RESOLVE : The Critical Gas Accretion/Depletion Transition in the Nascent Group Regime

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with LOTS of help from

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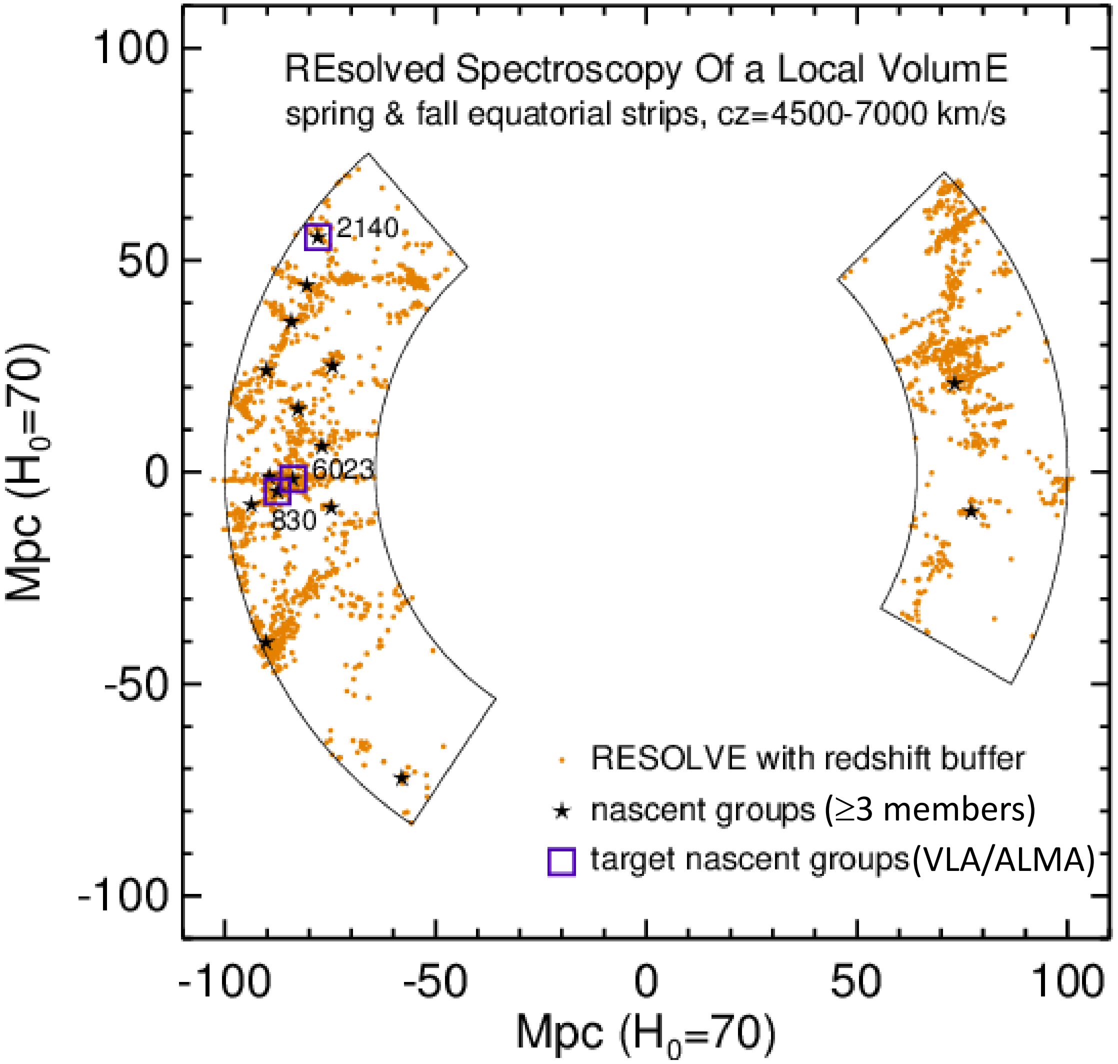
RESOLVE data *(public at http://resolve.astro.unc.edu)*



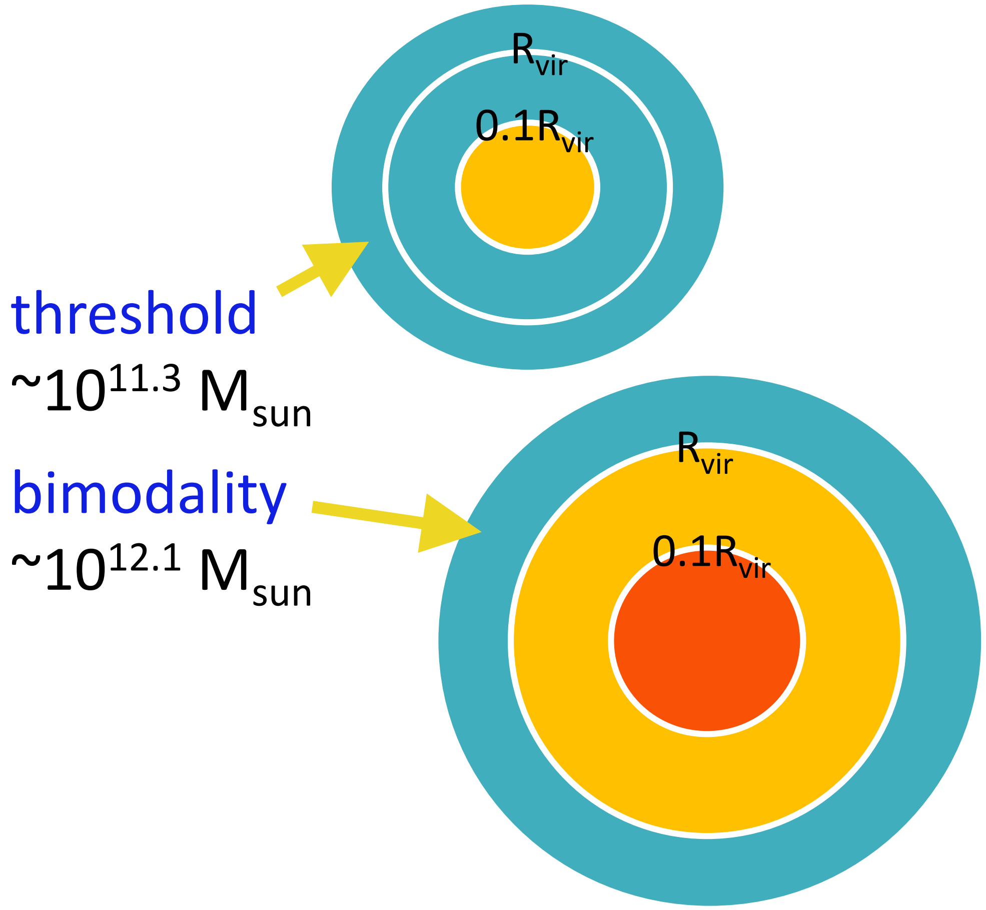
- volume-limited
- baryonic (stars + atomic gas) mass limit ~10^9 $M_\odot$
- *adaptive sensitivity single-dish 21cm data with strong G/S upper limits <0.05-0.1*
- ~900 “single” galaxies, >200 groups
- *VLA/ALMA HI/CO maps for three ‘nascent’ groups (N≥3, halo mass $10^{11.3\text{-}12.1}M_\odot$)*

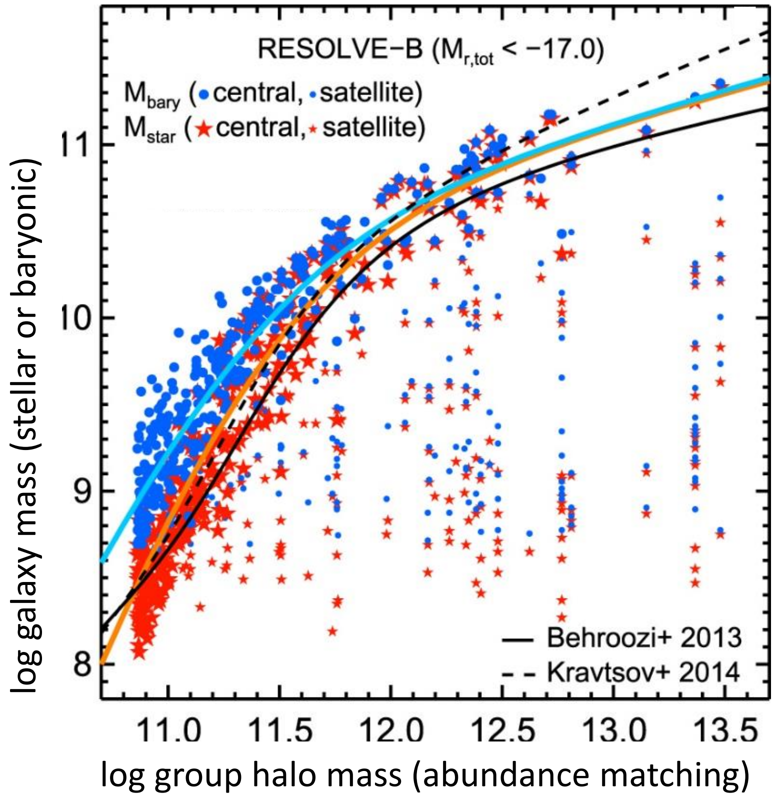
group #830 (X = galaxy not in group)
log group mass = 11.51
color gap -0.2
group cold gas-to-stellar mass ratio 2.9

group #6023
log group mass = 11.44
color gap 1.1
group cold gas-to-stellar mass ratio 1.0

group #2140
log group mass = 11.83
color gap 1.1
group cold gas-to-stellar mass ratio 0.3

Key halo masses for gas accretion/heating



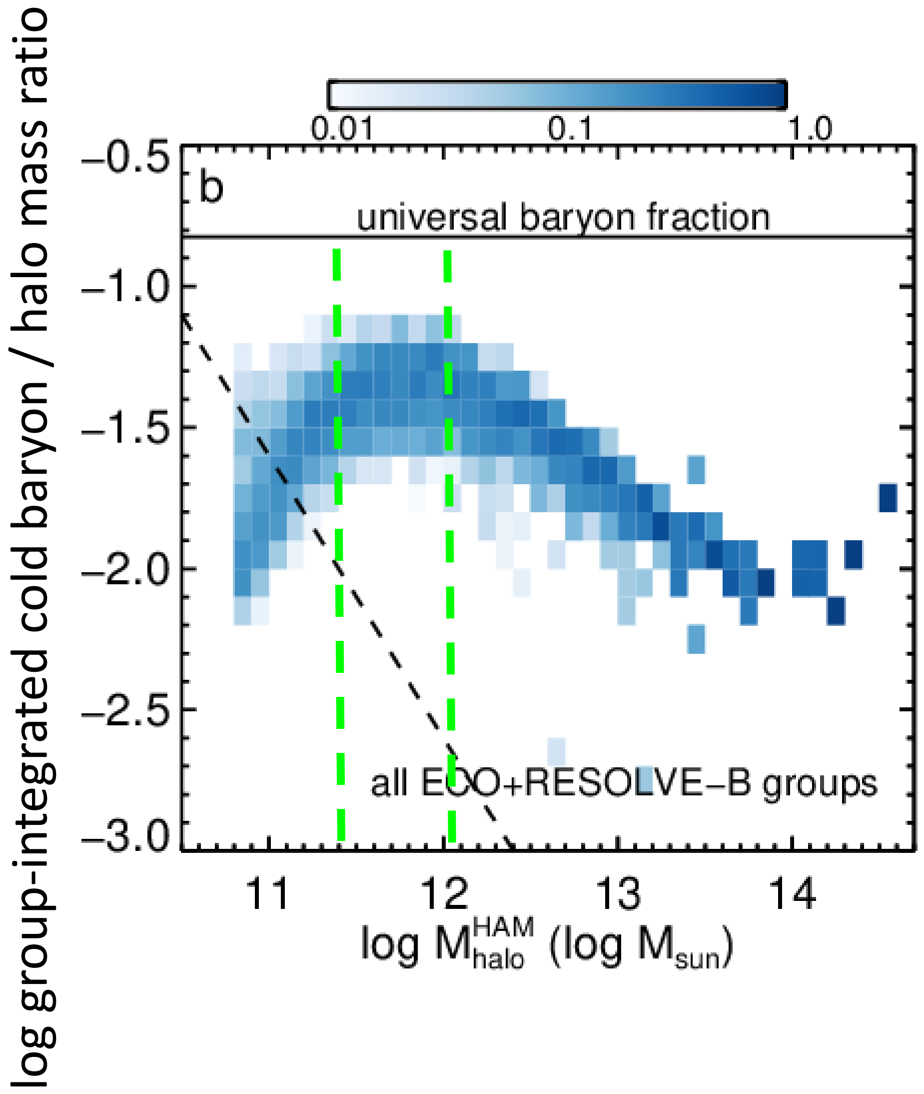


Eckert et al. 2016, RESOLVE-B

"cold" accretion predicted to turn off between these halo masses (Dekel & Birnboim 05)

corresponding central galaxies:
baryonic mass $10^{9.8}$ / $10^{10.6}$ $M_\odot$
V ~ 120/200 km/s

"Cold" baryon fraction flat across this halo mass range…



Eckert et al. (2017)

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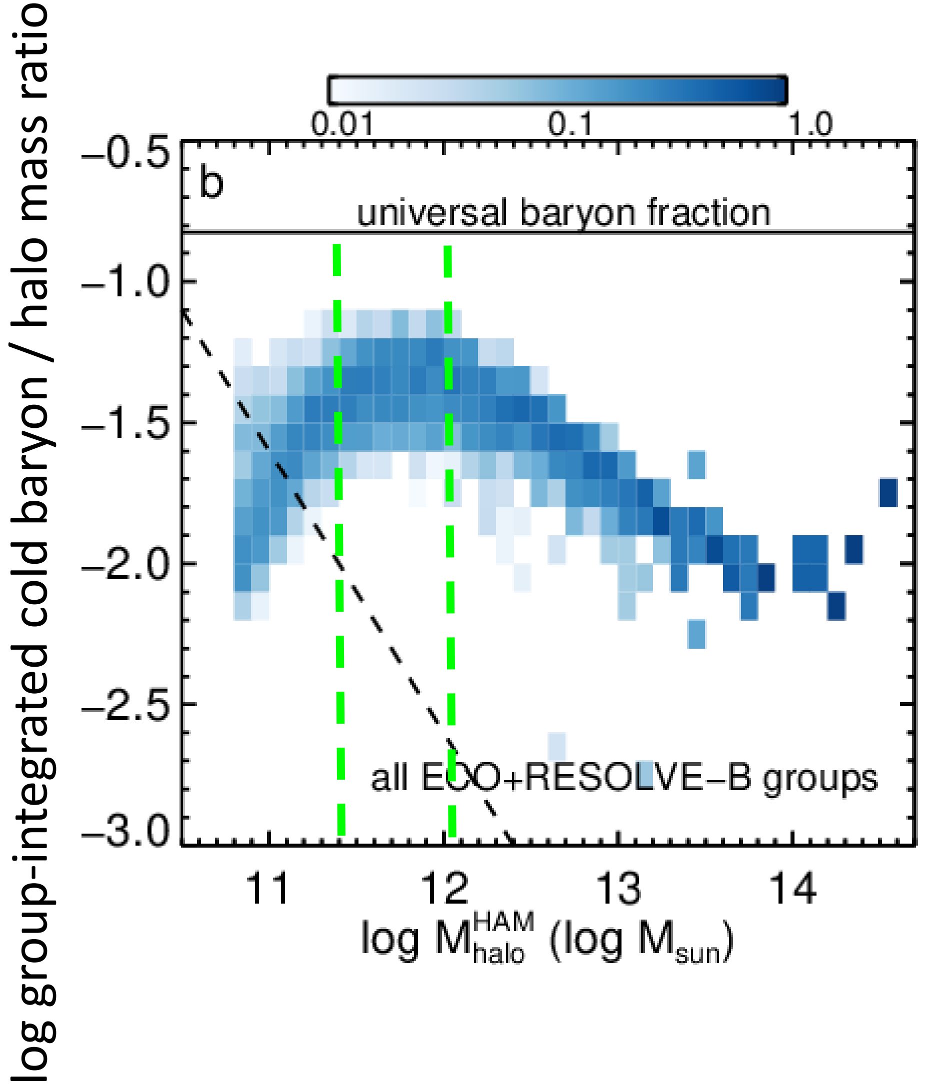
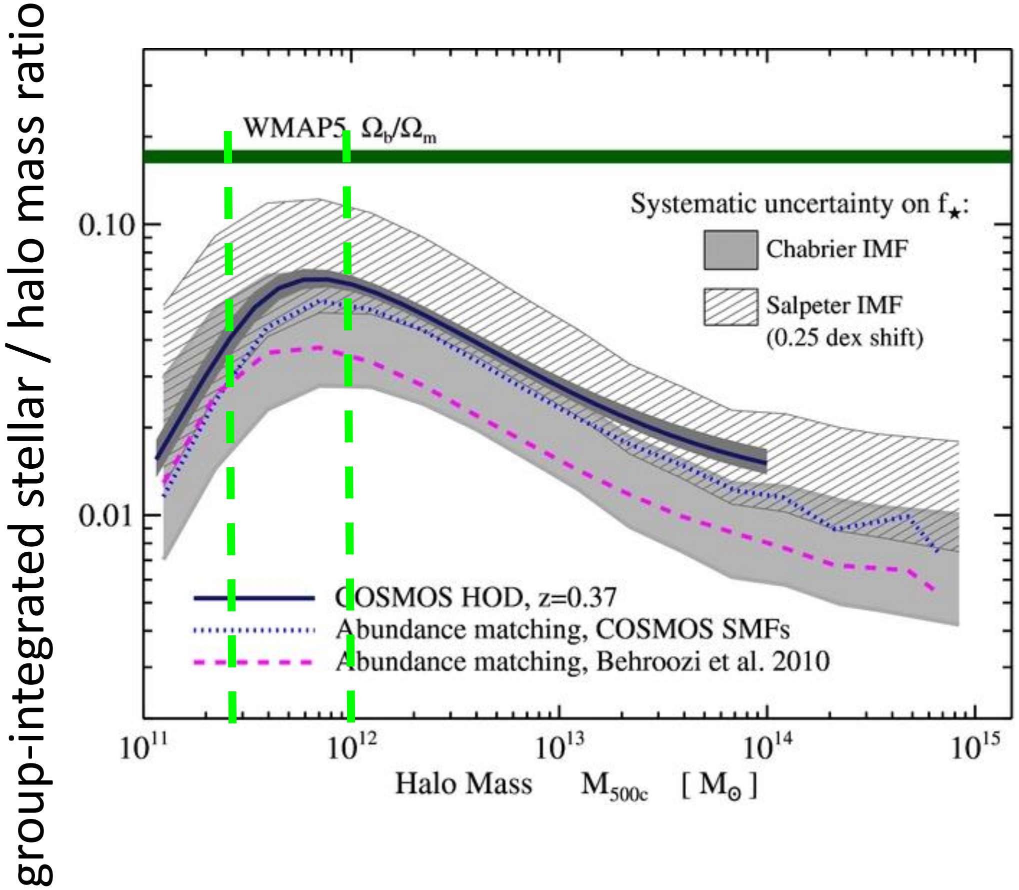


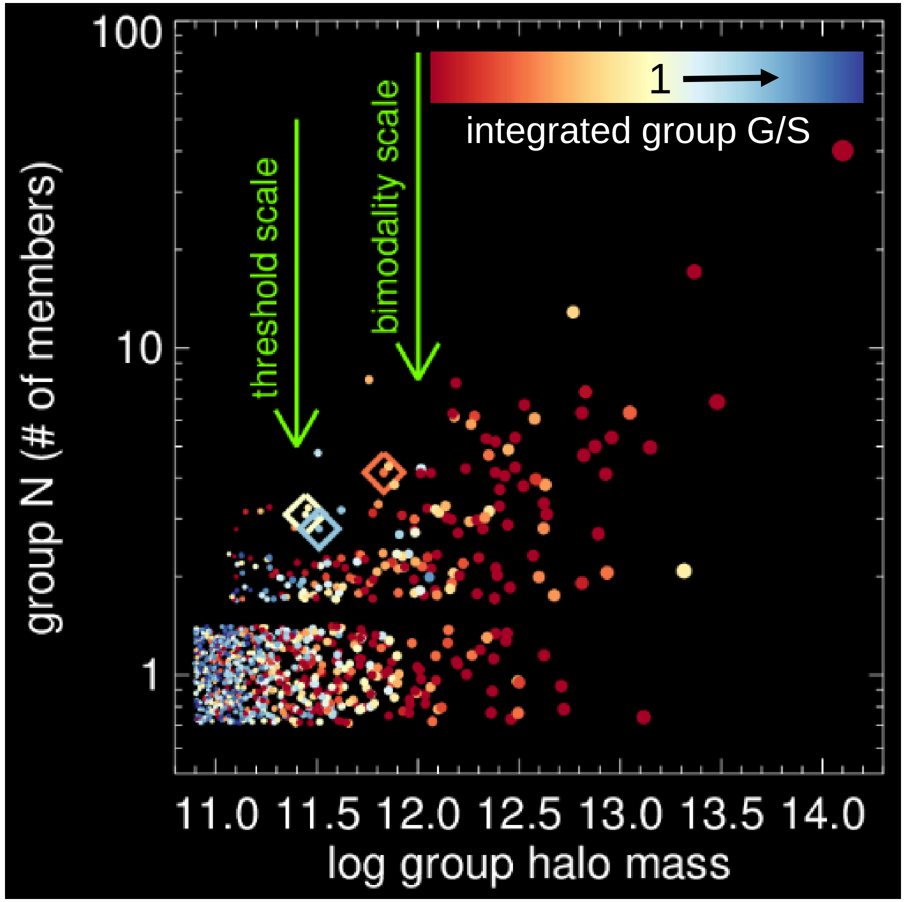
Eckert et al. (2017)

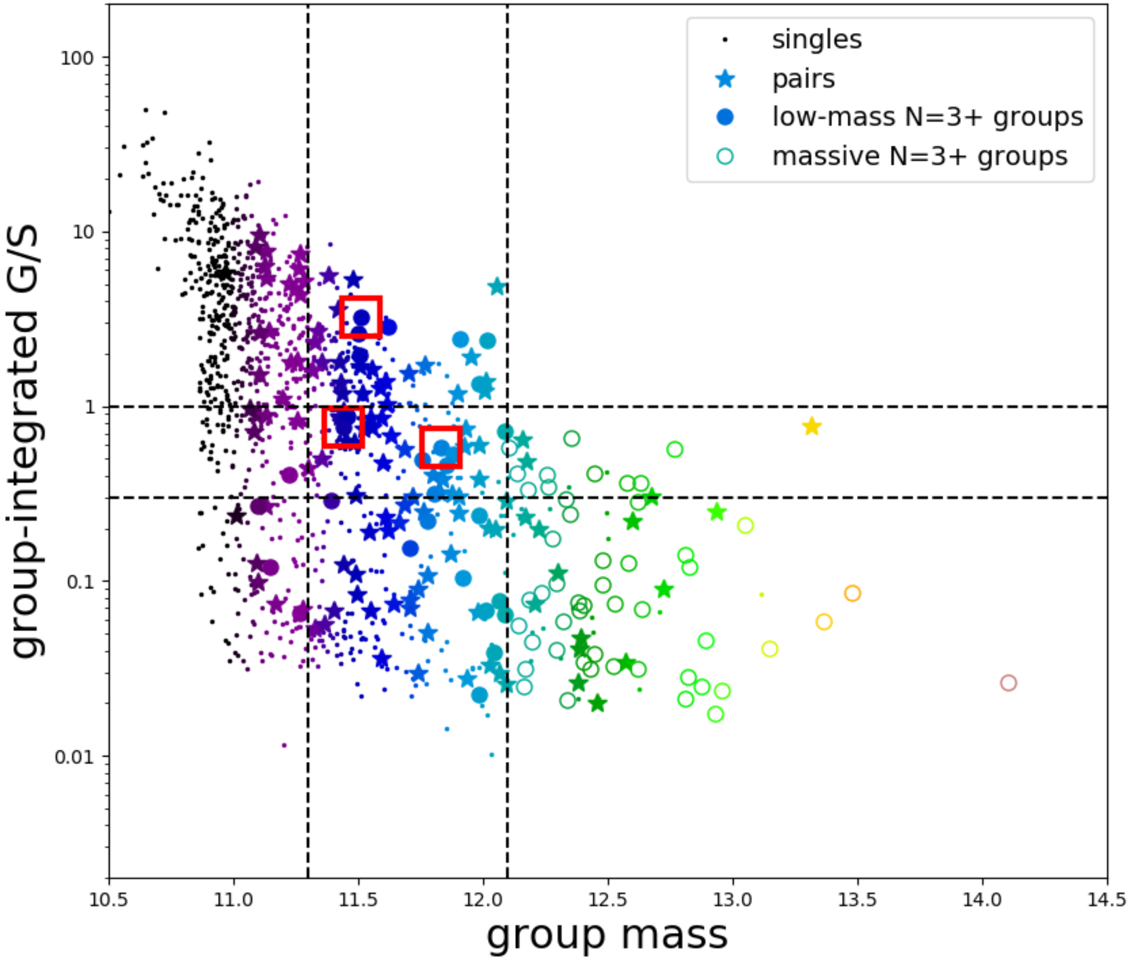
…but G/S dropping



Leauthaud et al. (2012)

Is it a coincidence that we see groups appear in this mass range?

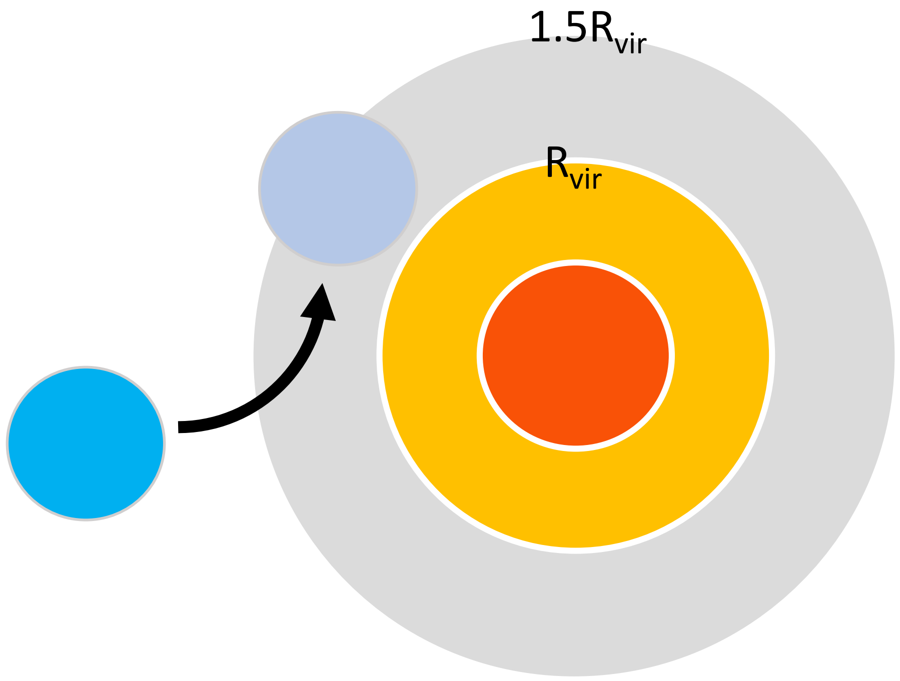


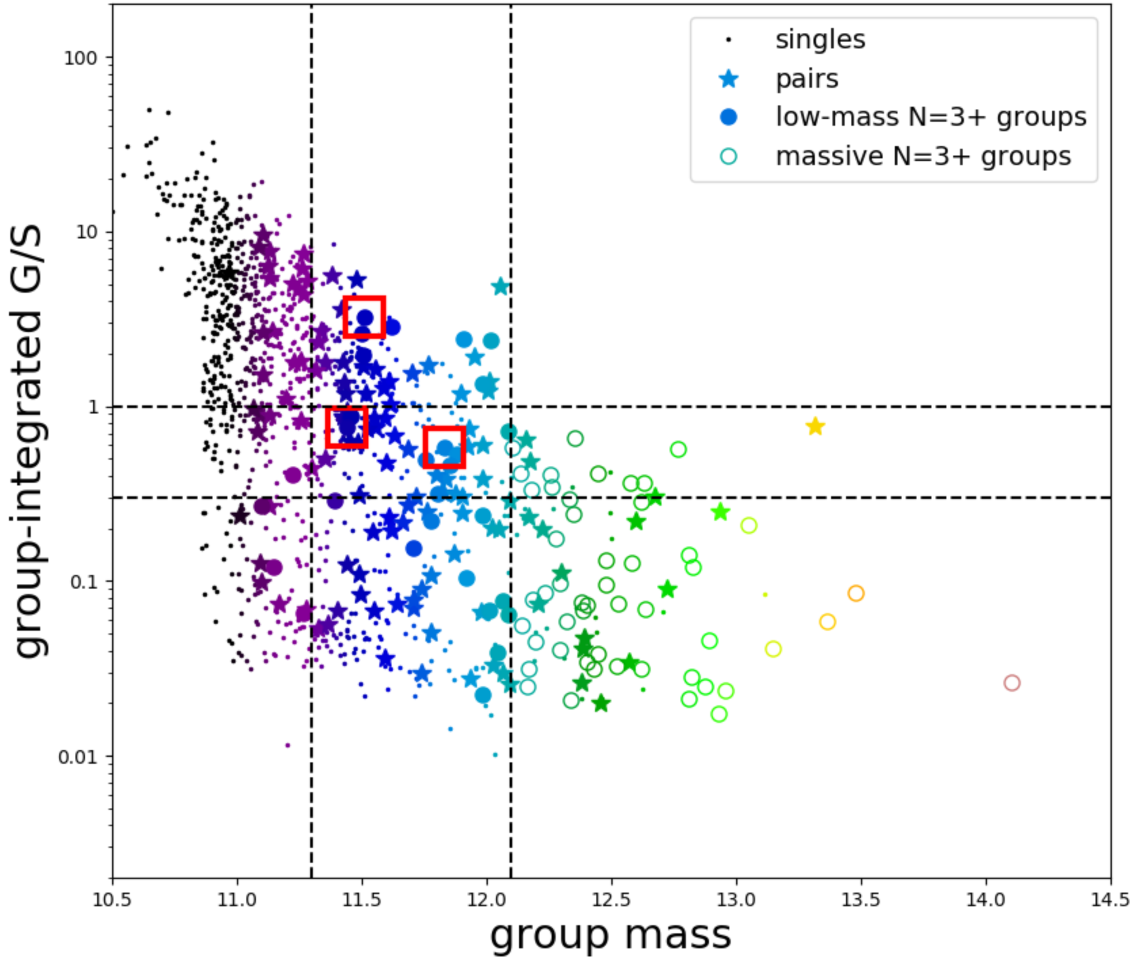


- friends-of-friends + abundance matching ➔ group halo masses (N=1 “single”)
- G/S = atomic gas to stellar mass ratio

threshold-scale centrals have $M_{bary} \sim 10^{9.8} M_{\odot}$, well above survey floor, yet most galaxies in nascent group regime still “single”

Is large-scale structure formation causing gas loss/quenching?





"flyby" = galaxy within 1.5R$_{vir}$ of hot halo (mass > 10^{12} $M_\odot$)

following Stark, D.V. et al (2016)

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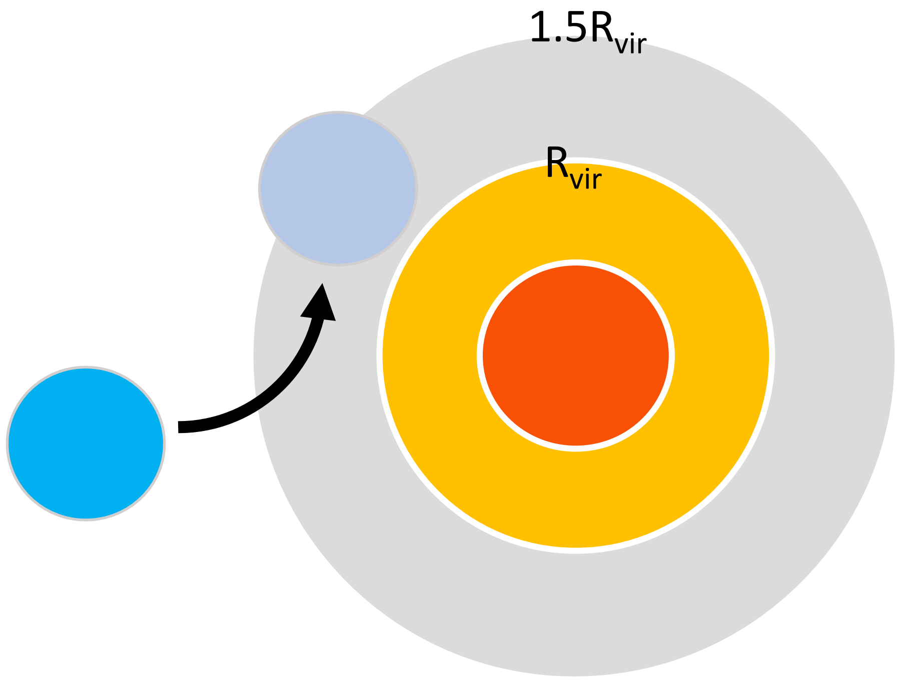

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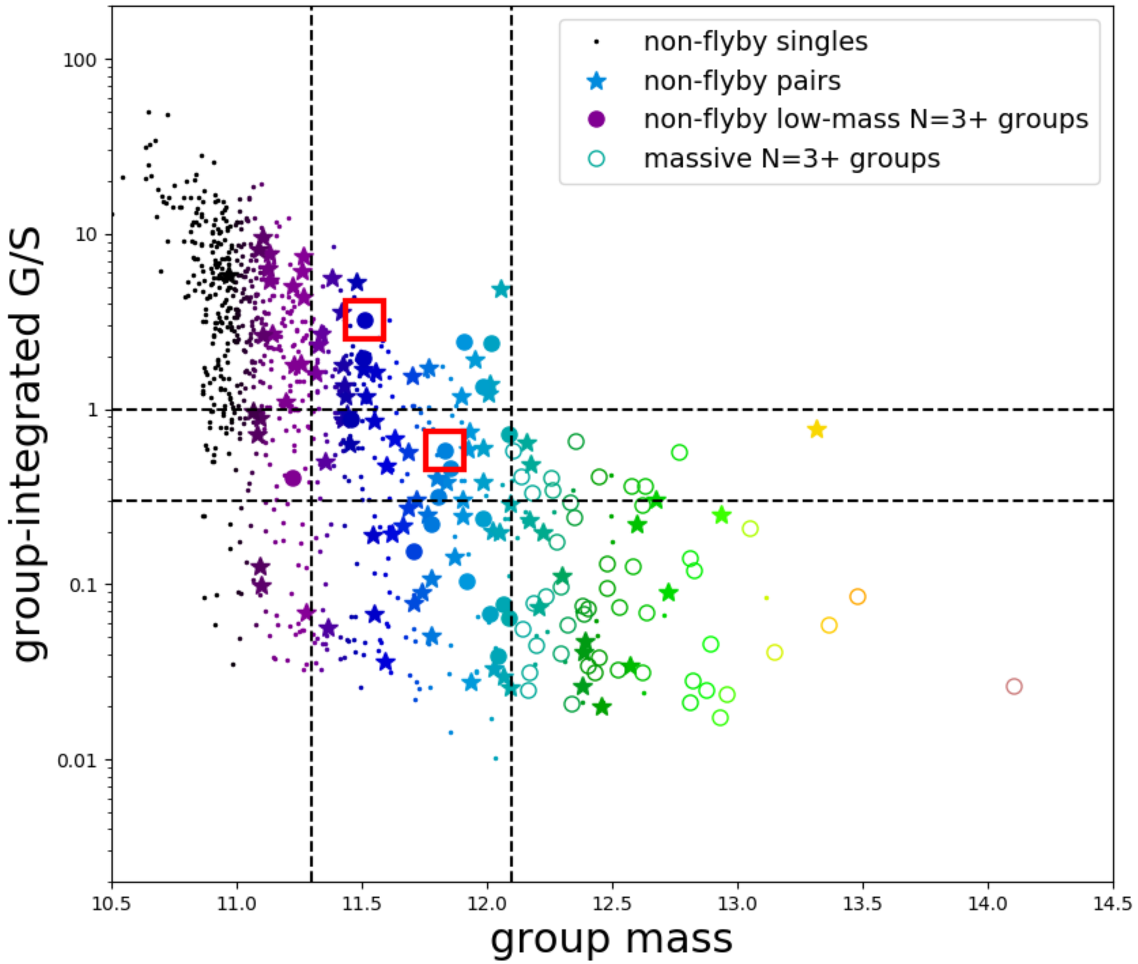

remove flybys

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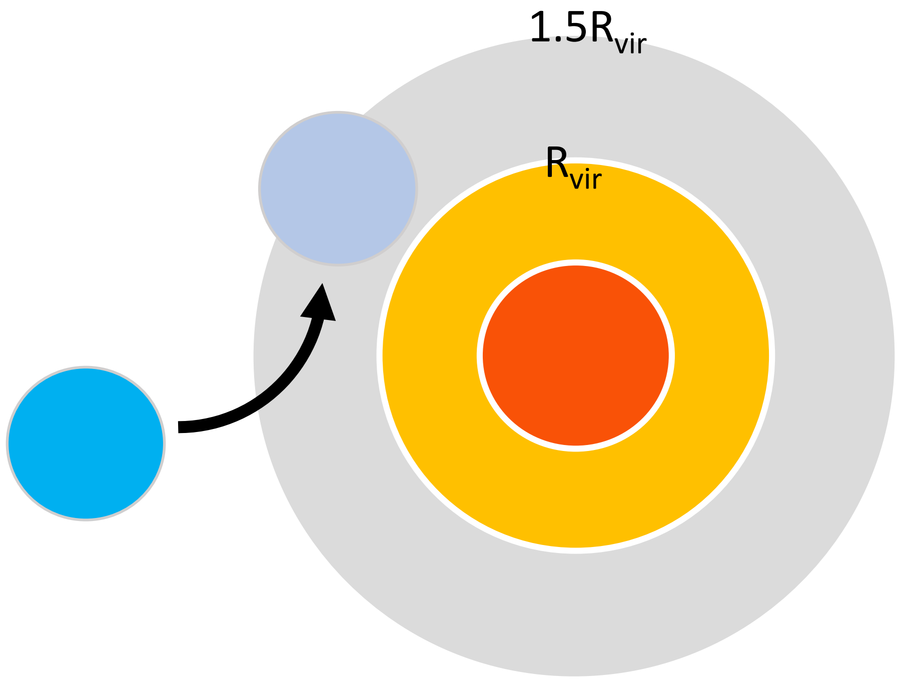

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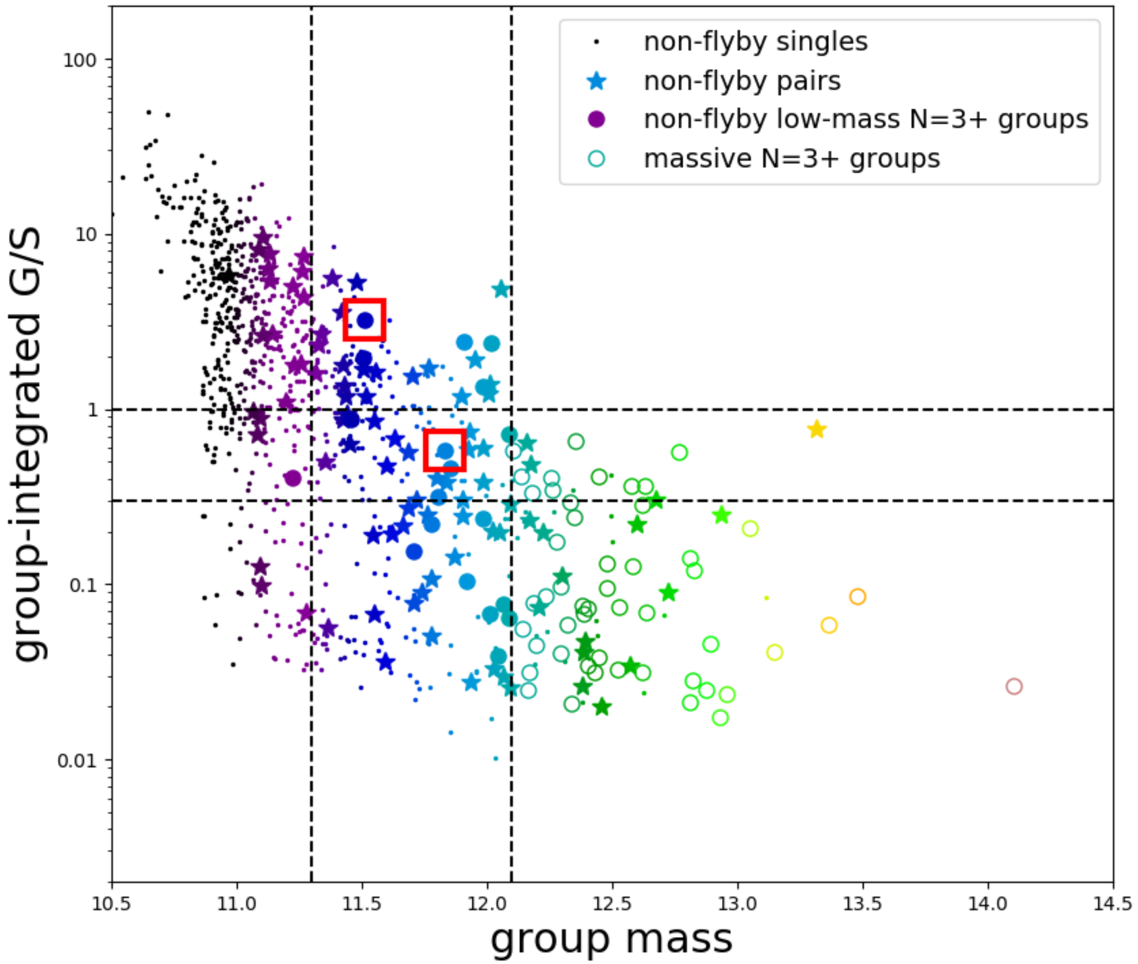
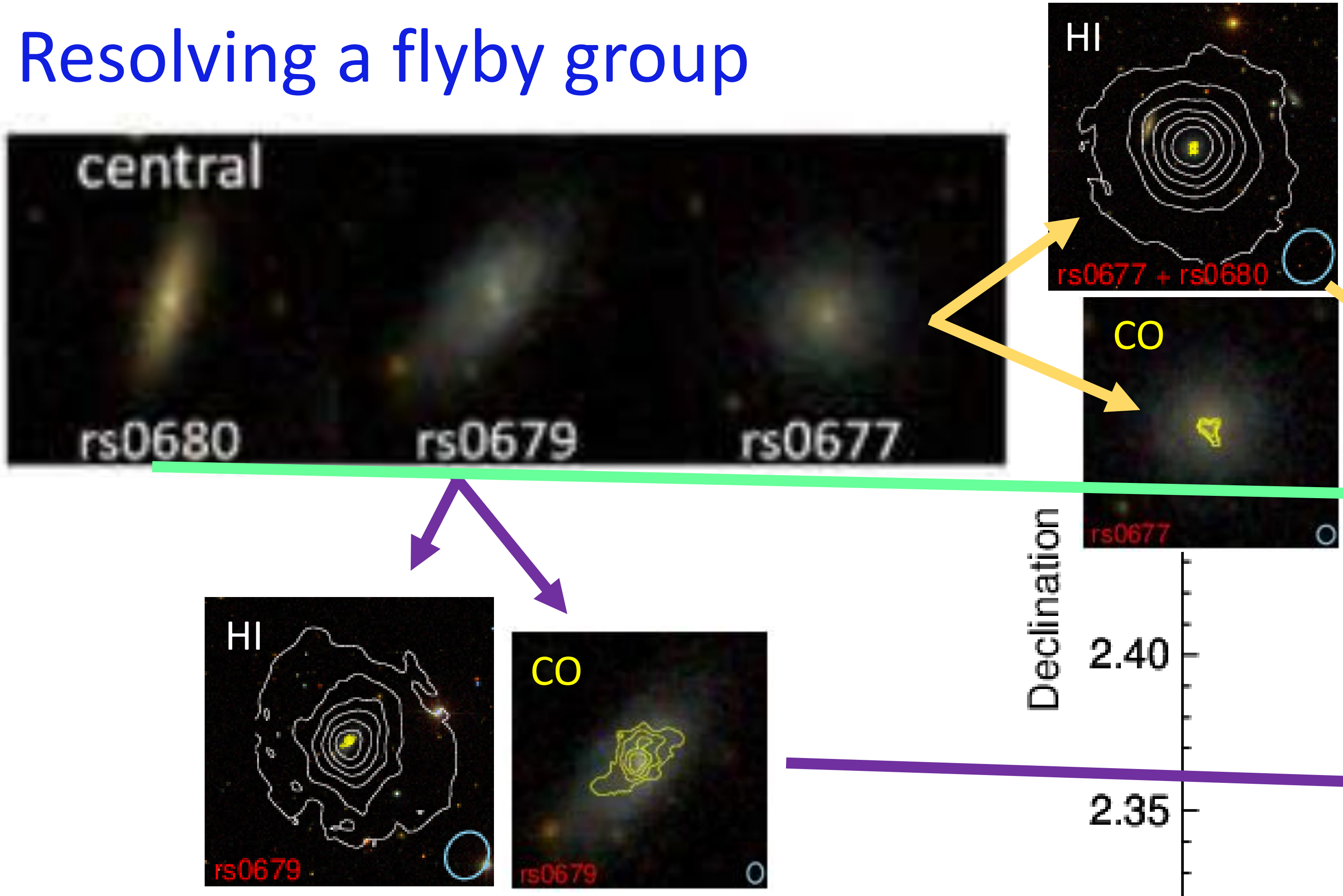
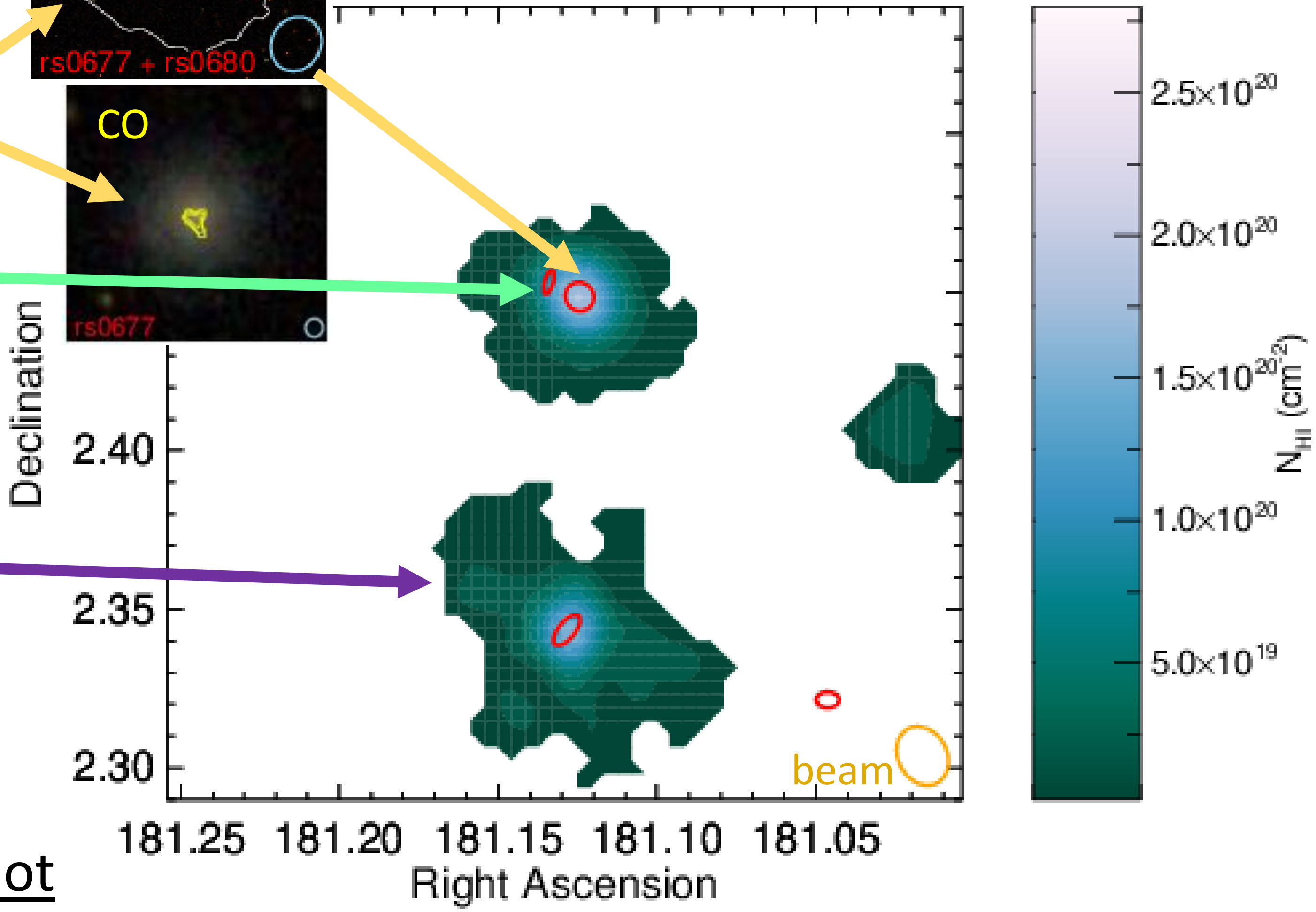


remove flybys

→ *quenching with halo mass stronger*

Resolving a flyby group

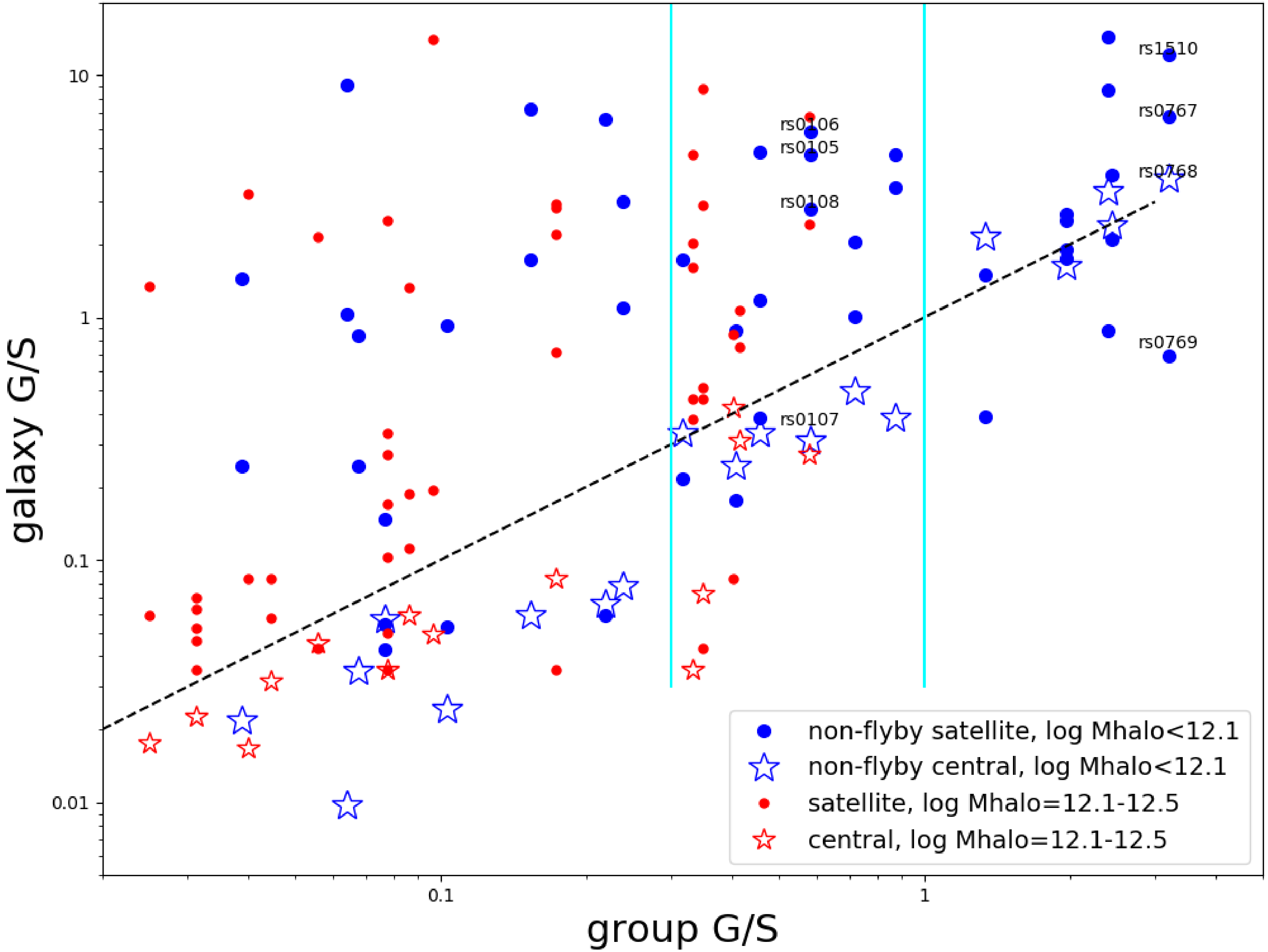




- in cluster infall region
- nominal central quenched; runner-up <u>not</u>
- disconnected HI; CO extended/spiral in rs0679 & compact in rs0677

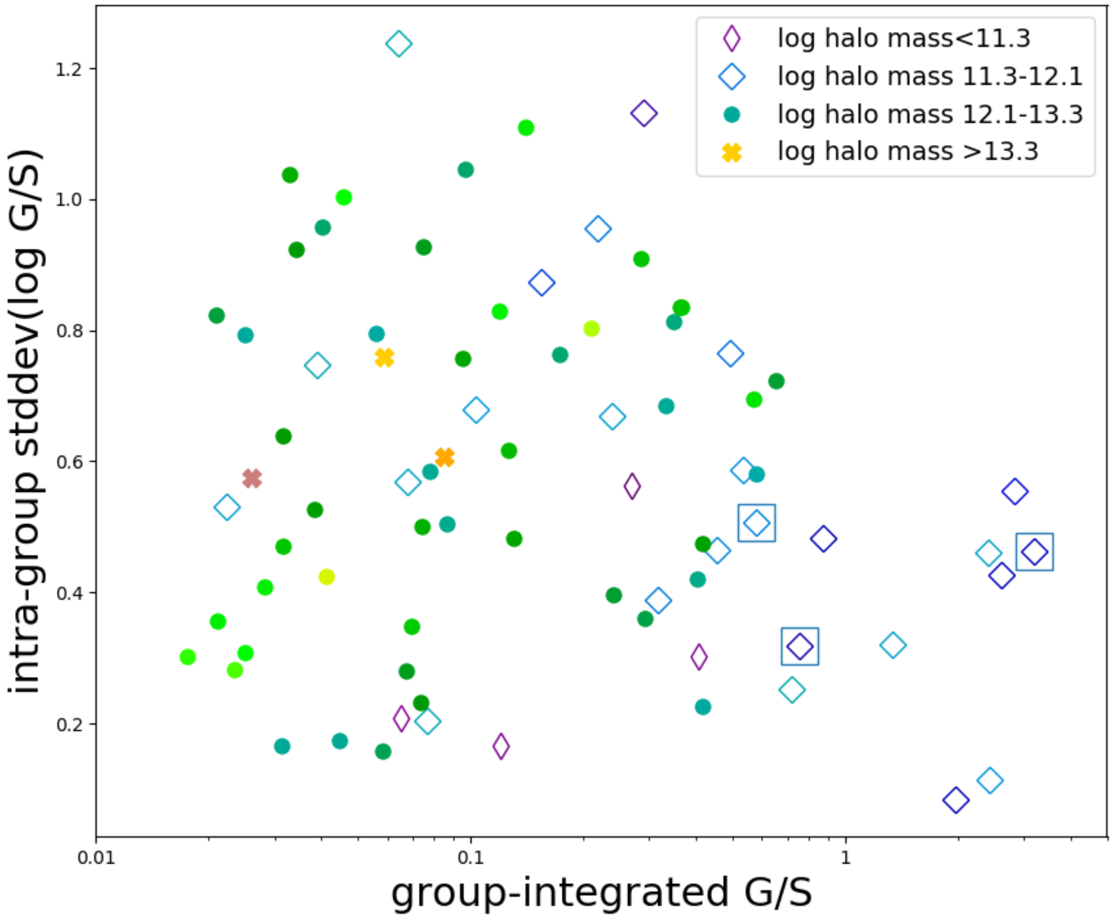
optical isophotal radii (*r* =24.5)

What’s going on inside non-flyby groups?

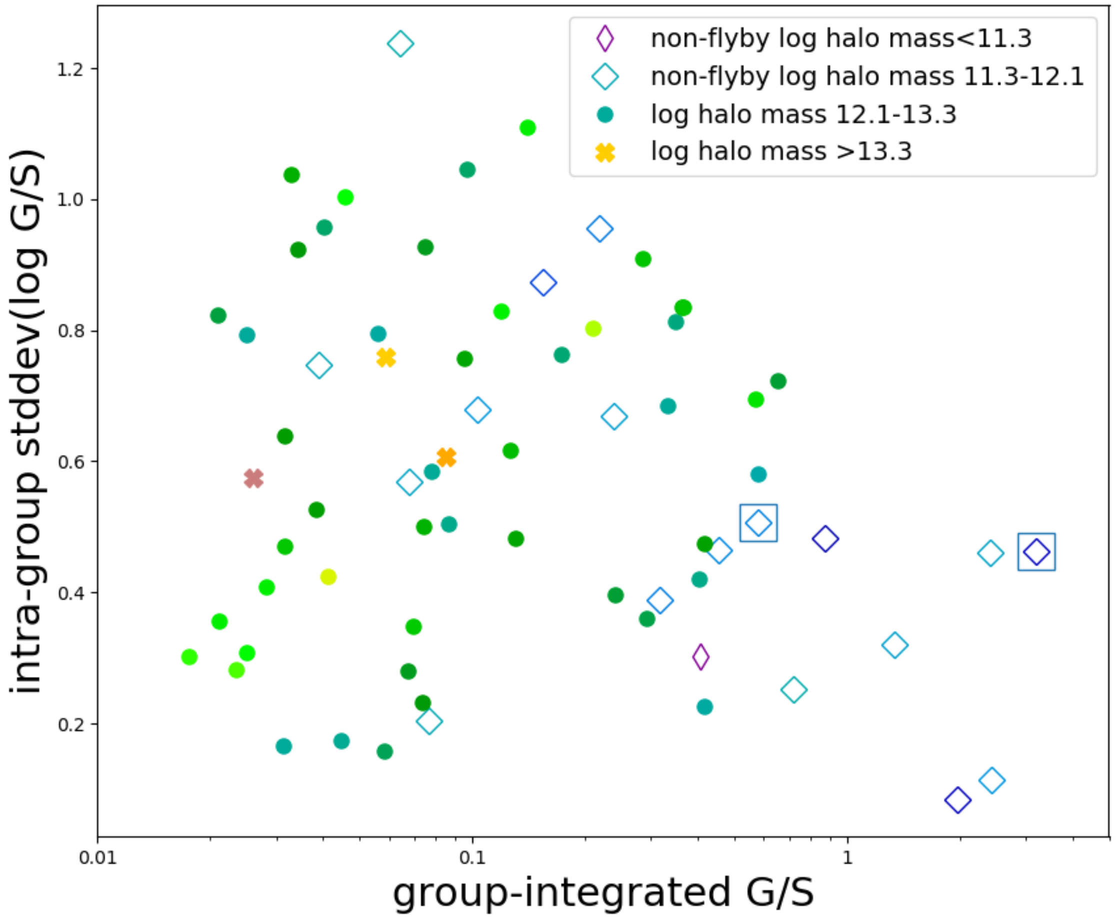


- focus on low-mass groups with N≥3, far from hot halos
- “central” (i.e., most massive galaxy) *becomes* most gas-poor galaxy for group G/S<1
- dispersion in G/S blows up for group G/S < 0.3
- slightly more massive hot halos shown for reference

Dispersion in G/S seems to rise then fall



with flybys



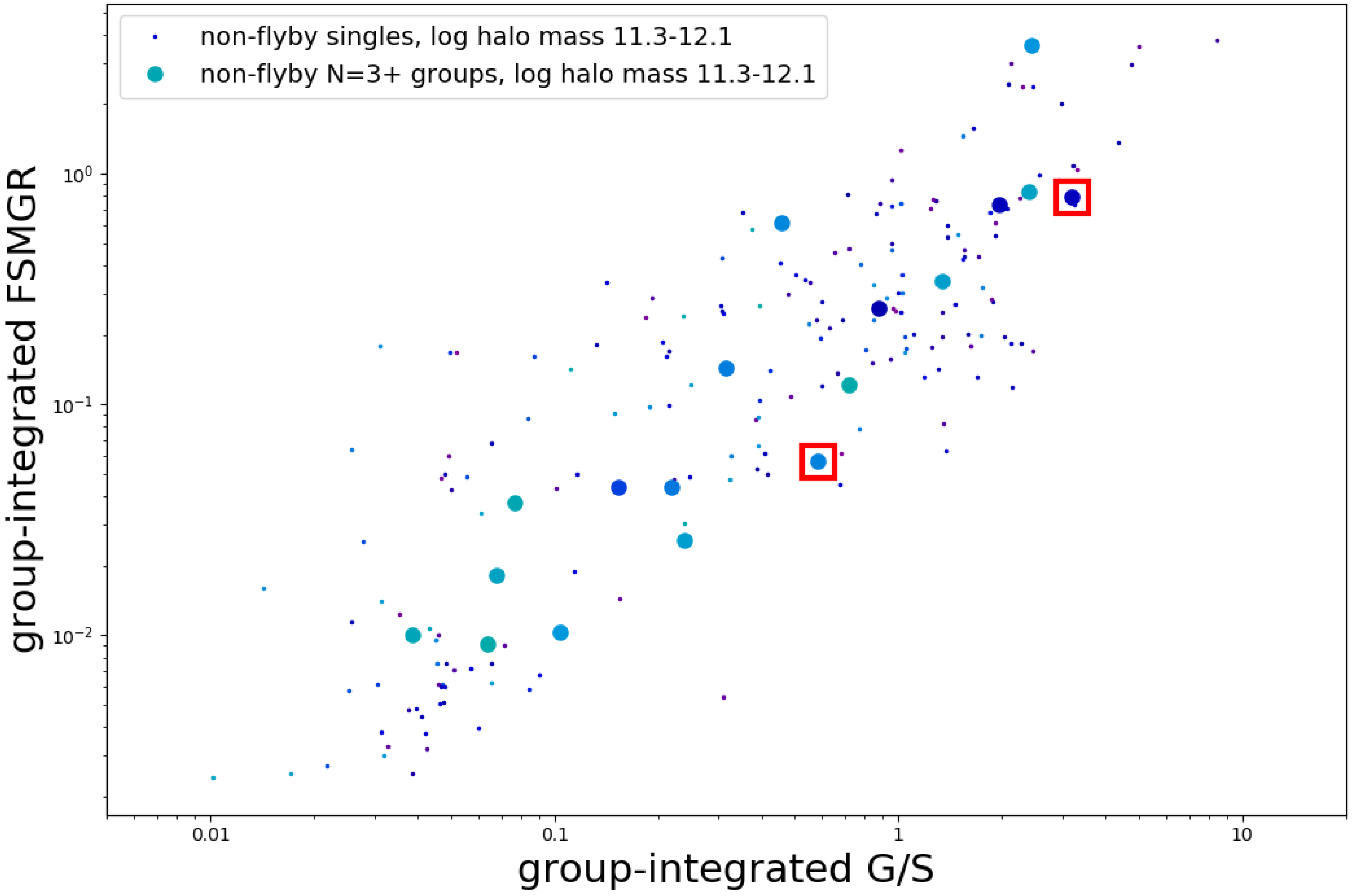
without flybys

Are nascent group star formation histories different from "single" galaxies in the same halo mass range?

SFH metric = "fractional stellar mass growth rate" (FSMGR)

($M_\star$ formed in last Gyr) ÷ ($M_\star$ formed in all previous Gyr)

differs from sSFR in that it does not asymptote for the most highly star-forming galaxies



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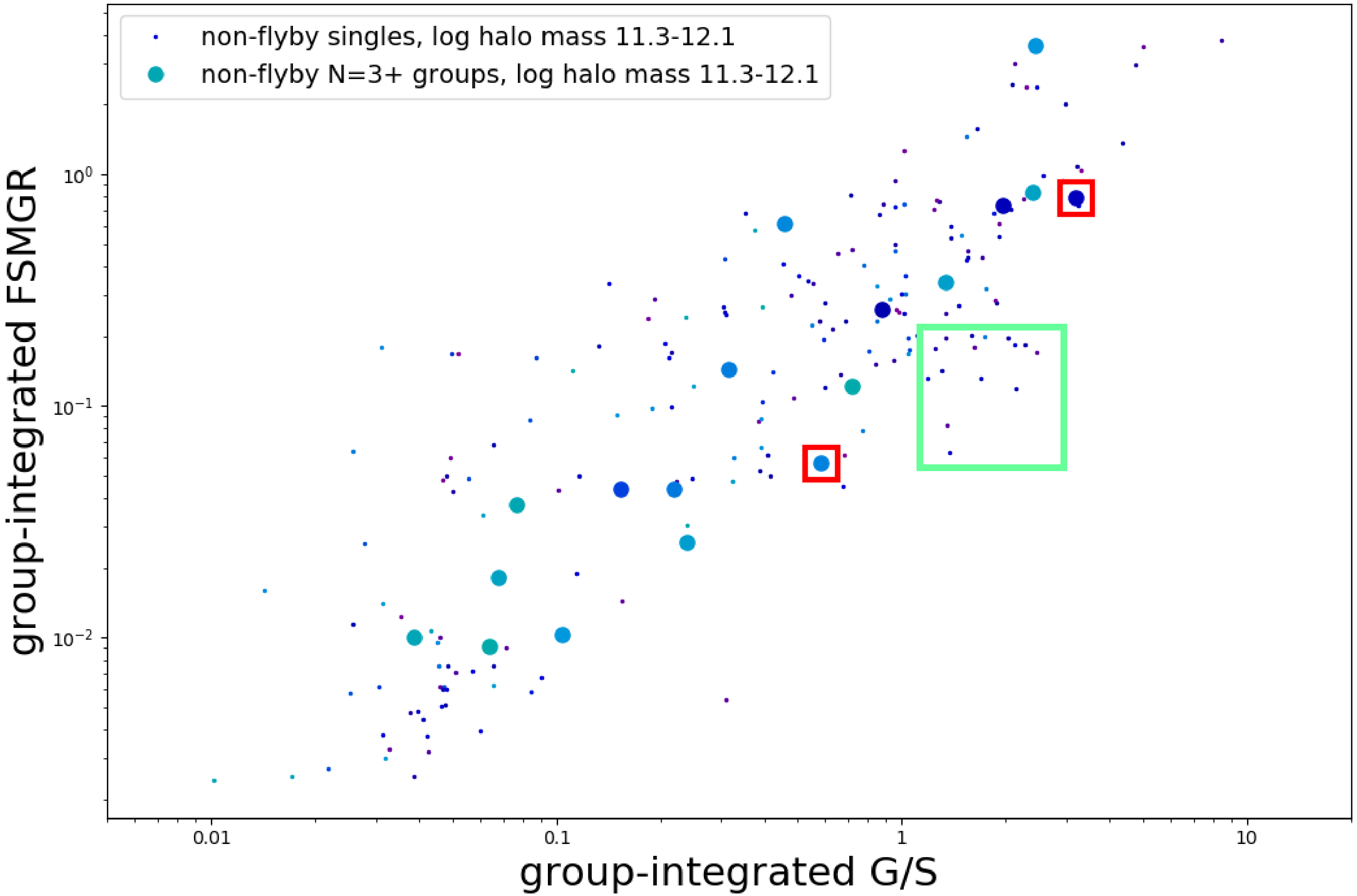
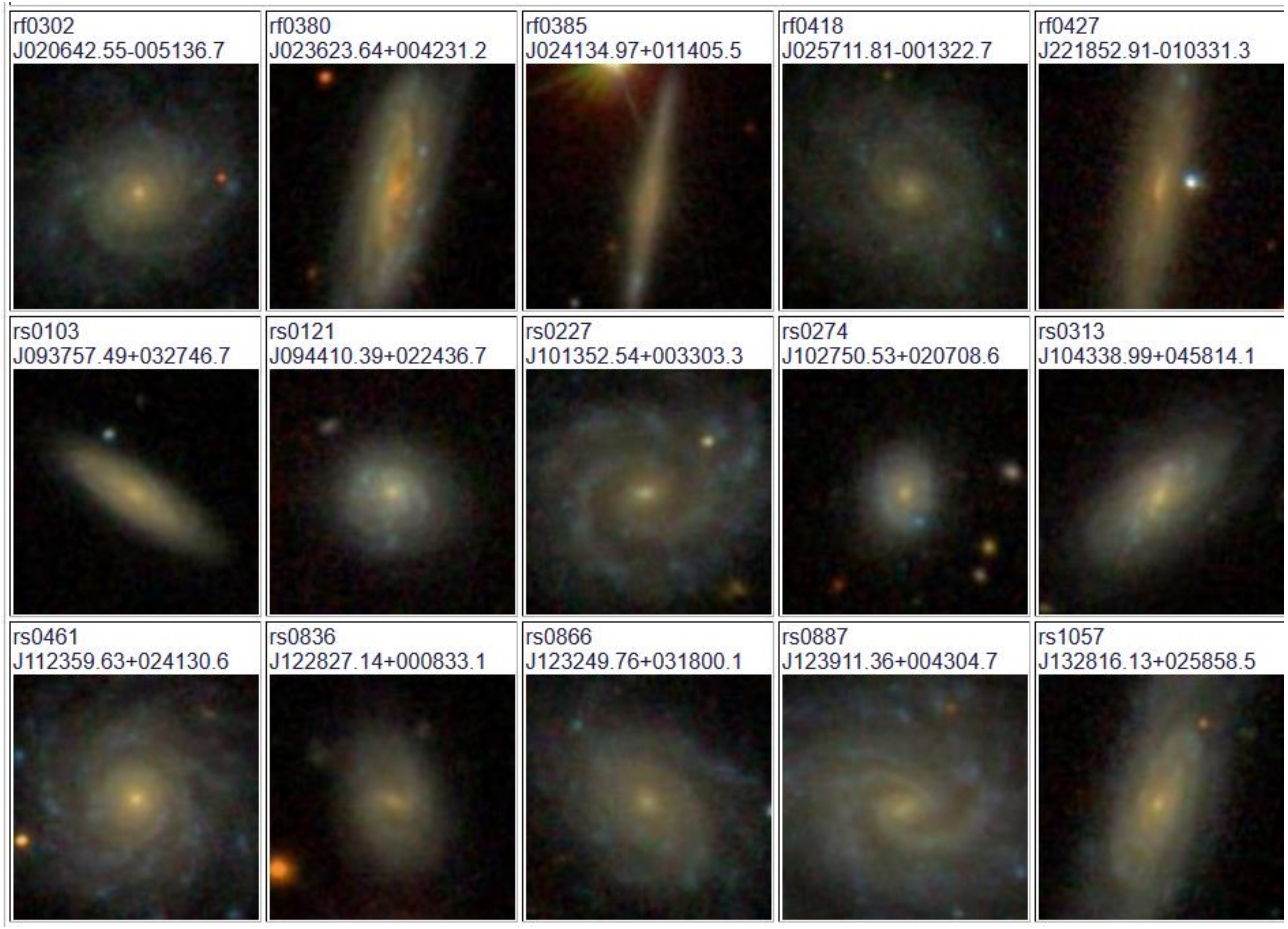
nascent group SFHs look suppressed, but:

- pairs not clear

- singles suppressed too?

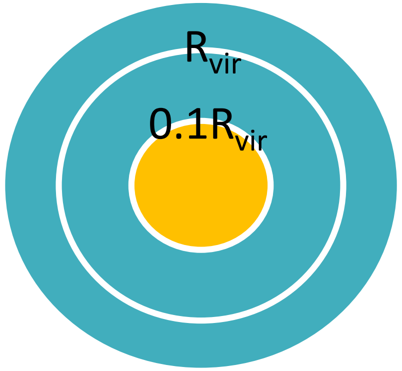


What are “single” galaxies doing in this transition?



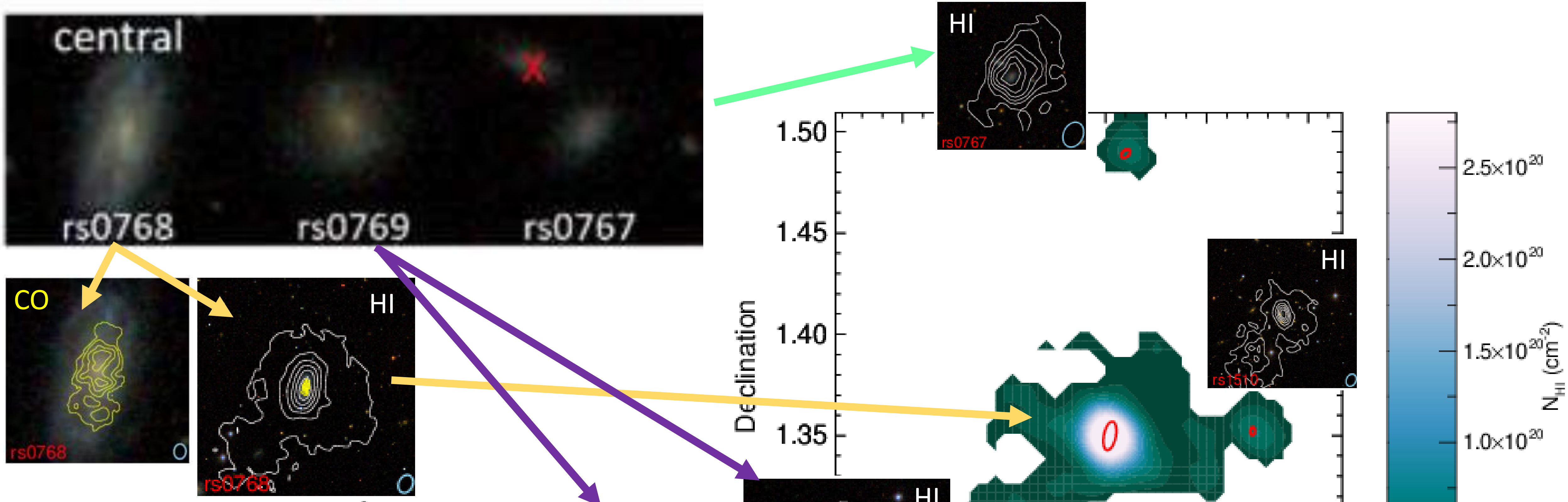
- not merger remnants
- not stripped or warped
- seem kinda... *faded*
- inadequate extinction corr.?
- or... remember Dalcanton 04? dust lanes & bulges emerge above V_{rot} ~ 120 km/s

→ *that’s the threshold scale*

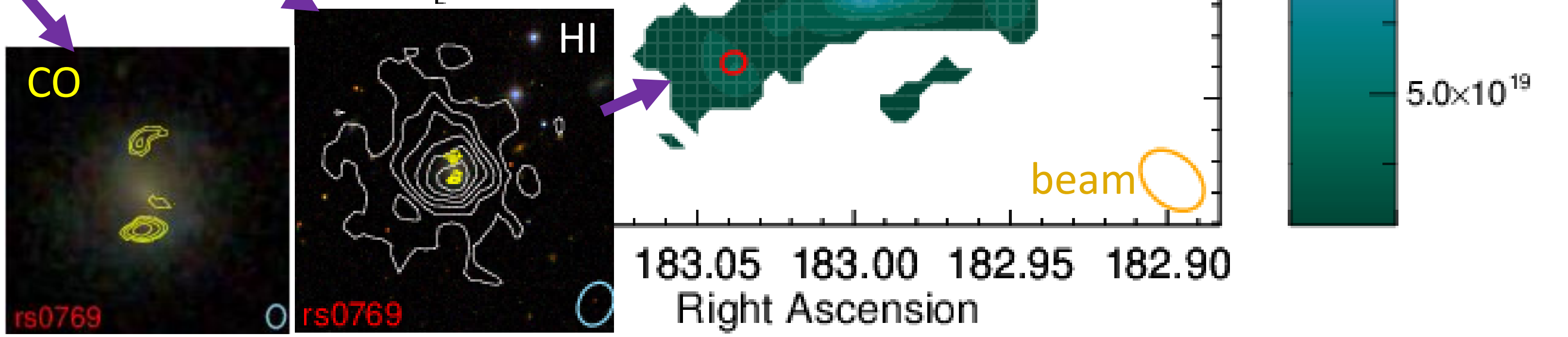


So turn the question around: can slower accretion explain an increasing frequency of groups?

Resolving a "dwarf association"



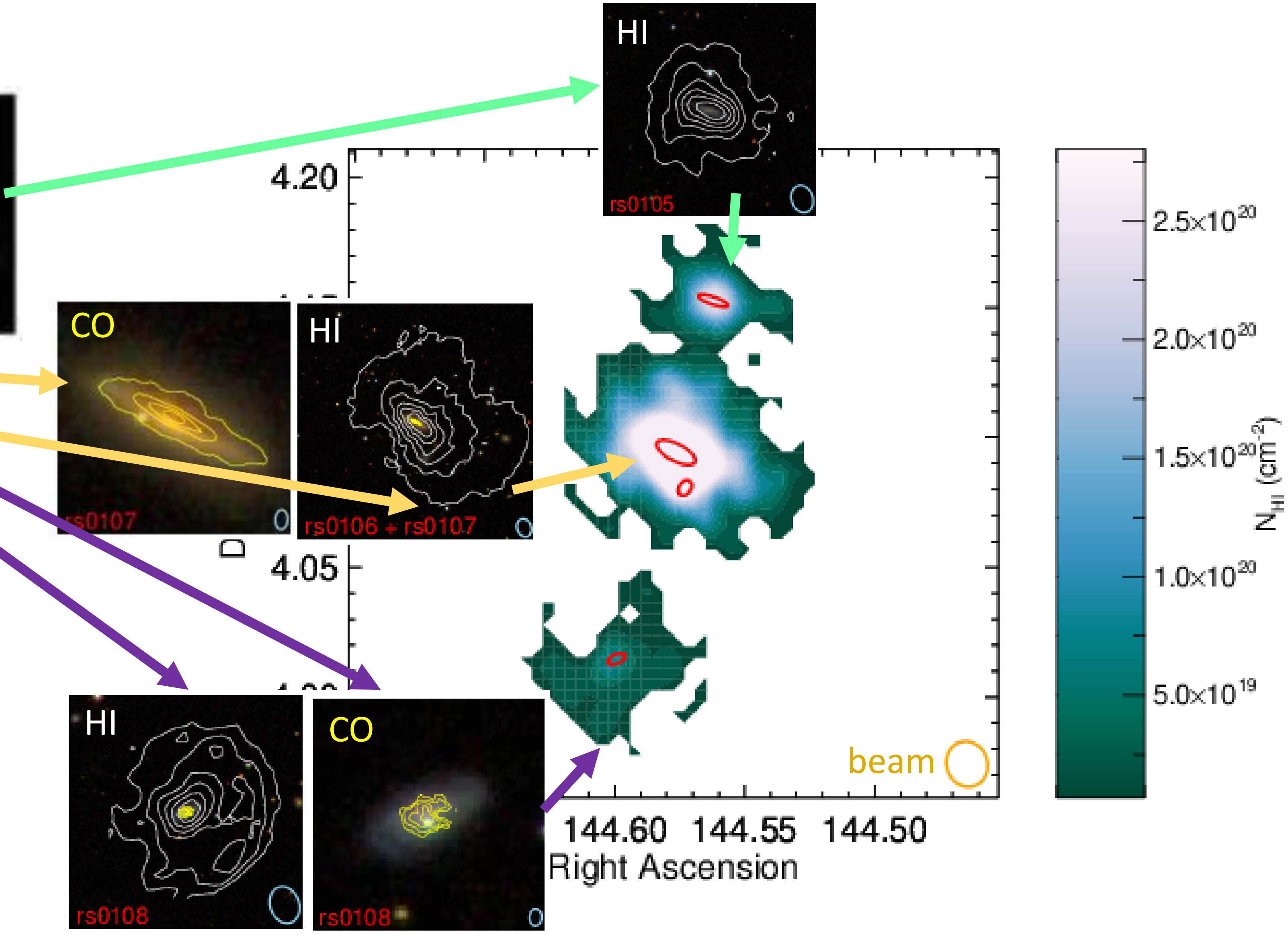
- in filament near cluster
- central gas dominated
- rs0769 has lower G/S = 0.7 and CO spiral
- HI connects three galaxies; CO extended where detected



optical isophotal radii (*r* =24.5)

Resolving a nascent group with a dusty central

- in filament between voids
- central gas poor
  (caveat: mass of H_2 TBD)
- satellites all gas-dominated
- HI connects two galaxies, one disconnecting? CO extended where detected



optical isophotal radii (r =24.5)

A scenario to kick around (input gratefully received!)

- Below the threshold scale, mergers proceed rapidly and are soon “covered over” by fresh gas accretion, so most galaxies appear single*
- Crossing the threshold scale heats halo gas within 0.1 R_{vir} enabling quenching and bulge formation
- Bulge formation promotes extended/spiral CO that efficiently forms stars
- Star formation feedback further heats halo gas
- Extended HI pools disconnect, reducing viscous entanglement
- With mergers slowed and not covered over so fast, groups maintain N>1 longer
- In this case, nascent groups are are a consequence rather than a driver of quenching

**but note high rate of double nuclei in BCDs*