

Faint Dwarfs Beyond Local Group Satellites

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Hubble Fellow
Yale University

Satellite Galaxies and Dwarfs in the Local Group
Potsdam, August 2014

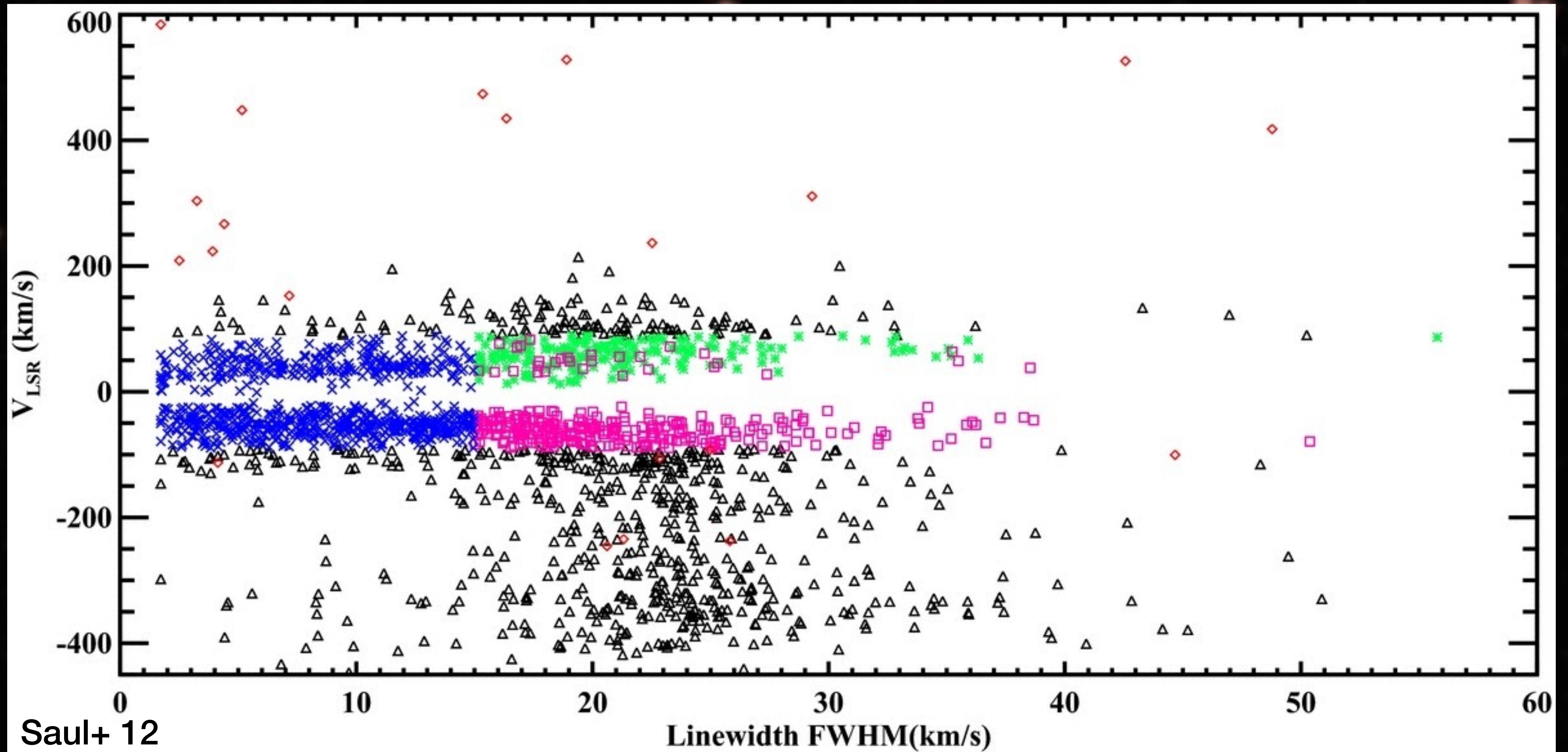
Faint Dwarfs from HI

With: Mary Putman, Jana Grcevich, Marla Geha

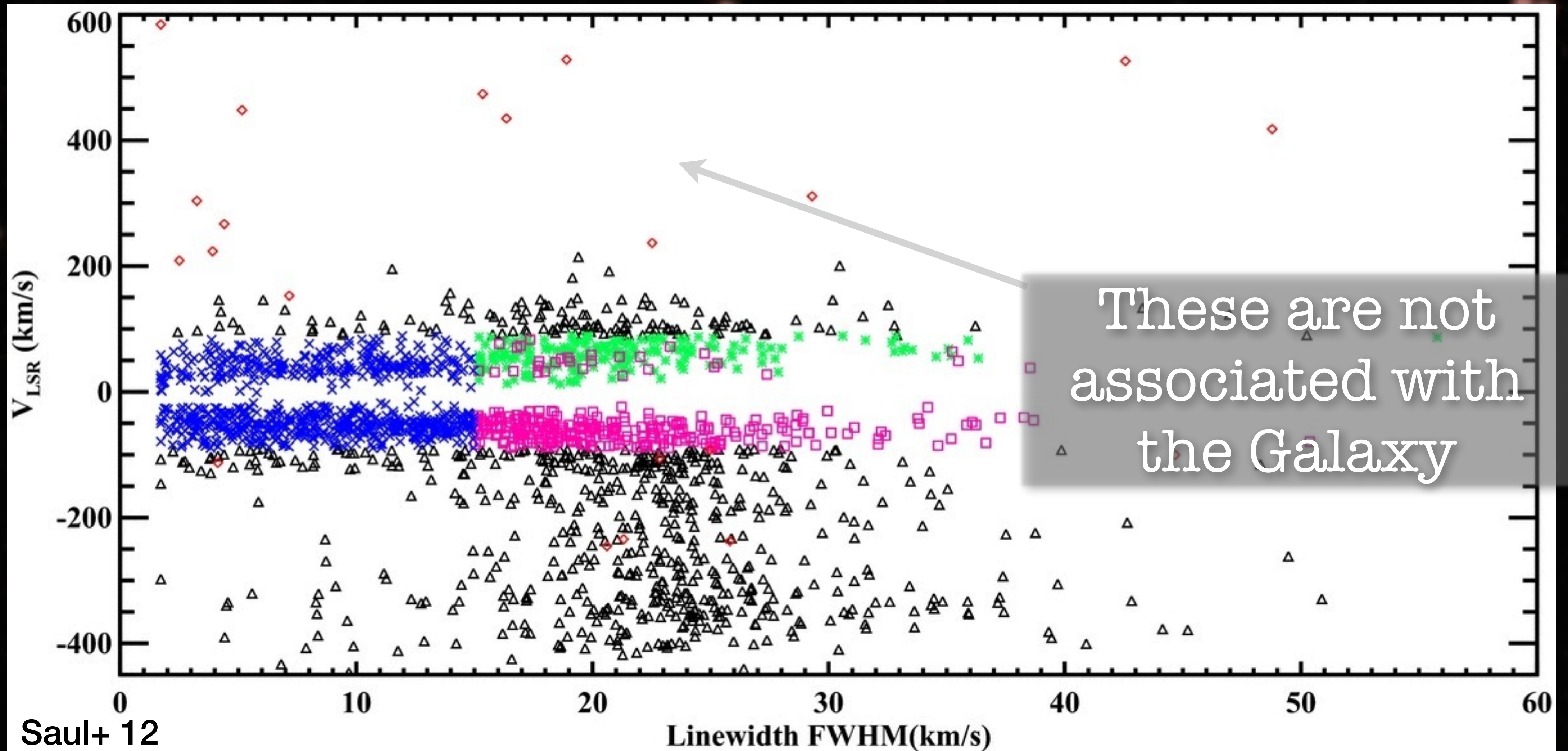


Peek+ 11

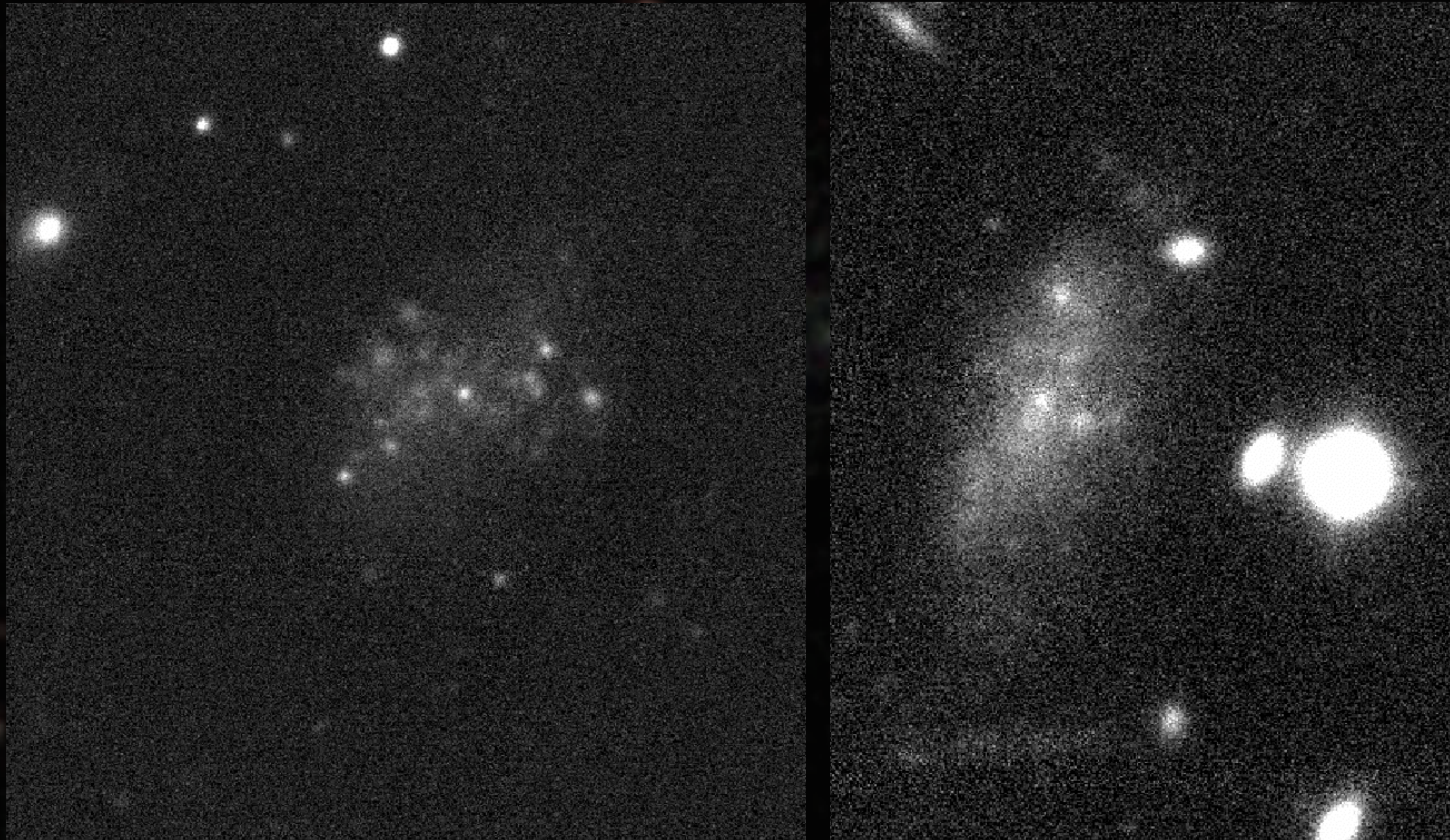
GALFA Blobs



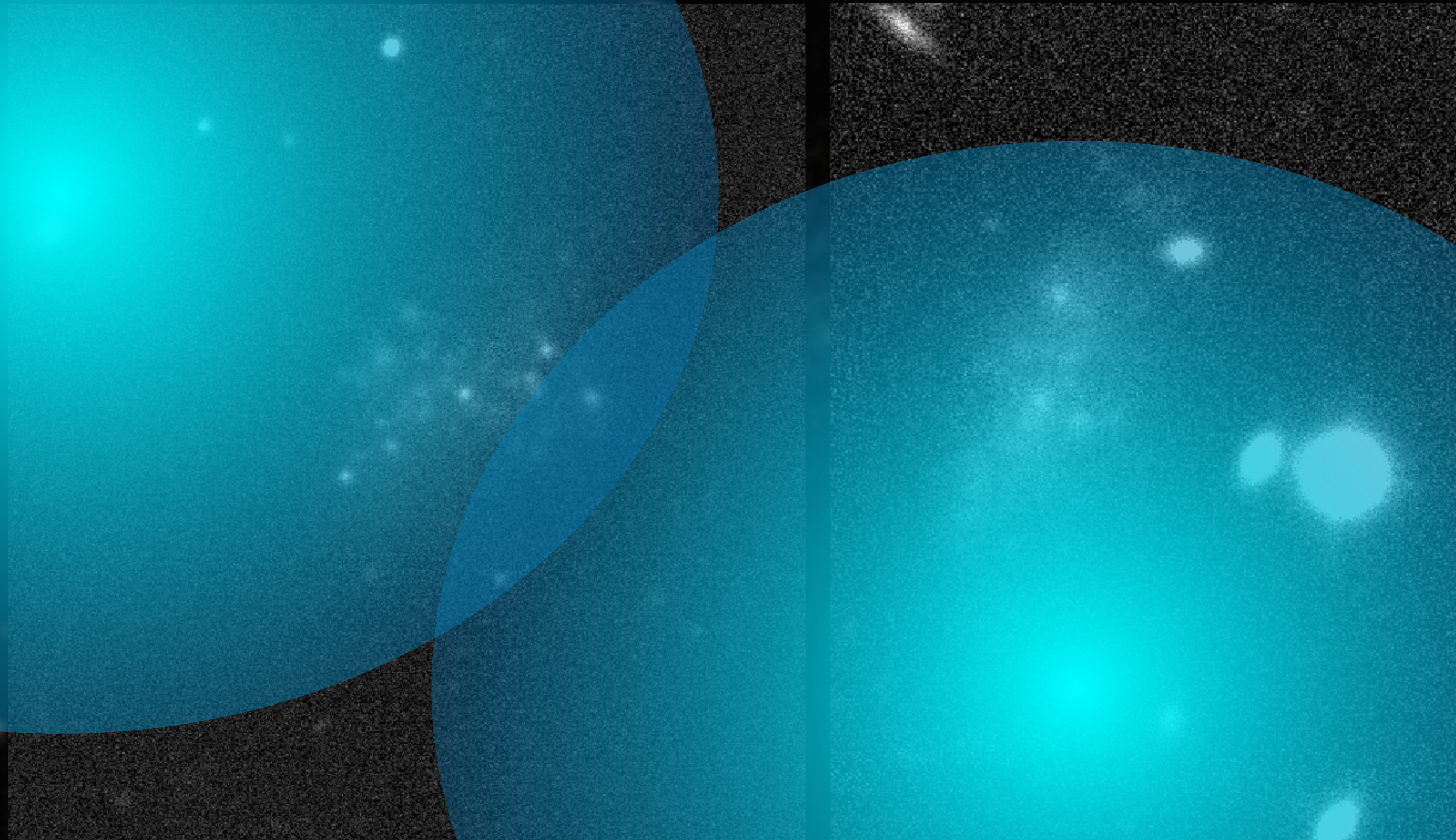
GALFA Blobs



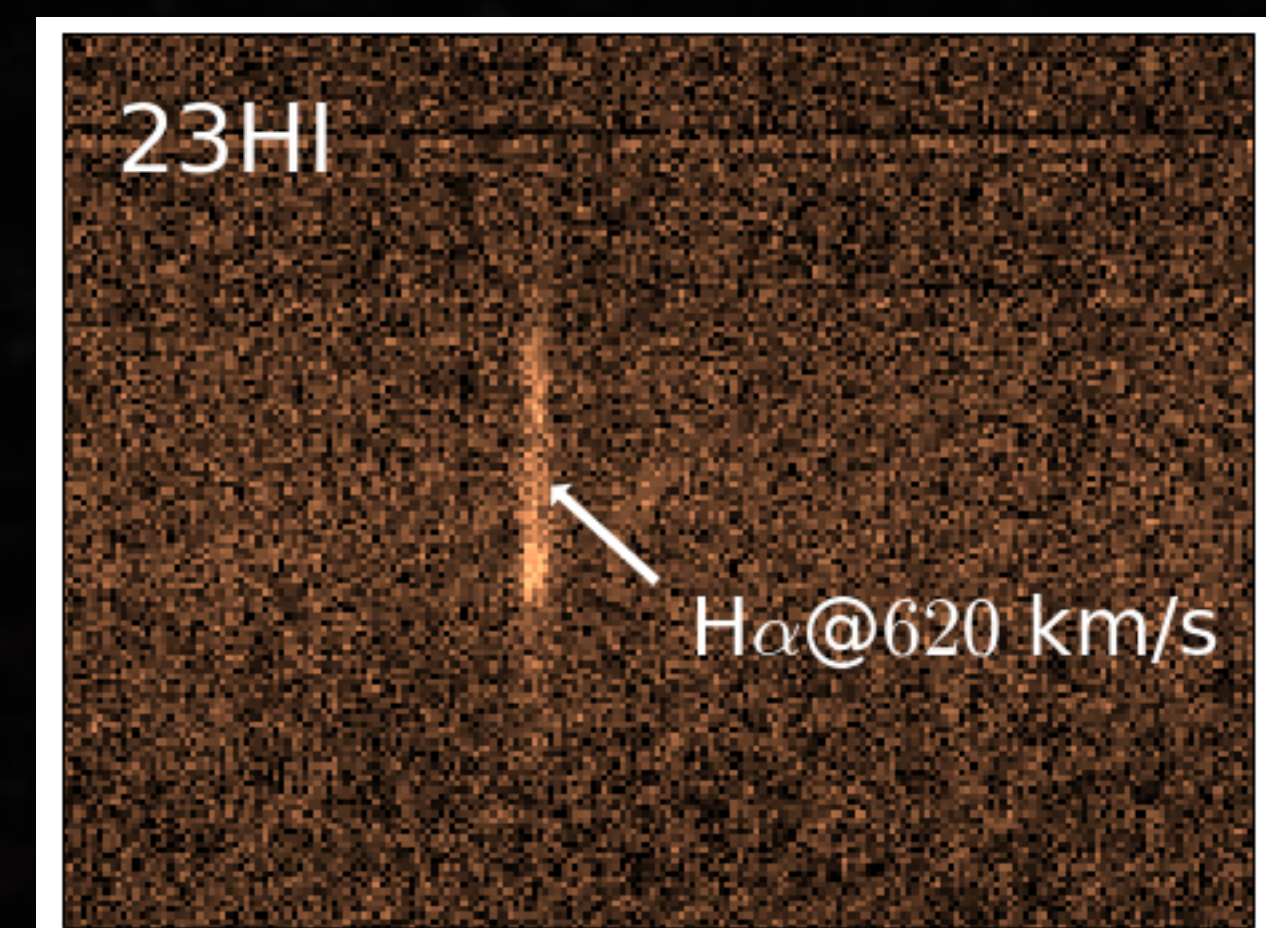
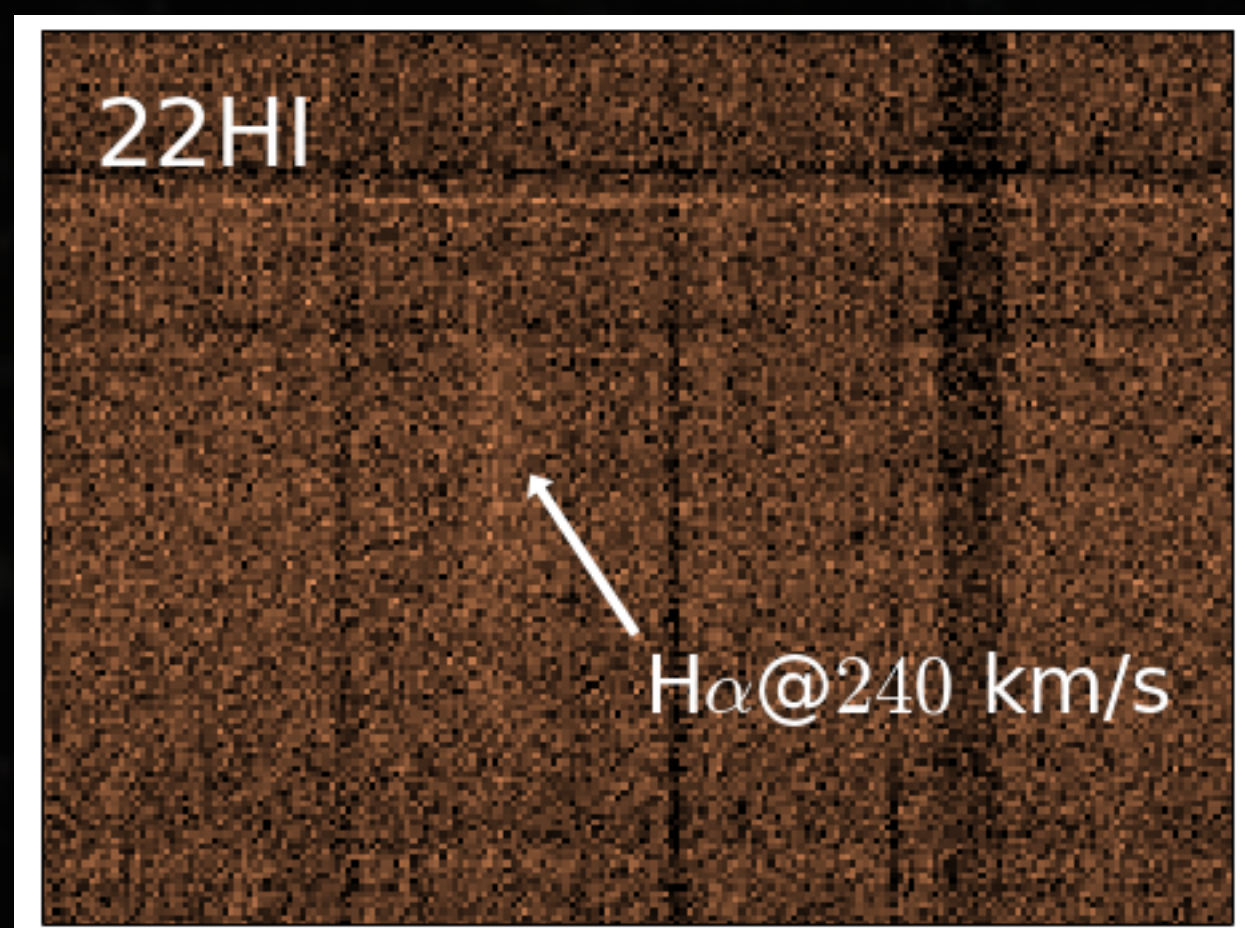
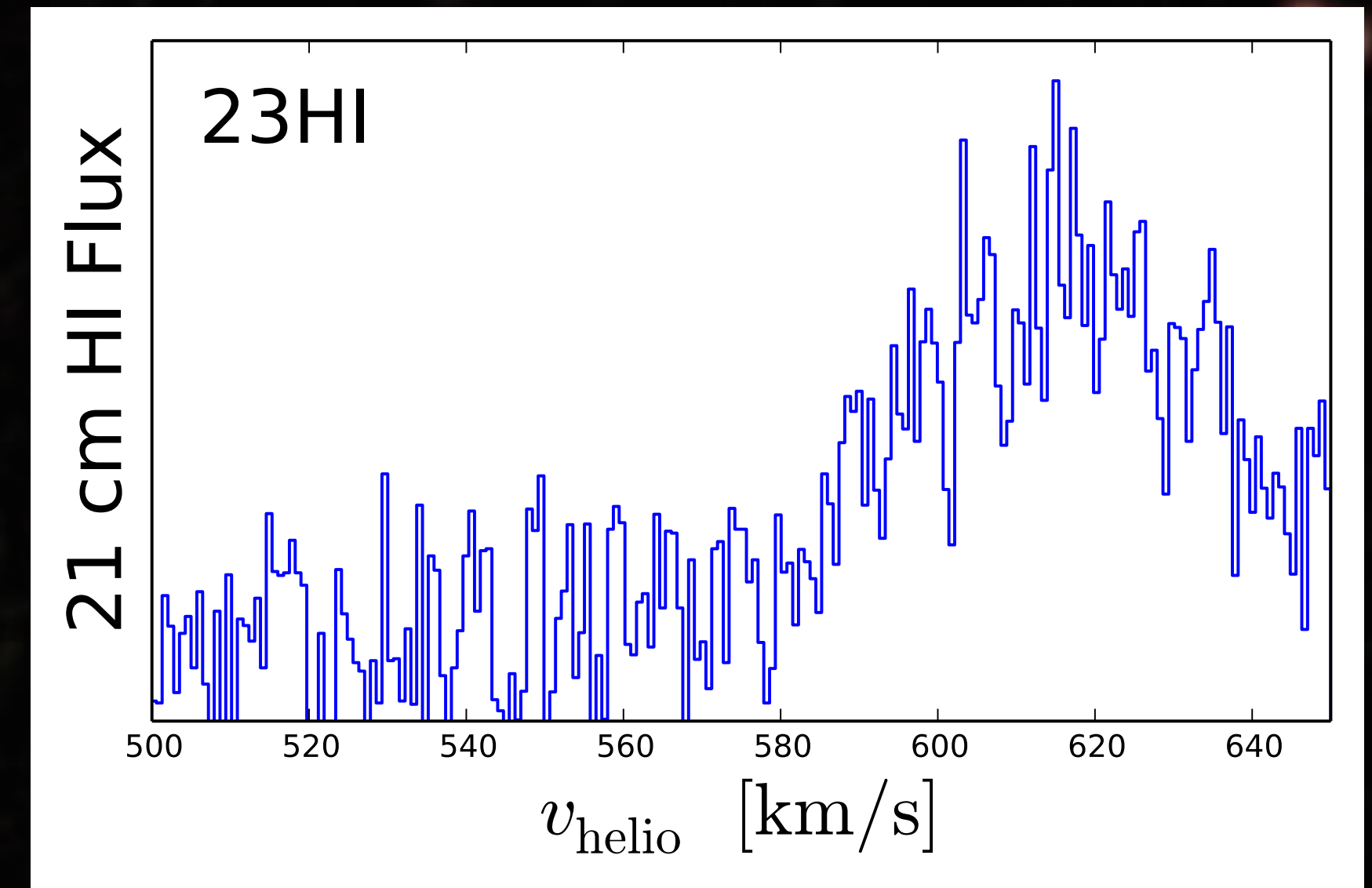
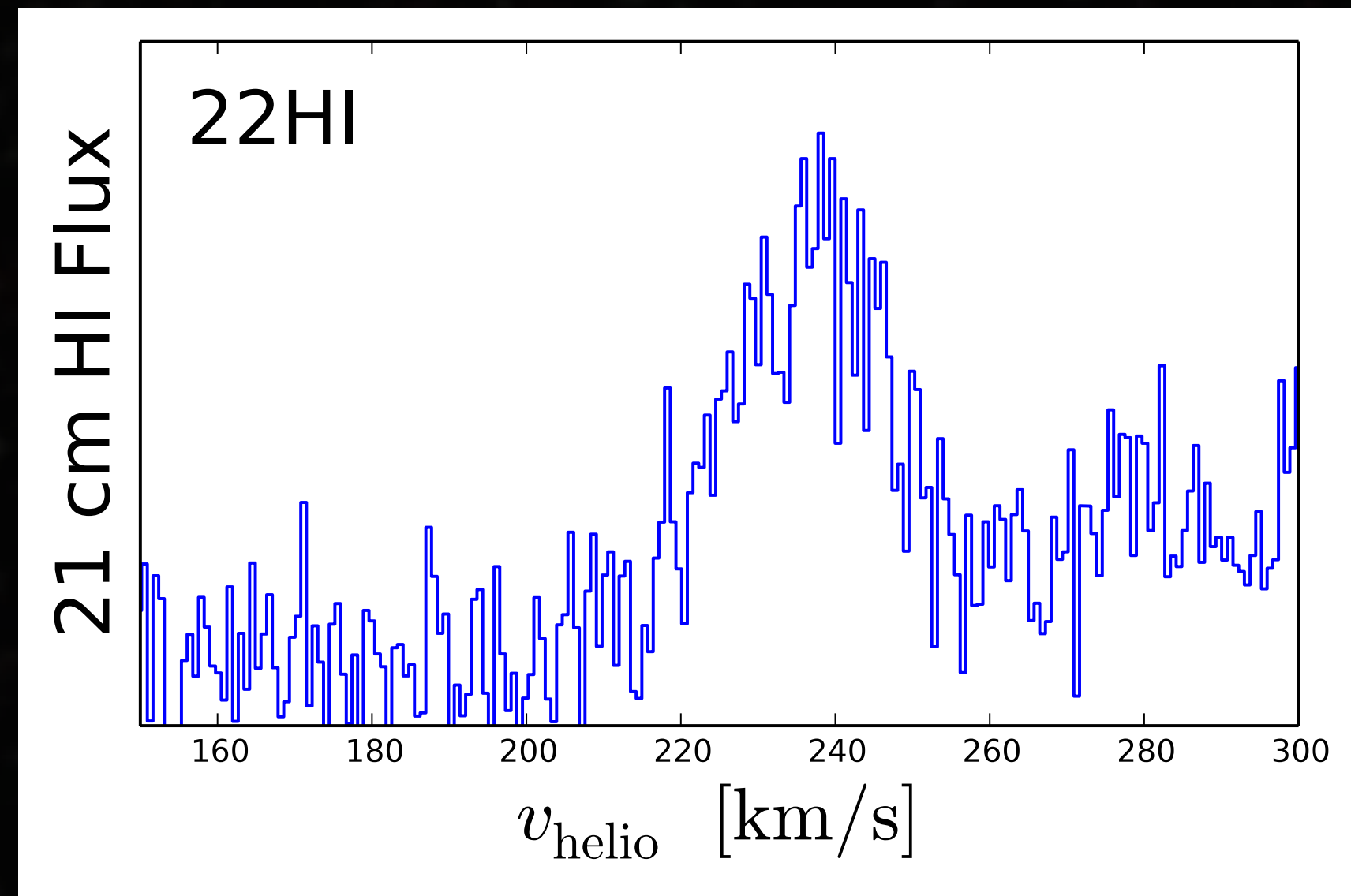
Faint Fuzzies: pODI



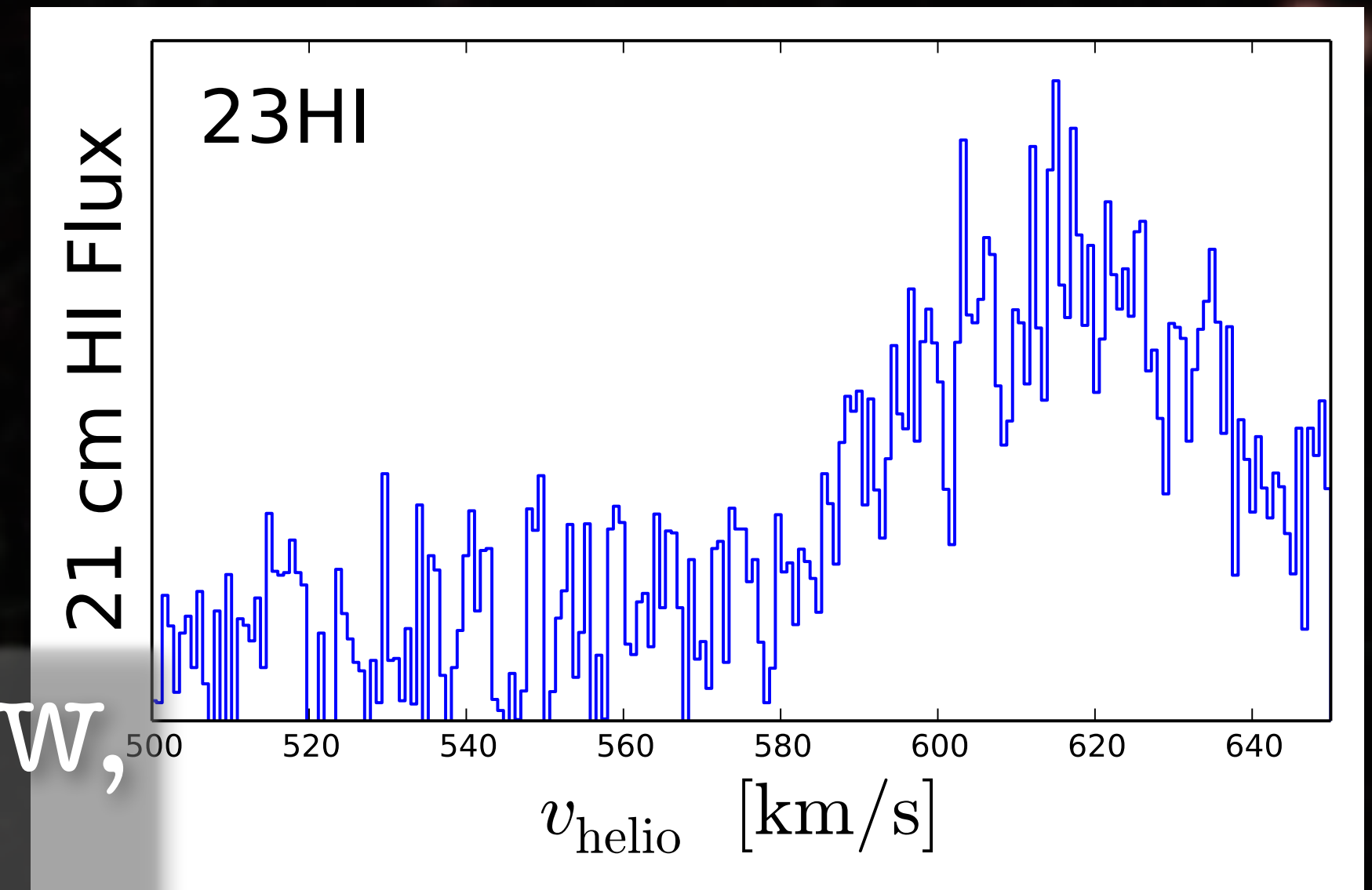
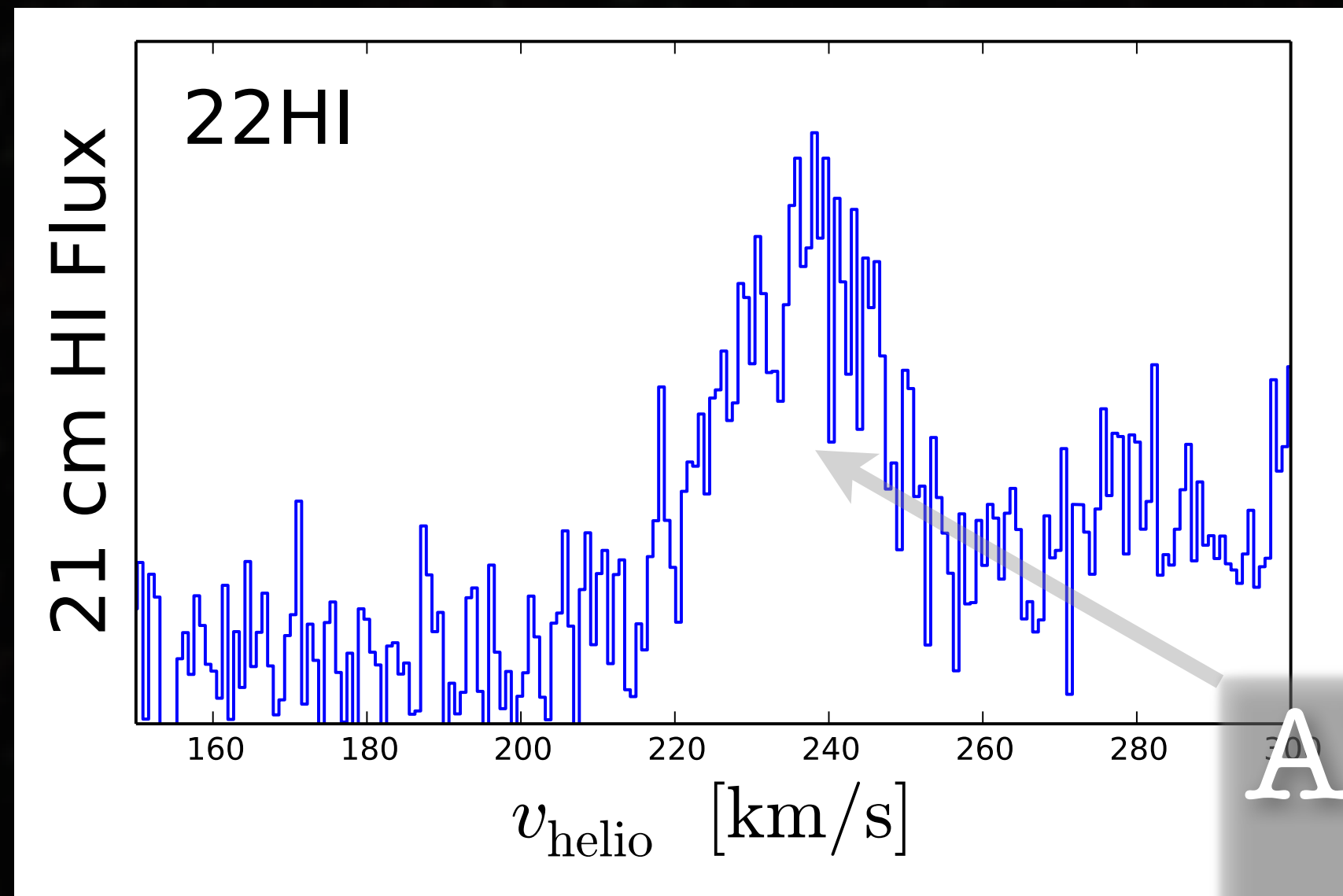
But are these the HI sources?



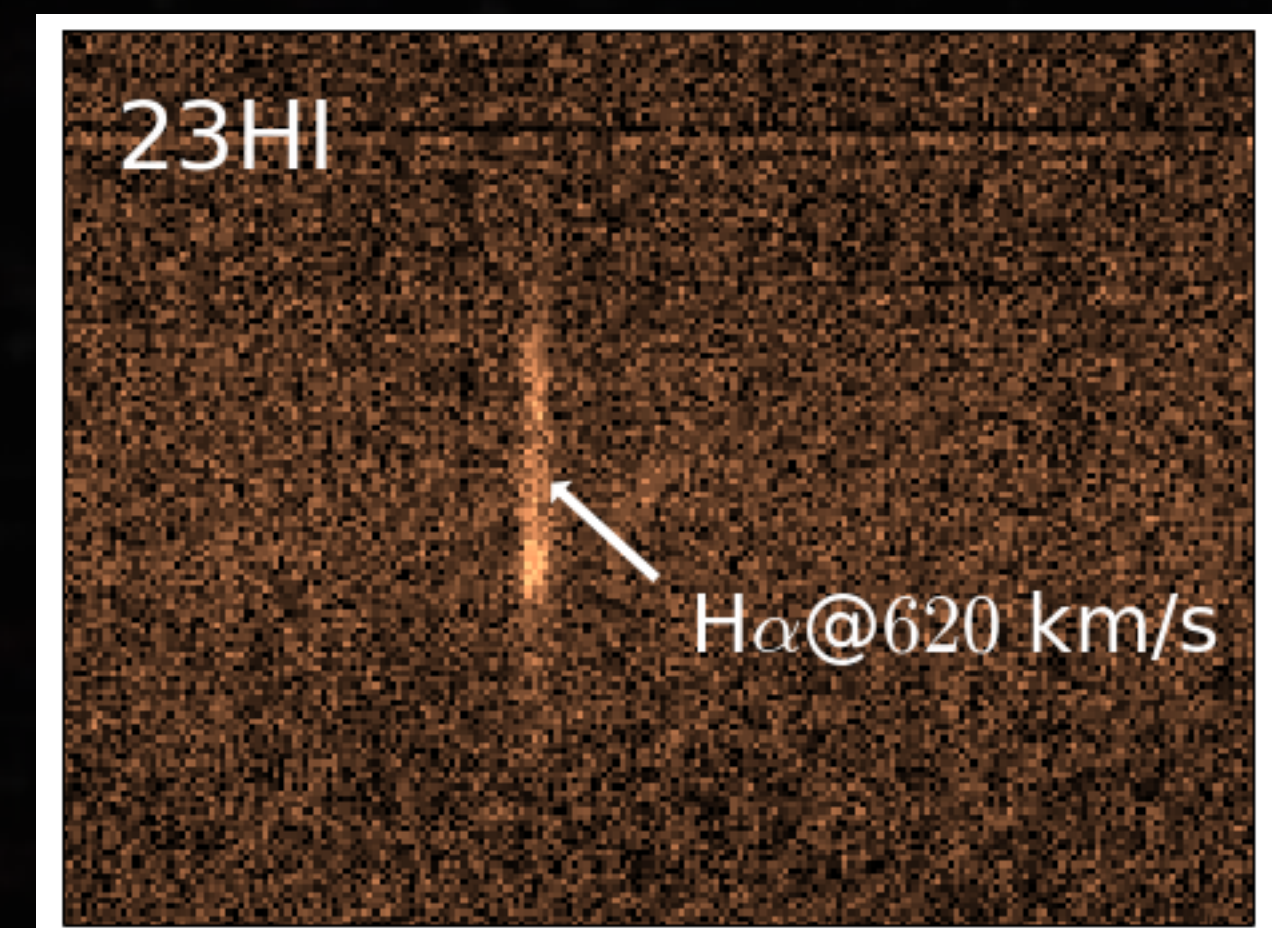
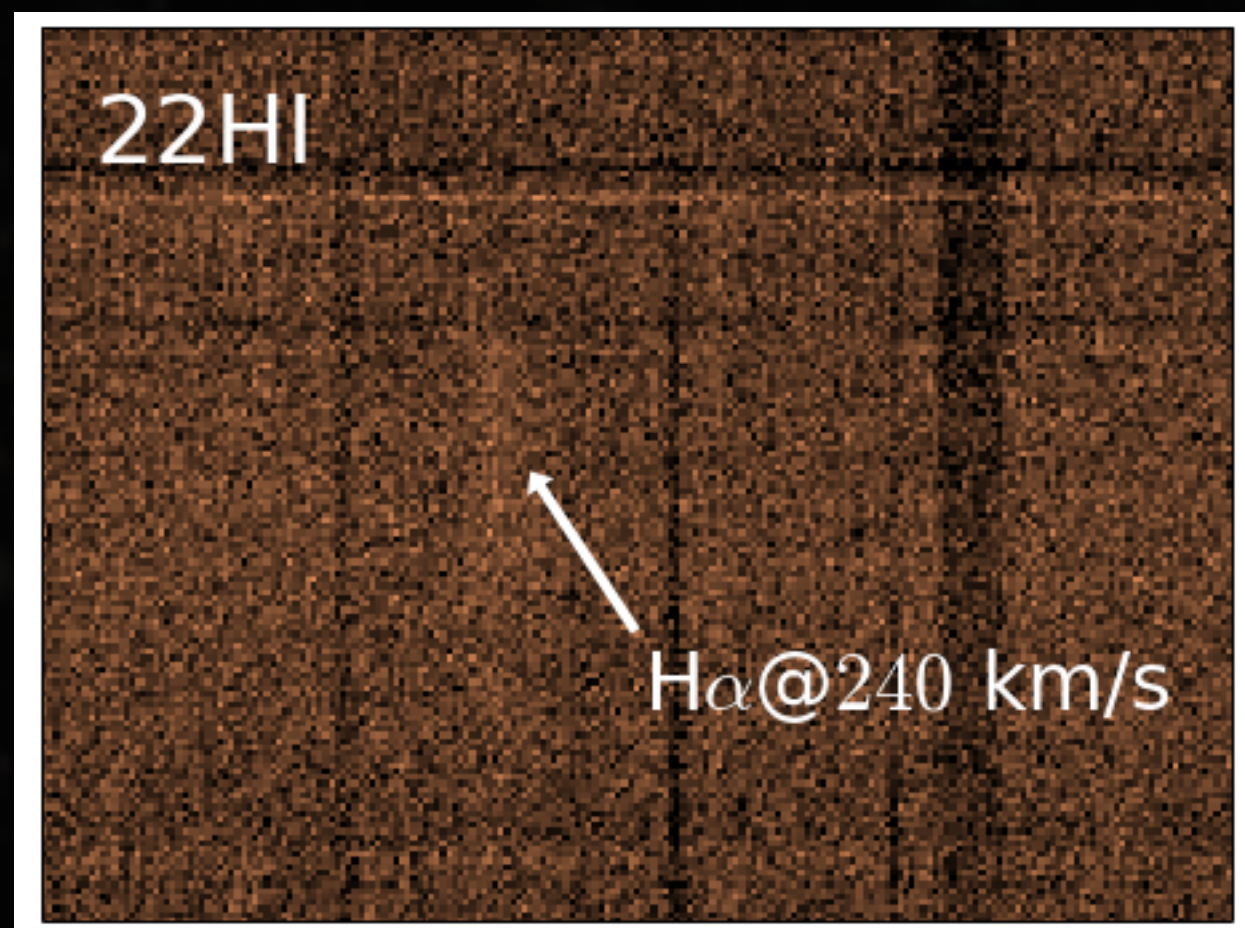
Faint Fuzzies: Optical Lines Match HI



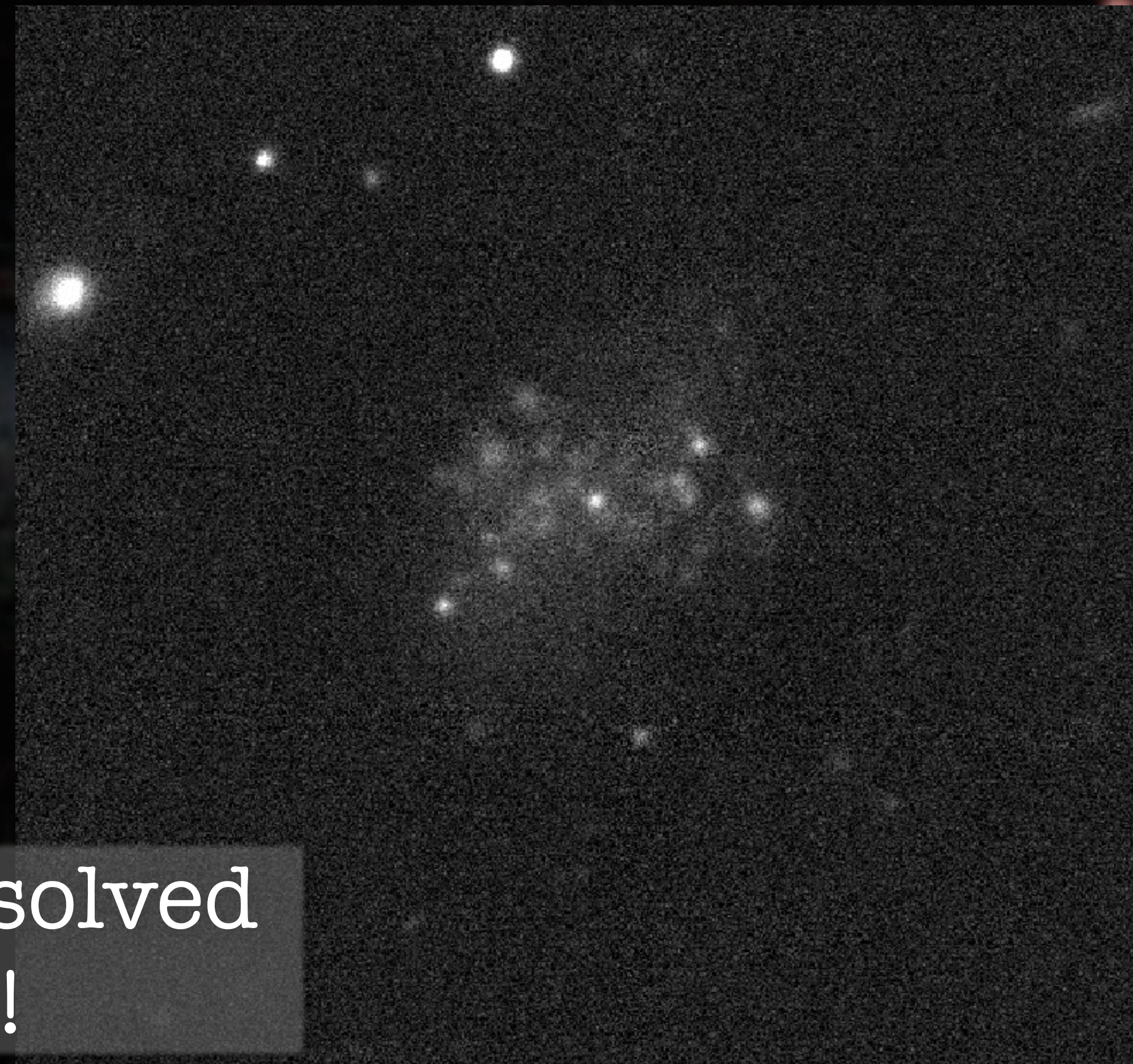
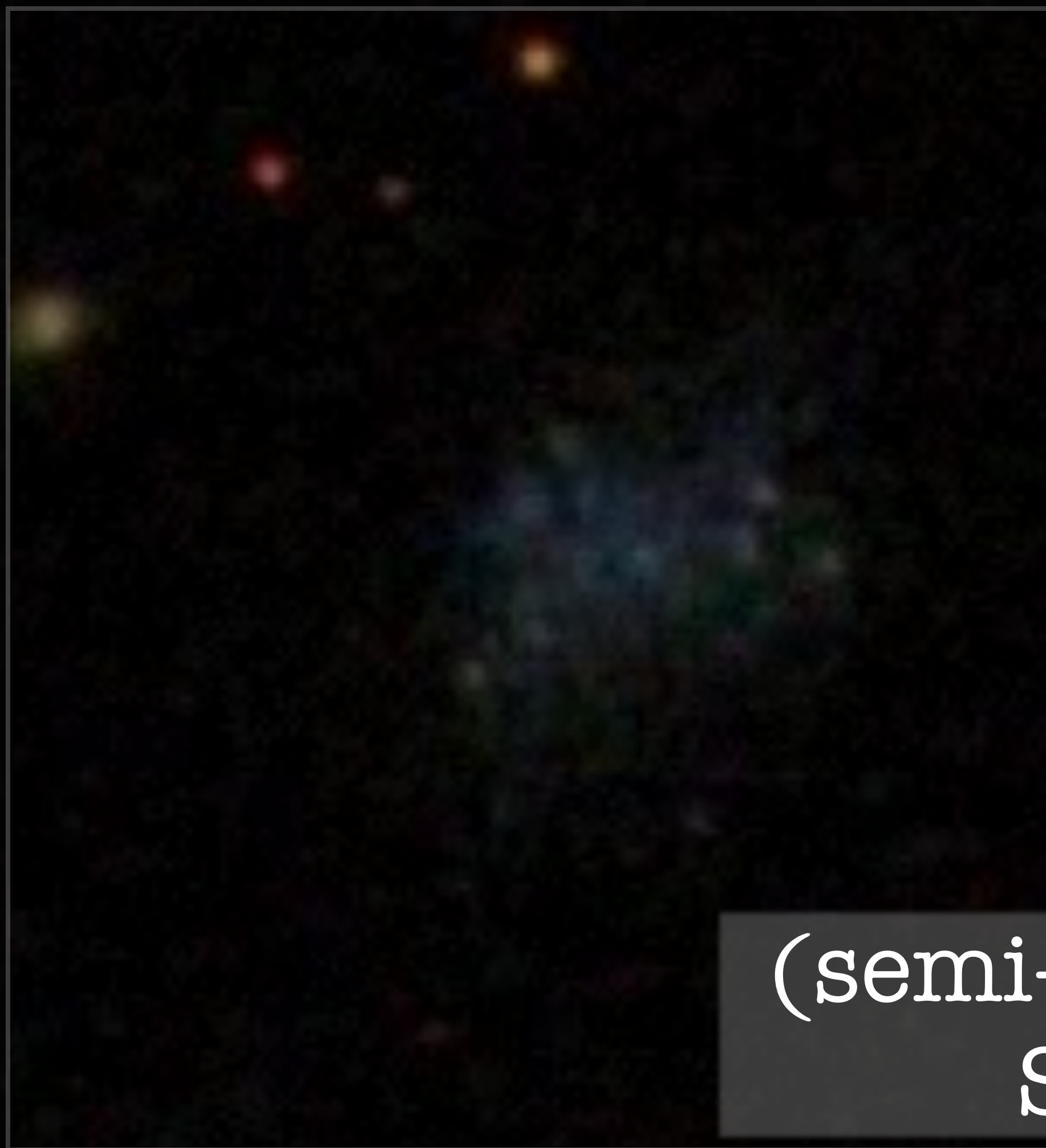
Faint Fuzzies: Optical Lines Match HI



Also Narrow,
~ Leo T

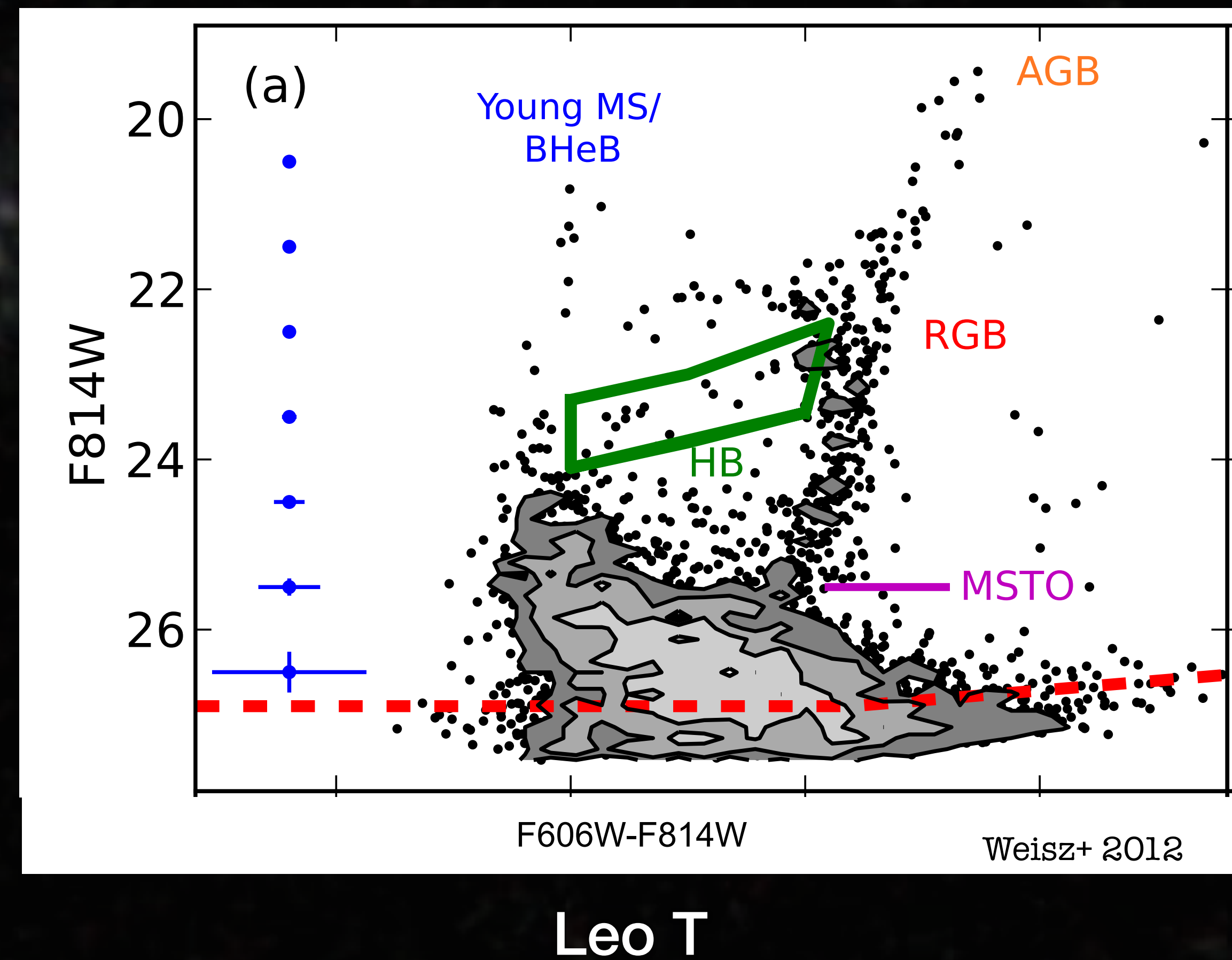
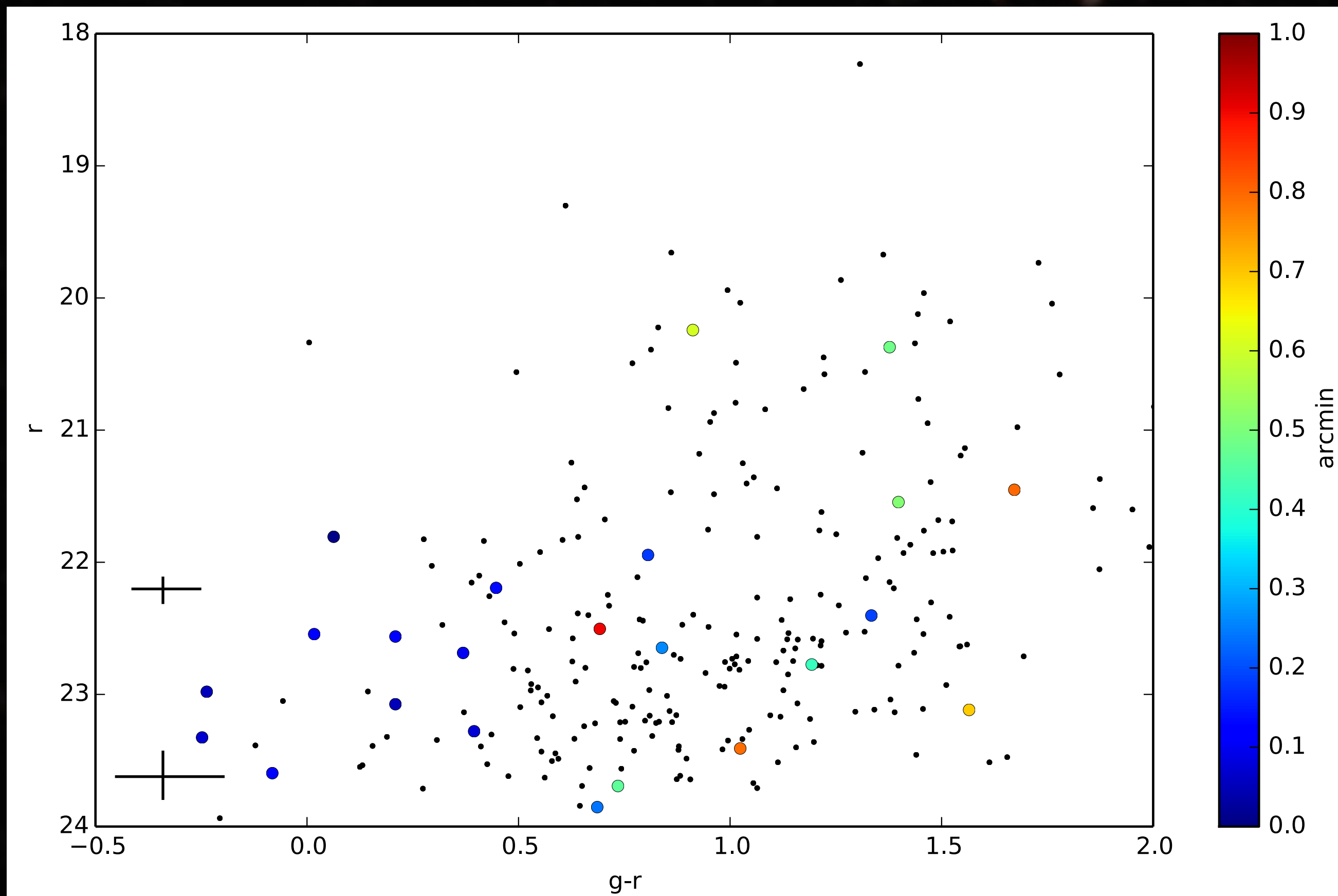


Faint Fuzzies: Distances

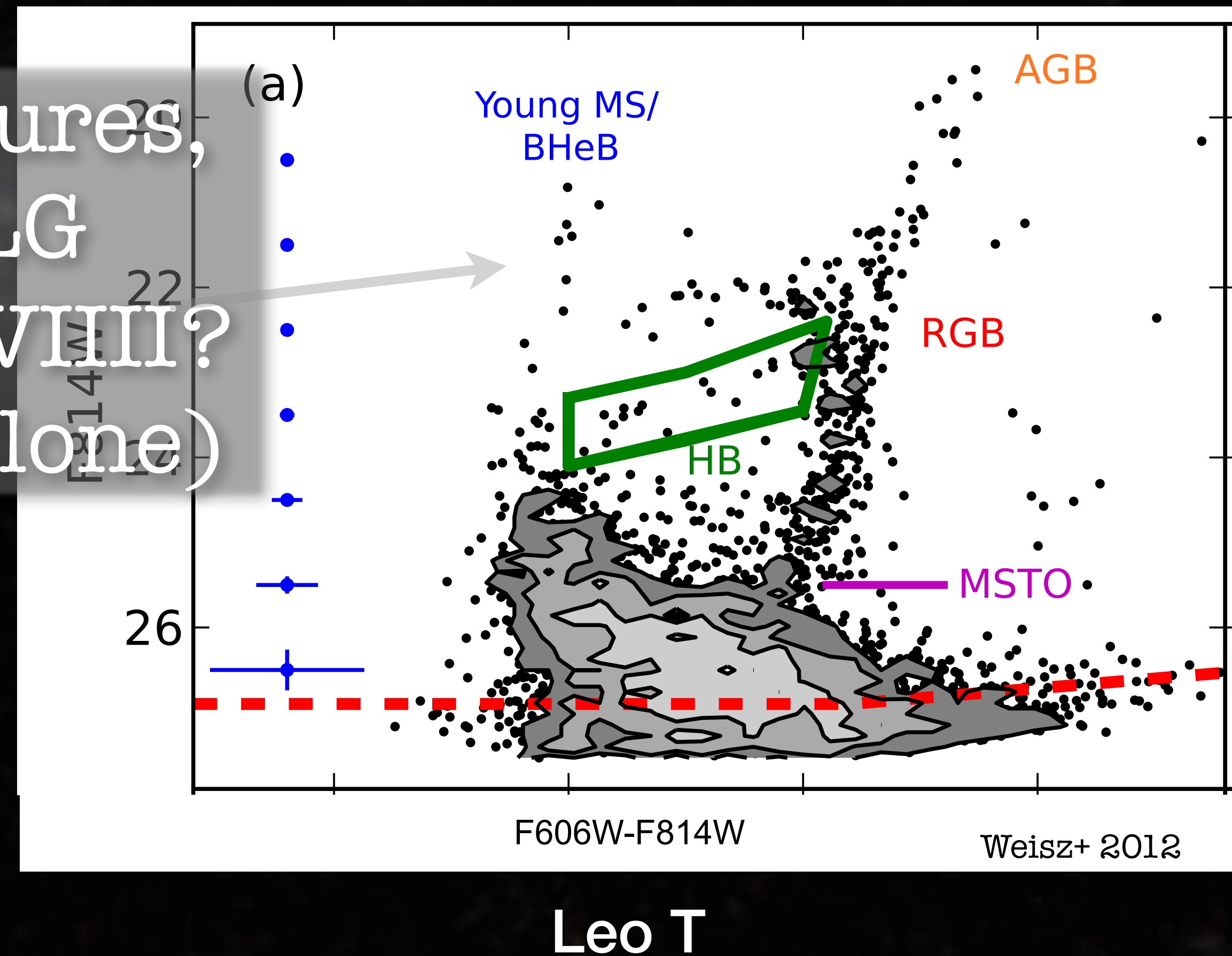
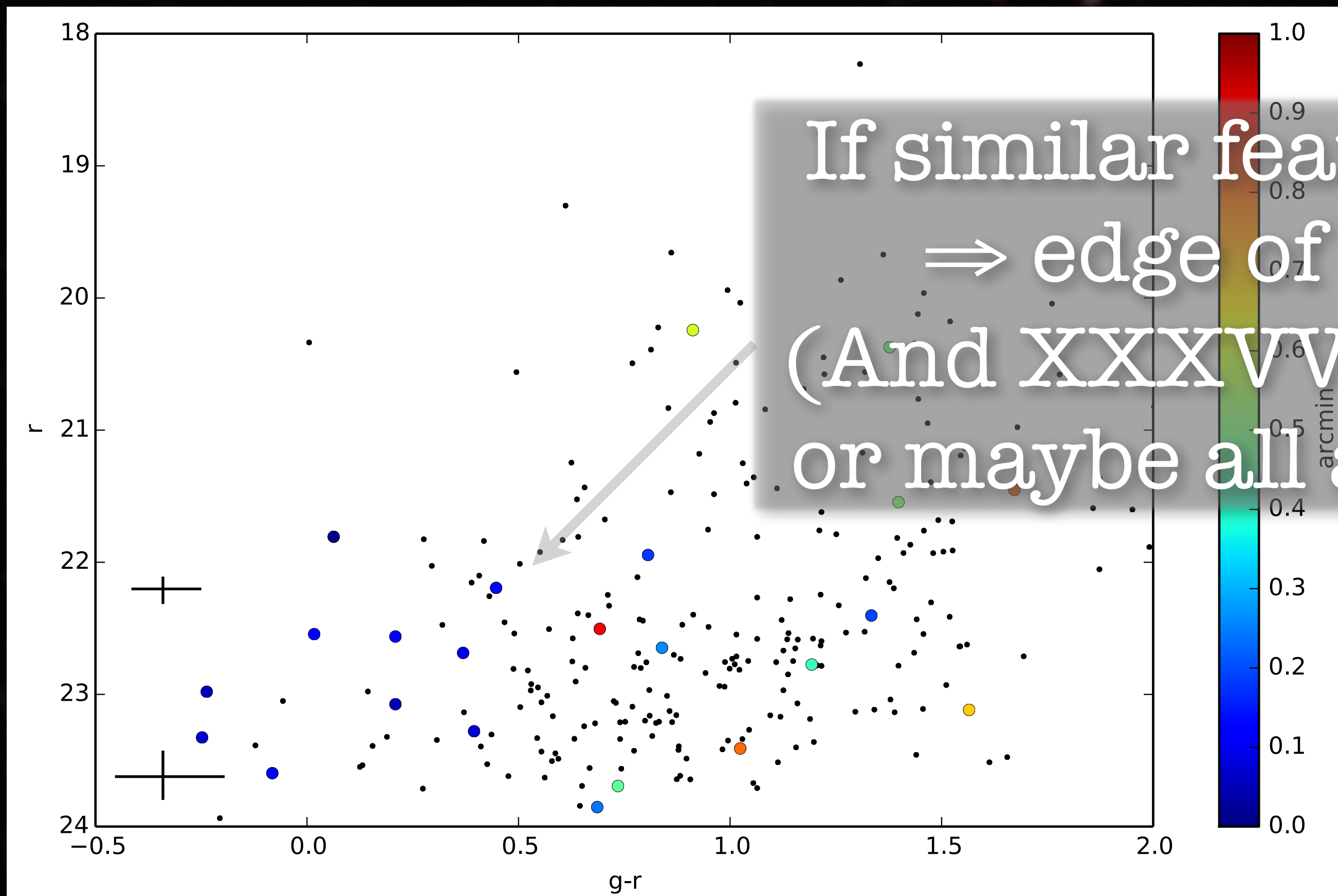


(semi-) Resolved
Stars!

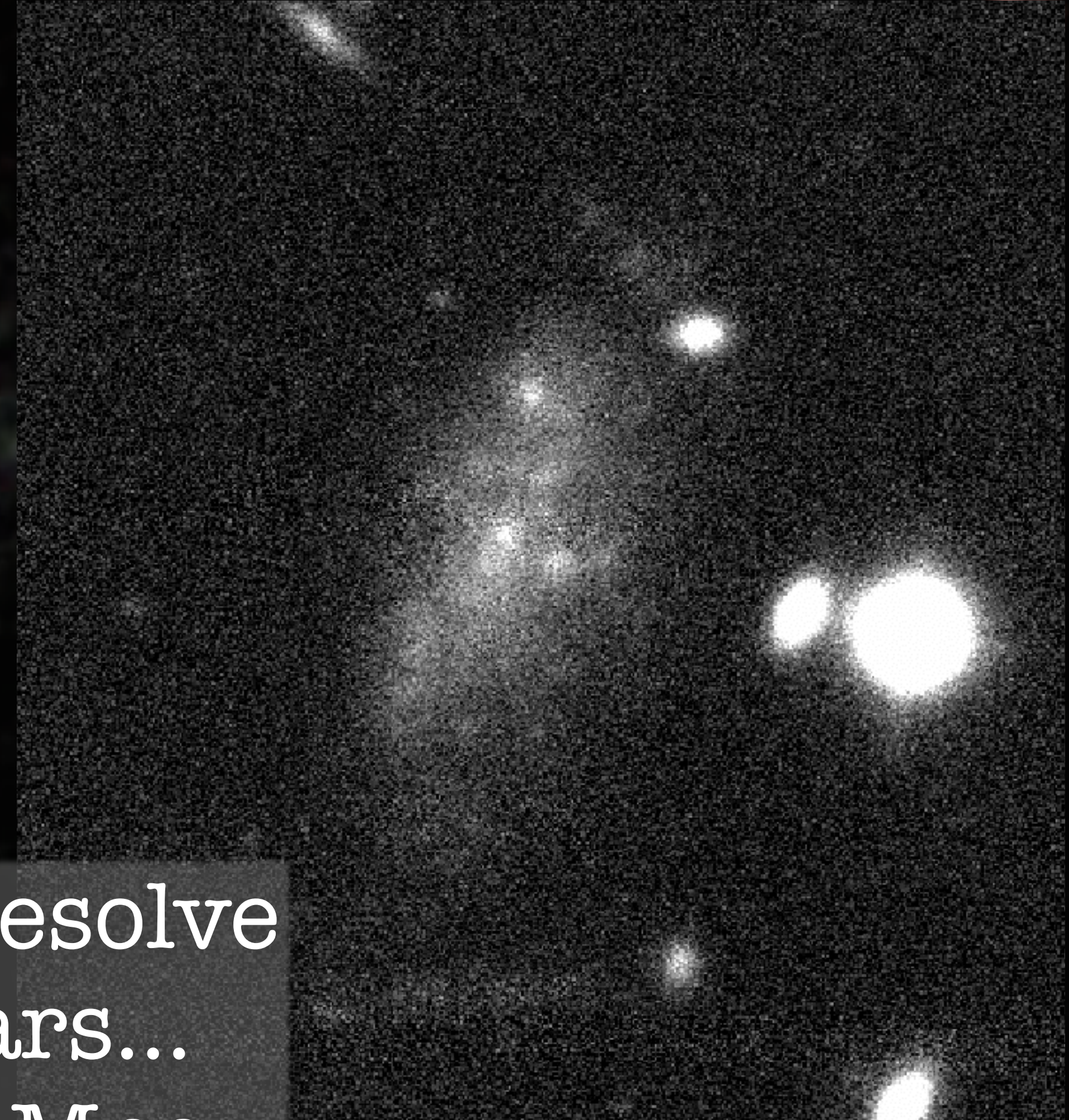
Faint Fuzzies: Distances



Faint Fuzzies: Distances

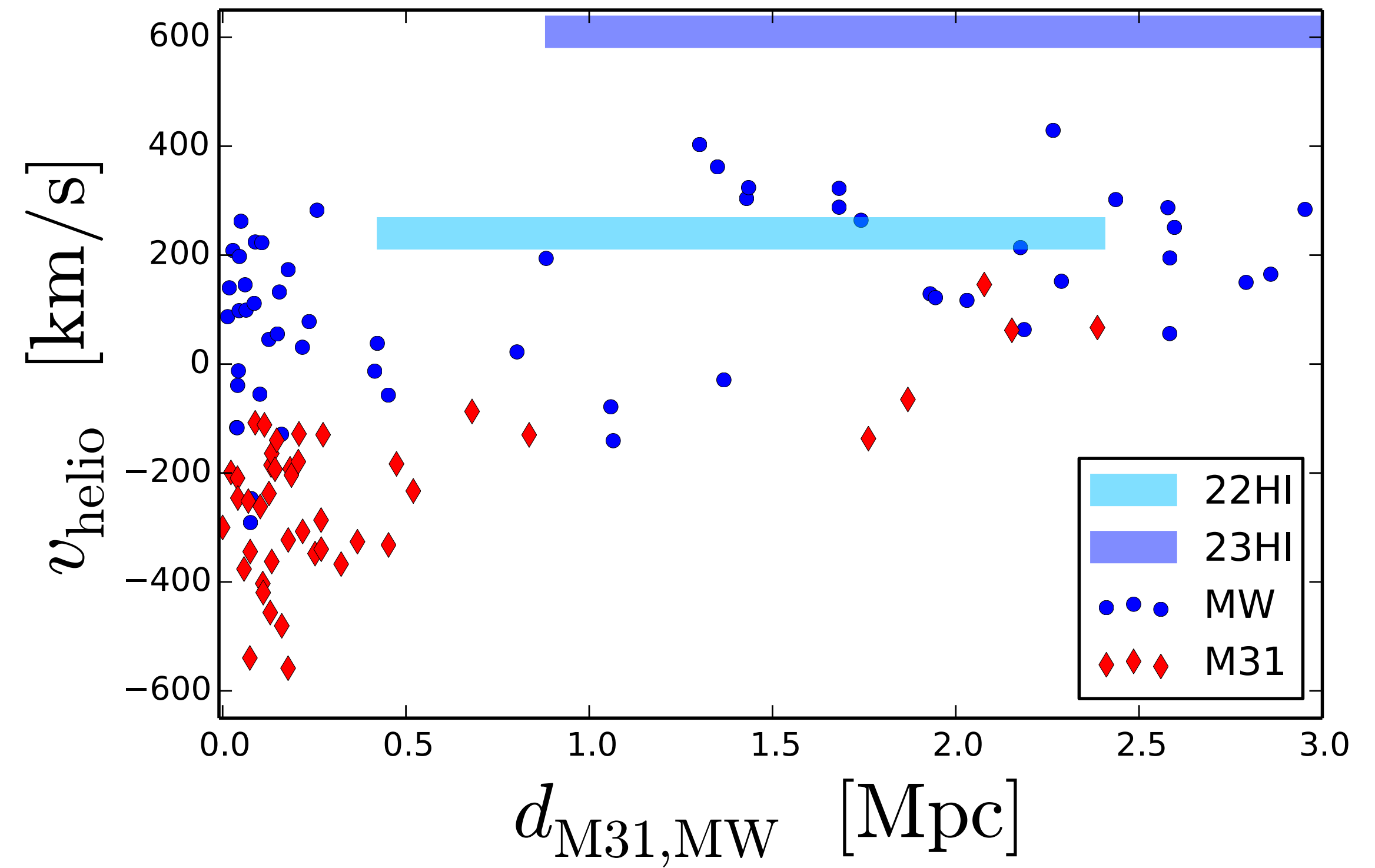
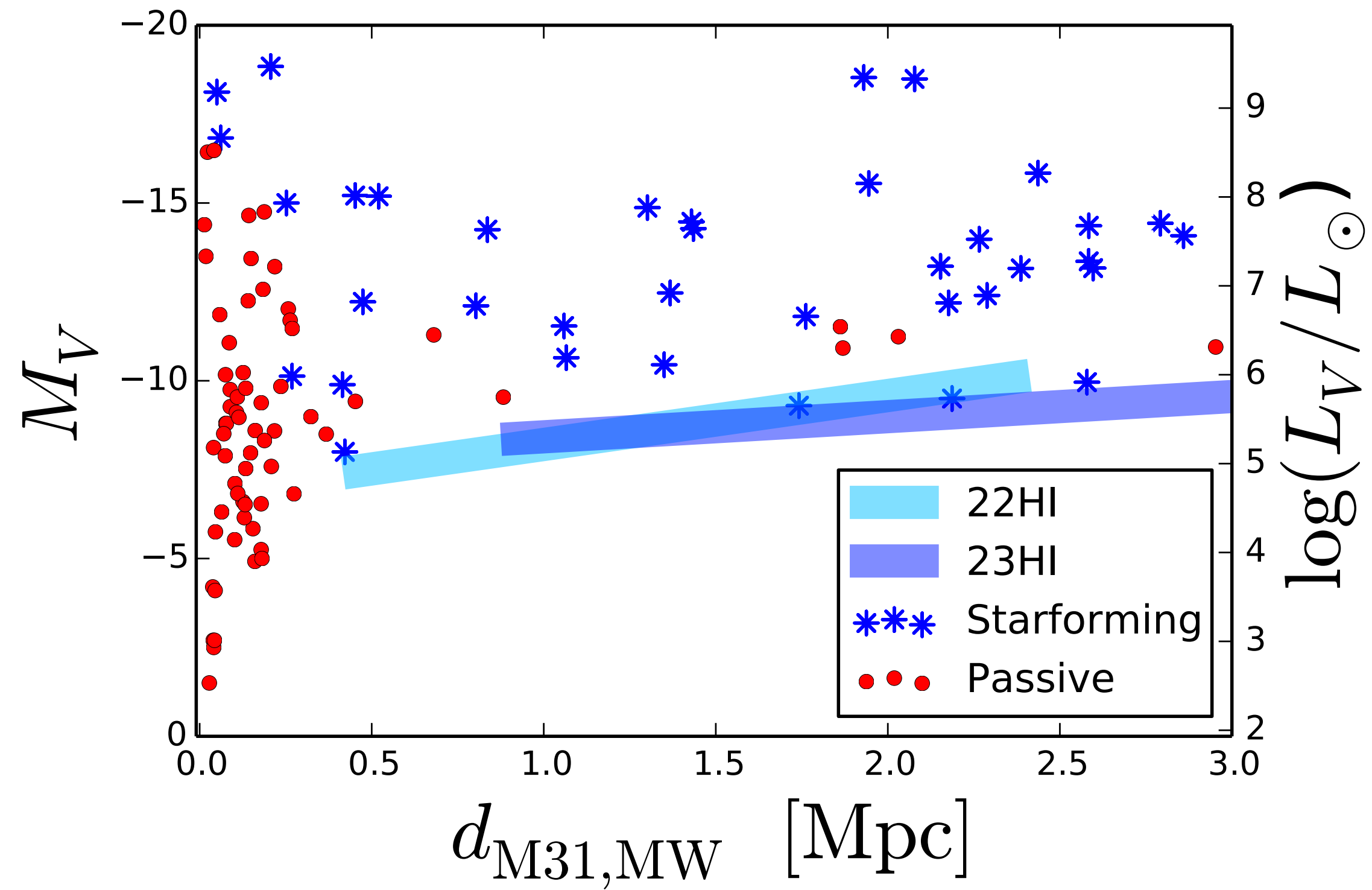


Faint Fuzzies: Distances

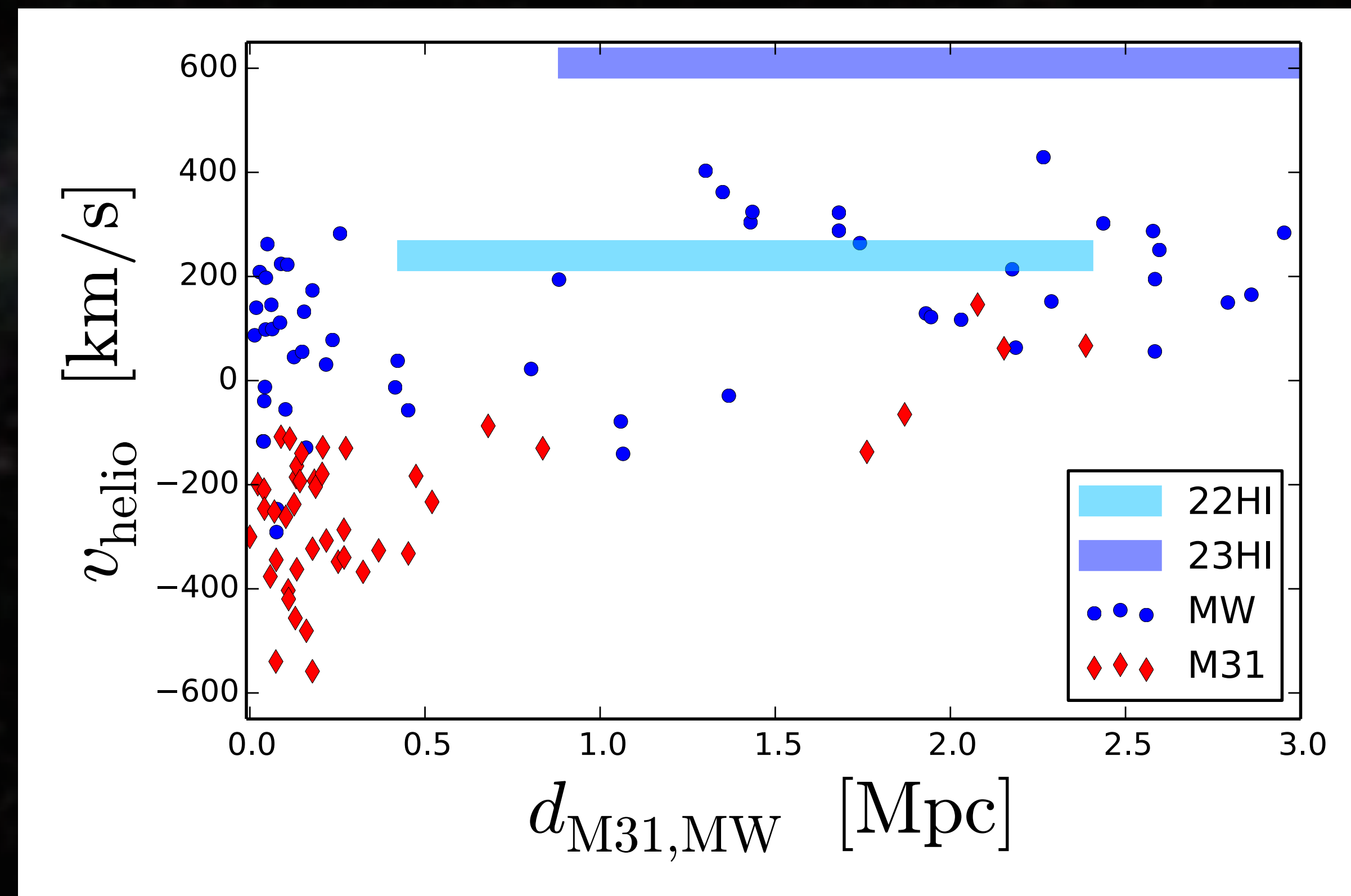
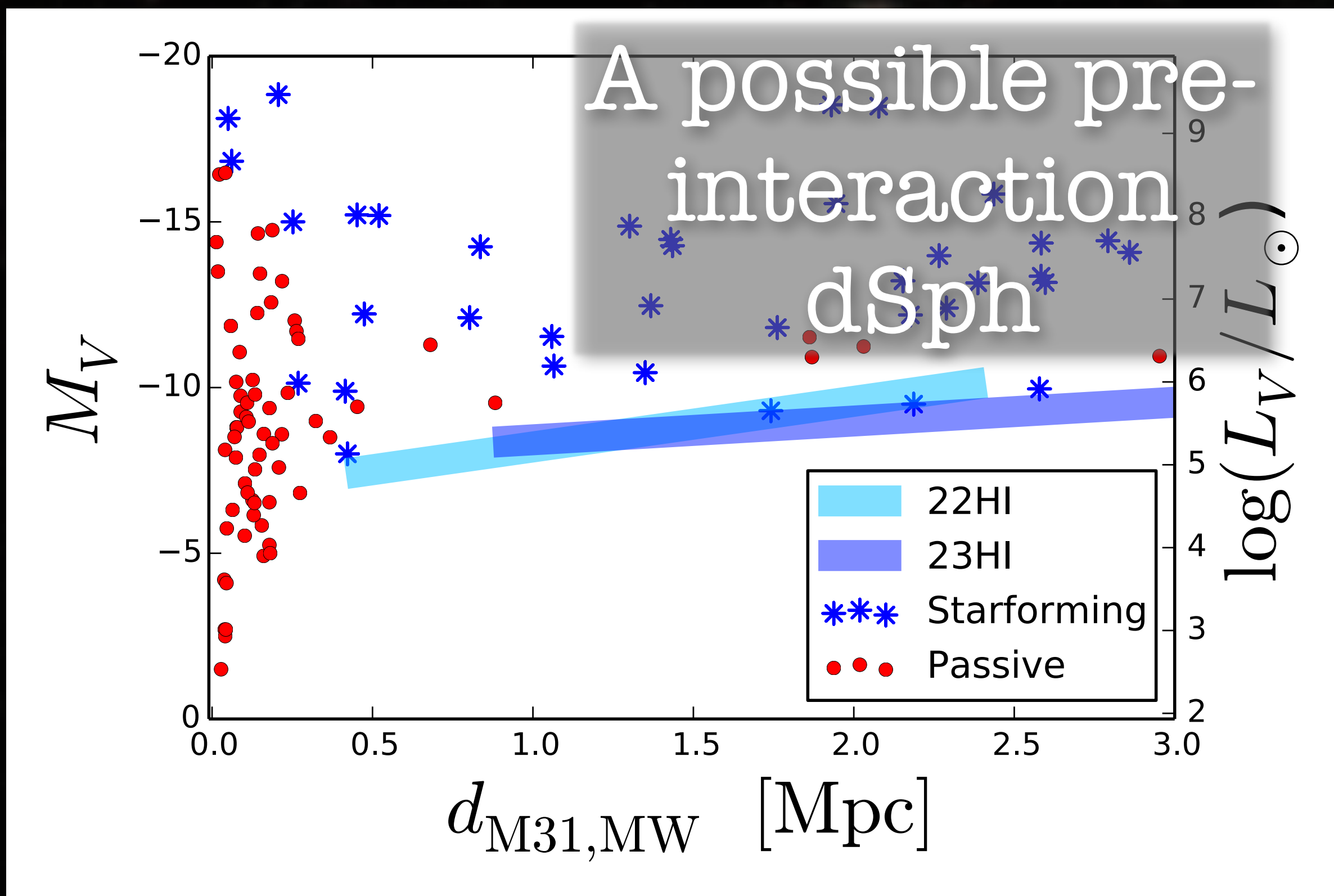


Can't quite resolve
enough stars...
maybe 2-6 Mpc

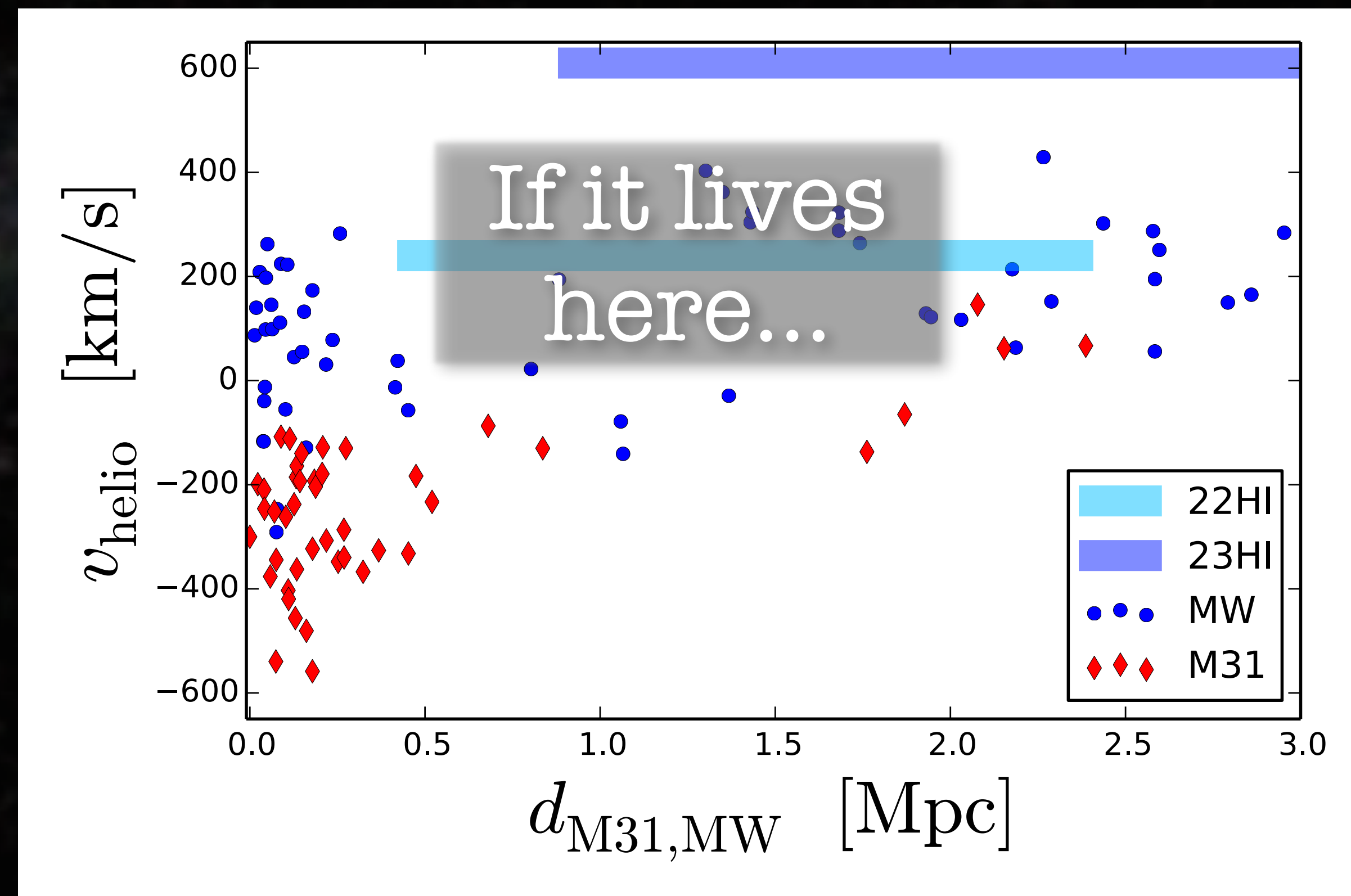
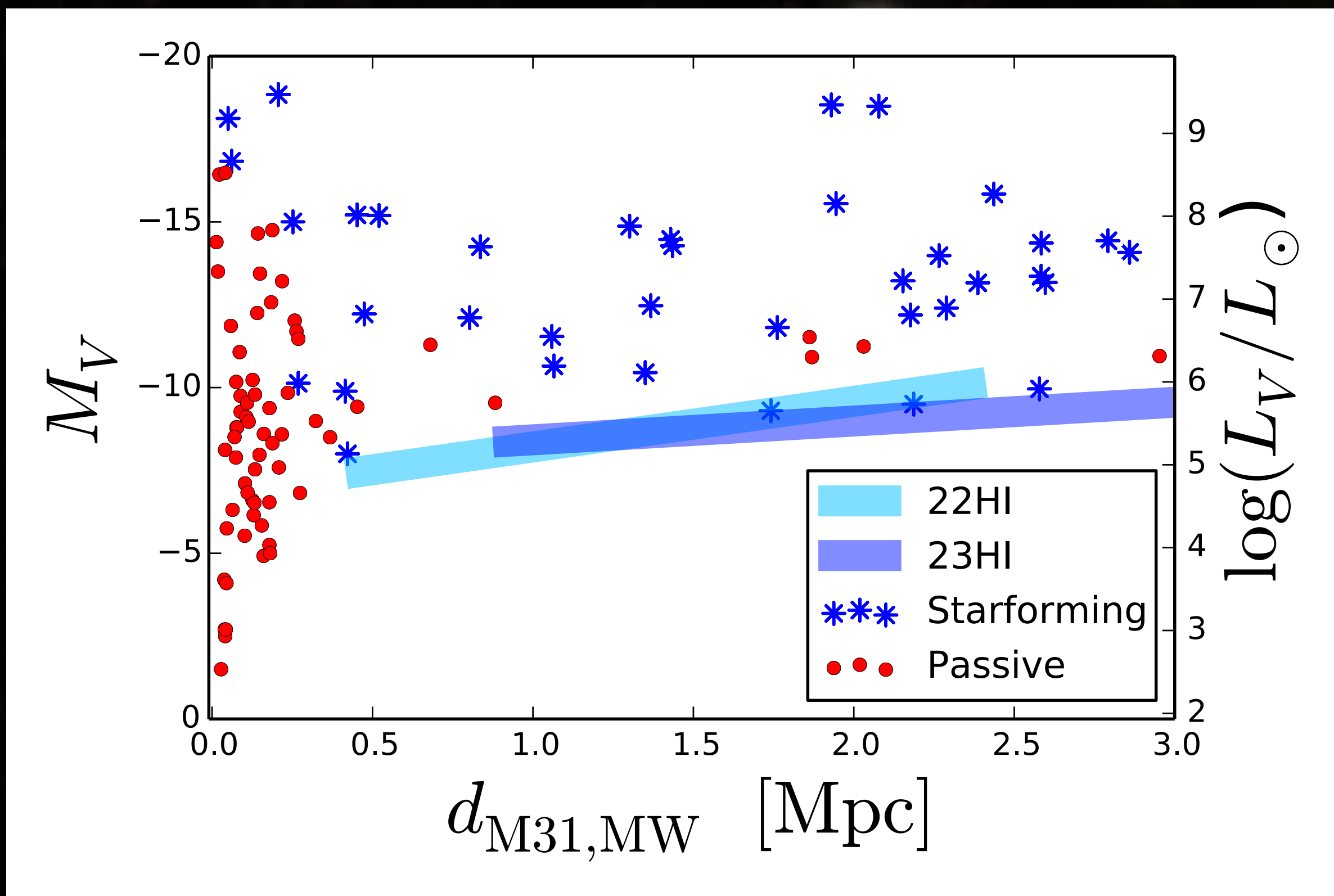
Faint Fuzzies: Context



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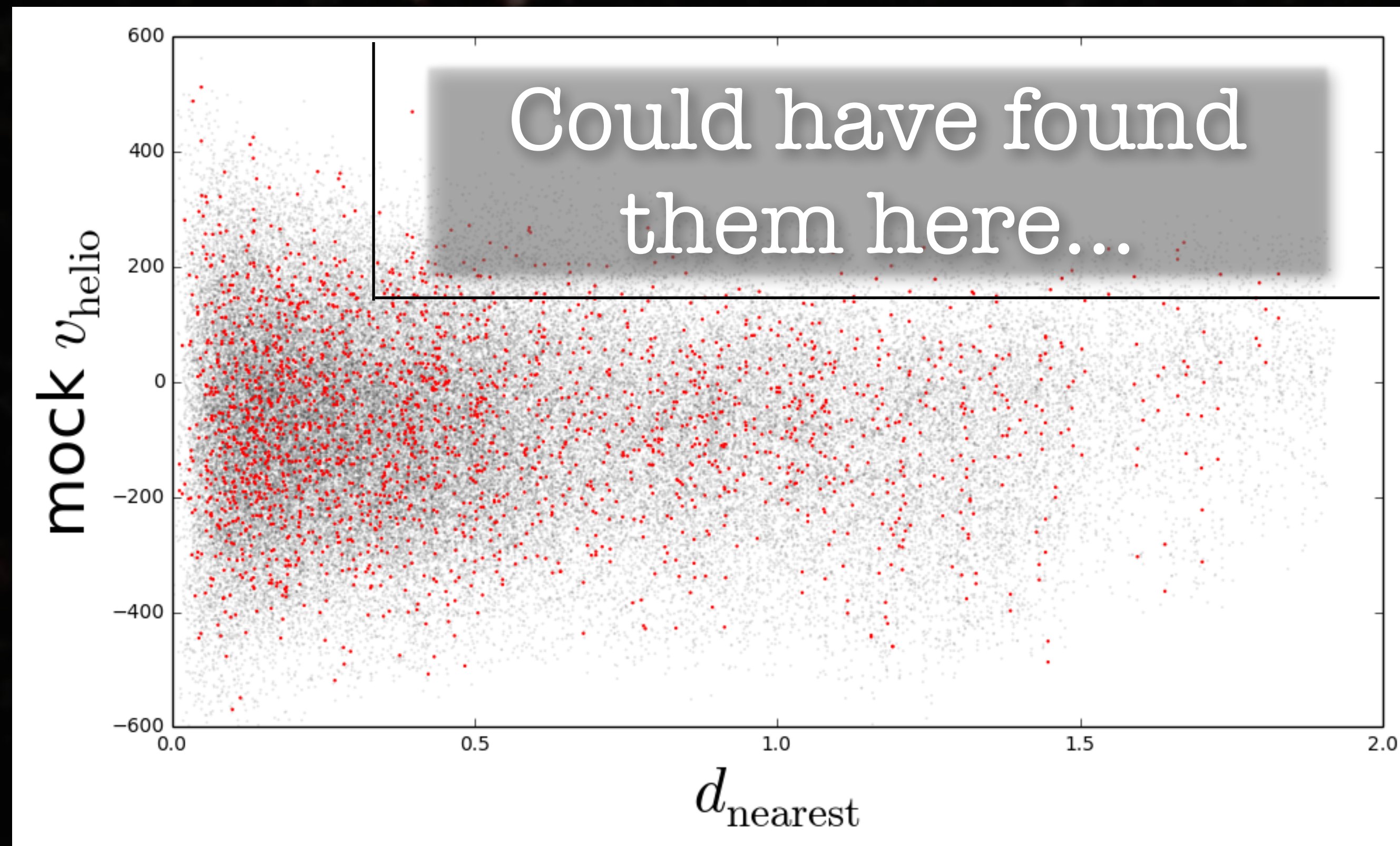


Faint Fuzzies: Context



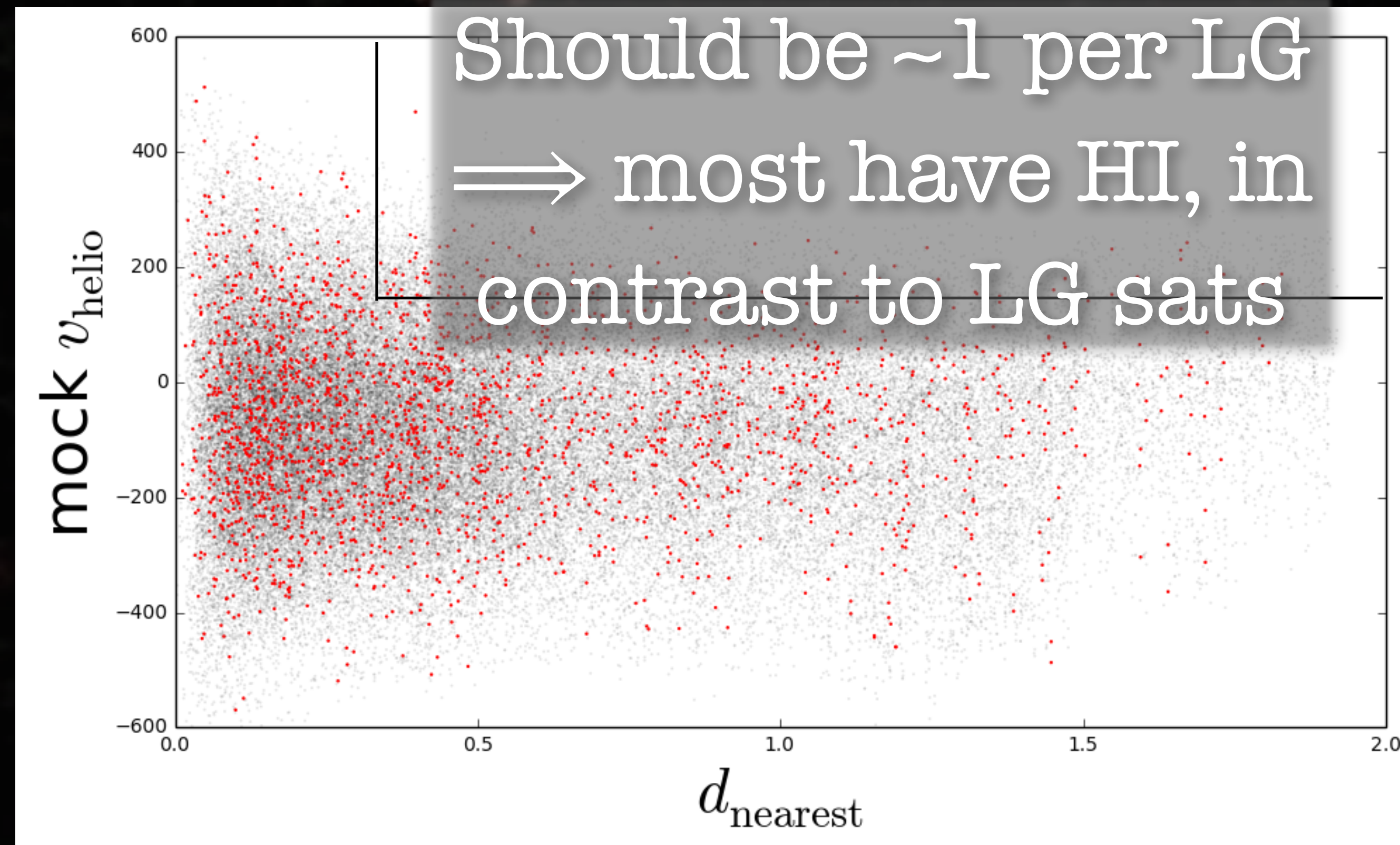
Faint Fuzzies: Comparison w/ ELVIS

Garrison-Kimmel+ 14



Faint Fuzzies: Comparison w/ ELVIS

Garrison-Kimmel+ 14



**There's more than one galaxy in the
Universe**

– Deason's talk

**There's more than one Local Group in
the Universe**

There's more than one Local Group in the Universe

So how many also
show e.g. TBTF (or
the 9 ± 3 solutions...)

SAGA

(Satellites Around Galactic Analogs)

With: Marla Geha, Risa Wechsler, Ben Wiener, **Yao-Yuan Mao**, Emily Sanford, Phil Marshall, Carlos Cunha, Yu Lu (Stanford), Ricardo Munoz, Sebastian Marchi, Rebecca Bernstein



Beowulf

- Find \sim dSph satellites within R_{vir} of ~ 10 nearby (20-40 Mpc) Milky Way-like galaxies
- Matched set of n-body simulations to interpret them in Λ CDM



Odysseus

Not a Trivial Task

$R_{\text{vir}} \sim 300 \text{ kpc}$ at
36 Mpc
 $\Rightarrow 1 \text{ deg FOV}$

Which one is a real satellite?

1



2



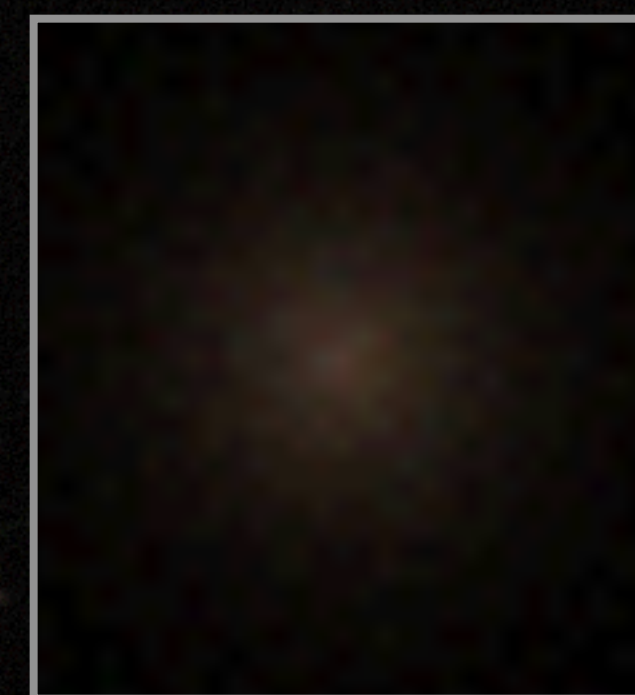
3



4



5



Which one is a real satellite?

1



2



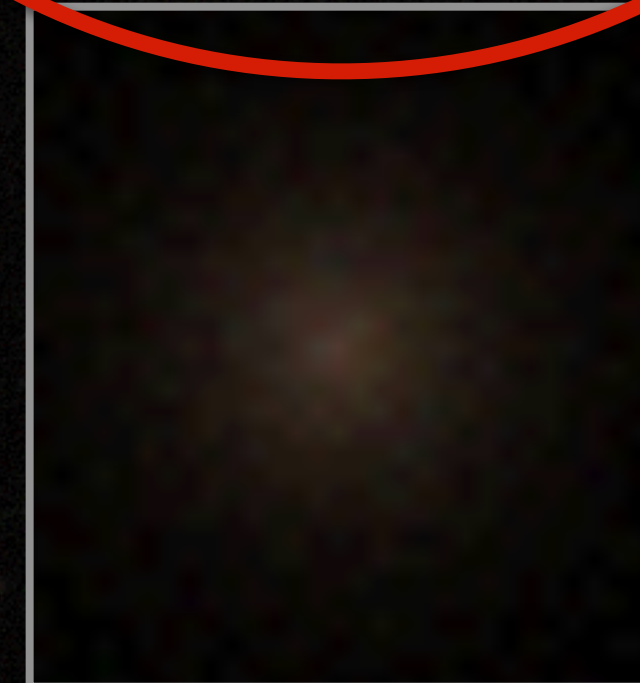
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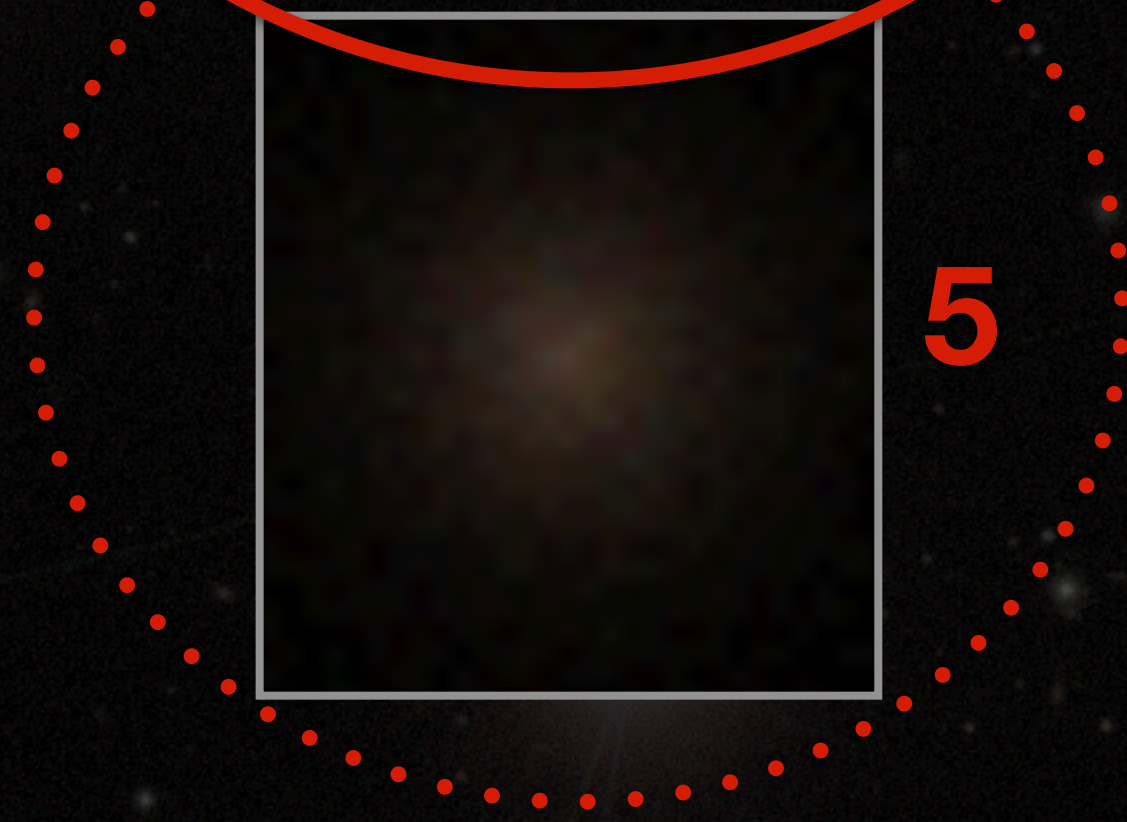
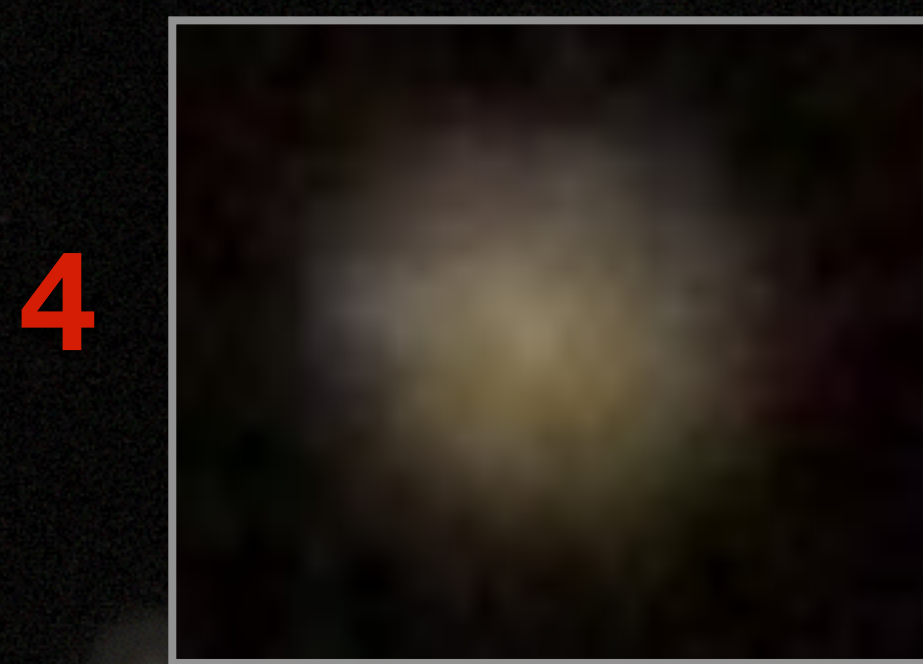
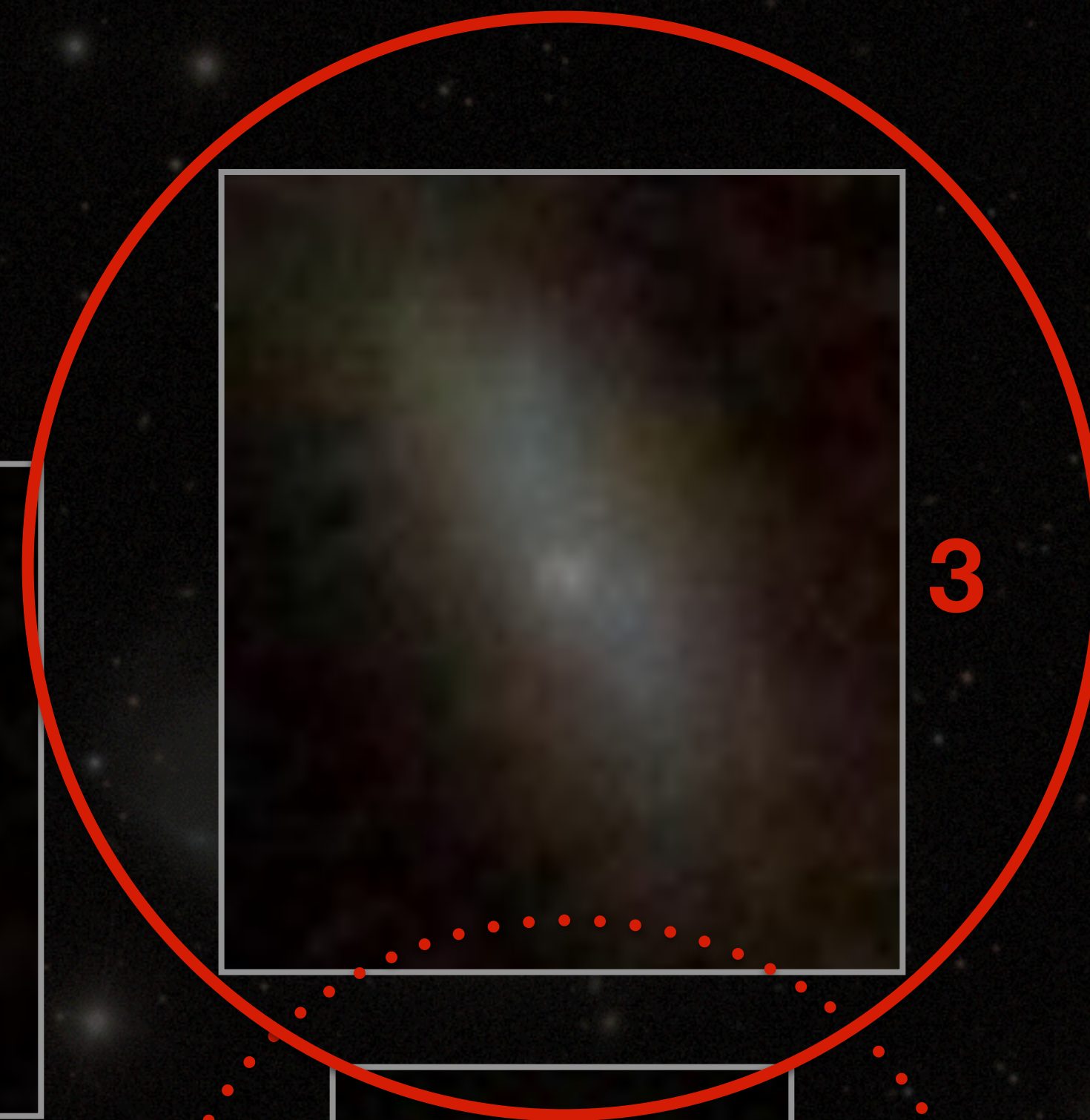
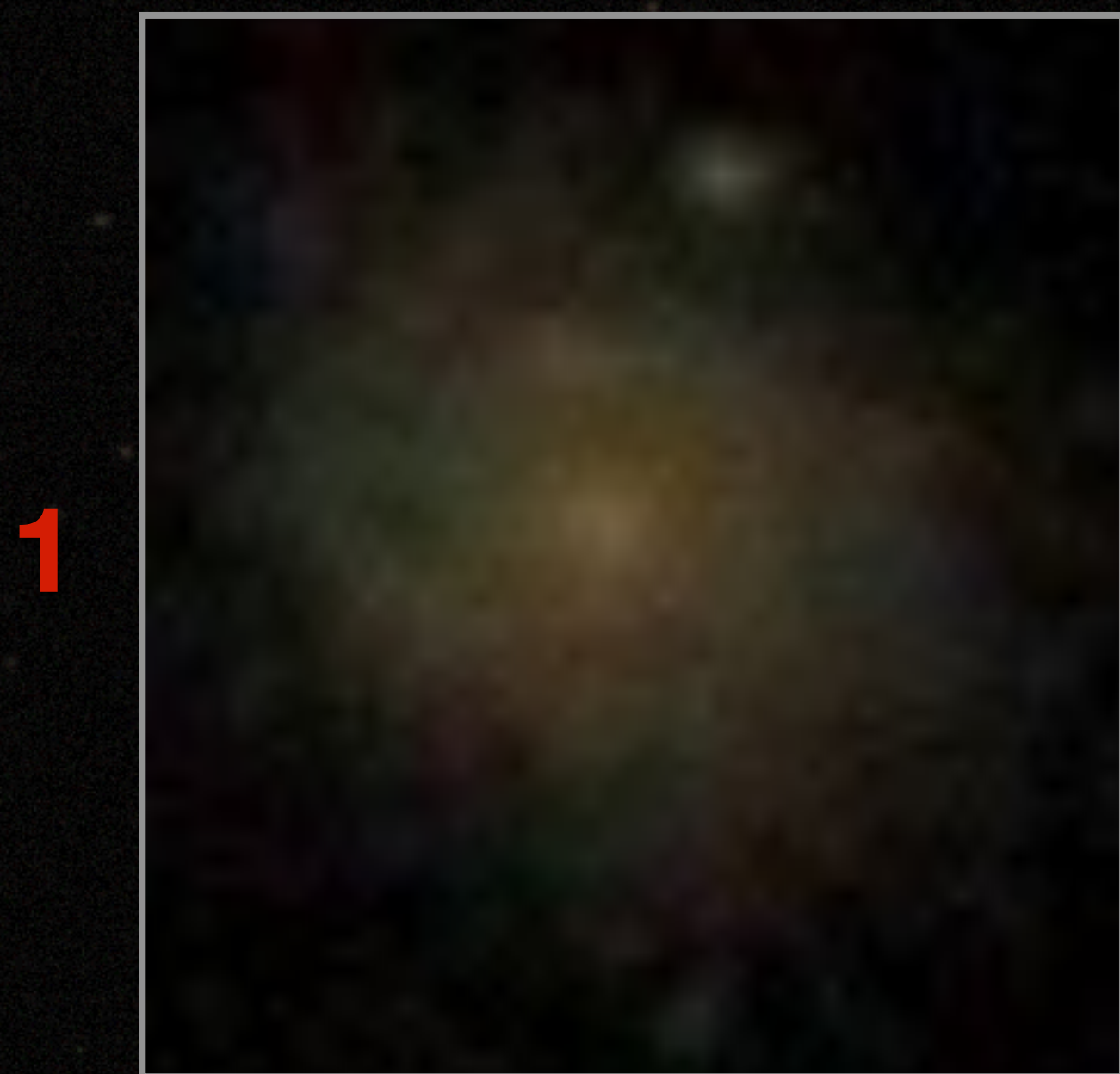
4



5



Which one is a real satellite?

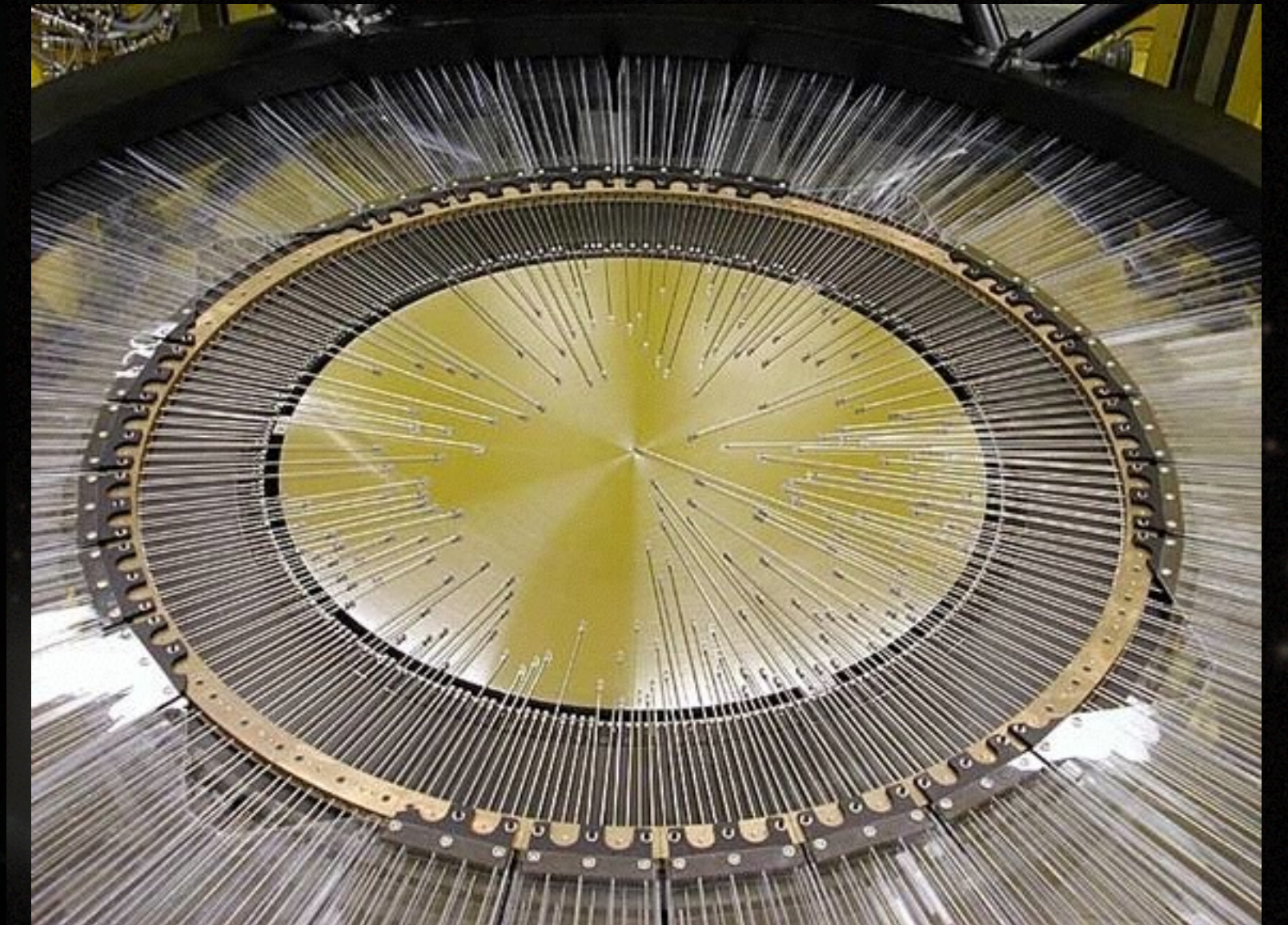
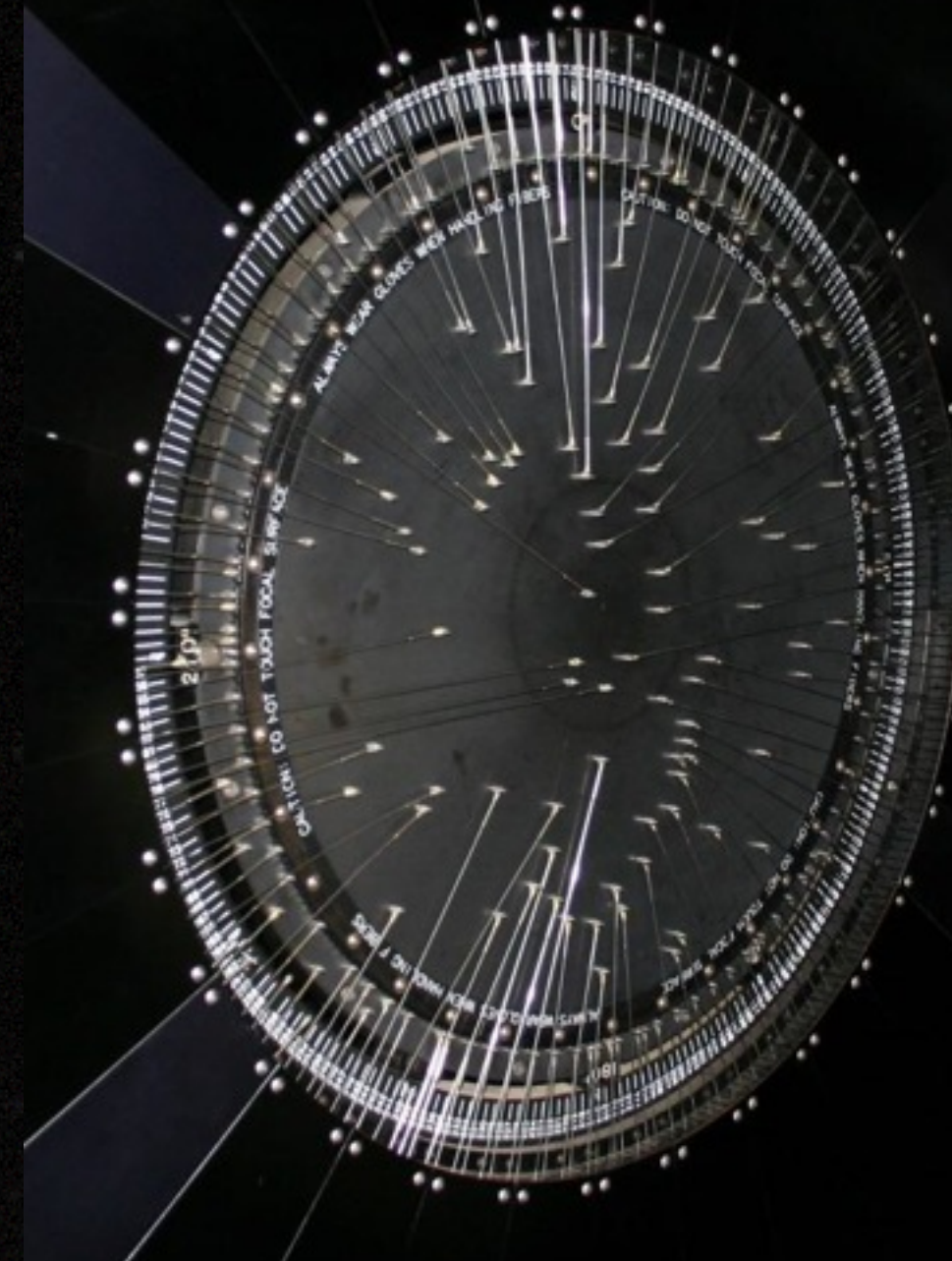


Not a Trivial Task

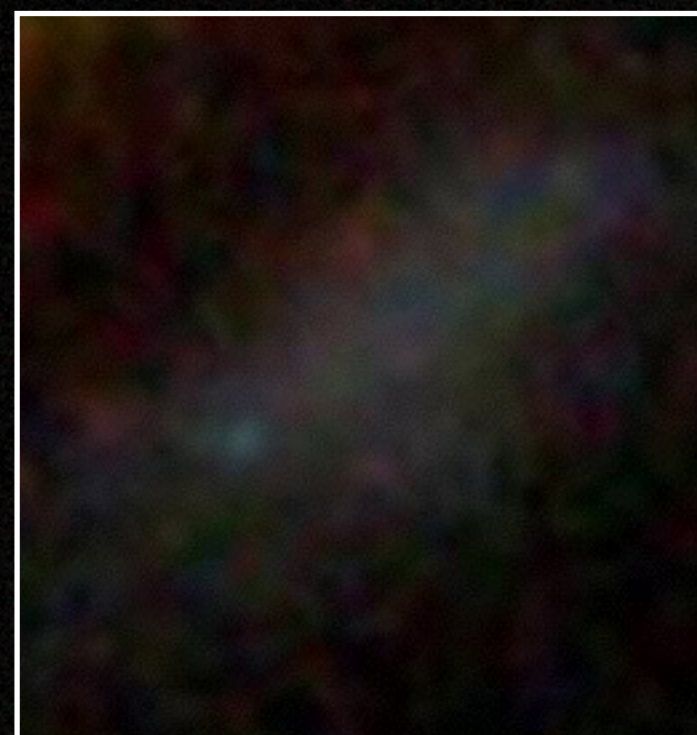
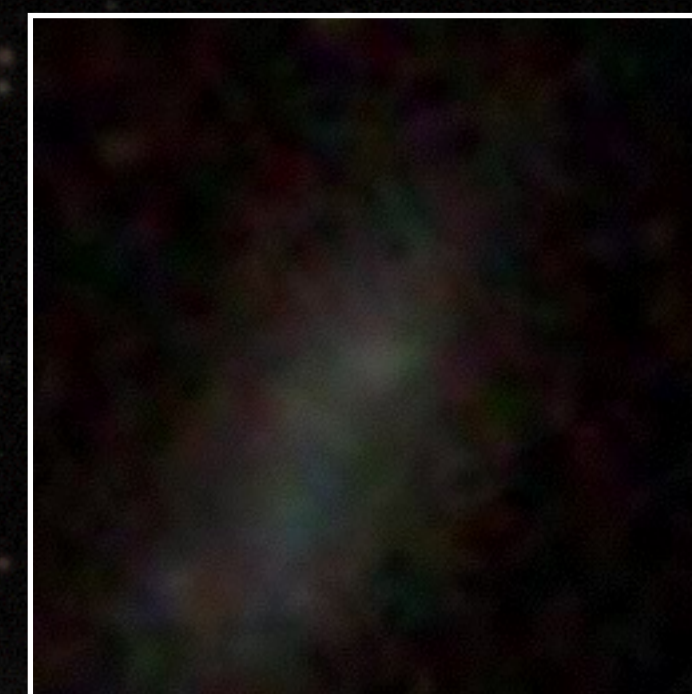
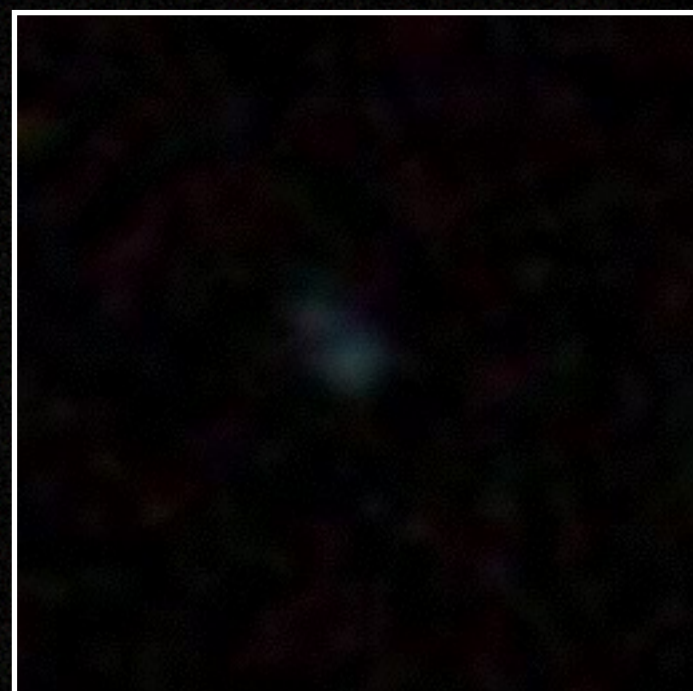
~ 1000 candidates
per host, expect a
few satellites.

How do we find the real satellites?

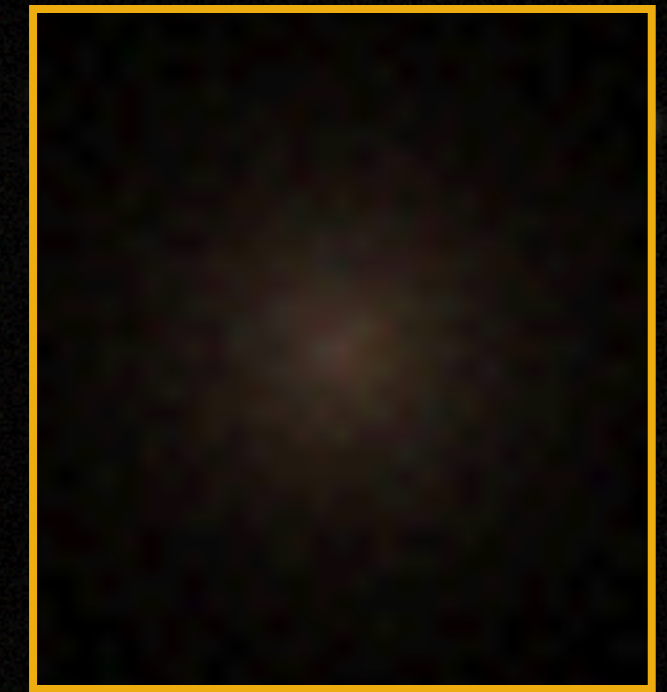
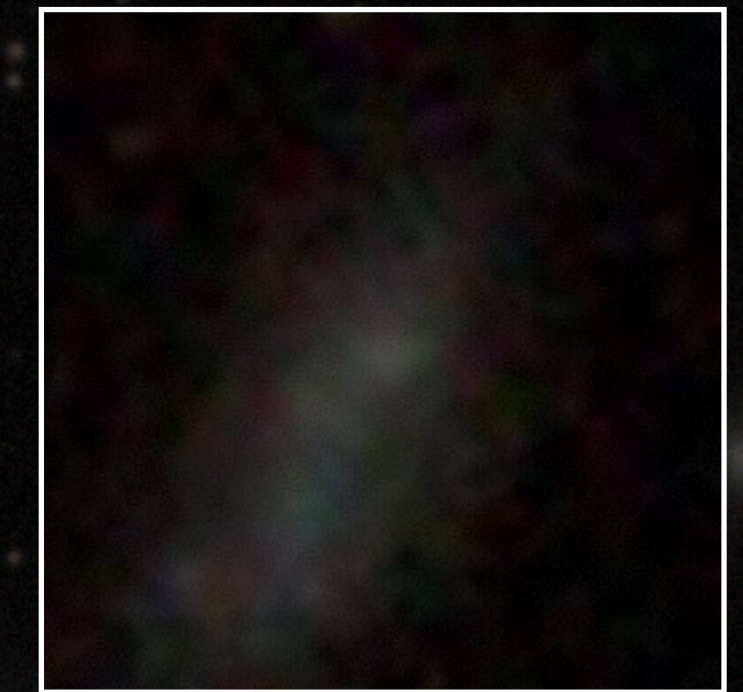
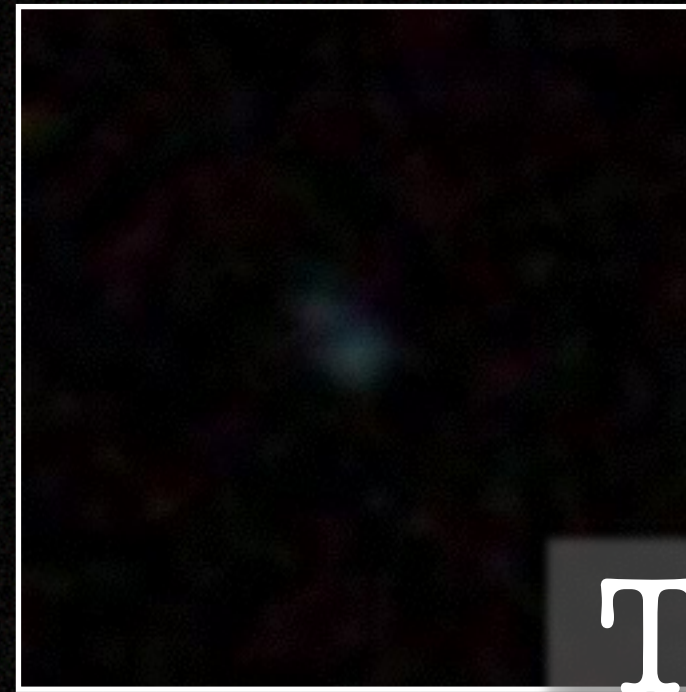
- Large multi-object spectrographs:
 - MMT/Hectospec
 - WIYN/Hydra
 - Magellan/IMACS
 - AAT/6dF
- In the future: follow-up with higher-res to investigate TBTF



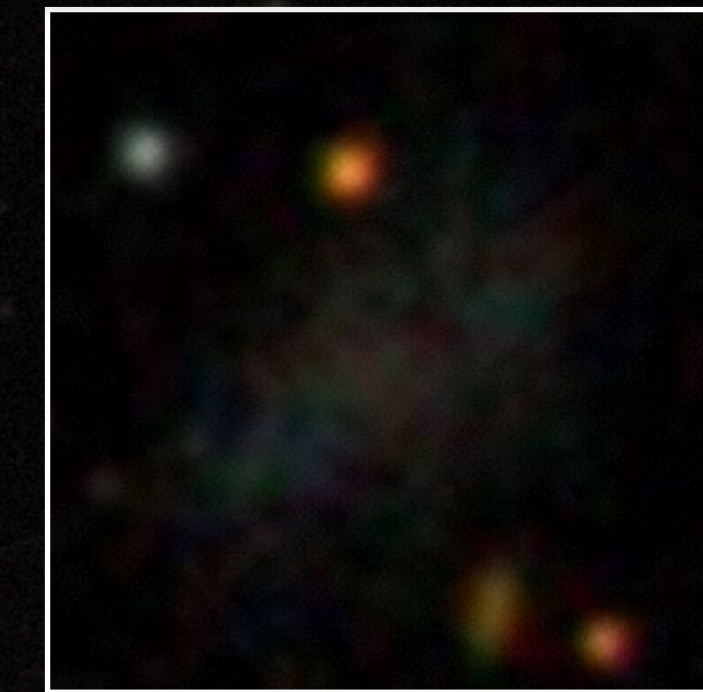
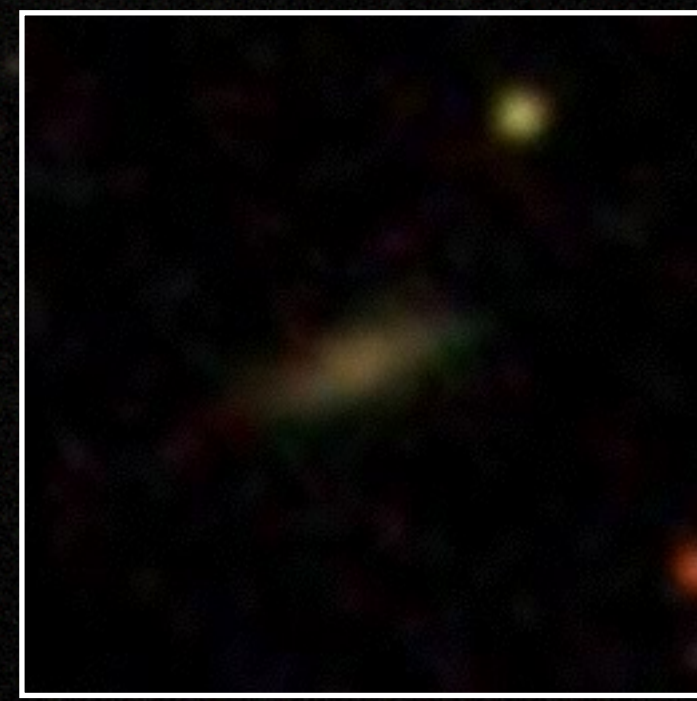
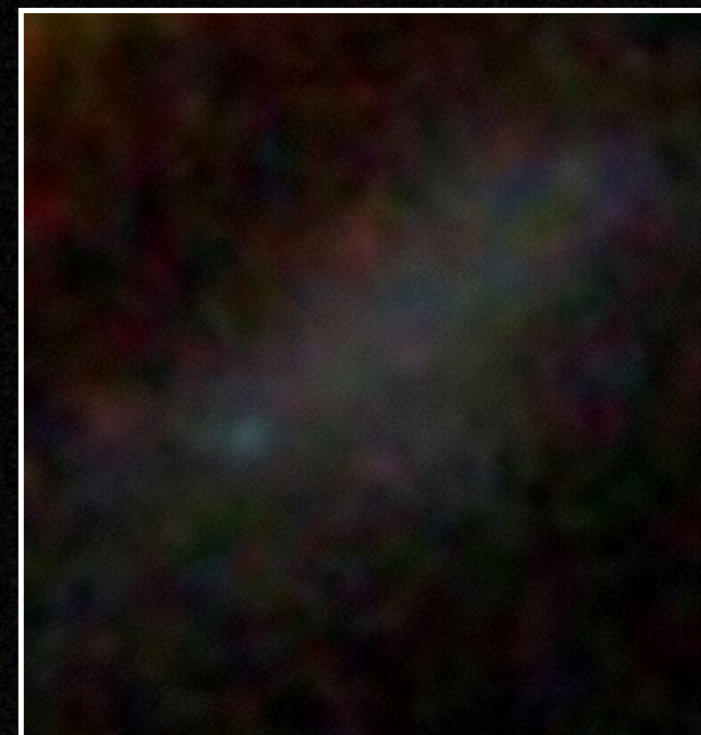
Satellites of the Odysseus



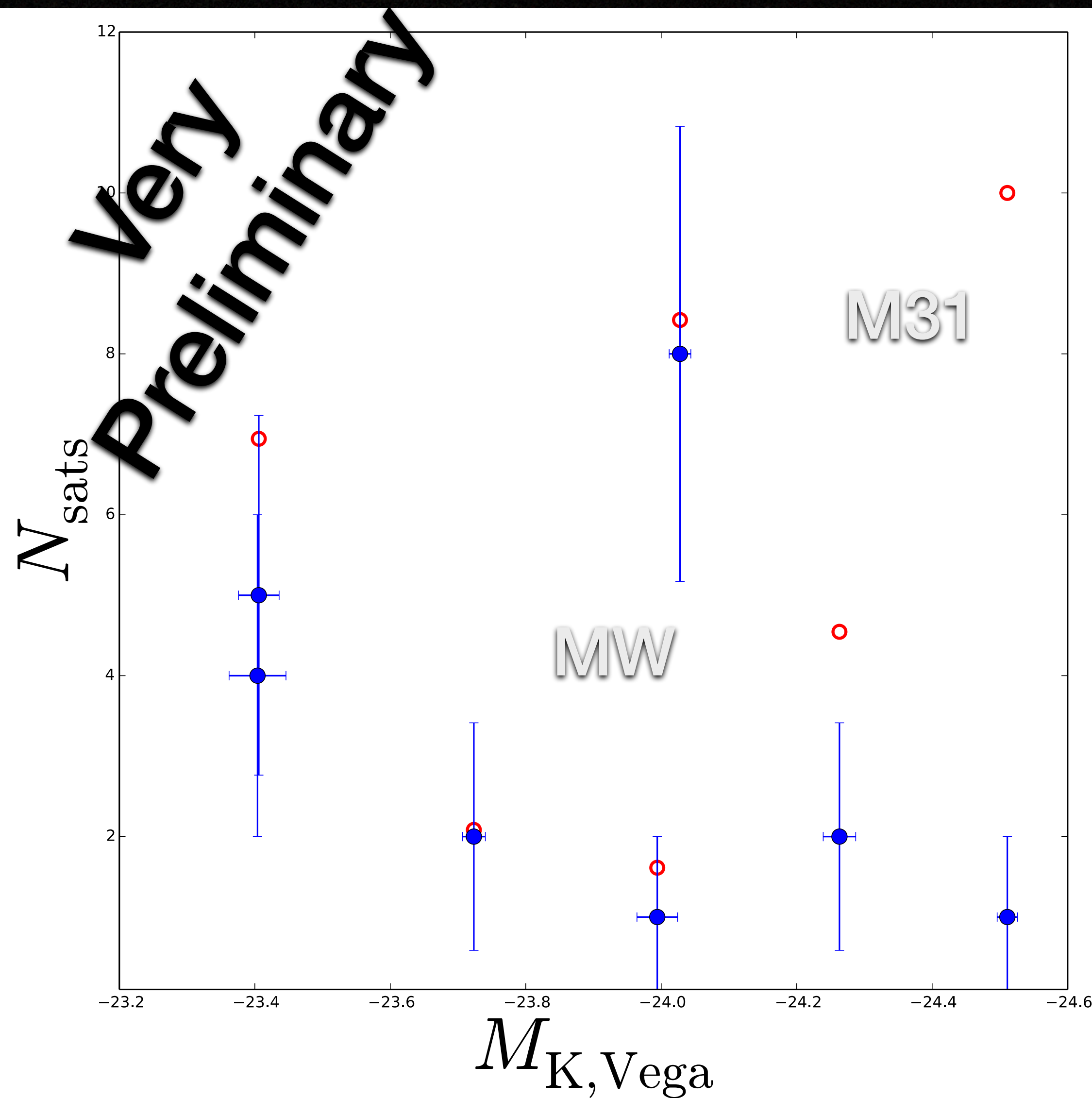
Satellites of the Odysseus



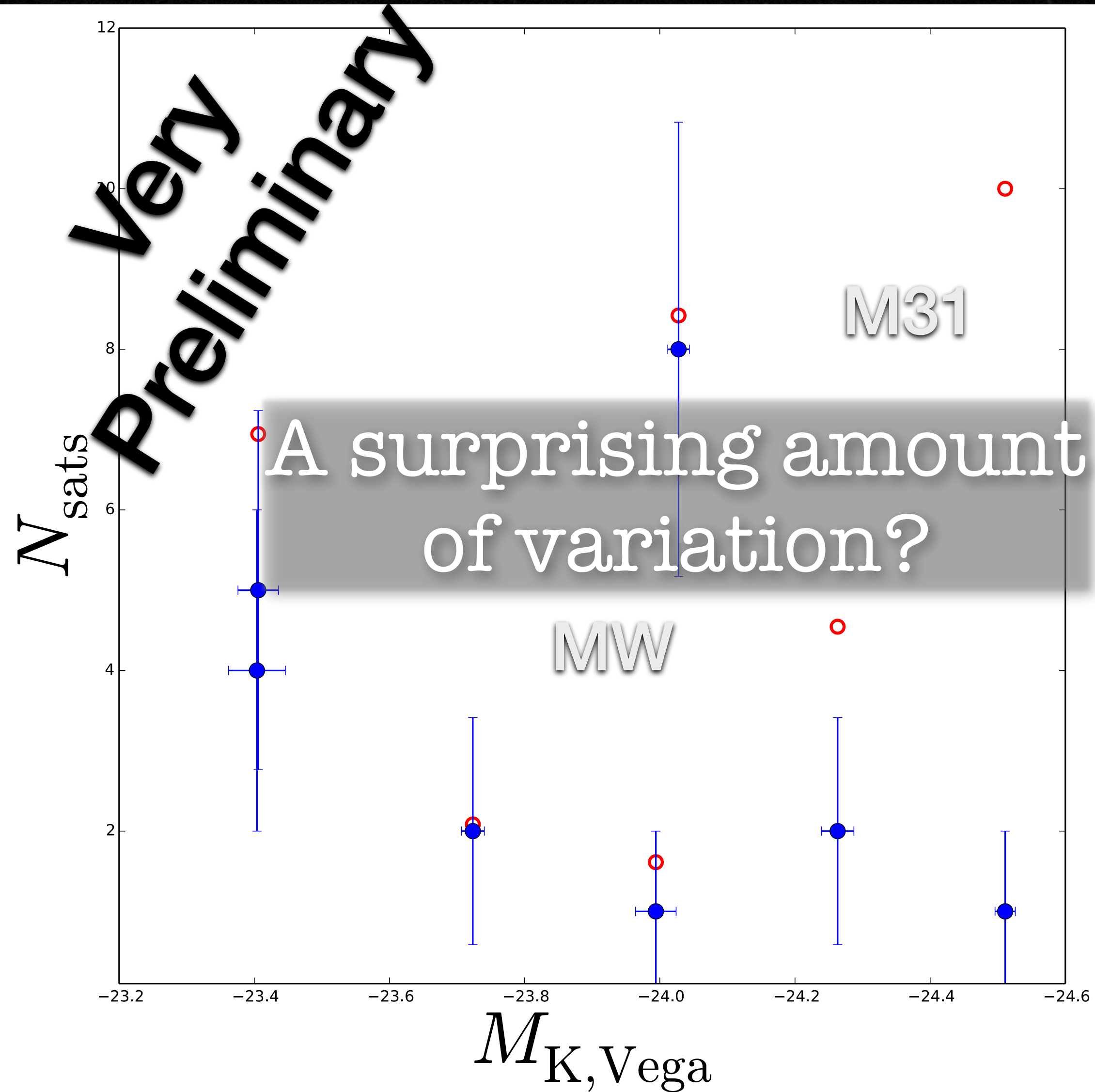
This is not what the LG looks like!



SAGA Satellite Counts



SAGA Satellite Counts



Summary

- HI + optical follow-up can find local dwarfs that otherwise might go missed
 - Suggests that even faint dSphish objects out in the field have lots of gas
- SAGA is finding LG-like satellites in MW-like systems
 - (Preliminary:) There's a lot of variation, should be a warning for everyone here!