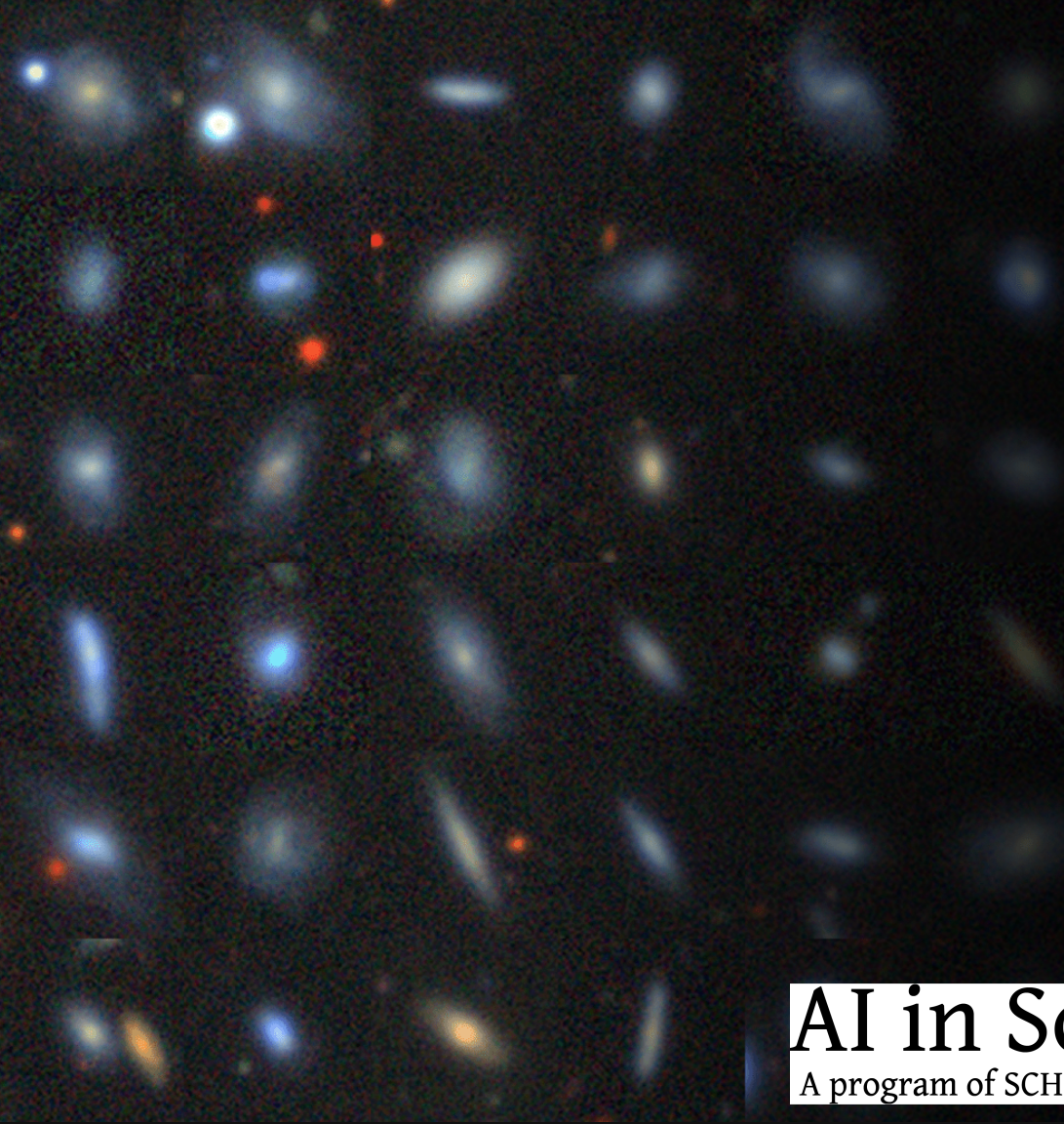

First Weak Lensing Detection of Spectroscopically Confirmed Dwarf Galaxies

Chun-Hao To*

Arxiv: 2509.20458, PRD accepted.

*chto@uchicago.edu

CCAPP Fellow (2021-2024)

AI in Science
A program of SCHMIDT FUTURES

THE UNIVERSITY OF CHICAGO

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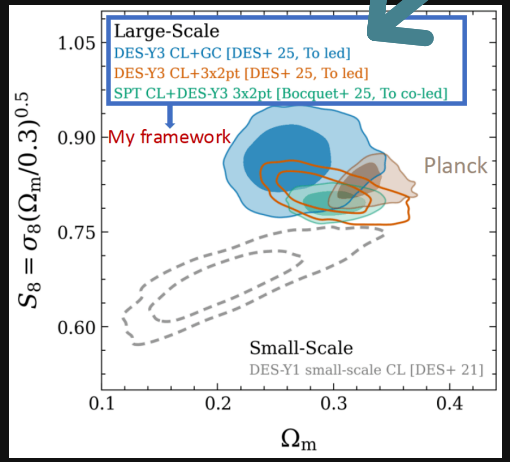
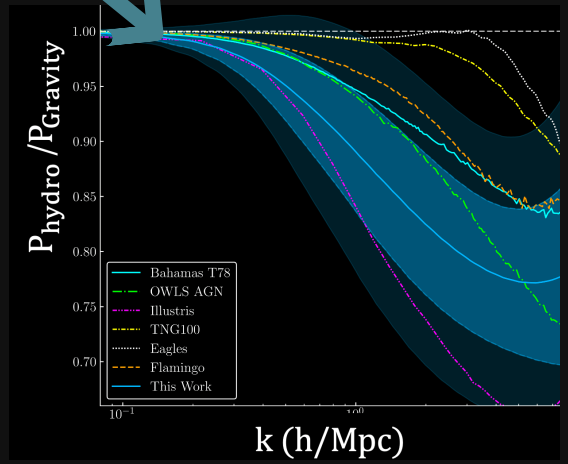
What I usually work on

Cosmology



To+ 21ab,22,25ab

Baryon feedback

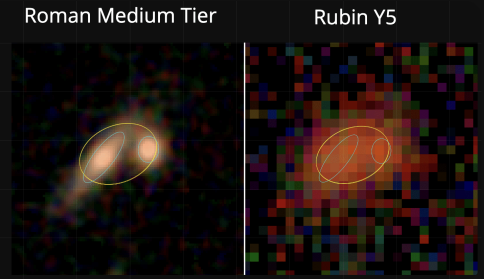


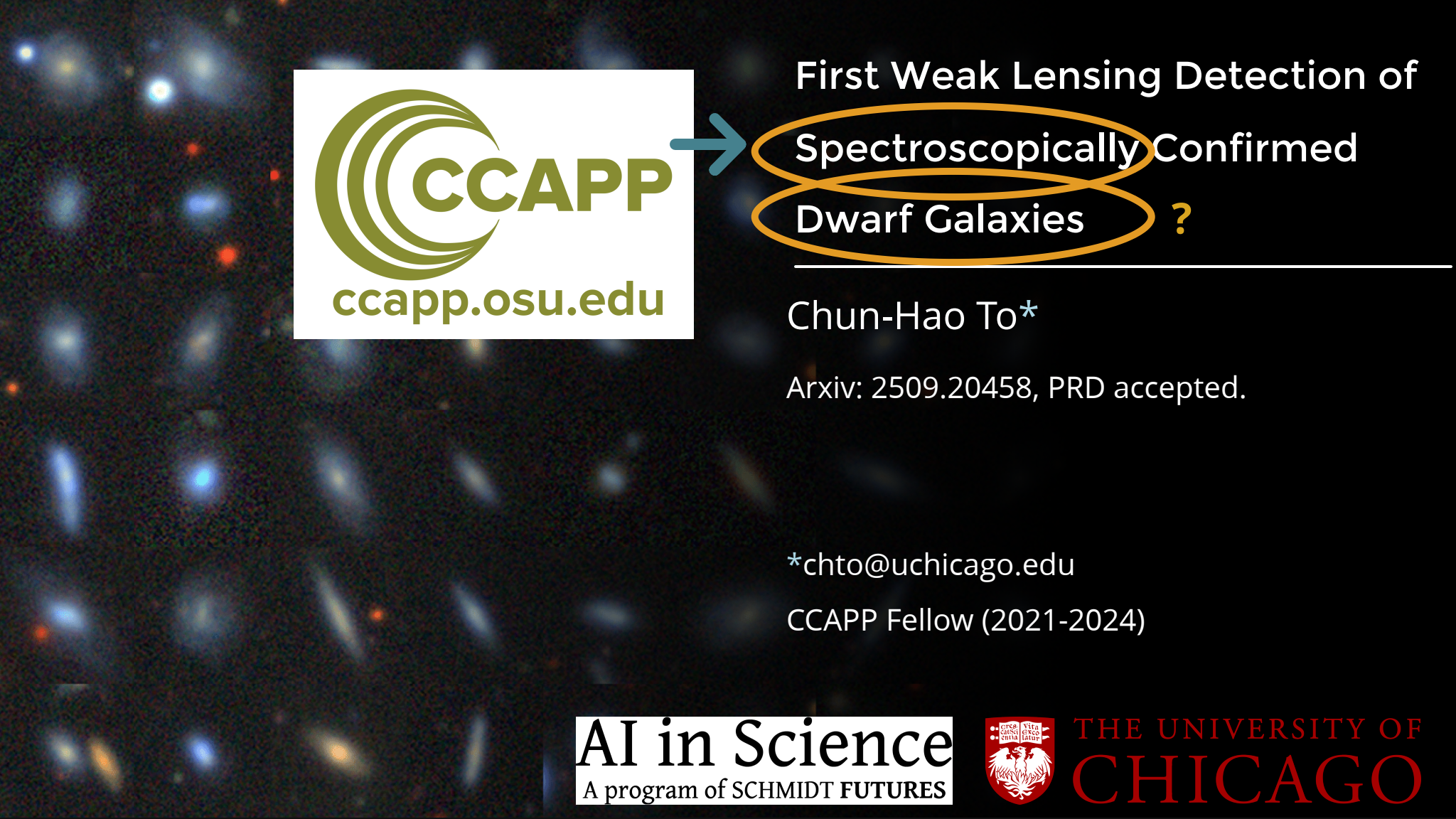
To+ 24, Dalal, To+25, To+26 (Diffgas, in prep.)

Survey mocks

To+ 23 https://chunhaoto.com/cardinalsim/

HLIS





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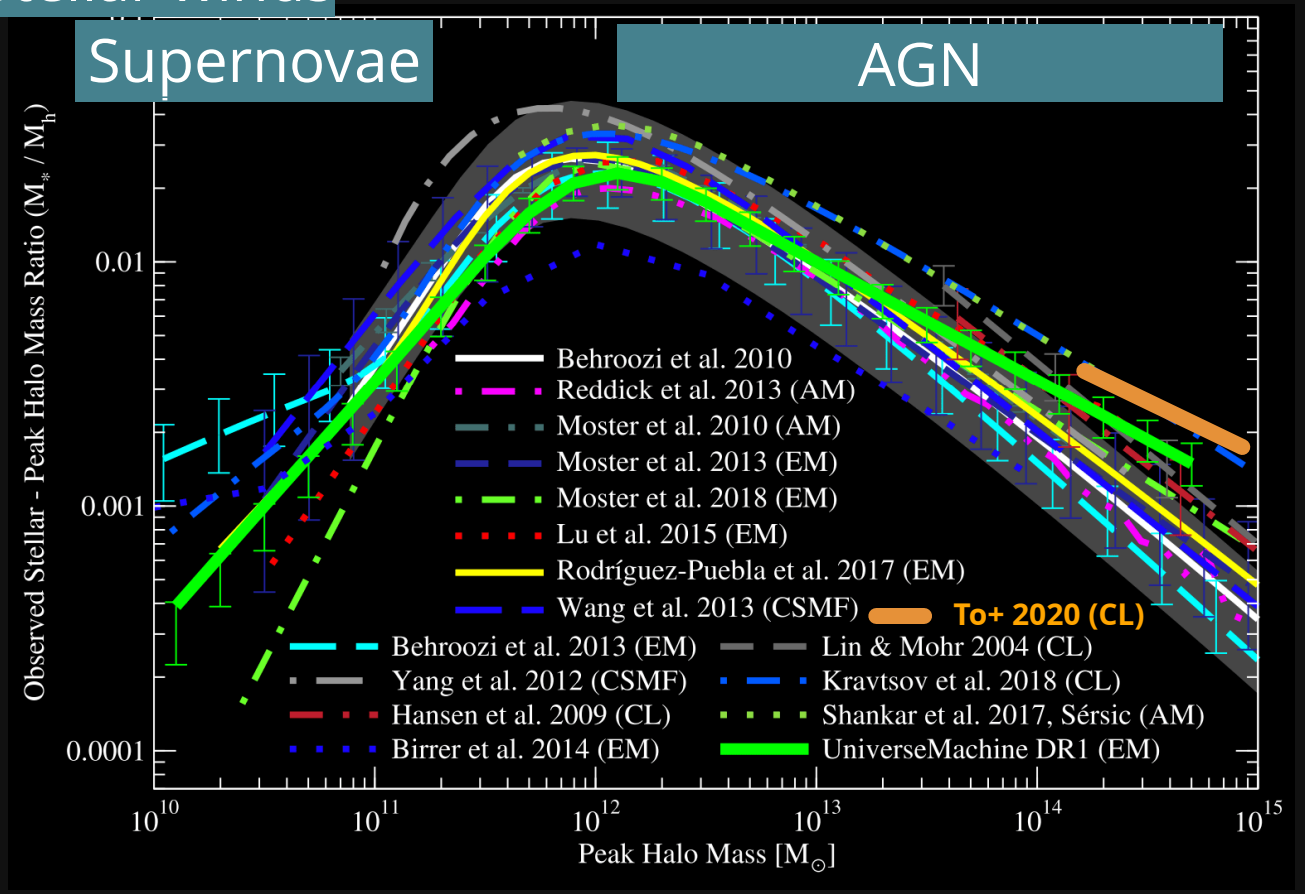
Galaxy-halo connection probes many astrophysics

Stellar winds

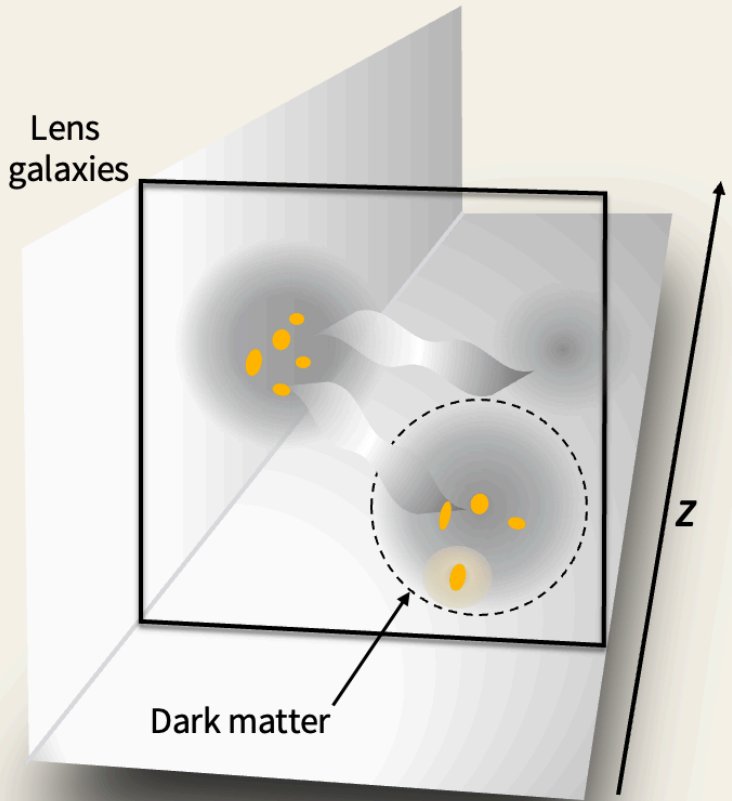
Supernovae

AGN



Lin+04, Wechsler&Tinker+18, Behroozi+18, Kravtsov+18, **To+20,** Manwadkar+21, Kravstov+22 .... many others

Weak lensing measures the total matter profiles



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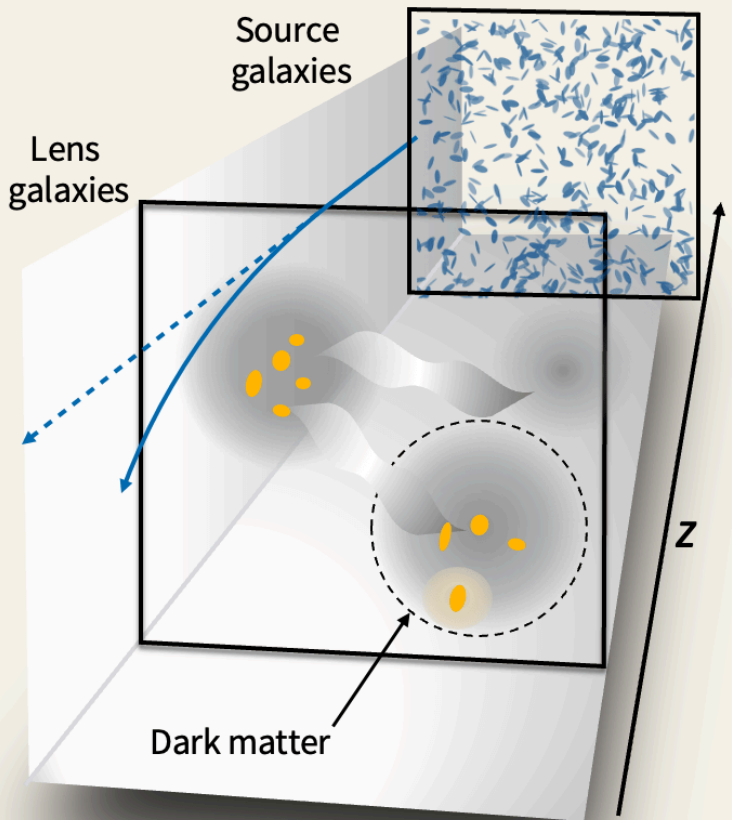

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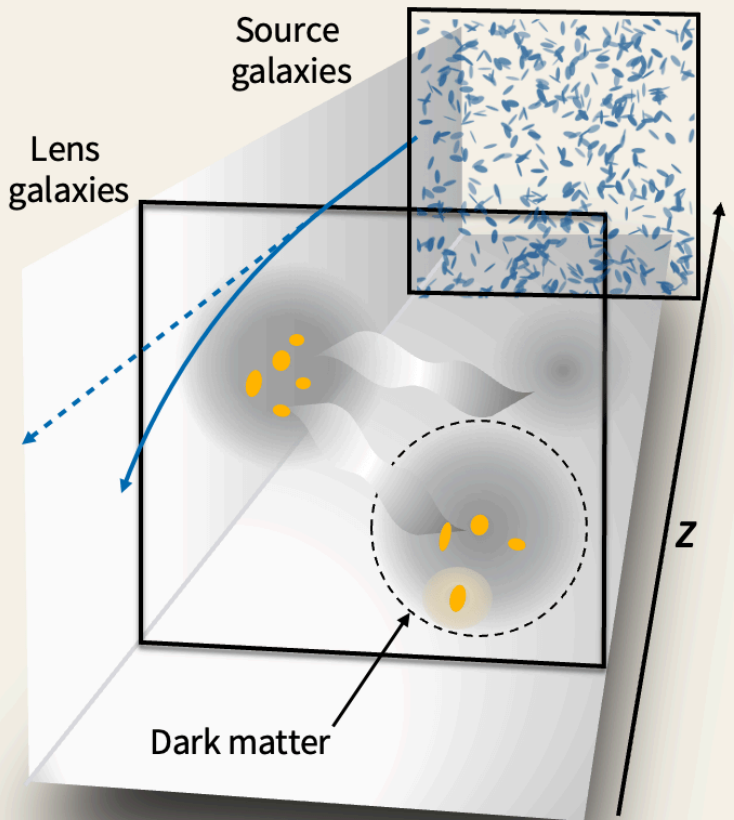

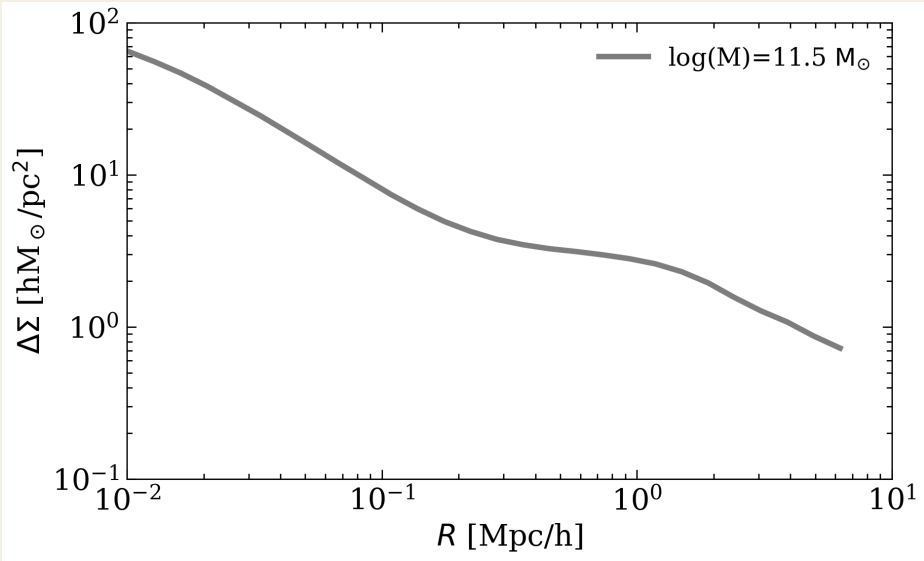

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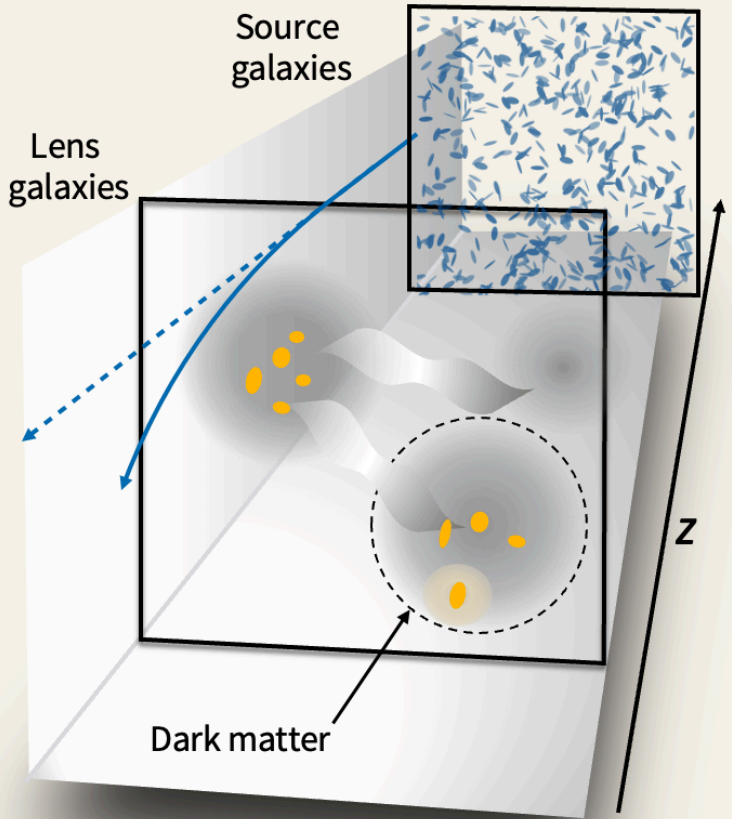

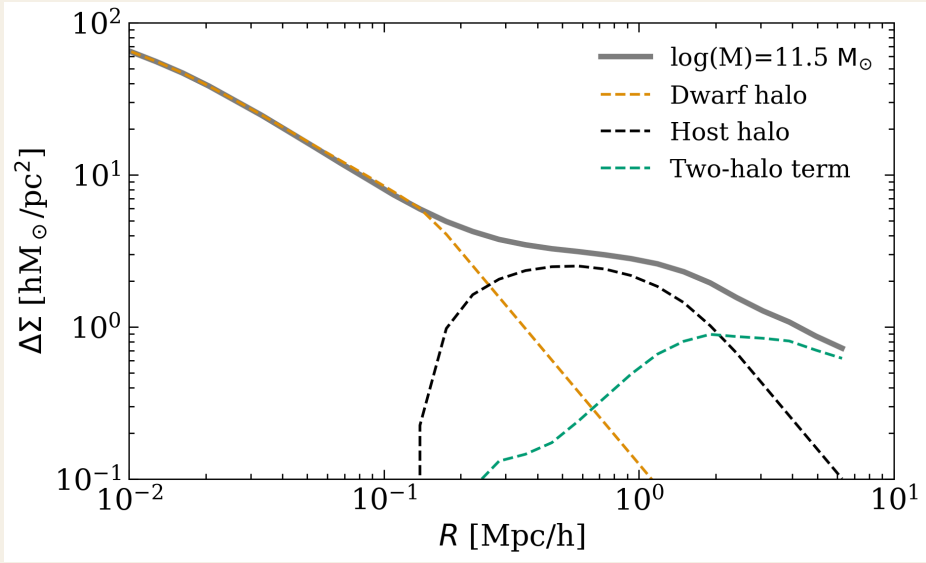

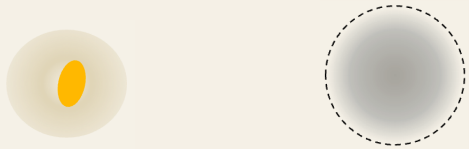

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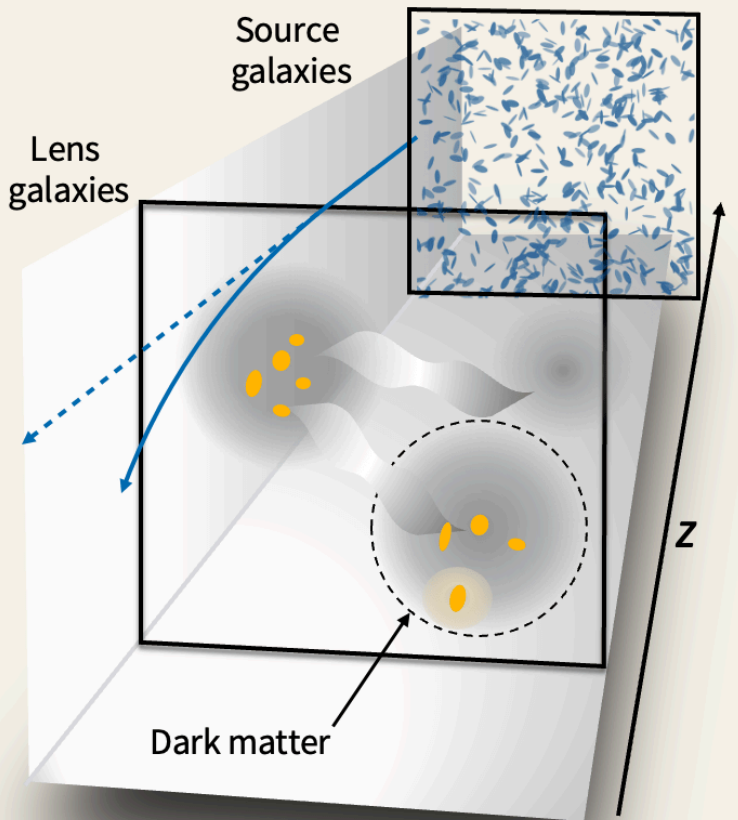
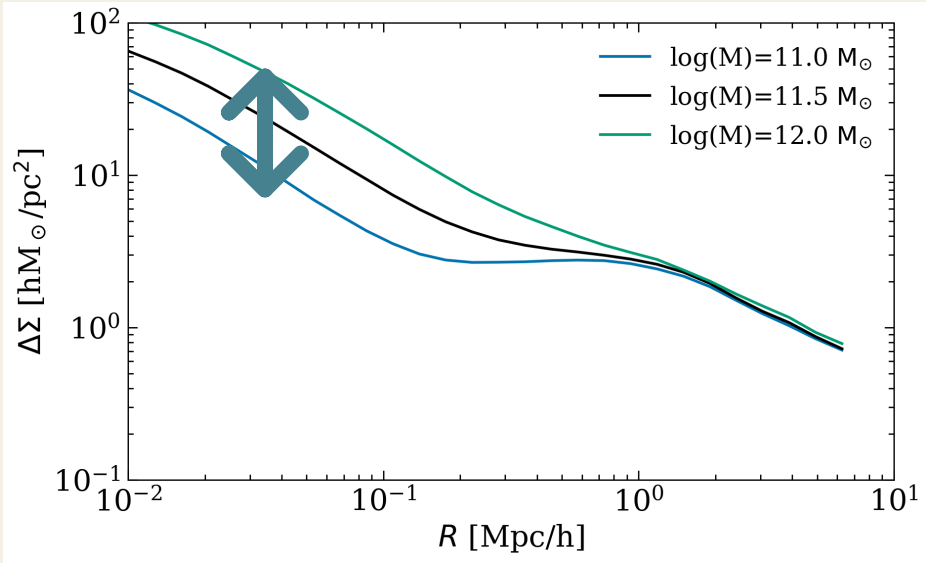
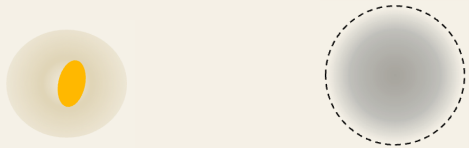


Halo Mass





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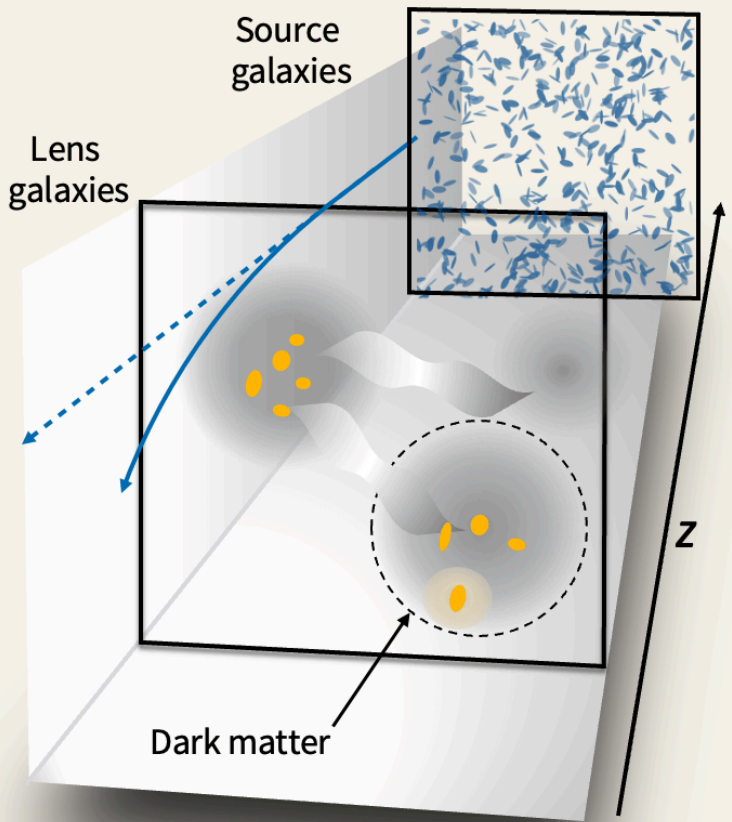
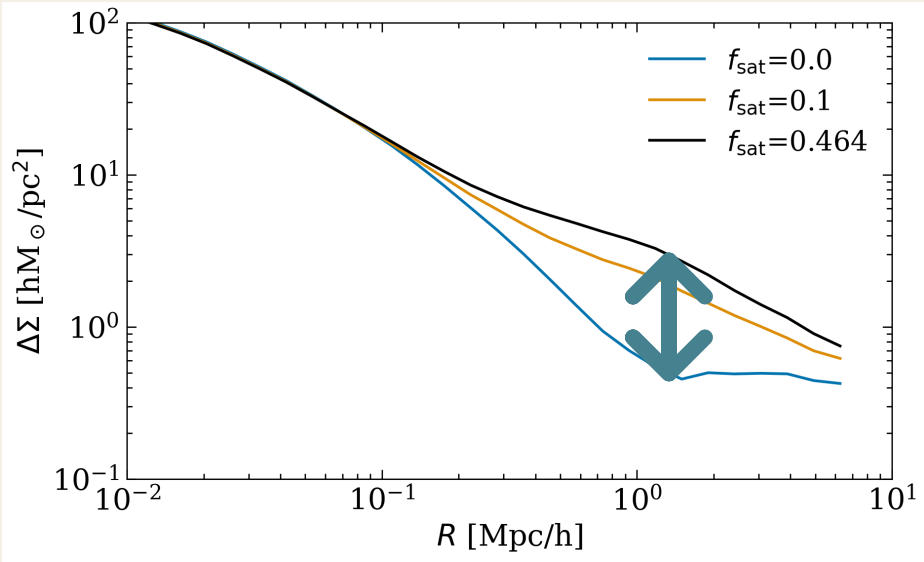
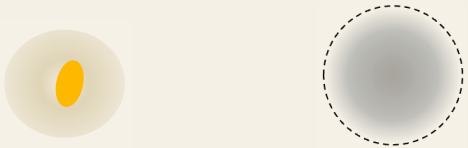


Satellite fraction





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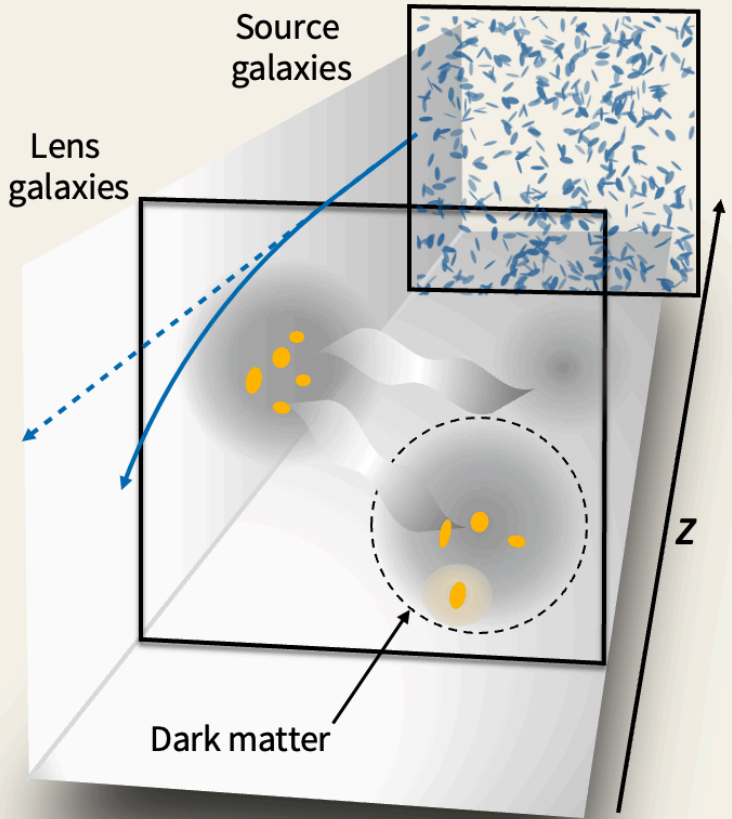
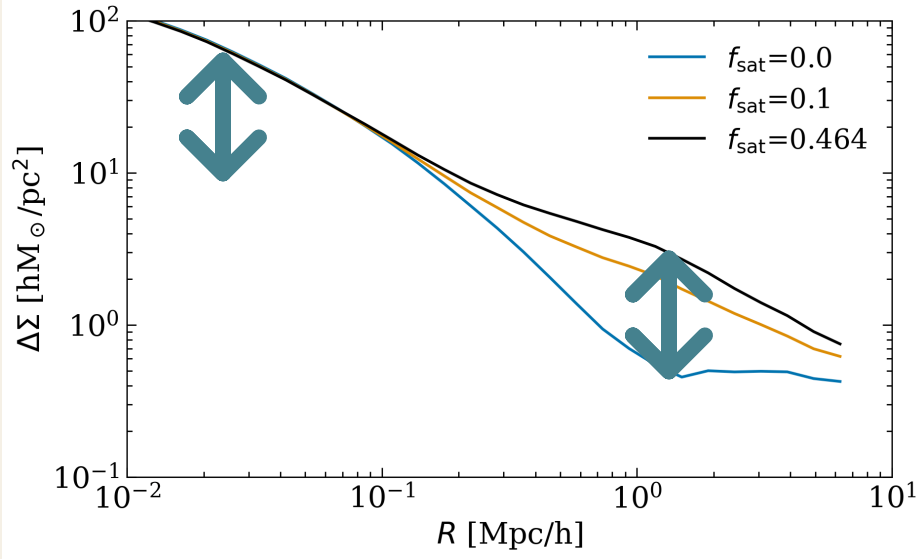
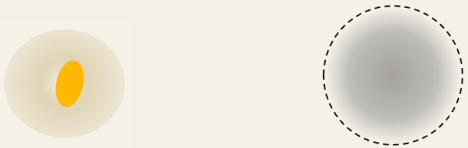


Halo Mass Satellite fraction





- But weak lensing is weak.
  - S/N ~2% for $\sigma_v \simeq 120\ \mathrm{km\ sec}^{-1}$
  - Weaker for low-mass objects.

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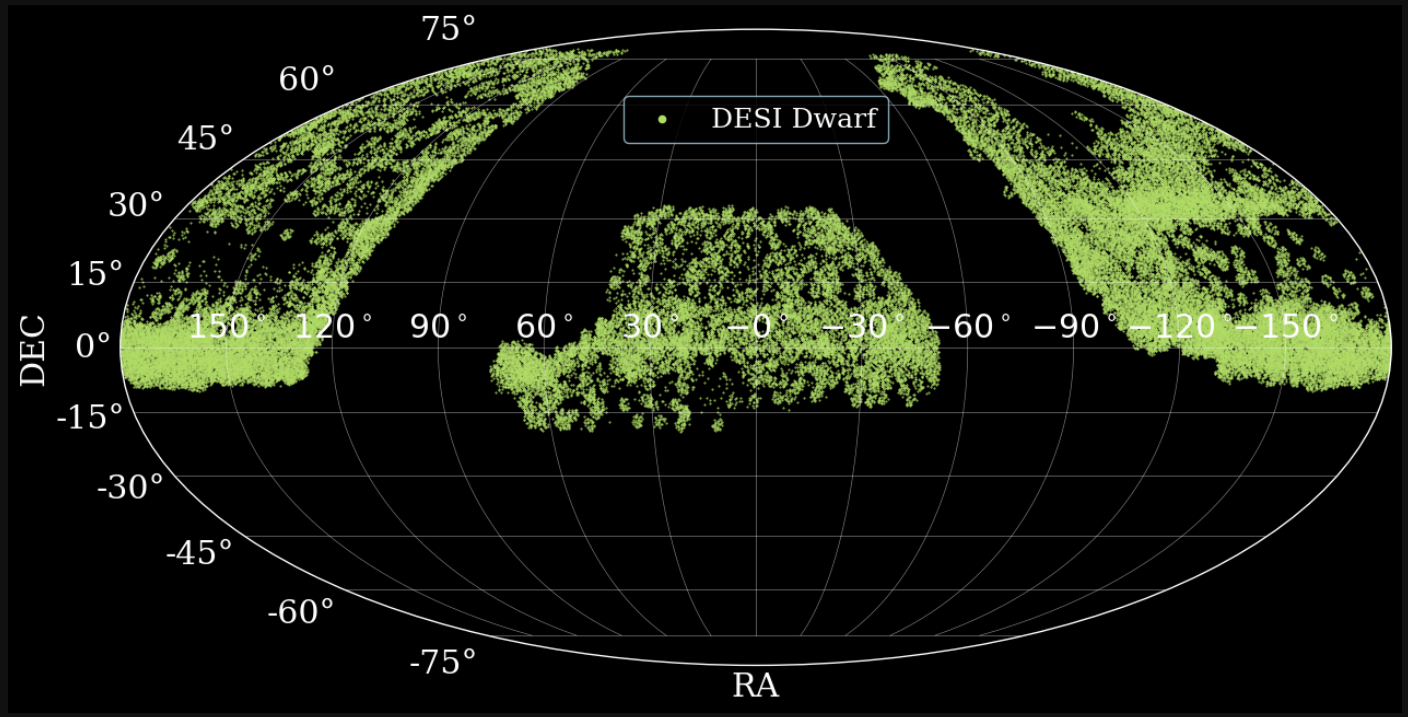
  - Weaker for low-mass objects.

→ Needs lots of lens and source galaxies!

DECADE + DESI*



*https://data.desi.lbl.gov/doc/releases/dr1/vac/extragalactic-dwarfs/, Manwadkar, Wechsler+ in prep.

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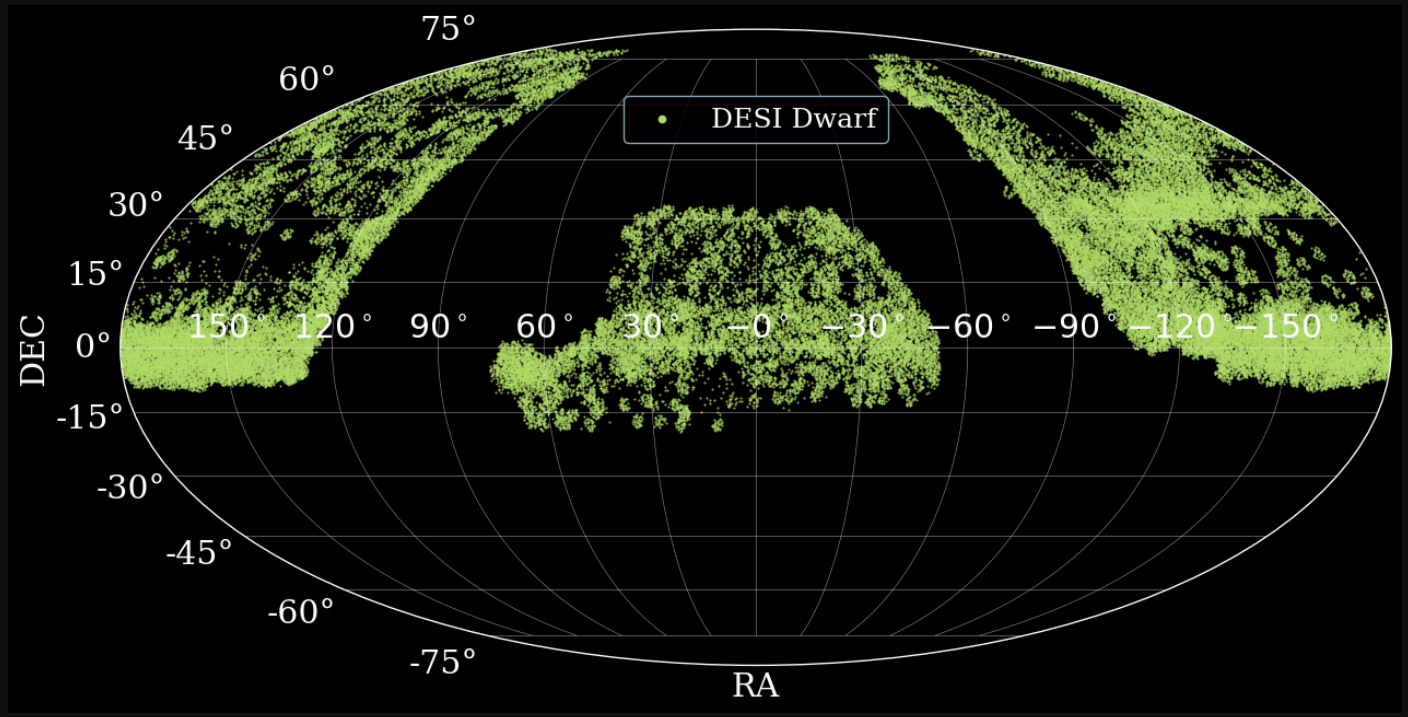

After sitting in lots of Little Galaxies meetings, I learned they are interesting.

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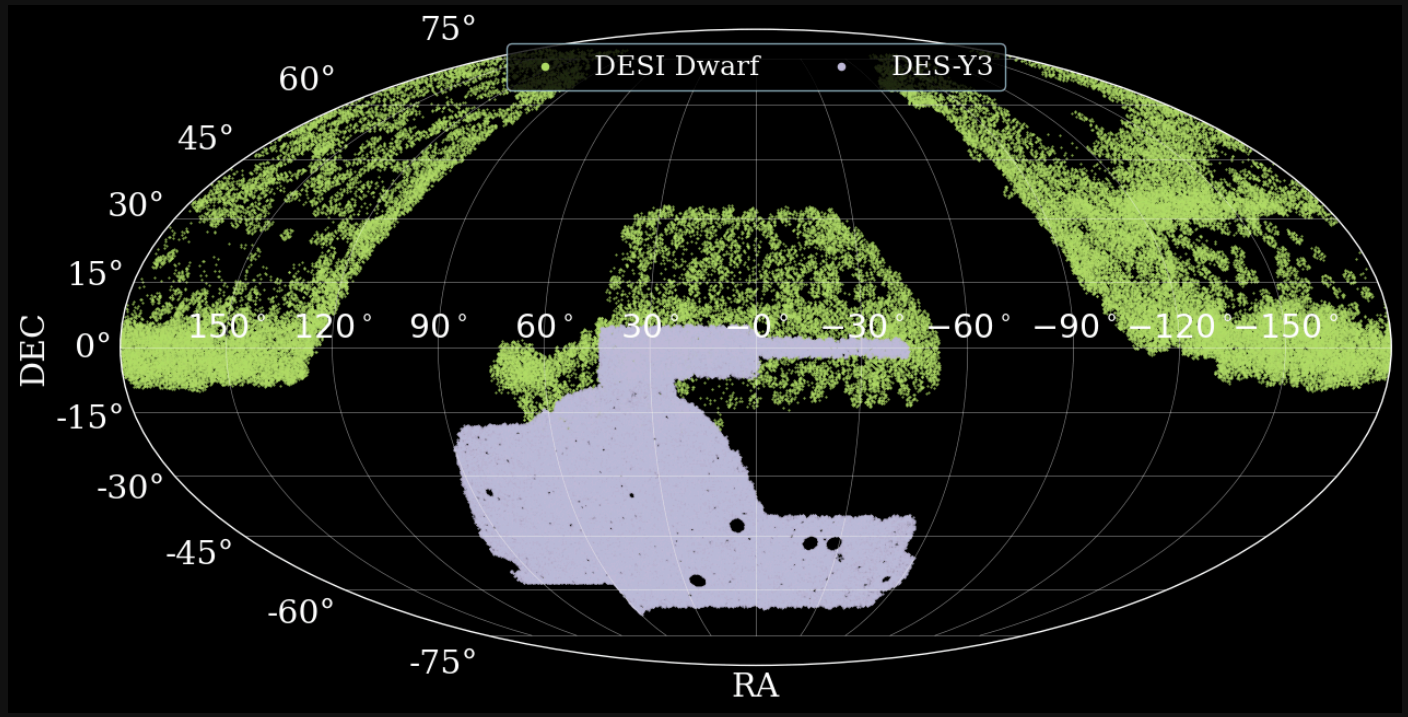

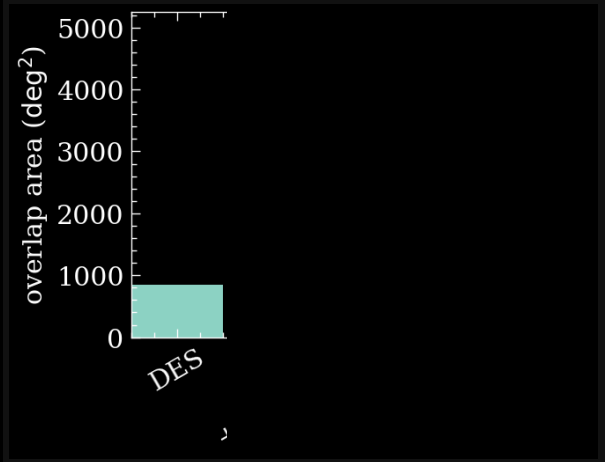

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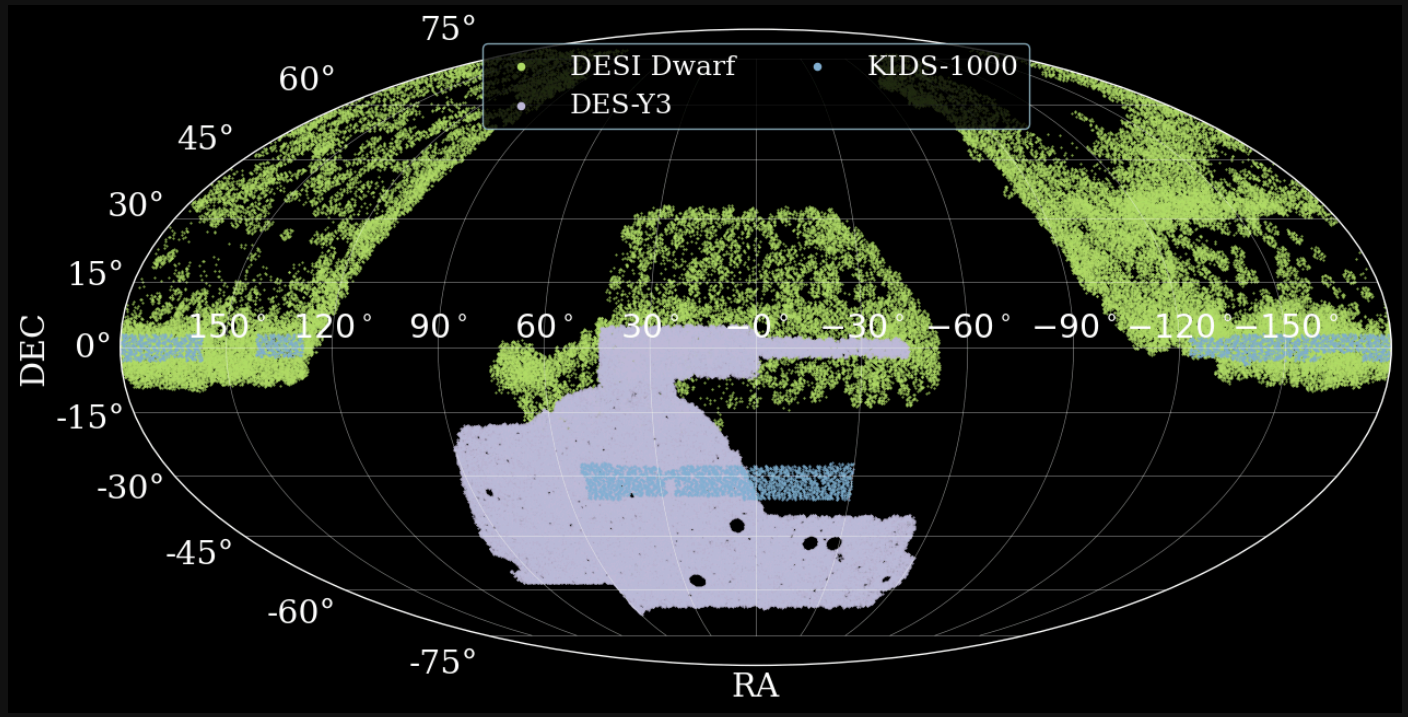

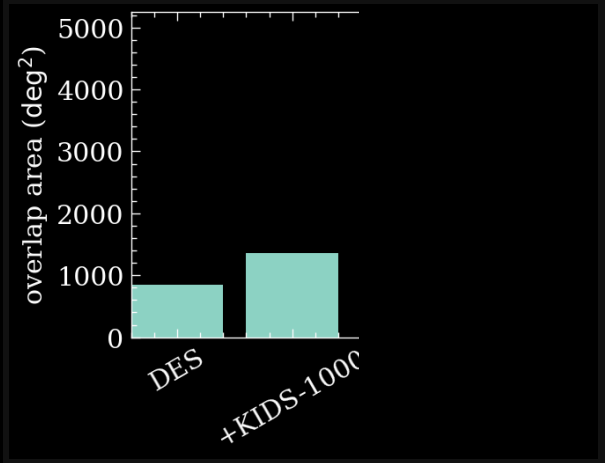

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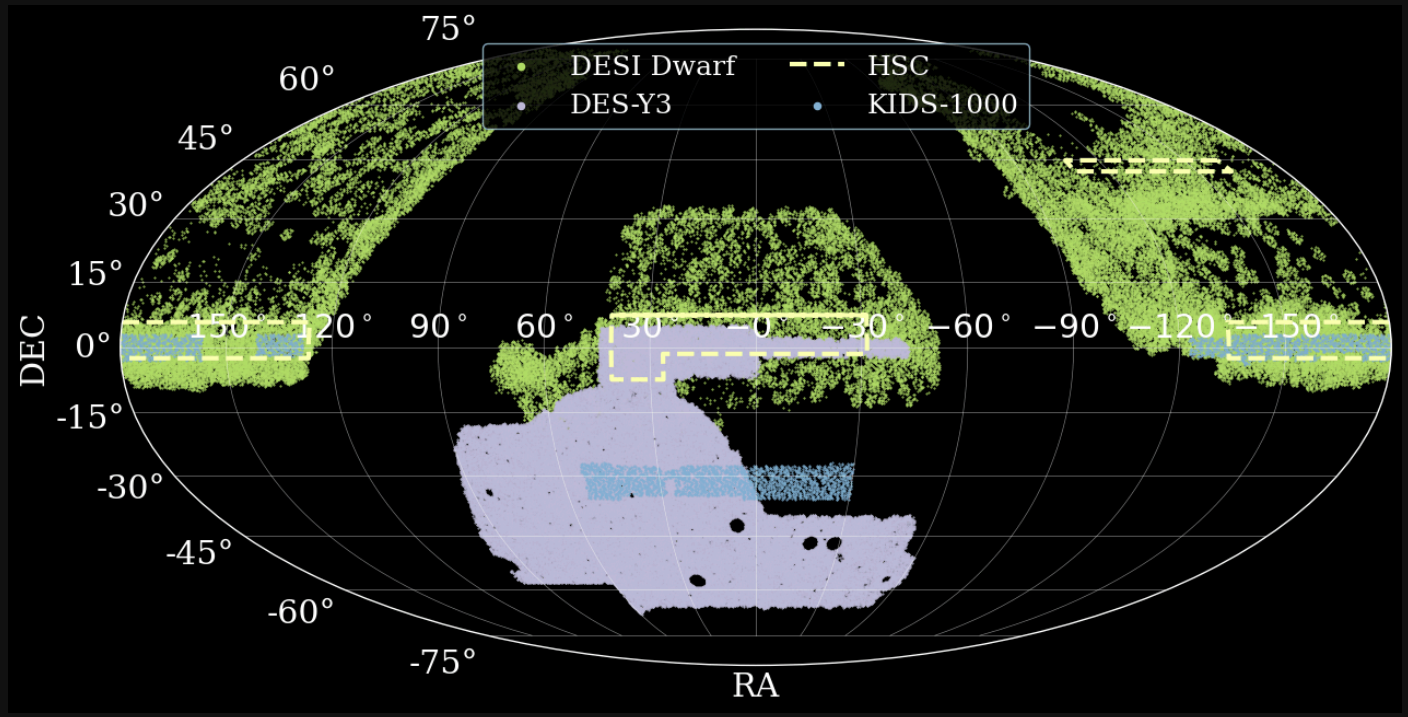

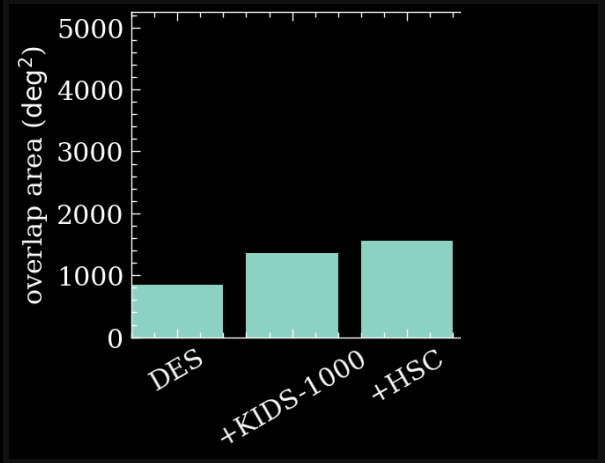

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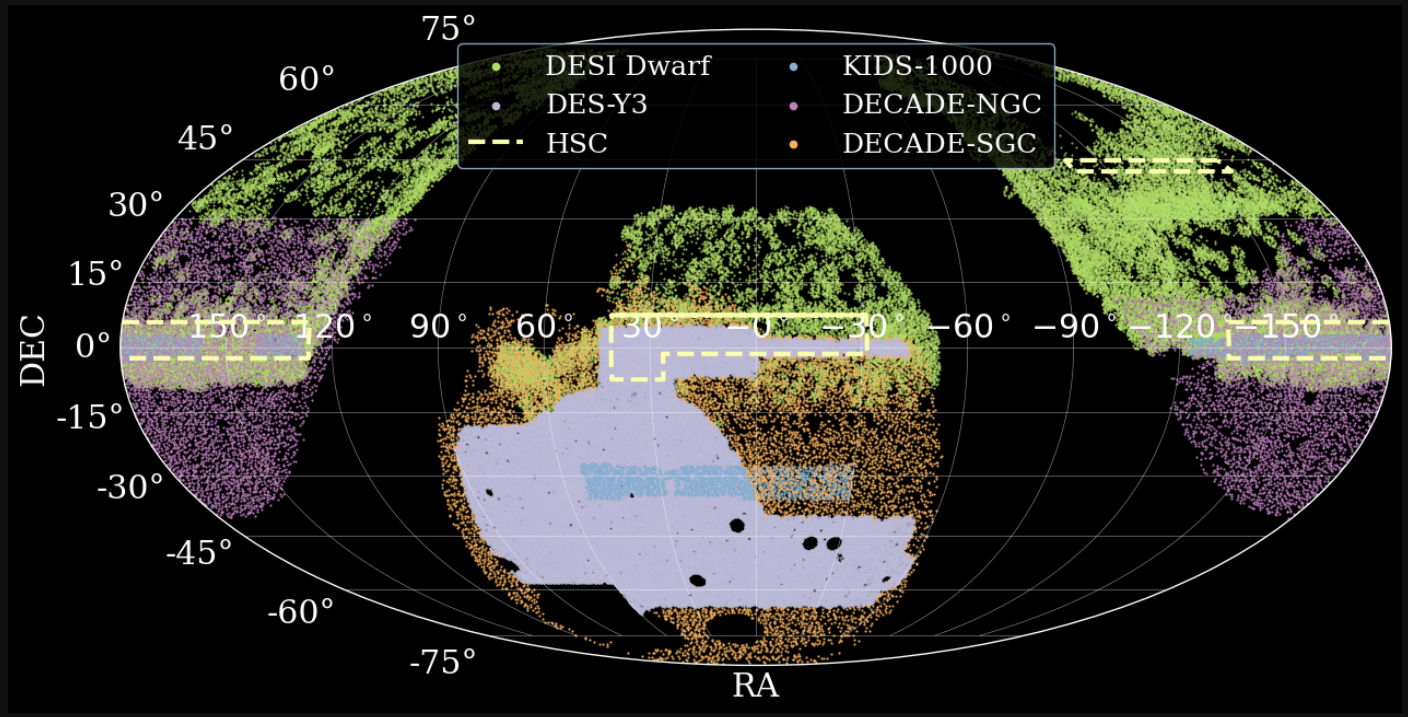

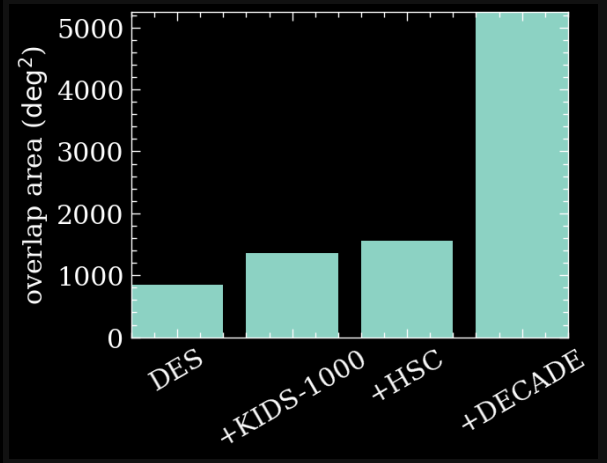

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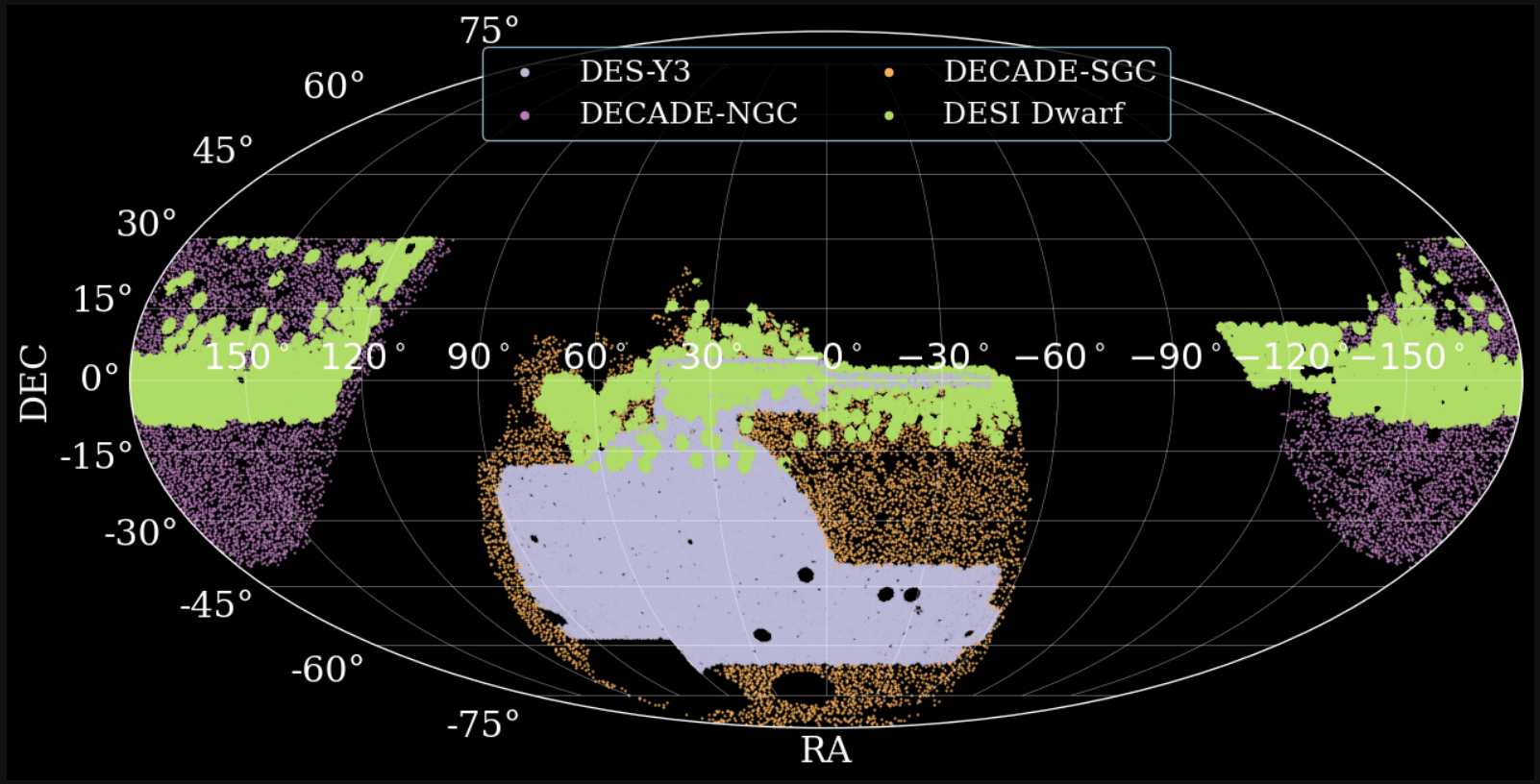

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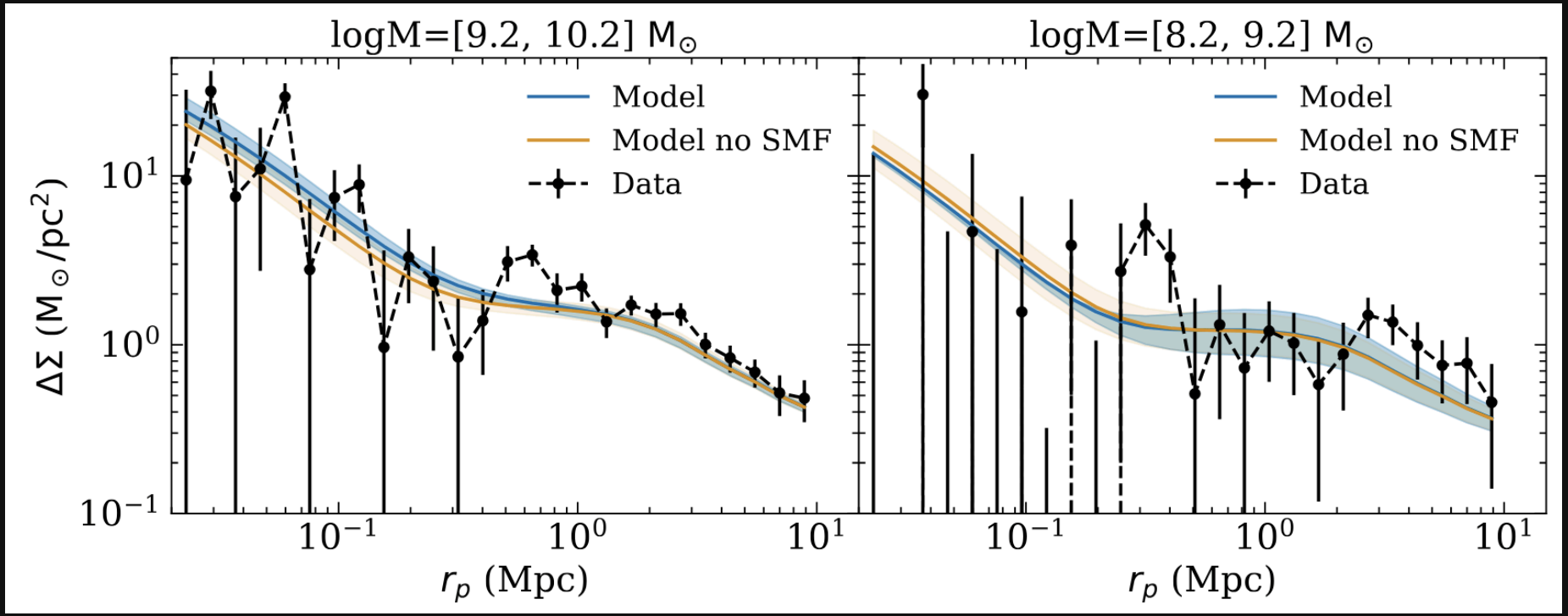
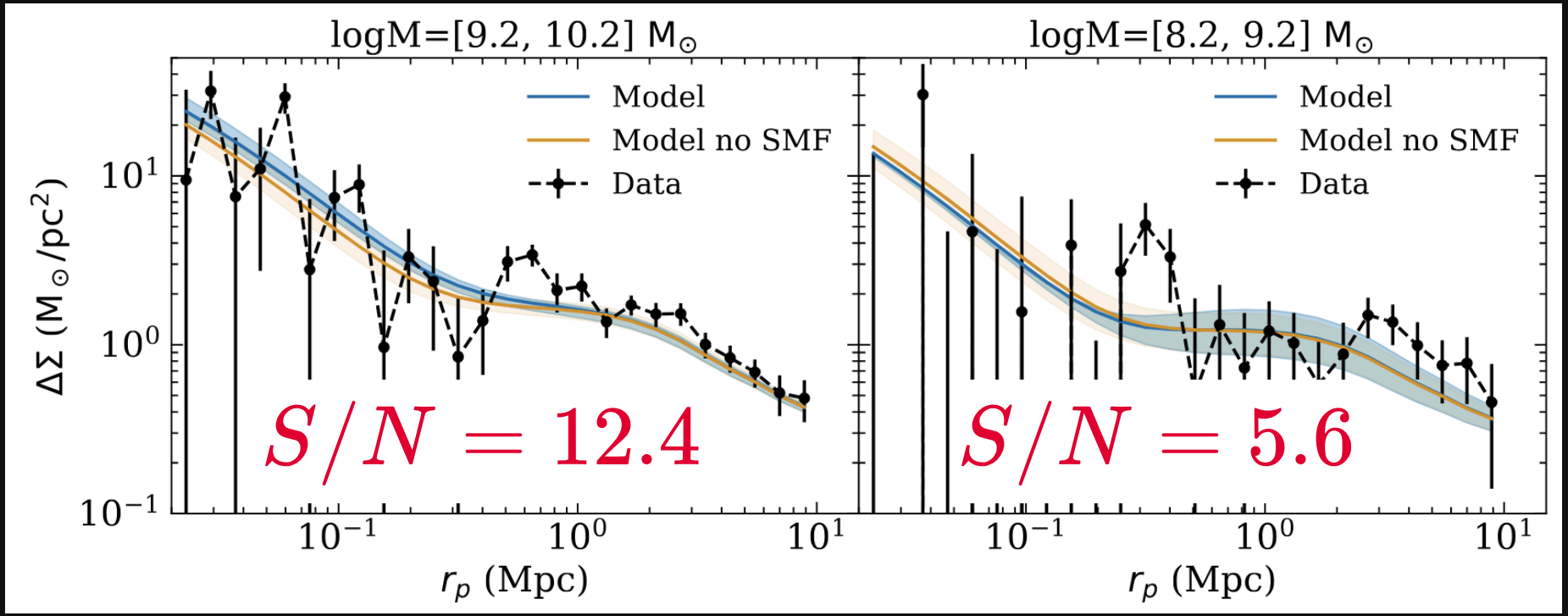
Mass profile around dwarfs



To+26

Mass profile around dwarfs



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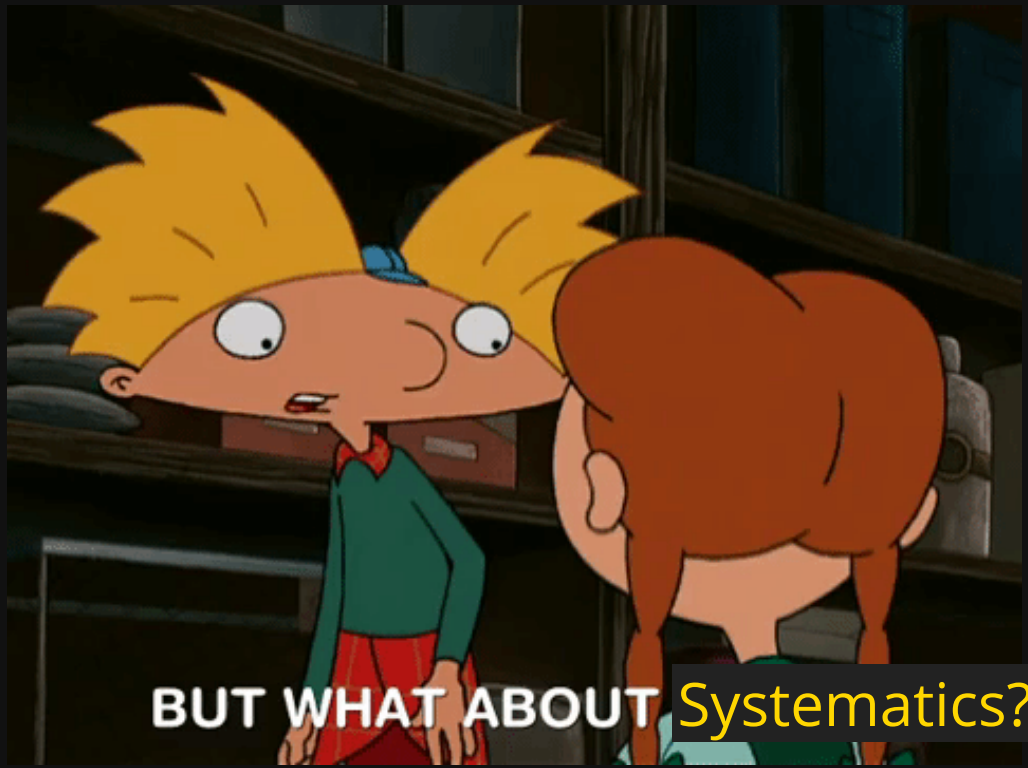


Measurement systematics

Stellar mass estimation

de los Reyes+25, Zou+24,...

Shear measurement

Various lensing paper...

Fiber incompleteness

Bianchi+ 18, Lange+ 24, Ross+ 25, Lasker+ 25

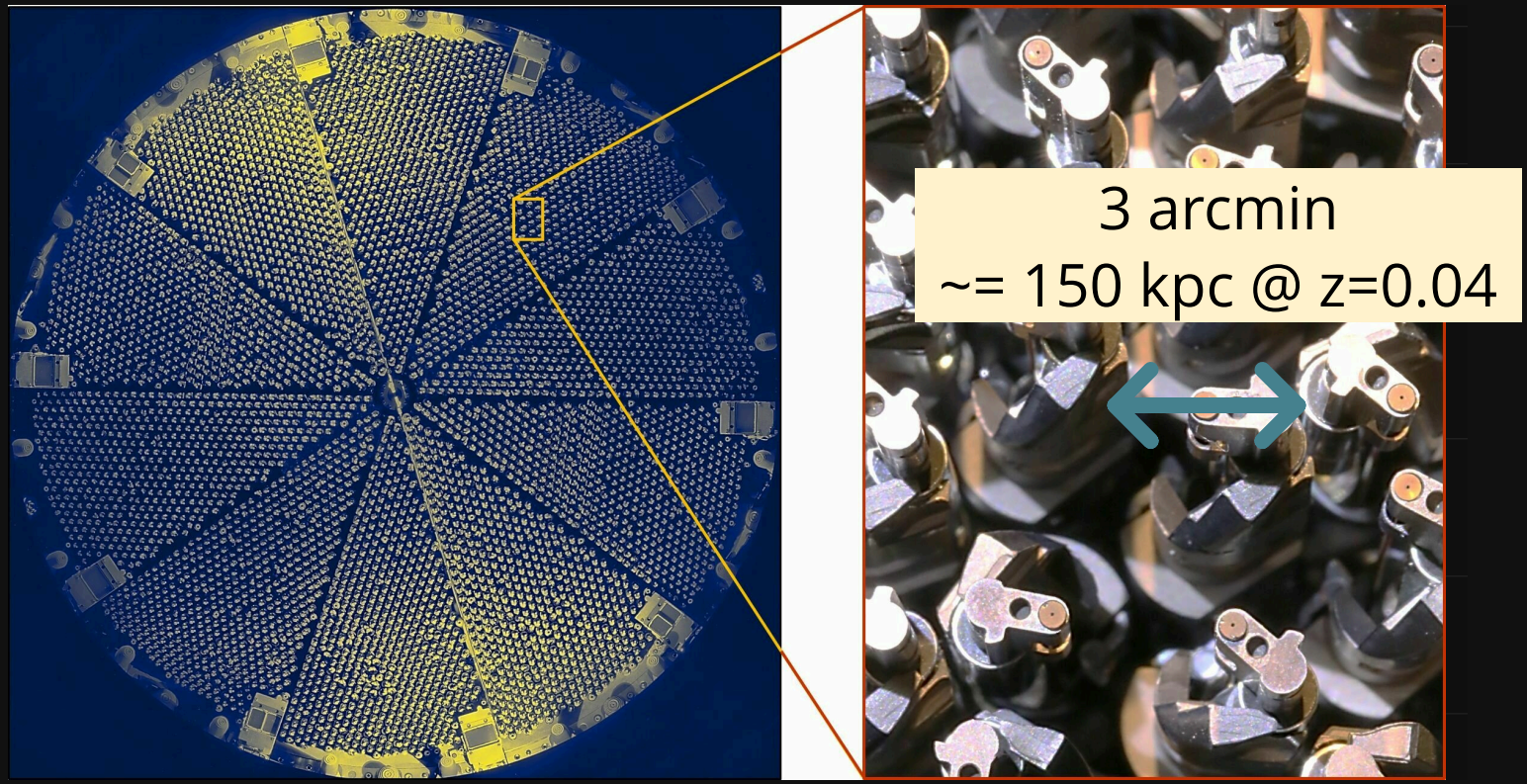
Photometry Shredding

Blanton+05, Mao+21, many others

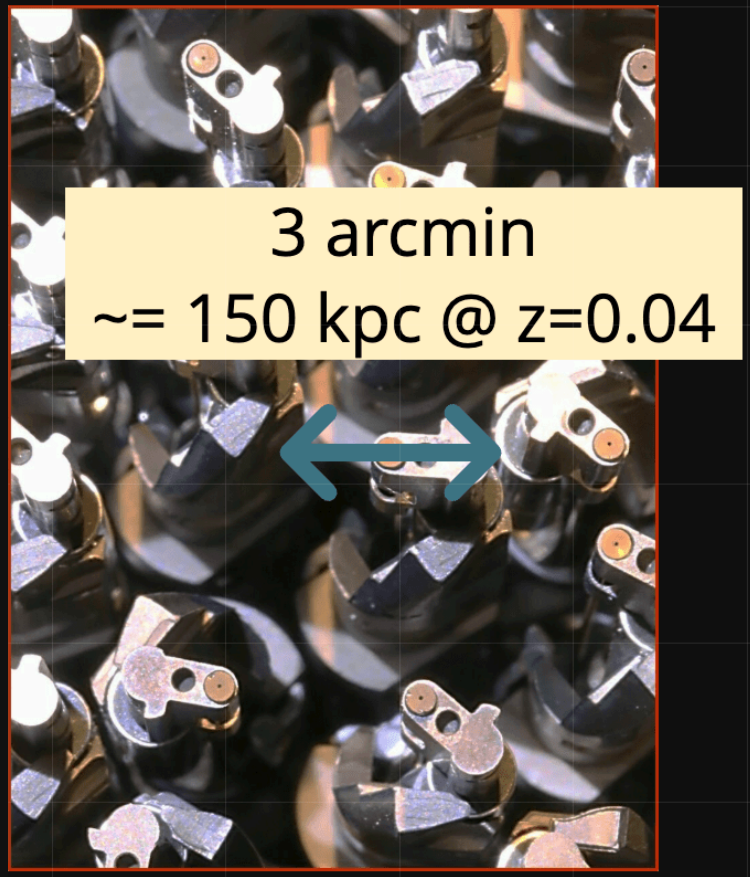
Boost factor

Sheldon+04, various lensing paper...

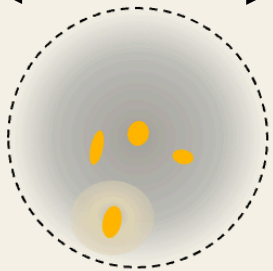
Fiber incompleteness



Fiber incompleteness

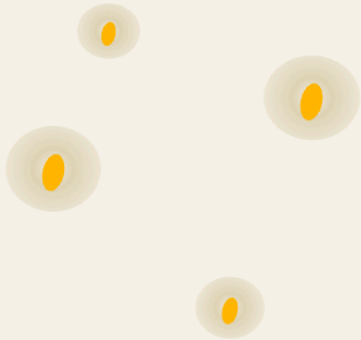


240 kpc for $M = 10^{11} M_{\odot}$



Satellite galaxies

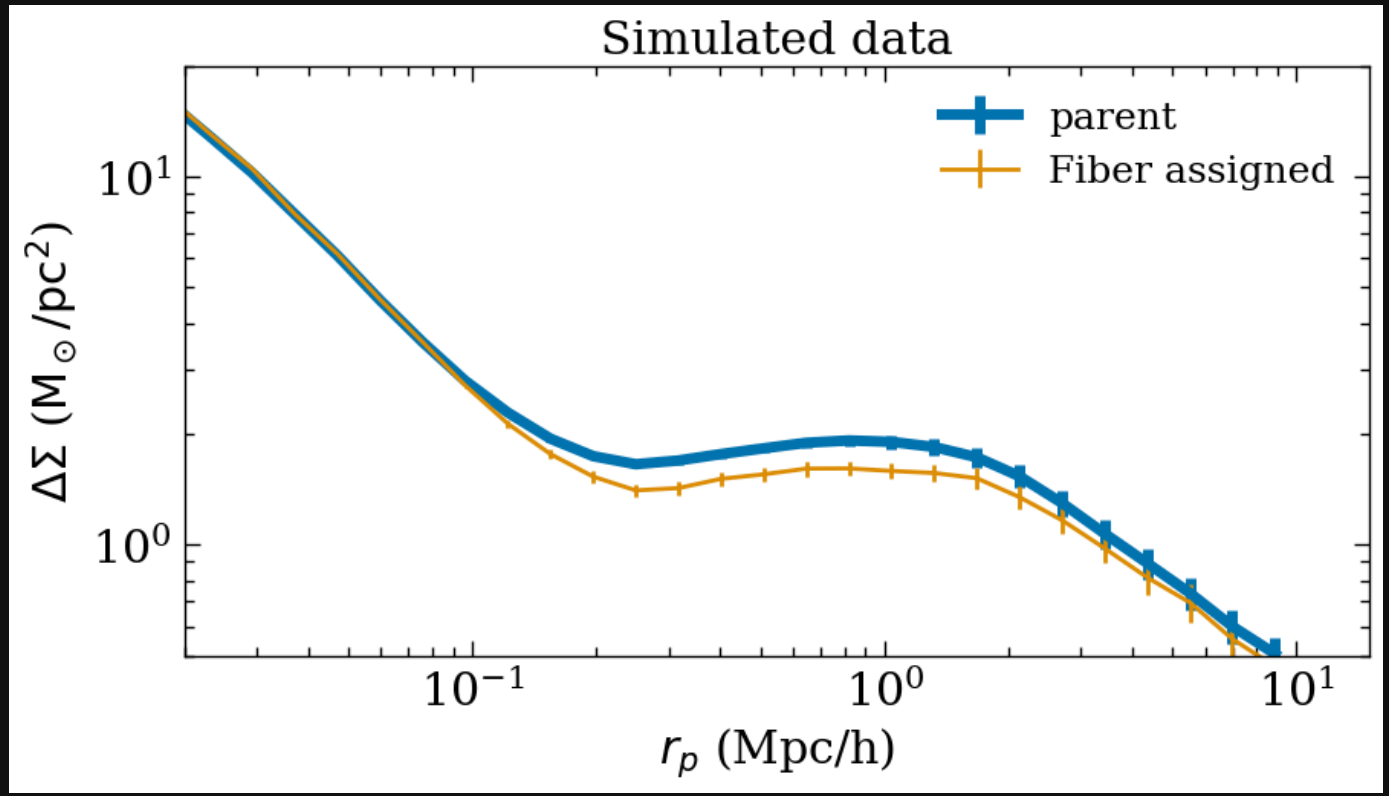
Less likely to all get fiber assigned



Isolated galaxies

More likely to all get fiber assigned

Fiber incompleteness impacts the measurement



To+26

Measurement systematics

After participating in many discussions about DESI in Cosmology Group Meetings...

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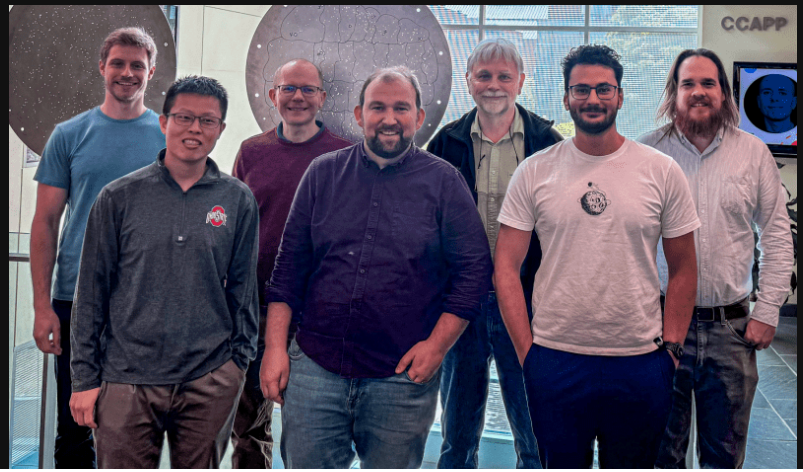


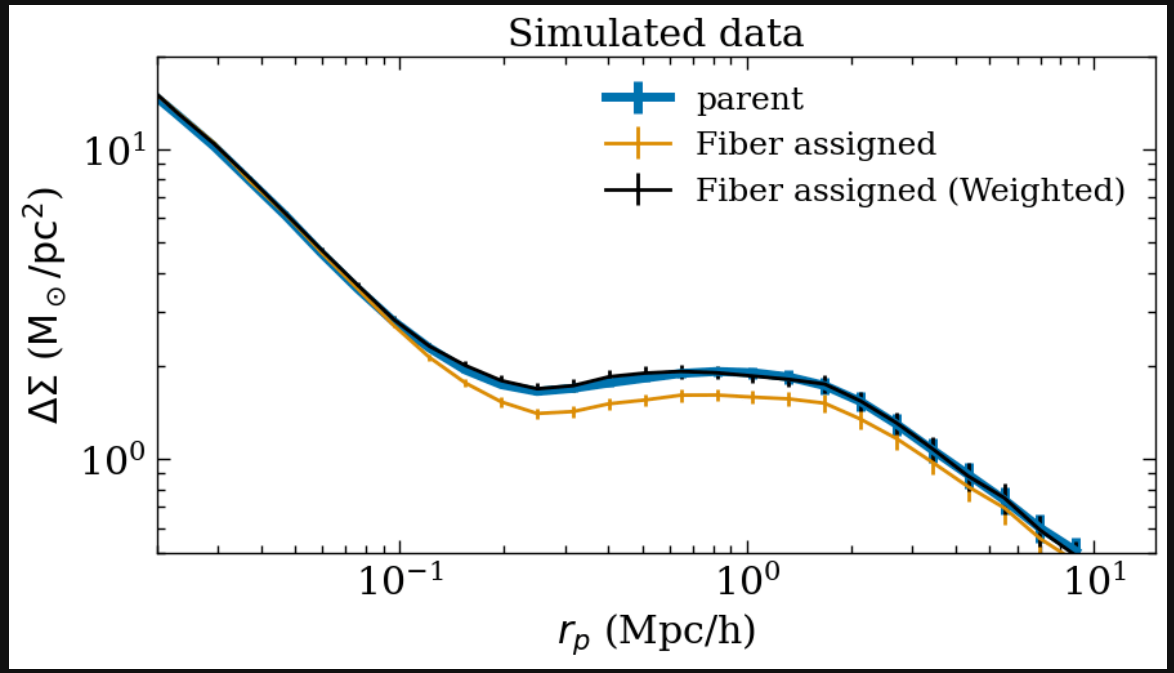
May 01, 2024

First year of DESI results unveil new clues about dark energy

Ohio State scientists make waves in universe-bending discovery

Tatyana Woodall
Ohio State News
woodall.52@osu.edu

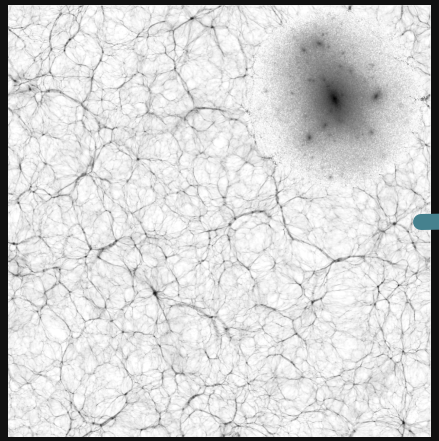
It turns out that this can be corrected



To+26

Inferences: a simulation based model

illustris-TNG 300 dark with
Rockstar halo and Consistency tree



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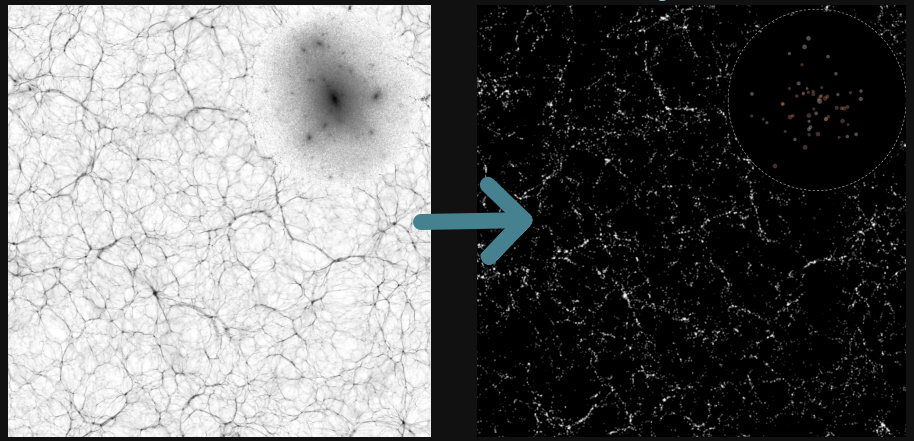

$$P(\log M_* | \log M_{\rm peak}) =$$
$$\mathcal{N}\left(\log M_{11} + \alpha(\log M_{\rm peak} - 11), \sigma_{\log M}\right)$$

$f_{\rm sat,l}$, $f_{\rm sat,h}$

control satellite fraction in each stellar mass bin

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illustris-TNG 300 dark with
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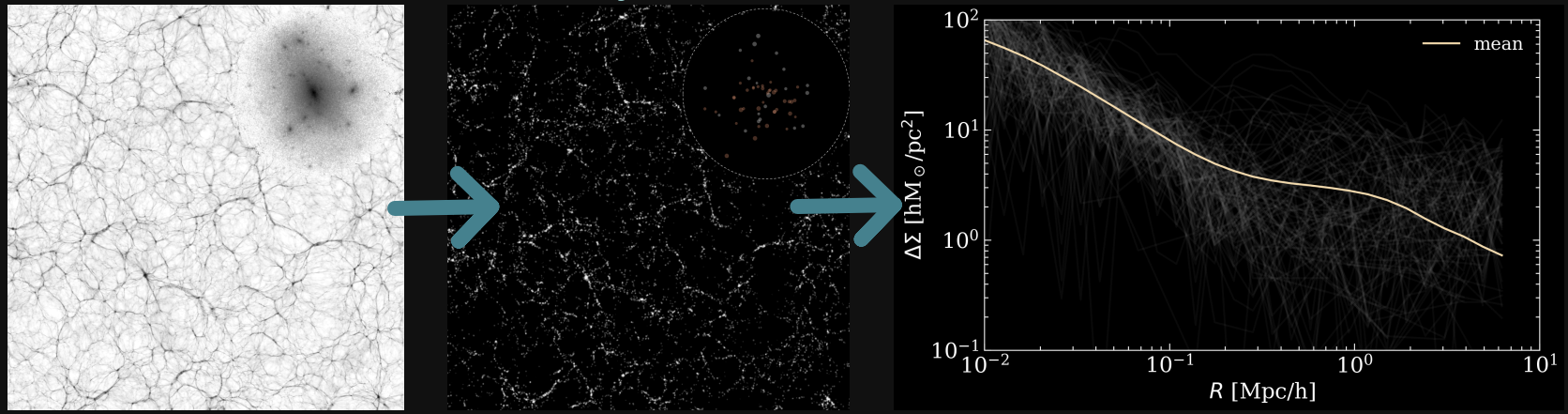

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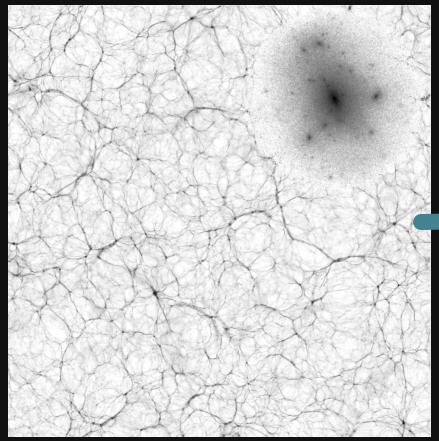

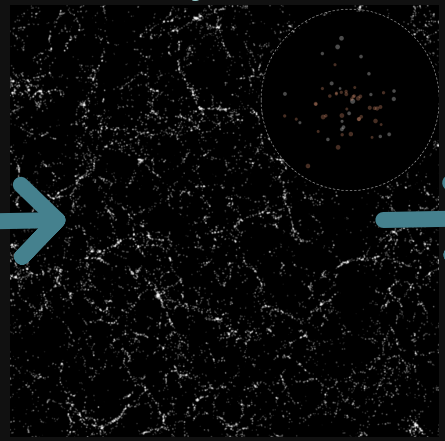

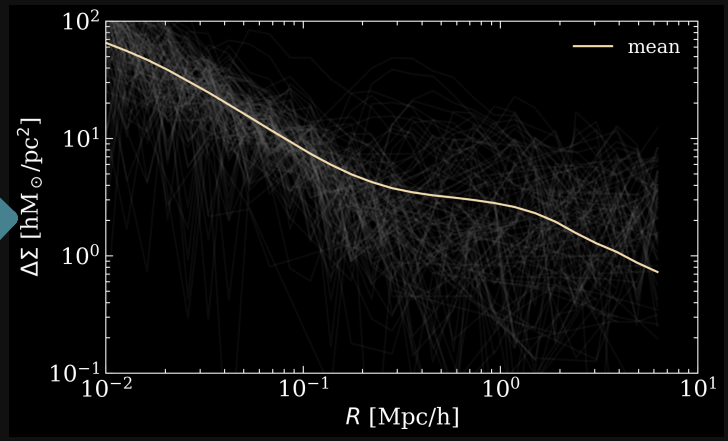

MCMC

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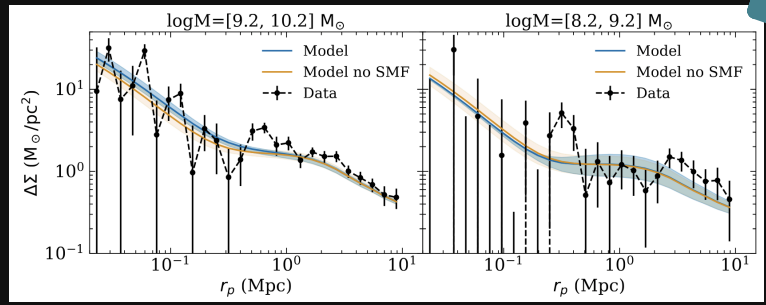
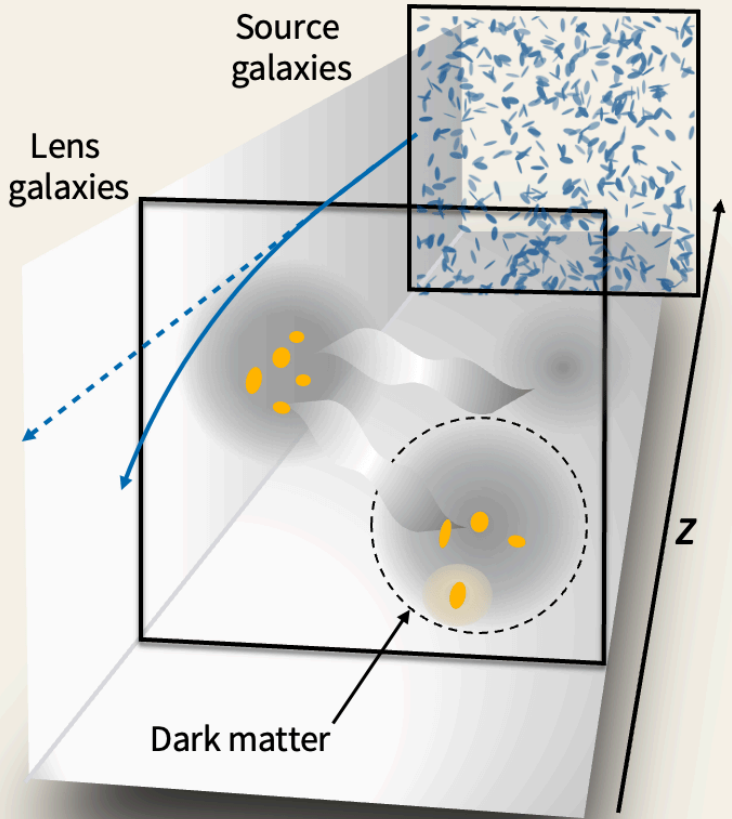
$f_{\rm sat,l}$, $f_{\rm sat,h}$

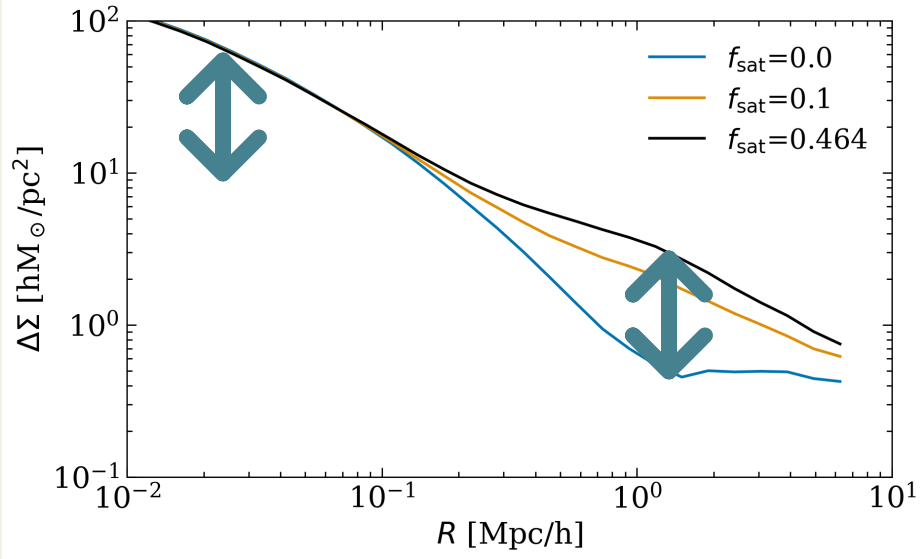
control satellite fraction in each stellar mass bin

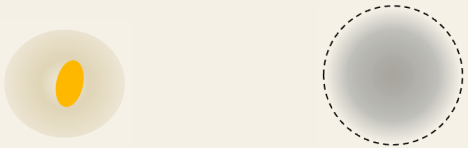


Weak lensing measures the total matter profiles

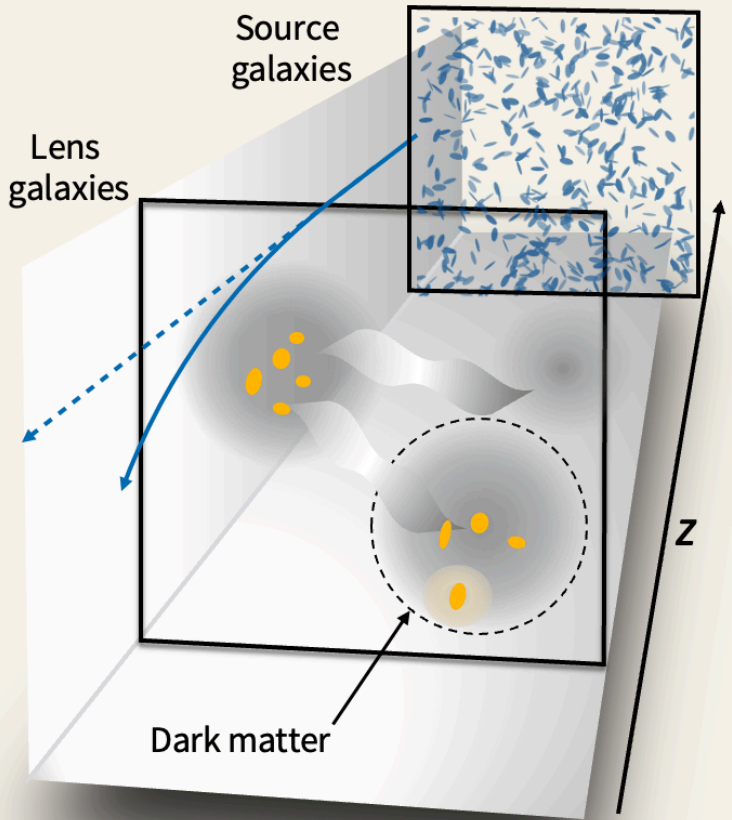


Halo Mass Satellite fraction



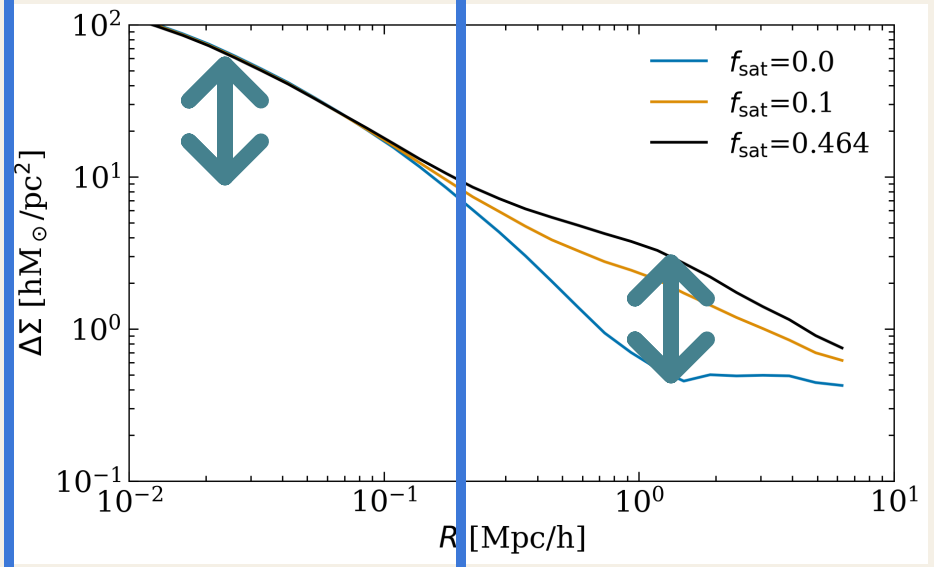


Weak lensing measures the total matter profiles

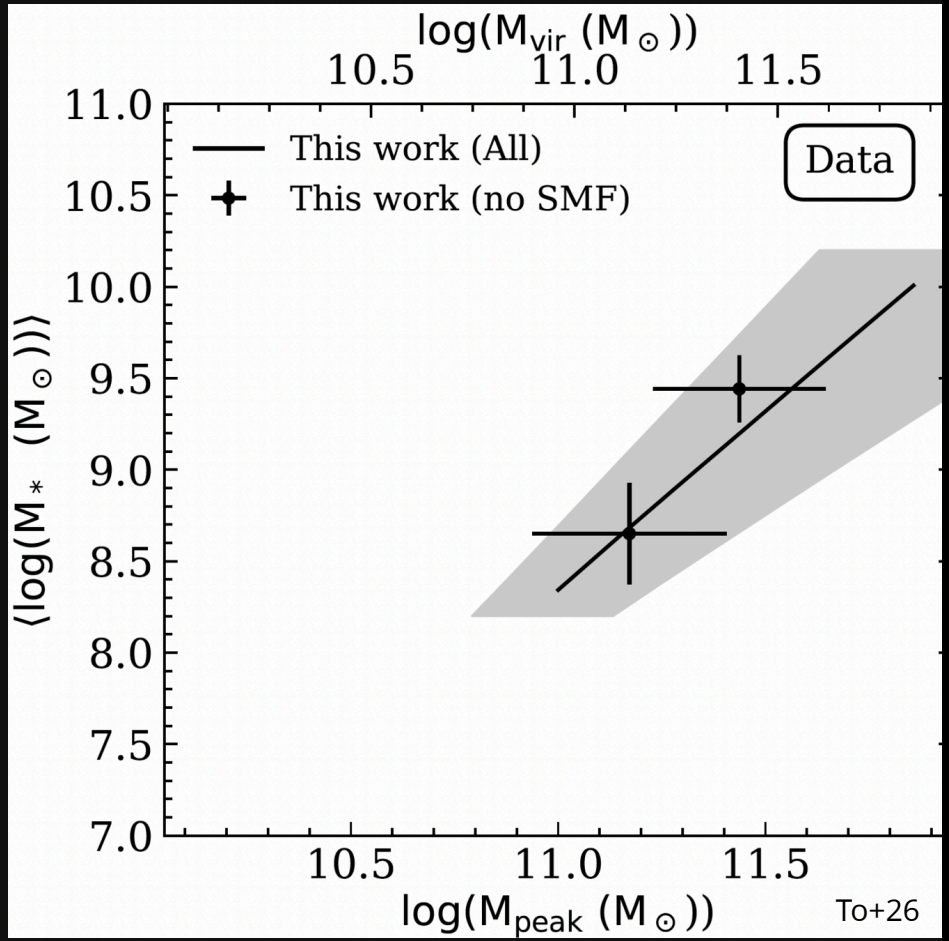


Halo Mass

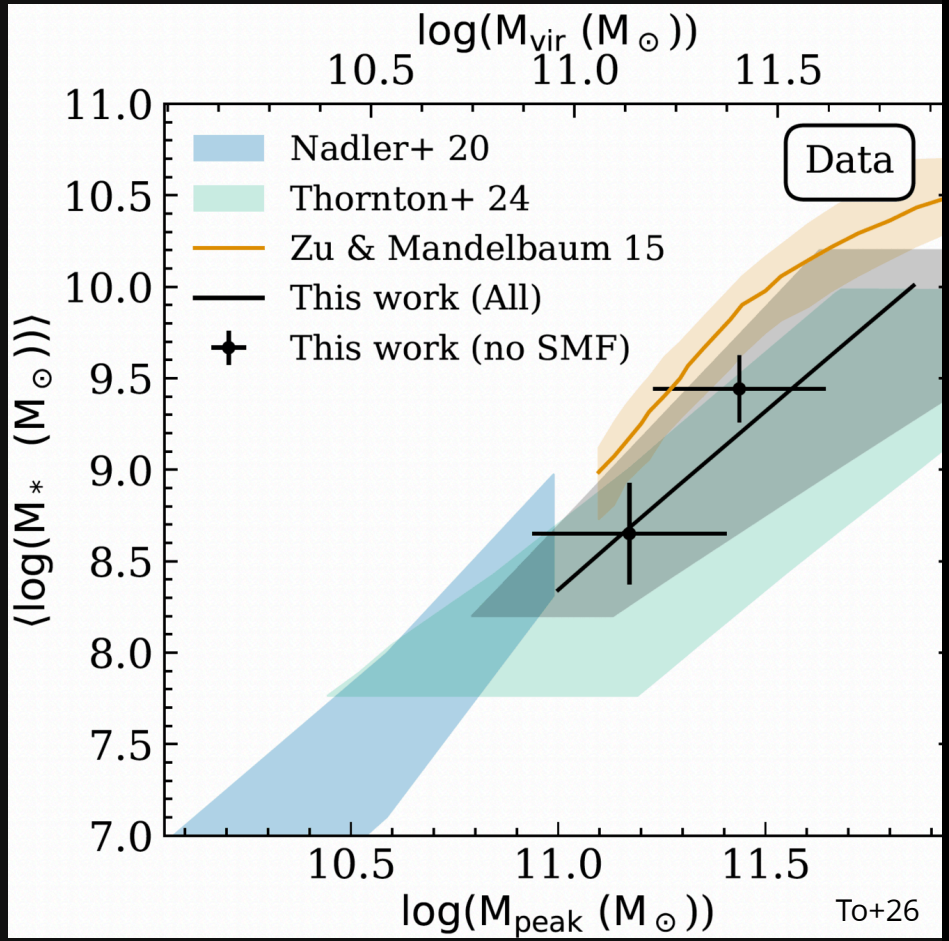
Satellite fraction



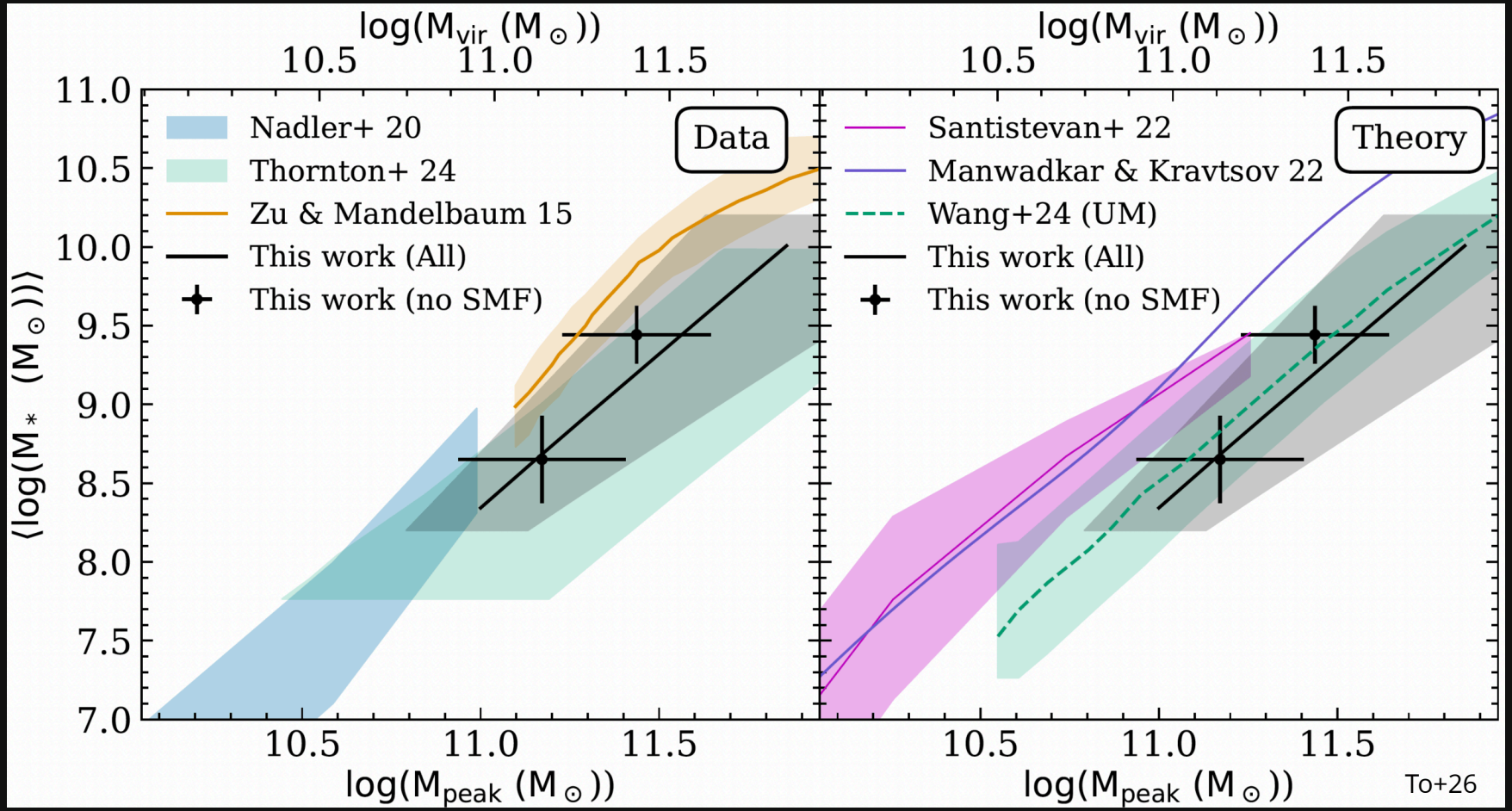
Stellar mass–Halo mass relation



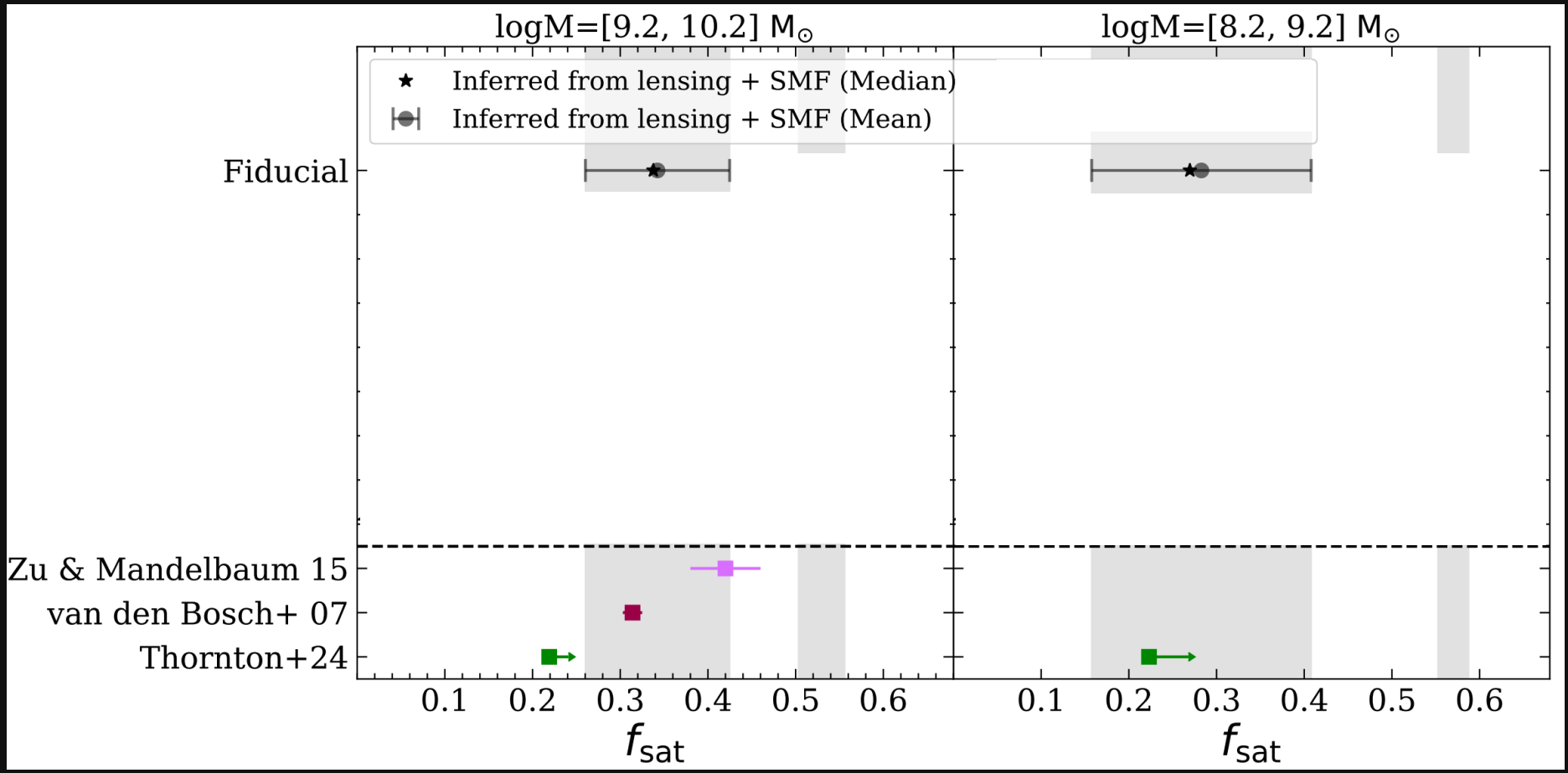
Stellar mass–Halo mass relation



Stellar mass–Halo mass relation



Satellite fraction



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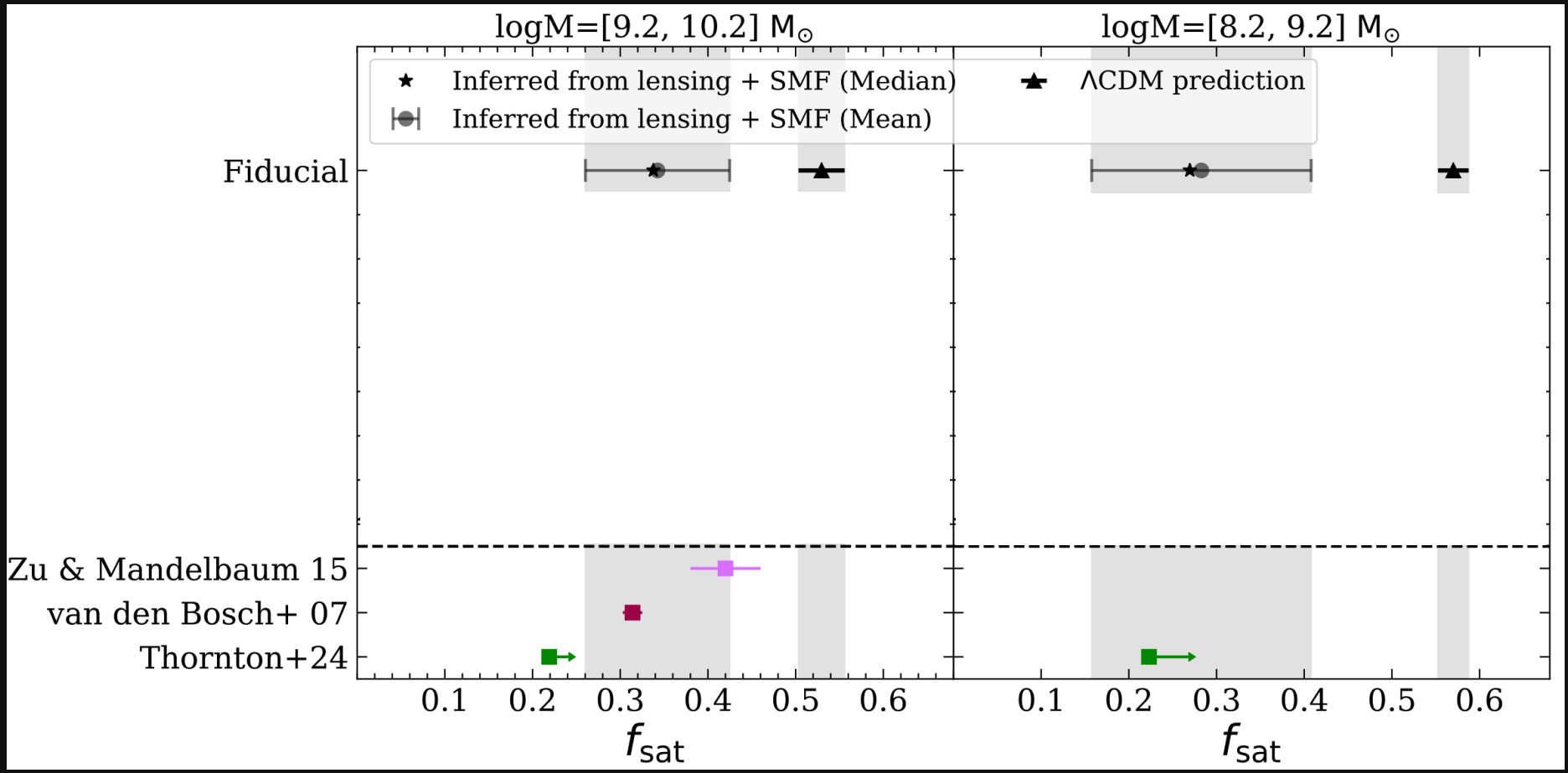

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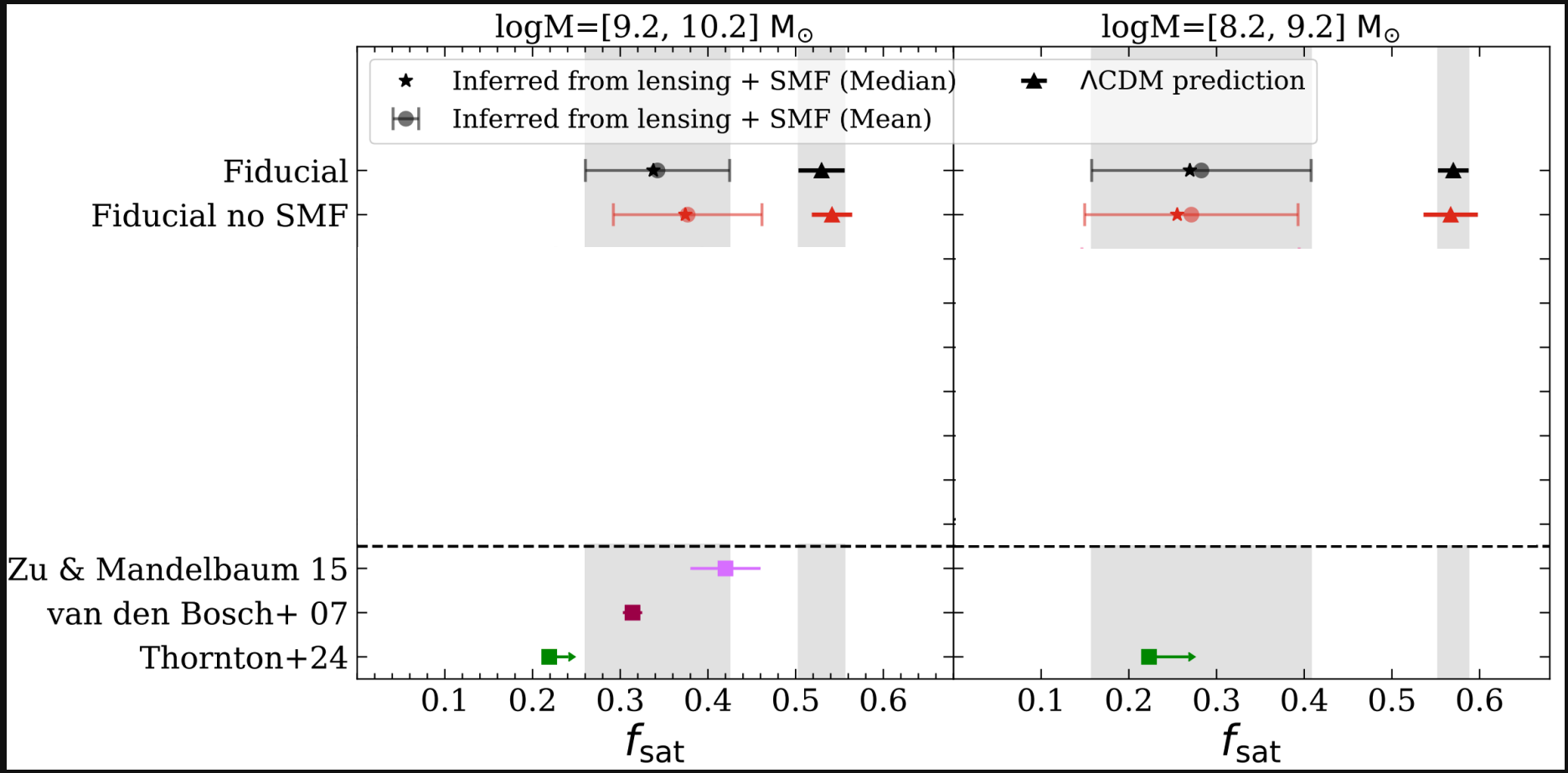
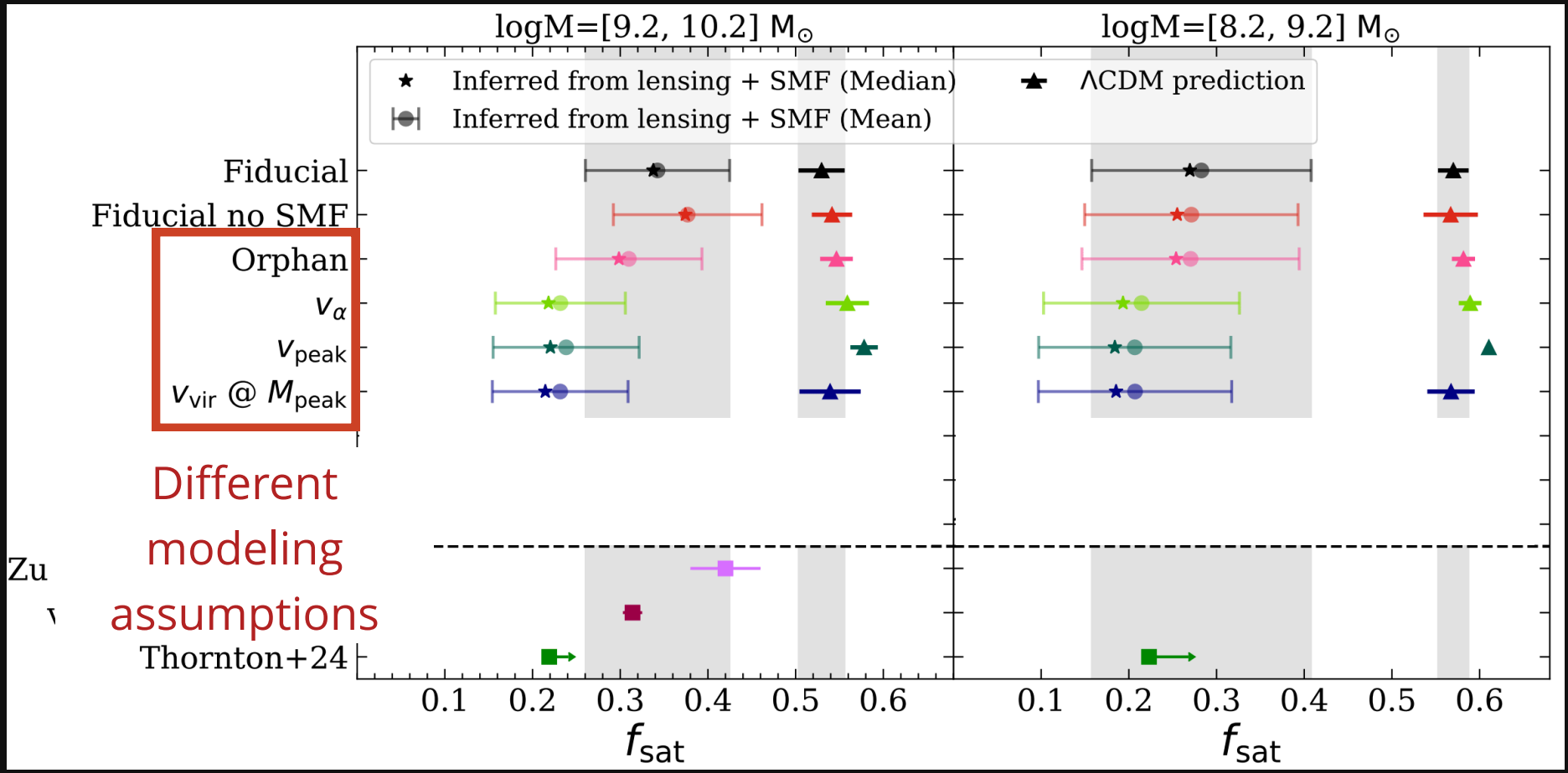
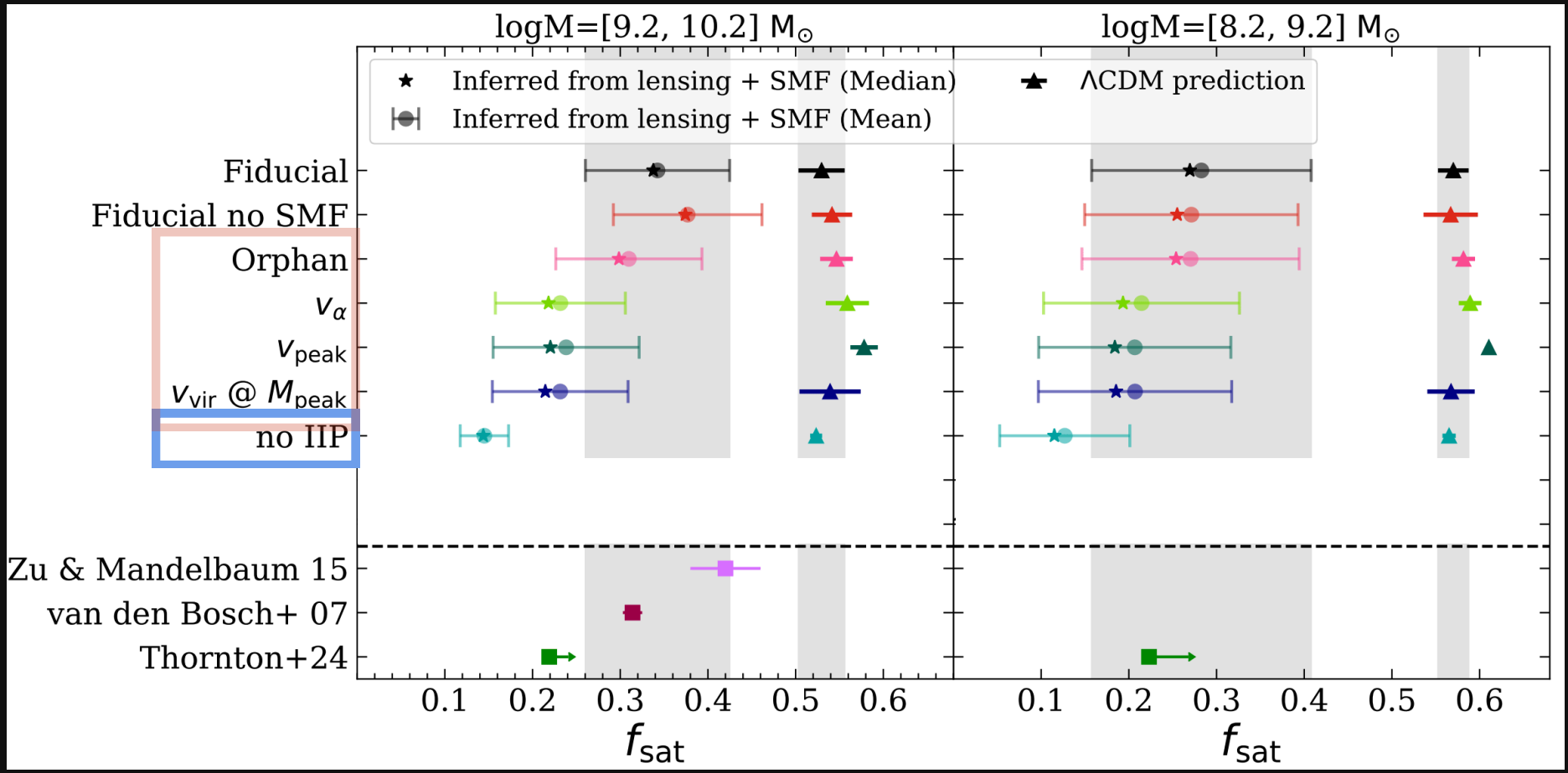


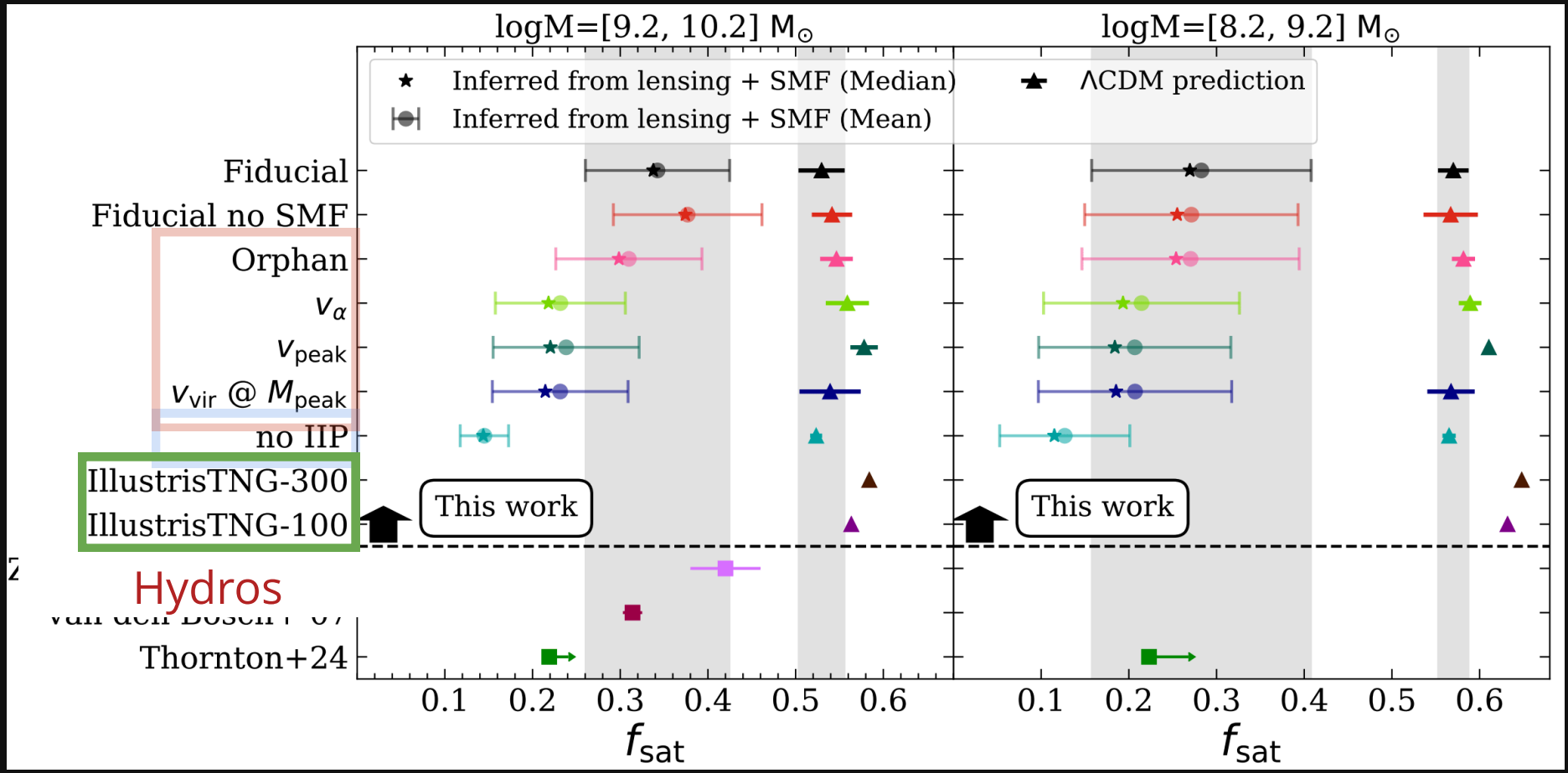
Satellite fraction



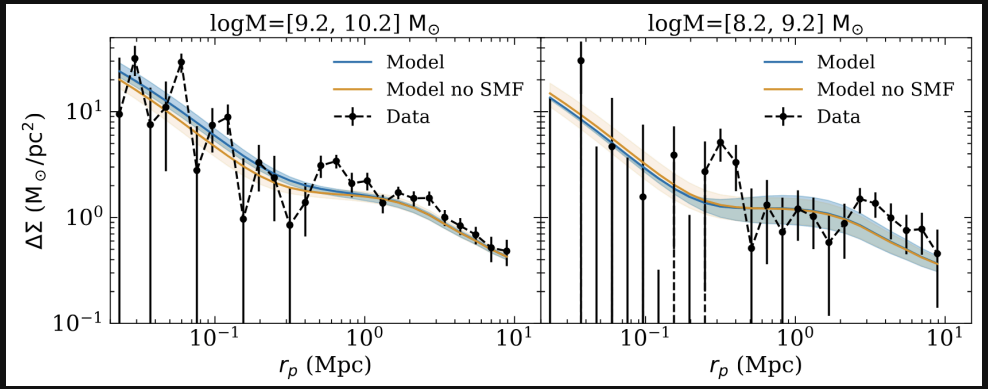
Satellite fraction



Satellite fraction



$S/N = 12.4, 5.6$



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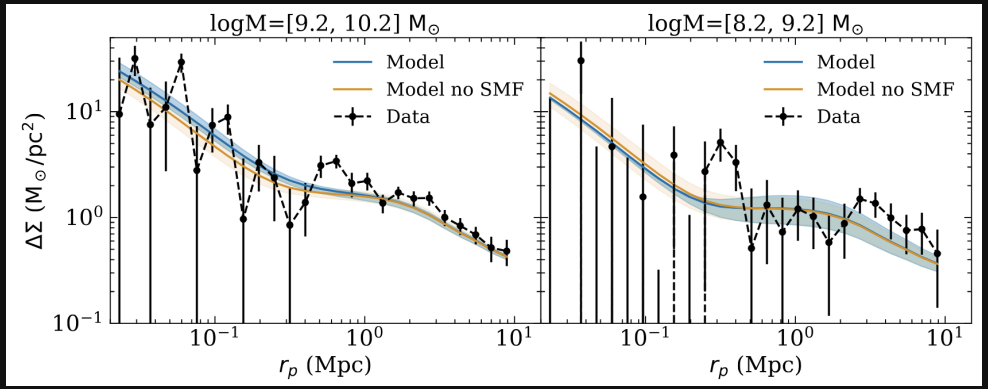
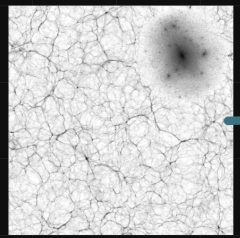
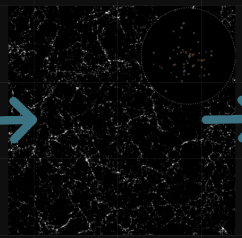
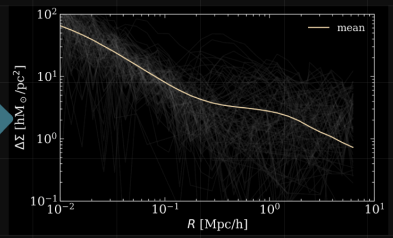
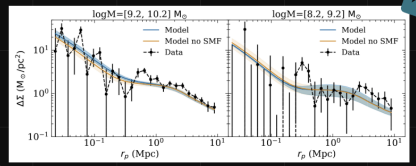








MCMC

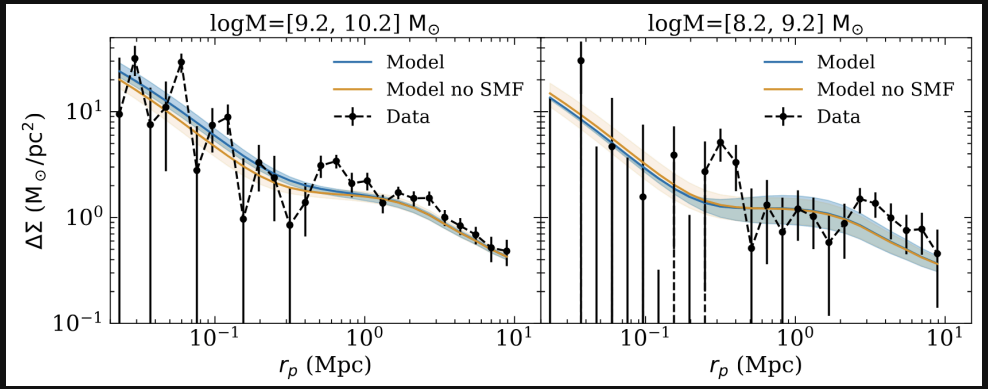


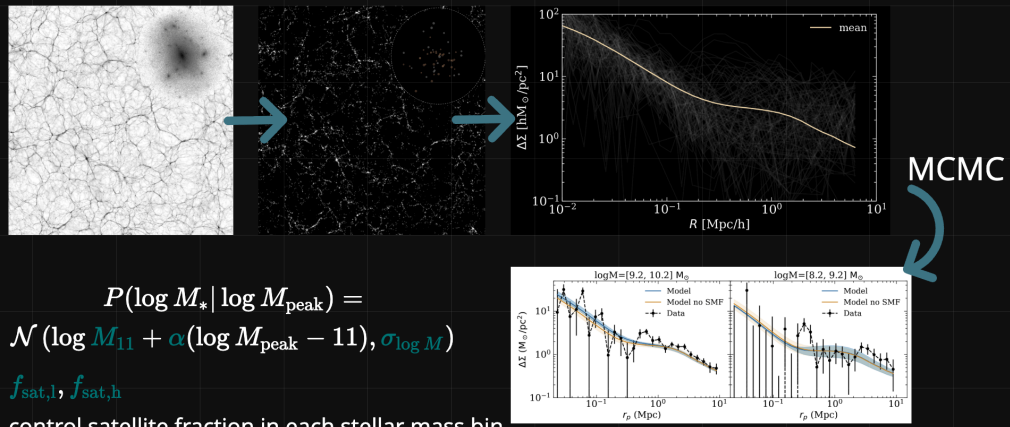
$$P(\log M_* | \log M_{\rm peak}) = \mathcal{N}(\log M_{11} + \alpha(\log M_{\rm peak} - 11), \sigma_{\log M})$$

$f_{\rm sat,l}$, $f_{\rm sat,h}$

control satellite fraction in each stellar mass bin

$S/N = 12.4, 5.6$





$$P(\log M_* | \log M_{\rm peak}) = \mathcal{N}\left(\log M_{11} + \alpha(\log M_{\rm peak} - 11), \sigma_{\log M}\right)$$

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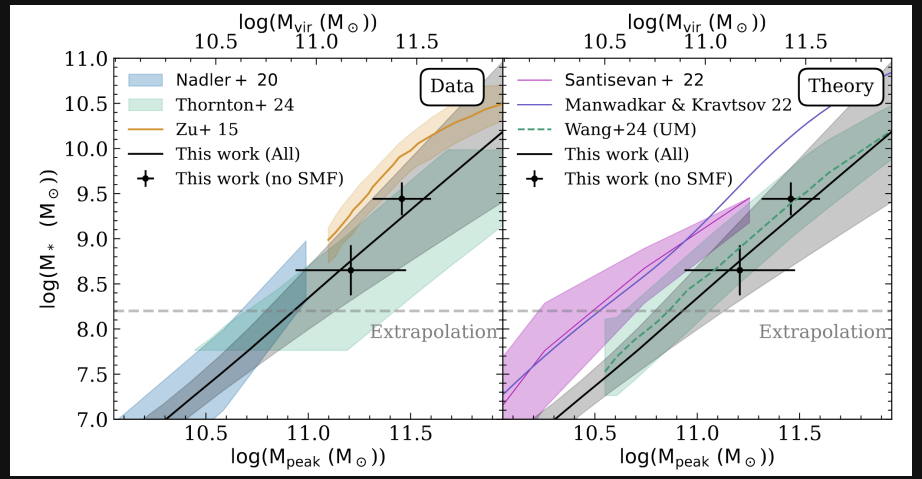

Conclusions:

First Weak Lensing Detection of

Spectroscopically Confirmed Dwarf Galaxies

Lots of Cosmology Group meetings

Lots of Little Galaxies meetings

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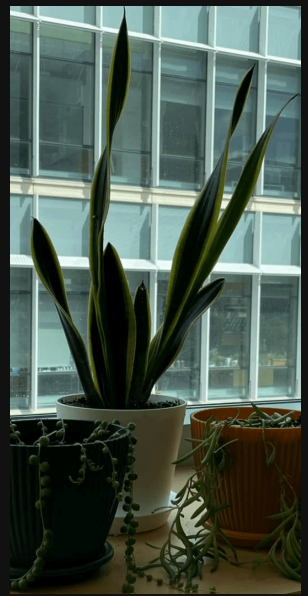

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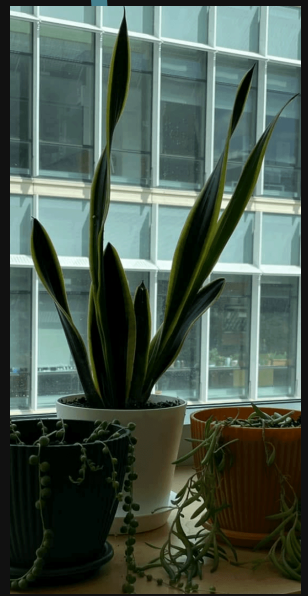

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