Implications for Reionization of a Search for Local Group Dwarfs with HI and Optical: Is There a Missing dIrr Problem?

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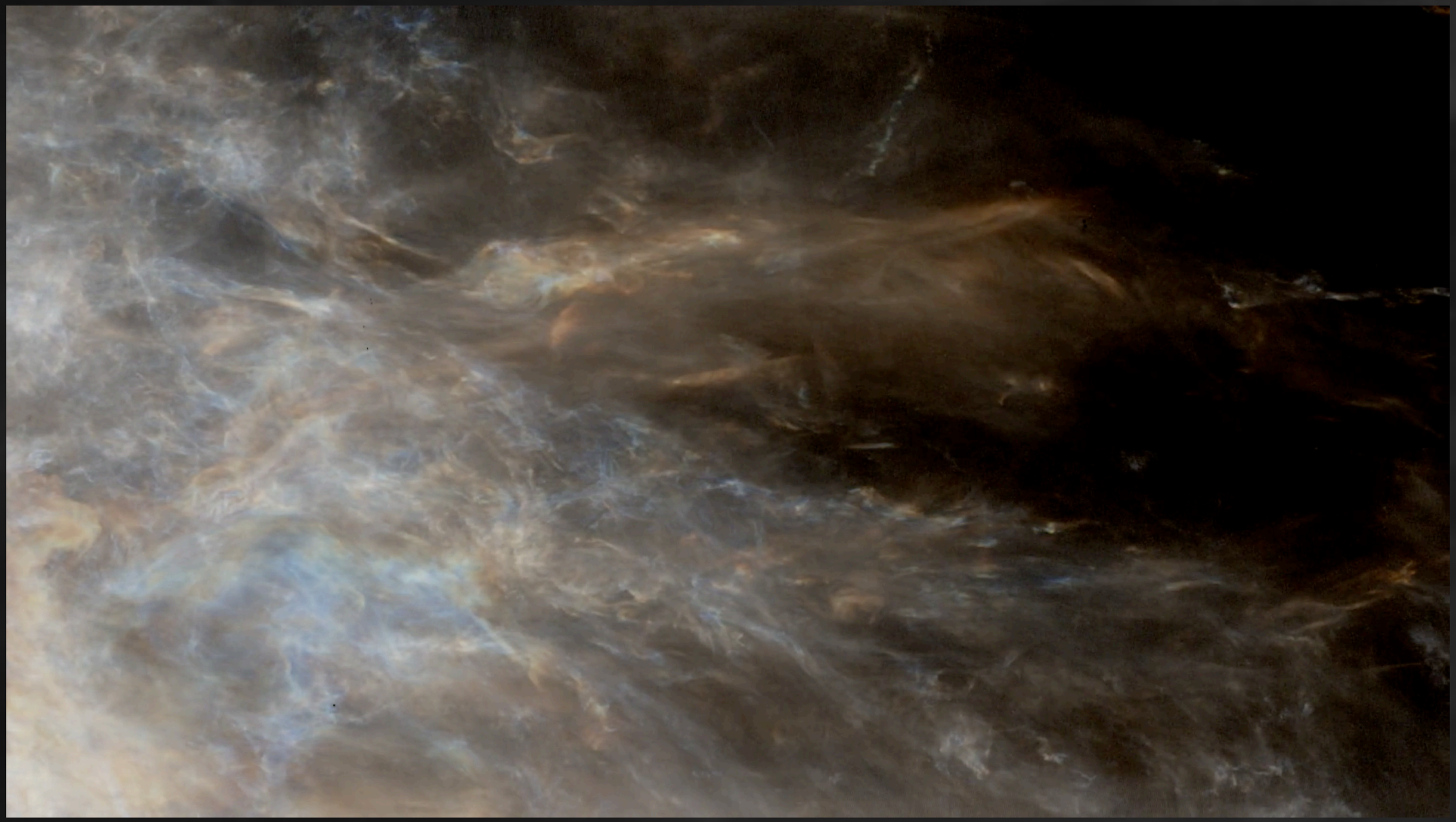
w/ Josh Peek, Mary Putman, Jana Grcevich

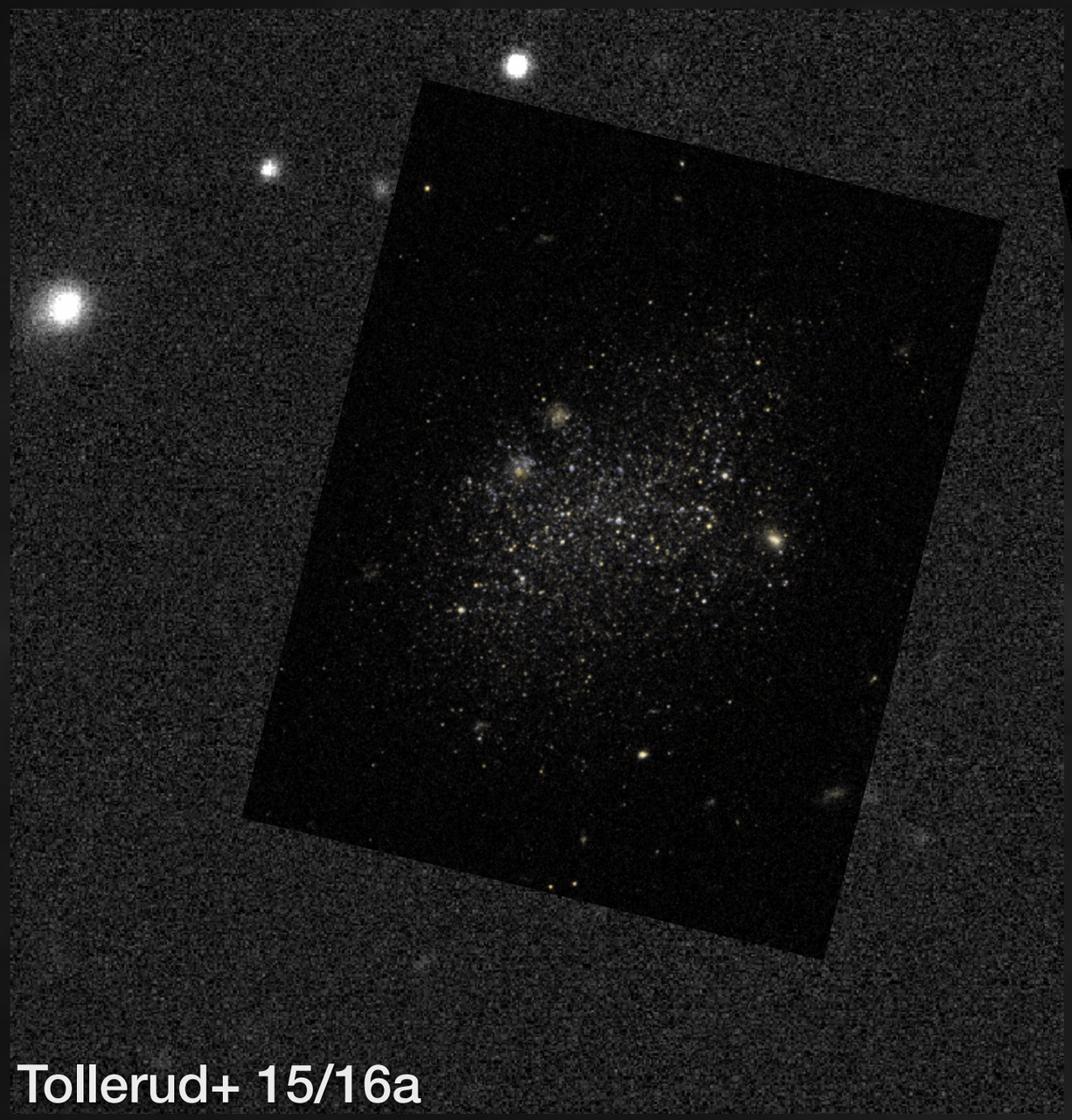
Tollerud & Peek 2018
ApJ 857 45

GALFA HI

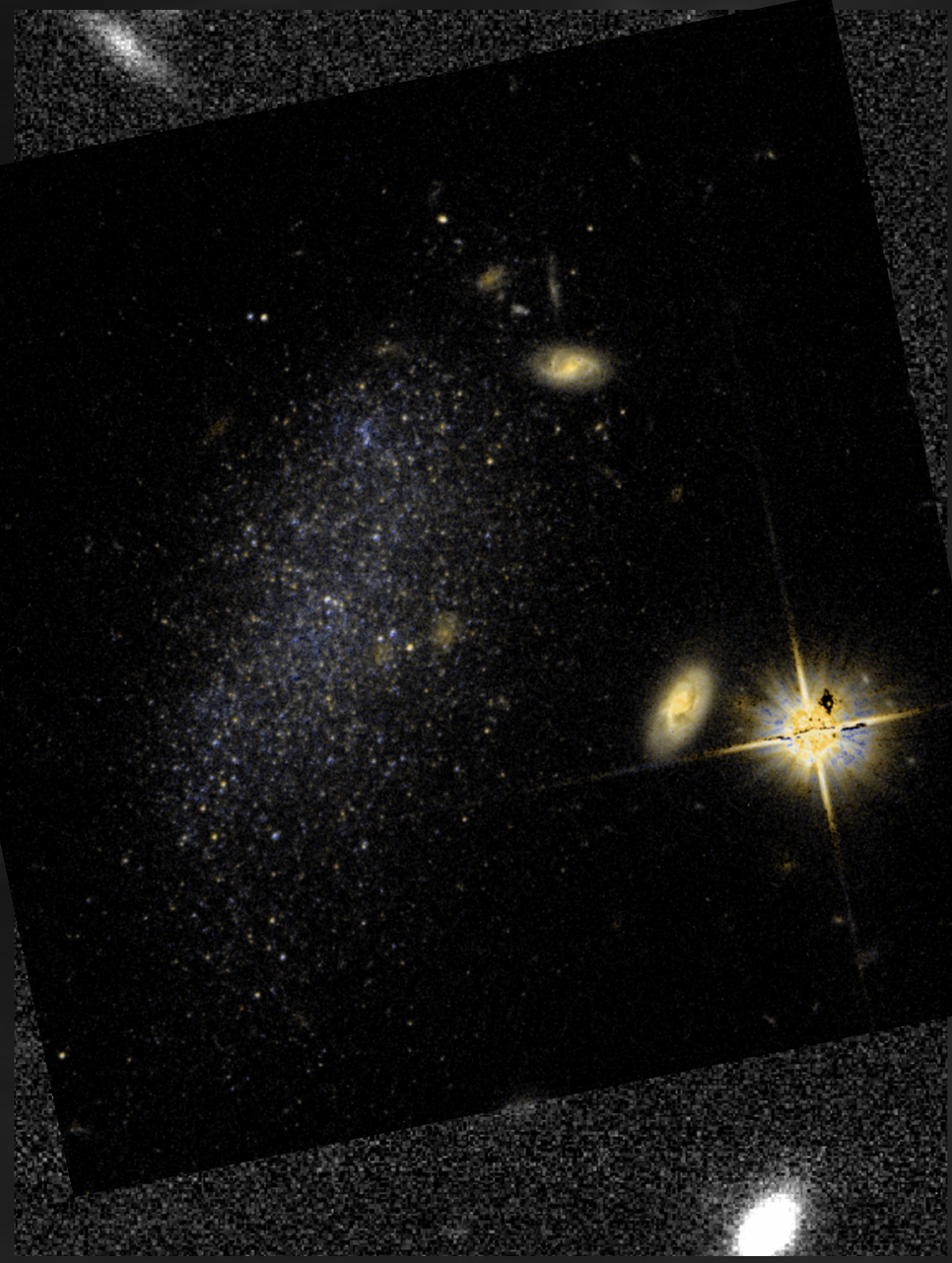


Four (of ~ 30 candidates) have dwarf optical counterparts

Pisces A

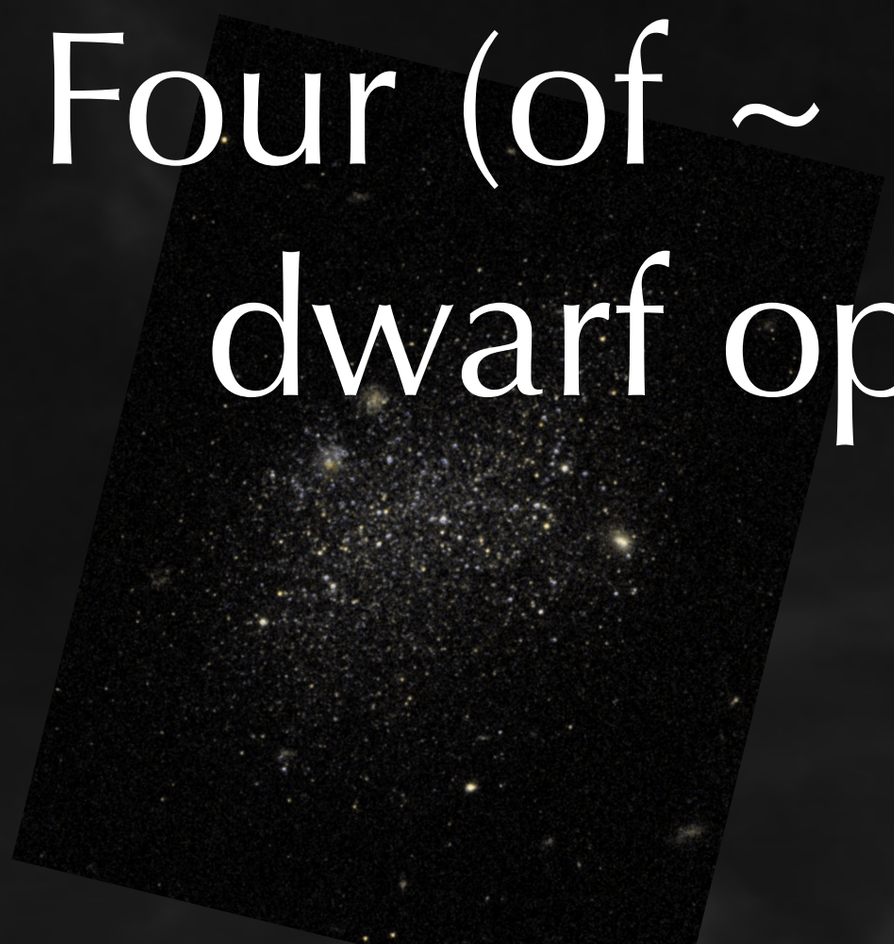


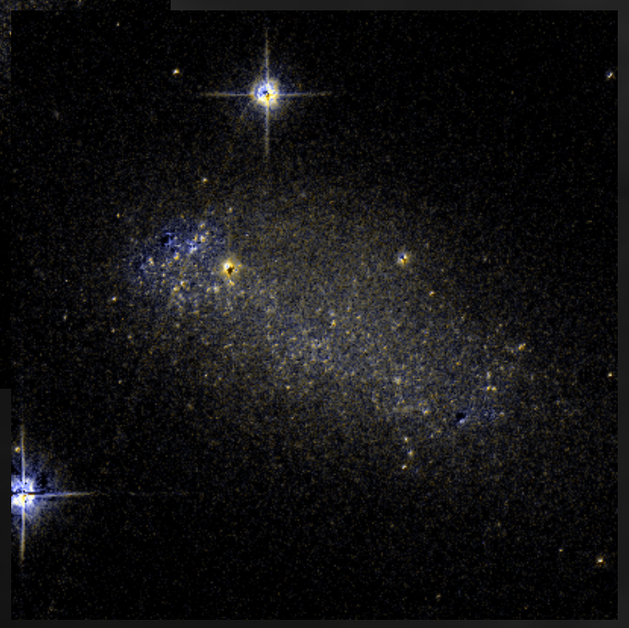
Pisces B



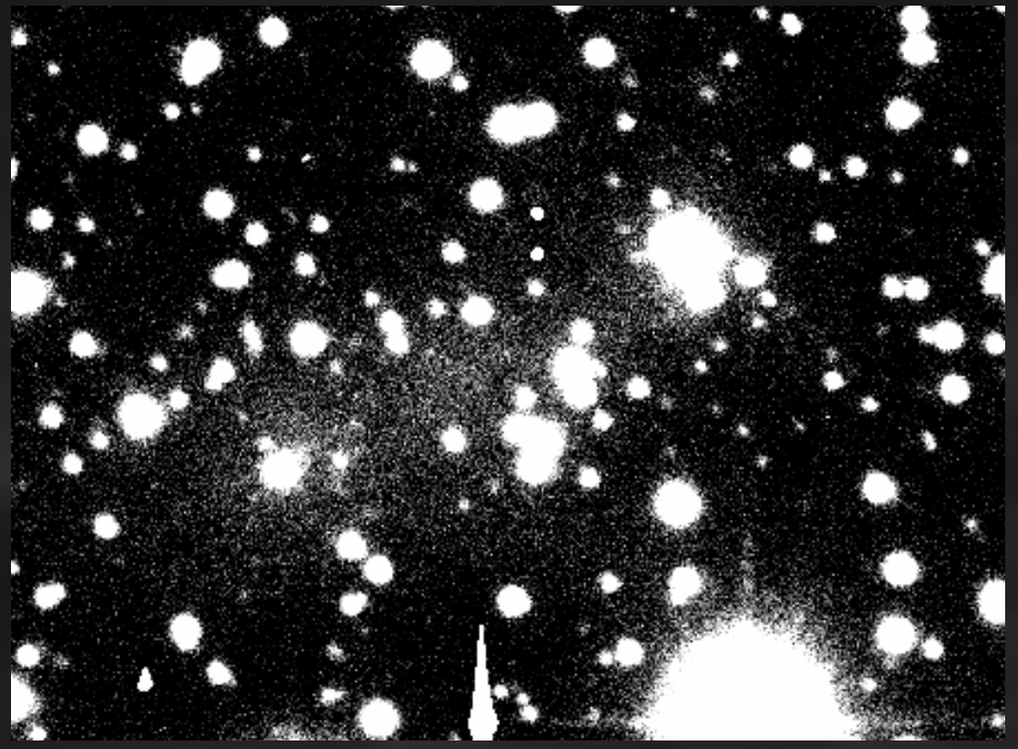
Tollerud+ 15/16a

Four (of ~ 30 candidates) have dwarf optical counterparts





Sand&Tollerud HST program

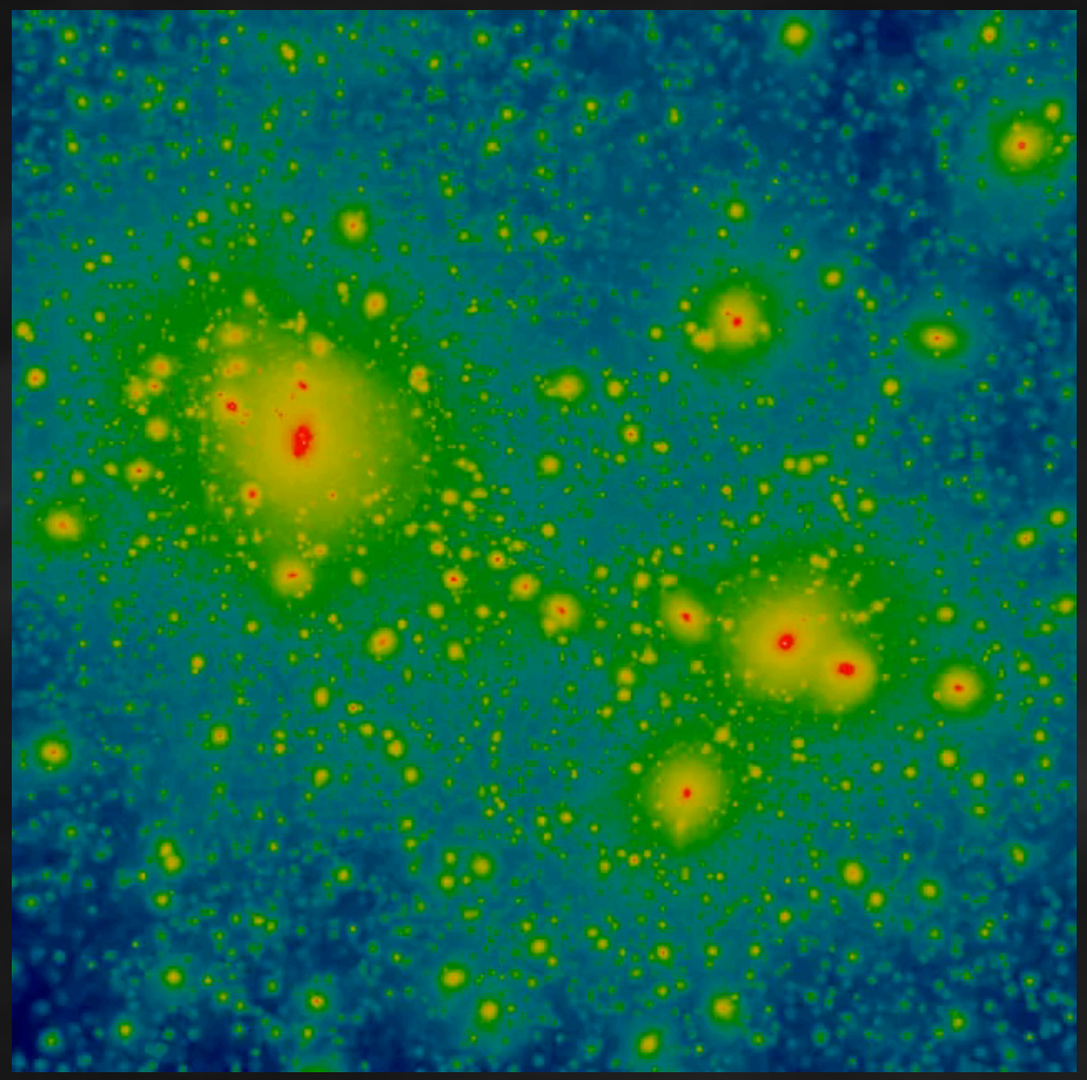


(And one candidate in the Galactic Plane)
Tollerud et al. in prep

But none in the Local Group (i.e., ≲ 2 Mpc)!

How many *should* we have found?

Let's start with Local Group-like DM-only simulations



We put the MW in one (-> Earth and GALFA-HI)

ELVIS

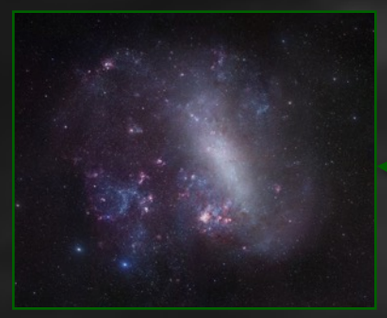
(Garrison-Kimmel+ 14)

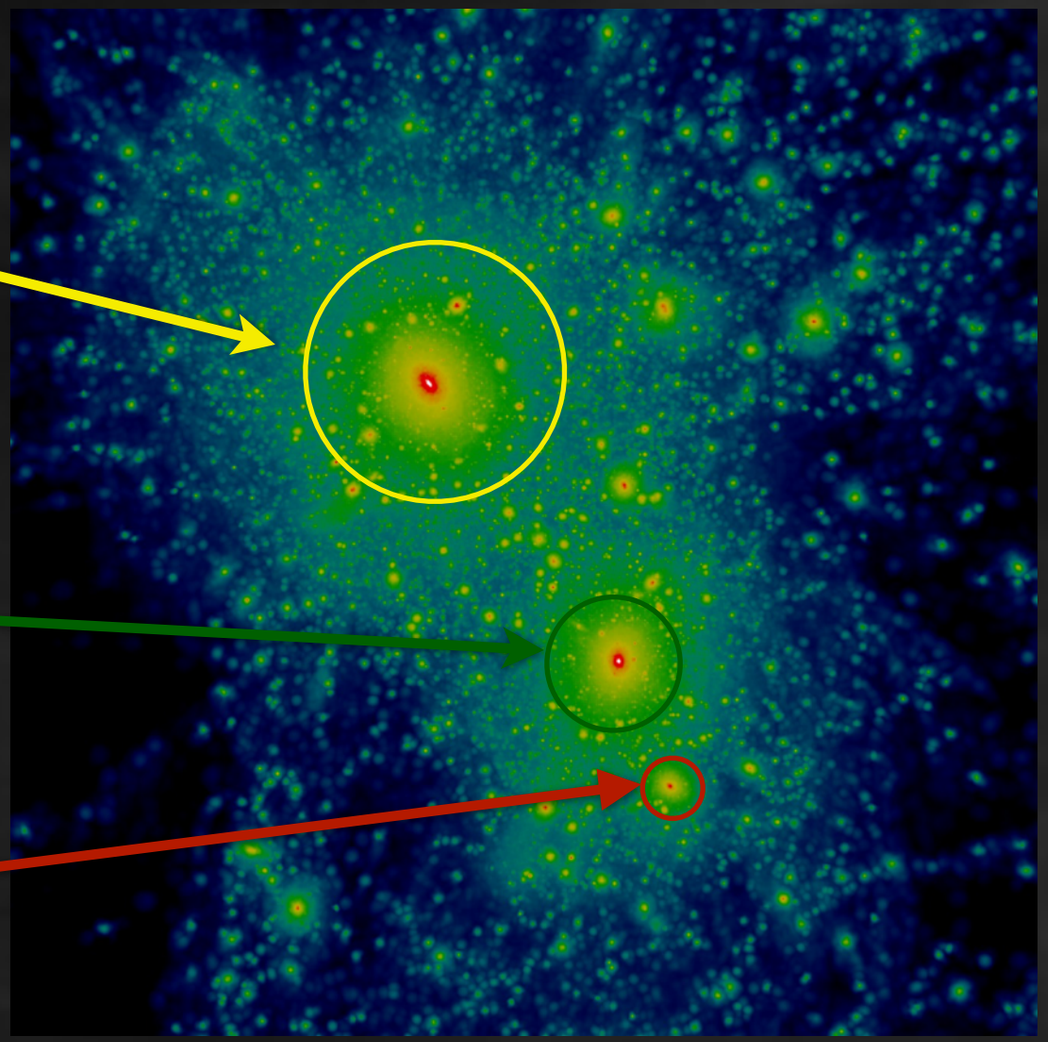
x12 * 2 = 24

And M31 in the other

That's halo mass. But we need gas mass…

Get to M_* from M_{halo} using Abundance Matching



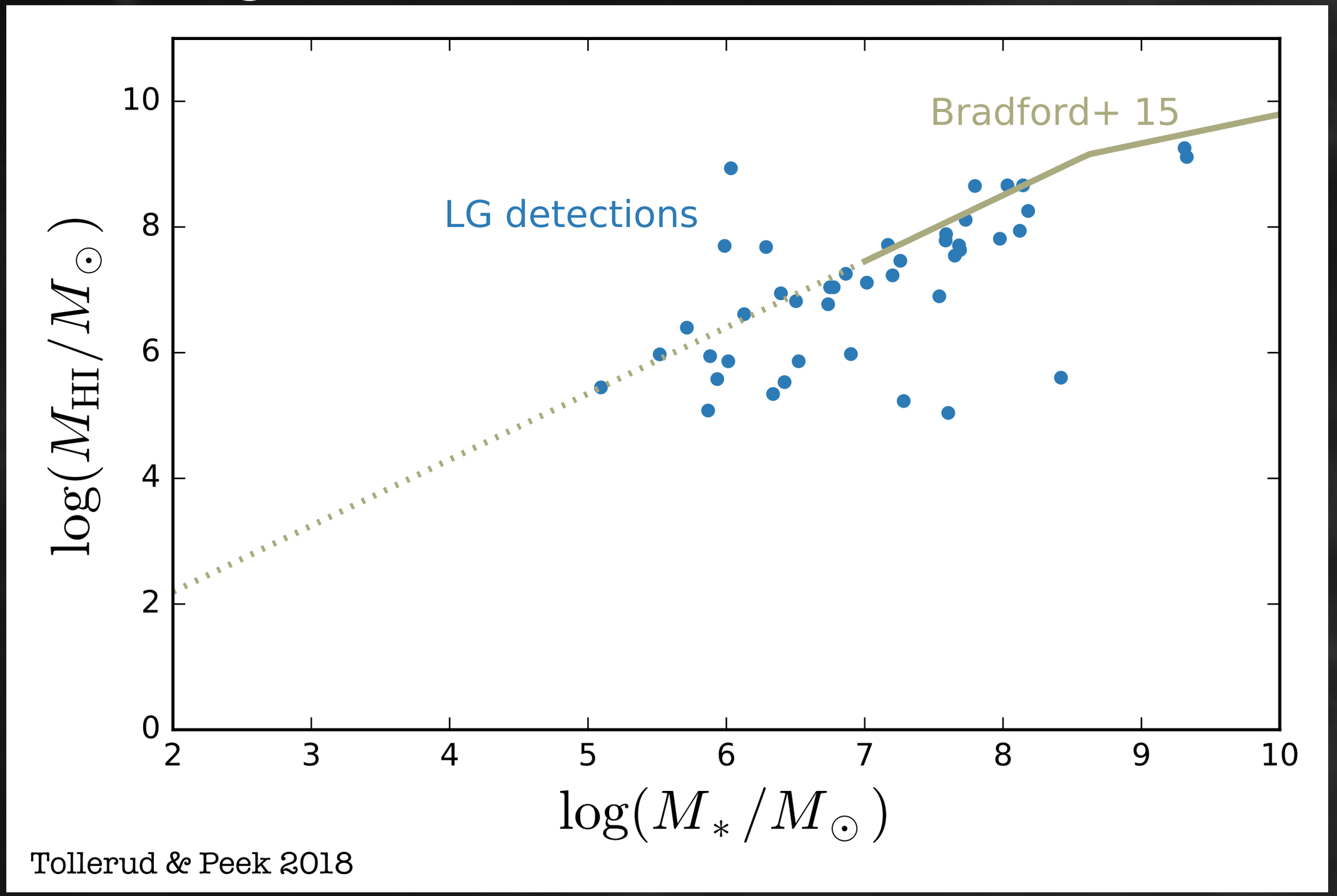


Observed Galaxies

Simulations/ Theory

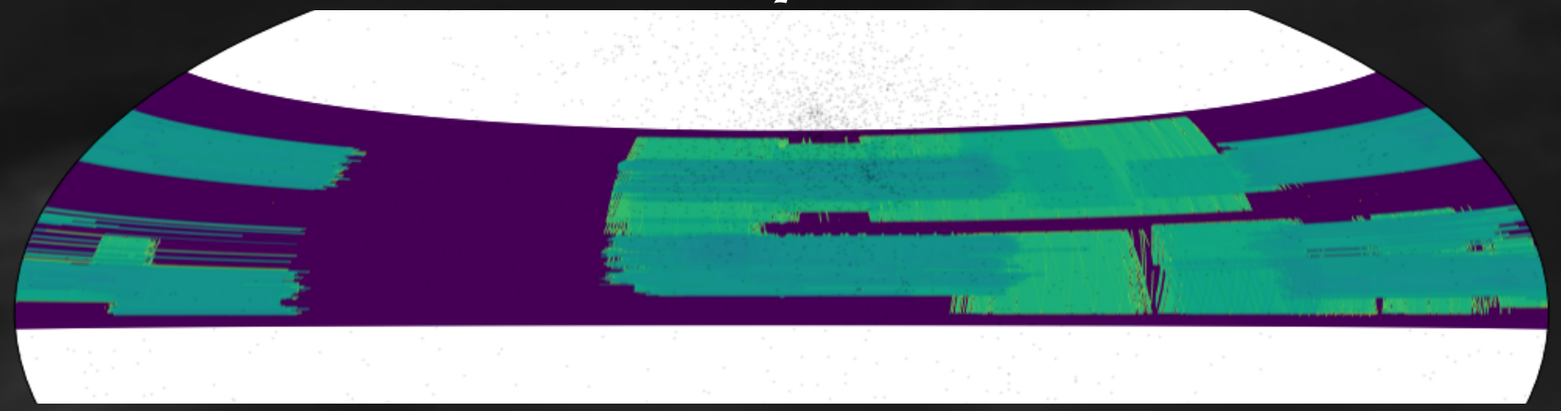
OK, that's M_*. But we wanted M_{gas} ...

OK, that's M_*. But we wanted M_{gas} : That's observed!



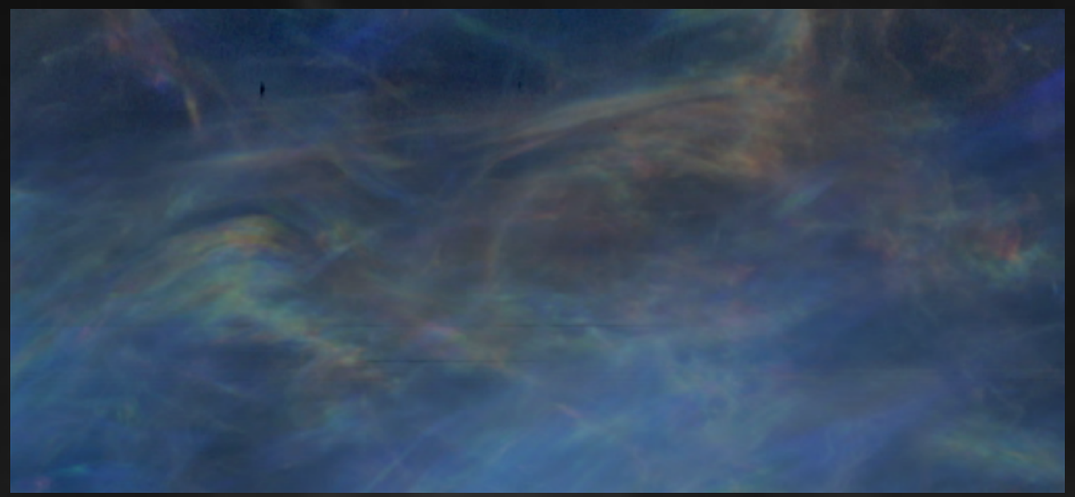
Tollerud & Peek 2018

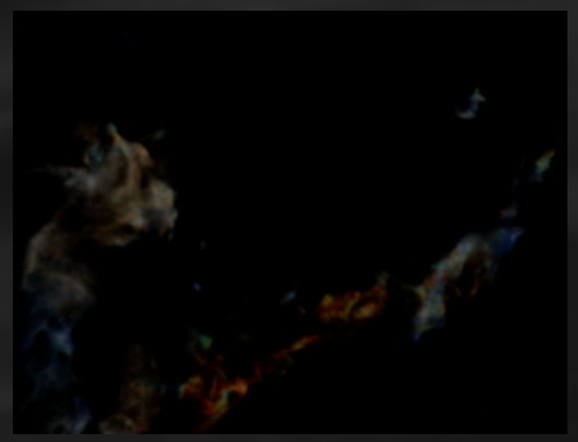
We've now got M_{gas} for each halo, so we know if it's detectable by GALFA-HI.

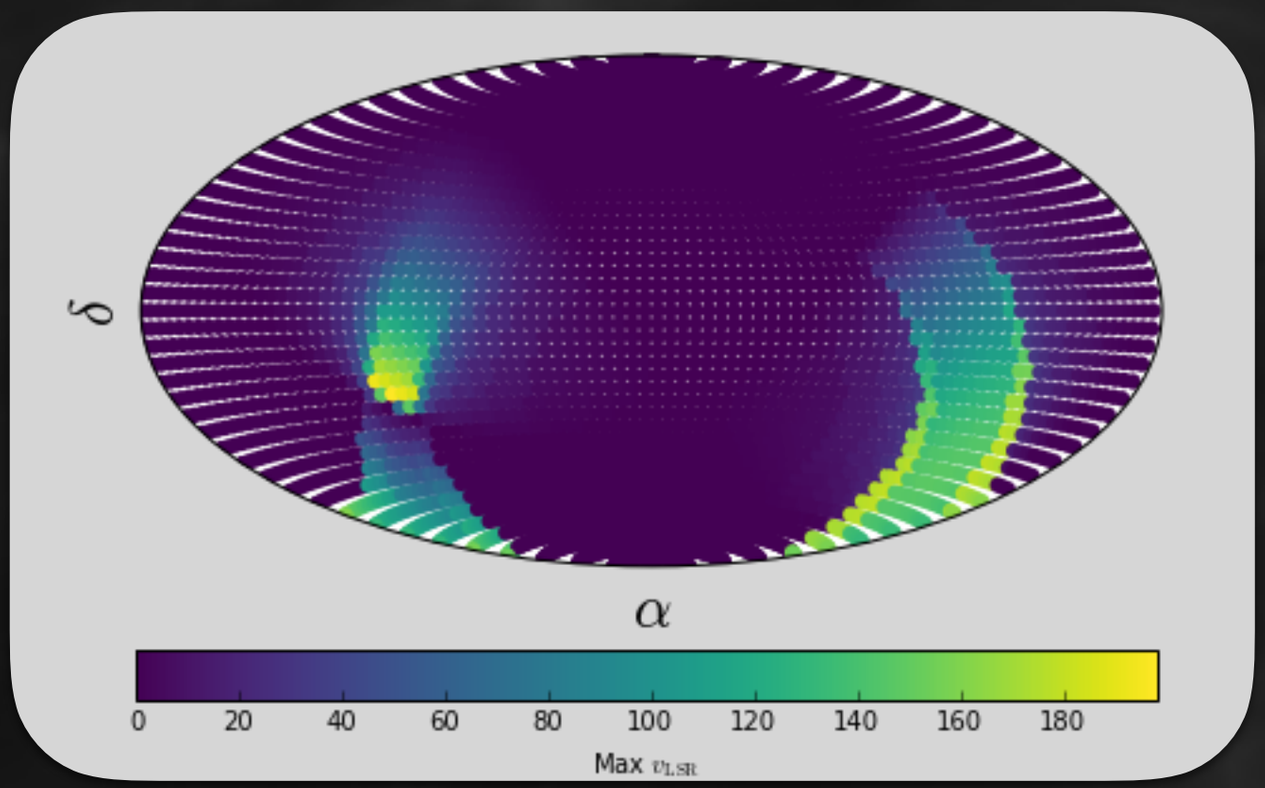


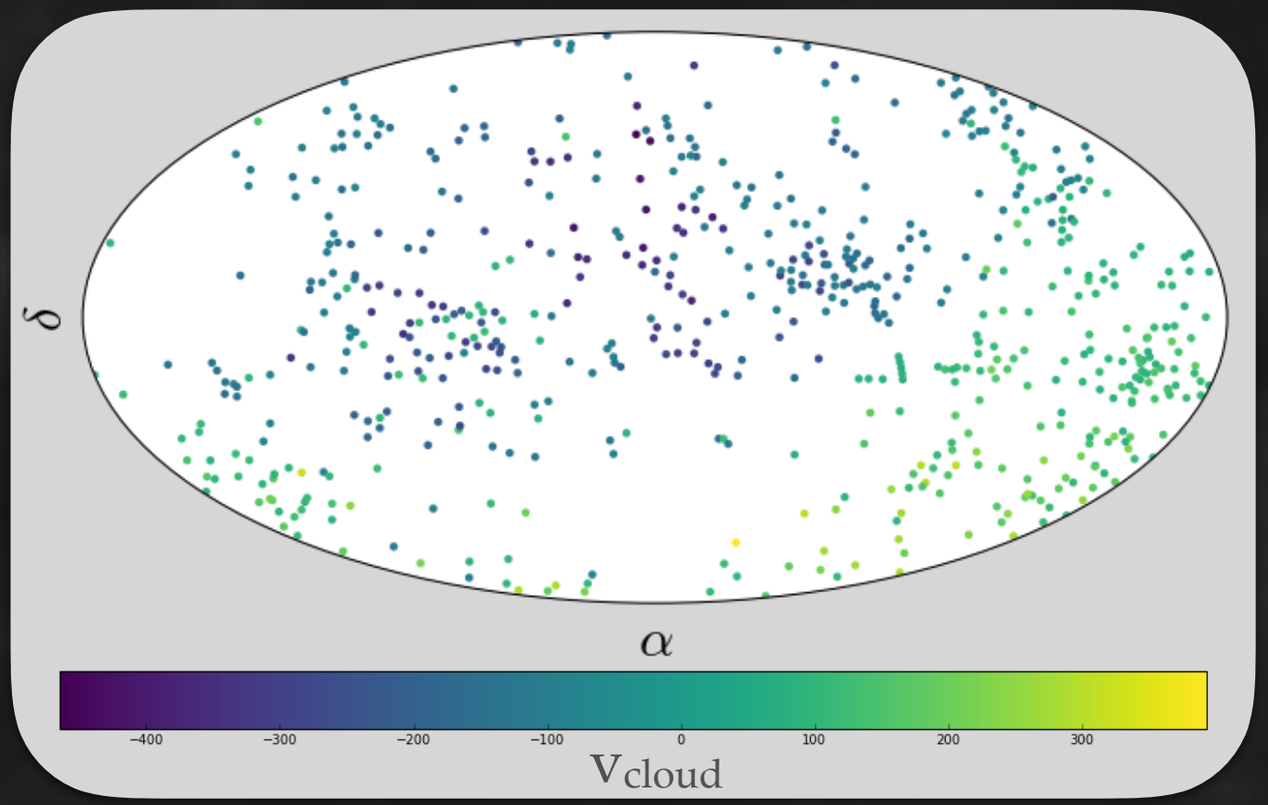
What else is in the observations that's not in the simulations?

Need to remove Galactic crud exactly as in Observations

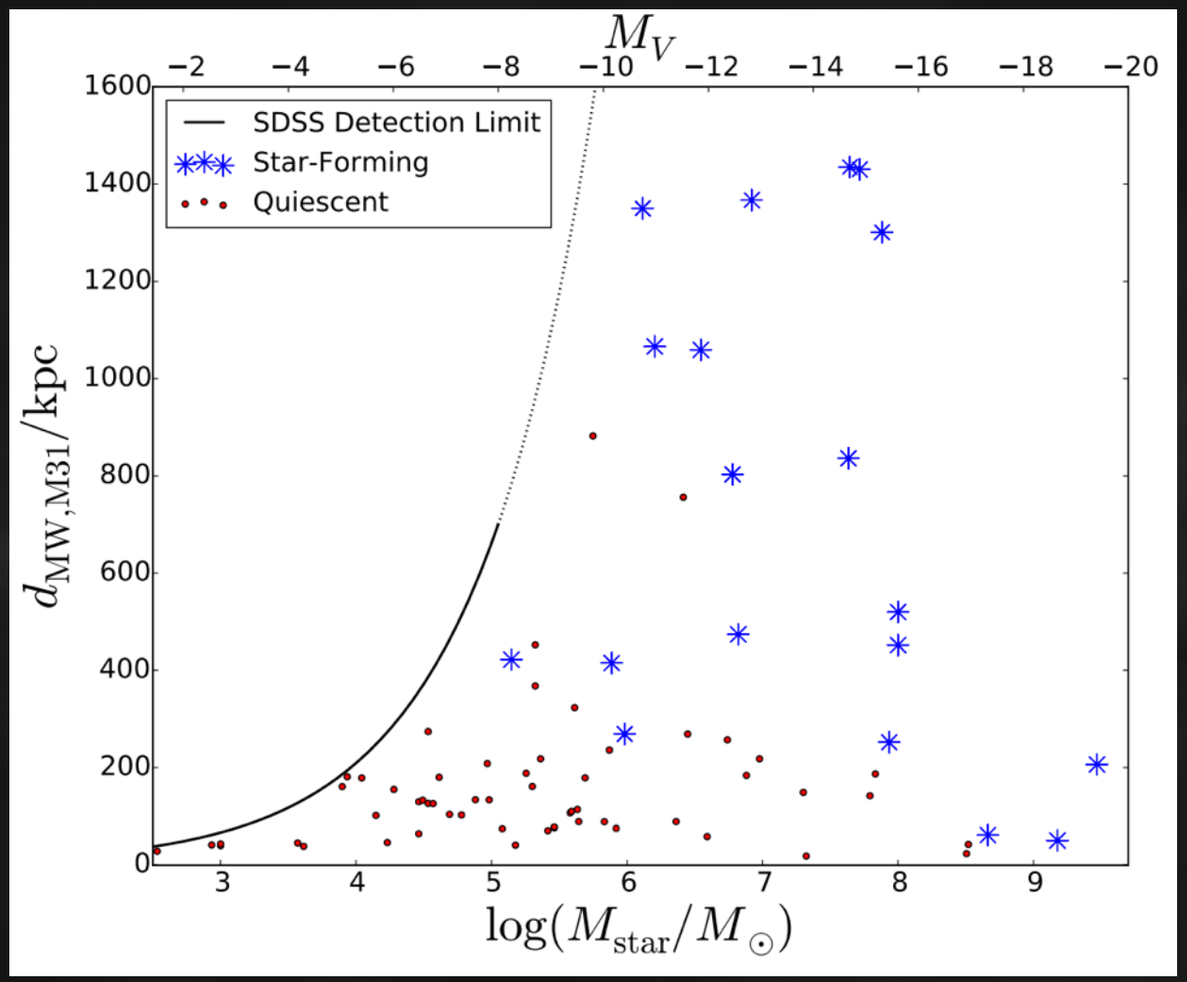


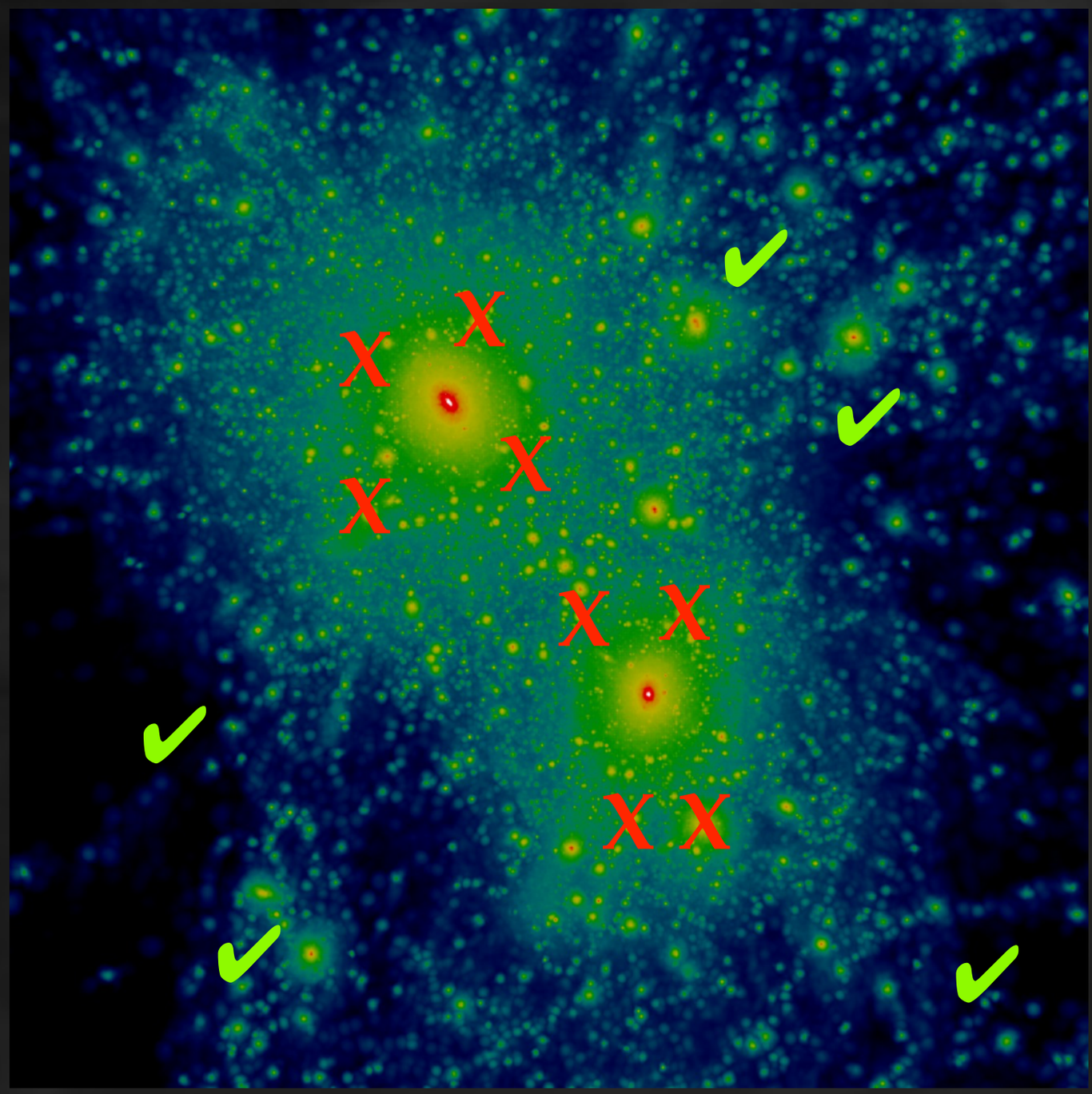






Also need to account for satellite quenching

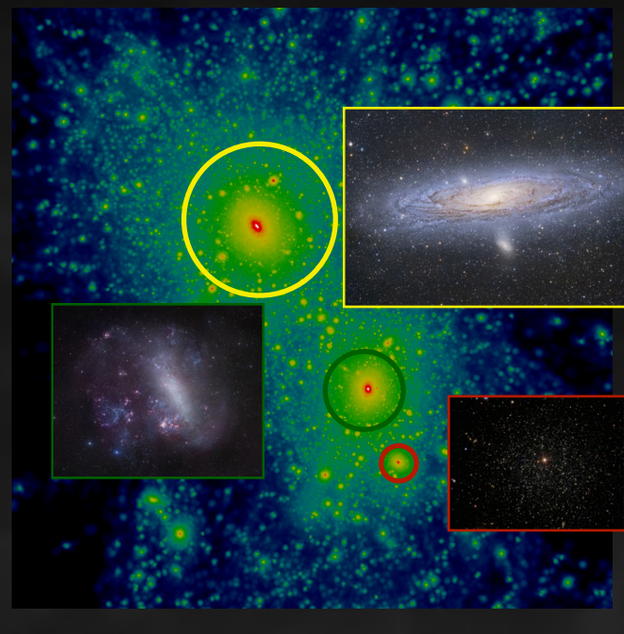




Formula for a mock GALFA-HI

x24

+



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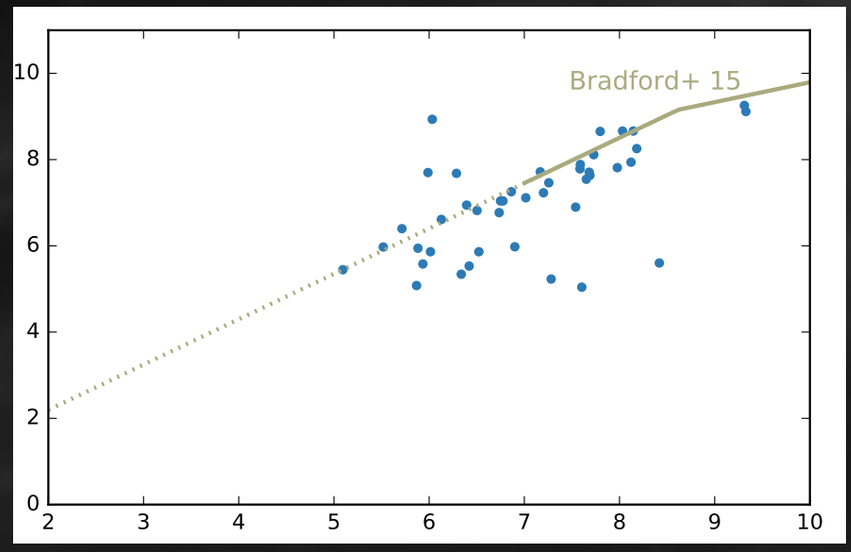

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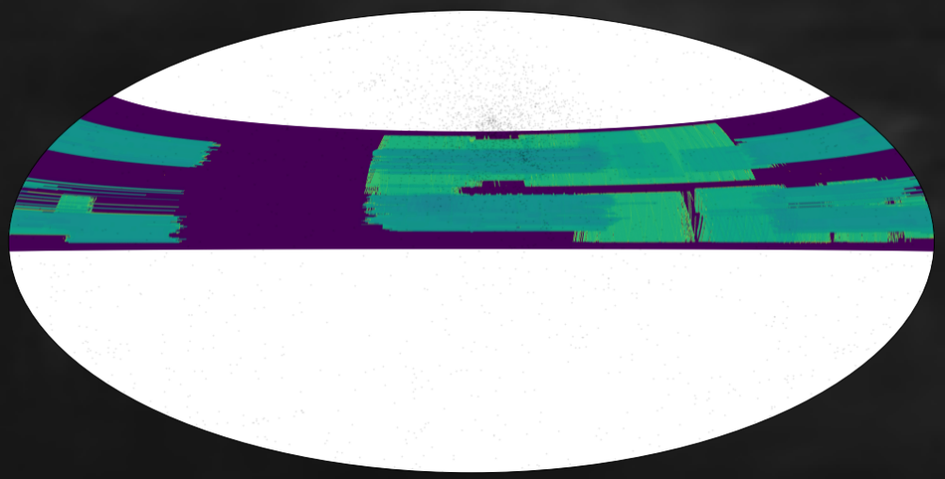

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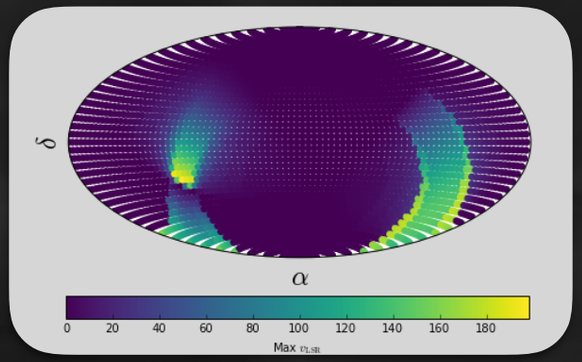

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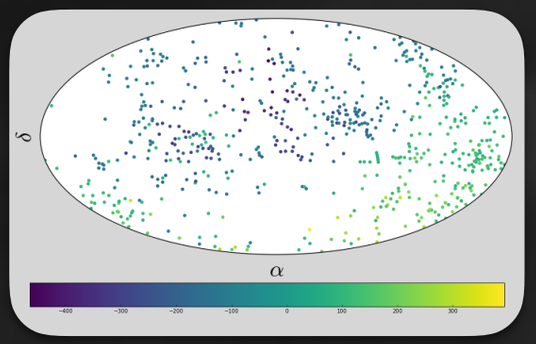

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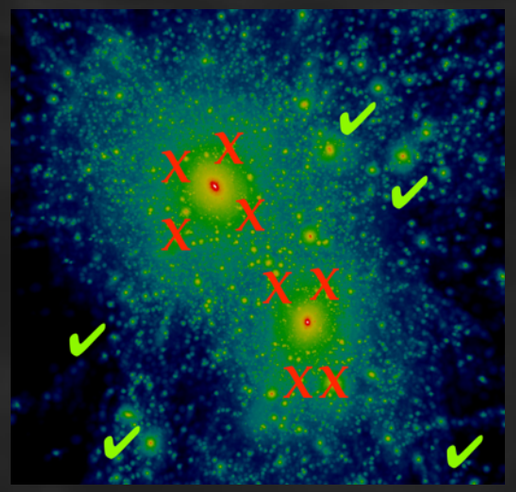
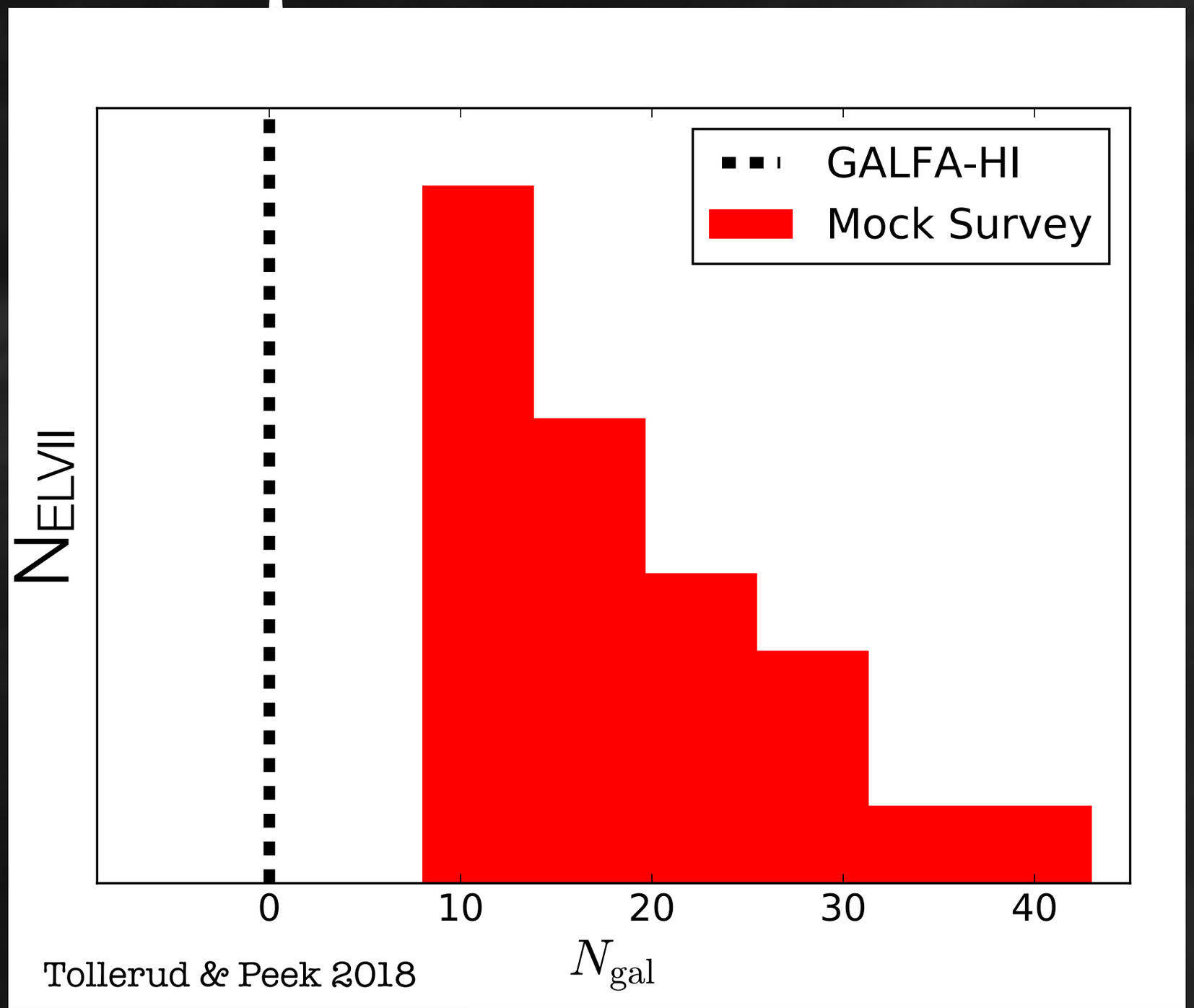


Which gives us…

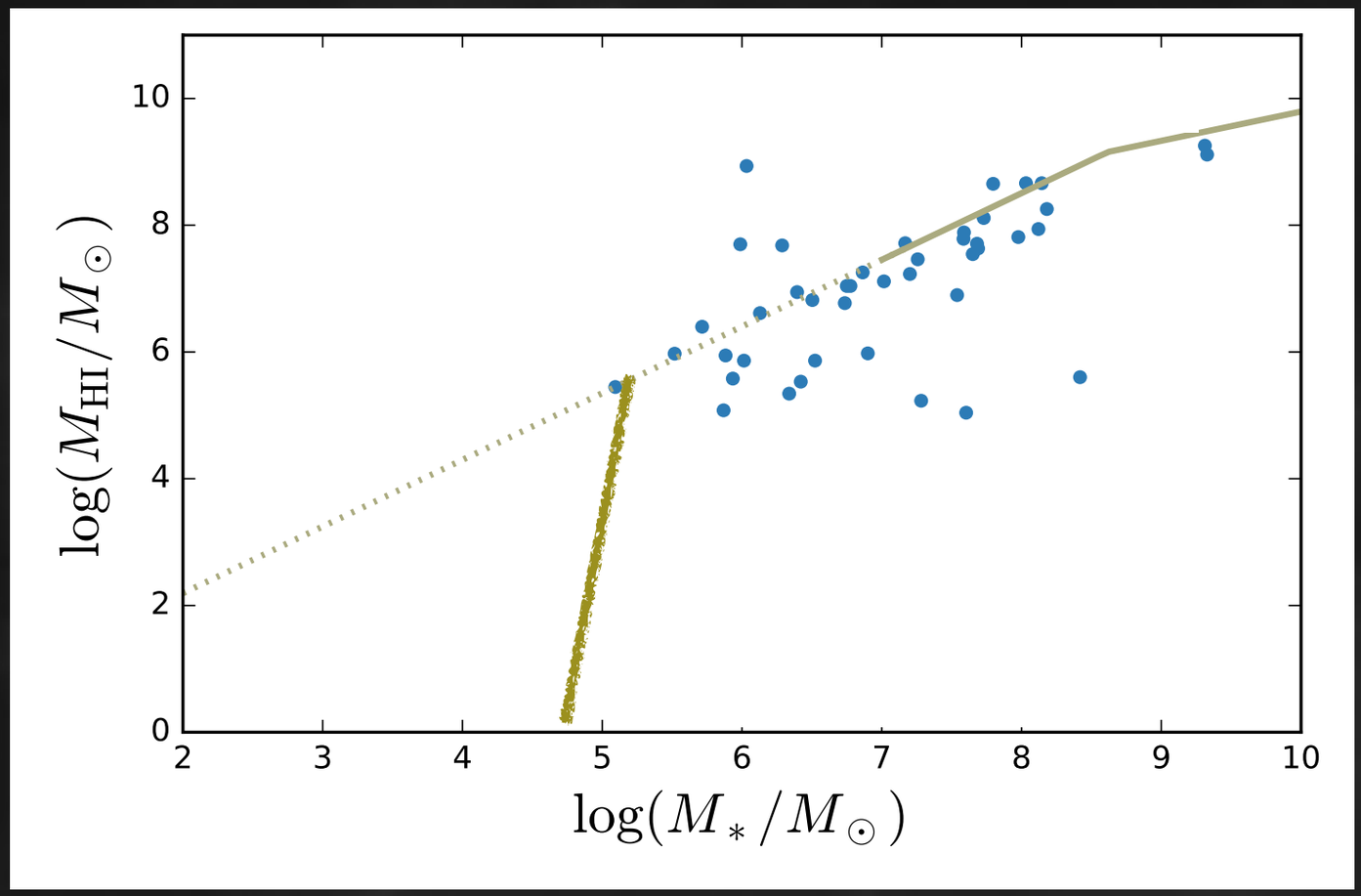
quite a few!

=



Why might there be a "Missing dIrr Crisis-Problem-isaster-portunity"?

1. The LG is a ≈1/24 outlier (SAGA?)
2. ΛCDM is wrong
3. The M_{HI}-M_{Halo} relation has a break
   - Reionization?



How does Reionization Help?

z>9

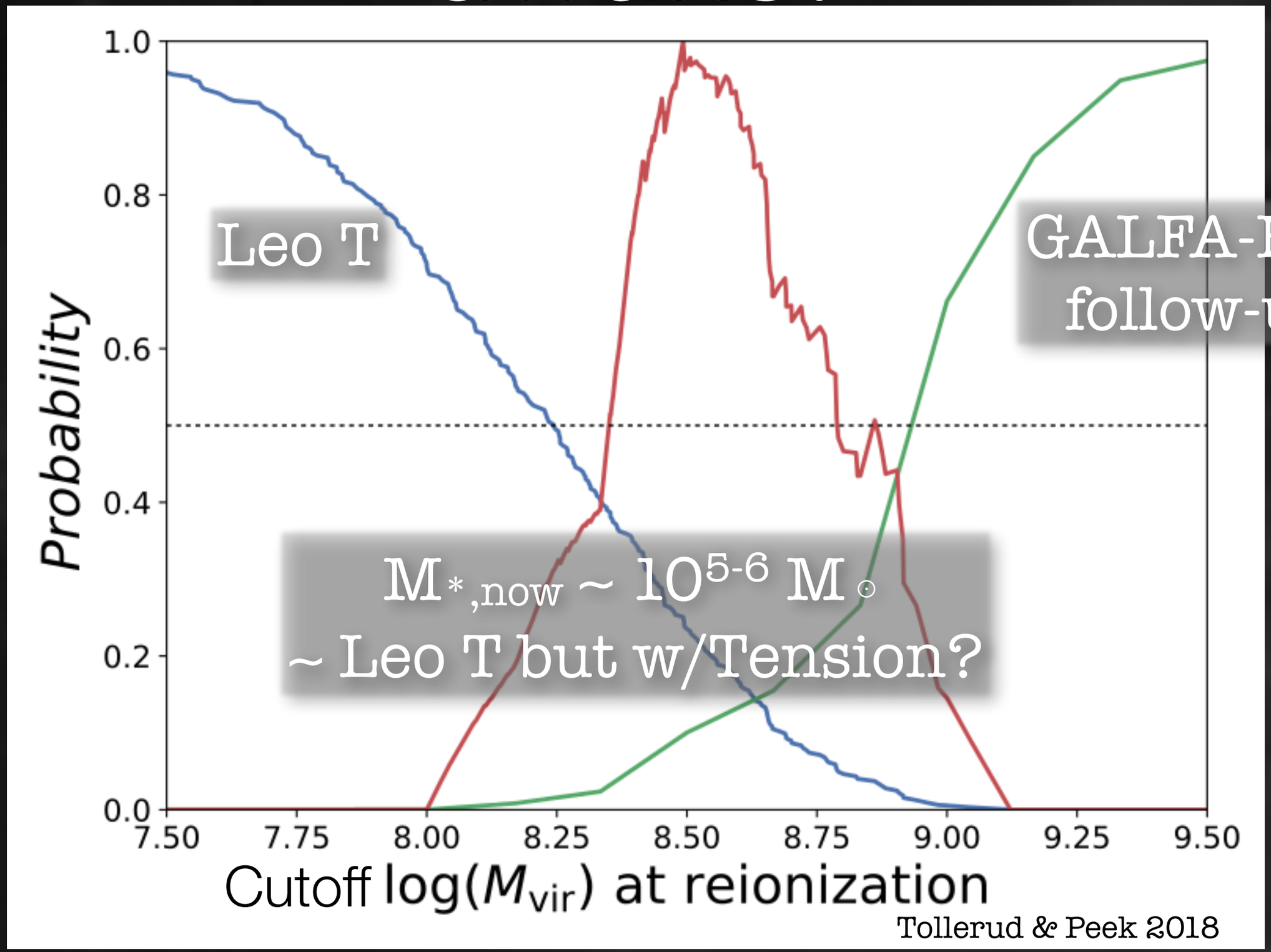
z~6-9

z<6

$M_{vir}>M_{cutoff}$

$M_{vir}<M_{cutoff}$

At what mass does ReI zap dwarfs?



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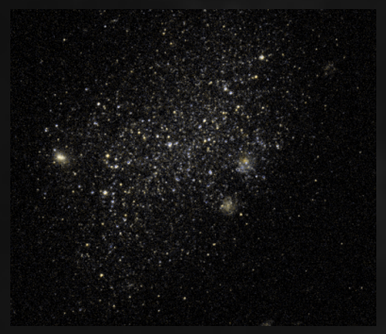
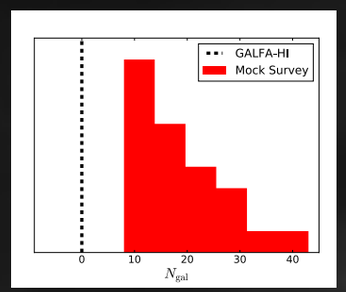
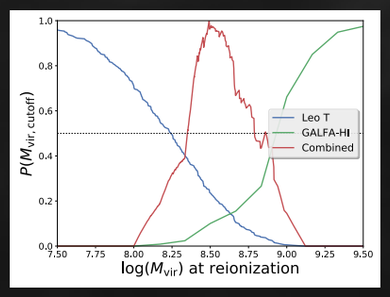
Summary



- Local Dwarf Galaxies can be found by HI surveys + deep follow-up (but none in LG)



- This + ΛCDM simulations suggest a missing dIrr (gas-rich) dwarfs problem



- This may be a limit on the reionization halo/galaxy mass scale (independent of star formation histories):
  - $M_{vir,reionization} \sim 10^{8..5\text{-}9}\,M_\odot$
  - $M_{*,now} \sim 10^{5\text{-}6}\,M_\odot$
  - *Maybe* some tension w/ Leo T?