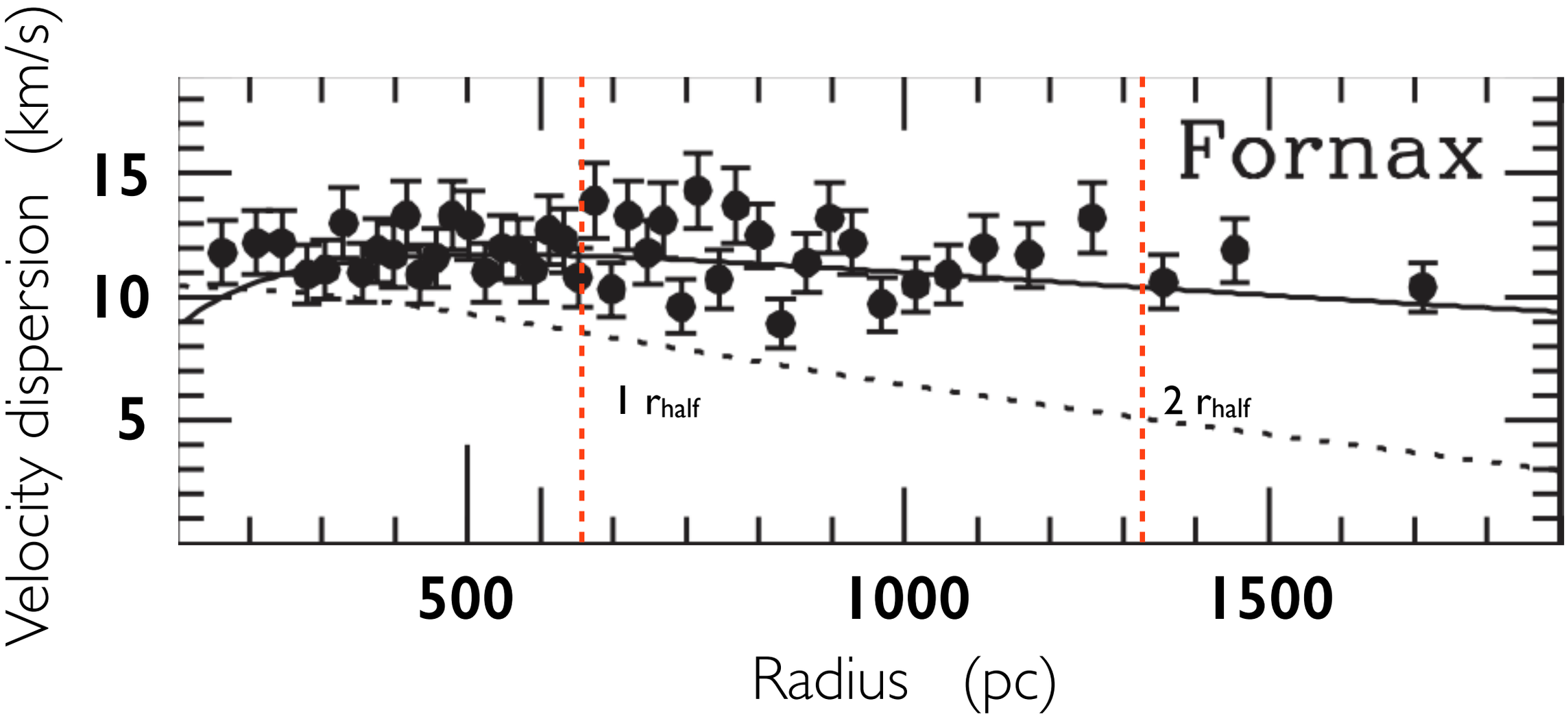
- Luminosity ~ 4×10^5 L_{sun}
- Half-light radii ~ 1kpc
- Velocities for ~100 stars



Collins+in prep

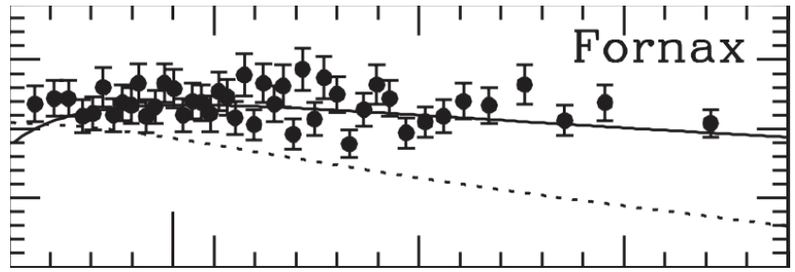
1ST STEP: VELOCITY DISPERSION PROFILE

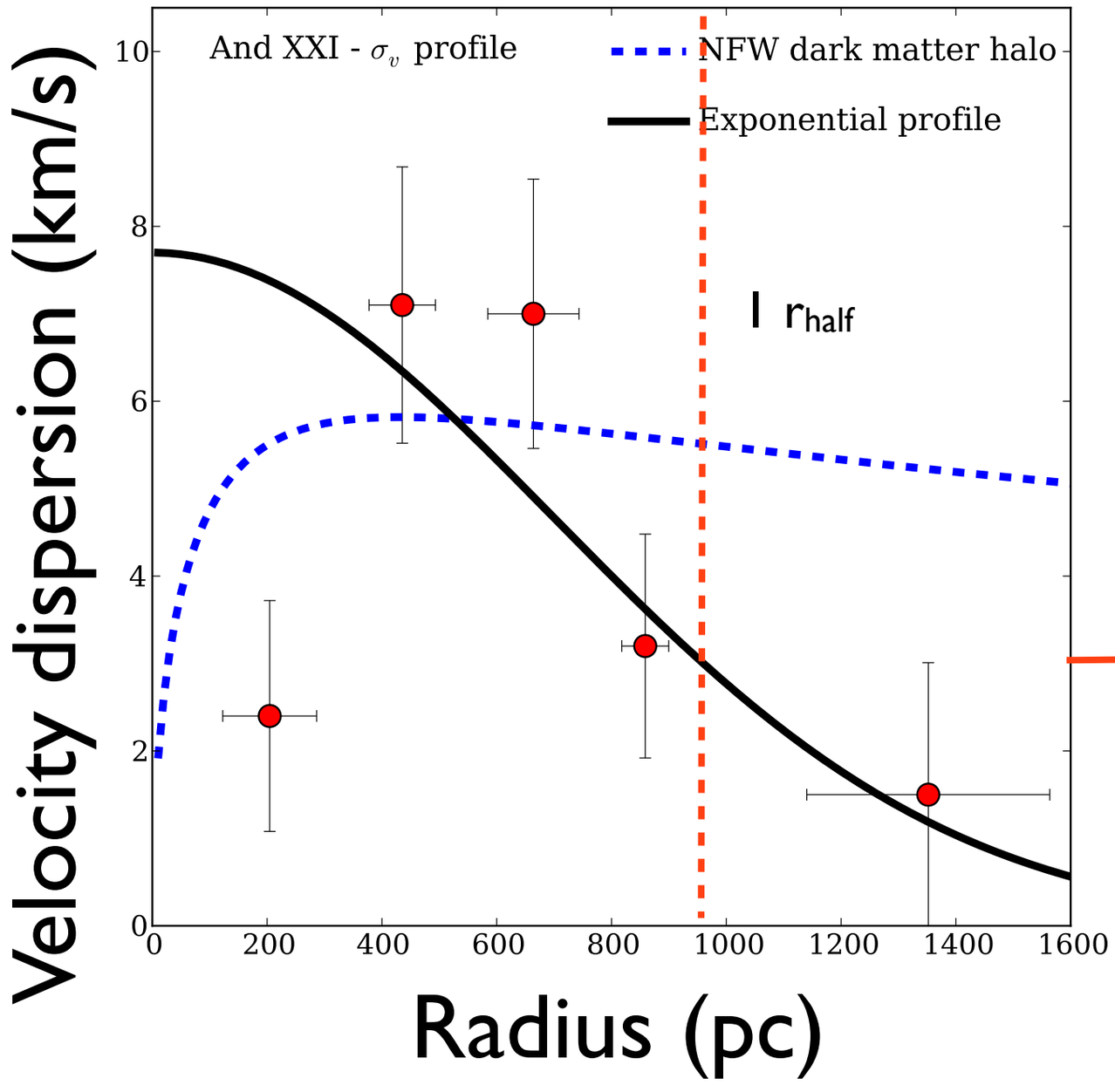
A Milky Way example



Walker et al. 2007

AND XXI





~ 20 stars/bin

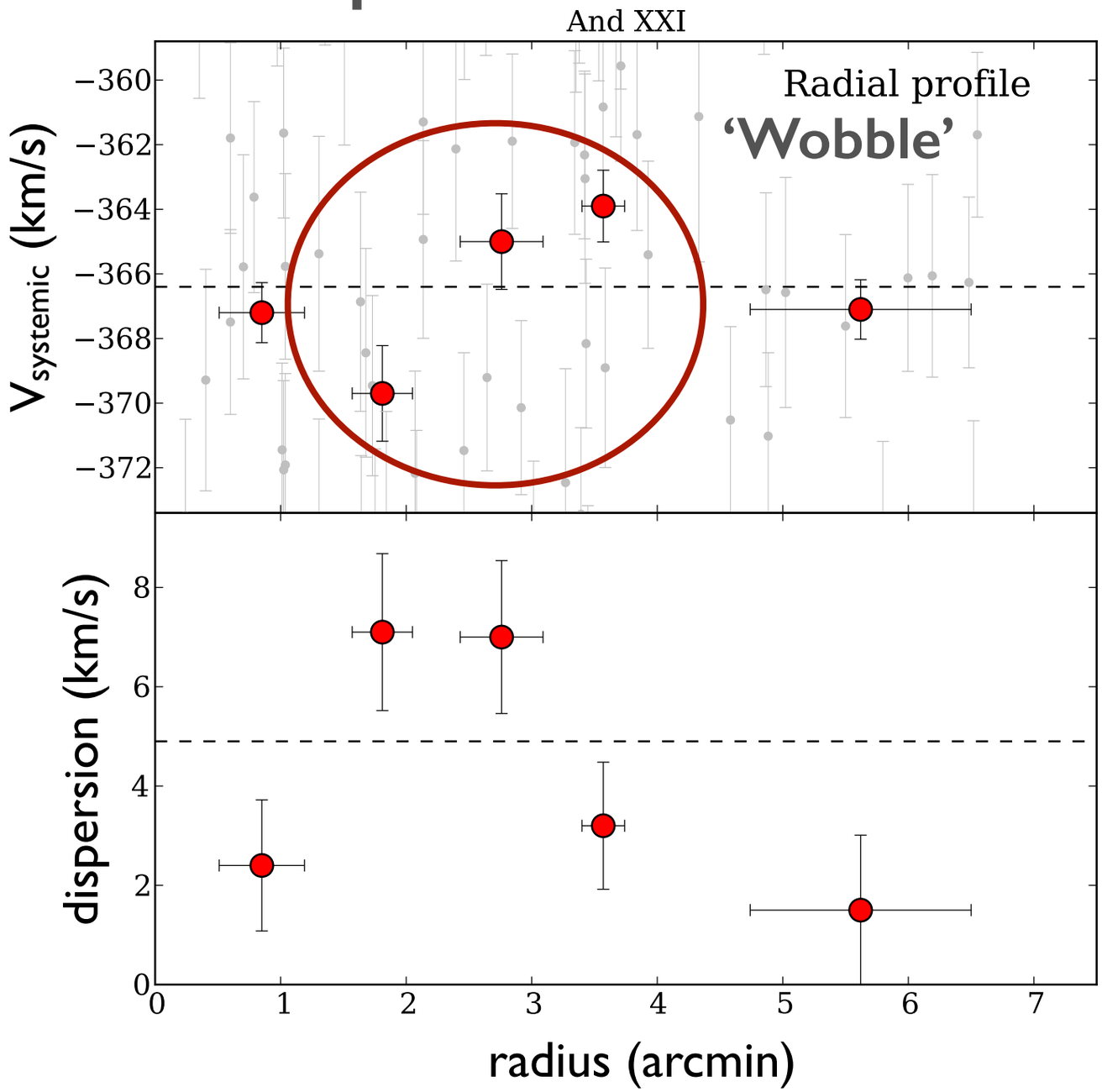
More And 21 stars

What's going on here..?

Collins et al. in prep

WHAT ABOUT ITS VELOCITY PROFILE?

Not in dynamical equilibrium?



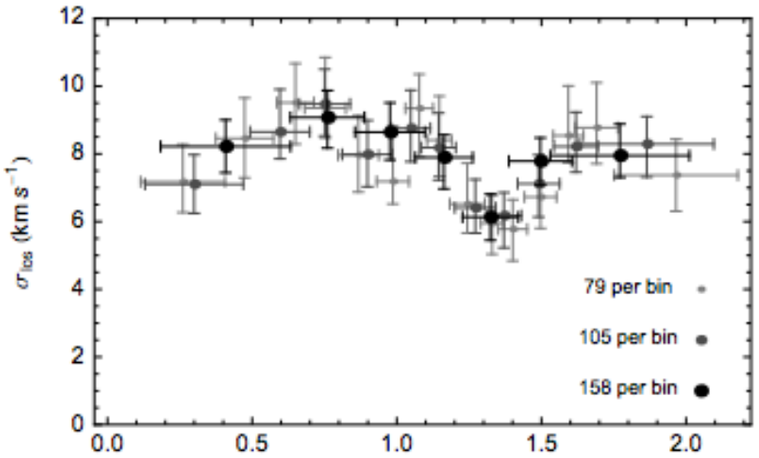
Collins et al. in prep

TIDAL INTERACTION WITH M31?

135 kpc

And XXI

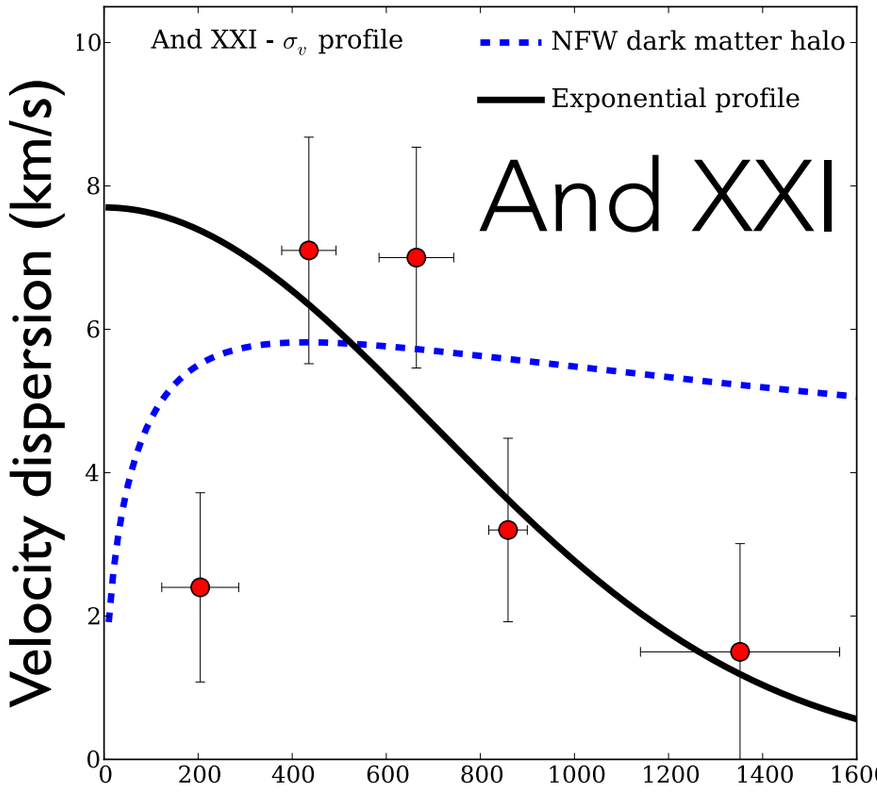
Or a merger?

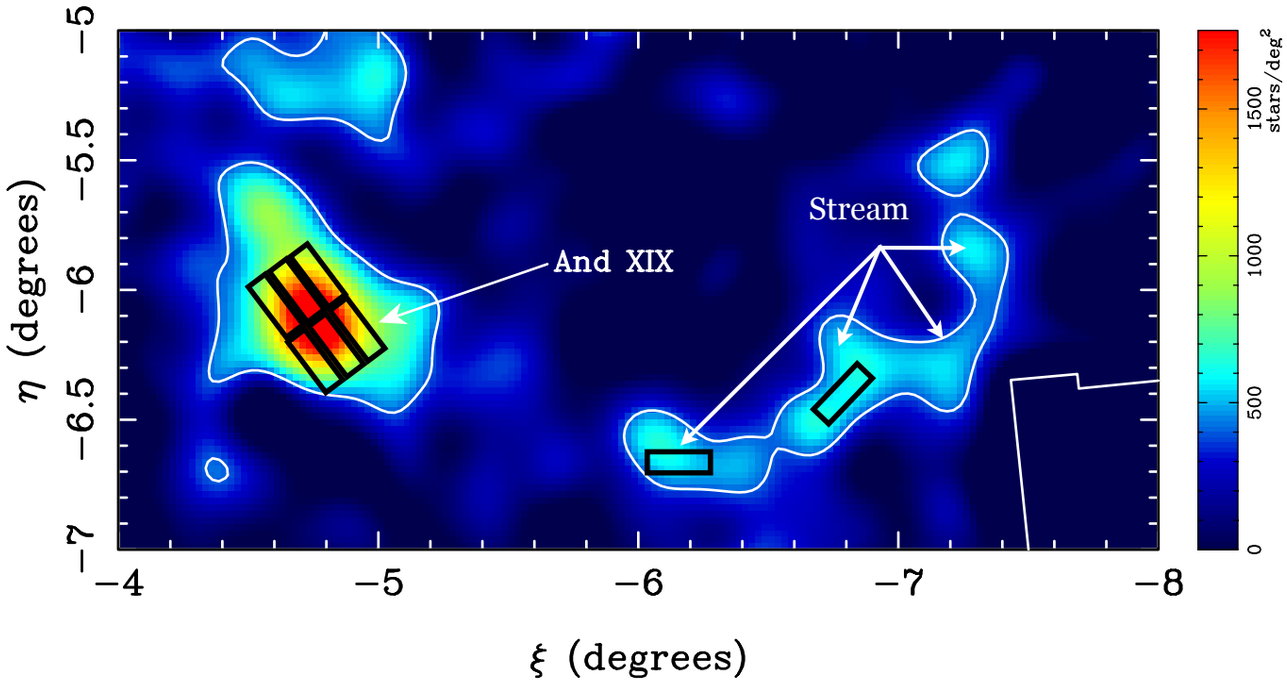


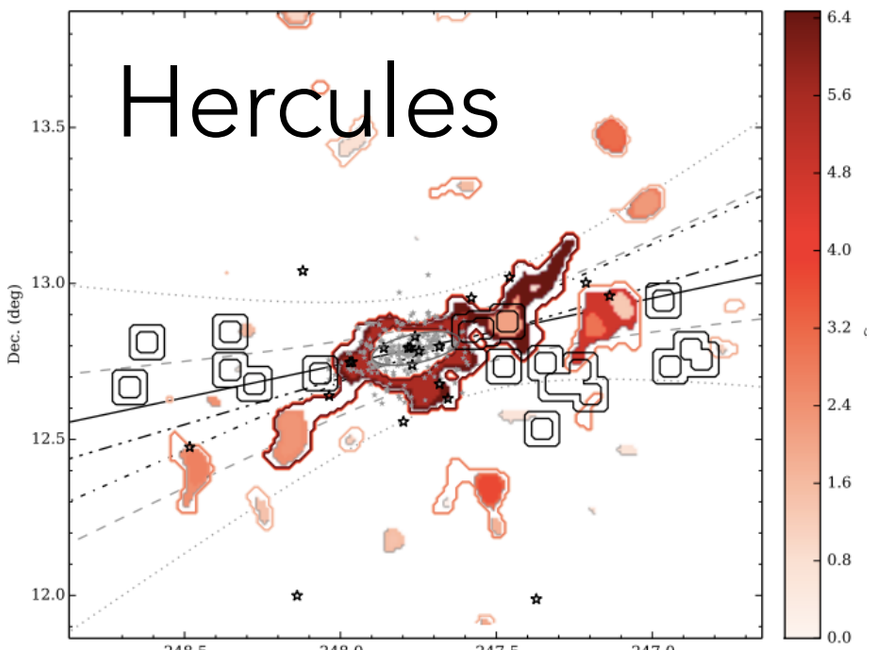
And II - Amorisco+14

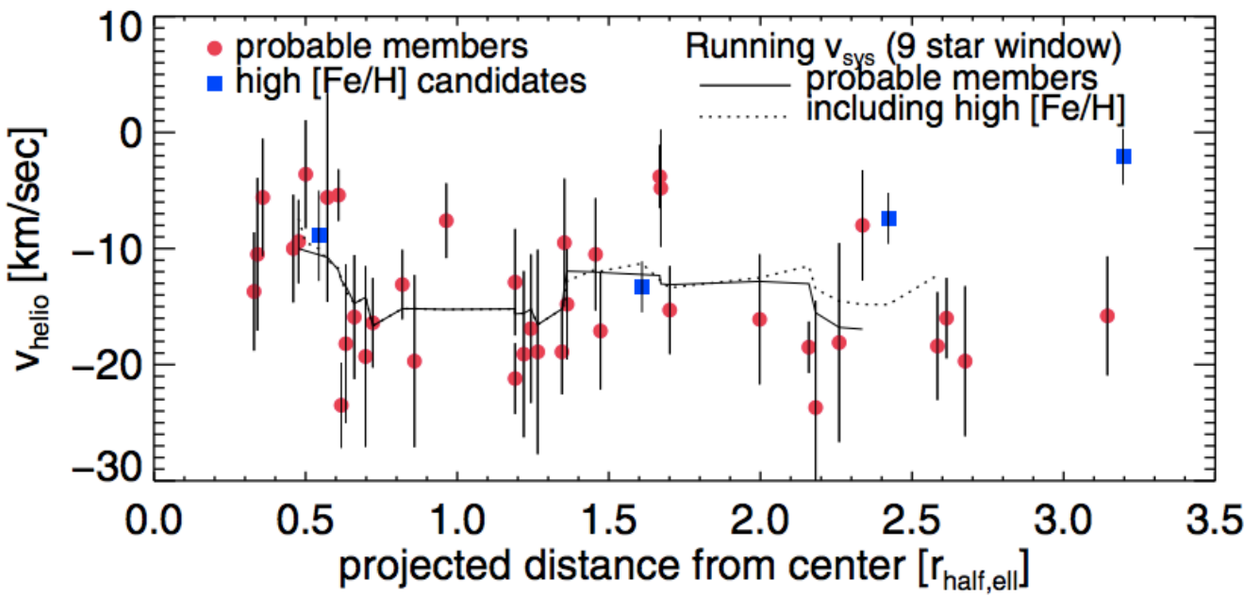
Could explain ‘weird’ kinematics?

A HOST OF DYNAMICALLY INTERESTING SYSTEMS









SUMMARY

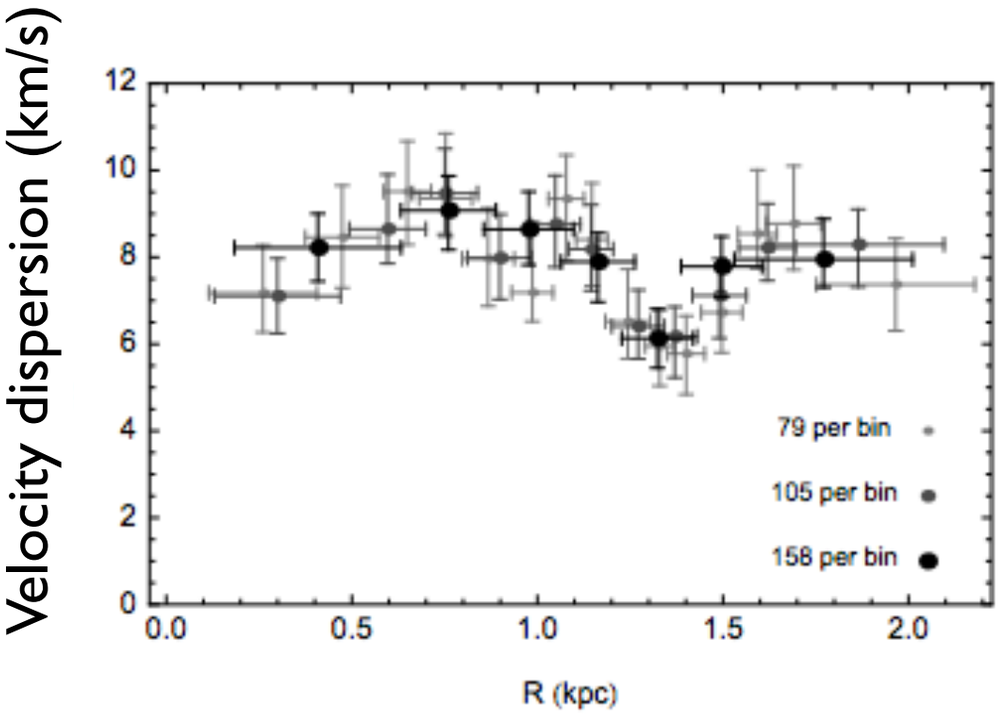
- Understanding dynamics not as simple as we'd hoped
  Messy, complicated dark matter laboratories…

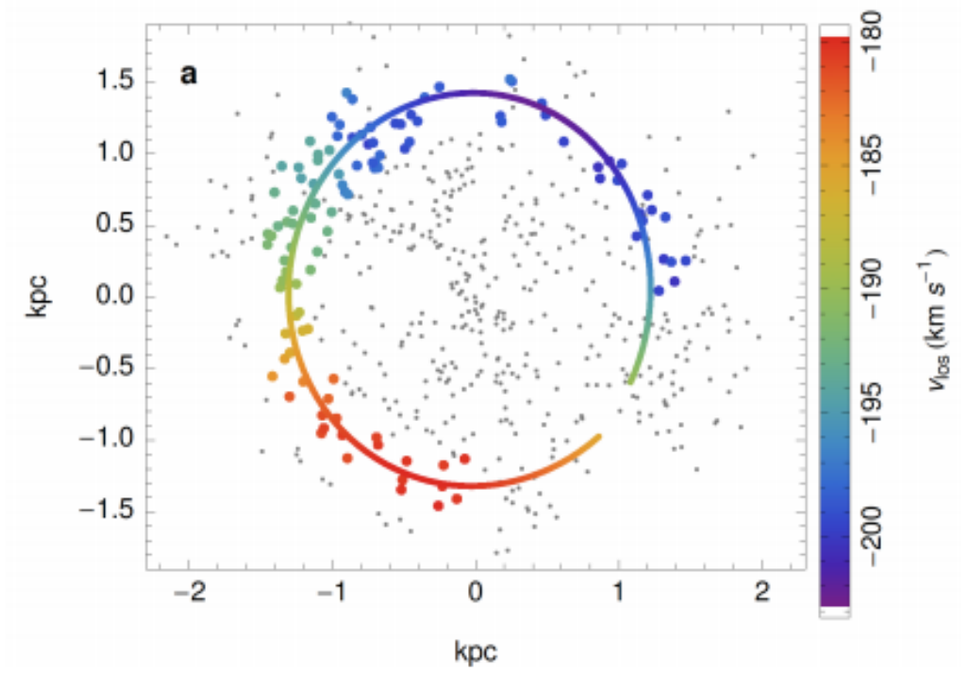
- Disrupting objects have interesting things to tell us
  Unusual orbits? Dark matter halo properties?

- More (chemo)dynamics for stars = more information = better understanding

MERGER?

And II
M_V~-12, r_h~1000pc, D_{M31}~110 kpc





Amorisco et al. 2014

And XXI
M_V~-10, r_h~1000pc, D_{M31}~130 kpc