

The Abundance of Dwarf Galaxies

Hot gas explodes out of young dwarf galaxies

Simulation by **Andrew Pontzen**, **Fabio Governato** and
Alyson Brooks on the **Darwin Supercomputer**, Cambridge UK.

Simulation code **Gasoline** by **James Wadsley** and **Tom Quinn**
with metal cooling by **Sijing Sheng**.

Visualization by **Andrew Pontzen**.

Alyson Brooks

Rutgers, the State University of New Jersey

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(1) BROOKS, PAPASTERGIS, ET AL., (2017), APJ,
SUBMITTED, ARXIV:1701.07835

“HOW TO RECONCILE THE OBSERVED VELOCITY
FUNCTION OF GALAXIES WITH THEORY”

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“GOING, GOING, GONE DARK: QUANTIFYING THE
SCATTER IN THE FAINTEST DWARF GALAXIES”

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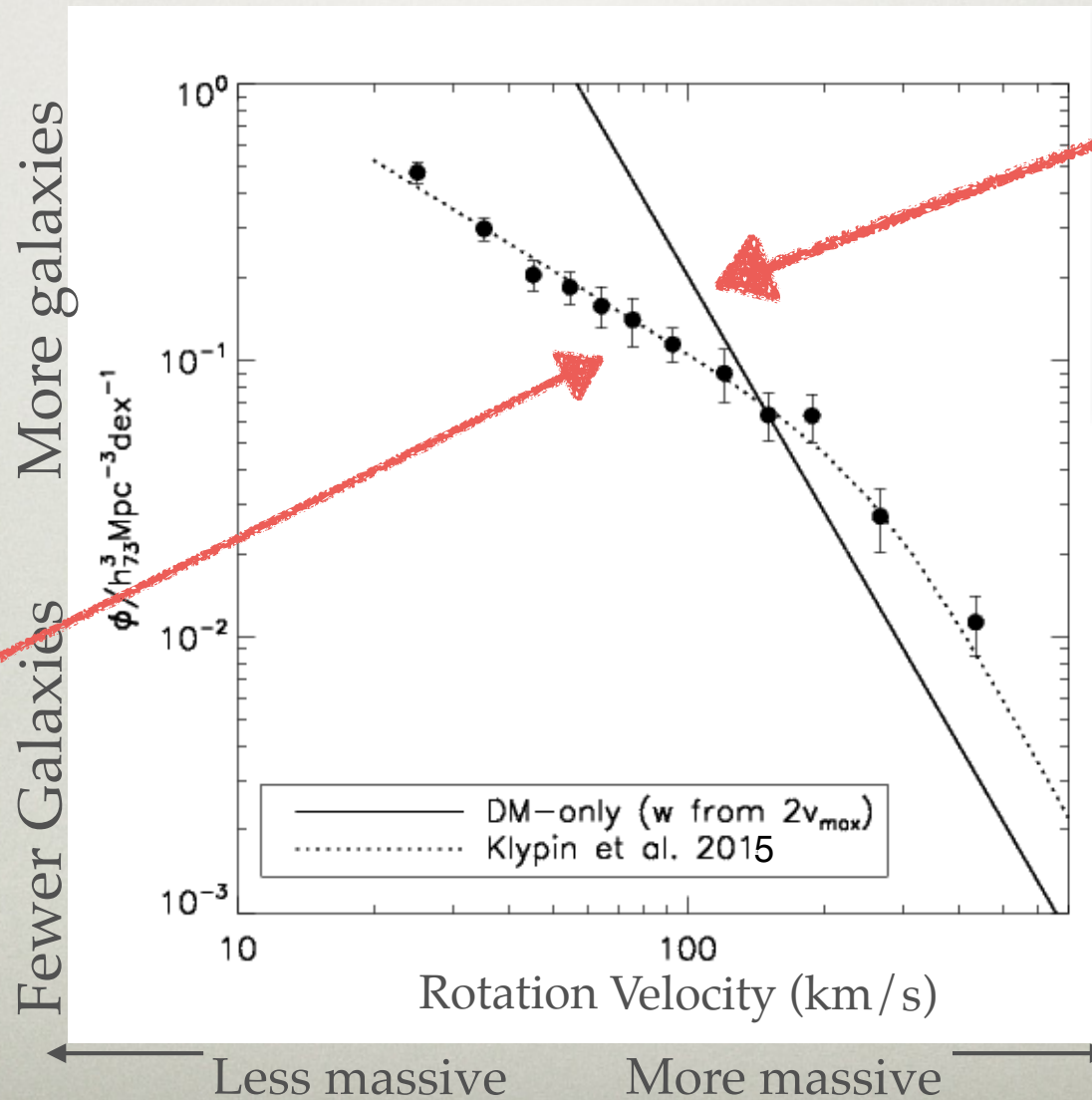
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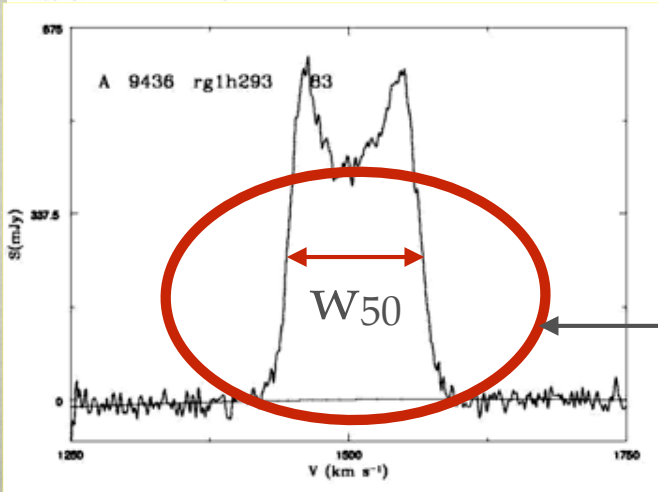
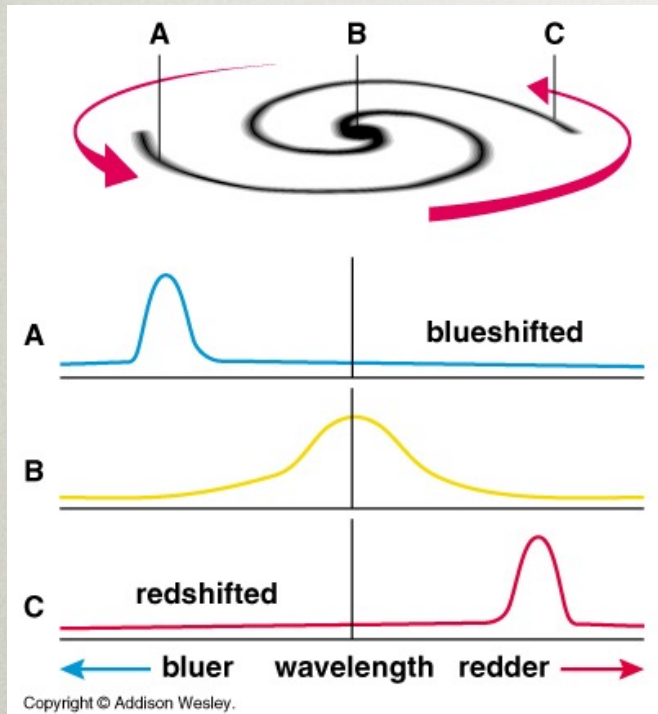
THE MISSING DWARF PROBLEM IN THE FIELD



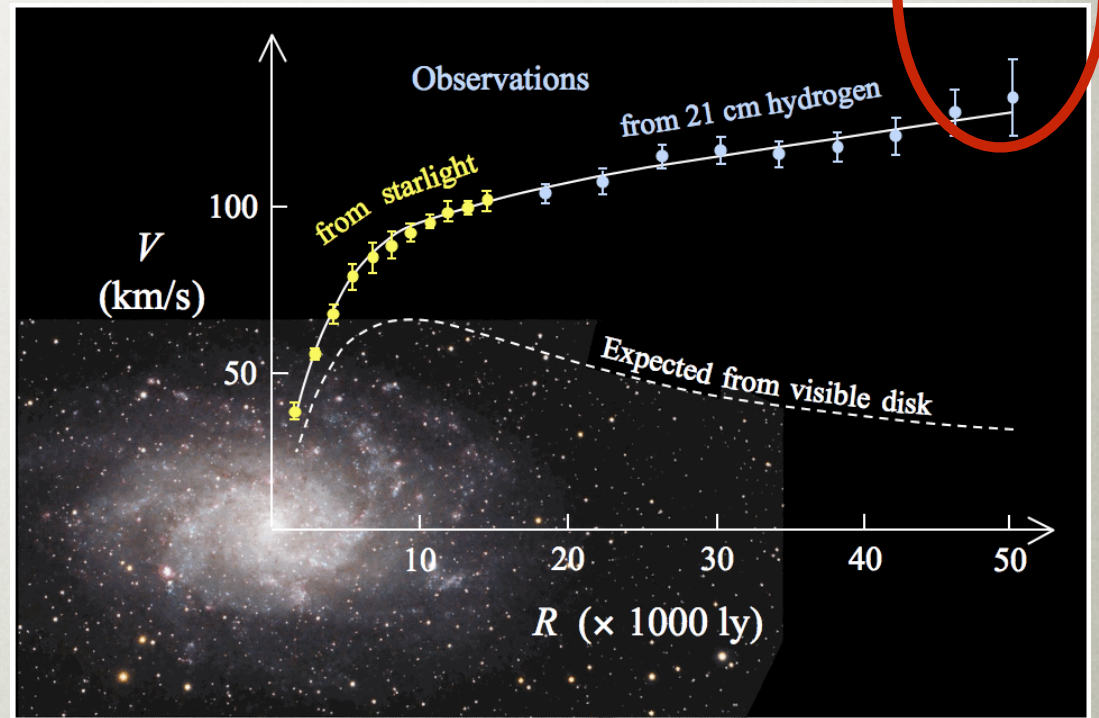
Observed
number of
galaxies

Predicted
number of
galaxies

BUT: TWO WAYS TO MEASURE ROTATION (RESOLVED VS UNRESOLVED)

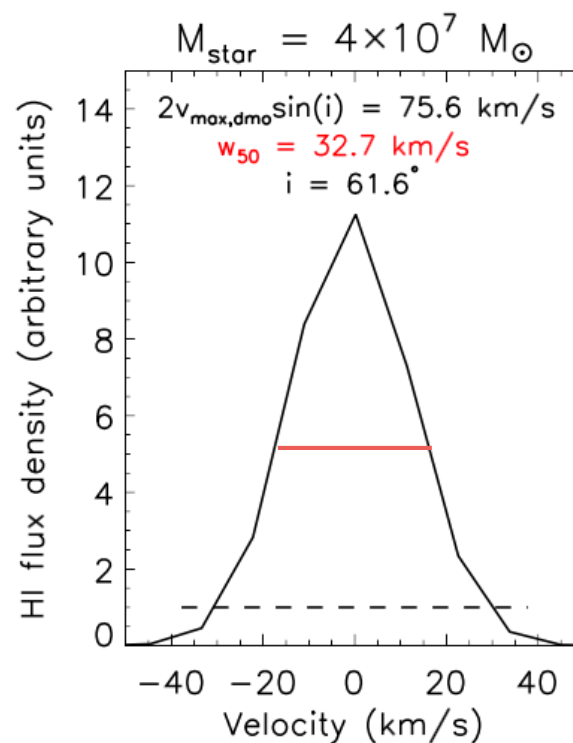
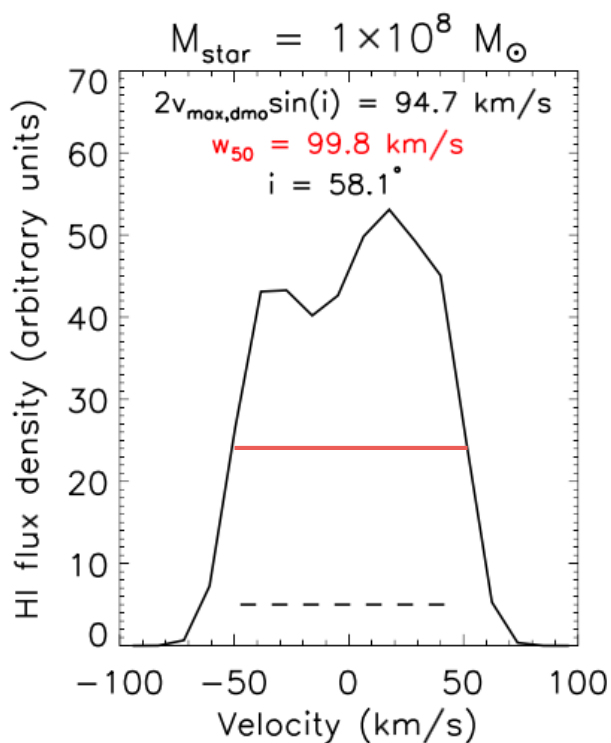
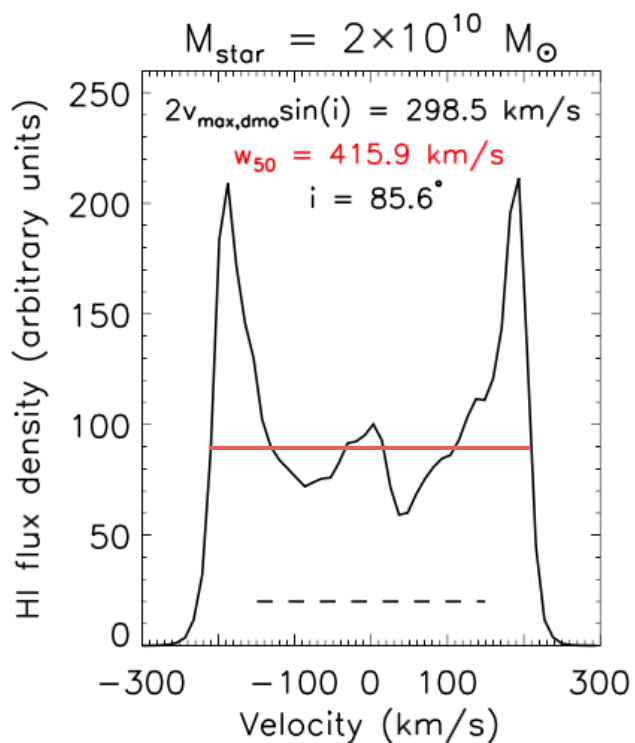


Theory \longrightarrow V_{max}

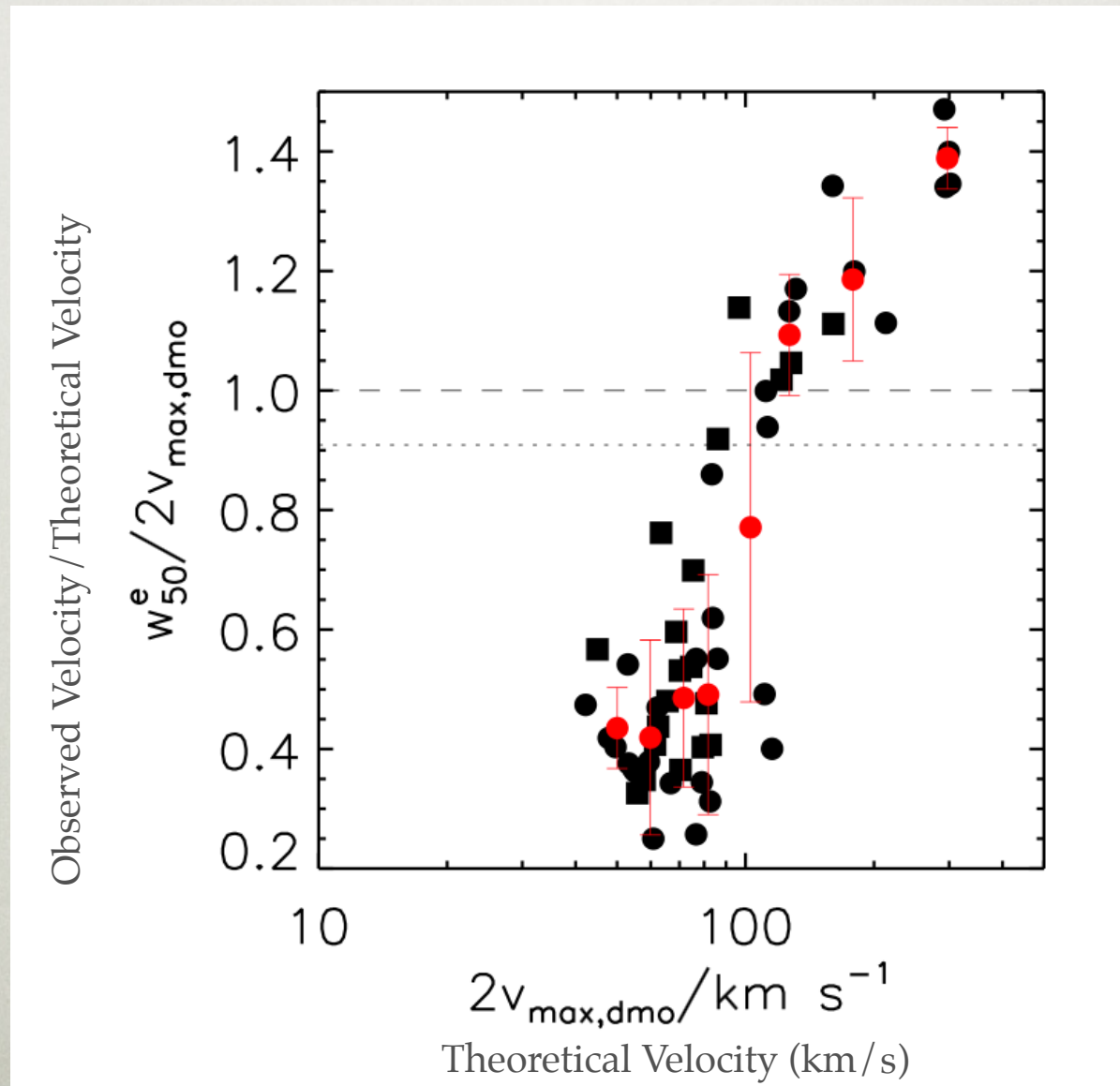


Observations

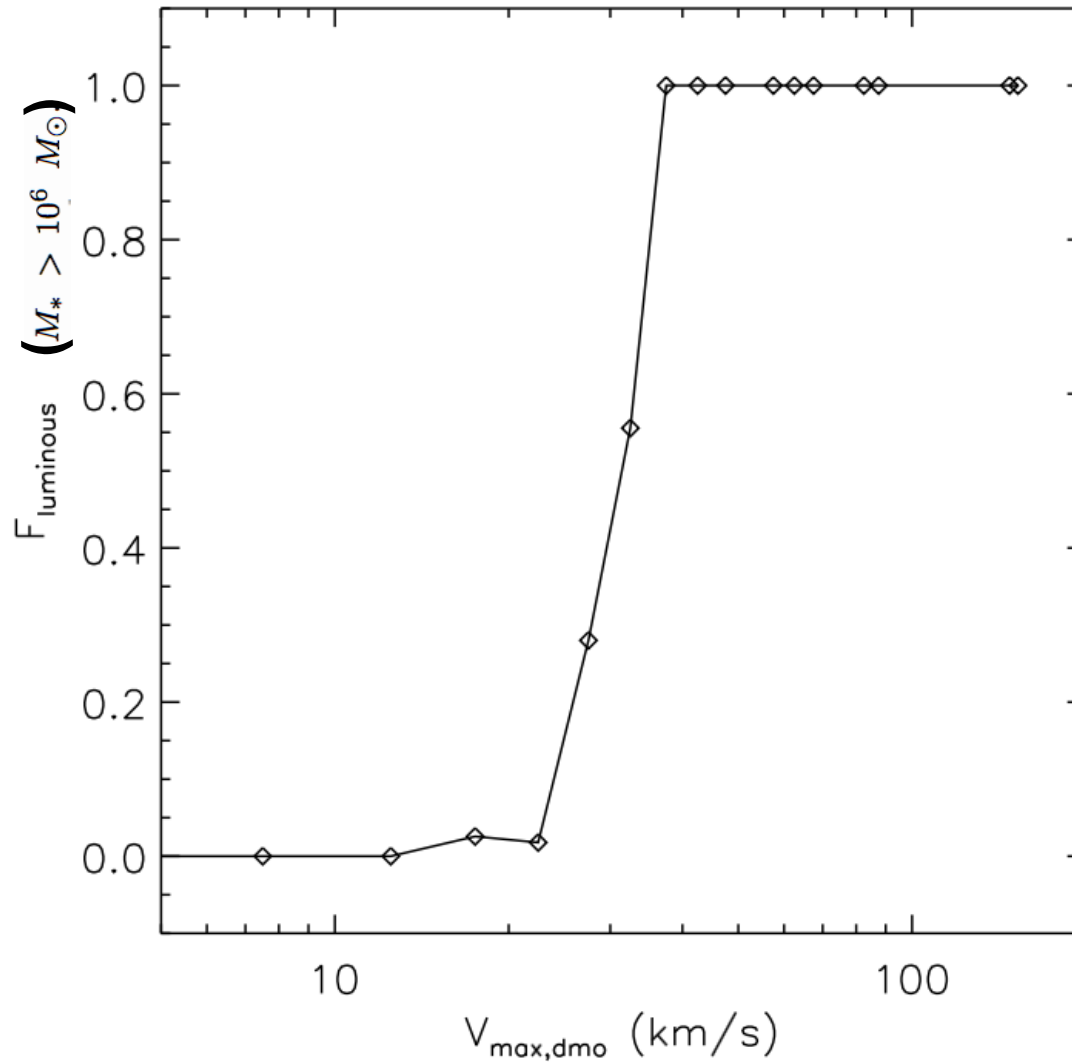
CREATING MOCK OBSERVATIONS



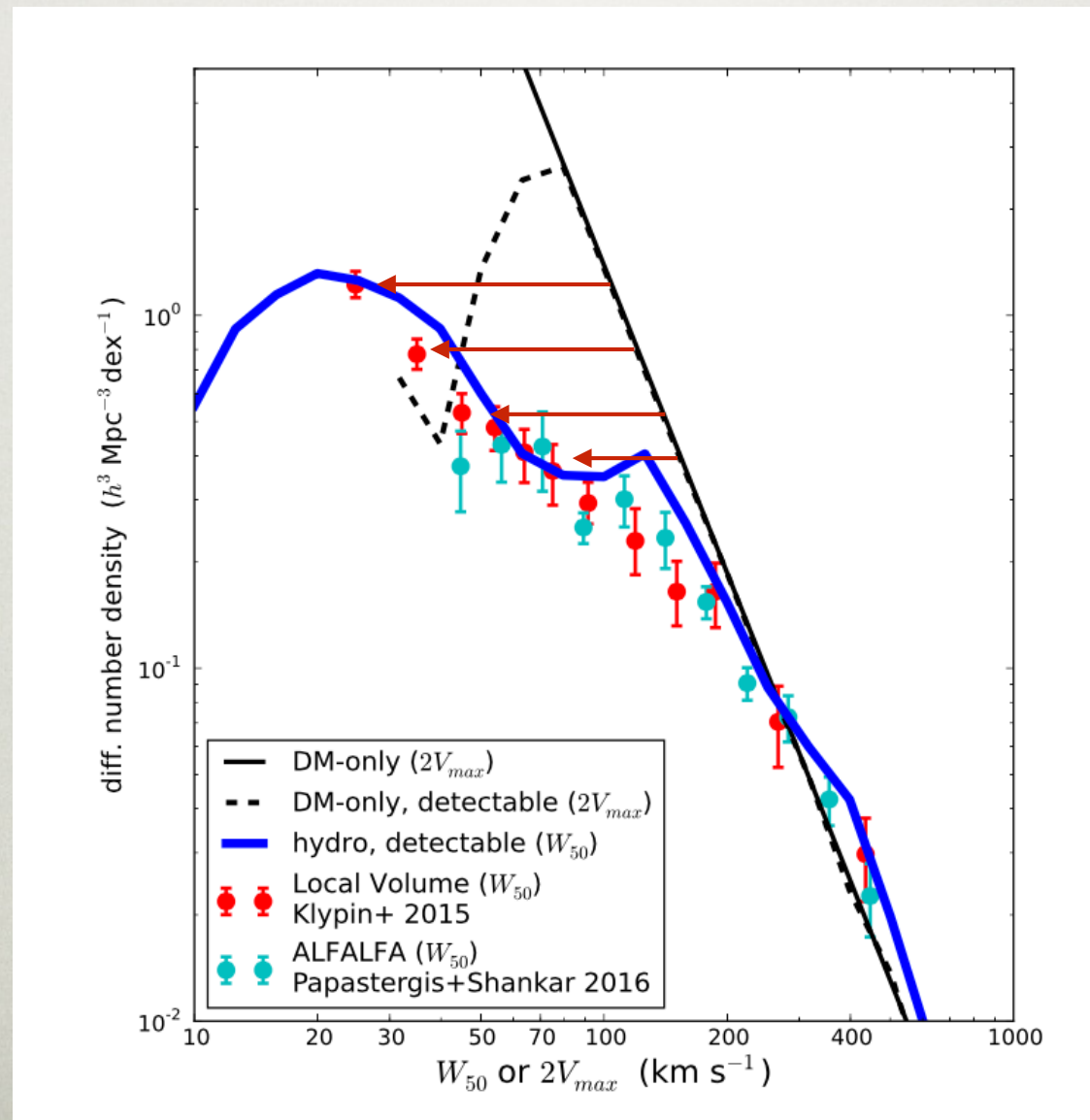
HOW WELL DO THEORY AND OBSERVATION MATCH?



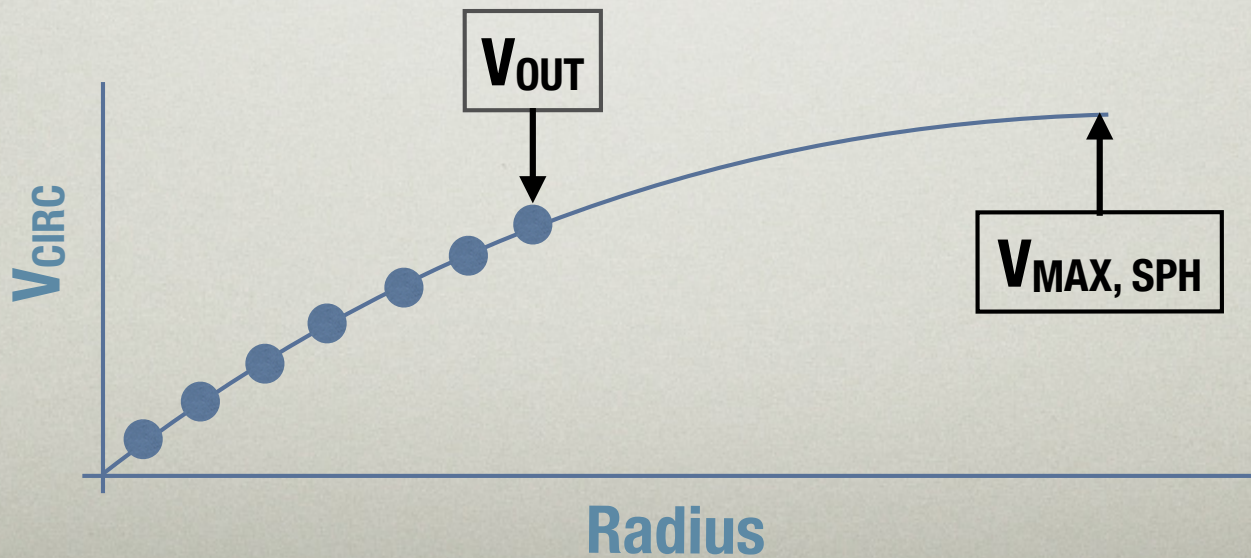
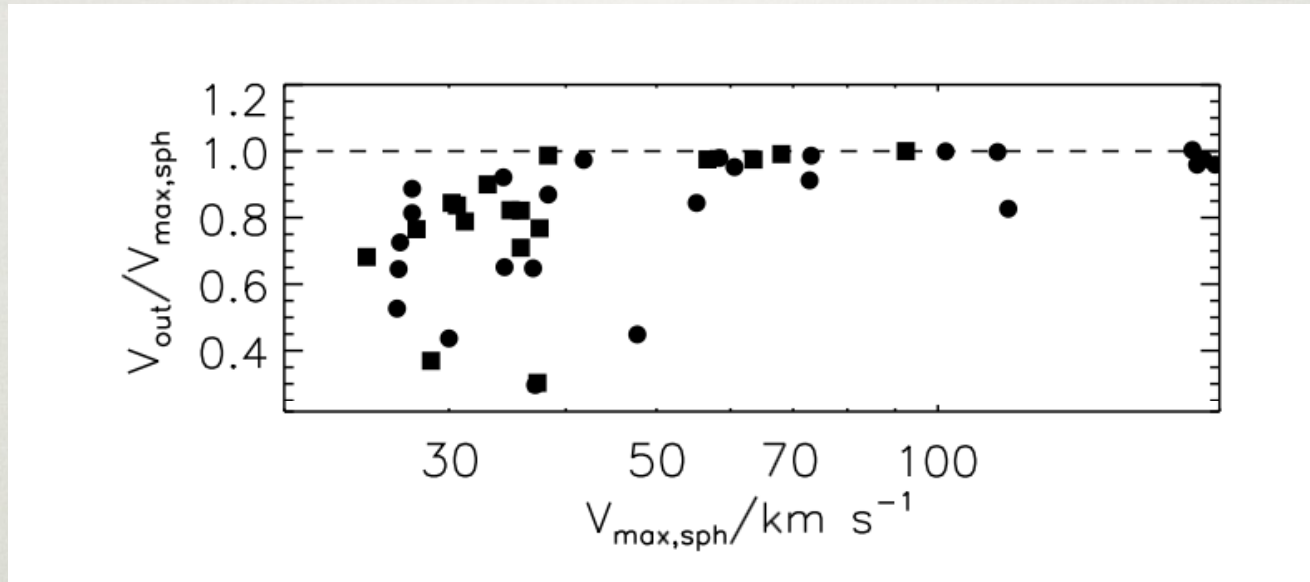
ALSO CONSIDER DETECTABILITY



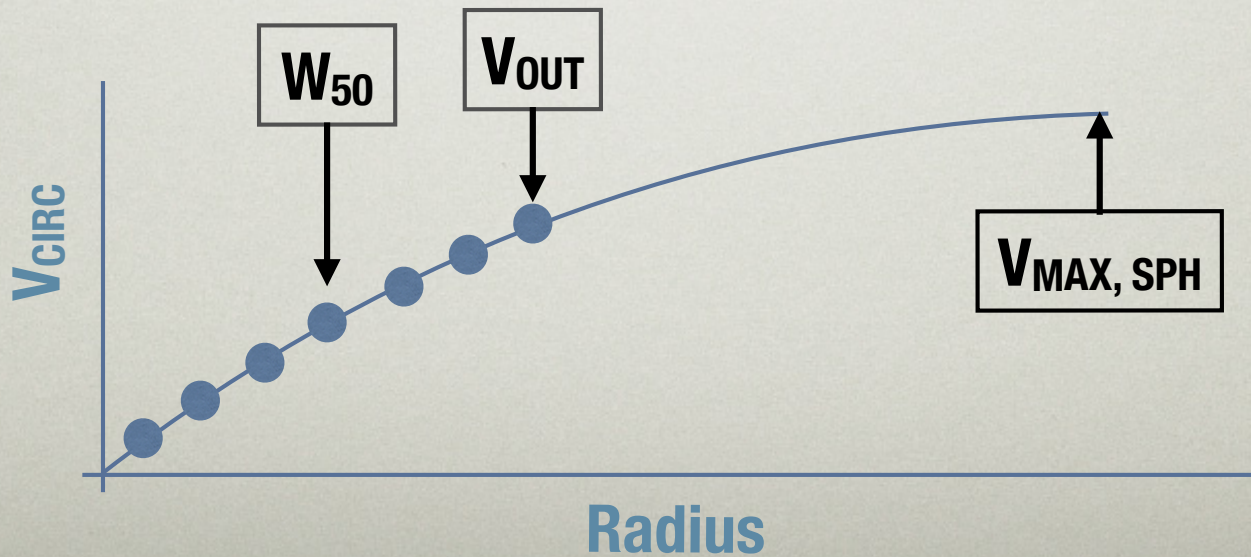
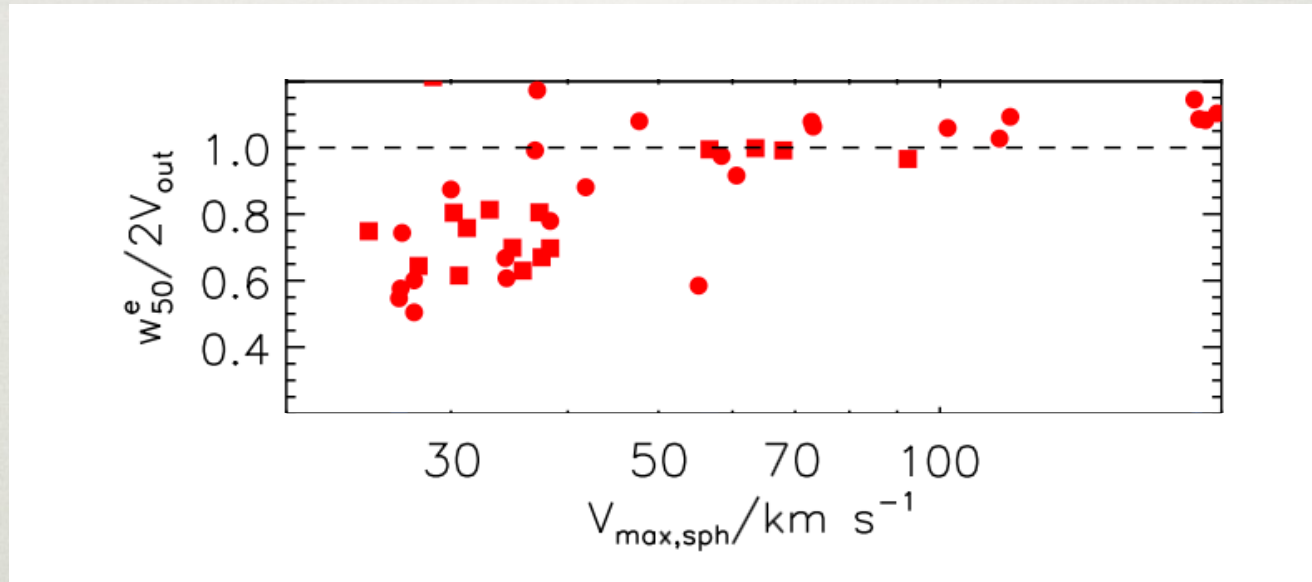
NO MISSING DWARFS: WE OBSERVE THEM AT LOWER VELOCITIES THAN EXPECTED



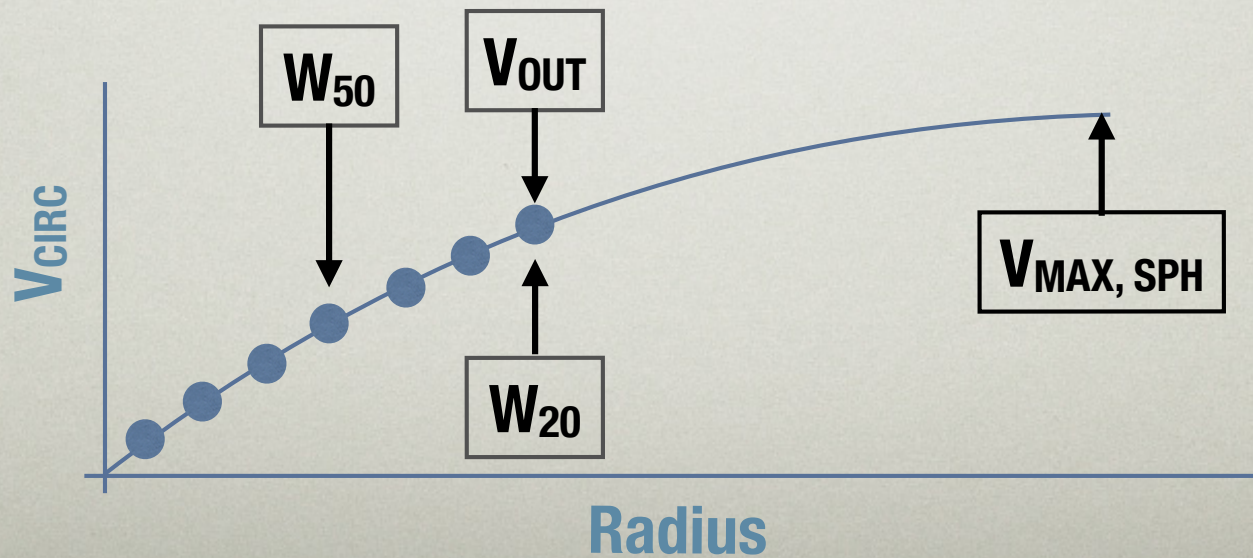
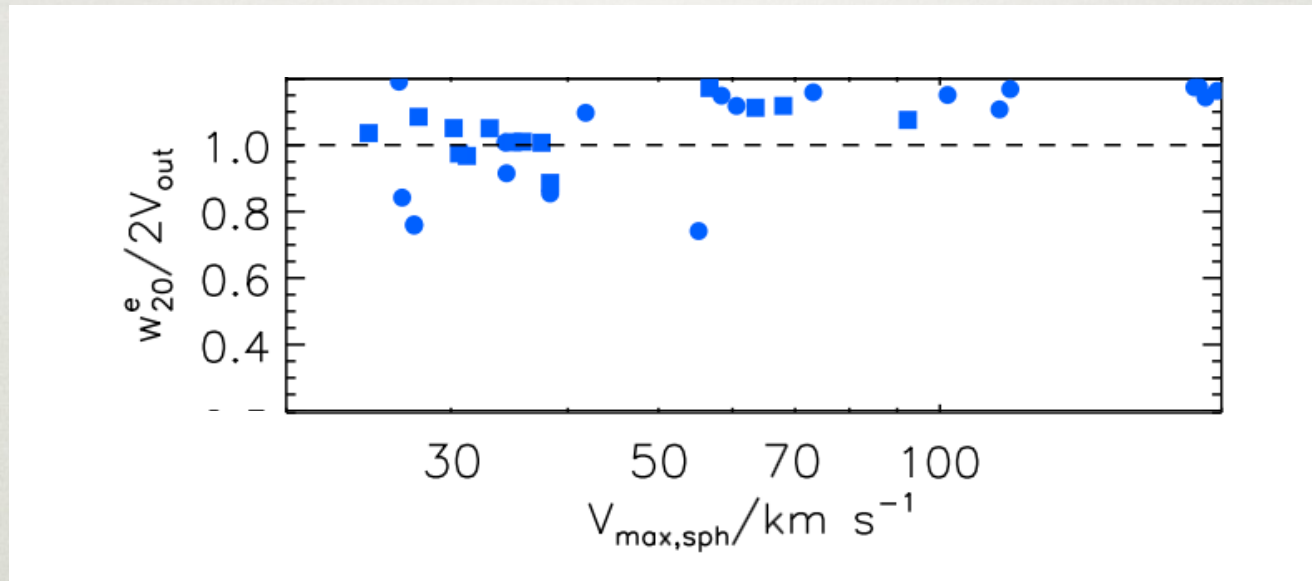
WHY THE VELOCITY SHIFT?



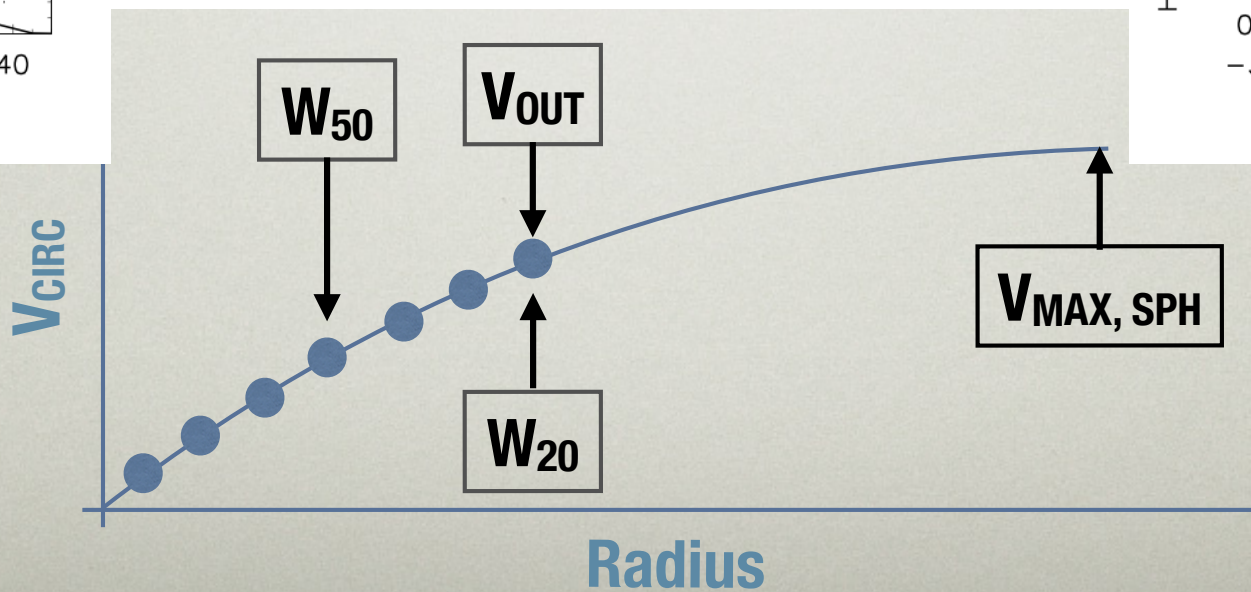
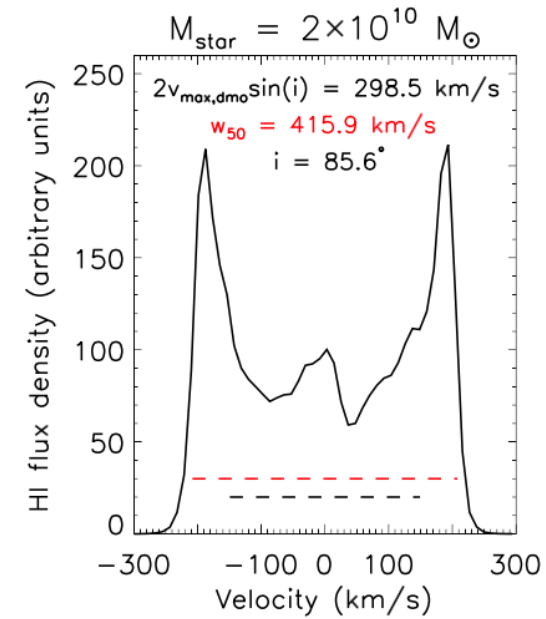
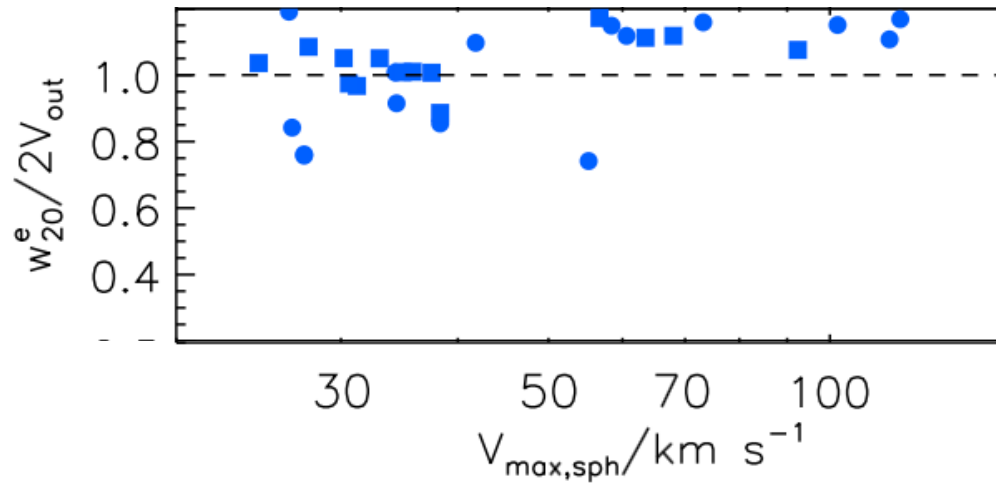
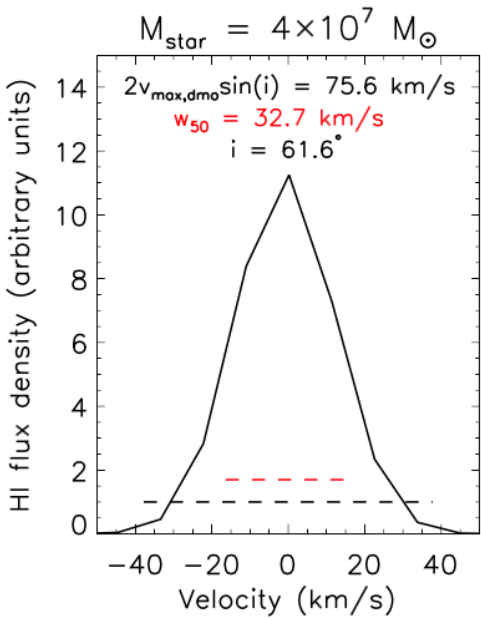
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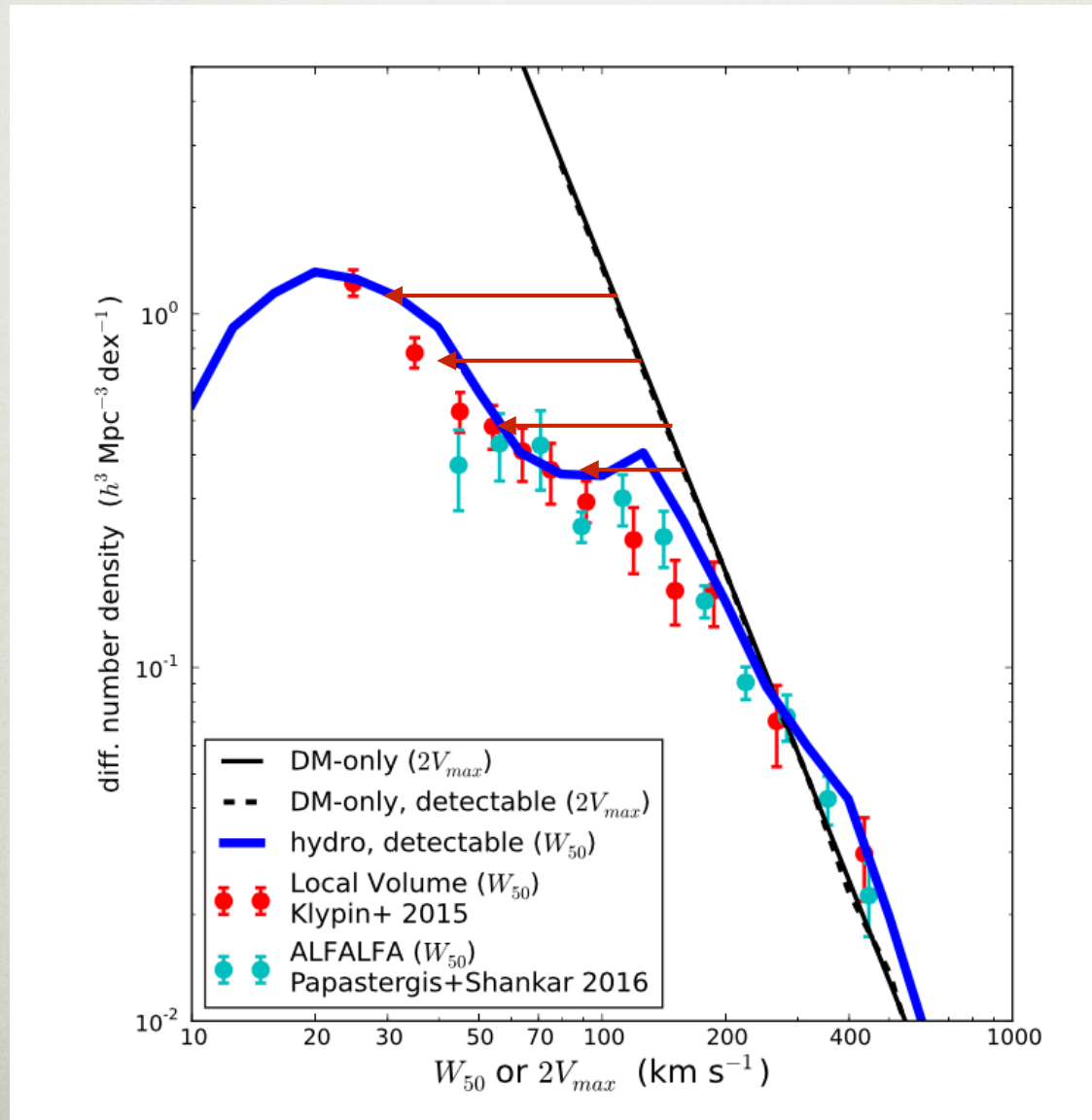
WHY THE VELOCITY SHIFT?



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POINT: ABUNDANCES ARE AS EXPECTED IN LCDM



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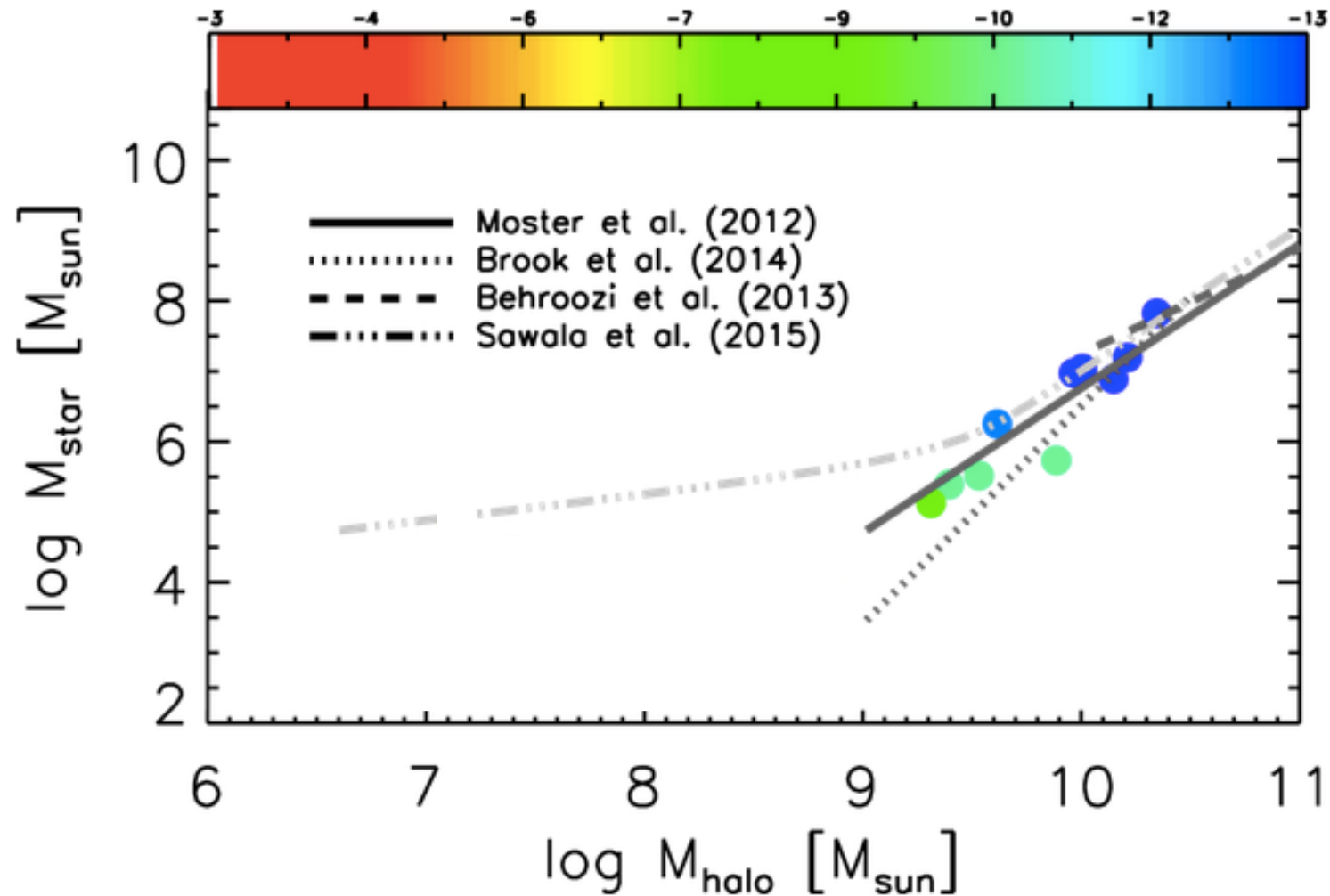
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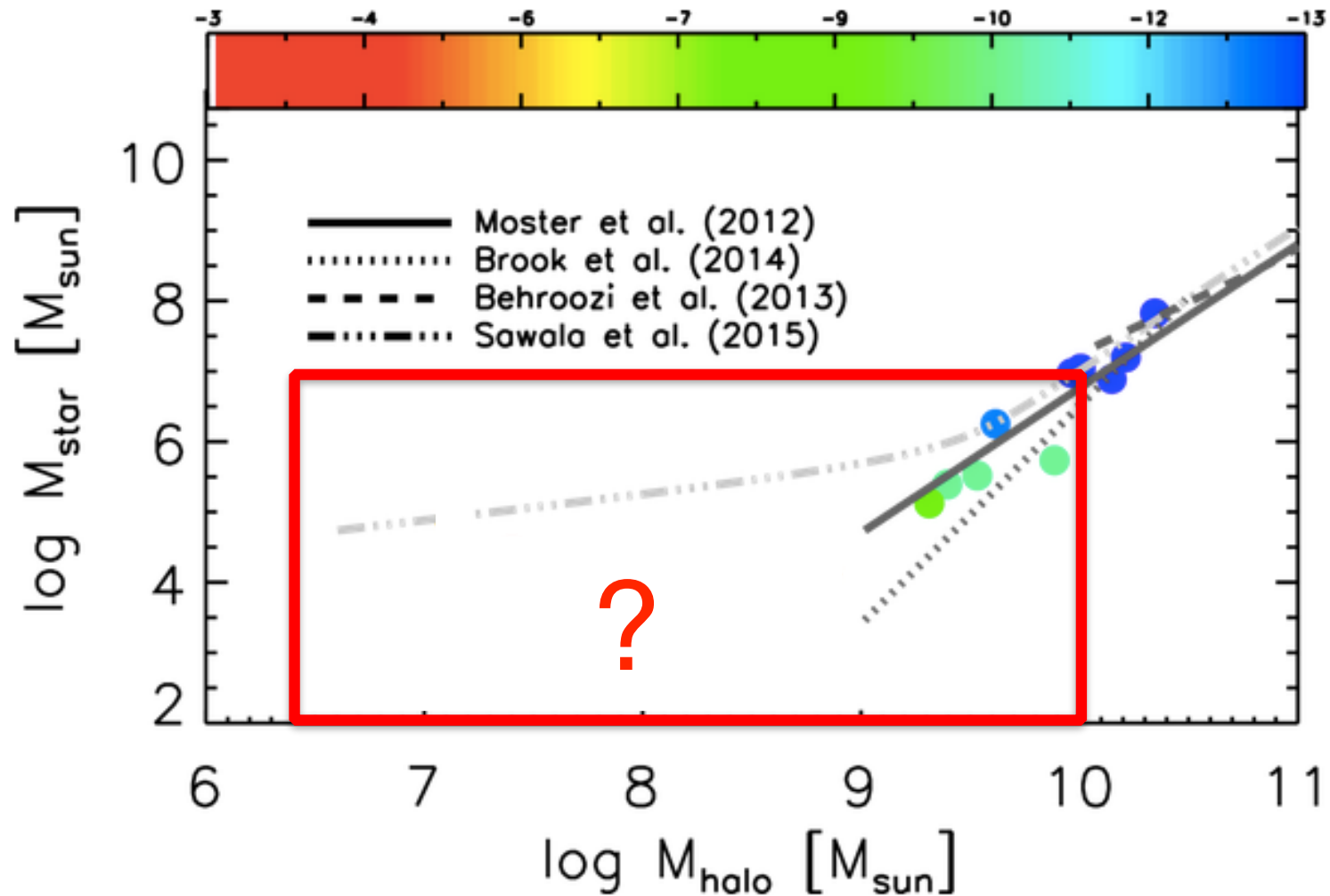
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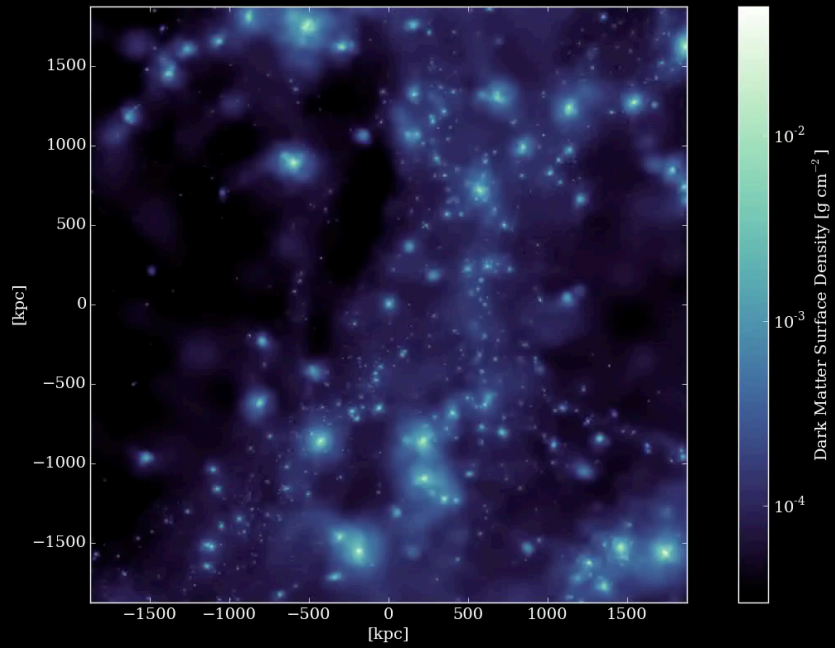
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THE STELLAR MASS — HALO MASS RELATION AT LOW MASSES

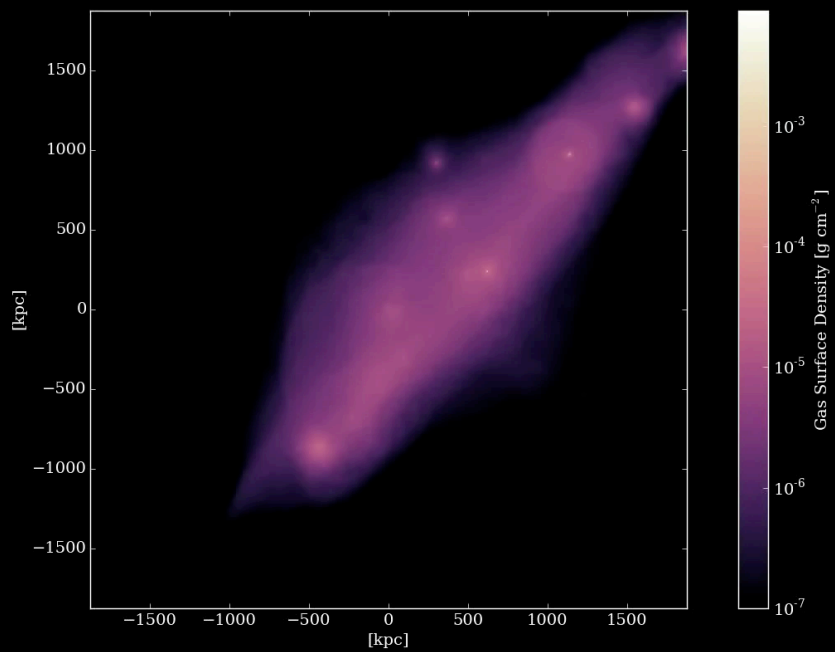


THE STELLAR MASS — HALO MASS RELATION





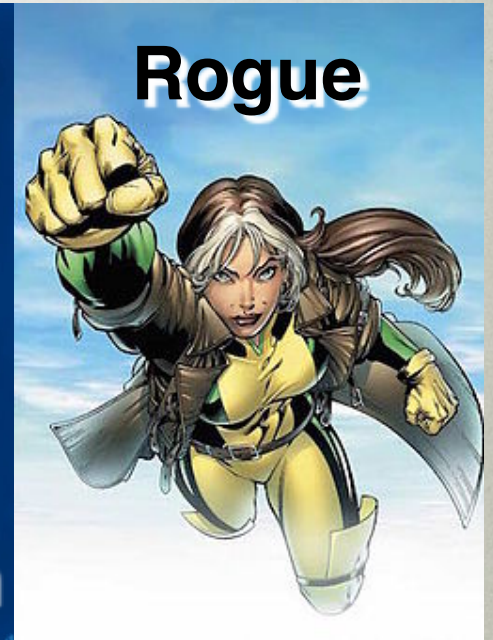
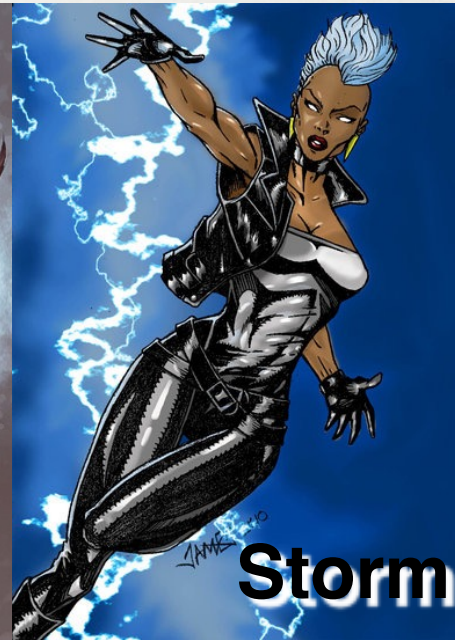
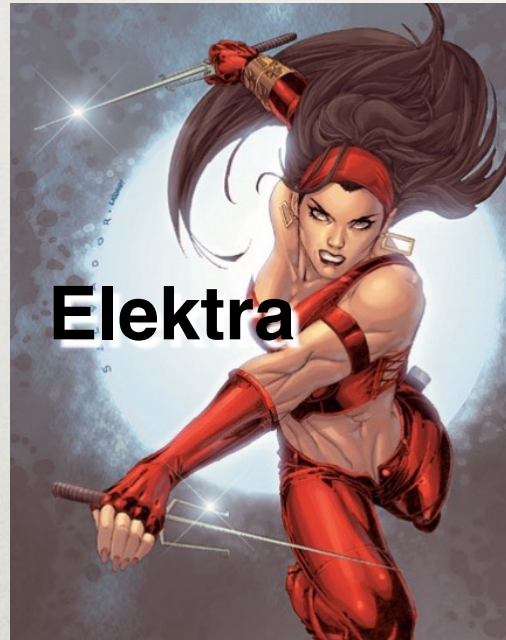
$z=0$ DM density



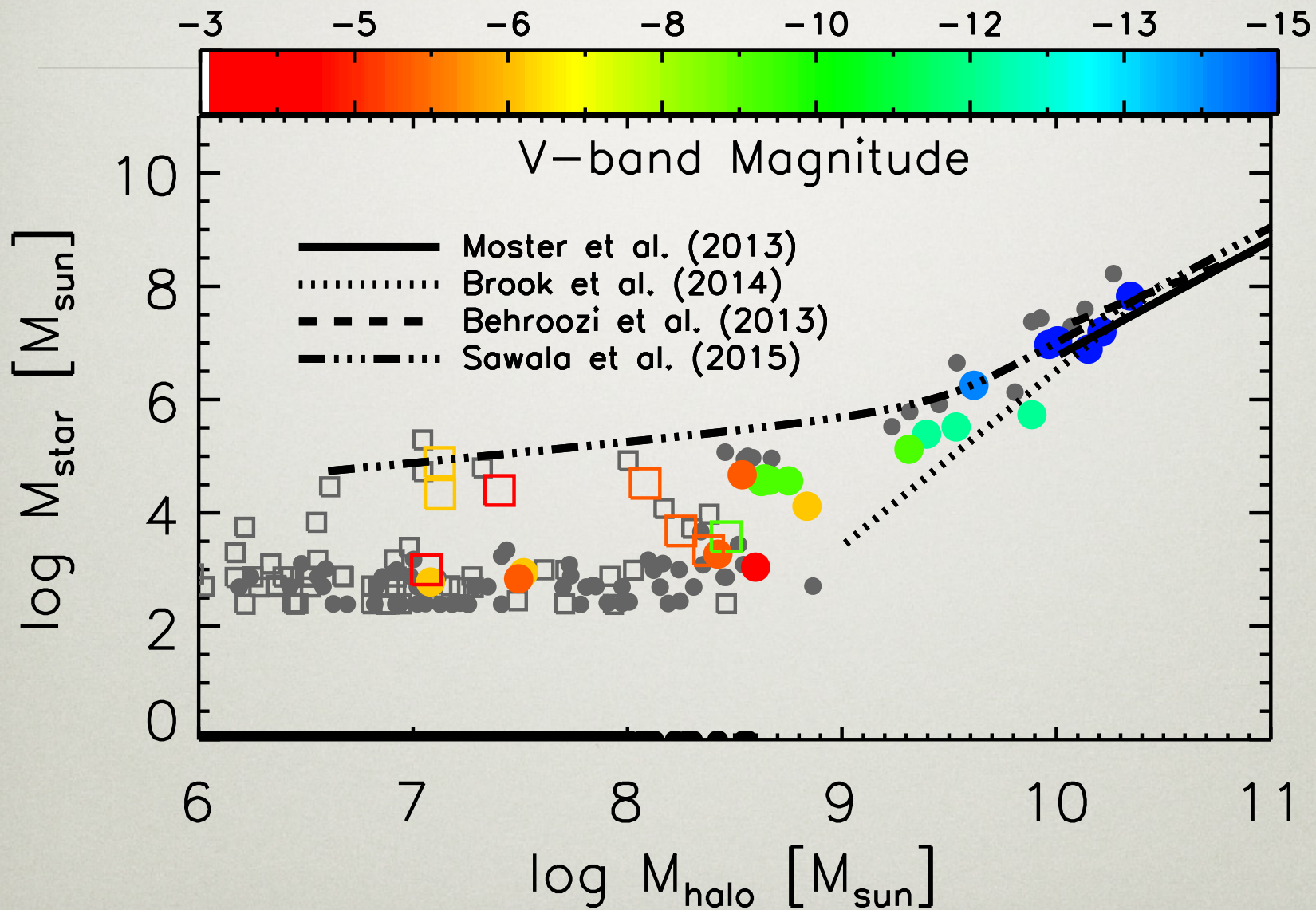
$z=0$ Gas density

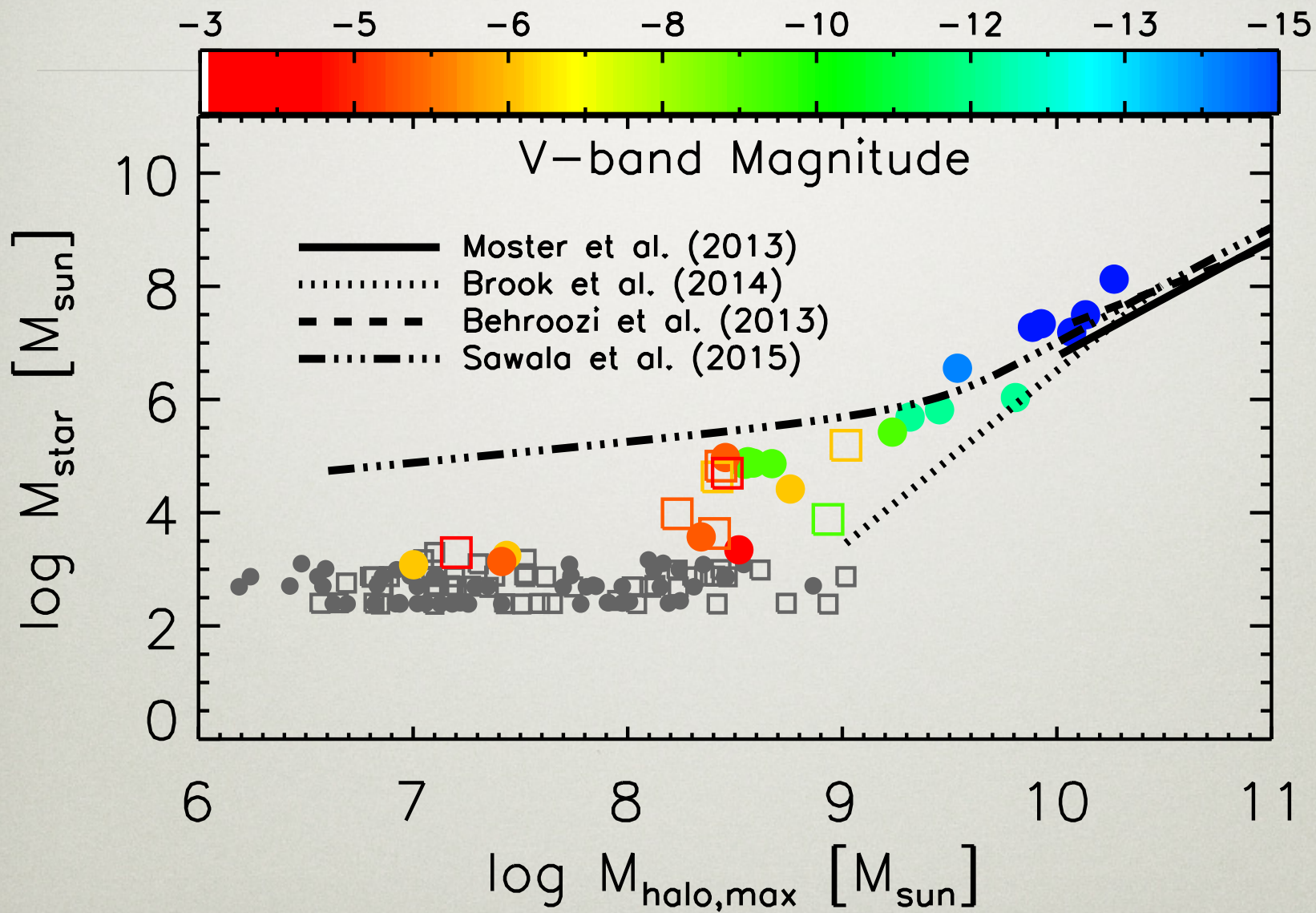
THE DWARF VOLUMES

Captain Marvel

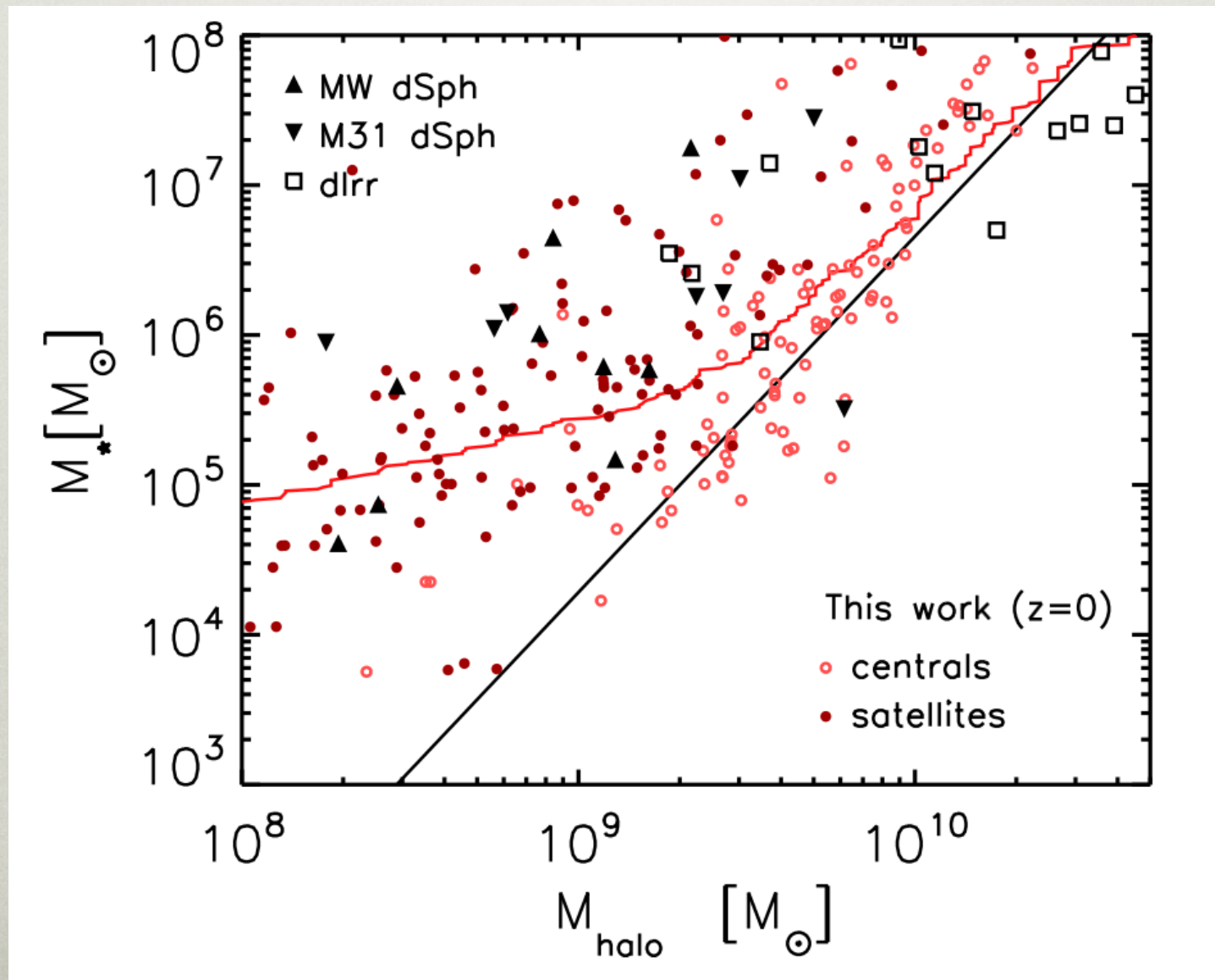


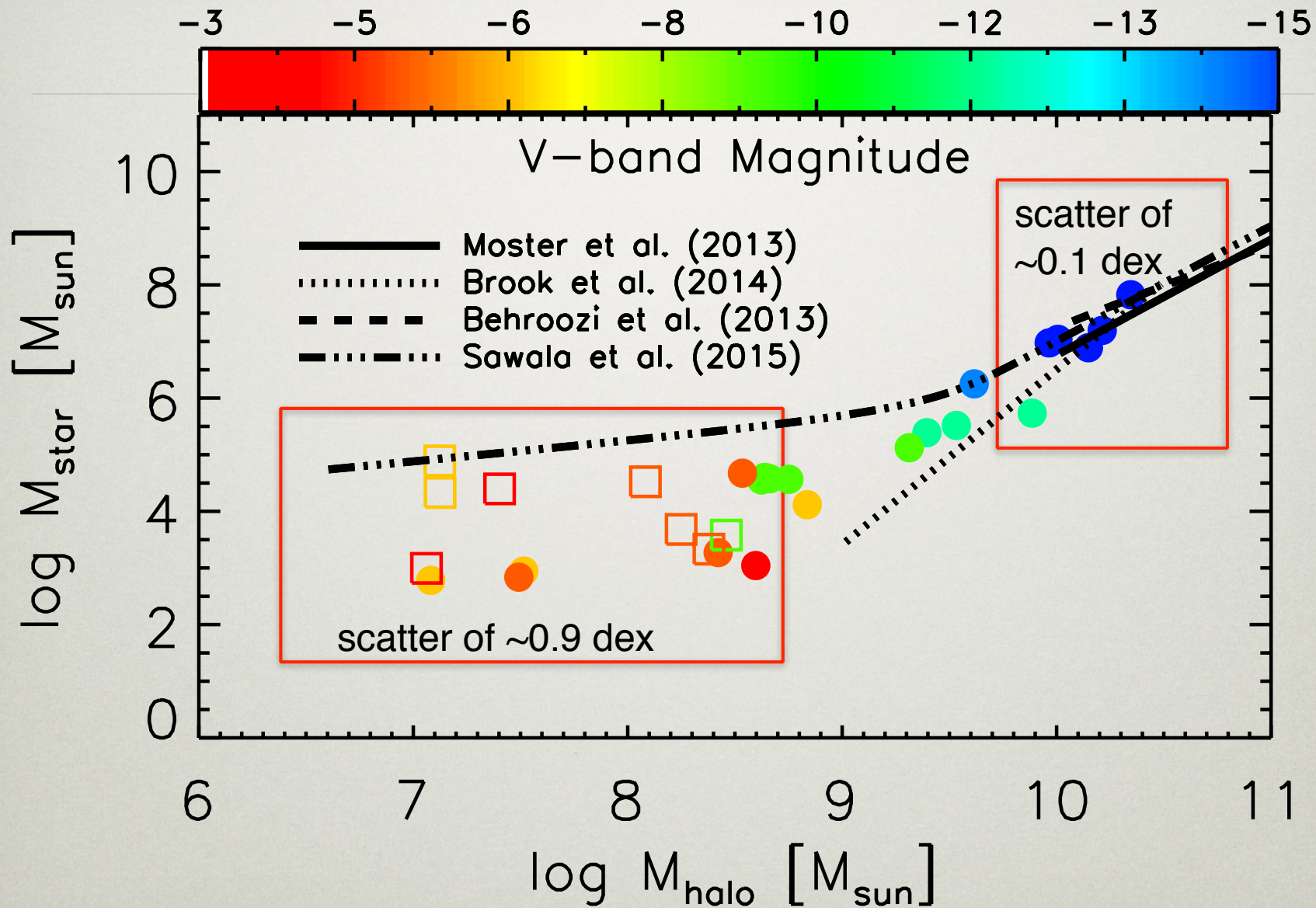
COMPLETE



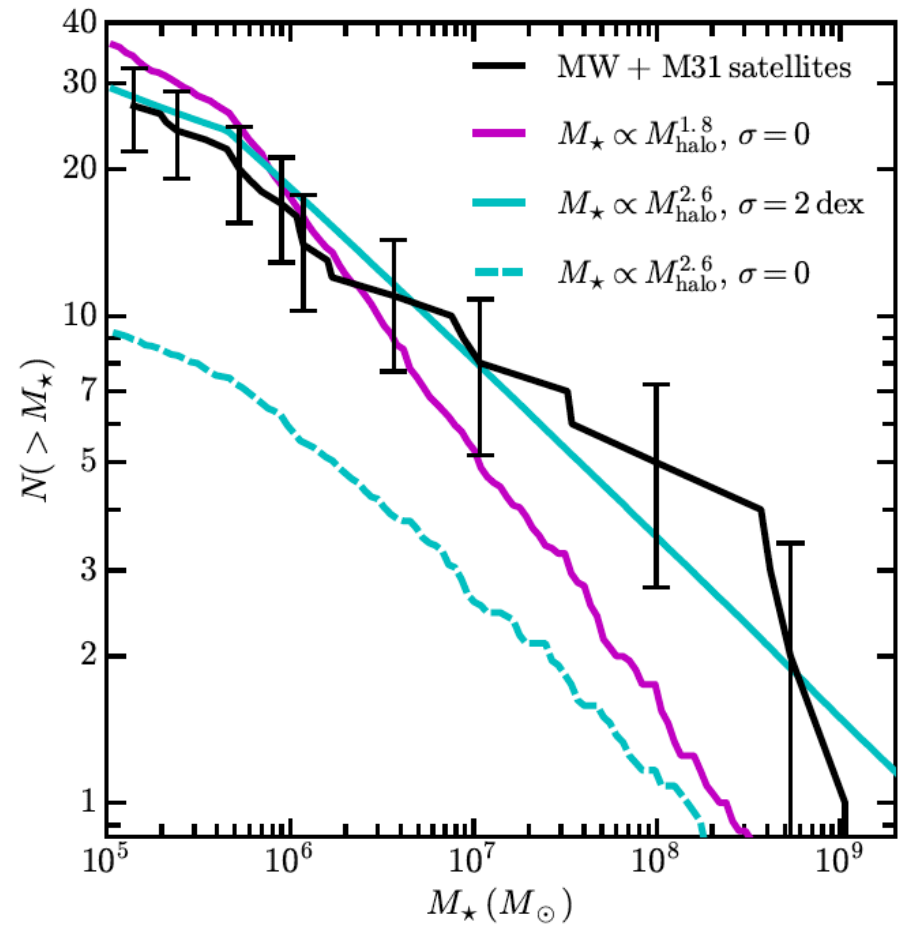
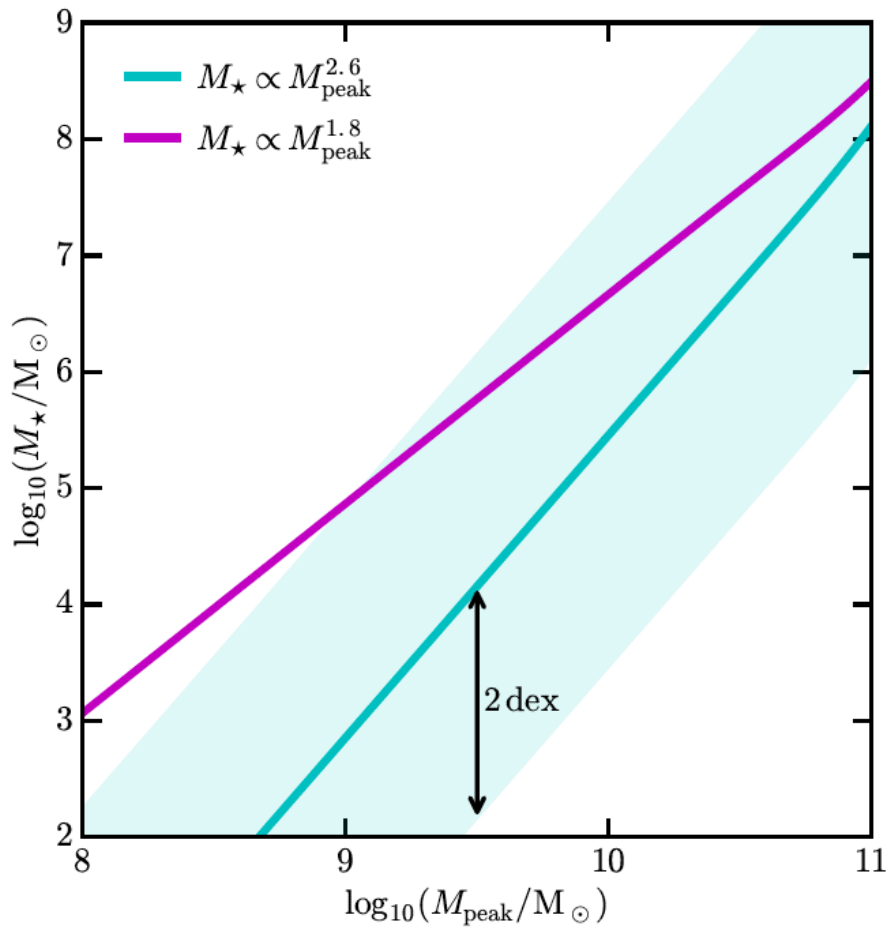


THE “BEND” IS DUE TO THE INCLUSION OF SATELLITES

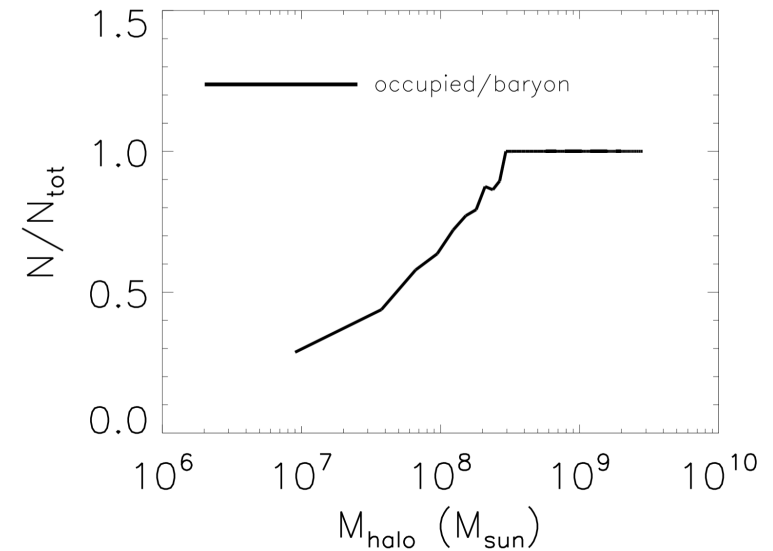
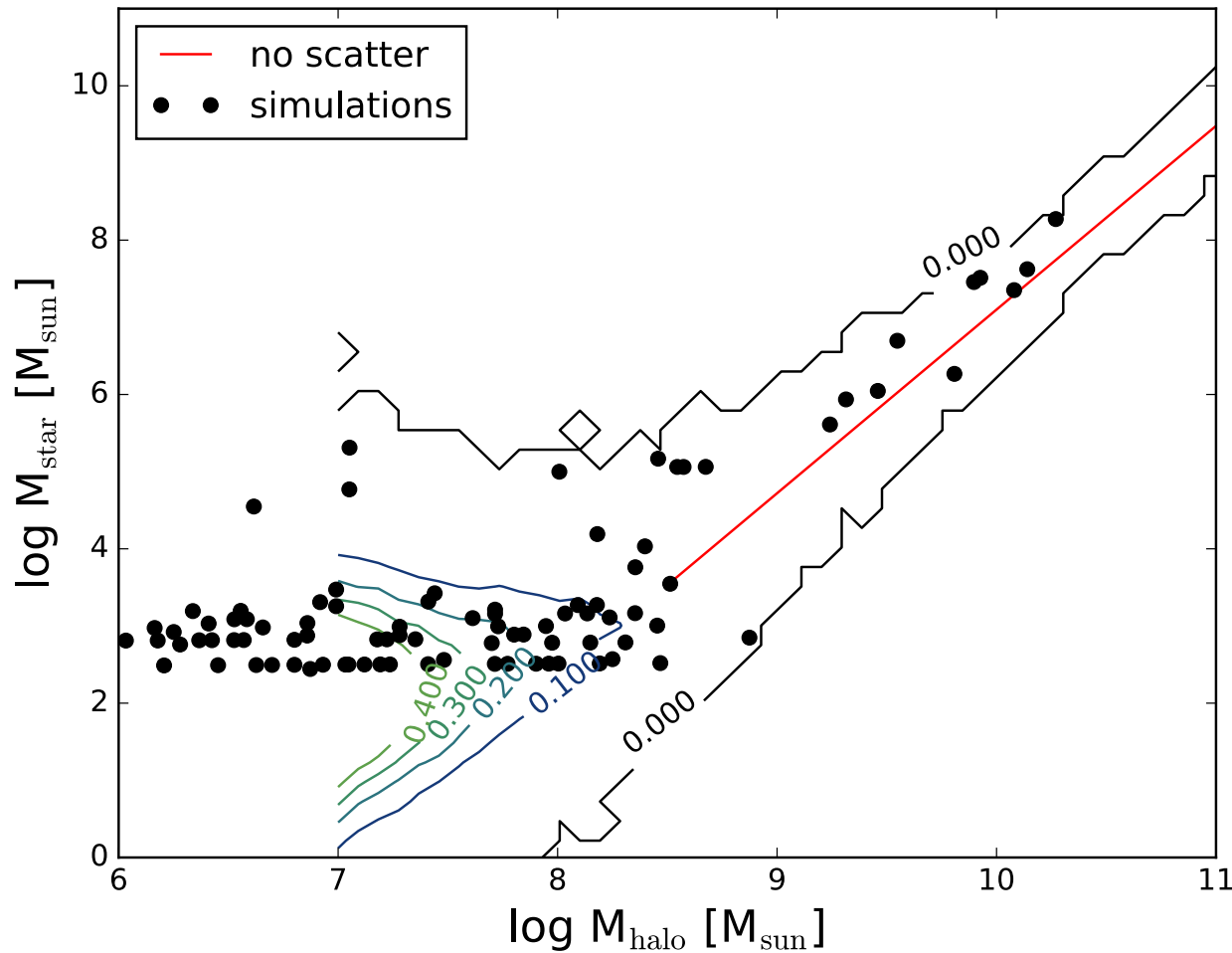




EFFECT OF SCATTER



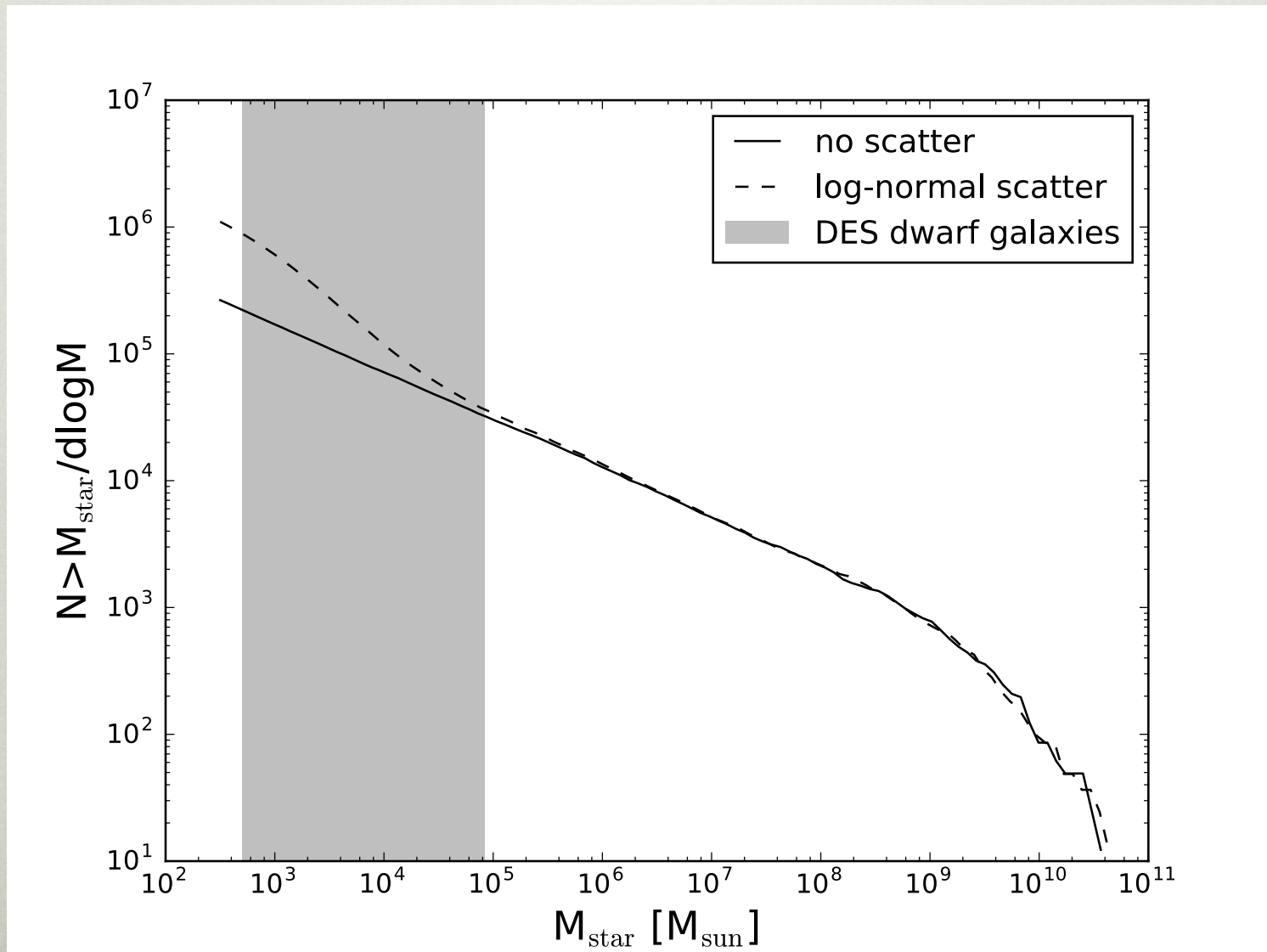
A TOOL TO POPULATE LOW MASS HALOS



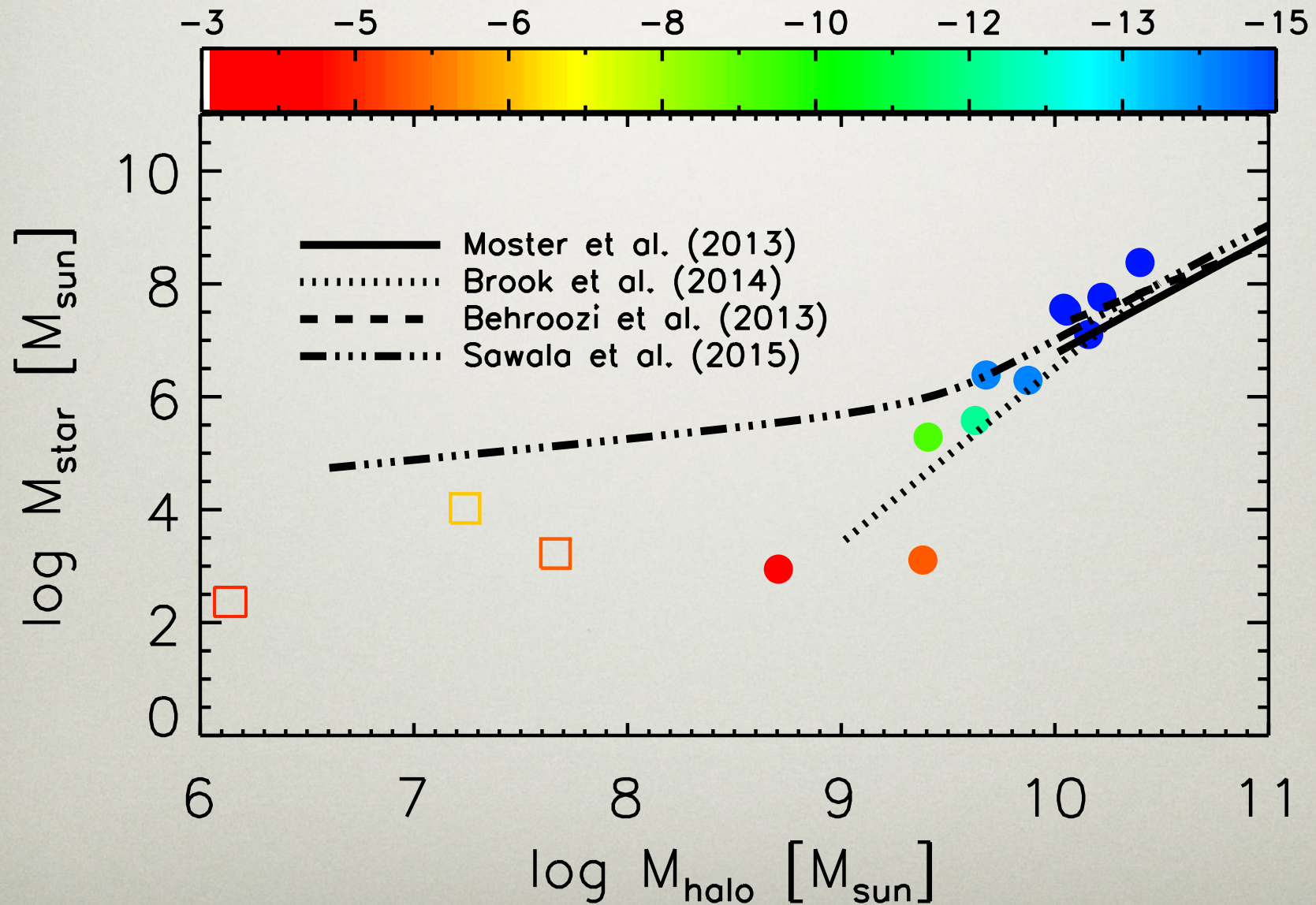
We adopt the trends defined for our well-resolved halos:
a slope of the SMHM $\alpha = 2.4$ for $8.4 < \log(M_{halo}) < 11.5$ (shown by the red dashed line), with a shallower slope of $\alpha = 0.64$ at lower halo masses. The scatter is fixed to a constant 0.2 above $M_1 = 5 \times 10^9 M_\odot$, and linearly grows below this halo mass so that $\gamma = -0.26$.

$$\sigma = 0.2 + \gamma(\log_{10}M_{halo} - \log_{10}M_1)$$

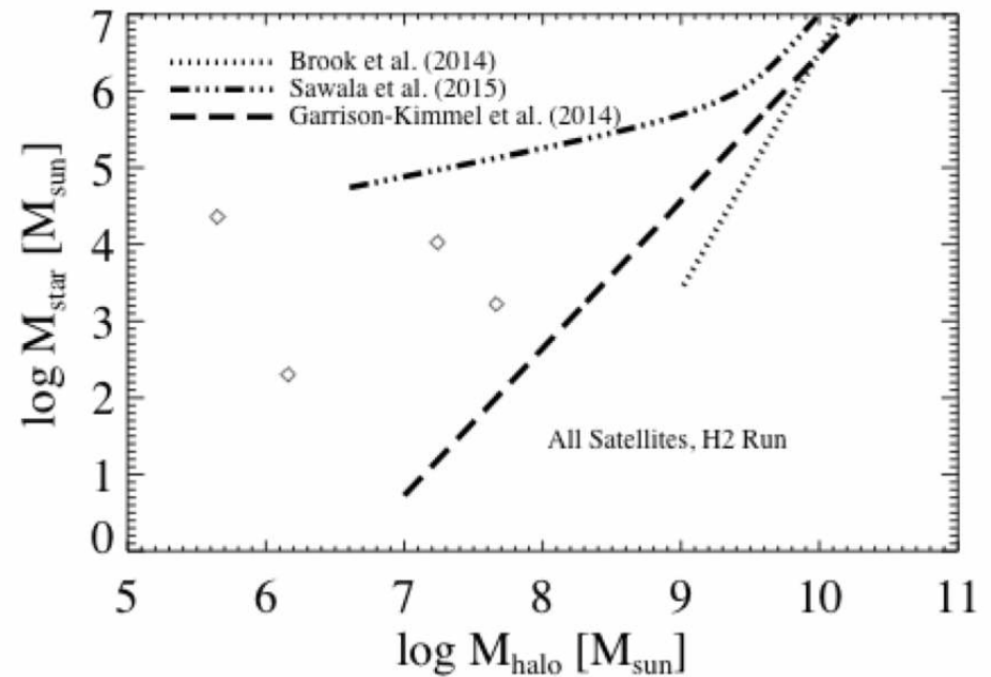
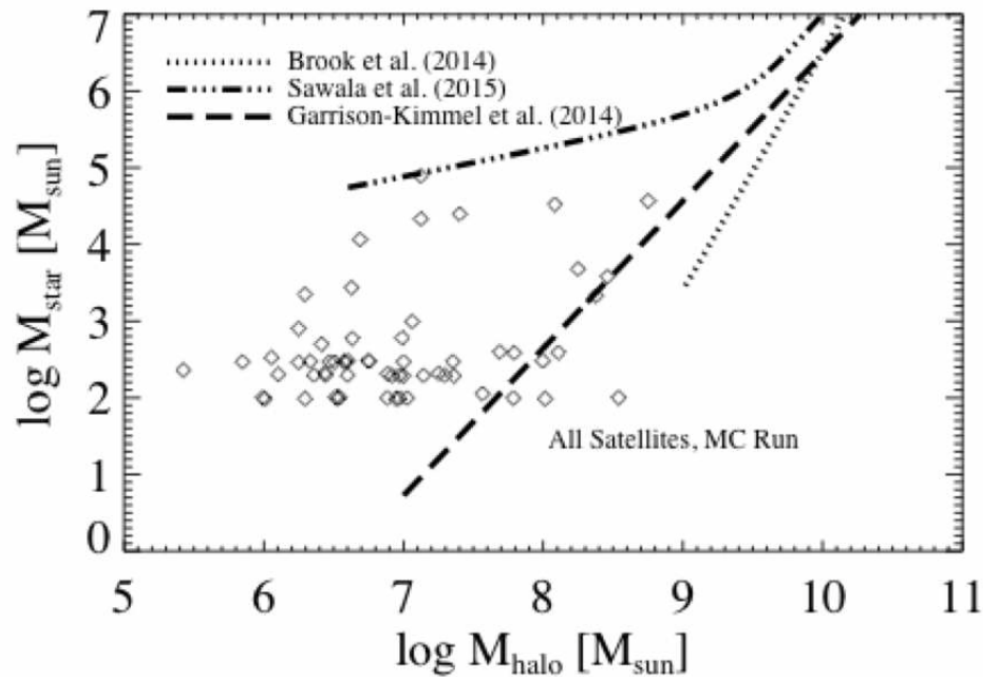
PREDICTED STELLAR MASS FUNCTION



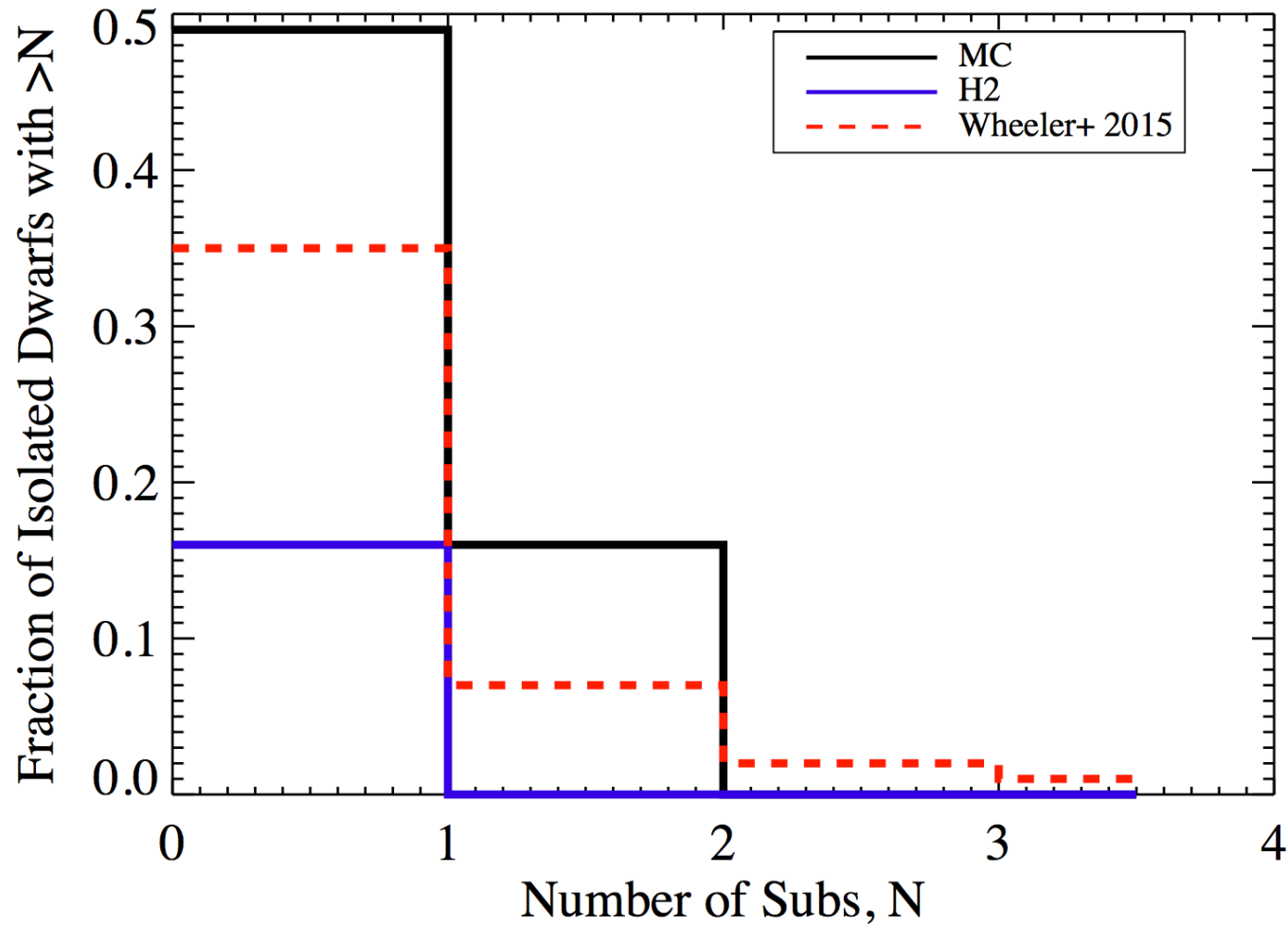
DOES STAR FORMATION PRESCRIPTION MATTER?



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IMPACT ON EXPECTED SATELLITE FRACTION IN DWARFS



CONCLUSIONS

- Starting from the *abundance* of dwarf galaxies predicted in LCDM, the HIFV can be recovered. There is no missing dwarf problem in the field.
- The scatter in the SMHM relation in low mass halos increases with decreasing halo mass. There is no one-to-one assignment of stellar mass to halo mass.
- The “bend” at low halo masses found by Sawala et al. (2015) is due to the inclusion of satellites.
- The increased scatter at low masses leads to a prediction of a steeper stellar mass function in the ultra-faint dwarf galaxy mass range, currently being probed by DES, HSC, MagLiteS, etc, and by LSST in the future.

